OSBORN
CONSULTING
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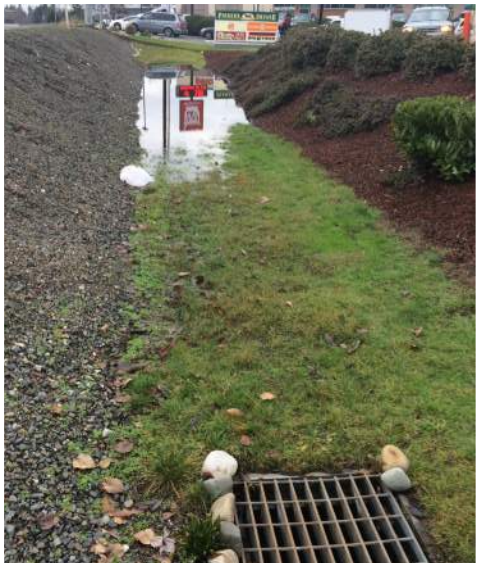
Washington State
Department of Transportation

SR 9 / SR 204
Intersection Improvements
Stage 3

FINAL
TYPE A HYDRAULIC REPORT

MAY 2021


FINAL
TYPE A
HYDRAULIC REPORT

SR 9 / SR 204
INTERSECTION IMPROVEMENTS
STAGE 3
SR 9 MP 15.48 to SR 9 MP 16.45
XL 11834, PIN 100901K

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
NW Region
Shoreline, Washington

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Highway Runoff Manual Training Certification # 190041

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LIST OF ABBREVIATIONS

Term	Definition
$M	Million Dollars
1-D	One Dimensional
AACE	AACE International (formerly the Association for the Advancement of Cost Engineering)
ADA	Americans with Disabilities Act
Approx.	Approximately
BA	Biological Assessement
cfs	Cubic ft per second
cy	Cubic yard(s)
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ESA	Endangered Species Act
EX	Existing
ft	Foot/feet
GIS	Geographic Information System
H&H	Hydraulic and Hydrological
HGL	Hydraulic Grade Line
hr	Hour(s)
in	Inch(es)
K	Thousand
LF	Linear Ft
MH	Maintenance Hole
NAVD88	North American Vertical Datum of 1988
No.	Number
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OCI	Osborn Consulting, Inc.
OPT	Option
PE	Professional Engineer
PMP	Project Management Plan
ROW	Right of Way; Rights of Way
SEPA	State Environmental Policy Act
SR	State Route
STA	Station
VER/v.	Version
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation
XS	Cross Section
yr	Year

SECTION 1 PROJECT OVERVIEW

The intersection of SR 9 and SR 204, located in the City of Lake Stevens, Snohomish County, is experiencing severe congestion affecting commuter traffic and freight movement in the region, as well as access to local businesses. The planned intersection improvements are being constructed in stages.

- Stage 1 improvements included the construction of an additional lane to Southbound SR 9 from Market place south approximately 1200 feet.
- Stage 2 project improvements included widening of the southbound lanes of SR 9 from Market Place to 4th St NE and widening the northbound lanes of SR 9 from 1,500 feet south of Market Place to 300 feet north of 4th St NE. Other improvements included road widening for turn lanes and curb, gutter, and sidewalk improvements at intersections.
- This Hydraulic Report describes the Stage 3 project, including the existing and developed conditions, existing site stormwater flow patterns and facilities, Threshold Discharge Areas (TDAs), stormwater requirements applicable to the project based on the proposed project improvements, design guidance and criteria, as well as documenting the hydrologic and hydraulic design proposed for this project and the permanent stormwater Best Management Practices (BMPs) that will be constructed to manage stormwater to meet the minimum requirements.

1.1 FUNDING

Funding for this project is through Connecting Washington.

The new BMPs that will be constructed under the Stage 3 project are summarized in **Table 1-1** below:

TABLE 1-1 | BMP SUMMARY

State Route	Mile Post	Sta. / Offset Dist. & Dir. (LT/RT)	County	Project Name	BMP Type	BMP Feature Number	Facility Size (Length / SF / Vol.)	Is this a Retrofit Facility?
SR 9	15.59	A 258+19 (52.0' LT) to A 262+99 (52.0' LT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.07 MFD Type 3	WSDOT000 1348834	480 LF	Yes
SR 9	15.81	A 269+32 (53.5' LT) to A 271+74 (53.6' LT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.07 MFD Type 1	WSDOT000 1365505	244 LF	Part of the BMP Provides Retrofit
SR 9	15.89	A 273+96 (78.1' LT) to A 278+98 (38.8' LT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.07 MFD Type 3	WSDOT0001 348835	515 LF	No
SR 9	15.89	A 273+90 (63.2' RT) to A 278+51 (37.2' RT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.07 MFD Type 1	WSDOT0001 348836	466 LF	Yes
SR 9	15.68	A 263+21 (73.1' RT) to A 246+43 (103.8' RT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.04 CABS	WSDOT000 1348840	121' L x 2'W x 1.15' H	Part of the BMP Provides Retrofit

SR 9	15.81	A 269+30 (66.3'LT) to A 271+30 (64.3' LT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.05 Wet BioFiltration Swale	WSDOT000 1364192	200 LF	Yes
SR 9	15.71	A 265+35.0 (133.5 RT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	FC.03 Walled Pond	WSDOT000 1348837	13,680 CF (Storage volume)	Part of the BMP Provides Retrofit
SR 9	15.78	A 268+04.0 (83.5 RT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	FC.03 Pond	WSDOT000 1348838	9,907CF (Storage Volume)	Part of the BMP Provides Retrofit
SR9	16.01	A 279+52 (52.5 LT to A 282+84 (40.0 LT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.07 MFD Type 3	WSDOT000 1364195	333 LF	Yes

1.2 SITE LOCATION

The project is located in Snohomish County, Washington in the City of Lake Stevens. The Stage 3 project begins approximately 160 feet north of the intersection of SR9 and Market Pl NE and extends 1,240 feet north of the intersection of SR9 and SR204. It includes a portion of SR204 west of its intersection with SR9. The improvements extend into the City of Lake Stevens right-of-way in several locations, including:

- 92nd Ave NE from 4th St NE north to the intersection of 7th Pl NE
- The section of 91st Ave NE from SR204 to 150 feet north of its intersection with Vernon Road
- Vernon Road from the west side of SR 9 to approximately 300 feet west of 91st Ave NE
- Vernon Road from 7th Place NE to 600 feet north of N Davies Road including a 200-foot portion of Davies Road to the east.

Between MP 15.48 to MP 16.45, SR 9 has a Federal Functional Classification of Type 2, Urban Other Freeways/Expressways, traversing rolling terrain in Snohomish County. SR 204 in the vicinity of SR 9 also has a Federal Functional Classification of Type 2, Urban Other Freeways/Expressways, traversing rolling terrain. The project corridor is within Section 13 of Township 29 North, Range 5 East of the Willamette Meridian. Refer to **Figure 1-1** for the project vicinity map.

1.3 VICINITY MAP

(Source: WSDOT SR 9 – SR 204 Intersection Improvements – Project Map)

Figure 1-1 | Vicinity Map

1.4 SCOPE OF WORK

The project improvements include constructing roundabouts at the intersections of SR9 and SR204, SR9 and westbound Vernon Rd, Vernon Rd and 91st Ave NE, Vernon Rd and N Davies Rd, as well as curb, gutter, and sidewalk improvements at the intersections. Major elements of the project include:

- Site preparation work, including shifting, handling, and maintenance of traffic.
- Implementation of Temporary Erosion and Sediment Control (TESC) BMPs.
- Earthwork, grading, and installation of retaining walls.
- Sawcutting, pavement widening, and striping.
- Construction of storm drainage conveyance features, including inlets, ditches, and enclosed conveyance pipes.
- Construction of a walled pond, a detention pond, Media Filter Drains (MFD), and a Compost Amended Bioswale (CABS).
- Signing and overhead sign installation.
- Lighting installation.
- Landscaping, irrigation, and other permanent erosion control and roadside restoration measures.

This hydraulic report presents the storm drainage design for the SR9, SR204 intersection improvements, the Vernon Road and 91st Ave NE intersection improvements, the Vernon Road and N Davies Road intersection improvements, the widening along SR9 from MP 15.05 to MP 15.73, and the roadway improvements along 92nd Ave NE and Vernon Road. The project is within the Puget Sound Basin and Project-Triggered Retrofit is required. The project area is within a “low priority” area for stormwater retrofit. A Stormwater Retrofit Cost-Effectiveness and Feasibility analysis will be performed to determine the extent to which the retrofit obligations can be met through additional stormwater mitigation provided on-site or through the transfer of funds equal to the 20% cost obligation, or balance thereof, to fund stand-alone stormwater retrofit projects.

Five TDAs (TDAs 2-6) are delineated within the Stage 3 project limits. Existing impervious areas, proposed new impervious surface areas, Pollution Generating Impervious Surfaces (PGIS), and Non-Pollution Generating Impervious Surfaces (NPGIS) have been measured and calculated for each TDA to determine the minimum requirements applicable to the project. Refer to **Appendix A** for the Stormwater Design Documentation Spreadsheet (SDDS), which documents these areas and the HRM Minimum Requirements that apply to the project and to each threshold discharge area (TDA). Refer to **Appendix B** for TDA maps and existing and proposed conditions figures. **Section 2** discusses the existing conditions, and **Section 4** provides a summary of the Developed Conditions by TDA.

Hydraulic features proposed for this project include detention ponds and runoff treatment BMPs including Media Filter Drains and a Compost-Amended Biofiltration Swale to provide mitigation for the triggered project minimum requirements for flow control and runoff treatment, respectively. Detention ponds are located near the SR 9 / SR 204 intersection. Due to limited space in and around the project limits, one of the ponds will be an open topped walled pond. Runoff treatment BMPs will either be located either along roadside side slopes and treat sheet flow from the roadway or will be located parallel to the roadway and will treat end-of-pipe flows.

The project will use enclosed pipe systems, underdrains, and roadside drainage ditches as means to capture and convey stormwater runoff from the roadway.

1.5 SPECIALITY DESIGN

No specialty design is included in this project.

SECTION 2 SITE CONDITIONS

An assessment of the existing site conditions has been conducted through a review of available information, including:

- Existing WSDOT base map files.
- WSDOT as-built documents and hydraulic reports.
- WSDOT drainage system supplemental surveys (March and April 2017).
- WSDOT Stormwater Discharge Point Inventory data.
- Geographic Information System (GIS) stormwater system maps from the City of Lake Stevens.
- Snohomish County GIS, 2-ft contours (July 2011).
- Basin and water quality data from the Washington State Department of Ecology (Ecology).
- Water supply well information from the Washington State Department of Health (DOH).
- Wetland Inventory Information from the United Stated Department of Fish and Wildlife Services (USFWS) Wetlands Mapper.
- Information from the WSDOT Environmental office.

Site visits were performed in January and April of 2018, December of 2019 and September of 2020 to observe the existing drainage systems, outfalls, and downstream conditions to the extent feasible. The available compiled background information was reviewed with respect to the existing conditions observed in the field to define major drainage patterns. The site reconnaissance included driving through the project limits in the northbound and southbound directions, as well as a walk-through along the SR 9 and SR 204 right-of-way (R/W).

2.1 EXISTING CONDITIONS

The project is located in Snohomish County in the vicinity of the SR 9/SR 204 Intersection. The project area is predominantly urban in nature with the land use surrounding the project corridor consisting of commercial/retail north of Market Place NE, which transitions to apartments and residential neighborhoods north of Vernon Rd to the east and west of SR 9.

The SR 9 corridor is generally flat to low rolling glacially influenced terrain and undulating topography. The SR 9 mainline has a high point in the roadway profile just south of the project limits near the intersection with 4th Street SE. The SR 9 profile slopes down towards the north. The western and eastern edges of the SR 9 R/W slope up from the existing SR 9 roadway. There is a second high point through the north side of the SR 9 / SR 204 intersection. SR 9 south of this high point generally slopes down to a low point just south of the intersection. In TDA 3, SR 9 slopes down and north towards the Davies Rd and Vernon Rd intersection. There is a third high point on SR 9 north of Vernon Rd towards the northern project limits. SR 9 within TDA 5 slopes down from this third high point towards the north.

This portion of the SR 9/SR 204 Intersection project is located within the Sunnyside Sub basin of Water Resource Inventory Area (WRIA) 7, the Snohomish River watershed. Within the Sunnyside Sub basin are a number of smaller drainage areas. The project is located within two of these smaller drainage areas. Much of the project drains to the Weiser Creek basin, which drains primarily to Ebey Slough with a small portion draining to Lake Stevens.

Six TDAs were delineated for the overall SR 9/SR 204 Intersection projects. The Stage 3 project limits are within TDAs 2-6. **Figure 2-1** shows the overall project and boundaries for TDAs 2-6. A more detailed map of the Stage 3 area is included in **Appendix B**.

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SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE 2-1 : EXISTING PROJECT TDAs

N

0 225 550

SCALE IN FEET

LEGEND

- OVERALL PROJECT LIMITS
- TDA BOUNDARY
- DOWNSTREAM FLOW PATH
- STREAM

NOTES:

1. SEE APPENDIX C-8 FOR DOWNSTREAM ANALYSIS.

WEISER CREEK TO EBEY SLOUGH

TDA 2 DISCHARGE POINT TO WEISER CREEK

TDA 3 DISCHARGE POINT TO WEISER CREEK

SR 204

1/4 MILE DOWNSTREAM

1/4 MILE DOWNSTREAM

VERNON RD

FRONTIER CIR

91ST AVE NE

MARKET PL NE

LAKE STEVENS MARKETPLACE SHOPPING CENTER

WETLAND 4

SR 9

TDA 3
7.17 ACRES

TDA 5
0.84 ACRES

1/4 MILE DOWNSTREAM

TDA 2
7.75 ACRES

TDA 6
0.04 ACRES

TDA 4
0.74 ACRES

WETLAND 5

WETLAND 9

FRONTIER VILLAGE

N DAVIES RD

VERNON RD

1/4 MILE DOWNSTREAM

TDA 4 DISCHARGE POINT TO LAKE STEVENS

TDA 5 DISCHARGE POINT TO LAKE STEVENS

1/4 MILE DOWNSTREAM

LAKE STEVENS

TDA 6 DISCHARGE POINT TO LAKE STEVENS

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SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE 2-2 : DEVELOPED PROJECT TDAs

0 225 550
SCALE IN FEET

2.2 EXISTING HYDRAULIC FEATURES

Based on available information, the notable hydraulic features along the SR 9/SR 204 Intersection – Stage 3 Project are discussed in the following sections.

2.2.1 EXISTING HYDRAULIC FEATURES

There are no major waterbodies within the project limits. Outside of the project limits, Weiser Creek is located to the west and Lake Stevens is located to the east of the project. Most of the project area drains via surface or subsurface flow toward Weiser Creek. The following is a brief description of the major waterbodies.

- Weiser Creek: Weiser Creek is to the west of the SR 9 / SR 204 intersection and flows north and west. It crosses under SR 204 outside the project limits and ultimately discharges to Ebey Slough.
- Lake Stevens: Lake Stevens is to the east of SR 9. The outfall of the lake is at the northeast end of the lake and drains into Catherine Creek and then to the Pilchuck River.

2.2.2 EXISTING CRITICAL AREAS

There are two wetlands, W5 and W9, adjoining the eastern edge of the SR 9 R/W directly north and south of Market Place at the intersection with SR 9. A third wetland (W4) is located in the southwest corner of the SR 9 / SR 204 intersection. See **Figure 2-3** for their locations. All wetlands are classified as Category III Wetlands with a habitat score of 14 and require a 50-foot buffer (Lake Stevens Municipal Code Section 14.88.830). A separate Wetland Report has been prepared.

Wetlands W4, W5 and W9 are depressional, emergent forested wetlands. W9 is located in the southeast corner of the intersection and is 3.42 acres in size. Wetland W5 is located directly north of Wetland W9 in the northeast corner of the intersection and is 2.31 acres in size. Wetland W4 is located on the Southeast corner of SR9/SR204 and is approx. 2.0 acres in size.

Weiser Creek, an unclassified stream, is west of the intersection of Lundeen Parkway and SR 204, outside of the project limits. Lake Stevens is located due east of the project and is also outside of the project limits.

A review of existing drinking water wells within, or in the vicinity of, the project limits was conducted by reviewing the DOH Office of Drinking Water mapping application for existing drinking water wells. There are no drinking water wells within the vicinity of the project.

2.2.3 EXISTING STORMWATER FACILITIES

The Stage 1 work of this project is installing two stormwater facilities that may be in place prior to the construction of Stage 3:

- A small detention pond along the eastern edge of the R/W at Sta. A 241+45
- A Media Filter Drain (MFD) along the western shoulder of SR 9 from Sta. A 235+97 to Sta. A 242+33

The Stage 2 work of this project is installing four stormwater facilities that may be in place prior to the construction of Stage 3:

- An MFD along the eastern edge of SR 9 from Sta. A 233+72 to Sta. A 239+21
- An MFD along the eastern edge of SR 9 from Sta. A 243+81 to Sta. A 245+59

- A Compost Amended Bioswale (CABS) along the west side of SR 9 from Sta. A 254+04 to Sta. A 255+38
- A walled detention pond along the west side of SR 9 at Sta. A 256+79

WSDOT has no other existing stormwater facilities within the project limits.

There is an existing City of Lake Stevens detention pond located south of the project limits at the northeast corner of SR 9 and Market Pl NE. The Stage 2 project regraded this pond to replace it in kind to accommodate the widening of SR 9.

The Lake Stevens Marketplace development, located west of SR 9 and north of Market Place NE, has an existing bioswale for runoff treatment. The bioswale is located at the northeast corner of the development and discharges to the WSDOT ditch alongside the southbound lanes of SR 9 at approximate Sta. A 260+20.

There are no other existing private stormwater facilities within or adjacent to the project limits.

The locations of the existing stormwater facilities are shown on the **Existing Conditions Exhibit** in **Appendix B**.

(Source: WSDOT SR 9/ SR 204 Interchange Environmental Review Memorandum)

Figure 2-3 | Wetlands & Streams

2.2.4 EXISTING CONVEYANCE

The existing conveyance features within the project area consist of ditches, cross-culverts, and enclosed storm drain conveyance pipes. A brief summary of the existing conveyance by TDA is described below. The conveyance installed by Stage 1 and Stage 2 of the project is described as existing.

Within TDA 2, runoff is conveyed in a stormdrain system along the east side of SR 9 from the south side of Market Place north to the south side of 4th St NE. The conveyance pipe then crosses SR 9 and joins the SR 9 west side conveyance system. On the west side of SR 9, an enclosed drainage system outfalls to a ditch on the north side of Market Pl NE and flows north. In the vicinity of 4th St NE, the west ditch flows into a CABS and then into the existing walled pond installed under Stage 2. The pond and the storm drain pipe crossing SR 9 from the east discharge to a ditch flowing north. The existing ditch outfalls to Wetland 4 at the SW quadrant of the SR 9 and SR 204 intersection. An existing culvert at Sta. B 122+20 collects Wetland 4 overflow and conveys it in an existing 24-inch diameter culvert under SR 204. This culvert flows into the SR 204 enclosed conveyance system that continues west along SR 204 beyond the project limits. TDA 2 eventually discharges to Weiser Creek.

Within TDA 2, SR 204 on the west side of SR 9 is crowned. The south side of the road sheet flows into Wetland 4. The north side of the roadway flows west in an existing ditch and is collected by the conveyance system that continues west along SR 204 beyond the project limits. The east side of the intersection of Vernon Rd and 91st Ave NE also contributes runoff to this conveyance system.

In TDA 2 on 92nd Ave NE between 4th St NE and 7th Pl NE, the drainage system along the east side of the R/W consists of a combination of ditches and storm drain conveyance pipes. The drainage system discharges to a 24-inch culvert at Sta. A 264+00, crossing SR 9. The 24-inch concrete culvert discharges to the ditch along the west side of SR 9, which outfalls to Wetland 4. 7th Pl NE also contributes runoff to this culvert crossing.

Within TDA 3, runoff from the east half of SR 9 and Vernon Rd is collected in existing conveyance systems and crosses to the west side of SR 9 in an existing 18-inch diameter culvert at Sta. A 268+35 and in an 18-inch diameter culvert at Sta. A 271+58. The south side of N Davies Road and several offsite drainage flows from the Frontier Village shopping center to the east also contribute runoff to these existing cross culverts. Runoff from the west side of SR 9 sheet flows into an existing ditch and is conveyed north to Vernon Rd, where it crosses under the roadway in an existing 18-inch diameter culvert. From there, the runoff from TDA 3 is conveyed northwest along Frontier Circle beyond the project limits.

In TDA 3 north of the Vernon Rd intersection, runoff from SR 9 discharges to existing ditches and grass infield areas. These areas discharge to the same conveyance system along Frontier Circle. Vernon Road on the west side of SR 9 including the northwest half of the intersection with 91st Ave NE discharges into existing conveyance systems that flow into the conveyance system along Frontier Circle. This system eventually discharges to Weiser Creek.

In TDA 4, runoff from the north side of Davies Rd and Vernon Rd are collected by the existing conveyance system in Vernon Rd and flow northeast towards Lake Stevens.

In TDA 5, runoff from the west and east sides of SR 9 flow north in existing ditches. Beyond the project limits, a cross culvert collects runoff from the west ditch and combines it with the east ditch. The combined runoff flows east outside of the WSDOT R/W and eventually discharges to Lake Stevens.

In TDA 6, a small portion of Davies Rd at the eastern project limit discharges through a conveyance system flowing east, which eventually discharges to Lake Stevens.

Existing Cross Culverts

There are 7 cross culverts conveying stormwater flows within the Stage 3 project limits. The size and location are listed in **Table 2-1**. The culverts were located during the field visit and are functional.

TABLE 2-1 | EXISTING CROSS CULVERTS

Type	Station (Location)	Description
18" CP	A 254+97	SR 9 Cross Culvert
18" CP	A 255+02, Rt to A 255+75, Rt	Culvert crossing 4th St NE
24" Concrete*	A 264+00	SR 9 Cross Culvert
18" Concrete/CPP*	A 268+35	SR 9 Cross Culvert
18" CPP*	A 271+58	SR 9 Cross Culvert
24" Concrete	B 122+20	SR 204 Cross Culvert
18" DCI*	A 272+47	Vernon Rd Cross Culvert

*Culverts will be replaced with new pipe. See drainage profile sheets for new pipe type and size.

Existing Stream Crossings

There are no stream crossings within the Stage 3 project limits.

Existing Ditches

Much of the conveyance system within the project limits is comprised of roadside ditches along the east and west sides of SR 9. The existing ditches are grass and brush covered. The ditches convey both on- and off-site flows.

There are three ditches in TDA 2. The first is on the west side of SR 9, and flows south to north to Wetland 4. The second ditch to the east of 4th St SE flows down to a low point at the existing cross culvert at Sta. A 264+00. There is a third ditch along the north side of SR 204 that flows to the west to 91st Ave NE.

There are three ditches in TDA 3. The first is on the west side of SR 9 north of the SR 204 intersection. It flows south to north to the culvert crossing under Vernon Rd. The second ditch on the east side of SR 9 flows south to north. The third ditch flows along the R/W line on the east side of SR 9, and discharges north of Vernon Rd.

There are two ditches in TDA 5, running south to north along SR 9 beyond the project limits.

Existing Enclosed Drainage Systems

There are enclosed drainage systems along SR 9 at the intersections with Market Place NE and 4th Street NE. Culverts convey the flows northward to the next section of ditch and to the Stage 2 walled detention pond. As discussed in **Section 2.2.3**, there are portions of existing enclosed drainage systems along the east of SR 9, which extend underneath three existing driveways and discharge into a ditch.

From the SR 9 / SR 204 intersection, north to N Davies Road, the eastern ditch discharges to an enclosed drainage system along the east side of SR 9, 92nd Ave NE and Vernon Rd. The enclosed drainage systems discharge to cross-culverts crossing SR 9 to the west.

There are existing enclosed conveyance systems at the intersections of 91st Ave NE and SR 204 and 91st Ave NE and Vernon Rd.

Existing Bridges

There are no bridge crossings within the project limits.

Existing Flood Plains

There are no mapped flood plains within the project limits.

Existing Subsurface Drainage
There are no subsurface drainage problems that have been identified within the project limits.

2.3 THRESHOLD DISCHARGE AREAS (TDAs)

Threshold discharge Areas (TDAs) are defined as on-site areas draining to a single natural discharge location or multiple natural discharge locations that combine within 0.25 miles downstream (as determined by the shortest flow path). The project TDA delineation is based on available GIS maps, as-builts, site reconnaissance, surveyed existing roadway topography, and the locations of surface water bodies in the vicinity of the project. The Existing TDA Exhibit for the overall project is shown in **Figure 2-1** and the detailed TDA exhibit for Stage 3 is provided in **Appendix B**.

The overall SR 9 / SR 204 Intersection Improvements project is located within six TDAs (TDAs 1-6), based on downstream flow paths. TDAs 2 and 3 discharge to Weiser Creek, which is located to the west of the SR 9 / SR 204 intersection. The creek flows north and west, crossing under SR 204 outside of the project limits, ultimately discharging to Ebey Slough. TDAs 1, 4, 5, and 6 discharge to the east to Lake Stevens. Stage 3 is located within TDAs 2-6. **Table 2-2** summarizes the TDA area, location, and receiving water body.

TABLE 2-2 | SUMMARY OF THRESHOLD DISCHARGE AREAS (TDAS)

TDA Number	Area (acres)	Description	Receiving Water Body
2	7.76	A Sta 255+07 to A Sta 269+42	Weiser Creek
3	6.77	A Sta 267+50 to A Sta 279+18	Weiser Creek
4	1.11	A Sta 273+42 to A Sta 276+58	Lake Stevens
5	0.84	A Sta 279+18 to SR 9 Sta 282+08	Lake Stevens
6	0.06	H Sta 32+40 to H Sta 32+14	Lake Stevens

2.4 SOILS

The available soil information in the project area has been reviewed and is based on the United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Web Soils Survey for Snohomish County, Washington. The NRCS soil data indicates that the soils within the project limits are predominantly Tokul gravelly medial loam, 0 to 8 percent slopes with a small section of Tokul gravelly medial loam 15 to percent slopes. Tokul soil is Hydrologic Soil Group C. The NRCS soils map is included as **Figure 2-4** and the Map Unit Legend as **Figure 2-5**.

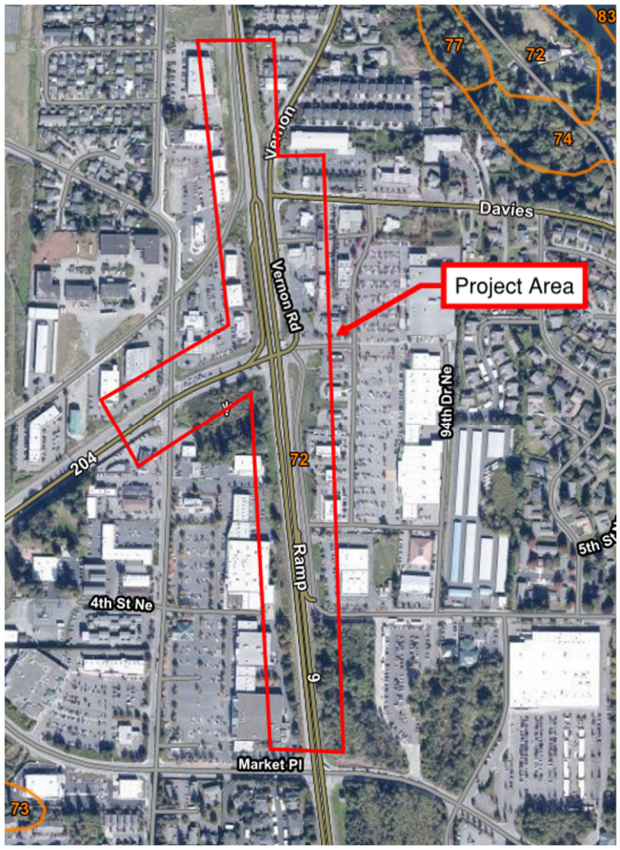


Figure 2-4 | Soils

Map Unit Legend

Map Unit Symbol	Map Unit Name
72	Tokul gravelly medial loam, 0 to 8 percent slopes
73	Tokul gravelly medial loam, 8 to 15 percent slopes
74	Tokul gravelly medial loam, 15 to 30 percent slopes
77	Tokul-Winston gravelly loams, 25 to 65 percent slopes
83	Water

Figure 2-5 | Soils Map Unit Legend

2.4.1 INFILTRATION RATE AND GROUNDWATER

Geotechnical analysis concluded that the K-equivalent for the soils within the project limit ranges between 0.010 in/hr and 0.607 in/hr. Geotechnical investigations indicate that groundwater depths vary within the project limits between 2.5 and 10 feet below existing grade. The majority of the soils within the Stage 3 project limits are loam soils near the surface that are moderately conducive to infiltration. However, with very little to no separation to groundwater, infiltration is not feasible within the project limits.

2.4.2 OTHER CONSIDERATIONS

Unsuitable Material

The geotechnical investigation has not identified unsuitable material that could adversely affect the constructability.

Hazardous Material

No hazardous materials have been identified within project limits.

2.5 EXISTING STORMWATER DISCHARGE POINT INVENTORY

The existing stormwater discharge point inventory map provided by WSDOT is included in **Figure 2-6**. Within the project limits, WSDOT shows three discharges along SR 9 and one discharge along SR 204 to or from the WSDOT system. There are numerous discharges to or from the WSDOT system along SR 204 west of SR 9 and one north of the project limits along SR 9 (also shown on the WSDOT stormwater discharge point inventory map). These discharge points are summarized in **Table 2-3**.

The Snohomish County Drainage Inventory Map was also reviewed and three outfalls from offsite stormwater facilities were found to discharge to the WSDOT drainage system in SR 9. These three connections are described in **Section 2.2.3**.

Review of the survey that was used as the basis of the conceptual design revealed numerous connections from offsite properties and streets discharging to the WSDOT system in SR 9 that are not shown on the WSDOT stormwater discharge point inventory map. These connections are summarized below in **Table 2-4**.

The design team is not aware of any illicit connections or discharges to the state drainage system within the project limits.

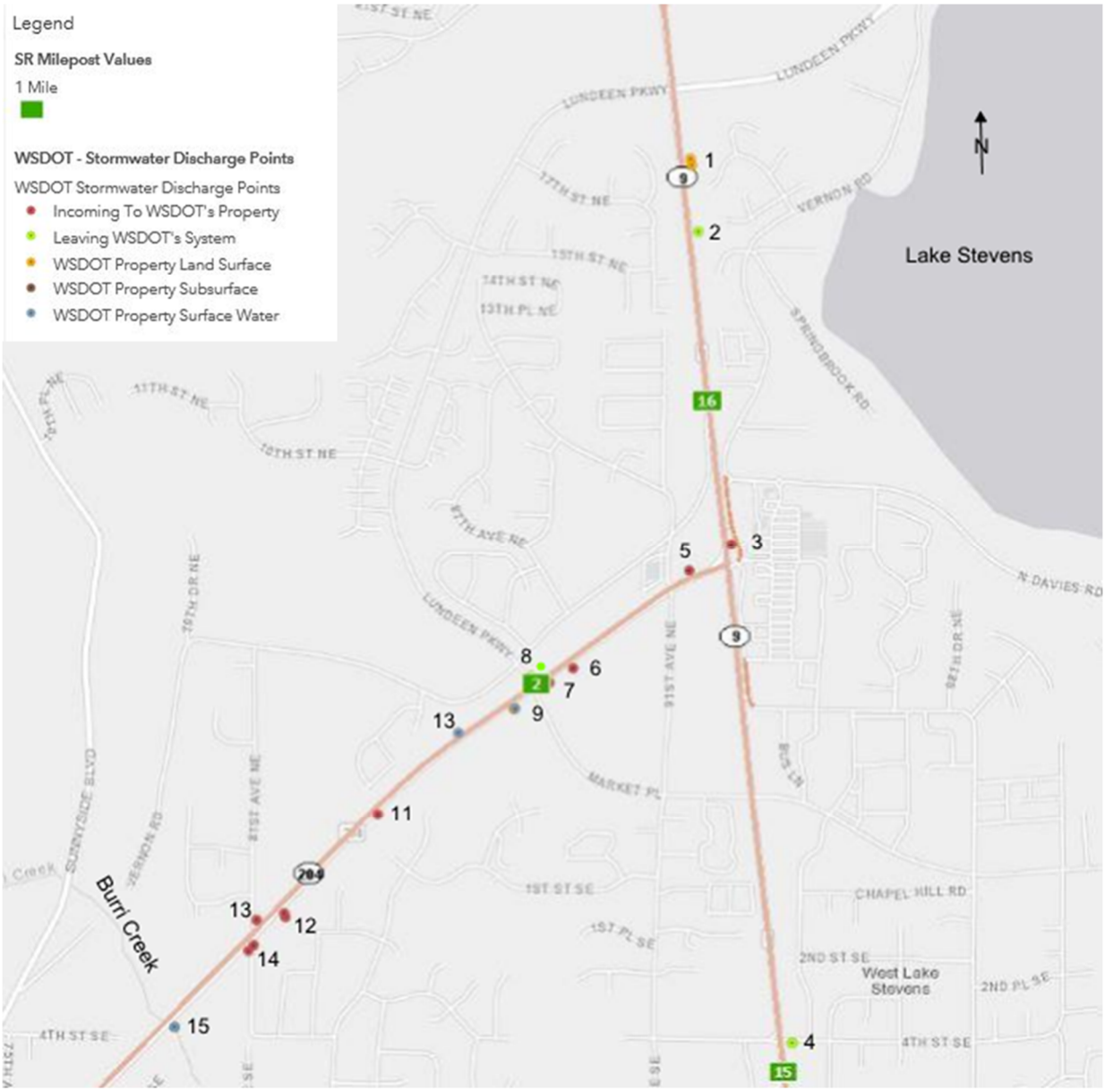


Figure 2-6 | WSDOT Stormwater Discharge Point Inventory Map

TABLE 2-3 | WSDOT EXISTING STORMWATER DISCHARGE POINTS[A]	
Number	**WSDOT Asset Reference**
1	0000945429, 0000945428
2	0000946373
3	0000942128
4	0000946374
5	0000941937
6	0000941936
7	0000941935
8	0000946372
9	0000945326, 00009951137

TABLE 2-3 | WSDOT EXISTING STORMWATER DISCHARGE POINTS[A]	
Number	**WSDOT Asset Reference**
10	0000951138
11	0000941934
12	0000941932, 0000941933
13	0000941938
14	0000941931, 0000941930
15	0000951135

A. Data from WSDOT Community Planning Portal - http://wsdot.maps.arcgis.com/home/webmap/viewer.html?webmap=927b5daaa7f4434db4b312364489544d

TABLE 2-4 | ADDITIONAL CONNECTIONS TO WSDOT DRAINAGE SYSTEM			
From	**Location**	**Pipe Dia. (inches)**	**Discharge Point***
4th St. NE drainage system	A 255+48, Rt	12" CMP	Discharges to CB Type 2, east side of 92nd Ave NE
Outlet from parking lot detention system	A 258+82, Rt	12" CMP	Discharges to CB Type 1, east side of 92nd Ave NE
Outlet from parking lot drainage system	A 259+06, Rt	18" PVC	Discharges to CB Type 1, east side of 92nd Ave NE
Outlet from parking lot drainage system	A 259+53, Rt	6" Conc	Discharges to CB Type 1, east side of 92nd Ave NE
Water Vault drain	A 259+77, Rt	6" PVC	Discharges to ditch, east side of 92nd Ave NE
Irrigation Vault drain	A 260+64, Rt	Size not noted	Discharges to ditch, east side of 92nd Ave NE
East of 92nd Ave NE (upstream end of pipe not located)[a]	A 261+81, Rt	8" Conc	Discharges to CB Type 1, east side of 92nd Ave NE, middle of driveway
CB at edge of parking and driveway	A 262+34, Rt	12" CMP	Discharges to ditch, east side of 92nd Ave NE[a]
Outlet from parking lot drainage system (McDonalds Drive-thru)	A 262+96, Rt	12" Conc	Discharges to ditch, east side of 92nd Ave NE[a]
Power Vault drain	A 263+48, Rt	6" PVC	Discharges to ditch, east side of 92nd Ave NE[a]

[a]Existing ditch bottom eroded, exposed rocks and dirt. Existing ditch is filled in with the proposed sidewalk on 92nd Avenue.

**Permitted and unpermitted systems into the WSDOT ROW is coordinated by WSDOT*

2.6 EXISTING UTILITIES

There are a number of utilities within this section of SR 9.

- A gas line and water line cross under SR 9 at A 255+25, near 4th Street NE. Both turn and continue north along the edge of 92nd Avenue NE and Vernon Road, past N Davies Road.
- An underground telephone line crosses 4th Street NE just east of SR 9 and runs parallel to 92nd Ave NE on the east side.
- A buried fiber line crosses 7th Pl NE.

- A sanitary sewer line crosses SR 9 at approximate Sta. A 274+67 and 268+67 and runs parallel to SR 9 at N Davies Road at approximate 30+42.
- A gas line, a buried telephone, and a sanitary sewer run along Vernon Rd between 7th Pl NE and N Davies Rd
- A gas line, a water line, and a buried telephone run along N Davies Rd
- A gas line, a water line, a buried telephone, and a sanitary sewer run under Vernon Road on the east side of SR 9
- A buried telephone crosses SR 9 at approximate A Sta. 273+20
- A water line, buried telephone, overhead telephone, buried fiber, and sanitary sewer run along Vernon Rd on the west side of SR 9.
- A gas line, a water line, buried fiber, and sanitary sewer run along 91st Ave NE.

SECTION 3 DESIGN STANDARDS

The design for this project is in accordance with the WSDOT 2019 Highway Runoff Manual (HRM), WSDOT Hydraulic Manual (2019), WSDOT Standard Plans and Standard Specifications, WSDOT Design Manual, and WSDOT Roadside Manual. Local streets follow the City of Lake Stevens Engineering Design and Development Standards (May 2009) and Ecology's SWMMWW (2019).

3.1 DESIGN FREQUENCY

The permanent and temporary stormwater facilities have been designed using the following:

- Storm drain inlets and gutter analysis: 10-year design storm.
- Storm drain inlets on a vertical curve sag: 50-year design storm.
- Storm drainpipe conveyance capacity: 25-year design storm.
- Ditch conveyance capacity: 10-year design storm.
- Downstream Analysis: 25-year storm for storm drainpipes, 10-year for ditch, compare 100-year pre- and post-developed flow rates for added impervious area.
- Continuous simulation modeling for flow control and runoff treatment facility design using MGSFlood Version 4.50 with 15-minute time steps.
- Time series for continuous simulation modeling (MGSFlood) for flow control and runoff treatment facility design is Puget East 40.

For modeling purposes, the predeveloped conditions were considered till forest. Design frequency, standard, and criteria for various flow control and treatment BMPs are discussed in **Section 5**. Modeling results and calculations are included in **Appendix C.**

3.2 STORMWATER MANAGEMENT GUIDELINES

The stormwater management approach followed guidelines from the 2019 WSDOT HRM. The project areas within the WSDOT R/W adhere to the following minimum requirements stated in the HRM:

Minimum Requirement 1 – Stormwater Planning
Minimum Requirement 2 – Construction Stormwater Pollution Prevention
Minimum Requirement 3 – Source Control of Pollutants
Minimum Requirement 4 – Maintaining the Natural Drainage System
Minimum Requirement 5 – Runoff Treatment
Minimum Requirement 6 – Flow Control
Minimum Requirement 7 – Wetlands Protection
Minimum Requirement 8 – Incorporating Watershed/Basin Planning into Stormwater Management
Minimum Requirement 9 – Operation and Maintenance

All nine Minimum Requirements apply to the planning and design of the stormwater management facilities and best management practices for this project, because more than 5,000 square feet of new impervious surfaces will be added. Minimum Requirements 1–4 apply to the new and replaced impervious surfaces and land disturbed. Minimum Requirement 6 applies to the new impervious surfaces and converted pervious surfaces. Minimum Requirement 5 applies to the new pollution generating impervious surfaces (PGIS) and any new Pollution Generating Pervious Surfaces (PGPS). Minimum Requirements 5 and 6 do not apply to the replaced impervious or PGIS, because less than 50 percent of the existing surfaces will be added within the project limits. Minimum Requirements 7–9 apply to the new impervious surfaces, converted pervious surfaces. **Table 3-1** provides the total area, new impervious surface and new PGIS, replaced impervious, and replaced PGIS areas for each TDA.

	TABLE 3-1 | SUMMARY OF AREAS						
TDA	**Total Existing Area (acres)**	**Existing Impervious (acres)**	**Existing Pervious (acres)**	**New Impervious (acres)**	**Effective PGIS (acres)**	**Replaced Impervious (acres)**	**Replaced PGIS (acres)**
2	7.76	4.99	2.77	0.87	0.60	1.45	0.97
3	6.77	4.55	2.22	0.56	0.46	2.51	1.88
4	1.11	0.91	0.20	0.07	0.05	0.18	0.16
5	0.84	0.34	0.50	-	-	-	-
6	0.06	0.06	-	-	-	0.01	0.01
Totals	**16.54**	**10.85**	**5.69**	**1.50**	**1.11**	**4.15**	**3.02**

The minimum requirements in accordance with the 2019 HRM are as follows:

HRM Minimum Requirements 1–3

These items require advanced planning of construction stormwater pollution prevention, permanent flow control, runoff treatment, and source control measures. A TESC Narrative and TESC Plan has been prepared as a separate document to specifically address construction stormwater control and each of the 13 TESC elements.

The TESC Narrative and the Spill Prevention, Control, and Countermeasures (SPCC) Plan together make up the construction Stormwater Pollution Prevention Plan (SWPPP) that addresses overall construction considerations to minimize impact to the environment. WSDOT will prepare a Hazmat Sampling Report to address contaminated soil handling and disposal if encountered during excavation for roadway, retaining wall, or stormwater facilities.

HRM Minimum Requirement 4 – Maintaining the Natural Drainage System

The project stormwater system shall be designed to match the natural outfall locations to the maximum extent practicable. Off-site and on-site runoff from TDAs 2-6 will continue to be routed to their existing discharge points.

HRM Minimum Requirement 5 – Runoff Treatment

Runoff treatment requirements apply to the new PGIS and converted PGPS. New PGIS will require enhanced treatment, because the project is within the Lake Stevens Urban Growth Area (UGA) with an average daily traffic (ADT) count greater than 7,500. The ADT volumes for the design year of 2025 have been included in **Appendix G**.

Equivalent areas that drain to the same receiving waters and have the same pollutant loading characteristics have been used to meet the treatment requirements. Media Filter Drains (MFDs) and a Compost Amended Biofiltration Swale (CABS) will be used to provide treatment.

Oil Control:

The oil control requirement applies to intersections where more than 15,000 vehicles (ADT) stop to cross a roadway with more than 25,000 vehicles. The intersections in the Stage 3 project are roundabouts, which are not stop controlled and do not trigger oil control.

Phosphorus Control:

Phosphorus control is required for designated areas as described through an adopted basin plan or Total Maximum Daily Load (TMDL). At this time there is no water quality improvement project or phosphorus TMDL associated with Lake Stevens. Lake Stevens is listed as Category 2, meaning the lake is "at risk" for future impairment. In addition, the Ecology does not list Weiser Creek on the 303(d) list for the Total Phosphorus parameter. Therefore, phosphorus control is not required for this project.

Facility Design Criteria:

Runoff treatment facilities have been sized to treat all flows tributary to the facility in addition to the new PGIS requiring treatment. The treatment facilities are upstream of flow control facilities where applicable and are considered in-line. They have been designed to meet the 91% of the annual average runoff that will be received for treatment at or below the design loading criteria, under the developed conditions, using a 15-minute time step.

Stormwater Retrofit:

The project drains to the Puget Sound Basin and exceeds the thresholds that trigger runoff treatment; therefore, Stormwater Retrofit is required. Refer to **Section 3.3** for stormwater retrofit requirements.

HRM Minimum Requirement 6 - Flow Control

Flow control requirements only apply to the new impervious and converted pervious project areas, as the new impervious surface area added by the project is less than 50 percent of the existing impervious surface area within the project limits.

Flow Control Exemptions:

None of the flow control exemptions listed in Section 3-3.6.2 of the HRM apply to this project. The space and natural vegetated area required for dispersion is not available, the project will not be discharging to a flow control exempt water body, the project is not within a 2-year floodplain, nor does the Stage 3 project discharge to a wetland.

Facility Design Criteria:

The flow control facility provides the storage volume required to match the duration of the predeveloped peak flows from 50 percent of the 2-year up to the 50-year storm flow, using a flow restrictor. The 100-year peak flows have been checked for downstream flooding and property damage.

Low Impact Development (LID) Flow Control BMPs:

LID BMPs, dispersion and infiltration, were considered as potential stormwater facilities for this project, but are not feasible. There is insufficient space within the project limits for dispersion. Based on the NRCS soils mapping, the area is expected to have a high groundwater table and the native soils have a low infiltration rate, limiting the use of infiltration. The WSDOT LID Feasibility Checklist is included in **Appendix A**.

Stormwater Retrofit:

The project drains to the Puget Sound Basin and exceeds the thresholds that trigger flow control; therefore, Stormwater Retrofit is required. Refer to **Section 3.3** for stormwater retrofit requirements.

HRM Minimum Requirement 7 – Wetlands Protection

As noted in Section 2, there are two existing wetlands, W4 and W5, delineated along the edges of the Stage 3 project. The Stage 3 project does not alter the existing contributing area or flow patterns to Wetland 5. The project maintains the existing drainage patterns and discharges to Wetland 4 from the WSDOT drainage system and off-site contributing areas. Flows from TDA 2 in Stage 1 and Stage 2 in existing and developed conditions contribute to flows into the buffer of Wetland 4. The HRM defers to the Department of Ecology Stormwater Manual for Western Washington (2019 SWMMWW) for the methodology for wetland protection.

In the developed condition, the wetland hydroperiod for Wetland 4 is within the limits specified in Section 4-6.1 of the 2019 HRM; therefore, no additional flow reduction strategies are required beyond what is needed to mitigate for the new impervious area. An evaluation of the wetland hydroperiod can be found in **Appendix C-9**. Wetland mitigation requirements for temporary and permanent impacts will be documented and confirmed through the environmental permits for this project.

HRM Minimum Requirement 8 – Incorporating Watershed/Basin Planning into Stormwater Management

Watershed plans for WRIA 7 were reviewed, and it was found that no additional stormwater design requirements are required.

HRM Minimum Requirement 9 – Operation and Maintenance

Operation and Maintenance within WSDOT R/W will be performed by WSDOT. In areas outside the WSDOT turn-back line, which are under local jurisdictional control, the operation and maintenance will be performed by the local jurisdiction. Operation and maintenance procedures for the permanent stormwater facilities will be based on Section 5-5 of the 2019 HRM. The Operation and Maintenance Manual for the stormwater facilities will be developed by WSDOT.

3.3 STORMWATER RETROFIT ANALYSIS

This project falls under the WSDOT Puget Sound Basin Retrofit requirements and qualifies as a low-priority location. As a result, a Stormwater Retrofit Cost-Effectiveness and Feasibility analysis has been completed to determine the extent to which the retrofit obligations can be met through additional stormwater mitigation provided on site or through the transfer of an amount of money equal to the 20% cost obligation to fund stand-alone stormwater retrofit projects. The stormwater retrofit cost-effectiveness and feasibility (RCEF) analysis is included in **Appendix A**. Based on current project design, approximately 24% of the retrofit obligation is being met by the Stage 3 project.

Per HRM Minimum Requirements 5 (Runoff Treatment) and 6 (Flow Control), treatment and flow control are required for new impervious surfaces and converted pervious area. The Stage 3 project generates 1.50 acres of new impervious surface and 1.11 acres of new PGIS area.

3.4 OTHER REQUIREMENTS

Portions of this project propose to make modifications to roadways that are not located within the WSDOT R/W, within the turn-back line, or permanent easements. These roadway areas are within the City of Lake Stevens limits. The City of Lake Stevens follows the current edition of the Ecology SWMMWW. WSDOT is coordinating with the City of Lake Stevens on the turn-back agreement and compliance of stormwater design within the City of Lake Stevens jurisdiction. The requirements from the 2019 WSDOT HRM and Hydraulic Manual are considered applicable for all areas within the project limits.

Section 6.2 of this report contains a list of permits necessary to construct this project.

The programmatic ESA requires the treatment of all new and replaced PGIS on the project if the new PGIS proposed by the project is between 500 sq ft and 2 acres. Per the programmatic biological assessment (BA) consultation, the project reduces the total amount of PGIS areas from existing to proposed conditions. The project is exempt from the programmatic BA consultation and no additional BMPs area required to meet ESA requirements.

3.5 HYDRAULICS MANUAL DEVIATIONS

A deviation to Minimum Requirement #4 – Maintain Existing Drainage Patterns is required. The project proposes roadway improvements that include converting two existing intersections into roundabouts, relocating an existing roundabout, and creating a new roundabout intersection connecting a previously grade separated local collector street with SR 9. Due to the proposed roadway improvements, there are unavoidable changes to the existing drainage patterns on the site and it has been determined that it is infeasible to maintain existing TDA boundaries in the developed condition. A written deviation has been prepared and is included in Appendix H.

3.6 HIGHWAY RUNOFF MANUAL DEVIATONS

No deviations are required from the Highway Runoff Manual for the Stage 3 project.

3.7 PIPE ALTERNATIVES

According to the WSDOT Hydraulics Manual, the majority of the project lies within Corrosion Zone II. Untreated aluminized steel, aluminum alloy, thermoplastic, and concrete pipe may be used in Corrosion Zone II. All approved pipe schedule alternatives for Corrosion Zones II will be considered in final design.

3.8 DOWNSTREAM ANALYSIS

The downstream conveyance system has been inspected to verify the available as-built information and information from the Snohomish County Drainage Inventory Map. The existing downstream conveyance paths for each TDA are described in **Section 2.3**.

The downstream analysis for TDAs 2-6 are included in **Appendix C-8**.

3.9 NEW STORMWATER DISCHARGE POINTS

The existing discharge locations for stormwater runoff from TDAs 2-6 will be maintained and are located as noted in **Section 2.5**.

SECTION 4 DEVELOPED CONDITIONS

The stage 3 project improvements include constructing roundabouts at the intersections of SR9 and SR204, SR9 and westbound Vernon Rd, Vernon Rd and 91st Ave NE, Vernon Rd and N Davies Rd: as well as curb, gutter, and sidewalk improvements at the intersections. SR9 will be widened from MP 15.48 to MP 16.45. Roadway improvements will be completed along 92nd Ave NE and Vernon Road to connect to the new roundabouts.

4.1 DRAINAGE BASINS

The existing and developed roadway footprint was delineated to determine the extent of the existing pavement areas, new impervious surfaces, removed impervious surfaces, and replaced impervious surfaces. Refer to **Appendix A** for breakdown of these areas. Developed Conditions TDA exhibits are also included in **Appendix B**. The WSDOT Stormwater Design Documentation Spreadsheet (SDDS) provides a summary of the areas under each TDA. The SDDS is included in **Appendix A**.

Based on the roadway layout, the HRM Minimum Requirements for flow control and runoff treatment are applicable to TDAs 2 and 3. The new impervious and pollution-generating impervious surface areas exceed the minimum threshold at the project level, but only for TDAs 2 and 3 at the TDA level. Within the project limits, the total project new impervious surface and the new PGIS surface areas do not exceed 50% of the existing impervious and existing PGIS surface, respectively. As a result, the project is not required to treat or detain the replaced impervious and replaced PGIS areas within the project limits. The removed impervious area totals noted in the area tallies assumes that existing impervious/PGIS areas are being removed and replanted with grass or landscaping. These areas will not be restored to a forested condition. Refer to **Section 5.1** for a summary of Project Flow Control and Runoff Treatment BMPs that will be constructed to meet the minimum requirements.

A BMP catchment area summary exhibit is included in **Appendix C**. The SDDS in **Appendix A** provides documentation of the project areas under each TDA that are receiving treatment and flow control. The minimum required runoff treatment and flow control areas are summarized below:

- TDA 2 is required to provide a minimum of 0.60 acres of enhanced runoff treatment
- TDA 3 is required to provide a minimum of 0.46 acres of enhanced runoff treatment
- TDA 2 is required to provide a minimum of 0.87 acres of flow control
- TDA 3 is required to provide a minimum of 0.56 acres of flow control

4.2 POST DEVELOPED TDAs

Developed TDA boundaries of the project have been delineated based on the proposed conditions and the existing TDA boundaries have been modified by the proposed roadway grades. Due to the extensive regrading required to install the two new roundabouts at the intersection of SR 9 and Vernon Rd/Davies Rd, there are existing areas of TDA 2, 3, 4, and 6 where it is no longer feasible to grade back to their existing TDAs in the developed condition. Proposed storm sewer conveyance was designed to capture and route these areas back to their existing TDAs to the maximum extent feasible. A detailed description of the areas transferred between TDAs is provided in the deviation in **Appendix H**. TDAs 2-6 will match the existing discharge points from the WSDOT R/W. See **Section 2.3** for further discussion on the existing TDA boundaries.

The pre-developed and post-developed TDA exhibits for Stage 3 are provided in **Appendix B**.

SECTION 5 HYDROLOGIC AND HYDRAULIC DESIGN

This section summarizes the preliminary design of the proposed hydrologic and hydraulic design features, including flow control, treatment BMPs, and storm drain conveyance sizing for the Stage 3 project. All modeling results are included in **Appendix C**. Inlet analysis, detailed storm conveyance, pipe outfall protection, ditch design, and downstream analysis are also included in **Appendix C**.

5.1 FLOW CONTROL AND RUNOFF TREATMENT BMPS

The proposed BMP facilities are designed to provide enhanced runoff treatment and flow control for the project's stormwater runoff for TDAs 2 and 3. The equivalent area option has been used to capture an equivalent area within the same TDA having similar characteristics to be treated, to provide the same amount of the required runoff treatment and flow control. These equivalent areas may contain existing, replaced, and/or new pavement. The contributing areas to each BMP are shown on the Catchment Area Figures included in **Appendix C**.

5.1.1 RUNOFF TREATMENT BMPS

The project is required to provide enhanced treatment for the new PGIS area under the HRM requirements. The following BMPs have been designed to provide the required enhanced treatment per the HRM for Stage 3 of the project. Additional BMPs also provide both basic and enhanced treatment to fulfill the project retrofit requirements.

- RT.07 - Media Filter Drain (MFD) – Enhanced Treatment
- RT.04 - Compost Amended Biofiltration Swale (CABS) -Enhanced treatment
- RT.05 - Wet Biofiltration Swale – Basic Treatment

Three MFDs have been sized following the recommendations listed in the HRM Section 5-4.1.3, RT.07 and Table 5-6. The pavement width of SR 9 draining to the MFDs is greater than 35 ft and requires an MFD width of 4 ft. The resultant roadway slope has been evaluated and meets the 9% maximum requirements listed in the HRM. The MFD underdrains has been sized using the MFD Underdrain Design Spreadsheet and by following the criteria described in the HRM for MFD underdrain design for Type 1 MFDs. MFD Type 3 have a ditch behind them to collect and convey the flows from the roadway after treatment. Ditch sizing calculations can be found in **Appendix C-7** and sized so that the 50-yr water surface elevation in the ditch is below the toe of the MFD slope. Further details regarding sizing criteria can be found in the calculations in **Appendix C-2.**

One CABS has been sized following the recommendations listed in the 2019 HRM Section 5-4.1.3, RT.04 and the WSDOT CABS design spreadsheet. The contributing areas are captured in catch basins and conveyed via storm pipes to the head of the CABS facility.

In addition to the MFD and CABS facilities the project proposes a Wet Biofiltration Swale (Bioswale) to provide basic treatment of PGIS areas within TDA 3. The bioswale is a retrofit BMP. Due to site and ROW constraints only a basic treatment facility was feasible. The bioswale is sized, in accordance with Section 5-4.1.3 of the HRM, to treat the discharge from the proposed detention pond (FC 3-1) and collected roadway runoff from the southbound SR 9 through and right turn lanes on approach to SR 204. A flow splitter is provided upstream of the head of the swale to divert flows greater than the water quality flow rate of the Bioswale. The bioswale has been designed with a divider on one side to separate WQ flows/treatment and off-site flows tributary to the swale. The bioswale and parallel ditch, opposite of the divider, discharges to an existing ditch before entering an enclosed pipe system in TDA 3.

The MGSFlood reports associated with the calculation of the runoff treatment design flows are included in **Appendix C-2**. A summary of the areas treated by the new BMPs is provided in **Table 5-1**.

TABLE 5-1 | RUNOFF TREATMENT BMP AND TREATMENT AREA					
TDA	**Facility Name**	**Location**	**Type of Facility**	**Total BMP Treatment Area (acres)**	**Size**
2	DR02-14	A 258+19 (52.0' LT) to A 262+99 (52.0' LT)	MFD Type 3	0.47	480 LF
2	DR02-76	A 263+31 (73.1' RT) to A 246+43 (103.8' RT)	CABS	0.71	121' L x 2' W x 1.15' D
3	DR03-34	A 269+32 (53.5' LT) to A 271+74 (53.6' LT)	MFD Type 1	0.17	244 LF
3	DR03-32	A 273+96 (78.1' LT) to A 278+98 (38.8' LT)	MFD Type 3	0.38	515 LF
3	DR03-31	A 273+90 (63.2' RT) to A 278+51 (37.2' RT)	MFD Type 1	0.37	466 LF
3	DR03-33	A 269+30 (66.3'LT) to A 271+30 (64.3' LT)	Wet Biofiltration Swale	1.01	200' L x 5' W x 1.0' D
5	DR04-1	A 279+52 (52.5 LT to A 282+84 (40.0 LT)	MFD Type 3	0.28	333 LF
			Total TDA 2	**1.18**	
			Total TDA 3	**1.93**	
			Total TDA 5	**0.28**	
			Project Total	**3.39**	

5.1.2 FLOW CONTROL BMPS

The new impervious surface proposed for TDAs 2 and 3 triggers the requirement for flow control. Flow control BMPs have been sized using MGSFlood so that discharges from the post-developed conditions match for the range of the predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The project uses the equivalent area approach to meet the required treatment areas for both TDAs 2 and 3. Due to the developed conditions of the project site and the size of the roundabouts and local roadways, available roadside area to site a graded pond facility in TDA 2 is extremely limited. To provide the required flow control, a vertical walled detention pond is proposed. The walled pond was sized for slightly more than the required impervious area to meet the 50% flow through rule for detention pond sizing per the HRM requirements. The proposed pond in TDA 3 has been designed as a graded pond and detains runoff from the SR9 roadway and Vernon Rd on the east side of SR 9. A summary of the flow control facility and area treated is provided below in **Table 5-2**.

TABLE 5-2 | FLOW CONTROL BMPS AND TREATMENT AREAS				
TDA	**Facility Name**	**Location**	**Type of Facility**	**Total BMP Treatment Area (acres)**
2	DR02-73	A 265+35.0 (133.5 RT)	Walled Detention Pond	0.88
3	DR02-78	A 268+04.0 (83.5 RT)	Detention Pond	0.68
			Total TDA 2	**0.88**
			Total TDA 3	**0.68**
			Project Total	**1.56**

The MGSFlood reports and input spreadsheets associated with the design of the ponds are included in **Appendix C-1**.

5.2 CONVEYANCE DESIGN

5.2.1 INLET SPACING

New concrete curb and gutter is proposed within and in the approaches to the three new roundabouts and along local roadways. An inlet spacing analysis has been conducted to site new catch basins along the curb face using the WSDOT Inlet Spacing – Curb and Gutter Spreadsheet on a continuous grade. These calculations are included in **Appendix C-3**. The design storm used in the analysis is a 10-year event. There are sag inlet locations in both TDA 2 and TDA3. The design storm for sag inlet analysis is the 50-year event. The sag inlet analysis is included in **Appendix C-4**. The inlets are shown in the Drainage Plans included in **Appendix D**. The catchment areas for each inlet are shown on the Conveyance Catchment Area figures included in **Appendix C**.

5.2.2 STORM DRAIN PIPING

Storm conveyance sizing calculations for the project following the 2019 WSDOT Hydraulics Manual and the WSDOT conveyance spreadsheet have been completed and are included in **Appendix C-5**. The system has been designed using the 25-year storm event. All proposed pipes provide adequate capacity for anticipated project flows and existing off-site flows. The catchment areas for each inlet are shown on the Conveyance Catchment Area figures included in **Appendix C**.

5.2.3 DITCH DESIGN

The Stage 3 project will construct nine ditches to convey runoff through the project in areas where curb and gutter is not included, outside of the roundabouts and approaches. The ditches have been sized per the 2019 Hydraulic Manual for the 10-year design storm. The sizing calculations are included in **Appendix C-7**.

5.2.4 CULVERT DESIGN

No new culverts are proposed as part of Stage 3 of the project. Existing culverts will be replaced by enclosed storm drainpipes, which have been sized as summarized in **Section 5.2.2**.

5.2.5 PIPE OUTFALL PROTECTION

Pipe outfall protection will be required where pipes outfall to ditches. Locations for pipe outfalls are shown in the Drainage Plans. Outfall protection sizing conforms to the criteria detailed in the 2019 HRM.

SECTION 6 PERMITS AND ASSOCIATED REPORTS

6.1 ENVIRONMENTAL ISSUES, FISH AND OTHER ENDANGERED HABITAT

6.1.1 RECEIVING BODIES

Stormwater from TDAs 2-3 ultimately discharge to Weiser Creek, a tributary of Ebey Slough. Stormwater from TDAs 4-6 ultimately discharge to Lake Stevens. This project is not anticipated to change flows going to Weiser Creek or Lake Stevens.

6.1.2 FLOOD PLAINS

This project is not in a flood plain nor will it affect a flood plain.

6.1.3 STREAM CROSSINGS

As stated in **Section 2.2**, no stream crossings are identified within the project limits.

6.1.4 WETLANDS

Wetland delineations have been conducted in areas where construction activities will occur outside of the existing subgrade shoulder. A separate technical Wetland Report has been prepared that addresses critical areas and details anticipated wetland impacts subject to jurisdiction under the City of Lake Stevens Critical Area Ordinances and the Army Corps of Engineers. Three wetlands have been delineated and are shown in **Figure 2-3**.

This project will widen the roadway and fill slope within the limits of the Category III wetland W4 in the southwest quadrant of the SR 9 / SR 204 intersection. In the pre-project existing condition, offsite flows from the Frontier Village area are collected and discharged through an existing pipe into the wetland buffer. The on-site pre-project existing SR 9 and SR 204 roadways in TDA 2 also discharge runoff to Wetland 4.

In the post-project conditions, the roadway is widened, and sidewalks are added. To maintain existing drainage patterns, the enclosed conveyance system will convey roadway and the off-site discharges into the wetland at approximately the same discharge location. To meet the Wetland Protection Requirement, a wetland hydroperiod analysis was conducted to determine if the roadway widening and sidewalk improvements in TDA 2 will significantly affect the existing wetland hydroperiod, including the discharges from the new walled detention pond. The analysis shows the pre- and post-project flow volumes are within the allowable deviation ranges for the daily and average monthly flows with the flow control from the TDA 2 walled pond. Design criteria meets the Highway Runoff Manual requirements. The Wetland 4 hydroperiod analysis is included in **Appendix C-9**.

The Stage 3 project will not impact Wetland 5 or its buffer.

6.1.5 STEEP SLOPES

No steep slopes exist within the Stage 3 project limits and none are proposed for this project.

6.1.6 OTHER CRITICAL AREAS

There are no critical habitat, sensitive area, or special basin plan or action plan issues specific to the area within the Stage 3 project limits.

There are no critical aquifer recharge areas (CARAs), wellhead protection zones, or sole-source aquifers (SSAs) within the Stage 3 project limits.

No wells have been identified within 100 feet of the R/W or easements.

6.1.7 ENDANGERED AND THREATENED SPECIES

No endangered or threatened species have been identified within the project limits.

6.1.8 FISH PASSAGE

As stated above, there are no identified streams existing within the Stage 3 project limits.

6.1.9 IMPAIRED WATER BODIES

There are no impaired water bodies within the project limits. Stormwater from this project ultimately discharges to Weiser Creek or Lake Stevens. Weiser Creek is not listed as an impaired body of water. Lake Stevens is listed as Category 2, meaning the lake is “at risk” for future impairment by Ecology.

6.2 PERMITS/APPROVALS

Permits and issuing agencies required for this project include, but are not limited to:

- National Environmental Policy Act (NEPA)/ State Environmental Policy Act (SEPA)
- Clearing and Grading Permit–City of Lake Stevens

Project permit requirements and conservation measures need to be determined and will be provided in the next submittal.

APPROVALS

No special approvals or variances from local jurisdictions are required to complete the project as proposed at this time.

DRAINAGE COMMITMENTS

No commitments have been made to the City of Lake Stevens or other agencies.

6.3 EASEMENTS

WSDOT will coordinate with local agencies if the need for easements for stormwater facility access or operation and maintenance should arise, and any such easements will be included in the contract documents.

6.4 ADDITIONAL REPORTS OR STUDIES

Draft Wetland Assessment Report – SR 9 / SR 204 Intersection Improvements, Confluence Environmental Company, April 2018.

SR 9/SR 204 Intersection Improvements Stage 2 Project – Geotechnical Report, WSDOT Geotechnical Office, November 2019.

SR 9/SR 204 Intersection Improvements Project – Stage 1 Geotechnical Data Report, Shannon and Wilson, April 2018.

SR 9/SR 204 Intersection Improvements Project, State Route 9 Mileposts 15.44 to 16.04 – Updated Piezometric Data, Shannon and Wilson, September 2019.

SR 9/SR 204 Intersection Improvements – Stage 3 Soil and Foundation Report, WSDOT Northwest Region Materials Lab, May 2021.

SR 9/SR 204, MP 15.75, XL-4989: Intersection Improvements (Stage 3) Infiltration Design, Geotechnical Office Memorandum, WSDOT, March 2020.

Noise Discipline Report Draft – SR 9/SR 204 Intersection Improvements, Parsons, May 2018.

Pavement Design Report – SR 9/SR 204 Intersection Improvements, WSDOT, May 2018.

SECTION 7 INSPECTION AND MAINTENANCE SUMMARY

WSDOT Maintenance will be responsible for the maintenance and operation of the installed stormwater facilities within the WSDOT R/W. Portions of the stormwater system will be turned back to the City of Lake Stevens for maintenance and operation. Guidelines for the maintenance requirements are outlined in the 2019 WSDOT HRM and the 2020 WSDOT Maintenance Manual and the City of Lake Stevens Engineering Design and Development Standards.

All proposed storm sewer structures, pipes and ditches as well as BMP facilities shall be maintained by WSDOT. A maintenance plan for this project will be developed by WSDOT and will be included in Appendix L.

SECTION 8 REFERENCES

Design Manuals and Publications

Washington State Department of Ecology (Ecology). Stormwater Management Manual for Western Washington (SWMMWW). Publication Number 19-10-021. July 2019.

Washington State Department of Transportation (WSDOT). Highway Runoff Manual (HRM). Publication Number M 31-16.05. April 2019.

Washington State Department of Transportation (WSDOT). Hydraulics Manual. Publication Number M 23-03.06. April 2019.

Websites

Federal Emergency Management Agency (FEMA) Flood Map Service Center. Flood hazard maps. Available online at https://msc.fema.gov/. Accessed May 2019.

Soil Survey Staff, Natural Resources Conservation Service (NRCS), United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed March 2020.

Snohomish County GIS Drainage Inventory Web Map. Available online at https://snohomishcountywa.gov/1129/Drainage-GIS

APPENDIX A

STORMWATER DESIGN DOCUMENTATION SPREADSHEET

RETROFIT COST-EFFECTIVENESS AND FEASIBILITY EVALUATION

LID FEASIBILITY CHECKLIST

Project Title:	**SR9/SR204 Corridor & Intersection Improvements - Stage 3**
WSDOT Region:	Northwest
WIN:	
PIN(s):	100910L
Design Manual Used:	Highway Runoff Manual
Manual Publication Year:	2019
Job Number:	18A828

2019 HRM Spreadsheet Version 6.3

Is this project in western Washington? **YES**

Existing Impervious Surface

Total Project Area (ft^2)	472,465
acres =	10.846

New Impervious Surface

Total Project Area (ft^2)	65,728
acres =	1.509

Conversion of Native Vegetation to Lawn or Landscaped

Total Project Area (ft^2)	0
acres =	0.000

Conversion of Native Vegetation to Pasture

Total Project Area (ft^2)	0
acres =	0.000

Replaced Impervious Surface

Total Project Area (ft^2)	180,926
acres =	4.153

Land Disturbing Activity

Total Project Area (ft^2)	720,409
acres =	16.538

Is this project a "non-road-related" project? (See HRM Glossary for definition) **NO**

Does any part of the project drain to Puget Sound AND does any TDA in the project exceed runoff treatment or flow control thresholds? **YES**

Description	Project Area	Threshold Area Triggers	HRM Figure 3-1 Step #	Decision Response	HRM Minimum Requirements
New and replace impervious surfaces added to Project	246,654	≥ 2,000 ft^2	2	YES	Apply MR 1-4 to the new and replaced impervious surfaces and land disturbed on the Project
Land disturbing activity for the Project	720,409	≥ 7,000 ft^2	2	YES	Apply MR 1-4 to new and replaced impervious surfaces and land disturbed on the Project
New impervious surface added to Project	65,728	≥ 5,000 ft^2	3	YES	Apply MR 6-9 for new impervious surfaces and converted pervious surfaces on the Project
Conversion of native vegetation to lawn or landscaped area	0	≥ 32,670 ft^2 (3/4 acres)	3	NO	Threshold does not apply since Project already exceeds new impervious surface threshold
Conversion of native vegetation to pasture	0	≥ 108,900 ft^2 (2.5 acres)	3	NO	Threshold does not apply since Project already exceeds new impervious surface threshold
New impervious surfaces add 50% or more to the existing impervious surfaces within the Project limit	14%	New impervious ≥ 5,000 sq. ft AND (New Impervious surface) ≥ 1/2 (Exist Impervious surface)	4	NO	DO NOT apply MR 6-9 to replaced impervious surfaces on Project
For non-road-related Projects, proposed value of improvements greater than replacement value	See HRM Figure 3-1 for complete threshold. Non-road-related project generally refers to rest area, ferry terminals, and maintenance facility Projects.	(New impervious + replaced impervious) ≥ 5,000 sq. ft AND (Proposed value of improvements) ≥ 1/2 (replacement value of existing site)	4	N/A	Check road-related project threshold above

Summary of All Minimum Requirements:

Apply MR 1-4 to New and Replaced impervious surfaces and land disturbed on the Project
Apply MR 6-9 to New impervious surfaces and Converted pervious surfaces on Project
Do not apply Minimum Requirements 6-9 to the replaced impervious surfaces on Project
Project Driven Retrofit requirements applies for a WSDOT project. Complete the Level of Retrofit Tab
Go To the 'Step 5 and 6' tab

MR #	Minimum Requirements	MR #	Minimum Requirements
1	Stormwater Planning	6	Flow Control (Quantity)
2	Construction Stormwater Pollution Prevention	7	Wetlands Protection
3	Source Control of Pollutants	8	Incorporating Approved Basin Plans into Stormwater Management
4	Maintaining the Natural Drainage System	9	Operation and Maintenance
5	Runoff Treatment (quality)		

Project Title: SR9/SR204 Corridor & Intersection Improvements - Stage 3
WSDOT Region: Northwest
WIN:
PIN(s): 100910L
Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2019
Job Number: 18A828

2019 HRM Spreadsheet Version 6.3

Is this project in western Washington? YES

Existing PGIS

Total Project Area (ft^2)	444,887
acres =	10.213

New PGIS

Total Project Area (ft^2)	48,811
acres =	1.121

Conversion of Native Vegetation to PGPS

Total Project Area (ft^2)	0
acres =	0.000

Replaced PGIS

Total Project Area (ft^2)	131,504
acres =	3.019

Is this project a "non-road-related" project? (See HRM Glossary for definition) NO

Description	Project Area (ft^2)	Threshold Area (ft^2)	HRM Figure 3-2 Step #	Decision Response	HRM Minimum Requirements
New PGIS added to Project	48,811	≥ 5,000	5	YES	Apply MR 5 for new PGIS and converted PGPS on the Project
Conversion of Native Vegetation to PGPS	0	≥ 32,670 (3/4 acres)	5	NO	Threshold does not apply since Project already exceeds new PGIS threshold
New PGIS add 50% or more to the existing PGIS within the Project limit	11%	New PGIS ≥ 5,000 AND (New PGIS) ≥ 1/2 (Exist PGIS)	6	NO	DO NOT apply MR 5 to the replaced PGIS on the Project
For non-road-related Projects, proposed value of improvements greater than replacement value	See HRM Figure 3-1 for complete threshold. Non-road-related Project generally refers to rest area, ferry terminals, and maintenance facility projects.	(New PGIS + replaced PGIS) ≥ 5,000 AND (Proposed value of improvements) ≥ 1/2 (replacement value of existing site)	6	N/A	Check road-related project threshold above

Summary of All Minimum Requirements:

Apply MR 5 to New PGIS and converted PGPS the on Project
Do not apply MR 5 to Replaced PGIS on Project
Project Driven Retrofit requirements applies for a WSDOT project. Complete the Level of Retrofit Tab
Go to Step 7 RT tab

MR #	Minimum Requirements	MR #	Minimum Requirements
1	Stormwater Planning	6	Flow Control (Quantity)
2	Construction Stormwater Pollution Prevention	7	Wetlands Protection
3	Source Control of Pollutants	8	Incorporating Approved Basin Plans into Stormwater Management
4	Maintaining the Natural Drainage System	9	Operation and Maintenance
5	Runoff Treatment (quality)		

Project Title: SR9/SR204 Corridor & Intersection Improvements - Stage 3
WSDOT Region: Northwest
WIN:

PIN(s): 100910L

Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2019
Job Number: 18A828

2019 HRM Spreadsheet Version 6.3

Refer to HRM Figure 3-3 Step 7

Are the replaced PGIS applicable to the project per HRM Figure 3-2 Step 6? NO
Are there any existing runoff treatment Stormwater BMPs within the project limits? YES

Is this project in western Washington? YES

Does the project have retrofit requirements for discharges to Puget Sound? YES

TDA Description	Description	New PGIS Area (ft^2)	Replaced PGIS Area (ft^2)	Non-Effective PGIS Area (ft^2)	Effective PGIS Area (ft^2)	Converted PGPS Area (ft^2)	RT needed for TDA based on Effective PGIS? *Flow Chart Step 7* (Yes/No)	RT needed for TDA based on PGPS? *Flow Chart Step 7* (Yes/No)	RT needed for TDA? PGIS Area (ft^2)	RT needed for TDA? Converted PGPS Area (ft^2)	If RT needed, what is ADT of roadway in TDA? (ADT)	Is Roadway inside Urban Growth Area? (Yes/No)	Does the Roadway Have Full or Partially Controlled Limited Access? (Yes/No)	Enhanced RT or Basic RT?	Oil Control (Yes/No)	Phosphorus Control? (Yes/No)	Comments
2	A Sta 255+07 to A Sta 269+42	26,247	42,212	0	26,247	0	YES	NO	26,247	0	21,000	YES	YES	Enhanced RT	NO	NO	
3	A Sta 267+50 to A Sta 279+18	20,218	81,873	0	20,218	0	YES	NO	20,218	0	21,000	YES	YES	Enhanced RT	NO	NO	
4	A Sta 273+42 to A Sta 276+58	2,346	6,952	0	2,346	0	NO	NO	0	0	21,000	YES	YES	N/A	NO	NO	
5	A Sta 279+18 to SR 9 Sta 282+08	0	0	0	0	0	NO	NO	0	0	21,000	YES	YES	N/A	NO	NO	
6	H Sta 32+40 to H Sta 32+14	0	467	0	0	0	NO	NO	0	0	21,000	YES	YES	N/A	NO	NO	
	Area Totals for Project	**48,811**	**131,504**	**0**	**48,811**	**0**			**46,465**	**0**							

Project Title: SR9/SR204 Corridor & Intersection Improvements - Stage 3
WSDOT Region: Northwest
WIN:

PIN(s): 100910L

Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2019
Job Number: 18A828

2019 HRM Spreadsheet Version 6.3

Refer to HRM Figure 3-3 Step 8

Are the replaced Impervious surfaces applicable to the project per HRM Figure 3-1 Step 4? NO
Are there any existing flow control stormwater BMPs within the project limits? YES
Is this project in western Washington? YES
Does the project have retrofit requirements for discharges to Puget Sound? YES

TDA Description	Description	New Impervious Surface Area (ft²)	Reverted Impervious Surface** Area (ft²)	Net-New Impervious Surface Area (ft²)	Replaced Impervious Surface Area (ft²)	Non-Effective Impervious Surface Area (ft²)	Effective Impervious Surface Area (ft²)	Conversion of Native Vegetation to Lawn or Landscape per TDA Area (ft²)	Increase of 0.15 cfs in 100-year Recurrence Interval Flow for TDA?*** (Yes/No)	FC Needed for TDA based on Effective Impervious surface threshold? (Yes/No)	FC needed for TDA based on Native Vegetation Conversion? (Yes/No)	FC needed for TDA based on 0.15 cfs increase in flow? (Yes/No)	FC needed for TDA? Effective Impervious Area (ft²)	FC needed for TDA? Converted Pervious Surfaces Area (ft²)	Comments
2	A Sta 255+07 to A Sta 269+42	38,093	0	38,093	63,132	0	38,093	0	NO	YES	NO	NO	38,093	0	
3	A Sta 267+50 to A Sta 279+18	24,524	0	24,524	109,468	0	24,524	0	NO	YES	NO	NO	24,524	0	
4	A Sta 273+42 to A Sta 276+58	3,110	0	3,110	7,755	0	3,110	0	NO	NO	NO	NO	0	0	
5	A Sta 279+18 to SR 9 Sta 282+08	0	0	0	0	0	0	0	NO	NO	NO	NO	0	0	
6	H Sta 32+40 to H Sta 32+14	1	0	1	571	0	1	0	NO	NO	NO	NO	0	0	
	Area Totals for Project	**65,728**	**0**	**65,728**	**180,926**	**0**	**65,728**	**0**					**62,617**	**0**	

**** Input zero into this column if the reverted impervious surface does not meet the reversion requirements per HRM 4-3.5.3.**

*****See Highway Runoff Manual 3-3.6.3 for MGSFlood modeling guidance.**

Project Title: SR9/SR204 Corridor & Intersection Improvements - Stage 3
WSDOT Region: Northwest
WIN:
PIN(s): 100910L
Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2019
Job Number: 18A828

2019 HRM Spreadsheet Version 6.3

Is this a WSDOT project initiated by WSDOT (i.e., this isn't a project initiated by a developer, local agency, or other state agency)?**	YES	
Does any part of the project drain to Puget Sound AND does any TDA in the project exceed runoff treatment or flow control thresholds?	YES	
Are the replaced Impervious surfaces applicable to the project per HRM Figure 3-2 Step 5?	NO	
Are the replaced PGIS applicable to the project per HRM Figure 3-2 Step 6?	NO	
Was there any retrofitting of existing impervious surfaces and/or existing PGIS done by the project (including offsite in-kind retrofitting)?	YES	
Choose the type of retrofit of existing impervious surfaces done by the project.	PROJECT TRIGGERED	
Is the project in a high, medium, or low priority stormwater retrofit location?	LOW	
Was retrofitting ALL existing impervious surfaces on the project infeasible or not cost-effective?**	YES	

PROJECT TRIGGERED

Leave Blank ---------->		acres
Leave Blank ---------->		acres
How much area of existing impervious was retrofitted onsite for flow control in the project?	0.13	acres
How much area of existing PGIS was retrofitted onsite for runoff treatment in the project?	2.37	acres
How much area of existing impervious was retrofitted offsite for flow control outside the project?	0.000	acres
How much area of existing PGIS was retrofitted offsite for runoff treatment outside the project?	0.000	acres
How much area of existing impervious was fully reverted to a pervious surface?	0.000	acres
Choose N/A ---------->	N/A	

Will project funds be shifted from the project to fund Stand Alone stormwater retrofit projects*** (PIN 099902L)?	YES
How much money will be shifted away from the project?****	
Were any new permanent stormwater BMPs constructed by the project OR were any existing stormwater BMPs modified by the project?	YES

Goto the 'BMPs_New_or_Modified' and 'BMPs_Removed_or_Modified' tabs and enter in the permenant stormwater BMP information.

Instructions on how to complete the Retrofit Cost-Effectiveness and Feasibility analysis are at: http://www.wsdot.wa.gov/Design/Hydraulics/HighwayRunoffManual.htm

Project Title:	**SR9/SR204 Corridor & Intersection Improvements - Stage 3**
WSDOT Region:	**Northwest**
CN WIN:	
PIN:	**100910L**
Design Manual Used:	**Highway Runoff Manual**
Manual Publication Year:	**2019**
Job Number:	**18A828**
CN Contract Number:	
SubstantiallyCompleteOperationallyComplete Date:	
CNPhaseEndPlanned Date:	
CNPhaseEndActual Date:	
Is the project within the WSDOT NPDES permit area?	
CN PE:	

2019 HRM Spreadsheet Version 6.3

State Route	Begin MP	Begin Latitude** (in Decimal Degrees)	Begin Longitude** (in Decimal Degrees)	End MP	End Latitude** (in Decimal Degrees)	End Longitude** (in Decimal Degrees)	TDA Name	Stormwater BMP Type	Is this an existing BMP to be modified by project or is this a new BMP?	Will this BMP be owned and operated by WSDOT?	Will this BMP be maintained by WSDOT?	List the old WSDOT Feature Number*** (existing BMPs that will be modified by the project will be given a new Feature Number)	List the new WSDOT Feature Number*** (existing BMPs that will be modified by the project will be given a new Feature Number)	Is this BMP designed to full or partial HRM standards?****	List the amount of Effective Impervious Surface (flow control) mitigated by the new or modified BMP (Acres)	List the amount of Effective PGIS (runoff treatment) mitigated by the new or modified BMP (Acres)	If retrofitting existing impervious surfaces, list the amount of existing impervious surface mitigated by the new or modified BMP for flow control (Acres)	If retrofitting existing PGIS, list the amount of existing PGIS mitigated by the new or modified BMP for runoff treatment (Acres)	Comments
009	015.59	48°00'02.0"N	122°06'21.9"W	015.59	48°00'04.6"N	122°06'22.4"W	2	Media Filter Drain Type 3	New	YES	YES		WSDOT0001348834	Full				0.47	Facility Name: RT 2-6 MFD Type 3
009	015.68	48°00'07.1"N	122°06'21.6"W	015.68	48°00'08.6"N	122°06'21.7"W	2	CABS	New	YES	YES		WSDOT0001348840	Full		0.60		0.11	Facility Name: RT 2-7 CABS
009	015.81	48°00'13.0"N	122°06'24.0"W	015.81	48°00'15.2"N	122°06'24.3"W	3	Media Filter Drain Type 1	New	YES	YES		WSDOT0001365505	Full		0.08		0.09	Facility Name: RT 3-1 MFD Type 1
009	015.89	48°00'22.3"N	122°06'25.5"W	015.89	48°00'17.4"N	122°06'25.1"W	3	Media Filter Drain Type 3	New	YES	YES		WSDOT0001348835	Full		0.38		0.00	Facility Name: RT 3-3 MFD Type 3
009	015.89	48°00'21.9"N	122°06'24.3"W	015.89	48°00'17.6"N	122°06'23.5"W	3	Media Filter Drain Type 1	New	YES	YES		WSDOT0001348836	Full				0.37	Facility Name: RT 3-4 MFD Type 1
009	015.81	48°00'13.2"N	122°06'24.2"W	015.81	48°00'15.1"N	122°06'24.6"W	3	Wet Biofiltration Swale	New	YES	YES		WSDOT0001364192	Full				1.05	Facility Name: RT 3-5 Wet Biofiltration Swale
009	016.01	48°00'22.7"N	122°06'25.6"W	016.01	48°00'25.1"N	122°06'25.9"W	5	Media Filter Drain Type 3	New	YES	YES		WSDOT0001364195	Full				0.28	Facility Name: RT 5-1 MFD Type 3
009	015.71	48°00'09.3"N	122°06'21.4"W	015.71			2	Detention Pond	New	YES	YES		WSDOT0001348837	Full	0.87		0.01		Facility Name: FC 2-3 Pond
009	015.78	48°00'11.7"N	122°06'22.0"W	015.78			3	Detention Pond	New	YES	YES		WSDOT0001348838	Full	0.56		0.12		Facility Name: FC 3-1 Pond

Project: **SR 9/SR 204 Interchange Improvements Stage 3**
Subject: **RCEF Analysis - Summary of Results**

RCEF Cost Category	Amount - Project Minimum			Amount - Project Retrofit			
	TDA 2	TDA 3	**Total**	TDA 2	TDA 3	TDA 5	**Total**
Detention Pond	$ 635,937	$ 79,869	$ 715,806	$ 2,236	$ 11,157	$ -	$ 13,393
MFD	$ -	$ 76,029	$ 76,029	$ 57,815	$ 71,572	$ 40,110	$ 169,497
CABS	$ 13,616	$ -	$ 13,616	$ 2,475.00	$ -	$ -	$ 2,475
Wet Biofiltration Swale	$ -	$ -	$ -	$ -	$ 6,600.00	$ -	$ 6,600
Conveyance	$ 239,990.00	$ 138,065.00	$ 378,055	$ 7,810.00	$ 73,565.00	$ -	$ 81,375
Estimated Construction Total[2], [3]	$ 889,543	$ 293,963	**$ 1,183,506**	$ 70,336	$ 162,894	$ 40,110	**$ 273,340**
Preliminary Engineering[4]			**$ 56,884**				**$ 28,442**
Right-of-Way[5]	$ -		**$ -**				**$ -**
TOTAL COST			**$ 1,240,390**				**$ 301,782**

TOTAL COST OF PROPOSED DESIGN	**$ 1,542,172**

% Retrofit by Cost	**24%**

TDA 1 does not trigger HRM minimum requirement thresholds.

Note:

1 The Retrofit analysis is an approximate analysis based on 90% design assumptions on BMP type and modeling considerations.

2 As per RCEF guidelines, the Estimated Construction Cost should:

a) Include cost of the stormwater BMP and all appurtenances connected upstream and downstream of the facility including drainage structures, pipes and excavation.
b) Exclude cost for design of culverts passing off-site flows, pipe and ditch systems passing off-site flows, fish passage culverts, stream channel construction, drainage items not directly related to flow control and treatment BMP facilities, dewatering and related elements, stream bypass, TESC, etc.,

3 Estimated Construction Total cost is not the total drainage and stormwater management cost for the project.

4 Engineering costs are based on estimated level of effort to design, model, and draft/grade of the BMP. Assumed 15% of total project engineering cost. Assumed 2/3rd for project minimum requirement level of effort and 1/3rd for retrofit level of effort.

5 No right-of-way cost for purchase of stormwater facilities

Project: SR 9/SR 204 Interchange Improvements Stage 3
Subject: RCEF - Cost Calculations for TDA 2

PROJECT REQUIREMENT

TDA 2 - FLOW CONTROL COST (PER HRM)

WALLED DETENTION POND Bid Item	Qty	Unit	Unit Price	Total	Notes
Roadway Excavation Incl. Haul	218	CY	$ 60.00	$ 13,050.00	For access road.
Structure Excavation Class A Incl Haul	1338	CY	$ 48.00	$ 77,047.20	Excavation for walled pond and footing +1 FT Wall bottom thickness +Gravel borrow+ 1FT extra Assume 1FT wall thickness; Unit Price: UBA-NW Region Avg+20%
Common Borrow Incl. Haul	0	CY	$ 12.00	$ -	Assumed excavated material is common borrow
Walled Detention Pond					40% Contingency added to all Walled Detention Pond item totals
Inverted Short Span Bridges (Delivered)	1	EACH	$ 179,714.29	$ 180,000.00	
Span Installed	1	EACH	$ 53,914.29	$ 54,000.00	Installation estimated at 25% of delivered price.
Footing	27	CY	$ 500.00	$ 14,000.00	For resistance to buoyant forces due to high GW
End Walls	9	CY	$ 500.00	$ 5,000.00	
Galv. Steel bolt on ladders	3	EACH	$ 650.00	$ 2,000.00	Provided at ~50 ft
CS-231 Mastic	570	LF	$ 3.00	$ 2,000.00	Joint sealant
Joint Wrap	570	LF	$ 4.00	$ 3,000.00	Joint wrap to prevent inflow from GW
Shop Drawings	1	LS	$ 20,000.00	$ 20,000.00	
Shoring or Extra Excavation Class A	1275	SF	$ 16.50	$ 26,400.00	Used WSDOT Bridge Manual values for depht >10ft. Added 20% cont.
Flexible Guide Post	1	Each	$ 65.00	$ 65.00	Assume 1 for pond entrance
Plastic Drainage Markings	1	Each	$ 75.00	$ 75.00	Assume 1 for pond entrance
Catch Basin Type 2 54" Diam. w/Flow Control	1	Each	$ 7,800.00	$ 7,800.00	Assume 1 per pond
Crushed Surface Base Course -CSBC	165	Ton	$ 75.00	$ 12,375.00	Access road area, 6" depth on CSBC ; 1.85 ton/CY
High-Tension Cable Barrier System (3 Cable)	440	LF	$ 345.00	$ 151,800.00	Mounted at the top of pond wall
Chain Link Fence Type 3	440	LF	$ 60.00	$ 26,400.00	Around the walled pond
Construction Geotextile for Soil Stablization	5310	SY	$ 7.50	$ 39,825.00	For access road
Double 20f FTChain Link Fence Gate	1	EACH	$ 1,100.00	$ 1,100.00	for fence
Estimated Construction Cost				**$ 635,937**	

Detention Pond Summary

Detention Pond	Avg. Width (FT)	Avg. Length (FT)	Volume at Riser (CF)
WALLED DETENTION POND	30	155	13,950

TDA 2 - RUNOFF TREATMENT COST (PER HRM)

Bid Item	Qty	Unit	Unit Price	Total	Notes
COMPOST AMENDED BIOFILTRATION SWALE (CABS)					
Length	121	LF			Provided for the project
Bottom Width	2.0	LF			
Top Width	9	LF			
Avg. Width	5	LF			
Depth (with FB)	1.15	LF			
Quarry Spalls	6.76	Tons	$85.00	$ 575.00	Outlet protection
Roadway Excavation Incl. Haul - Area CABS	76.06	CY	$60.00	$ 4,564.00	Exc qty from FG to EG
Construction Geotextile for Soil Stablization	25.35	SY	$7.50	$ 191.00	
Topsoil Type A	0.08	Acres	$65,000.00	$ 5,493.00	0.67'
Medium Compost	0.08	Acres	$15,500.00	$ 1,310.00	3"
Biofiltration Level Spreader	13.52	LF	$100.00	$ 1,353.00	One each at swale head and foot
Flexible Guide Post	2.00	Each	$65.00	$ 130.00	
Plastic Drainage Markings	2.00	Each	$75.00	$ 150.00	
Estimated CABS Construction Cost				**$ 13,616.00**	

Treatment BMP Summary for TDA

Facility Type	Project Req. (LF)	Retrofit (LF)	Total
COMPOST AMENDED BIOFILTRATION SWALE (CABS)	102	19	121
MEDIA FILTER DRAIN (MFD)		480	480

TDA 2 - CONVEYANCE (PER HRM)

Pipe Conveyance Bid Item	Qty	Unit	Unit Price	Total	Notes
Schedule A Storm Sewer Pipe 12 In. Diam.	934	LF	$ 85.00	$ 79,390.00	UBA from SoQ Updated 9/18/19
Schedule A Storm Sewer Pipe 12 In. Diam. Concrete CL V	342	LF	$ 110.00	$ 37,620.00	UBA from SoQ Updated 9/18/20
Schedule A Storm Sewer Pipe 24 In. Diam.		LF	$ 165.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 1	12	Each	$ 2,500.00	$ 30,000.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam.	1		$ 5,900.00	$ 5,900.00	UBA from SoQ Updated 9/18/20
Catch Basin Type 2 48 In. Diam. w/ solid lid	2	Each	$ 5,900.00	$ 11,800.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 54 In. Diam. w/ solid lid and FC	1	Each	$ 7,800.00	$ 7,800.00	UBA from SoQ Updated 9/18/19
Grate Inlet Type 2	2	Each	$ 2,800.00	$ 5,600.00	UBA from SoQ Updated 9/18/20
Excavation Class B Incl. Haul	880	CY	$ 50.00	$ 44,000.00	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	5960	SF	$ 3.00	$ 17,880.00	UBA from SoQ Updated 9/18/19
Testing Storm Sewer Pipe		LF	$ 4.00	$ -	UBA from SoQ Updated 9/18/19
Quarry Spalls		Tons	$ 85.00	$ -	UBA from SoQ Updated 9/18/19
Estimated Construction Cost				**$ 239,990**	

TDA 2 - RIGHT OF WAY COST

	Qty	Unit	Unit Price	Total	Notes
Parcel	0	SF	$ -	$ -	Flow control and runoff treatement facilities within WSDOT R/W

Considered Land Purchase R/W unit price documented in Phase 1 Opinion of Cost

RETROFIT REQUIREMENT

TDA 2 - FLOW CONTROL COST (RETROFIT)

WALLED DETENTION POND Bid Item	Qty	Unit	Unit Price	Total	Notes
Roadway Excavation Incl. Haul	3	CY	$ 60.00	$ 150.00	For access road.
Structure Excavation Class A Incl Haul	15	CY	$ 48.00	$ 885.60	Excavation for walled pond and footing +1 FT Wall bottom thickness +Gravel borrow+ 1FT extra Assume 1FT wall thickness; Unit Price: UBA-NW Region Avg+20%
Common Borrow Incl. Haul	0	CY	$ 12.00	$ -	Assumed excavated material is common borrow
Walled Detention Pond	0				40% Contingency added to all Walled Detention Pond item totals
Inverted Short Span Bridges (Delivered)	0	EACH	$ 179,714.29	$ -	
Span Installed	0	EACH	$ 53,914.29	$ -	Installation estimated at 25% of delivered price.
Footing	0	CY	$ 500.00	$ -	For resistance to buoyant forces due to high GW
End Walls	0	CY	$ 500.00	$ -	
Galv. Steel bolt on ladders	0	EACH	$ 650.00	$ -	Provided at ~50 ft
CS-231 Mastic	0	LF	$ 3.00	$ -	Joint sealant
Joint Wrap	0	LF	$ 4.00	$ -	Joint wrap to prevent inflow from GW
Shop Drawings	0	LS	$ 20,000.00	$ -	
Shoring or Extra Excavation Class A	15	SF	$ 16.50	$ 1,200.00	Used WSDOT Bridge Manual values for depht >10ft. Added 20% cont.
Flexible Guide Post	0	Each	$ 65.00	$ -	Assume 1 for pond entrance
Plastic Drainage Markings	0	Each	$ 75.00	$ -	Assume 1 for pond entrance
Catch Basin Type 2 54" Diam. w/Flow Control	0	Each	$ 7,800.00	$ -	Assume 1 per pond
Crushed Surface Base Course -CSBC	0	Ton	$ 75.00	$ -	Access road area, 6" depth on CSBC ; 1.85 ton/CY
High-Tension Cable Barrier System (3 Cable)	0	LF	$ 345.00	$ -	Mounted at the top of pond wall
Chain Link Fence Type 3	0	LF	$ 60.00	$ -	Around the walled pond
Construction Geotextile for Soil Stablization	0	SY	$ 7.50	$ -	For access road
Double 20f FTChain Link Fence Gate	0	EACH	$ 1,100.00	$ -	for fence
Estimated Construction Cost				**$ 2,236**	

Note: 0.87Ac required per HRM, 0.88 Ac provided to meet 50% rule for flow though area. 0.01 Ac retrofit for walled pond

TDA 2 -RUNOFF TREATMENT COST (RETROFIT)

MEDIA FILTER DRAIN (MFD) Bid Item	Qty	Unit	Unit Price	Total	Notes
MEDIA FILTER DRAIN	480	LF	$120.00	$ 57,600.00	Retrofit - MFD Cost includes excavation, MFD soil mix, compost blanket, underdrain, gravel backfill for drains, geotextile. Seeding or CSBC is not included.
Flexible Guide Post	1	Each	$65.00	$ 65.00	Typ per 500' of MFD
Plastic Drainage Markers	2	Each	$75.00	$ 150.00	At start and end of each MFD
Estimated MFD Construction Cost				**$ 57,815.00**	
COMPOST AMENDED BIOFILTRATION SWALE (CABS)-RETROFIT					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
Quarry Spalls	1.24	Tons	$85.00	$ 106.00	Outlet protection
Roadway Excavation Incl. Haul - Area CABS	13.94	CY	$60.00	$ 837.00	Exc qty from FG to EG
Construction Geotextile for Soil Stablization	4.65	SY	$7.50	$ 35.00	
Topsoil Type A	0.02	Acres	$65,000.00	$ 1,008.00	0.67'
Medium Compost	0.02	Acres	$15,500.00	$ 241.00	3"
Biofiltration Level Spreader	2.48	LF	$100.00	$ 248.00	One each at swale head and foot
Flexible Guide Post	0.00	Each	$65.00	$ -	
Plastic Drainage Markings	0.00	Each	$75.00	$ -	
Estimated CABS Construction Cost				**$ 2,475.00**	

Note: retrofit cost applied to CABS. 0.60 ac PGIS is required to be treated in TDA 2, but 0.71 ac is provided by CABS. 0.11ac contributing to CABS is retrofi

TDA 2 - CONVEYANCE (RETROFIT)

Pipe Conveyance Bid Item	Qty	Unit	Unit Price	Total	Notes
Schedule A Storm Sewer Pipe 12 In. Diam.	18	LF	$ 85.00	$ 1,530.00	UBA from SoQ Updated 9/18/19
Schedule A Storm Sewer Pipe 12 In. Diam. Concrete CL III		LF	$ 150.00	$ -	UBA from SoQ Updated 9/18/20
Schedule A Storm Sewer Pipe 24 In. Diam.		LF	$ 165.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 1		Each	$ 2,500.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam.	1	Each	$ 5,900.00	$ 5,900.00	UBA from SoQ Updated 9/18/20
Catch Basin Type 2 48 In. Diam. w/ cage		Each	$ 7,800.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 54 In. Diam. w/ solid lid and FC		Each	$ 7,800.00	$ -	UBA from SoQ Updated 9/18/19
Grate Inlet Type 2		Each	$ 2,800.00	$ -	UBA from SoQ Updated 9/18/20
Excavation Class B Incl. Haul		CY	$ 50.00	$ -	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	20	SF	$ 3.00	$ 60.00	UBA from SoQ Updated 9/18/19
Testing Storm Sewer Pipe	80	LF	$ 4.00	$ 320.00	UBA from SoQ Updated 9/18/19
Quarry Spalls		Tons	$ 85.00	$ -	UBA from SoQ Updated 9/18/19
Estimated Construction Cost				**$ 7,810**	

Project: SR 9/SR 204 Interchange Improvements Stage 3
Subject: RCEF - Cost Calculations for TDA 3

PROJECT REQUIREMENT

TDA 3 - FLOW CONTROL COST (PER HRM)					
DETENTION POND					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
Roadway Excavation Incl. Haul	770	CY	$ 60.00	$ 46,200.00	for pond and access road
Common Borrow Incl. Haul	37	CY	$ 12.00	$ 444.71	Access rd
Shoring or Extra Excavation Class A	0	SF	$ 16.50	$ -	Perimeter of excavation for calc
Flexible Guide Post	1	Each	$ 65.00	$ 65.00	Assume 1 for pond entrance
Plastic Drainage Markings	1	Each	$ 75.00	$ 75.00	Assume 1 for pond entrance
Catch Basin Type 2 54" Diam. w/Flow Control and Cage	1	Each	$ 7,800.00	$ 7,800.00	Assume 1 per pond
Crushed Surface Base Course -CSBC	41	Ton	$ 75.00	$ 3,089.00	Access road area, 6" depth on CSBC ; 1.85 ton/CY
High-Tension Cable Barrier System (3 Cable)	0	LF	$ 70.00	$ -	Mounted at the top of pond wall
Construction Geotextile for Soil Stablization	133	SY	$ 7.50	$ 995.00	For access road
Double 20f FTChain Link Fence Gate	1	EACH	$ 1,100.00	$ 1,100.00	For fence
Chain Link Fence Type 3	335	LF	$ 60.00	$ 20,100.00	Around the pond
Estimated Construction Cost				**$ 79,869**	

Detention Pond Summary			
Detention Pond	Avg. Width (FT)	Avg. Length (FT)	Volume at Riser (CF)
DETENTION POND	13	185	9,907

TDA 3 -RUNOFF TREATMENT COST (PER HRM)					
MEDIA FILTER DRAIN (MFD)					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
MEDIA FILTER DRAIN	630	LF	$120.00	$ 75,579.00	MFD Cost includes excavation, MFD soil mix, compost blanket, underdrain, gravel backfill for drains, geotextile. Seeding or CSBC is not included.
Flexible Guide Post	0	Each	$65.00	$ -	Typ per 500' of MFD
Plastic Drainage Markers	6	Each	$75.00	$ 450.00	At start and end of each MFD
Estimated MFD Construction Cost				**$ 76,029.00**	

Treatment BMP Summary for TDA			
Facility Type	Project Req. (LF)	Retrofit (LF)	Total
WET BIOFILTRATION SWALE	0	200	200
MEDIA FILTER DRAIN (MFD)	630	595	1,225

MFDs DR03-32 (RT3-3) and partial DR03-34 (partial RT 3-1, 0.08ac) are required per the HRM. DR03-31 (RT 4-1), partial DR03-34 (partial RT3-1, 0.09ac) are retrofit

TDA 3 - CONVEYANCE (PER HRM)					
Pipe Conveyance					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
Schedule A Storm Sewer Pipe 12 In. Diam.	237	LF	$ 85.00	$ 20,145.00	UBA from SoQ Updated 9/18/19
Schedule A Storm Sewer Pipe 12 In. Diam. Concrete CL III	94	LF	$ 150.00	$ 14,100.00	UBA from SoQ Updated 9/18/20
Schedule A Storm Sewer Pipe 18 In. Diam.	140	LF	$ 135.00	$ 18,900.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 1	6	Each	$ 2,500.00	$ 15,000.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam.	2	Each	$ 5,900.00	$ 11,800.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam. w/ solid lid and FC	1	Each	$ 5,900.00	$ 5,900.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 54 In. Diam. w/ solid lid	1	Each	$ 7,800.00	$ 7,800.00	UBA from SoQ Updated 9/18/20
Grate Inlet Type 2	1	CY	$ 2,800.00	$ 2,800.00	UBA from SoQ Updated 9/18/19
Excavation Class B Incl. Haul	550	CY	$ 50.00	$ 27,500.00	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	3480	SF	$ 3.00	$ 10,440.00	UBA from SoQ Updated 9/18/19
Drain pipe 6 In. Diam.	50	LF	$ 60.00	$ 3,000.00	UBA from SoQ Updated 9/18/19
Quarry Spalls	8	Tons	$ 85.00	$ 680.00	UBA from SoQ Updated 9/18/19
Estimated Construction Cost				**$ 138,065**	

TDA 2 - RIGHT OF WAY COST					
	Qty	**Unit**	**Unit Price**	**Total**	**Notes**
Parcel	0	SF	$ -	$ -	Flow control and runoff treatement facilities within WSDOT R/W

Considered Land Purchase R/W unit price documented in Phase 1 Opinion of Cost

RETROFIT REQUIREMENT

TDA 3 - FLOW CONTROL COST (RETROFIT)					
DETENTION POND					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
Roadway Excavation Incl. Haul	165	CY	$ 60.00	$ 9,900.00	for pond and access road
Common Borrow Incl. Haul	8	CY	$ 48.00	$ 381.18	Exc limits taken to 1-ft outside of pond bedding, all directions
Shoring or Extra Excavation Class A	0	SF	$ 16.50	$ -	Perimeter of excavation for calc
Flexible Guide Post		Each	$ 65.00	$ -	Assume 1 for pond entrance
Plastic Drainage Markings		Each	$ 75.00	$ -	Assume 1 for pond entrance
Catch Basin Type 2 54" Diam. w/Flow Control and Cage		Each	$ 7,800.00	$ -	Assume 1 per pond
Crushed Surface Base Course -CSBC	9	Ton	$ 75.00	$ 662.00	Access road area, 6" depth on CSBC ; 1.85 ton/CY
High-Tension Cable Barrier System (3 Cable)		LF	$ 70.00	$ -	Mounted at the top of pond wall
Construction Geotextile for Soil Stablization	28	SY	$ 7.50	$ 214.00	For access road
Double 20f FTChain Link Fence Gate			$ 1,100.00		For fence
Chain Link Fence Type 3			$ 60.00	$ -	Around the pond
Estimated Construction Cost				**$ 11,157**	

Note: retrofit cost applied to Pond. 0.56 ac imp is required to be detained in TDA 3, amount detained=0.68ac.

TDA 3 -RUNOFF TREATMENT COST (RETROFIT)					
MEDIA FILTER DRAIN (MFD)					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
MEDIA FILTER DRAIN	595	LF	$120.00	$ 71,422.00	Retrofit - MFD Cost includes excavation, MFD soil mix, compost blanket, underdrain, gravel backfill for drains, geotextile. Seeding or CSBC is not included.
Flexible Guide Post	0	Each	$65.00	$ -	Typ per 500' of MFD
Plastic Drainage Markers	2	Each	$75.00	$ 150.00	At start and end of each MFD
Estimated MFD Construction Cost				**$ 71,572.00**	
WET BIOFILTRATION SWALE					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
Roadway Excavation Incl. Haul - Area CABS	45.00	CY	$60.00	$ 2,700.00	Exc qty from FG to EG
Topsoil Type A	0.06	Acres	$65,000.00	$ 3,900.00	0.67'
Estimated Wet Bioswale Construction Cost				**$ 6,600.00**	

Wetbioswale is a retrofit BMP

TDA 3 - CONVEYANCE (RETROFIT)					
Pipe Conveyance					
Bid Item		**Unit**	**Unit Price**	**Total**	**Notes**
Schedule A Storm Sewer Pipe 12 In. Diam.	359	LF	$ 85.00	$ 30,515.00	UBA from SoQ Updated 9/18/19
Schedule A Storm Sewer Pipe 12 In. Diam. Concrete CL III		LF	$ 150.00	$ -	UBA from SoQ Updated 9/18/20
Schedule A Storm Sewer Pipe 24 In. Diam.		LF	$ 165.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 1		Each	$ 2,500.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam.		Each	$ 5,900.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam. w/ solid lid	2	Each	$ 7,800.00	$ 15,600.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 96 In. Diam. w/ solid lid and flow splitter	1	Each	$ 6,900.00	$ 6,900.00	UBA from SoQ Updated 9/18/20
Grate Inlet Type 2		CY	$ 2,800.00	$ -	UBA from SoQ Updated 9/18/19
Excavation Class B Incl. Haul	290	CY	$ 50.00	$ 14,500.00	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	1150	SF	$ 3.00	$ 3,450.00	UBA from SoQ Updated 9/18/19
Drain pipe 6 In. Diam.	32	LF	$ 60.00	$ 1,920.00	UBA from SoQ Updated 9/18/19
Quarry Spalls	8	Tons	$ 85.00	$ 680.00	UBA from SoQ Updated 9/18/19
Estimated Construction Cost				**$ 73,565**	

Project: SR 9/SR 204 Interchange Improvements Stage 3
Subject: RCEF - Cost Calculations for TDA 5

TDA 3 -RUNOFF TREATMENT COST (PER HRM)					
MEDIA FILTER DRAIN (MFD)					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
MEDIA FILTER DRAIN	0	LF	$120.00	$ -	MFD Cost includes excavation, MFD soil mix, compost blanket, underdrain, gravel backfill for drains, geotextile. Seeding or CSBC is not included.
Flexible Guide Post	0	Each	$65.00	$ -	Typ per 500' of MFD
Plastic Drainage Markers	0	Each	$75.00	$ -	At start and end of each MFD
Estimated MFD Construction Cost				**$ -**	

Treatment BMP Summary for TDA				
Facility Type	Project Req. (LF)	Retrofit (LF)	Total	
MEDIA FILTER DRAIN (MFD)		333	333	MFDs DR4-1 (RT4-1) is retrofit

TDA 3 -RUNOFF TREATMENT COST (RETROFIT)					
MEDIA FILTER DRAIN (MFD)					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
MEDIA FILTER DRAIN	333	LF	$120.00	$ 39,960.00	Retrofit - MFD Cost includes excavation, MFD soil mix, compost blanket, underdrain, gravel backfill for drains, geotextile. Seeding or CSBC is not included.
Flexible Guide Post	0	Each	$65.00	$ -	Typ per 500' of MFD
Plastic Drainage Markers	2	Each	$75.00	$ 150.00	At start and end of each MFD
Estimated MFD Construction Cost				**$ 40,110.00**	

Project: **SR 9/SR 204 Interchange Improvements Stage 3**
Subject: **RCEF Analysis - Preliminary Engg & R/W Cost**

Preliminary Engineering Cost per BMP			
	Total		**Notes**
Consultant	$	85,326	Assumed 15% of overall project (Stage 3)budget; 2/3rd of cost for project minimum and 1/3rd of cost for retrofit
WSDOT	$	-	
Total Prelim Engg. Cost	$	85,326	

LID Feasibility Checklist

Project Title and Number: SR 9/SR 204 Interchange Improvements - Stage 3
Hydraulic Designer: S. Sridharan/T.Hew
PEO:
Date: 4/15/2021
Region: Northwest

For WSDOT projects that exceede the triggers set forth in HRM MInimum Requirement 5 and/or 6 (see HRM Section 3-3.5 and 3-3.6 and HRM Figure 3-3 Steps 7 and 8), a LID Feasibility Checklist must be filled out for each TDA on the project. The checklist should be started at the Scoping Level of the project and should be re-examined during the project development phase (up to 60% design). The completed checklist should be attached in the project's hydraulic report.

Scoping Phase

Yes = LID not feasible
No = LID is feasible

Feasiblity Criteria	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response
Does the area have ground water that drains into an erosion hazard, or landslide hazard area?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Does the only area available for siting the LID BMP threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures, or pre-existing road or parking lot surfaces?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Are there houses or buildings in the project area that may have basements that might be threatened by infiltrating stormwater from the TDA?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Would the LID BMP be within setbacks from structures as established by the local government with jurisdiction?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the land for the LID BMP within an area designated as an erosion hazard, or landslide hazard?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the LID BMP within 50 feet from the top of slopes that are greater than 20% and over 10 feet of vertical relief?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the proposed site on property with known soil or ground water contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA))?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the proposed LID BMP within 100 feet of an area known to have deep soil contamination?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Would the LID BMP be within any area where the it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the LID BMP within 100 feet of a closed or active landfill?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the LID BMP within 100 feet of a drinking water well, or a spring used for drinking water supply?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the LID BMP within 10 feet of small on-site sewage disposal drain field, including reserve areas, and grey water reuse systems? For setbacks from a "large on-site sewage disposal system", see Chapter 246-272B WAC.			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the LID BMP within 10 feet of an underground storage tank and connecting underground pipes when the capacity of the tank and pipe system is 1100 gallons or less OR within 100 feet of an underground storage tank and connecting underground pipes when the capacity of the tank and pipe system is *greater* than 1100 gallons? An underground storage tank means any tank used to store petroleum products, chemicals, or liquid hazardous wastes of which 10% or more of the storage volume, including the volume in the connecting piping system, is beneath the ground surface.			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										

Design Office/Project Level

Yes = LID not feasible
No = LID is feasible

Feasiblity Criteria	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response
Does the only area available for siting the LID BMP not allow for a safe overflow pathway to the municipal separate storm sewer system?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the LID BMP not compatible with surrounding drainage system as determined by the local government with jurisdiction (e.g., project drains to an existing stormwater collection system whose elevation or location precludes connection to a properly functioning bioretention facility)?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is the LID BMP within 10 feet of an underground storage tank and connecting underground pipes when the capacity of the tank and pipe system is 1100 gallons or less OR within 100 feet of an underground storage tank and connecting underground pipes when the capacity of the tank and pipe system is greater than 1100 gallons? An underground storage tank means any tank used to store petroleum products, chemicals, or liquid hazardous wastes of which 10% or more of the storage volume, including the volume in the connecting piping system, is beneath the ground surface.			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Where surface soils have been found to be contaminated, they need to be removed within 10 horizontal feet from the infiltration area/ LID BMP. Would there be any problems with keeping this 10 horizontal foot distance from contaminated surface soils?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										

Geotechnical Evaluation

Yes = LID not feasible
No = LID is feasible

Feasiblity Criteria	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response
Does a professional geotechnical/geologic evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure, or down gradient flooding?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Would infiltrating water threaten shoreline structures such as bulkheads? (need geotech recommendation for proximity or radius to wall or structure)			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Does ground water modeling indicate infiltration will likely increase or change the direction of the migration of pollutants in the ground water?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Where surface soils have been found to be contaminated, they need to be removed within 10 horizontal feet from the infiltration area/ LID BMP. Would there be any problems with keeping this 10 horizontal foot distance from contaminated surface soils?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										

NATURAL AND ENGINEERED DISPERSION

Yes = LID not feasible
No = LID is feasible

Feasiblity Criteria	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response
Is there insufficient space for a natural dispersion area within the existing public right-of-way on public road projects?			YES	LID not Feasible, Analysis complete for TDA	YES	LID not Feasible, Analysis complete for TDA										
Is it not possible to reasonably design the site to locate a natural dispersion area on slopes flatter than 33%?																
Is it not possible to achieve a minimum vertical separation of 1 foot to the seasonal high water table, bedrock, or other impervious layer below the natural dispersion area that would serve a drainage area that is: 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface; and, 3) less than ¾ acres of pervious surface?																
Is it not possible to achieve a minimum vertical separation of 3 feet to the seasonal high water table, bedrock or other impervious layer below the natural dispersion area that: 1) would serve a drainage area that meets or exceeds: a) 5,000 square feet of pollution-generating impervious surface, or b) 10,000 square feet of impervious surface, or c) three-quarter (3/4) acres of pervious surfaces; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1)?																
Does field testing indicate that natural dispersion areas do not have a measured (a.k.a., initial) native soil saturated hydraulic conductivity greater than or equal to 0.30 inches per hour?																

COMPOST AMENDED VEGETATED FILTER STRIP (CAVFS)

Yes = LID not feasible
No = LID is feasible

Feasiblity Criteria	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response
Is there insufficient space for a CAVFS within the existing public right-of-way on public road projects?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is it not possible to reasonably design the site to locate CAVFS on slopes flatter than 33%?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is it not possible to achieve a minimum vertical separation of 1 foot to the seasonal high water table, bedrock, or other impervious layer below the CAVFS that would serve a drainage area that is: 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface; and, 3) less than ¾ acres of pervious surface?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Can a minimum vertical separation of 3 feet to the seasonal high water table, bedrock or other impervious layer be achieved below the CAVFS that: 1) would serve a drainage area that meets or exceeds: a) 5,000 square feet of pollution-generating impervious surface, or b) 10,000 square feet of impervious surface, or c) three-quarter (3/4) acres of pervious surfaces; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1)?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Does field testing indicate that CAVFS sites do not have a measured (a.k.a., initial) native soil saturated hydraulic conductivity greater than or equal to 0.30 inches per hour?			YES	LID not Feasible, Analysis complete for TDA	YES	LID not Feasible, Analysis complete for TDA										

CONTINUOUS INFLOW COMPOST AMENDED BIOFILTRATION SWALE (CICABS)

Yes = LID not feasible
No = LID is feasible

Feasiblity Criteria	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response
Is there insufficient space for a CICABS within the existing public right-of-way on public road projects?			YES	LID not Feasible, Analysis complete for TDA	YES	LID not Feasible, Analysis complete for TDA										
Is it not possible to achieve a minimum vertical separation of 1 foot to the seasonal high water table, bedrock, or other impervious layer below the CICABS that would serve a drainage area that is: 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface; and, 3) less than ¾ acres of pervious surface?																
Is it not possible to achieve a minimum vertical separation of 3 feet to the seasonal high water table, bedrock or other impervious layer below the CICABS that: 1) would serve a drainage area that meets or exceeds: a) 5,000 square feet of pollution-generating impervious surface, or b) 10,000 square feet of impervious surface, or c) three-quarter (3/4) acres of pervious surfaces; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1)?																

MEDIA FILTER DRAIN (MFD)

Yes = LID not feasible
No = LID is feasible

Feasiblity Criteria	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response	YES/NO	Response
Is there insufficient space for a MFD within the existing public right-of-way on public road projects?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is it not possible to reasonably design the site to locate a MFD on slopes flatter than 25%?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is it not possible to achieve a minimum vertical separation of 1 foot to the seasonal high water table, bedrock, or other impervious layer below the MFD that would serve a drainage area that is: 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface; and, 3) less than ¾ acres of pervious surface?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										
Is it not possible to achieve a minimum vertical separation of 3 feet to the seasonal high water table, bedrock or other impervious layer below the MFD that: 1) would serve a drainage area that meets or exceeds: a) 5,000 square feet of pollution-generating impervious surface, or b) 10,000 square feet of impervious surface, or c) three-quarter (3/4) acres of pervious surfaces; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1)?			NO	LID still feasible, go to next question	NO	LID still feasible, go to next question										

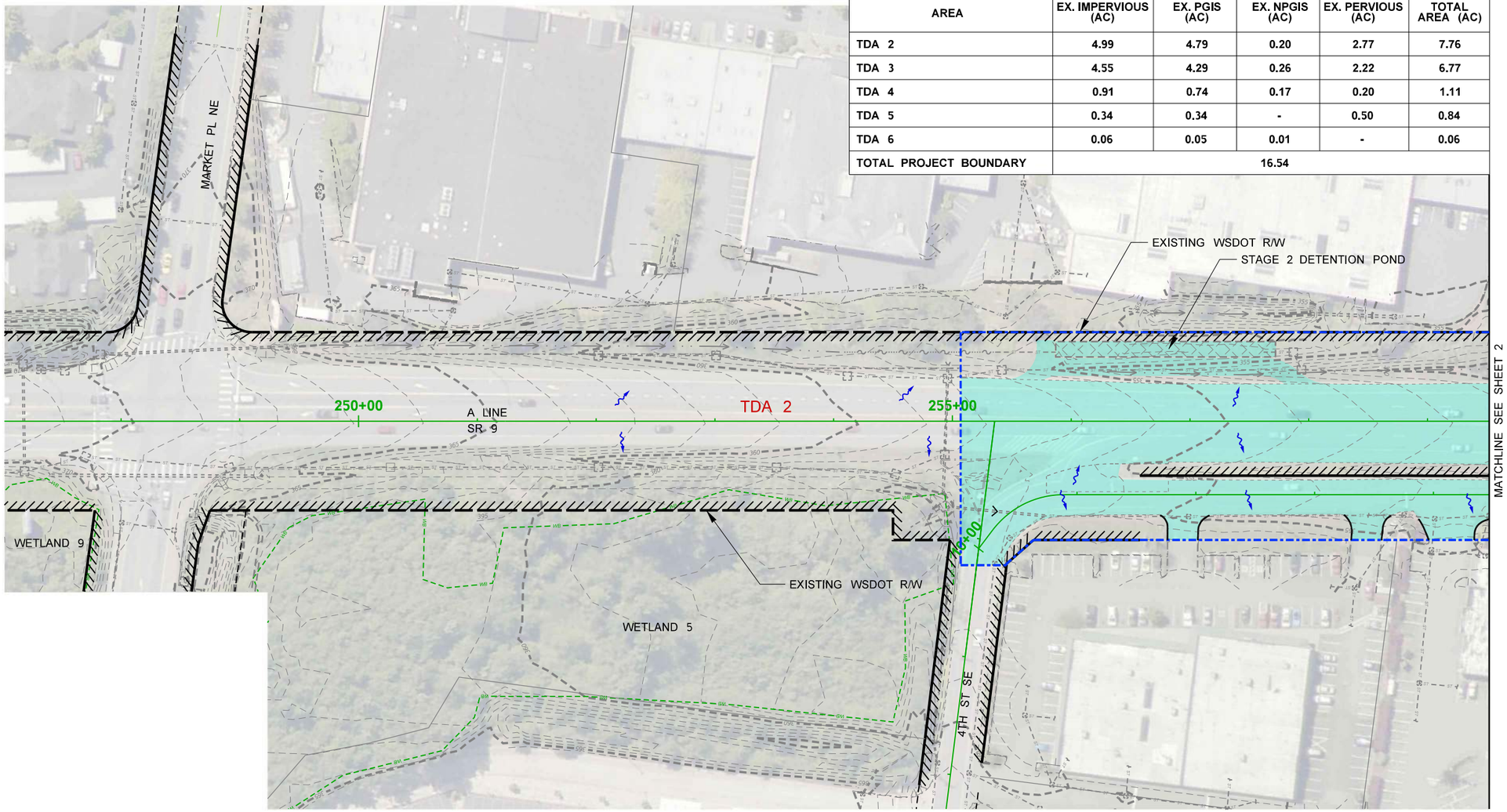
Yes = LID not feasible
No = LID is feasible

BIORETENTION AREA																
	TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
Feasiblity Criteria	**YES/NO**	**Response**	**YES/NO**	**Response**	**YES/NO**	**Response**	**YES/NO**	**Response**	**YES/NO**	**Response**	**YES/NO**	**Response**	**YES/NO**	**Response**	**YES/NO**	**Response**
Is there insufficient space for a bioretention area within the existing public right-of-way on public road projects?			YES	LID not Feasible, Analysis complete for TDA	YES	LID not Feasible, Analysis complete for TDA										
Is it not possible to achieve a minimum vertical separation of 1 foot to the seasonal high water table, bedrock, or other impervious layer below the bioretention area that would serve a drainage area that is: 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface; and, 3) less than ¾ acres of pervious surface?																
Is it not possible to achieve a minimum vertical separation of 3 feet to the seasonal high water table, bedrock or other impervious layer below the bioretention area that: 1) would serve a drainage area that meets or exceeds: a) 5,000 square feet of pollution-generating impervious surface, or b) 10,000 square feet of impervious surface, or c) three-quarter (3/4) acres of pervious surfaces; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1)?																

APPENDIX B

TDA MAPS, DRAINAGE BASIN MAPS AND AREA CALCULATIONS

SUMMARY OF AREAS					
AREA	EX. IMPERVIOUS (AC)	EX. PGIS (AC)	EX. NPGIS (AC)	EX. PERVIOUS (AC)	TOTAL AREA (AC)
TDA 2	4.99	4.79	0.20	2.77	7.76
TDA 3	4.55	4.29	0.26	2.22	6.77
TDA 4	0.91	0.74	0.17	0.20	1.11
TDA 5	0.34	0.34	-	0.50	0.84
TDA 6	0.06	0.05	0.01	-	0.06
TOTAL PROJECT BOUNDARY	16.54				



LEGEND

- EXISTING IMPERVIOUS AREA
- EXISTING NPGIS AREA
- EXISTING TDA BOUNDARY
- EXISTING SURFACE FLOW
- PROJECT LIMITS
- EXISTING STORM SEWER
- EXISTING DITCH
- EXISTING CULVERT
- EXISTING CATCH BASIN
- EXISTING R/W
- PROPOSED R/W
- WETLAND BOUNDARY

NOTES:

1. AREAS OUTSIDE OF EXISTING IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED EXISTING PERVIOUS AREA.

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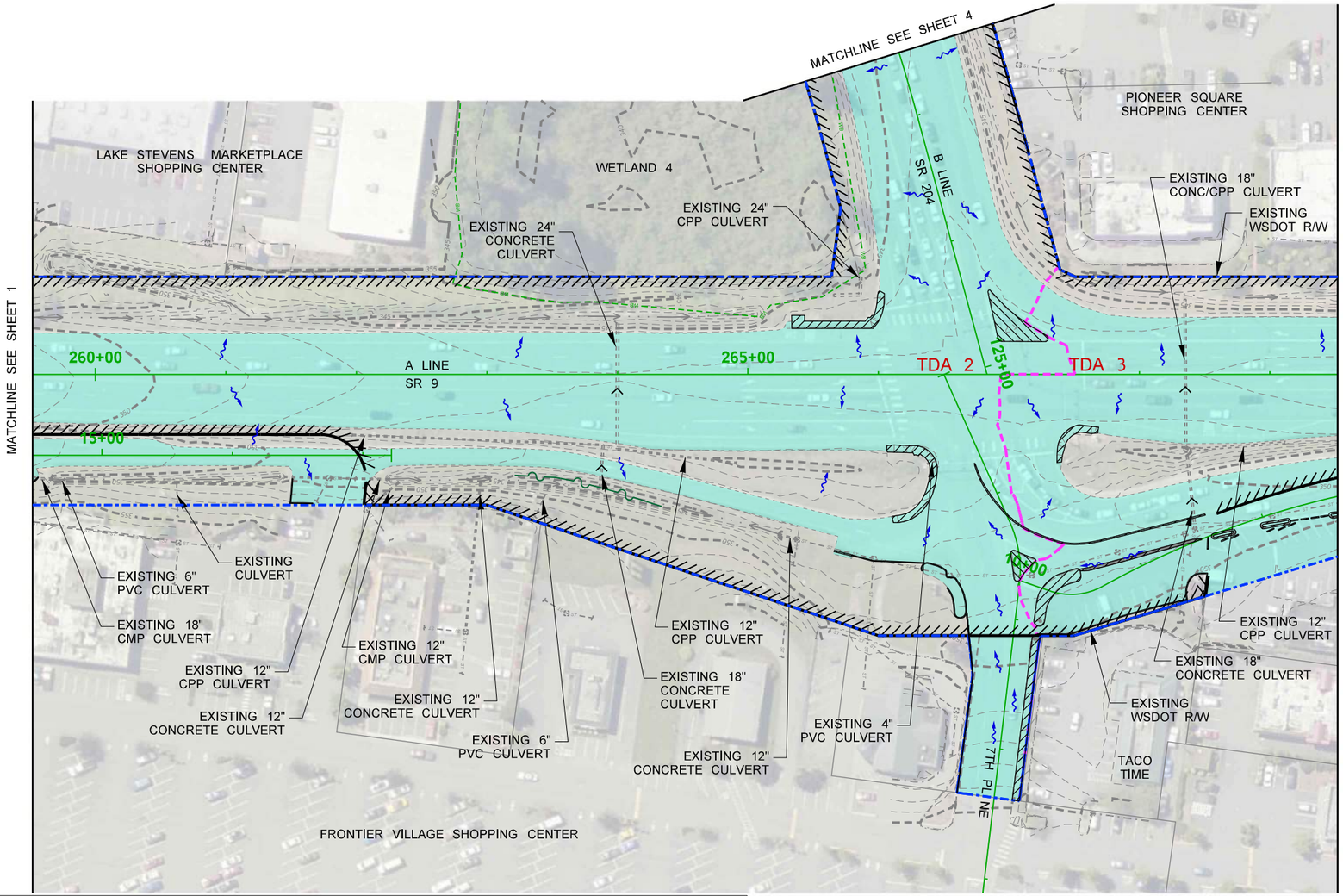
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 1

0 50 100
SCALE IN FEET



LEGEND

- EXISTING IMPERVIOUS AREA
- EXISTING NPGIS AREA
- EXISTING TDA BOUNDARY
- EXISTING SURFACE FLOW
- PROJECT LIMITS
- EXISTING STORM SEWER
- EXISTING DITCH
- EXISTING CULVERT
- EXISTING CATCH BASIN
- EXISTING R/W
- PROPOSED R/W
- WETLAND BOUNDARY

NOTES:

1. AREAS OUTSIDE OF EXISTING IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED EXISTING PERVIOUS AREA.

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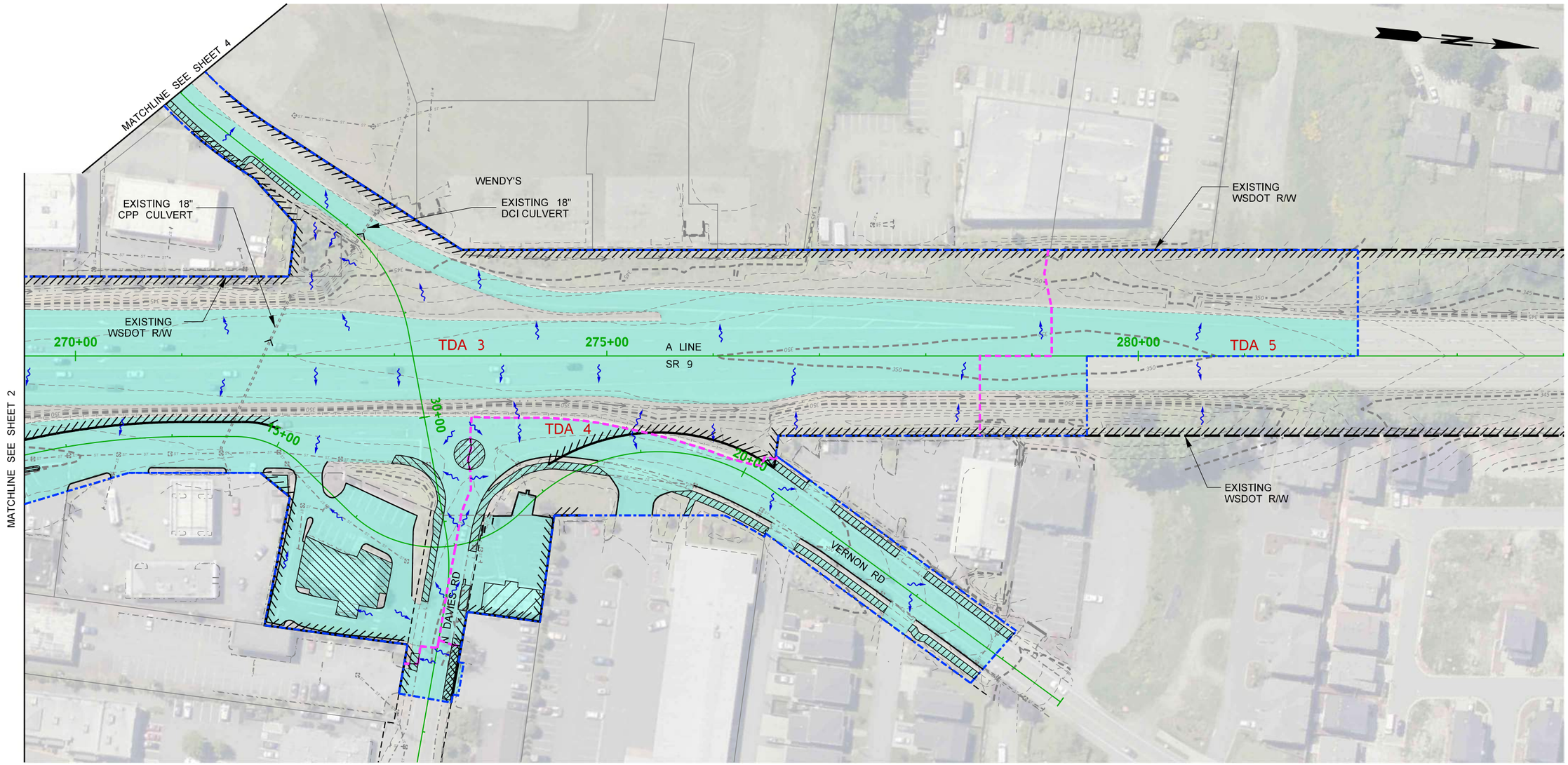
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 2

0 50 100
SCALE IN FEET



LEGEND

- EXISTING IMPERVIOUS AREA
- EXISTING NPGIS AREA
- EXISTING TDA BOUNDARY
- EXISTING SURFACE FLOW
- PROJECT LIMITS
- EXISTING STORM SEWER
- EXISTING DITCH
- EXISTING CULVERT
- EXISTING CATCH BASIN
- EXISTING R/W
- PROPOSED R/W
- WETLAND BOUNDARY

NOTES:

1. AREAS OUTSIDE OF EXISTING IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED EXISTING PERVIOUS AREA.

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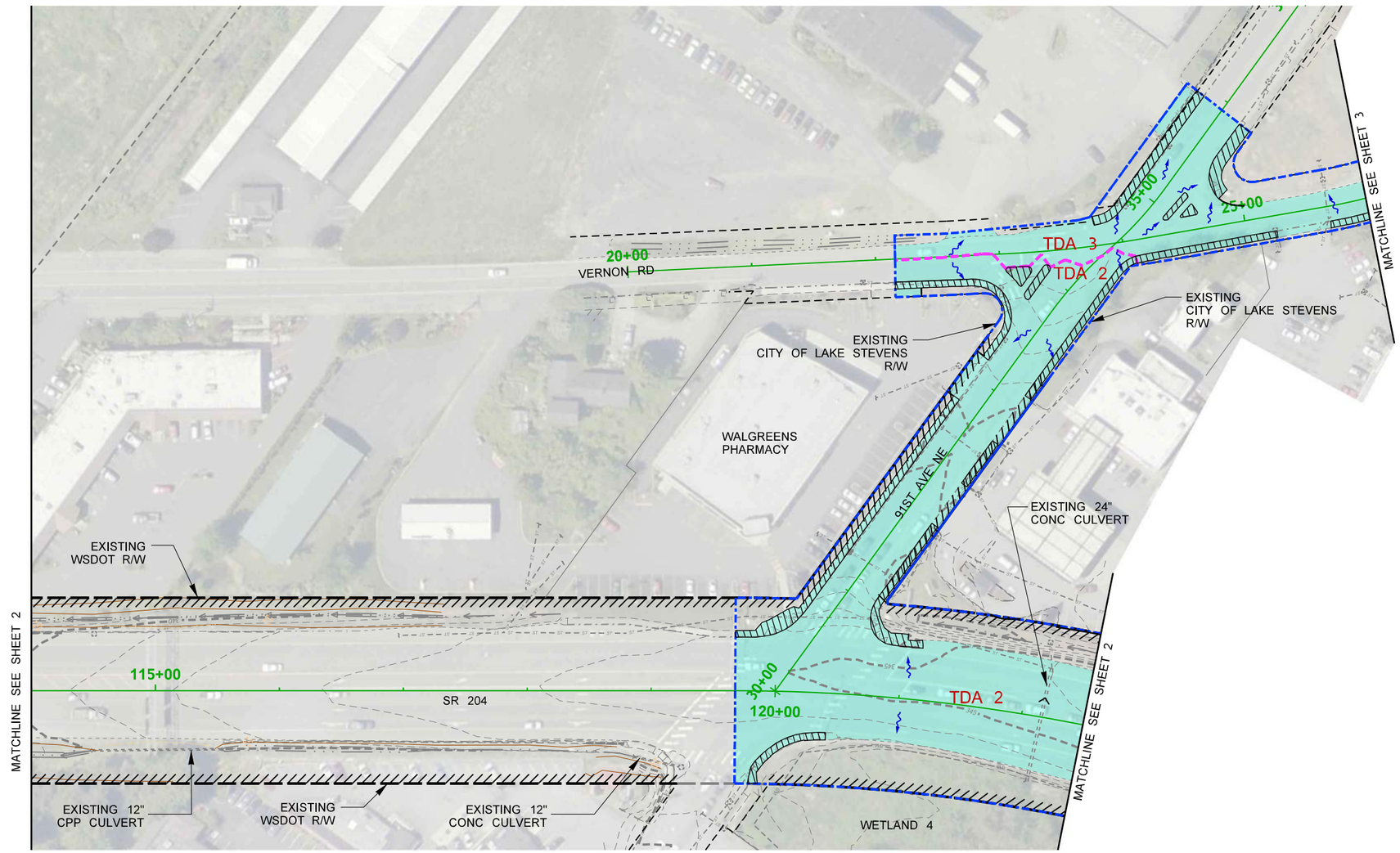
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 3

0 50 100
SCALE IN FEET



LEGEND

- EXISTING IMPERVIOUS AREA
- EXISTING NPGIS AREA
- EXISTING TDA BOUNDARY
- EXISTING SURFACE FLOW
- PROJECT LIMITS
- EXISTING STORM SEWER
- EXISTING DITCH
- EXISTING CULVERT
- EXISTING CATCH BASIN
- EXISTING R/W
- PROPOSED R/W
- WETLAND BOUNDARY

NOTES:

1. AREAS OUTSIDE OF EXISTING IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED EXISTING PERVIOUS AREA.

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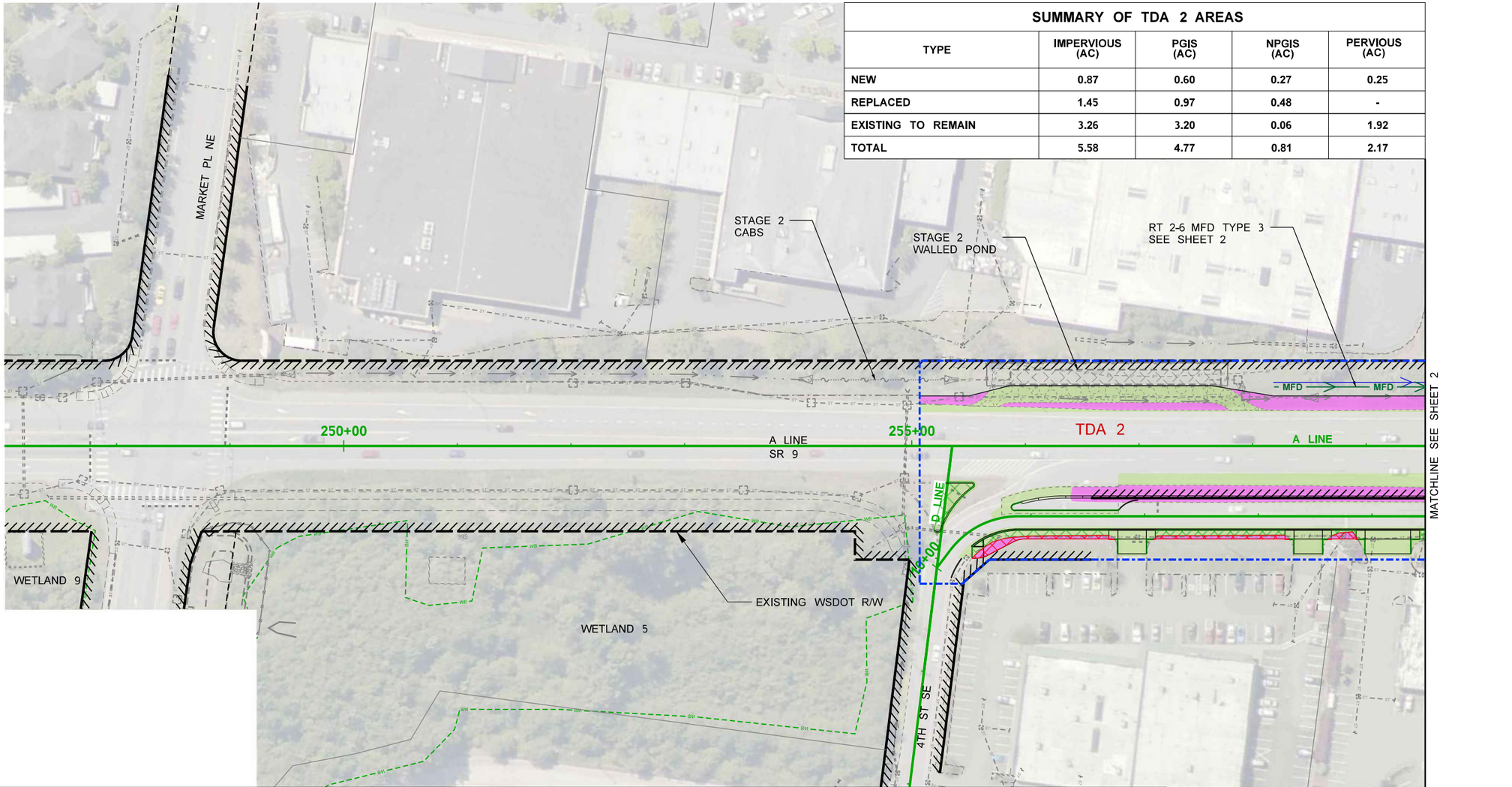
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 4

0 50 100
SCALE IN FEET

SUMMARY OF TDA 2 AREAS				
TYPE	IMPERVIOUS (AC)	PGIS (AC)	NPGIS (AC)	PERVIOUS (AC)
NEW	0.87	0.60	0.27	0.25
REPLACED	1.45	0.97	0.48	-
EXISTING TO REMAIN	3.26	3.20	0.06	1.92
TOTAL	5.58	4.77	0.81	2.17



LEGEND

- NEW IMPERVIOUS AREA
- NEW NPGIS AREA
- REPLACED IMPERVIOUS AREA
- MAINTENANCE ACCESS ROAD
- REPLACED NPGIS AREA
- EXISTING R/W
- LIMITED ACCESS
- PROPOSED TDA BOUNDARY
- PROJECT LIMITS
- EXISTING CATCH BASIN
- EXISTING MEDIA FILTER DRAIN (MFD)
- EXISTING STORM DRAIN PIPE
- EXISTING DITCH
- EXISTING CULVERT
- EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)
- WETLAND BOUNDARY
- MEDIA FILTER DRAIN
- COMPOST AMENDED BIOFILTRATION SWALE (CABS)

NOTES:

1. AREAS OUTSIDE OF DEVELOPED IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. SEE FIGURE A-2.1 FOR EXISTING AREAS.
3. SEE DRAFT DEVIATION REPORT FOR CHANGES IN TDA 2, 3, 4 AND 6 AREAS.

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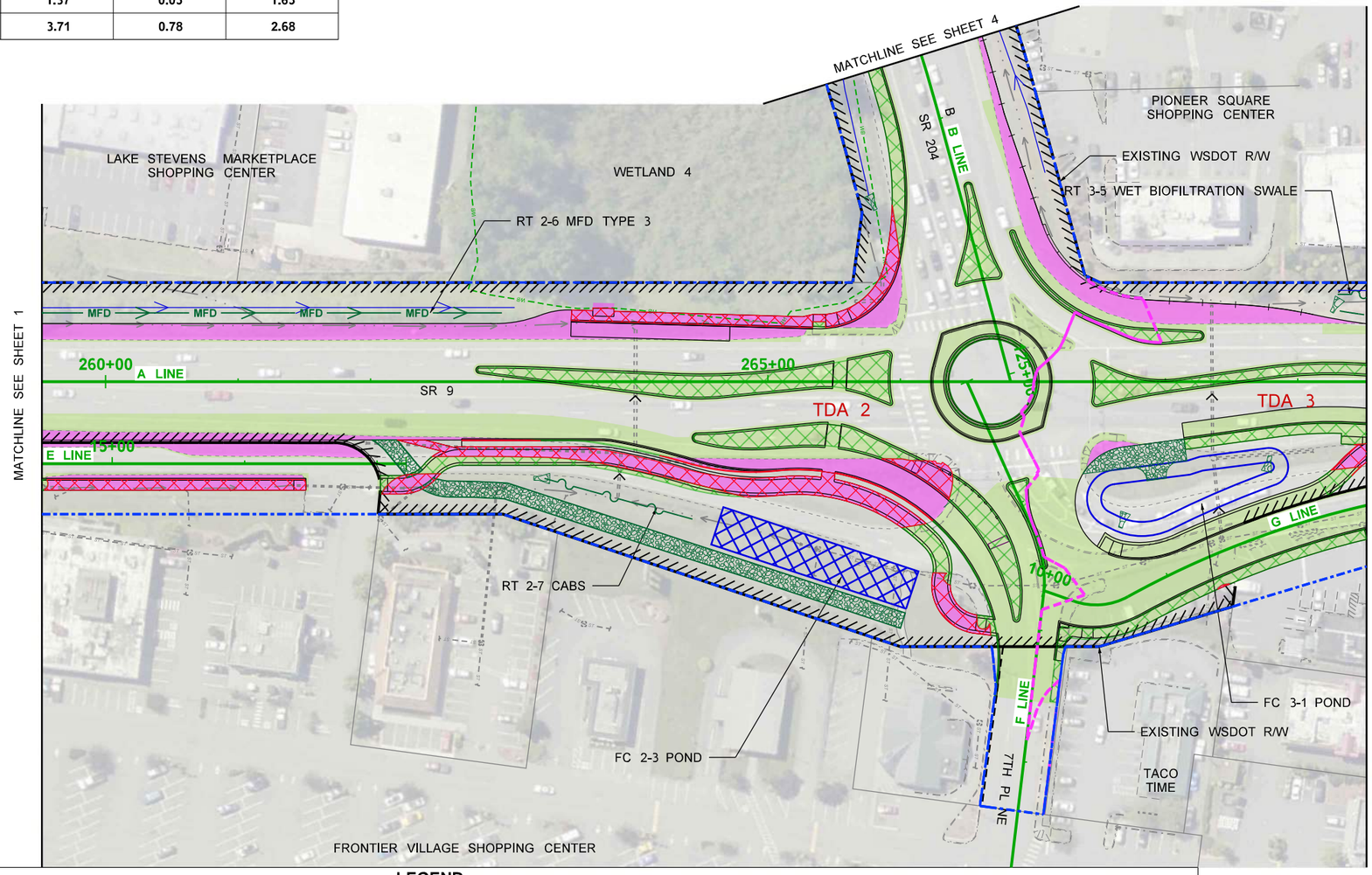
FIGURE A-2.2 : DEVELOPED CONDITIONS SHEET 1

0 50 100
SCALE IN FEET

SUMMARY OF TDA 3 AREAS

TYPE	IMPERVIOUS (AC)	PGIS (AC)	NPGIS (AC)	PERVIOUS (AC)
NEW	0.56	0.46	0.10	1.03
REPLACED	2.51	1.88	0.63	-
EXISTING TO REMAIN	1.42	1.37	0.05	1.65
TOTAL	4.49	3.71	0.78	2.68



LEGEND

- NEW IMPERVIOUS AREA
- NEW NPGIS AREA
- REPLACED IMPERVIOUS AREA
- MAINTENANCE ACCESS ROAD
- REPLACED NPGIS AREA
- EXISTING R/W
- LIMITED ACCESS
- PROPOSED TDA BOUNDARY
- PROJECT LIMITS
- EXISTING CATCH BASIN
- EXISTING MEDIA FILTER DRAIN (MFD)
- EXISTING STORM DRAIN PIPE
- EXISTING DITCH
- EXISTING CULVERT
- EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)
- WETLAND BOUNDARY
- MEDIA FILTER DRAIN
- COMPOST AMENDED BIOFILTRATION SWALE (CABS)

NOTES:

1. AREAS OUTSIDE OF DEVELOPED IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. SEE FIGURE A-2.1 FOR EXISTING AREAS.
3. SEE DRAFT DEVIATION REPORT FOR CHANGES IN TDA 2, 3, 4 AND 6 AREAS.

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SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.2 : DEVELOPED CONDITIONS SHEET 2

0 50 100
SCALE IN FEET

SUMMARY OF TDA 4 AREAS				
TYPE	IMPERVIOUS (AC)	PGIS (AC)	NPGIS (AC)	PERVIOUS (AC)
NEW	0.07	0.05	0.02	0.01
REPLACED	0.18	0.16	0.02	-
EXISTING TO REMAIN	0.36	0.29	0.07	0.12
TOTAL	0.61	0.50	0.11	0.13

SUMMARY OF TDA 5 AREAS			
TYPE	IMPERVIOUS (AC)	PGIS (AC)	PERVIOUS (AC)
EXISTING TO REMAIN	0.34	0.34	0.50
TOTAL	0.34	0.34	0.50

SUMMARY OF TDA 6 AREAS		
TYPE	IMPERVIOUS (AC)	PGIS (AC)
REPLACED	0.01	0.01
EXISTING TO REMAIN	0.03	0.03
TOTAL	0.04	0.04

MATCHLINE SEE SHEET 4

MATCHLINE SEE SHEET 2

RT 3-2 MFD TYPE 1

RT 3-1 MFD TYPE 1

RT 3-3 MFD TYPE 3

RT 5-1 MFD TYPE 3

RT 3-4 MFD TYPE 1

EXISTING WSDOT R/W

EXISTING WSDOT R/W

WENDY'S

VERNON RD

H LINE

G LINE

A LINE

SR 9

270+00

275+00

280+00

TDA 5

TDA 3

TDA 4

TDA 6

15+00

20+00

30+00

N DAVIES RD

MFD

NEW IMPERVIOUS AREA

NEW NPGIS AREA

REPLACED IMPERVIOUS AREA

MAINTENANCE ACCESS ROAD

REPLACED NPGIS AREA

EXISTING R/W

LIMITED ACCESS

PROPOSED TDA BOUNDARY

PROJECT LIMITS

EXISTING CATCH BASIN

EXISTING MEDIA FILTER DRAIN (MFD)

EXISTING STORM DRAIN PIPE

EXISTING DITCH

EXISTING CULVERT

EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)

WETLAND BOUNDARY

MEDIA FILTER DRAIN

COMPOST AMENDED BIOFILTRATION SWALE (CABS)

NOTES:

1. AREAS OUTSIDE OF DEVELOPED IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. SEE FIGURE A-2.1 FOR EXISTING AREAS.
3. SEE DRAFT DEVIATION REPORT FOR CHANGES IN TDA 2, 3, 4 AND 6 AREAS.

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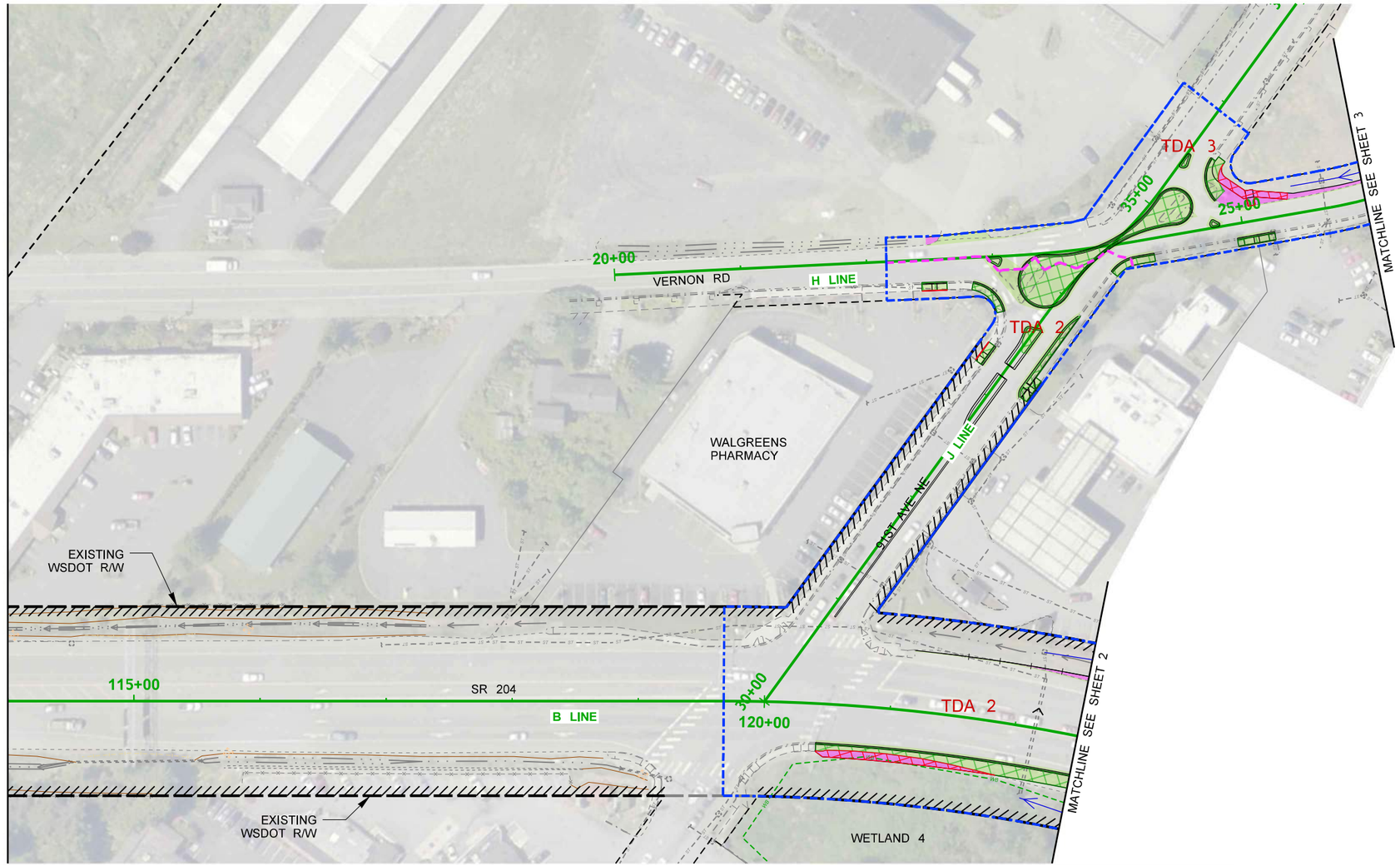
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.2 : DEVELOPED CONDITIONS SHEET 3

0 50 100

SCALE IN FEET



LEGEND

- NEW IMPERVIOUS AREA
- NEW NPGIS AREA
- REPLACED IMPERVIOUS AREA
- MAINTENANCE ACCESS ROAD
- REPLACED NPGIS AREA
- EXISTING R/W
- LIMITED ACCESS
- PROPOSED TDA BOUNDARY
- PROJECT LIMITS
- EXISTING CATCH BASIN
- EXISTING MEDIA FILTER DRAIN (MFD)
- EXISTING STORM DRAIN PIPE
- EXISTING DITCH
- EXISTING CULVERT
- EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)
- WETLAND BOUNDARY
- MEDIA FILTER DRAIN
- COMPOST AMENDED BIOFILTRATION SWALE (CABS)

NOTES:

1. AREAS OUTSIDE OF DEVELOPED IMPERVIOUS AREA HATCH WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. SEE FIGURE A-2.1 FOR EXISTING AREAS.
3. SEE DRAFT DEVIATION REPORT FOR CHANGES IN TDA 2, 3, 4 AND 6 AREAS.

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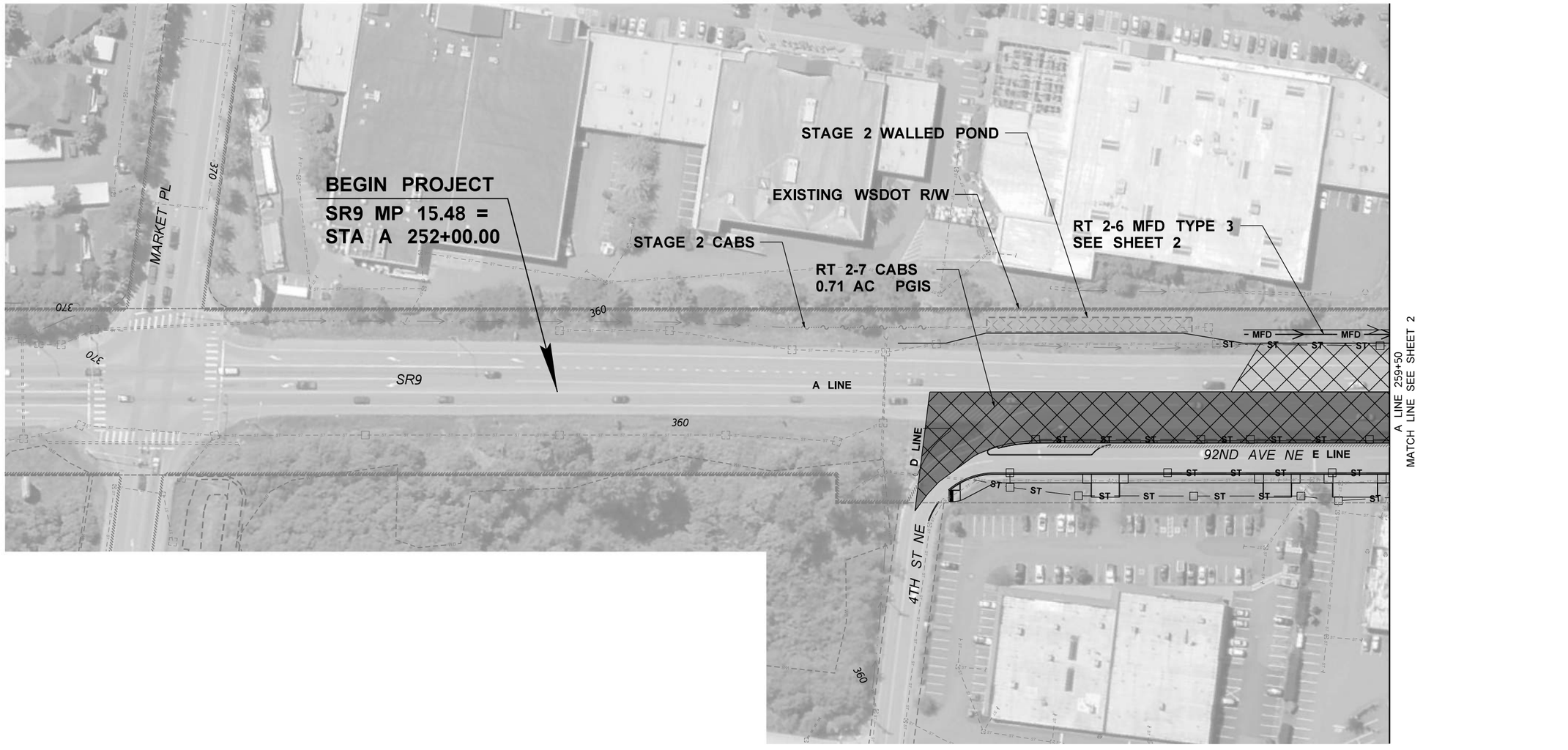
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.2 : DEVELOPED CONDITIONS SHEET 4

0 50 100
SCALE IN FEET



LEGEND

TDA BOUNDARY	EXISTING STORM DRAIN PIPE	MFD	MEDIA FILTER DRAIN (MFD)		BASIC TREATMENT AREA
WETLAND BOUNDARY	EXISTING DITCH	ST ST	PROPOSED STORM DRAIN PIPE		IMPERVIOUS FC CATCHMENT AREA
EXISTING CATCH BASIN	EXISTING CULVERT		PROPOSED DITCH		PERVIOUS FC CATCHMENT AREA
EXISTING R/W	PROPOSED BIOFILTRATION SWALE		ENHANCED TREATMENT AREA		

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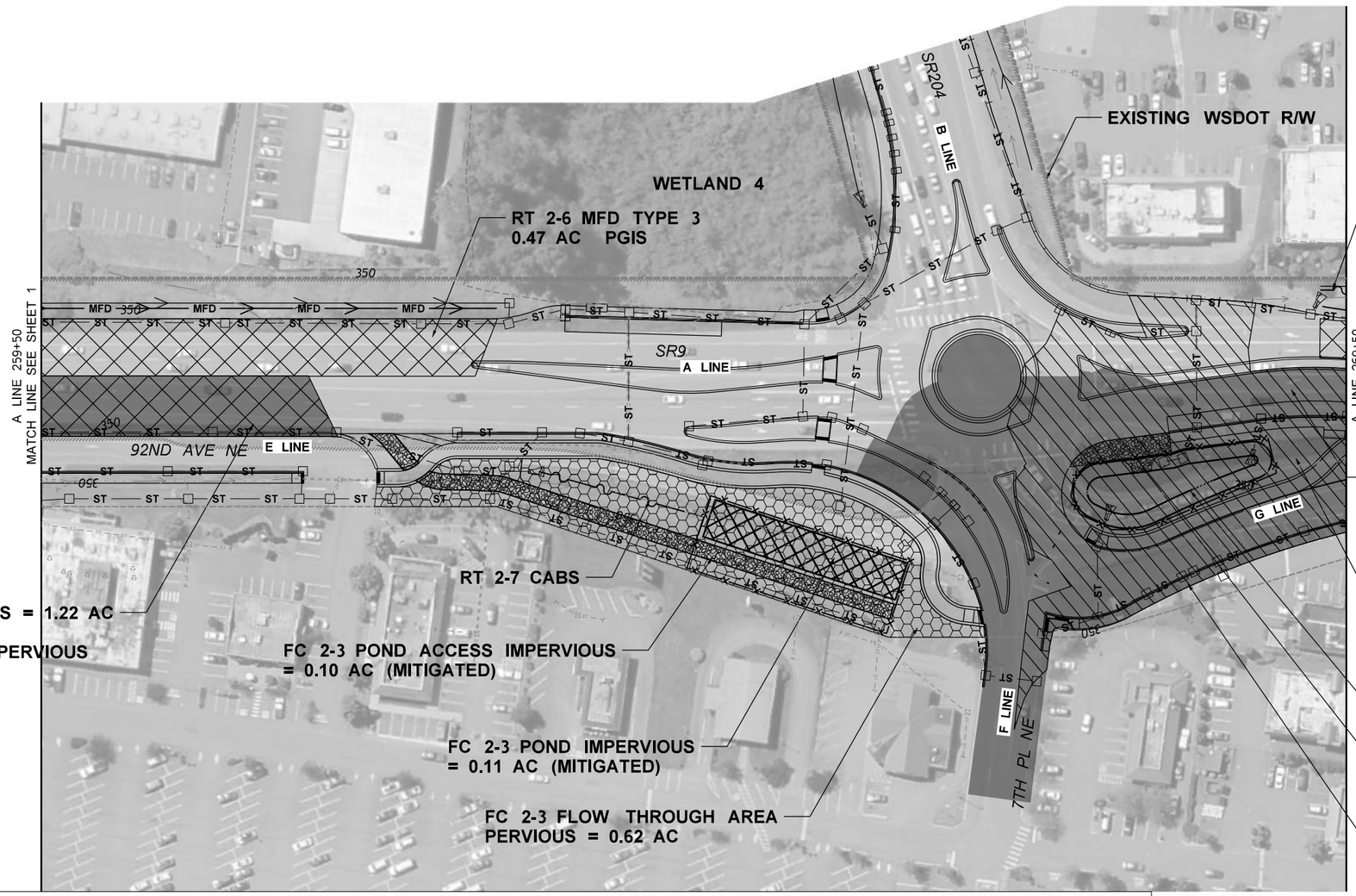
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.3 : BMP CATCHMENT AREA SHEET 1

0 50 100
SCALE IN FEET



LEGEND

TDA BOUNDARY	EXISTING STORM DRAIN PIPE	MFD	MEDIA FILTER DRAIN (MFD)		BASIC TREATMENT AREA
WETLAND BOUNDARY	EXISTING DITCH	ST ST	PROPOSED STORM DRAIN PIPE		IMPERVIOUS FC CATCHMENT AREA
EXISTING CATCH BASIN	EXISTING CULVERT		PROPOSED DITCH		PERVIOUS FC CATCHMENT AREA
EXISTING R/W	PROPOSED BIOFILTRATION SWALE		ENHANCED TREATMENT AREA		

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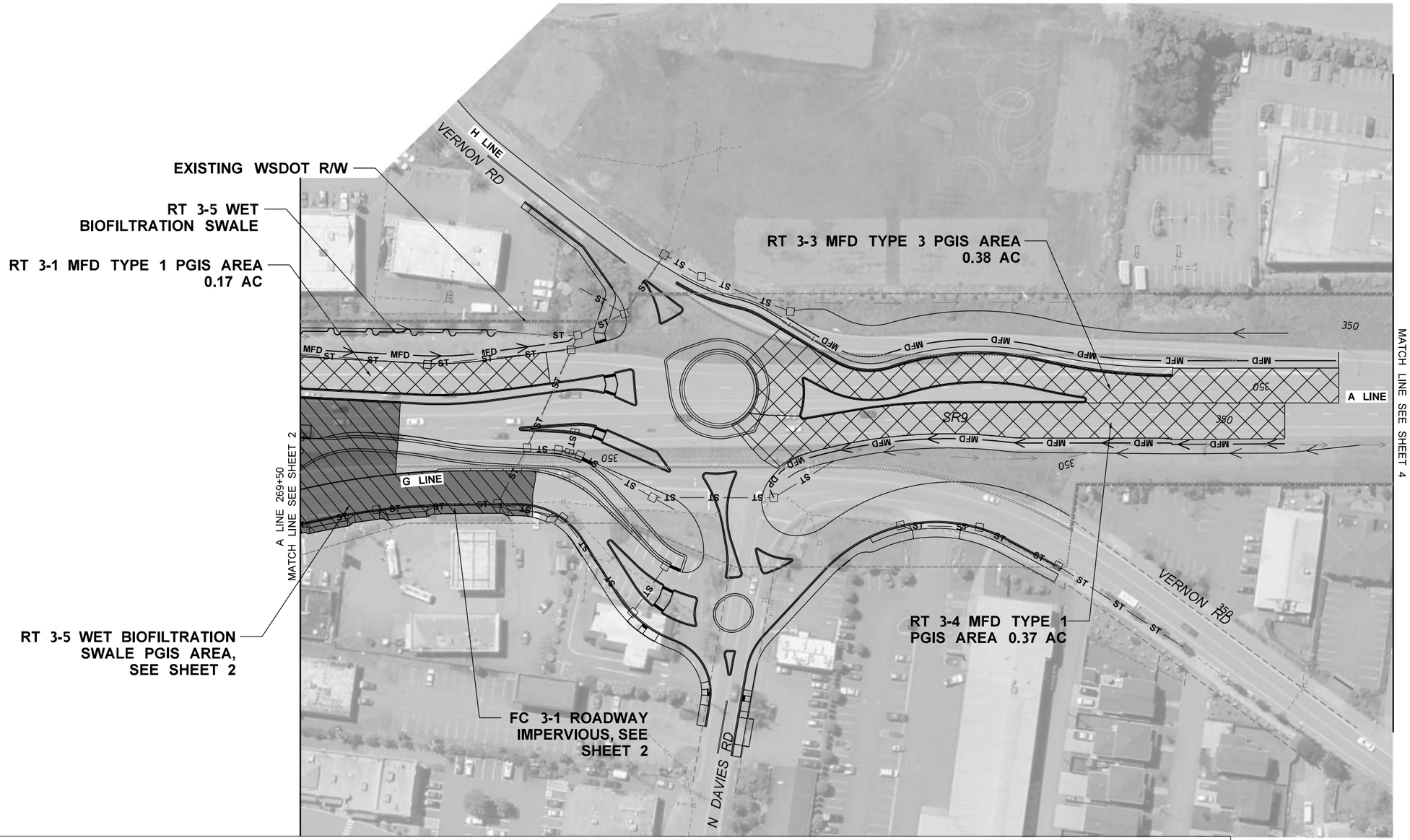
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.3: BMP CATCHMENT AREA SHEET 2

0 50 100
SCALE IN FEET



LEGEND

TDA BOUNDARY	EXISTING STORM DRAIN PIPE	MFD	MEDIA FILTER DRAIN (MFD)		BASIC TREATMENT AREA
WETLAND BOUNDARY	EXISTING DITCH	ST ST	PROPOSED STORM DRAIN PIPE		IMPERVIOUS FC CATCHMENT AREA
EXISTING CATCH BASIN	EXISTING CULVERT		PROPOSED DITCH		PERVIOUS FC CATCHMENT AREA
EXISTING R/W	PROPOSED BIOFILTRATION SWALE		ENHANCED TREATMENT AREA		

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.3 : BMP CATCHMENT AREA SHEET 3

0 50 100
SCALE IN FEET

LEGEND

TDA BOUNDARY	EXISTING STORM DRAIN PIPE	MFD	MEDIA FILTER DRAIN (MFD)		BASIC TREATMENT AREA
WETLAND BOUNDARY	EXISTING DITCH	ST ST	PROPOSED STORM DRAIN PIPE		IMPERVIOUS FC CATCHMENT AREA
EXISTING CATCH BASIN	EXISTING CULVERT		PROPOSED DITCH		PERVIOUS FC CATCHMENT AREA
EXISTING R/W	PROPOSED BIOFILTRATION SWALE		ENHANCED TREATMENT AREA		

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.3 : BMP CATCHMENT AREA SHEET 4

0 50 100
SCALE IN FEET

APPENDIX C

CALCULATIONS AND PROGRAM OUTPUT

APPENDIX C-1

FLOW CONTROL DESIGN

CALCULATIONS COVER PAGE

(DATE: 3/30/2021)

PROJECT: SR9, SR204 Interchange Improvements – Stage 3	OCI JOB NO.: 10-150063	PLAN NO.:	PAGE # OF # 1 of 20
CLIENT: Parsons / WSDOT	DEPARTMENT/DISCIPLINE: Civil/Drainage	CALCULATION NO. A-3.1	

SUBJECT/TITLE: Walled Detention Pond

CALCULATION REV. NO.	ORIGINATOR	DISCIPLINE REVIEWER	TECHNICAL PEER REVIEWER (IF REQUIRED)	CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II
0	S. Sridharan	A. Seethoff	N/A	N
1				
2				

CALCULATIONS OBJECTIVE

Determine the appropriate detention pond sizing for the targeted contributing areas and varying ground cover conditions. Detention ponds are designed to meet the flow control requirements of the 2019 Highway Runoff Manual (HRM) and reduce impervious surface runoff to meet pre-existing till forest runoff release rates.

CALCULATION METHODOLOGY/ LIST OF ASSUMPTIONS & INPUTS

METHODOLOGY:

1. Determine potential site location for a detention facility relative to available impervious areas for flow control and site constraints.
2. Calculate contributing pervious and impervious areas to the walled detention pond. Contributing areas include equivalent pavement area and tributary impervious and pervious/impervious flow through areas.
3. Use the MGSFlood Structure module to determine the preliminary detention pond size and flow restrictor specifications required to detain and release stormwater runoff with a flow duration at or below the till forest predeveloped condition. Flows are not to exceed the predeveloped durations from 50% of the 2-year peak flow up to the full 50-yr peak flow. Model to be run with 15-min timesteps.
4. Prepare a second iteration of the MGSFlood model using the pond size determined in Step 3 and route the pond tract and equivalent area for access road to the pond as additional mitigated impervious area. Flow restrictor sizes vary in the second iteration due to added impervious from access roads and pond tract that are mitigated.
5. Using the MGSFlood model results for required pond volume at the design water surface elevation (WSEL), include a minimum 0.5-ft sediment storage and at least 1-ft of freeboard and confirm pond dimensions.
6. Check the 50-year WSEL in second MGSFlood iteration. Confirm that the 50-year WSEL does not exceed the design WSEL.
7. Flow through areas were modeled using the 50% rule check (HRM Section 4-3.5.4) to ensure that 100-year undetained flow rate from flow through area is 50% or less than the 100-year undetained flow rate from the area receiving flow control.
8. Other pond dimension considerations:
    a. Vertical Wall side slopes
    b. Depth of design water surface elevation or riser = 3-ft.
    c. Hydraulic Structure #1 = Circular Orifice
    d. Hydraulic Structure #2 = Rectangular Orifice (vertical, no elbow)
    e. Riser Structure = Circular Overflow Riser (12-in diameter)
    f. Minimum freeboard = 1 ft

INPUTS:

9. Land Use:
    a. The predeveloped land cover condition was modeled as forested on till soils for the contributing roadway and access road, and pasture on till soils for the pond tract. Impervious and pervious flow through areas were modeled as impervious and till pasture, respectively.
    b. The post developed land cover condition was modeled as impervious for the contributing roadway, pond tract and access road. Impervious and pervious flow through areas were modeled as impervious and till pasture, respectively.
10. The project is located in the Puget East 40 climate region.
11. MGSFlood modeling is run with 15-minute time steps.
12. MGSFlood Structure Link modeled as Detention Pond Type with no infiltration.

ASSUMPTIONS:

13. The equivalent area option was used for this analysis.
14. Due to till-like deposits and a high groundwater table detailed in the geotechnical report, infiltration is deemed infeasible at the proposed pond location and has necessitated the use of a closed bottom design to exclude groundwater from entering the pond storage volume. The walled pond also provides protection from contaminated plume close to the pond location. See environmental report for plume location.
15. The walled detention pond design water surface elevation (WSEL) is set at the riser crest elevation.
16. A bird cage emergency overflow opening is provided on top of the outlet control structure and is set at the 100-year WSEL.
17. Flow through areas were modeled using the 50% rule check per HRM Section 4-3.5.4.

REFERENCES

- WSDOT 2019 Highway Runoff Manual (HRM),
    - Section 5-4.2.3 Detention BMPs, FC.03_Detention Pond
- WSDOT Hydraulic Manual, March 2019

CONCLUSIONS

- See attached MGSFlood modeling reports for the walled detention pond modeling results. The modeling reports provided includes the first and second iteration (run) of the walled detention pond, the 50% Rule Check. The model runs indicate the size of the detention facility that is able to detain the captured stormwater runoff and meet the project flow duration requirements.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW
Name: S. Sridharan
Date: 3/30/2021

Flow Control Input Sheet for TDA 2
Project: SR9, SR204 Interchange Improvements - Stage 3
Description: Detention Pond FC 2-3 Iteration #1

Version 6.1
Designed By: Swapna Sridharan
Checked By: Anne Seethoff

Is this BMP design following eastern or western WA guidelines? Western WA

What kind of flow control facility is this? Detention Pond

Is this your first iteration? YES See the bottom of this spreadsheet for an explanation of why two iterations are needed.
What type of flow control modeling scenario does this follow? Equivalent Area

Do any of the following situations occur in the TDA? NO

Are there any partial reversion or full reversion areas in the TDA? NO

List All Areas and Development in the TDA for the Postdeveloped Condition

Step 1

Existing	Ac.	Postdeveloped	Ac.
Forest	0.88	Forest	
Pasture	0.83	Pasture	0.830
Grass		Grass	
Sat. Soils		Sat. Soils	
Impervious	0.34	Impervious	1.220
	2.05		2.05

The Existing condition refers to the existing land cover observed prior to the start of the project.
Sat. Soil = Saturated Soils
For the first iteration, do not account for the land cover changes associated with the detention BMP footprint. The land cover for this footprint area should be represented as though the BMP will not exist when filling out Step 1.

Land Cover Conversions and Mitigated Areas for Flow Control

Step 2

	Brief Description of Land Cover Conversion
0.880 Acres	Forest to Impervious
	Proposed roadway widening

0.88 Acres

Mitigated (difference)

Step 3

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.880	Forest	
Pasture		Pasture	
Grass		Grass	
Sat. Soils		Sat. Soils	
Impervious		Impervious	0.880
	0.880	=	0.880

Non-Mitigated (unchanged area)

Step 4

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.000	Forest	0.000
Pasture	0.830	Pasture	0.830
Grass	0.000	Grass	0.000
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	0.340	Impervious	0.340
	1.170	=	1.170

Step 5

Area Physically Transported to Detention Facility

Postdeveloped	Ac.
Forest	
Pasture	0.830
Grass	
Sat. Soils	
Impervious	1.220

Step 6

Bypass Area		Flow-Through Area	
Ac.		Ac.	
		0.830	Pasture Flow-through Area
		0.340	Impervious Flow-through Area

Modeled (Input for MGSFlood)

Step 7 -

Step 9

Predeveloped	Ac.	Flow-Through	Ac.	Postdeveloped	Ac.	Bypass	Ac.	Flow-Through	Ac.
Forest	**0.880**	Forest		Forest	**0.000**	Forest		Forest	
Pasture	**0.000**	Pasture	**0.830**	Pasture	**0.000**	Pasture		Pasture	**0.830**
Grass	**0.000**	Grass		Grass	**0.000**	Grass		Grass	
Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	
Impervious	**0.000**	Impervious	**0.340**	Impervious	**0.880**	Impervious		Impervious	**0.340**
	0.880	+	1.170	=	0.880			+	1.170

Was the detention BMP footprint represented in the above MGSFlood inputs? NO

Choose N/A ----------> N/A

Choose N/A ----------> N/A

LEAVE BLANK ---------->
LEAVE BLANK ---------->

The designer should produce at least two iterations of this spreadsheet. The intent of the first iteration is to estimate the size of the detention BMP footprint and determine if the design meets flow control standards. The second iteration would create a separate subbasin to account for the BMP footprint and associated land cover conversions produced from the first model run. The resulting MGSFlood or StormShed3G inputs from the second iteration would be used to determine if the BMP footprint is still large enough and if it still meets flow control standards.

This is your first iteration. Please rename this TAB as Iteration #1. Copy this completed tab and rename the copied tab as Iteration #2 to start the second iteration adding in the detention BMP footprint land cover changes.

Flow Control Input Sheet for TDA 2
Project: SR9, SR204 Interchange Improvements - Stage 3
Description: Detention Pond FC 2-3 Iteration #2 (Final)

Version 6.1
Designed By: S. Sridharan
Checked By: A. Seethoff

Is this BMP design following eastern or western WA guidelines? Western WA

What kind of flow control facility is this? Detention Pond

Is this your first iteration? NO See the bottom of this spreadsheet for an explanation of why two iterations are needed.
What type of flow control modeling scenario does this follow? Equivalent Area

Do any of the following situations occur in the TDA? NO

Are there any partial reversion or full reversion areas in the TDA? NO

List All Areas and Development in the TDA for the Postdeveloped Condition

Step 1

Existing	Ac.	Postdeveloped	Ac.
Forest	1.09	Forest	
Pasture	0.62	Pasture	0.620
Grass		Grass	
Sat. Soils		Sat. Soils	
Impervious	0.34	Impervious	1.430
	2.05		2.05

The Existing condition refers to the existing land cover observed prior to the start of the project.
Sat. Soil = Saturated Soils
For the second iteration, modify the areas in Step 1 to account for the land cover changes associated with the detention BMP footprint. Fill in Step 2 with the land cover converstions for the detention BMP footprint.

Land Cover Conversions and Mitigated Areas for Flow Control

Step 2

0.880 Acres	Forest to Impervious
0.100 Acres	Forest to Impervious
0.110 Acres	Forest to Impervious

1.09 Acres

Brief Description of Land Cover Conversion
Proposed roadway widening
Pond Tract
Access Road

Mitigated (difference)

Step 3

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	1.090	Forest	
Pasture		Pasture	
Grass		Grass	
Sat. Soils	0.000	Sat. Soils	
Impervious	0.000	Impervious	1.090
	1.090 =		1.090

Non-Mitigated (unchanged area)

Step 4

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.000	Forest	0.000
Pasture	0.620	Pasture	0.620
Grass	0.000	Grass	0.000
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	0.340	Impervious	0.340
	0.960 =		0.960

Step 5

Area Physically Transported to Detention Facility	
Postdeveloped	Ac.
Forest	
Pasture	0.620
Grass	
Sat. Soils	
Impervious	1.430

Step 6

Bypass Area		Flow-Through Area	
Ac.		Ac.	
		0.620	Pasture Flow-through Area
		0.340	Impervious Flow-through Area

Step 7 - **Modeled (Input for MGSFlood)**

Step 9

Predeveloped	Ac.	Flow-Through	Ac.	Postdeveloped	Ac.	Bypass	Ac.	Flow-Through	Ac.
Forest	**1.090**	Forest		Forest	**0.000**	Forest		Forest	
Pasture	**0.000**	Pasture	**0.620**	Pasture	**0.000**	Pasture		Pasture	**0.620**
Grass	**0.000**	Grass		Grass	**0.000**	Grass		Grass	
Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	
Impervious	**0.000**	Impervious	**0.340**	Impervious	**1.090**	Impervious		Impervious	**0.340**
	1.090	+	0.960	=	1.090			+	0.960

Was the detention BMP footprint represented in the above MGSFlood inputs? YES

Choose N/A ----------> N/A

Choose N/A ----------> N/A

50% Rule Check

100year undetained flow rate (cfs) from area receiving flow control =	1.10
100year undetained flow rate (cfs) from flow through area =	0.53

The flow through area meets the 50% rule.

The designer should produce at least two iterations of this spreadsheet. The intent of the first iteration is to estimate the size of the detention BMP footprint and determine if the design meets flow control standards. The second iteration would create a separate subbasin to account for the BMP footprint and associated land cover conversions produced from the first model run. The resulting MGSFlood or StormShed3G inputs from the second iteration would be used to determine if the BMP footprint is still large enough and if it still meets flow control standards.

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 03/30/2021 11:30 AM
Report Generation Date: 03/30/2021 11:30 AM

Input File Name: FC 2-3_Iteration 1.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: FC 2-3 Iteration #1
Comments: Preliminary pond tract size for area requiring flow control.

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	2.050	2.050
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	2.050	2.050

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Predevelopment ----------

	-------Area (Acres) --------
Till Forest	0.880
Subbasin Total	0.880

---------- Subbasin : Flow Through ----------

	-------Area (Acres) --------
Till Pasture	0.830
Impervious	0.340
Subbasin Total	1.170

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Postdevelopment ----------

	-------Area (Acres) --------
Impervious	0.880
Subbasin Total	0.880

---------- Subbasin : Flow Through ----------

	-------Area (Acres) --------
Till Pasture	0.830
Impervious	0.340
Subbasin Total	1.170

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Preliminary FC 2-3
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00		
Riser Crest Elevation (ft)			:	103.00
Max Pond Elevation (ft)	:	104.00		
Storage Depth (ft)	:	3.00		

Pond Bottom Length (ft) : 83.0
Pond Bottom Width (ft) : 42.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 3486.
Area at Riser Crest El (sq-ft) : 3,486.
(acres) : 0.080
Volume at Riser Crest (cu-ft) : 10,458.
(ac-ft) : 0.240
Area at Max Elevation (sq-ft) : 3486.
(acres) : 0.080
Vol at Max Elevation (cu-ft) : 13,944.
(ac-ft) : 0.320

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.030
Riser Crest Elevation : 103.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.55
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 101.55
Length (in) : 0.25
Height (in) : 13.00
Orientation : Vertical
Elbow : No

**************************FLOOD FREQUENCY AND DURATION STATISTICS********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 2
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2
Number of Links: 1

********** Link: Preliminary FC 2-3 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.805
1.11-Year	100.917
1.25-Year	101.066
2.00-Year	101.378
3.33-Year	101.741
5-Year	101.954
10-Year	102.278
25-Year	102.822
50-Year	102.941
100-Year	103.010

----------SCENARIO: PREDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 353.95
Inflow Volume Including PPT-Evap (ac-ft): 353.95
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 353.95
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Preliminary FC 2-3 **********

Basic Wet Pond Volume (91% Exceedance): 6084. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 9126. cu-ft

*************Compliance Point Results **************

Scenario Predeveloped Compliance Link: New Copy Lnk1
Scenario Postdeveloped Compliance Link: Preliminary FC 2-3

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)

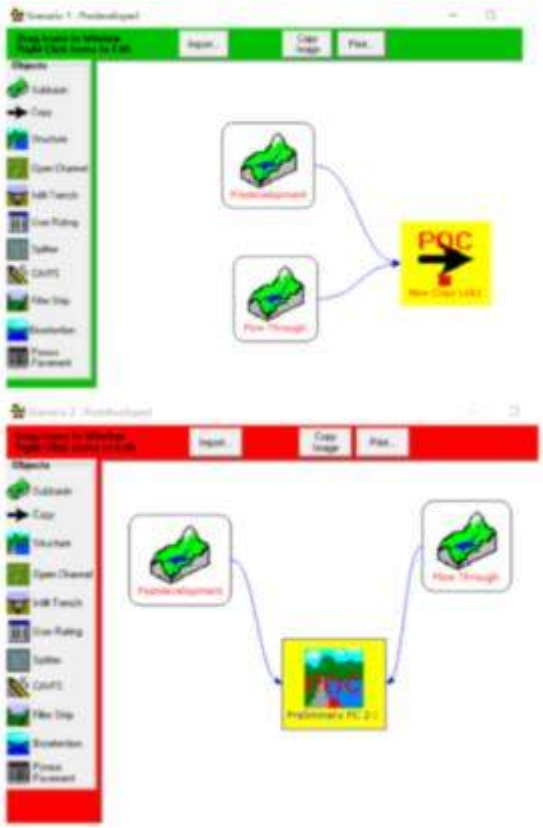
2-Year	0.163	2-Year	7.495E-02
5-Year	0.217	5-Year	0.104
10-Year	0.282	10-Year	0.131
25-Year	0.402	25-Year	0.187
50-Year	0.547	50-Year	0.204
100-Year	0.650	100-Year	0.223
200-Year	0.652	200-Year	0.450
500-Year	0.652	500-Year	0.757

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-11.9%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-4.4%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-17.9%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 03/30/2021 5:20 PM
Report Generation Date: 03/30/2021 5:21 PM

Input File Name: FC 2-3.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: FC 2-3 Iteration #2
Comments: Include access road and pond tract

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	2.050	2.050
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	2.050	2.050

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 3

---------- Subbasin : Predevelopment ----------

	-------Area (Acres) --------
Till Forest	0.880
Subbasin Total	0.880

---------- Subbasin : Flow Through ----------

	-------Area (Acres) --------
Till Pasture	0.620
Impervious	0.340
Subbasin Total	0.960

---------- Subbasin : Access roads, pond tract ----------

	-------Area (Acres) --------
Till Forest	0.210
Subbasin Total	0.210

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3

---------- Subbasin : Postdevelopment ----------

	-------Area (Acres) --------
Impervious	0.880
Subbasin Total	0.880

---------- Subbasin : Flow Through ----------

	-------Area (Acres) --------
Till Pasture	0.620
Impervious	0.340
Subbasin Total	0.960

---------- Subbasin : Access roads, pond tract ----------

	-------Area (Acres) --------
Impervious	0.210
Subbasin Total	0.210

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Preliminary FC 2-3
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 103.00
Max Pond Elevation (ft) : 104.00
Storage Depth (ft) : 3.00
Pond Bottom Length (ft) : 96.0
Pond Bottom Width (ft) : 47.5
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 4560.
Area at Riser Crest El (sq-ft) : 4,560.
(acres) : 0.105
Volume at Riser Crest (cu-ft) : 13,680.
(ac-ft) : 0.314
Area at Max Elevation (sq-ft) : 4560.
(acres) : 0.105
Vol at Max Elevation (cu-ft) : 18,240
(ac-ft) : 0.419

Area provided 4592 SF.

Volume provided 19,028 CF

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.010
Riser Crest Elevation : 103.00 ft

Hydraulic Structure Geometry

Number of Devices: 3

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.37
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 102.00
Diameter (in) : 1.69
Orientation : Horizontal

Elbow : Yes

--- Device Number 3 ---
Device Type : Rectangular Weir that Intersects the Riser Top
Invert Elevation (ft) : 102.80
Length (ft) : 0.6042

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 3
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 1

********** Subbasin: Postdevelopment **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.328
5-Year	0.426
10-Year	0.479
25-Year	0.603
50-Year	0.768
100-Year	0.888
200-Year	0.920
500-Year	0.963

********** Subbasin: Flow Through **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.147
5-Year	0.186
10-Year	0.237
25-Year	0.318
50-Year	0.452
100-Year	0.534
200-Year	0.556
500-Year	0.584

********** Subbasin: Access roads, pond tract **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)

==========

2-Year	7.826E-02
5-Year	0.102
10-Year	0.114
25-Year	0.144
50-Year	0.183
100-Year	0.212
200-Year	0.220
500-Year	0.230

0.534 cfs = Flow through flow rate
0.888+0.212=1.1 cfs is the undetained flows to the pond in post developed conditions.

0.534cfs< 50% of 1.1cfs. The 50% rule check criteria is met

********** Link: Preliminary FC 2-3 ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

==========

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.857
1.11-Year	101.022
1.25-Year	101.228
2.00-Year	101.499
3.33-Year	101.869
5-Year	102.107
10-Year	102.442
25-Year	102.906
50-Year	102.972
100-Year	103.004

100-yr at top of riser

----------SCENARIO: PREDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 342.34
Inflow Volume Including PPT-Evap (ac-ft): 342.34
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 342.34
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Preliminary FC 2-3 **********

Basic Wet Pond Volume (91% Exceedance): 6819. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 10228. cu-ft

************Compliance Point Results **************

Scenario Predeveloped Compliance Link: New Copy Lnk1
Scenario Postdeveloped Compliance Link: Preliminary FC 2-3

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

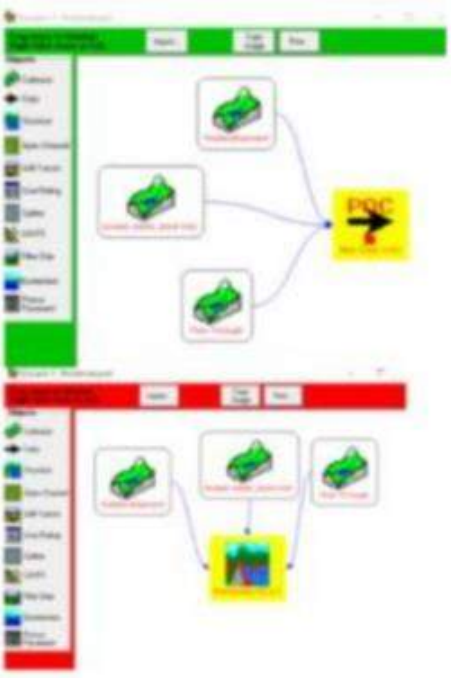
Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.160	2-Year	6.176E-02
5-Year	0.209	5-Year	9.652E-02
10-Year	0.269	10-Year	0.127
25-Year	0.382	25-Year	0.222
50-Year	0.499	50-Year	0.292
100-Year	0.577	100-Year	0.336
200-Year	0.601	200-Year	0.478
500-Year	0.632	500-Year	0.668

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

***** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-45.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-4.8%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	1.4%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.9%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS



OSBORN CONSULTING INCORPORATED

CALCULATIONS COVER PAGE

(DATE: 4/12/2021)

PROJECT: SR9, SR204 Interchange Improvements – Stage 3	OCI JOB NO.: 10-150063	PLAN NO.:	PAGE # OF # 1 of 18
CLIENT: Parsons / WSDOT	DEPARTMENT/DISCIPLINE: Civil/Drainage	CALCULATION NO. A-3.1	

SUBJECT/TITLE: Graded Detention Pond FC 3-1

CALCULATION REV. NO.	ORIGINATOR	DISCIPLINE REVIEWER	TECHNICAL PEER REVIEWER (IF REQUIRED)	CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II
0	T. Hew	A. Seethoff	N/A	N
1				
2				

CALCULATIONS OBJECTIVE

Determine the appropriate detention pond sizing for the targeted contributing areas and varying ground cover conditions. Detention ponds are designed to meet the flow control requirements of the 2019 Highway Runoff Manual (HRM) and reduce impervious surface runoff to meet pre-existing till forest runoff release rates.

CALCULATION METHODOLOGY/ LIST OF ASSUMPTIONS & INPUTS

METHODOLOGY:

1. Determine potential site location for a detention facility relative to available impervious areas for flow control and project site constraints.
2. Delineate and measure contributing pervious and impervious areas routed to the detention pond. Contributing areas include equivalent pavement area consisting of existing, new and replaced, and tributary impervious and pervious/impervious flow through areas.
3. Use the MGSFlood Structure module to determine the initial detention pond volume and flow restrictor specifications required to detain and release stormwater runoff from effective impervious and flow through areas. Flows are not to exceed the till forest predeveloped durations from the 50% of the 2-year peak flow up to the full 50-yr peak flow. Model uses a 15-min timestep.
4. Prepare a second iteration of the MGSFlood model using the pond size and flow restrictor specifications determined in Step 3 and route the pond tract and access road to the pond as additional mitigated impervious area. Confirm that the post developed flow durations do not exceed the predeveloped flows per the criteria in Step 3 and that the 50-yr design water surface elevation (WSEL) does not engage the riser crest of the flow restrictor.
5. Using the MGSFlood model results for required pond volume at WSEL, include 0.5-ft of sediment storage below the live storage and 1-ft of freeboard to finalize pond grading dimensions.
6. Grade pond in InRoads and generate the stage storage report from the pond dtm. Prepare the Specified Elevation Volume Table in the MGSFlood Structure module with the stage storage report and run model to confirm the proposed pond volume and footprint are adequate.
7. Other pond dimension considerations:
    a. 3:1 pond side slopes
    b. Depth of design water surface elevation or riser = 2.05-ft.
    c. Hydraulic Structure #1 = Circular Orifice
    d. Hydraulic Structure #2 = Rectangular Weir that Intersects the Riser Top
    e. Riser Structure = Circular Overflow Riser (12-in diameter)
    f. Minimum freeboard = 1 ft

INPUTS:

1. Land Use:
    a. The predeveloped land cover condition was modeled as forested on till soils for the contributing roadway, till pasture for the pond maintenance access road and pond tract. Impervious and pervious flow through areas were modeled as impervious and till grass, respectively.
    b. The post developed land cover condition was modeled as impervious for the contributing roadway, pond tract and access road. Impervious and pervious flow through areas were modeled as impervious and till grass, respectively.
2. The project is located in the Puget East 40 climate region.
3. MGSFlood modeling is run with 15-minute time steps.
4. MGSFlood Structure Link modeled as Detention Pond Type with no infiltration.

ASSUMPTIONS:

1. The equivalent area option was used for this analysis.
2. Due to till-like deposits detailed in the geotechnical report, infiltration is deemed infeasible at the proposed pond location. Groundwater at the proposed pond location is measured at 18 ft below the pond bottom and no groundwater issues are anticipated.
3. The detention pond design WSEL (50-yr) is set at the riser crest elevation.
4. A bird cage emergency overflow riser structure is provided separate from the outlet control structure and is set at the 100-year WSEL.
5. Flow through areas were modeled using the 50% rule check per HRM Section 4-3.5.4.

REFERENCES

- WSDOT 2019 Highway Runoff Manual (HRM),
    - Section 5-4.2.3 Detention BMPs, FC.03 - Detention Pond
- WSDOT Hydraulic Manual, March 2019

CONCLUSIONS

- See attached MGSFlood modeling reports for the graded detention pond modeling results. The modeling reports provided includes the first and second iteration (run) of the graded detention pond and the 50% Rule Check model. The model runs indicate that the size of the proposed detention facility that is able to detain the captured stormwater runoff and meet the project flow duration requirements.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW
Name: T. Hew
Date: 4/12/2021

Flow Control Input Sheet for TDA 3
Project: SR9, SR204 Interchange Improvements - Stage 3
Description: Detention Pond FC 3-1

Version 6.1
Designed By: T. Hew
Checked By:

Is this BMP design following eastern or western WA guidelines? Western WA

What kind of flow control facility is this? Detention Pond

Is this your first iteration? YES See the bottom of this spreadsheet for an explanation of why two iterations are needed.
What type of flow control modeling scenario does this follow? Equivalent Area

Do any of the following situations occur in the TDA? YES Flows are being sent to the TDA from another TDA

ERROR - This spreadsheet does not support the that situation. Please contact the Region Hydraulics Office for additional instructions on how to deve
Are there any partial reversion or full reversion areas in the TDA? NO

List All Areas and Development in the TDA for the Postdeveloped Condition

Step 1

Existing	Ac.	Postdeveloped	Ac.
Forest		Forest	
Pasture		Pasture	
Grass	2.22	Grass	2.39
Sat. Soils		Sat. Soils	
Impervious	4.55	Impervious	4.47
	6.77		6.86

The Existing condition refers to the existing land cover observed prior to the start of the project.
Sat. Soil = Saturated Soils
For the first iteration, do not account for the land cover changes associated with the detention BMP footprint. The land cover for this footprint area should be represented as though the BMP will not exist when filling out Step 1.

PROJECT ROUNDABOUT DESIGN CAUSES AREA TRANSFER FROM OTHER TDA

Land Cover Conversions and Mitigated Areas for Flow Control

Step 2

	Brief Description of Land Cover Conversion
0.570 Acres	Forest to Impervious
0.110 Acres	Forest to Impervious
0.68 Acres	

Effective Impervious Area (Equivalent)
Additional mitigated impervious

Mitigated (difference)

Step 3

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.680	Forest	0.000
Pasture	0.000	Pasture	0.000
Grass	0.000	Grass	0.000
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	0.000	Impervious	0.680
	0.680 =		0.680

Non-Mitigated (unchanged area)

Step 4

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.000	Forest	0.000
Pasture	0.000	Pasture	0.000
Grass	2.390	Grass	2.390
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	3.790	Impervious	3.790
	6.180 =		6.180

Step 5

Area Physically Transported to Detention Facility

Postdeveloped	Ac.
Forest	
Pasture	
Grass	0.160
Sat. Soils	
Impervious	1.000

Step 6

Bypass Area		Flow-Through Area	
Ac.		Ac.	
		0.160	Grass Flow-through Area
		0.320	Impervious Flow-through Area

Step 7 - Step 9

Modeled (Input for MGSFlood)

Predeveloped	Ac.	Flow-Through	Ac.	Postdeveloped	Ac.	Bypass	Ac.	Flow-Through	Ac.
Forest	**0.680**	Forest		Forest	**0.000**	Forest		Forest	
Pasture	**0.000**	Pasture		Pasture	**0.000**	Pasture		Pasture	
Grass	**0.000**	Grass	**0.160**	Grass	**0.000**	Grass		Grass	**0.160**
Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	
Impervious	**0.000**	Impervious	**0.320**	Impervious	**0.680**	Impervious		Impervious	**0.320**
	0.680	+	0.480	=	0.680			+	0.480

Was the detention BMP footprint represented in the above MGSFlood inputs? NO

Choose N/A ----------> N/A

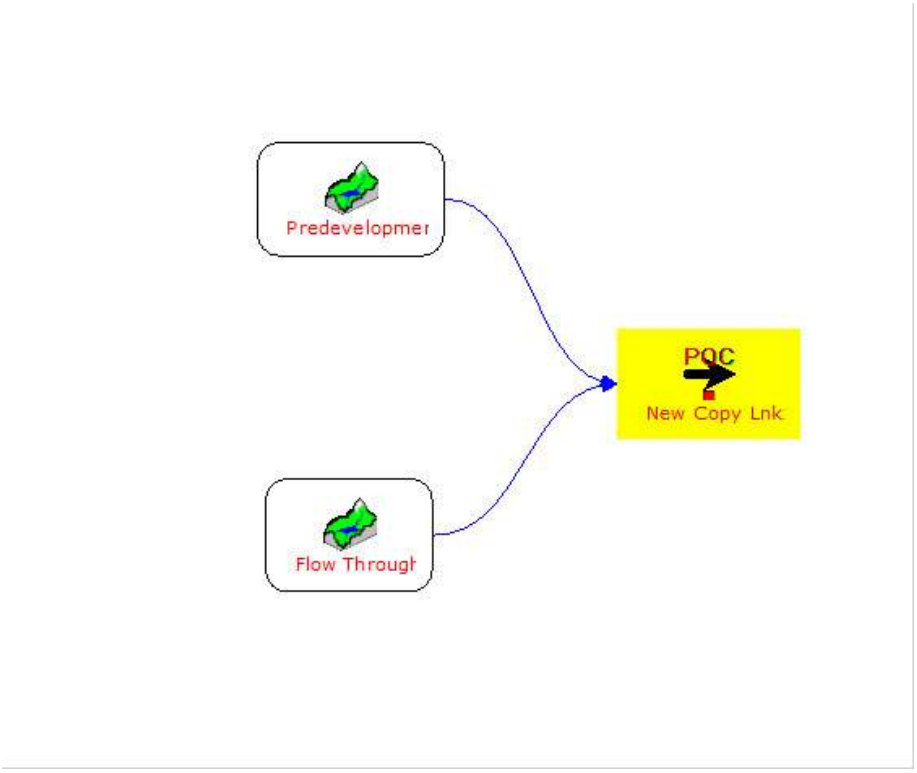
Choose N/A ----------> N/A

LEAVE BLANK ---------->
LEAVE BLANK ---------->

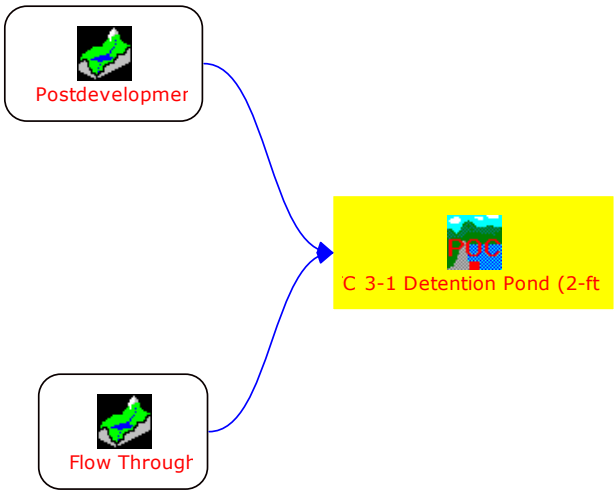
The designer should produce at least two iterations of this spreadsheet. The intent of the first iteration is to estimate the size of the detention BMP footprint and determine if the design meets flow control standards. The second iteration would create a separate subbasin to account for the BMP footprint and associated land cover conversions produced from the first model run. The resulting MGSFlood or StormShed3G inputs from the second iteration would be used to determine if the BMP footprint is still large enough and if it still meets flow control standards.

This is your first iteration. Please rename this TAB as Iteration #1. Copy this completed tab and rename the copied tab as Iteration #2 to start the second iteration adding in the detention BMP footprint land cover changes.

PREDEVELOPED SCENARIO:



POSTDEVELOPED SCENARO:



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 04/01/2021 2:13 PM
Report Generation Date: 04/01/2021 2:13 PM

Input File Name: FC 3-1 Det Pond Model Run #1.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: FC 2-3 Detention Pond Model - Run #1
Comments: Detention pond sizing (2.05' Depth) for mitigated effective impervious areas only.

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.160	1.160
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.160	1.160

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Predevelopment ----------

	-------Area (Acres) --------
Till Forest	0.680
Subbasin Total	0.680

---------- Subbasin : Flow Through ----------

	-------Area (Acres) --------
Till Grass	0.160
Impervious	0.320
Subbasin Total	0.480

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Postdevelopment ----------

	-------Area (Acres) --------
Impervious	0.680
Subbasin Total	0.680

---------- Subbasin : Flow Through ----------

	-------Area (Acres) --------
Till Grass	0.160
Impervious	0.320
Subbasin Total	0.480

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: FC 3-1 Detention Pond (2.05-ft)
Link Type: Structure
Downstream Link: None

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
100.00	0.
101.00	3616.
102.00	8182.

103.00	13754.
103.05	14060.

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.120
Riser Crest Elevation : 102.05 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.55
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Rectangular Weir that Intersects the Riser Top
Invert Elevation (ft) : 101.55
Length (ft) : 0.120

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 2
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2
Number of Links: 1

********** Link: FC 3-1 Detention Pond (2.05-ft) ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.593
1.11-Year	100.633
1.25-Year	100.730
2.00-Year	100.966
3.33-Year	101.138
5-Year	101.301

10-Year	101.495
25-Year	101.828
50-Year	101.904
100-Year	102.000

*************Groundwater Recharge Summary ***************

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Predevelopment	117.252
Subbasin: Flow Through	19.554
Link: New Copy Lnk1	0.000
Total:	136.805

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Postdevelopment	0.000
Subbasin: Flow Through	19.554
Link: FC 3-1 Detention Pon	0.000
Total:	19.554

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.866 ac-ft/year, Post Developed: 0.124 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 237.54
Inflow Volume Including PPT-Evap (ac-ft): 237.54
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 237.54
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: FC 3-1 Detention Pond (2.05-ft) **********

Basic Wet Pond Volume (91% Exceedance): 4579. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 6869. cu-ft

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 480.53
Inflow Volume Including PPT-Evap (ac-ft): 480.53
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 480.97
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Link: New Copy Lnk1
Scenario Postdeveloped Compliance Link: FC 3-1 Detention Pond (2.05-ft)

*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.142	2-Year	6.300E-02
5-Year	0.180	5-Year	7.313E-02
10-Year	0.224	10-Year	7.838E-02
25-Year	0.297	25-Year	0.134
50-Year	0.391	50-Year	0.156
100-Year	0.421	100-Year	0.187
200-Year	0.423	200-Year	0.213
500-Year	0.426	500-Year	0.246

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-30.6%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-30.6%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-72.3%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

Flow Control Input Sheet for TDA 3
Project: SR9, SR204 Interchange Improvements - Stage 3
Description: Detention Pond FC 3-1

Version 6.1
Designed By: T. Hew
Checked By:

Is this BMP design following eastern or western WA guidelines? Western WA

What kind of flow control facility is this? Detention Pond

Is this your first iteration? NO See the bottom of this spreadsheet for an explanation of why two iterations are needed.
What type of flow control modeling scenario does this follow? Equivalent Area

Do any of the following situations occur in the TDA? YES Flows are being sent to the TDA from another TDA

ERROR - This spreadsheet does not support the that situation. Please contact the Region Hydraulics Office for additional instructions on how to deve
Are there any partial reversion or full reversion areas in the TDA? NO

List All Areas and Development in the TDA for the Postdeveloped Condition

Step 1

Existing	Ac.	Postdeveloped	Ac.
Forest		Forest	
Pasture		Pasture	
Grass	2.22	Grass	2.24
Sat. Soils		Sat. Soils	
Impervious	4.55	Impervious	4.62
	6.77		6.86

The Existing condition refers to the existing land cover observed prior to the start of the project.
Sat. Soil = Saturated Soils
For the second iteration, modify the areas in Step 1 to account for the land cover changes associated with the detention BMP footprint. Fill in Step 2 with the land cover converstions for the detention BMP footprint.

PROJECT ROUNDABOUT DESIGN CAUSES AREA TRANSFER FROM OTHER TDA

Land Cover Conversions and Mitigated Areas for Flow Control

Step 2

	Brief Description of Land Cover Conversion
0.570 Acres	Forest to Impervious
0.110 Acres	Forest to Impervious
0.120 Acres	Pasture to Impervious
0.030 Acres	Pasture to Impervious

Effective Impervious Area (Equivalent)
Additional mitigated impervious
Pond Tract
Access Road

0.83 Acres

Mitigated (difference)

Step 3

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.680	Forest	0.000
Pasture	0.150	Pasture	0.000
Grass	0.000	Grass	0.000
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	0.000	Impervious	0.830
	0.830	=	0.830

Non-Mitigated (unchanged area)

Step 4

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.000	Forest	0.000
Pasture	0.000	Pasture	0.000
Grass	2.240	Grass	2.240
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	3.790	Impervious	3.790
	6.030	=	6.030

Step 5

Area Physically Transported to Detention Facility

Postdeveloped	Ac.
Forest	
Pasture	
Grass	0.160
Sat. Soils	
Impervious	1.150

Step 6

Bypass Area		Flow-Through Area	
Ac.		Ac.	
		0.160	Grass Flow-through Area
		0.320	Impervious Flow-through Area

Step 7 - Step 9

Modeled (Input for MGSFlood)

Predeveloped	Ac.	Flow-Through	Ac.	Postdeveloped	Ac.	Bypass	Ac.	Flow-Through	Ac.
Forest	**0.680**	Forest		Forest	**0.000**	Forest		Forest	
Pasture	**0.150**	Pasture		Pasture	**0.000**	Pasture		Pasture	
Grass	**0.000**	Grass	**0.160**	Grass	**0.000**	Grass		Grass	**0.160**
Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	
Impervious	**0.000**	Impervious	**0.320**	Impervious	**0.830**	Impervious		Impervious	**0.320**
	0.830	+	0.480	=	0.830			+	0.480

Was the detention BMP footprint represented in the above MGSFlood inputs? YES

Choose N/A ----------> N/A

Choose N/A ----------> N/A

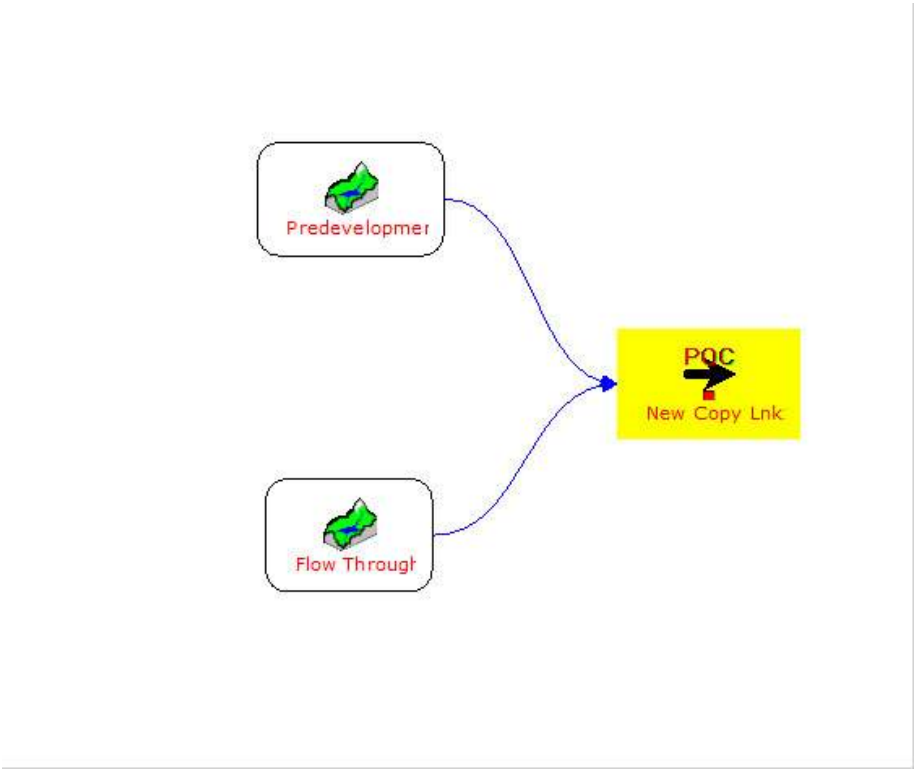
50% Rule Check

100year undetained flow rate (cfs) from area receiving flow control =	0.84
100year undetained flow rate (cfs) from flow through area =	0.42

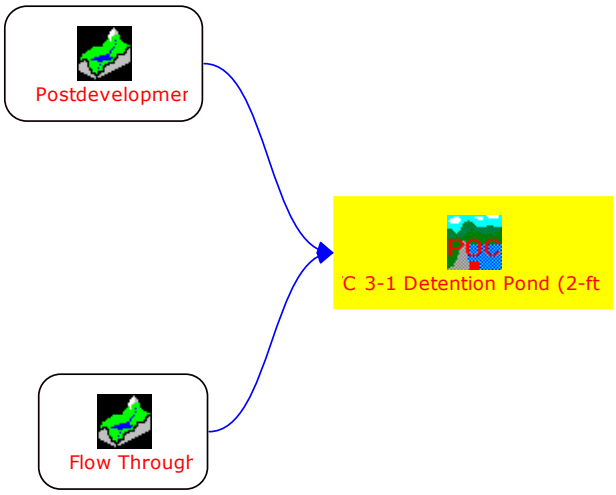
The flow through area meets the 50% rule.

The designer should produce at least two iterations of this spreadsheet. The intent of the first iteration is to estimate the size of the detention BMP footprint and determine if the design meets flow control standards. The second iteration would create a separate subbasin to account for the BMP footprint and associated land cover conversions produced from the first model run. The resulting MGSFlood or StormShed3G inputs from the second iteration would be used to determine if the BMP footprint is still large enough and if it still meets flow control standards.

PREDEVELOPED SCENARIO:



POSTDEVELOPED SCENARO:



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 04/01/2021 2:14 PM
Report Generation Date: 04/01/2021 2:14 PM

Input File Name: FC 3-1 Det Pond Model Run #2.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: FC 2-3 Detention Pond Model - Run #2
Comments: Detention pond sizing (2.05' Depth) for mitigated effective impervious, pond tract, access road and additional mitigated impervious.

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.310	1.310
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.310	1.310

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Predevelopment ----------

	-------Area (Acres) --------
Till Forest	0.680
Till Pasture	0.150

Subbasin Total 0.830

---------- Subbasin : Flow Through ----------
-------Area (Acres) --------
Till Grass 0.160
Impervious 0.320

Subbasin Total 0.480

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Postdevelopment ----------
-------Area (Acres) --------
Impervious 0.830

Subbasin Total 0.830

---------- Subbasin : Flow Through ----------
-------Area (Acres) --------
Till Grass 0.160
Impervious 0.320

Subbasin Total 0.480

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: FC 3-1 Detention Pond (2.05-ft)
Link Type: Structure
Downstream Link: None

User Specified Elevation Volume Table Used
Elevation (ft) Pond Volume (cu-ft)
100.00 0.

101.00	3616.
102.00	8182.
103.00	13754.
103.05	14060.

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.120
Riser Crest Elevation : 102.05 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.55
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Rectangular Weir that Intersects the Riser Top
Invert Elevation (ft) : 101.55
Length (ft) : 0.120

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 2
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2
Number of Links: 1

********** Subbasin: Postdevelopment **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.309
5-Year	0.402
10-Year	0.452
25-Year	0.569
50-Year	0.724

100-Year	0.837
200-Year	0.868
500-Year	0.908

100-YR UNDETAINED FLOW RATE FROM AREAS RECEIVING FLOW CONTROL

********** **Subbasin: Flow Through** **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.134
5-Year	0.169
10-Year	0.210
25-Year	0.285
50-Year	0.333
100-Year	0.416
200-Year	0.418
500-Year	0.421

0.416 cfs < 50% of 0.837 cfs.
The 50% rule check criteria is met

100-YR UNDETAINED FLOW RATE FROM FLOW THROUGH AREAS

********** Link: FC 3-1 Detention Pond (2.05-ft) ********** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.701
1.11-Year	100.759
1.25-Year	100.866
2.00-Year	101.115
3.33-Year	101.318
5-Year	101.486
10-Year	101.697
25-Year	102.009
50-Year	102.043
100-Year	102.107

**********Groundwater Recharge Summary **********

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Predevelopment	143.669
Subbasin: Flow Through	19.554
Link: New Copy Lnk1	0.000
Total:	163.223

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)

Subbasin: Postdevelopment 0.000
Subbasin: Flow Through 19.554
Link: FC 3-1 Detention Pon 0.000
_____
Total: 19.554

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 1.033 ac-ft/year, Post Developed: 0.124 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 259.48
Inflow Volume Including PPT-Evap (ac-ft): 259.48
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 259.48
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: FC 3-1 Detention Pond (2.05-ft) **********

Basic Wet Pond Volume (91% Exceedance): 5243. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 7864. cu-ft

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 547.78
Inflow Volume Including PPT-Evap (ac-ft): 547.78
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 548.25
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Link: New Copy Lnk1
Scenario Postdeveloped Compliance Link: FC 3-1 Detention Pond (2.05-ft)

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff		
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)	
2-Year	0.146	2-Year	6.769E-02	WQ FLOW RATE FOR WET BIOFILTRATION SWALE DESIGN
5-Year	0.187	5-Year	7.814E-02	
10-Year	0.234	10-Year	0.102	
25-Year	0.321	25-Year	0.190	
50-Year	0.429	50-Year	0.218	
100-Year	0.463	100-Year	0.364	100- YR FLOWS CONSIDER FOR FLOW SPLITTER DOWNSTREAM
200-Year	0.473	200-Year	0.385	
500-Year	0.486	500-Year	0.409	

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-3.1%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-3.1%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	2.5%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	1.7%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

Elevation	Incremental Volume cu ft	Cumulative Volume cu ft	Acre-Feet	Surface Area sq ft	MGSFLOOD MODEL EQUIVELANT ELEVATIONS:
344.58	3616.85	3616.85	0.08	4081.95	101.00
345.58	4565.90	8182.74	0.19	5059.26	102.00
346.58	5571.45	13754.20	0.32	6093.07	103.00
346.63	305.98	14060.18	0.32	6146.24	103.05

INROADS POND GRADING STAGE STORAGE VOLUME REPORT

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 05/04/2021 1:01 PM
Report Generation Date: 05/05/2021 9:34 AM

Input File Name: TDA 4 100-yr Flow Discharge.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: TDA 4 100-yr Flow Discharge
Comments: 0.15 cfs or more increase in 100-yr recurrence interval flow

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

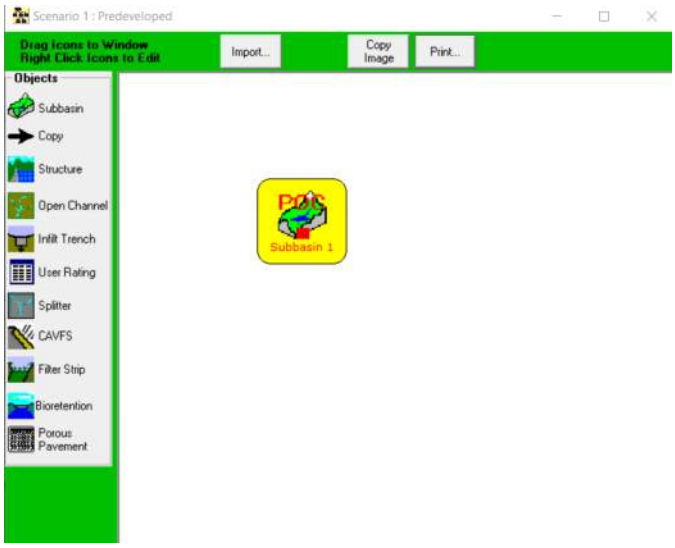
HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

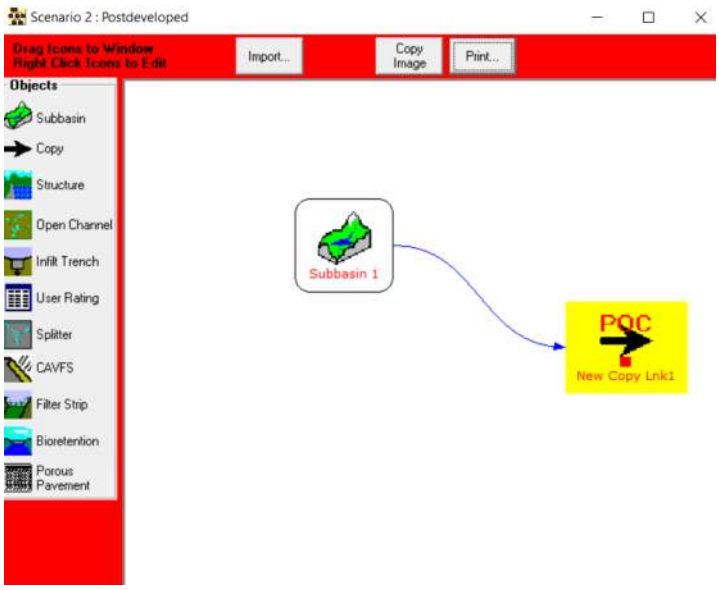
	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.110	0.740
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.110	0.740



----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Grass	0.200
Impervious	0.910
Subbasin Total	1.110



----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

--------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Till Grass 0.130
Impervious 0.610

Subbasin Total 0.740

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

************Groundwater Recharge Summary **************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Subbasin 1 24.442
_____
Total: 24.442

Total Post Developed Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Subbasin 1 15.887
Link: New Copy Lnk1 0.000

Total: 15.887

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.155 ac-ft/year, Post Developed: 0.101 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 299.64
Inflow Volume Including PPT-Evap (ac-ft): 299.64
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 299.64
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.355	2-Year	0.238
5-Year	0.455	5-Year	0.305
10-Year	0.538	10-Year	0.360
25-Year	0.710	25-Year	0.474
50-Year	0.843	50-Year	0.564
100-Year	1.034	100-Year	0.691
200-Year	1.056	200-Year	0.706
500-Year	1.084	500-Year	0.725

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

< 0.15 cfs increase
Decrease greater than 0.15 cfs due to an unavoidable area adjustment between TDA 3 and TDA 4.

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-78.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-77.7%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-67.7%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-39.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-42.1%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 05/04/2021 3:44 PM
Report Generation Date: 05/05/2021 9:35 AM

Input File Name: TDA 5 100-yr Flow Discharge.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: TDA 5 100-yr Flow Discharge
Comments: 0.15 cfs or more increase in 100-yr recurrence interval flow

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

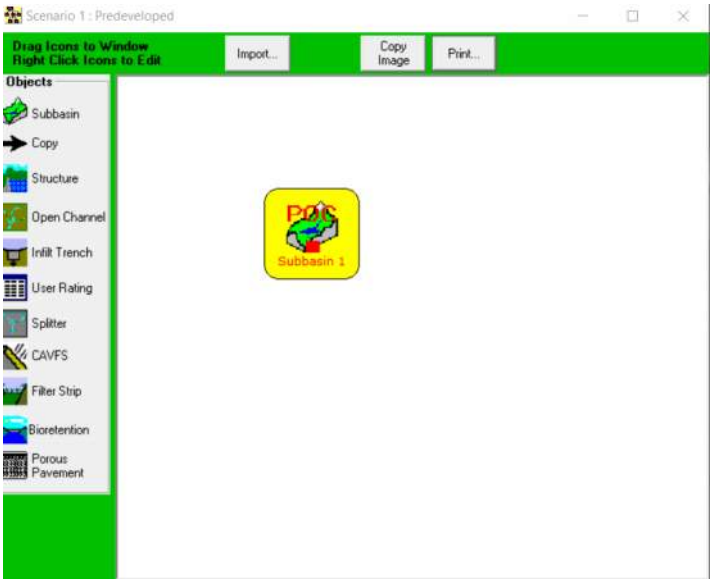
HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

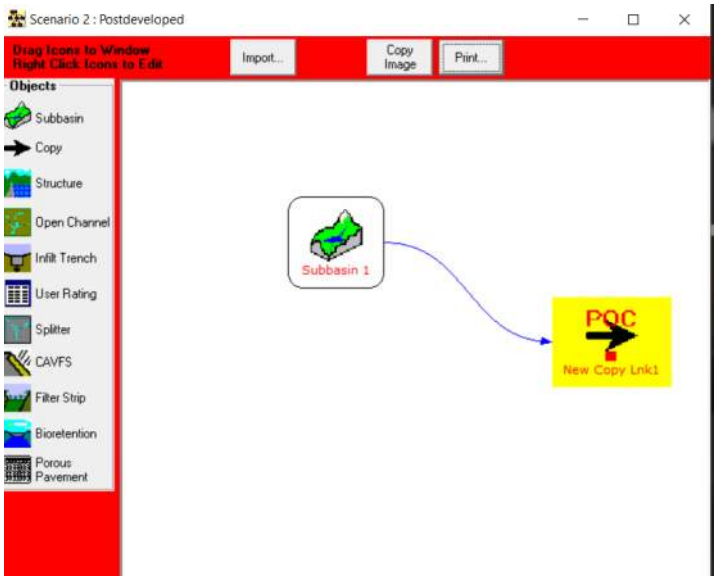
	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.840	0.840
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.840	0.840



----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Grass	0.500
Impervious	0.340
Subbasin Total	0.840



----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

--------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Till Grass 0.500
Impervious 0.340

Subbasin Total 0.840

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

************Groundwater Recharge Summary **************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Subbasin 1 61.105
_____
Total: 61.105

Total Post Developed Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Subbasin 1 61.105
Link: New Copy Lnk1 0.000

Total: 61.105

Total Predevelopment Recharge Equals Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.387 ac-ft/year, Post Developed: 0.387 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 252.99
Inflow Volume Including PPT-Evap (ac-ft): 252.99
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 252.99
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.171	2-Year	0.171
5-Year	0.226	5-Year	0.226
10-Year	0.289	10-Year	0.289
25-Year	0.385	25-Year	0.385
50-Year	0.509	50-Year	0.509
100-Year	0.606	100-Year	0.606
200-Year	0.627	200-Year	0.627
500-Year	0.652	500-Year	0.652

< 0.15 cfs increase

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 05/04/2021 1:04 PM
Report Generation Date: 05/05/2021 9:40 AM

Input File Name: TDA 6 100-yr Flow Discharge.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: TDA 6 100-yr Flow Discharge
Comments: 0.15 cfs or more increase in 100-yr recurrence interval flow

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

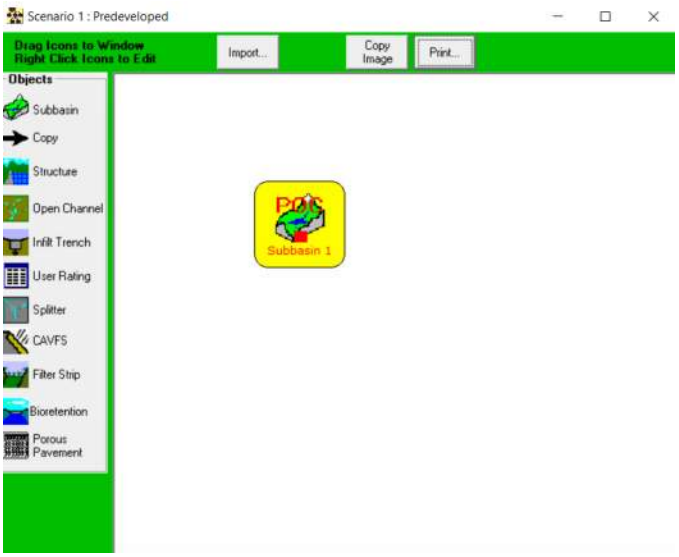
HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

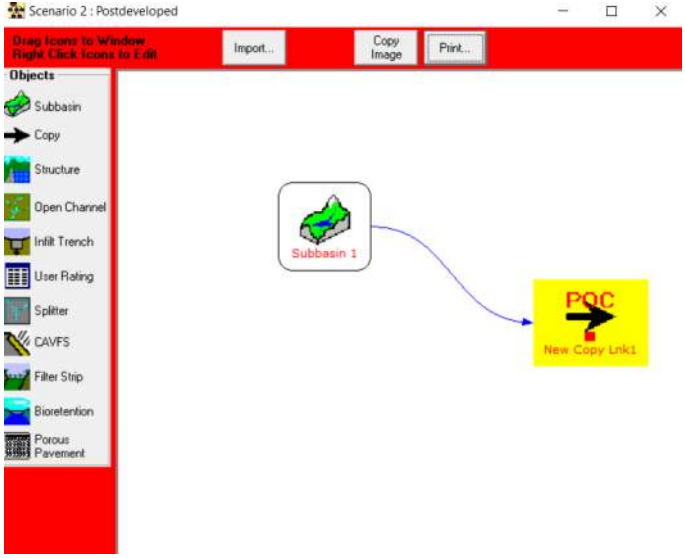
	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.060	0.040
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.060	0.040



----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.060
Subbasin Total	0.060



----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 0.040

Subbasin Total 0.040

************************** LINK DATA ****************************

----------SCENARIO: PREDEVELOPED
Number of Links: 0

************************** LINK DATA ****************************

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

***********************FLOOD FREQUENCY AND DURATION STATISTICS********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

*************Groundwater Recharge Summary ***************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Subbasin 1 0.000
_____
Total: 0.000

Total Post Developed Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Subbasin 1 0.000

Link: New Copy Lnk1 0.000

Total: 0.000

Total Predevelopment Recharge Equals Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.000 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 17.93
Inflow Volume Including PPT-Evap (ac-ft): 17.93
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 17.93
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	2.236E-02	2-Year	1.491E-02
5-Year	2.904E-02	5-Year	1.936E-02
10-Year	3.267E-02	10-Year	2.178E-02
25-Year	4.113E-02	25-Year	2.742E-02
50-Year	5.235E-02	50-Year	3.490E-02
100-Year	6.053E-02	100-Year	4.035E-02
200-Year	6.274E-02	200-Year	4.183E-02
500-Year	6.566E-02	500-Year	4.377E-02

< 0.15 cfs increase

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

APPENDIX C-2

RUNOFF TREATMENT DESIGN

OSBORN CONSULTING INCORPORATED

CALCULATIONS COVER PAGE

(DATE: 9/24/20)

PROJECT: SR9, SR204 Interchange Improvements – Stage 3	**OCI JOB NO**.: 10-150063	**PLAN NO**.:	**PAGE 1 OF 8** (Total pages included)
CLIENT: Parsons / WSDOT	**DEPARTMENT/DISCIPLINE**: Civil/Drainage	**CALCULATION NO**.	

SUBJECT/TITLE: CABS Sizing

CALCULATION REV. NO.	**ORIGINATOR**	**DISCIPLINE REVIEWER**	**TECHNICAL PEER REVIEWER (IF REQUIRED)**	**CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II**
0	S. Sridharan	A. Seethoff	N/A	N
1			N/A	N
2			N/A	N

CALCULATIONS OBJECTIVE

Determine the size of the Compost-Amended Biofiltration Swale (CABS) required to treat the targeted catchment area. The CABS is sized to meet the runoff treatment requirements of the 2019 Highway Runoff Manual (HRM).

CALCULATION METHODOLOGY/ LIST OF ASSUMPTIONS & INPUTS

METHODOLOGY:

1. Delineate runoff treatment impervious and pervious areas contributing to the proposed CABS facility.
2. Determine the online water quality flow rate from Post-developed contributing area using the Copy module in MGSFlood with 15-min time steps.
3. Determine 2-yr, 24-hr precipitation depth from Isopluvial Maps provided in WSDOT Hydraulic Manual.
4. Input online flow rate and precipitation depth values into WSDOT CABS design spreadsheet to determine required swale length, bottom width, depth, and top width.
5. Determine flow spreader lengths at the head of each bioswale and every 50 ft in length if the bottom of the CABS facility is greater than 6 ft in width. Add the total flow spreader length to the calculated swale length provided in the WSDOT CABS design spreadsheet.
6. Use WSDOT CABS design spreadsheet to check for required swale depth, including 1-ft freeboard, based on the Q_{50yr}

ASSUMPTIONS:

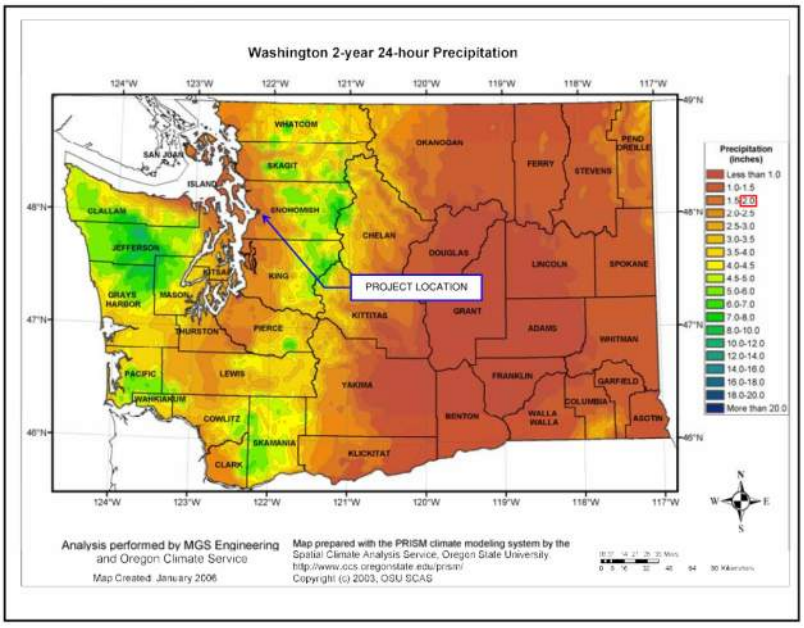
1. CABS facilities will be online.
2. Design water depth in CABS facility is 4 inches maximum. Assumed CABS will be mowed infrequently or inconsistently. Refer to HRM Table 5-4 for Biofiltration Swale Sizing Criteria.
3. The soil sand vegetation cover will be a grass-legume mix on lightly compacted topsoil with 3-inch medium compost blanket. Therefore, consider Mannings coefficient = 0.35. Refer to Table 5-3 of HRM.
4. Horizontal side slopes of both sides of the swale will be 3H:1V.
5. Bottom Width = min. 2 ft and max. 10 ft. Widths greater than 10 ft will have a swale divider.

6. Maximum longitudinal slope of CABS = To be updated post 90%

INPUTS:

1. MGSFlood
    a. The basin area draining to the CABS = To be updated post 90%
    b. Land Use: To be updated post-90%
    c. Project is located in Puget East 40.
    d. MGSFlood model is run with 15-min time step.

2. WSDOT CABS Design Spreadsheet:
    a. Runoff treatment design online flow rate obtained from MGSFlood.
    b. The 2-year 24-hour precipitation depth based on project location is 2.0 inches.



REFERENCES

- WSDOT 2019 Highway Runoff Manual (HRM),
    - Section 5-4.1.3 Biofiltration BMPs, RT.06_Biofiltration Swale
- WSDOT Hydraulic Manual, April 2019
- WSDOT CABS sizing worksheet

CONCLUSIONS

The CABS facility dimension results are attached. The MGSFlood results and CABS spreadsheet are attached as well.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW

Name: S. Sridharan

Date: 9/24/20

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 09/24/2020 7:05 PM
Report Generation Date: 09/24/2020 7:05 PM

Input File Name: RT 2-7.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: RT2-7 CABS
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.710	0.710
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.710	0.710

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Predevelopment ----------

	-------Area (Acres) --------
Till Forest	0.710
Subbasin Total	0.710

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Postdevelopment ----------
-------Area (Acres) --------
Impervious 0.710

Subbasin Total 0.710

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

Groundwater Recharge Summary
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Predevelopment 122.425
Link: New Copy Lnk1 0.000

Total: 122.425

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Postdevelopment	0.000
Link: New Copy Lnk1	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.775 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 64.62
Inflow Volume Including PPT-Evap (ac-ft): 64.62
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 64.62
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Basic Wet Pond Volume (91% Exceedance): 3145. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 4717. cu-ft

2-Year Discharge Rate : 0.265 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 0.10 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.06 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 318.33
Inflow Volume Including PPT-Evap (ac-ft): 318.33
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 318.33

Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

************Compliance Point Results **************

Scenario Predeveloped Compliance Link: New Copy Lnk1
Scenario Postdeveloped Compliance Link: New Copy Lnk1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.513E-02	2-Year	0.265
5-Year	2.466E-02	5-Year	0.344
10-Year	3.322E-02	10-Year	0.387
25-Year	4.213E-02	25-Year	0.487
50-Year	5.376E-02	50-Year	0.619
100-Year	5.826E-02	100-Year	0.716
200-Year	9.068E-02	200-Year	0.742
500-Year	0.134	500-Year	0.777

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

RT.04 - Basic Biofiltration Swale and Compost Amended Biofiltration Swale
Project: SR9/204 Stage 3 — Designed By: S. Sridharan
Description: RT2-7 (DR02-25) — Checked By: A. Seethoff

BASIC BIOSWALE AND COMPOST AMENDED BIOSWALE SPREADSHEET VERSION 2.1

Design Steps

D-1 Determine runoff treatment design flow rate Q_{wq}

Q_{wq} 0.100 Runoff treatment design flow rate from MGS Flood OR SBUH; MGSFlood reports an online and offline flow rate, please enter the applicable design flow rate

D-2 Determine the biofiltration design flow rate (Q_{biofil})

Is the bioswale in eastern WA? No

2.00 2-year 24 hr precip depth (in)
P72%, 2-yr 1.44 72% of the 2-year 24 hr precip depth (in)

Is bioswale online or offline? online

Q_{biofil} 0.198 runoff treatment design flow rate

D-3 Determine the longitudinal slope of the proposed biofiltration swale (ft/ft)

s 0.020 ft/ft

D-4 Select a soil and vegetation cover suitable for the biofiltration swale

soil/veg Grass-legume mix on lightly compacted topsoil with 3-inch medium compost blanket (CABS) <--Use pull down box
Manning's n= 0.35 From HRM Table 5-3

D-5 Select the design depth of flow y (see HRM Table 5-4)

y 0.33 (ft) design depth of flow; for basic biofiltration swale and CABS = 4" max (0.33 ft max) for WQ event

D-6 Select a trapezoidal swale cross-sectional shape.

D-7 Use Manning's Eq and first approximations relating hydraulic radius and dimensions to get width for trapezoidal cross section

$$Q_{biofil} = \frac{1.49 A R^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \qquad AR^{.67} = \frac{Q_{biofil}\, n}{1.49\, s^{0.5}}$$

<--manning's changed

HRM Chapter 5 Equation E-11

Use Excel Solver

D-7a

Q_{biofil}		0.198	cfs - runoff treatment design flow rate
A		0.869	ft2 - wetted area
R		0.233	ft - hydraulic radius
s		0.020	ft/ft longitudinal slope of swale
n		0.35	Manning's coefficient
b	1.64		ft - bioswale bottom width
$z_{foreslope}$	3.00		horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
$z_{backslope}$	3.00		horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
y		0.330	ft - design depth flow = maximum depth of flow
Q_{biofil}	0.198		cfs - use goal seek under "What-If Analysis" in the "DATA" menu to set this cell equal to Q_{biofil} above changing the "b" value

Note: Depth of flow for basic biofiltration swale and CABS = 4" max (0.33 ft max) for WQ event
Minimum bioswale bottom width is 2 feet

D-7b If the swale calculations above give a swale width less than 2 feet wide, re-run calculations with 2 foot wide swale, solve for depth y
Or if redesigning swale with different dimensions, use below calculator and use Excel Goal Seek to determine new depth of flow.

Q_{biofil}		0.198	cfs - runoff treatment design flow rate
A		0.888	ft2 - wetted area
R		0.226	ft - hydraulic radius
s		0.020	ft/ft longitudinal slope of swale
n		0.35	Manning's coefficient
b	2.00		ft - enter new bottom width if applicable (2 foot is minimum)
$z_{foreslope}$		3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
$z_{backslope}$		3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
y	0.305		ft - design depth flow
Q_{biofil}	0.198		cfs - use goal seek under "What-If Analysis" in the "DATA" menu to set this cell equal to Q_{biofil} above changing the "y" value

Note: Depth of flow for basic biofiltration swale and CABS = 4" max (0.33 ft max) for WQ event

D-8 **Enter Final Bioswale Dimensions from the calculations in Step D-7a or D-7b**

Enter Final Swale Area	0.888	ft2 - Wetted Area
Enter Final Swale R	0.226	ft - hydraulic radius
Enter Final Swale slope s	0.020	ft/ft longitudinal slope of swale
Enter Final Swale n	0.35	Manning's coefficient
Enter Final Swale bottom width b	2.00	ft - swale bottom width
Enter Final Swale $z_{foreslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
Enter Final Swale $z_{backslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
Enter Final Swale flow depth y	0.30	ft - design depth flow

D-9 **Computer the flow velocity at Q_{biofil}**

$$V_{biofil} = \frac{Q_{biofil}}{A}$$ HRM Chapter 5 Equation E-12

V_{biofil} 0.22 ft/sec - flow velocity; 1 ft/sec maximum

Flow veloicty is OK since it is less than 1 ft/sec

D-10 **Compute Swale Length L (ft)**

$$L = V_{biofil} \times t$$

t 540 seconds - 9 minutes (540 seconds) for CABS, Basic, and Wet bioswale

L 120.28 ft - required length of bioswale; If swale is less than 100 feet, make swale have narrower bottom width (2 foot minimum) and repeat Steps D-7 - D-10 and recalculate to get length over 100 feet or keep swale bottom width make swale length 100 feet minimum

D-11 Does the bioswale need to be redesigned to fit within the provided right of way?

No Continue to Step FC-1

Freeboard Check (Online Swales Only)

FC-1	Q50yr	0.62	cfs - MGSFlood, use the 50 year 15 minute time step, see HRM. If using station data, use the 100 year, 1 hour rate and multiply by the safety factor below.
		1.00	Safety Factor (For MGSFlood, 1.0 if using extended time series, 1.6 if using station data)
	Q_{convey}	0.62	cfs - Q50yr x saftey factor
FC-2	n	0.03	(lowest possible Manning's from HRM)
FC-3	depth y	0.15	ft - design depth flow
	A	0.36	ft2 - wetted area
	R	0.122	ft - hydraulic radius
	S	0.020	ft/ft longitudinal slope of swale
	b	2.00	ft - swale bottom width
	$z_{foreslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
	$z_{backslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
	Q_{convey}	0.62	cfs - use goal seek under "What-If Analysis" in the "DATA" menu to set this cell equal to Q_{convey} above changing the "y" value
FC-4	$D_{(total)}$	1.15	ft, total required swale depth. Does not take into account design standards for minimum ditch depth from the Design Manual (roadway sections)

Final Swale Dimensions		
Swale Length	120.28	ft
Bottom Width	2.0	ft
Swale Longitudinal Slope	0.020	ft/ft
$Z_{foreslope}$	3.0	
$Z_{backslope}$	3.0	
WQ Depth	0.30	ft
Swale Depth (includes 1 ft Freeboard)	1.15	ft

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CALCULATIONS COVER PAGE

(DATE: 8/28/20)

PROJECT: SR9, SR204 Interchange Improvements – Stage 3	**OCI JOB NO.**: 10-150063	**PLAN NO.**:	**PAGE 1 OF 11**
CLIENT: Parsons / WSDOT	**DEPARTMENT/DISCIPLINE**: Civil/Drainage	**CALCULATION NO.** A-3.2	

SUBJECT/TITLE: Media Filter Drain (MFD) Calculations

CALCULATION REV. NO.	**ORIGINATOR**	**DISCIPLINE REVIEWER**	**TECHNICAL PEER REVIEWER (IF REQUIRED)**	**CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II**
0	S.Sridharan/ T.Hew	A. Seethoff	N/A	N
1				
2				

CALCULATIONS OBJECTIVE

Determine media filter drain (MFD) sizing for the targeted contributing areas. The MFD is designed to meet the runoff treatment requirements (Minimum Requirement 5) detailed in the 2019 Highway Runoff Manual (HRM).

CALCULATION METHODOLOGY/ LIST OF ASSUMPTIONS & INPUTS

METHODOLOGY:

1. Determine potential MFD locations with available area adjacent to the edge of paved shoulder to treat roadway sheet flow runoff. Select the type of MFD required based on available MFD locations.
2. Measure contributing flow paths to MFD. Flow paths are defined as the width of the pavement that contributes runoff to the MFD.
3. Check that the resultant slope from the contributing pavement is less than or equal to 9.4% using *Equation 29* shown in Section 5-4.2.2 of the HRM.

   Ensure the resultant slope from the contributing pavement is less than or equal to 9.4%, calculated using Equation 29:

   $$S_{CFS} \leq (G^2 + e^2)^{0.5} \qquad \text{(E-29)}$$

   where: S_{CFS} = resultant slope of the lateral and longitudinal slopes (%)
   e = lateral slope (superelevation) (%)
   G = longitudinal slope (grade) (%)

4. Use Table 5-6 in the HRM to determine appropriate MFD bed sizing. Determine the width of the non-vegetation zone. Include a 3-ft grass strip and determine the required overall MFD width. All roadway widths are greater than 35-ft and hence a 4-ft minimum MFD width is needed. Widths for each MFD is provided within the calculations.

Table 5-6 Western Washington design widths for media filter drains (Type 1 and Type 3).

Pavement width that contributes runoff to the media filter drain	Minimum media filter drain width*
≤ 20 feet	2 feet
≥ 20 and ≤ 35 feet	3 feet
> 35 feet	4 feet

*Width does not include the required 1- to 3-foot gravel vegetation-free zone or the 3-foot grass strip width (see Figure 5-23).

5. MFD Type 1 was used since there is not sufficient room within the ROW to grade in a Type 3 MFD and where infiltration is poor. For MFD Type 1 follow the steps detailed in the *Underdrain Design* portion of Section 5-4.1.3 *RT.07 Media Filter Drain* of the HRM to determine the appropriate underdrain diameter. Use WSDOT Media Filter Drain – Underdrain Sizing Spreadsheet Version 2.1.
6. Route the MFD underdrain to an appropriate downstream storm drain system connection. Check the underdrain pipe connection to the storm drain system to confirm that the underdrain pipe invert is above the 25-yr water surface elevation (WSEL) in the storm drain to prevent backflow into the underdrain system.
7. Using the Rational Method, determine 25-yr and 50-yr flow depth of parallel conveyance ditch system. Check the 25-yr WSEL to confirm that a minimum 1-ft separation between the bottom of the roadway subgrade is maintained. Check the 50-yr WSEL to confirm that the flow does not inundate the media filter mix bed of the MFD. See ditch calculations and roadway sections for ditch calculations and design.
8. Other MFD considerations:
    a. Side Slopes (H:V) = 4:1 max
    b. Non-vegetative zone is 1' wide.
    c. Please see summary of MFD Types within the project limits in the table below.

ASSUMPTIONS:

1. The maximum contributing flow path (pavement width) does not exceed 150 ft in length and is sloped between 2% and 25%.
2. Phosphorous control is not required for the project. Therefore, compost blanket in the vegetated zone is considered.
3. MFD finished grade shall be seeded and mulched.

REFERENCES

- WSDOT 2019 Highway Runoff Manual (HRM),
    - Section 5-4.1.3 Biofiltration BMPs, RT.07_Media Filter Drain
- WSDOT Hydraulic Manual, March 2019

CONCLUSIONS

- See attached calculation sheets for the MFD underdrain sizing and Resultant Slope calculations. The MFDs will be sized with a 4' bed and the overall MFD width is 8'. The 25-yr and 50-yr flow depths in the parallel ditch systems are calculated in the Ditch Design Calculations. The ditch flow lines outside of the MFDs are set so the 50-yr water surface elevations do not inundate the media filter mix of the MFD. The MFD underdrains will connect to drainpipes that daylight into the ditch slopes. At the daylight or downstream connection location flows have been evaluated to confirm that the DS end of the underdrain is pipe is above the 25-yr water surface elevation.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW

Name: S. Sridharan/T.Hew

Date: 9/18/2020

MFD SUMMARY TABLE							
MFD ID	**MFD TYPE**	**TDA**	**STRUCTURE ID**	**TREATMENT AREA (AC)**	**LENGTH OF MFD/ PAVEMENT TREATED (FT)**	**PAVEMENT WIDTH (FT)**	**MFD SIDE SLOPE (H:V)**
RT 2-6	3	2	DR02-14	0.47	480	48	4:1
RT 3-1	1	3	DR03-34	0.17	244	36	4:1
RT 3-2	1	3	DR03-35	0.06	122	34	4:1
RT 3-3	3	3	DR03-32	0.40	515	50	VARIES (4:1 MAX)
RT 3-4	1	3	DR03-31	0.37	466	34	4:1

MEDIA FILTER DRAIN - UNDERDRAIN SPREADSHEET VERSION 2.1

TDA 3 - RT 3-1

UNDERDRAIN BELOW A MFD INSTALLATION

Assume underdrain corregated pipe (per WSDOT MFD spreadsheet)

Assume the underdrain slope is 0.5% and a Manning's n=0.017 (for corrugated underdrain). Assume the underdrain trench width is 2 feet wide, pavement width runoff contribution = 48FT

The MFD installation is in western Washington. MGSFlood was used to give a 50-year flow rate (using 15-minute time steps).

f = MFD mix infiltration rate

W = width of the underdrain trench per Standard Plan B-55.20.00, the minimum width is 2 feet

L = unit length of MFD = 1 ft

L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

FS = factor of safety default of 1.2

f =	10	in/hr	
f =	0.000231	ft/s	
W =	2	ft	
L =	1	ft	
A =	2	ft^2	
$Q_{MFD/FT}$ =	0.000463	cfs/ft	
$Q_{highway}$ =	0.171	cfs	From MGSFlood
$Q_{highway/ft}$ =	0.000701	cfs/ft	
$Q_{UD/ft}$ =	0.000463	cfs/ft	
L_{MFD} =	244	ft	
Q_{UD} =	0.23	cfs	
FS =	1.2		
Q_{UD} =	0.27	cfs	

Pipe Diameter calculation:

D = 16(Q*n/S^0.5)^(3/8) D is calcualted in inches

Q	n	S	D	Recommended Diameter (in)
0.27	0.017	0.005	5.74661	**6**

$$\frac{Q_{highway}}{ft} = \frac{Q_{highway}}{L_{MFD}} \quad \text{(E-21)}$$

where: $\frac{Q_{highway}}{ft}$ = contributing flow rate per foot (cfs/ft)

L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

2. Calculate the MFD flow rate of runoff per foot given an infiltration rate of 10 in/hr through the MFD mix.

$$Q_{\frac{MFD}{ft}} = \frac{f \times W \times 1ft}{ft} \times \frac{1ft}{12in} \times \frac{1hr}{3600sec} \quad \text{(E-22)}$$

where: $\frac{Q_{MFD}}{ft}$ = flow rate of runoff through MFD mix layer (cfs/ft)

W = width of underdrain trench (ft) – see Standard Plan B-55.20-02; the minimum width is 2 ft

f = infiltration rate though the MFD mix (in/hr) = 10 in/hr

3. Size the underdrain pipe to convey the runoff that can reach the underdrain trench. This is taken to be the smaller of the contributing basin flow rate or the flow rate through the MFD mix layer.

$$Q_{\frac{UD}{ft}} = smaller \left\{ Q_{\frac{highway}{ft}} \; or \; Q_{\frac{MFD}{ft}} \right\} \quad \text{(E-23)}$$

where: $Q_{\frac{UD}{ft}}$ = underdrain design flow rate per foot (cfs/ft)

4. Determine the underdrain design flow rate using the length of the MFD and a factor of safety of 1.2.

$$Q_{UD} = 1.2 \times Q_{\frac{UD}{ft}} \times W \times L_{MFD} \quad \text{(E-24)}$$

where: Q_{UD} = estimated flow rate to the underdrain (cfs)

W = width of the underdrain trench (ft) – see Standard Plan B-55.20-02; the minimum width is 2 ft

L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

5. Given the underdrain design flow rate, determine the underdrain diameter. Round pipe diameters to the nearest standard pipe size and have a minimum diameter of 6 inches. For diameters that exceed 12 inches, contact either the RHE or HQ Hydraulics Section.

$$D = 16\left(\frac{Q_{UD} \times n}{s^{0.5}}\right)^{\frac{3}{8}} \quad \text{(E-25)}$$

where: D = underdrain pipe diameter (inches)

n = Manning's coefficient

s = slope of pipe (ft/ft)

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 08/28/2020 4:35 PM
Report Generation Date: 08/28/2020 4:35 PM

Input File Name: RT3-1.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: 90% RT3-1 MFD Type 1
Comments: Runoff flowrate to RT 3-1 (50-yr)

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.196	0.196
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.196	0.196

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Predevelopment ----------

	-------Area (Acres) --------
Till Forest	0.196
Subbasin Total	0.196

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Postdevelopment ----------
-------Area (Acres) --------
Impervious 0.196

Subbasin Total 0.196

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation
Model Element Recharge Amount (ac-ft)

Subbasin: Predevelopment 33.710
Link: New Copy Lnk1 0.000

Total: 33.710

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Postdevelopment	0.000
Link: New Copy Lnk1	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.213 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 17.79
Inflow Volume Including PPT-Evap (ac-ft): 17.79
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 17.79
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 87.65
Inflow Volume Including PPT-Evap (ac-ft): 87.65
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 87.65
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results **************

Scenario Predeveloped Compliance Link: New Copy Lnk1
Scenario Postdeveloped Compliance Link: New Copy Lnk1

***** Point of Compliance Flow Frequency Data *****

Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	4.166E-03	2-Year	7.286E-02
5-Year	6.790E-03	5-Year	9.463E-02
10-Year	9.148E-03	10-Year	0.106
25-Year	1.160E-02	25-Year	0.134
50-Year	1.480E-02	50-Year	0.171
100-Year	1.604E-02	100-Year	0.197
200-Year	2.497E-02	200-Year	0.204
500-Year	3.696E-02	500-Year	0.214

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MEDIA FILTER DRAIN - UNDERDRAIN SPREADSHEET VERSION 2.1

TDA 3 - RT 3-2

UNDERDRAIN BELOW A MFD INSTALLATION

Assume underdrain corregated pipe (per WSDOT MFD spreadsheet)

Assume the underdrain slope is 0.5% and a Manning's n=0.017 (for corrugated underdrain). Assume the underdrain trench width is 2 feet wide, pavement width runoff contribution = 48FT

The MFD installation is in western Washington. MGSFlood was used to give a 50-year flow rate (using 15-minute time steps).

f =	MFD mix infiltration rate
W =	width of the underdrain trench per Standard Plan B-55.20.00, the minimum width is 2 feet
L =	unit length of MFD = 1 ft
L_{MFD} =	length of MFD contributing runoff to the underdrain (ft)
FS =	factor of safety default of 1.2

f =	10	in/hr	
f =	0.000231	ft/s	
W =	2	ft	
L =	1	ft	
A =	2	ft^2	
$Q_{MFD/FT}$ =	0.000463	cfs/ft	
$Q_{highway}$ =	0.05707	cfs	From MGSFlood
$Q_{highway/ft}$ =	0.000468	cfs/ft	
$Q_{UD/ft}$ =	0.000463	cfs/ft	
L_{MFD} =	122	ft	
Q_{UD} =	0.11	cfs	
FS =	1.2		
Q_{UD} =	0.14	cfs	

Pipe Diameter calculation:

D = 16(Q*n/S^0.5)^(3/8) D is calcualted in inches

Q	n	S	D	Recommended Diameter (in)
0.14	0.017	0.005	4.431242	**6**

$$\frac{Q_{highway}}{ft} = \frac{Q_{highway}}{L_{MFD}} \quad \text{(E-21)}$$

where: $\frac{Q_{highway}}{ft}$ = contributing flow rate per foot (cfs/ft)
L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

2. Calculate the MFD flow rate of runoff per foot given an infiltration rate of 10 in/hr through the MFD mix.

$$Q_{\frac{MFD}{ft}} = \frac{f \times W \times 1ft}{ft} \times \frac{1ft}{12in} \times \frac{1hr}{3600sec} \quad \text{(E-22)}$$

where: $\frac{Q_{MFD}}{ft}$ = flow rate of runoff through MFD mix layer (cfs/ft)
W = width of underdrain trench (ft) – see Standard Plan B-55.20-02; the minimum width is 2 ft
f = infiltration rate though the MFD mix (in/hr) = 10 in/hr

3. Size the underdrain pipe to convey the runoff that can reach the underdrain trench. This is taken to be the smaller of the contributing basin flow rate or the flow rate through the MFD mix layer.

$$Q_{\frac{UD}{ft}} = smaller\left\{Q_{\frac{highway}{ft}} \; or \; Q_{\frac{MFD}{ft}}\right\} \quad \text{(E-23)}$$

where: $Q_{\frac{UD}{ft}}$ = underdrain design flow rate per foot (cfs/ft)

4. Determine the underdrain design flow rate using the length of the MFD and a factor of safety of 1.2.

$$Q_{UD} = 1.2 \times Q_{\frac{UD}{ft}} \times W \times L_{MFD} \quad \text{(E-24)}$$

where: Q_{UD} = estimated flow rate to the underdrain (cfs)
W = width of the underdrain trench (ft) – see Standard Plan B-55.20-02; the minimum width is 2 ft
L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

5. Given the underdrain design flow rate, determine the underdrain diameter. Round pipe diameters to the nearest standard pipe size and have a minimum diameter of 6 inches. For diameters that exceed 12 inches, contact either the RHE or HQ Hydraulics Section.

$$D = 16\left(\frac{Q_{UD} \times n}{s^{0.5}}\right)^{\frac{3}{8}} \quad \text{(E-25)}$$

where: D = underdrain pipe diameter (inches)
n = Manning's coefficient
s = slope of pipe (ft/ft)

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 08/29/2020 11:46 AM
Report Generation Date: 08/29/2020 11:46 AM

Input File Name: RT3-3 MFD.fld
Project Name: SR 9 -SR 204 Interchange Improvements - Stage 3
Analysis Title: RT 3-2 MFD TYPE 1
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 3

Full Period of Record Available used for Routing
Precipitation Station : 95004005 Puget West 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951040 Puget West 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.068	0.068
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.068	0.068

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.068
Subbasin Total	0.068

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.068
Subbasin Total	0.068

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	11.655
Total:	11.655

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000

Link: New Copy Lnk1 0.000

Total: 0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.074 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 30.74
Inflow Volume Including PPT-Evap (ac-ft): 30.74
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 30.74
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.881E-03	2-Year	2.593E-02
5-Year	2.851E-03	5-Year	3.375E-02
10-Year	3.742E-03	10-Year	3.795E-02
25-Year	4.851E-03	25-Year	4.420E-02
50-Year	6.504E-03	50-Year	5.707E-02
100-Year	6.931E-03	100-Year	6.644E-02
200-Year	7.932E-03	200-Year	6.839E-02
500-Year	9.282E-03	500-Year	7.091E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MEDIA FILTER DRAIN - UNDERDRAIN SPREADSHEET VERSION 2.1

TDA 3 - RT 3-4

UNDERDRAIN BELOW A MFD INSTALLATION

Assume underdrain corregated pipe (per WSDOT MFD spreadsheet)

Assume the underdrain slope is 0.5% and a Manning's n=0.017 (for corrugated underdrain). Assume the underdrain trench width is 2 feet wide, pavement width runoff contribution = 48FT

The MFD installation is in western Washington. MGSFlood was used to give a 50-year flow rate (using 15-minute time steps).

f = MFD mix infiltration rate

W = width of the underdrain trench per Standard Plan B-55.20.00, the minimum width is 2 feet

L = unit length of MFD = 1 ft

L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

FS = factor of safety default of 1.2

f =	10	in/hr	
f =	0.000231	ft/s	
W =	2	ft	
L =	1	ft	
A =	2	ft^2	
$Q_{MFD/FT}$ =	0.000463	cfs/ft	
$Q_{highway}$ =	0.311	cfs	From MGSFlood
$Q_{highway/ft}$ =	0.000667	cfs/ft	
$Q_{UD/ft}$ =	0.000463	cfs/ft	
L_{MFD} =	466	ft	
Q_{UD} =	0.43	cfs	
FS =	1.2		
Q_{UD} =	0.52	cfs	

Pipe Diameter calculation:

D = 16(Q*n/S^0.5)^(3/8) D is calcualted in inches

Q	n	S	D	Recommended Diameter (in)
0.52	0.017	0.005	7.324622	**8**

$$\frac{Q_{highway}}{ft} = \frac{Q_{highway}}{L_{MFD}} \quad \text{(E-21)}$$

where: $\frac{Q_{highway}}{ft}$ = contributing flow rate per foot (cfs/ft)

L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

2. Calculate the MFD flow rate of runoff per foot given an infiltration rate of 10 in/hr through the MFD mix.

$$Q_{\frac{MFD}{ft}} = \frac{f \times W \times 1ft}{ft} \times \frac{1ft}{12in} \times \frac{1hr}{3600sec} \quad \text{(E-22)}$$

where: $Q_{\frac{MFD}{ft}}$ = flow rate of runoff through MFD mix layer (cfs/ft)

W = width of underdrain trench (ft) – see Standard Plan B-55.20-02; the minimum width is 2 ft

f = infiltration rate though the MFD mix (in/hr) = 10 in/hr

3. Size the underdrain pipe to convey the runoff that can reach the underdrain trench. This is taken to be the smaller of the contributing basin flow rate or the flow rate through the MFD mix layer.

$$Q_{\frac{UD}{ft}} = smaller \left\{ Q_{\frac{highway}{ft}} \; or \; Q_{\frac{MFD}{ft}} \right\} \quad \text{(E-23)}$$

where: $Q_{\frac{UD}{ft}}$ = underdrain design flow rate per foot (cfs/ft)

4. Determine the underdrain design flow rate using the length of the MFD and a factor of safety of 1.2.

$$Q_{UD} = 1.2 \times Q_{\frac{UD}{ft}} \times W \times L_{MFD} \quad \text{(E-24)}$$

where: Q_{UD} = estimated flow rate to the underdrain (cfs)

W = width of the underdrain trench (ft) – see Standard Plan B-55.20-02; the minimum width is 2 ft

L_{MFD} = length of MFD contributing runoff to the underdrain (ft)

5. Given the underdrain design flow rate, determine the underdrain diameter. Round pipe diameters to the nearest standard pipe size and have a minimum diameter of 6 inches. For diameters that exceed 12 inches, contact either the RHE or HQ Hydraulics Section.

$$D = 16\left(\frac{Q_{UD} \times n}{s^{0.5}}\right)^{\frac{3}{8}} \quad \text{(E-25)}$$

where: D = underdrain pipe diameter (inches)

n = Manning's coefficient

s = slope of pipe (ft/ft)

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 08/29/2020 12:10 PM
Report Generation Date: 08/29/2020 12:12 PM

Input File Name: RT3-3 MFD.fld
Project Name: SR 9 -SR 204 Interchange Improvements - Stage 3
Analysis Title: RT 3-4 MFD TYPE 1
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 3

Full Period of Record Available used for Routing
Precipitation Station : 95004005 Puget West 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951040 Puget West 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.370	0.370
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.370	0.370

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.370
Subbasin Total	0.370

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.370
Subbasin Total	0.370

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	63.418
Total:	63.418

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000

Link: New Copy Lnk1 0.000

Total: 0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.401 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 167.26
Inflow Volume Including PPT-Evap (ac-ft): 167.26
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 167.26
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.024E-02	2-Year	0.141
5-Year	1.551E-02	5-Year	0.184
10-Year	2.036E-02	10-Year	0.206
25-Year	2.639E-02	25-Year	0.241
50-Year	3.539E-02	50-Year	0.311
100-Year	3.771E-02	100-Year	0.362
200-Year	4.316E-02	200-Year	0.372
500-Year	5.050E-02	500-Year	0.386

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MFD RESULTANT SLOPE CHECK

Ensure the resultant slope from the contributing pavement is less than or equal to 9.4%, calculated using Equation 29:

$$S_{CFS} \leq (G^2 + e^2)^{0.5} \quad \text{(E-29)}$$

where: S_{CFS} = resultant slope of the lateral and longitudinal slopes (%)
e = lateral slope (superelevation) (%)
G = longitudinal slope (grade) (%)

MFD	*e**	*G**	S_{CFS}
RT 2-6	5.70%	1.10%	5.81%
RT 3-1	2.33%	0.58%	2.40%
RT 3-2	2.31%	3.19%	3.93%
RT 3-3	1.68%	1.57%	2.30%
RT 3-4	1.88%	2.19%	2.88%

** Steepest lateral and longitudinal slope within MFD catchment area considered.*

OSBORN CONSULTING INCORPORATED

CALCULATIONS COVER PAGE

PROJECT: SR9, SR204 Interchange Improvements – Stage 3	OCI JOB NO.: 10-150063	PLAN NO.:	PAGE # OF # 1 OF 9
CLIENT: P A R S O N S / W S D O T	DEPARTMENT/DISCIPLINE: Civil/Drainage	CALCULATION NO.	

SUBJECT/TITLE: TDA 3 Wet Biofiltration Swale (RT 3-5) and Flow Splitter (DR02-53) Design

CALCULATION REV. NO.	ORIGINATOR	DISCIPLINE REVIEWER	TECHNICAL PEER REVIEWER (IF REQUIRED)	CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II
0	T. Hew	A. Seethoff	N/A	N
1	T. Hew	D.Mungasavalli	N/A	N
2				

CALCULATIONS OBJECTIVE

Determine the size and dimensions of an off-line wet biofiltration swale able to treat 1.01 acres of PGIS in TDA 3 from the southbound SR 9 roadway approaching SR 204 and a proposed detention pond (FC 3-1) at the NE corner of the SR9-SR204 roundabout. The calculations include the flow splitter sizing to bypass contributing flows greater than the water quality design flowrate.

CALCULATION METHODOLOGY/ LIST OF ASSUMPTIONS & INPUTS

METHODOLOGY:

Wet Biofiltration Swale:

1. Determine feasible roadside location to construct a wet biofiltration swale (bioswale). Confirm constructable swale slope at chosen location.
2. Determine the runoff water quality (WQ) flowrate to be treated by the proposed bioswale. Since detention is upstream of the bioswale the 2-yr discharge from the pond is considered. Additional roadway area draining to the bioswale is modeled in MGSFlood to determine the 15-min off-line WQ flowrate.

Detention Pond 2-yr Discharge Rate	15-min Off-Line WQ Flowrate	Total Design WQ Flowrate
0.068 cfs	0.02 cfs	0.088 cfs

3. Determine the 2-yr 24 hr precipitation depth (in) for the site from the WSDOT Washington 24-hour Isopluvial Maps.
4. Define the soil and vegetation cover suitable for the proposed bioswale from Table 5-3 in the HRM.
5. Input the modeled runoff WQ flowrate + 2-yr discharge from the detention pond, 2-yr 24 hr precipitation depth (in), proposed swale slope and soil and vegetation cover into the WSDOT Biowale Spreadsheet (Version 2.1) to determine the wet biofiltration design flowrate and swale dimensions required to treat the wet biofiltration flowrate.
6. Using the spreadsheet, check the wet biofiltration flowrate velocity to confirm it is less than 1 ft/sec and compute the required swale length based on the required 9-minute (540 second) residence time. Apply the extended wet season adjustment for Western Washington and calculate the final adjusted bioswale bottom treatment area.

7. Determine the final, constructable bioswale length and bottom width to meet the adjusted bioswale bottom treatment area.

Flow Splitter:

1. Using the MGSFlood Flow Splitter Calculator tab in the WQ Statistics menu, input the runoff WQ flowrate as the Splitter Design Flowrate and choose an initial Flow Splitter Orifice Diameter.
2. Compute the flow splitter geometry and check if the calculated baffle wall height and overflow length is constructable and that the required wall height/diameter ratio of >= 2.0 is meet.
    a. If the calculated baffle wall height or the overflow length is not constructable or if the wall height/diameter ratio requirement is not meet, choose another orifice size and recalculate. Repeat the process until feasible dimensions are produced that meet the required wall height/diameter ratio.
3. Check 100-yr discharge entering flow splitter to determine if the WQ flowrate exceeds the 10% allowable WQ flowrate exceedance specified in the MGSFlood Manual for WQ flowrates.

INPUTS:

1. MGSFlood
    a. WQ Treatment Design Flowrate
        i. The undetained roadway (PGIS) area draining to the Wet Biofiltration Swale = 0.19 acres
        ii. Land Use:
            1. The predeveloped condition was modeled as 0.19 AC of Impervious.
            2. The postdeveloped condition was modeled as as 0.24 AC of.

            *WQ flowrate taken from postdeveloped impervious
    b. Detention Pond (FC 3-1) Model
        i. Land Use:
            1. The predeveloped condition was modeled as 0.68 AC of Till Forest and 0.15 of Till Pasture (Pond Tract & Access Rd)
            2. The predeveloped Flow-Through was modeled as 0.16 AC of Till Grass and 0.32 AC of Impervious
            3. The postdeveloped condition was modeled as 0.83 AC of Impervious
            4. The postdeveloped Flow-Through was modeled as 0.16 AC of Till Grass and 0.32 AC of Impervious.

            *0.84 AC of the 1.15 AC of impervious surface contributing to the pond is PGIS.
    c. Flow Splitter Sizing
        i. Splitter Design Flow Rate = 0.088 cfs
        ii. Orifice Diameter = 1.51 in
        iii. Baffle Wall Height = 2 ft
        iv. Baffle Wall Length = 0.34 ft
    d. Project is located in Puget East 40.
    e. MGSFlood model is run with 15-min time step.
2. WSDOT Wet Biofiltration Swale Design Spreadsheet:
    a. Runoff treatment design flow rate includes the WQ flowrate obtained from MGSFlood per parameters defined in Input #1 plus the 2-year discharge from the proposed detention pond also modeled in MGSFlood,
        i. Off-line WQ flowrate = 0.020 cfs
        ii. 2-yr detention pond discharge = 0.068 cfs
    b. The 2-year 24-hour precipitation depth based on project location is 2.0 inches.
    c. Longitudinal slope = 0.4%
    d. Soil and Vegetation cover is Grass-legume mix on lightly compacted topsoil.
    e. Design Depth y= 0.33 ft (4 in)
    f. Foreslope = 3:1 (H:V)

g. Backslope = 0:1 (H:V); Swale Divider, see Assumption #4

ASSUMPTIONS:

1. Assumed Wet Biofiltration Swale will be mowed infrequently or inconsistently.
2. The MFD (RT3-1) facility up gradient of the bioswale includes an underdrain and gravel trench and is sized to capture, filter and convey all 0.17 AC of contributing roadway sheet flow.
3. Bottom Width = 5 ft
4. The swale is 6' total and is split with a swale divider into a 5' WQ width and 1' bypass ditch width to bypass off-site landscape runoff tributary to the existing ditch the wet bioswale is replacing. See DRD08 for details.

REFERENCES

- WSDOT 2019 Highway Runoff Manual (HRM),
  - Section 5-4.1.3 Biofiltration BMPs, RT.05 - Wet Biofiltration Swale
- WSDOT Hydraulic Manual, April 2019
- WSDOT Wet and Basic Biofiltration Swale Design Spreadsheet
- WSDOT Washington 24-hour Isopluvial Maps

CONCLUSIONS

- The wet biofiltration swale designed provides treatment for 1.01 ac of pollution-generating impervious surface which includes the proposed detention pond (FC 3-1) discharge and the collected undetained roadway runoff. The total length of the bioswale is 200' and the bottom width is 5.0' The flow splitter upstream of the wet biofiltration swale has been designed to attenuate the stormwater flows and maintain the required WQ flowrate to the bioswale, all other flows shall be bypassed around the facility.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW

Name: T. Hew

Date: 5/1/2021

RT.05 - Wet Biofiltration Swale
Project: SR 9 - SR 204 Interchange Improvements - Stage 3 — Designed By: T. Hew
Description: Wet Biofiltration Swale along the west side of SR 9 north of SR 204. — Checked By:

WET BIOSWALE SPREADSHEET VERSION 2.1

Design Steps

D-1 **Determine runoff treatment design flow rate Q_{wq}**

2-yr Detention Pond discharge rate + Off-line WQ discharge rate for non-detained areas.

Q_{wq}	0.088	Runoff treatment design flow rate from MGS Flood OR SBUH; MGSFlood reports an online and offline flow rate, please enter the applicable design flow rate

D-2 **Determine the wet biofiltration design flow rate (Q_{biofil})**

Is the wet bioswale in eastern WA? No

	2.00	2-year 24 hr precip depth (in)
P72%, 2-yr	1.44	72% of the 2-year 24 hr precip depth (in)

Wet biofiltration swales are offline -------> offline

Q_{biofil}	0.311	runoff treatment design flow rate

D-3 **Determine the longitudinal slope of the proposed wet biofiltration swale (ft/ft)**

s = 0.004 ft/ft

D-4 **Select a soil and vegetation cover suitable for the wet biofiltration swale**

soil/veg: Grass-legume mix on lightly compacted topsoil <--Use pull down box

Manning's n= 0.22 From HRM Table 5-3

D-5 **Select the design depth of flow y (see HRM Table 5-4)**

y = 0.33 (ft) design depth of flow; wet biofiltration swales depth of flow = 4" (0.33 ft) for WQ event

D-6 **Select a trapezoidal swale cross-sectional shape.**

D-7 **Use Manning's Eq and first approximations relating hydraulic radius and dimensions to get width for trapezoidal cross section**

$$Q_{biofil} = \frac{1.49 A R^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$$

HRM Chapter 5 Equation E-11

$$AR^{.67} = \frac{Q_{biofil}\, n}{1.49\, s^{0.5}}$$

<--manning's changed

Use Excel Solver

D-7a

Q_{biofil}	0.311	cfs - runoff treatment design flow rate
A	1.821	ft2 - wetted area
R	0.275	ft - hydraulic radius
s	0.004	ft/ft longitudinal slope of swale
n	0.22	Manning's coefficient
b	4.53	ft; wet bioswale bottom width
$z_{foreslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
$z_{backslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
y	0.330	ft - design depth flow = maximum depth of flow
Q_{biofil}	0.311	cfs - use goal seek under "What-If Analysis" in the "DATA" menu to set this cell equal to Q_{biofil} above changing the "b" value

D-7b **If the swale calculations above give a swale width less than 2 feet wide, re-run calculations with 2 foot wide swale, solve for depth y Or if redesigning swale with different dimensions, use below calculator and use Excel Goal Seek to determine new depth of flow.**

Q_{biofil}	0.311	cfs - runoff treatment design flow rate
A	0.000	ft2 - wetted area
R	0.000	ft - hydraulic radius
s	0.004	ft/ft longitudinal slope of swale
n	0.22	Manning's coefficient
b	2.00	ft - enter new wet bioswale bottom width if applicable (2 foot is minimum)
$z_{foreslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
$z_{backslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
y		ft - design depth flow
Q_{biofil}	0.000	cfs - use goal seek under "What-If Analysis" in the "DATA" menu to set this cell equal to Q_{biofil} above changing the "y" value

D-8 **Enter Final Bioswale Dimensions from the calculations in Step D-7a or D-7b**

Enter Final Swale Area	1.821	ft2 - Wetted Area
Enter Final Swale R	0.275	ft - hydraulic radius
Enter Final Swale slope s	0.004	ft/ft longitudinal slope of swale
Enter Final Swale n	0.22	Manning's coefficient
Enter Final Swale bottom width b	4.53	ft - swale bottom width
Enter Final Swale $z_{foreslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
Enter Final Swale $z_{backslope}$	3.00	horizontal number of bioswale slope i.e. 1V:3H, z=3 in this instance
Enter Final Swale flow depth y	0.330	ft - design depth flow

D-9 **Computer the flow velocity at Q_{biofil}**

$$V_{biofil} = \frac{Q_{biofil}}{A}$$

HRM Chapter 5 Equation E-12

V_{biofil}	0.17	ft/sec - flow velocity; 1 ft/sec maximum

Flow veloicty is OK since it is less than 1 ft/sec

D-10 **Compute Swale Length L (ft)**

$$L = V_{biofil} \times t$$

t	540	seconds - 9 minutes (540 seconds) for CABS, Basic, and Wet bioswale
L	92.25	ft - required length of bioswale; If swale is less than 100 feet, make swale have narrower bottom width (2 foot minimum) and repeat Steps D-7 - D-10 and recalculate to get length over 100 feet or keep swale bottom width make swale length 100 feet minimum

D-11 **Extended Wet Season Adjustment for Western Washington designs only**

Is the wet bioswale downstream of a detention pond?	Yes	
Enter the wet bioswale length (ft) ---------->	100.00	ft
wet bioswale bottom treatment area x 2 =	905.80	ft2

Adjust the wet bioswale length and/or bottom width to provide an equivalent bottom treatment area; maintaining a 5:1 length to width ratio and depth of flow of 4 inches

D-12 Revise Wet Bioswale Dimensions to meet minimums and for construction
Is the wet bioswale length at least 100 feet? If not, increase swale length to 100 feet.
Is the wet bioswale bottom width a constructible width?
Do no recalculate the wet bioswale depth of flow or velocity if the wet bioswale has the extended wet season adjustment.

Enter Final Adjusted Wet Bioswale Dimensions

Enter Final Swale bottom width b	4.53	ft - swale bottom width
Enter Final Swale length	200.00	ft - swale bottom length

Final Wet Bioswale Dimensions		
Wet Bioswale Length	200.00	ft
Wet Bioswale Bottom Width	4.5	ft
Swale Longitudinal Slope	0.004	ft/ft
$Z_{foreslope}$	3.0	
$Z_{backslope}$	3.0	
WQ Depth	0.33	ft
Swale Depth = WQ Depth for offline swales	0.33	ft

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 05/01/2021 9:06 PM
Report Generation Date: 05/01/2021 9:07 PM

Input File Name: RT 3-5 Wet Biofiltration Swale Opt WQ Discharge Rate.fld
Project Name: SR9-SR204 Interchange Improvements - Stage 3
Analysis Title: RT 3-5 Wet Biofiltration Swale Water Quality Flowrate
Comments: This model includes additional roadway areas along SB SR 9 approaching SR 204 draining to the Wet Biofiltration Swale.

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.190	0.190
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.190	0.190

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.190
Subbasin Total	0.190

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Roadway Area ----------
-------Area (Acres) --------
Impervious 0.190

Subbasin Total 0.190

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy
Downstream Link: None

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Water Quality Facility Data **********

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: New Copy Lnk1 **********

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 0.03 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.02 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 85.19
Inflow Volume Including PPT-Evap (ac-ft): 85.19
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 85.19
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk1

*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	7.081E-02	2-Year	7.081E-02
5-Year	9.197E-02	5-Year	9.197E-02
10-Year	0.103	10-Year	0.103
25-Year	0.130	25-Year	0.130
50-Year	0.166	50-Year	0.166
100-Year	0.192	100-Year	0.192
200-Year	0.199	200-Year	0.199
500-Year	0.208	500-Year	0.208

100-YR DISCHARGE CONSIDERED IN FLOW SPLITTER DESIGN

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

OSBORN CONSULTING INCORPORATED

WSDOT - SR9 - SR204 Interchange Improvements - Stage 3
Flow Splitter for WQ Flow Rate to Wet Biofiltration Swale
See DRD08 for flow splitter detail.

Prepared By: T. Hew
Reviewed By: D.Mungasavalli

Structure Elevations (ft)	
Rim	347.10
Invert	342.26

WQ Flow to Wet Biofiltration Swale (DR02-53)
Orifice Diameter (inches) 1.51

Orifice Equation
$Q = Cd * A * (2gh)^{1/2}$
Cd = coefficient of discharge
A = area of orifice (SF)
g = acceleration from gravity (32.2 ft/s/s)
h = head acting on the orifice centerline (ft)

Overflow to Bypass Line (DR02-83)
Top of Baffle Wall Elev.(ft) 344.26
Baffle Wall Length (Weir) (ft) 0.34
Baffle Wall Height (ft) 2

Weir Equation (per DOE Fig 3.2.16)
$Q = 3.099 * L * h^{3/2}$
L = length of weir crest in feet
h = head on weir crest in feet

Wall Height/Orifice Diam. Ratio 15.8 >= 2.0

Target Minimum WQ Flow Rate = 0.088 cfs *WQ Flow Rate Calculated by MGSFlood*
2-yr discharge from detention pond + off-line WQ Q from CBs

Key Elevations to be Input into Plans:

Orifice to Wet Biofiltration Swale (Oulet IE)	=	342.26 ft
Top of Baffle Wall to Bypass	=	344.26 ft

100-yr Design Discharge Analysis:

100-yr discharge from detention pond	=	0.364	cfs
100-yr discharge from non-detained PGIS area	=	0.192	cfs
Total 100-yr discharge to flow splitter	=	0.556	cfs
10% Allowable Design WQ Flowrate Exceedance [1]	=	0.097	cfs

@ DR02-51 from DR02-57

[1] *10% design WQ flowrate exceedance criteria per MGSFlood Manual for WQ flowrate*

Flow Splitter Design Rating Table

Depth	Total	WQ	Overflow	
342.26	0.000	0.000	0.000	*Invert/Orifice Elevation*
342.36	0.020	0.020	0.000	
342.46	0.028	0.028	0.000	
342.56	0.034	0.034	0.000	
342.66	0.039	0.039	0.000	
342.76	0.044	0.044	0.000	
342.86	0.048	0.048	0.000	
342.96	0.052	0.052	0.000	
343.06	0.056	0.056	0.000	
343.16	0.059	0.059	0.000	
343.26	0.062	0.062	0.000	
343.36	0.065	0.065	0.000	
343.46	0.068	0.068	0.000	
343.56	0.071	0.071	0.000	
343.66	0.074	0.074	0.000	
343.76	0.076	0.076	0.000	
343.86	0.079	0.079	0.000	
343.96	0.081	0.081	0.000	
344.06	0.083	0.083	0.000	
344.16	0.086	0.086	0.000	
344.26	0.088	0.088	0.000	*Top of Baffle Wall; 15-min Off-line Design WQ Flowrate*
344.36	0.195	0.090	0.105	
344.46	0.388	0.092	0.296	
344.53	0.556	0.094	0.462	*100-yr Design Discharge (Pond + Undetained Areas)*
344.56	0.638	0.094	0.544	
344.66	0.934	0.096	0.837	
344.67	0.966	0.097	0.869	*10% Allowable Design WQ Flowrate Exceedance [1]*
344.76	1.269	0.098	1.170	
344.86	1.639	0.100	1.538	
344.96	2.041	0.102	1.939	
345.06	2.473	0.104	2.369	
345.16	2.932	0.106	2.826	
345.26	3.418	0.108	3.310	
345.36	3.928	0.110	3.819	
345.46	4.463	0.111	4.351	
345.56	5.019	0.113	4.906	
345.66	5.598	0.115	5.483	

APPENDIX C-3

INLET SPACING SPREADSHEETS

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: beginning of barrier on
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
Begin barrier	255+96.00																														
DR01-6	256+31.00	131.00		5,956	0.31	0.31	0.013	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	4.43	1.06	0.016	1.73	0.72	4.60	1.00	0.20	0.77	0.24	0.07	Zd Allowable > Zd Design		
DR01-7	257+80.00	149.00		6,902	0.36	0.43	0.016	0.017	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	5.34	1.09	0.016	1.10	0.63	4.60	1.00	0.32	0.75	0.32	0.11	Zd Allowable > Zd Design		
DR01-15	258+25.00	45.00		1,918	0.10	0.21	0.006	0.009	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	7.41	0.76	0.016	1.34	0.49	4.60	1.00	0.14	0.57	0.12	0.09	Zd Allowable > Zd Design		
DR01-8	259+32.00	107.00		4,950	0.26	0.34	0.015	0.017	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	4.99	1.02	0.016	1.73	0.66	4.60	1.00	0.17	0.72	0.25	0.10	Zd Allowable > Zd Design		
DR02-22	260+81.00	149.00		6,972	0.36	0.46	0.017	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	5.05	1.15	0.016	1.58	0.66	4.60	1.00	0.22	0.73	0.33	0.12	Zd Allowable > Zd Design		
DR02-24	261+76.00	95.00		4,155	0.21	0.34	0.012	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	4.81	1.10	0.016	1.25	0.68	4.60	1.00	0.29	0.77	0.26	0.08	Zd Allowable > Zd Design		End of barrier. Qbp<0.1 cfs
DR02-9	262+69.00	93.00		4,030	0.21	0.28	0.008	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	4.71	1.13	0.016	1.01	0.69	4.60	1.00	0.39	0.81	0.23	0.05	Zd Allowable > Zd Design		Transition to beginning of curb on SR9
DR02-34	263+34.00	65.00		3,104	0.16	0.21	0.005	0.014	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	6.50	8.50	5.79	0.97	0.016	0.71	0.60	4.60	1.00	0.46	0.78	0.17	0.05	Zd Allowable > Zd Design		
DR02-35	263+63.00	29.00		1,345	0.07	0.12	0.003	0.015	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00	4.00	6.00	4.84	0.87	0.016	0.66	0.68	4.60	1.00	0.51	0.84	0.10	0.02	Zd Allowable > Zd Design		
DR02-63	264+00.00	37.00		1,968	0.10	0.12	0.003	0.018	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00	4.00	6.00	4.38	0.95	0.016	0.69	0.72	4.60	1.00	0.53	0.87	0.10	0.02	Zd Allowable > Zd Design		
DR02-65	264+61.00	61.00		2,544	0.13	0.15	0.003	0.032	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized intersection? Input YES or NO ->	YES	Shoulder + 1/2 Driving Lane	12.00	3.00	9.00	3.30	1.27	0.016	0.00	0.85	4.60	1.00	1.00	1.00	0.15	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	From Figure 5-1 in the Hydraulics Manual 2019, right turn lane is a restrcited lane. The lane is assumed to be signalized since vehicles will need to stop for pedestrians who will be crossing across all of SR9. Low point. See 50-yr sag calcs and sag spreadsheet.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
9. Right turn lane to 7th place.
High point east of median on SR
9 to LP south of cross walk (east
S.R.: of median)
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP on SR 9 - east of Median	265+74.00																															
DR02-32	265+52.00	22.00		650	0.03	0.03	0.006	0.014	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized intersectio	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	2.79	0.47	0.016	0.43	0.91	4.60	1.00	0.67	0.97	0.03	0.00	Zd Allowable > Zd Design		From Figure 5-1 in the Hydraulics Manual 2019, right turn lane is a restricted lane. The lane is assumed to be signalized since vehicles will need to stop for pedestrians who will be crossing across all of SR9.
DR02-65	264+61.00	91.00		3,318	0.17	0.17	0.003	0.030	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized	YES	Shoulder + 1/2 Driving Lane	12.00	3.00	9.00	3.64	1.31	0.016	0.00	0.81	4.60	1.00	1.00	1.00	0.17	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Low point. See 50-yr sag calcs and sag spreadsheet.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00	
C =	0.90	
I =	2.50	10-yr
m=	6.31	
n=	0.58	

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
SR 9 - Right turn Lane to 7th place.
7th Pl South to LP on SR9 East
S.R.: (north of crosswalk, east of median)
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curbd (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
Begin curb on 7th place South	72+54.00																															
DR02-29	72+45.00	9.00		2,160	0.11	0.11	0.040	0.025	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	2.13	0.64	0.016	1.48	0.98	4.60	1.00	0.29	0.99	0.11	0.00	Zd Allowable > Zd Design		From Figure 5-1 in the Hydraulics Manual 2019, right turn lane is a restrcited lane. The lane is assumed to be signalized since vehicles will need to stop for pedestrians who will be crossing across all of SR9.
DR02-30	266+65.00	71.00		2,119	0.11	0.11	0.023	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	2.72	0.65	0.016	1.92	0.92	4.60	1.00	0.17	0.93	0.10	0.01	Zd Allowable > Zd Design		Assume lowest width of driving lane curb to curb for conservative inlet spacing estimate.
DR02-75	266+34.00	55.00		1,297	0.07	0.07	0.038	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	2.13	0.51	0.016	0.00	0.98	4.60	1.00	1.00	1.00	0.07	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Assume lowest width of driving lane curb to curb for conservative inlet spacing estimate. Low point. See 50-yr sag calcs and sag spreadsheet.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00	
C =	0.90	
I =	2.50	**10-yr**
m=	6.31	
n=	0.58	

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063

Hight point north of crosswalk to LP
S.R.: of SR East
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
High point	265+74.00																															
DR02-75	266+34.00	60.00		1,699	0.09	0.09	0.006	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	3.20	0.77	0.016	0.00	0.86	4.60	1.00	1.00	1.00	0.09	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	From Figure 5-1 in the Hydraulics Manual 2019, right turn lane is a restricted lane. The lane is assumed to be signalized since vehicles will need to stop for pedestrians who will be crossing across all of SR9. Low point. See 50-yr Sag spreadsheet

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
7th Place - North side
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
Begin curb	73+38.00																															
DR02-28	72+45.00	93.00	27.00	1,648	0.09	0.09	0.040	0.030	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00		6.00	1.72	0.62	0.016	0.00	1.00	4.60	1.00	1.00	1.00	0.09	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
Begin median curb near 7th Pl	71+94.00																															
DR02-41	70+90.00	104.00		5,484	0.28	0.28	0.021	0.022	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Roundabouts	Applicable to all speeds, Leave Blank ---------->		Maintain at least 10 feet of continuous driving lane that is free of water	15.00	1.00	6.00	3.70	0.98	0.016	1.87	0.82	4.75	1.00	0.46	0.90	0.26	0.03	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Low point. See 50-yr sag spreadsheet

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP west of median curb, north of sidewalk	70+29.00/266+03.00																															
DR02-40	70+61.00	33.00		2,341	0.12	0.12	0.001	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank -->		Maintain at least 10 feet of continuous driving lane that is free of water	15.00	1.00	6.00	5.22	1.19	0.016	0.47	0.64	4.60	1.00	0.71	0.90	0.11	0.01	Zd Allowable > Zd Design		
DR02-41	70+90.00	29.00		5,387	0.28	0.29	0.002	0.022	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Roundabouts	Applicable to all speeds, Leave Blank -->		Maintain at least 10 feet of continuous driving lane that is free of water	15.00	1.00	6.00	5.81	1.53	0.016	0.78	0.62	4.75	1.00	0.81	0.93	0.27	0.02	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Low point. See 50-yr sag spreadsheet

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP west of median curb, north of sidewalk	266+05.00																															
DR02-38	265+79.00	25.00		677	0.03	0.03	0.002	0.015	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank ---------->		Maintain at least 10 feet of continuous driving lane that is free of water	14.00	1.00	5.00	3.34	0.60	0.016	0.42	0.84	4.60	1.00	0.70	0.95	0.03	0.00	Zd Allowable > Zd Design		
DR02-74	265+56.00	23.00		1,453	0.08	0.08	0.002	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank ---------->		Maintain at least 10 feet of continuous driving lane that is free of water	14.00	1.00	5.00	3.74	0.90	0.016	0.55	0.79	4.60	1.00	0.66	0.93	0.07	0.01	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Low point. See 50-yr sag spreadsheet. End of curb and gutter. Inlet before crosswalk. Qbp<0.1 cfs

*Slope L was taken at the proposed curb face from the roadway dtm.

Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP west of median curb,south of sidewalk	265+23.00																															
DR02-37	265+34.00	11.00		300	0.02	0.02	0.000	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank -->		Maintain at least 10 feet of continuous driving lane that is free of water	14.00	1.00	5.00	2.93	0.70	0.016	0.18	0.89	4.60	1.00	0.94	0.99	0.02	0.00	Zd Allowable > Zd Design		
DR02-74	265+56.00	22.00		670	0.03	0.03	0.000	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank -->		Maintain at least 10 feet of continuous driving lane that is free of water	14.00	1.00	5.00	3.97	0.95	0.016	0.22	0.77	4.60	1.00	0.91	0.98	0.03	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Low point. End of curb and gutter. See 50-yr sag spreadsheet.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP west of median curb,south of sidewalk	265+23.00																															
DR02-36	264+46.00	77.00		2,128	0.11	0.11	0.003	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank -------------------->		Maintain at least 10 feet of continuous driving lane that is free of water	14.00	1.00	5.00	3.90	0.94	0.016	0.72	0.78	4.60	1.00	0.54	0.90	0.10	0.01	Zd Allowable > Zd Design	Qbp < 0.1 CFS	End of curb and gutter

*Slope L was taken at the proposed curb face from the roadway dtm.

Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 SB
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2
half the median to the curb

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP at RBT	265+76.00	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	Same high point on SR 204 WB 124+20.26
DR02-33	265+62.00	14.00		987	0.05	0.05	0.004	0.013	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank ---------->	35	Maintain at least 10 feet of continuous	14.00		4.00	3.69	0.58	0.016	0.57	0.80	4.60	1.00	0.54	0.91	0.05	0.00	Zd Allowable > Zd Design		
DR02-5	265+35.00	27.00		2,256	0.12	0.12	0.007	0.017	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	14.00	3.26	5.26	3.89	0.79	0.016	0.94	0.78	4.60	1.00	0.38	0.86	0.10	0.02	Zd Allowable > Zd Design	Qbp < 0.1 CFS	
DR02-84	263+51.00	184.00		11,598	0.60	0.60	0.003	0.026	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	13.00	6.00	8.00	6.38	1.99	0.016	1.14	0.58	4.75	1.00	0.71	0.88	0.53	0.07	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Assume half the 12' bus lane as shoulder width = 6 ft Qbp<0.10cfs at end of curb.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: SR204 EB to LP
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curbd (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
124+26/265+76	124+26.00	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
DR02-11	123+77.00	65.00		7,120	0.37	0.37	0.013	0.020	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Roundabouts	Applicable to all speeds, Leave Blank ---------->	35	Maintain at least 10 feet of continuous driving lane that is free of water	16.00		6.00	4.74	1.14	0.016	2.02	0.97	7.10	1.00	0.12	0.98	0.36	0.01	Zd Allowable > Zd Design		Assumed as part of roundabout until the splitter island on SR204 ends.
DR02-12	123+34.00	43.00		4,104	0.21	0.22	0.020	0.022	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Roundabouts	Applicable to all speeds, Leave Blank ---------->	35	Maintain at least 10 feet of continuous driving lane that is free of water	18.00		8.00	3.40	0.90	0.016	0.95	1.00	7.10	1.00	0.37	1.00	0.22	0.00	Zd Allowable > Zd Design		Assumed as part of roundabout until the splitter island on SR204 ends.
DR02-13	123+20.00	14.00		1,286	0.07	0.07	0.014	0.028	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	13.00		2.00	1.99	0.67	0.016	0.90	1.00	7.10	1.00	0.45	1.00	0.07	0.00	Zd Allowable > Zd Design		
DR02-67	123+08.00	12.00		1,216	0.06	0.06	0.015	0.030	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.84	0.66	0.016	0.96	1.00	7.10	1.00	0.44	1.00	0.06	0.00	Zd Allowable > Zd Design		
DR02-73	122+97.00	11.00		946	0.05	0.05	0.006	0.030	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.99	0.72	0.016	0.94	1.00	7.10	1.00	0.45	1.00	0.05	0.00	Zd Allowable > Zd Design		
DR02-81	122+88.00	9.00		664	0.03	0.03	0.003	0.031	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.95	0.72	0.016	0.67	1.00	7.10	1.00	0.61	1.00	0.03	0.00	Zd Allowable > Zd Design		
DR02-85	122+51.00	37.00		1,718	0.09	0.09	0.006	0.043	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.99	1.03	0.016	1.27	1.00	7.10	1.00	0.40	1.00	0.09	0.00	Zd Allowable > Zd Design		
DR05-1	122+20.00	31.00		1,456	0.08	0.08	0.008	0.042	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.80	0.91	0.016	0.78	1.00	7.10	1.00	0.61	1.00	0.08	0.00	Zd Allowable > Zd Design		
DR05-2	121+84.00	36.00		1,915	0.10	0.10	0.009	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.00	0.96	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.10	0.00	Zd Allowable > Zd Design		
DR05-3	121+54.00	30.00		1,767	0.09	0.09	0.008	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.99	0.96	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.09	0.00	Zd Allowable > Zd Design		
DR05-4	121+32.00	22.00		1,241	0.06	0.06	0.004	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.99	0.95	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.06	0.00	Zd Allowable > Zd Design		
DR05-5	121+00.00	32.00		1,842	0.10	0.10	0.009	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.98	0.95	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.10	0.00	Zd Allowable > Zd Design		
DR05-6	120+76.00	24.00		1,362	0.07	0.07	0.004	0.043	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	1.97	1.02	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.07	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Low point at 120+76. See 50-yr Sag spreadsheet

*Slope L was taken at the proposed curb face from the roadway dtm.

Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: SR204 EB to LP
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
Begin curb	120+45.00																															
DR05-6	120+76.00	31.00		1,581	0.08	0.08	0.005	0.043	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->		Shoulder + 2 feet	12.00		2.00	2.00	1.03	0.016	0.95	1.00	7.10	1.00	0.53	1.00	0.08	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Low point at 120+76. See 50-yr sag spreadsheet
*Slope L was taken at the proposed curb face from the roadway dtm.																																
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.																																

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 204 WB - south of RBT median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
TDA boundary	124+68.00																															
HP	124+68.00	0.00		-	0.00	0.00	0.000	0.000	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank ---------->	35	Maintain at least 10 feet of continuous driving lane that is free of water	20.00	1.00	11.00	0.00	0.00	0.016	0.00	1.00	4.60	1.00	1.00	1.00	0.00	0.00	Zd Allowable > Zd Design		
DR02-10	123+98.00	70.00		3,639	0.19	0.19	0.002	0.008	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank ---------->	35	Maintain at least 10 feet of continuous driving lane that is free of water	19.00	1.00	10.00	9.29	0.89	0.016	0.00	0.41	4.60	1.00	1.00	1.00	0.19	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	End of RBT median curb on the northwest side of RBT

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 204 WB - north of RBT median curb, in the right turn lane, along barrier
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	ΔQ cfs (cfs)	ΣQ (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_t (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
TDA boundary	124+48.00																															
DR02-69	123+94.00	54.00		3,372	0.17	0.17	0.001	0.013	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	15.00	6.00	8.00	7.33	1.14	0.016	0.00	0.50	4.60	1.00	1.00	1.00	0.17	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	End of barrier/wall

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

iHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50 **10-yr**
m=	6.31
n=	0.58

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
92nd Ave
NE EAST
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{op} (cfs)	Z_d Check	Q_{op} Check	Comments (L/R)
Existing CB on 4th	10+00.00																															
DR01-11	11+03.00	96.00		2,410	0.12	0.12	0.010	0.015	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed	35	Shoulder + 1/2 Driving Lane	11.00		5.50	3.97	0.71	0.016	1.10	0.77	4.60	1.00	0.29	0.84	0.10	0.02	Zd Allowable > Zd Design		
DR01-9	12+45.00	142.00		5,321	0.27	0.30	0.011	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed	35	Shoulder + 1/2 Driving Lane	11.00		5.50	4.65	1.06	0.016	1.43	0.70	4.60	1.00	0.25	0.77	0.23	0.07	Zd Allowable > Zd Design		
DR01-10	13+93.00	148.00		5,685	0.29	0.36	0.011	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed	35	Shoulder + 1/2 Driving Lane	11.00		5.50	5.02	1.14	0.016	1.51	0.66	4.60	1.00	0.23	0.74	0.27	0.09	Zd Allowable > Zd Design		
DR02-20	15+42.00	149.00		5,840	0.30	0.40	0.011	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed	35	Shoulder + 1/2 Driving Lane	11.00		5.50	5.19	1.18	0.016	1.61	0.65	4.60	1.00	0.21	0.72	0.29	0.11	Zd Allowable > Zd Design		
DR02-21	16+45.00	103.00		3,754	0.19	0.31	0.012	0.018	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed	35	Shoulder + 1/2 Driving Lane	11.00		5.50	4.79	1.04	0.016	1.20	0.68	4.60	1.00	0.30	0.78	0.24	0.07	Zd Allowable > Zd Design		
	17+00.00	55.00		1,605	0.08	0.15	0.008	0.012		#N/A	#N/A	Collector and Local Streets	Enter Speed	36	Shoulder + 1/2 Driving Lane	11.00		5.50	5.12	0.74	0.016	0.00	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Zd Allowable > Zd Design	#N/A	No structure needed at the end of barrier on the north barrier of 92nd

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49 **50-yr**
m=	8.96
n=	0.59

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: beginning of barrier on
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
Begin barrier	255+96.00																															
DR01-6	256+31.00	131.00		5,956	0.45	0.45	0.013	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	5.13	1.23	0.016	1.91	0.65	4.60	1.00	0.17	0.71	0.32	0.13	Zd Allowable > Zd Design		
DR01-7	257+80.00	149.00		6,902	0.53	0.66	0.016	0.017	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	6.28	1.28	0.016	1.23	0.56	4.60	1.00	0.28	0.68	0.45	0.21	Zd Allowable > Zd Design		
DR01-15	258+25.00	45.00		1,918	0.15	0.35	0.006	0.009	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	9.08	0.94	0.016	1.54	0.42	4.60	1.00	0.12	0.49	0.17	0.18	Zd Allowable > Zd Design		
DR01-8	259+32.00	107.00		4,950	0.38	0.56	0.015	0.017	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	5.98	1.22	0.016	1.95	0.58	4.60	1.00	0.14	0.64	0.36	0.20	Zd Allowable > Zd Design		
DR02-22	260+81.00	149.00		6,972	0.53	0.73	0.017	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	6.02	1.37	0.016	1.78	0.58	4.60	1.00	0.18	0.66	0.48	0.25	Zd Allowable > Zd Design		
DR02-24	261+76.00	95.00		4,155	0.32	0.57	0.012	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	5.85	1.33	0.016	1.42	0.59	4.60	1.00	0.25	0.69	0.39	0.17	Zd Allowable > Zd Design		End of barrier. Qbp<0.1 cfs
DR02-9	262+69.00	93.00		4,030	0.31	0.48	0.008	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	8.00	10.00	5.74	1.38	0.016	1.15	0.60	4.60	1.00	0.34	0.74	0.35	0.13	Zd Allowable > Zd Design		Transition to beginning of curb on SR9
DR02-34	263+34.00	65.00		3,104	0.24	0.36	0.005	0.014	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	6.50	8.50	7.06	1.19	0.016	0.81	0.51	4.60	1.00	0.40	0.71	0.26	0.11	Zd Allowable > Zd Design		
DR02-35	263+63.00	29.00		1,345	0.10	0.21	0.003	0.015	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00	4.00	6.00	6.03	1.09	0.016	0.76	0.58	4.60	1.00	0.45	0.77	0.16	0.05	Need to Decrease Zd		
DR02-63	264+00.00	37.00		1,968	0.15	0.20	0.003	0.018	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00	4.00	6.00	5.29	1.14	0.016	0.79	0.64	4.60	1.00	0.48	0.81	0.16	0.04	Zd Allowable > Zd Design		Low point at 264+61. See sag spreadsheet.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.
Highlighted values for Qbp and Qi are used in the sag spreadsheet, where these numbers are hard coded in. This is due to irregular areas due to the RBT where the LxW calculation is not accurate for areas to the sag

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00	
C =	0.95	
I =	3.49	**50-yr**
m=	8.96	
n=	0.59	

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
9. Right turn lane to 7th place.
High point east of median on SR
9 to LP south of cross walk (east
S.R.: of median)
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP on SR 9 - east of Median	265+74.00																														
DR02-32	265+52.00	22.00		650	0.05	0.05	0.006	0.014	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized intersectio	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	3.23	0.54	0.016	0.48	0.86	4.60	1.00	0.64	0.95	0.05	0.00	Zd Allowable > Zd Design		From Figure 5-1 in the Hydraulics Manual 2019, right turn lane is a restricted lane. The lane is assumed to be signalized since vehicles will need to stop for pedestrians who will be crossing across all of SR9.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00	
C =	0.95	
I =	3.49	**50-yr**
m=	8.96	
n=	0.59	

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
SR 9 - Right turn Lane to 7th place.
7th Pl South to LP on SR9 East
S.R.: (north of crosswalk, east of median)
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curbd (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
Begin curb on 7th place South	72+54.00																															
DR02-29	72+45.00	9.00		2,160	0.16	0.16	0.040	0.025	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or signalized	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	2.47	0.74	0.016	1.63	0.95	4.60	1.00	0.25	0.96	0.16	0.01	Zd Allowable > Zd Design		From Figure 5-1 in the Hydraulics Manual 2019, right turn lane is a restrcited lane. The lane is assumed to be signalized since vehicles will need to stop for pedestrians who will be crossing across all of SR9.
DR02-30	266+65.00	71.00		2,119	0.16	0.17	0.023	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Restricted Turning Lanes	With Stop sign or	YES	Shoulder + 1/2 Driving Lane	12.00	1.00	7.00	3.17	0.76	0.016	2.13	0.86	4.60	1.00	0.14	0.88	0.15	0.02	Zd Allowable > Zd Design		Assume lowest width of driving lane curb to curb for conservative inlet spacing estimate. Low point at 266+34. See sag spreadsheet.

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.
Highlighted values for Qbp are used in the sag spreadsheet

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49 **50-yr**
m=	8.96
n=	0.59

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP west of median curb, north of sidewalk	70+29.00/266+03.00																															
DR02-40	70+61.00	33.00		2,341	0.18	0.18	0.001	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank -->		Maintain at least 10 feet of continuous driving lane that is free of water	15.00	1.00	6.00	6.04	1.38	0.016	0.51	0.58	4.60	1.00	0.67	0.86	0.15	0.02	Need to Decrease Zd		Low point at 70+91. See sag spreadsheet
*Slope L was taken at the proposed curb face from the roadway dtm.																																
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.																																
Highlighted values for Qbp are used in the sag spreadsheet																																

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49 **50-yr**
m=	8.96
n=	0.59

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP west of median curb, north of sidewalk	266+05.00																															
DR02-38	265+79.00	25.00		677	0.05	0.05	0.002	0.015	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank -->		Maintain at least 10 feet of continuous driving lane that is free of water	14.00	1.00	5.00	3.86	0.69	0.016	0.46	0.78	4.60	1.00	0.67	0.93	0.05	0.00	Zd Allowable > Zd Design		Low point at 265+56. See sag spreadsheet
*Slope L was taken at the proposed curb face from the roadway dtm.																																
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.																																
Highlighted values for Qbp are used in the sag spreadsheet																																

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49 **50-yr**
m=	8.96
n=	0.59

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: 9 NB west of roundabout median curb
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
HP west of median curb,south of sidewalk	265+23.00																															
DR02-37	265+34.00	11.00		300	0.02	0.02	0.000	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank -->		Maintain at least 10 feet of continuous driving lane that is free of water	14.00	1.00	5.00	3.39	0.81	0.016	0.20	0.84	4.60	1.00	0.92	0.99	0.02	0.00	Zd Allowable > Zd Design		Low point at 265+56. See sag spreadsheet

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.
Highlighted values for Qbp are used in the sag spreadsheet

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49 **50-yr**
m=	8.96
n=	0.59

Project Name: SR9/204 Intersection Improvements
Project #: 10-150063
S.R.: SR204 EB to LP
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
124+26/265+76	124+26.00	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
DR02-11	123+77.00	65.00		7,120	0.54	0.54	0.013	0.020	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Roundabouts	Applicable to all speeds, Leave Blank ---------->	35	Maintain at least 10 feet of continuous driving lane that is free of water	16.00		6.00	5.48	1.32	0.016	2.23	0.94	7.10	1.00	0.10	0.94	0.51	0.03	Zd Allowable > Zd Design		Assumed as part of roundabout until the splitter island on SR204 ends.
DR02-12	123+34.00	43.00		4,104	0.31	0.34	0.020	0.022	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Roundabouts	Applicable to all speeds, Leave Blank ---------->	35	Maintain at least 10 feet of continuous driving lane that is free of water	18.00		8.00	4.02	1.06	0.016	1.06	1.00	7.10	1.00	0.32	1.00	0.34	0.00	Zd Allowable > Zd Design		Assumed as part of roundabout until the splitter island on SR204 ends.
DR02-13	123+20.00	14.00		1,286	0.10	0.10	0.014	0.028	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	13.00		2.00	2.31	0.78	0.016	0.99	1.00	7.10	1.00	0.41	1.00	0.10	0.00	Need to Decrease Zd		
DR02-67	123+08.00	12.00		1,216	0.09	0.09	0.015	0.030	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.13	0.77	0.016	1.04	1.00	7.10	1.00	0.40	1.00	0.09	0.00	Need to Decrease Zd		
DR02-73	122+97.00	11.00		946	0.07	0.07	0.006	0.030	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.31	0.83	0.016	1.04	1.00	7.10	1.00	0.40	1.00	0.07	0.00	Need to Decrease Zd		
DR02-81	122+88.00	9.00		664	0.05	0.05	0.003	0.031	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.25	0.84	0.016	0.74	1.00	7.10	1.00	0.56	1.00	0.05	0.00	Need to Decrease Zd		
DR02-85	122+51.00	37.00		1,718	0.13	0.13	0.006	0.043	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.30	1.19	0.016	1.40	1.00	7.10	1.00	0.36	1.00	0.13	0.00	Need to Decrease Zd		
DR05-1	122+20.00	31.00		1,456	0.11	0.11	0.008	0.042	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.08	1.05	0.016	0.86	1.00	7.10	1.00	0.57	1.00	0.11	0.00	Need to Decrease Zd		
DR05-2	121+84.00	36.00		1,915	0.15	0.15	0.009	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.33	1.12	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.15	0.00	Need to Decrease Zd		
DR05-3	121+54.00	30.00		1,767	0.13	0.13	0.008	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.31	1.11	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.13	0.00	Need to Decrease Zd		
DR05-4	121+32.00	22.00		1,241	0.09	0.09	0.004	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.30	1.10	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.09	0.00	Need to Decrease Zd		
DR05-5	121+00.00	32.00		1,842	0.14	0.14	0.009	0.040	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet (Rotated)	3.52	1.75	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	35	Shoulder + 2 feet	12.00		2.00	2.29	1.10	0.016	0.00	1.00	7.10	1.00	1.00	1.00	0.14	0.00	Need to Decrease Zd		Low point at 120+76. See Sag spreadsheet

*Slope L was taken at the proposed curb face from the roadway dtm.
Note: Longitudinal and Transverse slopes are based on surface provided on 4/2/2021. No roadway profiles or crossed sections were provided.
Highlighted values for Qbp are used in the sag spreadsheet

NB SR9 RT

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L[1,2] (ft/ft)	Super T[2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
	270+40.68																														**NB SR9 HIGH PT NORTH OF SR 204 DRAINING SOUTH**	
DR02-46	269+50.00	90.68		6,635.00	0.34	0.34	0.002	0.011	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	12.00	14.00	9.44	1.21	0.016	0.72	0.41	4.60	1.00	0.39	0.64	0.22	0.12	Zd Allowable > Zd Design		Shoulder includes bus stop lane
DR02-54	268+85.20	64.80		3,430.00	0.18	0.30	0.002	0.010	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	12.00	14.00	9.07	1.14	0.016	0.70	0.42	4.60	1.00	0.39	0.65	0.20	0.11	Zd Allowable > Zd Design		Shoulder includes bus stop lane
END OF CURB	268+14.50	135.50		2,978.00	0.15	0.28	0.002	0.010	NO GRATE	0.00	0.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	12.00	14.00	9.32	1.06	0.016	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.28	Zd Allowable > Zd Design	Need to Reduce Qbp	Shoulder includes bus stop lane, FC 3-1 pond access road used for energy dissipation
	270+40.68																														**NB SR9 HIGH PT NORTH OF SR 204 DRAINING NORTH**	
DR03-13	271+58.00	117.32		7,474.00	0.39	0.39	0.008	0.017	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	4.00	6.00	5.84	1.20	0.016	1.31	0.61	4.75	1.00	0.56	0.83	0.32	0.07	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Bypass flow goes to sag point, DR03-10

[1] Slope L was taken at the proposed curb face from the roadway dtm.

[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.

PLEASE REPORT ANY PROBLEMS TO WSDOT HQ HYDRAULICS SECTION. SPREADSHEET IS PROTECTED BUT DOES NOT REQUIRE A PASSWORD TO UNPROTECT.
This spreadsheet follows the HEC22 proceedures for a uniform gutter section and does not cover other gutter situations (composit, depressed, etc.).
Version 6.2, Revised 9/13/2019

NB SR9 RT (50-YR)

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49
m=	8.96
n=	0.59

50-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L[1,2] (ft/ft)	Super T[2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
	270+40.68																														**NB SR9 HIGH PT NORTH OF SR 204 DRAINING NORTH**
DR03-13	271+58.00	117.32		7,474.00	0.57	0.57	0.008	0.017	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	4.00	6.00	6.76	1.39	0.016	1.45	0.55	4.75	1.00	0.51	0.78	0.45	0.12	Need to Decrease Zd	Need to Reduce Qbp	Bypass flow goes to sag point, DR03-10

[1] Slope L was taken at the proposed curb face from the roadway dtm.

[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.

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Version 6.2, Revised 9/13/2019

SB SR9 LT

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope $L^{1,2}$ (ft/ft)	Super T^{2} (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_x	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
	268+05.00																														**SB SR9 HIGH PT DRAINING SOUTH**
DR02-57	267+70.64	34.36		2,010.00	0.10	0.10	0.007	0.008	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	4.00	6.00	5.87	0.57	0.016	0.74	0.61	4.75	1.00	0.62	0.85	0.09	0.02	Zd Allowable > Zd Design		
DR02-56	267+31.32	39.32		2,124.00	0.11	0.12	0.003	0.013	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Roundabouts	Applicable to all speeds, Leave Blank ---------->	-	Maintain at least 10 feet of continuous driving lane that is free of water	15.00	2.00	7.00	5.30	0.83	0.016	0.68	0.64	4.60	1.00	0.46	0.80	0.10	0.02	Zd Allowable > Zd Design	Qbp < 0.1 CFS	

[1] Slope L was taken at the proposed curb face from the roadway dtm.

[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.

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Version 6.2, Revised 9/13/2019

E VERNON RT

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L[1,2] (ft/ft)	Super T[2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_t (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
----------	14+72.00	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	**VERNON ROAD HIGH PT. DRAINING SOUTH**
DR02-59	11+18.00	354.00		13,457.00	0.70	0.70	0.002	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	5.00	11.00	8.83	2.08	0.016	0.91	0.43	4.60	1.00	0.43	0.68	0.47	0.23	Zd Allowable > Zd Design		Conveyance West of Vernon Rd draining into pond
DR02-58	10+87.00	31.00		750.00	0.04	0.26	0.002	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	5.00	11.00	6.01	1.43	0.016	0.74	0.58	4.60	1.00	0.53	0.80	0.21	0.05	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Conveyance West of Vernon Rd draining into pond, Bypass goes to sag point, DR02-44
----------	19+11.47	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	**VERNON RD HIGH PT @ STA 19+12**
DR03-20	20+35.18	123.71		2,974.00	0.15	0.15	0.006	0.039	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	0.00	6.00	2.58	1.21	0.016	1.17	0.94	4.60	1.00	0.49	0.97	0.15	0.00	Zd Allowable > Zd Design		
DR03-22	20+35.18	0.00		8,565.00	0.44	0.45	0.002	0.032	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	3.00	9.00	5.34	2.05	0.016	0.98	0.63	4.60	1.00	0.52	0.82	0.37	0.08	Zd Allowable > Zd Design	Qbp < 0.1 CFS	

[1] Slope L was taken at the proposed curb face from the roadway dtm.

[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.

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Version 6.2, Revised 9/13/2019

E VERNON RT (50-YR)

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49
m=	8.96
n=	0.59

50-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope $L^{1,2}$ (ft/ft)	Super T^2 (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_t (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
	14+72.00																														**VERNON ROAD HIGH PT. DRAINING SOUTH**
DR02-59	11+18.00	354.00		13,457.00	1.03	1.03	0.002	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	5.00	11.00	10.21	2.40	0.016	1.00	0.38	4.60	1.00	0.39	0.62	0.64	0.39	Zd Allowable > Zd Design		Conveyance West of Vernon Rd draining into pond
DR02-58	10+87.00	31.00		750.00	0.06	0.45	0.002	0.020	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	5.00	11.00	7.31	1.74	0.016	0.84	0.50	4.60	1.00	0.47	0.74	0.33	0.12	Zd Allowable > Zd Design	Need to Reduce Qbp	Conveyance West of Vernon Rd draining into pond, Bypass goes to sag point, DR02-44
	*Slope L was taken at the proposed curb face from the roadway dtm.																														
	Note: Longitudinal and Transverse slopes are based on surface (v6.0) provided on 1/31/2020. No roadway profiles or crossed sections were provided.																														

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Version 6.2, Revised 9/13/2019

E VERNON LT

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L[1,2] (ft/ft)	Super T[2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
----------	11+55.87	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	**VERNON ROAD LT CROSS OVER**
DR02-45	10+70.48	85.39		1,372.00	0.07	0.07	0.002	0.011	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	2.00	8.00	5.14	0.67	0.016	0.50	0.65	4.60	1.00	0.56	0.84	0.06	0.01	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Conveyance East of Vernon Rd draining into pond
----------	15+31.00	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	**VERNON ROAD HIGH PT. DRAINING NORTH**
DR03-01	16+16.00	85.00		3,805.00	0.20	0.20	0.012	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	4.00	10.00	4.01	0.90	0.016	1.31	0.76	4.60	1.00	0.27	0.83	0.16	0.03	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Area includes a portion of Vernon NB lanes south of Vernon/Davies RA.
	[1] Slope L was taken at the proposed curb face from the roadway dtm.																															
	[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.																															

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Version 6.2, Revised 9/13/2019

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L[1,2] (ft/ft)	Super T[2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_t (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
	72+83.00																														**7TH DRAINING EAST**
DR02-43	72+08.00	75.00		814.00	0.04	0.04	0.025	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	2.50	8.50	1.91	0.44	0.016	1.19	1.00	4.60	1.00	0.32	1.00	0.04	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Bypass goes to sag point, DR02-44
	[1] Slope L was taken at the proposed curb face from the roadway dtm.																															
	[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.																															

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Version 6.2, Revised 9/13/2019

7TH PL RT (50-YR)

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.95
I =	3.49
m=	8.96
n=	0.59

50-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L[1,2] (ft/ft)	Super T[2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_t (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
	72+83.00																														**7TH DRAINING EAST**
DR02-43	72+08.00	75.00		814.00	0.06	0.06	0.025	0.019	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	2.50	8.50	2.20	0.51	0.016	1.31	0.98	4.60	1.00	0.28	0.98	0.06	0.00	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Bypass goes to sag point, DR02-44
	[1] Slope L was taken at the proposed curb face from the roadway dtm.																															
	[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.																															

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Version 6.2, Revised 9/13/2019

SB SR9 RT TURN TO SR 204

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L [1,2] (ft/ft)	Super T [2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
----------	268+80.69	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	**SB SR9 HIGH PT DRAINING SOUTH**
DR02-52	268+34.94	45.75		2,355.00	0.12	0.12	0.000	0.015	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	15.00	6.00	8.00	7.96	1.42	0.016	0.26	0.47	4.60	1.00	0.85	0.92	0.11	0.01	Zd Allowable > Zd Design		
DR02-86	267+85.36	49.58		1,667.00	0.09	0.10	0.003	0.015	Standard Plan B-30.30-03 Rectangular Vaned Grate	1.67	2.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	15.00	6.00	8.00	4.49	0.80	0.016	0.64	0.71	4.60	1.00	0.52	0.86	0.08	0.01	Zd Allowable > Zd Design	Qbp < 0.1 CFS	

[1] Slope L was taken at the proposed curb face from the roadway dtm.

[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.

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Version 6.2, Revised 9/13/2019

CROSSOVER CHECK (10-YR)

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L [1,2] (ft/ft)	Super T² (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
	273+17.00																														
		87.00		1,212.00	0.06	0.06	0.016	0.010	NO GRATE	0.00	0.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	15.00	4.00	6.00	3.61	0.43	0.016	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.06	Zd Allowable > Zd Design	Qbp < 0.1 CFS	CROSSWALK Qbp & Zd CHECK
	272+30.00																														
	16+27.50																														
CURB END	15+60.00	67.50		1,905.00	0.10	0.10	0.007	0.010	NO GRATE	0.00	0.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	12.00	5.00	11.00	5.03	0.60	0.016	0.78	0.00	4.60	0.00	0.00	0.00	0.00	0.10	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Center Median on Vernon Rd @ Sta 16+00 Qbp & Zd CHECK
	32+42.00																														
VERNON/DAVIES RT	31+86.50	55.50		989.000	0.05	0.05	0.025	0.006	NO GRATE	0.00	0.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	15.00	0.00	7.50	4.25	0.31	0.016	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.05	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Davies Rd RT north of Vernon/Davies RA Qbp & Zd CHECK
	32+39.00																														
VERNON/DAVIES LT	31+78.00	61.00		1,066.000	0.06	0.06	0.023	0.009	NO GRATE	0.00	0.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	15.00	0.00	7.50	3.52	0.37	0.016	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Davies Rd LT north of Vernon/Davies RA Qbp & Zd CHECK
	272+71.00																														
SR9/VERNON RA 1	272+16.00	55.00		1,030.000	0.05	0.05	0.023	0.009	NO GRATE	0.00	0.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	15.00	0.00	7.50	3.47	0.36	0.016	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.05	Zd Allowable > Zd Design	Qbp < 0.1 CFS	NB SR9 approaching SR9/Vernon RA right turn lane Qbp (crossover)
	273+18.00																														
SR9/VERNON RA 2	272+67.00	51.00		1,232.000	0.06	0.06	0.023	0.009	NO GRATE	0.00	0.00	Collector and Local Streets	Enter Speed (mph) ---------->	35	Shoulder + 1/2 Driving Lane	15.00	0.00	7.50	3.72	0.39	0.016	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06	Zd Allowable > Zd Design	Qbp < 0.1 CFS	NB SR9 approaching SR9/Vernon RA thru lane Qbp (crossover)

[1] Slope L was taken at the proposed curb face from the roadway dtm.
[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.

PLEASE REPORT ANY PROBLEMS TO WSDOT HQ HYDRAULICS SECTION. SPREADSHEET IS PROTECTED BUT DOES NOT REQUIRE A PASSWORD TO UNPROTECT.
This spreadsheet follows the HEC22 proceedures for a uniform gutter section and does not cover other gutter situations (composit, depressed, etc.).
Version 6.2, Revised 9/13/2019

2019 INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

Fill in the data for the *grey shaded areas* only

Tc =	5.00
C =	0.90
I =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL 11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	Δ Q cfs (cfs)	Σ Q (cfs)	Slope L [1,2] (ft/ft)	Super T [2] (ft/ft)	Grate Type HM Figure 5-11	GRATE WIDTH (ft)	GRATE LENGTH (ft)	Roadway Classification	Enter Requested Information		Allowable Spread Policy	Driving Lane Width (ft)	Shoulder Width (ft)	Allowable Zd (ft)	Calculated Z_d (ft)	Depth of Flow at Face of Curb d (inches)	Manning's n for Street and Pavement Gutter	Velocity fo Gutter Flow (ft/sec)	Ratio of Frontal Flow to Total Gutter Flow E_o	Splash-Over Velocity V_o (ft/sec)	Ratio of Frontal Flow Intercepted to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_s	Effiency of Grate E	Q_i (cfs)	Q_{bp} (cfs)	Z_d Check	Q_{bp} Check	Comments (L/R)
----------	270+40.68	----------		----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	**NB SR9 HIGH PT NORTH OF SR 204 DRAINING SOUTH**
N/A	270+07.00	33.68		2,521.00	0.13	0.13	0.003	0.015	NO GRATE	0.00	0.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	4.00	6.00	5.11	0.91	0.016	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.13	Zd Allowable > Zd Design		Spread check for narrow shoulder section.
DR02-46	269+50.00	57.00		4,114.00	0.21	0.34	0.002	0.011	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	12.00	14.00	9.44	1.21	0.016	0.72	0.42	4.75	1.00	0.70	0.83	0.28	0.06	Zd Allowable > Zd Design		Shoulder includes bus stop lane
DR02-54	268+85.20	64.80		3,430.00	0.18	0.24	0.002	0.010	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	12.00	14.00	8.28	1.04	0.016	0.66	0.47	4.75	1.00	0.73	0.86	0.20	0.03	Zd Allowable > Zd Design		Shoulder includes bus stop lane
END OF CURB	268+14.50	135.50		2,978.00	0.15	0.21	0.002	0.010	NO GRATE	0.00	0.00	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	12.00	14.00	8.43	0.96	0.016	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.21	Zd Allowable > Zd Design	Need to Reduce Qbp	Shoulder includes bus stop lane, FC 3-1 pond access road used for energy dissipation
----------	270+40.68	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	**NB SR9 HIGH PT NORTH OF SR 204 DRAINING NORTH**
DR03-13	271+58.00	117.32		7,474.00	0.39	0.39	0.008	0.017	Standard Plan B-40.40-02 Frame and Dual Vaned Grates for Grate Inlet	1.75	3.52	Interstate, Principal, Minor Arterial, or Divided	Enter Speed (mph) ---------->	40	Shoulder + 2 feet	12.00	4.00	6.00	5.84	1.20	0.016	1.31	0.61	4.75	1.00	0.56	0.83	0.32	0.07	Zd Allowable > Zd Design	Qbp < 0.1 CFS	Bypass flow goes to sag point, DR03-10

[1] Slope L was taken at the proposed curb face from the roadway dtm.

[2] Longitudinal and Transverse slopes are based on surface (Div 3 FG 100pct) provided on 4/7/2021. No roadway profiles or crossed sections were provided.

PLEASE REPORT ANY PROBLEMS TO WSDOT HQ HYDRAULICS SECTION. SPREADSHEET IS PROTECTED BUT DOES NOT REQUIRE A PASSWORD TO UNPROTECT.
This spreadsheet follows the HEC22 proceedures for a uniform gutter section and does not cover other gutter situations (composit, depressed, etc.).
Version 6.2, Revised 9/13/2019

OSBORN CONSULTING INCORPORATED

CALCULATIONS COVER PAGE

(DATE: 4/26/2021)

PROJECT: SR9, SR204 Interchange Improvements – Stage 3	OCI JOB NO.: 10-150063	PLAN NO.:	PAGE # OF # 1 of 5
CLIENT: Parsons / WSDOT	DEPARTMENT/DISCIPLINE: Civil/Drainage	CALCULATION NO. A-3.1	

SUBJECT/TITLE: Curb Opening Capacity and Spread Analysis

CALCULATION REV. NO.	ORIGINATOR	DISCIPLINE REVIEWER	TECHNICAL PEER REVIEWER (IF REQUIRED)	CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II
0	T. Hew	A. Seethoff	N/A	N
1				
2				

CALCULATIONS OBJECTIVE

Using equations in Section 4.3.1 *Capacity Relationship* and Section 4.4.4.2 *Curb-Opening Inlets* in the U.S. Department of Transportation *Urban Drainage Design Manual* (HEC-22, 3rd Edition, 2009, Revised 2013), evaluate the efficiency and gutter flow interception of the proposed curb openings and determine the design flow spread for compliance with the allowable spread specified in the 2019 Hydraulics Manual (HM) Figure 5-1

CALCULATION METHODOLOGY/ LIST OF ASSUMPTIONS & INPUTS

METHODOLOGY:

1. Determine the 10-yr MRI rainfall coefficients (m & n) for the project location using Figure 2-4 in the HM.
2. Determine an initial curb opening length and curb segment length, the curb opening shall intercept flows from the upstream curb segment.
3. Due to the variation in the longitudinal and cross slope associated with the roundabout and chicane design, divide the curb into 10 separate sections for evaluation. Determine the allowable spread of each Section based of the roadway classification and speed listed in Figure 5-1 of the HM.
4. Starting in Section 1, begin the analysis at the upstream end of the section.
5. Measure the pavement width, longitudinal and cross slope for the pavement areas draining to the curb segment upstream of the curb opening to be evaluated. Apply the measurements to all curb segments within the Section being analyzed.
6. Using the rational method, calculate the runoff generated from the pavement area measured.
7. Using HEC 22 Equation 4-2, calculate the flow spread using the longitudinal and cross slope and the runoff generated by the pavement section plus any bypass flows from the previous opening.

$$T=[(Q_n)/(K_u S_x^{1.67} S_L^{0.5})]^{0.375}$$

8. Using HEC 22 Equation 4-3, calculate the flow depth at the curb face.

$$d = TS_x$$

9. Check the calculated flow spread against the allowable spread determined in Step 3 for the Section being evaluated. If the allowable spread is exceeded, extend the curb opening length or reduce the curb segment length until under the allowable.
10. Using HEC 22 Equation 4-22, calculate the curb opening length required to intercept 100% of the gutter flow.

$$L_T = K_U Q^{0.42} S_L^{0.3} [(1/n\ S_X)]^{0.6}$$

11. Using HEC 22 Equation 4-23, calculate the efficiency of the curb opening chosen in Step 4.

$$E = 1 - [1 - (L/L_T)]^{1.8}$$

12. Using the calculated efficiency in Step 9 and the curb opening and segment length determined in Step 7, determine the interception capacity of the curb opening for the runoff generated by the pavement area draining to the upstream curb segment.
13. Determine the bypass flows by subtracting the intercepted flows from Step 10 from the runoff generated by the pavement area found in Step 4.
14. Using the curb opening and segment length confirmed in Step 7, move to the next Section and repeat Steps 5 – 13.

INPUTS:

1. 10-yr MRI Rainfall Coefficients are from Everett
    a. m = 6.31
    b. n = 0.575
2. Time of Concentration, Tc = 5 mins
3. Runoff Coefficient, C = 0.9
4. Manning's Coefficient, n = 0.015

ASSUMPTIONS:

5. The analysis separates the 480' curb into 10 section for evaluation.
6. Interception capacity determined in Step 12 is equal to the flows intercepted by the curb opening.
7. Due to varying grades of the proposed roundabout and chicane design, the more conservative longitudinal and cross slopes measured a evaluation section were used.
8. Pavement is assumed to be asphalt pavement in determining Manning's n using Table 4-3 in HEC-22.
9. Flow depth and spread calculated assuming a uniform curb section.

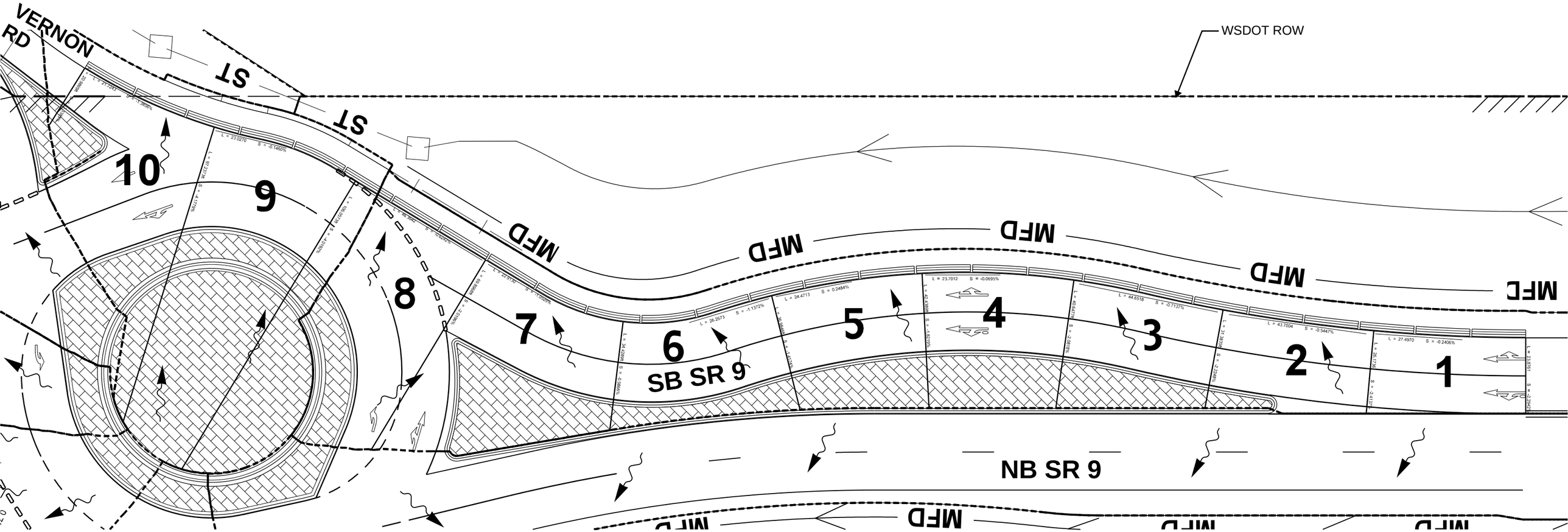
REFERENCES

- U.S. Department of Transportation, Federal Highway Administration, Highway Engineering Circular No. 22, Third Edition, *Urban Drainage Design Manual*, 2009 (Revised 2013)
- WSDOT Hydraulics Manual M 23-03.06, April 2019
- WSDOT Highway Runoff Manual M 31-16.05, April 2019

CONCLUSIONS

- See the attached curb opening analysis spreadsheet for flow spread and depth results. The current design provides adequate capacity to convey runoff and maintain the maximum allowable spread of each section. It has been determined that a 4.25' curb segment followed by a 1' curb opening will be required.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW
Name: T. Hew
Date: 4/26/2021



CURB OPENING CAPACITY AND SPREAD ANALYSIS

OSBORN CONSULTING INCORPORATED

CURB OPENING CAPACITY AND SPREAD ANALYSIS

The U.S. Department of Transportation Urban Drainage Design Manual (HEC-22, 3rd Edition, 2009) was used to confirm that the proposed curb cut openings are sufficient to convey the stormwater runoff from a 10-year storm event without exceeding the allowable spread specified in the 2019 WSDOT Hydraulics Manual. The gutter flow equations specified in the HEC-22 was used to evaluate the gutter flow depth and spread width.

Pavement Area Equation:

$A = L_{CA} * W$

Where:

A = Pavement Area
L_{CA} = Length of Contributing Pavement Area, ft
W = Width of Contributing Pavement Area, ft

HEC 22 Equation 4-22 - Length of Curb-Opening Required for Total Flow Interception:

$L_T = K_U Q^{0.42} S_L^{0.3} [(1/n\ S_x)]^{0.6}$

Where:

K_U = 0.6
n = 0.015 (Asphalt Pavement per Table 4-3 of HEC-22)
L_T = curb opening length required to intercept 100% of the gutter flow, ft
S_L = longitudinal slope, ft/ft
S_x =Cross slope, ft/ft (Assume uniform cross slope of pavement and gutter flow)
Q = gutter flow, cu.ft/sec

HEC 22 Equation 4-23 - Efficiency of Curb-Opening:

$E = 1 - [1 - (L/L_T)]^{1.8}$

Where:

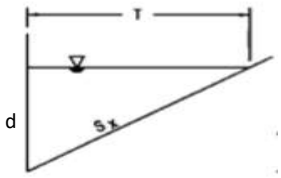
E = Efficiency
L = curb-opening length, ft
L_T = curb opening length required to intercept 100% of the gutter flow, ft

HEC 22 Equation 4-2 - Spread Width:

$T=[(Qn)/(K_u S_x^{1.67} S_L^{0.5})]^{0.375}$

Where:

T = Width of flow (spread), ft
K_U = 0.56
n = 0.016 (Manning's coefficient from Table 4-3)
S_L = longitudinal slope, ft/ft
S_x =Cross slope, ft/ft (Assume uniform cross slope of pavement and gutter flow)
Q = gutter flow, cu.ft/sec



1. Uniform Section

HEC 22 Equation 4-3 - Flow Depth at Curb Face:

$d = TS_x$

Where:

d = Depth of flow, ft
S_x =Cross slope, ft/ft (Assume uniform cross slope of pavement and gutter flow)

CURB OPENING CAPACITY AND SPREAD ANALYSIS

Curb Placement: Curb placed with intermittent curb cuts

Input Cells

10-yr MRI

m= 6.31
n = 0.575
C = 0.9
I = m/tc^n 2.50 2.50

Q (Pavement) = CIA

S_x = VARIES
n = 0.015 (Asphalt Pavement from Table 4-3 of HEC-22)

Curb Cut Details:

Curb Type = Roundabout Type 2 Curb and Gutter
Curb Segment Length (L_{cs}) = 4.25 ft
Curb Opening Length (L) = 1 ft

Equations:

$L_T = K_U Q^{0.42} S_x^{0.3} [(1/n\ S_x)]^{0.6}$ $K_u = 0.6$ HEC 22 Equation 4-22

$E = 1 - (1 - L/L_T)^{1.8}$ $K_u = 0.56$ HEC 22 Equation 4-23

$T = [(Qn)/(K_u S_x^{1.67} S_x^{0.5})]^{0.375}$ HEC 22 Equation 4-2

$d = TS_x$ HEC 22 Equation 4-3

Distance along Curb (ft)	Length of Curb (ft) L_{cA}	Pavement Width (ft)[1] W	Pavement Area (acres) A = L_{cA}*W	C*I	Gutter Flow (cfs) Q=CIA	Total Flow (cfs) $Q_t = Q + Q_b$	Longitudinal Slope[1] S_L	Cross Slope[1] S_x	Length of Total Interception L_T	Efficiency E	Interception Capacity (cfs) $Q_i = E*Q_t$	Bypass Flow (cfs) $Q_b = Q_t - Q_i$	Depth of flow (ft) d	Spread Width (ft) T
277+48	4.3	27	0.0026	2.2509	0.0059	0.0059	0.0024	0.0229	1.3656	0.9067	0.0054	0.0006	0.0284	1.241
277+44	8.5	27	0.0026	2.2509	0.0059	0.0065	0.0024	0.0229	1.4178	0.8891	0.0058	0.0007	0.0294	1.283
277+40	12.8	27	0.0026	2.2509	0.0059	0.0066	0.0024	0.0229	1.4328	0.8841	0.0059	0.0008	0.0297	1.295
277+35	17.0	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4375	0.8825	0.0059	0.0008	0.0297	1.299
277+31	21.3	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4390	0.8820	0.0059	0.0008	0.0298	1.300
277+27	25.5	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4395	0.8818	0.0059	0.0008	0.0298	1.301
277+23	29.8	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4397	0.8818	0.0059	0.0008	0.0298	1.301
277+18	34.0	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4397	0.8817	0.0059	0.0008	0.0298	1.301
277+14	38.3	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4397	0.8817	0.0059	0.0008	0.0298	1.301
277+10	42.5	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4398	0.8817	0.0059	0.0008	0.0298	1.301
277+06	46.8	27	0.0026	2.2509	0.0059	0.0067	0.0024	0.0229	1.4398	0.8817	0.0059	0.0008	0.0298	1.301
277+01	51.0	32	0.0031	2.2509	0.0070	0.0078	0.00545	0.0222	1.9990	0.7131	0.0056	0.0022	0.0267	1.204
276+97	55.3	32	0.0031	2.2509	0.0070	0.0093	0.00545	0.0222	2.1470	0.6765	0.0063	0.0030	0.0285	1.283
276+93	59.5	32	0.0031	2.2509	0.0070	0.0100	0.00545	0.0222	2.2187	0.6599	0.0066	0.0034	0.0293	1.321
276+89	63.8	32	0.0031	2.2509	0.0070	0.0104	0.00545	0.0222	2.2565	0.6514	0.0068	0.0036	0.0298	1.341
276+84	68.0	32	0.0031	2.2509	0.0070	0.0107	0.00545	0.0222	2.2770	0.6469	0.0069	0.0038	0.0300	1.352
276+80	72.3	32	0.0031	2.2509	0.0070	0.0108	0.00545	0.0222	2.2884	0.6444	0.0070	0.0038	0.0301	1.358
276+76	76.5	32	0.0031	2.2509	0.0070	0.0109	0.00545	0.0222	2.2948	0.6430	0.0070	0.0039	0.0302	1.361
276+72	80.8	32	0.0031	2.2509	0.0070	0.0109	0.00545	0.0222	2.2984	0.6423	0.0070	0.0039	0.0303	1.363
276+67	85.0	32	0.0031	2.2509	0.0070	0.0109	0.00545	0.0222	2.3005	0.6418	0.0070	0.0039	0.0303	1.364
276+63	89.3	32	0.0031	2.2509	0.0070	0.0109	0.00545	0.0222	2.3016	0.6416	0.0070	0.0039	0.0303	1.365
276+59	93.5	32	0.0031	2.2509	0.0070	0.0109	0.00545	0.0222	2.3023	0.6414	0.0070	0.0039	0.0303	1.365
276+55	97.8	41	0.0040	2.2509	0.0090	0.0129	0.00714	0.0208	2.7839	0.5512	0.0071	0.0058	0.0299	1.439
276+50	102.0	41	0.0040	2.2509	0.0090	0.0148	0.00714	0.0208	2.9470	0.5258	0.0078	0.0070	0.0315	1.514
276+46	106.3	41	0.0040	2.2509	0.0090	0.0160	0.00714	0.0208	3.0465	0.5114	0.0082	0.0078	0.0324	1.560
276+42	110.5	41	0.0040	2.2509	0.0090	0.0168	0.00714	0.0208	3.1101	0.5025	0.0085	0.0084	0.0330	1.589
276+38	114.8	41	0.0040	2.2509	0.0090	0.0174	0.00714	0.0208	3.1519	0.4969	0.0086	0.0087	0.0334	1.608
276+33	119.0	41	0.0040	2.2509	0.0090	0.0177	0.00714	0.0208	3.1799	0.4932	0.0088	0.0090	0.0337	1.620
276+29	123.3	41	0.0040	2.2509	0.0090	0.0180	0.00714	0.0208	3.1987	0.4907	0.0088	0.0092	0.0339	1.629
276+25	127.5	41	0.0040	2.2509	0.0090	0.0182	0.00714	0.0208	3.2115	0.4891	0.0089	0.0093	0.0340	1.635
276+21	131.8	41	0.0040	2.2509	0.0090	0.0183	0.00714	0.0208	3.2202	0.4879	0.0089	0.0094	0.0341	1.639
276+16	136.0	41	0.0040	2.2509	0.0090	0.0184	0.00714	0.0208	3.2261	0.4872	0.0089	0.0094	0.0341	1.641
276+12	140.3	41	0.0040	2.2509	0.0090	0.0184	0.00714	0.0208	3.2302	0.4867	0.0090	0.0095	0.0342	1.643
276+08	144.5	41	0.0040	2.2509	0.0090	0.0185	0.00714	0.0208	3.2330	0.4863	0.0090	0.0095	0.0342	1.645
276+04	148.8	43	0.0042	2.2509	0.0094	0.0189	0.000695	0.0182	1.7597	0.7795	0.0148	0.0042	0.0508	2.793
275+99	153.0	43	0.0042	2.2509	0.0094	0.0136	0.000695	0.0182	1.5323	0.8509	0.0116	0.0020	0.0449	2.469
275+95	157.3	43	0.0042	2.2509	0.0094	0.0115	0.000695	0.0182	1.4260	0.8864	0.0102	0.0013	0.0421	2.315
275+91	161.5	43	0.0042	2.2509	0.0094	0.0107	0.000695	0.0182	1.3874	0.8994	0.0097	0.0011	0.0411	2.259
275+87	165.8	43	0.0042	2.2509	0.0094	0.0105	0.000695	0.0182	1.3753	0.9035	0.0095	0.0010	0.0408	2.242
275+82	170.0	43	0.0042	2.2509	0.0094	0.0105	0.000695	0.0182	1.3717	0.9047	0.0095	0.0010	0.0407	2.236
275+78	174.3	43	0.0042	2.2509	0.0094	0.0104	0.000695	0.0182	1.3706	0.9050	0.0094	0.0010	0.0407	2.235
275+74	178.5	43	0.0042	2.2509	0.0094	0.0104	0.000695	0.0182	1.3703	0.9051	0.0094	0.0010	0.0407	2.234
275+70	182.8	43	0.0042	2.2509	0.0094	0.0104	0.000695	0.0182	1.3702	0.9052	0.0094	0.0010	0.0407	2.234
275+65	187.0	43	0.0042	2.2509	0.0094	0.0104	0.000695	0.0182	1.3702	0.9052	0.0094	0.0010	0.0407	2.234
275+61	191.3	43	0.0042	2.2509	0.0094	0.0104	0.000695	0.0182	1.3702	0.9052	0.0094	0.0010	0.0407	2.234
275+57	195.5	43	0.0042	2.2509	0.0094	0.0104	0.00248	0.0142	2.3291	0.6357	0.0066	0.0038	0.0292	2.056
275+53	199.8	43	0.0042	2.2509	0.0094	0.0132	0.00248	0.0142	2.5746	0.5873	0.0078	0.0055	0.0319	2.249
275+48	204.0	43	0.0042	2.2509	0.0094	0.0149	0.00248	0.0142	2.7059	0.5641	0.0084	0.0065	0.0334	2.351
275+44	208.3	43	0.0042	2.2509	0.0094	0.0159	0.00248	0.0142	2.7831	0.5513	0.0088	0.0072	0.0342	2.410
275+40	212.5	43	0.0042	2.2509	0.0094	0.0166	0.00248	0.0142	2.8305	0.5437	0.0090	0.0076	0.0347	2.447
275+36	216.8	43	0.0042	2.2509	0.0094	0.0170	0.00248	0.0142	2.8604	0.5390	0.0092	0.0078	0.0351	2.470
275+31	221.0	43	0.0042	2.2509	0.0094	0.0173	0.00248	0.0142	2.8795	0.5360	0.0093	0.0080	0.0353	2.485
275+27	225.3	43	0.0042	2.2509	0.0094	0.0175	0.00248	0.0142	2.8918	0.5341	0.0093	0.0081	0.0354	2.494
275+23	229.5	43	0.0042	2.2509	0.0094	0.0176	0.00248	0.0142	2.8998	0.5329	0.0094	0.0082	0.0355	2.500
275+19	233.8	43	0.0042	2.2509	0.0094	0.0177	0.00248	0.0142	2.9050	0.5321	0.0094	0.0083	0.0356	2.504
275+14	238.0	43	0.0042	2.2509	0.0094	0.0177	0.00248	0.0142	2.9084	0.5316	0.0094	0.0083	0.0356	2.507
275+10	242.3	37	0.0036	2.2509	0.0081	0.0164	0.0114	0.00987	5.5389	0.3012	0.0049	0.0115	0.0227	2.299
275+06	246.5	37	0.0036	2.2509	0.0081	0.0196	0.0114	0.00987	5.9665	0.2812	0.0055	0.0141	0.0243	2.457
275+02	250.8	37	0.0036	2.2509	0.0081	0.0222	0.0114	0.00987	6.2886	0.2678	0.0059	0.0163	0.0254	2.575
274+97	255.0	37	0.0036	2.2509	0.0081	0.0244	0.0114	0.00987	6.5404	0.2582	0.0063	0.0181	0.0263	2.667
274+93	259.3	37	0.0036	2.2509	0.0081	0.0262	0.0114	0.00987	6.7420	0.2510	0.0066	0.0196	0.0270	2.740
274+89	263.5	37	0.0036	2.2509	0.0081	0.0278	0.0114	0.00987	6.9062	0.2454	0.0068	0.0210	0.0276	2.800
274+85	267.8	37	0.0036	2.2509	0.0081	0.0291	0.0114	0.00987	7.0415	0.2410	0.0070	0.0221	0.0281	2.849
274+80	272.0	37	0.0036	2.2509	0.0081	0.0302	0.0114	0.00987	7.1541	0.2374	0.0072	0.0230	0.0285	2.890
274+76	276.3	37	0.0036	2.2509	0.0081	0.0312	0.0114	0.00987	7.2485	0.2345	0.0073	0.0238	0.0289	2.924
274+72	280.5	37	0.0036	2.2509	0.0081	0.0320	0.0114	0.00987	7.3281	0.2321	0.0074	0.0246	0.0291	2.952
274+68	284.8	37	0.0036	2.2509	0.0081	0.0327	0.0114	0.00987	7.3955	0.2301	0.0075	0.0252	0.0294	2.976
274+63	289.0	53	0.0052	2.2509	0.0116	0.0368	0.0105	0.00987	7.5843	0.2247	0.0083	0.0285	0.0312	3.160
274+59	293.3	53	0.0052	2.2509	0.0116	0.0402	0.0105	0.00987	7.8687	0.2170	0.0087	0.0315	0.0322	3.266
274+55	297.5	53	0.0052	2.2509	0.0116	0.0431	0.0105	0.00987	8.1042	0.2111	0.0091	0.0340	0.0331	3.353
274+51	301.8	53	0.0052	2.2509	0.0116	0.0456	0.0105	0.00987	8.3019	0.2063	0.0094	0.0362	0.0338	3.426
274+46	306.0	53	0.0052	2.2509	0.0116	0.0479	0.0105	0.00987	8.4696	0.2024	0.0097	0.0382	0.0344	3.488
274+42	310.3	53	0.0052	2.2509	0.0116	0.0498	0.0105	0.00987	8.6130	0.1992	0.0099	0.0399	0.0349	3.540
274+38	314.5	53	0.0052	2.2509	0.0116	0.0515	0.0105	0.00987	8.7364	0.1965	0.0101	0.0414	0.0354	3.586
274+34	318.8	53	0.0052	2.2509	0.0116	0.0530	0.0105	0.00987	8.8432	0.1943	0.0103	0.0427	0.0358	3.625
274+29	323.0	53	0.0052	2.2509	0.0116	0.0544	0.0105	0.00987	8.9360	0.1923	0.0105	0.0439	0.0361	3.659
274+25	327.3	53	0.0052	2.2509	0.0116	0.0556	0.0105	0.00987	9.0169	0.1907	0.0106	0.0450	0.0364	3.688
274+21	331.5	53	0.0052	2.2509	0.0116	0.0566	0.0105	0.00987	9.0877	0.1893	0.0107	0.0459	0.0367	3.714
274+17	335.8	53	0.0052	2.2509	0.0116	0.0575	0.0105	0.00987	9.1499	0.1881	0.0108	0.0467	0.0369	3.737
274+12	340.0	106	0.0103	2.2509	0.0233	0.0700	0.00624	0.0202	5.5304	0.3016	0.0211	0.0489	0.0572	2.832
274+08	344.3	106	0.0103	2.2509	0.0233	0.0722	0.00624	0.0202	5.6017	0.2981	0.0215	0.0506	0.0579	2.864
274+04	348.5	106	0.0103	2.2509	0.0233	0.0739	0.00624	0.0202	5.6590	0.2953	0.0218	0.0521	0.0584	2.890
274+00	352.8	106	0.0103	2.2509	0.0233	0.0754	0.00624	0.0202	5.7053	0.2931	0.0221	0.0533	0.0588	2.911
273+95	357.0	106	0.0103	2.2509	0.0233	0.0766	0.00624	0.0202	5.7428	0.2913	0.0223	0.0543	0.0592	2.928
273+91	361.3	106	0.0103	2.2509	0.0233	0.0775	0.00624	0.0202	5.7734	0.2899	0.0225	0.0551	0.0594	2.942
273+87	365.5	106	0.0103	2.2509	0.0233	0.0783	0.00624	0.0202	5.7984	0.2888	0.0226	0.0557	0.0597	2.954
273+83	369.8	106	0.0103	2.2509	0.0233	0.0790	0.00624	0.0202	5.8188	0.2878	0.0227	0.0563	0.0599	2.963
273+78	374.0	106	0.0103	2.2509	0.0233	0.0795	0.00624	0.0202	5.8356	0.2871	0.0228	0.0567	0.0600	2.971
273+74	378.3	106	0.0103	2.2509	0.0233	0.0800	0.00624	0.0202	5.8493	0.2864	0.0229	0.0571	0.0601	2.977
273+70	382.5	106	0.0103	2.2509	0.0233	0.0804	0.00624	0.0202	5.8607	0.2859	0.0230	0.0574	0.0602	2.982
273+66	386.8	106	0.0103	2.2509	0.0233	0.0807	0.00146	0.0402	2.5122	0.5989	0.0483	0.0323	0.1024	2.548
273+61	391.0	106	0.0103	2.2509	0.0233	0.0556	0.00146	0.0402	2.1493	0.6759	0.0376	0.0180	0.0891	2.217
273+57	395.3	106	0.0103	2.2509	0.0233	0.0413	0.00146	0.0402	1.8967	0.7404	0.0306	0.0107	0.0797	1.983
273+53	399.5	106	0.0103	2.2509	0.0233	0.0340	0.00146	0.0402	1.7479	0.7830	0.0266	0.0074	0.0741	1.843
273+49	403.8	106	0.0103	2.2509	0.0233	0.0307	0.00146	0.0402	1.6734	0.8057	0.0247	0.0060	0.0713	1.773
273+44	408.0	106	0.0103	2.2509	0.0233	0.0292	0.00146	0.0402	1.6404	0.8161	0.0239	0.0054	0.0700	1.742
273+40	412.3	106	0.0103	2.2509	0.0233	0.0287	0.00146	0.0402	1.6267	0.8204	0.0235	0.0051	0.0695	1.729
273+36	416.5	106	0.0103	2.2509	0.0233	0.0284	0.00146	0.0402	1.6212	0.8221	0.0234	0.0051	0.0693	1.723
273+32	420.8	106	0.0103	2.2509	0.0233	0.0283	0.00146	0.0402	1.6190	0.8228	0.0233	0.0050	0.0692	1.721
273+27	425.0	106	0.0103	2.2509	0.0233	0.0283	0.00146	0.0402	1.6181	0.8231	0.0233	0.0050	0.0692	1.721
273+23	429.3	106	0.0103	2.2509	0.0233	0.0283	0.00146	0.0402	1.6178	0.8232	0.0233	0.0050	0.0692	1.720
273+19	433.5	59	0.0058	2.2509	0.0130	0.0180	0.0139	0.0334	2.9373	0.5272	0.0095	0.0085	0.0357	1.068
273+15	437.8	59	0.0058	2.2509	0.0130	0.0214	0.0139	0.0334	3.1647	0.4952	0.0106	0.0108	0.0381	1.141
273+10	442.0	59	0.0058	2.2509	0.0130	0.0238	0.0139	0.0334	3.3051	0.4772	0.0114	0.0124	0.0396	1.186
273+06	446.3	59	0.0058	2.2509	0.0130	0.0254	0.0139	0.0334	3.3972	0.4661	0.0118	0.0136	0.0406	1.216
273+02	450.5	59	0.0058	2.2509	0.0130	0.0265	0.0139	0.0334	3.4595	0.4589	0.0122	0.0143	0.0413	1.236
272+98	454.8	59	0.0058	2.2509	0.0130	0.0273	0.0139	0.0334	3.5024	0.4540	0.0124	0.0149	0.0417	1.250
272+93	459.0	59	0.0058	2.2509	0.0130	0.0279	0.0139	0.0334	3.5325	0.4507	0.0126	0.0153	0.0421	1.259
272+89	463.3	59	0.0058	2.2509	0.0130	0.0283	0.0139	0.0334	3.5537	0.4483	0.0127	0.0156	0.0423	1.266
272+85	467.5	59	0.0058	2.2509	0.0130	0.0286	0.0139	0.0334	3.5687	0.4467	0.0128	0.0158	0.0424	1.271
272+81	471.8	59	0.0058	2.2509	0.0130	0.0288	0.0139	0.0334	3.5794	0.4455	0.0128	0.0159	0.0426	1.274
272+76	476.0	59	0.0058	2.2509	0.0130	0.0289	0.0139	0.0334	3.5870	0.4447	0.0129	0.0160	0.0426	1.276
272+72	480.3	59	0.0058	2.2509	0.0130	0.0290	0.0139	0.0334	3.5925	0.4441	0.0129	0.0161	0.0427	1.278

Section	Section Range Start	Section Range End	Pavement Width	Long Slope	Cross Slope	Max Allowable Spread	Max Calc'd Spread	
1	0	48	27	0.0024	0.0229	3	1.30	
2	49	96	32	0.0055	0.0222	3	1.37	
3	97	144	41	0.0071	0.0208	3	1.64	
4	145	192	43	0.0007	0.0182	3	2.23	
5	193	240	43	0.0025	0.0142	3	2.51	
6	241	288	37	0.0114	0.0099	3	2.98	*Critical Spread Check*
7	289	336	53	0.0105	0.0099	3.9	3.74	
8	337	384	106	0.0062	0.0202	4.6	2.98	*Start RA*
9	385	432	106	0.0015	0.0402	6	1.72	
10	433	480	59	0.0139	0.0334	5.5	1.28	*End RA*

Critical Spread Check at 288' 2.98

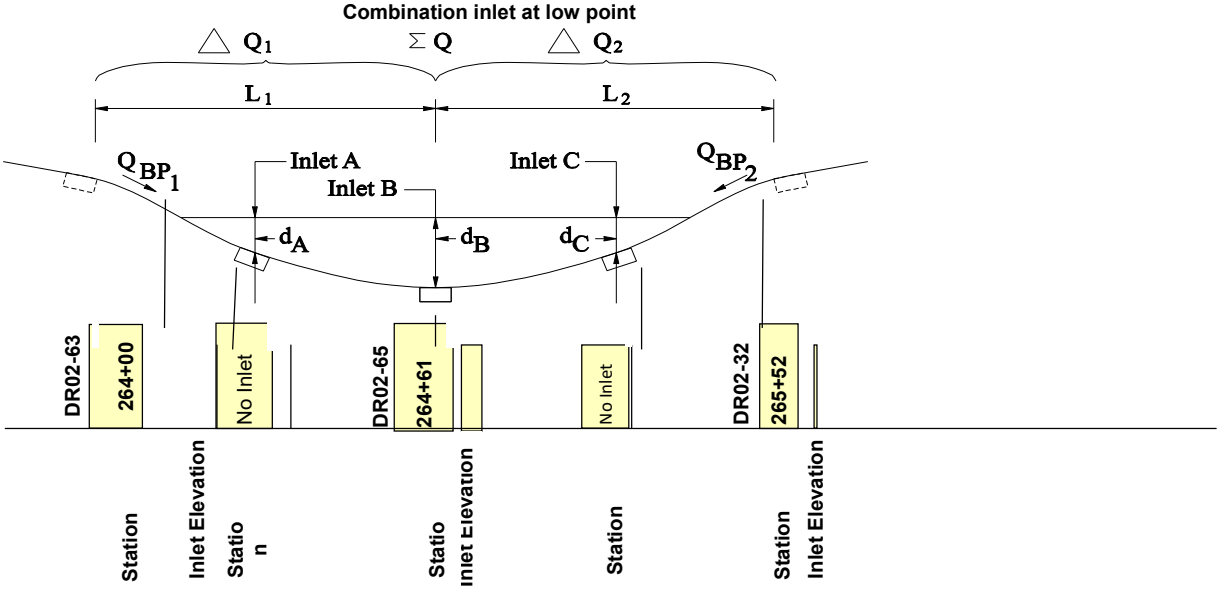
Total Curb Length (ft) 480

APPENDIX C-4

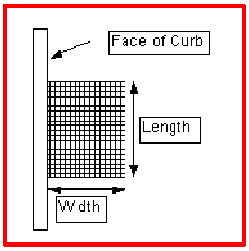
SAG DESIGN

SAG INLET DESIGN WORKSHEET

Combination inlet at low point



Transverse Slope	S_T	0.032	ft/ft	Shoulder Width		3.00	ft
Allowable	Z_d	9.00	ft	Lane Width		12.00	ft
Allowable	d_B	0.288	ft	(d_A = d_C = 0.144 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	8.96					
	n	0.585					
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)			
		2544sf				3318sf	
Distance between last inlet	L_1[5]	84.80	ft	L_2[5]		94.80	ft
Width of catchment area	W_1[5]	30.00	ft	W_2[5]		35.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.04	cfs	Q_{BP2}[4]		0.00	cfs
Discharge of catchment area	Q_1	0.19	cfs	Q_2		0.25	cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.04 + 0.19 + 0.00 + 0.25 = 0.49 cfs

Combination[1] or Grate Inlet for sag P_B (C/G): G

Effective Perimeter of Grate Inlets (reduced by 50% for plugging)								
P_A	Flank	0	ft	Width		Length		
P_B		2.56	ft	Width	1.31	Length	1.25	Catch basin
P_C	Flank	0	ft	Width		Length		

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 1.19 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.159 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

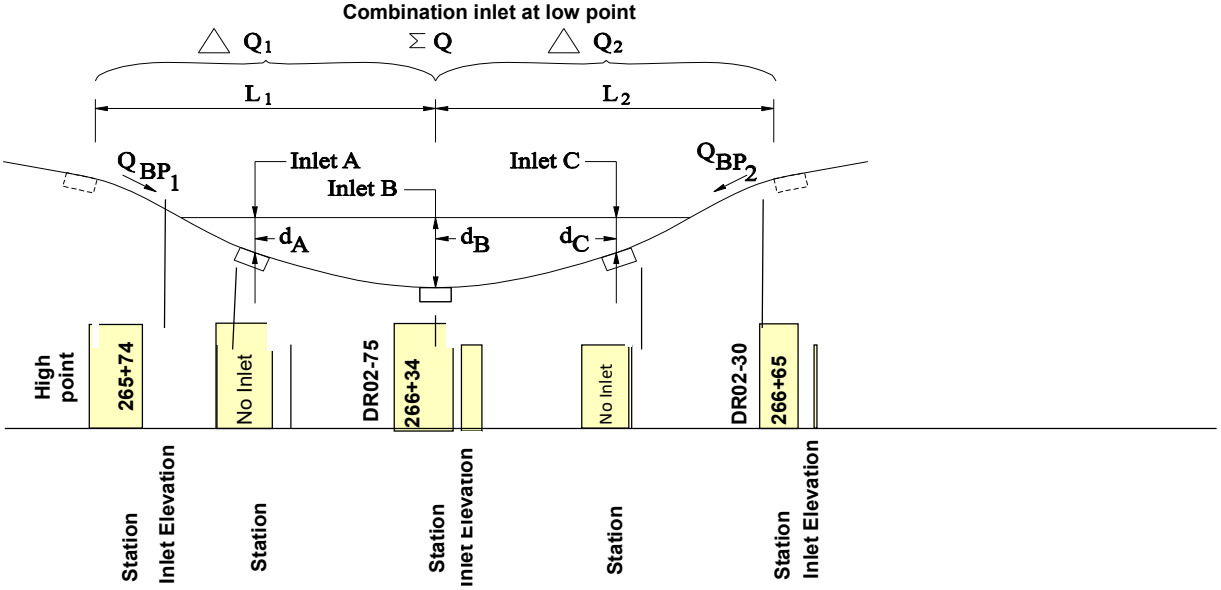
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

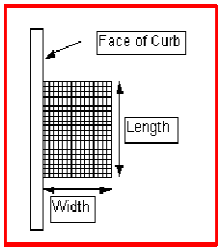
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET

Combination inlet at low point



Transverse Slope	S_T	0.020	ft/ft	Shoulder Width		1.00	ft
Allowable	Z_d	7.00	ft	Lane Width		12.00	ft
Allowable	d_B	0.140	ft	(d_A = d_C = 0.07 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	8.96					
	n	0.585					
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)			
		1699sf				1297sf	
Distance between last inlet	L_1[5]	60.67	ft	L_2[5]		30.88	ft
Width of catchment area	W_1[5]	28.00	ft	W_2[5]		42.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.00	cfs	Q_{BP2}[4]		0.02	cfs
Discharge of catchment area	Q_1	0.13	cfs	Q_2		0.10	cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.00 + 0.13 + 0.02 + 0.10 = 0.25 cfs

Combination[1] or Grate Inlet for sag P_B (C/G): G

Effective Perimeter of Grate Inlets (reduced by 50% for plugging)								
P_A	Flank	0	ft	Width		Length		
P_B		2.56	ft	Width	1.31	Length	1.25	Catch basin
P_C	Flank	0	ft	Width		Length		

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 0.40 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.101 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

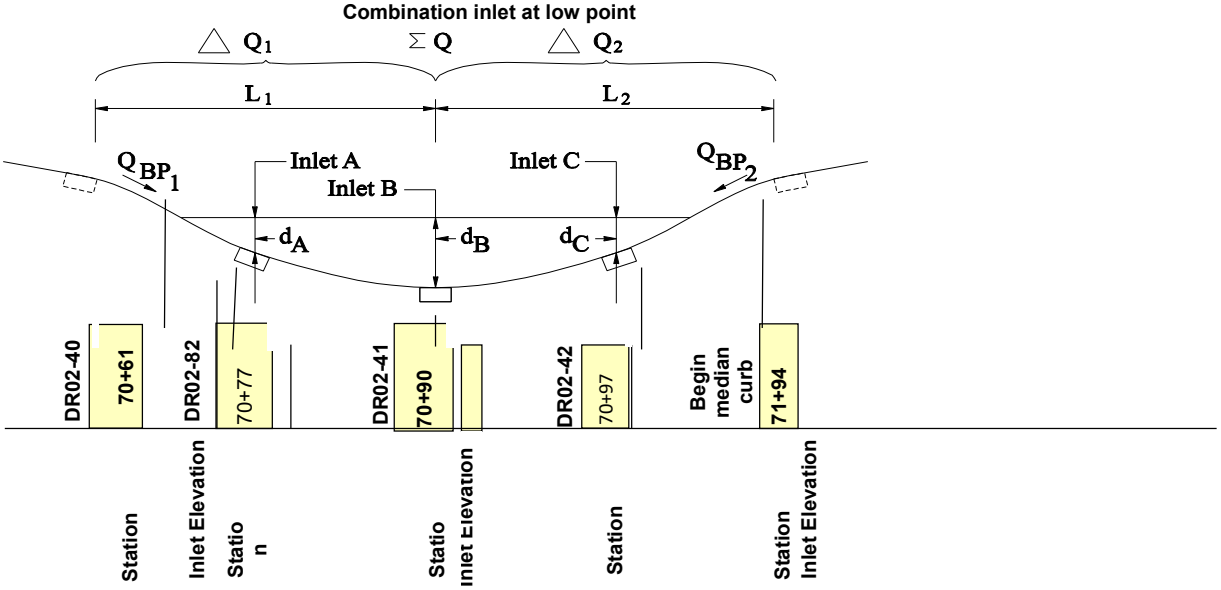
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

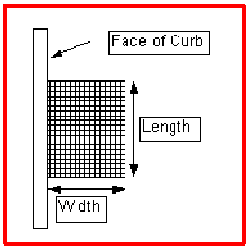
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET

Combination inlet at low point



Transverse Slope	S_T	0.022	ft/ft	Shoulder Width	1.00	ft
Allowable	Z_d	6.00	ft	Lane Width	15.00	ft
Allowable	d_B	0.132	ft	(d_A = d_C = 0.066 ft allowable)		
Time of Concentration	T_c	5.0	min			
50 yr. rainfall coefficients	m	8.96				
	n	0.585				
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)		
		5387sf			5484sf	
Distance between last inlet	L_1[5]	128.26	ft	L_2[5]	38.35	ft
Width of catchment area	W_1[5]	42.00	ft	W_2[5]	143.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.02	cfs	Q_{BP2}[4]	0.00	cfs
Discharge of catchment area	Q_1	0.41	cfs	Q_2	0.42	cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.02 + 0.41 + 0.00 + 0.42 = 0.85 cfs

Combination[1] or Grate Inlet for sag P_B (C/G): G

Effective Perimeter of Grate Inlets (reduced by 50% for plugging)								
P_A	Flank	3.87	ft	Width	1.29	Length	2.58	GI
P_B		3.87	ft	Width	1.29	Length	2.58	GI
P_C	Flank	2.56	ft	Width	1.31	Length	1.25	CB

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 0.88 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.128 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

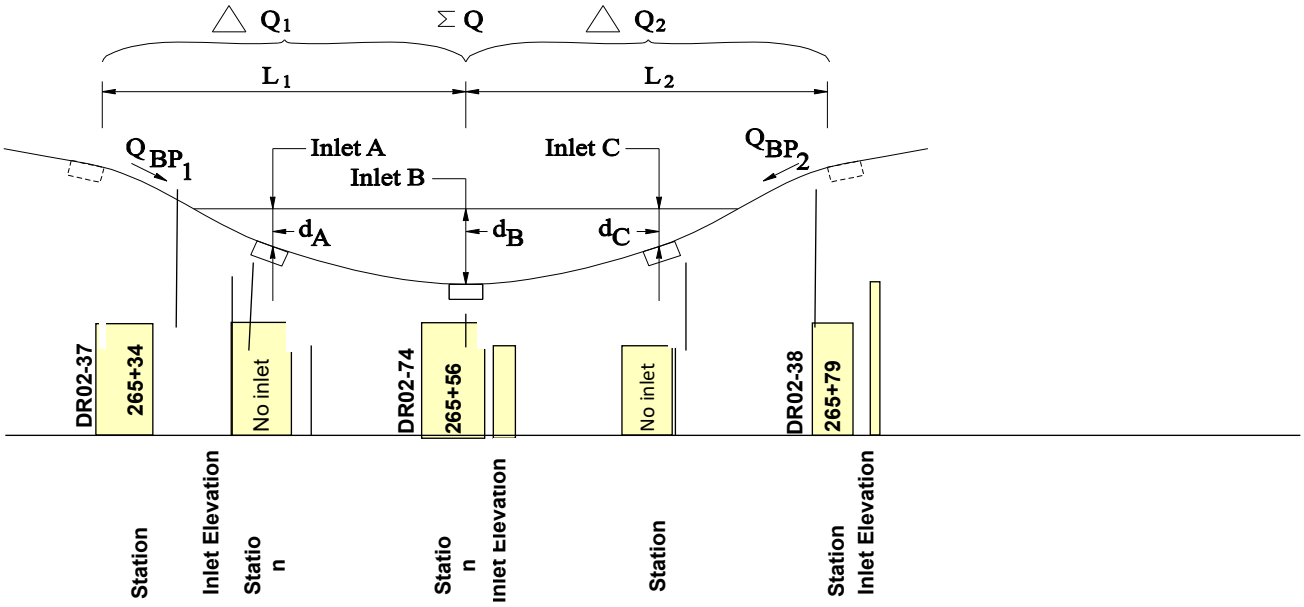
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

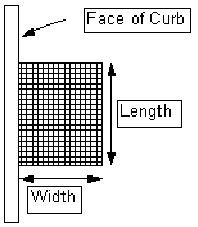
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET

Combination inlet at low point



Transverse Slope	S_T	0.020	ft/ft	Shoulder Width		1.00	ft
Allowable	Z_d	5.00	ft	Lane Width		14.00	ft
Allowable	d_B	0.100	ft	($d_A = d_C$ = 0.05 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	8.96					
	n	0.585					
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)			
		670sf				1453sf	
Distance between last inlet and	L_1[5]	21.61	ft	L_2[5]		24.22	ft
Width of catchment area	W_1[5]	31.00	ft	W_2[5]		60.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.00	cfs	Q_{BP2}[4]		0.00	cfs
Discharge of catchment area	Q_1	0.05	cfs	Q_2		0.11	cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.00 + 0.05 + 0.00 + 0.11 = 0.162 cfs

Combination[1] or Grate Inlet for sag P_B (C/G)		G						
Effective Perimeter of Grate Inlets (reduced by 50% for plugging)	P_A Flank	0	ft	Width		Length		
	P_B	2.56	ft	Width	1.31	Length	1.25	CB
	P_C Flank	0	ft	Width		Length		

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 0.243 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.076 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

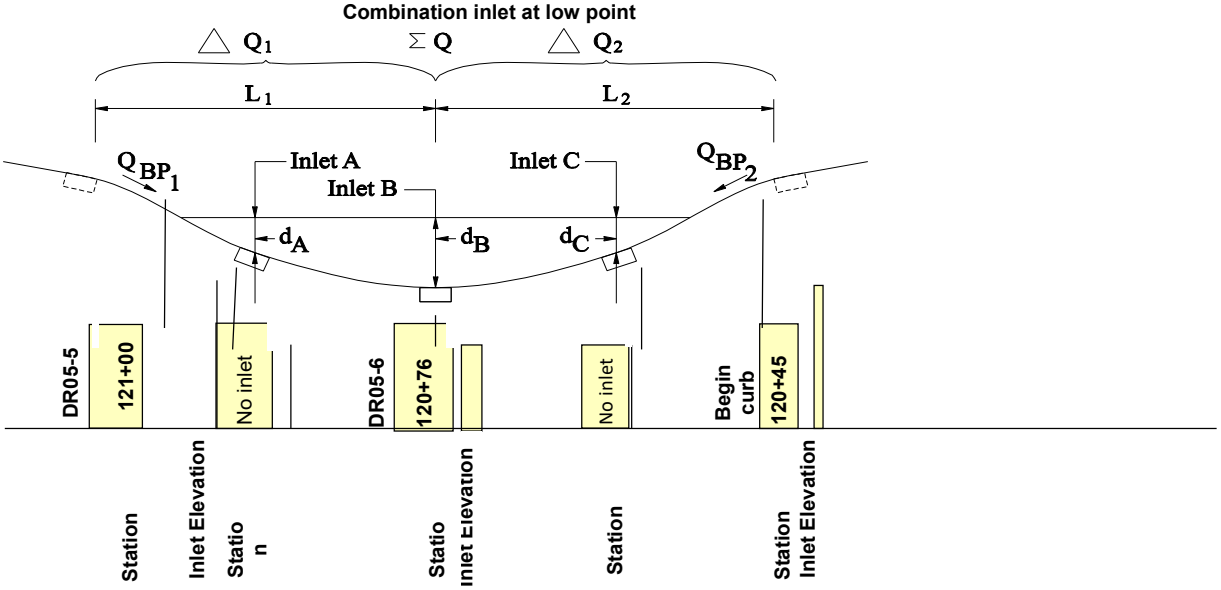
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

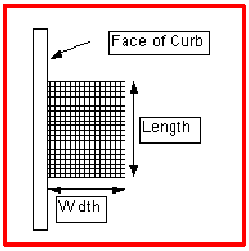
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET

Combination inlet at low point



Transverse Slope	S_T	0.043	ft/ft	Shoulder Width		0.00	ft
Allowable	Z_d	2.00	ft	Lane Width		12.00	ft
Allowable	d_B	0.086	ft	(d_A = d_C = 0.043 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	8.96					
	n	0.585					
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)			
		1362sf				1581sf	
Distance between last inlet	L_1[5]	28.38	ft	L_2[5]		33.00	ft
Width of catchment area	W_1[5]	48.00	ft	W_2[5]		48.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.00	cfs	Q_{BP2}[4]		0.00	cfs
Discharge of catchment area	Q_1	0.10	cfs	Q_2		0.12	cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.00 + 0.10 + 0.00 + 0.12 = 0.225 cfs

Combination[1] or Grate Inlet for sag P_B (C/G)		G						
Effective Perimeter of Grate Inlets (reduced by 50% for plugging)	P_A Flank	0	ft	Width		Length		
	P_B	3.87	ft	Width	2.58	Length	1.29	GI (rotated)
	P_C Flank	0	ft	Width		Length		

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 0.293 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.072 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

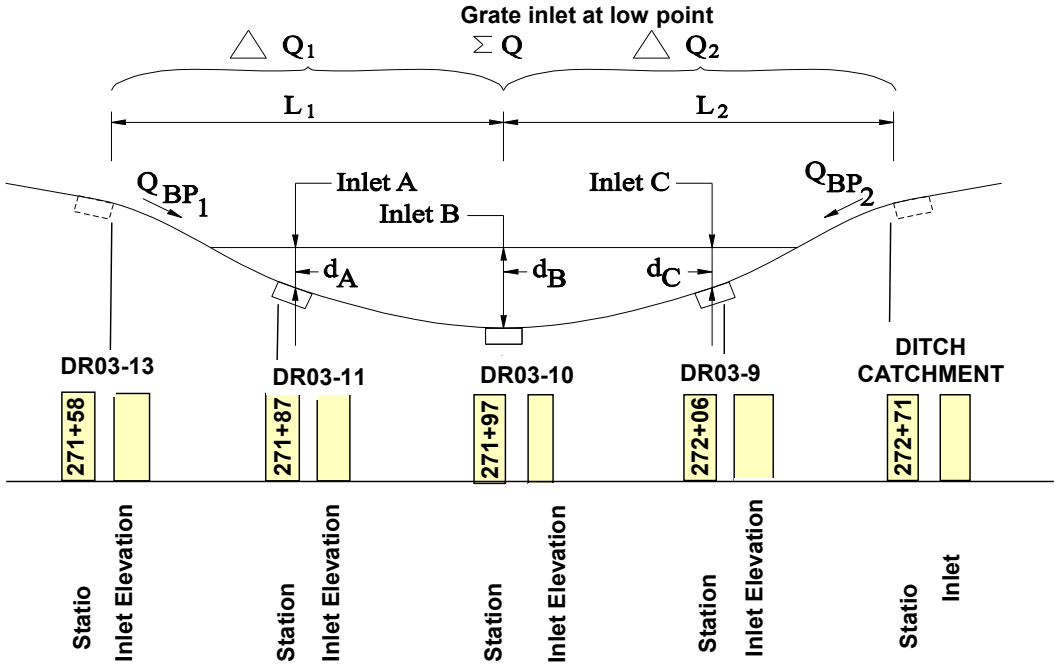
[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

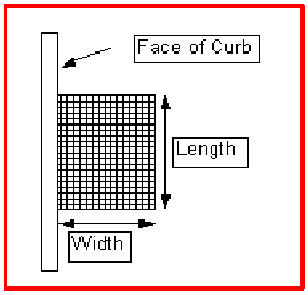
[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET



Transverse Slope	S_T	0.020	ft/ft	Shoulder Width		4.00	ft
Allowable	Z_d	6.00	ft	Lane Width		12.00	ft
Allowable	d_B	0.12	ft	(d_A = d_C = 0.06 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	8.96					
	n	0.585					
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)			
Distance between last inlet and low point	A_1	1624	ft^2	A_2	2827		ft^2
	L_1[5]	32.48	ft	L_2[5]	56.54		ft
Width of catchment area	W_1[5]	50.00	ft	W_2[5]	50.00		ft
Bypass from last inlet	Q_{BP1}[4]	0.12	cfs	Q_{BP2}[4]	0.00		cfs
Discharge of catchment area	Q_1	0.12	cfs	Q_2	0.22		cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.12 + 0.12 + 0.00 + 0.22 = 0.46 cfs

Combination[1] or Grate Inlet for sag P_B (C/G) → G

Effective Perimeter of Grate Inlets (reduced by 50% for plugging)	P_A	Flank	2.56	ft	Width	1.31	Length	1.25
	P_B		3.87	ft	Width	1.29	Length	2.58
	P_C	Flank	2.56	ft	Width	1.31	Length	1.25

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 0.68 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.09 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

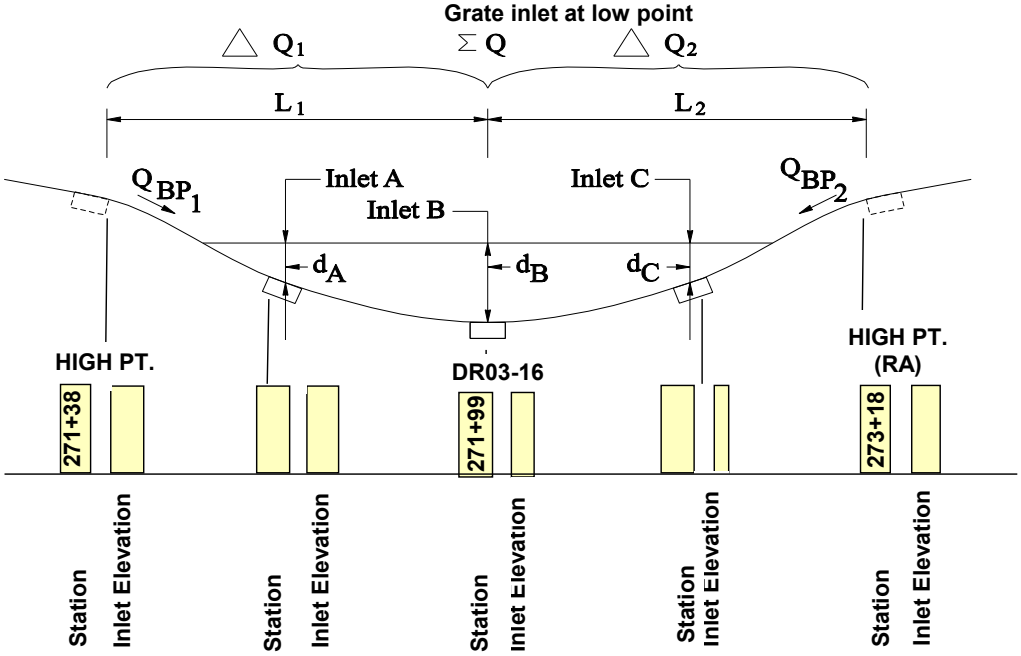
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

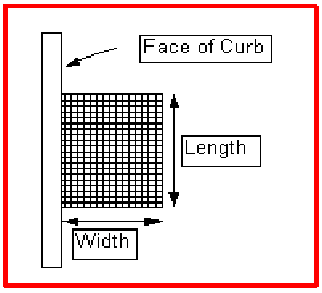
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET

Grate inlet at low point



Transverse Slope	S_T	0.018	ft/ft	Shoulder Width	1.00	ft
Allowable	Z_d[6]	6.00	ft	Lane Width	14.00	ft
Allowable	d_B	0.11	ft	(d_A = d_C = 0.05 ft allowable)		
Time of Concentration	T_c	5.0	min			
50 yr. rainfall coefficients	m	8.96				
	n	0.585				
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)		
Distance between last inlet and low point	A_1	2166	ft^2	A_2	3418	ft^2
	L_1[5]	72.17	ft	L_2[5]	113.93	ft
Width of catchment area	W_1[5]	30.00	ft	W_2[5]	30.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.00	cfs	Q_{BP2}[4]	0.00	cfs
Discharge of catchment area	Q_1	0.17	cfs	Q_2	0.26	cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.00 + 0.17 + 0.00 + 0.26 = **0.43** cfs

Combination[1] or Grate Inlet for sag P_B (C/G) → **G**

Effective Perimeter of Grate Inlets (reduced by 50% for plugging)				Width	Length
	P_A Flank	0.00	ft	0	0
	P_B	4.14	ft	1.29	2.85
	P_C Flank	0	ft	0	0

⇨

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = **0.45** cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} =$$ **0.11** ft

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

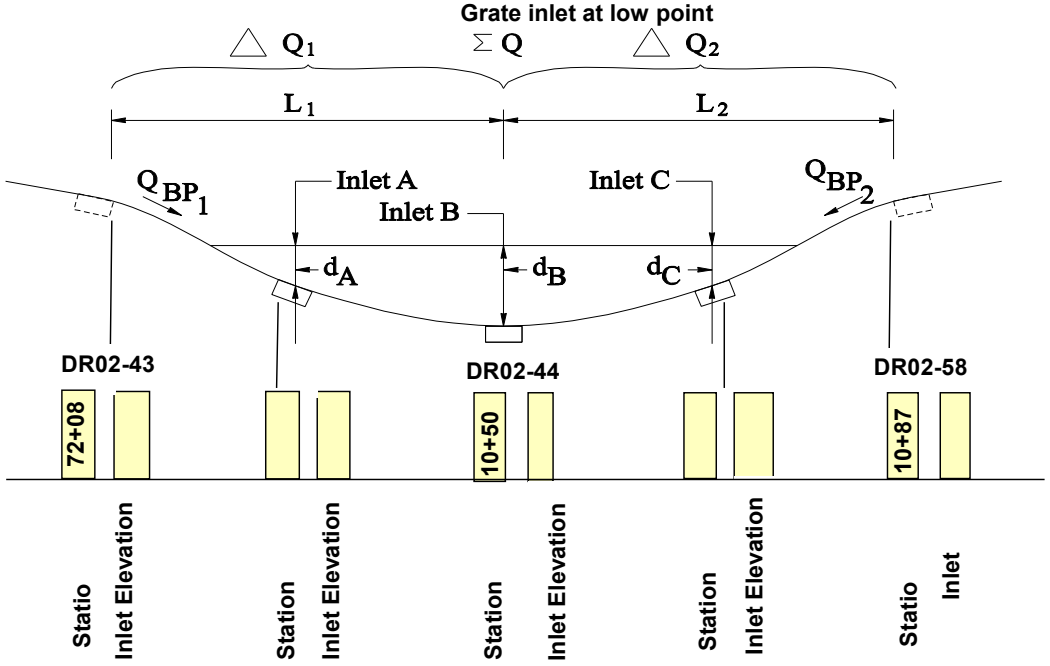
[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

[6] Allowable Zd includes an additional 5' (min.) measured from shoulder line to recessed CB in traffic island.

SAG INLET DESIGN WORKSHEET

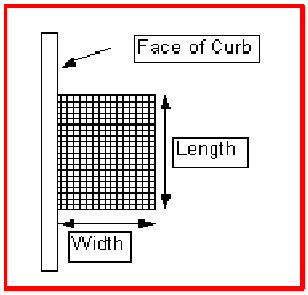
Grate inlet at low point



Transverse Slope	S_T	0.020	ft/ft	Shoulder Width		5.00	ft
Allowable	Z_d	11.00	ft	Lane Width		12.00	ft
Allowable	d_B	0.22	ft	(d_A = d_C = 0.11 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	8.96					
	n	0.585					
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)			
Distance between last inlet and low point	A_1	1432	ft^2	A_2	1024	ft^2	
	L_1[5]	57.28	ft	L_2[5]	40.96	ft	
Width of catchment area	W_1[5]	25.00	ft	W_2[5]	25.00	ft	
Bypass from last inlet	Q_{BP1}[4]	0.00	cfs	Q_{BP2}[4]	0.12	cfs	
Discharge of catchment area	Q_1	0.11	cfs	Q_2	0.08	cfs	

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.00 + 0.11 + 0.12 + 0.08 = 0.31 cfs



See Figure 5-11 in Hydraulics Manual for grate dimensions.

Combination[1] or Grate Inlet for sag P_B (C/G) → G

Effective Perimeter of Grate Inlets (reduced by 50% for plugging)							
P_A	Flank	0	ft	Width	0	Length	0
P_B		3.87	ft	Width	1.29	Length	2.58
P_C	Flank	0	ft	Width	0	Length	0

⇨

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 1.20 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.09 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

Depth at fog line = 0.12'

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

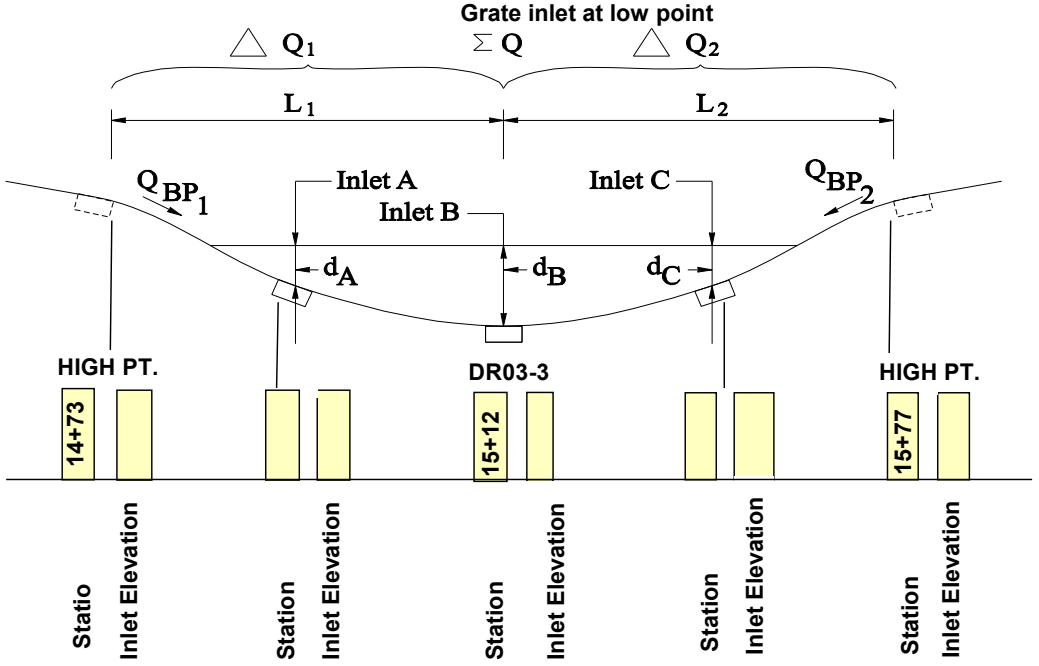
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

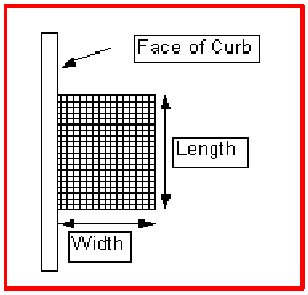
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET

Grate inlet at low point



Transverse Slope	S_T	0.030	ft/ft	Shoulder Width		5.00	ft
Allowable	Z_d	11.00	ft	Lane Width		12.00	ft
Allowable	d_B	0.34	ft	($d_A = d_C$ = 0.17 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	8.96					
	n	0.585					
Rainfall Intensity	$I_{50\text{-}yr}$	3.50	in/hr	(for 5 minute duration)			
	A_1	1422	ft^2	A_2	3017	ft^2	
Distance between last	L_1[5]	35.55	ft	L_2[5]	75.43	ft	
Width of catchment area	W_1[5]	40.00	ft	W_2[5]	40.00	ft	
Bypass from last inlet	Q_{BP1}[4]	0.00	cfs	Q_{BP2}[4]	0.00	cfs	
Discharge of catchment area	Q_1	0.11	cfs	Q_2	0.23	cfs	



See Figure 5-11 in Hydraulics Manual for grate dimensions.

$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

Q_{Total} = 0.00 + 0.11 + 0.00 + 0.23 = 0.34 cfs

Combination[1] or Grate Inlet for sag P_B (C/G) → G

Effective Perimeter of Grate Inlets (reduced by 50% for plugging)	P_A	Flank	0	ft	Width	0	Length	0
	P_B		2.56	ft	Width	1.31	Length	1.25
	P_C	Flank	0	ft	Width	0	Length	0

⇨

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 1.49 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.12 \text{ ft}$$

Check calculated d_B against allowable d_B.

If d_B < allowable d_B, the design is complete.

Depth at fog line = 0.12'

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Notes:

[1] If using a combination inlet for the sag, the flank grate inlets are not required except in a depressed area (See Hydaulics Manual).

[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

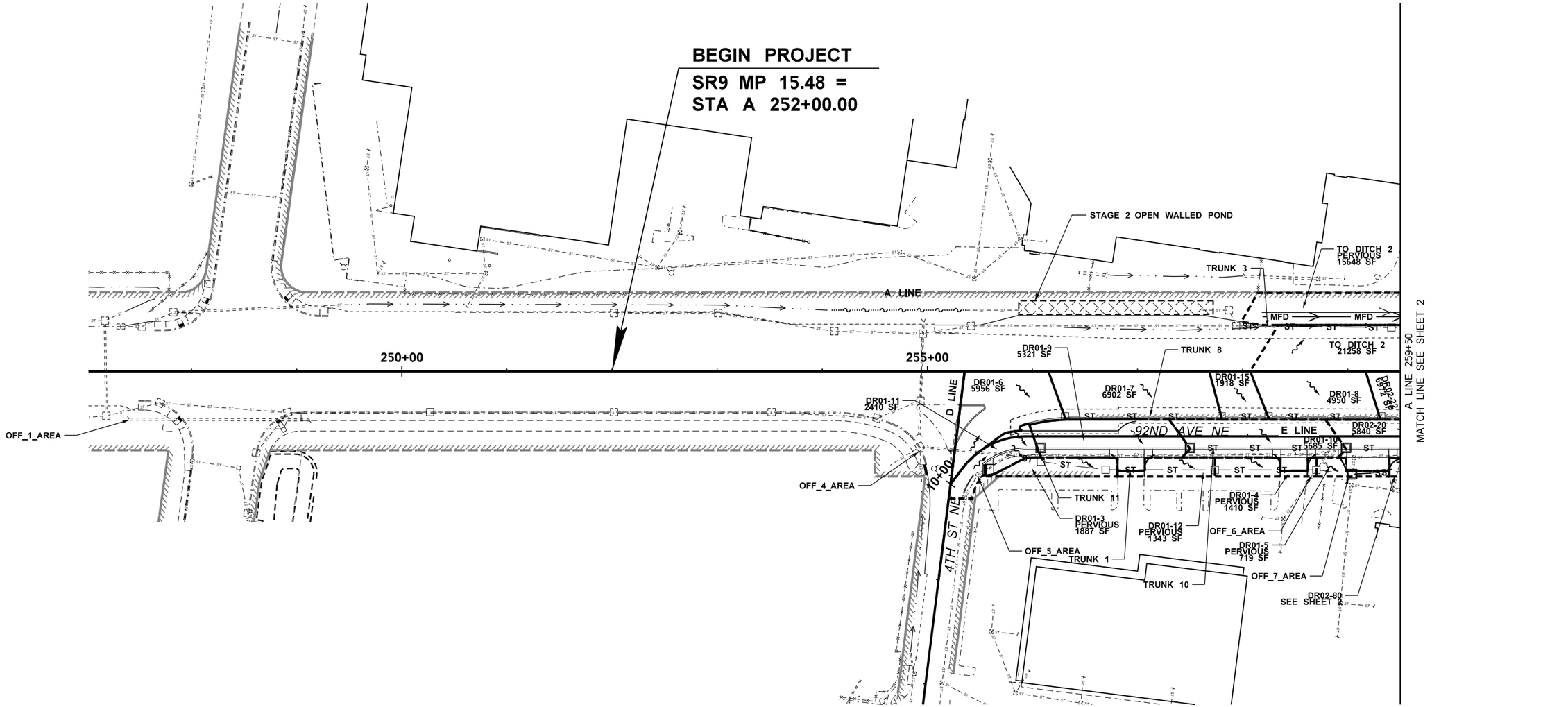
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

APPENDIX C-5

STORM DRAIN DESIGN

NOTES:

1. SEE FIGURE A-3.6 FOR OFFSITE AREAS.
2. CONVEYANCE IS BASED OFF OF 03/31/2021 ROADWAY DESIGN.
3. CATCHMENT AREAS ARE IMPERVIOUS UNLESS OTHERWISE NOTED.



LEGEND

EXISTING STORM DRAIN PIPE	EXISTING DITCH	MFD	MEDIA FILTER DRAIN (MFD)
WETLAND BOUNDARY	EXISTING CULVERT	ST ST	PROPOSED STORM DRAIN PIPE
EXISTING CATCH BASIN	PROPOSED BIOFILTRATION SWALE		PROPOSED DITCH
EXISTING R/W	PROPOSED TDA BOUNDARY		FLOW ARROWS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

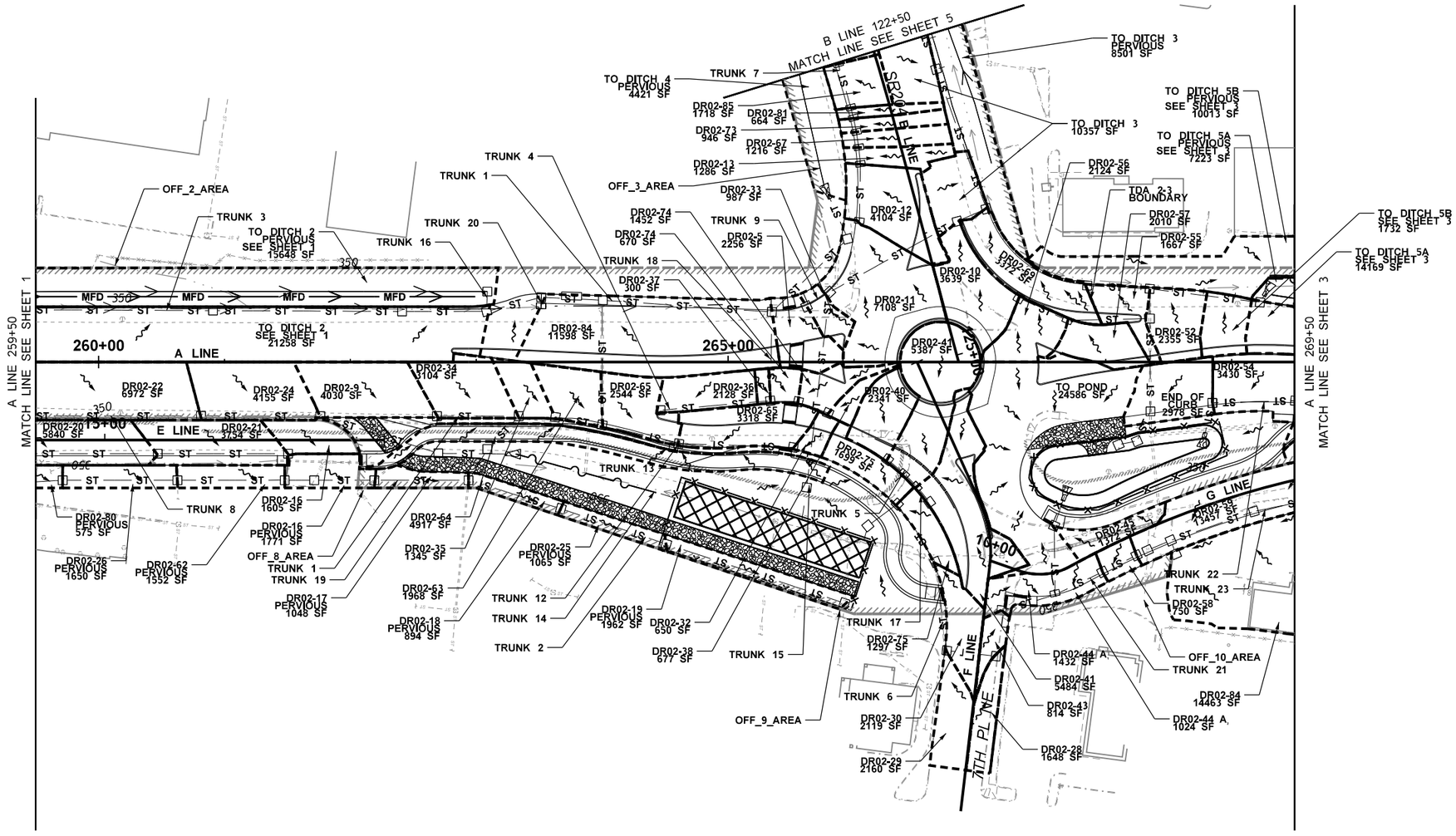
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.5 CONVEYANCE CATCHMENT AREA SHEET 1

0 50 100
SCALE IN FEET

NOTES:

1. SEE FIGURE A-3.6 FOR OFFSITE AREAS.
2. CONVEYANCE IS BASED OFF OF 03/31/2021 ROADWAY DESIGN.
3. CATCHMENT AREAS ARE IMPERVIOUS UNLESS OTHERWISE NOTED.



LEGEND

EXISTING STORM DRAIN PIPE	EXISTING DITCH	MFD	MEDIA FILTER DRAIN (MFD)
WETLAND BOUNDARY	EXISTING CULVERT	ST — ST	PROPOSED STORM DRAIN PIPE
EXISTING CATCH BASIN	PROPOSED BIOFILTRATION SWALE		PROPOSED DITCH
EXISTING R/W	PROPOSED TDA BOUNDARY		FLOW ARROWS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

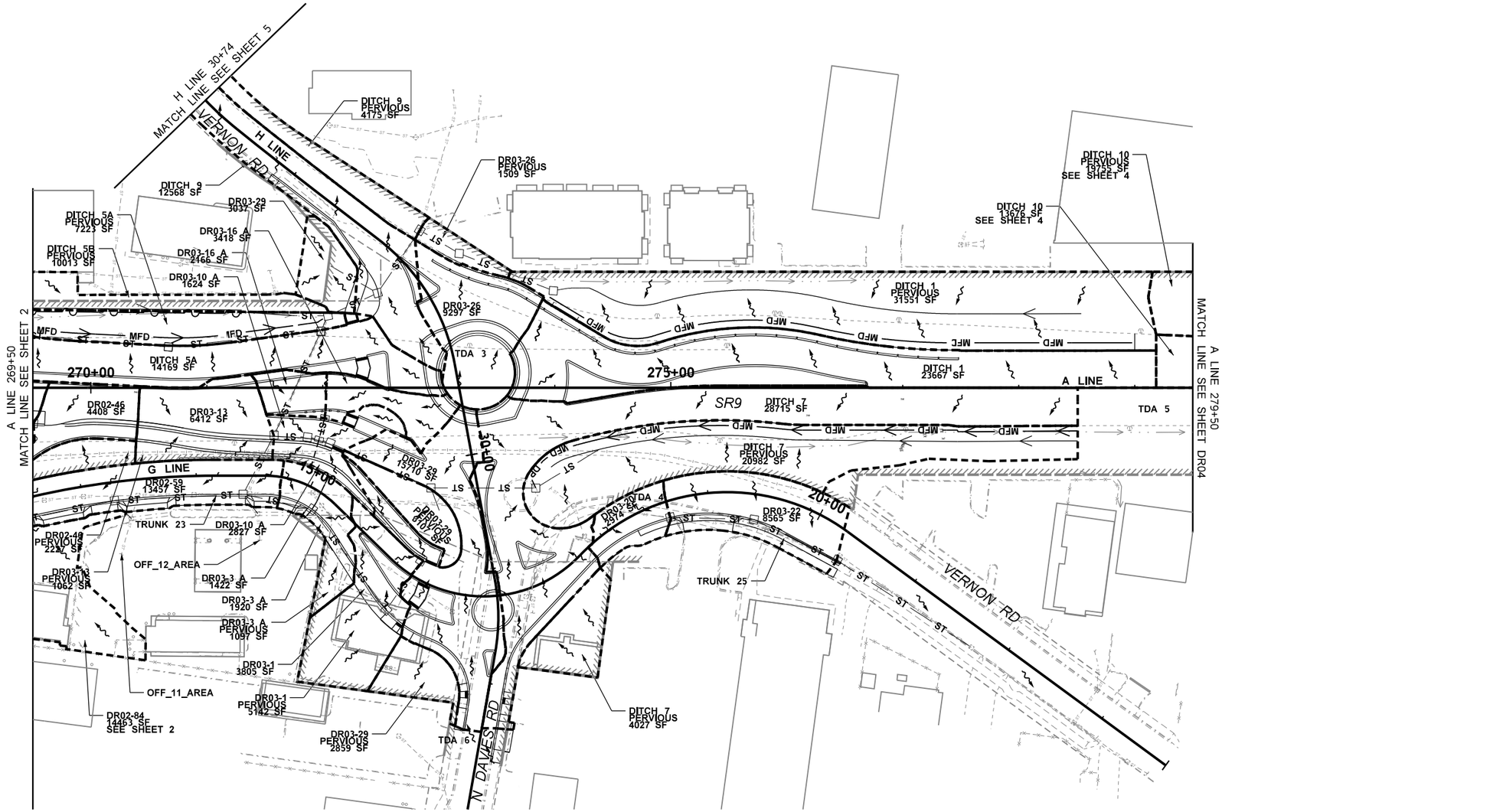
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.5 CONVEYANCE CATCHMENT AREA SHEET 2

0 50 100
SCALE IN FEET

NOTES:

1. SEE FIGURE A-3.6 FOR OFFSITE AREAS.
2. CONVEYANCE IS BASED OFF OF 03/31/2021 ROADWAY DESIGN.
3. CATCHMENT AREAS ARE IMPERVIOUS UNLESS OTHERWISE NOTED.



LEGEND

EXISTING STORM DRAIN PIPE	EXISTING DITCH	MFD	MEDIA FILTER DRAIN (MFD)
WETLAND BOUNDARY	EXISTING CULVERT	ST ST	PROPOSED STORM DRAIN PIPE
EXISTING CATCH BASIN	PROPOSED BIOFILTRATION SWALE		PROPOSED DITCH
EXISTING R/W	PROPOSED TDA BOUNDARY		FLOW ARROWS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

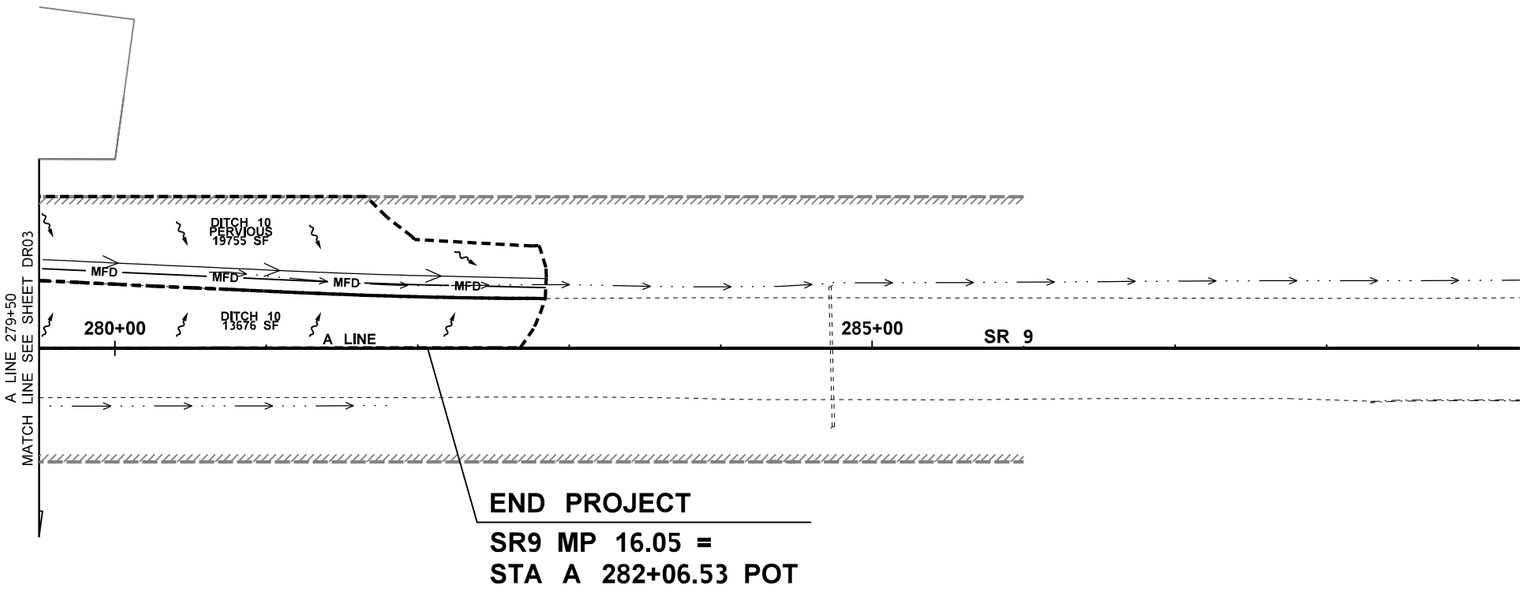
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.5 CONVEYANCE CATCHMENT AREA SHEET 3

0 50 100
SCALE IN FEET

NOTES:

1. SEE FIGURE A-3.6 FOR OFFSITE AREAS.
2. CONVEYANCE IS BASED OFF OF 03/31/2021 ROADWAY DESIGN.
3. CATCHMENT AREAS ARE IMPERVIOUS UNLESS OTHERWISE NOTED.



LEGEND

EXISTING STORM DRAIN PIPE	EXISTING DITCH	MFD	MEDIA FILTER DRAIN (MFD)
WETLAND BOUNDARY	EXISTING CULVERT	ST ST	PROPOSED STORM DRAIN PIPE
EXISTING CATCH BASIN	PROPOSED BIOFILTRATION SWALE		PROPOSED DITCH
EXISTING R/W	PROPOSED TDA BOUNDARY		FLOW ARROWS

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Washington State Department of Transportation

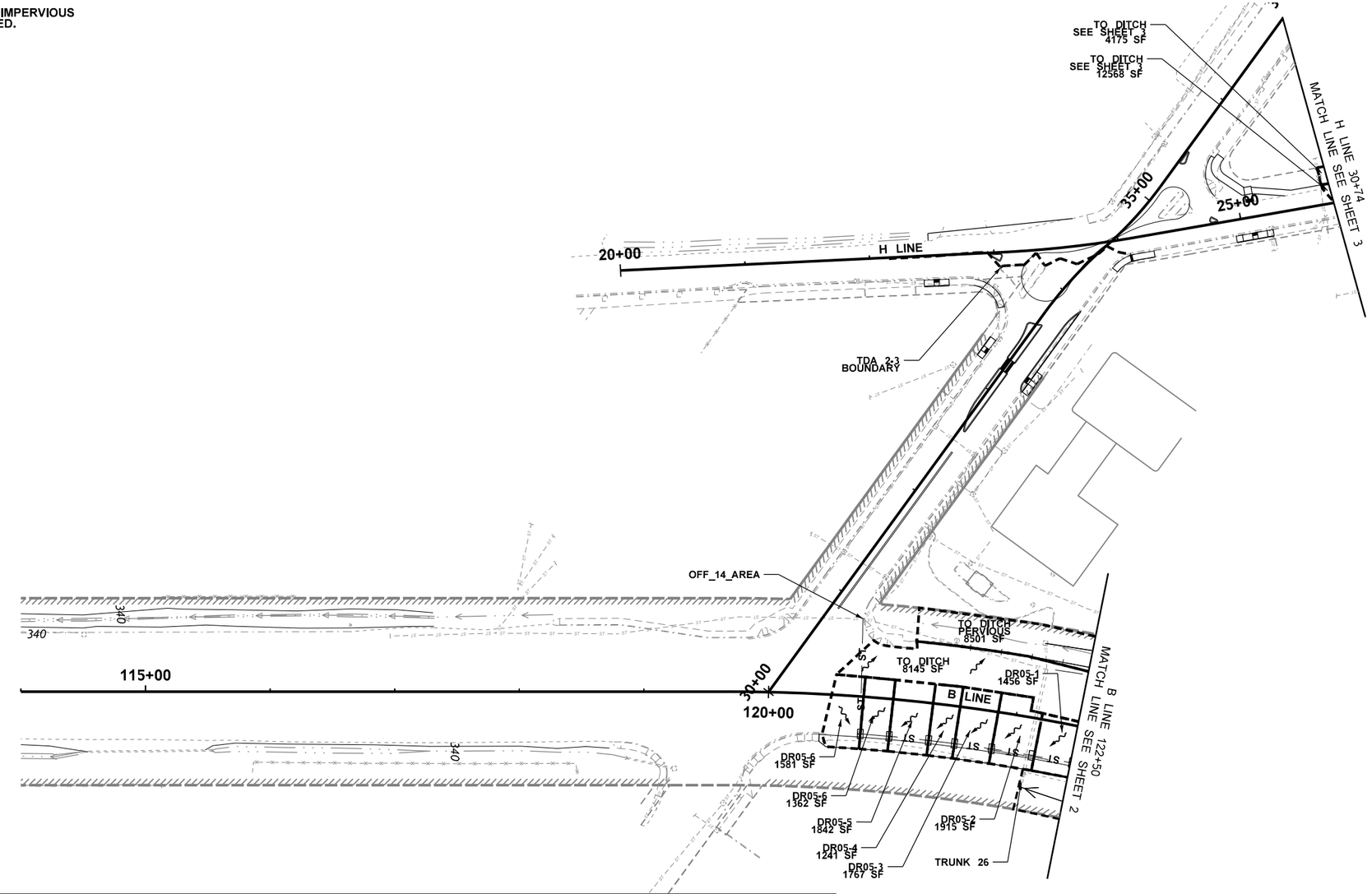
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.5 CONVEYANCE CATCHMENT AREA SHEET 4

0 50 100
SCALE IN FEET

NOTES:

1. SEE FIGURE A-3.6 FOR OFFSITE AREAS.
2. CONVEYANCE IS BASED OFF OF 03/31/2021 ROADWAY DESIGN.
3. CATCHMENT AREAS ARE IMPERVIOUS UNLESS OTHERWISE NOTED.



LEGEND

EXISTING STORM DRAIN PIPE	EXISTING DITCH	MFD	MEDIA FILTER DRAIN (MFD)
WETLAND BOUNDARY	EXISTING CULVERT	ST ST	PROPOSED STORM DRAIN PIPE
EXISTING CATCH BASIN	PROPOSED BIOFILTRATION SWALE		PROPOSED DITCH
EXISTING R/W	PROPOSED TDA BOUNDARY		FLOW ARROWS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.5 CONVEYANCE CATCHMENT AREA SHEET 5

0 50 100
SCALE IN FEET

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 6 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																		Drain Profile														Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b													
F LINE	DR02-28	CATCH BASIN TYPE 1	72+45.0	13.4 RT	72+45.0	25.9 RT	Roadway	1,648	0.038	0.95	0.04	0.04	5.0	5.0	3.07	0.11	0.00	0.11	12	0.013	0.0088	4.24	3.33	VELOCITY OK	ADEQUATE PIPE CAPACITY	40.0	0.35	345.98	345.63	350.01	349.65	4.03	2.01	2.00	More than 2 ft of cover	More than 2 ft of cover	
F LINE	DR02-29	CATCH BASIN TYPE 1	72+45.0	25.9 RT	266+65.0	158.8 RT	Roadway	2,160	0.050	0.95	0.05	0.08	5.0	5.0	3.07	0.25	0.00	0.25	12	0.013	0.0230	6.87	5.39	VELOCITY OK	ADEQUATE PIPE CAPACITY	71.0	1.63	345.63	344.00	349.65	348.02	4.02	2.00	2.00	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR02-30	CATCH BASIN TYPE 1	266+65.0	158.8 RT	266+34.0	112.8 RT	Roadway	2,119	0.049	0.95	0.05	0.13	5.0	5.2	3.01	0.39	0.00	0.39	12	0.013	0.0387	8.92	7.00	VELOCITY OK	ADEQUATE PIPE CAPACITY	55.0	2.13	344.00	341.87	348.02	345.90	4.02	2.00	2.01	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR02-75	CATCH BASIN TYPE 1	266+34.0	112.8 RT	266+11.0	130.1 RT	Roadway	2,996	0.069	0.95	0.07	0.19	5.0	5.3	2.97	0.58	0.88	1.46	12	0.013	0.0044	3.01	2.36	VELOCITY OK	ADEQUATE PIPE CAPACITY	25.0	0.11	341.87	341.76	345.90	346.79	4.03	2.01	3.01	More than 2 ft of cover	More than 2 ft of cover	Inflow from Trunk 5
A LINE	DR02-31	CATCH BASIN TYPE 2 48IN. DIAM. W/ SOLID LID	266+11.0	130.1 RT	266+08.0	141.5 RT		-	0.000	0.95	0.00	0.19	5.0	5.4	2.93	0.58	0.00	1.46	12	0.013	0.0046	3.08	2.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	13.0	0.06	341.76	341.70	346.79	347.00	5.03	3.01	3.28	More than 2 ft of cover	More than 2 ft of cover	Discharges in to the walled pond. CB in pervious area; pavement thickness not included in pipe cover calcs

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 5 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location								Discharge Drainage Design																				Drain Profile										Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b												
F LINE	DR02-40	CATCH BASIN TYPE 1	70+61.0	53.1 RT	70+77.0	45.4 RT	Roadway	2,341	0.054	0.95	0.05	0.05	5.0	5.0	3.07	0.16	0.00	0.16	12	0.013	0.0106	4.67	3.66	VELOCITY OK	ADEQUATE PIPE CAPACITY	17.0	0.18	342.68	342.50	346.87	346.75	4.19	2.17	2.23	More than 2 ft of cover	More than 2 ft of cover	
F LINE	DR02-82	GRATE INLET TYPE 2	70+77.0	45.4 RT	70+90.0	40.5 RT	Roadway	5,387	0.124	0.95	0.12	0.17	5.0	5.0	3.07	0.52	0.00	0.52	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	14.0	0.07	342.50	342.43	346.75	346.66	4.25	2.23	2.21	More than 2 ft of cover	More than 2 ft of cover	Added area to DR02-41 in u/s structure - DR02-82 to be conservative for pipe sizes
F LINE	DR02-41	GRATE INLET TYPE 2	70+90.0	40.5 RT	266+34.0	112.8 RT	Roadway		0.000	0.95	0.00	0.17	5.0	5.1	3.04	0.52	0.37	0.88	12	0.013	0.0255	7.24	5.68	VELOCITY OK	ADEQUATE PIPE CAPACITY	22.0	0.56	342.43	341.87	346.66	345.90	4.23	2.21	2.01	More than 2 ft of cover	More than 2 ft of cover	Inflows from Trunk 17; Connects to DR02-75
								7,728																													

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 17 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																		Drain Profile										Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b										
F LINE	DR02-42	CATCH BASIN TYPE 1	71+06.0	36.5 RT	70+90.0	40.5 RT	Roadway	5,484	0.126	0.95	0.12	0.12	5.0	5.0	3.07	0.37	0.00	0.37	12	0.013	0.0137	5.32	4.17	VELOCITY OK	ADEQUATE PIPE CAPACITY	16.0	0.22	342.65	342.43	346.93	346.66	4.28	2.26	2.21	More than 2 ft of cover	More than 2 ft of cover	Connects to DR02-41 (Trunk 5). Add area to DR02-41 to u/s structure - DR02-42 for conservative pipe size

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 8 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location																Discharge Drainage Design											Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b													
A LINE	DR01-6	CATCH BASIN TYPE 1	256+31.0	42.7 RT	257+80.0	42.7 RT	Roadway	5,956	0.137	0.95	0.13	0.13	5.0	5.0	3.07	0.40	0.00	0.40	12	0.013	0.0188	6.22	4.88	VELOCITY OK	ADEQUATE PIPE CAPACITY	149.0	2.80	351.78	348.98	355.80	353.00	4.02	2.00	2.00	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR01-7	CATCH BASIN TYPE 1	257+80.0	42.7 RT	258+25.0	42.8 RT	Roadway	6,902	0.158	0.95	0.15	0.28	5.0	5.0	3.07	0.86	0.00	0.86	12	0.013	0.0104	4.63	3.64	VELOCITY OK	ADEQUATE PIPE CAPACITY	45.0	0.47	348.98	348.51	353.00	352.53	4.02	2.00	2.00	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR01-15	CATCH BASIN TYPE 1	258+25.0	42.8 RT	259+32.0	42.8 RT	Roadway	1,918	0.044	0.95	0.04	0.32	5.0	5.2	3.01	0.97	0.00	0.97	12	0.013	0.0145	5.46	4.28	VELOCITY OK	ADEQUATE PIPE CAPACITY	107.0	1.55	348.51	348.96	352.53	350.98	4.02	2.00	2.00	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR01-8	CATCH BASIN TYPE 1	259+32.0	42.8 RT	260+81.0	42.8 RT	Roadway	4,950	0.114	0.95	0.11	0.39	5.0	5.2	3.01	1.17	0.00	1.17	12	0.013	0.0116	4.89	3.83	VELOCITY OK	ADEQUATE PIPE CAPACITY	149.0	1.73	346.96	345.23	350.98	347.75	4.02	2.00	0.50	More than 2 ft of cover	Low Cover - See Notes at Bottom	CONC CL V
A LINE	DR02-22	CATCH BASIN TYPE 1	260+81.0	42.8 RT	261+76.0	42.9 RT	Roadway	6,972	0.160	0.95	0.15	0.54	5.0	5.7	2.85	1.54	0.00	1.54	12	0.013	0.0087	4.24	3.33	VELOCITY OK	ADEQUATE PIPE CAPACITY	95.0	0.83	345.23	344.40	347.75	346.92	2.52	0.50	0.50	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC CL V
A LINE	DR02-24	CATCH BASIN TYPE 1	261+76.0	42.9 RT	262+70.0	72.5 RT	Roadway	4,155	0.095	0.95	0.09	0.63	5.0	6.0	2.75	1.73	0.00	1.73	12	0.013	0.0115	4.87	3.82	VELOCITY OK	ADEQUATE PIPE CAPACITY	98.0	1.13	344.40	343.27	346.92	348.53	2.52	0.50	3.24	Low Cover - See Notes at Bottom	More than 2 ft of cover	CONC CL V
A LINE	DR02-68	CATCH BASIN TYPE 2 48IN. DIAM. W/ SOLID LID	262+70.0	72.5 RT	263+31.0	73.1 RT			0.000	0.95	0.00	0.63	5.0	6.4	2.66	1.73	0.00	1.73	12	0.013	0.0110	4.75	3.73	VELOCITY OK	ADEQUATE PIPE CAPACITY	61.0	0.67	343.27	342.60	348.53	342.60	5.26	3.24	-2.02	More than 2 ft of cover	Not Enough Cover - Need to Revise Pipe Elevations	Downstream pipe discharges to CABS bottom

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to
model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 14 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location								Drainage Area									Discharge Drainage Design							Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*											
A LINE	DR02-78	PIPE FROM CABS	264+43.0	103.8 RT	264+62.0	108.0 RT	Roadway		0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	0.49	0.49	12	0.013	0.0058	3.45	2.71	VELOCITY OK	ADEQUATE PIPE CAPACITY	19.0	0.11	340.18	340.07	340.18	346.21	0.00	-2.02	4.12	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	25-yr inflow from RT 2-7 MGSFlood for CABS. D/S pipe from outfall of CABS-daylights Pipe is located outside of roadway; discharges to the walled pond

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 15 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location								Drainage Area										Discharge Drainage Design								Drain Profile														Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b														
A LINE	DR02-39	CATCH BASIN TYPE 2 54IN. DIAM. W/ BEEHIVE GRATE AND FC	265+62.0	99.6 RT	265+81.0	55.6 LT			0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	0.22	0.22	12	0.013	0.0046	3.08	2.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	156.0	0.72	340.07	339.35	346.40	346.59	6.33	4.31	5.22	More than 2 ft of cover	More than 2 ft of cover	Pipe from walled pond FC. Use 25-yr flow rate from walled pond MGSFlood calcs
A LINE	DR02-68	CATCH BASIN TYPE 2 48IN. DIAM. W/ SOLID LID	265+81.0	55.6 LT	123+98.0	28.1 LT			0.000	0.95	0.00	0.00	5.0	0.8	3.07	0.00	0.07	0.29	12	0.013	0.0044	3.02	2.37	VELOCITY OK	ADEQUATE PIPE CAPACITY	117.0	0.52	339.35	338.83	346.59	346.90	7.24	5.22	6.05	More than 2 ft of cover	More than 2 ft of cover	Trunk 9 inflows
B LINE	DR02-10	CATCH BASIN TYPE 2 48IN. DIAM.	123+98.0	28.1 LT	123+94.0	52.8 LT	Roadway	3,639	0.084	0.95	0.08	0.08	5.0	5.0	3.07	0.24	0.00	0.53	12	0.013	0.0046	3.07	2.41	VELOCITY OK	ADEQUATE PIPE CAPACITY	24.0	0.11	338.83	338.72	346.90	346.52	8.07	6.05	5.78	More than 2 ft of cover	More than 2 ft of cover	
B LINE	DR02-69	CATCH BASIN TYPE 2 48IN. DIAM.	123+94.0	52.8 LT	122+77.0	43.5 LT	Roadway	3,372	0.077	0.95	0.07	0.15	5.0	5.1	3.02	0.46	0.00	0.75	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	118.0	0.59	338.72	338.13	346.52	346.26	7.80	5.78	6.11	More than 2 ft of cover	More than 2 ft of cover	
B LINE	DR02-70	CATCH BASIN TYPE 2 48IN. DIAM. W/ SOLID LID	122+77.0	43.5 LT	122+18.0	40.6 LT		-	0.000	0.95	0.00	0.15	5.0	5.7	2.83	0.46	0.00	0.75	12	0.013	0.0053	3.31	2.60	VELOCITY OK	ADEQUATE PIPE CAPACITY	62.0	0.33	338.13	337.80	346.26	345.55	8.13	6.11	5.73	More than 2 ft of cover	More than 2 ft of cover	Connect to existing manhole
B LINE		EXISTING STRUCTURE AND PIPE	122+18.0	40.6 LT	120+72.0	63.0 LT		-	0.000	0.95	0.00	0.15	5.0	6.1	2.74	0.46	0.00	0.75	24	0.013	0.0013	2.60	8.17	INCREASE VE	ADEQUATE PIPE CAPACITY	153.0	0.20	337.80	337.60	345.55	342.76	7.75	4.73	2.14	More than 2 ft of cover	More than 2 ft of cover	Existing pipe has sufficient capacity. Existing pipe is flat, velocity cannot be increased

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 9 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Discharge Drainage Design						Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2													Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14e*				*17a*	*17b*										
A LINE	DR02-33	GRATE INLET TYPE 2	265+62.0	44.1 LT	265+81.0	55.6 LT	Roadway	987	0.023	0.95	0.02	0.02	5.0	5.0	3.07	0.07	0.00	0.07	12	0.013	0.0068	3.74	2.94	VELOCITY OK	ADEQUATE PIPE CAPACITY	22.0	0.15	342.55	342.40	346.64	346.59	4.09	2.07	2.17	More than 2 ft of cover	More than 2 ft of cover	Adequate cover for 12" pipe. Connects to DR02-68 (Trunk 15)

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

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The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
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STORM SEWER DESIGN (English Units)

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Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 16 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2.5

Location							Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Discharge Drainage Design							Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2													Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a						14a					17a	17b											
A LINE	DR02-7	CATCH BASIN TYPE 2 48IN. DIAM. W/ BEEHIVE GRATE	263+09.0	56.0 LT	263+08.0	40.3 LT	Pervious ditch		0.000	0.30	0.00	0.00	5.0	0.0	3.07	0.00	10.62	10.62	24	0.013	0.0028	3.79	11.91	VELOCITY OK	ADEQUATE PIPE CAPACITY	18.0	0.05	341.22	341.17	343.74	346.38	2.52	0.52	3.21	Low Cover - See Notes at Bottom	More than 2 ft of cover	25-year flow from Ditch calculations (TDA 2 MFD+Ditch - A LINE SR9 LT). Sufficient cover in pervious area - no vehicular traffi

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

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The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 3 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 3.5

Location																	Discharge Drainage Design						Drain Profile										Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*											
A LINE	DR01-14	EX CB	257+92.0	43.1 LT	259+42.0	41.6 LT	Stage 2-DR3-6		0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	16.61	16.61	24	0.013	0.0180	9.66	30.32	VELOCITY OK	ADEQUATE PIPE CAPACITY	150.0	2.70	347.10	344.40	352.29	349.60	5.19	2.05	2.06	More than 2 ft of cover	More than 2 ft of cover	U/S pipe elevations for SR9 Stage 2 pipe DR3-6. See Stage 2 hydraulic report Appendix C-S.Sufficient cover for 24" pipe
A LINE	DR01-13	CATCH BASIN TYPE 2 54IN. DIAM. W/ SOLID LID	259+42.0	41.6 LT	260+91.0	40.9 LT			0.000	0.95	0.00	0.00	5.0	0.3	3.07	0.00	0.00	16.61	30	0.013	0.0028	4.42	21.68	VELOCITY OK	ADEQUATE PIPE CAPACITY	150.0	0.42	342.01	341.59	349.60	346.73	7.59	3.95	1.50	More than 2 ft of cover	Low Cover - See Notes at Bottom	Concrete pipe CL III
A LINE	DR02-1	CATCH BASIN TYPE 2 54IN. DIAM. W/ SOLID LID	260+91.0	40.9 LT	262+41.0	40.2 LT			0.000	0.95	0.00	0.00	5.0	0.8	3.07	0.00	0.00	16.61	30	0.013	0.0019	3.67	18.02	VELOCITY OK	ADEQUATE PIPE CAPACITY	150.0	0.29	341.59	341.30	346.73	347.00	5.14	1.50	2.06	Low Cover - See Notes at Bottom	More than 2 ft of cover	Concrete pipe CL III
A LINE	DR02-2	CATCH BASIN TYPE 2 54IN. DIAM. W/ SOLID LID	262+41.0	40.2 LT	263+08.0	40.3 LT			0.000	0.95	0.00	0.00	5.0	1.5	3.07	0.00	0.00	16.61	30	0.013	0.0019	3.68	18.05	VELOCITY OK	ADEQUATE PIPE CAPACITY	67.0	0.13	341.30	341.17	347.00	346.38	5.70	2.06	1.57	More than 2 ft of cover	Low Cover - See Notes at Bottom	Concrete pipe CL III
A LINE	DR02-3	CATCH BASIN TYPE 2 54IN. DIAM. W/ SOLID LID	263+08.0	40.3 LT	263+52.0	51.5 LT			0.000	0.95	0.00	0.00	5.0	1.8	3.07	0.00	10.62	27.23	30	0.013	0.0071	7.04	34.55	VELOCITY OK	ADEQUATE PIPE CAPACITY	45.0	0.32	341.17	340.85	346.38	346.37	5.21	1.57	1.88	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL III; Inflow from Trunk 16
A LINE	DR02-71	CATCH BASIN TYPE 2 54IN. DIAM. W/ SOLID LID	263+52.0	51.5 LT	264+00.0	48.3 LT			0.000	0.95	0.00	0.00	5.0	1.9	3.07	0.00	0.78	28.01	30	0.013	0.0051	5.97	29.27	VELOCITY OK	ADEQUATE PIPE CAPACITY	49.0	0.25	340.85	340.60	346.37	346.30	5.52	1.88	2.06	Low Cover - See Notes at Bottom	More than 2 ft of cover	Concrete pipe CL III; Inflow from Trunk 20; Pipe discharges to DR02-4 (Trunk 1)

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 20 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Drainage Area										Discharge Drainage Design							Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*											
A LINE	DR02-84	GRATE INLET TYPE 2	263+51.0	44.6 LT	263+52.0	51.5 LT	Roadway	11,598	0.266	0.95	0.25	0.25	5.0	5.0	3.07	0.78	0.00	0.78	12	0.013	0.0071	3.83	3.01	VELOCITY OK	ADEQUATE PIPE CAPACITY	7.0	0.05	342.40	342.35	345.90	345.77	3.50	1.48	1.40	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL III, Connects to DR02-71 (Trunk 3)

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 12 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																			Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
								8a												*14a*				*17a*	*17b*											
A LINE	DR02-64	CATCH BASIN TYPE 2 48IN. DIAM. W/ BEEHIVE GRATE	264+57.0	68.4 RT	264+61.0	64.8 RT	Sidewalk	4,917	0.113	0.95	0.11	0.11	5.0	5.0	3.07	0.33	0.00	0.33	12	0.013	0.0400	9.07	7.12	VELOCITY OK	ADEQUATE PIPE CAPACITY	5.0	0.20	341.90	341.70	345.36	345.84	3.46	1.44	2.12	Low Cover - See Notes at Bottom	More than 2 ft of cover	To Trunk 13; Sufficient cover. Pipe in pervious area. Pavement thickness not included in u/s cover calcs

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative as4917 sf

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 13 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																		Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b											
A LINE	DR02-32	CATCH BASIN TYPE 1	265+52.0	67.7 RT	264+61.0	64.8 RT	Roadway	650	0.015	0.95	0.01	0.01	5.0	5.0	3.07	0.04	0.00	0.04	12	0.013	0.0047	3.12	2.45	VELOCITY OK	ADEQUATE PIPE CAPACITY	91.0	0.43	342.13	341.70	346.17	345.84	4.04	2.02	2.12	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR02-65	CATCH BASIN TYPE 1	264+61.0	64.8 RT	264+00.0	50.0 RT	Roadway	5,862	0.135	0.95	0.13	0.14	5.0	5.0	3.07	0.44	0.33	0.76	12	0.013	0.0039	2.82	2.21	INCREASE VE	ADEQUATE PIPE CAPACITY	62.0	0.24	341.70	341.46	345.84	346.10	4.14	2.12	2.62	More than 2 ft of cover	More than 2 ft of cover	Inflow from Trunk 12

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 19 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																				Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*													
A LINE	DR02-9	CATCH BASIN TYPE 1	262+69.0	42.9 RT	263+34.0	42.9 RT	Roadway	4,030	0.093	0.95	0.09	0.09	5.0	5.0	3.07	0.27	0.00	0.27	12	0.013	0.0109	4.74	3.72	VELOCITY OK	ADEQUATE PIPE CAPACITY	65.0	0.71	342.47	341.76	346.74	346.40	4.27	2.25	2.62	More than 2 ft of cover	More than 2 ft of cover	Adequate cover for 12" pipe, connect to DR02-34 (Trunk 1)

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 4 & 18 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																Drain Profile										Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
Trunk 4													8a							14a				17a	17b										
A LINE	DR02-36	CATCH BASIN TYPE 1	264+46.0	38.2 RT	265+34.0	30.8 RT	Roadway	2,128	0.049	0.95	0.05	0.05	5.0	5.0	3.07	0.14	0.00	0.14	12	0.013	0.0044	3.02	2.37	VELOCITY OK	ADEQUATE PIPE CAPACITY	88.0	0.39	342.48	342.09	346.50	346.73	4.02	2.00	2.62	More than 2 ft of cover	More than 2 ft of cover	Connects to DR02-37 (Trunk 18)
Trunk 4																																				
A LINE	DR02-38	CATCH BASIN TYPE 1	265+79.0	40.6 RT	265+56.0	31.4 RT	Roadway	677	0.016	0.95	0.01	0.01	5.0	5.0	3.07	0.05	0.00	0.05	12	0.013	0.0044	3.01	2.36	VELOCITY OK	ADEQUATE PIPE CAPACITY	25.0	0.11	342.76	342.65	346.78	346.70	4.02	2.00	2.03	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR02-74	CATCH BASIN TYPE 1	265+56.0	31.4 RT	265+34.0	30.8 RT	Roadway	2,122	0.049	0.95	0.05	0.05	5.0	5.0	3.07	0.14	0.00	0.14	12	0.013	0.0255	7.24	5.68	VELOCITY OK	ADEQUATE PIPE CAPACITY	22.0	0.56	342.65	342.09	346.70	346.73	4.05	2.03	2.62	More than 2 ft of cover	More than 2 ft of cover	Connects to DR02-37 (Trunk 18)
Trunk 18																																				
A LINE	DR02-37	CATCH BASIN TYPE 2 48IN. DIAM.	265+34.0	30.8 RT	265+35.0	39.8 LT	Roadway	300	0.007	0.95	0.01	0.01	5.0	5.0	3.07	0.02	0.28	0.30	12	0.013	0.0048	3.14	2.46	VELOCITY OK	ADEQUATE PIPE CAPACITY	71.0	0.34	342.09	341.75	346.73	346.42	4.64	2.62	2.65	More than 2 ft of cover	More than 2 ft of cover	Inflow from Trunk 4; Connects to DR02-5 (Trunk 1)
								5,227																												

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 10,11 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																	Drain Profile										Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
Trunk 10													8a							14a				17a	17b										
E LINE	DR01-9	CATCH BASIN TYPE 1	12+45.0	10.9 RT	13+93.0	10.9 RT	Roadway	5,321	0.122	0.95	0.12	0.12	5.0	5.0	3.07	0.36	0.00	0.36	12	0.013	0.0049	3.19	2.50	VELOCITY OK	ADEQUATE PIPE CAPACITY	148.0	0.73	350.43	349.70	354.40	352.63	3.97	1.95	0.91	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL V
E LINE	DR01-10	CATCH BASIN TYPE 1	13+93.0	10.9 RT	15+42.0	10.9 RT	Roadway	5,685	0.131	0.95	0.12	0.24	5.0	5.0	3.07	0.74	0.00	0.74	12	0.013	0.0114	4.84	3.80	VELOCITY OK	ADEQUATE PIPE CAPACITY	149.0	1.70	349.70	348.00	352.63	350.67	2.93	0.91	0.65	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL V
E LINE	DR02-20	CATCH BASIN TYPE 1	15+42.0	10.9 RT	16+46.0	10.9 RT	Roadway	5,840	0.134	0.95	0.13	0.37	5.0	5.5	2.90	1.07	0.00	1.07	12	0.013	0.0110	4.75	3.73	VELOCITY OK	ADEQUATE PIPE CAPACITY	103.0	1.13	348.00	346.87	350.67	349.58	2.67	0.65	0.69	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL V
E LINE	DR02-21	CATCH BASIN TYPE 1	16+46.0	10.9 RT	261+47.0	93.8 RT	Roadway	3,754	0.086	0.95	0.08	0.45	5.0	5.9	2.79	1.26	0.00	1.26	12	0.013	0.0045	3.06	2.40	VELOCITY OK	ADEQUATE PIPE CAPACITY	22.0	0.10	346.87	346.77	349.58	351.55	2.71	0.69	2.76	Low Cover - See Notes at Bottom	More than 2 ft of cover	Concrete pipe CL V , connects to DR02-62 (Trunk 1)
Trunk 11																																				
E LINE	DR01-11	CATCH BASIN TYPE 1	11+03.0	10.9 RT	256+08.0	85.9 RT	Roadway	2,410	0.055	0.95	0.05	0.05	5.0	5.0	3.07	0.16	0.00	0.16	12	0.013	0.0046	3.08	2.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	13.0	0.06	352.85	352.79	356.20	356.60	3.35	1.33	1.79	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Conc pipe CL IV; connects to DR01-2 (Trunk 1)

23,010

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 2 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.00 | **Pipe Thickness (inches) =** 2.5

Location								Drainage Area										Discharge Drainage Design						Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14e*				*17a*	*17b*											
A LINE	DR02-19	CATCH BASIN TYPE 1	265+92.0	191.4 RT	264+51.0	144.5 RT	Pervious	1,962	0.045	0.30	0.01	0.01	5.0	5.0	3.07	0.04	3.03	3.07	18	0.013	0.0030	3.27	5.77	VELOCITY OK	ADEQUATE PIPE CAPACITY	149.0	0.45	345.90	345.45	349.00	351.28	3.10	1.39	4.12	Low Cover - See Notes at Bottom	More than 2 ft of cover	CONC CL IV, inflow from OFF_9. Pipe in pervious area; pavement thickness not included in pipe cover calculations
A LINE	DR02-25	CATCH BASIN TYPE 2 48IN. DIAM.	264+51.0	144.5 RT	263+67.0	116.4 RT	Pervious	1,065	0.024	0.30	0.01	0.02	5.0	5.8	2.83	0.06	0.00	3.09	18	0.013	0.0031	3.33	5.89	VELOCITY OK	ADEQUATE PIPE CAPACITY	89.0	0.28	345.45	345.17	351.28	351.90	5.83	4.12	5.02	More than 2 ft of cover	More than 2 ft of cover	Pipe in pervious area; pavement thickness not included in pipe cover calculations
A LINE	DR02-18	CATCH BASIN TYPE 2 48IN. DIAM.	263+67.0	116.4 RT	262+94.0	93.9 RT	Pervious	894	0.021	0.30	0.01	0.03	5.0	6.2	2.71	0.07	0.00	3.10	18	0.013	0.0032	3.39	5.98	VELOCITY OK	ADEQUATE PIPE CAPACITY	77.0	0.25	345.17	344.92	351.90	350.36	6.73	5.02	3.73	More than 2 ft of cover	More than 2 ft of cover	Connects to DR02-17 (Trunk 1). Pipe in pervious area; pavement thickness not included in pipe cover calculations

Per figure 2-2 in 2019 Hydraulics Manual, runoff coefficient for flat pasture/meadow is 0.25 for a 10-yr MRI. For 25-yr, the coefficient shall be increased by 10%. A conservative coefficient of 0.30 is used for flat pasture for calculations.
A conservative time of concentration of 5 mins is assumed for the pervious catchment areas

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 1 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 3.5

Location							Discharge Drainage Design																Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*					*17a*	*17b*											
A LINE	DR01-1	EXISTING CATCH BASN	255+78.0	79.6 RT	256+08.0	85.9 RT	Offsite		0.000	0.30	0.00	0.00	5.0	0.0	3.07	0.00	11.95	11.95	18	0.013	0.0240	9.21	16.26	VELOCITY OK	ADEQUATE PIPE CAPACITY	35.0	0.84	353.13	352.29	356.16	356.60	3.03	0.39	1.67	Not Enough Cover - Need to Revise Pipe Elevations	Low Cover - See Notes at Bottom	U/S structure is existing D/s cover not achieved to meet velocity requirements. Use Concrete pipe CL V. Inflows from OFF_1 OFF_4 and OFF_5
A LINE	DR01-2	CATCH BASIN TYPE 2 48IN. DIAM. W/ SOLID LID	256+08.0	85.9 RT	256+70.0	93.6 RT			0.000		0.00	0.00	5.0	0.1	3.07	0.00	0.16	12.11	24	0.013	0.0059	5.52	17.32	VELOCITY OK	ADEQUATE PIPE CAPACITY	63.0	0.37	351.79	351.42	356.60	356.52	4.81	1.67	1.96	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Trunk 11 inflows. Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR01-3	CATCH BASIN TYPE 2 48IN. DIAM.	256+70.0	93.6 RT	257+74.0	93.9 RT	Pervious	1,887	0.043	0.30	0.01	0.01	5.0	5.0	3.07	0.04	0.00	12.15	24	0.013	0.0040	4.57	14.36	VELOCITY OK	ADEQUATE PIPE CAPACITY	104.0	0.42	351.42	351.00	356.52	356.07	5.10	1.96	1.93	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR01-12	CATCH BASIN TYPE 2 48IN. DIAM.	257+74.0	93.9 RT	258+70.0	93.8 RT	Pervious	1,343	0.031	0.30	0.01	0.02	5.0	5.4	2.94	0.07		12.17	24	0.013	0.0115	7.71	24.19	VELOCITY OK	ADEQUATE PIPE CAPACITY	96.0	1.10	351.00	349.90	356.07	355.03	5.07	1.93	1.99	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR01-4	CATCH BASIN TYPE 2 72IN. DIAM.	258+70.0	93.8 RT	259+04.0	97.9 RT	Offsite & Pervious	1,410	0.032	0.30	0.01	0.03	5.0	5.6	2.88	0.09	1.53	13.73	24	0.013	0.0147	8.73	27.40	VELOCITY OK	ADEQUATE PIPE CAPACITY	34.0	0.50	349.90	349.40	355.03	353.90	5.13	1.99	1.36	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	OFF_6 inflows. Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR01-5	CATCH BASIN TYPE 2 48IN. DIAM.	259+04.0	97.9 RT	259+71.0	93.9 RT	Offsite & Pervious	719	0.017	0.30	0.00	0.04	5.0	5.7	2.86	0.11	4.43	18.17	24	0.013	0.0074	6.17	19.38	VELOCITY OK	ADEQUATE PIPE CAPACITY	68.0	0.50	349.40	348.90	353.90	354.45	4.50	1.36	2.41	Low Cover - See Notes at Bottom	More than 2 ft of cover	OFF_7 inflows.Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR02-80	CATCH BASIN TYPE 2 54IN. DIAM.	259+71.0	93.9 RT	260+63.0	93.8 RT	Pervious	575	0.013	0.30	0.00	0.04	5.0	5.7	2.86	0.10		18.17	24	0.013	0.0133	8.30	26.06	VELOCITY OK	ADEQUATE PIPE CAPACITY	91.0	1.21	348.90	347.69	354.45	352.80	5.55	2.41	1.97	More than 2 ft of cover	Low Cover - See Notes at Bottom	Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR02-26	CATCH BASIN TYPE 2 48IN. DIAM.	260+63.0	93.8 RT	261+47.0	93.8 RT	Pervious	1,650	0.038	0.30	0.01	0.05	5.0	5.8	2.81	0.13		18.20	24	0.013	0.0145	8.66	27.18	VELOCITY OK	ADEQUATE PIPE CAPACITY	85.0	1.23	347.69	346.46	352.80	351.55	5.11	1.97	1.95	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR02-62	CATCH BASIN TYPE 2 48IN. DIAM.	261+47.0	93.8 RT	261+71.0	93.8 RT	Pervious	1,552	0.036	0.30	0.01	0.06	5.0	6.0	2.76	0.16	1.26	19.48	24	0.013	0.0178	9.61	30.17	VELOCITY OK	ADEQUATE PIPE CAPACITY	23.0	0.41	346.46	346.05	351.55	351.18	5.09	1.95	1.99	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Trunk 10 inflows. Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR02-15	CATCH BASIN TYPE 2 48IN. DIAM. W/ SOLID LID	261+71.0	93.8 RT	262+19.0	93.8 RT	Roadway		0.000	0.95	0.00	0.06	5.0	6.0	2.75	0.16		19.48	24	0.013	0.0135	8.38	26.30	VELOCITY OK	ADEQUATE PIPE CAPACITY	48.0	0.65	346.05	345.40	351.18	350.79	5.13	1.99	2.25	Low Cover - See Notes at Bottom	More than 2 ft of cover	
A LINE	DR02-16	CATCH BASIN TYPE 2 60IN. DIAM.	262+19.0	93.8 RT	262+94.0	93.9 RT	Offsite & Roadway & Pervious**	3,376	0.078	0.61	0.05	0.11	5.0	6.1	2.72	0.29	1.28	20.88	30	0.013	0.0067	6.82	33.45	VELOCITY OK	ADEQUATE PIPE CAPACITY	75.0	0.50	344.90	344.40	350.79	350.36	5.89	2.25	2.32	More than 2 ft of cover	More than 2 ft of cover	OFF_8 inflows
A LINE	DR02-17	CATCH BASIN TYPE 2 54IN. DIAM.	262+94.0	93.9 RT	263+09.0	69.1 RT	Pervious	1,048	0.024	0.30	0.01	0.11	5.0	6.3	2.68	0.30	3.10	24.00	30	0.013	0.0034	4.91	24.06	VELOCITY OK	ADEQUATE PIPE CAPACITY	29.0	0.10	344.40	344.30	350.36	348.70	5.96	2.32	0.76	More than 2 ft of cover	Low Cover - See Notes at Bottom	Concrete pipe CL III; Trunk 2 inflows. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR02-27	CATCH BASIN TYPE 2 54IN. DIAM. W/ SOLID LID	263+09.0	69.1 RT	263+34.0	42.9 RT	Offsite		0.000	0.30	0.00	0.11	5.0	6.3	2.68	0.29		23.99	30	0.013	0.0039	5.21	25.55	VELOCITY OK	ADEQUATE PIPE CAPACITY	36.0	0.14	341.90	341.76	348.70	346.40	6.80	3.16	1.00	More than 2 ft of cover	Low Cover - See Notes at Bottom	Concrete pipe CL III, Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR02-34	CATCH BASIN TYPE 2 60IN. DIAM.	263+34.0	42.9 RT	263+63.0	43.6 RT	Roadway	3,104	0.071	0.95	0.07	0.17	5.0	6.4	2.65	0.46	0.27	24.43	30	0.013	0.0048	5.80	28.47	VELOCITY OK	ADEQUATE PIPE CAPACITY	29.0	0.14	341.76	341.62	346.40	346.27	4.64	1.00	1.01	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL IV; Trunk 19 inflows
A LINE	DR02-35	CATCH BASIN TYPE 2 54IN. DIAM.	263+63.0	43.6 RT	264+00.0	50.0 RT	Roadway	1,345	0.031	0.95	0.03	0.20	5.0	6.5	2.63	0.53		24.50	30	0.013	0.0042	5.42	26.59	VELOCITY OK	ADEQUATE PIPE CAPACITY	38.0	0.16	341.62	341.46	346.27	346.10	4.65	1.01	1.00	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL IV
A LINE	DR02-63	CATCH BASIN TYPE 2 54IN. DIAM.	264+00.0	50.0 RT	264+00.0	48.3 LT	Roadway	1,968	0.045	0.95	0.04	0.04	5.0	5.0	3.07	0.13	0.76	24.86	30	0.013	0.0038	5.15	25.26	VELOCITY OK	ADEQUATE PIPE CAPACITY	98.0	0.36	341.46	341.10	346.10	346.30	4.64	1.00	1.56	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL IV; Trunk 13 inflows
A LINE	DR02-4	CATCH BASIN TYPE 2 72IN. DIAM. W/ SOLID LID	264+00.0	48.3 LT	265+35.0	39.8 LT	Offsite		0.000	0.95	0.00	0.04	5.0	0.0	3.07	0.00	28.01	52.74	42	0.013	0.0034	6.10	58.67	VELOCITY OK	ADEQUATE PIPE CAPACITY	135.0	0.46	340.10	339.64	346.30	346.42	6.20	1.56	2.14	Low Cover - See Notes at Bottom	More than 2 ft of cover	Concrete pipe CL III; Trunk 3 inflows
A LINE	DR02-5	CATCH BASIN TYPE 2 72IN. DIAM.	265+35.0	39.8 LT	265+95.0	97.9 LT	Roadway	2,256	0.052	0.95	0.05	0.09	5.0	5.0	3.07	0.15	0.30	53.19	42	0.013	0.0032	5.93	56.98	VELOCITY OK	ADEQUATE PIPE CAPACITY	84.0	0.27	339.64	339.37	346.42	346.58	6.78	2.14	2.57	More than 2 ft of cover	More than 2 ft of cover	Trunk 18 inflows
A LINE	DR02-6	CATCH BASIN TYPE 2 72IN. DIAM. W/ SOLID LID	265+95.0	97.9 LT	265+76.0	142.9 LT			0.000	0.95	0.00	0.09	5.0	0.0	3.07	0.00		53.04	42	0.013	0.0031	5.78	55.61	VELOCITY OK	ADEQUATE PIPE CAPACITY	49.0	0.15	339.37	339.22	346.58	339.22	7.21	2.57	-4.64	More than 2 ft of cover	Not Enough Cover - Need to Revise Pipe Elevations	Beveled end into ditch

Per figure 2-2 in 2019 Hydraulics Manual, runoff coefficient for flat pasture/meadow is 0.25 for a 10-yr MRI. For 25-yr, the coefficient shall be increased by 10%. A conservative coefficient of 0.30 is used for flat pasture for calculations.
A conservative time of concentration of 5 mins is assumed for the pervious catchment areas
** Composit "C" calculation is provided for pervious area= 1771 sf and roadway area=1605 sf draining to DR02-16.

$C_{imp.}$	0.95	$C_{perv.}$	0.30
$A_{imp.}$ (SF)	1605	$A_{perv.}$ (SF)	1771

C_{total} (DR02-16)=	0.61

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Notes:

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The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 7 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.85 | **Pipe Thickness (inches) =** 2

Location							Drainage Area									Discharge Drainage Design								Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 14)...	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8e							*14a*				*17a*	*17b*											
B LINE	DR02-11	GRATE INLET TYPE 2 (ROTATED)	123+77.0	47.0 RT	123+34.0	34.4 RT	Roadway	7,108	0.163	0.95	0.16	0.16	5.0	5.0	3.07	0.48	0.00	0.48	12	0.013	0.0049	3.17	2.49	VELOCITY OK	ADEQUATE PIPE CAPACITY	45.0	0.22	342.42	342.20	345.90	345.04	3.48	1.46	0.82	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR02-12	GRATE INLET TYPE 2 (ROTATED)	123+34.0	34.4 RT	123+20.0	32.3 RT	Roadway	4,104	0.094	0.95	0.09	0.24	5.0	5.2	2.99	0.73	0.00	0.73	12	0.013	0.0077	3.98	3.12	VELOCITY OK	ADEQUATE PIPE CAPACITY	13.0	0.10	342.20	342.10	345.04	344.87	2.84	0.82	0.75	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR02-13	GRATE INLET TYPE 2 (ROTATED)	123+20.0	32.3 RT	123+08.0	30.9 RT	Roadway	1,286	0.030	0.95	0.03	0.27	5.0	5.3	2.97	0.81	0.00	0.81	12	0.013	0.0117	4.90	3.84	VELOCITY OK	ADEQUATE PIPE CAPACITY	12.0	0.14	342.10	341.96	344.87	344.77	2.77	0.75	0.79	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR02-67	GRATE INLET TYPE 2 (ROTATED)	123+08.0	30.9 RT	122+97.0	30.2 RT	Roadway	1,216	0.028	0.95	0.03	0.30	5.0	5.3	2.96	0.88	0.00	0.88	12	0.013	0.0045	3.06	2.40	VELOCITY OK	ADEQUATE PIPE CAPACITY	11.0	0.05	341.96	341.91	344.77	344.74	2.81	0.79	0.81	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR02-73	GRATE INLET TYPE 2 (ROTATED)	122+97.0	30.2 RT	122+88.0	30.0 RT	Roadway	946	0.022	0.95	0.02	0.32	5.0	5.4	2.94	0.94	0.00	0.94	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	8.0	0.04	341.91	341.87	344.74	344.72	2.83	0.81	0.83	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR02-81	GRATE INLET TYPE 2 (ROTATED)	122+88.0	30.0 RT	122+51.0	30.0 RT	Roadway	664	0.015	0.95	0.01	0.33	5.0	5.4	2.92	0.98	0.00	0.98	12	0.013	0.0046	3.07	2.41	VELOCITY OK	ADEQUATE PIPE CAPACITY	37.0	0.17	341.87	341.70	344.72	344.48	2.85	0.83	0.76	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR02-85	GRATE INLET TYPE 2 (ROTATED)	122+51.0	30.0 RT	122+20.0	30.0 RT	Roadway	1,718	0.039	0.95	0.04	0.37	5.0	5.6	2.86	1.06	0.00	1.06	12	0.013	0.0045	3.05	2.39	VELOCITY OK	ADEQUATE PIPE CAPACITY	31.0	0.14	341.70	341.56	344.48	344.22	2.78	0.76	0.64	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR05-1	GRATE INLET TYPE 2 (ROTATED)	122+20.0	30.0 RT	121+84.0	30.0 RT	Roadway	1,456	0.033	0.95	0.03	0.40	5.0	5.8	2.81	1.14	0.00	1.14	12	0.013	0.0459	9.71	7.62	VELOCITY OK	ADEQUATE PIPE CAPACITY	34.0	1.56	341.56	340.00	344.22	343.91	2.66	0.64	1.89	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL V
B LINE	DR05-2	GRATE INLET TYPE 2 (ROTATED)	121+84.0	30.0 RT	121+54.0	30.0 RT	Roadway	1,915	0.044	0.95	0.04	0.45	5.0	5.9	2.80	1.25	0.00	1.25	12	0.013	0.0232	6.91	5.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	31.0	0.72	340.00	339.28	343.91	343.65	3.91	1.89	2.35	Low Cover - See Notes at Bottom	More than 2 ft of cover	CONC PIPE CL III
B LINE	DR05-3	GRATE INLET TYPE 2 (ROTATED)	121+54.0	30.0 RT	121+32.0	30.0 RT	Roadway	1,767	0.041	0.95	0.04	0.48	5.0	5.9	2.78	1.34	0.00	1.34	12	0.013	0.0052	3.28	2.58	VELOCITY OK	ADEQUATE PIPE CAPACITY	21.0	0.11	339.28	339.17	343.65	343.59	4.37	2.35	2.40	More than 2 ft of cover	More than 2 ft of cover	
B LINE	DR05-4	GRATE INLET TYPE 2 (ROTATED)	121+32.0	30.0 RT	121+00.0	30.0 RT	Roadway	1,241	0.028	0.95	0.03	0.51	5.0	6.0	2.75	1.40	0.00	1.40	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	32.0	0.16	339.17	339.01	343.59	343.36	4.42	2.40	2.33	More than 2 ft of cover	More than 2 ft of cover	
B LINE	DR05-5	GRATE INLET TYPE 2 (ROTATED)	121+00.0	30.0 RT	120+76.0	30.0 RT	Roadway	1,842	0.042	0.95	0.04	0.55	5.0	6.2	2.71	1.49	0.00	1.49	12	0.013	0.0048	3.14	2.46	VELOCITY OK	ADEQUATE PIPE CAPACITY	23.0	0.11	339.01	338.90	343.36	343.25	4.35	2.33	2.33	More than 2 ft of cover	More than 2 ft of cover	
B LINE	DR05-6	GRATE INLET TYPE 2 (ROTATED)	120+76.0	30.0 RT	120+71.0	62.5 LT	Roadway	2,943	0.068	0.95	0.06	0.62	5.0	6.3	2.67	1.65	0.00	1.65	12	0.013	0.0056	3.39	2.66	VELOCITY OK	ADEQUATE PIPE CAPACITY	95.0	0.53	338.90	338.37	343.25	342.55	4.35	2.33	2.16	More than 2 ft of cover	More than 2 ft of cover	
		EXISTING CATCH BASIN	120+71.0	62.5 LT	119+76.0	60.1 LT	Roadway		0.000	0.95	0.00	0.62	5.0	6.8	2.57	1.65	0.56	2.21	24	0.013	0.0067	5.89	18.50	VELOCITY OK	ADEQUATE PIPE CAPACITY	100.0	0.67	337.37	336.70	342.55	343.42	5.18	2.16	3.70	More than 2 ft of cover	More than 2 ft of cover	Checked capacity of ex 24" pipe downstream; capacity available; inflow from OFF_14. RIM and IE for existing pipe from as builts

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR9 / SR204 Corridor and Interchange Improvements - Stage 3

Designed By: S.Sridharan
Project Office: Osborn Consulting, Inc.

Trunk 26 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.00 | **Pipe Thickness (inches) =** 3

Location							Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Discharge Drainage Design						Drain Profile										Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2													Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*										
A LINE	DR05-7	EXTEND CULVERT	122+13.0	56.6 RT	122+13.0	53.0 RT	Pervious	4,421	0.101	0.30	0.03	0.03	5.0	5.0	3.07	0.09	53.04	53.14	24	0.013	0.0100	7.20	22.60	VELOCITY OK	NEED MORE CAPACITY	4.0	0.04	338.88	338.84	338.84	345.00	0.00	-2.25	3.91	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	Pipe daylights to bottom of proposed ditch, connect to ex. 24" culvert d/s
A LINE		EXISTING CULVERT	122+13.0	53.0 RT	122+18.0	40.6 LT		-	0.000	0.95	0.00	0.03	5.0	5.0	3.07	0.09		53.14	24	0.013	0.0111	7.57	23.77	VELOCITY OK	NEED MORE CAPACITY	94.0		338.84	337.80	345.00	345.55	6.16	3.91	5.50	More than 2 ft of cover	More than 2 ft of cover	Existing culvert under SR204 does not have sufficient capacity. In existing conditions, the culvert is already under sized. This prevents the wetland from being fully drained and maintains the wetland hydroperiod. See Wetland hydroperiod calculations. In proposed conditions, the existing pipe size is not upsized to maintain the wetland hydroperiods.

Per figure 2-2 in 2019 Hydraulics Manual, runoff coefficient for flat pasture/meadow is 0.25 for a 10-yr MRI. For 25-yr, the coefficient shall be increased by 10%. A conservative coefficient of 0.30 is used for flat pasture for calculations.
A conservative time of concentration of 5 mins is assumed for the pervious catchment areas

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

Name	Total Area		Wetland Area		Remaining Imp.Area	25-yr flow rates from MGSFlood
	SF	AC	SF	AC	AC	CFS
OFF_1	86640.20	1.99		0.00	1.99	1.364
OFF_2	560575.80	12.87		0.00	12.87	8.822
OFF_3	619337.00	14.22	86584.50	1.99	12.23	8.527
OFF_4	860991.30	19.77	278749.60	6.40	13.37	9.541
OFF_5	66379.00	1.52		0.00	1.52	1.042
OFF_6	97048.50	2.23		0.00	2.23	1.529
OFF_7	281528.20	6.46		0.00	6.46	4.428
OFF_8	81104.60	1.86		0.00	1.86	1.275
OFF_9	192430.20	4.42		0.00	4.42	3.03
OFF_10	16863.40	0.39		0.00	0.39	0.267
OFF_11	23416.90	0.54		0.00	0.54	0.37
OFF_12	12246.70	0.28		0.00	0.28	0.192
OFF_14	35831.80	0.82		0.00	0.82	0.562

Note: Offsite areas enter the WSDOT ROW into bypass trunk systems

TRUNK 21

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.65 **Pipe Thickness (inches) =** 2

Location						Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Discharge Drainage Design							Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.														Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b											
G LINE	DR02-59	Catch Basin Type 1	11+18	15.9 RT	10+87	15.9 RT	ROADWAY	13,457	0.309	0.95	0.29	0.29	5.0	5.0	3.07	0.90	0.00	0.90	12	0.013	0.0057	3.41	2.68	VELOCITY OK	ADEQUATE PIPE CAPACITY	30.0	0.17	344.38	344.21	348.63	348.58	4.25	2.43	2.55	More than 2 ft of cover	More than 2 ft of cover	
G LINE	DR02-58	Catch Basin Type 1	10+87	15.9 RT	10+50	16.2 RT	ROADWAY	750	0.017	0.95	0.02	0.31	5.0	5.1	3.02	0.93	0.00	0.93	12	0.013	0.0055	3.36	2.63	VELOCITY OK	ADEQUATE PIPE CAPACITY	42.0	0.23	344.21	343.98	348.58	348.51	4.37	2.55	2.71	More than 2 ft of cover	More than 2 ft of cover	
G LINE	DR02-44	Grate Inlet Type 2	10+50	16.2 RT	10+70	34.3 LT	ROADWAY	2,456	0.056	0.95	0.05	0.36	5.0	5.4	2.95	1.07	0.05	1.13	12	0.013	0.0057	3.41	2.68	VELOCITY OK	ADEQUATE PIPE CAPACITY	53.0	0.30	343.98	343.68	348.51	348.46	4.53	2.71	2.96	More than 2 ft of cover	More than 2 ft of cover	
G LINE - A LINE	DR02-45	Catch Basin Type 1	10+70	34.3 LT	267+67	106.2 RT	ROADWAY	1,372	0.031	0.95	0.03	0.39	5.0	5.6	2.87	1.13	0.00	1.18	12	0.013	0.0054	3.34	2.62	VELOCITY OK	ADEQUATE PIPE CAPACITY	24.0	0.13	343.68	343.55	348.46	343.55	4.78	2.96	-1.82	More than 2 ft of cover	Not Enough Cover - Need to Revise Pipe Elevations	FC 3-1 Detention Pond inlet pipe

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

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Please report any problems to the WSDOT HQ Hydraulics Office.

TRUNK 21

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.65 **Pipe Thickness (inches) =** 2

Location						Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Discharge Drainage Design							Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.														Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b											
7th Pl NE - Vernon Rd	DR02-43	Catch Basin Type 1	72+08	13.5 LT	10+50	16.2 RT	ROADWAY	814	0.019	0.95	0.02	0.02	5.0	5.0	3.07	0.05	0.00	0.05	12	0.013	0.0151	5.57	4.37	VELOCITY OK	ADEQUATE PIPE CAPACITY	45.0	0.68	344.66	343.98	349.04	348.51	4.38	2.56	2.71	More than 2 ft of cover	More than 2 ft of cover	

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 1.00 **Pipe Thickness (inches) =** 2

Location																		
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)
													8a					
SR 9	DR02-48	Catch Basin Type 2 54 In. Diam w/ FR	268+10	65.5 RT	268+25	62.7 RT	-	-	0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	0.19	0.19
SR 9	DR02-49	Catch Basin Type 2 48 In. Diam w/ Beehive Grate	268+25	62.7 RT	268+36	39.1 RT	-	-	0.000	0.95	0.00	0.00	5.0	0.1	3.07	0.00	0.00	0.19
SR 9	DR02-50	Catch Basin Type 2 48 In. Diam w/ Solid Lid	268+36	39.1 RT	268+35	34.6 LT	-	-	0.000	0.95	0.00	0.00	5.0	0.2	3.07	0.00	0.00	0.19
SR 9	DR02-51	Catch Basin Type 2 48 In. Diam w/ Solid Lid	268+35	34.6 LT	268+35	58.2 LT	-	-	0.000	0.95	0.00	0.00	5.0	0.5	3.07	0.00	0.27	0.46
SR 9	DR02-52	Catch Basin Type 2 48 In. Diam	268+35	58.2 LT	269+23	47.4 LT	-	-	0.000	0.95	0.00	0.00	5.0	0.7	3.07	0.00	0.00	0.46
SR 9	DR02-53	Catch Basin Type 2 96 In. Diam w/ Flow Splitter	269+23	47.4 LT	269+03	64.1 LT	-	-	0.000	0.95	0.00	0.00	5.0	1.1	3.07	0.00	0.00	0.46

Structure ID	Discharge Drainage Design							
	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)
		14a				17a	17b
DR02-48	12	0.013	0.0073	3.88	3.05	VELOCITY OK	ADEQUATE PIPE CAPACITY
DR02-49	12	0.013	0.0068	3.74	2.93	VELOCITY OK	ADEQUATE PIPE CAPACITY
DR02-50	12	0.013	0.0062	3.58	2.81	VELOCITY OK	ADEQUATE PIPE CAPACITY
DR02-51	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY
DR02-52	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY
DR02-53	12	0.013	0.0072	3.85	3.02	VELOCITY OK	ADEQUATE PIPE CAPACITY

Structure ID	Drain Profile											Remarks
	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
DR02-48	15.0	0.11	343.58	343.47	347.63	345.69	4.05	1.88	0.05	Low Cover - See Notes at Bottom	Not Enough Cover - Need to Revise Pipe Elevations	Pond FC 3-1 outlet control structure with flow restrictor, contributing flow is 100-yr pond discharge, Rim set at top of pond elevatior
DR02-49	28.0	0.19	343.47	343.28	345.69	347.57	2.22	0.05	2.12	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	Pond FC 3-1 Emergency Overflow Structure, US pipe end outside of roadway, Rim set at 100-yr WSEL of pond
DR02-50	74.0	0.46	343.28	342.82	347.57	347.51	4.29	2.12	2.52	More than 2 ft of cover	More than 2 ft of cover	
DR02-51	24.0	0.12	342.82	342.70	347.51	347.19	4.69	2.52	2.32	More than 2 ft of cover	More than 2 ft of cover	Inflow from DR02-57
DR02-52	88.0	0.44	342.70	342.26	347.19	347.15	4.49	2.32	2.72	More than 2 ft of cove	More than 2 ft of cove	
DR02-53	18.0	0.13	342.26	342.13	347.15	342.13	4.89	2.72	-2.17	More than 2 ft of cover	Not Enough Cover - Need to Revise Pipe Elevations	Flow Splitter, Pipe outfalls to proposed Wet Biofiltration Swale

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to
model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.90 **Pipe Thickness (inches) =** 2

Location																	Discharge Drainage Design													Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*														
A Line	DR02-56	Catch Basin Type 1	267+31	51.0 LT	267+69	33.2 LT	ROADWAY	2,124	0.049	0.95	0.05	0.05	5.0	5.0	3.07	0.14	0.00	0.14	12	0.013	0.0052	3.28	2.58	VELOCITY OK	ADEQUATE PIPE CAPACITY	42.0	0.22	343.39	343.17	347.06	347.28	3.67	1.60	2.04	Low Cover - See Notes at Bottom	More than 2 ft of cover	CL IV Conc Pipe
A Line	DR02-57	Grate Inlet Type 2	267+69	33.2 LT	268+35	34.6 LT	ROADWAY	2,010	0.046	0.95	0.04	0.09	5.0	5.2	3.00	0.27	0.00	0.27	12	0.013	0.0053	3.30	2.59	VELOCITY OK	ADEQUATE PIPE CAPACITY	66.0	0.35	343.17	342.82	347.28	347.51	4.11	2.04	2.62	More than 2 ft of cover	More than 2 ft of cover	

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Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.90 **Pipe Thickness (inches) =** 2

Location																	Discharge Drainage Design							Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acres)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*											
A Line	DR02-55	Catch Basin Type 1	267+85	60.8 RT	268+35	58.2 LT	ROADWAY	2,355	0.054	0.95	0.05	0.05	5.0	5.0	3.07	0.16	0.00	0.16	12	0.013	0.0100	4.54	3.56	VELOCITY OK	ADEQUATE PIPE CAPACITY	50.0	0.50	343.20	342.70	346.92	347.19	3.72	1.65	2.42	Low Cover - See Notes at Bottom	More than 2 ft of cover	CL III Conc Pipe,

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 1.00 **Pipe Thickness (inches) =** 2

Location																			Discharge Drainage Design								Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b												
A LINE	DR02-46	Catch Basin Type 1	269+51	30.7 RT	268+85	32.4 RT	ROADWAY	6,635	0.152	0.74	0.11	0.11	5.0	5.0	3.07	0.35	0.00	0.35	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	66.0	0.33	344.16	343.83	347.86	347.69	3.70	1.53	1.69	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL III Conc Pipe, Composite C value equal to the weighted average of 4408 SF impervious (0.95) and 2227 SF pervious (0.33) area draining to structure
A LINE	DR02-54	Catch Basin Type 1	268+85	32.4 RT	268+79	59.2 RT	ROADWAY	3,430	0.079	0.95	0.07	0.19	5.0	5.3	2.95	0.55	0.00	0.55	12	0.013	0.0089	4.29	3.36	VELOCITY OK	ADEQUATE PIPE CAPACITY	28.0	0.25	343.83	343.58	347.69	343.58	3.86	1.69	-2.17	Low Cover - See Notes at Bottom	Not Enough Cover - Need to Revise Pipe Elevations	CL III Conc Pipe

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to
model the conveyance system. Please contact your region Hydraulic Contact.

WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

TRUNK 23

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.90 **Pipe Thickness (inches) =** 2.5

Location								Drainage Area								Discharge Drainage Design							Drain Profile										Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b											
G LINE	DR02-60	Catch Basin Type 1 w/ Solid Lid	11+28	15.9 RT	11+48	15.9 RT	OFF-SITE AREA 10	-	0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	0.27	0.27	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	20.0	0.10	345.88	345.78	348.64	348.68	2.76	0.65	0.79	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL V Conc Pipe, Offsite flows
G LINE	DR02-85	Catch Basin Type 1 w/ Solid Lid	11+48	15.9 RT	12+20	15.9 RT	-	-	0.000	0.95	0.00	0.00	5.0	0.1	3.07	0.00	1.00	1.27	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	69.8	0.35	345.78	345.43	348.68	348.98	2.90	0.79	1.44	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL V Conc Pipe, Offsite flows
G LINE	DR02-61	Catch Basin Type 1 w/ Solid Lid	12+20	15.9 RT	13+27	15.9 RT	-	-	0.000	0.95	0.00	0.00	5.0	0.5	3.07	0.00	0.00	1.27	12	0.013	0.0050	3.19	2.50	VELOCITY OK	ADEQUATE PIPE CAPACITY	105.0	0.52	345.43	344.91	348.98	349.95	3.55	1.44	2.93	Low Cover - See Notes at Bottom	More than 2 ft of cover	CL III Conc Pipe,
G LINE	DR03-28	Catch Basin Type 2 48 In. Diam. w/ Solid Lid	13+27	15.9 RT	14+40	15.9 RT	OFF-SITE AREA 11	-	0.000	0.95	0.00	0.00	5.0	1.0	3.07	0.00	0.37	1.64	12	0.013	0.0050	3.19	2.51	VELOCITY OK	ADEQUATE PIPE CAPACITY	111.0	0.55	344.91	344.36	349.95	351.04	5.04	2.93	4.57	More than 2 ft of cover	More than 2 ft of cover	Offsite flows
G LINE - A LINE	DR03-4	Catch Basin Type 2 48 In. Diam. w/ Solid Lid	14+40	15.9 RT	271+58	40.7 RT	OFF-SITE AREA 12	-	0.000	0.95	0.00	0.00	5.0	1.6	3.07	0.00	0.77	2.42	12	0.013	0.0333	8.27	6.49	VELOCITY OK	ADEQUATE PIPE CAPACITY	58.0	1.93	344.36	342.43	351.04	347.43	6.68	4.57	2.89	More than 2 ft of cover	More than 2 ft of cover	Offsite flows from DR03-5 + flows from DR03-3
A LINE	DR03-13	Catch Basin Type 2 48 In. Diam.	271+58	40.7 RT	271+98	48.8 LT	ROADWAY	7,474	0.172	0.86	0.15	0.15	5.0	5.0	3.07	0.45	4.09	6.96	18	0.013	0.0132	6.82	12.04	VELOCITY OK	ADEQUATE PIPE CAPACITY	98.0	1.29	341.93	340.64	347.43	347.61	5.50	2.89	4.36	More than 2 ft of cover	More than 2 ft of cover	Composite C value equal to the weighted average c 6412 SF impervious (0.95) and 1062 SF pervious (0.33) area draining to structure
A LINE	DR03-19	Catch Basin Type 2 54 In. Diam. w/ Solid Lid	271+98	48.8 LT	272+04	62.2 LT	-	-	0.000	0.95	0.00	0.15	5.0	5.2	2.99	0.45	0.23	8.97	18	0.013	0.0127	6.69	11.81	VELOCITY OK	ADEQUATE PIPE CAPACITY	15.0	0.19	340.64	340.45	347.61	345.51	6.97	4.36	2.45	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-14	Catch Basin Type 2 60 In. Diam. w/ Solid Lid	272+04	62.2 LT	272+48	83.7 LT	-	-	0.000	0.95	0.00	0.15	5.0	5.3	2.97	0.45	1.78	8.97	18	0.013	0.0100	5.94	10.49	VELOCITY OK	ADEQUATE PIPE CAPACITY	47.0	0.47	340.45	339.98	345.51	346.89	5.06	2.45	4.30	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-15	Catch Basin Type 2 60 In. Diam. w/ Solid Lid	272+48	83.7 LT	272+84	135.9 LT	-	-	0.000	0.95	0.00	0.15	5.0	5.4	2.93	0.45	0.00	8.97	18	0.013	0.0197	8.34	14.72	VELOCITY OK	ADEQUATE PIPE CAPACITY	65.0	1.28	339.98	338.70	346.89	343.38	6.91	4.30	2.07	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-26	Catch Basin Type 2 48 In. Diam.	272+84	135.9 LT	273+14	237 LT	ROADWAY/PERVIOUS	6,968	0.160	0.93	0.15	0.30	5.0	5.0	3.07	0.91	2.62	12.05	18	0.013	0.0425	12.24	21.62	TRY TO REDUCE VELOCITY	ADEQUATE PIPE CAPACITY	106.0	4.50	338.70	334.20	343.38	341.50	4.68	2.07	4.69	More than 2 ft of cover	More than 2 ft of cover	New structure connecting to existing pipe

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

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Notes:

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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

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STORM SEWER DESIGN (English Units)

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Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.65 **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																								Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*																
G LINE	DR03-27	PIPE	13+40	33.1 RT	13+27	15.9 RT	OFF-SITE AREA 11	-	0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	0.37	0.37	12	0.013	0.1581	18.03	14.15	TRY TO REDUCE VELOCITY	ADEQUATE PIPE CAPACITY	21.0	3.32	348.23	344.91	351.05	348.98	2.82	1.00	2.25	Low Cover - See Notes at Bottom	More than 2 ft of cover	CL V Conc Pipe, off-site connection pipe Off-Site Area 11

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.65 **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																								Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*16*	*17a*	*17b*															
G LINE	DR02-84	Catch Basin Type 1	11+48	27.4 RT	11+48	15.9 RT	OFF-SITE AREA	15,013	0.345	0.95	0.33	0.33	5.0	5.0	3.07	1.00	0.00	1.00	12	0.013	0.0055	3.35	2.63	VELOCITY OK	ADEQUATE PIPE CAPACITY	11.0	0.06	345.84	345.78	350.14	348.68	4.30	2.48	1.08	More than 2 ft of cover	Low Cover - See Notes at Bottom	CL IV Conc Pipe, off-site parcel runoff consolidated to drain to proposed CE

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

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For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
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STORM SEWER DESIGN (English Units)

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Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.65 **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																								Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*																
G LINE	DR03-5	Pipe	14+53	32.7 RT	13+27	15.9 RT	OFF-SITE AREA 12	-	0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	0.19	0.19	12	0.013	0.1652	18.43	14.47	TRY TO REDUCE VELOCITY	ADEQUATE PIPE CAPACITY	21.0	3.47	347.83	344.36	351.41	349.95	3.58	1.76	3.77	Low Cover - See Notes at Bottom	More than 2 ft of cover	CL III Conc Pipe, off-site connection pipe Off-Site Area 12

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
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For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.65 | **Pipe Thickness (inches) =** 2

Location																		
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)
													8a					
G LINE	DR03-1	Catch Basin Type 1	16+16	15.0 LT	16+15	36.9 RT	ROADWAY/PERVIOUS AREA	8,947	0.205	0.59	0.12	0.12	5.0	5.0	3.07	0.37	0.00	0.37
G LINE	DR03-2	Catch Basin Type 2 48 In. Diam w/ Solid Lid	16+15	36.9 RT	15+12	15.9 RT	-	-	0.000	0.95	0.00	0.12	5.0	5.2	3.00	0.37	0.00	0.37
G LINE	DR03-3	Catch Basin Type 2 48 In. Diam	15+12	15.9 RT	13+27	15.9 RT	ROADWAY/PERVIOUS AREA	4,439	0.102	0.80	0.08	0.20	5.0	5.6	2.86	0.58	0.00	0.58

Structure ID	Discharge Drainage Design							Drain Profile											Remarks
	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
		14a				17a	17b												
DR03-1	12	0.013	0.0085	4.17	3.27	VELOCITY OK	ADEQUATE PIPE CAPACITY	52.0	0.44	346.28	345.84	350.63	352.73	4.35	2.53	5.07	More than 2 ft of cover	More than 2 ft of cover	Composite C value equal to the weighted average o 3805 SF impervious (0.95) and 5142 SF pervious (0.33) area draining to structure
DR03-2	12	0.013	0.0085	4.19	3.28	VELOCITY OK	ADEQUATE PIPE CAPACITY	108.0	0.92	345.84	344.92	352.73	351.11	6.89	5.07	4.37	More than 2 ft of cover	More than 2 ft of cover	
DR03-3	12	0.013	0.0092	4.35	3.41	VELOCITY OK	ADEQUATE PIPE CAPACITY	61.0	0.56	344.92	344.36	351.11	349.95	6.19	4.37	3.77	More than 2 ft of cover	More than 2 ft of cover	Connects to DR03-4, Composite C value equal to the weighted average of 3341 SF impervious (0.95) and 1097 SF pervious (0.33) area draining to structure.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

The spreadsheet will only calculate one storm sewer line at a time. Please copy the "Blank Template" and use this for calculating new storm sewer lines.
If analyzing complicated stormsewer system with multiple lateral lines to the trunk line, it is recommended that Stormshed be used to
model the conveyance system. Please contact your region Hydraulic Contact.

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.65 **Pipe Thickness (inches) =** 2.5

Location																			Discharge Drainage Design							Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b												
A LINE	DR03-40	Beveled Pipe End	273+91	73.6 RT	273+84	86.5 RT	DITCH	51,419	1.180	0.69	0.81	0.81	5.0	5.0	3.07	2.49	0.00	2.49	12	0.013	0.0191	6.26	4.91	VELOCITY OK	ADEQUATE PIPE CAPACITY	64.0	1.22	344.84	343.62	344.84	347.55	0.00	-1.86	2.07	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	Pipe is outside of roadway, Ditch Tc calc at less than 5 mins, 5 mins used,Composite C value equal to the weighted average of 29673 SF impervious (0.95) and 21746 SF pervious (0.33) area draining to structure.
A LINE	DR03-7	Catch Basin Type 2 48 In. Diam w/Solid Lid	273+84	86.5 RT	272+73	86.4 RT	-	-	0.000	0.95	0.00	0.81	5.0	5.2	3.01	2.49	0.00	2.49	18	0.013	0.0050	4.20	7.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	90.0	0.45	343.12	342.67	347.55	346.17	4.43	2.07	1.14	More than 2 ft of cover	Low Cover - See Notes at Bottom	Conc Pipe CL IV
A LINE	DR03-8	Catch Basin Type 2 48 In. Diam w/Solid Lid	272+93	86.4 RT	272+06	47.6 RT	-	-	0.000	0.95	0.00	0.81	5.0	5.5	2.89	2.49	1.19	3.68	18	0.013	0.0052	4.27	7.54	VELOCITY OK	ADEQUATE PIPE CAPACITY	95.0	0.49	342.67	342.18	348.30	347.21	5.63	3.27	2.67	More than 2 ft of cover	More than 2 ft of cover	Conc Pipe CL IV
A LINE	DR03-9	Catch Basin Type 2 48 In. Diam	272+06	47.6 RT	271+97	44.5 RT	-	-	0.000	0.95	0.00	0.81	5.0	5.9	2.79	2.49	0.00	3.68	18	0.013	0.0050	4.20	7.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	10.0	0.05	342.18	342.13	347.21	347.17	5.03	2.67	2.68	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-10	Grate Inlet Type 2	271+97	44.5 RT	271+87	42.5 RT	ROADWAY	4,451	0.102	0.95	0.10	0.91	5.0	5.9	2.78	2.52	0.00	3.71	18	0.013	0.0050	4.20	7.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	10.0	0.05	342.13	342.08	347.17	347.21	5.04	2.68	2.77	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-11	Catch Basin Type 2 48 In. Diam	271+87	42.5 RT	14+40	15.9 RT	-	-	0.000	0.95	0.00	0.91	5.0	6.0	2.77	2.52	0.37	4.09	18	0.013	0.0052	4.27	7.55	VELOCITY OK	ADEQUATE PIPE CAPACITY	29.0	0.15	342.08	341.93	347.21	351.04	5.13	2.77	6.75	More than 2 ft of cover	More than 2 ft of cover	Connects to DR03-13

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

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STORM SEWER DESIGN (English Units)

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Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 1.00 **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																								Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							14a				17a	17b																	
A LINE	DR03-16	Grate Inlet Type 2	272+02	25.9 RT	271+97	44.5 RT	ROADWAY	5,584	0.128	0.95	0.12	0.12	5.0	5.0	3.07	0.37	0.00	0.37	12	0.013	0.0400	9.07	7.12	VELOCITY OK	ADEQUATE PIPE CAPACITY	19.0	0.76	343.39	342.63	347.87	347.17	4.48	2.31	2.37	More than 2 ft of cover	More than 2 ft of cover	Sag Inlet, Connects to DR03-10

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Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

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Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.00 **Pipe Thickness (inches) =** 2

Location								Drainage Area										Discharge Drainage Design										Drain Profile											Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*													
A LINE	DR03-38	Pipe End	273+00	105.8 RT	272+93	86.4 RT	ROADWAY/PERVIOUS	21,674	0.498	0.78	0.39	0.39	5.0	5.0	3.07	1.19	0.00	1.19	12	0.013	0.1133	15.27	11.98	TRY TO REDUCE VELOCITY	ADEQUATE PIPE CAPACITY	21.0	2.38	345.55	343.17	345.55	348.30	0.00	-1.17	3.96	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	US end of pipe daylights to roadway embankment slope Composite C value equal to the weighted average of 15709 SF impervious (0.95) and 5965 SF pervious (0.33) area draining to pipe end

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

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WARNING: START YOUR STORMSEWER RUN ON ROW 12. DO NOT SKIP ANY ROWS IN BETWEEN. USE ONE SHEET PER STORMSEWER RUN

Please report any problems to the WSDOT HQ Hydraulics Office.

STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event
** C value calculated from the weighted average of impervious and pervious drainage area

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 1.00 **Pipe Thickness (inches) =** 2

Location									Discharge Drainage Design																								Drain Profile															Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*																			
A LINE	DR02-83	Schedule A Storm Sewer Pipe	269+23	47.4 LT	270+67	35.3 LT	-	-	0.000	0.95	0.00	0.00	5.0	0.0	3.07	0.00	0.23	0.23	12	0.013	0.0050	3.22	2.53	VELOCITY OK	ADEQUATE PIPE CAPACITY	145.0	0.73	342.26	341.53	347.10	347.79	4.84	2.67	4.09	More than 2 ft of cover	More than 2 ft of cover	25-yr discharge from the pond and undetained area upstream of the flow splitter minus the WQ flowrate to wet biofiltration swale
A LINE	DR03-6	Catch Basin Type 2	270+67	35.3 LT	271+98	48.8 LT	-	-	0.000	0.95	0.00	0.00	5.0	0.8	3.07	0.00	0.00	0.23	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	132.0	0.66	341.53	340.87	347.79	347.61	6.26	4.09	4.57	More than 2 ft of cover	More than 2 ft of cover	Connects to DR03-19

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For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.00 **Pipe Thickness (inches) =** 2.5

Location								Discharge Drainage Design																				Drain Profile																Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*16*	*17a*	*17b*																
A LINE	DR03-37	Schedule A Storm Sewer Pipe	271+75	62.3 LT	272+04	62.2 LT	DITCH	34,753	0.798	0.73	0.58	0.58	5.0	5.0	3.07	1.78	0.00	1.78	18	0.013	0.0183	8.03	14.19	VELOCITY OK	ADEQUATE PIPE CAPACITY	29.0	0.53	340.98	340.45	340.98	345.51	0.00	-1.71	3.35	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	US end of pipe daylights at end of ditch 5B/5B. Composite C value equal to the weighted average of 22229 SF impervious (0.95) and 12524 SF pervious (0.33) area draining to structure

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

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The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.00 **Pipe Thickness (inches) =** 2.5

Location							Discharge Drainage Design																				Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*												
G LINE	DR03-29	Schedule A Storm Sewer Pipe	272+07	107.9 LT	272+48	83.7 LT	PERVIOUS AREA	3,037	0.070	0.33	0.02	0.02	5.0	5.0	3.07	0.07	0.00	0.07	18	0.013	0.0200	8.40	14.84	VELOCITY OK	ADEQUATE PIPE CAPACITY	47.0	0.94	340.92	339.98	340.92	344.91	0.00	-1.71	3.22	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	US pipe end daylights to proposed slope, grass slope area only

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

Notes:

Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

For pipe cover calculation, Pipe cover = (Ground or Rim Elevation - Pipe invert elevation) - (pavement thickness) - (top of pipe thickness) - (pipe diameter).
The pipe thickness is based on the pipe diameter per WSDOT Manual Concrete for Shallow Pipe Cover Installations Fill Height Table 8-11.2
Please specify the largest pipe thickness of the storm sewer run being analyzed.

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STORM SEWER DESIGN (English Units)

This spreadsheet accomplishes a storm sewer design using the rational method. Enter the data in the non-shaded areas only.
Please use one spreadsheet per stormsewer run.

Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.00 **Pipe Thickness (inches) =** 2.5 0.00594

Location																		Discharge Drainage Design														Drain Profile												Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*																	
A LINE	DR03-17	Schedule A Storm Sewer Pipe	274+12	86.0 LT	273+99	83.7 LT	DITCH	61,463	1.411	0.61	0.86	0.86	5.0	5.0	3.07	2.62	0.00	2.62	18	0.013	0.0054	4.36	7.70	VELOCITY OK	ADEQUATE PIPE CAPACITY	13.0	0.07	340.96	340.89	343.93	345.25	2.97	1.26	2.65	Low Cover - See Notes at Bottom	More than 2 ft of cover	US pipe end daylights at end of proposed ditch, entire pipe outside of roadway, Composite C value equal to the weighted average of 27366 SF impervious (0.95) and 34097 SF pervious (0.33) area draining to structure.
A LINE	DR03-24	Catch Basin Type 2 48 In. Diam. w/ Solid Lid	273+99	83.7 LT	273+18	115.9 LT	-	-	0.000	0.95	0.00	0.86	5.0	5.0	3.05	2.62	0.00	2.62	18	0.013	0.0051	4.23	7.46	VELOCITY OK	ADEQUATE PIPE CAPACITY	87.0	0.44	340.89	340.45	345.25	344.63	4.36	2.65	2.47	More than 2 ft of cover	More than 2 ft of cover	Structure and pipe outside of roadway, rim set 0.5' above FG slope
A LINE	DR03-25	Catch Basin Type 2 48 In. Diam. w/ Solid Lid	273+18	115.9 LT	272+48	83.7 LT	-	-	0.000	0.95	0.00	0.86	5.0	5.4	2.94	2.62	0.00	2.62	18	0.013	0.0438	12.43	21.95	TRY TO REDUCE VELOCITY	ADEQUATE PIPE CAPACITY	40.0	1.75	340.45	338.70	344.63	346.89	4.18	2.47	6.48	More than 2 ft of cover	More than 2 ft of cover	

Pavement C = 0.95
Grass side slope C = 0.33
Grass ditch C = 0.33
* C values include adjustment for 25-yr storm event

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Please specify the largest pipe thickness of the storm sewer run being analyzed.

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STORM SEWER DESIGN (English Units)

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Project Name: SR 9 - SR 204 INTERCHANGE IMPROVEMENTS - STAGE 3

Designed By: T. Hew
Project Office: Osborn Consulting, Inc.

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.65 **Pipe Thickness (inches) =** 2

Location																	Discharge Drainage Design														Drain Profile																Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.	Offset 2	Source of Drainage	Drainage Area A (sq ft)	Drainage Area A (acre)	Runoff Coeff. C**	CA (acre)	Sum CA (acre)	T_c Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (ft/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 13 vs. Column 17)	Pipe Length*** (ft)	Elevation Change (ft)	Upstr. Invert Elev. (ft)	Downstr. Invert Elev. (ft)	Upstr. Ground Elev. (ft)	Downstr. Ground Elev. (ft)	Rim to Invert Distance (ft)	Upstr. Pipe Cover (ft)	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													8a							*14a*				*17a*	*17b*																			
G LINE	DR03-20	Catch Basin Type 1	18+63	14.1 RT	19+43	21.8 RT	ROADWAY	2,974	0.068	0.95	0.06	0.06	5.0	5.0	3.07	0.20	0.00	0.20	12	0.013	0.0051	3.25	2.55	VELOCITY OK	ADEQUATE PIPE CAPACITY	72.0	0.37	348.38	348.01	351.27	350.83	2.89	1.07	1.00	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL IV Conc Pipe,
G LINE	DR03-21	Catch Basin Type 1 w/ Solid Lid	19+43	21.8 RT	20+35	25.2 RT	-	-	0.000	0.95	0.00	0.06	5.0	5.4	2.94	0.20	0.00	0.20	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	80.0	0.40	348.01	347.61	350.83	350.52	2.82	1.00	1.09	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL IV Conc Pipe,
G LINE	DR03-22	Catch Basin Type 1	20+35	25.2 RT	21+73	17.2 RT	ROADWAY	8,565	0.197	0.95	0.19	0.25	5.0	5.0	3.07	0.77	0.00	0.77	12	0.013	0.0088	4.25	3.33	VELOCITY OK	ADEQUATE PIPE CAPACITY	138.0	1.21	347.61	346.40	350.52	348.51	2.91	1.09	0.29	Low Cover - See Notes at Bottom	Not Enough Cover - Need to Revise Pipe Elevations	CL IV Conc Pipe,

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

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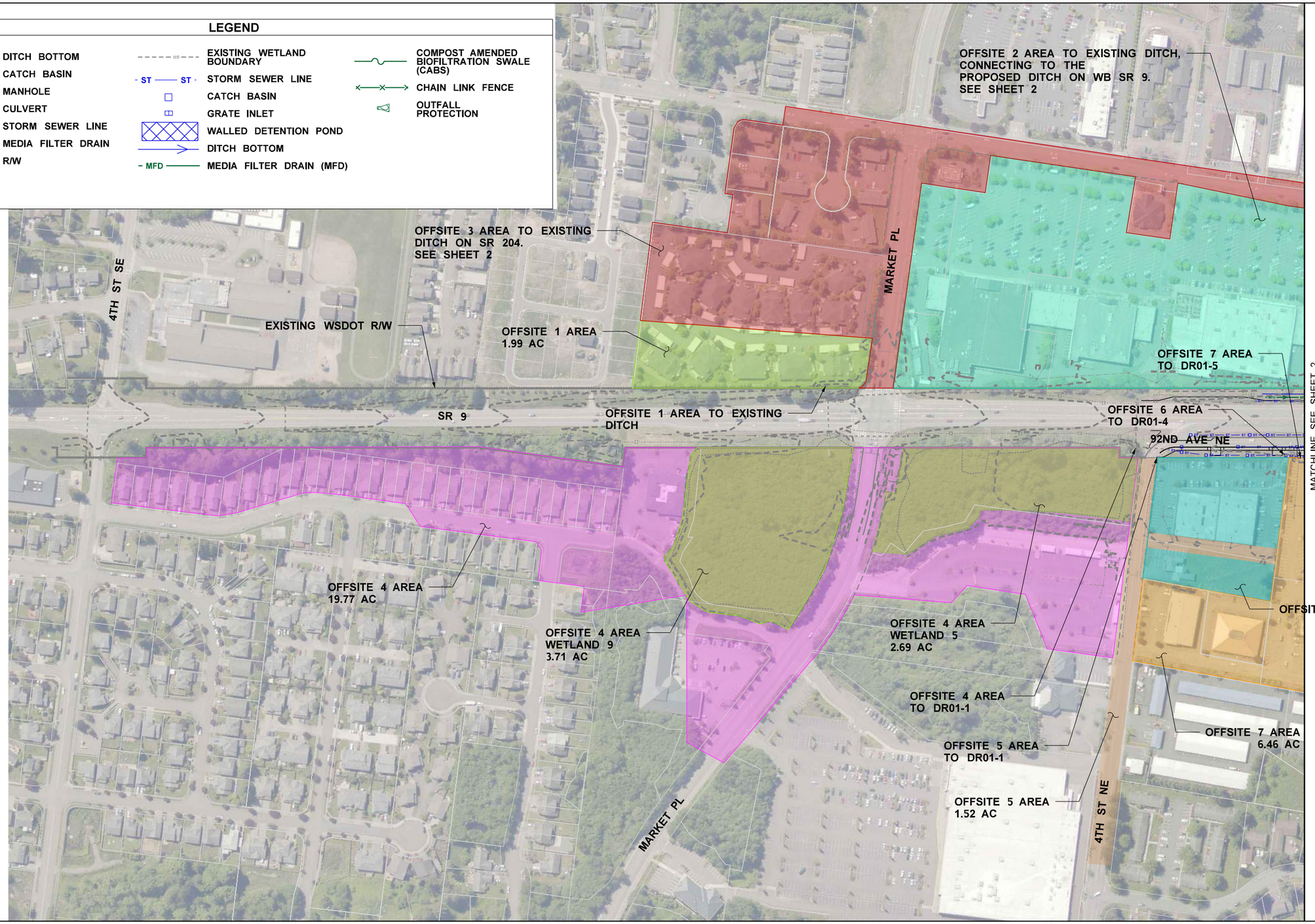
LEGEND

- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
- EXISTING R/W
- EXISTING WETLAND BOUNDARY
- STORM SEWER LINE
- CATCH BASIN
- GRATE INLET
- WALLED DETENTION POND
- DITCH BOTTOM
- MEDIA FILTER DRAIN (MFD)
- COMPOST AMENDED BIOFILTRATION SWALE (CABS)
- CHAIN LINK FENCE
- OUTFALL PROTECTION



OSBORN CONSULTING INCORPORATED

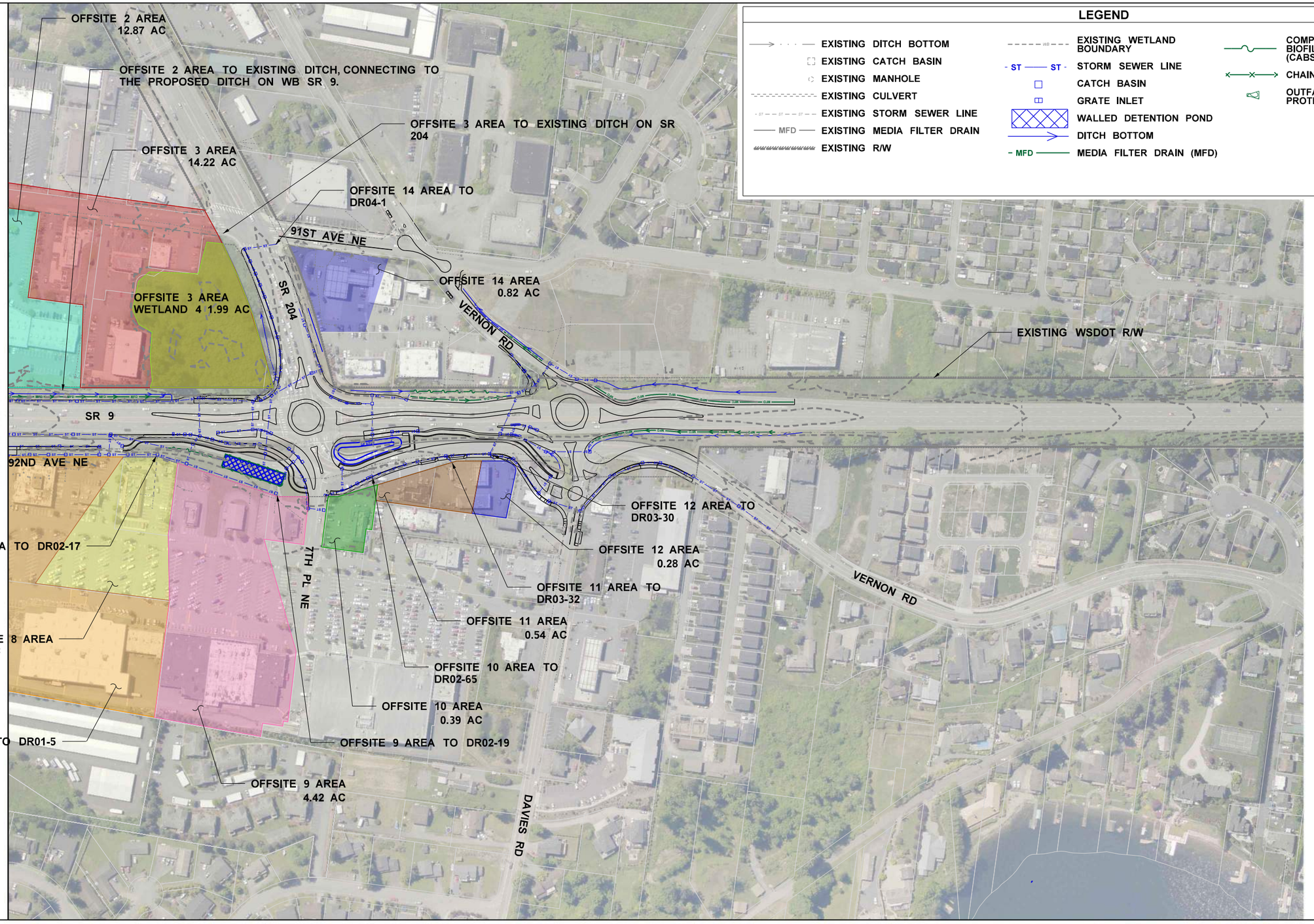
Washington State Department of Transportation

SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.6 : OFFSITE AREAS SHEET 1

N

0 125 250
SCALE IN FEET



OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.6 : OFFSITE AREAS SHEET 2

0 125 250
SCALE IN FEET

OFFSITE 25-YEAR FLOW RATES FROM MGSFLOOD

MGSFlood Rainfall: Puget East 40in. MAP

Name	Total Area		Wetland Area		Remaining Imp.Area	25-yr flow rates from MGSFlood
	SF	AC	SF	AC	AC	CFS
OFF_1	86640.20	1.99		0.00	1.99	1.364
OFF_2	560575.80	12.87		0.00	12.87	8.822
OFF_3	619337.00	14.22	86584.50	1.99	12.23	8.527
OFF_4	860991.30	19.77	278749.60	6.40	13.37	9.541
OFF_5	66379.00	1.52		0.00	1.52	1.042
OFF_6	97048.50	2.23		0.00	2.23	1.529
OFF_7	281528.20	6.46		0.00	6.46	4.428
OFF_8	81104.60	1.86		0.00	1.86	1.275
OFF_9	192430.20	4.42		0.00	4.42	3.03
OFF_10	16863.40	0.39		0.00	0.39	0.267
OFF_11	23416.90	0.54		0.00	0.54	0.37
OFF_12	12246.70	0.28		0.00	0.28	0.192
OFF_14	35831.80	0.82		0.00	0.82	0.562

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:34 PM
Report Generation Date: 10/10/2019 4:35 PM

Input File Name: OFF_1.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_1
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.990	1.990
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.990	1.990

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	1.990
Subbasin Total	1.990

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 1.990

Subbasin Total 1.990

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

************Compliance Point Results **************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	4.241E-02	2-Year	0.742
5-Year	6.911E-02	5-Year	0.963
10-Year	9.312E-02	10-Year	1.084
25-Year	0.118	25-Year	1.364
50-Year	0.151	50-Year	1.736
100-Year	0.163	100-Year	2.008
200-Year	0.254	200-Year	2.081
500-Year	0.376	500-Year	2.178

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:38 PM
Report Generation Date: 10/10/2019 4:38 PM

Input File Name: OFF_2.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_2
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	12.870	12.870
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	12.870	12.870

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	12.870
Subbasin Total	12.870

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	12.870
Subbasin Total	12.870

*************************** LINK DATA ****************************

----------SCENARIO: PREDEVELOPED
Number of Links: 0

*************************** LINK DATA ****************************

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

************************FLOOD FREQUENCY AND DURATION STATISTICS********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

*************Compliance Point Results **************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.274	2-Year	4.796
5-Year	0.447	5-Year	6.230
10-Year	0.602	10-Year	7.008
25-Year	0.764	25-Year	8.822
50-Year	0.974	50-Year	11.229
100-Year	1.056	100-Year	12.983
200-Year	1.644	200-Year	13.458
500-Year	2.433	500-Year	14.084

** Record too Short to Compute Peak Discharge for These Recurrence Interval

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:39 PM
Report Generation Date: 10/10/2019 4:39 PM

Input File Name: OFF_3.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_3
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	14.220	14.220
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	14.220	14.220

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	12.230
Wetland	1.990
Subbasin Total	14.220

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Wetland	1.990
Impervious	12.230
Subbasin Total	14.220

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0
**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.321	2-Year	4.626
5-Year	0.531	5-Year	5.920
10-Year	0.767	10-Year	6.826
25-Year	0.995	25-Year	8.527
50-Year	1.230	50-Year	10.675
100-Year	1.383	100-Year	12.338
200-Year	1.759	200-Year	12.790
500-Year	2.265	500-Year	13.387

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:41 PM
Report Generation Date: 10/10/2019 4:41 PM

Input File Name: OFF_4.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_4
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	19.770	19.770
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	19.770	19.770

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	13.370
Wetland	6.400
Subbasin Total	19.770

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Wetland	6.400
Impervious	13.370
Subbasin Total	19.770

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

************Compliance Point Results **************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.514	2-Year	5.156
5-Year	0.908	5-Year	6.539
10-Year	1.276	10-Year	7.809
25-Year	1.902	25-Year	9.541
50-Year	2.104	50-Year	11.679
100-Year	2.354	100-Year	13.489
200-Year	2.382	200-Year	13.985
500-Year	2.419	500-Year	14.641

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 09/02/2020 12:17 PM
Report Generation Date: 09/02/2020 12:17 PM

Input File Name: OFF_5.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_5
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.520	1.520
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.520	1.520

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	1.520
Subbasin Total	1.520

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 1.520

Subbasin Total 1.520

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

Compliance Point Results ********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	3.239E-02	2-Year	0.566
5-Year	5.279E-02	5-Year	0.736
10-Year	7.113E-02	10-Year	0.828
25-Year	9.018E-02	25-Year	1.042
50-Year	0.115	50-Year	1.326
100-Year	0.125	100-Year	1.533
200-Year	0.194	200-Year	1.589
500-Year	0.287	500-Year	1.663

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 09/02/2020 12:18 PM
Report Generation Date: 09/02/2020 12:19 PM

Input File Name: OFF_6.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_6
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	2.230	2.230
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	2.230	2.230

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	2.230
Subbasin Total	2.230

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 2.230

Subbasin Total 2.230

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

Compliance Point Results ********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	4.752E-02	2-Year	0.831
5-Year	7.745E-02	5-Year	1.079
10-Year	0.104	10-Year	1.214
25-Year	0.132	25-Year	1.529
50-Year	0.169	50-Year	1.946
100-Year	0.183	100-Year	2.250
200-Year	0.285	200-Year	2.332
500-Year	0.422	500-Year	2.440

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:45 PM
Report Generation Date: 10/10/2019 4:45 PM

Input File Name: OFF_7.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_7
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	6.460	6.460
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	6.460	6.460

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	6.460
Subbasin Total	6.460

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 6.460

Subbasin Total 6.460

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.138	2-Year	2.408
5-Year	0.224	5-Year	3.127
10-Year	0.302	10-Year	3.518
25-Year	0.383	25-Year	4.428
50-Year	0.489	50-Year	5.637
100-Year	0.530	100-Year	6.517
200-Year	0.825	200-Year	6.755
500-Year	1.221	500-Year	7.069

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:46 PM
Report Generation Date: 10/10/2019 4:46 PM

Input File Name: OFF_8.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_8
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.860	1.860
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.860	1.860

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	1.860
Subbasin Total	1.860

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 1.860

Subbasin Total 1.860

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

Compliance Point Results ********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	3.964E-02	2-Year	0.693
5-Year	6.460E-02	5-Year	0.900
10-Year	8.704E-02	10-Year	1.013
25-Year	0.110	25-Year	1.275
50-Year	0.141	50-Year	1.623
100-Year	0.153	100-Year	1.876
200-Year	0.238	200-Year	1.945
500-Year	0.352	500-Year	2.035

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:47 PM
Report Generation Date: 10/10/2019 4:47 PM

Input File Name: OFF_9.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_9
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	4.420	4.420
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	4.420	4.420

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	4.420
Subbasin Total	4.420

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 4.420

Subbasin Total 4.420

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	9.419E-02	2-Year	1.647
5-Year	0.154	5-Year	2.140
10-Year	0.207	10-Year	2.407
25-Year	0.262	25-Year	3.030
50-Year	0.335	50-Year	3.857
100-Year	0.363	100-Year	4.459
200-Year	0.565	200-Year	4.622
500-Year	0.836	500-Year	4.837

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:47 PM
Report Generation Date: 10/10/2019 4:47 PM

Input File Name: OFF_10.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_10
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.390	0.390
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.390	0.390

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.390
Subbasin Total	0.390

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 0.390

Subbasin Total 0.390

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	8.311E-03	2-Year	0.145
5-Year	1.354E-02	5-Year	0.189
10-Year	1.825E-02	10-Year	0.212
25-Year	2.314E-02	25-Year	0.267
50-Year	2.953E-02	50-Year	0.340
100-Year	3.200E-02	100-Year	0.393
200-Year	4.981E-02	200-Year	0.408
500-Year	7.373E-02	500-Year	0.427

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:48 PM
Report Generation Date: 10/10/2019 4:48 PM

Input File Name: OFF_11.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_11
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.540	0.540
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.540	0.540

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.540
Subbasin Total	0.540

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 0.540

Subbasin Total 0.540

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.151E-02	2-Year	0.201
5-Year	1.875E-02	5-Year	0.261
10-Year	2.527E-02	10-Year	0.294
25-Year	3.204E-02	25-Year	0.370
50-Year	4.089E-02	50-Year	0.471
100-Year	4.431E-02	100-Year	0.545
200-Year	6.897E-02	200-Year	0.565
500-Year	0.102	500-Year	0.591

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:49 PM
Report Generation Date: 10/10/2019 4:49 PM

Input File Name: OFF_12.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_12
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.280	0.280
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.280	0.280

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.280
Subbasin Total	0.280

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Impervious 0.280

Subbasin Total 0.280

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	5.967E-03	2-Year	0.104
5-Year	9.724E-03	5-Year	0.136
10-Year	1.310E-02	10-Year	0.152
25-Year	1.661E-02	25-Year	0.192
50-Year	2.120E-02	50-Year	0.244
100-Year	2.297E-02	100-Year	0.282
200-Year	3.576E-02	200-Year	0.293
500-Year	5.293E-02	500-Year	0.306

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201010003
Project Simulation Performed on: 10/10/2019 4:51 PM
Report Generation Date: 10/10/2019 4:51 PM

Input File Name: OFF_14.fld
Project Name: SR9/204 Stage 3
Analysis Title: OFF_14
Comments: Flow Rates

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.820	0.820
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.820	0.820

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.820
Subbasin Total	0.820

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.820
Subbasin Total	0.820

********** LINK DATA **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** LINK DATA **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.747E-02	2-Year	0.306
5-Year	2.848E-02	5-Year	0.397
10-Year	3.837E-02	10-Year	0.447
25-Year	4.865E-02	25-Year	0.562
50-Year	6.209E-02	50-Year	0.715
100-Year	6.728E-02	100-Year	0.827
200-Year	0.105	200-Year	0.857
500-Year	0.155	500-Year	0.897

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

APPENDIX C-6

CULVERT DESIGN

NOT USED

APPENDIX C-7

DITCH DESIGN

SR9 / SR204 Stage 3- Ditch Summary Spreadsheet

Input cells

100% Design
Calcs By: T. Hew/S.Sridharan
Checked By: A. Seethoff

Ground Cover Co-efficients, K Value			
Type of Cover		K (English)	
	Paved Area	1200	
	Short Pasture Grass/Lawn	420	
	Small Roadside Ditch w/ Grass	600	
	1 foot deep	1100	*typical case for this project
Open Channel Flow Narrow Channel (w/d = 1)	2 foot deep	1800	
	4 foot deep	2800	

Runoff Coefficient:		
Site Condition:	Rolling 2 -10%	
10-year:		
Impervious	0.9	per HRM Section 2.5-2
Pervious	0.3	per HRM Section 2.5-2
100-year		
Impervious	0.95	per HRM Section 2.5-2
Pervious	0.375	per HRM Section 2.5-2

Runoff Coefficient:		
Site Condition:	Rolling 2 -10%	
25-year		
Impervious	0.95	per HRM Section 2.5-2
Pervious	0.33	per HRM Section 2.5-2
50-year		
Impervious	0.95	per HRM Section 2.5-2
Pervious	0.36	per HRM Section 2.5-2

Rainfall Coefficient:		
Project Site	Everett	
10-year:		
m	6.31	per HRM Section 2.5-2
n	0.575	per HRM Section 2.5-2
100-year:		
m	10.07	per HRM Section 2.5-2
n	0.586	per HRM Section 2.5-2

Rainfall Coefficient:		
Project Site	Everett	
25-year		
m	7.83	per HRM Section 2.5-2
n	0.582	per HRM Section 2.5-2
50-year		
m	8.96	per HRM Section 2.5-2
n	0.585	per HRM Section 2.5-2

DITCH FLOWS (RATIONAL METHOD, Tc < 1 HR)

Ditch No.	Ditch Location	Time of Concentration (Tc) of longest flow path (min)					Tc Considered (min) (lower value of combined or minimum 5 min)	Contributing Areas		10-year		25-year		50-year		100-year		Notes
		Piped Inflow, Tc (min) from conveyance spreadsheet	Ditch, Tc (min)			Combined Tc, (min)		Impervious Area (acres)	Pervious Area (acres)	Rainfall Intensity (in/hr)	Flow Rate (cfs)	Rainfall Intensity (in/hr)	Flow Rate (cfs)	Rainfall Intensity (in/hr)	Flow Rate (cfs)	Rainfall Intensity (in/hr)	Flow Rate (cfs)	
			Ditch Length, L (ft)	Ditch Slope, S (ft/ft)	$Tc = L/K.S^{0.5}$													
1	A LINE - SB SR9 LT - MFD and Ditch (TDA 3)		372.00	0.0050	4.78	4.78	5.00	0.54	0.72	2.50	1.76	3.07	2.31	3.49	2.70	3.92	3.08	Ditch down slope of a MFD Type 3
2	A LINE - SW on SR9 LT (TDA 2) - MFD and Ditch		491.00	0.0106	4.34	4.34	5.00	0.49	0.36	2.50	8.38	3.07	10.62	3.49	13.31	3.92	15.34	Adding OFF_2 flow rates . Use 25-yr flow rate for Trunk 16 inflow. 8:1 or flatter slopes for MFD, grade break to 2:1 foreslope for ditch.
3	B LINE - SR 204 LT, WB (TDA 2 - existing ditch)		151.00	0.0070	1.64	1.64	5.00	0.24	0.20	2.50	0.69					3.92	1.19	This is not a proposed ditch, hence not in DRD sheets. There is sufficient ditch capacity. Current ditch depth=5ft from edge of pavement
4	B Line SR 204 RT, EB (South) - TDA2		126.00	0.0027	2.20	2.20	5.00	0.00	0.07	2.50	57.02					3.92	71.18	Inflows from DR02-6 (Trunk 1). Use conveyance spreadsheet to change m and n values and manually input for each MRI to get total flows at DR02-6 (Trunk 1). Also change ditch inflows based on calc above to Trunk 16 in conveyance spreadsheets for each MRI. Additonal OFF_3 contributes to the ditch. See attached sketch for inflows into this ditch
5A	A LINE - SB on SR 9 LT - Wet Biofiltration Swale (TDA 3)		245.00	0.0040	3.52	3.52	5.00	0.33	0.17	2.50	0.96	3.07	1.22	3.49	1.40	3.92	1.57	Wet Biofiltration Swale, Discharge from flow splitter
5B	A LINE - SB on SR 9 LT - Off-site flows Ditch (TDA 3)		245.00	0.0040	3.52	3.52	5.00	0.04	0.23	2.50	0.26	3.07	0.35	3.49	0.42	3.92	0.49	Off-site flow bypass ditch, Ditch divided by bioswale divider to provide bypass for off-site landscapted area runoff.
7	A LINE NB on SR 9 RT - MFD and Ditch (TDA 3)		414.00	0.0033	6.56	6.56	5.00	0.66	0.57	2.50	1.91	3.07	2.50	3.49	2.91	3.92	3.30	Wet biofiltration swale ditch, Ditch divided by bioswale divider to provide bypass for off-site landscapted area runoff.
9	H LINE on Vernon Road LT MFD (TDA 3)		215.00	0.0132	1.70	1.70	5.00	0.29	0.10	2.50	0.73	3.07	0.95	3.49	1.09	3.92	1.23	Ditch along Vernon Rd west of SR 9.
10	A LINE SB SR 9 LT - MFD and Ditch (TDA 5)		333.00	0.0070	3.63	3.63	5.00	0.31	0.45	2.50	1.05	3.07	1.37	3.49	1.61	3.92	1.84	Ditch at north end of the project on the west side of SR 9.

DITCH DIMENSIONS

From FHWA Hydraulic Toolbox 5.0

Ditch No.	Ditch Location	Roughness Coefficient**	Front Slope (Z1)	Back Slope (Z2)	Bottom Width (ft)	Ditch Slope	10-yr Flow (cfs)	100-yr Flow (cfs)	10-year				25-year				50-year				100-year				Required Depth of Ditch*	Design Ditch Depth (as graded)	10-yr Critical Depth Check
									Depth of Flow (ft)	Critical Depth (ft)	Top Width (ft)	Avg Velocity (ft/sec)	Depth of Flow (ft)	Critical Depth (ft)	Top Width (ft)	Avg Velocity (ft/sec)	Depth of Flow (ft)	Critical Depth (ft)	Top Width (ft)	Avg Velocity (ft/sec)	Depth of Flow (ft)	Critical Depth (ft)	Top Width (ft)	Avg Velocity (ft/sec)			
1	A LINE - SB SR9 LT - MFD and Ditch (TDA 3)	0.10	4.5:1	3.5:1	0.0	0.0050	1.76	3.08	0.87	0.41	6.92	0.59	0.96	0.46	7.66	0.63	1.02	0.49	8.12	0.66	1.07	0.52	8.53	0.68	2.22	6.95	O.K.
2	A LINE - SW on SR9 LT (TDA 2) - MFD and Ditch	0.10	2:1	2:1	0.0	0.0106	8.38	15.34	1.78	1.02	7.14	1.32					2.12	1.22	8.49	1.48	2.24	1.30	8.95	1.53	2.12	2.50	O.K.
3	B LINE - SR 204 LT, WB (TDA 2 - existing ditch)	0.10	3:1	3:1	0.0	0.0070	0.69	1.19	0.64	0.32	3.84	0.56									0.79	0.40	4.71	0.64	1.99	5.00	O.K.
4	B Line SR 204 RT, EB (South) - TDA2	0.05	2:1	3:1	3.0	0.0027	57.02	71.18	2.78	1.51	16.92	2.06									3.07	1.69	18.33	2.18	4.13	5.60	O.K.
5A	A LINE - SB on SR 9 LT - Wet Biofiltration Swale (TDA 3)	0.10	3:1	0:1	5.0	0.0040	0.96	1.57	0.39	0.10	6.16	0.45	0.45	0.12	6.34	0.48	0.48	0.13	6.45	0.51	0.52	0.14	6.55	0.53	1.74	6.00	O.K.
5B	A LINE - SB on SR 9 LT - Off-site flows Ditch (TDA 3)	0.10	0:1	3:1	1.0	0.0040	0.26	0.49	0.43	0.12	2.27	0.37	0.50	0.15	2.49	0.41	0.55	0.16	2.64	0.42	0.59	0.18	2.77	0.44	1.78	6.00	O.K.
7	A LINE NB on SR 9 RT - MFD and Ditch (TDA 3)	0.10	4:1	4:1	0.0	0.0033	1.91	3.30	0.96	0.43	7.71	0.51	1.07	0.48	8.53	0.55	1.13	0.51	9.03	0.57	1.18	0.53	9.46	0.59	2.31	3.25	O.K.
9	H LINE on Vernon Road LT MFD (TDA 3)	0.10	4:1	2:1	0.0	0.0132	0.73	1.23	0.63	0.35	3.13	0.75	0.69	0.39	3.45	0.80	0.73	0.42	3.63	0.83	0.76	0.44	3.80	0.85	1.98	3.00	O.K.
10	A LINE SB SR 9 LT - MFD and Ditch (TDA 5)	0.10	4:1	3:1	0.0	0.0070	1.05	1.84	0.71	0.36	4.93	0.60	0.78	0.40	5.45	0.65	0.83	0.42	5.79	0.67	0.87	0.45	6.09	0.70	2.1	3.50	O.K.

0.85	Proposed depth of pavement to bottom of subgrade (ft)	
0.5	Freeboard (ft)	

*Required Depth of Ditch from Edge of Pavement = 10-yr flow depth + Freeboard + Proposed depth to subgrade (HMA+CSBC) OR Required depth of ditch for MFD to the toe of MFD slope=50-yr flow depth

**Manning's roughness coefficient is from Hydraulics Manual, Appendix 4A. Use Figure 4A-3 for ditch depths less than 1.5 ft and Figure 4A-2 (Floodplains, High grass) for ditch depths greater than 1.5 ft.

SR 9/ SR 204 Intersection - Stage 3

WSDOT TESCM Section 5-1.1.12

Input cells

	DITCH NO.	1	2	3	4	5A	5B	7	9	10
	DITCH LINE	A LINE - SB SR9 LT - MFD and Ditch (TDA 3)	A LINE - SW on SR9 LT (TDA 2) - MFD and Ditch	B LINE - SR 204 LT, WB (TDA 2 - existing ditch)	B Line SR 204 RT, EB (South) - TDA2	A LINE - SB on SR 9 LT - Wet Biofiltration Swale (TDA 3)	A LINE - SB on SR 9 LT - Off-site flows Ditch (TDA 3)	A LINE NB on SR 9 RT - MFD and Ditch (TDA 3)	H LINE on Vernon Road LT MFD (TDA 3)	A LINE SB SR 9 LT - MFD and Ditch (TDA 5)
Design for Ditch Stability after Excavation										
	Q = 10-year flow rate (cfs) =	1.76	8.38	0.69	57.02	0.96	0.26	1.91	0.73	1.05
	s = Ditch Slope (ft/ft) =	0.005	0.0106	0.007	0.0027	0.004	0.004	0.003	0.013	0.007
	d = Depth of Flow (ft) =	0.87	1.78	0.64	2.78	0.39	0.43	0.96	0.63	0.71
Check Shear Stress										
Shear Stress =	(Weight of Water) X (Depth of Flow) X (Ditch Slope) = 62.4 x d X s									
	Calculated Shear Stress (lb/ft^2)=	**0.27**	**1.18**	**0.28**	**0.47**	**0.10**	**0.11**	**0.20**	**0.52**	**0.31**

From Table 5-2		Permissible Shear Stress		Result															
Liner Category	**Liner Type**	**Low**	**High**	**Low End**	**High End**	**Low End**	**High End**	**Low End**	**High End**	**Low End**	**High End**	**Low End**	**High End**	**Low End**	**High End**	**Low End**	**High End**	**Low End**	**High End**
Bare Soil - No Liner																			
	Noncohesive Soil	0.01	0.04	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE	ERODE
	Cohesive Soil	0.10	0.80	ERODE	O.K.	ERODE	ERODE	ERODE	O.K.	ERODE	O.K.	O.K.	O.K.	ERODE	O.K.	ERODE	O.K.	ERODE	O.K.	ERODE	O.K.
Erosion Control Blanket (temporary / permanent)																			
	Jute	0.45	1.00	O.K.	O.K.	ERODE	ERODE	O.K.	O.K.	ERODE	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	ERODE	O.K.	O.K.	O.K.
	Curlex Wood or straw	1.00	2.50	O.K.	O.K.	ERODE	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
	Coir	2.00	4.00	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
	Organic, synthetic , or mix	10.00	12.00	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Vegetative (varies w/ type and density of grass stand)																			
	Uncut stand	2.10	3.70	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
	Cut stand	0.60	1.00	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Gravel/ rip rap																			
	1-inch		0.33		O.K.		ERODE		O.K.		ERODE		O.K.		O.K.		O.K.		ERODE		O.K.
	2-inch		0.67		O.K.		ERODE		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.
	6-inch		2.00		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.
	12-inch	0.00	4.00		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.		O.K.

Hydraulic Analysis Report

Project Data

Project Title:
Designer:
Project Date: Monday, February 3, 2020
Project Units: U.S. Customary Units
Notes:

Channel Analysis: SW SR9_Ditch behind MFD_10-yr

Notes:

Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 2.0000 ft/ft
Side Slope 2 (Z2): 2.0000 ft/ft
Longitudinal Slope: 0.0106 ft/ft
Manning's n: 0.1000
Flow: 8.3800 cfs

Result Parameters

Depth: 1.7842 ft
Area of Flow: 6.3669 ft^2
Wetted Perimeter: 7.9793 ft
Hydraulic Radius: 0.7979 ft
Average Velocity: 1.3162 ft/s
Top Width: 7.1369 ft
Froude Number: 0.2456
Critical Depth: 1.0175 ft
Critical Velocity: 4.0474 ft/s
Critical Slope: 0.2120 ft/ft
Critical Top Width: 4.07 ft
Calculated Max Shear Stress: 1.1802 lb/ft^2
Calculated Avg Shear Stress: 0.5278 lb/ft^2

Channel Analysis: SW SR9_Ditch behind MFD_50-yr

Notes:

Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 2.0000 ft/ft
Side Slope 2 (Z2): 2.0000 ft/ft
Longitudinal Slope: 0.0106 ft/ft
Manning's n: 0.1000
Flow: 13.3100 cfs

Result Parameters

Depth: 2.1223 ft
Area of Flow: 9.0080 ft^2
Wetted Perimeter: 9.4911 ft
Hydraulic Radius: 0.9491 ft
Average Velocity: 1.4776 ft/s
Top Width: 8.4891 ft
Froude Number: 0.2528
Critical Depth: 1.2243 ft
Critical Velocity: 4.4398 ft/s
Critical Slope: 0.1993 ft/ft
Critical Top Width: 4.90 ft
Calculated Max Shear Stress: 1.4038 lb/ft^2
Calculated Avg Shear Stress: 0.6278 lb/ft^2

Channel Analysis: SW SR9_Ditch behind MFD_100-yr

Notes:

Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 2.0000 ft/ft
Side Slope 2 (Z2): 2.0000 ft/ft
Longitudinal Slope: 0.0106 ft/ft
Manning's n: 0.1000
Flow: 15.3400 cfs

Result Parameters

Depth: 2.2383 ft
Area of Flow: 10.0199 ft^2
Wetted Perimeter: 10.0100 ft
Hydraulic Radius: 1.0010 ft
Average Velocity: 1.5309 ft/s
Top Width: 8.9532 ft
Froude Number: 0.2550
Critical Depth: 1.2958 ft
Critical Velocity: 4.5676 ft/s
Critical Slope: 0.1955 ft/ft
Critical Top Width: 5.18 ft
Calculated Max Shear Stress: 1.4805 lb/ft^2
Calculated Avg Shear Stress: 0.6621 lb/ft^2

Channel Analysis: SR204 Ex.ditch_10-yr

Notes:

Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 3.0000 ft/ft
Side Slope 2 (Z2): 3.0000 ft/ft
Longitudinal Slope: 0.0070 ft/ft
Manning's n: 0.1000
Flow: 0.6900 cfs

Result Parameters

Depth: 0.6400 ft
Area of Flow: 1.2287 ft^2
Wetted Perimeter: 4.0475 ft
Hydraulic Radius: 0.3036 ft
Average Velocity: 0.5616 ft/s
Top Width: 3.8398 ft
Froude Number: 0.1749
Critical Depth: 0.3187 ft
Critical Velocity: 2.2650 ft/s
Critical Slope: 0.2886 ft/ft
Critical Top Width: 1.91 ft
Calculated Max Shear Stress: 0.2795 lb/ft^2
Calculated Avg Shear Stress: 0.1326 lb/ft^2

Channel Analysis: SR204 Ex. ditch_100-yr

Notes:

Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 3.0000 ft/ft
Side Slope 2 (Z2): 3.0000 ft/ft
Longitudinal Slope: 0.0070 ft/ft
Manning's n: 0.1000
Flow: 1.1900 cfs

Result Parameters

Depth: 0.7851 ft
Area of Flow: 1.8491 ft^2
Wetted Perimeter: 4.9654 ft
Hydraulic Radius: 0.3724 ft
Average Velocity: 0.6435 ft/s
Top Width: 4.7106 ft
Froude Number: 0.1810
Critical Depth: 0.3963 ft
Critical Velocity: 2.5259 ft/s
Critical Slope: 0.2683 ft/ft
Critical Top Width: 2.38 ft
Calculated Max Shear Stress: 0.3429 lb/ft^2
Calculated Avg Shear Stress: 0.1627 lb/ft^2

Channel Analysis: SR204_South 10-yr

Notes:

Input Parameters

Channel Type: Trapezoidal
Side Slope 1 (Z1): 2.0000 ft/ft
Side Slope 2 (Z2): 3.0000 ft/ft
Channel Width: 3.0000 ft
Longitudinal Slope: 0.0027 ft/ft
Manning's n: 0.0500
Flow: 57.0200 cfs

Result Parameters

Depth: 2.7831 ft
Area of Flow: 27.7142 ft^2
Wetted Perimeter: 18.0244 ft
Hydraulic Radius: 1.5376 ft
Average Velocity: 2.0574 ft/s
Top Width: 16.9157 ft
Froude Number: 0.2833
Critical Depth: 1.5081 ft
Critical Velocity: 5.5847 ft/s
Critical Slope: 0.0397 ft/ft
Critical Top Width: 10.54 ft
Calculated Max Shear Stress: 0.4689 lb/ft^2
Calculated Avg Shear Stress: 0.2591 lb/ft^2

Channel Analysis: SR204_South 100-yr

Notes:

Input Parameters

Channel Type: Trapezoidal
Side Slope 1 (Z1): 2.0000 ft/ft
Side Slope 2 (Z2): 3.0000 ft/ft
Channel Width: 3.0000 ft
Longitudinal Slope: 0.0027 ft/ft
Manning's n: 0.0500
Flow: 71.1800 cfs

Result Parameters

Depth: 3.0667 ft
Area of Flow: 32.7126 ft^2
Wetted Perimeter: 19.5554 ft
Hydraulic Radius: 1.6728 ft
Average Velocity: 2.1759 ft/s
Top Width: 18.3337 ft
Froude Number: 0.2871
Critical Depth: 1.6856 ft
Critical Velocity: 5.8535 ft/s
Critical Slope: 0.0385 ft/ft
Critical Top Width: 11.43 ft
Calculated Max Shear Stress: 0.5167 lb/ft^2
Calculated Avg Shear Stress: 0.2818 lb/ft^2

Hydraulic Analysis Report

Project Data

Project Title: SR9/SR204 Interchange Improvements - Stage 3 - TDA 3 Ditch Analysis

Designer: T. Hew

Project Date: Saturday, September 12, 2020

Project Units: U.S. Customary Units

Notes: Ditch analysis for the 10, 25, 50, and 100-yr storm events. Ditch designs follows criteria specified in the 2019 WSDOT Hydraulics Manual.

Channel Analysis: DITCH 1 - 10

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.5000 ft/ft

Side Slope 2 (Z2): 3.5000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.1000

Flow: 1.7600 cfs

Result Parameters

Depth: 0.8646 ft

Area of Flow: 2.9903 ft^2

Wetted Perimeter: 7.1330 ft

Hydraulic Radius: 0.4192 ft

Average Velocity: 0.5886 ft/s

Top Width: 6.9170 ft

Froude Number: 0.1578

Critical Depth: 0.4144 ft

Critical Velocity: 2.5626 ft/s

Critical Slope: 0.2527 ft/ft

Critical Top Width: 3.37 ft

Calculated Max Shear Stress: 0.2698 lb/ft^2

Calculated Avg Shear Stress: 0.1308 lb/ft^2

Channel Analysis: DITCH 1 - 25

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.5000 ft/ft

Side Slope 2 (Z2): 3.5000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.1000

Flow: 2.3100 cfs

Result Parameters

Depth: 0.9574 ft

Area of Flow: 3.6668 ft^2

Wetted Perimeter: 7.8988 ft

Hydraulic Radius: 0.4642 ft

Average Velocity: 0.6300 ft/s

Top Width: 7.6596 ft

Froude Number: 0.1605

Critical Depth: 0.4620 ft

Critical Velocity: 2.7059 ft/s

Critical Slope: 0.2437 ft/ft

Critical Top Width: 3.75 ft

Calculated Max Shear Stress: 0.2987 lb/ft^2

Calculated Avg Shear Stress: 0.1448 lb/ft^2

Channel Analysis: DITCH 1 - 50

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.5000 ft/ft

Side Slope 2 (Z2): 3.5000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.1000

Flow: 2.7000 cfs

Result Parameters

Depth: 1.0151 ft

Area of Flow: 4.1219 ft^2

Wetted Perimeter: 8.3746 ft

Hydraulic Radius: 0.4922 ft

Average Velocity: 0.6550 ft/s

Top Width: 8.1210 ft

Froude Number: 0.1620

Critical Depth: 0.4917 ft

Critical Velocity: 2.7916 ft/s

Critical Slope: 0.2387 ft/ft

Critical Top Width: 4.00 ft

Calculated Max Shear Stress: 0.3167 lb/ft^2

Calculated Avg Shear Stress: 0.1536 lb/ft^2

Channel Analysis: DITCH 1 - 100

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.5000 ft/ft

Side Slope 2 (Z2): 3.5000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.1000

Flow: 3.0800 cfs

Result Parameters

Depth: 1.0665 ft

Area of Flow: 4.5498 ft^2

Wetted Perimeter: 8.7986 ft

Hydraulic Radius: 0.5171 ft

Average Velocity: 0.6770 ft/s

Top Width: 8.5321 ft

Froude Number: 0.1634

Critical Depth: 0.5183 ft

Critical Velocity: 2.8661 ft/s

Critical Slope: 0.2346 ft/ft

Critical Top Width: 4.21 ft

Calculated Max Shear Stress: 0.3328 lb/ft^2

Calculated Avg Shear Stress: 0.1613 lb/ft^2

Channel Analysis: DITCH 5A - 10

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 0.0010 ft/ft

Channel Width: 5.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 0.9600 cfs

Result Parameters

Depth: 0.3863 ft

Area of Flow: 2.1557 ft^2

Wetted Perimeter: 6.6081 ft

Hydraulic Radius: 0.3262 ft

Average Velocity: 0.4453 ft/s

Top Width: 6.1594 ft

Froude Number: 0.1327

Critical Depth: 0.1035 ft

Critical Velocity: 1.7988 ft/s

Critical Slope: 0.3231 ft/ft

Critical Top Width: 5.31 ft

Calculated Max Shear Stress: 0.0964 lb/ft^2

Calculated Avg Shear Stress: 0.0814 lb/ft^2

Channel Analysis: DITCH 5A - 25

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 0.0010 ft/ft

Channel Width: 5.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 1.2200 cfs

Result Parameters

Depth: 0.4456 ft

Area of Flow: 2.5256 ft^2

Wetted Perimeter: 6.8545 ft

Hydraulic Radius: 0.3685 ft

Average Velocity: 0.4830 ft/s

Top Width: 6.3371 ft

Froude Number: 0.1348

Critical Depth: 0.1212 ft

Critical Velocity: 1.9419 ft/s

Critical Slope: 0.3085 ft/ft

Critical Top Width: 5.36 ft

Calculated Max Shear Stress: 0.1112 lb/ft^2

Calculated Avg Shear Stress: 0.0920 lb/ft^2

Channel Analysis: DITCH 5A - 50

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 0.0010 ft/ft

Channel Width: 5.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 1.4000 cfs

Result Parameters

Depth: 0.4835 ft

Area of Flow: 2.7686 ft^2

Wetted Perimeter: 7.0127 ft

Hydraulic Radius: 0.3948 ft

Average Velocity: 0.5057 ft/s

Top Width: 6.4511 ft

Froude Number: 0.1360

Critical Depth: 0.1327 ft

Critical Velocity: 2.0287 ft/s

Critical Slope: 0.3005 ft/ft

Critical Top Width: 5.40 ft

Calculated Max Shear Stress: 0.1207 lb/ft^2

Calculated Avg Shear Stress: 0.0985 lb/ft^2

Channel Analysis: DITCH 5A - 100

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 0.0010 ft/ft

Channel Width: 5.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 1.5700 cfs

Result Parameters

Depth: 0.5174 ft

Area of Flow: 2.9889 ft^2

Wetted Perimeter: 7.1537 ft

Hydraulic Radius: 0.4178 ft

Average Velocity: 0.5253 ft/s

Top Width: 6.5528 ft

Froude Number: 0.1371

Critical Depth: 0.1431 ft

Critical Velocity: 2.1037 ft/s

Critical Slope: 0.2941 ft/ft

Critical Top Width: 5.43 ft

Calculated Max Shear Stress: 0.1291 lb/ft^2

Calculated Avg Shear Stress: 0.1043 lb/ft^2

Channel Analysis: DITCH 5B - 10

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 0.0010 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Channel Width: 1.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 0.2600 cfs

Result Parameters

Depth: 0.4246 ft

Area of Flow: 0.6950 ft^2

Wetted Perimeter: 2.7672 ft

Hydraulic Radius: 0.2512 ft

Average Velocity: 0.3741 ft/s

Top Width: 2.2741 ft

Froude Number: 0.1192

Critical Depth: 0.1202 ft

Critical Velocity: 1.8325 ft/s

Critical Slope: 0.3529 ft/ft

Critical Top Width: 1.36 ft

Calculated Max Shear Stress: 0.1060 lb/ft^2

Calculated Avg Shear Stress: 0.0627 lb/ft^2

Channel Analysis: DITCH 5B - 25

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 0.0010 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Channel Width: 1.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 0.3500 cfs

Result Parameters

Depth: 0.4960 ft

Area of Flow: 0.8652 ft^2

Wetted Perimeter: 3.0646 ft

Hydraulic Radius: 0.2823 ft

Average Velocity: 0.4045 ft/s

Top Width: 2.4886 ft

Froude Number: 0.1209

Critical Depth: 0.1446 ft

Critical Velocity: 1.9882 ft/s

Critical Slope: 0.3401 ft/ft

Critical Top Width: 1.43 ft

Calculated Max Shear Stress: 0.1238 lb/ft^2

Calculated Avg Shear Stress: 0.0705 lb/ft^2

Channel Analysis: DITCH 5B - 50

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 0.0010 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Channel Width: 1.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 0.4200 cfs

Result Parameters

Depth: 0.5450 ft

Area of Flow: 0.9907 ft^2

Wetted Perimeter: 3.2684 ft

Hydraulic Radius: 0.3031 ft

Average Velocity: 0.4240 ft/s

Top Width: 2.6355 ft

Froude Number: 0.1219

Critical Depth: 0.1619 ft

Critical Velocity: 2.0879 ft/s

Critical Slope: 0.3328 ft/ft

Critical Top Width: 1.49 ft

Calculated Max Shear Stress: 0.1360 lb/ft^2

Calculated Avg Shear Stress: 0.0757 lb/ft^2

Channel Analysis: DITCH 5B - 100

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 0.0010 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Channel Width: 1.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.1000

Flow: 0.4900 cfs

Result Parameters

Depth: 0.5893 ft

Area of Flow: 1.1104 ft^2

Wetted Perimeter: 3.4529 ft

Hydraulic Radius: 0.3216 ft

Average Velocity: 0.4413 ft/s

Top Width: 2.7685 ft

Froude Number: 0.1228

Critical Depth: 0.1778 ft

Critical Velocity: 2.1748 ft/s

Critical Slope: 0.3270 ft/ft

Critical Top Width: 1.53 ft

Calculated Max Shear Stress: 0.1471 lb/ft^2

Calculated Avg Shear Stress: 0.0803 lb/ft^2

Channel Analysis: DITCH 7 - 10

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0033 ft/ft

Manning's n: 0.1000

Flow: 1.9100 cfs

Result Parameters

Depth: 0.9637 ft

Area of Flow: 3.7148 ft^2

Wetted Perimeter: 7.9468 ft

Hydraulic Radius: 0.4675 ft

Average Velocity: 0.5142 ft/s

Top Width: 7.7095 ft

Froude Number: 0.1305

Critical Depth: 0.4268 ft

Critical Velocity: 2.6214 ft/s

Critical Slope: 0.2541 ft/ft

Critical Top Width: 3.41 ft

Calculated Max Shear Stress: 0.1984 lb/ft^2

Calculated Avg Shear Stress: 0.0963 lb/ft^2

Channel Analysis: DITCH 7 - 25

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0033 ft/ft

Manning's n: 0.1000

Flow: 2.5000 cfs

Result Parameters

Depth: 1.0660 ft

Area of Flow: 4.5458 ft^2

Wetted Perimeter: 8.7908 ft

Hydraulic Radius: 0.5171 ft

Average Velocity: 0.5500 ft/s

Top Width: 8.5284 ft

Froude Number: 0.1327

Critical Depth: 0.4753 ft

Critical Velocity: 2.7663 ft/s

Critical Slope: 0.2451 ft/ft

Critical Top Width: 3.80 ft

Calculated Max Shear Stress: 0.2195 lb/ft^2

Calculated Avg Shear Stress: 0.1065 lb/ft^2

Channel Analysis: DITCH 7 - 50

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0033 ft/ft

Manning's n: 0.1000

Flow: 2.9100 cfs

Result Parameters

Depth: 1.1285 ft

Area of Flow: 5.0942 ft^2

Wetted Perimeter: 9.3060 ft

Hydraulic Radius: 0.5474 ft

Average Velocity: 0.5712 ft/s

Top Width: 9.0281 ft

Froude Number: 0.1340

Critical Depth: 0.5051 ft

Critical Velocity: 2.8517 ft/s

Critical Slope: 0.2402 ft/ft

Critical Top Width: 4.04 ft

Calculated Max Shear Stress: 0.2324 lb/ft^2

Calculated Avg Shear Stress: 0.1127 lb/ft^2

Channel Analysis: DITCH 7 - 100

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0033 ft/ft

Manning's n: 0.1000

Flow: 3.3000 cfs

Result Parameters

Depth: 1.1830 ft

Area of Flow: 5.5981 ft^2

Wetted Perimeter: 9.7554 ft

Hydraulic Radius: 0.5738 ft

Average Velocity: 0.5895 ft/s

Top Width: 9.4641 ft

Froude Number: 0.1351

Critical Depth: 0.5311 ft

Critical Velocity: 2.9243 ft/s

Critical Slope: 0.2362 ft/ft

Critical Top Width: 4.25 ft

Calculated Max Shear Stress: 0.2436 lb/ft^2

Calculated Avg Shear Stress: 0.1182 lb/ft^2

Channel Analysis: DITCH 9 - 10

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Longitudinal Slope: 0.0132 ft/ft

Manning's n: 0.1000

Flow: 0.7300 cfs

Result Parameters

Depth: 0.6251 ft

Area of Flow: 0.9770 ft^2

Wetted Perimeter: 3.3748 ft

Hydraulic Radius: 0.2895 ft

Average Velocity: 0.7472 ft/s

Top Width: 3.1257 ft

Froude Number: 0.2355

Critical Depth: 0.3535 ft

Critical Velocity: 2.3373 ft/s

Critical Slope: 0.2763 ft/ft

Critical Top Width: 1.84 ft

Calculated Max Shear Stress: 0.5149 lb/ft^2

Calculated Avg Shear Stress: 0.2385 lb/ft^2

Channel Analysis: DITCH 9 - 25

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Longitudinal Slope: 0.0132 ft/ft

Manning's n: 0.1000

Flow: 0.9500 cfs

Result Parameters

Depth: 0.6901 ft

Area of Flow: 1.1904 ft^2

Wetted Perimeter: 3.7252 ft

Hydraulic Radius: 0.3196 ft

Average Velocity: 0.7980 ft/s

Top Width: 3.4503 ft

Froude Number: 0.2394

Critical Depth: 0.3927 ft

Critical Velocity: 2.4637 ft/s

Critical Slope: 0.2668 ft/ft

Critical Top Width: 2.05 ft

Calculated Max Shear Stress: 0.5684 lb/ft^2

Calculated Avg Shear Stress: 0.2632 lb/ft^2

Channel Analysis: DITCH 9 - 50

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Longitudinal Slope: 0.0132 ft/ft

Manning's n: 0.1000

Flow: 1.0900 cfs

Result Parameters

Depth: 0.7266 ft

Area of Flow: 1.3197 ft^2

Wetted Perimeter: 3.9222 ft

Hydraulic Radius: 0.3365 ft

Average Velocity: 0.8259 ft/s

Top Width: 3.6328 ft

Froude Number: 0.2415

Critical Depth: 0.4149 ft

Critical Velocity: 2.5324 ft/s

Critical Slope: 0.2619 ft/ft

Critical Top Width: 2.16 ft

Calculated Max Shear Stress: 0.5985 lb/ft^2

Calculated Avg Shear Stress: 0.2771 lb/ft^2

Channel Analysis: DITCH 9 - 100

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Longitudinal Slope: 0.0132 ft/ft

Manning's n: 0.1000

Flow: 1.2300 cfs

Result Parameters

Depth: 0.7602 ft

Area of Flow: 1.4449 ft^2

Wetted Perimeter: 4.1041 ft

Hydraulic Radius: 0.3521 ft

Average Velocity: 0.8513 ft/s

Top Width: 3.8012 ft

Froude Number: 0.2433

Critical Depth: 0.4355 ft

Critical Velocity: 2.5944 ft/s

Critical Slope: 0.2577 ft/ft

Critical Top Width: 2.27 ft

Calculated Max Shear Stress: 0.6262 lb/ft^2

Calculated Avg Shear Stress: 0.2900 lb/ft^2

Channel Analysis: DITCH 10 - 10

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0070 ft/ft

Manning's n: 0.1000

Flow: 1.0500 cfs

Result Parameters

Depth: 0.7048 ft

Area of Flow: 1.7385 ft^2

Wetted Perimeter: 5.1346 ft

Hydraulic Radius: 0.3386 ft

Average Velocity: 0.6040 ft/s

Top Width: 4.9335 ft

Froude Number: 0.1793

Critical Depth: 0.3559 ft

Critical Velocity: 2.3690 ft/s

Critical Slope: 0.2679 ft/ft

Critical Top Width: 2.54 ft

Calculated Max Shear Stress: 0.3078 lb/ft^2

Calculated Avg Shear Stress: 0.1479 lb/ft^2

Channel Analysis: DITCH 10 - 25

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0070 ft/ft

Manning's n: 0.1000

Flow: 1.3700 cfs

Result Parameters

Depth: 0.7787 ft

Area of Flow: 2.1224 ft^2

Wetted Perimeter: 5.6732 ft

Hydraulic Radius: 0.3741 ft

Average Velocity: 0.6455 ft/s

Top Width: 5.4510 ft

Froude Number: 0.1823

Critical Depth: 0.3958 ft

Critical Velocity: 2.4985 ft/s

Critical Slope: 0.2585 ft/ft

Critical Top Width: 2.83 ft

Calculated Max Shear Stress: 0.3401 lb/ft^2

Calculated Avg Shear Stress: 0.1634 lb/ft^2

Channel Analysis: DITCH 10 - 50

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0070 ft/ft

Manning's n: 0.1000

Flow: 1.6100 cfs

Result Parameters

Depth: 0.8273 ft

Area of Flow: 2.3955 ft^2

Wetted Perimeter: 6.0273 ft

Hydraulic Radius: 0.3975 ft

Average Velocity: 0.6721 ft/s

Top Width: 5.7912 ft

Froude Number: 0.1842

Critical Depth: 0.4222 ft

Critical Velocity: 2.5805 ft/s

Critical Slope: 0.2530 ft/ft

Critical Top Width: 3.02 ft

Calculated Max Shear Stress: 0.3614 lb/ft^2

Calculated Avg Shear Stress: 0.1736 lb/ft^2

Channel Analysis: DITCH 10 - 100

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0070 ft/ft

Manning's n: 0.1000

Flow: 1.8400 cfs

Result Parameters

Depth: 0.8698 ft

Area of Flow: 2.6479 ft^2

Wetted Perimeter: 6.3368 ft

Hydraulic Radius: 0.4179 ft

Average Velocity: 0.6949 ft/s

Top Width: 6.0885 ft

Froude Number: 0.1857

Critical Depth: 0.4454 ft

Critical Velocity: 2.6503 ft/s

Critical Slope: 0.2486 ft/ft

Critical Top Width: 3.18 ft

Calculated Max Shear Stress: 0.3799 lb/ft^2

Calculated Avg Shear Stress: 0.1825 lb/ft^2

APPENDIX C-8

DOWNSTREAM ANALYSIS

APPENDIX C.8 DOWNSTREAM ANALYSIS

1.1 STUDY AREA

This section provides information on the Phase 3 Downstream Analysis that was conducted for the SR 9 and SR 204 Roadway project. See Figure C-8.1 through C-8.3 for the Downstream Flow Path exhibits. The study area extends downstream a quarter mile from each of the proposed project discharge locations. A site visit was performed on September 1st, 2020 by Cheyenne Covington, and the site photos are attached.

1.2 RESOURCE REVIEW

The following resources have been reviewed for existing and potential problems in the study area:

1.2.1 PREVIOUS REPORTS

1.2.1.1 BASIN PLANS

The project area is comprised of five threshold discharge areas (TDAs): TDA 2, TDA 3, TDA 4, TDA 5 and TDA 6. Both TDA 2 and TDA 3 both fall within the Weiser Creek subbasin which is a tributary to Ebey Slough. Ebey Slough drains to Port Gardener Bay and then to Possession Sound. TDAs 4, 5 and 6 drain to the Lake Stevens basin.

There are no basin plans for these basin areas; however, there is a basin plan for the larger Snohomish area. The Snohomish Basin Protection Plan (SBPP) was published in 2015 and identifies areas that are important to the goal of protecting hydrology and examines new and existing tools to help support that goal. The SR9 and SR204 Road project will not be significantly impacted by the SBPP. The City of Lake Stevens operates under a Phase II NPDES permit.

1.2.1.2 OFFSITE ANALYSIS REPORTS

There are no known offsite analysis reports.

1.2.1.3 STORMWATER COMPLIANCE PLANS

There are no known stormwater compliance plans for Weiser Creek or Lake Stevens at this time.

1.2.2 REVIEW OF MAPS AND INVENTORIES

1.2.2.1 NATURAL RESOURCES SOIL SURVEY

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, all three TDAs for the site have Tokul gravelly medial loam, with 0 to 8 percent slopes. Tokul soils are designated as Hydrologic Soils Group Type B which are characterized by having a moderate infiltration rate when thoroughly wet.

1.2.2.2 SNOHOMISH COUNTY WETLANDS INVENTORY

According to Snohomish County Critical Area Regulations Update, there are two wetland areas in the vicinity of the project. A full analysis of these areas is included in the Hydraulic Report Section 6.1.4.

1.2.2.3 MIGRATING RIVER STUDIES

Based on Snohomish County GIS data, the project location is not in a channel migration hazard area.

1.2.2.4 FEMA MAPS

According to the FEMA Flood Insurance Rate Map (FIRM) Numbers 53061C1055F and 53061C0740E there are no special hazard areas inundated by the 100-year flood within the project boundaries.

1.2.2.5 SENSITIVE AREAS FOLIO

According to Snohomish County GIS data, accessed on January 31, 2020, the project site is adjacent to three potential critical areas located along SR 9. Below is a table of the parcels ID and their critical area descriptions. Locations of the critical areas can be seen on Figures C-8.1 through C-8.3.

Critical Area Reference #	Parcel ID	Critical Areas Site Plan Number	Critical Area Description
CA-1	00493400300204	200410200173	Wetland
CA-2	29051300101200	200202051342	Native Growth Protection Area, Wetland
CA-3	29051300100900	200202051342	Native Growth Protection Area, Wetland

1.2.2.6 CLIMATE IMPACTS

According to the Climate Impacts Vulnerability Assessment Statewide map (WSDOT 2011), the project area is in the Northwest Region – Area 3 which is a Low Vulnerability area for the SR 9 and SR 204 roadways. In general, for this project area, most climate impacts would result in either reduced capacity or temporary road closures due to heavy rain events. In general, with increased heavy rains, existing drainage ditches and culverts may be undersized for larger events. Roads at the base of steep slopes may see more landslides, but these are not anticipated to close the road for more than 60 days.

1.2.2.7 SECTION 303(D) LIST OF POLLUTED WATERS

According to the DOE Water Quality Assessment and 303(d) List, Lake Stevens is listed as a Category 5 for Hexachlorobenzene, Dieldrin, Toxaphene, and Polychlorinated Biphenyls (PCBs).

1.3 INSPECTION OF DRAINAGE CONVEYANCE SYSTEMS

1.3.1 ROAD DRAINAGE PROBLEMS

According to the Snohomish County GIS, there are no known flooding problems.

1.3.2 DRAINAGE COMPLAINTS AND PROBLEMS

According to the Snohomish County GIS, there are no known drainage complaints within the project boundary.

1.3.3 SNOHOMISH COUNTY DESIGNATED WATER QUALITY PROBLEMS

There are no known Snohomish County designated water quality problems in the project site.

1.3.4 FIELD INSPECTION

A site visit was conducted on Setember, 2020 to document existing conditions and note existing problems. It was an overcast and rainy afternoon at the time of inspection. The existing drainage system and topography have been surveyed and are documented in the project base map.

The existing on-site and off-site drainage system were generally found to be in adequate condition. No evidence of erosion or flooding was observed.

1.4 ANALYSIS OF DOWNSTREAM EFFECTS

The downstream analysis evaluated project impacts ¼ mile downstream of each TDA outfall. Below are the findings of this analysis, including existing problems, potential problems, field observations, and hydraulic modeling for each TDA. The results of the Hydraulic modeling are provided in Section 1.4.2 of this appendices.

1.4.1 EXISTING CONVEYANCE

Both TDA 2 and TDA 3 drain to the Weiser Creek subbasin which is a tributary to the Ebey Slough Creek. TDA 4 drains to the Lake Stevens basin. A full description of these TDA areas is included in Hydraulic Report Section 2.3. Figures C-8.1 through C-8.3 show the downstream areas and stormwater conveyance with Downstream Reference numbers pointing to drainage areas. The existing discharge points will be maintained within the project limits.There is no proposed conveyance system added for TDA 5 and TDA 6, no downstream analysis is required for these TDAs.

In TDA 2, the existing stormwater culvert under SR204 is a 24-inch concrete culvert but is currently undersized. This culvert acts as a control structure for Wetland 4, so some flows backwater into the wetland so the wetland is not completely drained. Hence, the system is not upsized in the proposed conditions and a wetland hydroperiod analysis is completed to confirm that the wetland still functions similarly in existing and proposed conditions. The City of Lake Stevens confirmed that there are no existing downstream issues for TDA 2. No changes to the downstream systems is expected once the project is constructed. The City of Lake Stevens has not identified any downstream issues for TDAs 3, 4, 5 and 6. For the proposed drainage conveyance improvements in TDAs 2, 3 and 4, refer to the conveyance calculations in Appendix C-5. The existing drainage systems in TDAs 2, 3 and 4 have sufficient capacity.

Upstream TDA/Downstream Reference #	Drainage Area Name	Drainage Area Description	Drainage Component Description	Slope (%)	Distance from Discharge Site (ft)	Existing Problems	Potential Problems	Observation of field inspector, resource reviewer, or resident.
TDA-2_DS-1	NW half of SR 204	Sheet flow drains to a series of CB's and 30" concrete SD.	Impervious pavement, roadway	Unknown	0 – 1500 ft	No problems noted.	No problems anticipated.	N/A
TDA-2_DS-2	Commerical Parking Lot and Fueling Station, East	Sheet flow from fueling station area drains to a detention pipe	Impervious asphalt, fueling station	Unknown	350 ft	No problems noted.	No problems anticipated.	N/A

	of 91st Ave NE and north of SR 204	before joining a 12" DIP SD along the east side of 91st Ave NE. Additional CB's drain the parking lot and connect directly to the mainline.						
TDA-2_DS-3	Commerical Parking Lot, West of 91st Ave NE and south of Vernon Rd	Sheet flow from parking lot area drains to a 8" DIP SD along the west side of 91st Ave NE.	Impervious asphalt, parking lot	Unknown	215 ft	No problems noted.	No problems anticipated.	N/A
TDA-2_DS-4	Commerical Parking Lot, East of 91st Ave NE and South of SR 204	Sheet flow from parking lot area drains to a series of CB's and a detention vault. Drainage then flows through a stream in Wetland Area #4 to a 24" concrete SD.	Impervious asphalt, parking lot	Unknown	0 ft	No problems noted; however, drainage flows through Wetland Area #4.	No problems anticipated	N/A
TDA-2_DS-5	Commercial Parking Lot, West of 91st Ave NE and north of SR 204.	Sheet flow from parking lot area drains to a 12" PVC SD on the north side of SR 204.	Impervious asphalt, parking lot	Unknown	445 ft	No problems noted.	No problems anticipated.	N/A
TDA-2_DS-6	Commerical Property at 8928 Vernon Rd, North of SR 204	Drainage from grassy depression on the south side of the property and north of SR 204	Grassy depression	Unknown	725 ft	No problems noted.	No problems anticipated.	N/A

		drains to 8” PVC SD.						
TDA-2_DS-7	Vegetated ditch along north side of SR 204	Vegetated ditch runs parallel to SR 204 on the north side of the roadway.	Vegetated ditch	Unknown	725 – 1500 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-1	Frontier Circle mainline	Sheet flow along Frontier circle and various laterals from offsite areas described below drain to 30” concrete SD.	Impervious pavement, roadway and other offsite areas described in laterals below.	Unknown	0 – 1375 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-2	Commerical Parking Lot, West of SR 9 and south of Vernon Rd	Sheet flow from parking lot area drains to a series of CB’s.	Impervious asphalt, parking lot	Unknown	200 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-3	West half of 91st Ave NE, north of Vernon Rd.	Sheet flow drains to 5 CB’s and 12” concrete SD.	Impervious pavement, roadway	Unknown	290 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-4	Commercial Parking Lot, west of 91st Ave NE and north of Vernon Rd.	Sheet flow from parking lot area drains to a 24” CMP detention pipe before joining the mainline along Frontier Circle.	Impervious asphalt, parking lot	Unknown	290 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-5	Both sides of Frontier Circle E.	Sheet flow drains to a series of CB’s and 12” concrete SD.	Impervious pavement, roadway	Unknown	430 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-6	Vegetated Ditch west of 920 Frontier	Drainage from vegetated depression and 1 roadway CB	Vegetated ditch and impervious	Unknown	940 ft	No problems noted.	No problems anticipated.	N/A

	Circle address.	drains to 18" concrete SD.	pavement, roadway					
TDA-3_DS-7	Vegetated ditch along east side of Frontier Heights Park	Vegetated ditch drains to the mainline along Frontier Circle	Vegetated ditch and grassy parking strip	Unknown	940 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-8	Vegetated ditch along west side of Frontier Heights Park	Vegetated ditch drains to the mainline along Frontier Circle	Vegetated ditch and grassy parking strip	Unknown	1375 ft	No problems noted.	No problems anticipated.	N/A
TDA-4_DS-1	Both sides of Vernon Rd	Sheet flow drains to several CB's and 12" CMP SD and 18" PVC SD.	Impervious pavement, roadway	Unknown	0 - 1500 ft	No problems noted.	No problems anticipated.	N/A
TDA-4_DS-2	Commercial Parking Lot, west of Vernon Rd	Sheet flow from parking lot area drains to a 36" CMP detention pipe before joining mainline along Vernon Rd.	Impervious asphalt, parking lot	Unknown	100 ft	No problems noted.	No problems anticipated.	N/A
TDA 4_DS-3	Residential Community, west of Vernon Rd.	Sheet flow from to CB's within the Lake Pointe residential community drains to a 15" PVC SD and then a detention vault.	Impervious pavement, roadway	Unknown	780 ft	No problems noted.	No problems anticipated.	N/A

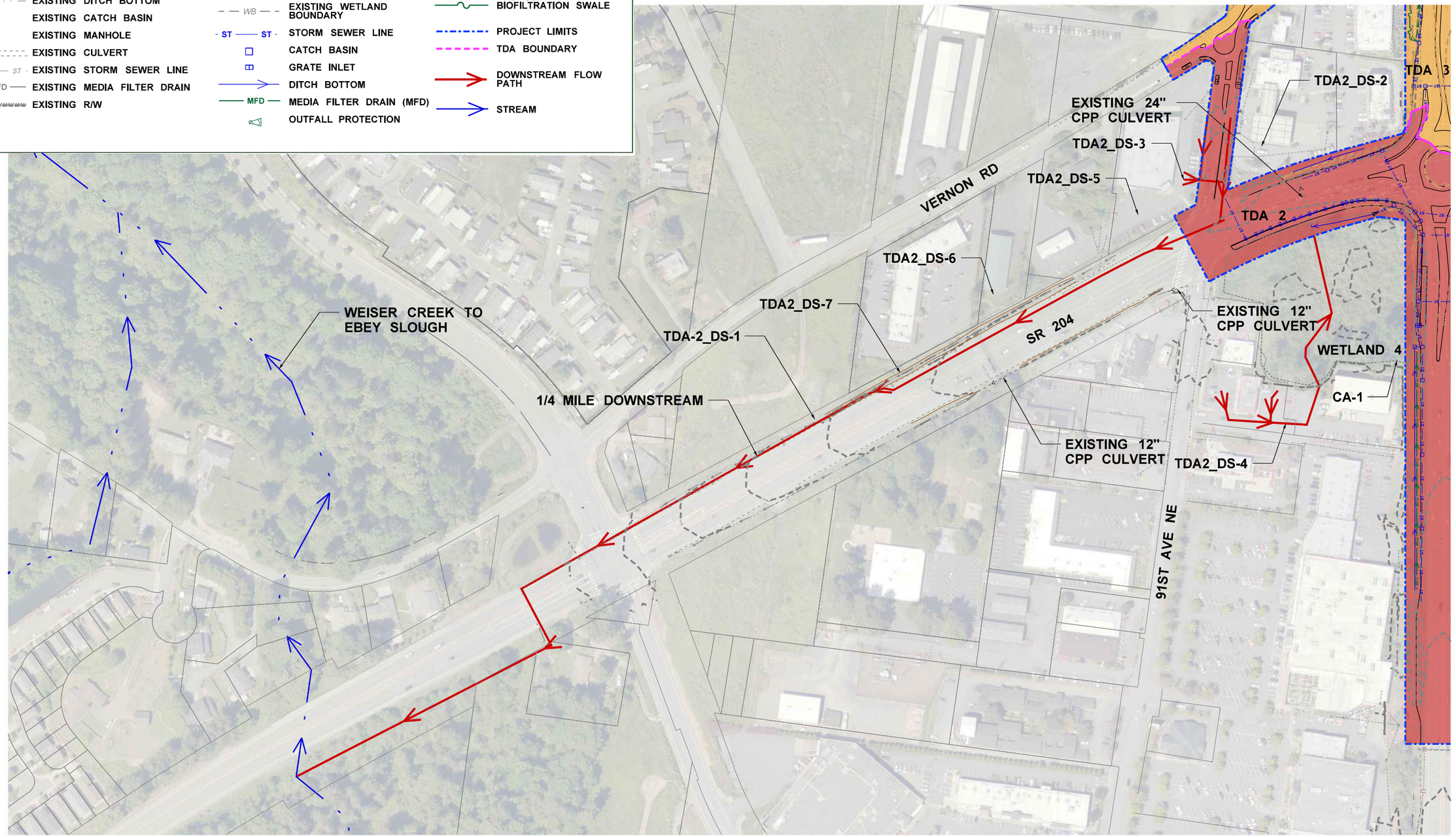
1.4.2 HYDRAULIC MODELING

Hydraulic Modeling was performed using MGSFlood software and compared pre-development to post-development site conditions. TDAs 2 and 3 triggers flow control per HRM requirements and therefore does not require modeling for the downstream analysis. In TDA 4, post-development conditions shows a decrease greater than 0.15 cfs in the pre-development flows due to an unavoidable adjustment in TDA boundaries (see the Deviation Report found in the Hydraulic Report Appendix H for details).Therefore, the ability of the existing conveyance system is assumed to remain unchanged compared to existing conditions. Results of the hydraulic models are found in the Hydraulic Report Appendix C-1.

TDA 1 is not included in Stage 3 project limits and is not included in the downstream analysis. TDAs 5 and 6 post-development conditions do not increase runoff flows by more than 0.15 cfs compared to pre-developed conditions; therefore, negligible hydraulic impacts to downstream areas are expected.

LEGEND

- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
- EXISTING R/W
- EXISTING WETLAND BOUNDARY
- STORM SEWER LINE
- CATCH BASIN
- GRATE INLET
- DITCH BOTTOM
- MEDIA FILTER DRAIN (MFD)
- OUTFALL PROTECTION
- PROPOSED BIOFILTRATION SWALE
- PROJECT LIMITS
- TDA BOUNDARY
- DOWNSTREAM FLOW PATH
- STREAM



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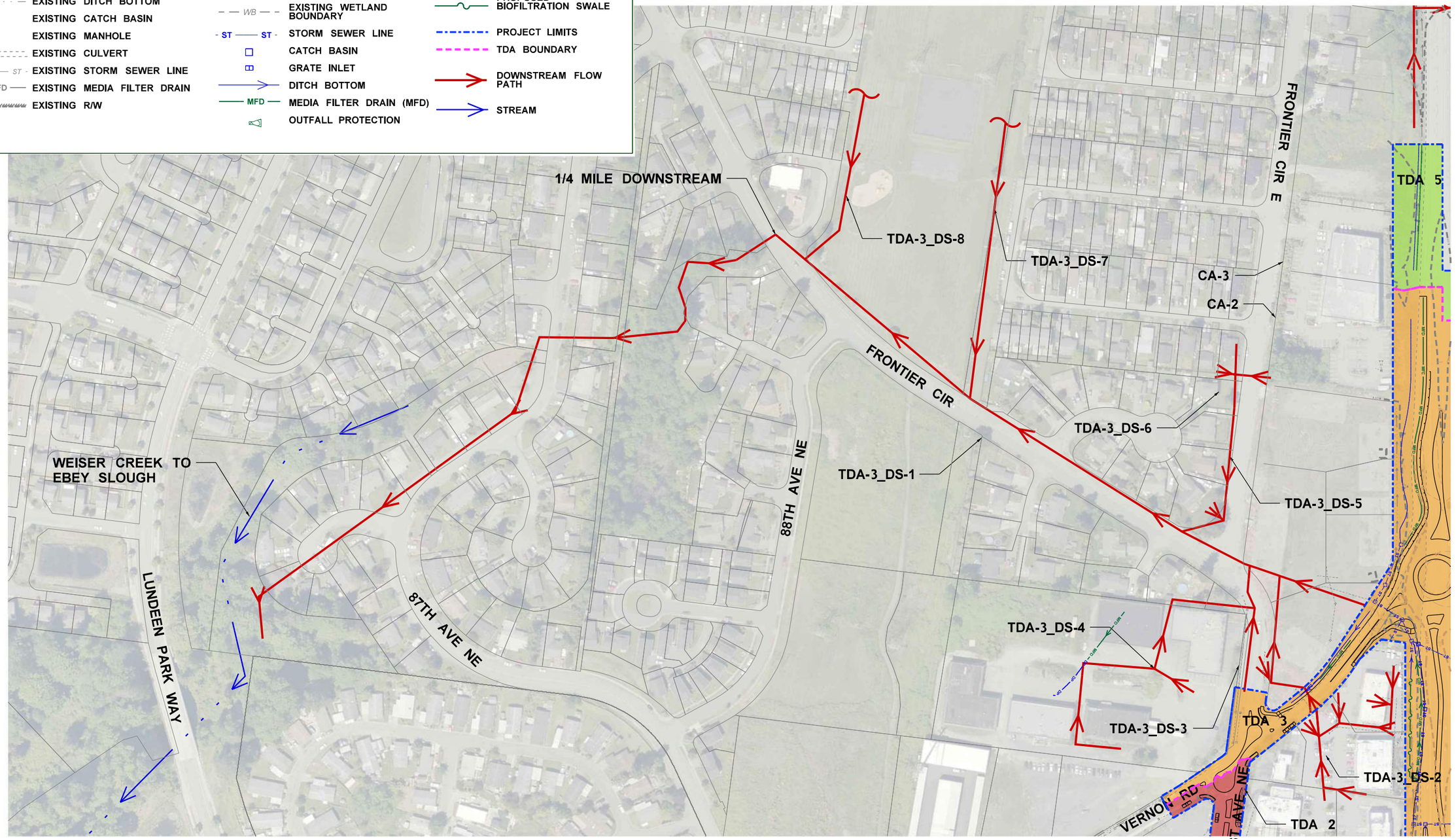
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE C-8.1 DOWNSTREAM FLOW PATH TDA 2

0 50 100
SCALE IN FEET

LEGEND

- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
- EXISTING R/W
- EXISTING WETLAND BOUNDARY
- STORM SEWER LINE
- CATCH BASIN
- GRATE INLET
- DITCH BOTTOM
- MEDIA FILTER DRAIN (MFD)
- OUTFALL PROTECTION
- PROPOSED BIOFILTRATION SWALE
- PROJECT LIMITS
- TDA BOUNDARY
- DOWNSTREAM FLOW PATH
- STREAM



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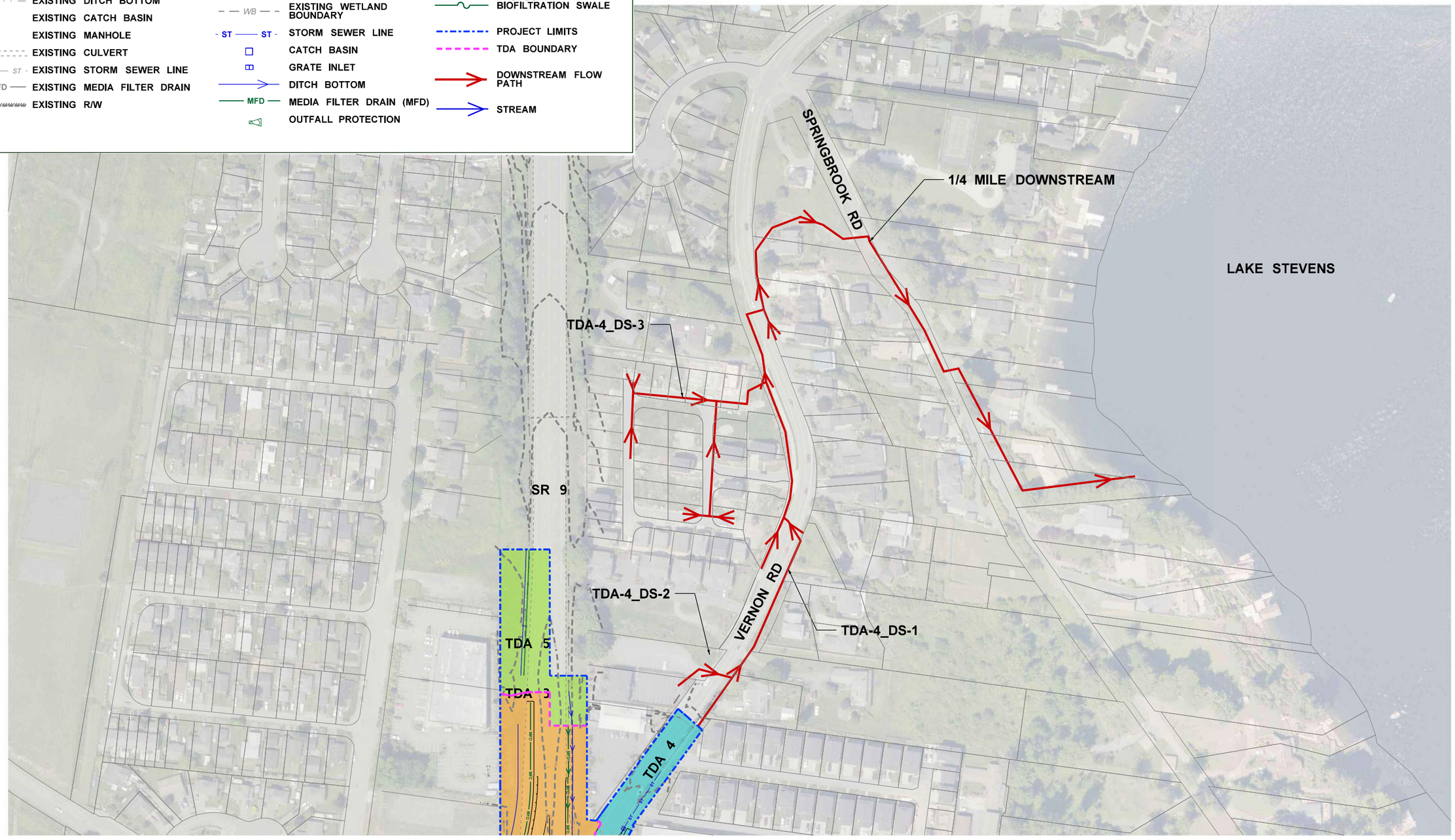
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE C-8.2 DOWNSTREAM FLOW PATH TDA 3

0 50 100
SCALE IN FEET

LEGEND

- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
- EXISTING R/W
- EXISTING WETLAND BOUNDARY
- STORM SEWER LINE
- CATCH BASIN
- GRATE INLET
- DITCH BOTTOM
- MEDIA FILTER DRAIN (MFD)
- OUTFALL PROTECTION
- PROPOSED BIOFILTRATION SWALE
- PROJECT LIMITS
- TDA BOUNDARY
- DOWNSTREAM FLOW PATH
- STREAM



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SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE C-8.3 DOWNSTREAM FLOW PATH TDA 4

0 50 100
SCALE IN FEET

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CALCULATIONS COVER PAGE

PROJECT: SR9/204 Corridor & Interchange Improvements – Stage 3	OCI JOB NO.: 10-150063	PLAN NO.:	PAGE 1 OF 13
CLIENT: (PARSONS / WSDOT)	DEPARTMENT/DISCIPLINE: Civil/Drainage	CALCULATION NO.	

SUBJECT/TITLE: Downstream Analysis

CALCULATION REV. NO.	ORIGINATOR	DISCIPLINE REVIEWER	TECHNICAL PEER REVIEWER (IF REQUIRED)	CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II
0	J. HINDMAN	A. SEETHOFF	N/A	N
1	N. CHEN	L. THOMSEN	N/A	N
2	N. CHEN	A. SEETHOFF	N/A	N

CALCULATIONS OBJECTIVE

For TDAs 2-6, a downstream analysis was performed to determine if the project site will have any significant impacts to the downstream systems. At a minimum, the analysis must include the area of the project site to a point 0.25-mile downstream of the site and upstream to a point where any backwater conditions cease. The results of the analysis must be documented in the project hydraulic report. Potential impacts to be assessed in the report also include but are not limited to changes in flows for extreme events, changes in flood duration, bank erosion, channel erosion, and nutrient loading changes from the project site. The analysis is divided into three parts that follow sequentially:

1. Review of resources.
2. Inspection of drainage conveyance systems in the site area.
3. Analysis of downstream effects.

The following is the process for Review of Resources:

The PEO reviews available resources to assess the existing conditions of the drainage conveyance systems in the project vicinity. Resource data commonly includes aerial photographs, area maps, floodplain maps, wetland inventories, stream surveys, habitat surveys, engineering reports concerning the entire drainage basin, the Climate Impacts Vulnerability Assessment Statewide map (WSDOT 2011), geographic information system (GIS) and LiDAR information, and any previously completed downstream analyses. All of this information shall encompass an area 0.25-mile downstream of the project site's discharge point from WSDOT's ROW.

The background information is used to review and establish the existing conditions of the drainage conveyance system. This baseline information is used to determine whether the project will improve upon existing conditions, have no impact, or degrade existing conditions if no mitigating measures are implemented. The RHE and HQ Environmental Services Office staff will be able to provide most of this information. Other resource information sources include the Washington State Department of Ecology (Ecology), the Washington Department of Fish and Wildlife (WDFW), and local agencies.

The following is the process for inspection of drainage conveyance systems in the site area:

The PEO must inspect the downstream conveyance system and identify any existing problems that might relate to stormwater runoff. The PEO will physically inspect (if possible) the drainage conveyance system at the project site and downstream from WSDOT ROW for a distance of at least 0.25-mile. The inspection shall include any problems or areas of concern that were noted during the resource review process or in conversations with local residents and the WSDOT Maintenance Office. The PEO shall also identify existing or potential conveyance capacity problems in the drainage system, existing or potential areas where flooding may occur, existing or potential areas of extensive channel destruction erosion, and existing or potential areas of significant destruction of aquatic habitat (runoff treatment or flow control) that can be related to stormwater runoff. If areas of potential and existing impacts related to project site runoff are established, actions must be taken to minimize impacts to downstream resources.

The following is the process for Analysis of downstream effects:

This final step analyzes information gathered in the first two steps of the downstream analysis. It is necessary to determine if the project will create any drainage conveyance problems downstream or make any existing problems worse. The PEO must analyze downstream effects to determine corrective or preventive actions that may be necessary. If the project is within a medium or high vulnerability location according to the Climate Impacts Vulnerability Assessment Map (WSDOT 2011), the PEO must run extreme events (for example, the 100-year storm event) and evaluate the impacts and stability of the conveyance system. The PEO shall perform a risk assessment based on the extreme events showing impacts to the conveyance system and to downstream properties and sensitive areas. A risk assessment evaluation was performed for the Deviation Report. The analysis verifies that the 100 year storm event does not show an increase of 0.15 cfs or greater from pre to post development scenarios.

PEOs shall consult the Highway Runoff Manual for further guidance on the design flow for runoff treatment and flow control BMP design. In some cases, analysis of downstream effects may indicate that no corrective or preventive actions are necessary. If corrective or preventive actions are necessary, the following options must be considered:

- Design the on-site treatment and/or flow control facilities to provide a greater level of runoff control than stipulated in the minimum requirements in Chapter 3 of the Highway Runoff Manual.
- Take a protective action separate from meeting Minimum Requirements Nos. 5 and 6 in the Highway Runoff Manual for runoff treatment and flow control. In some situations, a project will have negative impacts even when the minimum requirements are met; for example, a site where the project discharges runoff into a small, closed-basin wetland even though a detention pond was installed to comply with Minimum Requirement 6. The total volume of runoff draining into the wetland will change, possibly affecting habitat and plant species in the area. If a situation is encountered where there will be downstream impacts resulting from the project, the corrective action must be applied to the project based on a practicability analysis.
- If a project is flow control exempt, the conveyance system downstream of the project site shall be inspected to ensure adequate capacity. The PEO shall also analyze and document any changes to the downstream conveyance system, properties, and sensitive areas. If there are any negative impacts, the PEO shall perform a risk analysis showing what would happen if no actions were taken to minimize the negative impacts.

REFERENCES

- WSDOT Hydraulics Manual, April 2019 (M 23-03.06)

CONCLUSIONS

The Downstream Analysis, shows the project improvements will not negatively impact downstream conditions.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW

Name: N. Chen

Date: 4/28/2021

Site Photo 1: Ditch along North side of SR 204 looking West towards Market Pl.

Site Photo 2: NE Corner of SR 204 and 91st Ave NE Looking East Along SR 204

Site Photo 3: Google Map Image Along Frontier Cir. Looking Northwest

Site Photo 4: Google Map Image Along Vernon Rd Looking Northeast

APPENDIX C-9

WETLAND HYDROPERIOD ANALYSIS

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CALCULATIONS COVER PAGE

PROJECT: SR9/204 Corridor & Interchange Improvements – Stage 3	OCI JOB NO.: 10-150063	PLAN NO.:	PAGE 1 OF 14 Total pages include attachments
CLIENT: (PARSONS / WSDOT)	DEPARTMENT/DISCIPLINE: Civil/Drainage	CALCULATION NO.	

SUBJECT/TITLE: Wetland Hydroperiod Analysis for Wetland 4 in TDA 2

CALCULATION REV. NO.	ORIGINATOR	DISCIPLINE REVIEWER	TECHNICAL PEER REVIEWER (IF REQUIRED)	CONFIRMATION REQUIRED (Y/N) IF YES, INCLUDED ATTACHMENT II
0	S. SRIDHARAN	A. SEETHOFF	N/A	N
1				
2				

CALCULATIONS OBJECTIVE

Flows from Stage 1 and Stage 2 of the SR9/204 Intersection Improvements project contribute to Wetland 4. Per the Draft Wetland Assessment Report (2018), Wetland 4 is an emergent and forested wetland located on the SW corner of the SR9/SR204 intersection. Wetland 4 is a category III depressional wetland with a buffer width of 50 feet and a habitat score of 14, scoring 48 points on the overall wetland rating form. Contributing flows to Wetland 4 are part of TDA 2. A detailed breakdown of areas from each stage of the project is provided in a separate PDF along with these calculations. Forest conditions are considered as pre-developed conditions for Stage 1 and Stage 2. Post-project conditions include widening for Stage 1 and Stage 2 projects as well.

Stage 3 offsite flows from the Frontier Village area are collected and discharged through an existing pipe into the wetland buffer in pre-project conditions. For Stage 3, post-developed conditions, the on-site roadway in TDA 2 also discharges water to Wetland 4. In the Post-project conditions, the roadway is widened and sidewalks are added, conveying flows into the wetland at approximately the same location. The discharge from the walled pond is not directed to Wetland 4. There is also overall decrease in area to the wetland since SR 204 areas no longer discharges to the wetland. This calculation is provided to determine if roadway widening and sidewalk improvements within TDA 2, combined with improvements in Stages 1 and 2, will affect the existing wetland hydroperiods.

Per the guidance for protecting wetlands, Department of Ecology Stormwater Manual for Western Washington (DOE SWMMWW), 2019, Appendix I-C, the analysis, using Method 2 must show :

1. The total volume of water into the wetland on a daily basis is not more than 20% higher or lower than the pre-project volumes.
2. Total volume of water into a wetland on a monthly basis is not more than 15% higher or lower than the pre-project volumes.

The following is the process used to show the project does not affect the amount of water flowing to Wetland 4 and that volumes are within the 20% single event and 15% monthly ranges:

1. The Ecology approved continuous hydrologic simulation model MGSFlood (ver. 4.52), is used to determine the daily and monthly volumes of flow into Wetland 4 for the Pre and Post-project scenarios. Point of compliance is at the edge of the wetland buffer

2. Determine the total contributing area to Wetland 4 buffer. Define the Pre and Post-project surface conditions. Wetland buffer is included in pre-project and post-project conditions.
3. Connect all flow components, surface, interflow and ground water to the wetland buffer, point of compliance (POC).
    - Impervious surface via surface flow only.
    - Pervious surfaces via surface flow, interflow and groundwater.
4. Route the flows through the Pre and Post-project scenarios. Run the Wetland Inflow Analysis tool to determine Post-project and Pre-project flow volumes. Point of compliance is at the wetland buffer outflow.
5. Verify the daily Post-project volume for each day is within 20% of the pre-project daily volume for the same day of the year.
6. Verify the post-project monthly volume does not vary by more than 15% from the pre-project monthly volume for every month.

This project also requires meeting Minimum Requirement #6 for flow control in TDA 2. A walled pond has been sized for TDA 2 to meet this flow control requirement. The volume of water to the wetland buffer for the existing condition and the post-developed site with flow control will be modeled to verify the Wetland Protection Standard is met.

Assumptions:

1. The total contributing area encompasses the offsite area from Frontier Village as well as the contributing roadway area from SR 9 in TDA 2 from Stage 1,2 and 3.
2. The MGSFlood analysis uses 15-minute time steps and the Puget East 40 in. rainfall data.

REFERENCES

- WSDOT Highway Runoff Manual (HRM), April 2019 (M 31-16.05)
- Ecology's Stormwater Management Manual for Western Washington (SWMMWW), July 2019.

Inputs:

Contributing areas and runoff component used: See area tables attached to this calculation.

MGSFlood (Version 4.52) Input Parameters:

- Project Location (Puget East 40-in Map)
- Calculate flows using 15-min time step

See the attached MGSFlood results.

CONCLUSIONS

The attached MGSFlood report, *TDA2_Hydroperiod analysis* summary shows the Pre- and Post-project flow volumes are within the allowed deviations for the daily and average monthly flows from the wetland buffer.
Design criteria meets the the SWMMWW (2019) Appendix 1-Crequirements.

See the attached MGSFlood results for the hydroperiod analysis.

THE CALCULATIONS ARE COMPLETED AND READY FOR DISCIPLINE REVIEW

Name: S. Sridharan

Date:04/19/2020

Stage 1

Stage 1 Pond - Post Developed				
Subbasin	Pond Tract		Flow Through	
IMP	Access	Pond tract	Till Pasture	IMP
0.31	0.09	0.11	1.25	0.22

Stage 1-Predeveloped (Area Tally TDA 2)		
Impervious	Till Pasture	Total
2.07	4.00	6.07

Stage 1-Post developed basin (Area Tally TDA 2)				
Imp	Imp Area to Pond (Imp and flow through)	Remaining Imp in TDA 2	Till Pasture (Pervious)	Tiill Pasture (Remaining Pervious)
2.37	0.53	1.84	3.70	2.45

Stage 2

Stage 2 Pond - Post Developed			
Subbasin		Flow Through	
IMP		Till Pasture	IMP
0.885		0.318	0.321

Stage 2 Wetland Hydroperiod-Wetland 5

Pre developed-Offsite flows

U/s of wetland 9		Market Street	Wetland 9	
Till Forest	IMP	IMP	Till Forest	Wetland
1.33	2.34	0.73	0.57	3.42

Post Developed- all areas are offsite, except sidewalk

U/s of wetland 9		Market Street	Wetland 9		Sidewalk (onsite)
Till Forest	IMP	IMP	Till Forest	Wetland	IMP
1.33	2.34	0.68	0.57	3.42	0.14

Stage 2-Predeveloped (Area Tally TDA 2)		
Impervious	Till Pasture	Total
4.66	5.58	10.24

Stage 2-Post developed basin (Area Tally TDA 2)				
Total Imp in TDA 2	Imp area to wetland and pond	Remaining Imp in TDA 2	Till Pasture (Pervious)	Tiill Pasture (Remaining Pervious)
5.49	1.346	4.144	4.75	4.43

Stage 3

Stage 3-Predeveloped (TDA 2)				Offsite	
Impervious	Till Pasture	Total	Impervious to wetland	**IMP**	**Wetland 5 (offsite)**
5.76	3.12	8.88	5.32	65.34	2.69

Stage 3-Post developed basin (TDA2)					Offsite	
Total Imp in TDA 2	Imp area to pond and bypass	Remaining Imp to wetland	Till Pasture	Till Pasture (Remaining Perv)	**IMP**	**Wetland 5 (offsite)**
6.38	2.63	3.75	2.47	2.08	65.34	2.69

Note: Offsite imp areas contributing to the wetland are only from Offsite areas 1 through 9 = 65.34 ac

Post Developed-Walled pond

Subbasin		Flow Through	
IMP	access roads	Till Pasture	IMP
0.84	0.21	0.39	0.35

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 201010003
Project Simulation Performed on: 04/19/2021 2:58 PM
Report Generation Date: 04/19/2021 3:00 PM

Input File Name: TDA2_Hydroperiod analysis.fld
Project Name: SR9 Stage 3
Analysis Title: Wetland Hydroperiod analysis for TDA 2
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	100.820	98.188
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	100.820	98.188

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 8

---------- Subbasin : Stage 3 area ----------

	-------Area (Acres) --------
Till Pasture	2.770
Impervious	5.320
Subbasin Total	8.090

---------- Subbasin : Stage 3 Offsite area ----------

	-------Area (Acres) --------
Impervious	65.340
Subbasin Total	65.340

---------- Subbasin : Stage 1 TDA 2 ----------

	-------Area (Acres) --------
Till Pasture	4.000
Impervious	2.070
Subbasin Total	6.070

---------- Subbasin : Stage 2-u/s of wetland 9 ----------

	-------Area (Acres) --------
Till Forest	1.330
Impervious	2.340
Subbasin Total	3.670

---------- Subbasin : Stage 2 - Wetland 9 ----------

	-------Area (Acres) --------
Till Forest	0.570
Wetland	3.420
Subbasin Total	3.990

---------- Subbasin : Stage 2 Market St ----------

	-------Area (Acres) --------
Impervious	0.730
Subbasin Total	0.730

---------- Subbasin : Stage 2 TDA 2 ----------

	-------Area (Acres) --------
Till Pasture	5.580
Impervious	4.660
Subbasin Total	10.240

---------- Subbasin : Offsite Wetland 5 ----------

	-------Area (Acres) --------
Wetland	2.690
Subbasin Total	2.690

----------SCENARIO: POSTDEVELOPED

Number of Subbasins: 14

---------- Subbasin : Stage 3 Offsite area ----------

	-------Area (Acres) --------
Impervious	65.340
Subbasin Total	65.340

---------- Subbasin : Stage 3 area ----------

	-------Area (Acres) --------
Till Pasture	2.070
Impervious	3.240
Subbasin Total	5.310

---------- Subbasin : Stage 1 Eq area ----------

	-------Area (Acres) --------
Impervious	0.310
Subbasin Total	0.310

---------- Subbasin : Stage 1 Pond Tract ----------

	-------Area (Acres) --------
Impervious	0.200
Subbasin Total	0.200

---------- Subbasin : Stage 1 flow through ----------

	-------Area (Acres) --------
Till Pasture	1.250
Impervious	0.220
Subbasin Total	1.470

---------- Subbasin : Stage 2 Eq Area ----------

	-------Area (Acres) --------
Impervious	0.885
Subbasin Total	0.885

---------- Subbasin : Stage 2 Flow through ----------

	-------Area (Acres) --------
Till Pasture	0.318
Impervious	0.321
Subbasin Total	0.639

---------- Subbasin : Stage 2-U/s of wetland 9 ----------

-------Area (Acres) --------

Till Forest	1.330
Impervious	2.340
Subbasin Total	3.670

---------- Subbasin : Stage 2-wetland 9 ----------

	-------Area (Acres) --------
Till Forest	0.570
Wetland	3.420
Subbasin Total	3.990

---------- Subbasin : Stage 2 Market Sr ----------

	-------Area (Acres) --------
Impervious	0.680
Subbasin Total	0.680

---------- Subbasin : Stage 2 Sidewalk area ----------

	-------Area (Acres) --------
Impervious	0.140
Subbasin Total	0.140

---------- Subbasin : Stage 1 TDA 2 ----------

	-------Area (Acres) --------
Till Pasture	2.450
Impervious	1.840
Subbasin Total	4.290

---------- Subbasin : Stage 2 TDA2 ----------

	-------Area (Acres) --------
Till Pasture	4.430
Impervious	4.144
Subbasin Total	8.574

---------- Subbasin : Offsite Wetland 5 ----------

	-------Area (Acres) --------
Wetland	2.690
Subbasin Total	2.690

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 4

Link Name: Wetland 4 POC
Link Type: Copy
Downstream Link: None

Link Name: Stage 1 POC
Link Type: Copy
Downstream Link Name: Stage 2 POC

Link Name: Stage 2 wetland POC
Link Type: Copy
Downstream Link Name: Stage 2 POC

Link Name: Stage 2 POC
Link Type: Copy
Downstream Link Name: Wetland 4 POC

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 7

Link Name: Wetland 4 POC
Link Type: Copy
Downstream Link: None

Link Name: Stage 1 Pond A
Link Type: Structure
Downstream Link Name: Stage 1 POC

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
373.25	0.
374.25	2009.
375.25	2686.
376.25	8222.
377.25	12867.
377.75	15584.

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low

Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.010
Riser Crest Elevation : 376.75 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 373.25
Diameter (in) : 0.37
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 376.02
Diameter (in) : 0.87
Orientation : Horizontal
Elbow : Yes

Link Name: Stage 2 Pond
Link Type: Structure
Downstream Link Name: Stage 2 POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 104.08
Max Pond Elevation (ft) : 105.00
Storage Depth (ft) : 4.08
Pond Bottom Length (ft) : 185.0
Pond Bottom Width (ft) : 13.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 2405.
Area at Riser Crest El (sq-ft) : 2,405.
(acres) : 0.055
Volume at Riser Crest (cu-ft) : 9,812.
(ac-ft) : 0.225
Area at Max Elevation (sq-ft) : 2405.
(acres) : 0.055
Vol at Max Elevation (cu-ft) : 12,025.
(ac-ft) : 0.276

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 104.08 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.33
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 102.80
Diameter (in) : 1.45
Orientation : Horizontal
Elbow : Yes

Link Name: Wetland 9
Link Type: Copy
Downstream Link Name: To wetland 5 buffer

Link Name: To wetland 5 buffer
Link Type: Copy
Downstream Link Name: Stage 2 POC

Link Name: Stage 1 POC
Link Type: Copy
Downstream Link Name: Stage 2 POC

Link Name: Stage 2 POC
Link Type: Copy
Downstream Link Name: Wetland 4 POC

**************************FLOOD FREQUENCY AND DURATION STATISTICS********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 8
Number of Links: 4

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 14
Number of Links: 7

*************Groundwater Recharge Summary ***************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin:	Stage 3 area	487.843
Subbasin:	Stage 3 Offsite area	0.000
Subbasin:	Stage 1 TDA 2	704.467
Subbasin:	Stage 2-u/s of wetla	229.331
Subbasin:	Stage 2 - Wetland 9	830.872
Subbasin:	Stage 2 Market St	0.000
Subbasin:	Stage 2 TDA 2	982.731
Subbasin:	Offsite Wetland	576.216
Link:	Wetland 4 POC	0.000
Link:	Stage 1 POC	Not Applicable
Link:	Stage 2 wetland POC	Not Applicable
Link:	Stage 2 POC	Not Applicable
Total:		3811.460

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin:	Stage 3 Offsite area	0.000
Subbasin:	Stage 3 area	364.562
Subbasin:	Stage 1 Eq area	0.000
Subbasin:	Stage 1 Pond Tract	0.000
Subbasin:	Stage 1 flow through	220.146
Subbasin:	Stage 2 Eq Area	0.000
Subbasin:	Stage 2 Flow through	56.005
Subbasin:	Stage 2-U/s of wetla	229.331
Subbasin:	Stage 2-wetland 9	830.872
Subbasin:	Stage 2 Market Sr	0.000
Subbasin:	Stage 2 Sidewalk are	0.000
Subbasin:	Stage 1 TDA 2	431.486
Subbasin:	Stage 2 TDA2	780.197
Subbasin:	Offsite Wetland	576.216
Link:	Wetland 4 POC	0.000
Link:	Stage 1 Pond A	Not Computed
Link:	Stage 2 Pond	Not Computed
Link:	Wetland 9	Not Applicable
Link:	To wetland 5 buffer	Not Applicable
Link:	Stage 1 POC	Not Applicable
Link:	Stage 2 POC	Not Applicable
Total:		3488.814

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 24.123 ac-ft/year, Post Developed: 22.081 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 4

********** Link: Wetland 4 POC **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 39478.10
Inflow Volume Including PPT-Evap (ac-ft): 39478.10
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 39478.10
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 7

********** Link: Wetland 4 POC **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 38851.78
Inflow Volume Including PPT-Evap (ac-ft): 38851.78
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 38851.78
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Link: Wetland 4 POC
Scenario Postdeveloped Compliance Link: Wetland 4 POC

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	30.555	2-Year	29.504
5-Year	39.405	5-Year	38.101
10-Year	45.777	10-Year	44.320
25-Year	58.815	25-Year	56.229
50-Year	71.340	50-Year	68.683
100-Year	85.585	100-Year	81.651
200-Year	87.945	200-Year	84.070
500-Year	90.975	500-Year	87.203

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

*************Wetland Hydrologic Loading Analysis Results **************

Predeveloped Wetland Location: Wetland 4 POC, Inflow
Postdeveloped Wetland Location: Wetland 4 POC, Inflow

Days out of Compliance: 0
Months out of Compliance: 0

***********Mean Daily Wetland Inflow (cfs) *************
Must be within 20% for each Day

Month	Predeveloped	Postdeveloped	Percent Difference
Oct-01	2.408E-01	2.369E-01	-1.61%
Oct-02	1.830E-01	1.813E-01	-0.97%
Oct-03	2.556E-01	2.519E-01	-1.45%
Oct-04	3.091E-01	3.041E-01	-1.60%
Oct-05	2.243E-01	2.218E-01	-1.10%
Oct-06	4.151E-01	4.078E-01	-1.76%
Oct-07	2.951E-01	2.909E-01	-1.40%
Oct-08	2.907E-01	2.865E-01	-1.45%
Oct-09	3.729E-01	3.665E-01	-1.72%
Oct-10	3.425E-01	3.374E-01	-1.51%
Oct-11	2.966E-01	2.927E-01	-1.30%
Oct-12	3.160E-01	3.111E-01	-1.55%
Oct-13	3.116E-01	3.079E-01	-1.19%
Oct-14	3.336E-01	3.287E-01	-1.47%
Oct-15	2.454E-01	2.430E-01	-1.00%
Oct-16	2.115E-01	2.095E-01	-0.97%
Oct-17	3.811E-01	3.737E-01	-1.94%
Oct-18	3.658E-01	3.599E-01	-1.62%
Oct-19	3.889E-01	3.828E-01	-1.58%
Oct-20	5.059E-01	4.977E-01	-1.62%
Oct-21	4.947E-01	4.867E-01	-1.61%
Oct-22	4.963E-01	4.883E-01	-1.60%
Oct-23	5.043E-01	4.952E-01	-1.81%
Oct-24	4.115E-01	4.059E-01	-1.36%
Oct-25	4.407E-01	4.339E-01	-1.54%
Oct-26	5.144E-01	5.052E-01	-1.77%
Oct-27	5.885E-01	5.775E-01	-1.86%
Oct-28	4.624E-01	4.559E-01	-1.41%
Oct-29	5.053E-01	4.968E-01	-1.67%
Oct-30	4.084E-01	4.031E-01	-1.29%
Oct-31	6.011E-01	5.900E-01	-1.86%
Nov-01	4.481E-01	4.418E-01	-1.41%
Nov-02	3.981E-01	3.920E-01	-1.54%
Nov-03	6.412E-01	6.285E-01	-1.98%
Nov-04	6.068E-01	5.971E-01	-1.61%
Nov-05	3.876E-01	3.825E-01	-1.31%
Nov-06	4.315E-01	4.252E-01	-1.48%
Nov-07	5.011E-01	4.928E-01	-1.65%
Nov-08	4.355E-01	4.291E-01	-1.48%
Nov-09	6.041E-01	5.928E-01	-1.86%
Nov-10	6.123E-01	6.012E-01	-1.82%
Nov-11	6.496E-01	6.377E-01	-1.83%

Nov-12	4.745E-01	4.676E-01	-1.46%
Nov-13	6.213E-01	6.102E-01	-1.79%
Nov-14	5.411E-01	5.325E-01	-1.58%
Nov-15	5.366E-01	5.283E-01	-1.56%
Nov-16	6.326E-01	6.214E-01	-1.78%
Nov-17	6.613E-01	6.496E-01	-1.76%
Nov-18	5.626E-01	5.526E-01	-1.77%
Nov-19	7.585E-01	7.436E-01	-1.96%
Nov-20	5.775E-01	5.672E-01	-1.78%
Nov-21	6.258E-01	6.143E-01	-1.85%
Nov-22	5.370E-01	5.293E-01	-1.44%
Nov-23	8.328E-01	8.160E-01	-2.02%
Nov-24	8.618E-01	8.452E-01	-1.93%
Nov-25	7.575E-01	7.432E-01	-1.89%
Nov-26	6.009E-01	5.909E-01	-1.67%
Nov-27	6.806E-01	6.683E-01	-1.81%
Nov-28	4.640E-01	4.575E-01	-1.41%
Nov-29	6.040E-01	5.935E-01	-1.73%
Nov-30	7.051E-01	6.921E-01	-1.85%
Dec-01	6.362E-01	6.261E-01	-1.60%
Dec-02	7.162E-01	7.026E-01	-1.89%
Dec-03	7.672E-01	7.519E-01	-1.99%
Dec-04	7.069E-01	6.939E-01	-1.84%
Dec-05	6.586E-01	6.474E-01	-1.71%
Dec-06	6.516E-01	6.408E-01	-1.65%
Dec-07	5.992E-01	5.901E-01	-1.52%
Dec-08	5.388E-01	5.307E-01	-1.50%
Dec-09	5.174E-01	5.099E-01	-1.45%
Dec-10	6.599E-01	6.482E-01	-1.77%
Dec-11	5.811E-01	5.715E-01	-1.66%
Dec-12	5.398E-01	5.313E-01	-1.58%
Dec-13	5.154E-01	5.075E-01	-1.52%
Dec-14	5.416E-01	5.332E-01	-1.55%
Dec-15	6.376E-01	6.262E-01	-1.79%
Dec-16	5.193E-01	5.113E-01	-1.55%
Dec-17	5.488E-01	5.407E-01	-1.47%
Dec-18	5.053E-01	4.977E-01	-1.51%
Dec-19	5.381E-01	5.292E-01	-1.65%
Dec-20	6.847E-01	6.718E-01	-1.88%
Dec-21	6.594E-01	6.481E-01	-1.72%
Dec-22	4.811E-01	4.740E-01	-1.48%
Dec-23	5.192E-01	5.111E-01	-1.56%
Dec-24	4.817E-01	4.747E-01	-1.45%
Dec-25	4.971E-01	4.888E-01	-1.68%
Dec-26	6.307E-01	6.188E-01	-1.89%
Dec-27	5.557E-01	5.464E-01	-1.69%
Dec-28	4.170E-01	4.114E-01	-1.33%
Dec-29	6.541E-01	6.418E-01	-1.88%
Dec-30	5.533E-01	5.444E-01	-1.62%
Dec-31	3.970E-01	3.917E-01	-1.33%
Jan-01	5.010E-01	4.924E-01	-1.71%
Jan-02	6.081E-01	5.963E-01	-1.94%
Jan-03	4.930E-01	4.847E-01	-1.69%
Jan-04	5.075E-01	4.992E-01	-1.63%
Jan-05	4.677E-01	4.600E-01	-1.66%
Jan-06	5.131E-01	5.039E-01	-1.79%

Jan-07	5.067E-01	4.981E-01	-1.70%
Jan-08	4.565E-01	4.498E-01	-1.47%
Jan-09	5.438E-01	5.347E-01	-1.67%
Jan-10	5.815E-01	5.713E-01	-1.75%
Jan-11	4.622E-01	4.549E-01	-1.59%
Jan-12	5.353E-01	5.255E-01	-1.83%
Jan-13	5.567E-01	5.463E-01	-1.88%
Jan-14	7.196E-01	7.046E-01	-2.09%
Jan-15	6.614E-01	6.488E-01	-1.90%
Jan-16	5.512E-01	5.419E-01	-1.70%
Jan-17	5.477E-01	5.378E-01	-1.81%
Jan-18	5.826E-01	5.715E-01	-1.90%
Jan-19	5.954E-01	5.844E-01	-1.86%
Jan-20	5.402E-01	5.313E-01	-1.65%
Jan-21	3.963E-01	3.913E-01	-1.24%
Jan-22	4.850E-01	4.775E-01	-1.55%
Jan-23	6.476E-01	6.351E-01	-1.94%
Jan-24	5.486E-01	5.391E-01	-1.72%
Jan-25	4.624E-01	4.550E-01	-1.60%
Jan-26	4.523E-01	4.450E-01	-1.63%
Jan-27	5.721E-01	5.607E-01	-1.99%
Jan-28	3.967E-01	3.910E-01	-1.44%
Jan-29	4.449E-01	4.377E-01	-1.63%
Jan-30	4.257E-01	4.196E-01	-1.42%
Jan-31	6.139E-01	6.016E-01	-2.01%
Feb-01	5.604E-01	5.499E-01	-1.87%
Feb-02	5.211E-01	5.112E-01	-1.90%
Feb-03	4.261E-01	4.186E-01	-1.75%
Feb-04	4.308E-01	4.239E-01	-1.60%
Feb-05	4.594E-01	4.510E-01	-1.82%
Feb-06	5.985E-01	5.870E-01	-1.93%
Feb-07	4.899E-01	4.815E-01	-1.72%
Feb-08	5.701E-01	5.599E-01	-1.79%
Feb-09	5.103E-01	5.014E-01	-1.75%
Feb-10	4.726E-01	4.645E-01	-1.71%
Feb-11	4.437E-01	4.364E-01	-1.66%
Feb-12	6.413E-01	6.286E-01	-1.99%
Feb-13	6.265E-01	6.143E-01	-1.94%
Feb-14	5.064E-01	4.971E-01	-1.83%
Feb-15	5.837E-01	5.727E-01	-1.88%
Feb-16	6.697E-01	6.560E-01	-2.05%
Feb-17	7.861E-01	7.697E-01	-2.10%
Feb-18	7.217E-01	7.072E-01	-2.01%
Feb-19	6.370E-01	6.245E-01	-1.97%
Feb-20	4.571E-01	4.499E-01	-1.58%
Feb-21	4.714E-01	4.636E-01	-1.66%
Feb-22	4.099E-01	4.045E-01	-1.32%
Feb-23	4.041E-01	3.987E-01	-1.35%
Feb-24	5.917E-01	5.803E-01	-1.94%
Feb-25	5.535E-01	5.433E-01	-1.85%
Feb-26	5.017E-01	4.928E-01	-1.77%
Feb-27	5.351E-01	5.254E-01	-1.81%
Feb-28	5.338E-01	5.244E-01	-1.76%
Mar-01	5.148E-01	5.053E-01	-1.84%
Mar-02	4.476E-01	4.404E-01	-1.62%
Mar-03	6.009E-01	5.892E-01	-1.95%

Mar-04	5.211E-01	5.121E-01	-1.73%
Mar-05	5.406E-01	5.313E-01	-1.72%
Mar-06	2.940E-01	2.914E-01	-0.89%
Mar-07	4.110E-01	4.050E-01	-1.46%
Mar-08	5.120E-01	5.029E-01	-1.76%
Mar-09	6.223E-01	6.100E-01	-1.97%
Mar-10	4.670E-01	4.596E-01	-1.59%
Mar-11	4.362E-01	4.288E-01	-1.68%
Mar-12	5.702E-01	5.595E-01	-1.87%
Mar-13	4.268E-01	4.201E-01	-1.56%
Mar-14	4.615E-01	4.538E-01	-1.67%
Mar-15	4.580E-01	4.505E-01	-1.63%
Mar-16	3.802E-01	3.750E-01	-1.38%
Mar-17	4.588E-01	4.510E-01	-1.71%
Mar-18	4.217E-01	4.150E-01	-1.60%
Mar-19	3.691E-01	3.636E-01	-1.49%
Mar-20	3.967E-01	3.904E-01	-1.60%
Mar-21	3.611E-01	3.561E-01	-1.40%
Mar-22	5.524E-01	5.419E-01	-1.90%
Mar-23	5.438E-01	5.337E-01	-1.85%
Mar-24	4.368E-01	4.290E-01	-1.79%
Mar-25	4.185E-01	4.112E-01	-1.75%
Mar-26	4.452E-01	4.371E-01	-1.82%
Mar-27	3.949E-01	3.888E-01	-1.53%
Mar-28	4.165E-01	4.097E-01	-1.62%
Mar-29	5.368E-01	5.264E-01	-1.94%
Mar-30	4.762E-01	4.678E-01	-1.76%
Mar-31	4.363E-01	4.292E-01	-1.64%
Apr-01	3.458E-01	3.412E-01	-1.32%
Apr-02	3.024E-01	2.988E-01	-1.21%
Apr-03	2.675E-01	2.644E-01	-1.17%
Apr-04	3.956E-01	3.892E-01	-1.60%
Apr-05	4.285E-01	4.216E-01	-1.62%
Apr-06	3.583E-01	3.529E-01	-1.50%
Apr-07	2.887E-01	2.852E-01	-1.21%
Apr-08	4.421E-01	4.345E-01	-1.70%
Apr-09	4.457E-01	4.380E-01	-1.73%
Apr-10	3.298E-01	3.254E-01	-1.36%
Apr-11	4.223E-01	4.151E-01	-1.72%
Apr-12	3.653E-01	3.597E-01	-1.52%
Apr-13	2.811E-01	2.780E-01	-1.12%
Apr-14	2.995E-01	2.957E-01	-1.26%
Apr-15	2.350E-01	2.329E-01	-0.87%
Apr-16	3.171E-01	3.129E-01	-1.32%
Apr-17	2.994E-01	2.952E-01	-1.39%
Apr-18	1.866E-01	1.855E-01	-0.59%
Apr-19	4.330E-01	4.248E-01	-1.90%
Apr-20	3.545E-01	3.492E-01	-1.49%
Apr-21	2.225E-01	2.204E-01	-0.97%
Apr-22	3.441E-01	3.381E-01	-1.75%
Apr-23	4.381E-01	4.307E-01	-1.68%
Apr-24	3.099E-01	3.058E-01	-1.31%
Apr-25	2.067E-01	2.046E-01	-1.00%
Apr-26	2.094E-01	2.071E-01	-1.10%
Apr-27	3.404E-01	3.350E-01	-1.59%
Apr-28	2.866E-01	2.828E-01	-1.35%

Apr-29	2.687E-01	2.650E-01	-1.40%
Apr-30	3.161E-01	3.109E-01	-1.62%
May-01	3.541E-01	3.475E-01	-1.84%
May-02	2.853E-01	2.815E-01	-1.32%
May-03	3.104E-01	3.053E-01	-1.63%
May-04	2.015E-01	1.992E-01	-1.10%
May-05	3.318E-01	3.264E-01	-1.63%
May-06	2.738E-01	2.705E-01	-1.20%
May-07	2.234E-01	2.210E-01	-1.05%
May-08	2.023E-01	2.006E-01	-0.82%
May-09	1.408E-01	1.405E-01	-0.19%
May-10	1.619E-01	1.609E-01	-0.62%
May-11	2.328E-01	2.307E-01	-0.90%
May-12	2.309E-01	2.280E-01	-1.26%
May-13	2.057E-01	2.042E-01	-0.71%
May-14	2.105E-01	2.085E-01	-0.94%
May-15	2.131E-01	2.106E-01	-1.13%
May-16	2.229E-01	2.202E-01	-1.19%
May-17	2.532E-01	2.495E-01	-1.48%
May-18	1.509E-01	1.505E-01	-0.24%
May-19	2.250E-01	2.218E-01	-1.42%
May-20	1.920E-01	1.903E-01	-0.90%
May-21	1.543E-01	1.529E-01	-0.91%
May-22	2.045E-01	2.019E-01	-1.31%
May-23	2.012E-01	1.988E-01	-1.21%
May-24	1.875E-01	1.858E-01	-0.96%
May-25	1.902E-01	1.884E-01	-0.95%
May-26	2.683E-01	2.642E-01	-1.53%
May-27	1.994E-01	1.973E-01	-1.04%
May-28	1.808E-01	1.788E-01	-1.10%
May-29	2.084E-01	2.056E-01	-1.36%
May-30	2.153E-01	2.125E-01	-1.33%
May-31	3.011E-01	2.964E-01	-1.56%
Jun-01	2.031E-01	2.007E-01	-1.20%
Jun-02	1.297E-01	1.288E-01	-0.71%
Jun-03	1.696E-01	1.672E-01	-1.41%
Jun-04	2.430E-01	2.393E-01	-1.54%
Jun-05	1.449E-01	1.440E-01	-0.67%
Jun-06	2.544E-01	2.501E-01	-1.68%
Jun-07	1.859E-01	1.841E-01	-0.98%
Jun-08	1.536E-01	1.520E-01	-1.04%
Jun-09	2.070E-01	2.037E-01	-1.60%
Jun-10	2.401E-01	2.363E-01	-1.58%
Jun-11	1.674E-01	1.658E-01	-0.94%
Jun-12	1.617E-01	1.599E-01	-1.09%
Jun-13	1.600E-01	1.586E-01	-0.91%
Jun-14	2.062E-01	2.033E-01	-1.40%
Jun-15	1.177E-01	1.173E-01	-0.32%
Jun-16	1.882E-01	1.857E-01	-1.33%
Jun-17	1.725E-01	1.709E-01	-0.95%
Jun-18	1.319E-01	1.309E-01	-0.82%
Jun-19	9.487E-02	9.478E-02	-0.10%
Jun-20	1.450E-01	1.434E-01	-1.10%
Jun-21	1.160E-01	1.156E-01	-0.37%
Jun-22	1.203E-01	1.194E-01	-0.78%
Jun-23	1.338E-01	1.327E-01	-0.84%

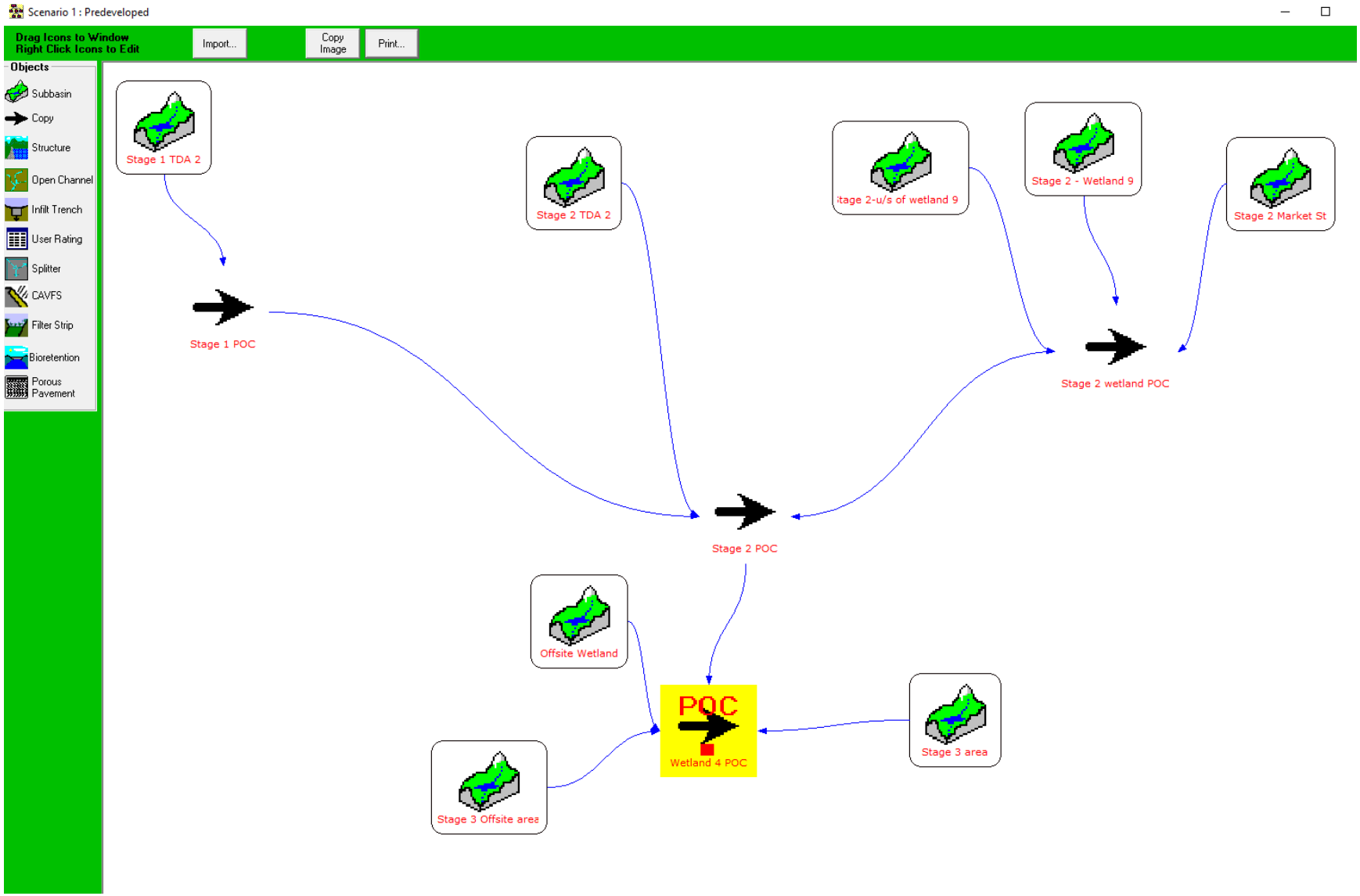
Jun-24	2.485E-01	2.441E-01	-1.76%
Jun-25	1.234E-01	1.229E-01	-0.38%
Jun-26	1.268E-01	1.254E-01	-1.07%
Jun-27	1.062E-01	1.056E-01	-0.62%
Jun-28	1.700E-01	1.678E-01	-1.32%
Jun-29	2.421E-01	2.381E-01	-1.65%
Jun-30	8.562E-02	8.572E-02	0.12%
Jul-01	1.460E-01	1.442E-01	-1.19%
Jul-02	8.584E-02	8.557E-02	-0.32%
Jul-03	1.273E-01	1.257E-01	-1.25%
Jul-04	8.980E-02	8.966E-02	-0.15%
Jul-05	1.935E-01	1.904E-01	-1.59%
Jul-06	4.801E-02	4.900E-02	2.07%
Jul-07	6.980E-02	6.931E-02	-0.70%
Jul-08	1.727E-01	1.699E-01	-1.61%
Jul-09	1.271E-01	1.260E-01	-0.91%
Jul-10	1.051E-01	1.042E-01	-0.87%
Jul-11	9.560E-02	9.469E-02	-0.95%
Jul-12	1.095E-01	1.082E-01	-1.18%
Jul-13	5.447E-02	5.458E-02	0.20%
Jul-14	6.607E-02	6.561E-02	-0.70%
Jul-15	7.188E-02	7.136E-02	-0.72%
Jul-16	1.337E-01	1.317E-01	-1.52%
Jul-17	1.088E-01	1.080E-01	-0.76%
Jul-18	6.984E-02	6.928E-02	-0.80%
Jul-19	6.847E-02	6.817E-02	-0.44%
Jul-20	4.788E-02	4.784E-02	-0.09%
Jul-21	6.896E-02	6.823E-02	-1.06%
Jul-22	2.833E-02	2.875E-02	1.47%
Jul-23	1.183E-02	1.238E-02	4.59%
Jul-24	1.930E-02	1.955E-02	1.34%
Jul-25	4.656E-02	4.598E-02	-1.26%
Jul-26	1.118E-01	1.102E-01	-1.47%
Jul-27	5.681E-02	5.650E-02	-0.54%
Jul-28	4.217E-02	4.211E-02	-0.13%
Jul-29	2.350E-02	2.365E-02	0.64%
Jul-30	1.780E-02	1.797E-02	0.93%
Jul-31	1.700E-02	1.707E-02	0.38%
Aug-01	2.184E-02	2.190E-02	0.26%
Aug-02	7.160E-02	7.035E-02	-1.74%
Aug-03	6.460E-02	6.379E-02	-1.26%
Aug-04	6.830E-02	6.724E-02	-1.56%
Aug-05	3.199E-02	3.212E-02	0.40%
Aug-06	6.818E-02	6.705E-02	-1.65%
Aug-07	1.143E-01	1.125E-01	-1.59%
Aug-08	3.493E-02	3.526E-02	0.96%
Aug-09	4.002E-02	3.971E-02	-0.79%
Aug-10	2.338E-02	2.348E-02	0.46%
Aug-11	3.683E-02	3.640E-02	-1.17%
Aug-12	7.741E-02	7.629E-02	-1.45%
Aug-13	5.761E-02	5.731E-02	-0.52%
Aug-14	1.097E-01	1.077E-01	-1.88%
Aug-15	1.174E-01	1.158E-01	-1.36%
Aug-16	9.754E-02	9.662E-02	-0.94%
Aug-17	8.574E-02	8.476E-02	-1.15%
Aug-18	9.177E-02	9.057E-02	-1.31%

Aug-19	1.016E-01	9.997E-02	-1.58%
Aug-20	6.628E-02	6.595E-02	-0.51%
Aug-21	9.653E-02	9.496E-02	-1.62%
Aug-22	7.528E-02	7.475E-02	-0.70%
Aug-23	1.913E-01	1.876E-01	-1.94%
Aug-24	1.439E-01	1.424E-01	-0.98%
Aug-25	1.323E-01	1.305E-01	-1.35%
Aug-26	1.265E-01	1.249E-01	-1.27%
Aug-27	1.770E-01	1.740E-01	-1.65%
Aug-28	1.515E-01	1.496E-01	-1.31%
Aug-29	1.795E-01	1.768E-01	-1.55%
Aug-30	1.549E-01	1.528E-01	-1.37%
Aug-31	1.024E-01	1.018E-01	-0.58%
Sep-01	2.515E-01	2.467E-01	-1.90%
Sep-02	1.832E-01	1.810E-01	-1.19%
Sep-03	1.475E-01	1.460E-01	-0.97%
Sep-04	1.534E-01	1.517E-01	-1.12%
Sep-05	1.442E-01	1.427E-01	-1.02%
Sep-06	1.433E-01	1.418E-01	-1.08%
Sep-07	8.238E-02	8.249E-02	0.13%
Sep-08	1.396E-01	1.379E-01	-1.23%
Sep-09	1.924E-01	1.896E-01	-1.45%
Sep-10	1.879E-01	1.855E-01	-1.24%
Sep-11	1.199E-01	1.194E-01	-0.38%
Sep-12	5.751E-02	5.790E-02	0.68%
Sep-13	1.699E-01	1.673E-01	-1.52%
Sep-14	2.268E-01	2.239E-01	-1.26%
Sep-15	2.491E-01	2.456E-01	-1.42%
Sep-16	2.180E-01	2.155E-01	-1.17%
Sep-17	2.969E-01	2.921E-01	-1.64%
Sep-18	2.057E-01	2.037E-01	-0.96%
Sep-19	2.731E-01	2.692E-01	-1.45%
Sep-20	2.135E-01	2.112E-01	-1.04%
Sep-21	1.649E-01	1.636E-01	-0.81%
Sep-22	2.345E-01	2.308E-01	-1.58%
Sep-23	2.398E-01	2.365E-01	-1.40%
Sep-24	2.064E-01	2.038E-01	-1.28%
Sep-25	1.229E-01	1.229E-01	-0.05%
Sep-26	2.532E-01	2.492E-01	-1.60%
Sep-27	2.032E-01	2.011E-01	-1.05%
Sep-28	2.629E-01	2.593E-01	-1.38%
Sep-29	1.465E-01	1.455E-01	-0.67%
Sep-30	2.350E-01	2.313E-01	-1.56%

**********Mean Monthly Wetland Inflow (cfs) **********
Must be within 15% for each Month

Month	Predeveloped	Postdeveloped	Percent Difference
Oct	3.774E-01	3.717E-01	-1.52%
Nov	5.915E-01	5.814E-01	-1.70%
Dec	5.776E-01	5.680E-01	-1.65%
Jan	5.285E-01	5.193E-01	-1.75%
Feb	5.399E-01	5.300E-01	-1.83%
Mar	4.623E-01	4.544E-01	-1.70%
Apr	3.247E-01	3.200E-01	-1.45%
May	2.237E-01	2.210E-01	-1.20%

Jun	1.650E-01	1.632E-01	-1.12%
Jul	7.855E-02	7.792E-02	-0.80%
Aug	9.392E-02	9.272E-02	-1.28%
Sep	1.906E-01	1.883E-01	-1.17%


Scenario 1 : Predeveloped
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Print...
Objects
Subbasin
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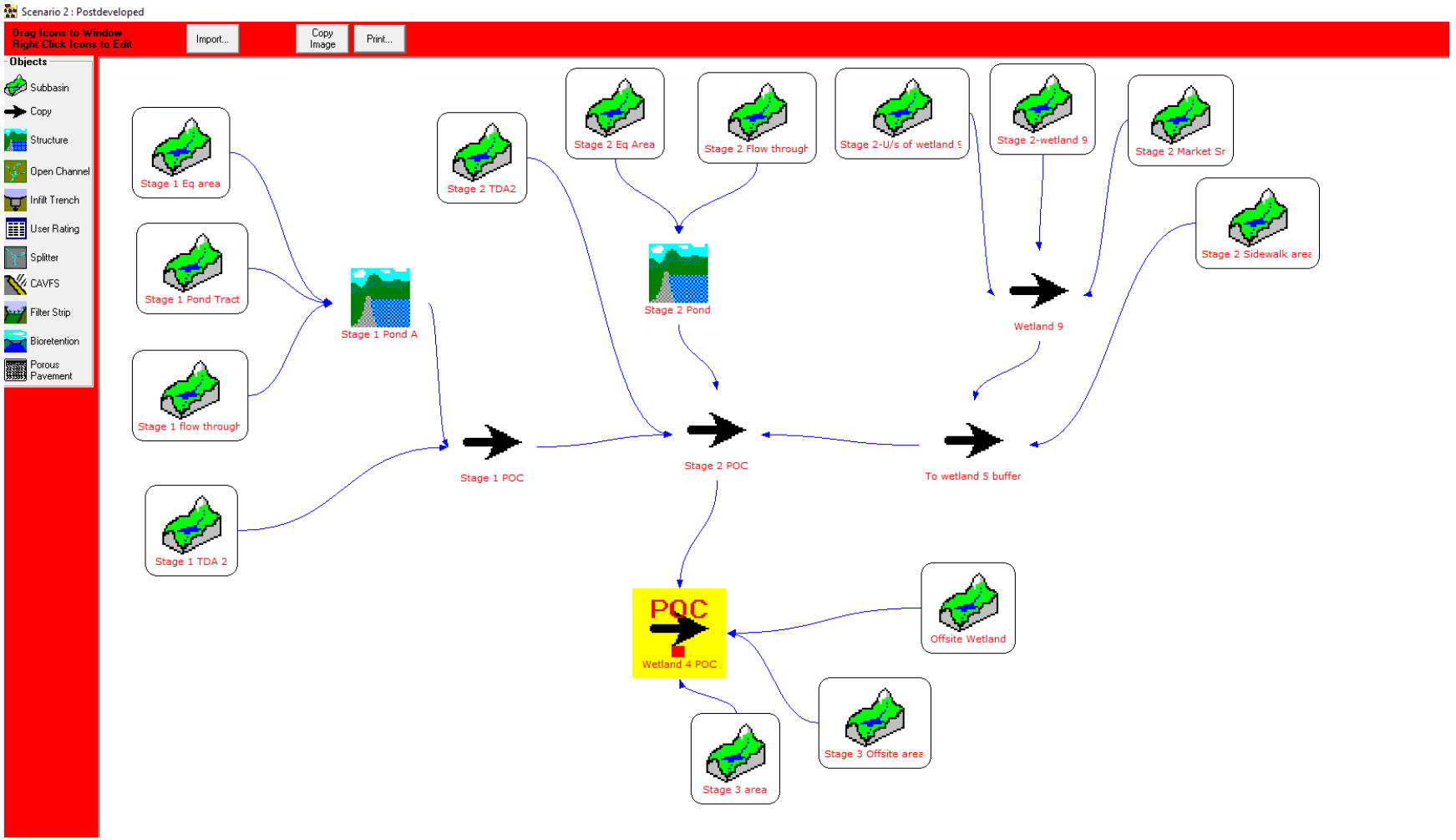
Structure
Open Channel
Infilt Trench
User Rating
Splitter
CAVFS
Filter Strip
Bioretention
Porous Pavement
Stage 1 TDA 2
Stage 2 TDA 2
itage 2-u/s of wetland 9
Stage 2 - Wetland 9
Stage 2 Market St
Stage 1 POC
Stage 2 wetland POC
Stage 2 POC
Offsite Wetland
POC
Wetland 4 POC
Stage 3 area
Stage 3 Offsite area


Scenario 2 : Postdeveloped
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Right Click Icons to Edit
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Print...
Objects
Subbasin
Copy
Structure
Open Channel
Infilt Trench
User Rating
Splitter
CAVFS
Filter Strip
Bioretention
Porous Pavement
Stage 1 Eq area
Stage 1 Pond Tract
Stage 1 flow through
Stage 1 TDA 2
Stage 1 Pond A
Stage 2 TDA2
Stage 2 Eq Area
Stage 2 Flow through
Stage 2 Pond
Stage 2-U/s of wetland 9
Stage 2-wetland 9
Wetland 9
Stage 2 Market Sr
Stage 2 Sidewalk area
Stage 1 POC
Stage 2 POC
To wetland 5 buffer
POC
Wetland 4 POC
Offsite Wetland
Stage 3 Offsite area
Stage 3 area

APPENDIX C-10

FLOOD PLAIN MITIGATION

NOT USED

APPENDIX C-11

BRIDGE SCOUR EVALUATION

NOT USED

APPENDIX D

DRAINAGE PLAN SHEETS, STRUCTURE NOTES AND DETAILS

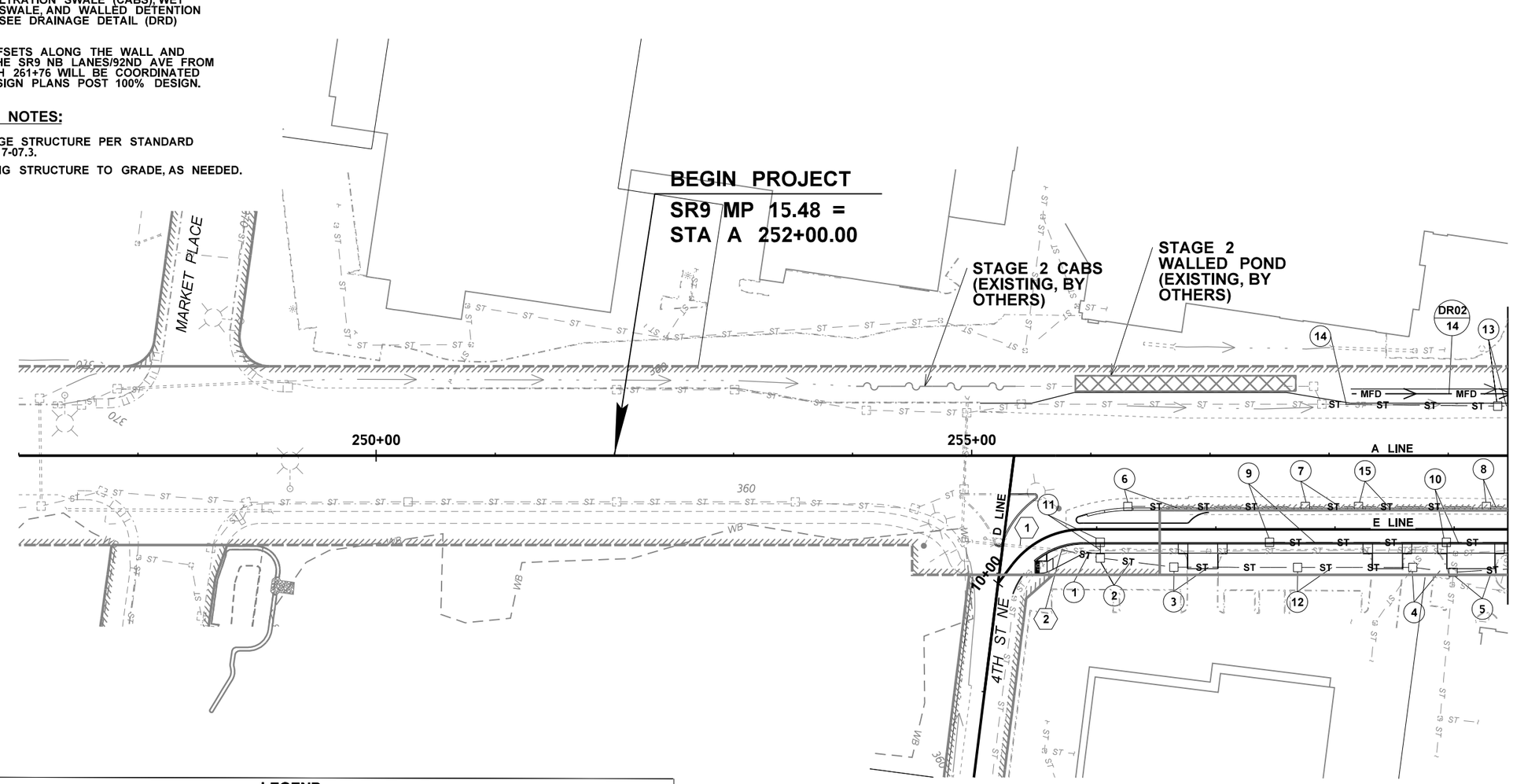
T. 29N. R. 5E. W.M. SEC. 13

NOTES:

1. FOR DRAINAGE PROFILES, SEE DP SHEETS.
2. FOR DRAINAGE DETAILS INCLUDING DRAINAGE DITCHES, MEDIA FILTER DRAIN (MFD), COMPOST AMENDED BIOFILTRATION SWALE (CABS), WET BIOFILTRATION SWALE, AND WALLED DETENTION POND DETAILS, SEE DRAINAGE DETAIL (DRD) SHEETS.
3. STRUCTURE OFFSETS ALONG THE WALL AND BARRIER ON THE SR9 NB LANES/92ND AVE FROM 256+31 THROUGH 261+76 WILL BE COORDINATED WITH WALL DESIGN PLANS POST 100% DESIGN.

CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.



0 50 100
SCALE IN FEET

LEGEND

- STRUCTURE NOTE CODE
- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
- EXISTING R/W
- EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)
- BARRIER
- EXISTING WETLAND BOUNDARY
- STORM SEWER LINE
- CATCH BASIN
- GRATE INLET
- WALLED DETENTION POND
- DITCH BOTTOM
- MEDIA FILTER DRAIN (MFD)
- COMPOST AMENDED BIOFILTRATION SWALE (CABS)
- DRAIN PIPE LINE
- CHAIN LINK FENCE
- NOISE WALL
- OUTFALL PROTECTION
- MAINTENANCE ACCESS ROAD

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DESIGNED BY	S. SRIDHARAN/T.HEW				
ENTERED BY	N. CHEN				
CHECKED BY	L. THOMSEN				
PROJ. ENGR.	K. NDILE				
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO. 10 | STATE WASH | FED.AID PROJ.NO.
JOB NUMBER 18A828
CONTRACT NO. | LOCATION NO.

P.E. STAMP BOX — DATE

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PLAN

PLAN REF NO DR01
SHEET
OF
SHEETS

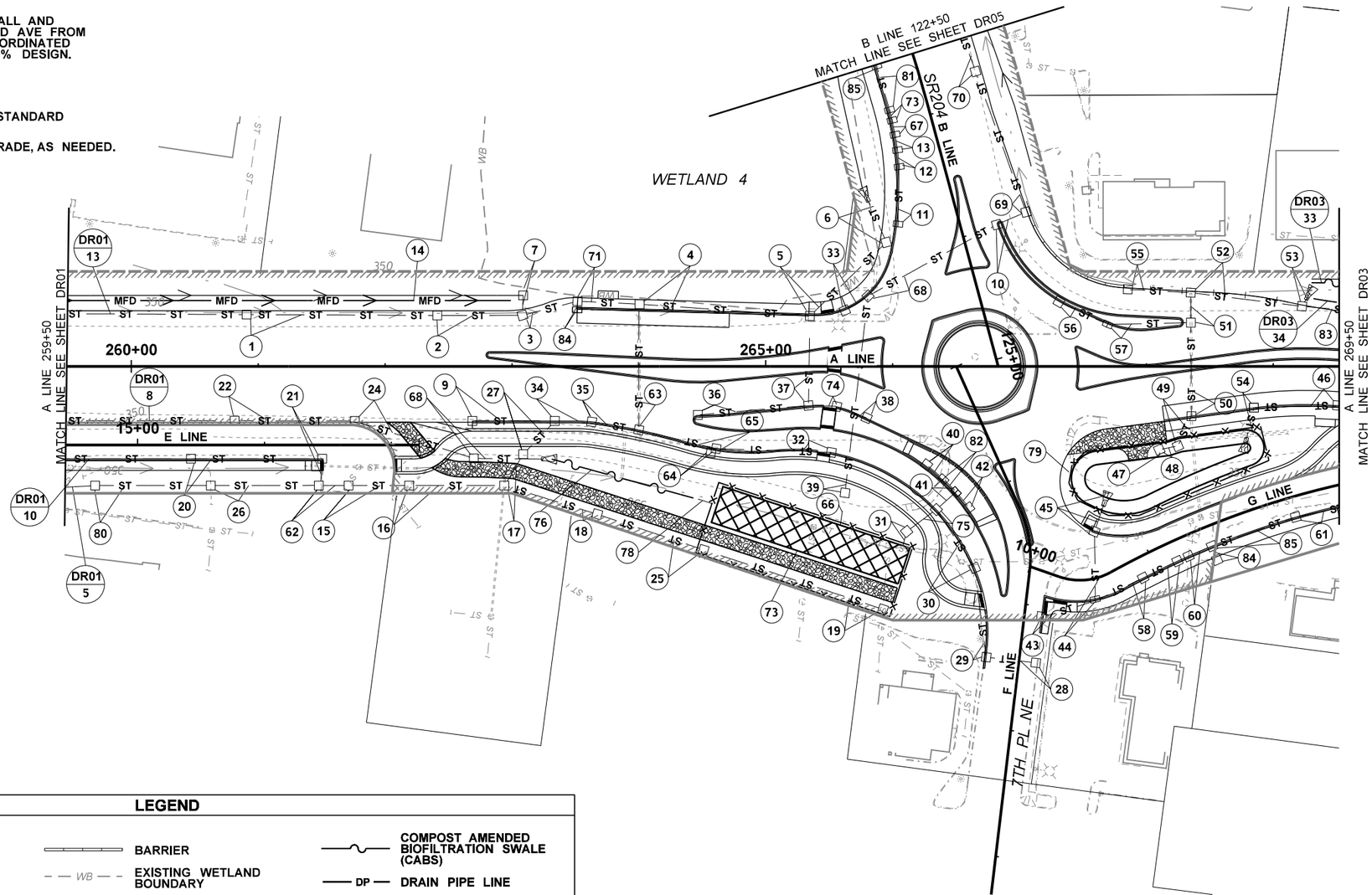
T. 29N. R. 5E. W.M. SEC. 13

NOTES:

1. FOR DRAINAGE PROFILES, SEE DP SHEETS.
2. FOR DRAINAGE DETAILS INCLUDING DRAINAGE DITCHES, MEDIA FILTER DRAIN (MFD), COMPOST AMENDED BIOFILTRATION SWALE (CABS), WET BIOFILTRATION SWALE, AND WALLED DETENTION POND DETAILS, SEE DRAINAGE DETAIL (DRD) SHEETS.
3. STRUCTURE OFFSETS ALONG THE WALL AND BARRIER ON THE SR9 NB LANES/92ND AVE FROM 256+31 THROUGH 261+76 WILL BE COORDINATED WITH WALL DESIGN PLANS POST 100% DESIGN.

CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.



0 50 100
SCALE IN FEET

LEGEND

- (X) STRUCTURE NOTE CODE
- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
- EXISTING R/W
- EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)
- BARRIER
- EXISTING WETLAND BOUNDARY
- STORM SEWER LINE
- CATCH BASIN
- GRATE INLET
- WALLED DETENTION POND
- DITCH BOTTOM
- MEDIA FILTER DRAIN (MFD)
- COMPOST AMENDED BIOFILTRATION SWALE (CABS)
- DRAIN PIPE LINE
- CHAIN LINK FENCE
- NOISE WALL
- OUTFALL PROTECTION
- MAINTENANCE ACCESS ROAD

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ENTERED BY	N. CHEN				
CHECKED BY	L. THOMSEN				
PROJ. ENGR.	K. NDILE				
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO.	STATE	FED.AID PROJ.NO.
10	WASH	
JOB NUMBER 18A828		
CONTRACT NO.		LOCATION NO.

P.E. STAMP BOX — DATE

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PLAN

PLAN REF NO DR02

SHEET OF SHEETS

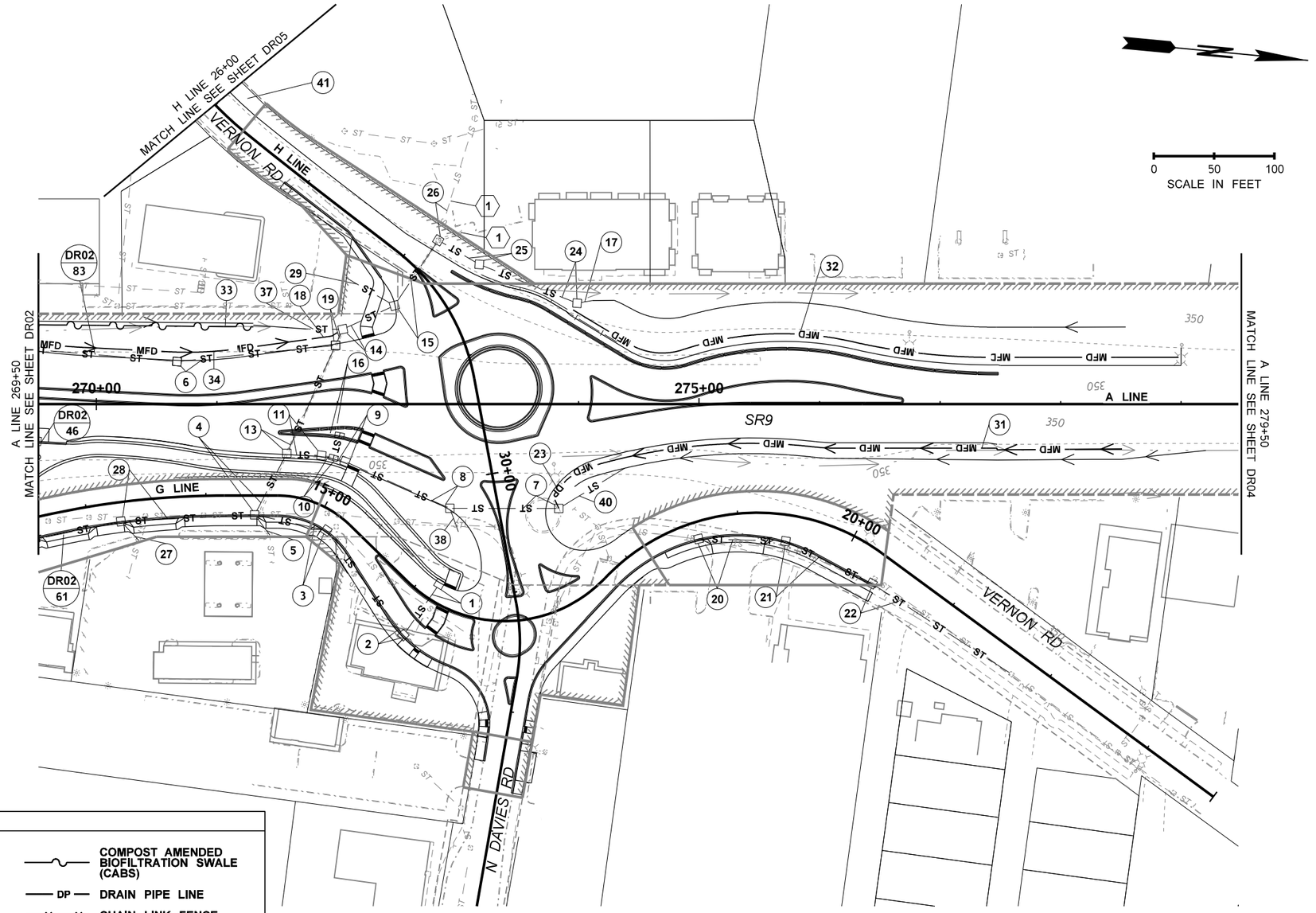
T. 29N. R. 5E. W.M. SEC. 13

NOTES:

1. FOR DRAINAGE PROFILES, SEE DP SHEETS.
2. FOR DRAINAGE DETAILS INCLUDING DRAINAGE DITCHES, MEDIA FILTER DRAIN (MFD), COMPOST AMENDED BIOFILTRATION SWALE (CABS), WET BIOFILTRATION SWALE, AND WALLED DETENTION POND DETAILS, SEE DRAINAGE DETAIL (DRD) SHEETS.
3. STRUCTURE OFFSETS ALONG THE WALL AND BARRIER ON THE SR9 NB LANES/92ND AVE FROM 256+31 THROUGH 261+76 WILL BE COORDINATED WITH WALL DESIGN PLANS POST 100% DESIGN.

CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.



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- STRUCTURE NOTE CODE
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- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
- EXISTING R/W
- EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)
- BARRIER
- EXISTING WETLAND BOUNDARY
- STORM SEWER LINE
- CATCH BASIN
- GRATE INLET
- WALLED DETENTION POND
- DITCH BOTTOM
- MEDIA FILTER DRAIN (MFD)
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- DRAIN PIPE LINE
- CHAIN LINK FENCE
- NOISE WALL
- OUTFALL PROTECTION
- MAINTENANCE ACCESS ROAD

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DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

CHRYSANE S. COVINGTON — STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PLAN

PLAN REF NO DR03

SHEET OF SHEETS

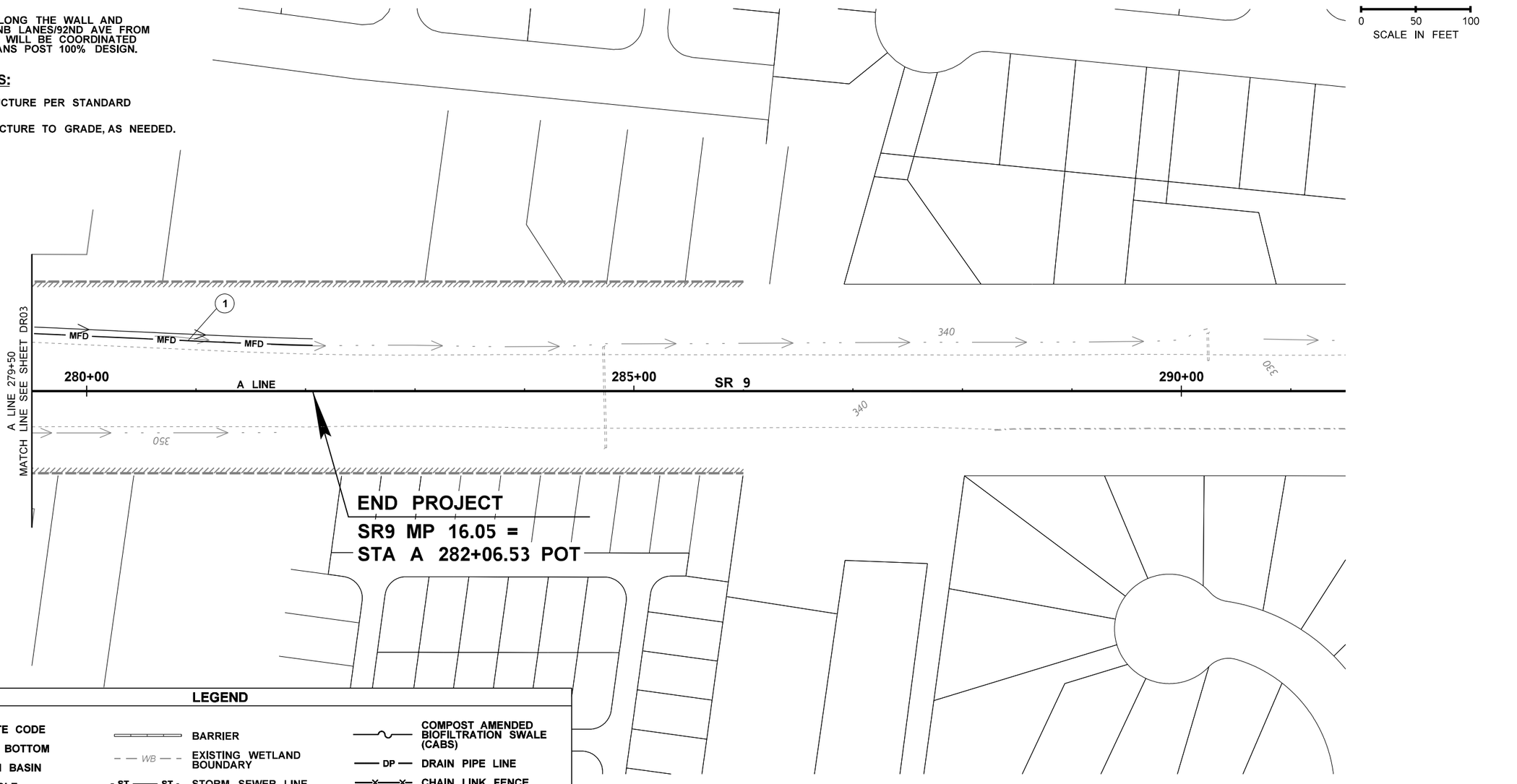
T. 29N. R. 5E. W.M. SEC. 13

NOTES:

1. FOR DRAINAGE PROFILES, SEE DP SHEETS.
2. FOR DRAINAGE DETAILS INCLUDING DRAINAGE DITCHES, MEDIA FILTER DRAIN (MFD), COMPOST AMENDED BIOFILTRATION SWALE (CABS), WET BIOFILTRATION SWALE, AND WALLED DETENTION POND DETAILS, SEE DRAINAGE DETAIL (DRD) SHEETS.
3. STRUCTURE OFFSETS ALONG THE WALL AND BARRIER ON THE SR9 NB LANES/92ND AVE FROM 256+31 THROUGH 261+76 WILL BE COORDINATED WITH WALL DESIGN PLANS POST 100% DESIGN.

CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.



LEGEND

(X)	STRUCTURE NOTE CODE
	EXISTING DITCH BOTTOM
	EXISTING CATCH BASIN
	EXISTING MANHOLE
	EXISTING CULVERT
ST — ST	EXISTING STORM SEWER LINE
MFD	EXISTING MEDIA FILTER DRAIN
	EXISTING R/W
	EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)
	BARRIER
WB	EXISTING WETLAND BOUNDARY
ST — ST	STORM SEWER LINE
	CATCH BASIN
	GRATE INLET
	WALLED DETENTION POND
	DITCH BOTTOM
MFD	MEDIA FILTER DRAIN (MFD)
	COMPOST AMENDED BIOFILTRATION SWALE (CABS)
DP	DRAIN PIPE LINE
	CHAIN LINK FENCE
	NOISE WALL
	OUTFALL PROTECTION
	MAINTENANCE ACCESS ROAD

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DESIGNED BY	S. SRIDHARAN/T.HEW					
ENTERED BY	N. CHEN					
CHECKED BY	L. THOMSEN					
PROJ. ENGR.	K. NDILE					
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY	

REGION NO. 10 | STATE WASH | JOB NUMBER | CONTRACT NO. | FED.AID PROJ.NO. | LOCATION NO.

P.E. STAMP BOX — DATE

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OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PLAN

PLAN REF NO DR04

SHEET OF SHEETS

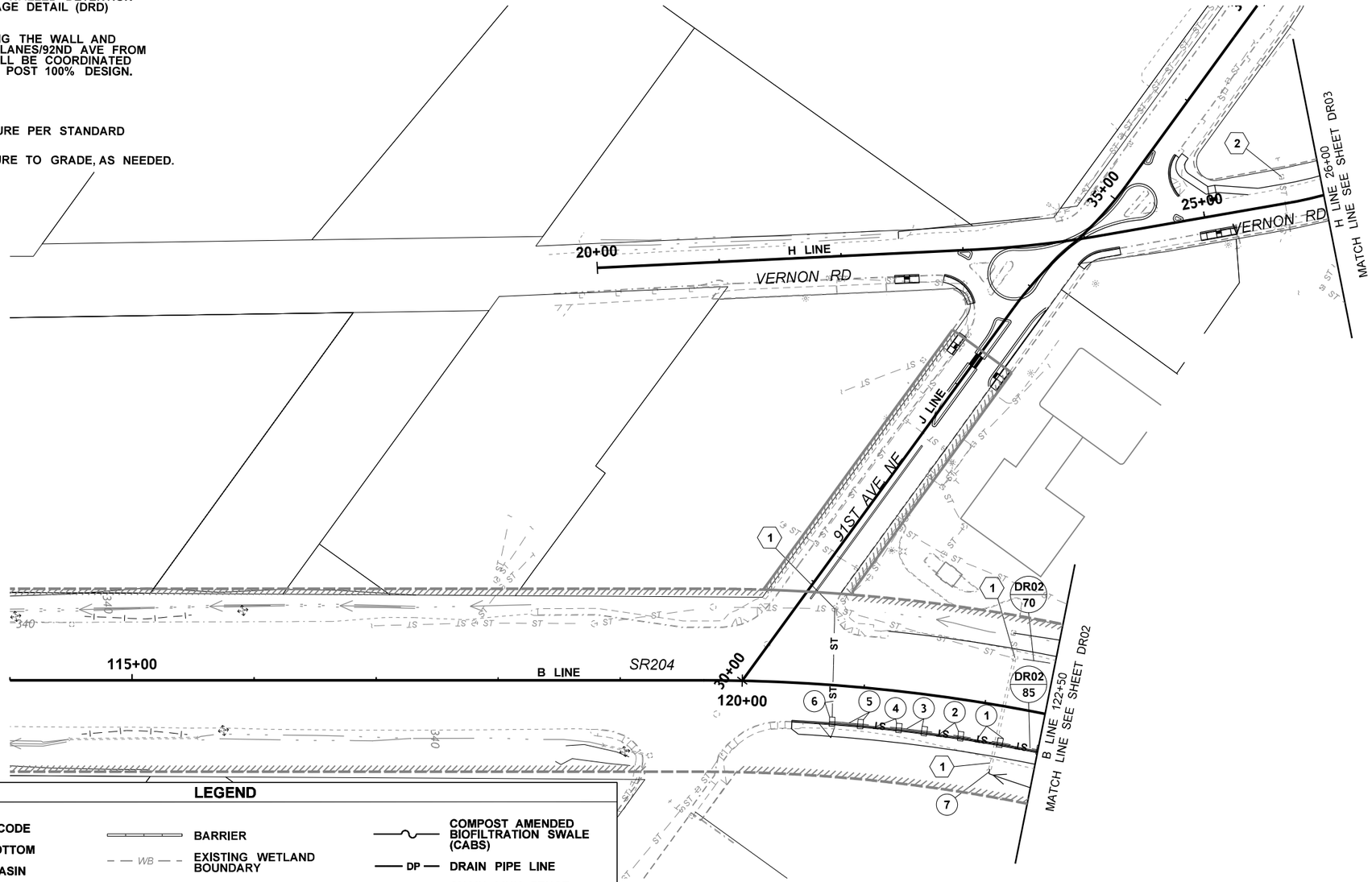
T. 29N. R. 5E. W.M. SEC. 13

NOTES:

1. FOR DRAINAGE PROFILES, SEE DP SHEETS.
2. FOR DRAINAGE DETAILS INCLUDING DRAINAGE DITCHES, MEDIA FILTER DRAIN (MFD), COMPOST AMENDED BIOFILTRATION SWALE (CABS), WET BIOFILTRATION SWALE, AND WALLED DETENTION POND DETAILS, SEE DRAINAGE DETAIL (DRD) SHEETS.
3. STRUCTURE OFFSETS ALONG THE WALL AND BARRIER ON THE SR9 NB LANES/92ND AVE FROM 256+31 THROUGH 261+76 WILL BE COORDINATED WITH WALL DESIGN PLANS POST 100% DESIGN.

CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.



LEGEND

- STRUCTURE NOTE CODE
- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
- EXISTING MANHOLE
- EXISTING CULVERT
- EXISTING STORM SEWER LINE
- EXISTING MEDIA FILTER DRAIN
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- CHAIN LINK FENCE
- NOISE WALL
- OUTFALL PROTECTION
- MAINTENANCE ACCESS ROAD

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DATE	5/3/2021					JOB NUMBER 18A828	
PLOTTED BY	emilyt						
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.	LOCATION NO.
ENTERED BY	N. CHEN						
CHECKED BY	L. THOMSEN						
PROJ. ENGR.	K. NDILE						
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY		

P.E. STAMP BOX — DATE

PARSONS

OSBORN CONSULTING INCORPORATED

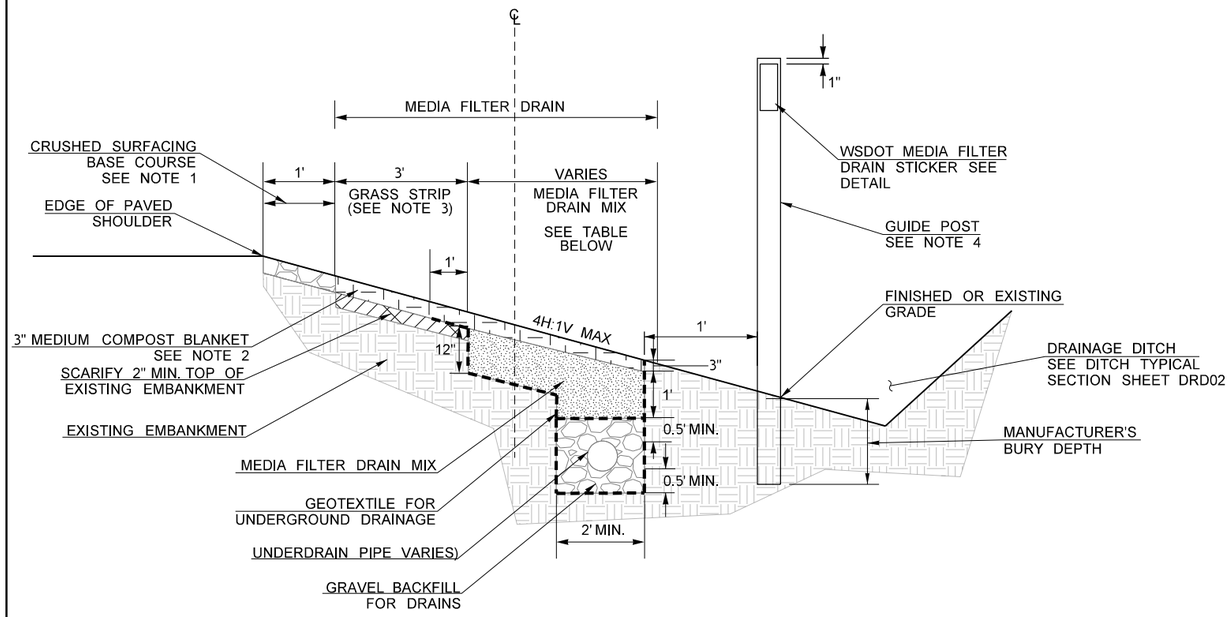
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PLAN

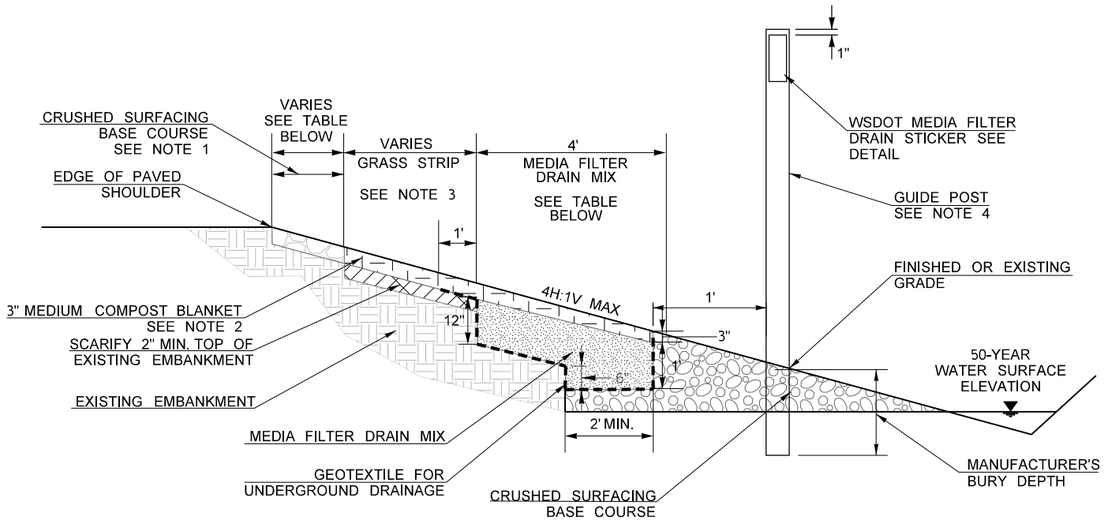
PLAN REF NO DR05

SHEET OF SHEETS



MEDIA FILTER DRAIN TYPE 1

SIDE SLOPE APPLICATION WITH UNDERDRAIN
NOT TO SCALE



MEDIA FILTER DRAIN TYPE 3

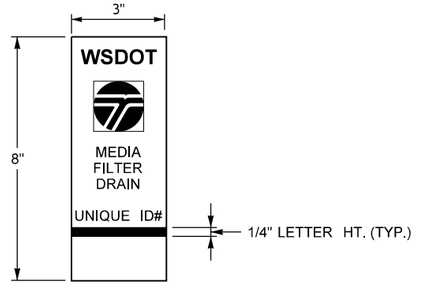
SIDE SLOPE APPLICATION WITHOUT UNDERDRAIN
NOT TO SCALE

MFD LOCATION TABLE

STRUCTURE CODE	MFD TYPE	LOCATION	LENGTH	WIDTH	UNDER-DRAIN DIAM.	CSBC	GRASS STRIP
			FEET	FEET	INCHES	FEET	FEET
DR02-14	3	A LINE STA 258+19 (52.0' LT) TO A LINE STA 262+99 (52.0' LT)	480	4	N/A	1	3
DR03-34	1	A LINE STA 269+32 (53.5' LT) TO A LINE STA 271+74 (53.6' LT)	244	4	6	1	3
DR03-32	3	A LINE STA 273+96 (78.1' LT) TO A LINE STA 278+98 (38.8' LT)	515	4	N/A	2	4
DR03-31	1	A LINE STA 273+90 (63.2' RT) TO A LINE STA 278+51 (37.2' RT)	466	4	8	1	3
DR04-1	3	A LINE STA 279+52 (52.5' LT) TO A LINE STA 282+84 (40.0' LT)	333	4	N/A	1	3

NOTES:

1. CRUSHED SURFACING BASE COURSE WITH 4-IN MIN. DEPTH.
2. ALL ITEMS NOT INCLUDED IN THIS DETAIL ARE CONSIDERED INCIDENTAL TO THE WORK IN ACCORANCE WITH SECTION 7-01 - MEDIA FILTER DRAIN OF THE SPECIAL PROVISIONS, INCLUDING BUT NOT LIMITIED TO, GEOTEXTILE. CRUSHED SURFACE BASE COURSE, COMMON BORROW, AND UNDERDRAIN PIPE.
3. EROSION CONTROL COMPOST SEEDING AND 1-INCH FINE COMPOST OVER COMPOST BLANKET IN ACCORDANCE WITH SECTION 8-02 AND LANDSCAPE PLANS.
4. GUIDE POST SHALL BE FLEXIBLE, NON-REFLECTIVE AND BROWN IN COLOR. INSTALL GUIDE POST IN ACCORDANCE WITH STD. PLAN M-24-65.
5. PLASTIC DRAINAGE MARKING IN ACCORDANCE WITH STD. PLAN M-24.65.
6. FOR FINISHED ROADWAY EMBANKMENT SLOPE, SEE ROADWAY SECTION (RS) SHEETS.



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SEE NOTE 5

WSDOT MEDIA FILTER DRAIN STICKER

NOT TO SCALE

MEDIA FILTER DRAIN

NOT TO SCALE

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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PLOTTED BY	terrenceh					18A828		
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
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P.E. STAMP BOX — DATE

PARSONS

OSBORN CONSULTING INCORPORATED

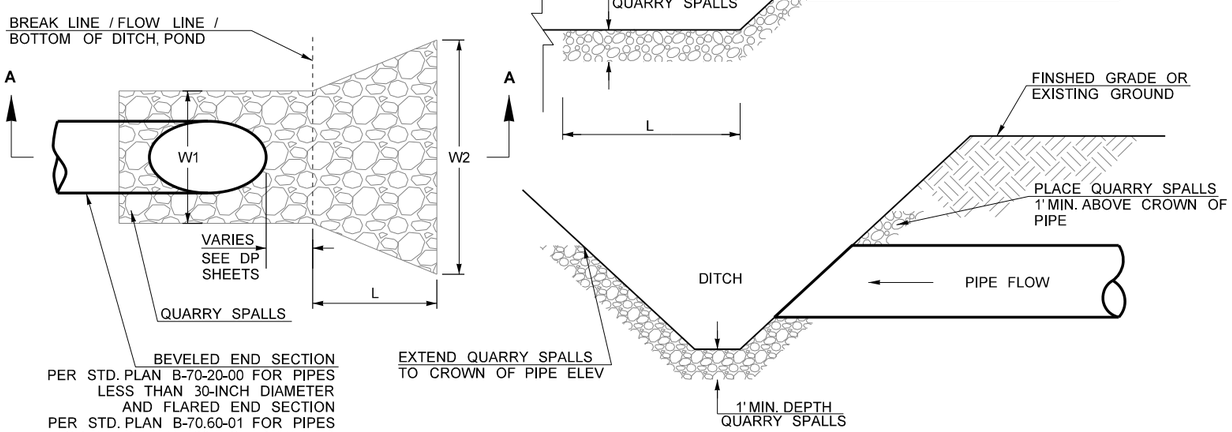
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO
DRD01
SHEET
OF
SHEETS

PIPE OUTFALL PROTECTION			
PIPE DIA.	W1	W2	L
12"	3.0'	8.0'	8.0'
18"	4.5'	9.0'	8.0'
24"	6.0'	12.0'	8.0'
42"	10.5'	21.0'	8.0'



NOTES:

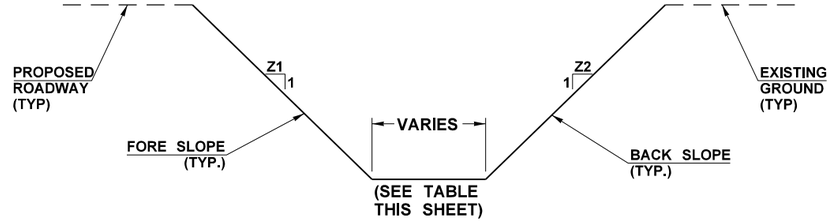
1. QUARRY SPALLS SHALL BE IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION SECTION 9-13.1(5).

SECTION A-A

NOT TO SCALE

OUTFALL PROTECTION

NOT TO SCALE



NOTES:

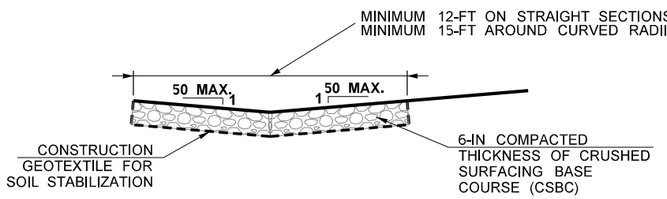
1. DITCH EXCAVATION IS INCLUDED IN ROADWAY EXCAVATION INCLUDING HAUL.
2. FOR DITCH GRADING DETAILS, SEE ROADWAY TYPICAL SECTIONS (RS) SHEETS.
3. SEE DITCH TABLE, THIS SHEET, FOR DITCH LOCATIONS.
4. MAXIMUM DITCH SIDE SLOPE IS 2H:1V. DITCH SIDE SLOPES MAY VARY FROM TYPICAL 3H:1V TO MATCH INTO EXISTING SIDE SLOPES AND ROADWAY EMBANKMENT SLOPES.

DITCH TYPICAL SECTION

NOT TO SCALE

DITCH TABLE							
DRAINAGE SHEET	DITCH LOCATION	BOTTOM WIDTH	BOTTOM LENGTH	FRONT SLOPE (Z1)	BACK SLOPE (Z2)	LONGITUDINAL SLOPE	MIN. DITCH DEPTH REQUIRED*
		LF	LF	X:1	X:1	PERCENT	FT
DR03	A LINE STA 278+89 (47.6' LT) TO STA 274+67 (51.8' LT)	0	372	4.5	3.5	0.50	2.20
DR01, DR02	A LINE STA 258+18 (56.0' LT) TO STA 263+09 (56.0' LT)	0	491	2	2	1.06	2.12
DR02, DR03	A LINE STA 269+30 (66.3' LT) TO STA 271+75 (62.3' LT)	5	245	3	0	0.40	1.82
DR02, DR03	A LINE STA 269+30 (66.3' LT) TO STA 271+75 (62.3' LT)	1	245	0	3	0.40	1.57
DR03	A LINE STA 279+20 (38.4' RT) TO STA 273+91 (86.5' RT)	0	414	4	4	0.33	2.31
DR03, DR05	H LINE STA 27+95 (25.0' LT) TO STA 25+68 (22.0' LT)	0	215	4	2	1.32	1.98
DR02, DR05	B LINE STA 123+42 (66.8' RT) TO STA 122+13 (56.6' RT)	3	126	2	3	0.27	4.13
DR04	A LINE STA 279+52 (58.5' LT) TO STA 282+45 (46.8' LT)	0	333	4	3	0.70	2.10

* REQUIRED DEPTH OF DITCH FROM EDGE OF PAVEMENT = 10-YR FLOW DEPTH + FREEBOARD + PROPOSED DEPTH TO SUBGRADE (HMA + CSCB) OR REQUIRED DEPTH OF DITCH FOR MFD = DEPTH FROM TOE OF MFD SLOPE = 50-YR FLOW DEPTH



NOTES:

1. FOR ADDITIONAL SLOPE AND SECTION DETAILS, SEE DRAINAGE DETAIL SHEET DRD06 AND DRD07.
2. SEE ROADWAY AND GRADING PLANS FOR STATION OFFSETS AND ELEVATIONS ALONG THE MAINTENANCE ACCESS ROAD FOR THE WALLED POND, IN ORDER TO EFFECTIVELY GRADE IN THE CABS.

MAINTENANCE ACCESS ROAD QUANTITIES (WALLED POND)			
CRUSHED SURFACING BASE COURSE (CSBC)	COMMON BORROW INCL. HAUL	ROADWAY EXCAVATION INCL. HAUL	CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
TONS	CU YD	CU YD	SY
165	69	400	590

MAINTENANCE ACCESS ROAD TYPICAL SECTION

NOT TO SCALE

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

CHRISTINE S. CONNOLLY — STATE OF WASHINGTON — 40801 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

OSBORN CONSULTING INCORPORATED

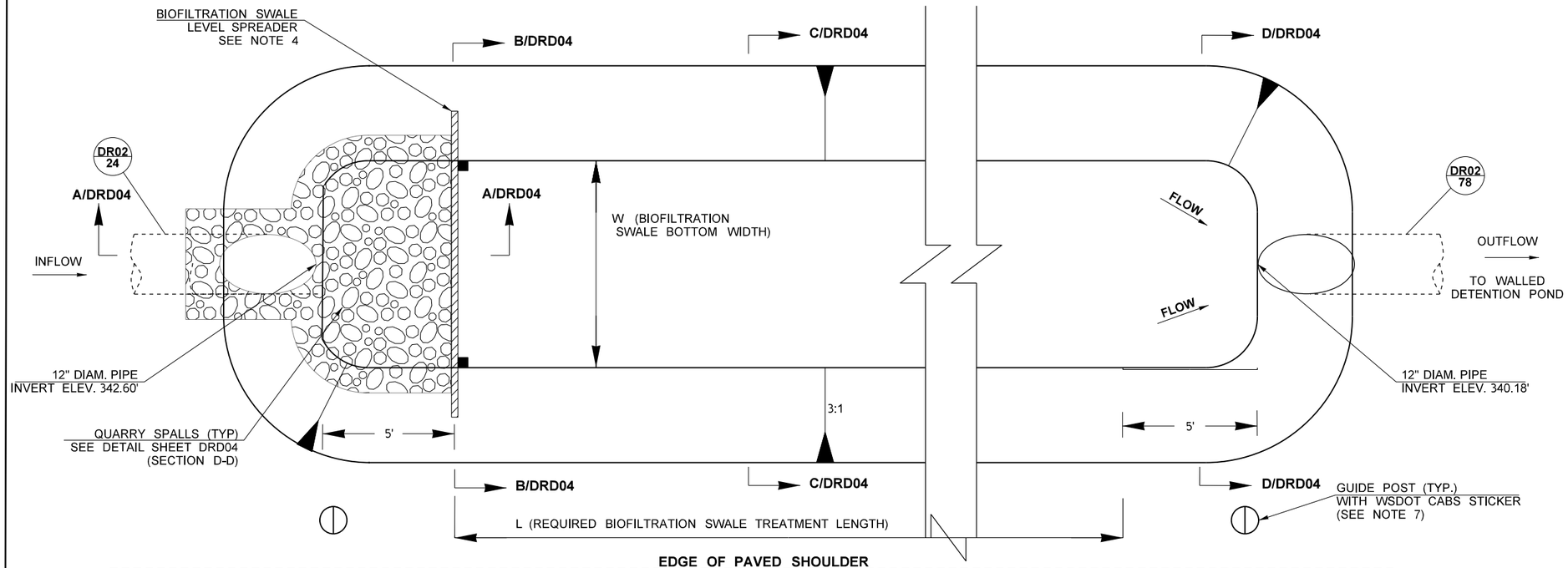
Washington State Department of Transportation

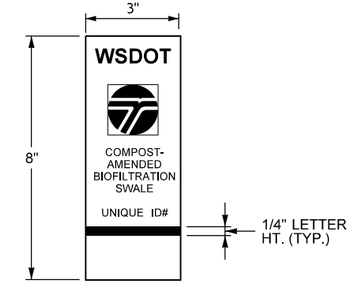
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO
DRD02

SHEET
OF
SHEETS

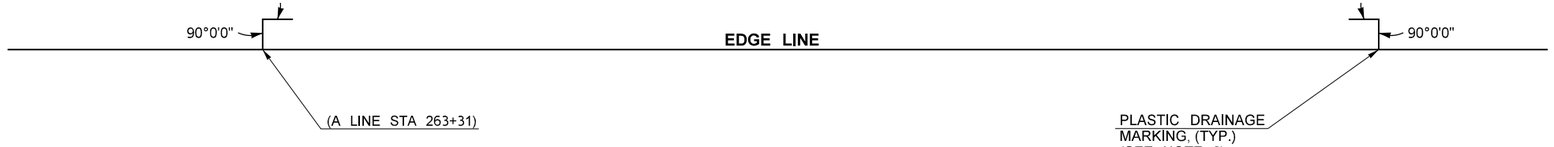




WHITE TEXT ON
GREEN BACKGROUND
SEE NOTE 7

WSDOT CABS STICKER

NOT TO SCALE

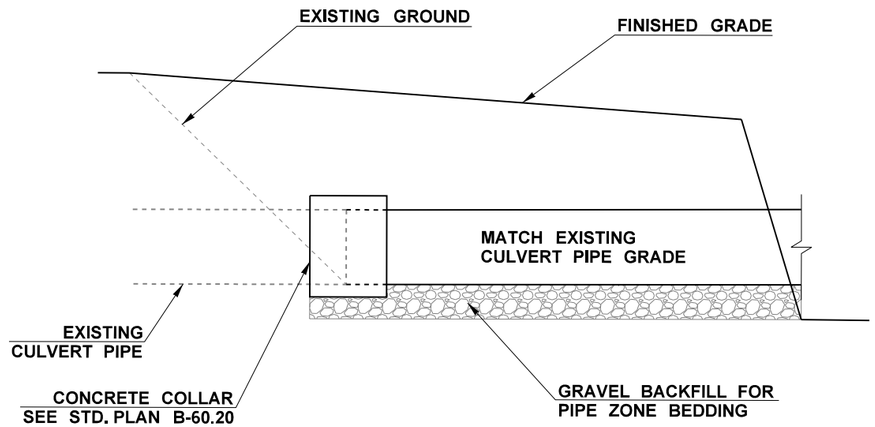


NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.
2. FOR LOCATION OF COMPOST AMENDED BIOFILTRATION SWALE, SEE DRAINAGE PLAN SHEET DR02 AND DRAINAGE PROFILE SHEET DP07.
3. FOR BIOFILTRATION SWALE LEVEL SPREADER, SEE SPECIAL PROVISION 8-02.2.
4. INSTALL BIOFILTRATION LEVEL SPREADER PERPENDICULAR TO THE CENTERLINE OF THE SWALE. SEE PLATE INSTALLATION DETAIL SHEET DRDXX (TO BE COMPLETED AT 90% SUBMITTAL).
5. CABS COMPOST SEEDING IN ACCORDANCE WITH SPECIAL PROVISION SECTION 8-02.
6. PLASTIC DRAINAGE MARKER IN ACCORDANCE WITH STANDARD PLAN M-24.65.
7. GUIDE POST SHALL BE FLEXIBLE, NON-REFLECTIVE AND BROWN IN COLOR. INSTALL GUIDE POST IN ACCORDANCE WITH STD. PLAN M-24.65.

CABS TABLE

CABS ID	W	L	H	LONGITUDINAL SLOPE	MEDIUM COMPOST	TOPSOIL TYPE A
	FT	FT	FT	%	ACRES	ACRES
DR02-76	2.0	121	1.15	2.0	0.1	0.1



100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

COMPOST AMENDED BIOFILTRATION SWALE (CABS) PLAN VIEW

DR02 76

NOT TO SCALE

CULVERT EXTENSION PIPE DETAIL

DR05 7

NOT TO SCALE

FILE NAME	c:\pw_workIng\wastate\parsons_epw16979\dms08810\Stage_3_Y-11834_PS_DRD_03.dgn					REGION NO.	STATE	FED.AID PROJ.NO.	
TIME	6:26:24 PM					10	WASH		
DATE	5/3/2021					JOB NUMBER			
PLOTTED BY	terrenceh					18A828			
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.	
ENTERED BY	N. CHEN								
CHECKED BY	L. THOMSEN								
PROJ. ENGR.	K. NDILE								
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY				

CHRISTINE S. COVINGTON
STATE OF WASHINGTON
40801
REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

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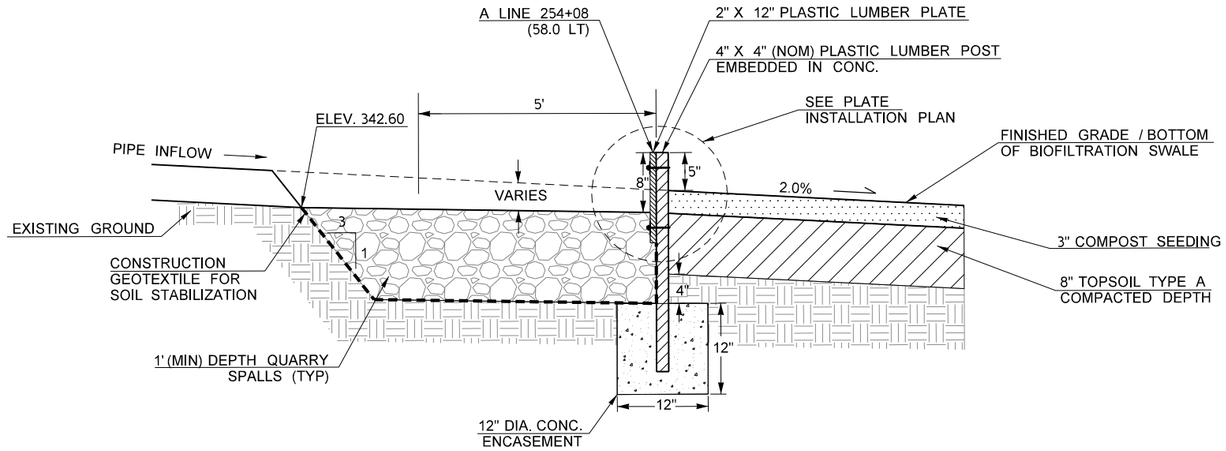
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO
DRD03

SHEET
OF
SHEETS

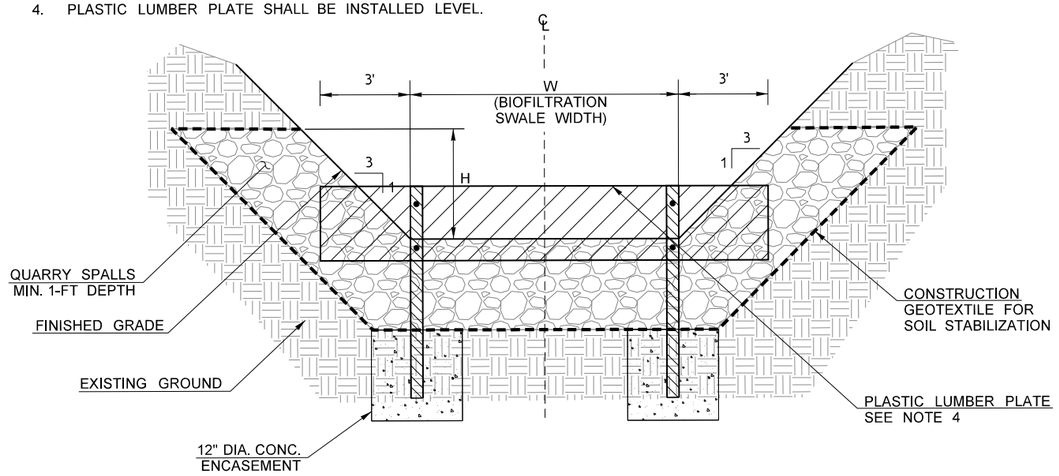


SECTION A-A SHEET DRD03

NOT TO SCALE

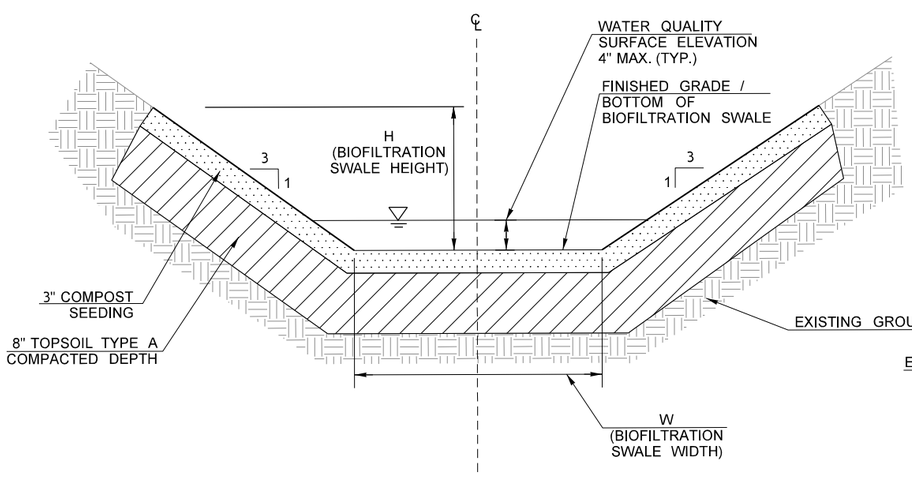
NOTES:

1. EXTEND COMPOST AND TOPSOIL FROM THE BOTTOM OF THE BIOFILTRATION SWALE ONTO THE SIDE SLOPES UP TO THE BIOFILTRATION SWALE HEIGHT NOTED IN THE TABLE ON DETAIL SHEET DRD03.
2. EXCAVATION OF CABS FROM ROADWAY FINISHED GRADE FOR INSTALLATION OF COMPOST, TOPSOIL, QUARRY SPALLS, CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION, BIOFILTRATION SWALE LEVEL SPREADER AND OTHER ASSOCIATED AREAS IS INCLUDED IN ROADWAY EXCAVATION INCL. HAUL
3. CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION PER STANDARD SPECIFICATION 9-33.2(1), TABLE 3, NON-WOVEN.
4. PLASTIC LUMBER PLATE SHALL BE INSTALLED LEVEL.



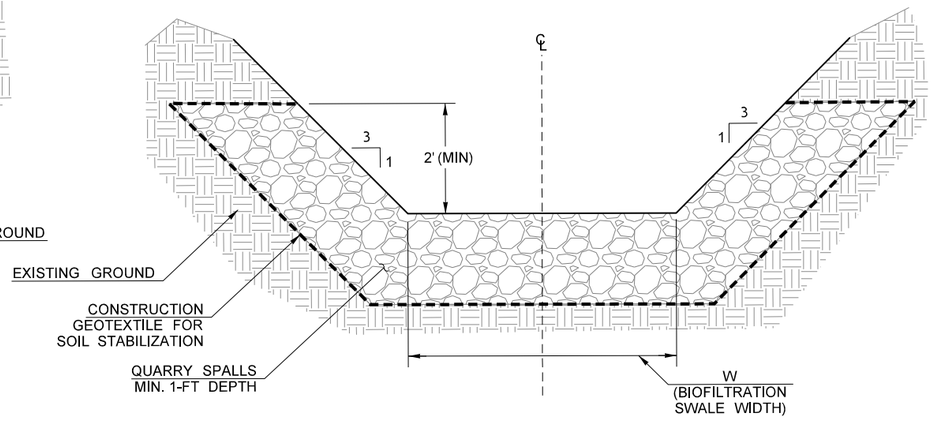
BIOFILTRATION SWALE LEVEL SPREADER SECTION B-B SHEET DRD03

NOT TO SCALE



SECTION C-C SHEET DRD03

NOT TO SCALE



SECTION D-D SHEET DRD03

NOT TO SCALE

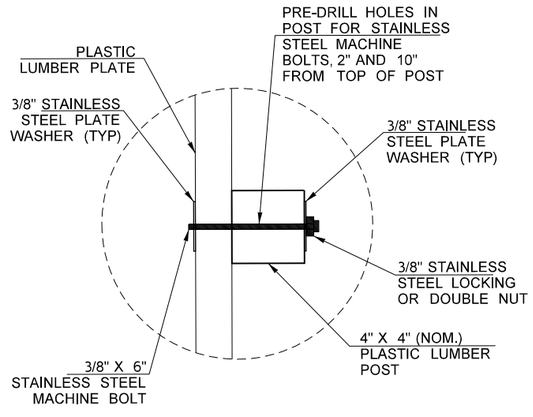


PLATE INSTALLATION PLAN

NOT TO SCALE

100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

COMPOST AMENDED BIOFILTRATION SWALE (CABS) SECTION VIEW

DR02
76

FILE NAME	c:\pw_working\wastate\parsons_epw16979\dms08810\Stage_3_Y-11834_PS_DRD_04.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
TIME	6:26:33 PM					10	WASH	
DATE	5/3/2021					JOB NUMBER		
PLOTTED BY	terrenceh					18A828		
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

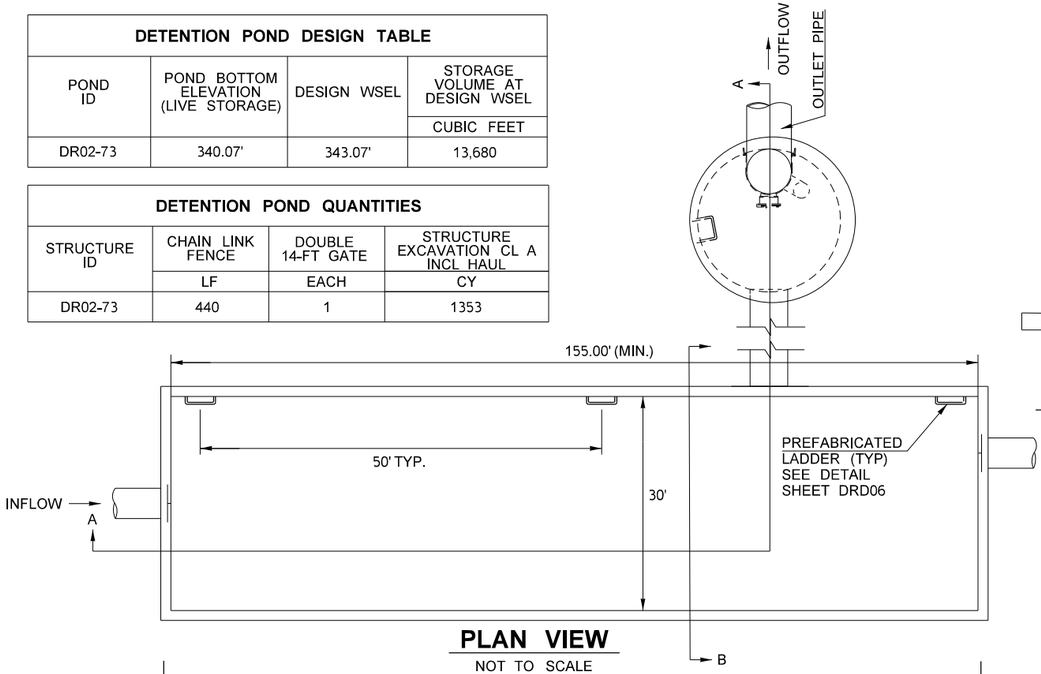
DRAINAGE DETAILS

PLAN REF NO
DRD04

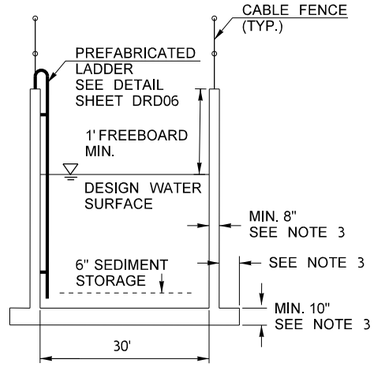
SHEET
OF
SHEETS

DETENTION POND DESIGN TABLE			
POND ID	POND BOTTOM ELEVATION (LIVE STORAGE)	DESIGN WSEL	STORAGE VOLUME AT DESIGN WSEL
			CUBIC FEET
DR02-73	340.07'	343.07'	13,680

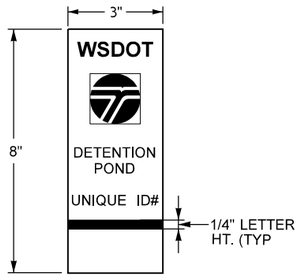
DETENTION POND QUANTITIES			
STRUCTURE ID	CHAIN LINK FENCE	DOUBLE 14-FT GATE	STRUCTURE EXCAVATION CL A INCL HAUL
	LF	EACH	CY
DR02-73	440	1	1353



PLAN VIEW
NOT TO SCALE

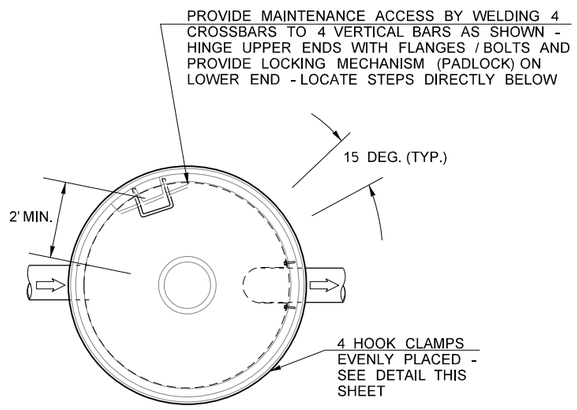


SECTION B-B
NOT TO SCALE

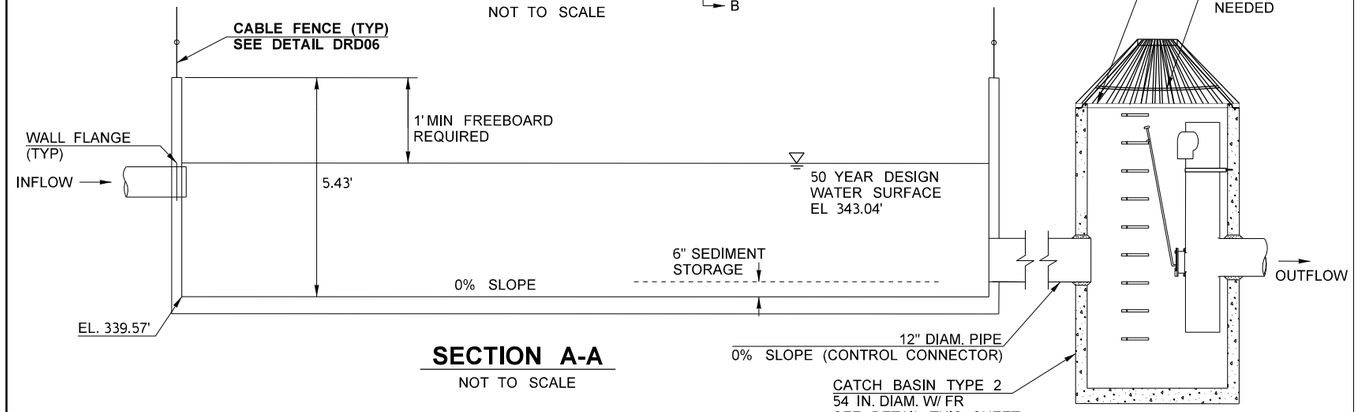


WHITE TEXT ON GREEN BACKGROUND SEE NOTE 5

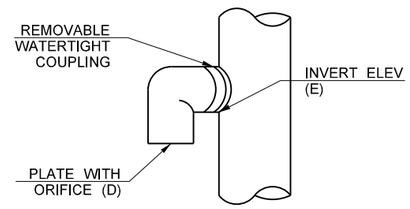
WSDOT WALLED DETENTION POND STICKER
NOT TO SCALE



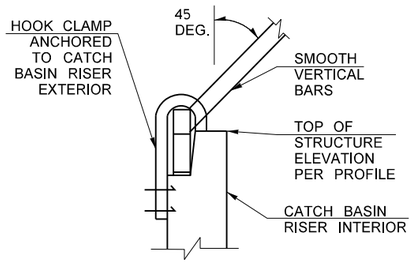
PLAN VIEW



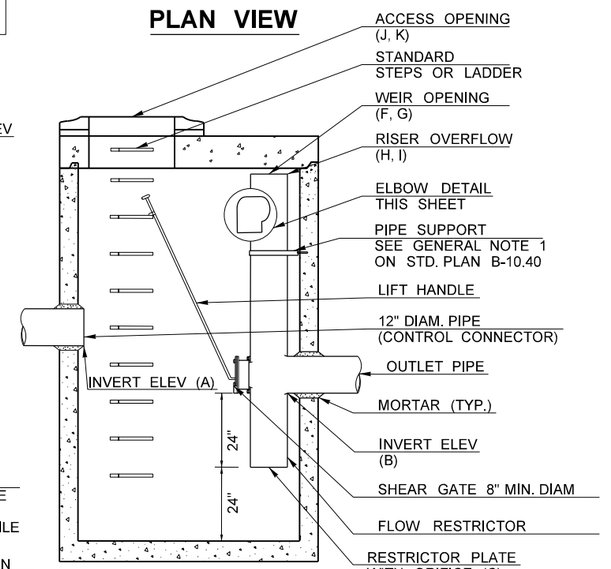
SECTION A-A
NOT TO SCALE



ELBOW DETAIL
NOT TO SCALE



DETAIL HOOK CLAMP



FLOW RESTRICTOR DETAIL
NOT TO SCALE

NOTES:

1. FOR GENERAL NOTES, DIMENSIONS, AND DETAILS NOT SHOWN SEE STD PLN B-10.40 FOR CATCH BASIN TYPE 2 WITH FLOW RESTRICTOR.
2. ALL METAL APPURTENANCES MUST BE CORROSION RESISTANT.
3. STRUCTURAL DESIGN SHALL ADDRESS REQUIRED CONCRETE THICKNESS, REINFORCEMENT, RESISTANCE OT BUOYANT FORCES, AND SPECIAL PROVISIONS.

WALLED DETENTION POND TYPICAL DETAIL

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

STRUCTURE NO.	PIPE DIAMETER (IN AND OUT)	PIPE INVERT IN (A)	PIPE INVERT OUT (B)	RESTRICTOR PLATE ORIFICE DIA (C)	DOWNTURN ELBOW ORIFICE DIA (D)	DOWNTURN ELBOW ORIFICE ELEVATION (E)	WEIR TYPE AND LENGTH (F)	WEIR ELEVATION (G)	RISER DIA (H)	RISER OVERFLOW ELEVATION (I)	ACCESS OPENING TYPE (J)	ACCESS OPENING RIM ELEVATION (K)
	IN	FT	FT	IN	IN	FT		FT	IN	FT		FT
DR02-39	12	340.07	340.07	1.37	1.69	342.07	RECTANGULAR WEIR THAT INTERSECTS AT RISER TOP, 0.60 FT	342.87	12	343.07	BEEHIVE GRATE	346.40
DR02-48	12	343.58	343.58	1.55	N/A	N/A	RECTANGULAR WEIR THAT INTERSECTS AT RISER TOP, 0.12 FT	345.13	12	345.63	CIRCULAR FRAME (RING) AND COVER TYPE 2	347.63

CATCH BASIN TYPE 2 54 IN. DIAM. W/FR
NOT TO SCALE

FILE NAME	c:\pw_workIng\wastate\parsons_epw16979\dms08810\Stage_3_Y-11834_PS_DRD_05.dgn
TIME	6:26:41 PM
DATE	5/3/2021
PLOTTED BY	terrenceh
DESIGNED BY	S. SRIDHARAN/T.HEW
ENTERED BY	N. CHEN
CHECKED BY	L. THOMSEN
PROJ. ENGR.	K. NDILE
REGIONAL ADM.	M. COTTEN

NO	REVISION	DATE	BY

REGION NO.	STATE	FED.AID PROJ.NO.
10	WASH	
JOB NUMBER		
18A828		
CONTRACT NO.		LOCATION NO.

P.E. STAMP BOX — DATE

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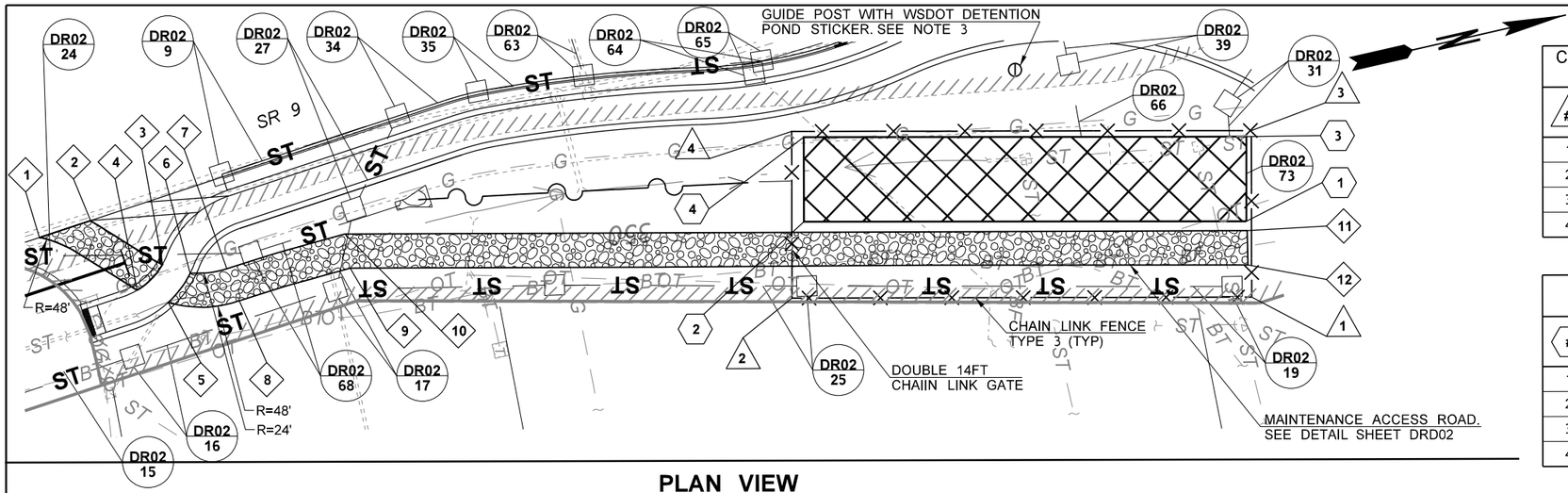
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO
DRD05

SHEET
OF
SHEETS



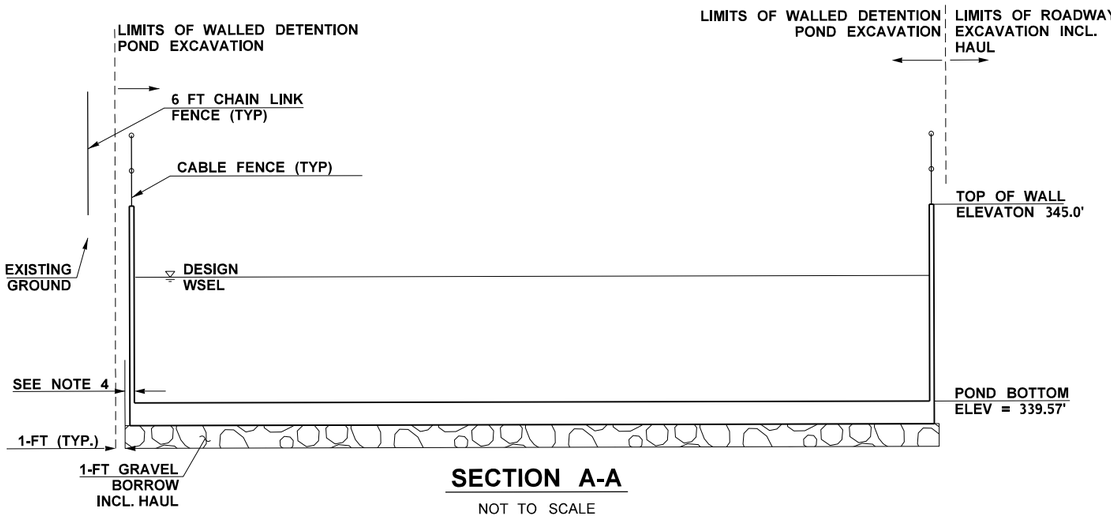
CHAIN LINK FENCE TYPE 3 POINT TABLE	
#	LOCATION
1	A LINE 265+98 (197.1' RT)
2	A LINE 264+45 (146.9' RT)
3	A LINE 266+16 (141.7' RT)
4	A LINE 264+63 (91.5' RT)

WALLED POND POINT TABLE	
#	LOCATION
1	A LINE 266+04 (171.3' RT)
2	A LINE 264+57 (122.8' RT)
3	A LINE 266+14 (143.2' RT)
4	A LINE 264+66 (94.7' RT)

ACCESS ROAD ANGLE POINT TABLE		
#	LOCATION	ELEVATION
1	A LINE 262+01 (44.0' RT)	
2	A LINE 262+20 (44.0' RT)	347.03
3	A LINE 262+39 (66.5' RT)	348.67
4	A LINE 262+28 (72.3' RT)	348.89
5	A LINE 262+37 (79.8' RT)	348.85
6	A LINE 262+47 (72.5' RT)	348.59
7	A LINE 262+60 (75.0' RT)	348.44
8	A LINE 262+59 (87.0' RT)	348.64
9	A LINE 263+01 (88.4' RT)	348.34
10	A LINE 263+03 (76.4' RT)	348.03
11	A LINE 266+04 (174.5' RT)	348.09
12	A LINE 266+00 (186.0' RT)	348.40

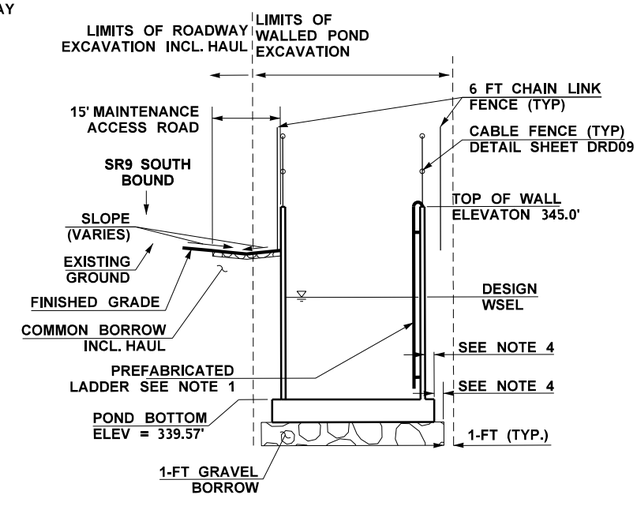
PLAN VIEW

NOT TO SCALE



SECTION A-A

NOT TO SCALE



SECTION B-B

NOT TO SCALE

NOTES:

1. SEE STANDARD PLAN B-30.90 FOR PREFABRICATED LADDER DETAILS.
2. SEEDING AND RESTORATION IN ACCORDANCE WITH SPECIFICATION 8-02 ROADSIDE RESTORATION.
3. GUIDE POST SHALL BE FLEXIBLE, NON-REFLECTIVE AND BROWN IN COLOR. SEE STANDARD PLAN M-24.66-00 FOR POND MARKER AND PLASTIC DRAINAGE MARKER LOCATION
4. STRUCTURAL DESIGN SHALL ADDRESS REQUIRED CONCRETE THICKNESS, REINFORCEMENT AND RESISTANCE TO BUOYANT FORCES.
5. POINTS 1, 2, 3, AND 4 ARE BOTTOM OF WALL ELEVATIONS. SEE DRD05 FOR ADDITIONAL WALLED POND DETAILS.
6. THE COLOR OF THE CHAIN LINK FENCE AND GATE FABRIC SHALL MATCH SAE AMS STANDARD 595 COLOR NO. 27038.
7. THE CONTRACTOR SHALL APPLY PIGMENTED SEALER TO ALL EXPOSED CONCRETE SURFACES TO 1-FOOT BELOW FINISH GROUNDLINE.
8. THERE IS LIMITED SPACE FOR EXTRA EXCAVATION ALONG THE RIGHT-OF-WAY.

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

WALLED DETENTION POND DETAIL PLAN & SECTION

FILE NAME	c:\pw_workIng\wastate\parsons_epw16979\dms08810\Stage_3_Y-11834_PS_DRD_06.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
TIME	6:26:50 PM					10	WASH	
DATE	5/3/2021					JOB NUMBER		
PLOTTED BY	terrenceh					18A828		
DESIGNED BY	S. SRIDHARAN/T. HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

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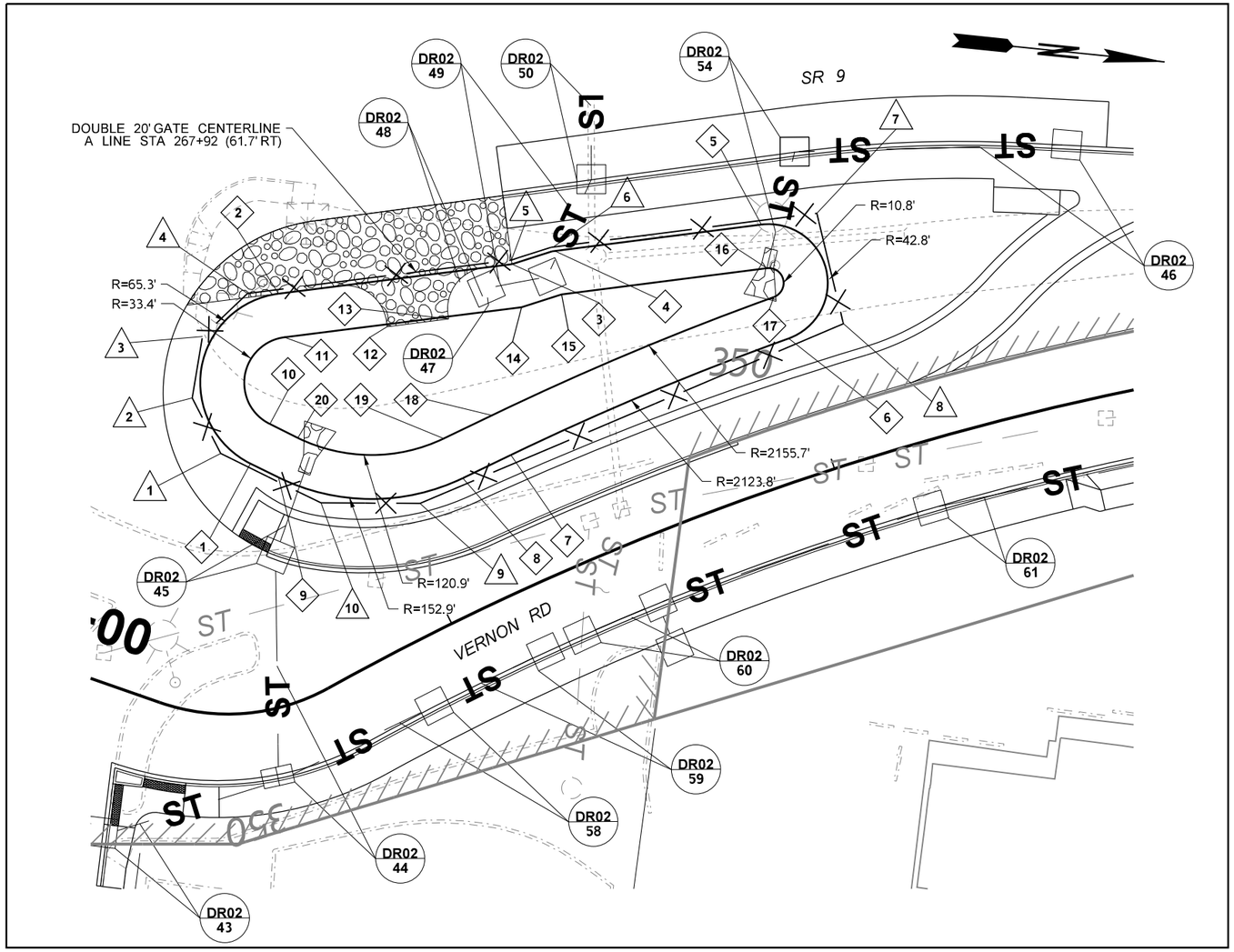
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO DRD06

SHEET OF SHEETS



POND PLAN VIEW DR02 79

NOT TO SCALE

POND DESIGN TABLE			
STRUCTURE ID	POND BOTTOM ELEVATION	DESIGN WSEL	STORAGE VOLUME TO DESIGN WSEL
			CUBIC FEET
DR02-79	343.08'	345.63'	9907

ANGLE POINT TABLE		
#	LOCATION	ELEVATION
1	A LINE 267+53 (107.9' RT)	346.63'
2	A LINE 267+60 (66.8' RT)	346.63'
3	A LINE 268+16 (59.7' RT)	346.63'
4	A LINE 268+26 (56.6' RT)	346.63'
5	A LINE 268+77 (50.1' RT)	346.63'
6	A LINE 268+83 (77.6' RT)	346.63'
7	A LINE 268+16 (105.8' RT)	346.63'
8	A LINE 268+04 (111.4' RT)	346.63'
9	A LINE 267+60 (111.2' RT)	346.63'
10	A LINE 267+58 (98.4' RT)	343.08'
11	A LINE 267+61 (77.3' RT)	343.08'
12	A LINE 267+86 (74.8' RT)	343.08'
13	A LINE 268+01 (72.9' RT)	343.08'
14	A LINE 268+19 (70.1' RT)	343.08'
15	A LINE 268+28 (67.0' RT)	343.08'
16	A LINE 268+78 (60.7' RT)	343.08'
17	A LINE 268+80 (67.6' RT)	343.08'
18	A LINE 268+11 (96.2' RT)	343.08'
19	A LINE 268+00 (101.8' RT)	343.08'
20	A LINE 267+64 (101.7' RT)	343.08'

CHAIN LINK FENCE TYPE 3 POINT TABLE	
#	LOCATION
1	A LINE 267+46 (105.5' RT)
2	A LINE 267+39 (92.1' RT)
3	A LINE 267+41 (77.2' RT)
4	A LINE 267+52 (66.7' RT)
5	A LINE 268+16 (58.7' RT)
6	A LINE 268+26 (55.6' RT)
7	A LINE 268+90 (47.4' RT)
8	A LINE 268+96 (74.1' RT)
9	A LINE 267+94 (117.5' RT)
10	A LINE 267+70 (117.4' RT)

MAINTENANCE ACCESS ROAD QUANTITIES			
CRUSHED SURFACING BASE COURSE (CSBC)	COMMAN BORROW INCL. HAUL	ROADWAY EXCAVATION INCL. HAUL	CONSTRUCTION CEOTEXTILE FOR SOIL STABILIZATION
TONS	CU YD	CU YD	SY
50	45	0	161

POND QUANTITIES		
CHAIN LINK FENCE TYPE 3	DOUBLE 20-FT GATE	ROADWAY EXCAVATION INCL. HAUL - POND
LF	EACH	CY
335	1	935

NOTES:

1. SEE SHEET DR05 FOR OUTLET CONTROL STRUCTURE AND FLOW RESTRICTOR DETAIL AND DIMENSIONS.
2. FOR CHAIN LINK FENCE AND GATE GENERAL NOTES, DIMENSIONS, AND DETAILS NOT SHOWN, SEE WSDOT STANDARD PLAN L-20.10 AND STANDARD PLAN L-30.10.
3. SEEDING AND RESTORATION IN ACCORDANCE WITH SPECIFICATION SECTION 8-02 ROADSIDE RESTORATION.
4. THE COLOR OF THE CHAIN LINK FENCE AND GATE FABRIC SHALL MATCH SAE AMS STANDARD 595 COLOR NO. 27038.
5. QUARRY SPALLS SHALL BE IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION SECTION 9-13.1(6).
6. CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION SHALL BE IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION SECTION 9-33.2(1), TABLE 3, NON-WOVEN.

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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TIME	6:26:59 PM					10	WASH	
DATE	5/3/2021					JOB NUMBER		
PLOTTED BY	terrenceh					18A828		
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

STATE OF WASHINGTON — EUGENE S. COLLINGER — 40807 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

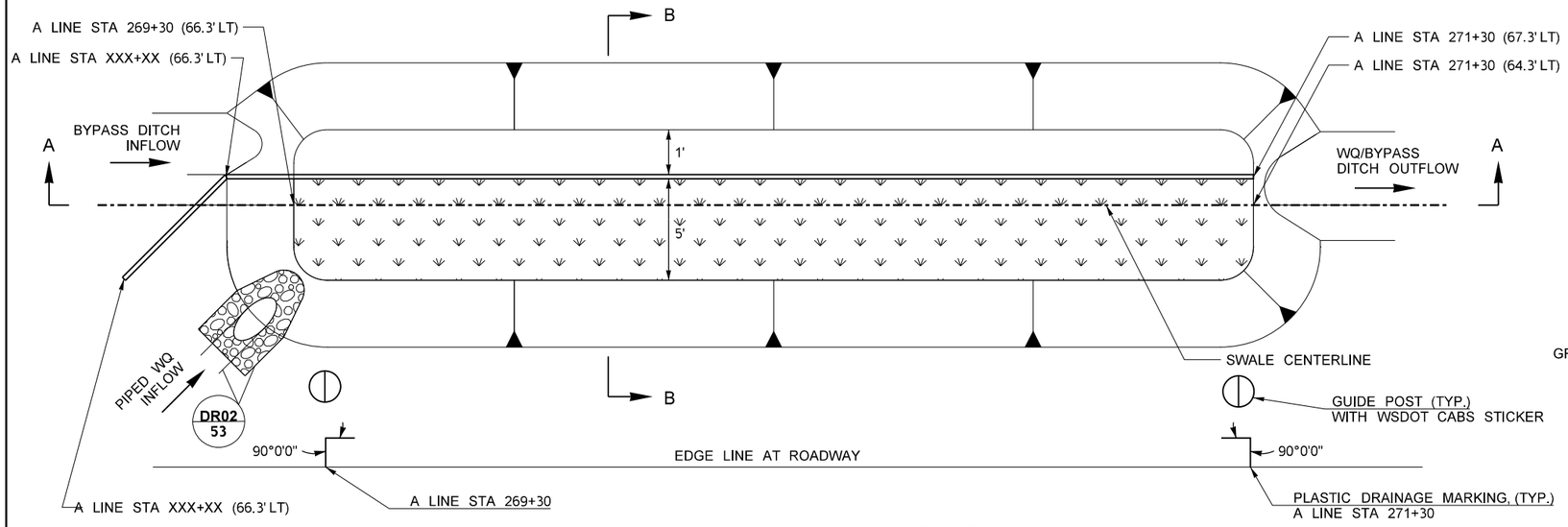
DRAINAGE DETAILS

PLAN REF NO DRD07

SHEET

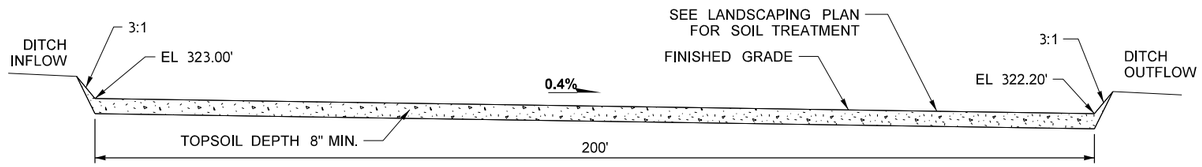
OF

SHEETS



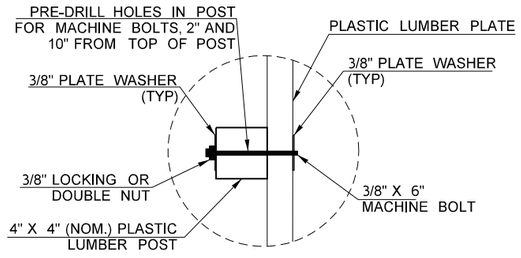
WET BIOFILTRATION SWALE DR03 33

NOT TO SCALE



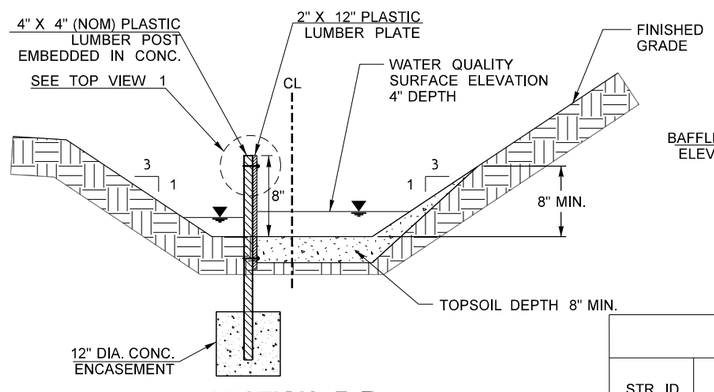
SECTION A-A

NOT TO SCALE



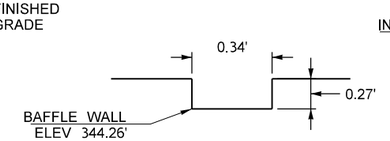
TOP VIEW 1 PLATE INSTALLATION PLAN

NOT TO SCALE



SECTION B-B

NOT TO SCALE



BAFFLE WALL DETAIL

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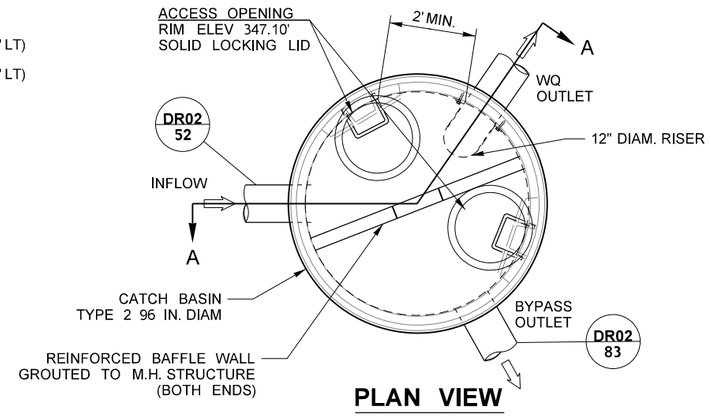
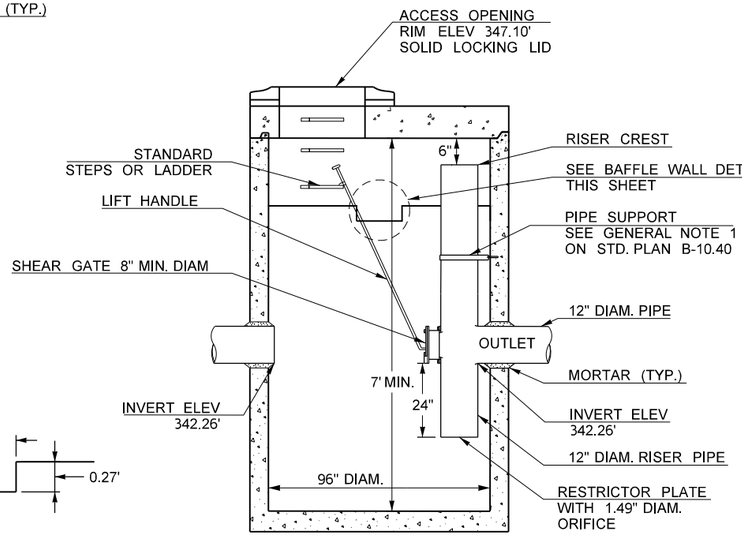


PLAN VIEW



SECTION A-A

NOT TO SCALE

FLOW SPLITTER DR02 53

NOT TO SCALE

WET BIOFILTRATION SWALE TABLE

STR ID	W	L	H	LONGITUDINAL SLOPE	TOPSOIL TYPE A
	FT	FT	FT	%	ACRES
DR03-33	5	200	0.67	0.4	0.04

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

FILE NAME	c:\pw_working\wastate\parsons_epw16979\dms08810\Stage_3_Y-11834_PS_DRD_08.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
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DATE	5/3/2021					JOB NUMBER		
PLOTTED BY	terrenceh					18A828		
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO DRD08

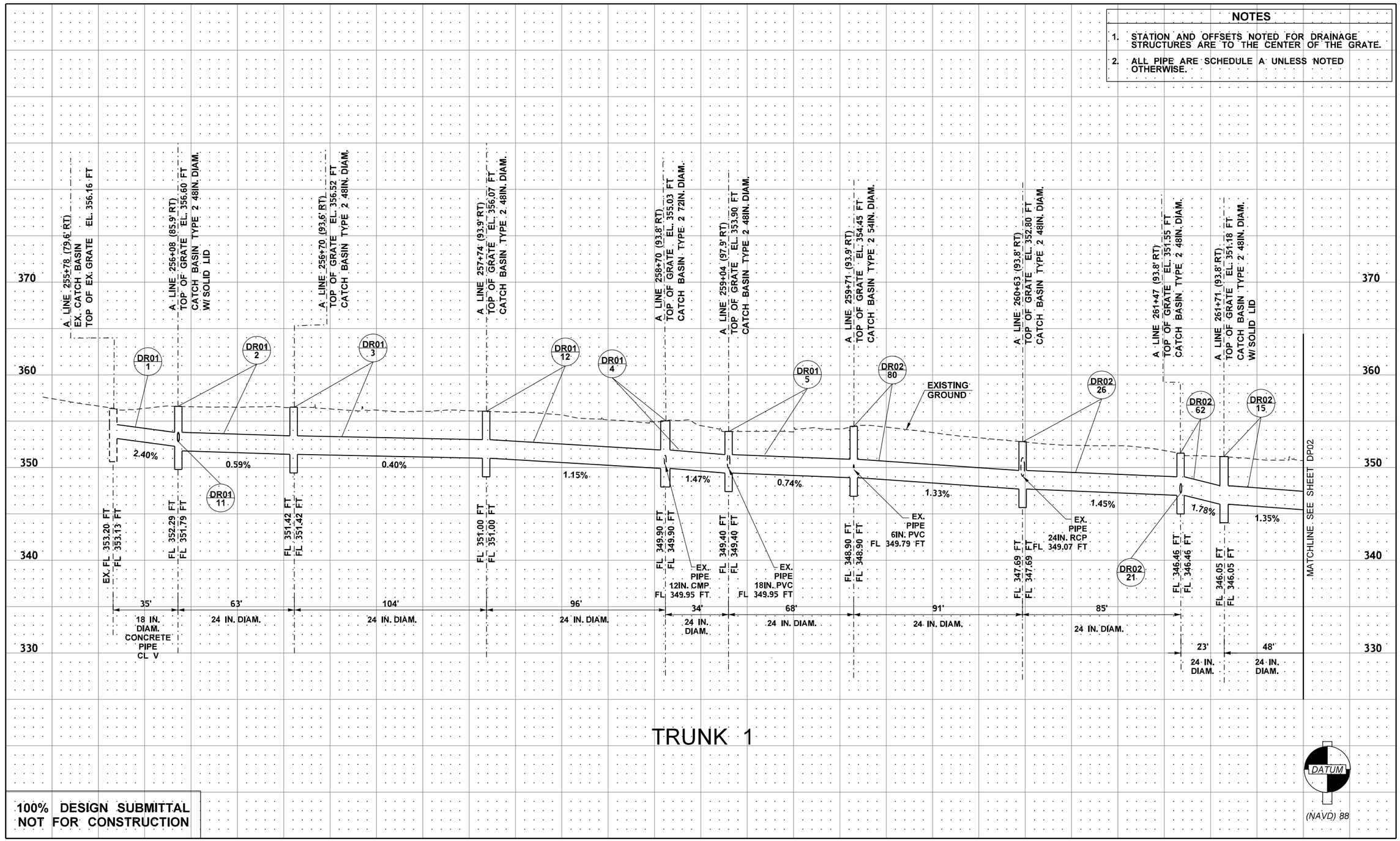
SHEET OF SHEETS

APPENDIX E

DRAINAGE PROFILE SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

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DATE	5/3/2021					JOB NUMBER		
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DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

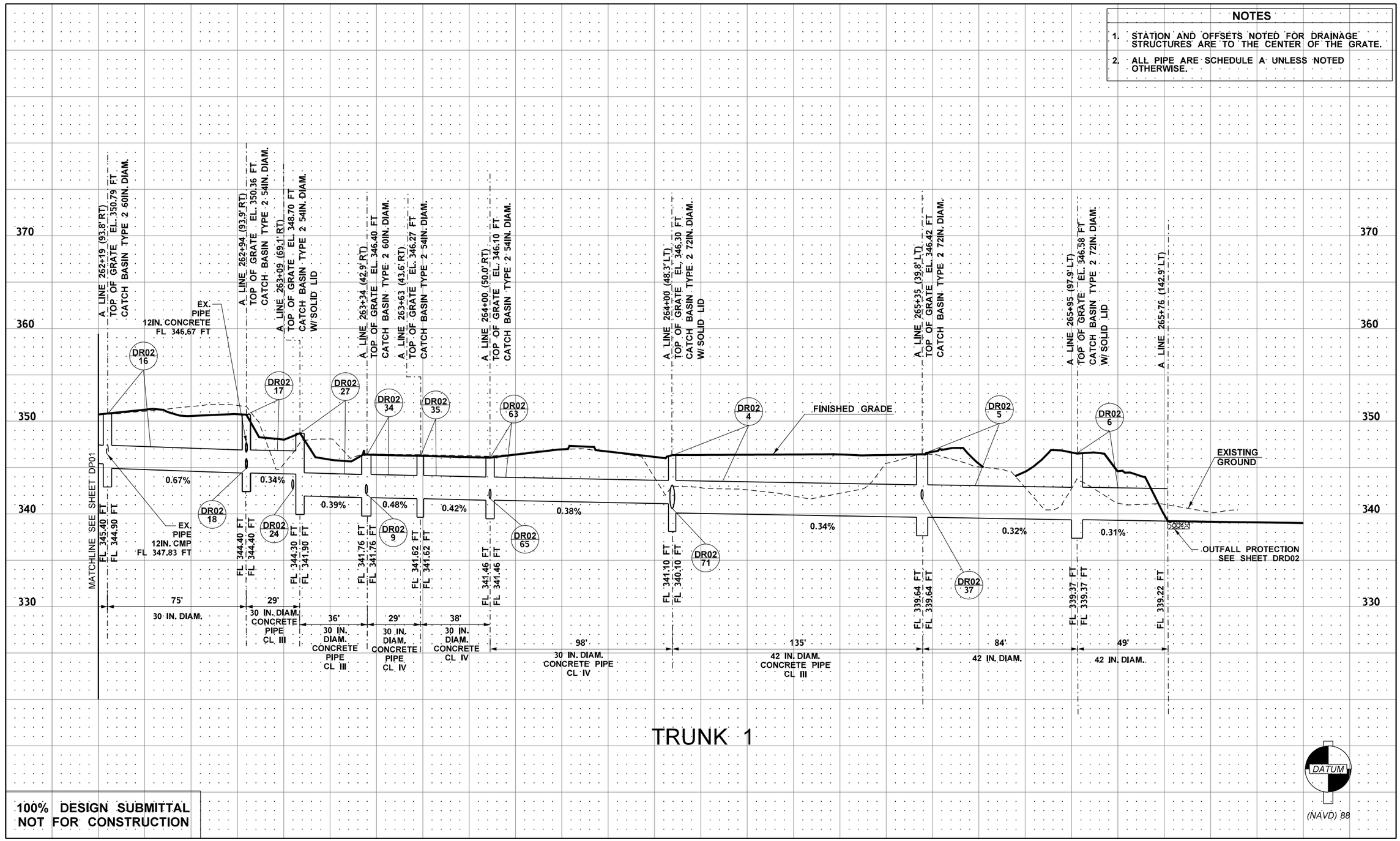
DRAINAGE PROFILES

PLAN REF NO DP01

SHEET OF SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

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DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.	LOCATION NO.
ENTERED BY	N. CHEN						
CHECKED BY	L. THOMSEN						
PROJ. ENGR.	K. NDILE						
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY		

FED.AID PROJ.NO.

CHRISTINE S. CONNELLY — STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

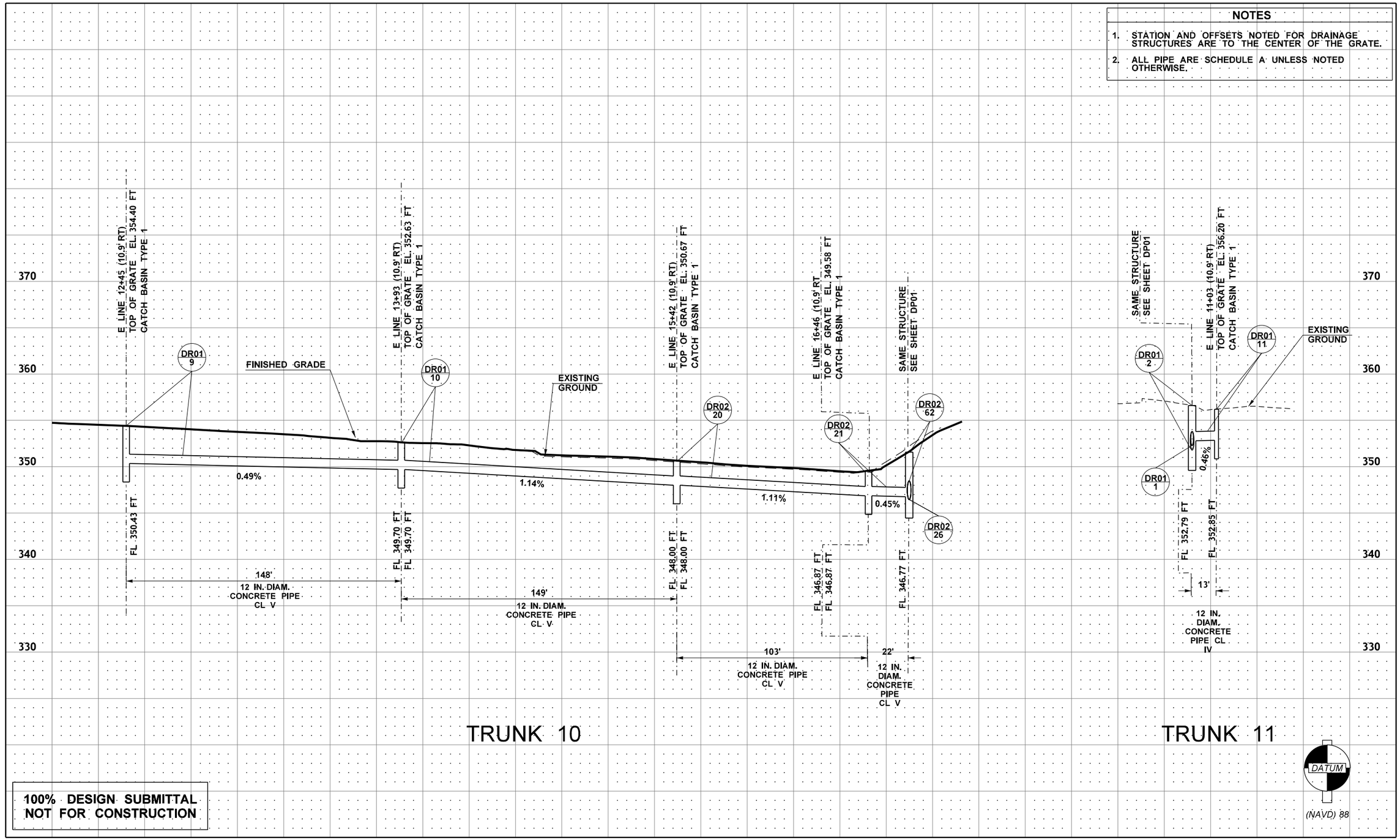
DRAINAGE PROFILES

PLAN REF NO
DP02

SHEET
OF
SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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DATE	5/3/2021					JOB NUMBER 18A828		
PLOTTED BY	emilyt							
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS

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Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

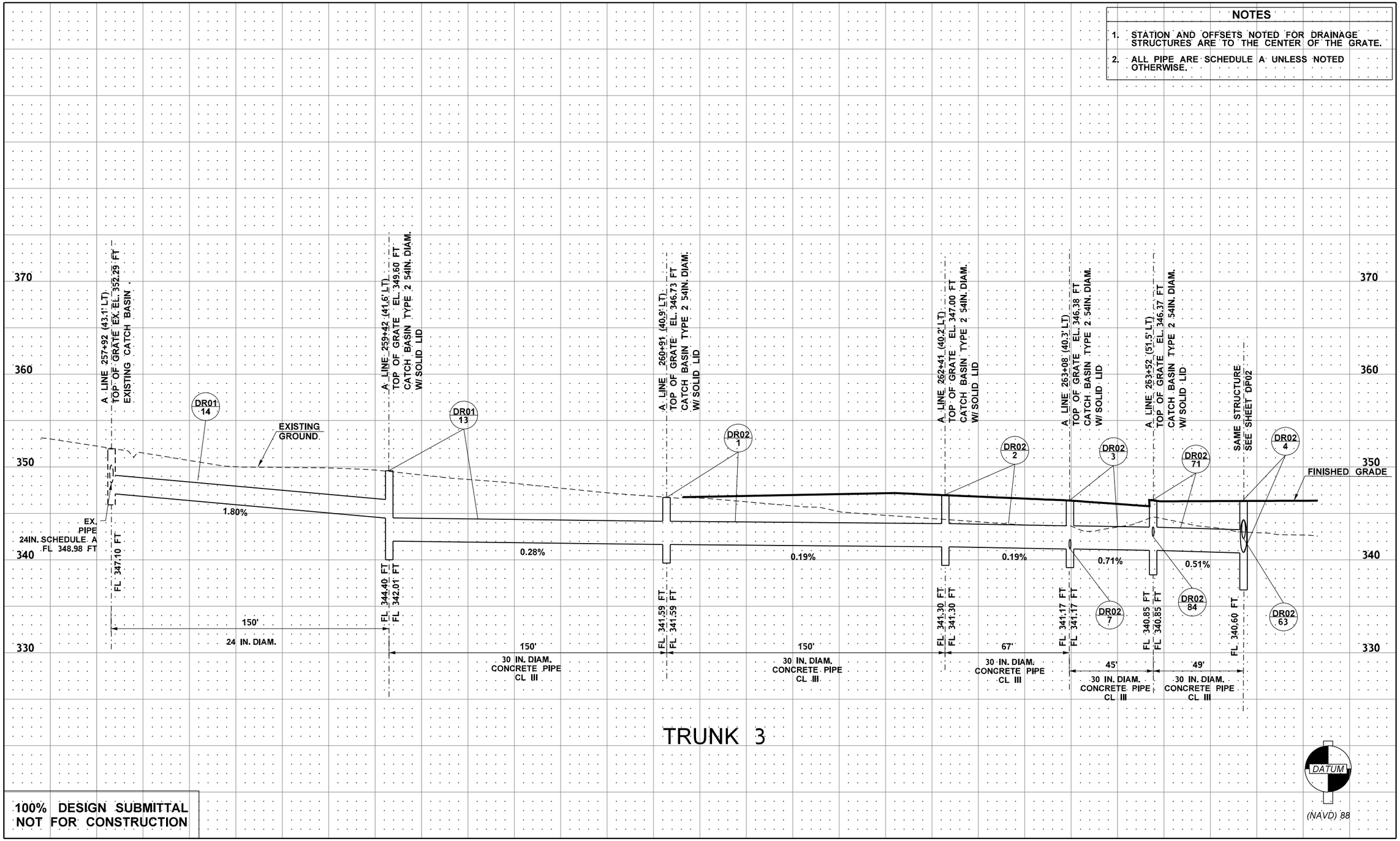
DRAINAGE PROFILES

PLAN REF NO **DP03**

SHEET OF SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



TRUNK 3

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NOT FOR CONSTRUCTION

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DATE	5/3/2021					JOB NUMBER 18A828	
PLOTTED BY	emilyt					CONTRACT NO.	LOCATION NO.
DESIGNED BY	S. SRIDHARAN/T.HEW						
ENTERED BY	N. CHEN						
CHECKED BY	L. THOMSEN						
PROJ. ENGR.	K. NDILE						
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY		

CHRISTINE S. O'CONNELL — STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

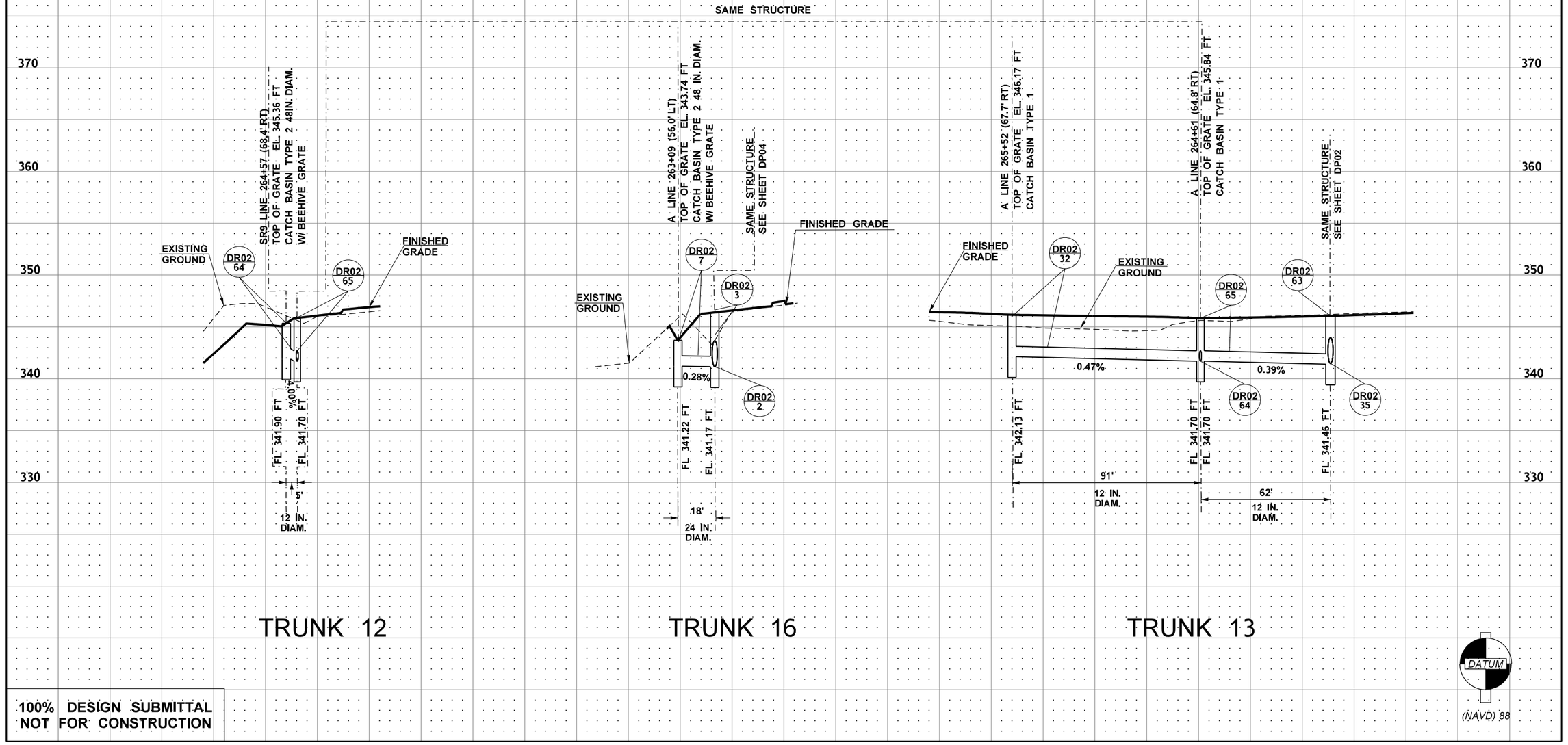
DRAINAGE PROFILES

PLAN REF NO DP04

SHEET OF SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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DESIGNED BY	S. SRIDHARAN/T.HEW						
ENTERED BY	N. CHEN					CONTRACT NO.	LOCATION NO.
CHECKED BY	L. THOMSEN						
PROJ. ENGR.	K. NDILE						
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY		

GREGORY S. CORNINGSTOCK — STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER
P.E. STAMP BOX — DATE

PARSONS
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Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO **DP05**
SHEET OF SHEETS

NOTES

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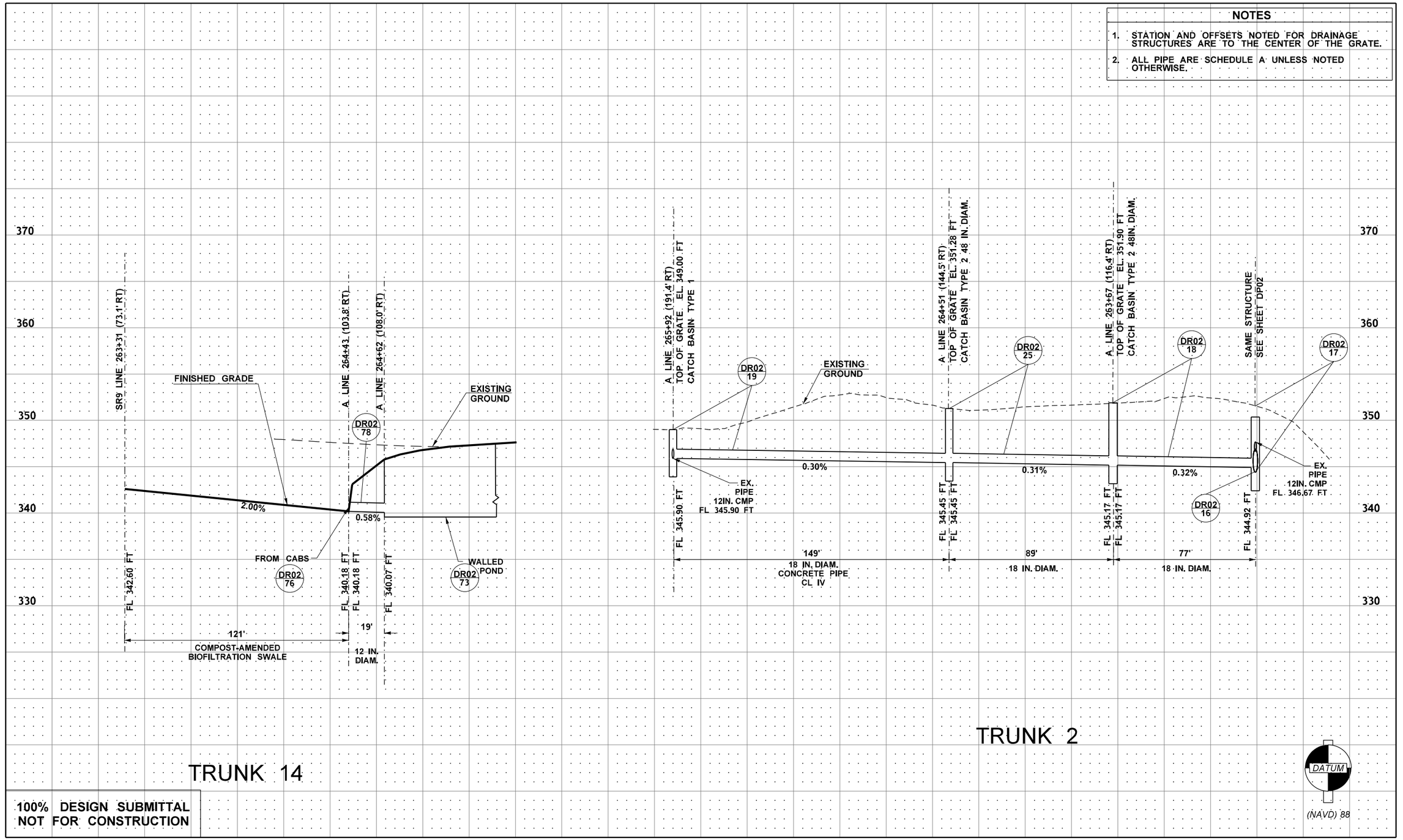
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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DESIGNED BY	S. SRIDHARAN/T.HEW					
ENTERED BY	N. CHEN					
CHECKED BY	L. THOMSEN					
PROJ. ENGR.	K. NDILE					
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY	

REGION NO.	STATE	FED.AID PROJ.NO.
10	WASH	
JOB NUMBER		
18A828		
CONTRACT NO.		LOCATION NO.

STATE OF WASHINGTON · 46893 · REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP06

SHEET
OF
SHEETS

NOTES

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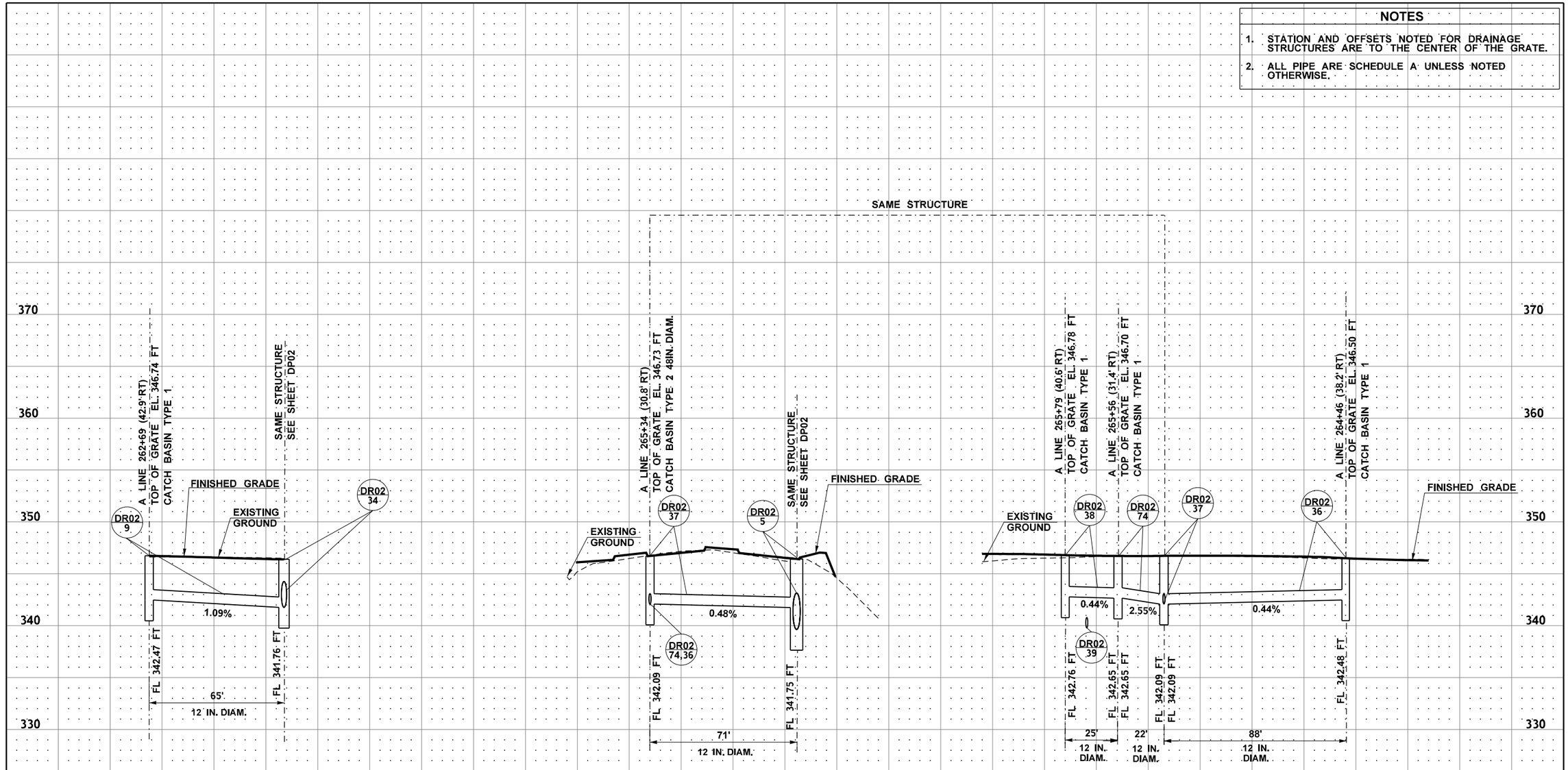
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP07

SHEET
OF
SHEETS

NOTES

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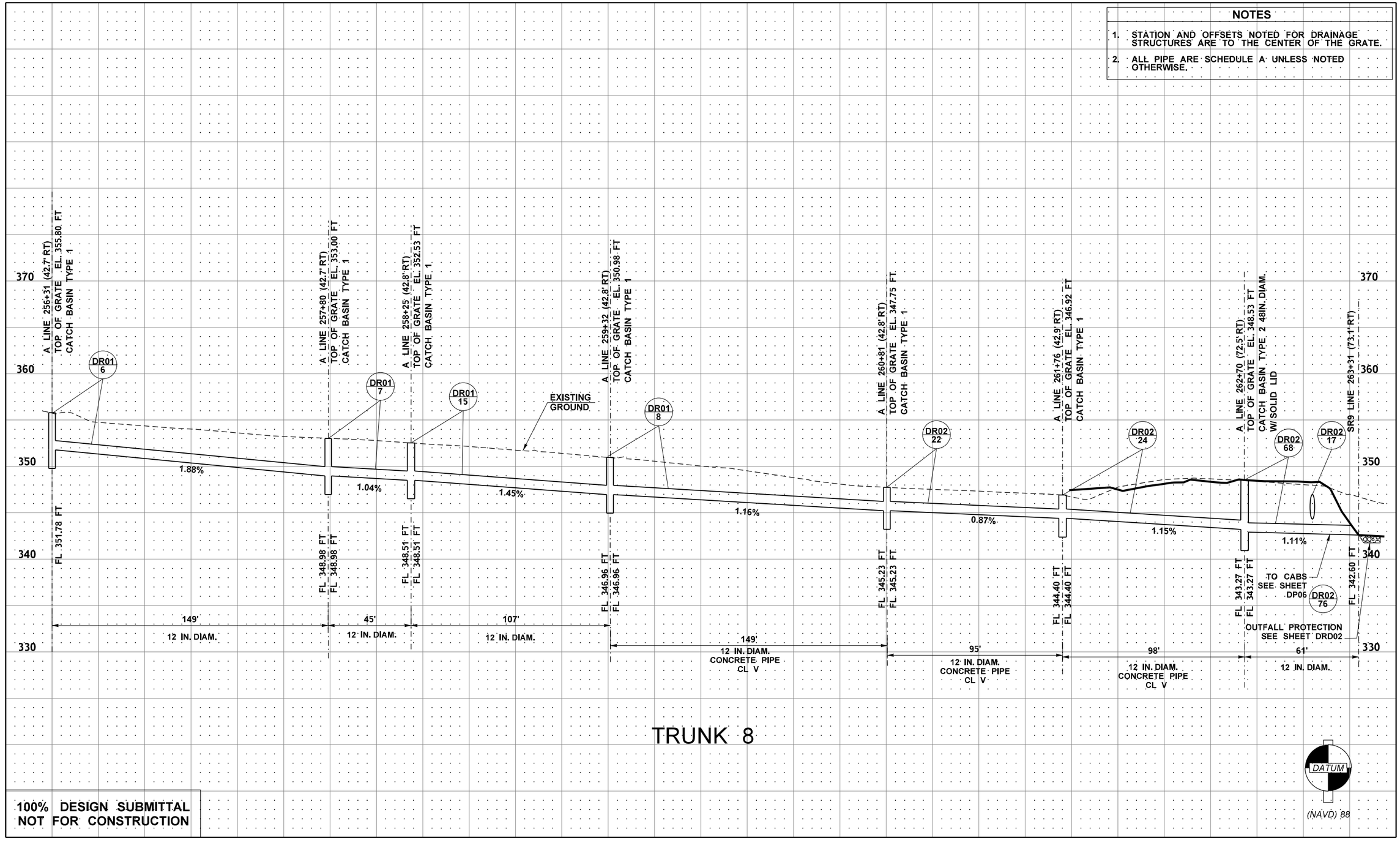
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



TRUNK 8

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ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

STATE OF WASHINGTON · 18803 · REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP08

SHEET
OF
SHEETS

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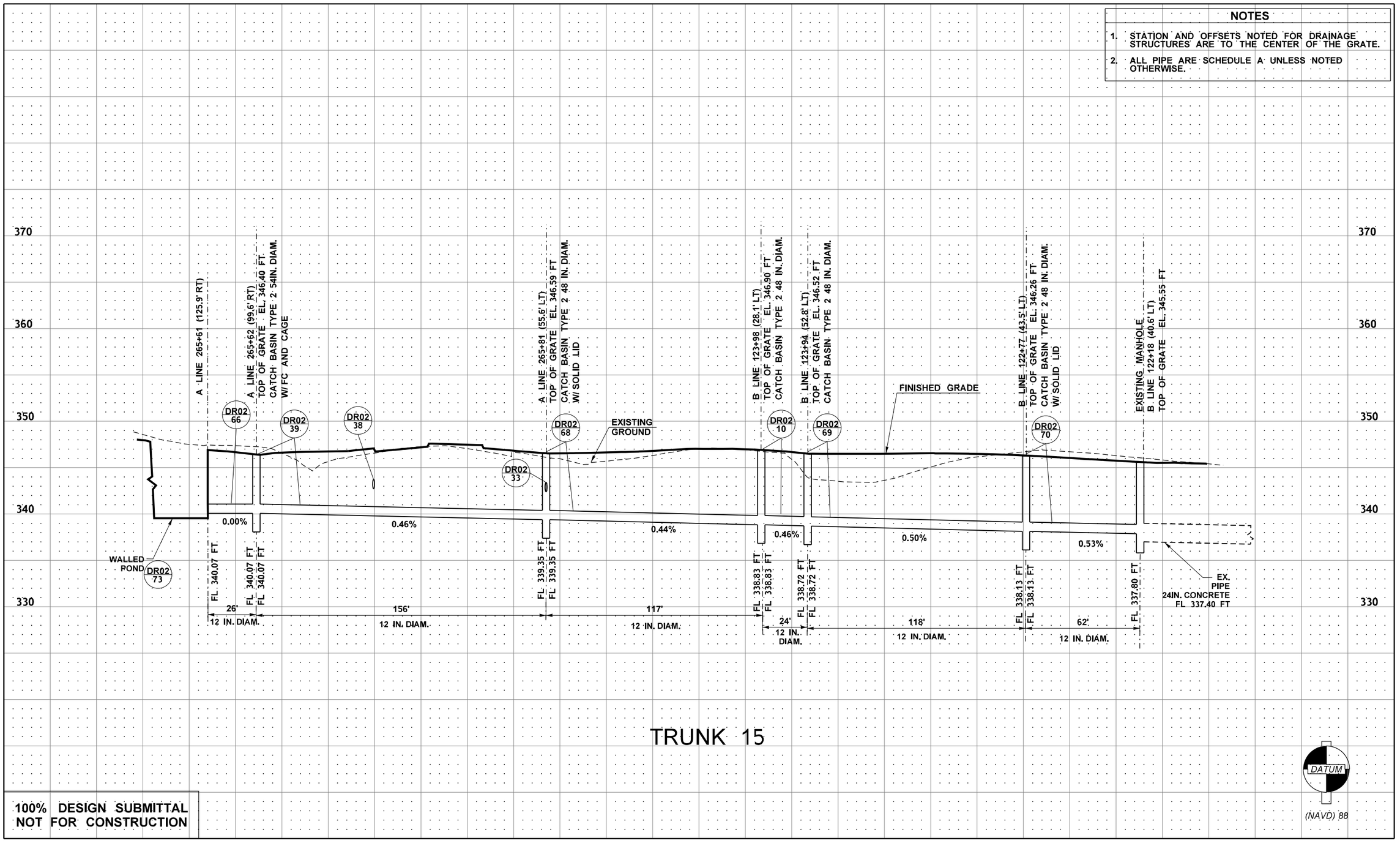
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

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PLOTTED BY	emilyt					18A828		
DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

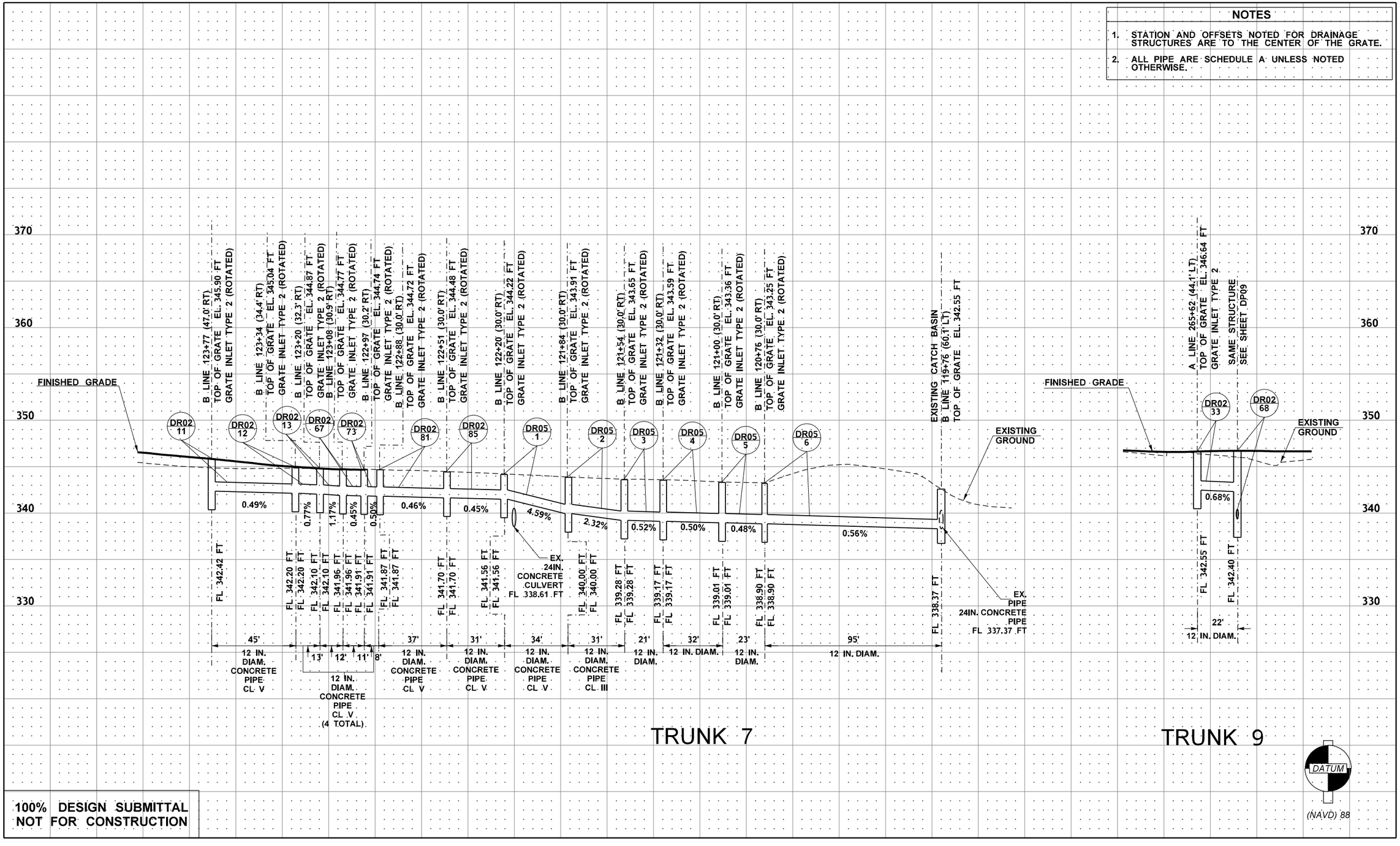
DRAINAGE PROFILES

PLAN REF NO
DP09

SHEET
OF
SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

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DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT NO.		LOCATION NO.
ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

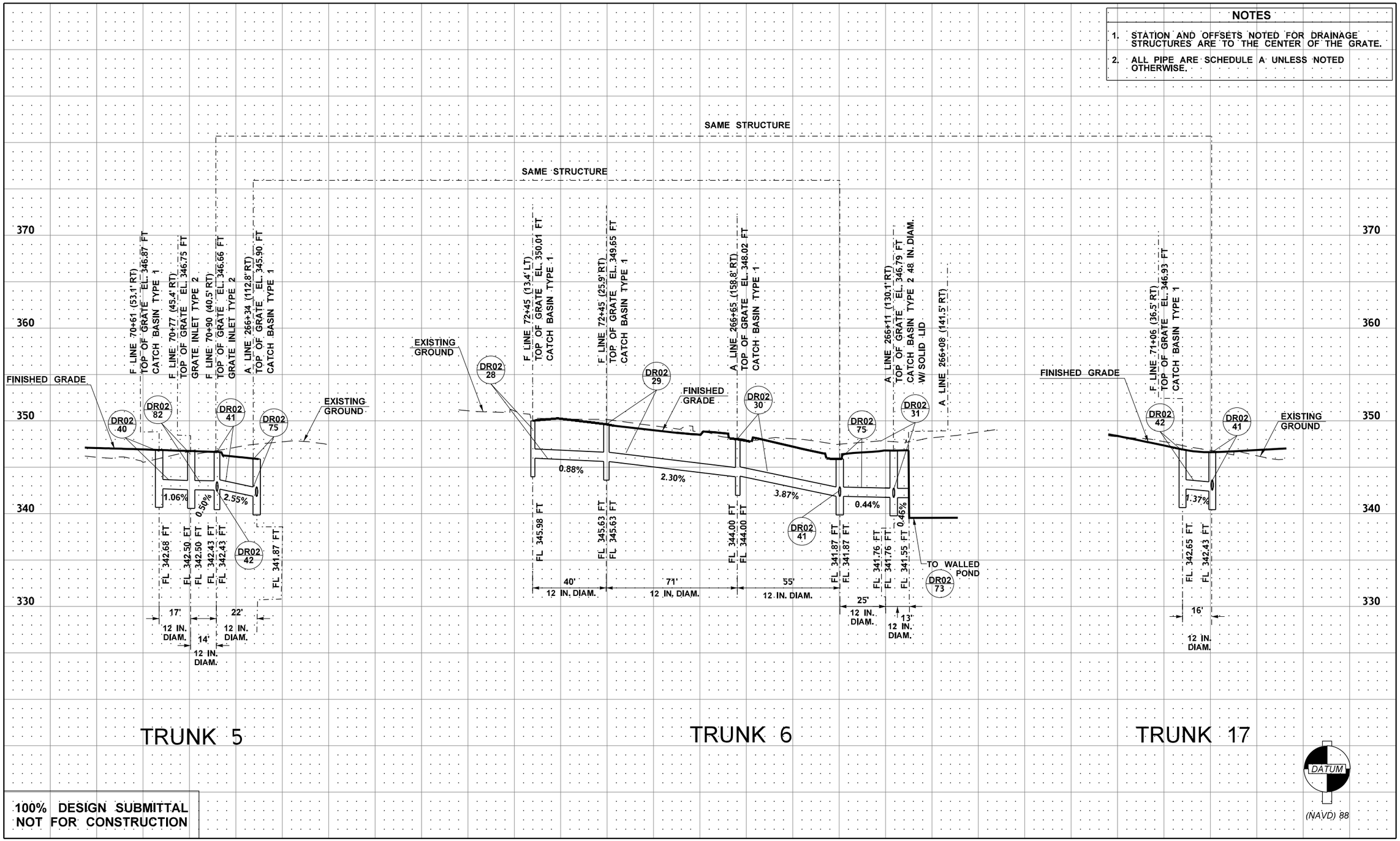
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO DP10
SHEET
OF
SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

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CHECKED BY	L. THOMSEN					
PROJ. ENGR.	K. NDILE					
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY	

REGION NO.	STATE	FED.AID PROJ.NO.
10	WASH	
JOB NUMBER		
18A828		
CONTRACT NO.		LOCATION NO.

STATE OF WASHINGTON — JOSEPH S. JOHNSON — 40003 — REGISTERED PROFESSIONAL ENGINEER

P.E. STAMP BOX — DATE

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

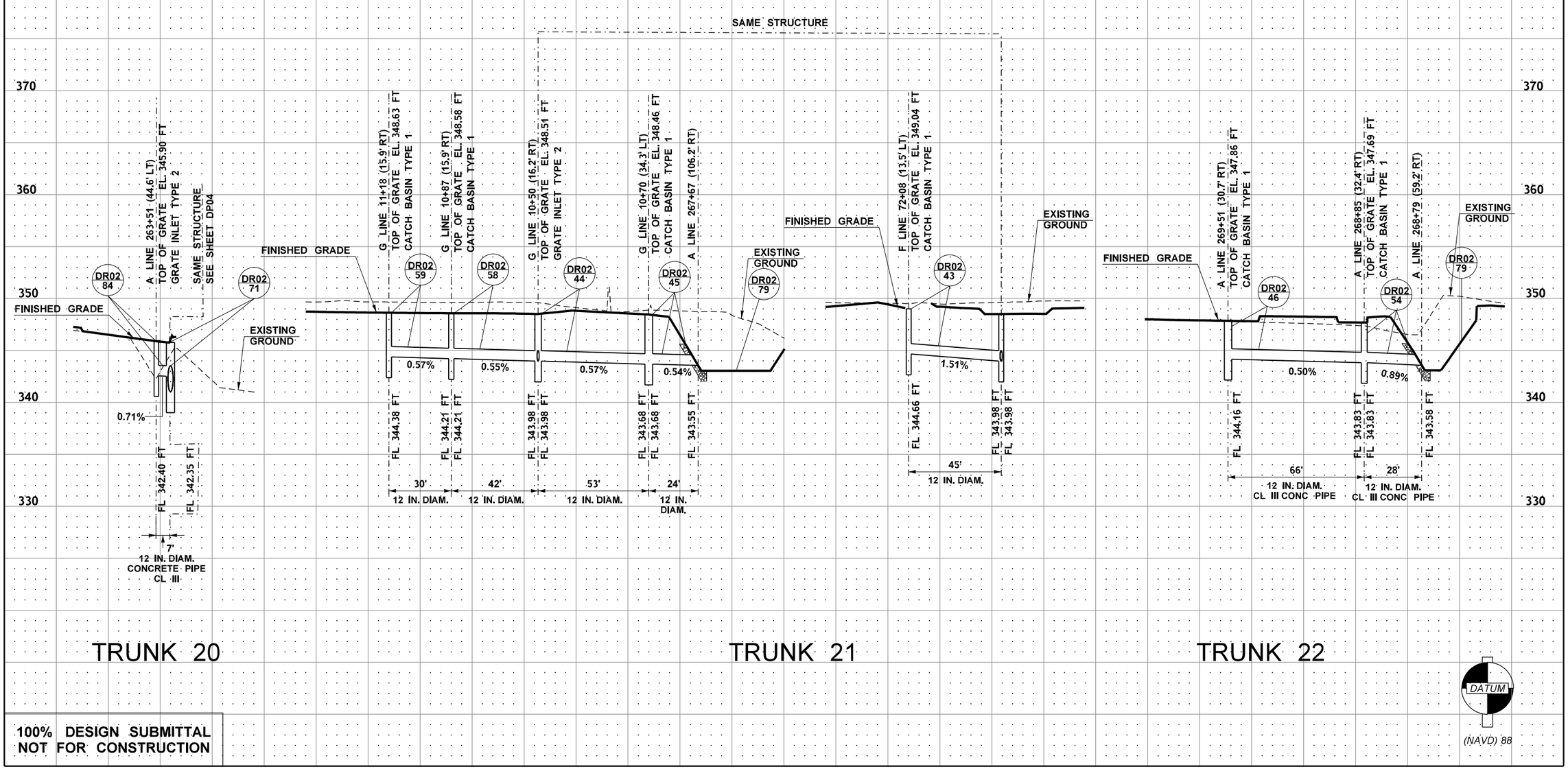
DRAINAGE PROFILES

PLAN REF NO
DP11

SHEET
OF
SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

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DESIGNED BY	S. SRIDHARAN/T.HEW						
ENTERED BY	N. CHEN						
CHECKED BY	L. THOMSEN						
PROJ. ENGR.	K. NDILE						
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY		

STATE OF WASHINGTON · OSBORNE S. CORNWALL · 40803 · REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

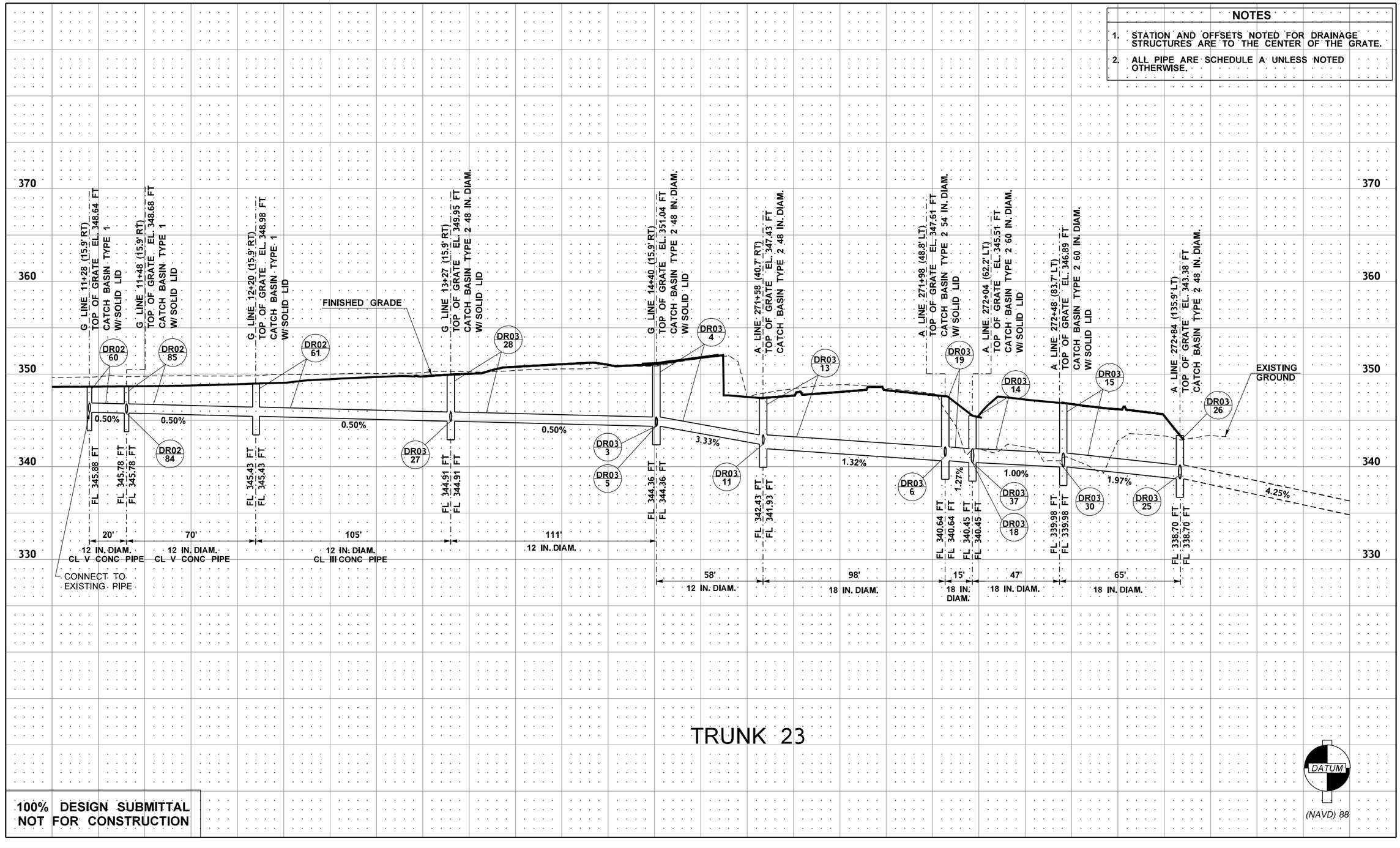
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP12
SHEET
OF
SHEETS

NOTES

1. STATION AND OFFSETS NOTED FOR DRAINAGE STRUCTURES ARE TO THE CENTER OF THE GRATE.
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP13
SHEET
OF
SHEETS

NOTES

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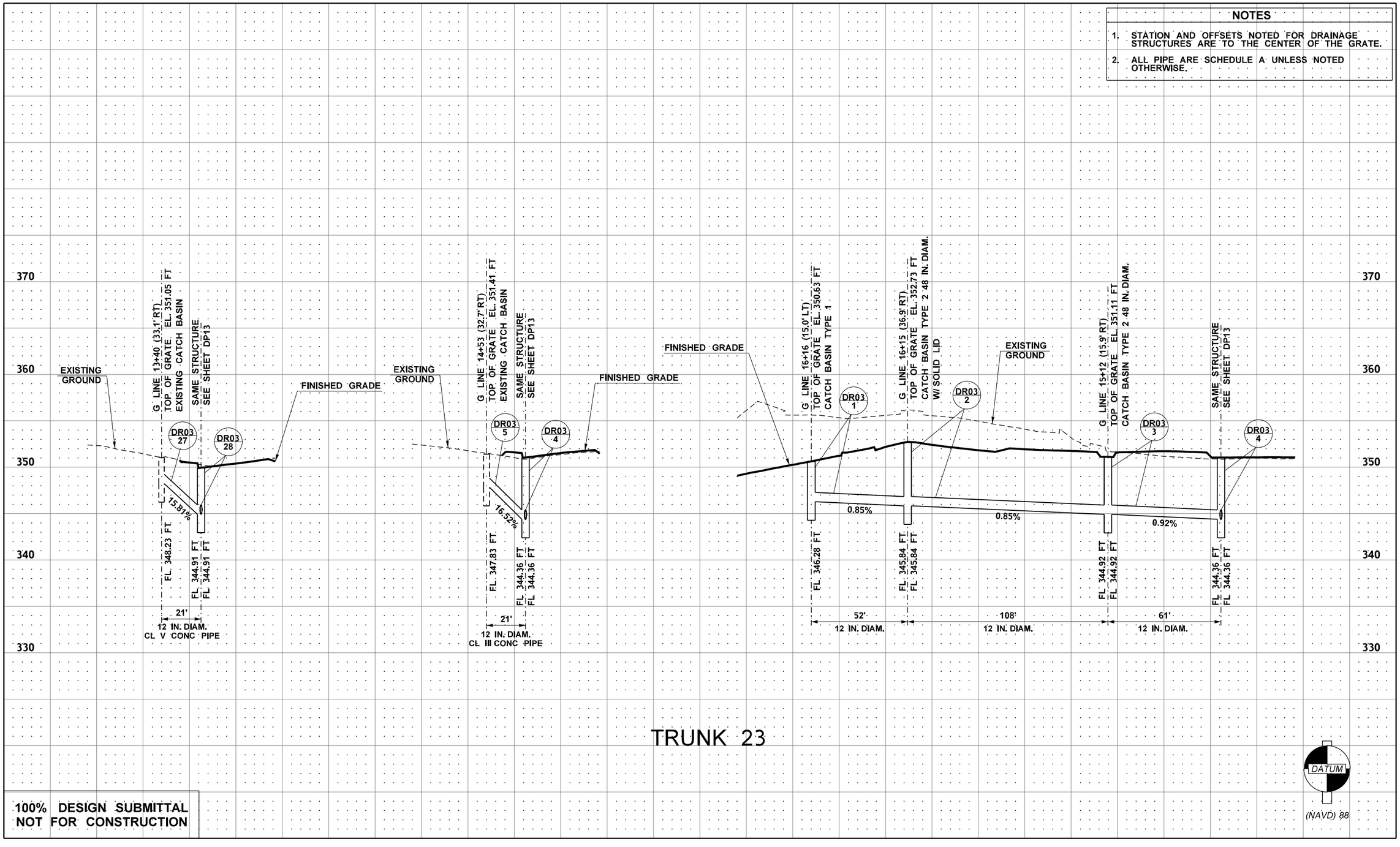
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

P.E. STAMP BOX — DATE

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP14

SHEET OF SHEETS

NOTES

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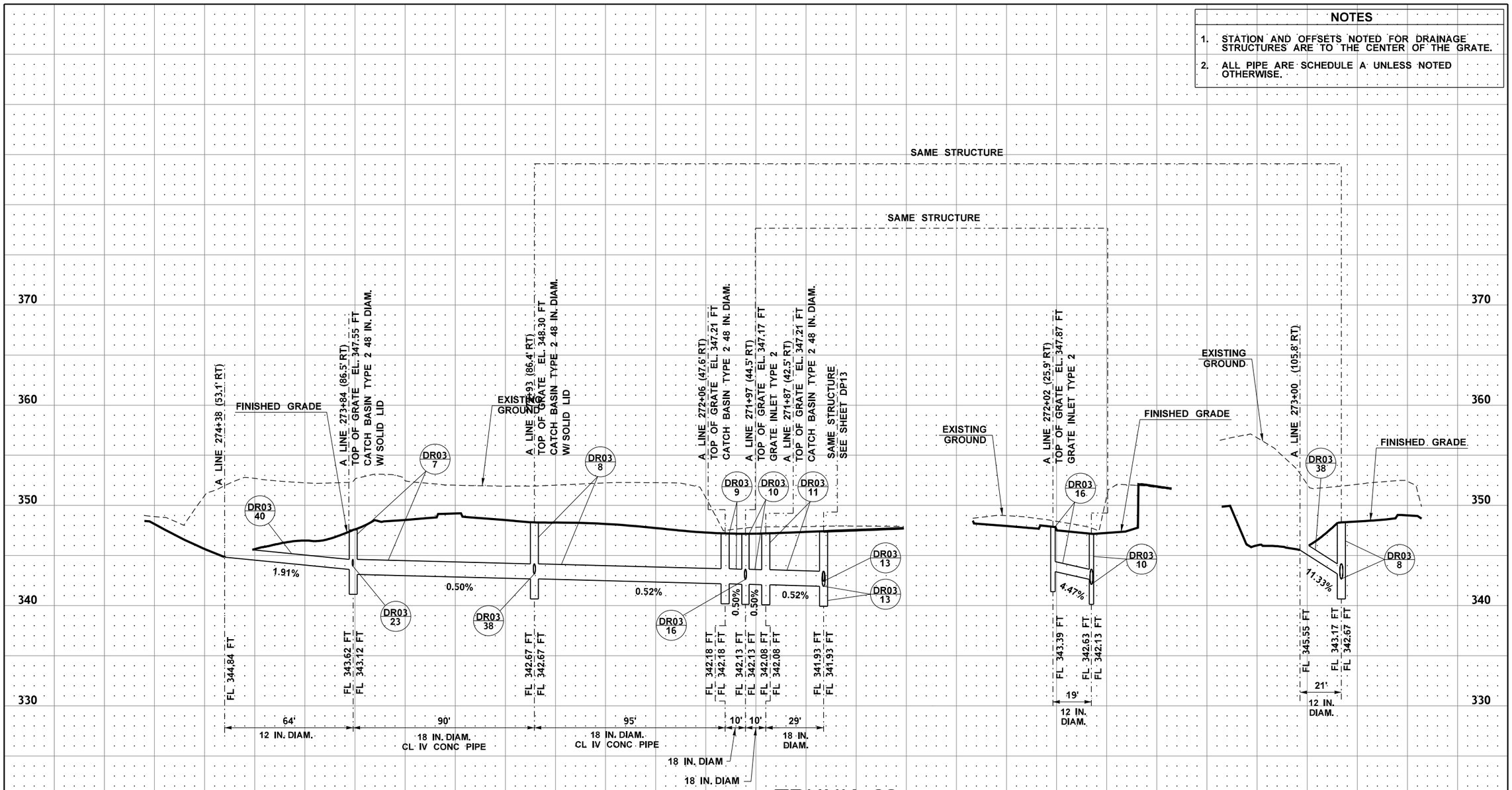
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

GIOVENNE STOMBAUGH — STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)
DRAINAGE PROFILES

PLAN REF NO
DP15
SHEET
OF
SHEETS

NOTES

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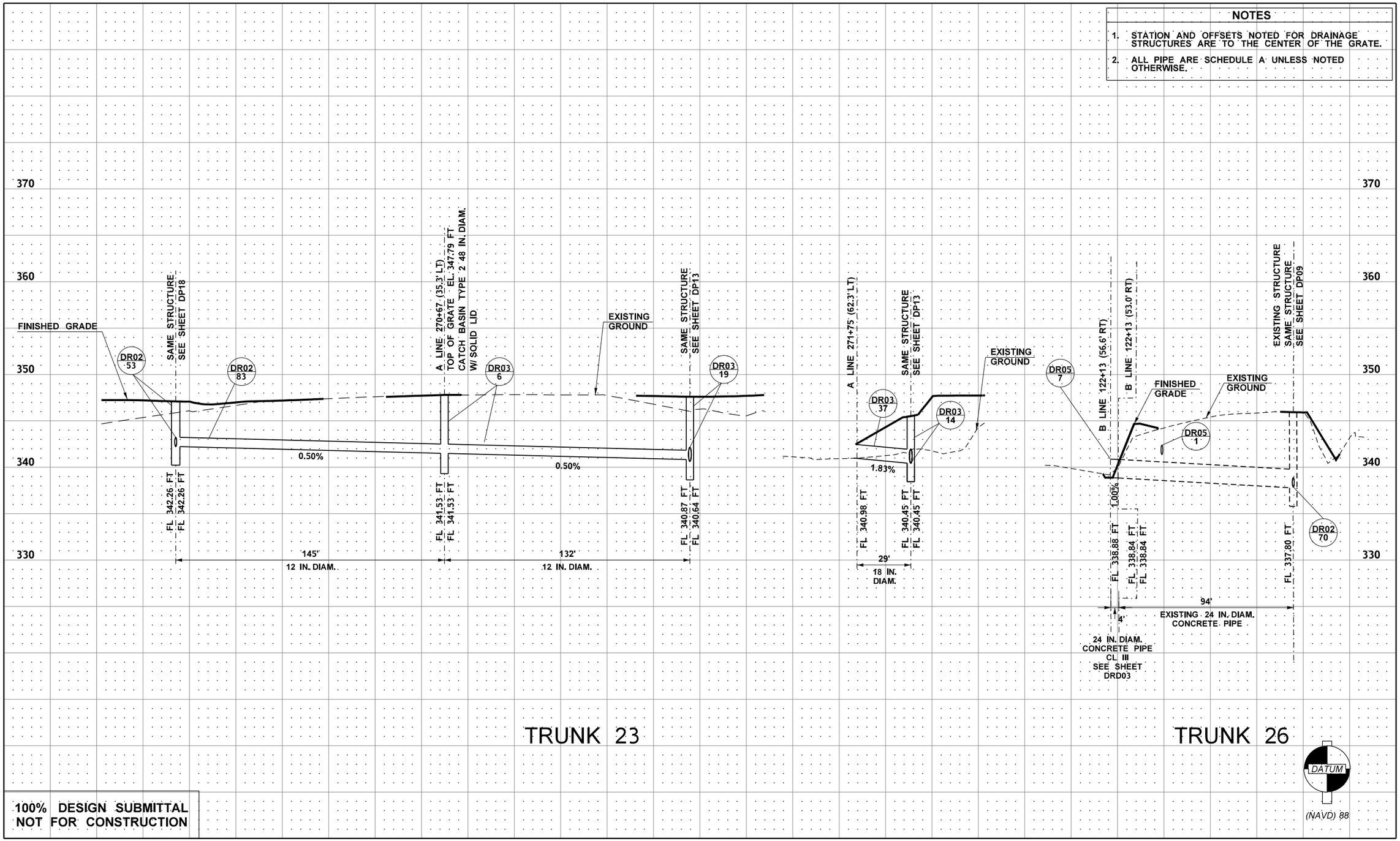
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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ENTERED BY	N. CHEN				
CHECKED BY	L. THOMSEN				
PROJ. ENGR.	K. NDILE				
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO.	STATE	FED.AID PROJ.NO.
10	WASH	
JOB NUMBER		
18A828		
CONTRACT NO.		LOCATION NO.

STATE OF WASHINGTON 46893 REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP16

SHEET
OF
SHEETS

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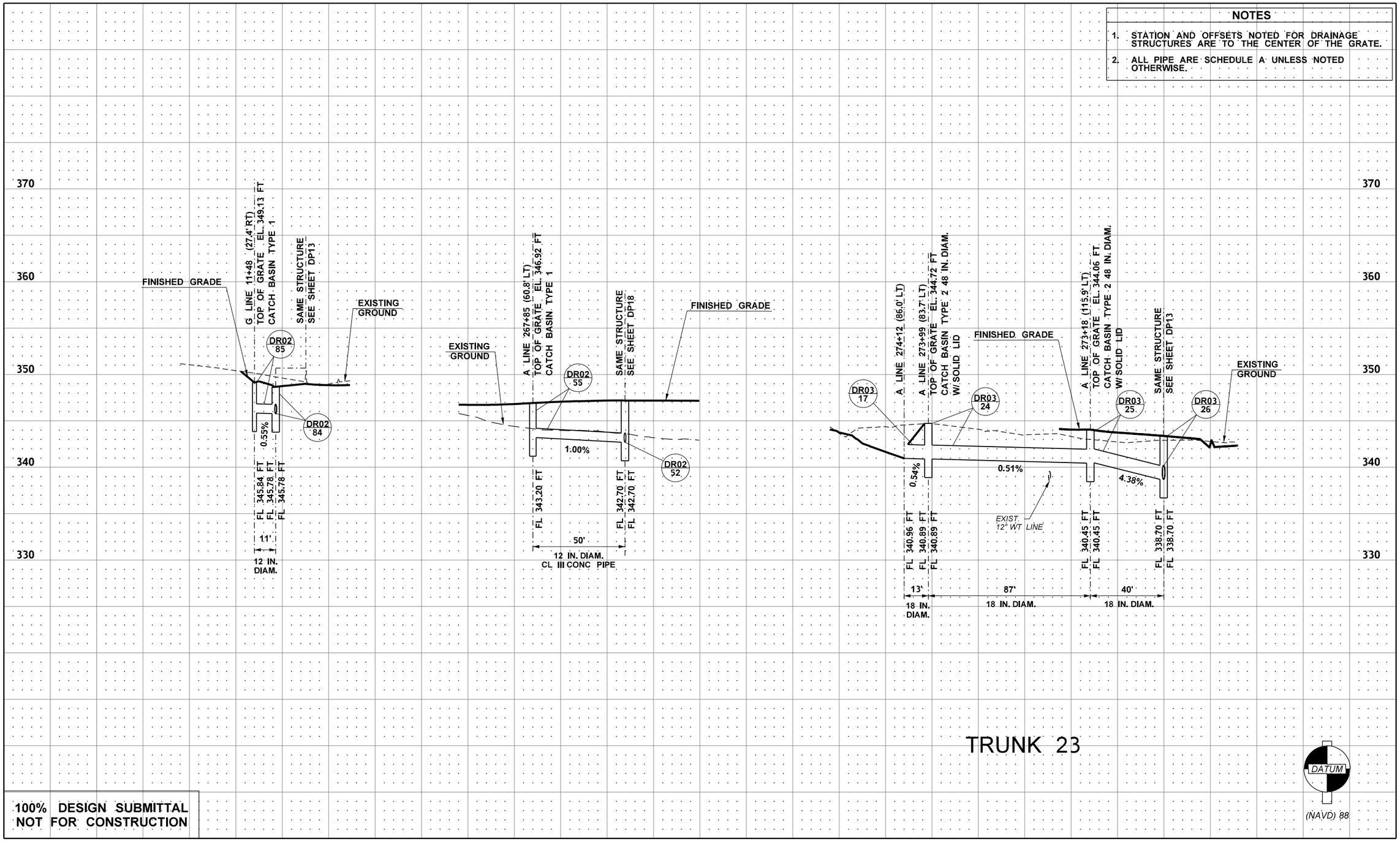
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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ENTERED BY	N. CHEN							
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PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

CHRISTINE S. O'CONNELL — STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP17
SHEET
OF
SHEETS

NOTES

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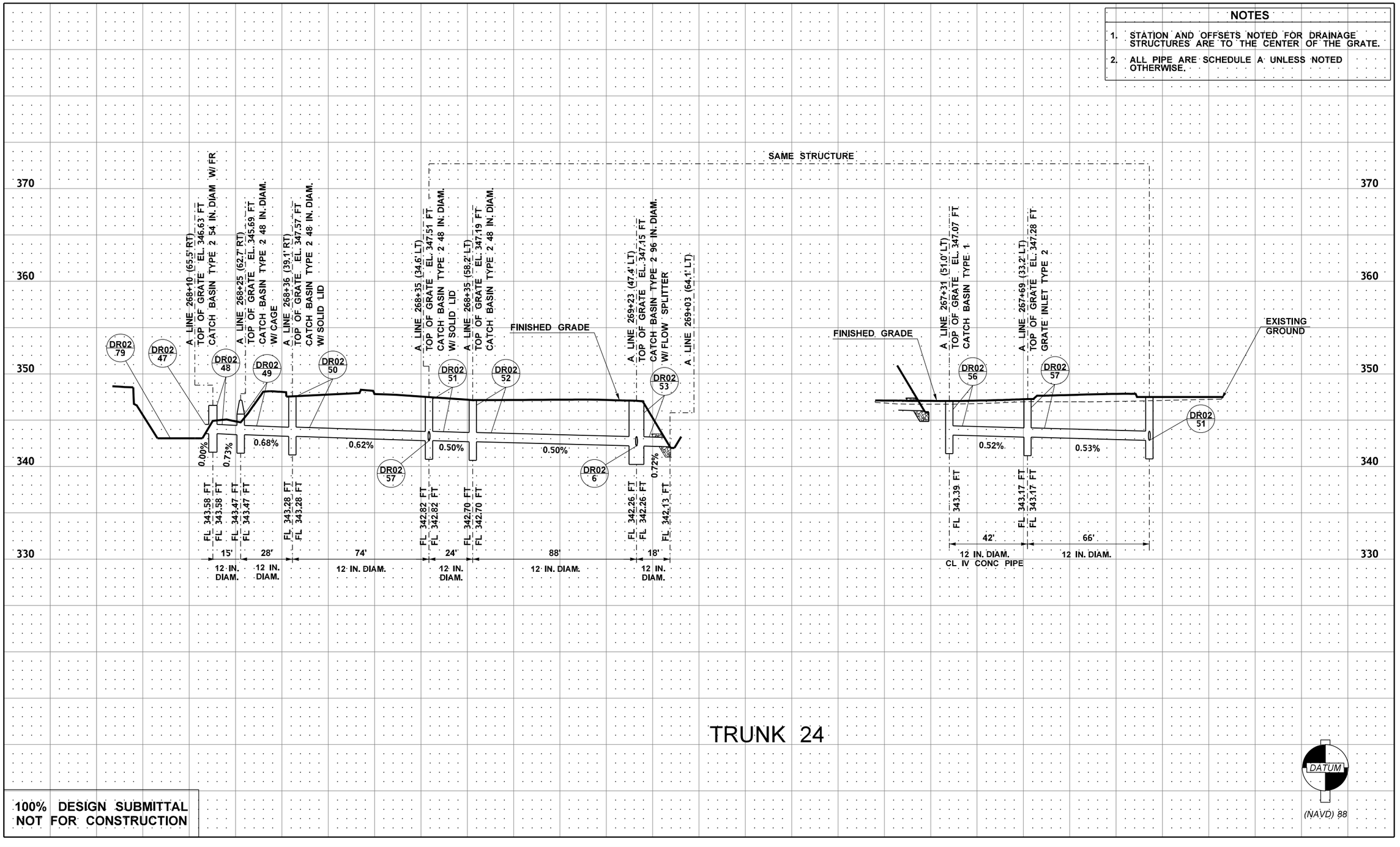
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

CHRISTINE S. O'CONNOR STATE OF WASHINGTON 40803 REGISTERED PROFESSIONAL ENGINEER
P.E. STAMP BOX
DATE

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)
DRAINAGE PROFILES

PLAN REF NO
DP18
SHEET
OF
SHEETS

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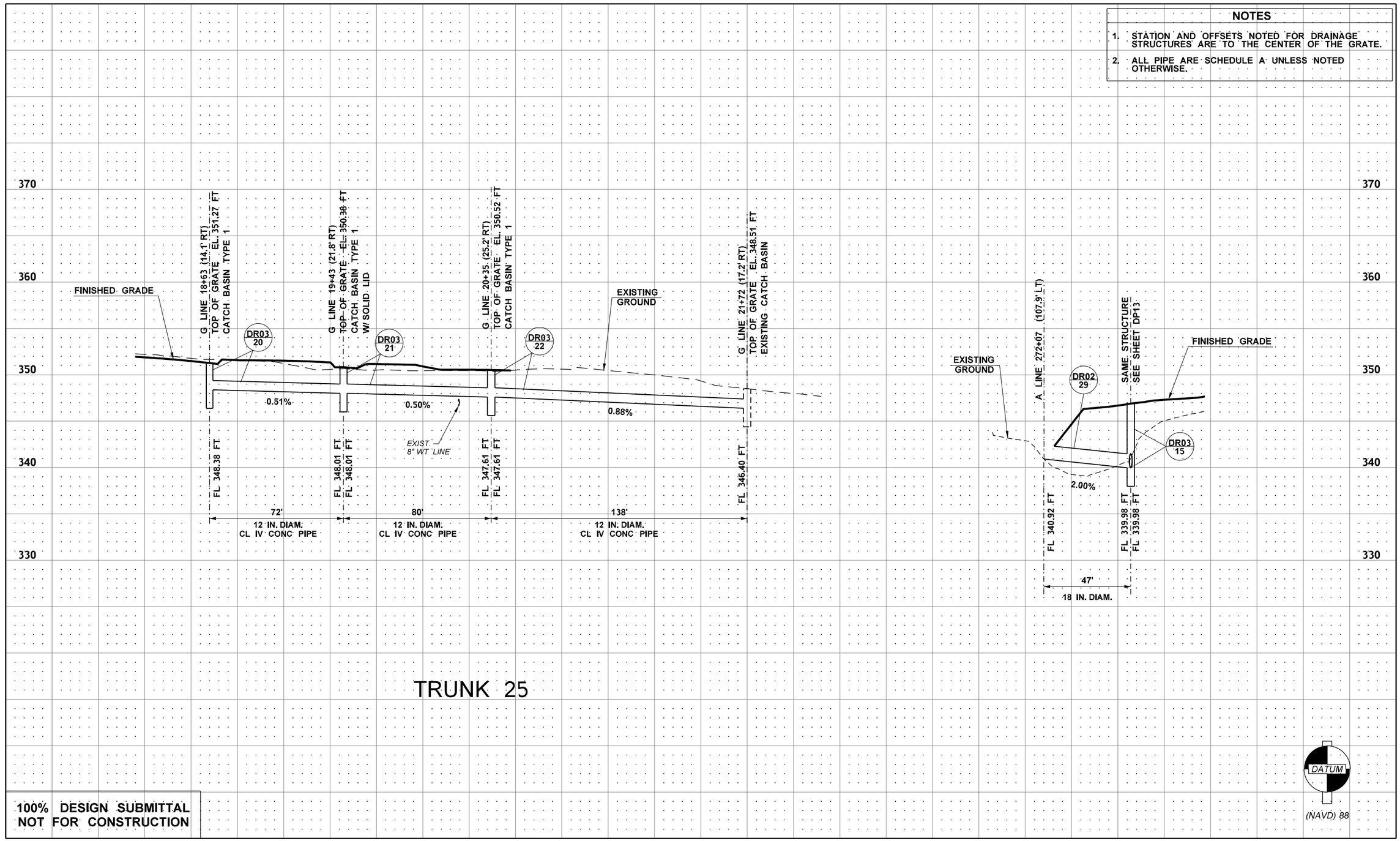
2. ALL PIPE ARE SCHEDULE A UNLESS NOTED OTHERWISE.



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ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

STATE OF WASHINGTON — 46803 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

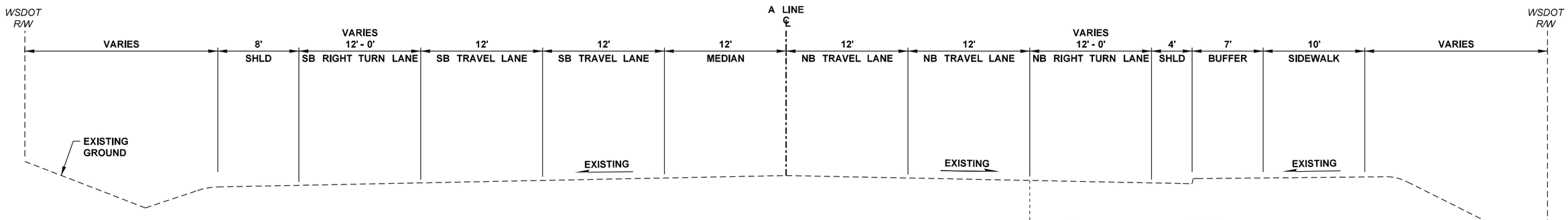
PLAN REF NO
DP19
SHEET
OF
SHEETS

APPENDIX F

ROADWAY CROSS SECTIONS AND PROFILES

GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION A

SR 9 A 252+00.00 TO A 255+06.87

SR 9 A 254+89.84 TO A 255+19.45

LEGEND

1. HMA CL 1/2 IN., PG 58H-22
2. CRUSHED SURFACING BASE COURSE
3. SELECT BORROW INCL. HAUL
4. PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)
5. CEMENT CONC. SIDEWALK
6. PLANING BITUMINOUS PAVEMENT
7. TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS
8. CEMENT CONC. TRAFFIC CURB AND GUTTER
9. ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER
10. ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
11. ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
12. CEMENT CONC. TRAFFIC CURB
13. SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
14. ROADWAY EXCAVATION INCL. HAUL
15. CEMENT CONC. PAVEMENT
16. HMA FOR PRELEVELING CL. 1/2 IN. PG
17. BALLAST

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DESIGNED BY	Z. BROWN				
ENTERED BY	K. MCWILLIAMS				
CHECKED BY	R. HOWARD				
PROJ. ENGR.	K. NDILE				
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO. 10 | STATE WASH | FED.AID PROJ.NO.
JOB NUMBER
CONTRACT NO. | LOCATION NO.

ZACHARY R. BROWN STATE OF WASHINGTON 17624 REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

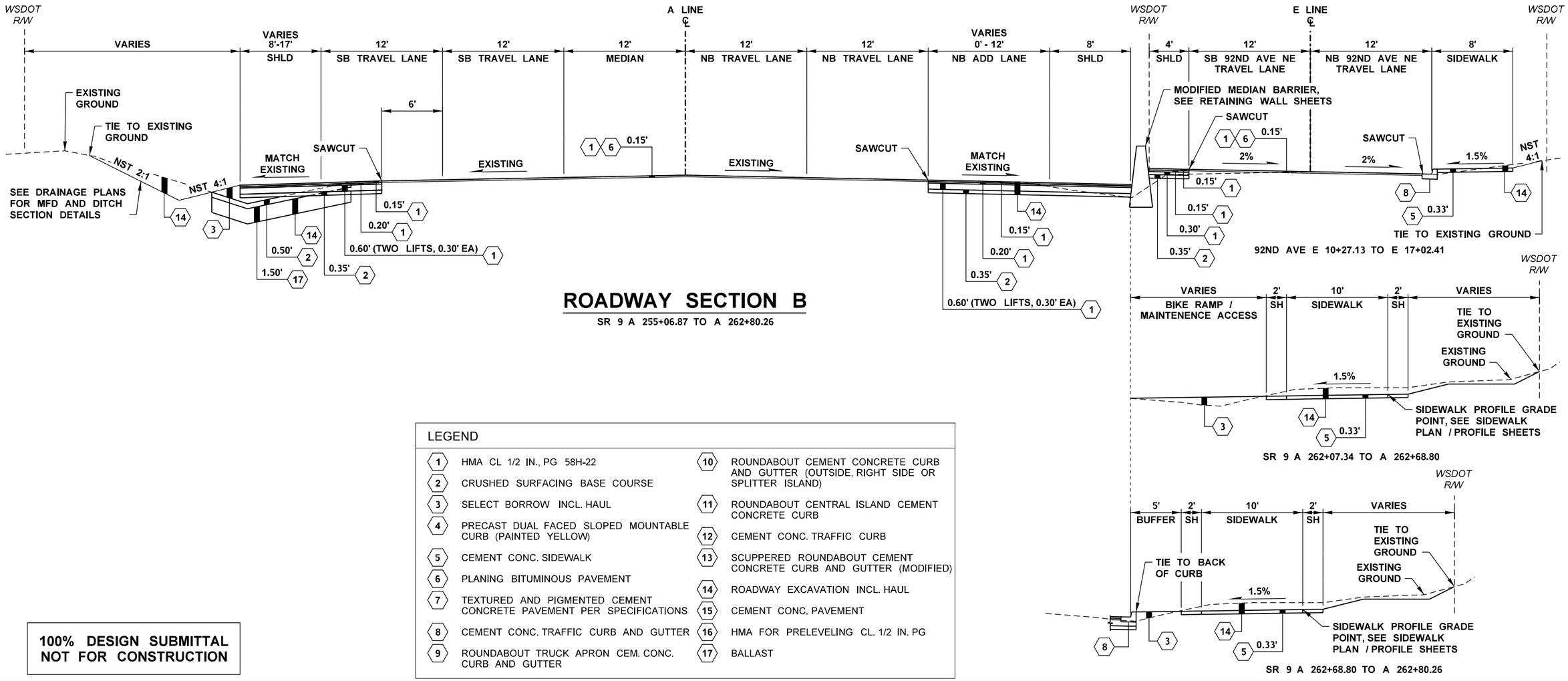
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO RS01
SHEET
OF
SHEETS

GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION B

SR 9 A 255+06.87 TO A 262+80.26

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	CEMENT CONC. PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	BALLAST
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD					CONTRACT NO.		LOCATION NO.
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 21703 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

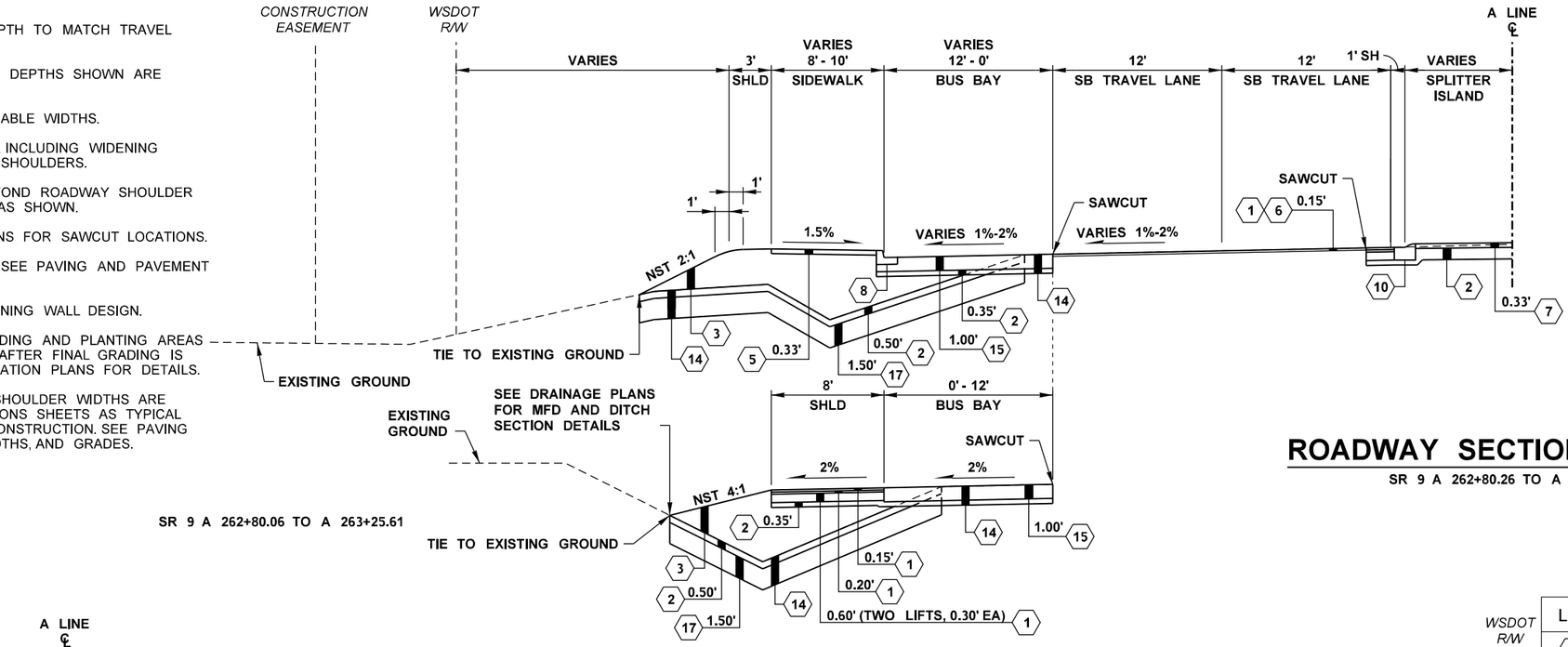
ROADWAY SECTIONS

PLAN REF NO RS02

SHEET OF SHEETS

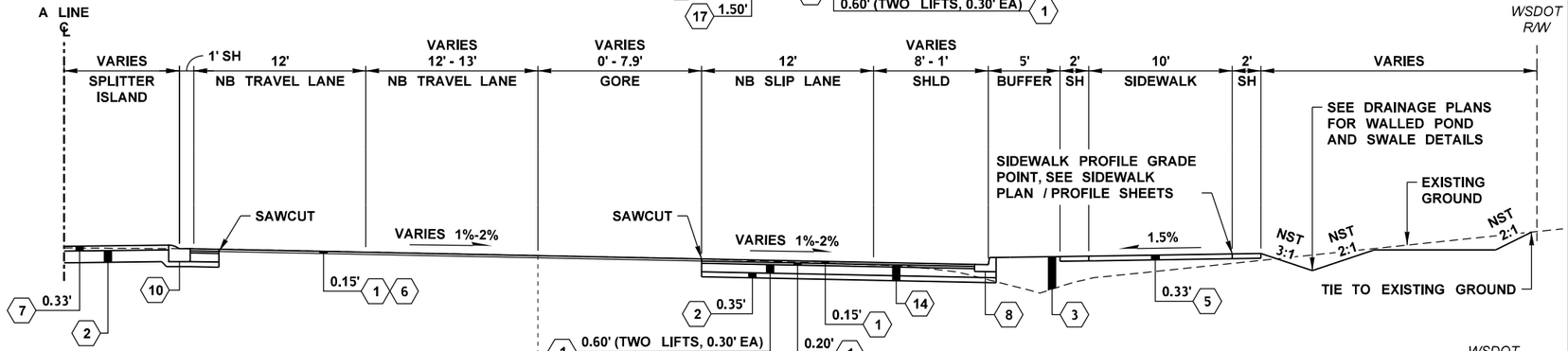
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



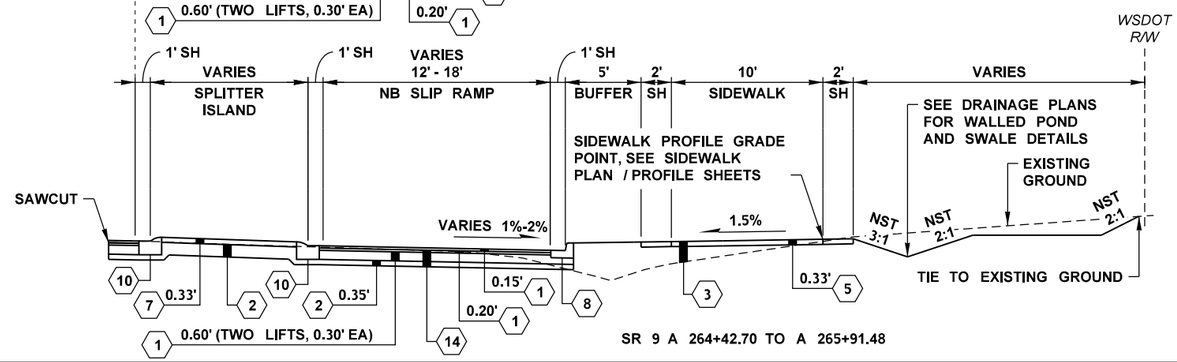
ROADWAY SECTION C (LEFT)

SR 9 A 262+80.26 TO A 265+91.48



ROADWAY SECTION C (RIGHT)

SR 9 A 262+80.26 TO A 265+91.48



100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

LEGEND

1	HMA CL 1/2 IN., PG 58H-22
2	CRUSHED SURFACING BASE COURSE
3	SELECT BORROW INCL. HAUL
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)
5	CEMENT CONC. SIDEWALK
6	PLANING BITUMINOUS PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS
8	CEMENT CONC. TRAFFIC CURB AND GUTTER
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER
10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
12	CEMENT CONC. TRAFFIC CURB
13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
14	ROADWAY EXCAVATION INCL. HAUL
15	CEMENT CONC. PAVEMENT
16	HMA FOR PRELEVELING CL. 1/2 IN. PG
17	BALLAST

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CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 21753 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO RS03

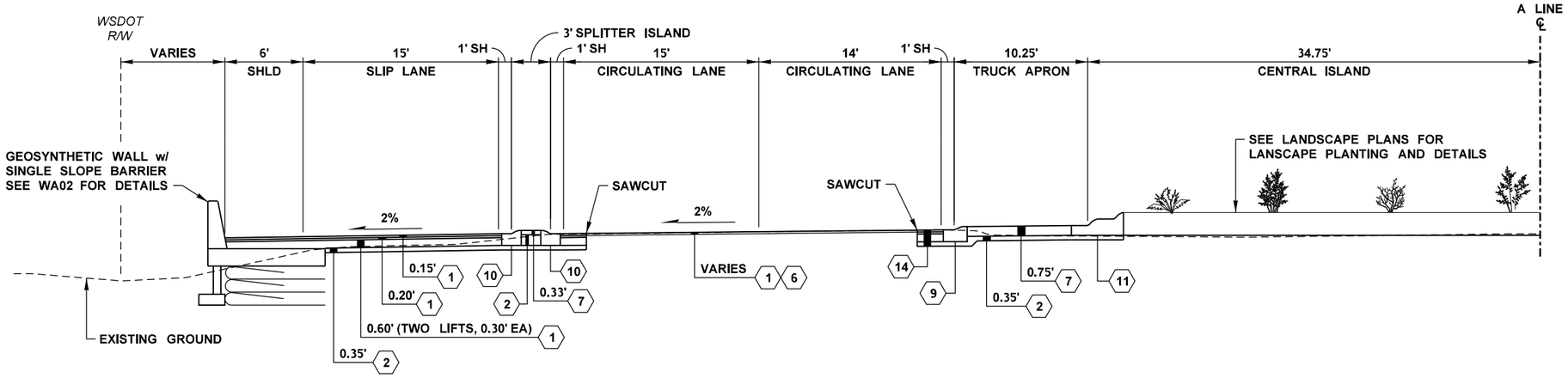
SHEET

OF

SHEETS

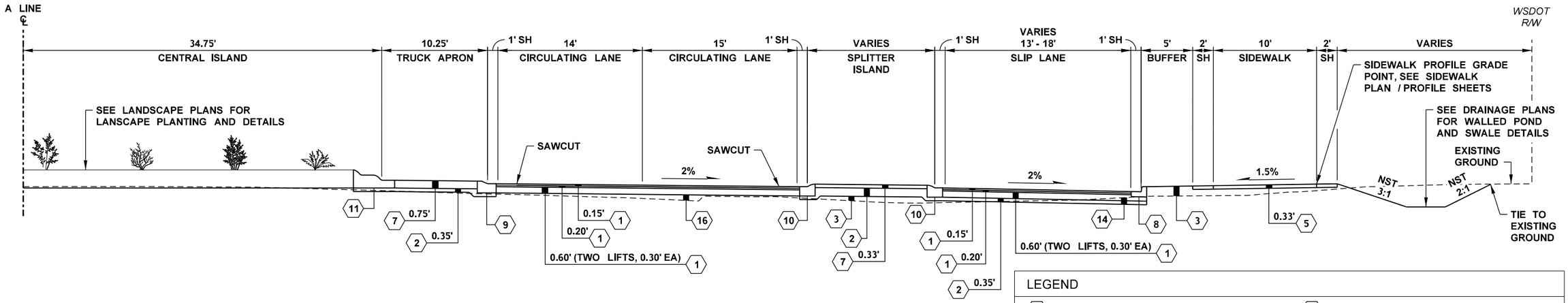
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROUNDABOUT SECTION - SR9/SR204

NORTHWEST



ROUNDABOUT SECTION - SR9/SR204

SOUTHEAST

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	CEMENT CONC. PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	BALLAST
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

FILE NAME	c:\pw_workIng\wastate\p0024020\dms08802\Stage_3_Y-11834_PS_RS_04.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
TIME	4:16:01 PM					10	WASH	
DATE	4/30/2021					JOB NUMBER		
PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 47024 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

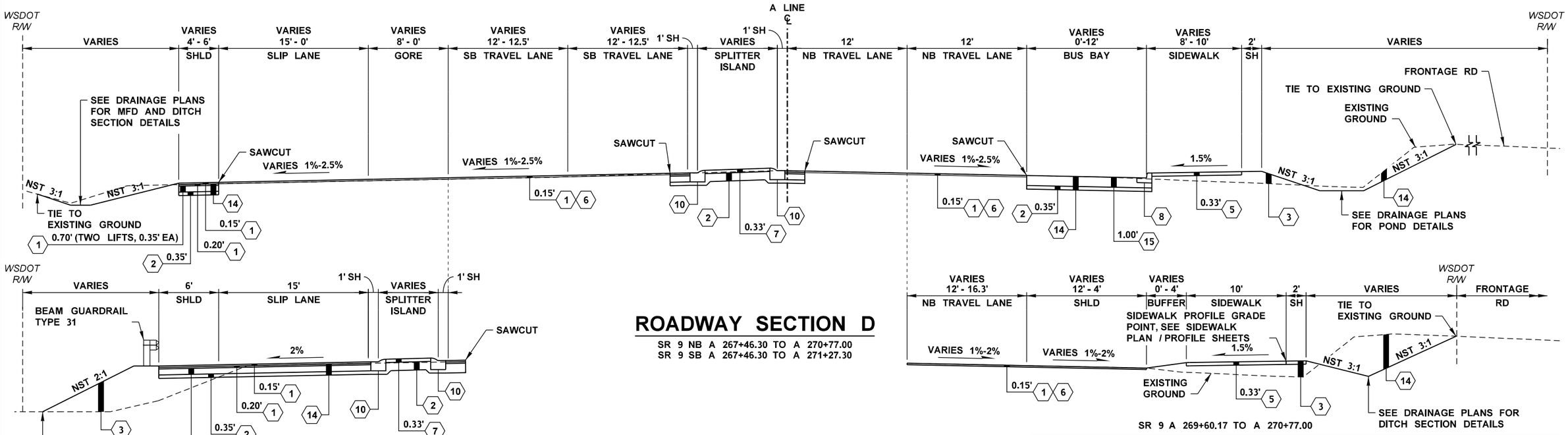
ROADWAY SECTIONS

PLAN REF NO RS04

SHEET OF SHEETS

GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION D

SR 9 NB A 267+46.30 TO A 270+77.00
SR 9 SB A 267+46.30 TO A 271+27.30

SR 9 A 268+82.42 TO A 269+30.00

SR 9 A 269+60.17 TO A 270+77.00

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	CEMENT CONC. PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	BALLAST
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

FILE NAME	c:\pw_working\wastate\p0024020\dms08802\Stage 3_Y-11834_PS_RS_05.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
TIME	4:16:18 PM					10	WASH	
DATE	4/30/2021					JOB NUMBER		
PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 21762 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

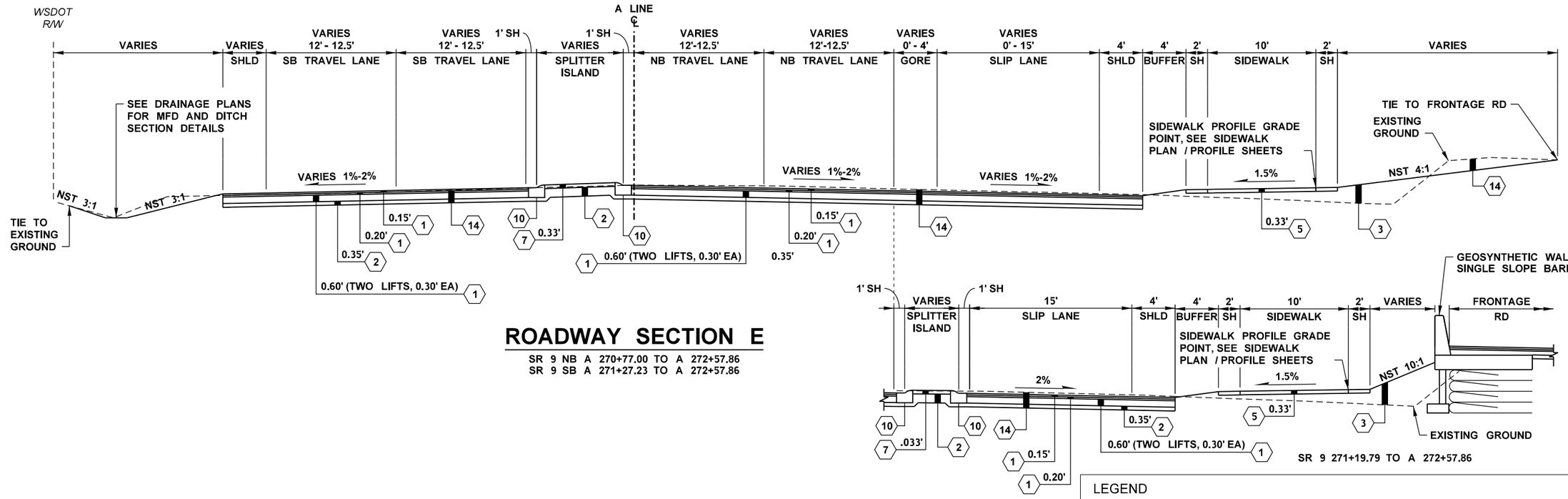
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO
RS05
SHEET
OF
SHEETS

GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION E

SR 9 NB A 270+77.00 TO A 272+57.86
SR 9 SB A 271+27.23 TO A 272+57.86

SR 9 271+19.79 TO A 272+57.86

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	CEMENT CONC. PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	BALLAST
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

FILE NAME	c:\pw_workIng\wastate\p0024020\dms08802\Stage_3_Y-11834_PS_RS_06.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
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PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN							
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD					CONTRACT NO.		LOCATION NO.
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 21624 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

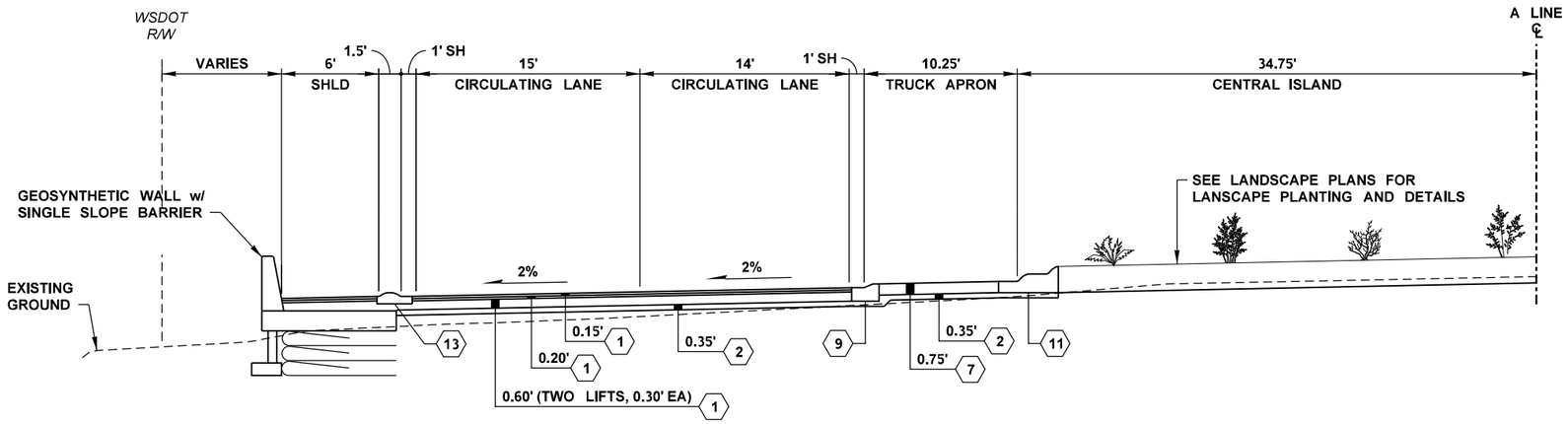
ROADWAY SECTIONS

PLAN REF NO RS06

SHEET OF SHEETS

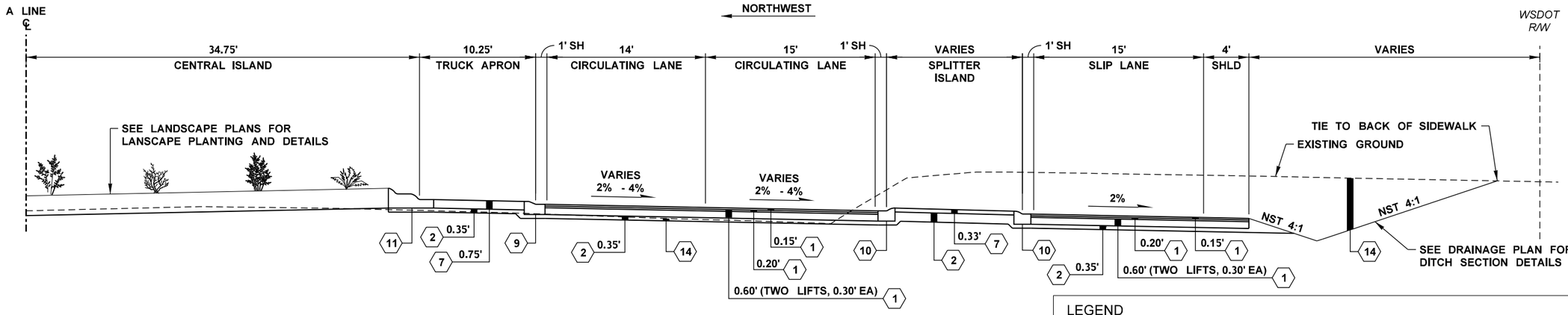
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROUNDABOUT SECTION - SR9/VERNON

NORTHWEST



ROUNDABOUT SECTION - SR9/VERNON

SOUTHEAST

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	CEMENT CONC. PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	BALLAST
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

FILE NAME	c:\pw_workIng\wastate\p0024020\dms08802\Stage_3_Y-11834_PS_RS_07.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
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PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 21624 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

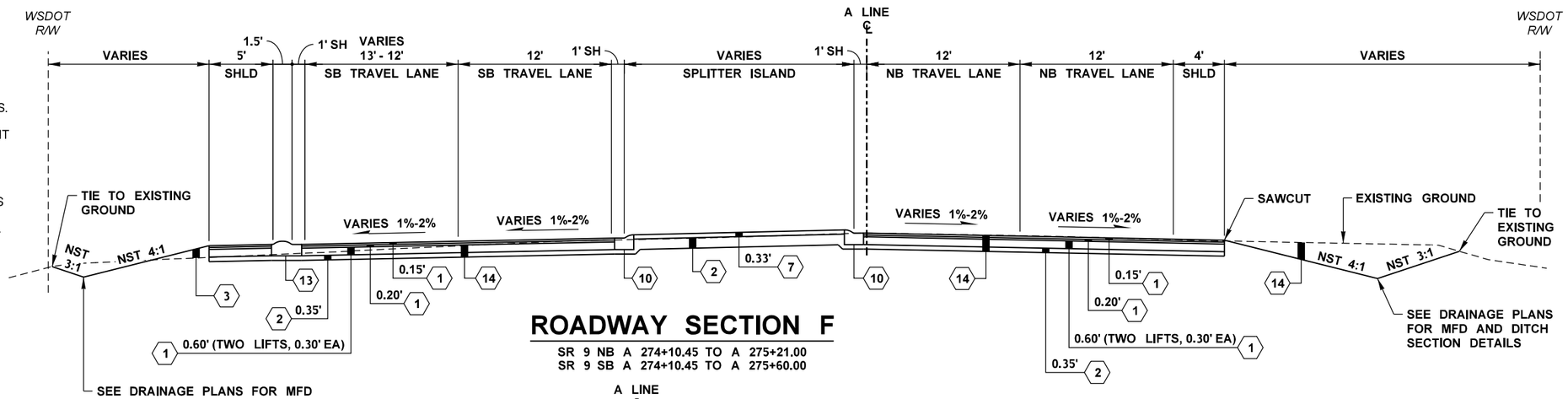
ROADWAY SECTIONS

PLAN REF NO RS07

SHEET OF SHEETS

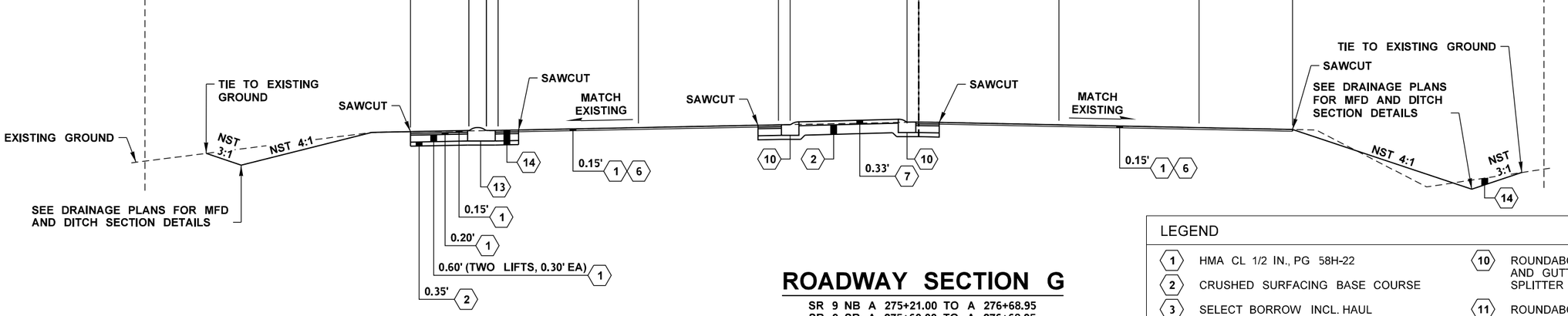
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION F

SR 9 NB A 274+10.45 TO A 275+21.00
SR 9 SB A 274+10.45 TO A 275+60.00



ROADWAY SECTION G

SR 9 NB A 275+21.00 TO A 276+68.95
SR 9 SB A 275+60.00 TO A 276+68.95

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	CEMENT CONC. PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	BALLAST
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

FILE NAME	c:\pw_workIng\wastate\p0024020\dms08802\Stage_3_Y-11834_PS_RS_08.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
TIME	4:17:01 PM					10	WASH	
DATE	4/30/2021					JOB NUMBER		
PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 47762 — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

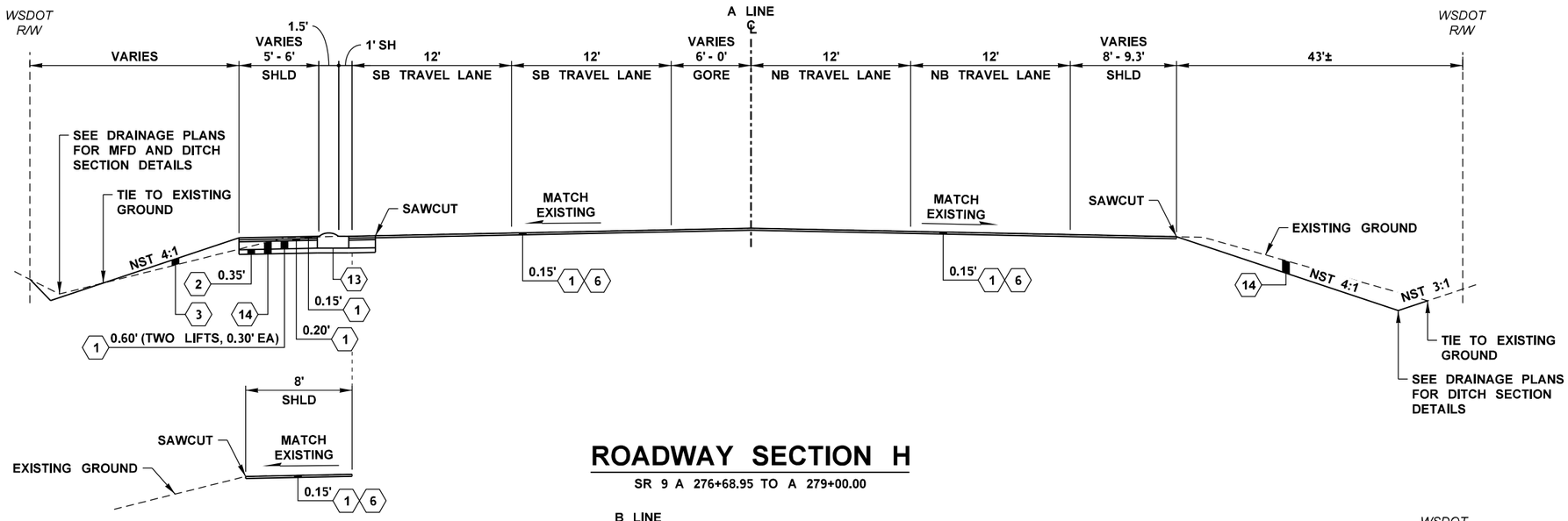
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO
RS08
SHEET
OF
SHEETS

GENERAL NOTES:

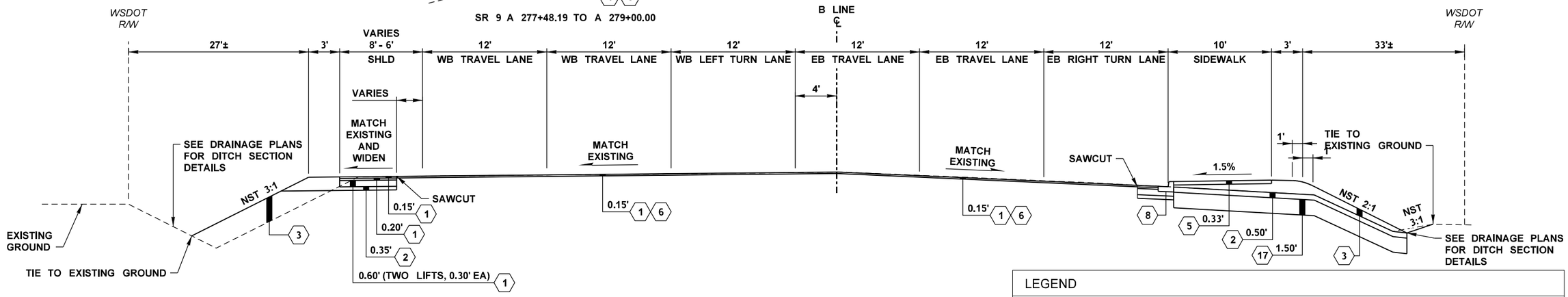
1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION H

SR 9 A 276+68.95 TO A 279+00.00

SR 9 A 277+48.19 TO A 279+00.00



ROADWAY SECTION I

SR 204 B 121+15.00 TO B 123+52.57

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	CEMENT CONC. PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	BALLAST
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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TIME	4:17:12 PM					JOB NUMBER		
DATE	4/30/2021							
PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN							
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD					CONTRACT NO.		LOCATION NO.
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 22782 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

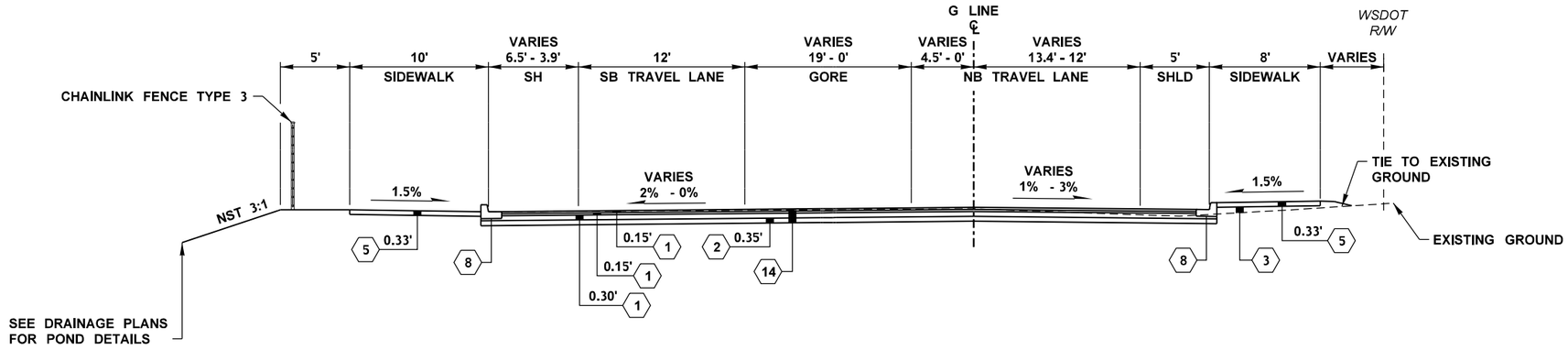
ROADWAY SECTIONS

PLAN REF NO RS09

SHEET OF SHEETS

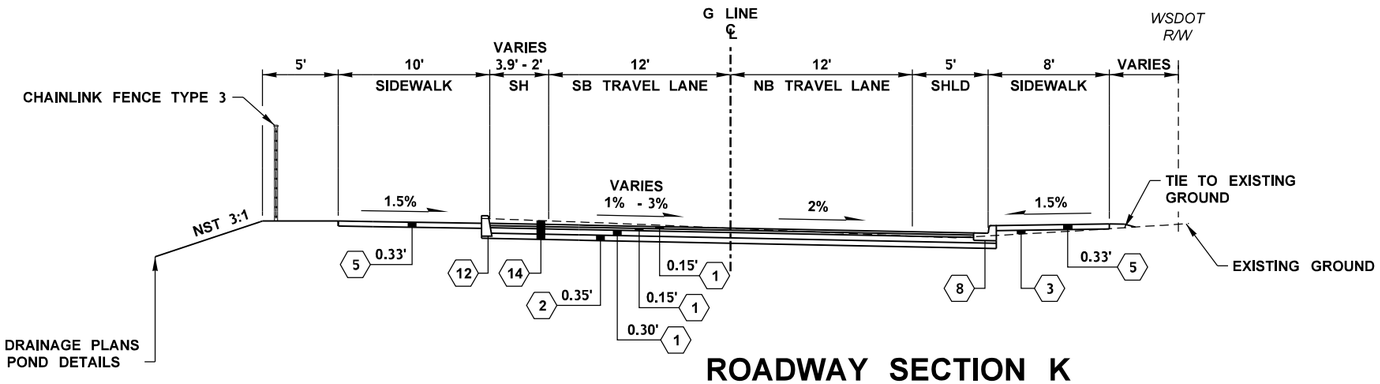
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



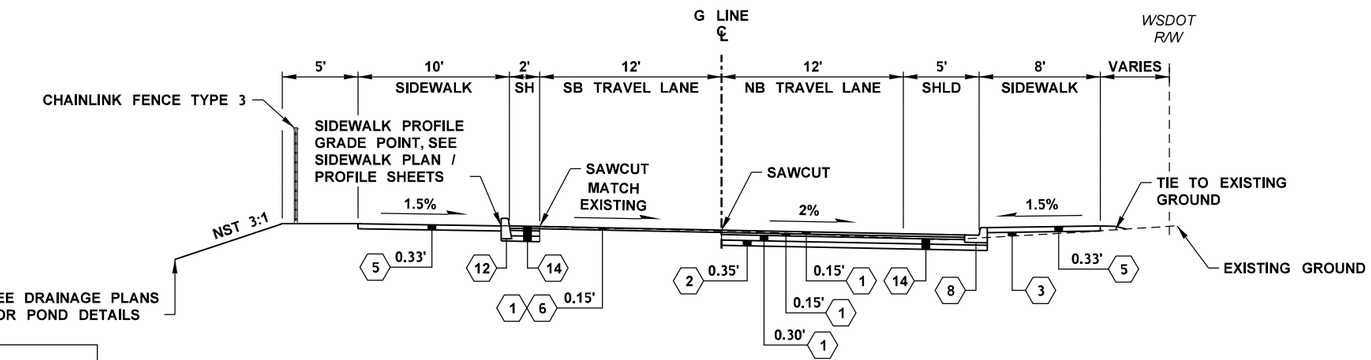
ROADWAY SECTION J

FRONTAGE RD G 10+34.69 TO G 11+80.00



ROADWAY SECTION K

FRONTAGE RD G 11+80.00 TO G 12+10.87



ROADWAY SECTION L

FRONTAGE RD G 12+10.87 TO G 13+52.88

LEGEND

1	HMA CL 1/2 IN., PG 58H-22
2	CRUSHED SURFACING BASE COURSE
3	SELECT BORROW INCL. HAUL
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)
5	CEMENT CONC. SIDEWALK
6	PLANING BITUMINOUS PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS
8	CEMENT CONC. TRAFFIC CURB AND GUTTER
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER
10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
12	CEMENT CONC. TRAFFIC CURB
13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
14	ROADWAY EXCAVATION INCL. HAUL
15	CEMENT CONC. PAVEMENT
16	HMA FOR PRELEVELING CL. 1/2 IN. PG
17	BALLAST

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

FILE NAME	c:\pw_workIng\wastate\p0024020\dms08802\Stage_3_Y-11834_PS_RS_10.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
TIME	4:17:24 PM					10	WASH	
DATE	4/30/2021					JOB NUMBER		
PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

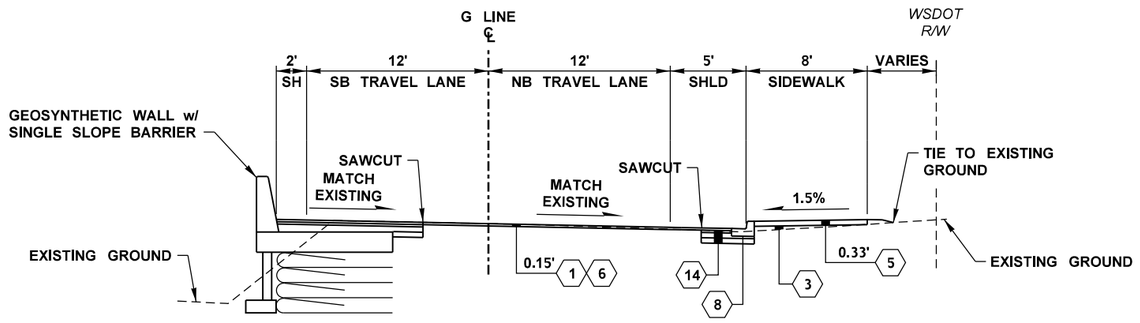
ROADWAY SECTIONS

PLAN REF NO RS10

SHEET OF SHEETS

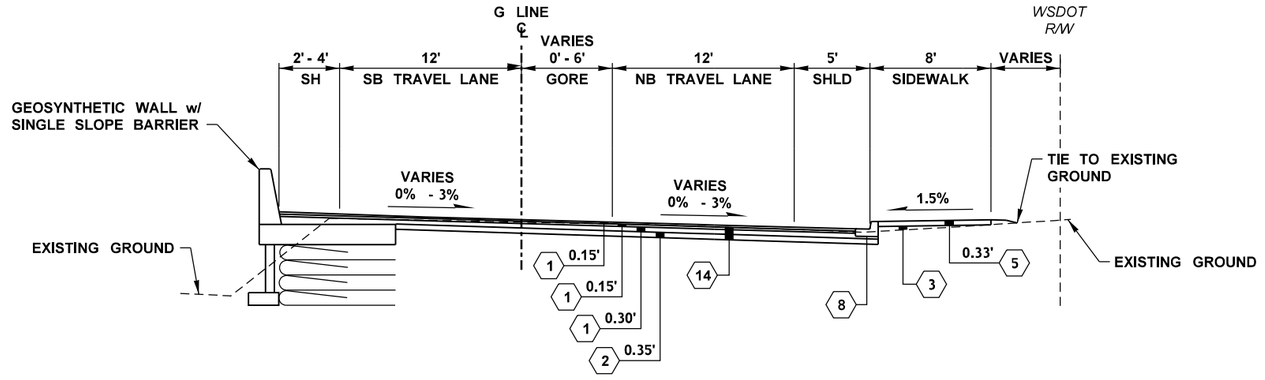
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION M

FRONTAGE RD G 13+52.88 TO G 14+59.41



ROADWAY SECTION N

FRONTAGE RD G 14+59.41 TO G 15+56.41

LEGEND

1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE		
3	SELECT BORROW INCL. HAUL	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	12	CEMENT CONC. TRAFFIC CURB
5	CEMENT CONC. SIDEWALK	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
6	PLANING BITUMINOUS PAVEMENT	14	ROADWAY EXCAVATION INCL. HAUL
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	15	CEMENT CONC. PAVEMENT
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	16	HMA FOR PRELEVELING CL. 1/2 IN. PG
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER	17	BALLAST

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN STATE OF WASHINGTON 47624 REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

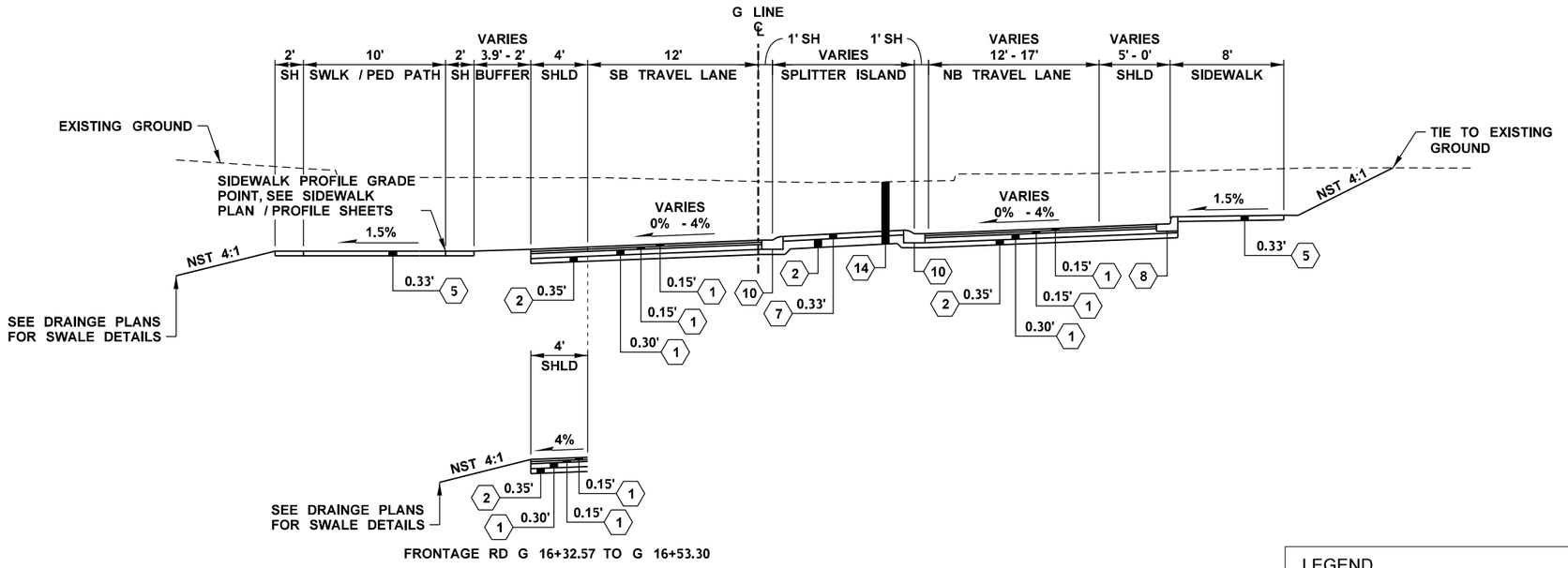
ROADWAY SECTIONS

PLAN REF NO
RS11

SHEET
OF
SHEETS

GENERAL NOTES:

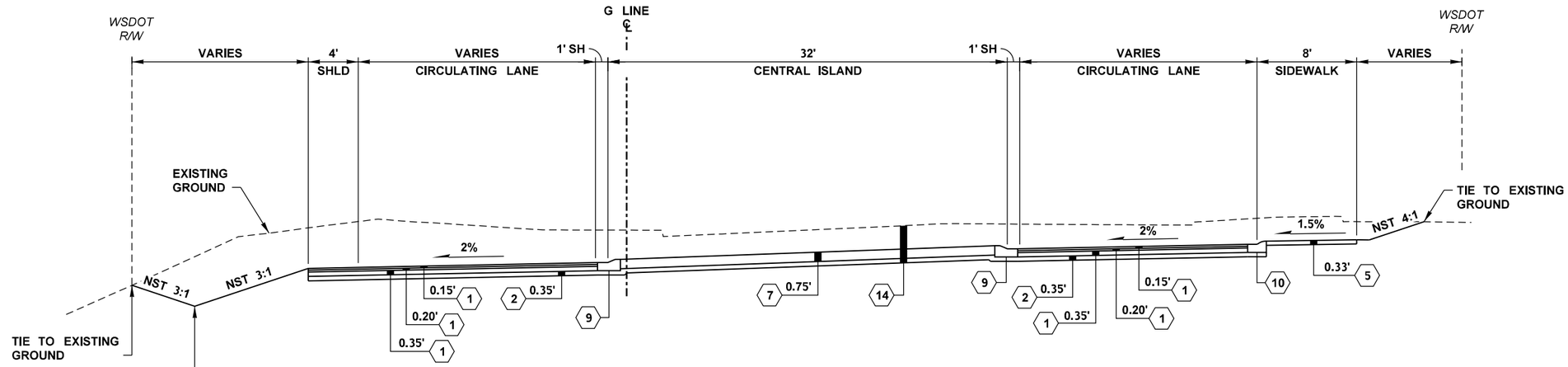
1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



FRONTAGE RD G 16+32.57 TO G 16+53.30

ROADWAY SECTION O

FRONTAGE RD G 15+59.91 TO G 16+53.30



ROUNDABOUT SECTION - VERNON/DAVIES

SOUTHWEST | NORTHEAST

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

LEGEND

1. HMA CL 1/2 IN., PG 58H-22
2. CRUSHED SURFACING BASE COURSE
3. SELECT BORROW INCL. HAUL
4. PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)
5. CEMENT CONC. SIDEWALK
6. PLANING BITUMINOUS PAVEMENT
7. TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS
8. CEMENT CONC. TRAFFIC CURB AND GUTTER
9. ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER
10. ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
11. ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
12. CEMENT CONC. TRAFFIC CURB
13. SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
14. ROADWAY EXCAVATION INCL. HAUL
15. CEMENT CONC. PAVEMENT
16. HMA FOR PRELEVELING CL. 1/2 IN. PG
17. BALLAST

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DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 47628 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

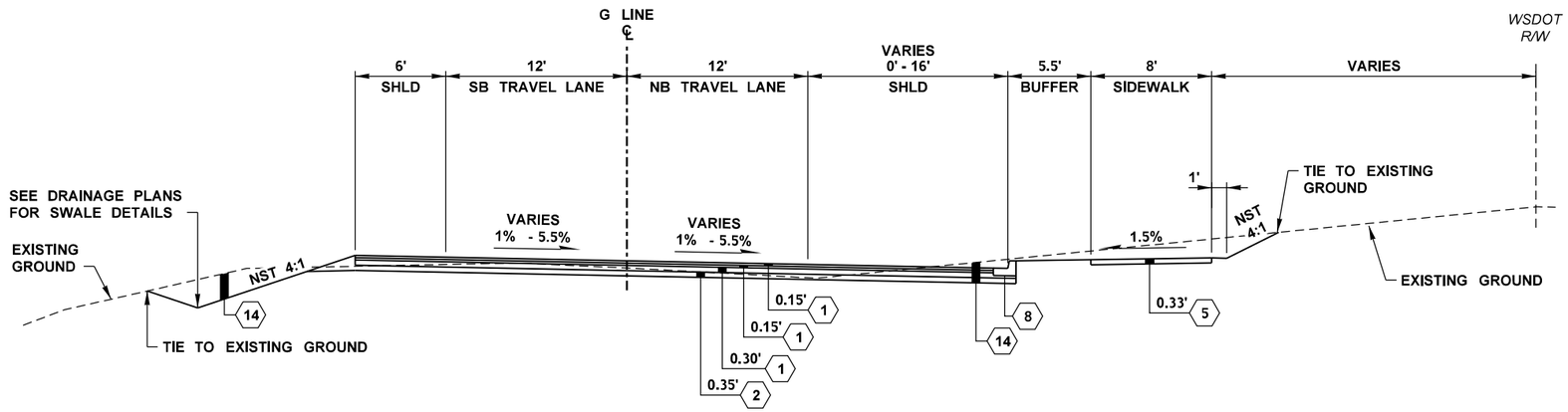
ROADWAY SECTIONS

PLAN REF NO RS12

SHEET OF SHEETS

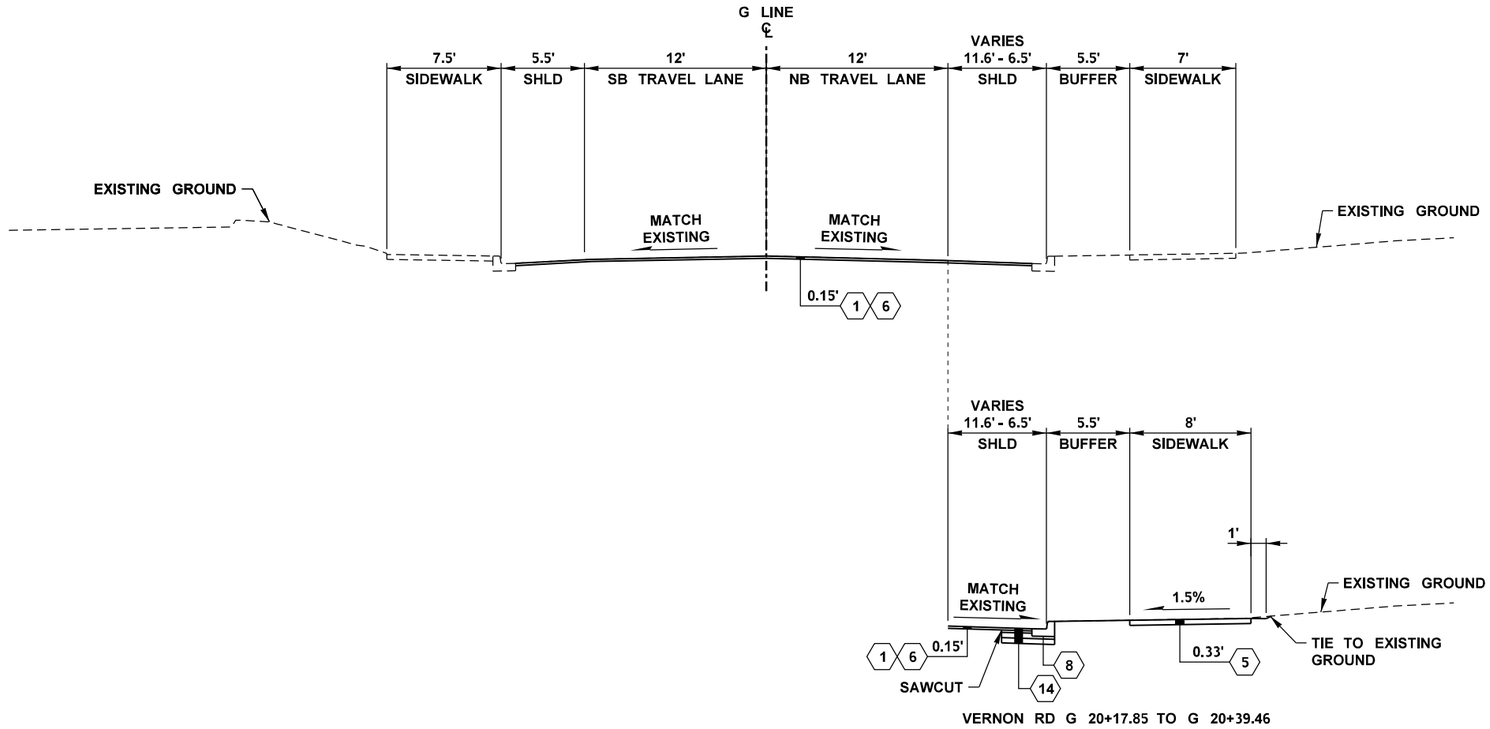
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



ROADWAY SECTION P

VERNON RD G 17+24.45 TO G 20+17.85



ROADWAY SECTION Q

VERNON RD G 20+17.85 TO G 21+16.77

VERNON RD G 20+17.85 TO G 20+39.46

LEGEND

1	HMA CL 1/2 IN., PG 58H-22
2	CRUSHED SURFACING BASE COURSE
3	SELECT BORROW INCL. HAUL
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)
5	CEMENT CONC. SIDEWALK
6	PLANING BITUMINOUS PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS
8	CEMENT CONC. TRAFFIC CURB AND GUTTER
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER
10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
12	CEMENT CONC. TRAFFIC CURB
13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
14	ROADWAY EXCAVATION INCL. HAUL
15	CEMENT CONC. PAVEMENT
16	HMA FOR PRELEVELING CL. 1/2 IN. PG
17	BALLAST

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 47024 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

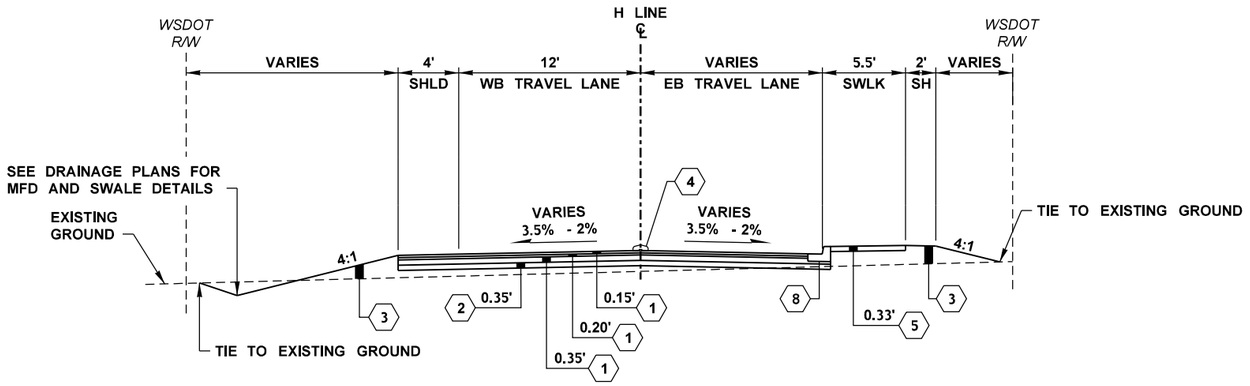
ROADWAY SECTIONS

PLAN REF NO RS13

SHEET OF SHEETS

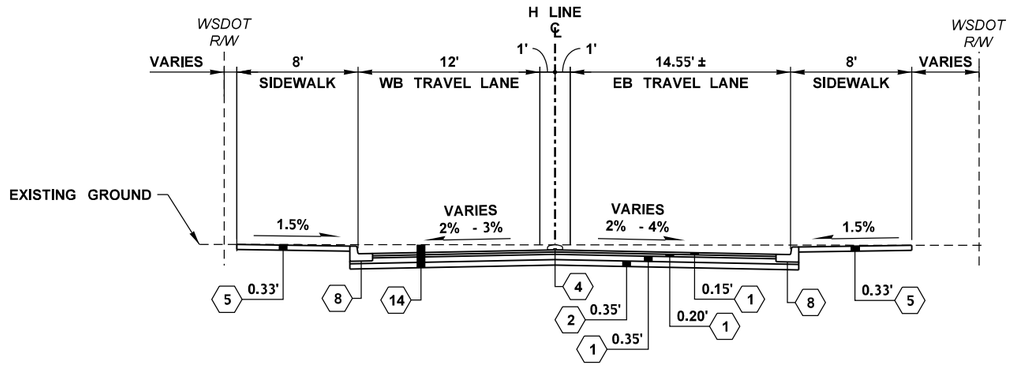
GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
9. SOIL PREPARATION FOR SEEDING AND PLANTING AREAS SHALL OCCUR IMMEDIATELY AFTER FINAL GRADING IS COMPLETE. SEE SOIL PREPARATION PLANS FOR DETAILS.
10. GRADES, SPLITTER ISLANDS, SHOULDER WIDTHS ARE SHOWN ON ROADWAY SECTIONS SHEETS AS TYPICAL TO SHOW MATERIAL AND CONSTRUCTION. SEE PAVING SHEETS FOR LOCATIONS, WIDTHS, AND GRADES.



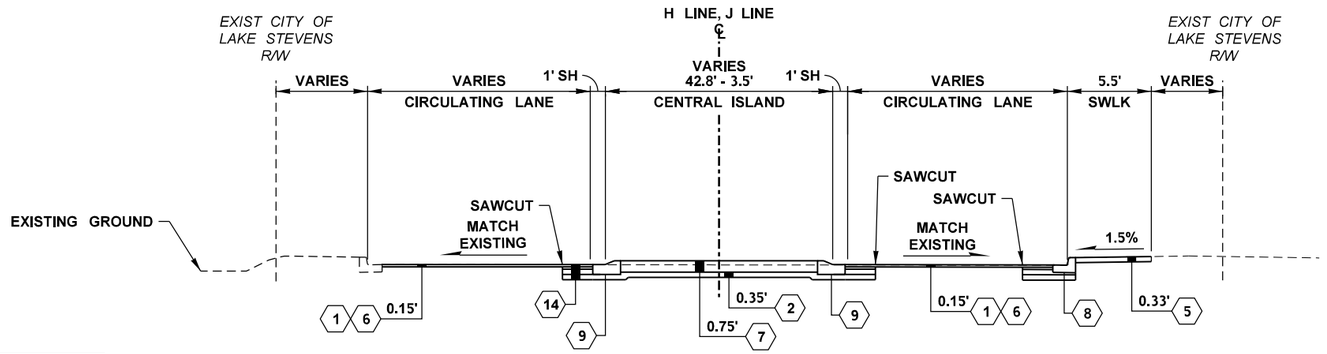
ROADWAY SECTION R

VERNON RD H 26+85.65 TO H 28+58.05
SEE SR9 / VERNON ROUNDABOUT SECTION, RS07 FOR ROUNDABOUT SECTION



ROADWAY SECTION S

N DAVIES RD H 32+07.50 TO H 32+43.98



ROUNDABOUT SECTION - VERNON/91ST AVE NE

SOUTHWEST | NORTHEAST

100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

LEGEND

1. HMA CL 1/2 IN., PG 58H-22
2. CRUSHED SURFACING BASE COURSE
3. SELECT BORROW INCL. HAUL
4. PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)
5. CEMENT CONC. SIDEWALK
6. PLANING BITUMINOUS PAVEMENT
7. TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS
8. CEMENT CONC. TRAFFIC CURB AND GUTTER
9. ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER
10. ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
11. ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
12. CEMENT CONC. TRAFFIC CURB
13. SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
14. ROADWAY EXCAVATION INCL. HAUL
15. CEMENT CONC. PAVEMENT
16. HMA FOR PRELEVELING CL. 1/2 IN. PG
17. BALLAST

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PLOTTED BY	p0024020						
DESIGNED BY	Z. BROWN						
ENTERED BY	K. MCWILLIAMS					CONTRACT NO.	LOCATION NO.
CHECKED BY	R. HOWARD						
PROJ. ENGR.	K. NDILE						
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY		

ZACHARY R. BROWN — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO RS14

SHEET OF SHEETS

GENERAL NOTES:

1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING AS SHOWN.
6. SEE SITE PREPARATION PLANS FOR SAWCUT LOCATIONS.
7. FOR INTERSECTION DETAILS, SEE PAVING AND PAVEMENT MARKING PLANS.
8. SEE WALL PLANS FOR RETAINING WALL DESIGN.
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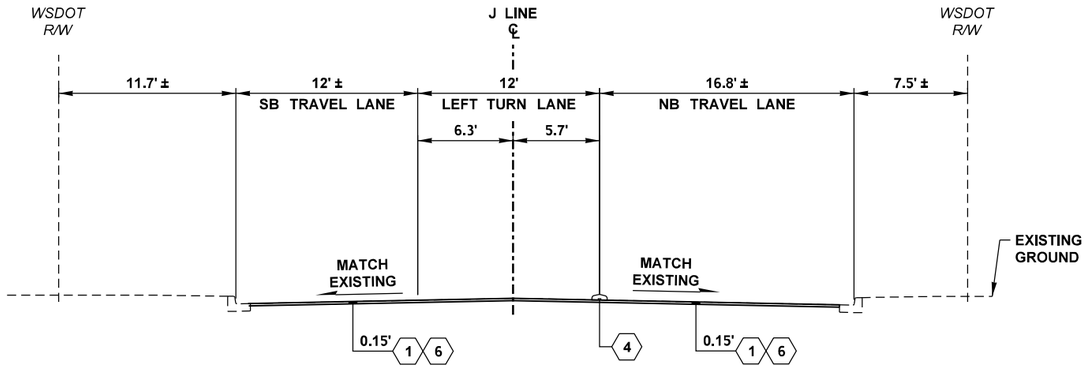
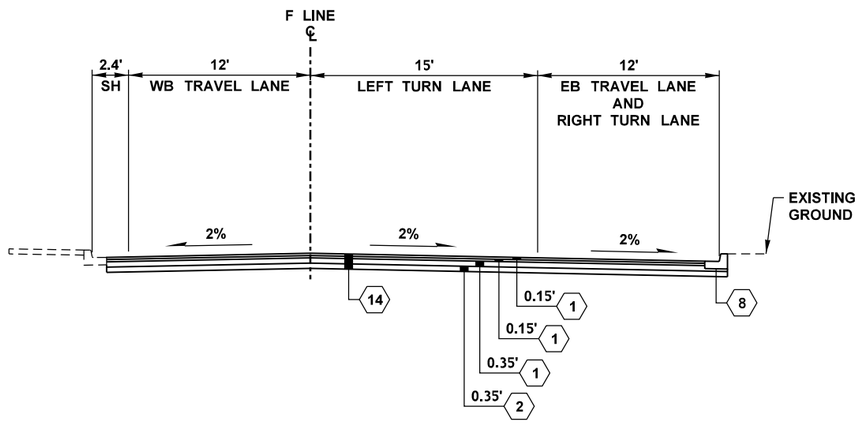


ROADWAY SECTION T

91ST AVE J 30+73.79 TO J 33+13.16



ROADWAY SECTION U

7TH PL NE F 71+95.11 TO F 72+53.85

LEGEND

1	HMA CL 1/2 IN., PG 58H-22
2	CRUSHED SURFACING BASE COURSE
3	SELECT BORROW INCL. HAUL
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)
5	CEMENT CONC. SIDEWALK
6	PLANING BITUMINOUS PAVEMENT
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS
8	CEMENT CONC. TRAFFIC CURB AND GUTTER
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER
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12	CEMENT CONC. TRAFFIC CURB
13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED)
14	ROADWAY EXCAVATION INCL. HAUL
15	CEMENT CONC. PAVEMENT
16	HMA FOR PRELEVELING CL. 1/2 IN. PG
17	BALLAST

100% DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DATE	4/30/2021					JOB NUMBER		
PLOTTED BY	p0024020							
DESIGNED BY	Z. BROWN					CONTRACT NO.		LOCATION NO.
ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 57703 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

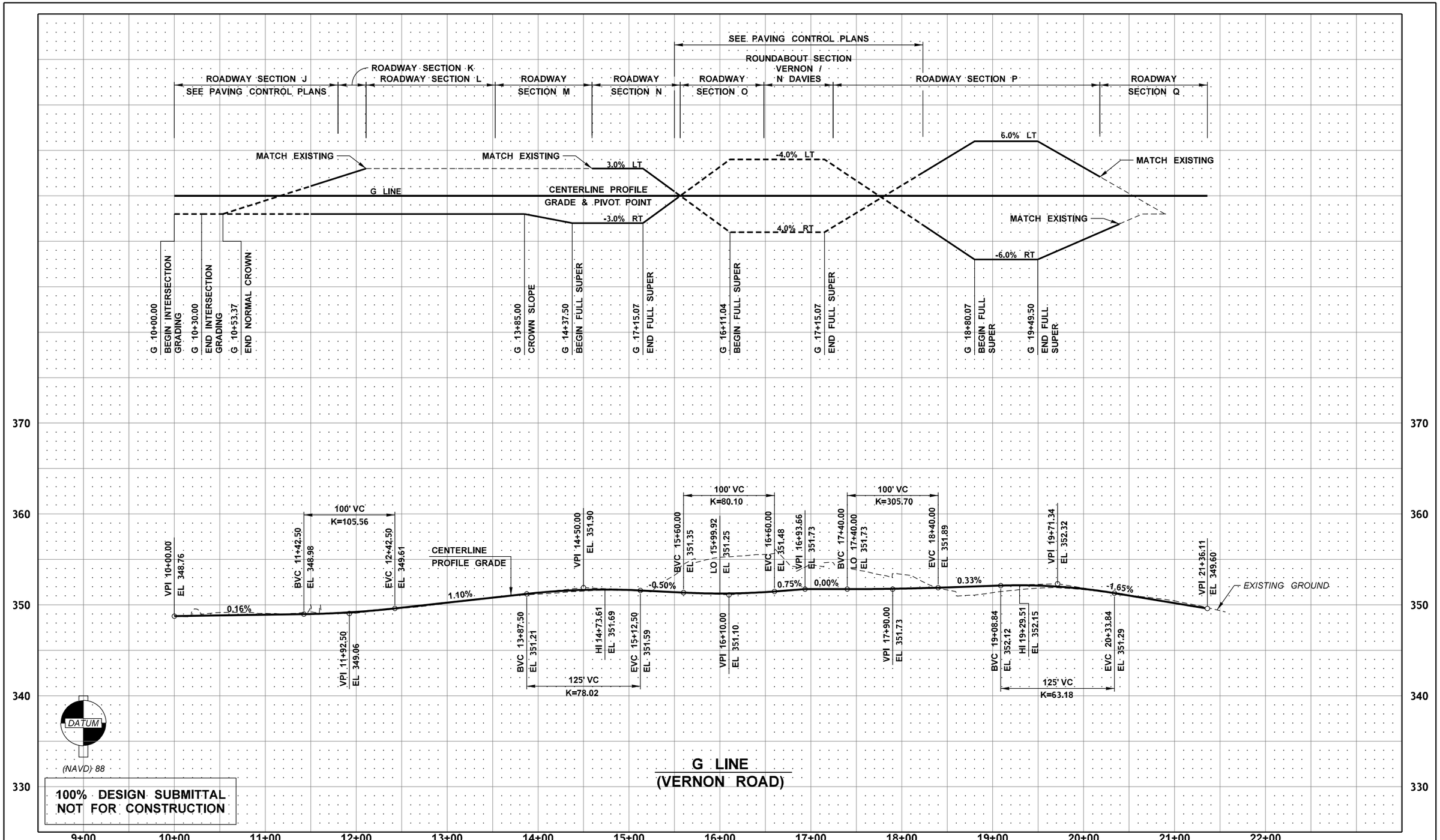
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO
RS15

SHEET
OF
SHEETS



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PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER

DATE

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PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY PROFILE

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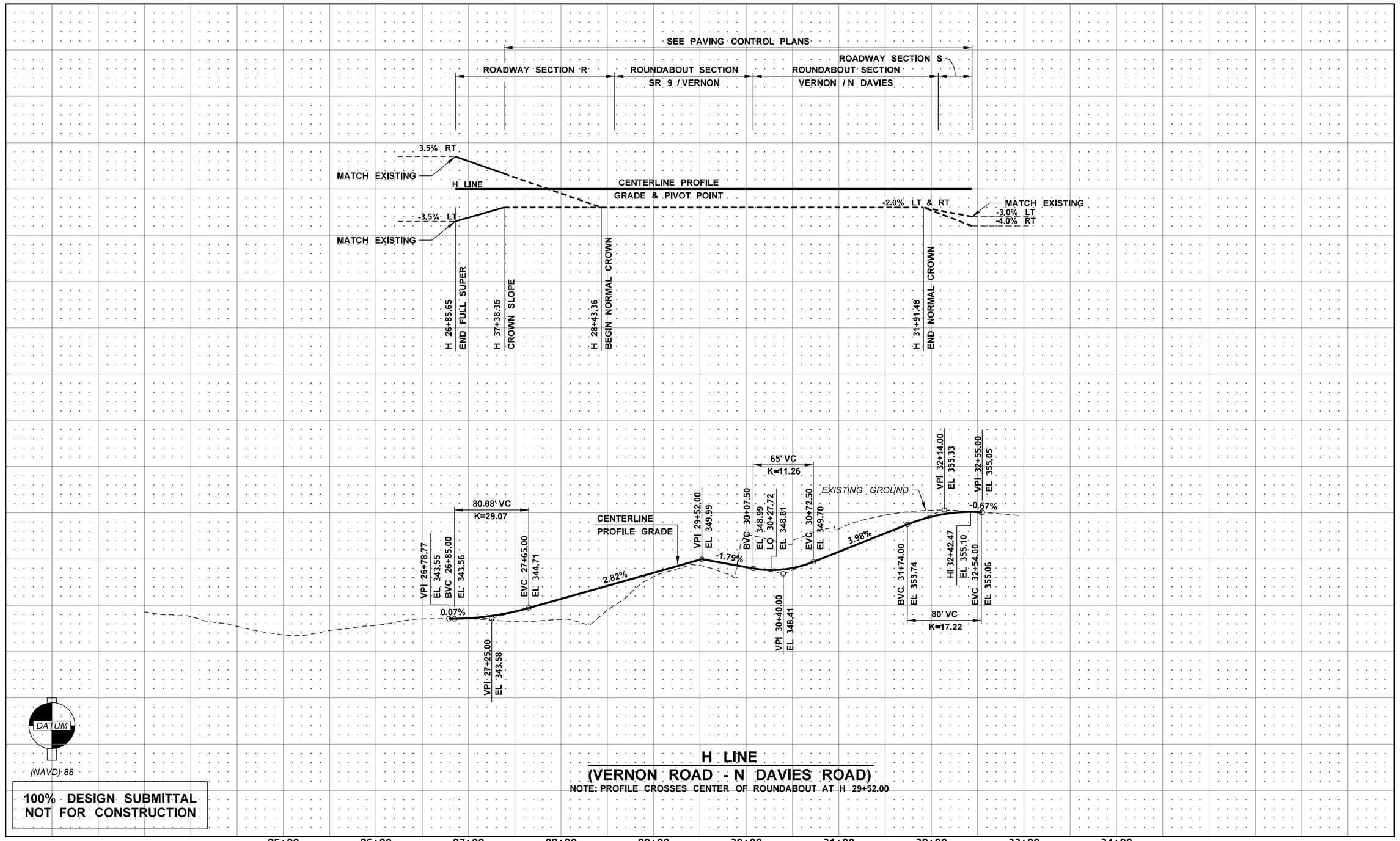

H LINE
(VERNON ROAD - N DAVIES ROAD)

NOTE: PROFILE CROSSES CENTER OF ROUNDABOUT AT H 29+52.00

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NOT FOR CONSTRUCTION

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CHECKED BY	H. VENNA							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN — STATE OF WASHINGTON — 47628 — REGISTERED PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY PROFILE

PLAN REF NO
RP02

SHEET
OF
SHEETS

SR 9 GORE AREA
SEE PV SHEETS

SINGLE LANE
NORTHBOUND

DEVELOPMENT OF
SOUTHBOUND LANE

DRIVEWAY
SEE PV SHEETS

E LINE

CENTERLINE PROFILE
GRADE & PIVOT POINT

1.5% LT

-1.5% RT

VPI 10+00.00
EL 357.47

-1.04%

VPI 11+30.58
EL 356.11

CENTERLINE
PROFILE GRADE

EXISTING GROUND

-1.18%

VPI 16+96.67
EL 349.43

370
360
350
340
330

10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00

DATUM

(NAVD) 88

100% DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

E LINE
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PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

ZACHARY R. BROWN
STATE OF WASHINGTON
21528
REGISTERED
PROFESSIONAL ENGINEER

DATE

P.E. STAMP BOX

PARSONS

Washington State
Department of Transportation

SR 9
SR 204 INTERSECTION
IMPROVEMENTS (STAGE 3)

ROADWAY PROFILE

PLAN REF NO
RP03

SHEET
OF
SHEETS

APPENDIX G

TRAFFIC ANALYSIS

PARSONS

SPECIFICATION/REPORT CHECK PRINT

COVER SHEET

Contract Package	648774 – SR 9/SR 204 Intersection Improvement Project
Title	Transportation Impact Discipline Report
Phase	4.4

ACTION	NAME (First Initial, Last Name)	DATE
Originated by:	N. Chan, W. Lisska, C. Kwan	6/1/17
Checked by:	M. Hayashi	10/5/17
Corrected by:	C. Kwan, N Chan	10/24/17
Reviewed by:	D. Grayuski	10/25/17
Corrected by:	C. Kwan & N. Chan	11/30/17
Verified by:	M. Hayashi	
Checked by:	M. Gavino	1/14/18
Response by:	C. Kwan, D. Dye, & N. Chan	9/19/19
Verified by:	J. Pierson, A. Davis, D. Grayuski	9/23/19

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SR 9/SR 204 Intersection Improvement Project

Transportation Impact Discipline Report

(9/2018)

WSDOT
Washington State
Department of Transportation
15700 Dayton Avenue N
Shoreline WA 98133-9710

Submitted by:
PARSONS

Prepared by:
FEHR & PEERS

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SR 9/SR 204 Intersection Improvements

TRANSPORTATION IMPACT DISCIPLINE REPORT

Agreement No. 14-034

FINAL

September 2018

The SR 9/SR 204 Intersection Improvements Project is an effort between the Washington State Department of Transportation (WSDOT), and Parsons Transportation Group, Inc. To conduct this project, WSDOT contracted with:

Parsons Transportation Group, Inc.

600 University Street
Suite 700
Seattle, WA 98101

In association with:

Confluence
Fehr & Peers
Lin & Associates
Osborn
Perteet
PRR
Shannon & Wilson
Traffic Data Gathering

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WSDOT

Transportation Impact Discipline Report

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APPENDICES

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ADT	average daily traffic
CT	Community Transit route indicator
FGTS	Freight and Goods Transportation System
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HSM	Highway Safety Manual
HSS	highway of statewide significance
LOS	level of service
MEV	million entering vehicles
mph	miles per hour (speed)
MVMT	million vehicle miles of travel
O-D	origin-destination
PSRC	Puget Sound Regional Council
SAG	Stakeholder Advisory Group
SnoCo Model	Snohomish County Travel Demand Model
SR	State Route
State	State of Washington
TIP	Transportation Improvement Program
WSDOT	Washington State Department of Transportation

DEFINITIONS

Access/accessibility	The ability to reach desired goods, services, activities, and destinations via entry/exit points along a transportation network
Arterial	A major street that primarily serves through traffic but also provides access to abutting properties and destinations. Arterials are often divided into principal and minor classifications depending on the number of lanes, connections made, volume of traffic, nature of traffic, speeds, intersection frequency, and length.
Capacity	The maximum sustained traffic flow of a roadway under prevailing conditions in a specified direction.
Congestion	For a corridor, the condition when unstable traffic flows constrain travel speeds to less than the posted limit. Recurring corridor congestion is caused by constant excess traffic volume compared with the highway's capacity. Non-recurring corridor congestion is caused by unusual or unpredictable events such as traffic accidents. For an intersection, the condition when demand at one or more movements at the intersection is greater that the processing capacity of that control scheme. Sustained periods of higher demand than capacity will cause delay and queuing at a given approach.
Delay	The increased travel time experienced because of circumstances that impede the desirable movement of traffic.
Demand	The desire for travel by potential users of the transportation system. Often identified at a specific location or along a specific route.
Emergency vehicle	Any vehicle used to responding to an incident or collision, such as police, fire department, ambulance, maintenance, and towing vehicles.
EMME	A travel demand forecasting software package used by the PSRC and Snohomish County to develop their travel demand modeling platforms.
Jurisdiction	A municipal government agency, such as a city or county, and as appropriate, federal and state agencies and federally recognized tribes. Can also mean "to have authority over."
Level of service	A measure of how well a freeway or intersection operates. For freeways, it is a measure of traffic congestion typically based on vehicle volume-to-capacity and density calculations. For intersections, it is based on how long it takes a typical vehicle to clear the intersection. Typically reported as a letter grade from A to F. Industry standard thresholds are described in the *Highway Capacity Manual*.
Measure of effectiveness	An indicator or criterion used to assess how a transportation system performs.

Mobility	The efficient movement of people or goods from place to place.
Modeling	The use of statistics and mathematical equations to simulate and/or predict real events, processes, and probable outcomes.
Non-motorized	Bicycle, pedestrian, and other modes of transportation not involving a motor vehicle.
Peak direction	The direction of roadway travel with the highest demand for a given period of time.
Peak hour	The hour in the morning or in the afternoon when the maximum demand for travel occurs on a given transportation facility, often due to commuting schedules.
Person trips	The number of persons that pass through a section of roadway during a given time period, including passenger cars, bicyclists, and transit riders. For example, one vehicle carrying four people comprises four person trips.
Puget Sound Regional Council (PSRC)	The Metropolitan Planning Organization (MPO) and Regional Transportation Planning Organization (RTPO) for the counties of King, Snohomish, Pierce, and Kitsap.
Queue	A line of vehicles waiting to move through an access point on a roadway, such as a signal or turn lane.
State Environmental Policy Act (SEPA)	Washington State legislation adopted in 1974, that establishes an environmental review process for all development proposals and major planning studies prior to taking any action. SEPA includes early coordination to identify and mitigate any substantial issues or significant effects that may result from a project or study.
Throughput	The number of vehicles or persons being carried on a transportation facility. Usually measured at a specific point on the roadway facility for a predetermined period of time.
Travel demand forecasting	Methods for estimating the desire for travel by potential users of the transportation system, including the number of travelers, the time of day, travel mode, and travel routes.
Vehicle	Any car, truck, van, motorcycle, or bus designed to carry passengers and/or goods. Bicycles and other pedestrian-oriented vehicles (e.g. mobility aids, compact personal transporter) are not included in this definition.
Vehicle trips	The number of vehicles that pass a section of roadway over a given period of time.

Vissim	A traffic analysis software package used for the modeling and simulation operation of the transportation system and its elements.
VISUM	A travel demand forecasting software package often used to develop routing inputs for Vissim.

SECTION 1. EXECUTIVE SUMMARY

The Washington State Department of Transportation (WSDOT) is proposing to construct the SR 9/SR 204 Intersection Improvements Project to improve traffic operations at this intersection in the City of Lake Stevens. This discipline report assesses the project's operational and construction effects on transportation. This report documents the evaluation of a No Build Alternative and twelve Build Alternatives and notes the selection of the Preferred Alternative.

1.1 INTRODUCTION

The purpose of this document is to evaluate the twelve Build Alternatives compared to the No Build Alternative of the SR 9/SR 204 Intersection Improvements Project located in Lake Stevens (**Figure 1-1**).

The scope of this report covers the analysis methodology, affected environment, and potential effects of the Build Alternatives. The outline is as follows:

- Section 1 Executive Summary
- Section 2 Introduction
- Section 3 Methodology and Coordination
- Section 4 Affected Environment
- Section 5 Potential Effects

The appendix provides more detailed information relating to the analysis of the project, as well as a list of data referenced. The organization of this report is similar to the WSDOT Transportation Impact Discipline Report Checklist. The purpose and need statement of this project focuses on improvements to shorten travel times for commuters and between adjacent businesses during peak commute hours, lower the serious and fatal crash rate at the intersection, and improve access to businesses. More detailed information on the baseline and contextual needs for this project is included in **Appendix A**.

This report documents the analysis completed for this project through September 2018. Upon further study, the construction costs for the preferred alternative (Modified Tight Diamond) in this report were estimated to exceed the project budget. A supplemental TIDR (September 2019) documents analysis of more two new at-grade alternatives developed by the project team with a refined analysis methodology. The supplemental TIDR documents the At-Grade Roundabouts alternative as the final Preferred Alternative.

1.1.1 Study Area

The study area for the SR 9/SR 204 Intersection Improvements Project includes the segment of SR 204 from Lundeen Parkway to SR 9 and the segment of SR 9 from Market Place NE to Lundeen Parkway. The study area was chosen to include adjacent intersections and local streets that may be affected by the improvements to the SR 9/SR 204 intersection. The extent of the study area was also defined through community engagement/stakeholder outreach, which included project open houses, workshops, mailings, and door-to-door outreach. Stakeholders included neighborhood and local business interests, the freight community, the City of Lake Stevens, property owners, and the general traveling public. The

final study area is consistent with Project goals; provides the ability to address issues and questions critical to the stakeholders, State, and elected officials; and informs the environmental documentation process. A map detailing the study area and study intersections is shown in **Figure 1-2**.

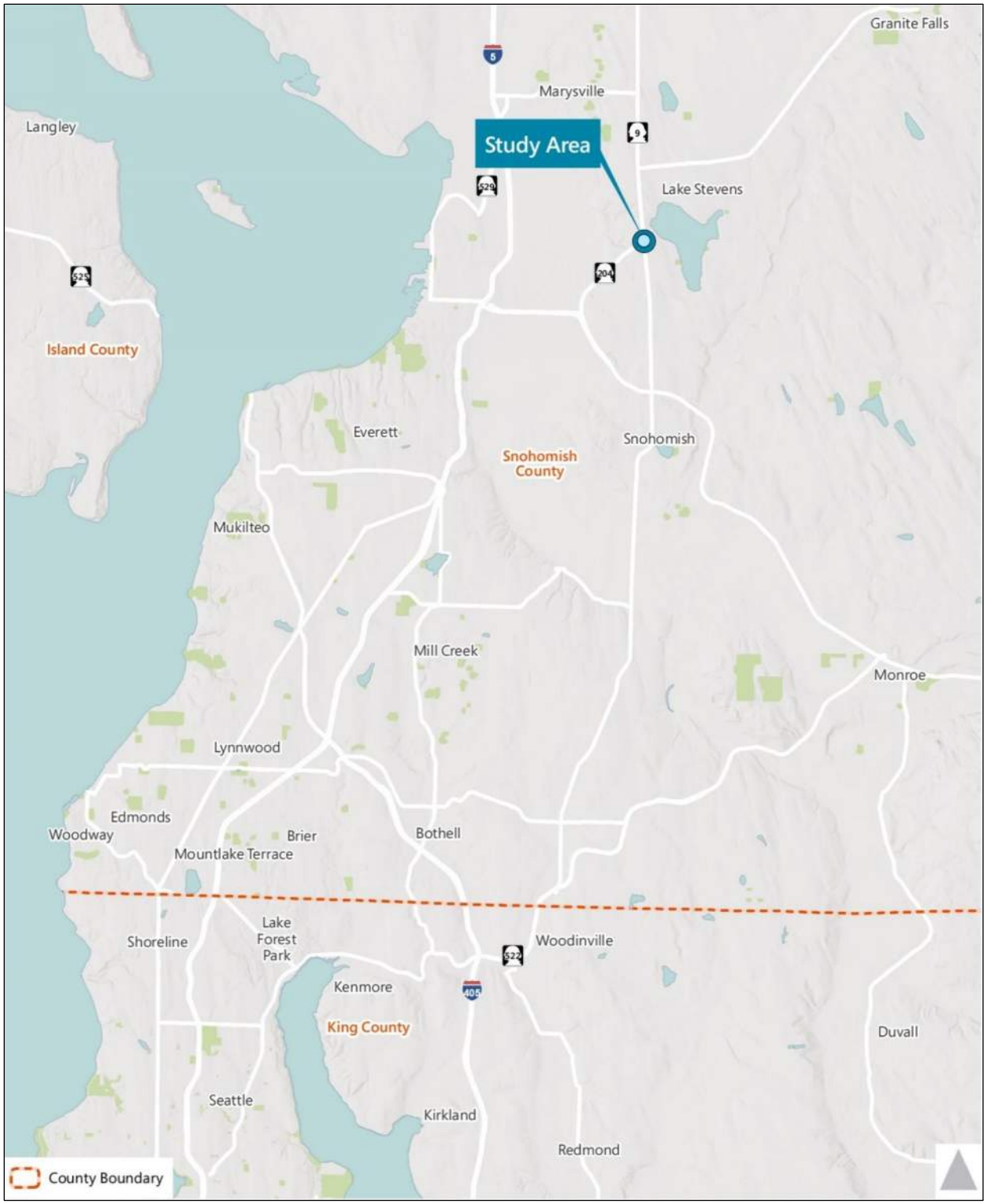

Figure 1-1. Regional Map

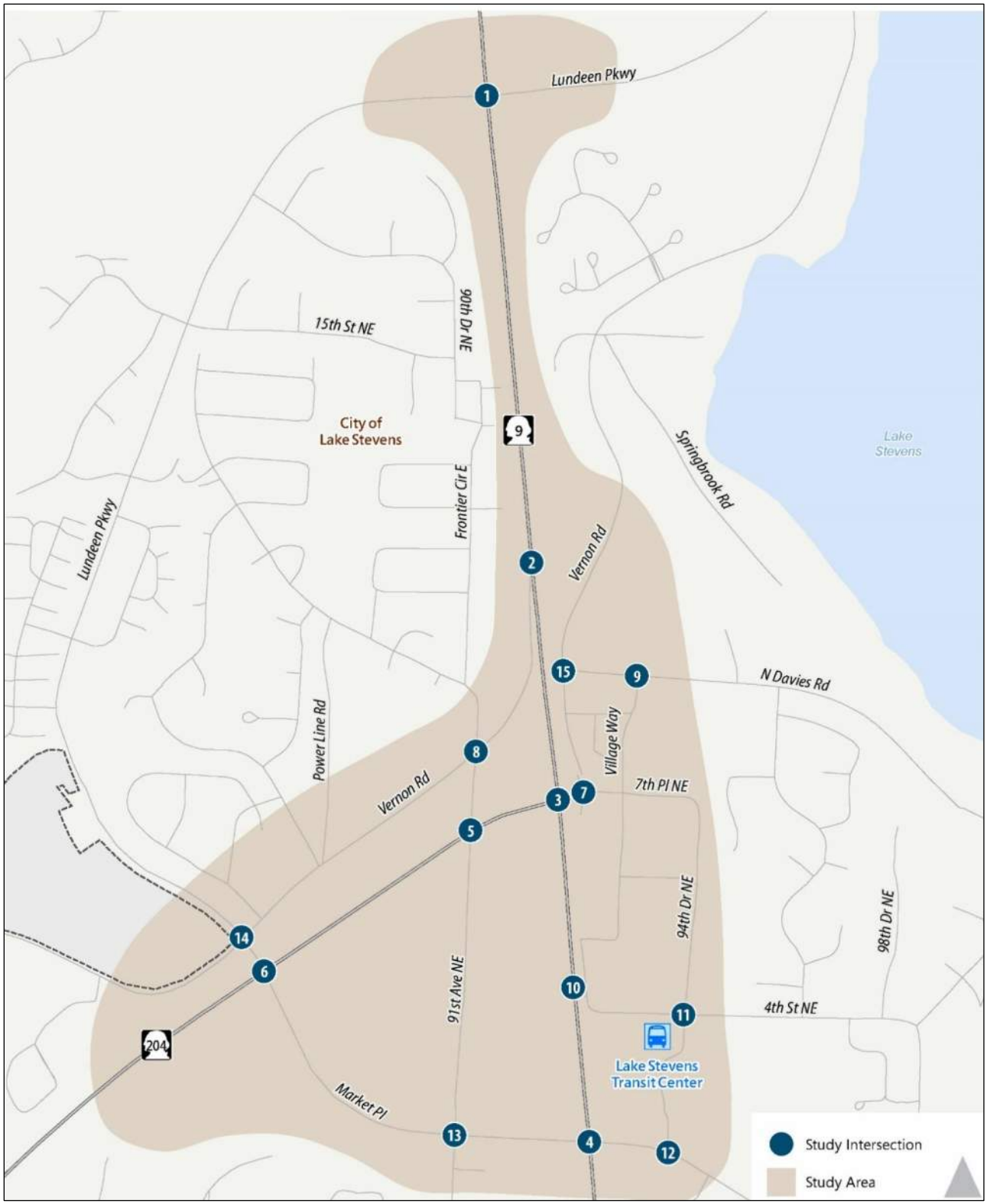

Figure 1-2. Study Area and Study Intersections

1.2 EXISTING TRANSPORTATION CONDITIONS

The roadway network in the study area consists of two state highways: SR 9 and SR 204, as well as local arterials and collector streets. Both SR 9 and SR 204 are "partial control limited access highways," as defined by WSDOT[1]. During peak commute hours, long queues and delays are observed along minor east-west approaches of SR 9. The combination of increased residential and commercial development in the study area and beyond, reliance on vehicle travel, inadequate road network design and connectivity, among others, contributes to the ongoing recurring congestion and long queues on study area roadways during peak commute periods. On-street parking along the roadway network is limited, but some parking is available along Vernon Road (between Lundeen Parkway and 91st Avenue NE) and N Davies Road.

Some of the study area roadway segments are designated as truck routes under the Washington State Freight and Goods Transportation System (FGTS) and are classified by the annual tonnage carried on the segment. The FGTS classifications range from T2 roads (4 million to 10 million annual tons) such as SR 9, to T4 roads (100,000 to 300,000 annual tons), which apply to lower traveled roads such as Vernon Road west of SR 204.

Four Community Transit routes (routes 109, 209, 280, and 425) serve the area with primary access provided at the Lake Stevens Transit Center. While crosswalks are present at three of the four legs of the SR 9/SR 204 intersection, limited bicycle and pedestrian facilities throughout the study area result in few connections to the SR 9/SR 204 intersection by foot or by bicycle. While the existing wide shoulders of SR 9 and SR 204 could be used by people walking and biking through the area, there are relatively few controlled crossing opportunities along SR 9. Within the study area, the only crossings of SR 9 are at Lundeen Parkway, SR 204, and Market Place.

Existing transportation conditions are documented in **Section 4.** More detailed information is included in **Appendix D**.

1.3 BASELINE CONDITIONS

The analysis years for this project include an existing year (2016), opening year (2021), and design year (2040) as described in **Section 3**. The No Build Alternative serves as the baseline condition for the 2021 and 2040 analysis. This alternative was evaluated using the same project transportation network assumptions as the existing conditions analysis, with no changes in the transportation network to accommodate increased demand. In the No Build Alternative analysis, volumes were updated to reflect forecasted vehicle demand through the study area. Traffic congestion is expected to increase under the No Build Alternative due to this increased demand.

[1] A "partial control limited access highway" is a highway with at-grade intersections with selected permitted public roads. There may be some crossings and some driveway approaches at-grade. Direct commercial access is not permitted.

1.4 DEVELOPMENT OF ALTERNATIVES AND SELECTION OF THE PREFERRED ALTERNATIVE

The project needs were developed and agreed upon through a collaborative process. This process underwent several iterations to clearly define the needs identified by performance gaps, jurisdiction plans, stakeholder needs, and State requirements. As a result, qualitative metrics and measures were developed to evaluate the different alternative concepts. These metrics and measures included Safety; Mobility; Economic Vitality; Multimodal Opportunities; Commercial Space Impacted; Consistency with State, Regional, and Local Plans; and Visual Aesthetics. Through a two-step screening process, twelve Build Alternatives, including the Preferred Alternative, were developed and are further discussed in this report.

Figure 1-3 illustrates the alternatives development and screening process throughout the project. It should be noted that ten alternatives were initially studied in 2017, and then as a result of more detailed review by the Consultant team, additional alternatives were introduced at a later stage of the process in 2018. The two new alternatives included a modified Single Point Urban Interchange (SPUI), and a modification of the tight-diamond interchange (E2B Variation 4) where the two ramp traffic signals were combined into a single signalized intersection.

Figure 1-3. Alternatives Screening Process

A summary of the Build Alternatives evaluated in this two-step screening process is described in **Table 1-1**. The major theme for changes proposed in Build Alternatives was grade separation of SR 9 below SR 204 to construct a new interchange. Unless otherwise stated, all alternatives include a "Village Way" concept for a new north-south street through Frontier Village's parking lot from 4th Street NE to N Davies Road, this would create a new intersection with 7th Place NE. This would result in a cul-de-sac of Vernon Road at 7th Place NE and a cul-de-sac of 92nd Avenue NE at 7th Place NE, which reduces the number of legs at the SR 9/SR 204 intersection and could help simplify traffic operations. Access to businesses would be provided along Village Way and through parking lot aisles.

TABLE 1-1. OVERVIEW OF BUILD ALTERNATIVES

Build Alternative	Description
Alternative B	Three new roundabouts located at the following intersections: • Vernon Road/N Davies Road/SR 9 ramps (grade-separated from SR 9) • SR 9/SR 204 (grade-separated from SR 9 mainline) • SR 9/4th Street NE (at-grade with SR 9) Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative C	Alternative C is similar to the No Build Alternative where SR 9 and SR 204 intersection remains at-grade. There is an addition of a right-turn pocket from northbound SR 9 to 4th Street NE. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E	Alternative E consists of a new tight diamond interchange at the SR 9/SR 204 intersection where the SR 9 mainline is grade-separated below SR 204. The interchange has two signalized intersections at the SR 9 on/off-ramps. South of SR 204 there is an added travel lane in each direction on SR 9. North of SR 204 there is an added northbound lane to Lundeen Parkway on SR 9. This added northbound lane becomes the right-turn only lane at the Lundeen Parkway intersection. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E2A	Alternative E2A is a variation on Alternative E. SR 9 and SR 204 are grade-separated with a tight diamond interchange, however no lanes are added on SR 9. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E2B	SR 9 and SR 204 are grade-separated with a tight diamond interchange. Alternative E2B differs from Alternative E2A in that it adds travel lanes in both directions of SR 9 from south of SR 204 to approximately 1,000 feet south of the Market Place NE intersection. The added lane southbound begins from the new southbound SR 9 on-ramp from SR 204 to south of Market Place NE. The new northbound lane begins south of Market Place NE and transitions to the new northbound SR 9 off-ramp to SR 204. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E2B-V4	Alternative E2B-V4 is similar to E2B with grade separation of the two roadways under a proposed tight diamond interchange and is the only alternative that does not cul-de-sac Vernon Road. Village Way is not included. Therefore, access to Vernon Road is maintained at SR 9/SR 204.
Alternative E2C	Alternative E2C is similar to Alternative E2A except it includes a new crossing over SR 9 to connect N Davies Road east of SR 9 to Vernon Road west of SR 9. This alternative would not include the Village Way connector (the private drive aisle through the Frontier Village parking lot would remain). The new overpass connecting the Vernon Road/N Davies Road intersection would provide another connection across SR 9. This connection would also create three new intersections: • SR 9 Southbound Off-Ramp/N Davies Road & Vernon Road • Vernon Road/N Davies Road • SR 9 Northbound On-Ramp/Vernon Road This alternative creates a new half interchange on the north side of the Davies/Vernon crossing, but does not provide a direct connection to SR 9 south of the crossing.

Build Alternative	Description
Alternative E2D	Alternative E2D is a combination of Alternatives E2B and E2C. The additional SR 9 lanes would be included south of SR 204, as well as the new overpass connecting N Davies Road and Vernon Road and the new half interchange north of the overpass. This does not include Village Way (the private drive aisle through the Frontier Village parking lot would remain).
Alternative G2B	This alternative includes a tunnel bypass for traffic traveling from SR 204 eastbound to SR 9 northbound. This tunnel is designed to begin west of 91st Avenue NE and merge with SR 9 approximately 1,200 feet north of the SR 9/SR 204 intersection.
Alternative H	This alternative includes a roundabout at SR 9/SR 204 in the same configuration as Alternative B. This also includes grade-separating the SR 9 mainline to allow for better operations along the corridor.
Modified Single Point Urban Interchange (SPUI)	SR 9 would be grade-separated below the SR 204 roadway. The SPUI interchange structure would be controlled by a single signalized intersection. This is a modified SPUI alternative as it adds an additional leg to a traditional SPUI interchange by maintaining access to Vernon Road.
Preferred Alternative (Modified E2B-V4)	The Preferred Alternative is a refinement of Alternative E2B-V4 where the two ramp signals of the tight diamond interchange are combined into one signalized intersection. This was developed after more detailed design identified that the close proximity of the two signals in Alternative E2B-V4 would not be able to accommodate left-turning heavy trucks. This alternative also maintains access to southbound 92nd Avenue NE from the SR 9/SR 204 intersection. The existing northbound SR 9 access point from 4th Street NE is shifted north to become an access point to the northbound SR 9 off-ramp from 92nd Avenue NE.

In the initial phase of the screening process, Alternatives B, E, and H were ranked as the highest performing using the baseline metrics for Safety, Mobility, and Economic Vitality (among Alternatives B, C, E, G and H). Alternative E was ranked highest as it separates SR 9 and SR 204 with a tight diamond interchange. Additional options were developed from Alternative E to include different project elements such as widening SR 9 or adding a new east-west crossing north of the project intersection.

Additionally, in response to a request from the community and local business owners, the Preferred Alternative (Modified E2B-V4) includes elements such as maintaining access to Vernon Road and 92nd Avenue NE. Design refinements at a later stage include combining the two ramp traffic signals into a single intersection to accommodate turning vehicles. The proposed layout for the Preferred Alternative is shown in **Figure 1-4**.

Figure 1-4: Preferred Alternative

1.5 POTENTIAL IMPACTS AND BENEFITS OF THE PREFERRED ALTERNATIVE

The Preferred Alternative includes a tight diamond interchange at SR 9/SR 204 with SR 9 depressed below the SR 204 roadway; however, the interchange would be controlled by a single traffic signal. SR 9 would be widened to include an additional through lane in both directions from south of SR 204 and the SR 9 ramps to south of Market Place. A right-turn lane from northbound SR 9 to 4th Street NE is also included. In addition, access to Vernon Road northeast of the intersection is maintained, as well as access to southbound 92nd Avenue NE from 7th Place NE.

The tight diamond grade-separated interchange would improve intersection operations at SR 9/SR 204 and the additional lanes on SR 9 in both directions would improve operations at the SR 9/Market Place intersection. Grade-separation of SR 9 below the SR 204 roadway means that through traffic along SR 9 would be free-flow which is expected to reduce travel time by up to three minutes under 2040 PM conditions compared to the No Build Alternative. Improved operations at the intersection would also result in travel time savings for freight and most transit routes through the study area. The project would also improve non-motorized connections throughout the study area with the addition of marked crosswalks.

The Preferred Alternative has the potential to slightly reduce the number of potential collisions in the study area compared to the No Build Alternative. At the project intersection, grade-separating the SR 9 and SR 204 roadway could reduce all types of collisions by up to 30 percent[2].

The operations of the alternatives under 2040 PM peak hour conditions were evaluated and the impacts on the non-motorized and transit facilities of these alternatives are detailed in **Section 5**.

The project would be constructed and staged to minimize the effects of project construction whenever possible. The project team would coordinate with local agencies, stakeholders, and the project teams for relevant, nearby projects prior to making any revisions to traffic operations.

[2] Source: Highway Safety Manual, Volume 3, Table 15-2 (AASHTO, 2010).

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SECTION 2. INTRODUCTION

The traffic operations of the SR 9 and SR 204 project intersection, located in Lake Stevens, Snohomish County, affect commuter traffic, the movement of freight in the region, and access to local businesses. Due to existing and anticipated future traffic congestion at this intersection, WSDOT and the project team evaluated multiple improvement alternatives that could improve vehicle flow, safety, and local access through the intersection.

2.1 PURPOSE OF THE REPORT

This Transportation Impact Discipline Report (TIDR) presents the results of the project team's detailed study of the SR 9 / SR 204 Intersection Improvements Project. The report identifies the key differences between twelve Build Alternatives and the No Build Alternative, and provides the rationale for the selection of the Preferred Alternative. Evaluation includes analysis of highway and local street performance, safety, and effects to transit and non-motorized facilities and summarizes the effects that would result from each alternative.

The primary purpose of the (TIDR) is to support the following project goals:

- Clearly identify gaps in the transportation system for the design and horizon years of operation.
- Define transportation components of the project need statement.
- Provide analysis and data to support project alternatives development and evaluation.
- Inform the design process and define the channelization and transportation design elements for the project (Preferred Alternative).
- Inform the environmental documentation process.

This report is required to inform the NEPA/SEPA process.

This report documents the analysis completed for this project through September 2018. Upon further study, the construction costs for the preferred alternative (Modified Tight Diamond) in this report were estimated to exceed the project budget. A supplemental TIDR (September 2019) documents analysis of more two new at-grade alternatives developed by the project team with a refined analysis methodology. The supplemental TIDR documents the At-Grade Roundabouts alternative as the final Preferred Alternative.

2.2 PURPOSE AND NEEDS STATEMENT

The economic center of the City of Lake Stevens surrounds the intersection of SR 9 and SR 204. By year 2040, traffic volumes are forecasted to grow by over 20 percent, increasing congestion and travel delays beyond the state's acceptable limits and impacting local businesses. In an effort to support travel efficiency and safety for freight, transit, and general purpose commuting traffic, improvements at the SR 9/SR 204 intersection are required. This project studied the transportation network and recommended possible improvements. Improvements focused on the following:

- Shortening travel times for evening commuters and commercial drivers headed north of Lake Stevens using eastbound SR 204 to northbound SR 9;
- Reducing travel time between adjacent businesses to the east, northwest, and southwest of the intersection during the evening commute period;
- Lowering the serious and fatal crash rate at the intersection to zero; and
- Improving access to businesses while complying with state guidelines.

The baseline and contextual performance gaps that contributed to this statement of needs are detailed in the Needs Statement Technical Memorandum (**Appendix A**).

2.3 PROJECT DESCRIPTION

The Washington State Department of Transportation (WSDOT) proposes to construct the SR 9/SR 204 Intersection Improvements Project to improve traffic operations at this intersection in the City of Lake Stevens. To improve the traffic operations of the SR 9/SR 204 intersection, the project team coordinated with stakeholders to develop high level conceptual improvements to the intersection. During the level one screening process alternatives were evaluated and screened out or refined. The second phase of the two-step screening process evaluated twelve Build Alternatives compared to the No Build Alternative.

2.3.1 Study Area

The transportation study area includes classified state and local roadways that may be impacted by or may benefit from improvements proposed for the SR 9/SR 204 intersection or the surrounding roadway network:

- SR 204: from Lundeen Parkway to SR 9
- SR 9: from Market Place NE to Lundeen Parkway
- Vernon Road: from SR 204 to N Davies Road
- 92nd Avenue NE: from 4th Street NE to 7th Place NE
- Lundeen Parkway: from Vernon Road to SR 204 (segment directly north of the SR 204/Lundeen Parkway/Market Place NE intersection).
- Vernon Road: from Lundeen Parkway to SR 9 southbound slip ramp
- Market Place NE: from SR 204 to 99th Ave NE
- 91st Avenue NE: from Market Place NE to Vernon Road
- N Davies Road: from Vernon Road to 94th Drive NE (extension)
- 4th Street NE/99th Avenue NE: from Market Place to 7th Place NE

The study intersections for the traffic operations analysis are shown in **Figure 2-1**.

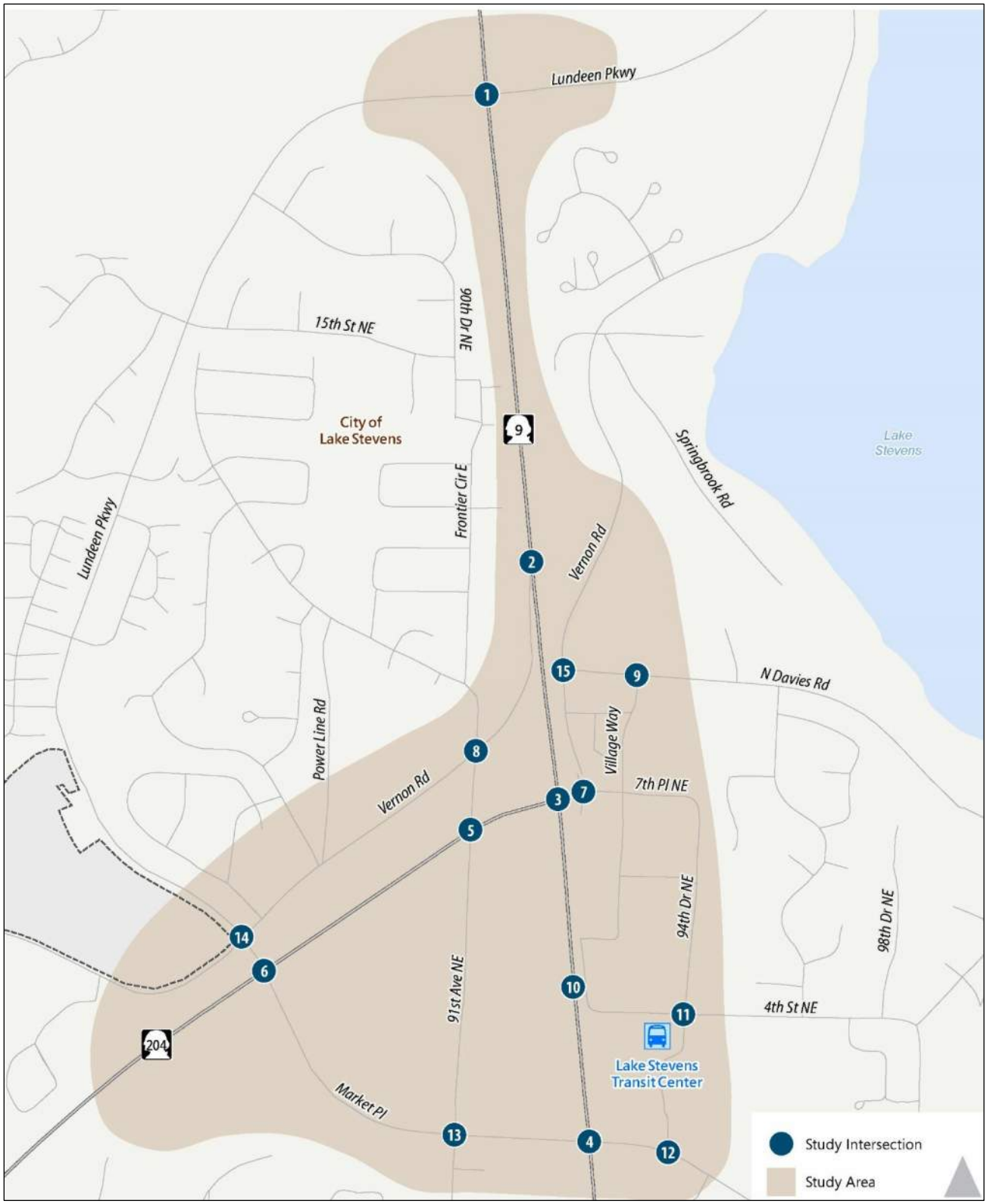

Figure 2-1. Study Area and Study Intersections

2.4 PROJECT ALTERNATIVES

Project needs were identified and agreed upon through a collaborative process involving the project team and members of the stakeholder advisory group (SAG). Qualitative metrics and measures were developed to provide a means for the team to evaluate all preliminary improvement alternatives through a first-level screening process. These metrics and measures included Safety; Mobility; Economic Vitality; Multimodal Opportunities; Commercial Space Impacted; Consistency with State, Regional, and Local Plans; and Visual Aesthetics. Five of the 16 alternatives were carried forward to the second-level quantitative screening. Five variations of one alternative were later added for a total of ten alternatives included in the second-level screening process. More detailed review produced another two alternatives. Ultimately, the screening process produced a Preferred Alternative. The Preferred Alternative, No Build Alternative, and the other eleven Build Alternatives are described in the following sections. The alternative development process and qualitative first-level screening is described in further detail in **Appendix B. Section 5** details the evaluation of all alternatives against the second-level transportation screening criteria.

2.4.1 Preferred Alternative

The SR 9/SR 204 Intersection Improvements Project would modify the intersection geometry and the SR 9 corridor geometry in order to improve traffic operations in this region. The Preferred Alternative includes the following:

- The SR 9/SR 204 intersection would be grade-separated with SR 9 mainline depressed beneath SR 204.
- The SR 9/SR 204 intersection would form a tight diamond interchange with one signalized intersection for the SR 9 on and off-ramps.
- SR 9 would be widened by adding a through lane in both directions from south of Market Place to south of SR 204 interchange.
- Access to Vernon Road from the SR 9/SR 204 interchange would be maintained.
- 92nd Avenue NE one-way southbound would be maintained from 7th Place NE.
- The existing access point from 4th Street NE to SR 9 northbound would be shifted north to create a connection from 92nd Avenue NE to the SR 9 northbound off-ramp.
- A SR 9 northbound right turn to 4th Street NE would be added.

A concept drawing of the proposed Preferred Alternative improvements at the SR 9/SR 204 intersection is shown in **Figure 2-2.**

Figure 2-2. Preferred Alternative

2.4.2 No Build Alternative

The No Build Alternative assumes no changes to the existing configurations of SR 9 and SR 204. The analysis years for this project include an existing year (2016), opening year (2021), and design year (2040) as described in **Section 3**. By 2021, the forecasted increase in traffic demand in the study area is expected to worsen traffic congestion and result in decreased travel speeds compared to 2016 existing conditions. By 2040, traffic volumes are expected to continue to increase thus exacerbating congestion and travel times, extending peak hour queues, increasing collision rates, and degrading traffic operations overall compared to 2021 conditions.

2.4.3 Build Alternatives

Table 2-1 provides a brief overview of each alternative concept included in the second-level screening and highlights the substantive changes for each alternative considered in this report. All design alternatives propose the following improvements unless otherwise noted:

- New sidewalks on both sides of SR 204 between 91st Avenue NE and SR 9.
- The Vernon Road/7th Place NE/92nd Avenue NE intersection would be replaced. Vernon Road south of N Davies Road would end as a cul-de-sac and 92nd Avenue NE would be closed just south of 7th Place NE.

- The existing north-south drive aisle through the Frontier Village parking lot would be converted to a minor arterial known as Village Way providing access between N Davies Road and 4th Street NE with a signalized intersection at 7th Place NE/Village Way with crosswalks along all legs of the intersection except for some of the Alternative E concepts as described below. Sidewalks would be provided along both sides of 7th Place NE between SR 9 and Village Way and on Village Way.

The conceptual drawing of each build alternative is provided in **Appendix C**.

TABLE 2-1. OVERVIEW OF BUILD ALTERNATIVES

Build Alternative	Description
Alternative B	Three new roundabouts located at the following intersections: • Vernon Road/N Davies Road/SR 9 ramps (grade-separated from SR 9) • SR 9/SR 204 (grade-separated from SR 9 mainline) • SR 9/4th Street NE (at-grade with SR 9) Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative C	Alternative C is similar to the No Build Alternative where SR 9 and SR 204 intersection remains at-grade. There is an addition of a right-turn pocket from northbound SR 9 to 4th Street NE. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E	Alternative E consists of a new tight diamond interchange at the SR 9/SR 204 intersection where the SR 9 mainline is grade-separated below SR 204. The interchange has two signalized intersections at the SR 9 on/off-ramps. South of SR 204 there is an added travel lane in each direction on SR 9. North of SR 204 there is an added northbound lane to Lundeen Parkway on SR 9. This added northbound lane becomes the right-turn only lane at the Lundeen Parkway intersection. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E2A	Alternative E2A is a variation on Alternative E. SR 9 and SR 204 are grade-separated with a tight diamond interchange, however no lanes are added on SR 9. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E2B	SR 9 and SR 204 are grade-separated with a tight diamond interchange. Alternative E2B differs from Alternative E2A in that it adds travel lanes in both directions of SR 9 from south of SR 204 to approximately 1,000 feet south of the Market Place NE intersection. The added lane southbound begins from the new southbound SR 9 on-ramp from SR 204 to south of Market Place NE. The new northbound lane begins south of Market Place NE and transitions to the new northbound SR 9 off-ramp to SR 204. Includes "Village Way" concept, Vernon Road cul-de-sac, and 92nd Avenue NE cul-de-sac.
Alternative E2B-V4	Alternative E2B-V4 is similar to E2B with grade separation of the two roadways under a proposed tight diamond interchange and is the only alternative that does not cul-de-sac Vernon Road. Village Way is not included. Therefore, access to Vernon Road is maintained at SR 9/SR 204.

Build Alternative	Description
Alternative E2C	Alternative E2C is similar to Alternative E2A except it includes a new crossing over SR 9 to connect N Davies Road east of SR 9 to Vernon Road west of SR 9. This alternative would not include the Village Way connector (the private drive aisle through the Frontier Village parking lot would remain). The new overpass connecting Vernon Road/N Davies Road intersection would provide another connection across SR 9. This connection would also create three new intersections: • SR 9 Southbound Off-Ramp /N Davies Road & Vernon Road • Vernon Road/N Davies Road • SR 9 Northbound On-Ramp/Vernon Road This alternative creates a new half interchange on the north side of the Davies/Vernon crossing, but does not provide a direct connection to SR 9 south of the crossing.
Alternative E2D	Alternative E2D is a combination of Alternatives E2B and E2C. The additional SR 9 lanes would be included south of SR 204, as well as the new overpass connecting N Davies Road and Vernon Road and the new half interchange north of the overpass. This does not include Village Way (the private drive aisle through the Frontier Village parking lot would remain).
Alternative G2B	This alternative includes a tunnel bypass for traffic traveling from SR 204 eastbound to SR 9 northbound. This tunnel is designed to begin west of 91st Avenue NE and merge with SR 9 approximately 1,200 feet north of the SR 9/SR 204 intersection.
Alternative H	This alternative includes a roundabout at SR 9/SR 204 in the same configuration as Alternative B. This also includes grade-separating the SR 9 mainline to allow for better operations along the corridor.
Modified Single Point Urban Interchange (SPUI)	SR 9 would be grade-separated below the SR 204 roadway. The SPUI interchange structure would be controlled by a single signalized intersection. This is a modified SPUI alternative as it adds an additional leg to a traditional SPUI interchange by maintaining access to Vernon Road.
Preferred Alternative (Modified E2B-V4)	The Preferred Alternative is a refinement of Alternative E2B-V4 where the two ramp signals of the tight diamond interchange are combined into one signalized intersection. This was developed after more detailed design identified that the close proximity of the two signals in Alternative E2B-V4 would not be able to accommodate left-turning heavy trucks. This alternative also maintains access to southbound 92nd Avenue NE from the SR 9/SR 204 intersection. The existing northbound SR 9 access point from 4th Street NE is shifted north to become an access point to the northbound SR 9 off-ramp from 92nd Avenue NE.

In the initial phase of the screening process, Alternatives B, E, and H were ranked highest using the baseline metrics for Safety, Mobility, and Economic Vitality (among Alternatives B, C, E, G and H). Alternative E was appealing as it separated SR 9 and SR 204 with a tight diamond interchange. Alternative E2 was created when it was determined that widening SR 9 north of SR 204 had little operational benefit. Alternative E2 was then modified into four new alternatives (Alternatives E2A – E2D) to test different suggested project improvements such as excluding the widening of SR 9 (E2A) or a new half interchange north of Davies/Vernon intersection (E2C and E2D).

These four E2A – E2D alternatives were evaluated using metrics previously established for comparing alternatives. E2B and E2D were then determined to have the highest benefit-cost ratio. In parallel with developing these four alternatives, the design team evaluated four variations of the termination of Vernon Road at the Frontier Village entrance. This was in response to a request from local business owners to explore options for maintaining the Vernon Road connection, rather than terminating it in a cul-de-sac. These variations 1, 2, 3 and 4 were also reviewed at SAG Meeting #6, where a final decision was made to move forward with the recommended Alternative E2B Variation 4.

During the more detailed design process, further refinements were made to Alternative E2B Variation 4 to improve operations and address other considerations from stakeholders including maintaining access along 92nd Avenue NE. This Modified E2B Variation 4 became the Preferred Alternative.

Further information on the concept development and alternatives screening can be found in **Appendix B**.

SECTION 3. METHODOLOGY AND COORDINATION

3.1 ANALYSIS YEARS AND TIME PERIODS

The analysis years for this project include an existing year (2016), opening year (2021), and design year (2040).

Opening Year: The project opening year has been established as year 2021. The PSRC Transportation 2040 long range plan assumes that the improvements for the SR 9/SR 204 project will be constructed by the year 2021. Planning, design, and construction of the SR 9/SR 204 intersection improvements is desired to occur four to five years after this project began, also aligning with a 2021 opening year. This also supports assumptions made within the City of Lake Stevens Subarea Plan for the Lake Stevens Center, which encompasses the SR 9/SR 204 intersection.

Design Year: The project design year has been established as 2040, approximately 20 years beyond the year of opening which is typical for a project of this type. This timeline is also consistent with the long-range planning efforts completed by the Puget Sound Regional Council as part of their adopted Transportation 2040 Plan.

3.2 TRAVEL DEMAND FORECASTING

The Snohomish County Travel Demand Model (SnoCo Model) was used as the basis for estimating 2021 and 2040 traffic demand volumes. This model was the most appropriate travel demand forecasting tool for the study area for the following reasons:

- Based on the 4,000 zone version of the Puget Sound Regional Council's travel demand model (PSRC 4k Model, Version 4.0.1);
- Includes the most up-to-date comprehensive plan land use and transportation assumptions within Snohomish County jurisdictions and unincorporated areas;
- Incorporates the land use and transportation assumptions of the recently adopted subarea plans in Lake Stevens (Lake Stevens Center and 20th Street SE); and
- Consistent with PSRC Land Use Targets across region.

The SnoCo Model was implemented using the transportation planning software package EMME, version 4.2.5. This is the same software package used for the PSRC 4k Model.

3.2.1 Travel Demand Model Inputs

Several key travel demand model inputs and parameters were adjusted to better represent the existing study area and forecast 2021 and 2040 conditions:

- Existing and future land uses refined by Lake Stevens staff;
- Transportation analysis zone (TAZ) model centroid connectors adjusted to better replicate existing travel; and
- Roadway network and transit service assumptions updated based on reasonably foreseeable planned improvements.

The travel forecast modeling process including base year model validation is detailed in **Appendix E** and summarized in the following sections.

3.2.1.1 Land Use

The SnoCo Model contains land use scenarios for a 2012 base year and the 2035 Comprehensive Plan horizon. For the 2012 base year, population and housing data are based on information from the PSRC regional land use estimates and input from Snohomish County planning staff. The 2035 forecast was previously developed using the official PSRC release of regional land use forecasts, known as the Land Use Targets (September 2013).

The 2016 baseline model land use was created by scaling the 2012 production and attraction file tables by the relative increase or decrease in land use indicated by Lake Stevens' staff, both for the Lake Stevens' Center Subarea and the remaining citywide areas.

This Snohomish County 2035 travel demand model land use summary was also reviewed by the Lake Stevens' planning and public works staff, and updates were suggested to make the forecasts consistent with the Lake Stevens Comprehensive Plan and the Lake Stevens Center Subarea Plan. The 2021 and 2040 land use inputs were derived using the average annual growth rate (by TAZ) for the period between the revised 2016 and revised 2035 land use.

3.2.1.2 Transportation Analysis Zones

The SnoCo Model has a slightly more refined TAZ structure than the 4k version of the PSRC model. Specifically, the SnoCo Model has more detail around the Lake Stevens Center area and the neighborhoods to the south of SR 204. Due to the amount of zonal detail in the vicinity of the study area, it was determined that no additions or refinements to the existing, 2021, or 2040 TAZ systems were necessary as part of the model update.

3.2.1.3 Roadway Network and Transit Service Assumptions

The SnoCo Model includes all major intersections along the SR 9 and SR 204 corridors within the study area. To improve the accuracy of network representation and local traffic routing, several modifications were made to the base version of the SnoCo Model in the vicinity of the SR 9/SR 204 study area network. In particular, several centroid connectors were modified to better represent current access patterns to shopping centers and residential neighborhoods, improving the model's representation of local traffic routing and driver origin-destination patterns.

The future year scenario of the SnoCo Model used a 2035 transportation network that included capacity expansion projects included in regional and local transportation improvement programs (TIPs). The project team reviewed the comprehensive plans and TIPs for the Cities of Lake Stevens and Everett, as well as for Snohomish County, Puget Sound Regional Council (Transportation 2040), and WSDOT to determine what projects to include in the 2021 and 2040 analysis years. In addition, projects included in Sound Transit 2 and 3 (ST2 and ST3), Nickel, and TPA (Transportation Partnership Agreement) funding packages, the Legislative Evaluation & Accountability Program (LEAP) transportation project list, and the Community Transit Development Plan were reviewed. No changes to capacity or access along SR 9 and SR

204 within the study area were assumed for the 2021 opening and 2040 design year No Build models. Specific existing and opening/design network modifications are described in detail in **Appendix E**.

3.2.1.4 Tolling/Congestion Pricing Assumptions

Tolling/congestion pricing for major state highways was not assumed for any of the future year modelling scenarios. The PSRC indicates that recent efforts with their Transportation Futures Task Force model show that regional highway tolling would result in less overall traffic on SR 9 and SR 204 compared to a non-tolled scenario. This suggests that the non-tolled SnoCo Model is a more conservative reflection of demand. WSDOT project team members agreed to this approach through email correspondence (September 13, 2016).

3.2.2 Travel Demand Model Validation

After updating the SnoCo model to a 2016 existing year baseline, model outputs were validated against available data at key locations. The validation process compared the PM peak hour model traffic volume outputs to observed counts on SR 9 north of the Lundeen Parkway intersection, south of the 20th Street SE intersection, on the US 2 trestle, and on a screenline crossing SR 204, 20th Street SE, and US 2. The updated SnoCo Model was found to reasonably replicate observed counts at the key locations listed above and across the screenline. Detailed validation results are provided in **Appendix E**. Models were validated for the PM conditions because that peak hour is the more critical analysis period as the AM peak hour volumes are lower.

3.2.3 Travel Demand Model Forecast Development

Traffic volume forecasts were developed for input into the Vissim operations models using origin-destination (O-D) matrix estimation processes described in the WSDOT Vissim Protocol. As part of this process, a VISUM subarea routing model was developed to translate trip growth from the travel demand model (SnoCo Model) to input into the Vissim operations models. The step-by-step process for the development of the 2016 turning movement counts and the 2021 and 2040 turning movement forecasts is described in **Appendix E**.

3.3 TRAFFIC OPERATIONS ANALYSIS

Roadway operations are defined by how well intersections function. The primary traffic operations metrics evaluated for each alternative are intersection level of service, which referenced the Highway Capacity Manual 2010 level of service (LOS) grades/delay thresholds, and travel time as estimated by the model between key destinations in the project area. These metrics were calculated using Vissim 8, a detailed traffic microsimulation modeling platform that is described in the following sections.

3.3.1 Level of Service

LOS is a qualitative description of traffic flow based on such factors as speed, travel time, delay, and freedom to maneuver. Six levels are defined, from LOS A, with the least congested operating conditions, to LOS F, with the most congested operating conditions. LOS E represents “at-capacity” operations.

Operations are designated as LOS F when volumes exceed capacity, resulting in stop-and-go conditions. LOS thresholds vary depending on whether an intersection is signalized or unsignalized, as shown in **Table 3-1**.

The LOS analysis considered the adopted LOS standards of the operating agencies (i.e. SR 9 and SR 204 intersections using WSDOT LOS standards and local street intersections using City of Lake Stevens LOS standards). As a Highway of Statewide Significance (HSS), SR 9 has a LOS standard of D. SR 204 is a non-HSS in a Tier 2 zone (i.e. the "outer" urban area beyond of a 3-mile buffer from I-5), and also has a LOS D standard. The City of Lake Stevens has set a citywide standard of LOS E for major and minor arterials and collector roadways, which comprise all roadways within the study area.

TABLE 3-1. INTERSECTION LEVEL OF SERVICE THRESHOLDS

Level of Service	Signalized Intersection Control Delay (sec/veh)[a,b]	Unsignalized Intersection Control Delay (sec/veh)[a,b]	General Description
A	0 – 10	0 – 10	Little to no congestion or delays.
B	>10 – 20	>10 – 15	Limited congestion, short delays
C	>20 – 35	>15 – 25	Modest delays and stable flow
D	>35 – 55	>25 – 35	Long delays, but stable flow
E	>55 – 80	>35 – 50	Operations at or near capacity
F	> 80.0	> 50.0	Over-capacity, breakdown flow

Source: Highway Capacity Manual 2010 (Transportation Research Board 2010).

a. Intersection vehicle delay results generated by microsimulation models such as Vissim are not HCM compliant. HCM calculations are based on control delay and stopped delay that directly contribute to the traffic control devices. Vissim directly measures the total delay, which consists of control delay, stopped delay, and other delay incurred in the vicinity of the traffic control device, such as vehicles slowing down for turn movements. However, the differences are usually negligible. Per the WSDOT Vissim protocol, the control delay-based LOS thresholds can be applied to the total delay-based outputs from Vissim.

b. HCM typically measures delay and intersection LOS for the peak 15-minute period of the peak hour. For the project analysis, LOS was measured and averaged over the entire one-hour simulation model. The Vissim model did include a 15-minute peaking factor to simulate higher vehicle arrival rates. The peak 15-minute period queues and delays, along with any remaining queues that continue into the following period were incorporated into the one-hour average delay analysis to determine LOS.

3.3.2 Vissim Simulation Model

Intersection operations were assessed using Vissim 8. Vissim provides the ability to evaluate the interaction between different travel modes (such as pedestrians and heavy vehicles), the effects of congestion and queuing between intersections, and more accurately evaluates non-standard geometry throughout the study area, such as the east leg (7th Place NE and Vernon Road) of the SR 9/SR 204 intersection.

Vissim simulation models were developed for the AM and PM peak hours and include the intersections and roadway network components listed in **Section 2**. Model network coding, parameters, and data input were developed according to the *WSDOT Vissim Protocol* (September 2014).

According to the *Protocol*, there are two separate criteria that must be met in order to justify the validity of a particular model and its usefulness in evaluating the transportation system:

- **Confidence** – Ensuring that the reported model results are representative of the model
- **Calibration** – Matching the model results to real world conditions such as existing traffic counts and observed queues from site visits.

The Vissim model was validated with respect to both confidence and calibration to traffic counts and observed queues via processes detailed in **Appendix D**. To ensure consistency between models representing different times of day, the PM peak period model was constructed and calibrated first. The AM peak period model was built by modifying the PM peak period model and calibrating to AM traffic counts and queues, while using AM signal timing. These calibrated project models were used to evaluate LOS under existing conditions. All future year models were developed using the validated existing conditions models as a starting point.

The screening analysis and evaluation of alternatives was based on design year (2040) PM peak hour conditions. The preferred alternative was analyzed for both the AM and PM peak hours under 2021 and 2040 conditions. The AM and PM peak hours generally result in the most congested traffic conditions in the study area during a typical weekday. Turning movement volumes and LOS results for the Existing conditions, No Build Alternative, and each of the twelve Build Alternatives are depicted in the following figures.

- 2016 Turning Movement Counts
  - **Figure 3-1**. Existing PM Peak Hour
  - **Figure 3-2**. Existing AM Peak Hour
- 2040 Turning Movement Forecasts
  - **Figure 3-3**. 2040 No Build PM Peak Hour
  - **Figure 3-4**. 2040 Alternative B PM Peak Hour
  - **Figure 3-5**. 2040 Alternative C PM Peak Hour
  - **Figure 3-6**. 2040 Alternative E PM Peak Hour
  - **Figure 3-7**. 2040 Alternative E2A PM Peak Hour
  - **Figure 3-8**. 2040 Alternative E2B PM Peak Hour
  - **Figure 3-9**. 2040 Alternative E2B Variation 4 PM Peak Hour
  - **Figure 3-10**. 2040 Alternative E2C PM Peak Hour
  - **Figure 3-11**. 2040 Alternative E2D PM Peak Hour
  - **Figure 3-12**. 2040 Alternative G2B PM Peak Hour
  - **Figure 3-13**. 2040 Alternative H PM Peak Hour

- **Figure 3-14**. 2040 Alternative SPUI PM Peak Hour
- **Figure 3-15.** 2040 Modified Alternative E2B Variation 4 PM Peak Hour– Preferred Alternative
- **Figure 3-16**. 2040 No Build AM Peak Hour
- **Figure 3-17**. 2040 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative

- 2021 Turning Movement Forecasts
  - **Figure 3-18**. 2021 No Build PM Peak Hour
  - **Figure 3-19**. 2021 Modified E2B Variation 4 PM Peak Hour – Preferred Alternative
  - **Figure 3-20**. 2021 No Build AM Peak Hour
  - **Figure 3-21**. 2021 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative

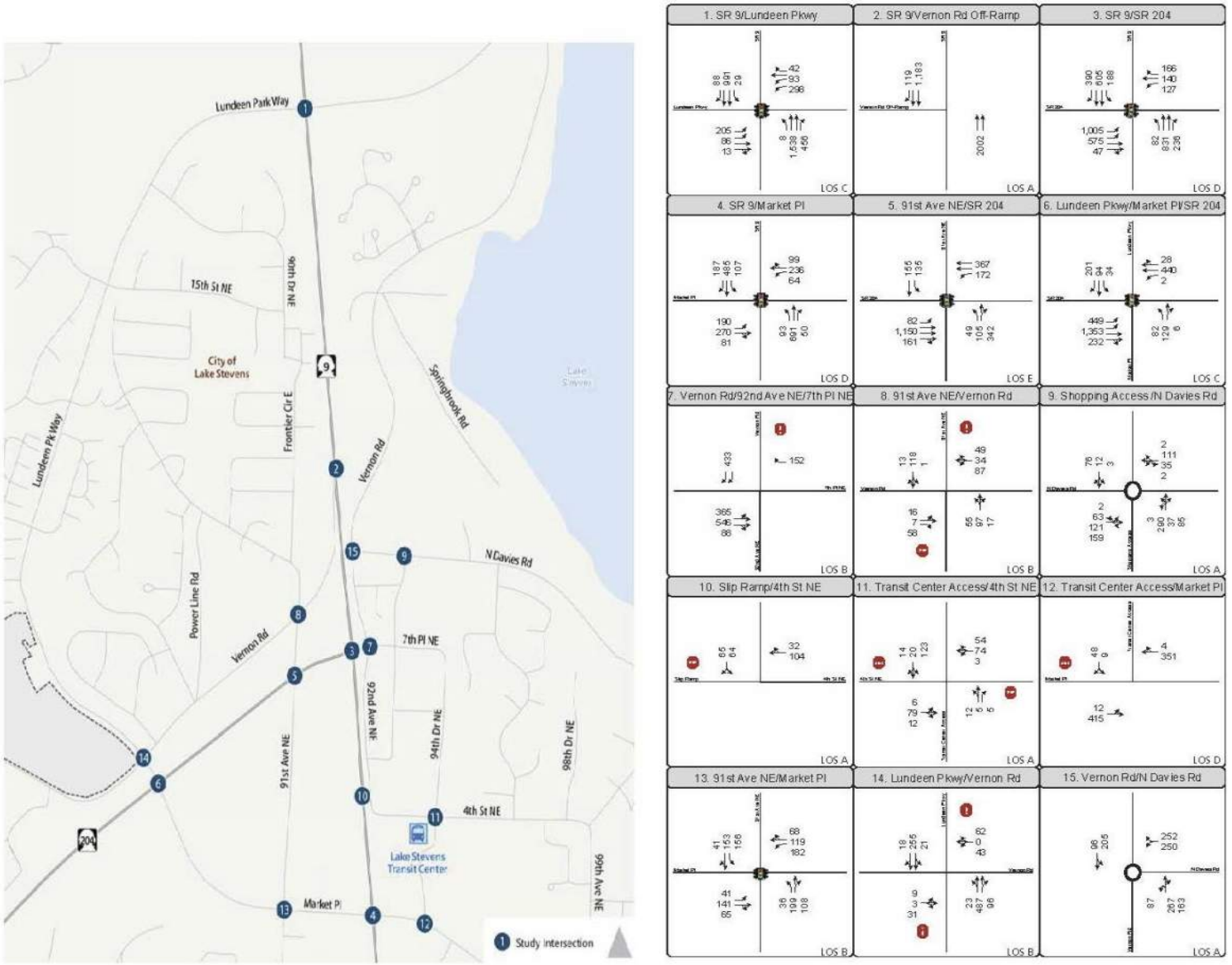

Figure 3-1. Existing PM Peak Hour

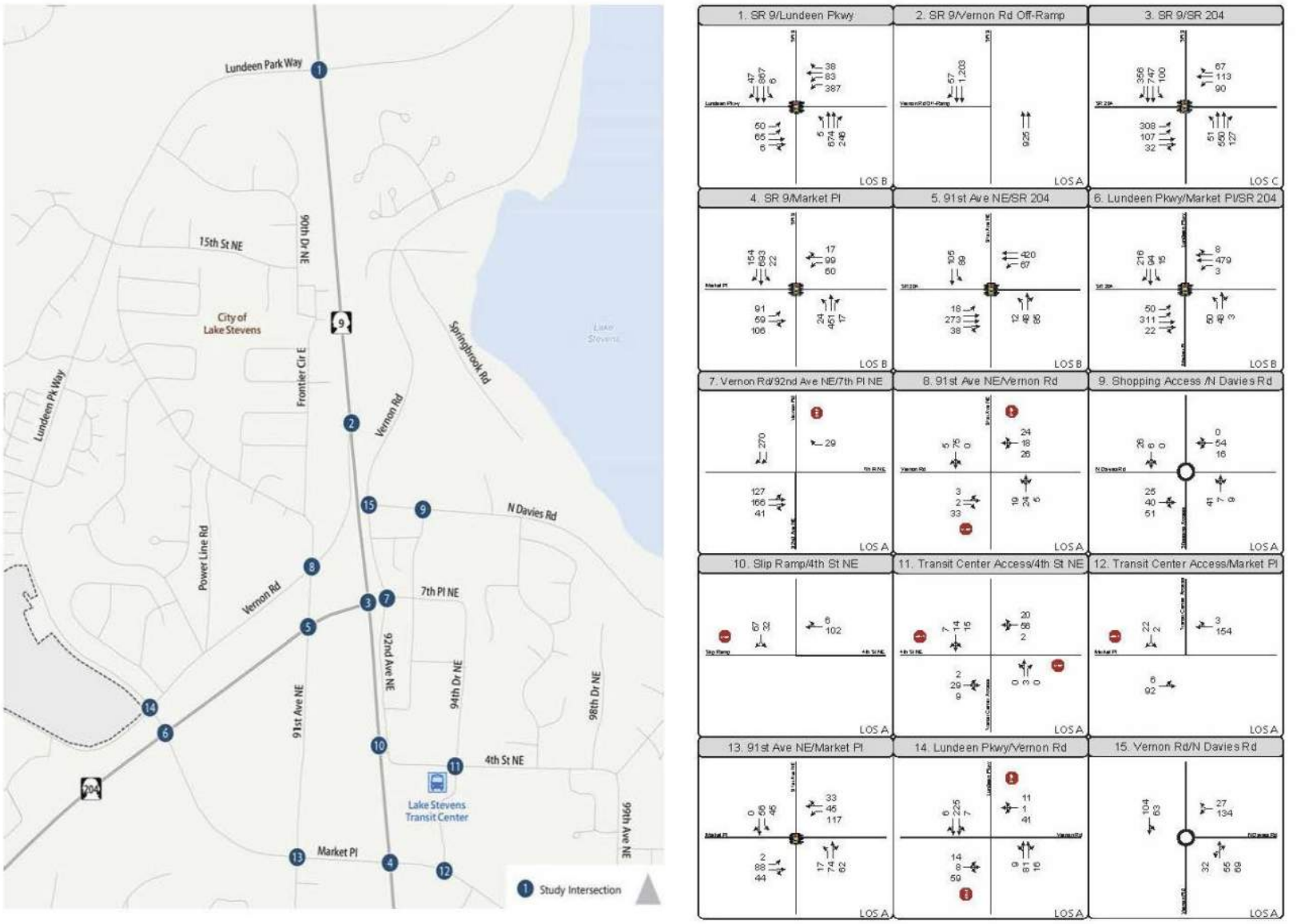

Figure 3-2. Existing AM Peak Hour

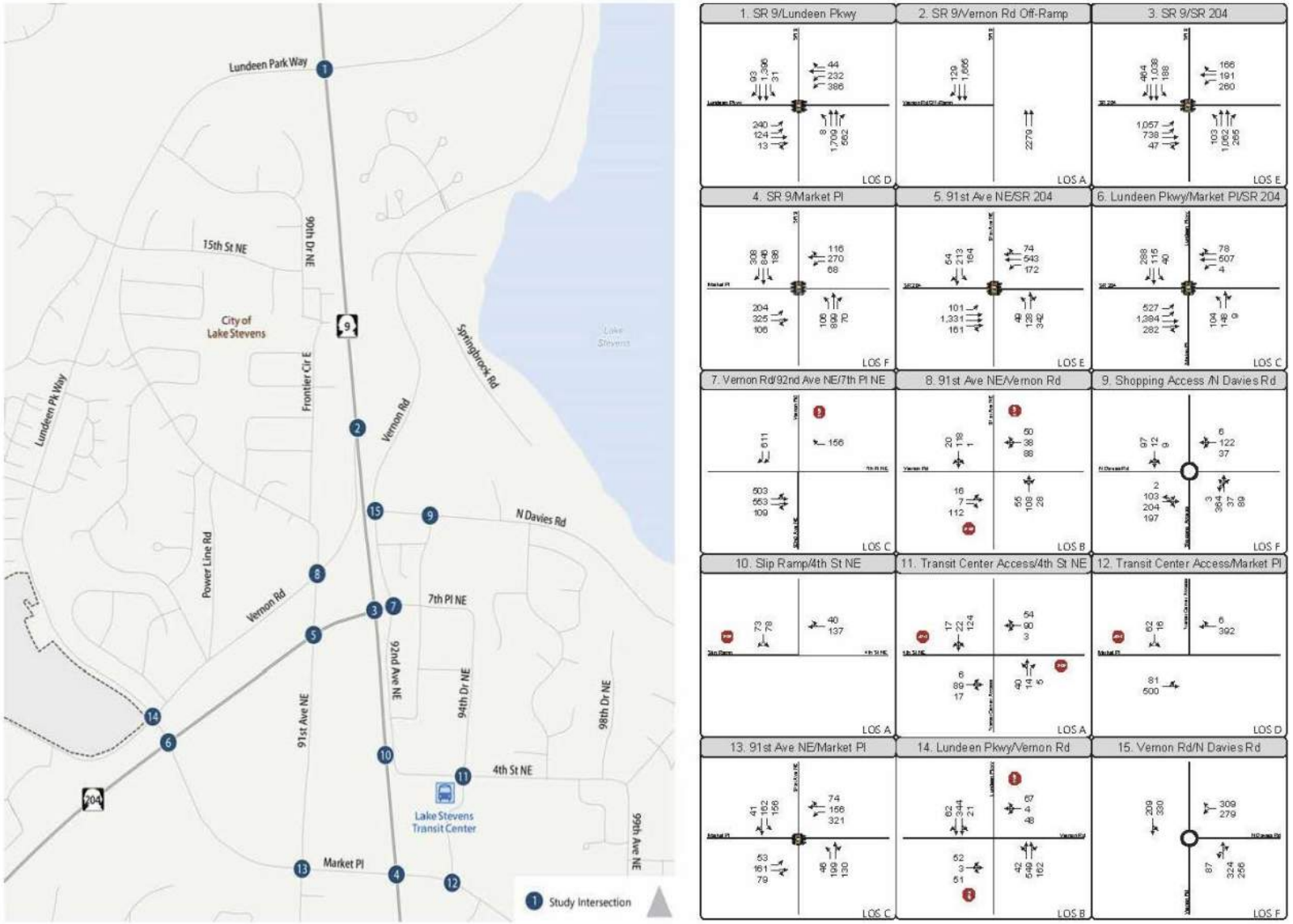

Figure 3-3. 2040 No Build PM Peak Hour

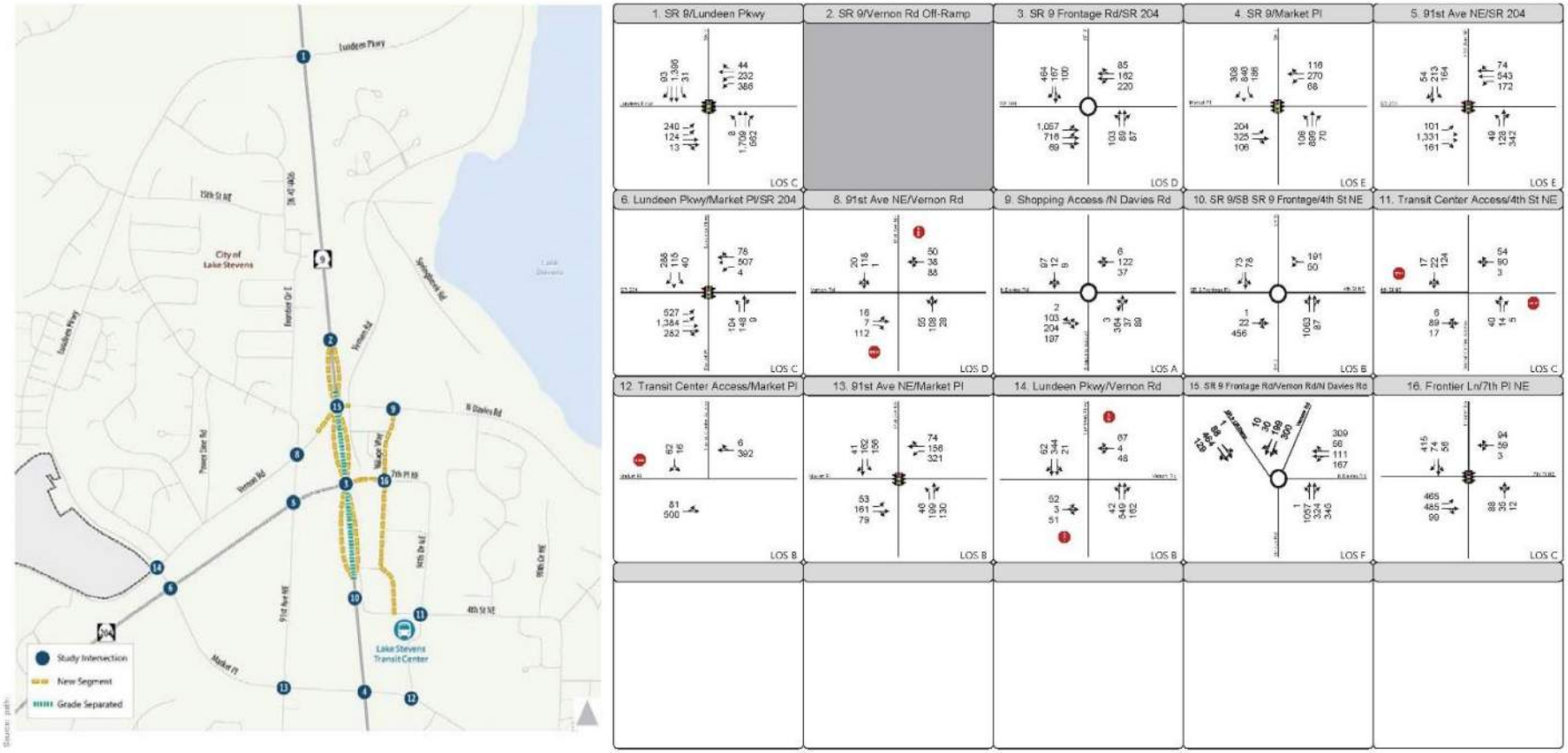

Figure 3-4. 2040 Alternative B PM Peak Hour

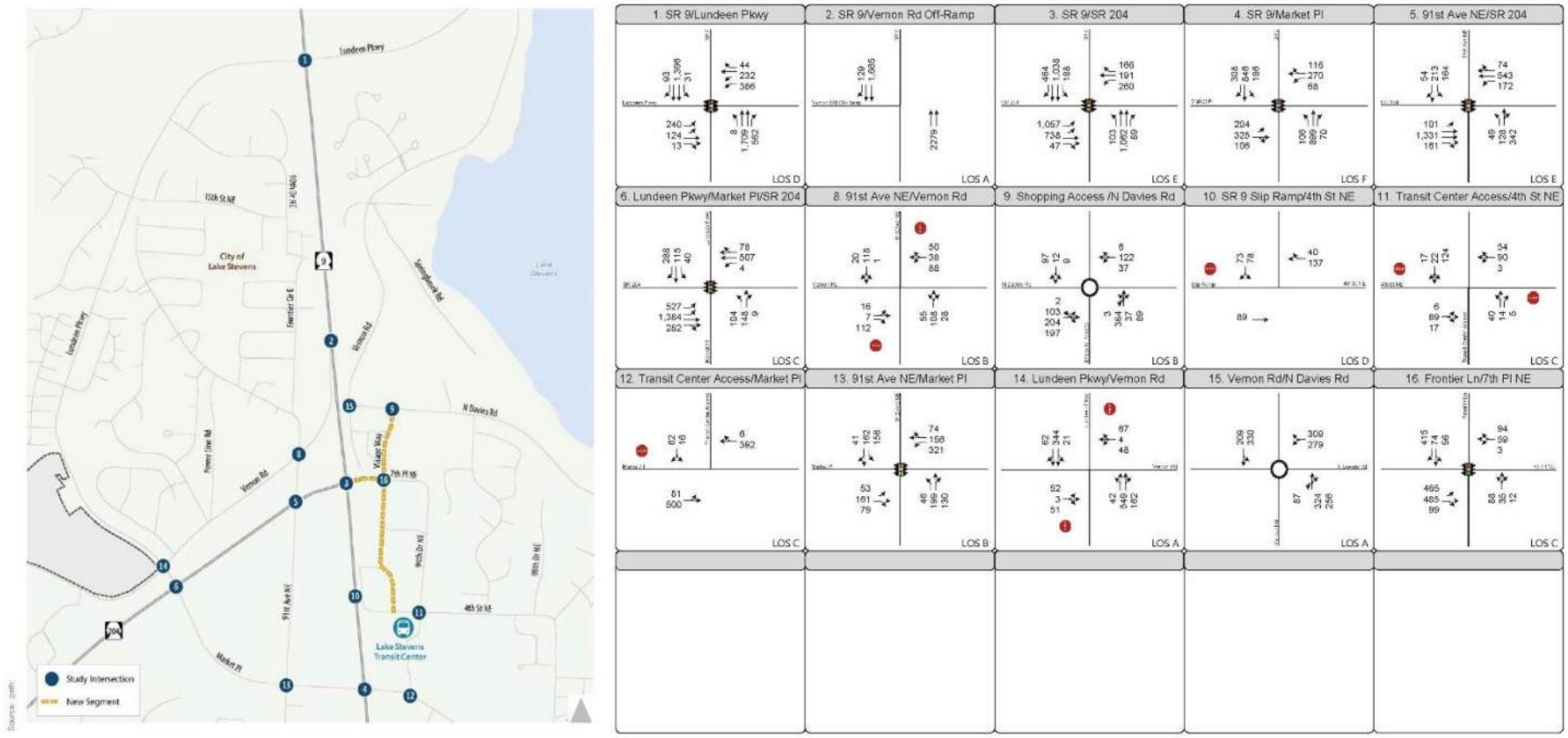

Figure 3-5. 2040 Alternative C PM Peak Hour

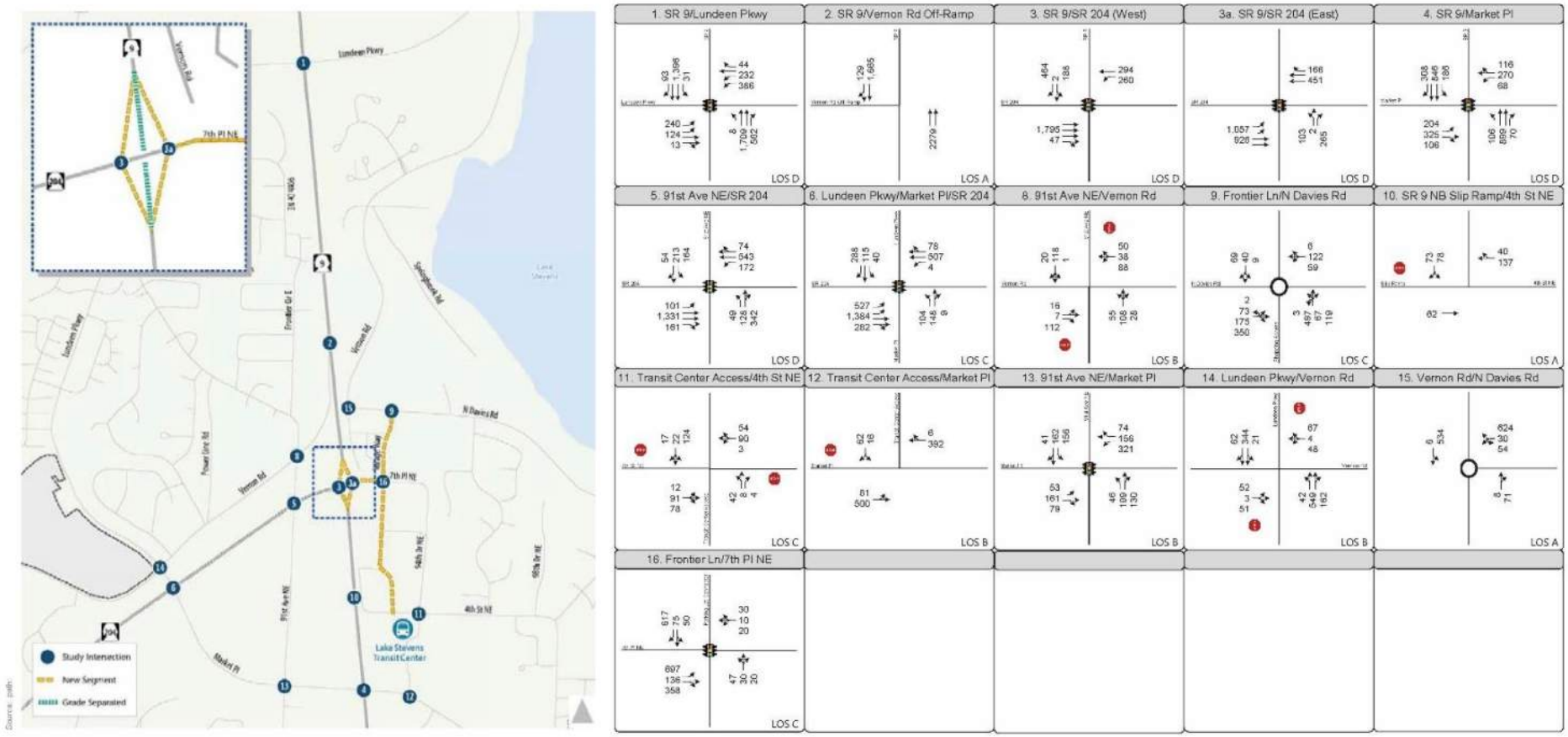

Figure 3-6. 2040 Alternative E PM Peak Hour

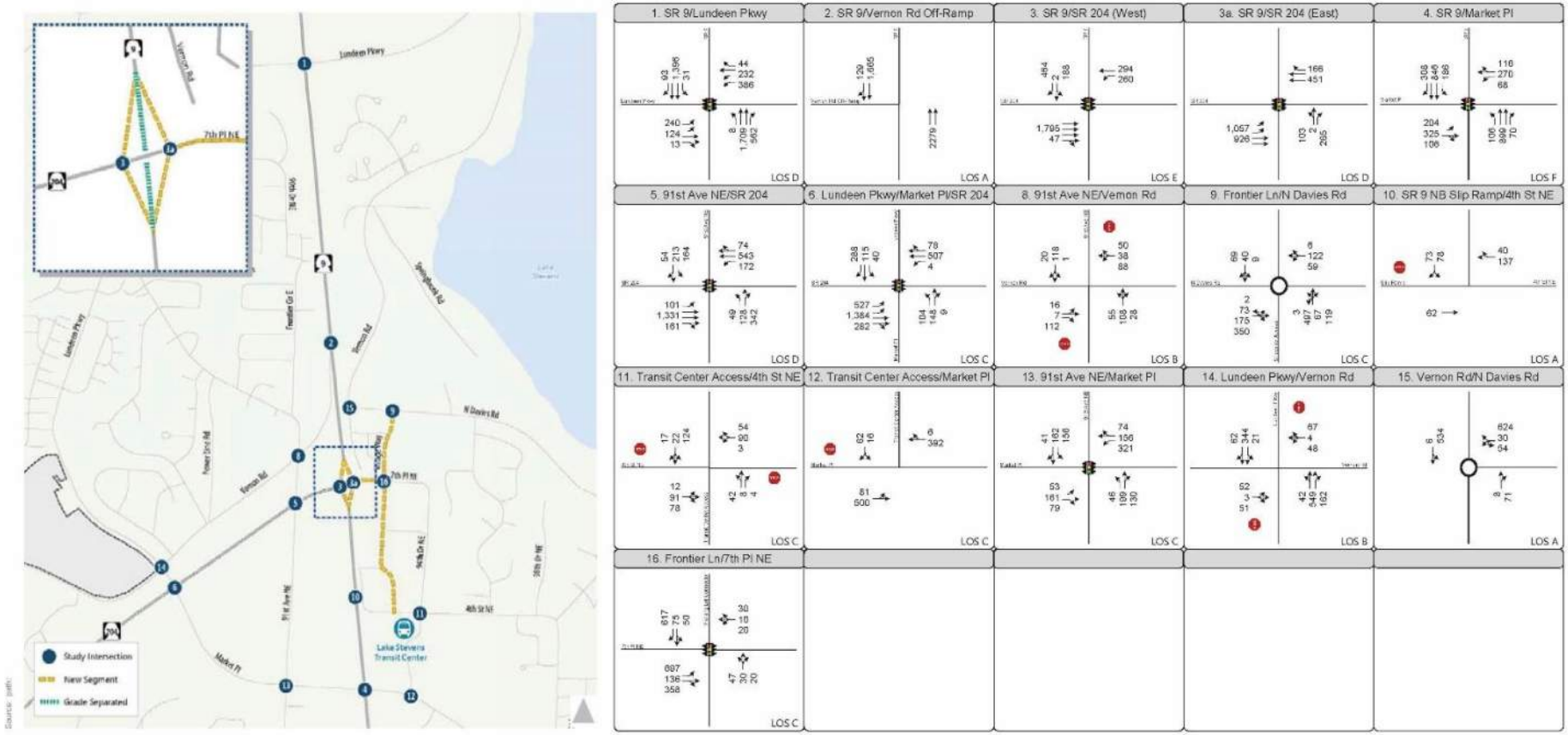

Figure 3-7. 2040 Alternative E2A PM Peak Hour

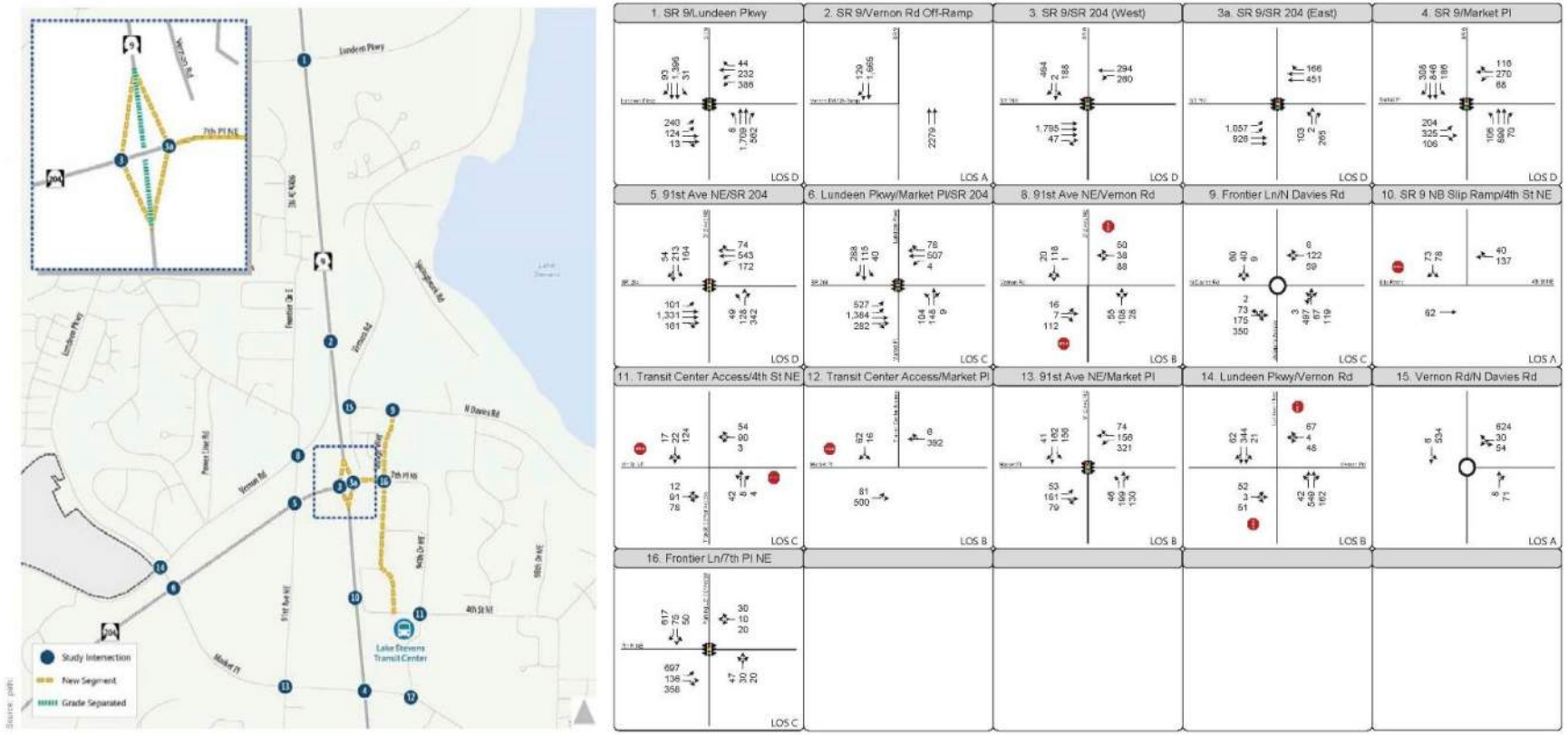

Figure 3-8. 2040 Alternative E2B PM Peak Hour

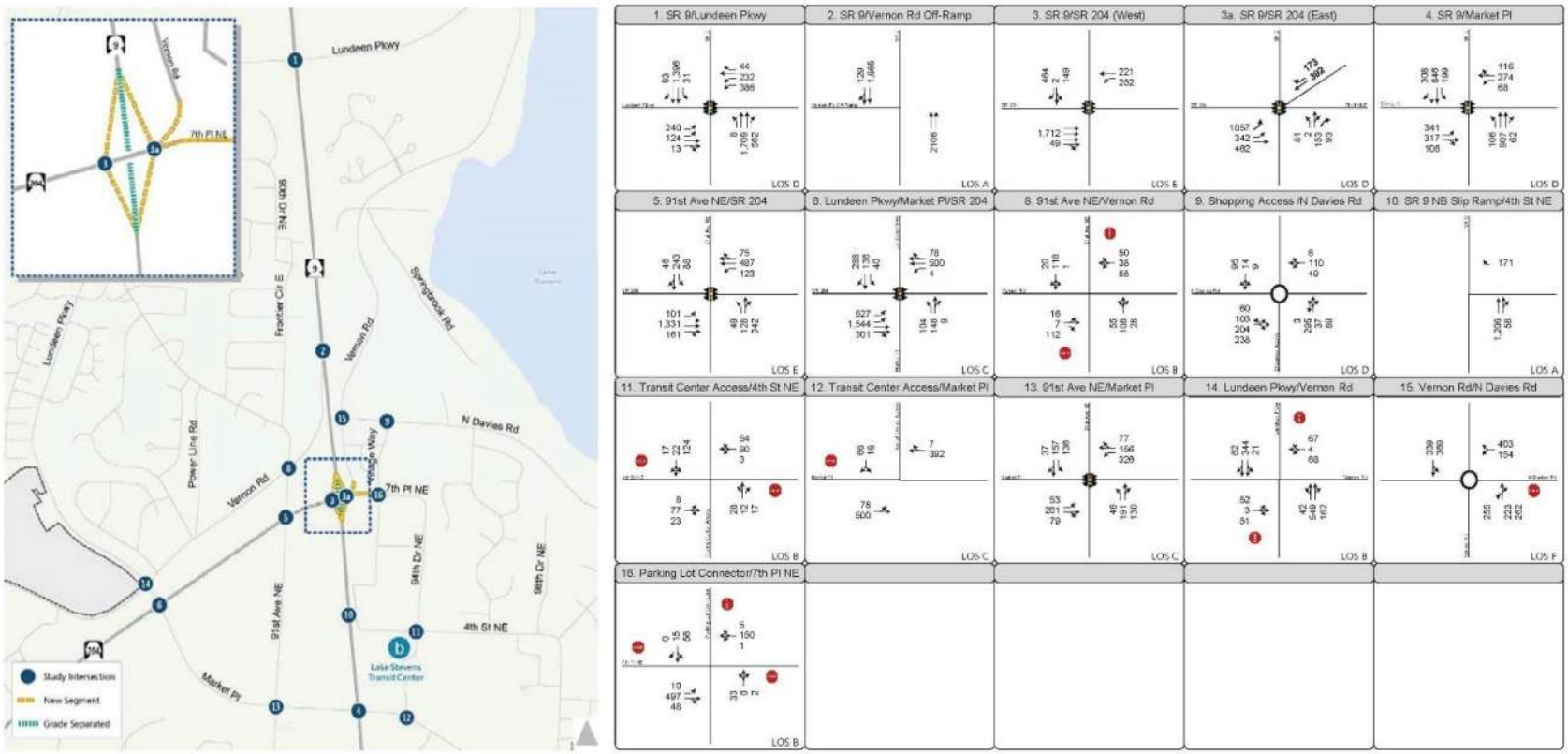

Figure 3-9. 2040 Alternative E2B Variation 4 PM Peak Hour

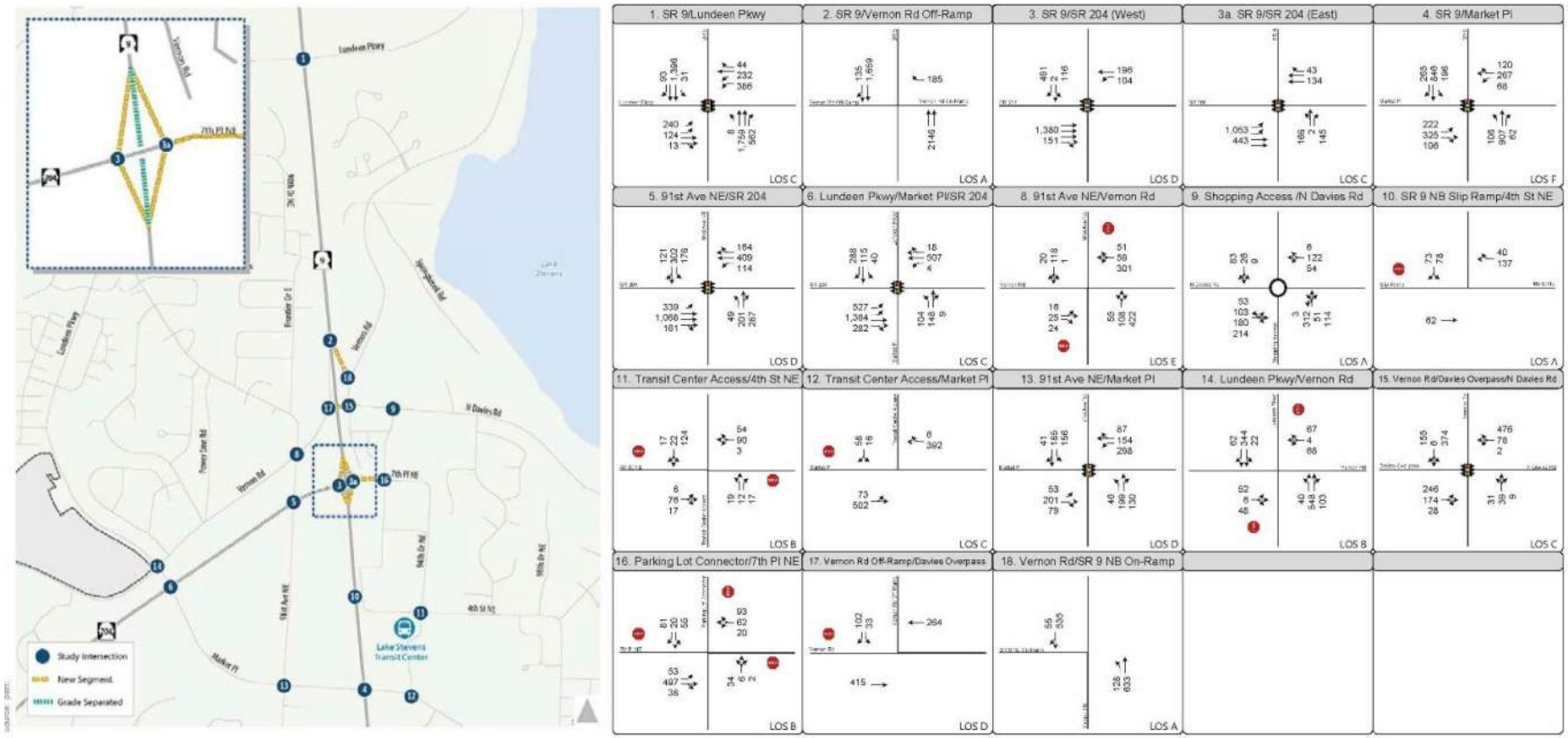

Figure 3-10. 2040 Alternative E2C PM Peak Hour

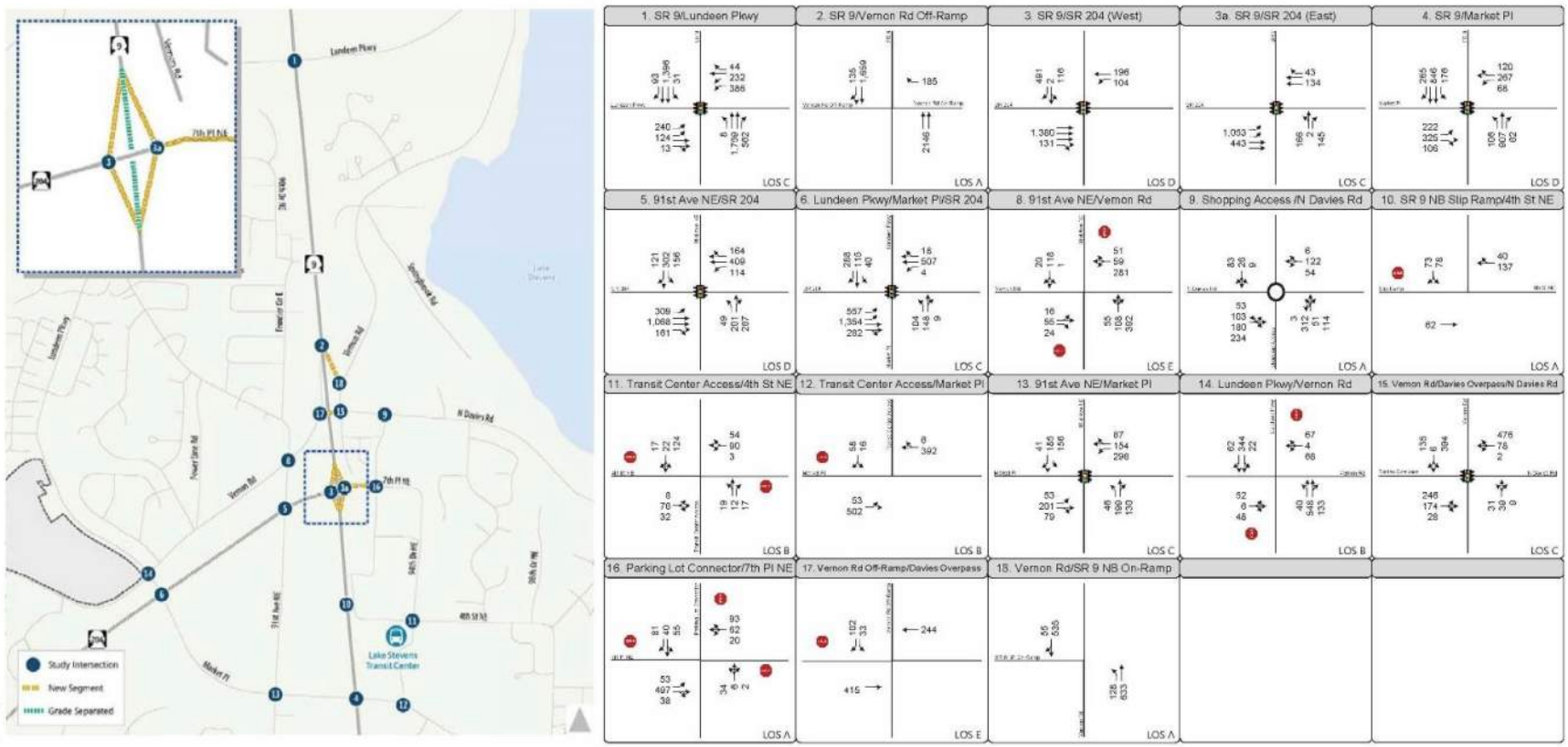

Figure 3-11. 2040 Alternative E2D PM Peak Hour

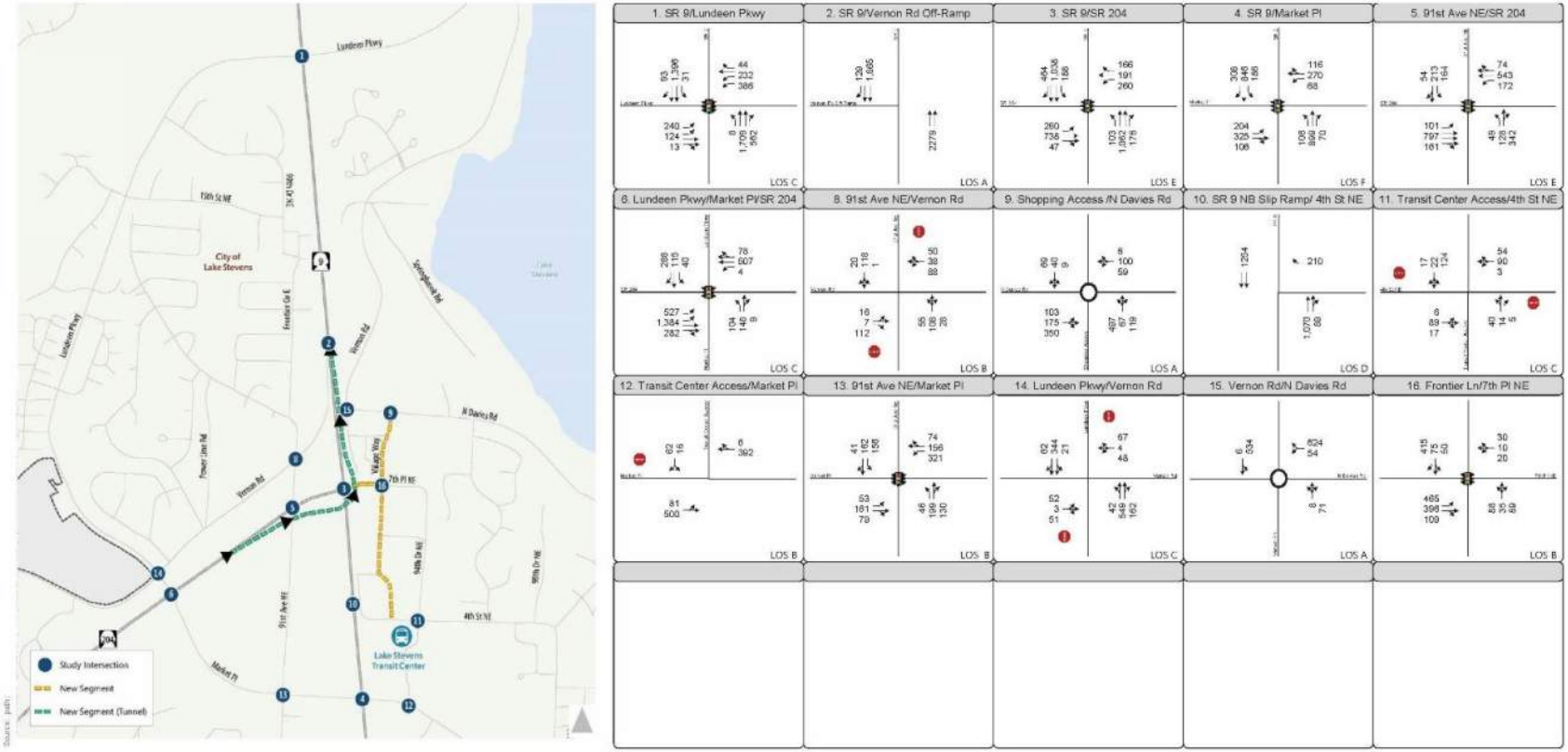

Figure 3-12. 2040 Alternative G2B PM Peak Hour

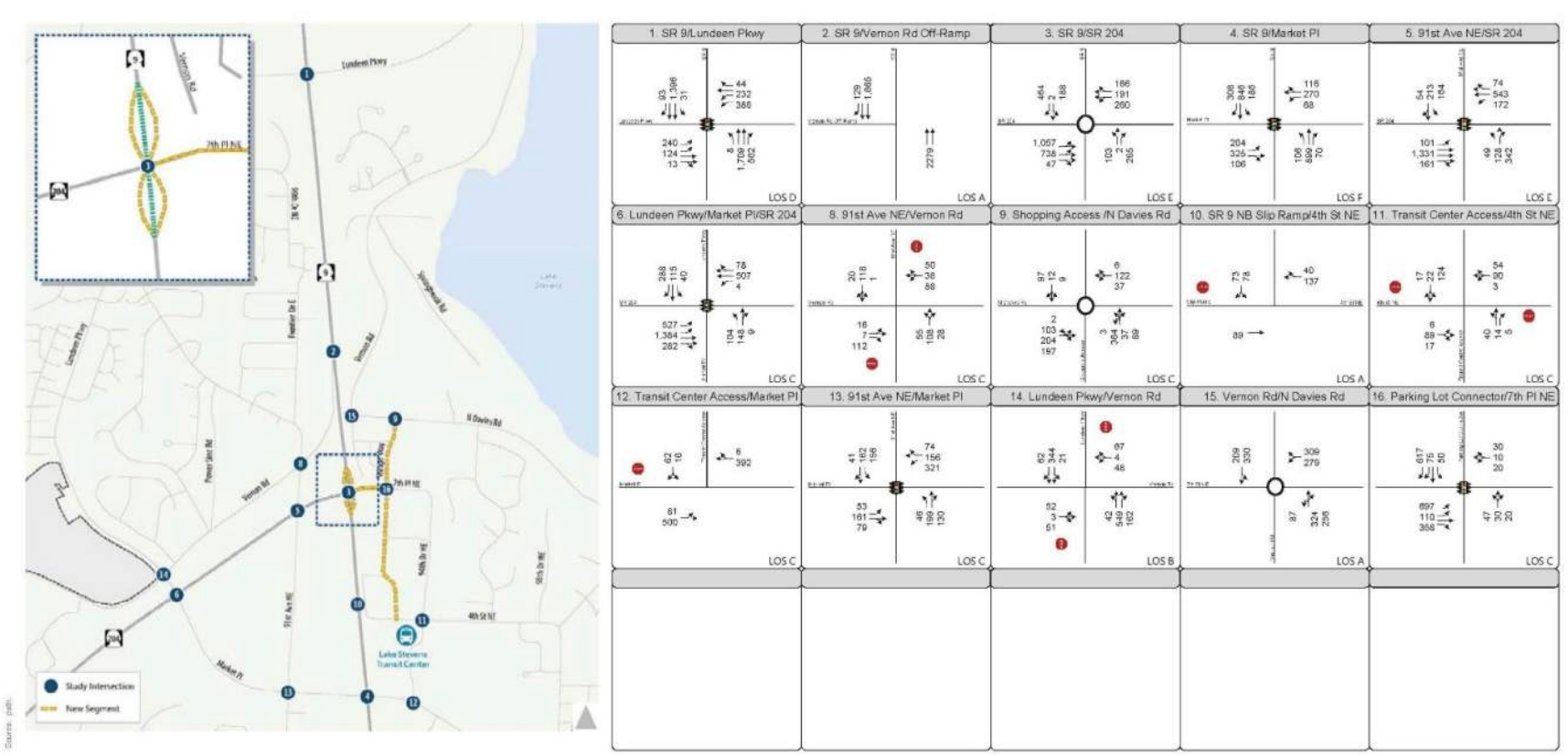

Figure 3-13. 2040 Alternative H PM Peak Hour

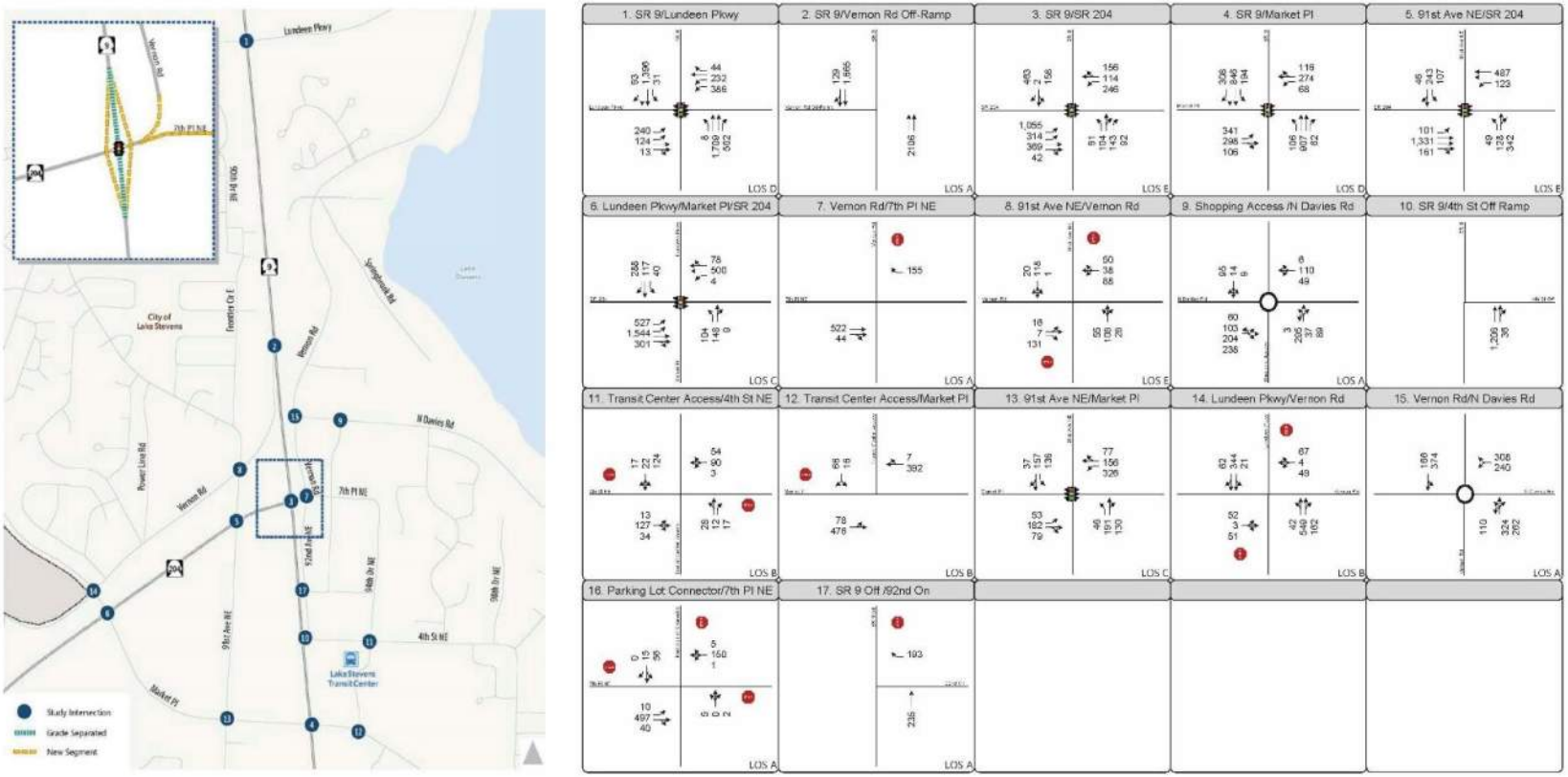

Figure 3-14. 2040 Alternative SPUI PM Peak Hour

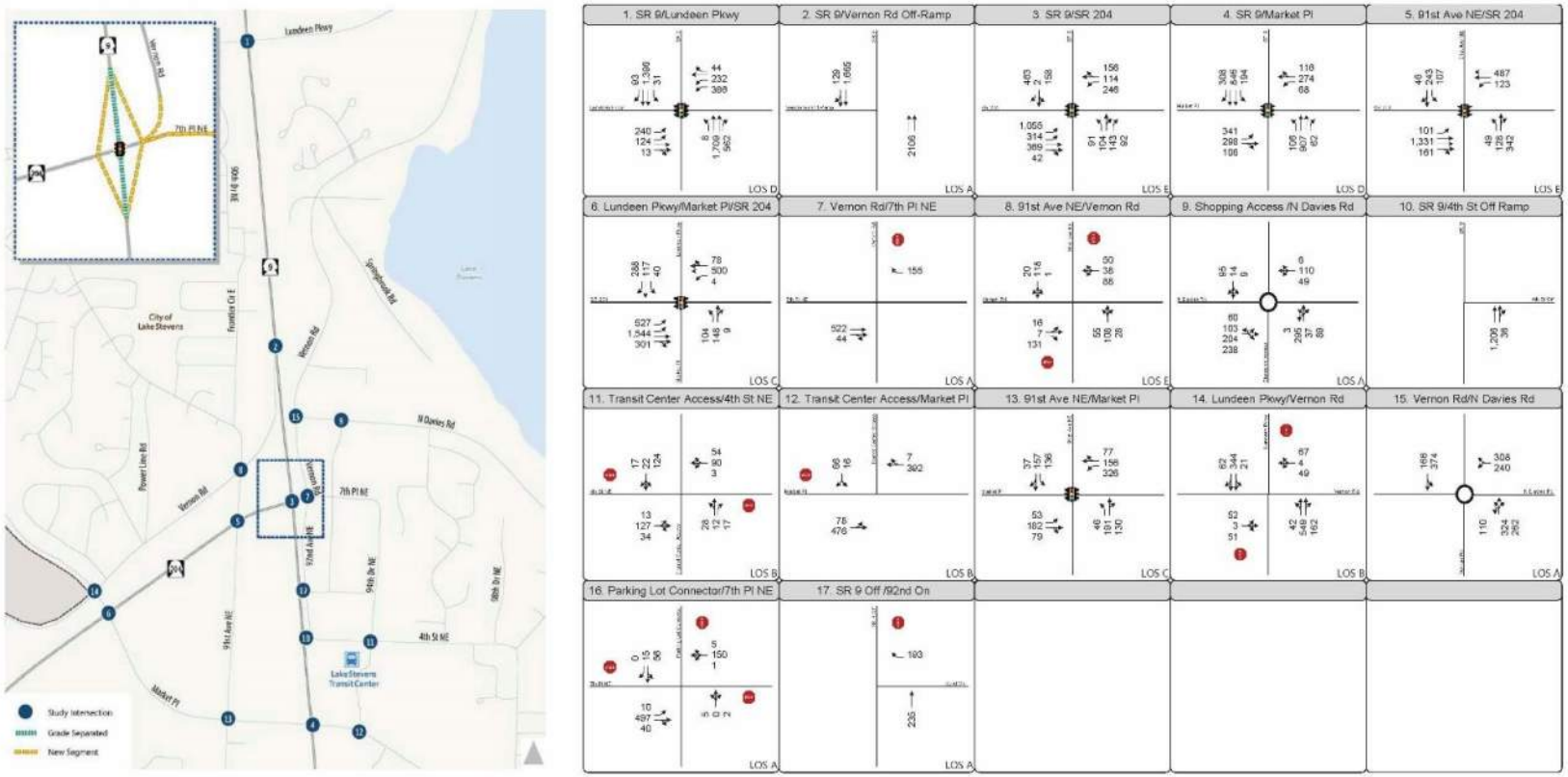

Figure 3-15. 2040 Preferred Alternative - Modified E2B Variation 4 PM Peak Hour

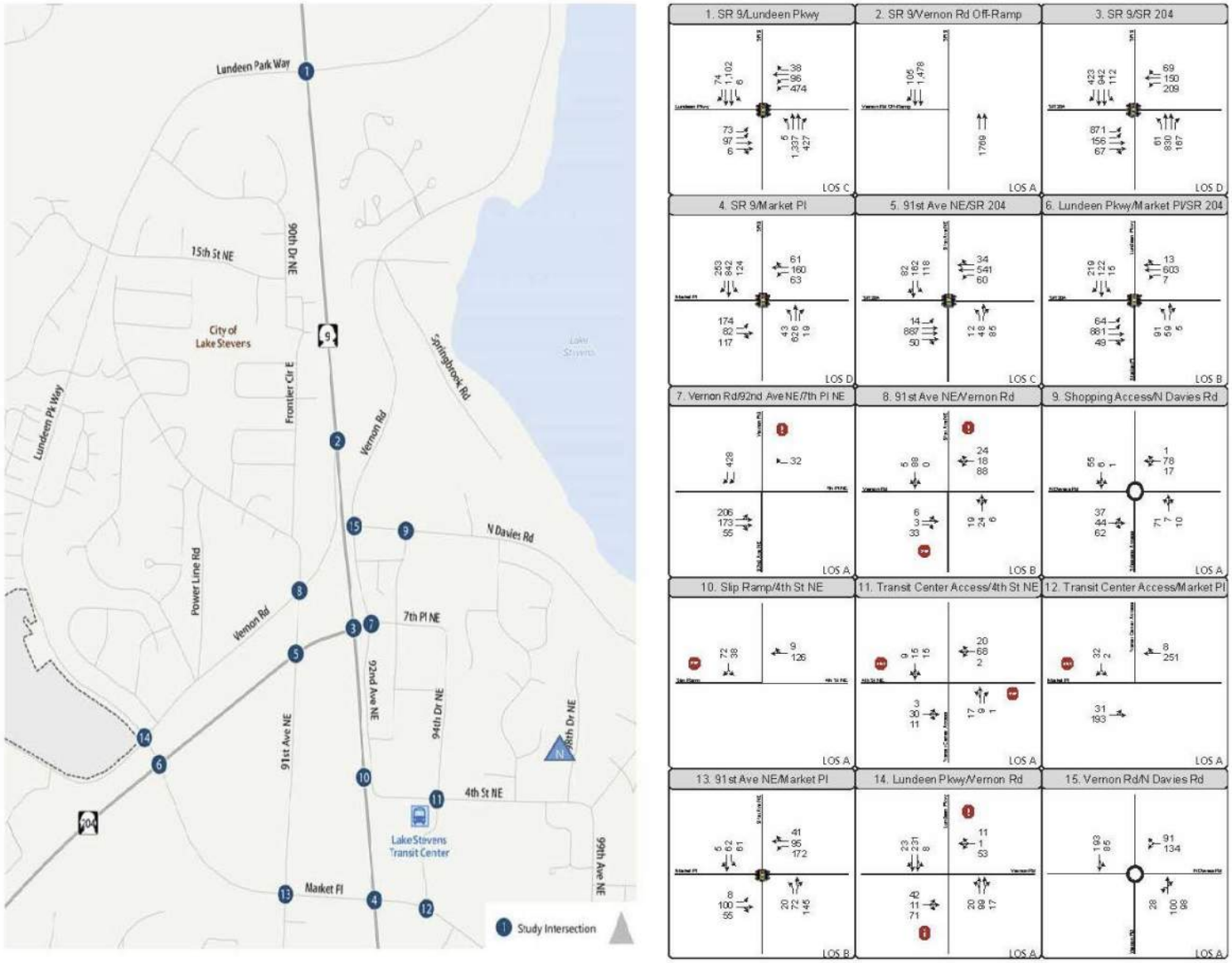

Figure 3-16. 2040 No Build AM Peak Hour

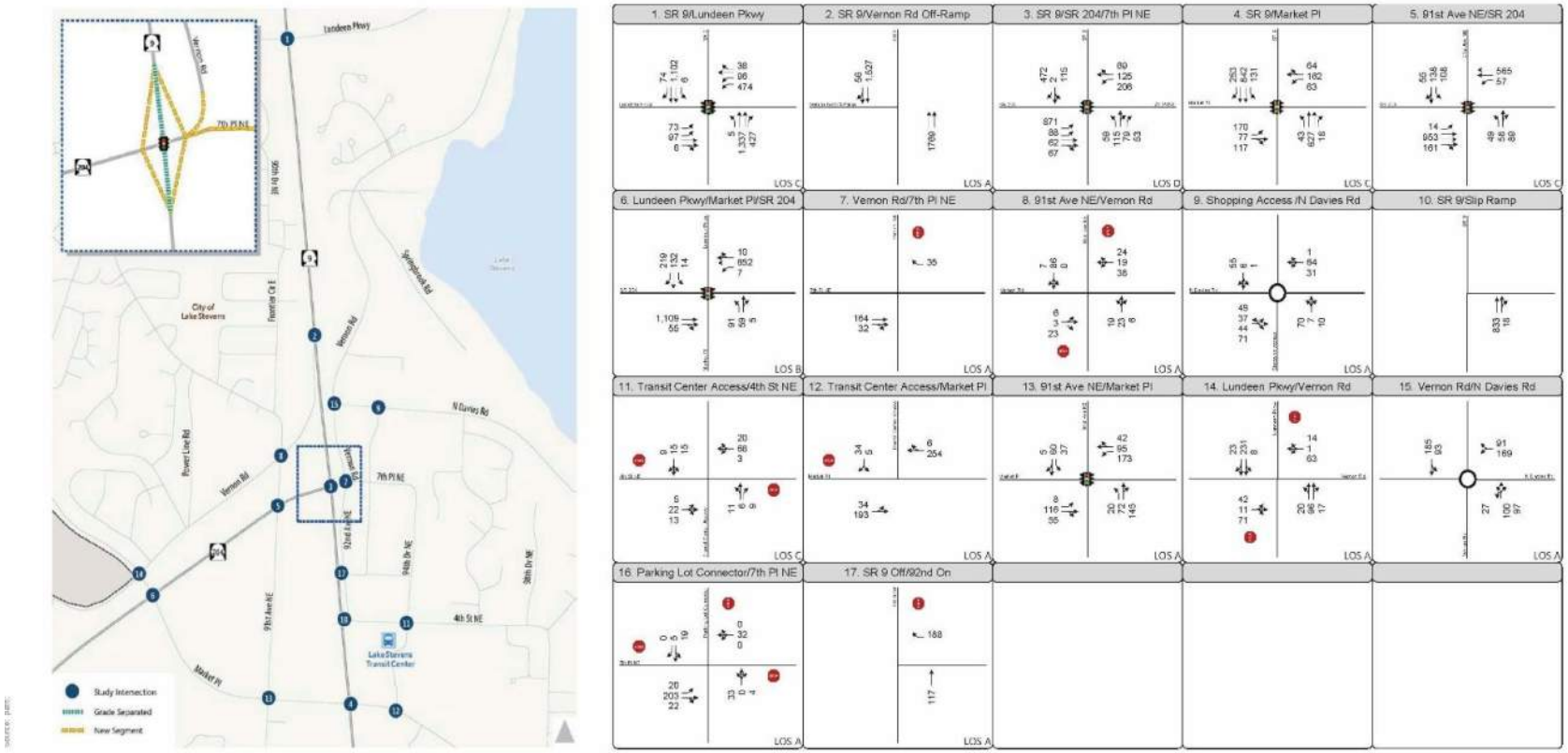

Figure 3-17. 2040 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative

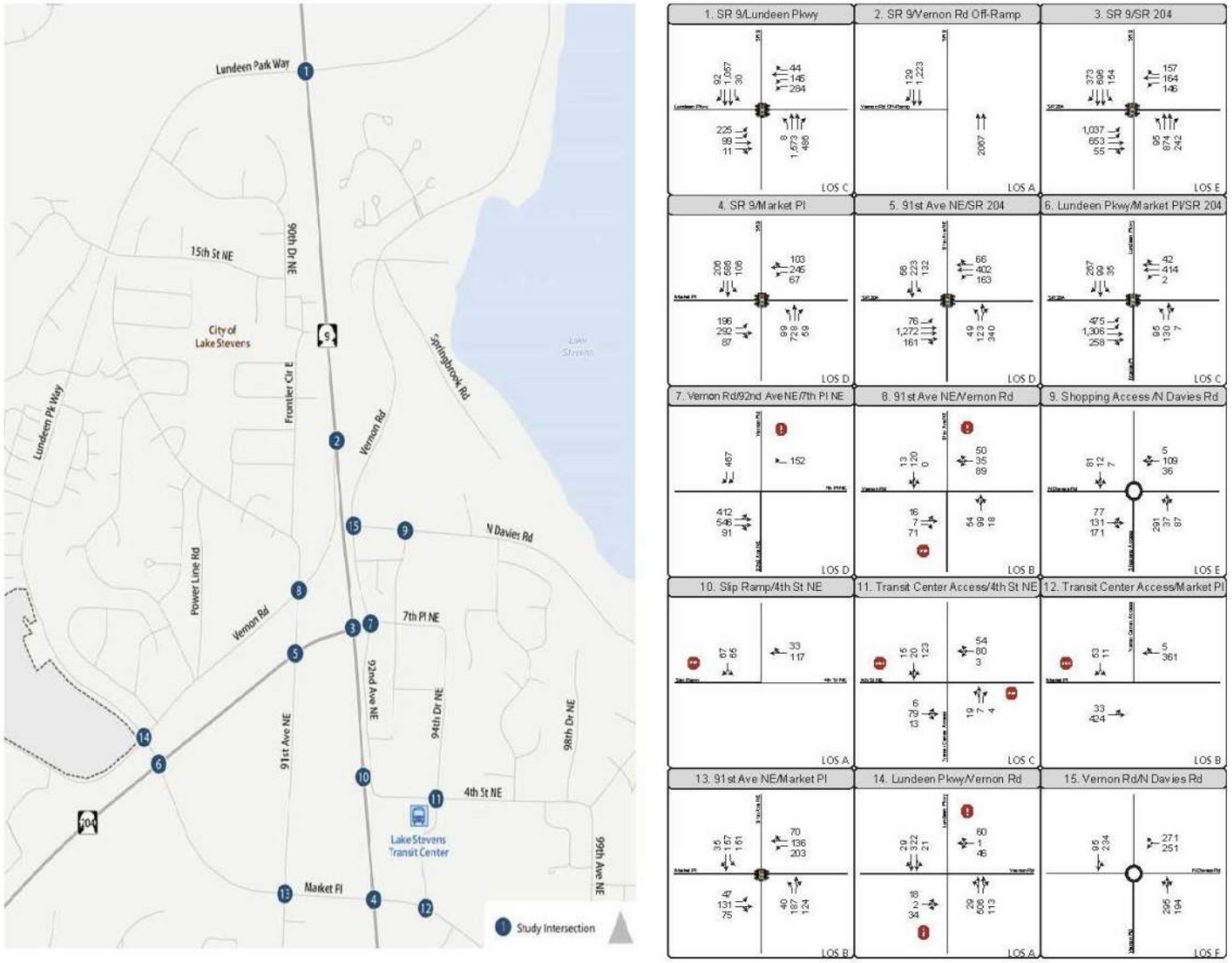

Figure 3-18. 2021 No Build PM Peak Hour

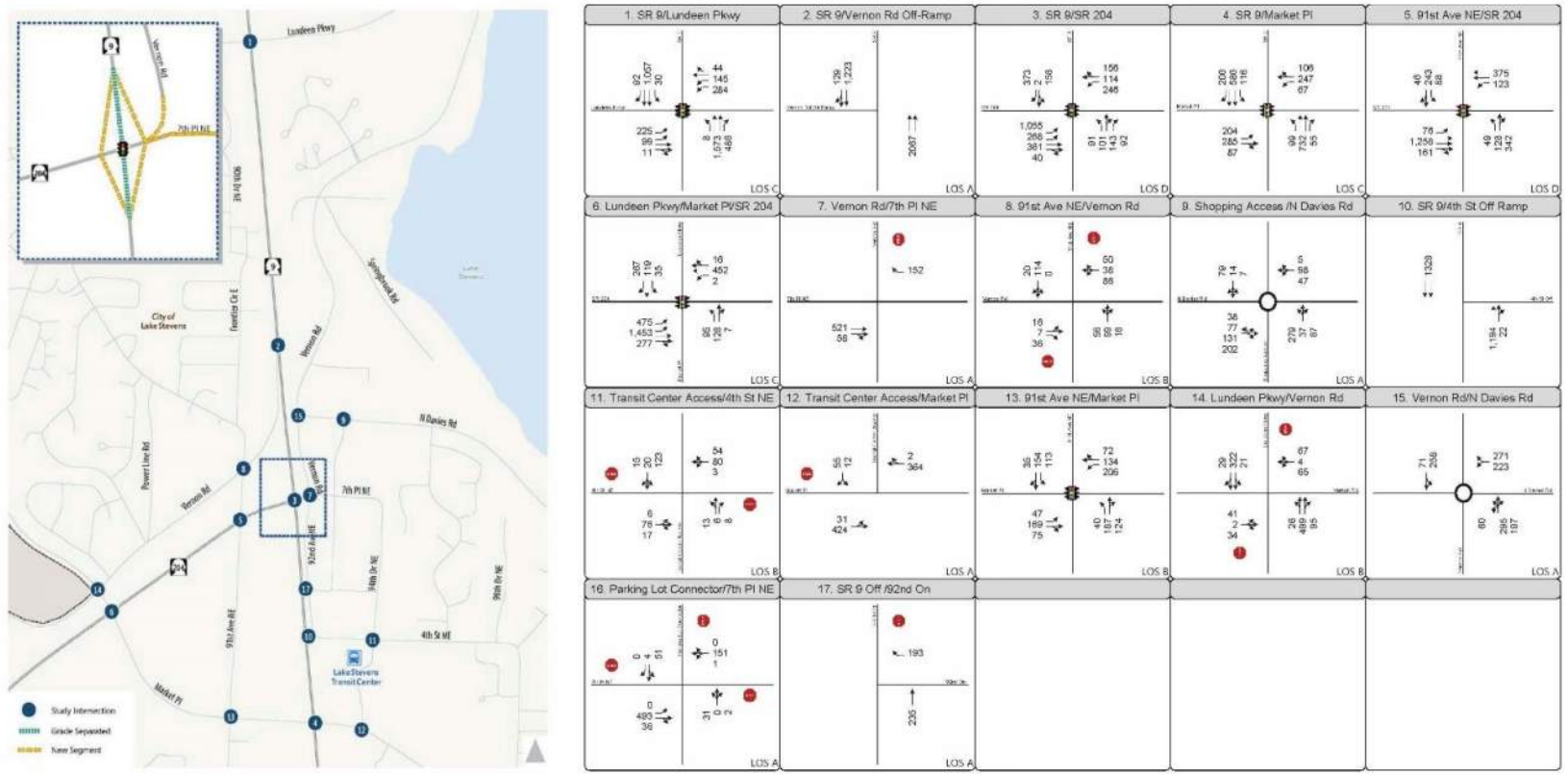

Figure 3-19. 2021 Preferred Alternative - Modified E2B Variation 4 PM Peak Hour

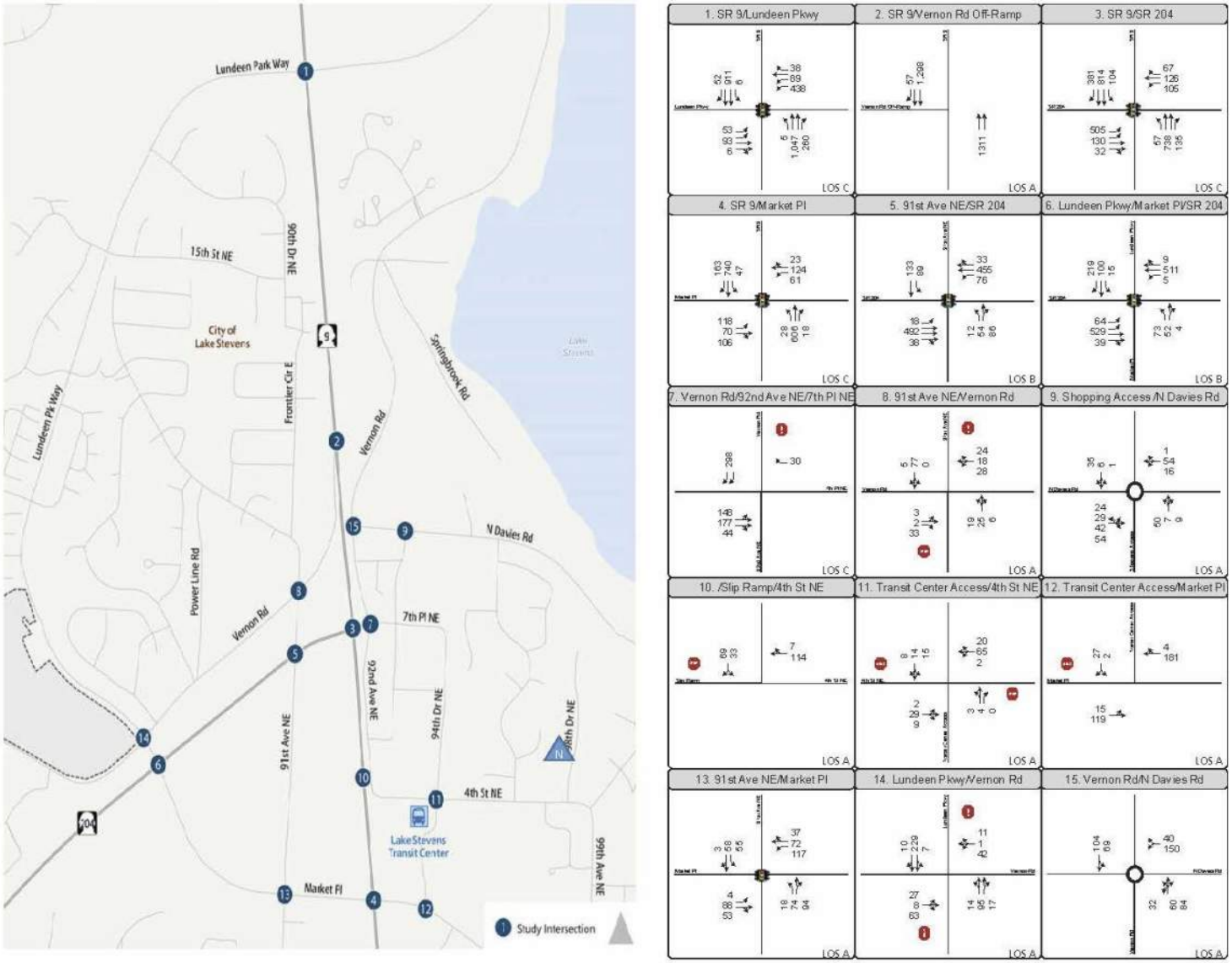

Figure 3-20. 2021 No Build AM Peak Hour

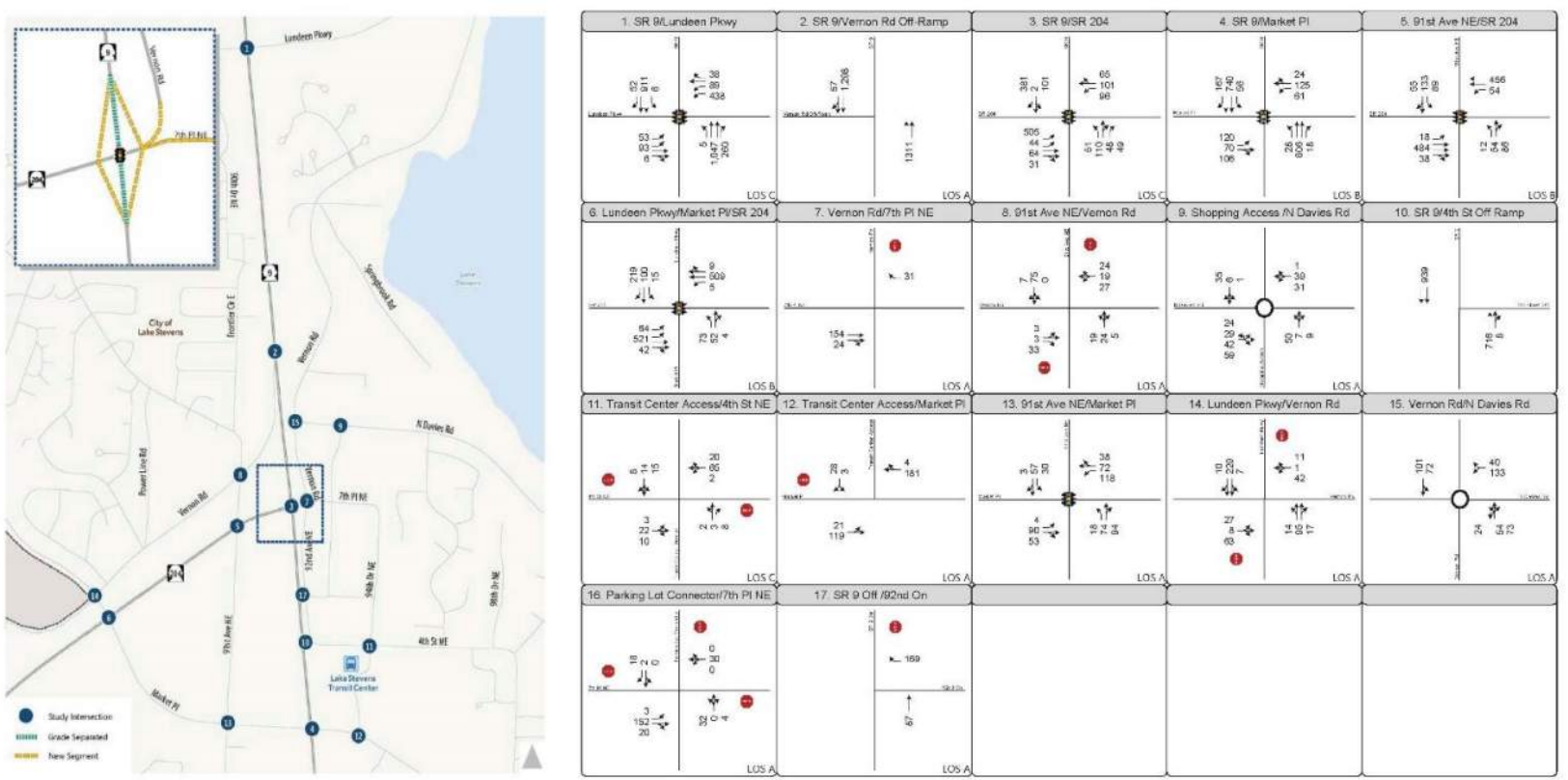

Figure 3-21. 2021 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative

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3.3.1 Travel Time

Travel times between key locations within the study area were estimated from the project models as a means of comparing the twelve Build Alternatives to the No Build condition. Travel time between the following seven key locations was measured:

1. SR 9 north of Lundeen Parkway
2. SR 9 south of Market Place NE
3. SR 204 west of Market Place NE/Lundeen Parkway
4. N Davies Road and access driveway to the Safeway parking area
5. 4th Street NE and 94th Drive NE
6. 91st Avenue NE Commercial District (near Ace Hardware)
7. Lundeen Parkway neighborhoods (near Vernon Road/91st Avenue NE intersection)

Figure 3-22 shows the overall study area and the seven locations. These locations were selected to illustrate how regional vehicle travel times would change (locations 1 through 3), as well as between key neighborhood origins and destinations within the study area (locations 4 through 7).

Transit travel time impact and benefits were measured by route. Currently, four Community Transit (CT) routes operate through the study area during the PM peak hour (CT 109, CT 209, CT 280, and CT 425).

Additionally, the analysis of non-motorized travel times focused on internal neighborhood origins/destination (locations 4 through 7). The technical process of estimating travel times between locations for each mode, which includes analyzing origin-destination pairs, and crossings at signalized intersections and locations is described in **Appendix F**.

Figure 3-22. Key Locations to Evaluate Travel Time

3.4 COLLISION ANALYSIS

The Highway Safety Manual (HSM) spreadsheet for urban and suburban arterials published by the American Association of State Highway and Transportation Officials (AASHTO) was used to forecast the collision rate for the future No Build and Build Alternatives as a means to compare the safety performance of each alternative. The Interchange Safety Analysis Tool (ISAT), published by the Federal Highway Administration (FHWA), was applied for certain alternatives to estimate collision rates at merge and diverge points, ramps, and for segments that operate more like a freeway than an arterial. The collision rates are generated based on roadway type, forecasted Annual Average Daily Traffic (AADT), geometric features of a roadway segment or an intersection (i.e. number of lanes, median width, shoulder width), speed limit, roadside fixed objects, signal control, proximity to alcohol establishments, proximity to schools, proximity to transit stops, and street lighting. Results of the collision analysis are provided in **Section 5**.

3.5 NON-ROADWAY TRANSPORTATION SYSTEMS

Non-roadway transportation systems including sidewalks, crosswalks/crossing signals, biking accommodations, and transit service were identified by reviewing existing local and regional plans, aerial imagery, and site visits. Referenced plans included the Lake Stevens Comprehensive Plan, the Lake Stevens Center Subarea Plan, and the Community Transit 2016 – 2021 Transit Development Plan. A detailed summary of these plans (including existing conditions and planned future non-motorized improvements) are provided in **Appendix G**. An overview of the existing non-roadway transportation systems is provided in **Section 4**.

3.6 COORDINATION

A Stakeholder Advisory Group (SAG) was formed to allow major project stakeholders an opportunity to understand and provide comment on project approach and ongoing findings, including the transportation analysis. SAG members provided input on the statement of the project needs, identification of performance metrics, alternative development and evaluation, and alternative selection and refinement. Members of the SAG included City of Lake Stevens, Washington Trucking Association, Snohomish County, Community Transit, Kimco Realty, TENW, Cascade Bicycle Club, Lake Stevens Chamber of Commerce, Boeing, and WSDOT.

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SECTION 4. AFFECTED ENVIRONMENT

4.1 STUDY AREA

The SR 9/SR 204 intersection is a major regional crossroads located in Lake Stevens, Snohomish County. This intersection serves a wide variety of both regional and local traffic including commuters, freight, and local business access. The transportation study area includes classified state and local roadways that may be impacted by or may benefit from improvements proposed for the SR 9/SR 204 intersection or the surrounding roadway network:

- SR 204: from Lundeen Parkway to SR 9
- SR 9: from Market Place NE to Lundeen Parkway
- Vernon Road: from SR 204 to N Davies Road
- 92nd Avenue NE: from 4th Street NE to 7th Place NE
- Lundeen Parkway: from Vernon Road to SR 204 (segment directly north of the SR 204/Lundeen Parkway/Market Place NE intersection).
- Vernon Road: from Lundeen Parkway to SR 9 southbound slip ramp
- Market Place NE: from SR 204 to 99th Avenue NE
- 91st Avenue NE: from Market Place NE to Vernon Road
- N Davies Road: from Vernon Road to 94th Drive NE (extension)
- 4th Street NE/99th Avenue NE: from Market Place to 7th Place NE

Study intersections for the traffic operations analysis are shown in **Figure 2-1**.

4.1.1 Roadway Network

The roadway network in the transportation study area consists of two state highways, SR 9 and SR 204, as well as minor arterials and collector streets. Both SR 9 and SR 204 are "partial control" limited access highways, as defined by WSDOT. This designation "provides a considerable level of protection from traffic interference and protects the highway from future strip-type development." Specific access control designations and requirements for the portions of SR 9 and SR 204 within the study area are defined in **Table 4-1**. Minor arterials, such as Lundeen Parkway and 91st Avenue NE (south of SR 204), serve to distribute traffic from the highways to local streets, which include collector arterials and local access streets. Collector streets in the study area include: Vernon Road, 91st Avenue NE (north of SR 204), Market Place NE, 4th Street NE, 92nd Avenue NE, and N Davies Road.

TABLE 4-1. ACCESS CONTROL DESIGNATIONS FOR STUDY AREA STATE ROUTES

Location Description	Milepost		Access Control Designation	
	Begin	End	Code	Control
SR 9 from Lake Avenue (98th Avenue SE) to N Davies Road	11.15	15.90	LP	Limited Partial Control [a]
SR 9 from N Davies Road to 201st Street NE	15.90	27.94	LP	Limited Partial Control [a]
SR 204 from US 2 ramps to 91st Avenue NE	0.08	2.25	LP	Limited Partial Control [a]
SR 204 from 91st Avenue NE to SR 9	2.25	2.35	M2	Managed Access Class 2 [b]

Source: WSDOT Access Control Tracking System

a. Limited Partial Control
   - At-grade intersections are allowed for selected public roads, and approaches for existing private driveways
   - No commercial approaches allowed
   - No direct access if alternate public road access is available

b. Managed Access Class 2
   - Access spaced 660' apart
   - No direct access unless property has no other reasonable access
   - No additional approaches for created parcels from property divisions
   - Permitted access goes away when alternate access available
   - Variance permits may be allowed

Speed limits for SR 9 are generally posted at 55 miles per hour (mph) but are lowered to 40 mph in both directions from the Vernon Road off-ramp to just south of Market Place. On SR 204, the posted speed limit is 35 mph from Market Place NE/Lundeen Parkway to SR 9. Speeds of minor and collector arterials in the study area range from a minimum speed of 15 mph to a maximum of 35 mph. The minor arterials intersect with smaller collector arterials, local access roads, and driveways.

4.1.2 Freight

Some of the study area roadway segments are designated as truck routes under the Washington State Freight and Goods Transportation System (FGTS) and are classified by the annual tonnage carried on the segment. The FGTS classifications range from T2 roads (4 million to 10 million annual tons) to T3 (300,000 to 4 million annual tons) to T4 (100,000 to 300,000 annual tons), as listed below:

- T2 (4 million to 10 million annual tons)
  - SR 9
- T3 (300,000 to 4 million annual tons)
  - SR 204
  - Market Place
  - 91st Avenue NE
  - Vernon Road from SR 204 to N Davies Road
  - N Davies Road
- T4 (100,000 to 300,000 annual tons)
  - Vernon Road from 81st Avenue SE to SR 204

4.1.3 Parking

On-street parking is generally not provided or allowed throughout the study area. However, approximately 30 on-street parallel parking stalls are available along Vernon Road (between Lundeen Parkway and 91st Avenue NE) and about five stalls are available on N Davies Road (east of the Safeway driveway). The remaining parking supply is provided in off-street lots.

4.1.4 Pedestrian and Bicyclist Facilities

Both SR 9 and SR 204 provide wide shoulders which can serve as pedestrian and bicycle facilities within the transportation study area. Controlled crossing opportunities exist only at signalized intersections. On city maintained arterials, conditions vary – some corridors have sidewalks on both sides, others have sidewalks only on one side, and many locations provide no sidewalks. Some notable gaps in the existing pedestrian network are as follows:

- Along 92nd Avenue NE from 4th Street NE to the Vernon Road/7th Place NE intersection.
- Along Vernon Road from 7th Place NE to N Davies Road.
- Along Vernon Road from Power Line Road to the driveway directly northeast of the Vernon Road/Lundeen Parkway intersection.

Dedicated bicycle facilities in the study area are limited to:

- Bike lanes along both sides of Lundeen Parkway from SR 9 to SR 204
- Bike lanes on Market Place NE from SR 204 to 99th Avenue NE
- Sharrows on N Davies Road between Vernon Road and 96th Avenue NE

Figure 4-1 shows the bicycle and pedestrian facilities in the study area. Overall, pedestrian and bicycle activity in the area is minimal based on collected data and on field observations completed July 13, 2016. The data suggests there is more pedestrian and bicycle activity near the transit center and the commercial area along 91st Avenue NE and Market Place NE where most transit users board and alight. Most of the activity is during the PM peak period. During the AM peak hour, pedestrian volumes are substantially lower with only one or two pedestrians crossing the key intersections.

Figure 4-1. Existing Dedicated Pedestrian and Bicyclist Facilities

4.1.5 Transit Facilities and Service

The study area is served by four transit routes operated by Community Transit. These routes are:

- Route 109: connects Lake Stevens to the Ash Way Park & Ride. The route originates at the Lake Stevens Transit Center and runs along 4th Street NE, 99th Avenue NE, and Market Place NE to SR 9 toward the Ash Way Park & Ride.
- Route 209: connects Lake Stevens to the Quil Ceda Village in Tulalip. The route begins at the Lake Stevens Transit Center and operates along SR 9. The route accesses the transit center via Market Place NE and accesses SR 9 via 4th Street NE.
- Route 280: connects the Boeing Plant in Everett and the Granite Falls Park & Ride. This route operates on SR 9 to the Lake Stevens Transit Center, through Market Place NE and 91st Avenue NE.
- Route 425: connects Lake Stevens to Downtown Seattle. The route originates at the Lake Stevens Transit Center and operates along the following streets in the study area: 4th Street NE, 99th Avenue NE, Market Place NE, and 91st Avenue NE to Downtown Seattle via the Lynnwood Transit Center.

Figure 4-2 shows the transit routes, stops, and daily boarding and alighting activity in the study area. **Tables 4-2** and **4-3** summarize bus service information and the number of average daily boardings and alightings by stop, as reported by Community Transit for October 2016. The boarding and alighting data is typical for a low density suburban area like Lake Stevens. Most boarding and alighting activity is concentrated at the stops adjacent to Market Place/91st Avenue NE and the Transit Center.

TABLE 4-2. COMMUNITY TRANSIT BUS SERVICE THROUGH STUDY AREA

Route Number	Route Name	Weekday Frequency (minutes)	Approximate Time of Service
CT 109	Lake Stevens to Ash Way Park & Ride	30	5:00 AM – 10:00 PM
CT 209	Lake Stevens to Quil Ceda Village	30	6:00 AM – 9:30 PM
CT 280	Lake Stevens/Granite Falls to Everett	30	5:00 AM – 9:30 PM
CT 425	Lake Stevens to Downtown Seattle	30 – 35	5:20 AM – 8:00 AM; 3:30 PM – 6:30 PM

Source: Community Transit, September 2016.

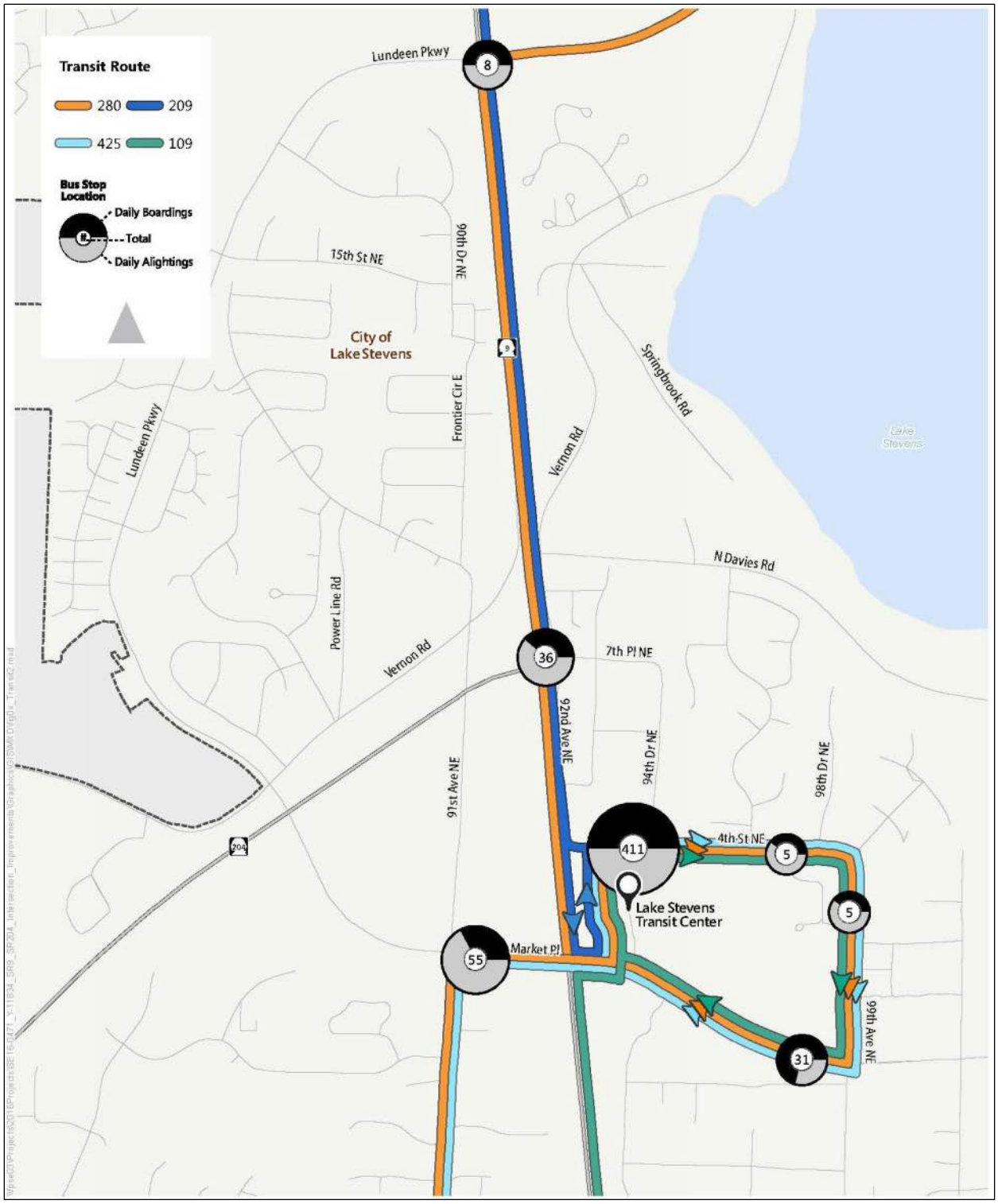

Figure 4-2. Existing Transit Routes and Stop Activity

TABLE 4-3. AVERAGE DAILY BOARDING AND ALIGHTING BY TRANSIT STOP

Stop ID	Stop Name	Route	Average Daily Boardings	Average Daily Alightings
454	Lundeen Pkwy & Hwy 9	280	0	3
469	Market Pl & 91st Ave NE	280	7	31
994	Hwy 9 & Lundeen Pkwy	209	1	0
995	Hwy 9 & Hwy 204	209	4	1
		280	6	5
1491	Hwy 9 & Lundeen Pkwy	209	0	1
		280	3	0
1492	Hwy 9 & Hwy 204	209	0	5
		280	4	11
1833	Market Pl & 91st Ave NE	425	10	0
		280	31	6
2665	Lake Stevens Transit Center Bay 1	209	40	43
		425	52	49
2666	Lake Stevens Transit Center Bay 2	280	49	43
		109	64	71
2669	4th St NE & 97th Dr NE	280	2	3
		109	0	0
		425	0	0
2670	99th Ave NE & 4th St NE	280	1	3
		109	0	0
		425	1	0
2671	Market Pl & 99th Ave NE	280	17	8
		109	4	1
		425	1	0

Source: Community Transit. Data collected in September 2016.
Note: Boardings and alightings are well balanced across the selected stops, however stops across the street are not paired leading to the appearance of an imbalance.

4.1.6 Marine, Rail, and Air Transportation Systems

No marine, rail, or air transportation systems are located within or directly affect the transportation study area.

4.1.7 Emergency Services and Response Times

Lakes Stevens Fire Station 82 is located near the transportation study area on 99th Avenue SE near Market Place. Emergency response times can depend largely on congestion levels along nearby local and regional access routes such as Market Place, SR 9, and SR 204.

4.2 EXISTING OPERATING CONDITIONS

The existing operating conditions for intersections in the SR 9/SR 204 study area were determined for AM and PM peak hour conditions. As described in **Section 3**, traffic operations were analyzed using a validated Vissim microsimulation model.

4.2.1 Intersection Counts

Intersection turning movement counts were compiled from 2013-2015 WSDOT data and AM and PM peak period turning movement counts were collected in June and July 2016. These counts were adjusted to account for growth between 2013 and 2016, seasonal peaking, and volume balancing between intersections by the methods described in **Section 3.2**. The intersection lane configurations and adjusted, balanced counts for the AM and PM peak hours are shown in **Figures 4-3** and **4-4**.

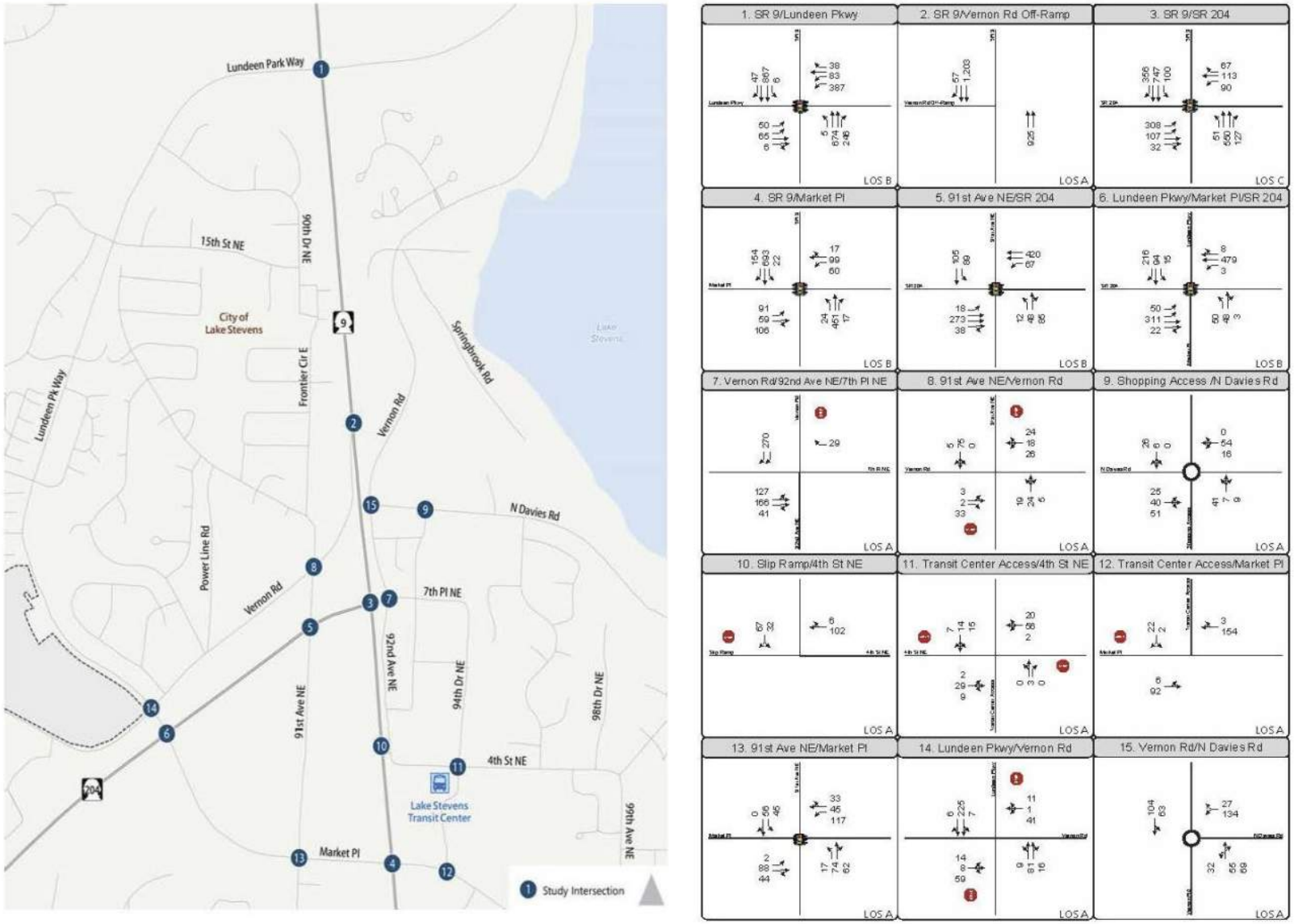

Figure 4-3. AM Existing Peak Hour Turning Movement Counts

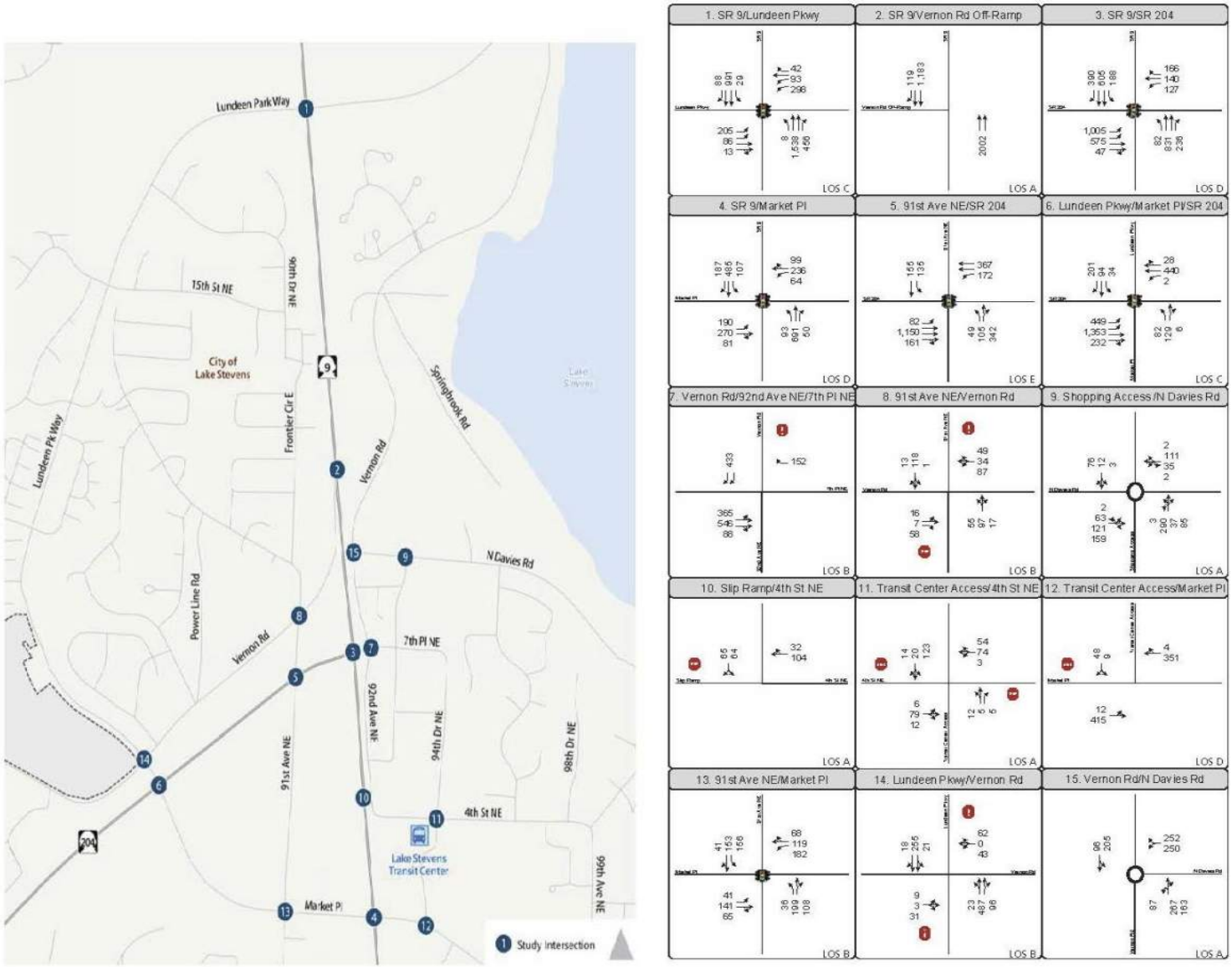

Figure 4-4. PM Existing Peak Hour Turning Movement Counts

4.2.2 Intersection Operations Results

This section presents the results of the intersection operations analysis. **Table 4-4** summarizes the AM peak hour LOS results and **Table 4-5** summarizes the PM peak hour results. A detailed description of Vissim model validation and operational outputs are provided in **Appendix D**.

TABLE 4-4. EXISTING AM PEAK HOUR INTERSECTION LEVEL OF SERVICE RESULTS (APPROACH AND OVERALL)

			Approach Delay (seconds) and Level of Service				Overall
#	Intersection	Control	NB	SB	EB	WB	
1	SR 9/Lundeen Pkwy	Signal	14 (B)	16 (B)	41 (D)	33 (C)	19 (C)
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	n/a	n/a	n/a[a]
3	SR 9/SR 204	Signal	22 (C)	19 (B)	34 (C)	30 (C)	21 (C)
4	SR 9/Market Pl	Signal	16 (B)	20 (B)	28 (C)	33 (C)	20 (B)
5	91st Ave/SR 204	Signal	15 (B)	23 (C)	24 (C)	19 (B)	19 (B)
6	Lundeen Pkwy/SR 204	Signal	17 (B)	12 (B)	8 (A)	14 (B)	11 (B)
7	Vernon Rd/7th Pl	Side-street Stop			1 (A)	7 (A)	8 (A)
8	91st Ave/Vernon Rd	Side-street Stop	1 (A)	0 (A)	6 (A)	3 (A)	6 (A)
9	Safeway Dwy/Davies Rd	Roundabout	1 (A)	1 (A)	1 (A)	1 (A)	1 (A)
10	SR 9/4th St On-Ramp	Side-street Stop		2 (A)		0 (A)	2 (A)
11	Transit Center Dwy/4th St	Side-street Stop	0 (A)	7 (A)	0 (A)	0 (A)	7 (A)
12	Transit Dwy/Market Pl	Side-street Stop		5 (A)	1 (A)	0 (A)	6 (A)
13	91st Ave/Market Pl	Signal	7 (A)	7 (A)	2 (A)	6 (A)	6 (A)
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0 (A)	2 (A)	8 (A)	6 (A)	8 (A)
15	Vernon Rd/Davies Rd	Roundabout	1 (A)	2 (A)		2 (A)	2 (A)

a. Location operates as an uncontrolled diverging off-ramp for southbound SR 9 traffic onto Vernon Road and 91st Avenue NE. By definition, this location does not create control delay from any approach.

All intersections operate at an overall LOS of C or better during the AM peak hour.

TABLE 4-5. EXISTING PM PEAK HOUR INTERSECTION LEVEL OF SERVICE RESULTS (APPROACH AND OVERALL)

			Approach Delay (seconds) and Level of Service				Overall
#	Intersection	Control	NB	SB	EB	WB	
1	SR 9/Lundeen Pkwy	Signal	20 (C)	14 (B)	52 (D)	47 (D)	23 (C)
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	n/a	n/a	n/a[a]
3	SR 9/SR 204	Signal	51 (D)	31 (C)	22 (C)	62 (E)	35 (D)
4	SR 9/Market Pl	Signal	43 (D)	41 (D)	91 (F)	100 (F)	52 (D)
5	91st Ave/SR 204	Signal	69 (E)	61 (E)	80 (F)	42 (D)	66 (E)
6	Lundeen Pkwy/SR 204	Signal	28 (C)	16 (B)	35 (C)	34 (C)	27 (C)
7	Vernon Rd/7th Pl	Side-street Stop			1 (A)	11 (B)	11 (B)
8	91st Ave/Vernon Rd	Side-street Stop	1 (A)	8 (A)	15 (C)	8 (A)	13 (B)
9	Safeway Dwy/Davies Rd	Roundabout	7 (A)	5 (A)	2 (A)	5 (A)	4 (A)
10	SR 9/4th St On-Ramp	Side-street Stop		1 (A)		0 (A)	2 (A)
11	Transit Center Dwy/4th St	Side-street Stop	4 (A)	9 (A)	1 (A)	0 (A)	10 (A)
12	Transit Dwy/Market Pl	Side-street Stop		28 (D)	3 (A)	36 (E)	33 (D)
13	91st Ave/Market Pl	Signal	31 (C)	19 (B)	7 (A)	17 (B)	14 (B)
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	2 (A)	2 (A)	11 (B)	6 (A)	12 (B)
15	Vernon Rd/Davies Rd	Roundabout	5 (A)	5 (A)		9 (A)	6 (A)

a. Location operates as an uncontrolled diverging off-ramp for southbound SR 9 traffic onto Vernon Road and 91st Avenue NE. By definition, this location does not create control delay from any approach.

As shown in the tables above, the PM peak hour delays are higher than those in the AM peak hour. This result is due to a considerable increase in traffic demand during the PM peak hour compared to the AM peak.

The SR 204/91st Avenue intersection operates at LOS E, exceeding the LOS D standard set by WSDOT. Vehicles experience the largest delays along SR 9 at the Market Place intersection.

Along SR 204, vehicles travelling eastbound through the Market Place, 91st Avenue NE, and SR 9 intersections experience heavy queuing and delay at each signalized intersection. The short length of the segment of SR 204 between 91st Avenue NE and SR 9 and coordination between the signals leads to LOS C for the eastbound approach at the SR 9/SR 204 intersection, this reflects that delay is experienced at the upstream signal.

All the local street intersections operate at an acceptable level per the City of Lake Stevens standard of LOS E. Although meeting the standard, the Transit Center Driveway/Market Place intersection is shown to have high westbound delay (LOS E) because the queue from the SR 9/Market Place intersection extends back through the Transit Center Driveway access.

More detailed information about the intersection operations can be found in **Appendix D**.

4.3 COLLISION ANALYSIS

This section presents the result of a vehicle collision analysis. The focus of the analysis is on the state facilities (SR 9 and SR 204) from January 2011 to December 2015 to identify locations with safety concerns and the contributing circumstances. Vehicle collision data were obtained from WSDOT, which includes various details about the collisions: type, probable cause, severity, time of day, and weather conditions. Over the five year study period, there were a total of 446 collisions in the study area.

Using the data collected, the consultant team calculated collision rates for intersections and roadway segments along SR 9 and SR 204 using a methodology developed by the FHWA. The rates were calculated to allow comparison of collision rates between locations in the study area and around the state. In addition to the FHWA Method, the methods identified in the AASHTO *Highway Safety Manual* (HSM) were also applied using the HSM spreadsheet for urban and suburban arterials.

Additional details regarding the data collected and methodology of the analysis can be found in **Appendix D**.

4.3.1 Results – FHWA Method

Collision rates per million entering vehicles (MEVs) for intersections and million vehicle miles of travel (MVMT) for road segments along SR 9 and SR 204 are summarized below in **Figure 4-5** as well as **Table 4-6** and **Table 4-7**.

Figure 4-5. Existing Collision Rates

TABLE 4-6. ANNUAL AVERAGE INTERSECTION COLLISION RATES 2011-2015

Intersection	Type of Collision			5-Year Total	ADT	Collision Rate (per MEV)
	Fatal	Injury	Property Damage Only			
SR 9 and Lundeen Parkway	0	17	41	58	38,470	0.83
SR 9 and Vernon Ramp	0	0	0	0	13,020	0.00
SR 9 and SR 204	1	14	52	67	43,920	0.84
SR 9 and Market Place NE	0	15	37	52	25,530	1.12
SR 204 and 91st Avenue NE	0	16	28	44	28,450	0.85
SR 204 and Market Place NE/Lundeen Parkway	0	17	35	52	30,500	0.93
Vernon Road and 7th Place NE/92nd Avenue NE	0	0	2	2	13,520	0.08
SR 9 and 4th Street NE slip ramp	0	0	5	5	11,490	0.24

TABLE 4-7. ANNUAL AVERAGE ROADWAY SEGMENT COLLISION RATES 2011-2015

Segments	Segment Length (mi)	Type of Collision			5-Year Total	ADT	Collision Rate (per 100 MVMT)
		Fatal	Injury	Property Damage Only			
SR 9 from Soper Hill Road to Lundeen Parkway	0.6	0	22	28	70	28,930	221.0
SR 9 from Lundeen Parkway to Vernon Slip Ramp	0.5	2	10	6	16	33,040	53.1
SR 9 from Vernon Slip Ramp to SR 204	0.25	0	0	1	1	31,850	6.9
SR 9 from SR 204 to 4th St NE Slip Ramp	0.18	0	2	3	5	19,280	79.0
SR 9 from 4th St NE Slip Ramp to Market Place NE	0.16	0	3	3	6	19,280	106.6
SR 9 from Market Place NE to 4th Street SE	0.37	1	8	16	24	14,640	242.8
SR 204 from 81st Avenue NE to Market Place NE	0.6	1	8	18	26	27,570	86.1
SR 204 from Market Place NE to 91st Avenue NE	0.3	0	2	2	4	18,630	39.2
Vernon Road from SR 204/92nd Avenue NE/7th Place NE to N Davies Road	0.1	0	0	1	1	8,630	63.5

Based on a previous study done by the University of Wisconsin for the Wisconsin Department of Transportation (WisDOT), the average collision rate for intersections that share similar characteristics as those evaluated in the study area is 0.82 per MEV (WSDOT does not have statewide intersection collision rate data). These characteristics include intersections in incorporated areas with 25,000 or more average daily entering volumes. For intersections with fewer than 15,000 daily entering vehicles (e.g. Vernon Road and 7th Place NE/92nd Avenue NE), the average collision rate is 1.33.

The following intersections in the study area have a higher collision rate than 0.82 per MEV:

- SR 9/Market Place NE (1.12 per MEV)
- SR 204/Market Place NE/Lundeen Parkway (0.93 per MEV)
- SR 204/91st Avenue NE (0.85 per MEV)
- SR 9/SR 204 (0.84 per MEV)
- SR 9/Lundeen Parkway (0.83 per MEV)

Along roadway segments, Snohomish County averages about 221.3 collisions per 100 million vehicle miles traveled according to the 2014 Statewide Annual Collision Summary published by WSDOT.[3] The roadway segments in the study area with collision rates approximately equal to or greater than the county average are:

- SR 9 from Market Place NE to 4th Street SE (242.8 per MVMT)
- SR 9 from Soper Hill Road to Lundeen Parkway (221.0 per MVMT)

The detailed reports indicate that 446 collisions were reported in the study area where approximately 63 percent of the collisions were at an intersection, 34 percent of collisions were along roadway segments, and the remainder occurred at or near a driveway in the study area. More than 50 percent of all the collisions were rear-end collisions, mostly due to driver inattention. Additional study area collision statistics are summarized in **Table 4-8**.

[3] The 2014 study was the most recent study published at the time of this analysis.

TABLE 4-8. COLLISION SUMMARY STATISTICS

Category	Number	Percent of Total[a]
Rear-End Collisions	242	54%
Single Vehicle Collisions	42	9%
Exceeding Reasonably Safe Speed	34	8%
Under Influence of Alcohol/Drugs	15	3%
Bike Collisions	0	0%
Pedestrian Collisions	6	1%
Injury Collisions	133	30%
Fatal Collisions	5	1%
Night Time Collisions	114	26%
Wet/ice/snow Conditions	184	41%
Total Collisions in study area	**446**	**100%**

a. Column sums to more than 100% because several collision characteristics can occur simultaneously.

The table above shows that about 30 percent of all collisions in the study area resulted in an injury or fatality. Of the 446 collisions, 133 resulted in an injury, and five resulted in a fatality. This is slightly lower than the Lake Stevens citywide average for fatal and injury collisions from 2010 to 2014 – about 33 percent of all collisions recorded were fatal or injury collisions. The dates, locations, and contributing circumstances for each of the fatalities is listed below and is shown on **Figure 4-6**.

- December 7, 2012, 10:45 PM (two fatalities) – 230 feet north of Vernon Road off-ramp; dry, nighttime conditions with no street lights, four vehicles involved, head-on collision, driver under influence of drugs.
- October 23, 2013, 11:29 AM – At SR 204/81st Avenue NE intersection; dry, daytime conditions, two vehicles involved, left turning vehicle did not grant right of way to through vehicle.
- November 23, 2013, 6:46 PM – At SR 9/SR 204 intersection; dry, nighttime conditions with street lights on, one vehicle involved, collision with street light pole or base.
- April 19, 2015, 1:21 PM – 770 feet south of SR 9/Lundeen Pkwy intersection; dry, daytime conditions, three vehicles involved, inattention, rear-end collision.
- September 8, 2015, 6:09 AM – At SR 9/4th St SE intersection; dry, dawn, one vehicle and one pedestrian involved, vehicle going straight hits pedestrian.

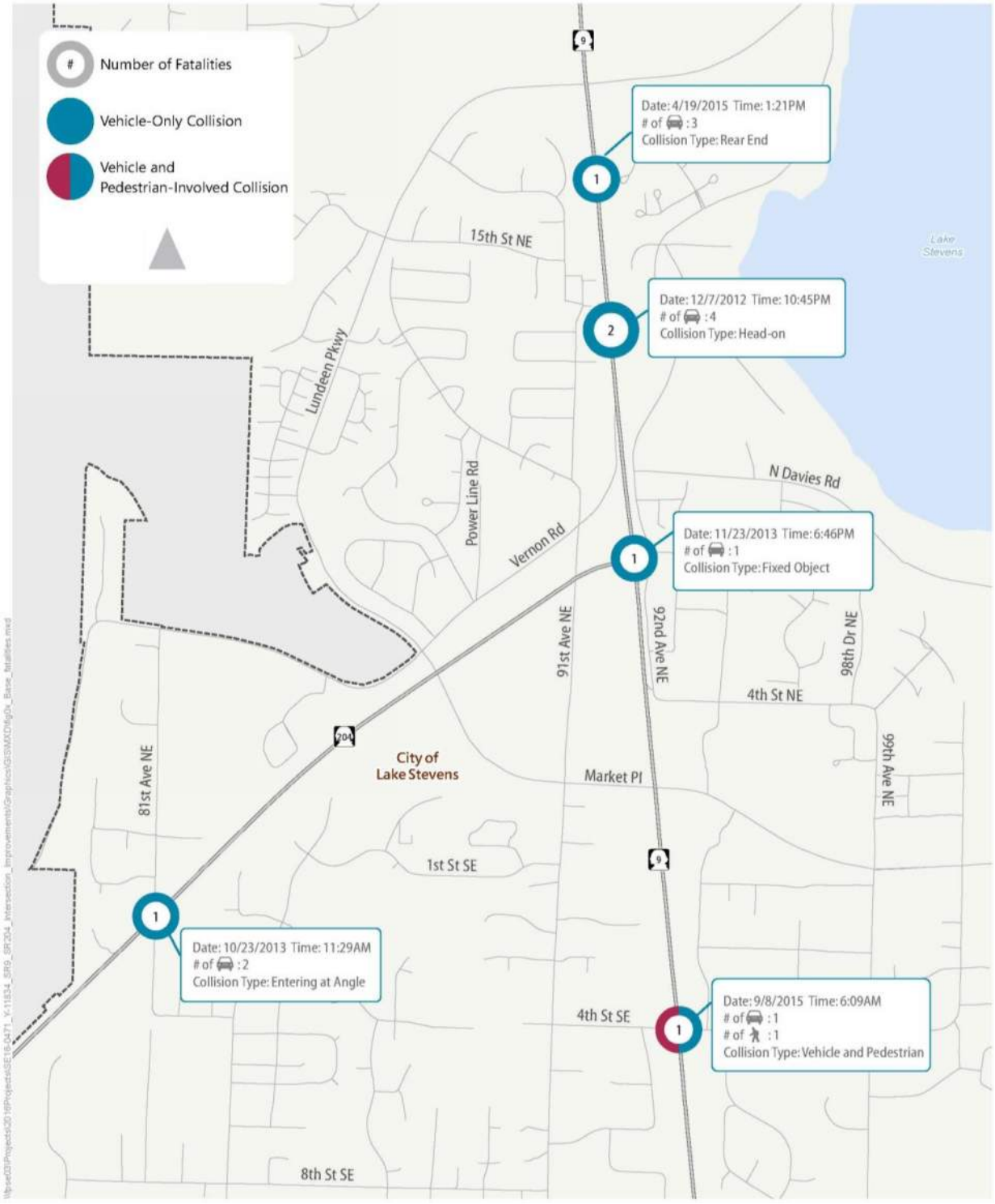

Figure 4-6. Existing Collisions Resulting in a Fatality

4.3.2 Results – HSM Method

The existing roadway was entered into the HSM spreadsheet for urban and suburban arterials for comparison with actual conditions. **Table 4-9** provides a summary of the predicted and expected average crash frequency (calculated from the existing collision data). The "KABCO" injury scale used in Table 4-9 was developed by the National Safety Council and is used to classify injuries accordingly:

- K – Fatal
- A – Incapacitating injury
- B – Non-incapacitating injury
- C – Possible injury
- O – No injury/Property damage only

TABLE 4-9. SUMMARY OF ANTICIPATED PERFORMANCE BY SEGMENT AND INTERSECTION

Project Element	Safety performance		
	Predicted average crash frequency (crashes/yr)	Expected average crash frequency (crashes/yr)	Potential for Improvement (crashes/yr)
INDIVIDUAL SEGMENTS			
SR 9 from Soper Hill Road to Lundeen Parkway	3.7	*11.7*	8.0
SR 9 from Lundeen Parkway to Vernon Slip Ramp	5.5	3.6	0.0
SR 9 from Vernon Slip Ramp to SR 204	2.6	1.3	0.0
SR 9 from SR 204 to 4th Street NE Slip Ramp	1.0	1.0	0.0
SR 9 from 4th Street NE Slip Ramp to Market Place NE	0.9	*1.0*	0.1
SR 9 from Market Place NE to 4th Street SE	1.3	*2.6*	1.3
SR 204 from 81st Avenue NE to Market Place NE	5.2	4.7	0.0
SR 204 from Market Place NE to 91st Avenue NE	1.6	1.1	0.0
Vernon Road from SR 204/92nd Avenue NE/7th Place NE to N Davies Road	0.3	0.3	0.0
INDIVIDUAL INTERSECTIONS			
SR 9 and Lundeen Parkway	10.6	*12.2*	1.6
SR 9 and Vernon Ramp	0.1	0.1	0.0
SR 9 and SR 204	12.3	*13.9*	1.6
SR 9 and Market Place NE	9.5	*11.0*	1.5
SR 204 and 91st Avenue NE	10.0	*11.1*	1.1
SR 204 and Market Place NE/Lundeen Parkway	12.1	11.4	0.0
Vernon Road and 7th Place NE/92nd Avenue NE	1.2	0.9	0.0
SR 9 and 4th Street NE slip ramp	0.2	0.2	0.0
COMBINED (sum of column)	78.1	88.1	10.0

Areas in **Table 4-9** with the expected average crash frequency italicized are locations with a potential for safety improvements. These include the following roadway segments and intersections:

- SR 9 segment from Soper Hill Road to Lundeen Parkway
- SR 9 segment from 4th Street NE Slip Ramp to Market Place NE
- SR 9 segment from Market Place NE to 4th Street SE
- SR 9 and Lundeen Parkway intersection
- SR 9 and SR 204 intersection
- SR 9 and Market Place NE intersection
- SR 204 and 91st Avenue NE intersection

It is important to note that the HSM methods can identify potential collision "hot spots" along the corridor, but there is no guaranteed solution to these hot spots. These findings do not definitively identify areas that require immediate attention to address safety concerns as even with five years of collision data, the sample size for these roadway segments and intersections is still relatively small and subject to random variation.

SECTION 5. POTENTIAL EFFECTS

This section describes the direct, indirect, and cumulative transportation impacts of the project on the transportation systems, features, and elements and indicates whether the project is likely to have more than a moderate effect on transportation conditions in the study area.

5.1 2040 OPERATIONS

Traffic operations in the 2040 horizon year were analyzed to compare forecasted traffic conditions under the No Build Alternative with the various Build Alternatives and the Preferred Alternative. The methods by which Vissim was used to analyze the No Build and Build Alternatives is described in **Section 3**. Detailed operational outputs from Vissim, including intersection delay and LOS, approach delay and LOS, and queuing, are included in **Appendix H**. The following sections provide a summary of intersection delay and LOS results.

5.1.1 No Build Alternative

5.1.1.1 Future Network

The No Build Alternative was evaluated using the same project transportation network assumptions as the existing conditions analysis. The vehicle volume input and routing to the Vissim traffic operations model was updated to reflect forecasted vehicle demand through the study area (described in **Section 3**).

5.1.1.2 Level of Service and Delay

The intersection level of service results for the AM and PM peak hour are shown in **Table 5-1**. All intersections would operate at an overall average LOS D or better during the 2040 AM peak hour. The westbound approach of the SR 9/SR 204 intersection would experience long delays (operating at LOS F conditions), as the signal timing favors the eastbound left movement. The eastbound approach at SR 9/Market Place is also expected to experience long delays (operating at LOS F conditions with 114 seconds of delay), as the signal timing favors the north-south movement on SR 9.

Similar to existing conditions, 2040 PM peak period delays would be higher than the AM peak period. This result is due to a considerable increase in traffic demand during the PM peak hour compared to the AM peak hour. The 2040 AM peak period is expected to have approximately 4,100 vehicles traveling through the SR 9/SR 204 intersection, while the PM peak period would have 5,600 vehicles, almost one-third more than the AM total.

By 2040, PM peak hour vehicle demand is forecasted to increase to a level where certain intersections not only exceed the LOS D standard, but also begin to exceed capacity with expected LOS F operations and average delay of over 80 seconds per vehicle. These include SR 9/Market Place, Safeway Driveway/Davies Road, and Vernon Road/Davies Road. Specific issues identified at these intersections are described below:

- The SR 9/Market Place intersection operates at LOS F during the PM peak hour as all approaches have vehicle demand greater than existing capacity. This intersection creates a bottleneck with two southbound through lanes dropping to one lane approaching the Market

Place intersection, and the outside lane becoming a right-turn only lane. The demand on this southbound approach is expected to increase by approximately 550 vehicles during the PM peak hour compared to existing conditions. Modeling of the 2040 No Build scenario suggests that during the peak 15 minutes of the analysis hour, the southbound queues could at times extend to the SR 9/SR 204 intersection, blocking the flow of southbound-through, eastbound-right, and westbound-left traffic through that intersection.

- Both intersections on Davies Road (Vernon Road and the Safeway Driveway) are expected to operate at LOS F during the PM peak hour, primarily due to the queues spilling back from the westbound approach at the SR 9/SR 204 study intersection. Signal timing at this intersection serves the higher regional traffic demand of the eastbound left movement, limiting the westbound approach green time.

The following intersections are expected to operate at LOS E in the 2040 PM No Build Scenario and exceed WSDOT's LOS D standard: SR 9/SR 204 and SR 204/91st Avenue NE.

- The SR 9/204 intersection is expected to operate at LOS E with signal timing that favors regional throughput from the eastbound left movement. This can cause additional delay to the westbound approach, which factors into the LOS F operations of the two intersections on Davies Road.
- The SR 204/91st Avenue NE intersection experiences additional delay as the eastbound and westbound approach volumes are expected to increase by almost 200 vehicles in each direction compared to existing conditions. Optimized signal timing to accommodate a slightly higher northbound approach volume also adds delay to eastbound approach vehicles, which further degrades the overall intersection operations.

Signal timing on SR 9 is set to provide more time to the higher north-south vehicle demand so side-street approaches such as at Market Place may experience queueing back to 91st Avenue NE to the west and the Transit Center driveway to the east. Likewise, the intersections along SR 204 have signal timings with more green time to serve the major eastbound and westbound through movements. The intersection at 91st Avenue NE is coordinated with the SR 9 signal, and meters the amount of vehicle demand approaching the SR 9/SR 204 intersection. Generally, queues clear at 91st Avenue NE and SR 9 within one or two cycles. A slight increase in the eastbound left traffic volumes and a larger increase in the eastbound through volumes into Frontier Village could cause queues at the SR 9/SR 204 intersection to extend past 91st Avenue NE at times.

TABLE 5-1. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2040 NO BUILD

ID	Location	Control[a]	AM Peak Hour				PM Peak Hour			
			Existing AM		2040 No Build		Existing		2040 No Build	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	18	B	21	C	23	C	36	D
2	SR 9/Vernon Rd Off-Ramp	n/a	1	A	2	A	2	A	8	A
3	SR 9/SR 204	Signal	21	C	37	D	35	D	57	E
4	SR 9/Market Pl	Signal	19	B	39	D	52	D	100	F
5	91st Ave/SR 204	Signal	18	B	22	C	60	E	65	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	10	B	12	B	26	C	29	C
7	Vernon Rd/7th Pl	SSSC	8	A	8	A	11	B	18	C
8	91st Ave/Vernon Rd	SSSC	6	A	10	B	13	B	12	B
9	Safeway Dwy/Davies Rd	RAB	1	A	1	A	4	A	107	F
10	SR 9/4th St On-Ramp	SSSC	2	A	2	A	2	A	2	A
11	Transit Center Dwy/4th St	SSSC	7	A	10	A	9	A	9	A
12	Transit Center Dwy/Market Pl	SSSC	6	A	6	A	33	D	29	D
13	91st Ave/Market Pl	Signal	6	A	17	B	13	B	24	C
14	Lundeen Pkwy/Vernon Rd	SSSC	8	A	10	A	11	B	14	B
15	Vernon Rd/Davies Rd	RAB	1	A	2	A	6	A	95	F

a. SSSC = side-street stop controlled
RAB = roundabout

n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

5.1.2 Build Alternatives

5.1.2.1 Alternative Concepts

An overview of the Build Alternatives analyzed for potential effects under 2040 PM peak hour conditions is provided above in **Table 2-1**. The conceptual drawing of the Build Alternatives are provided in **Appendix C**.

5.1.2.2 Level of Service and Delay

A description of traffic control and access changes under each Build Alternative and the expected traffic operations during the PM peak hour for the 2040 horizon year are described below. PM peak hour delay and LOS results are summarized in **Table 5-2**. Analysis of the AM peak hour analysis was only completed for the Preferred Alternative and is summarized in **Table 5-3**.

- **Alternative B** – Includes three roundabout intersections along SR 9 at Vernon Road/Davies Road, SR 204, and 4th Street NE, as well as grade separation of the north-south SR 9 mainline at Vernon Road/Davies Road and SR 204. To the east of SR 9, 92nd Avenue NE would be closed, and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.
  - This alternative improves access to Frontier Village with the three new roundabouts on SR 9. While intersection operations would improve compared to the No Build option with operations improving from LOS E (58 seconds) to LOS C (22 seconds), the SR 9/SR 204 roundabout design required a three-lane section due to the high vehicle demand at the eastbound approach. This alternative was considered unfeasible due to the three-lane roundabout.
- **Alternative C** – Addition of a northbound right-turn slip ramp from SR 9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed, and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.
  - Traffic operations under Alternative C would improve slightly over the No Build option. The new access improvements to Frontier Village at 4th Street NE along with the new Village Way would facilitate vehicle circulation through the shopping mall area. Access out of Frontier Village would also improve as drivers would not have to make the circuitous u-turn around the Davies/Vernon roundabout that is required today.
- **Alternative E** – Includes the addition of a through lane on SR 9 from Lundeen Parkway to south of Market Place in both directions and a tight diamond interchange at SR 204 with grade-separation for the north-south through lanes. Includes addition of a northbound right-turn lane from SR 9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the exiting shopping center drive aisles from Davies Road to 4th Street NE.
  - The grade-separated north-south through lanes on SR 9 would improve regional traffic flow. The grade separation of the SR 9 through lanes would also improve the intersection operations at SR 9/SR 204 intersection as the signal timing would not have to include the north-south through movement, and more green time could be allotted to the eastbound and westbound approaches.
  - Widening of SR 9 to the south of the SR 9/SR 204 intersection would improve intersection operations at SR 9/Market Place. During the PM peak hour, southbound queues would clear the intersection on most cycles and would not extend back to or inhibit access at the SR 9/SR 204 intersection.
- **Alternative E2A** – Same as Alternative E with no widening of SR 9.
  - The grade-separated north-south through lanes on SR 9 would improve regional traffic flow.
  - Similar to No Build conditions, SR 9 would carry only one through lane into the Market Place intersection, so vehicle queueing under this alternative is likely to resemble No Build

conditions during the PM peak hour. At times, queueing could extend up the southbound on-ramp to SR 9 from SR 204.

  - The access improvements to Frontier Village described in Alternative E would also apply to this alternative.

- **Alternative E2B** – Same at Alternative E with no additional lanes on SR 9 north of SR 204.
  - This alternative has similar operational improvements to those described for Alternative E. The added lane northbound on SR 9 in Alternative E to the north of SR 204 is not expected to provide substantial operational benefit.
  - The access improvements to Frontier Village described in Alternative E would also apply to this alternative.
- **Alternative E2C** – Same as Alternative E with no additional lanes on SR 9 and an added half interchange at Davies Road with a two-way overcrossing connecting to Vernon Road on the west side of SR 9. Village Way would not be added under this alternative, but 92nd Avenue NE would still be closed, and Vernon Road would still be terminated in a cul-de-sac to the north of 7th Place NE.
  - The new two-way Vernon-Davies overcrossing would provide new access to Frontier Village and reduce some of the vehicle demand in and out of Frontier Village at the SR 204 intersection.
  - The vehicle demand at the 91st Avenue NE/Vernon Road intersection would increase with the new two-way overcrossing to access Frontier Village and receive much of the through traffic allocated to Village Way under other alternatives. The current side-street stop control would result in LOS F operations and vehicles queueing back across the SR 9 overcrossing. An all-way stop would also result in LOS F operations, causing vehicles to queue back on 91st Avenue, and affecting operations at the 91st Avenue/SR 204 intersection. A three-way stop with a free northbound approach would result in LOS E operations, which meets City of Lake Stevens standards.
  - A traffic signal would be needed at the Vernon Road/N Davies Road intersection due to the high vehicle demand and left-turning volumes. A roundabout was ruled out due to overpass design costs and constraints.
  - As additional lanes are not proposed for SR 9 under this alternative, the southbound queuing issues described in Alternative E2A would also apply to this alternative and would be exacerbated by the vehicles merging from the southbound SR 9 on-ramp from SR 204 to the left-turn lane at the Market Place intersection.
- **Alternative E2D** – Same as Alternative E2C except an additional travel lane in each direction would be added to SR 9 from south of SR 204 to south of Market Place.
  - Widening of SR 9 to south of Market Place would resolve the southbound queueing issues observed in Alternative E2C (queues extending back to the SR 9/SR 204 interchange).
- **Alternative H** – Includes grade-separation for the north-south through lanes on SR 9 through the SR 204 intersection with a roundabout interchange. Includes addition of a northbound right-turn slip ramp from SR 9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A

new north-south local access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.

  - Similar to Alternative B, this option would require a three-lane section at the SR 9/SR 204 roundabout.

- **Alternative G2B** – Includes grade-separation of the left-turn lane from eastbound SR 204 to northbound SR 9, diverging upstream of the 91st Avenue NE intersection. To the east of SR 9, 92nd Avenue NE would be vacated, and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the exiting shopping center drive aisles from Davies Road to 4th Street NE.

  - The separated eastbound left turn would allow for more green time to be allocated to north-south through movements. While the operations at the SR 9/SR 204 intersection would improve, the southbound queueing at the SR 9/Market Place intersection would continue to be an issue.

- **Alternative E2B Variation 4** – Same as alternative E2B except access to Vernon Road would be maintained at the SR 9/SR 204 intersection similar to No Build. The access road Village Way would not be constructed. However, 92nd Avenue NE would be vacated.

  - The intersection operations at the SR 9/SR 204 intersection would improve compared to No Build conditions. By keeping Vernon Road open, businesses along the street would continue to be accessible from the SR 9/SR 204 intersection. As Village Way is not included in this alternative, most vehicle traffic would travel on Vernon Road similar to No Build conditions. Vehicles exiting Frontier Village on 7th Street NE would still need to travel north on Vernon Road and make a U-turn around the Vernon Road/Davies Road roundabout to exit Frontier Village and access SR 9 or SR 204.

  - Due to the high vehicle demand during the PM peak hour, queueing on the westbound approach to the SR 9/SR 204 intersection (Vernon Road) could extend past Davies Road during the peak 15 minutes. Under No Build conditions, this level of queuing would occur for nearly half of the PM peak hour.

- **Modified Single Point Urban Interchange** – A Single Point Urban Interchange (SPUI) connects all interchange ramps and the crossroad at one centralized intersection over or under the through highway. Typically, SPUI intersections can serve opposing left movements simultaneously. A modified SPUI was proposed for the SR 9/204 intersection as it includes an extra leg to maintain access to Vernon Road. With this additional intersection leg, it was not feasible to serve the left-turns simultaneously so the initially expected benefits are not as great.

  - The intersection operations at the SR 9/SR 204 intersection would improve compared to No Build, but would be worse than the Alternative E2B Variation 4 and the Preferred Alternative (Modified E2B Variation 4).

- **Preferred Alternative (Modified E2B Variation 4)** – Modifications were made to concept E2B Variation 4 to eliminate queuing on the bridge structure by changing SR 9/SR 204 to one signalized intersection, as opposed to two signalized intersections at the northbound and southbound SR 9 ramps. Additionally, more queue storage was provided for westbound traffic on Vernon Road through the extension of the dual storage lanes. Crosswalks on the west and north legs of the intersection were also removed because of the lack of pedestrian

destinations, to provide a safer pedestrian experience, and to improve intersection operations. No sidewalk connections to these crosswalks would be provided on Vernon Road or on the north side of SR 204. In addition, the northbound SR 9 transit stop (the likely generator of most pedestrian crossings) would be relocated to south of the SR 204 roadway (on northbound SR 9 off-ramp). Other modifications included maintaining 92nd Avenue southbound as it is under existing conditions, and relocating the northbound SR 9 access from 4th Street to the north. The access now connects 92nd Avenue NE to the northbound SR 9 off-ramp. This allows vehicles originating south of 7th Place to use this access point to travel north on SR 9 or west on SR 204.

- The intersection operations at the SR 9/SR 204 intersection would improve compared to No Build conditions and would be similar to Alternative E2B Variation 4. The elimination of crosswalks on the west leg would improve intersection operations because there is no need to provide a longer signal phase for pedestrians to cross six traffic lanes. However, the addition of 4th Street to SR 9 volumes traveling through the SR 9/SR 204 intersection and increased time given to the westbound movement offsets the majority of this benefit. The additional westbound queue storage and increased signal timing would greatly reduce the queuing back to Davies Road that was expected under Alternative E2B Variation 4.

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TABLE 5-2. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2040 PM PEAK HOUR

		No Build			Alternative B			Alternative C			Alternative E			Alternative E2A			Alternative E2B			Alternative E2C		
ID	Location	Control[a]	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	36	D	Signal	34	C	Signal	36	D	Signal	36	D	Signal	38	D	Signal	39	D	Signal	34	C
2	SR 9/Vernon Rd Off-Ramp	n/a			n/a			n/a			n/a			n/a			n/a			n/a		
3	SR 9/SR 204 (west signal)[c]	Signal	57	E	RAB	22	C	Signal	45	D	Signal	19	B	Signal	20	B	Signal	19	B	Signal	15	D
3A	SR 9/SR 204 (Tight Diamond-east signal)	n/a									Signal	15	B	Signal	15	B	Signal	15	B	Signal	10	A
4	SR 9/Market Pl	Signal	100	F	Signal	78	E	Signal	82	F	Signal	36	D	Signal	86	F	Signal	36	D	Signal	99	F
5	91st Ave/SR 204	Signal	65	E	Signal	75	E	Signal	66	E	Signal	53	D	Signal	54	D	Signal	51	D	Signal	47	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	29	C	Signal	25	C	Signal	25	C	Signal	23	C	Signal	23	C	Signal	22	C	Signal	24	C
7	Vernon Rd/7th Pl	SSSC	18	C	n/a			n/a			n/a			n/a			n/a			n/a		
8	91st Ave/Vernon Rd	SSSC	12	B	SSSC	34	D	SSSC	11	B	SSSC	11	B	SSSC	11	B	SSSC	11	B	SSSC	48	E
9	Safeway Dwy/Davies Rd	RAB	107	F	RAB	6	A	RAB	9	B	RAB	18	C	RAB	17	C	RAB	17	C	RAB	6	A
10	SR 9/4th St On-Ramp	SSSC	2	A	RAB	12	B	SSSC	35	D	SSSC	1	A	SSSC	9	A	SSSC	2	A	SSSC	1	A
11	Transit Center Dwy/4th St	SSSC	9	A	SSSC	15	C	SSSC	21	C	SSSC	19	C	SSSC	17	C	SSSC	18	C	SSSC	13	B
12	Transit Center Dwy/Market Pl	SSSC	29	D	SSSC	14	B	SSSC	18	C	SSSC	13	B	SSSC	20	C	SSSC	13	B	SSSC	20	C
13	91st Ave/Market Pl	Signal	24	C	Signal	19	B	Signal	19	B	Signal	17	B	Signal	33	C	Signal	16	B	Signal	46	D
14	Lundeen Pkwy/Vernon Rd	SSSC	14	B	SSSC	15	B	SSSC	5	A	SSSC	13	B	SSSC	14	B	SSSC	14	B	SSSC	13	B
15	Vernon Rd/Davies Rd	RAB	95	F	RAB	56	F	RAB	9	A	RAB	5	A	RAB	4	A	RAB	3	A	Signal	21	C
16	Parking Lot Connector/7th Pl NE				Signal	29	C	Signal	26	C	Signal	21	C	Signal	20	C	Signal	21	C	SSSC	11	B
17	92nd Ave/ Slip Ramp																					

a. SSSC = side-street stop controlled
AWSC= all way stop controlled
RAB = roundabout
n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

b. This represents intersection operations at 92nd/4th St.

c. The LOS reported for a roundabout at the SR 9/SR 204 intersection under Alternatives B and H reference signalized intersection delay thresholds for a consistent comparison to other signalized intersection alternatives.

ID	Location	No Build			Alternative E2D			Alternative E2B Var 4			Alternative G			Alternative H			Modified SPUI			Preferred Alternative (Modified E2B V4)		
		Control[a]	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	36	D	Signal	31	C	Signal	36	D	Signal	30	C	Signal	37	D	Signal	38	D	Signal	38	D
2	SR 9/Vernon Rd Off-Ramp	n/a	8	A	n/a			n/a			n/a			n/a			n/a			n/a		
3	SR 9/SR 204 (west signal) [c]	Signal	57	E	Signal	17	B	Signal	19	B	Signal	41	D	RAB	35	D	Signal	50	D	Signal	46	D
3A	SR 9/SR 204 (Tight Diamond-east signal)	n/a			Signal	27	B	Signal	30	C												
4	SR 9/Market Pl	Signal	100	F	Signal	44	D	Signal	48	D	Signal	82	F	Signal	94	F	Signal	44	D	Signal	45	D
5	91st Ave/SR 204	Signal	65	E	Signal	41	D	Signal	56	E	Signal	60	E	Signal	74	E	Signal	70	E	Signal	57	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	29	C	Signal	22	C	Signal	24	C	Signal	31	C	Signal	24	C	Signal	25	C	Signal	25	C
7	Vernon Rd/7th Pl	SSSC	18	C	n/a			n/a			n/a			n/a						SSSC	8	A
8	91st Ave/Vernon Rd	SSSC	12	B	SSSC	48	E	SSSC	11	B	SSSC	11	B	SSSC	21	C	SSSC	83	F	SSSC	38	E
9	Safeway Dwy/Davies Rd	RAB	107	F	RAB	7	A	RAB	13	D	RAB	8	A	RAB	16	C	RAB	5	A	RAB	5	A
10	SR 9/4th St On-Ramp	SSSC	2	A	SSSC	1	A	SSSC			SSSC	34	D	SSSC	1	A	n/a			SSSC	1[b]	A[b]
11	Transit Center Dwy/4th St	SSSC	9	A	SSSC	12	B	SSSC	11	B	SSSC	18	C	SSSC	15	C	SSSC	13	B	SSSC	14	B
12	Transit Center Dwy/Market Pl	SSSC	29	D	SSSC	13	B	SSSC	17	C	SSSC	13	B	SSSC	16	C	SSSC	22	C	SSSC	15	C
13	91st Ave/Market Pl	Signal	24	C	Signal	26	C	Signal	32	C	Signal	19	B	Signal	27	C	Signal	20	C	Signal	22	C
14	Lundeen Pkwy/Vernon Rd	SSSC	14	B	SSSC	14	B	SSSC	13	B	SSSC	16	C	SSSC	14	B	SSSC	13	B	SSSC	13	B
15	Vernon Rd/Davies Rd	RAB	95	F	Signal	25	C	Signal	60	F	RAB	3	A	RAB	3	A	RAB	10	A	RAB	9	A
16	Parking Lot Connector/7th Pl NE				SSSC	10	A	SSSC	13	B	Signal	14	B	Signal	34	C				SSSC	10	A
17	92nd Ave/ Slip Ramp																			AWSC	7	A

a. SSSC = side-street stop controlled
AWSC= all way stop controlled
RAB = roundabout
n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

b. This represents intersection operations at 92nd/4th St

c. The LOS reported for a roundabout at the SR 9/SR 204 intersection under Alternatives B and H reference signalized intersection delay thresholds for a consistent comparison to other signalized intersection alternatives.

TABLE 5-3. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2040 AM PEAK HOUR

ID	Location	No Build			Preferred Alternative (Modified E2B-V4)		
		Control[a]	Delay	LOS	Control	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	21	C	Signal	29	C
2	SR 9/Vernon Rd Off-Ramp	n/a			n/a		
3	SR 9/SR 204	Signal	37	D	Signal	35	D
4	SR 9/Market Pl	Signal	39	D	Signal	24	C
5	91st Ave/SR 204	Signal	22	C	Signal	22	C
6	Lundeen Pkwy/Market Pl/SR 204	Signal	13	B	Signal	13	B
7	Vernon Rd/7th Pl	SSSC	8	A	SSSC	6	A
8	91st Ave/Vernon Rd	SSSC	10	B	SSSC	8	A
9	Safeway Dwy/Davies Rd	RAB	1	A	RAB	1	A
10	SR 9/4th St On-Ramp	SSSC	2	A	SSSC	2*	A[b]
11	Transit Center Dwy/4th St	SSSC	10	A	SSSC	17	C
12	Transit Center Dwy/Market Pl	SSSC	6	A	SSSC	7	A
13	91st Ave/Market Pl	Signal	17	B	Signal	9	A
14	Lundeen Pkwy/Vernon Rd	SSSC	10	A	SSSC	9	A
15	Vernon Rd/Davies Rd	RAB	2	A	RAB	2	A
16	Frontier Lane/7th Place				SSSC	8	A
17	92nd Ave/Slip Ramp				AWSC	7	A

a. SSSC = side-street stop controlled
AWSC= all way stop controlled
RAB = roundabout
n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

b. This represents intersection operations at 92nd/4th St

5.1.2.3 Access Management

The changes in access management along the SR 9 and SR 204 corridors vary by Build Alternative. In general, the number of intersections along SR 204 are expected to remain the same. The Preferred Alternative (and all Alternative E options) propose a tight-diamond interchange at the SR 9/SR 204 intersection that is grade-separated from SR 9.

Access on SR 9 changes as many of the Build Alternatives propose a depressed SR 9 mainline beneath the SR 204 study intersection. In addition, all alternatives include a new northbound SR 9 right-turn access point to 4th Street NE. The Preferred Alternative also proposes to shift the existing SR 9 access point from 4th Street NE north to become an access point to the northbound SR 9 off-ramp to SR 204 from 92nd Avenue NE.

Access standards for a grade-separated interchange may not allow these access points along the northbound SR 9 off-ramp to SR 204 or to maintain the existing southbound SR 9 off-ramp to Vernon Road. A design analysis approved by WSDOT would be needed to proceed with this Preferred Alternative.

5.1.2.4 Emergency Services

Access through the roadway network would improve compared to existing conditions under almost all Build Alternatives. A new access point from northbound SR 9 to 4th Street NE may shorten driving distances as vehicles do not have to enter through the SR 9/SR 204 intersection into Frontier Village.

Emergency vehicles are expected to have a shortened response time through the SR 9 corridor as the through traffic is free-flow and depressed below the SR 204 intersection. SR 9 on and off-ramps would be provided to maintain full access at the intersection so that emergency vehicles could continue to serve the area. In addition, the improved intersection traffic operations under the Build Alternatives may shorten emergency service vehicle response times through the study area.

5.2 2021 OPERATIONS

Traffic operations in the 2021 year of opening were analyzed to understand potential traffic conditions under the Preferred Alternative (Modified E2B Variation 4) compared to the No Build Alternative. Detailed operational outputs from Vissim, including intersection delay and LOS, approach delay and LOS, and queuing, are included in **Appendix H**. The following sections provide a summary of intersection level delay and LOS results.

5.2.1 No Build Alternative

5.2.1.1 Future Network

The 2021 No Build Alternative was evaluated using the same project transportation network assumptions as the existing conditions analysis. The vehicle volume input and routing was updated to reflect forecasted vehicle demand through the study area (described in **Section 3**).

5.2.1.2 Level of Service and Delay

The 2021 No Build intersection operations for the AM and PM peak hours are summarized in **Table 5-4**. Under AM peak hour conditions, delay would increase in some locations compared to existing conditions, but all intersections would continue to operate at an overall LOS of C or better. Under PM peak hour conditions, overall delay would increase at the SR 9/SR 204 intersection compared to existing conditions, however the intersection is expected to continue to operate at LOS D. Congestion would continue to grow at the westbound approach to SR 9/SR 204 (Vernon Road), causing queues to frequently spill back into the roundabouts at Vernon Road/Davies Road and Davies Road/Safeway Driveway and for operations to degrade to LOS F and E, respectively.

TABLE 5-4. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2021 NO BUILD

ID	Location	Control[a]	AM Peak Hour				PM Peak Hour			
			Existing		2021 No Build		Existing		2021 No Build	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	18	B	24	C	23	C	31	C
2	SR 9/Vernon Rd Off-Ramp	n/a								
3	SR 9/SR 204	Signal	21	C	26	C	35	D	51	D
4	SR 9/Market Pl	Signal	19	B	26	C	52	D	53	D
5	91st Ave/SR 204	Signal	18	B	19	B	60	E	41	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	10	B	14	B	26	C	22	C
7	Vernon Rd/7th Pl	SSSC	8	A	8	A	11	B	15	B
8	91st Ave/Vernon Rd	SSSC	6	A	10	A	13	B	14	B
9	Safeway Dwy/Davies Rd	RAB	1	A	1	A	4	A	45	E
10	SR 9/4th St On-Ramp	SSSC	2	A	2	A	2	A	2	A
11	Transit Center Dwy/4th St	SSSC	7	A	7	A	9	A	18	C
12	Transit Center Dwy/Market Pl	SSSC	6	A	6	A	33	D	10	B
13	91st Ave/Market Pl	Signal	6	A	8	A	13	B	15	B
14	Lundeen Pkwy/Vernon Rd	SSSC	8	A	8	A	11	B	10	A
15	Vernon Rd/Davies Rd	RAB	1	A	1	A	6	A	56	F

a. SSSC = side-street stop controlled
RAB = roundabout
n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

5.2.2 Preferred Alternative

5.2.2.1 Alternative Configuration

The Preferred Alternative (Modified E2B Variation 4) was analyzed for 2021 opening year conditions. This alternative is described in **Table 2-1** and depicted in **Figure 2-2**.

5.2.2.2 Level of Service and Delay

The 2021 intersection operations for the Preferred Alternative during the AM and PM peak hours are summarized in **Table 5-5**. Under AM peak hour conditions, intersections would all operate at LOS D or better, meeting the WSDOT and Lake Stevens operational standards. Under PM peak hour conditions, operations would improve from LOS E to LOS D at the SR 9/SR 204 compared to the 2021 No Build Alternative. The Preferred Alternative improvements to this intersection would also prevent queues from spilling back into the roundabouts at Vernon Road/Davies Road and Davies Road/Safeway Driveway, improving operations to LOS A. All intersections would operate at LOS D or better under 2021 PM conditions.

TABLE 5-5. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2021 ALTERNATIVE E2B VARIATION 4

ID	Location	AM Peak Hour						PM Peak Hour					
		2021 No Build			Preferred Alternative			2021 No Build			Preferred Alternative		
		Control[a]	Delay	LOS	Control[a]	Delay	LOS	Control[a]	Delay	LOS	Control[a]	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	24	C	Signal	25	C	Signal	31	C	Signal	31	C
2	SR 9/Vernon Rd Off-Ramp	n/a			n/a			n/a			n/a		
3	SR 9/SR 204	Signal	26	C	Signal	32	C	Signal	51	D	Signal	40	D
4	SR 9/Market Pl	Signal	26	C	Signal	19	B	Signal	53	D	Signal	31	C
5	91st Ave/SR 204	Signal	19	B	Signal	19	B	Signal	41	D	Signal	55	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	14	B	Signal	14	B	Signal	22	C	Signal	21	C
7	Vernon Rd/7th Pl	SSSC	24	C	SSSC	5	A	SSSC	32	D	SSSC	8	A
8	91st Ave/Vernon Rd	SSSC	10	A	SSSC	8	A	SSSC	14	B	SSSC	12	B
9	Safeway Dwy/Davies Rd	RAB	1	A	RAB	1	A	RAB	45	E	RAB	3	A
10	SR 9/4th St On-Ramp	SSSC	2	A	SSSC	1[b]	A[b]	SSSC	2	A	SSSC	1[b]	A[b]
11	Transit Center Dwy/4th St	SSSC	7	A	SSSC	20	C	SSSC	18	C	SSSC	14	B
12	Transit Center Dwy/Market Pl	SSSC	6	A	SSSC	6	A	SSSC	10	B	SSSC	8	A
13	91st Ave/Market Pl	Signal	8	A	Signal	8	A	Signal	15	B	Signal	14	B
14	Lundeen Pkwy/Vernon Rd	SSSC	8	A	SSSC	8	A	SSSC	10	A	SSSC	12	B
15	Vernon Rd/Davies Rd	RAB	1	A	RAB	2	A	RAB	56	F	RAB	6	A
17	92nd Ave/Slip Ramp				AWSC	8	A				AWSC	8	A

a. SSSC = side-street stop controlled
AWSC= all way stop controlled
RAB = roundabout
n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

b. This represents intersection operations at 92nd/4th St

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5.3 TRAVEL TIME ANALYSIS

This section documents travel time analysis results for each proposed alternative compared to the 2040 No Build. All auto and transit travel times were evaluated using the Vissim model developed for each alternative under the 2040 PM conditions. The transit travel times are an average of the transit vehicles travel through the network over the analysis hour. The detailed methods used to simulate and calculate travel time are documented in **Appendix F**.

Automobile travel times between points on the regional network (SR 9 and SR 204) are summarized and compared to No Build in **Table 5-6**. Auto travel times for an extended set of routes, including local access to neighborhood commercial and residential areas, is provided in **Appendix F**. The major findings are summarized below:

- Alternative B and Alternative H propose roundabouts along SR 9, which would require vehicles to drive at slower speeds. Travel times for regional trips from SR 204 to southbound or northbound SR 9 would generally increase by up to two minutes under these alternatives.
- Grade separation at the SR 9/SR 204 intersection would result in northbound and southbound through travel times decreasing by up to three minutes.
- All options with revised access into and out of Frontier Village, as well as Village Way, would experience vehicle travel time savings. The highest decreases in travel time would be for trips originating at the Safeway Driveway to all other locations, where travel time could decrease by more than eight minutes. Travel between locations within Frontier Village would also improve with the proposed Village Way.
- Alternative G, with the eastbound left tunnel from SR 204 to northbound SR 9, had travel time improvements of up to one minute from SR 204 west of Market Place to north of Lundeen Parkway on SR 9.
- Alternative C generally had travel time savings similar to Alternative G, with the eastbound left movement from SR 204 to northbound SR 9 similar to No Build conditions.
- Alternative E2B had very similar results to Alternative E, as the only difference is the lack of widening of SR 9 north of SR 9 /SR 204 intersection.
- Alternative E2C includes a new overpass connection between Davies Road to Vernon Road west of SR 9, but does not include Village Way. Alternative E2C also does not include widening of SR 9 near Market Street, and, similar to E2A, vehicles heading southbound on SR 9 would experience increased delays. Without Village Way, little travel time savings is expected between locations within Frontier Village. However, travel between neighborhoods on either side of SR 9 to the north of SR 204 would improve with the new connection.
- Alternative E2D is similar to E2C, but SR 9 would be widened near Market Place. This option would perform similarly to E2B and Alternative E. This alternative is expected to have generally the highest travel time savings as traffic could disperse through a more connected roadway system.
- The Preferred Alternative (Modified E2B Variation 4) has travel time improvements similar to Alternative E and E2B. SR 9 through travel time would decrease by up to three minutes. There

could be a slight increase in travel time from eastbound SR 204 to northbound SR 9 compared to No Build. The signal timing was adjusted to provide more time to the Vernon Road westbound approach to reduce the expected queueing beyond the Vernon Road/Davies roundabout. Additional signal timing refinements could likely be made to improve travel times for this movement.

TABLE 5-6. AUTO TRAVEL TIME RESULTS ON REGIONAL FACILITIES (IN MINUTES) – 2040 PM PEAK HOUR

#	Route	No Build	Difference Compared to No Build											
			Alternative B	Alternative C	Alternative E	Alternative E2A	Alternative E2B	Alternative E2C	Alternative E2D	Alternative E2B Var 4	Alternative G	Alternative H	SPUI	Preferred Alternative
SR 9 North of Lundeen Parkway to SR 9 south of Market Place														
1	Northbound	4.3	-0.5	-0.1	-1.7	-0.7	-1.6	-0.8	-1.6	-1.5	-0.3	-0.7	-1.5	-1.5
2	Southbound	5.2	-1.8	-0.9	-2.5	-1.8	-2.5	-0.9	-2.4	-2.3	-1.1	-2.7	-2.5	-2.4
SR 9 North of Lundeen Parkway to SR 204 west of Market Place/Lundeen Parkway														
3	Eastbound to northbound	3.6	+1.9	+0.8	+0.2	+0.4	+0.4	-0.1	-0.1	+0.3	-0.5	+1.2	+2.7	+0.7
4	Southbound to westbound	3.8	+0.2	-0.1	+0.2	+0.2	+0.1	+0.3	+0.2	+0.0	+0.1	+0.1	+0.1	+0.1
SR 9 South of Market Place to SR 204 west of Market Place/Lundeen Parkway														
5	Northbound to westbound	4.9	-0.2	-0.2	+0.1	-0.3	-0.2	+0.4	-0.5	+0.0	+0.1	+0.2	+0.1	-0.2
6	Eastbound to southbound	2.9	+0.2	+0.2	-0.2	+0.7	-0.2	+0.7	+0.1	+0.7	+0.3	+0.6	+1.0	+0.2

Results averaged from Vissim model output for 2040 PM peak hours conditions.

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5.4 COLLISION ANALYSIS

This section describes the results of the vehicle collision analysis for Alternative Concepts under 2040 traffic conditions. The Highway Safety Manual's predictive methodology was applied to the study area in order to estimate the collision rate in the study area.

5.4.1 Results

All roadway geometries were assumed to follow WSDOT standards. Roadway information was entered into the HSM spreadsheet for urban and suburban arterials and the ISAT spreadsheet for freeway-like facilities for comparison with forecasted No Build conditions in 2040. The analysis is a combination of two separate tools specific to arterial or freeway-like conditions. Detailed HSM and ISAT results are provided in **Appendix I**. **Table 5-7** provides a summary of the predicted average crash frequency calculated for each alternative, including the predicted collision rates for all intersections and segments for each alternative. The segments correspond to those listed previously in Section 4.3.3 and include any new segments or intersections as a part of the alternatives.

The "KABC" column provides an estimate of the predicted injury collisions for the entire alternative. The "KA" column is an estimate of the predicted number of fatal and serious injury collisions. This number was calculated by assuming the same percentage of fatal and serious injury collisions from the 2011-2015 data for the future alternatives.

For Alternatives B and H, a collision reduction factor was applied to the collision rates at certain intersections which would be replaced with roundabouts.[4] Thus the estimated collision rates for Alternatives B and H are lower than the 2040 No Build Alternative.

Similarly, the estimated collision rates for the Modified SPUI and the Preferred Alternative are potentially similar or slightly lower than the 2040 No Build Alternative. These two alternatives consider the SR 9/SR 204 intersection as one intersection which reduces the collision rates as compared with the alternatives that consider the SR 9/SR 204 intersection as two separate intersections.

The Modified SPUI and Preferred Alternative analysis also includes 92nd Avenue NE as well as a 4th Street ramp onto the SR 9 northbound off-ramp.

The results for Alternatives E, E2A, E2B, E2B Variation 4, E2C, and E2D consider the SR 9/SR 204 intersection as two separate intersections.

[4] WSDOT has published collision reduction rates for intersections that were converted from stop or signal control to roundabouts. https://www.wsdot.wa.gov/Safety/roundabouts/benefits.htm

TABLE 5-7. SUMMARY OF ANTICIPATED PERFORMANCE FOR EACH 2040 ALTERNATIVE

Predicted Collision Totals[a]			
Scenario	Predicted Average Crash Frequency (crash/yr)		
	All Collision Types KABCO[b]	Fatal, Serious and Possible Injury KABC	Fatal and Serious Injury KA
Existing	79.4	28.0	2.4
2040 No Build	107.5	38.6	3.2
2040 Alternative B	105.1	35.1	3.2
2040 Alternative C	115.8	41.6	3.5
2040 Alternative E[c]	120.0	43.8	3.6
2040 Alternative E2A[c]	121.0	44.0	3.6
2040 Alternative E2B[c]	121.0	43.9	3.6
2040 Alternative E2B Variation 4[c]	118.4	40.8	3.4
2040 Alternative E2C[c]	121.5	44.7	3.6
2040 Alternative E2D[c]	121.6	44.7	3.6
2040 Alternative G	109.8	39.7	3.3
2040 Alternative H	105.0	35.6	3.2
2040 Modified SPUI	106.5	38.9	3.2
2040 Preferred Alternative	105.9	38.7	3.2

a. Collision totals include intersections, segments, ramps, and merge/diverge points
b. K – Fatal
   A – Incapacitating injury
   B – Nonincapacitating injury
   C – Possible injury
   O – No injury/Property damage only
c. These alternatives analyzed the SR 9/SR 204 tight diamond project as two separate intersections.

The results in **Table 5-7** suggest that, except for alternatives that include roundabouts as well as the Modified SPUI and Preferred Alternative, the alternative concepts could have a higher potential for collisions as compared with the No Build. This higher potential is mainly due to additional intersections or segments associated with these alternatives. For example, Alternatives E2C and E2D have the highest predicted collision rate because of the addition of an SR 9 overpass at Vernon Road and N Davies Road and the new intersection it would create at the southbound SR 9 off-ramp. Of the Alternative E concepts, the Preferred Alternative is expected to have the lowest crash rate and thus ranks the highest in terms of safety.

Although there is an increase in potential for collisions, this does not necessarily equate to a higher number of collisions that will occur in 2040 under each of these Build Alternatives when compared with the No Build Alternative. It should be noted that, while many of the Build Alternative concepts would increase total (including property damage only) and injury collisions, the expected increase in KA collisions (fatality and serious injury) would be much smaller than the increase in all collisions. The predicted crash frequencies are shown as a way to compare the different alternatives.

Alternative B and Alternative H include roundabout intersection improvements which are expected to reduce the total number of intersection conflict points and, thus, reduce collision rates. As a result, the crash rates are lower than the No Build scenario based on an estimated collision rate reduction factor from WSDOT.[5]

The lower crash rates for the Preferred Alternative and Modified SPUI mainly result from the fact that the SR 9/SR 204 intersection is considered one intersection instead of two.

According to research published in the Journal of Transportation Engineering, a tight diamond interchange and SPUI have very similar crash rates which confirms the results that are shown in the above table.[6] However, the Modified SPUI has a slightly higher crash rate than the Preferred Alternative because the northbound SR 9 off-ramp does not include a right-turn pocket which would slightly decrease collision rates.

5.5 WALKING AND BIKING FACILITIES

As the study area is expected to transition into more of a mixed-use center in the future, walking and biking accommodations (i.e. non-motorized infrastructure) will be essential to improving community connectivity and enhancing vitality. This section describes the walking and biking improvements provided with each Alternative Concept and assesses the relative improvement over the No Build condition.

5.5.1 Future Network

The No Build condition assumes no improvements to the walking or biking networks. However, improvements would be included in each of the twelve Build Alternative Concepts. Several improvements are common to all Build Alternatives unless otherwise noted:

- New sidewalks on both sides of SR 204 between 91st Avenue NE and SR 9.
- 92nd Avenue NE would be vacated just south of 7th Place NE, and a continuous sidewalk would be provided along 7th Place NE from SR 9 to the Frontier Village Parking lot.
- All alternatives that include constructing the new north-south Village Way road through Frontier Village's existing parking lot between N Davies Road and 4th Street NE with a signalized intersection at 7th Place NE are assumed to include crosswalks along all legs of this intersection. Sidewalks will be provided along both sides of 7th Place NE between SR 9 and Village Way and on Village Way. Vernon Road would be closed as a cul-de-sac north of 7th Place NE.

Walking and biking improvements specific to each Build Alternative are described below. If no mention is made regarding pedestrian or bicycle improvements, there were no improvements included in the alternative:

- **Alternative B** proposes three new roundabouts located at the following intersections – Vernon Road/N Davies Road/SR 9 ramps (grade-separated from SR 9), SR 9/SR 204 (grade-

[5] WSDOT. Roundabout benefits. https://www.wsdot.wa.gov/Safety/roundabouts/benefits.htm

[6] Bared, J, et al. *Crash Comparison of Single Point and Tight Diamond Interchanges*. Journal of Transportation Engineering, May 2005.

separated from SR 9 mainline), and SR 9/4th Street NE (at-grade with SR 9). Although the roundabout at Vernon Road/N Davies Road/SR 9 ramps provides access across SR 9 for vehicles, there is no east-west bicycle or pedestrian crossing. There would be a crosswalk along the east leg of the roundabout with a median refuge and Rectangular Rapid Flashing Beacons (RRFBs). At the SR 9/SR 204 intersection, crosswalks would be provided along the east, west, and north legs of the intersection to connect the Frontier Village Shopping Center to the commercial areas to the west of SR 9. RRFBs will be located at each leg to enhance the safety of the crossing and visibility of pedestrian and bicyclists. This is the only access point across SR 9 between Lundeen Parkway to the north and Market Place to the south. The crosswalks on the east and west legs would also provide access to key transit stops on SR 9 serving routes 209 and 280.

- **Alternative** C is similar to the No Build Alternative but adds a right turn pocket from northbound SR 9 to 4th Street NE (in addition to those listed as common to all Alternatives).
- **Alternative E** consists of a new tight diamond interchange at the SR 9/SR 204 intersection where the SR 9 mainline is grade-separated from SR 204. There are four variations of Alternative E which are denoted as E2A, E2B, E2C, and E2D. E2A and E2B differ only in the lane geometry along SR 9 where there are no pedestrian or bicycle facilities. The only effect these two alternatives would have on the pedestrian and bicycle network would be the number of lanes pedestrians would need to cross east-west at certain intersections (SR 9/SR 204 and SR 9/Market Place NE).
  - **Alternative E2A** includes a tight diamond interchange with a pair of closely spaced intersections, one for each on/off-ramp. Although this reduces the north-south vehicle traffic that traverses the intersection, it does create additional conflict points between pedestrians, bicyclists, and vehicles due to the two new intersections. This alternative would provide crosswalks across all legs of the intersection to allow pedestrians to travel across SR 9 on SR 204 from 91st Avenue NE to the Frontier Village Shopping Center and to the transit stops located on the southbound and northbound on-ramps to SR 9.
  - **Alternative E2B** differs from Alternative E2A in that it adds travel lanes on SR 9 south of SR 204 to about 1,000 feet south of the Market Place NE intersection. Non-motorized access would be the same as Alternative E2A.
  - **Alternative E2C** is similar to Alternative E2A except it includes a new crossing over SR 9 that connects Davies Road in the east to Vernon Road in the west. This alternative would not include the Village Way connector (the private drive aisle through the Frontier Village parking lot would remain). Accordingly, non-motorized access would be the same as Alternative E2A. The new overpass crossing at the Vernon Road/Davies Road intersection provides another connection across SR 9. This connection would also create three new intersections – SR 9 Southbound Off-Ramp/Davies Road & Vernon Road, Vernon Road/Davies Road, and SR 9 Northbound On-Ramp/Vernon Road. This alternative would complete the sidewalks on Vernon Road west of SR 9 across the overpass to Davies Road. There would be crosswalks at each of the three intersections providing connectivity of pedestrian facilities. Additionally, a crosswalk along the east leg of the 91st Avenue NE/Vernon Road intersection is included in this alternative.
  - **Alternative E2D** is a combination of Alternatives E2B and E2C. The additional lanes would be added on SR 9 south of SR 204, as well as the new overpass connecting N Davies Road

and Vernon Road, and Village Way would not be implemented in this alternative (the private drive aisle through the Frontier Village parking lot would remain).

- **Alternative E2B Variation 4** would be similar to alternative E2B, except the Village Way connector would not be constructed and the east leg of the SR 9/SR 204 intersection and access to Vernon Road would remain. However, crosswalks would be provided across all legs of Vernon Road and 7th Place NE. Like many other alternatives, 92nd Avenue NE would be vacated just south of 7th Place NE, and a continuous sidewalk would be provided along 7th Place NE from SR 9 to the Frontier Village Parking lot.
- **Preferred Alternative (Modified E2B Variation 4)** is similar to E2B V4, but 92nd Avenue remains open similar to existing conditions, and crosswalks would be removed from the west, north and Vernon legs of the intersection. These crosswalks would be removed due to a lack of north-side pedestrian destinations on either side of the intersection (bus stop would be relocated to the off-ramp south of the intersection), to increase pedestrian safety by limiting the number of intersection legs to cross SR 9, and to improve intersection operations. Crosswalks would be provided across the SR 9 southbound on-ramp, SR 9 northbound off-ramp, 92nd Avenue NE, and 7th Place NE.

- **Alternative G** includes a tunnel bypass for traffic traveling from SR 204 eastbound to SR 9 northbound. This tunnel is designed to begin west of 91st Avenue NE and merge with SR 9 approximately 1,200 feet north of the SR 9/SR 204 intersection. No changes beyond those common to all scenarios would be made to the non-motorized facilities in this alternative; however, a significant number of vehicles would be diverted from the SR 9/SR 204 intersection, potentially improving the overall comfort and reducing the wait times (via a potentially shorter signal cycle length) of pedestrians crossing the SR 9/SR 204 intersection.
- **Alternative H** redesigns the SR 9/SR 204 intersection with a roundabout while grade-separating the SR 9 mainline to allow for better operations through the corridor (similar to Alternative B and E). This roundabout would have the same configuration as the roundabout in Alternative B at SR 9/SR 204.
- **Modified SPUI** includes the same pedestrian accommodations as the Preferred Alternative.

5.5.2 Results

The impacts and benefits to walking and biking travel related to each of the alternatives described in the prior section are summarized in **Table 5-8**. The No Build Alternative serves as the baseline alternative to compare all twelve Build Alternatives.

The table includes three different categories by which each alternative was evaluated: non-motorized connectivity, potential for conflicts, and consistency with existing plans.

- Non-motorized connectivity: evaluates each alternative on whether it improves, degrades or does not change the non-motorized network by adding new facilities or improving connections.
- Potential for conflicts: whether the alternative increases, decreases, or does not change the number of potential conflict points between vehicles, pedestrians, and bicycles.
- Implementation of existing plans: evaluates if this alternative supports the implementation of existing plans.

TABLE 5-8. NON-MOTORIZED NETWORK SUMMARY

Alternative	Non-motorized connectivity	Potential for conflicts	Implementation of existing plans
	++ = improves both pedestrian and bicycle connection + = improves pedestrian or bicycle connection 0 = stays the same - = degrades	+ = decreases 0 = does not change - = increases	+ = helps implement existing plans 0 = does not hinder or help implementation - = hinders implementation
No Build			
Alternative B	+	+	+
Alternative C	0	-	0
Alternative E2A	+	-	+
Alternative E2B	+	-	+
Alternative E2C	+	-	+
Alternative E2D	+	-	+
Alternative E2B Var 4	+	-	+
Alternative G	0	+	+
Alternative H	+	+	+
Modified SPUI	+	+	+
Preferred Alternative	+	+	+

As shown in **Table 5-8**, Alternatives B, H, the Modified SPUI, and the Preferred Alternative rank the highest because they do the most to improve non-motorized connectivity in the study area, decrease the potential for conflicts, and help implement the city's existing plans. The Preferred Alternative proposes to remove the crosswalk on the north side of the interchange This can simplify the signal timing and can more efficiently serve vehicles through the intersection. In addition, the relocation of the transit stop to the south side of SR 204 means there is little reason for a pedestrian to be on the north side of SR 204.

Alternatives E2A, E2B, E2B Variation 4, E2C, E2D, and G have the next highest ranking as they improve the non-motorized network in two of the three categories.

The No Build Alternative and Alternative C rank the lowest as they do not make significant changes to the existing non-motorized network along SR 9 and SR 204.

5.6 TRANSIT

The potential impacts and benefits to study area transit routes were evaluated by comparing average route travel times under No Build and Build Alternatives conditions. Transit travel times were evaluated using the Vissim model developed for each alternative under the 2040 PM conditions. The transit travel times are an average of the transit vehicles travel through the network over the analysis hour. Analysis results are summarized in **Table 5-9**.

In 2040, all Build Alternatives will improve the southbound travel times of Routes 109, 209, and 280. Northbound travel times predominantly improve except for:

- Alternative B – Route 209 northbound
- Alternative E2B Variation 4 – Route 209 northbound
- Modified SPUI– Route 209 northbound
- Preferred Alternative– Route 209 northbound
- Alternative C – Route 425 northbound

In the Preferred Alternative, all transit travel times decrease by 0.6 to 2.7 minutes, with the exception of Route 209 northbound. This route travel time increase by 1.2 minutes. The increase is likely because the route would travel through the slower roadways to the new 92nd Avenue NE access point to the SR 9 off and on-ramps, as well as through the SR 9/SR 204 signalized intersection.

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TABLE 5-9. TRANSIT TRAVEL TIME RESULTS ON REGIONAL FACILITIES (IN MINUTES) – 2040 PM PEAK HOUR

#	Route	No Build Travel Time	Difference Compared to No Build											
			Alternative B	Alternative C	Alternative E	Alternative E2A	Alternative E2B	Alternative E2C	Alternative E2D	Alternative E2B Var 4	Alternative G	Alternative H	SPUI	Preferred Alternative
Route 109														
1	Northbound	2.5	-0.4	-0.6	-1.2	-0.5	-1.3	-0.1	-1.3	-1.3	-0.6	-0.5	-1.0	-1.1
2	Southbound	6.2	-0.8	-0.1	-1.2	-0.6	-1.1	-0.5	-1.1	-0.8	-0.8	-1.2	-0.6	-1.0
Route 209														
3	Northbound	4.5	+0.7	-0.1	-0.3	-0.3	-0.4	-0.1	-0.4	+0.0	-0.7	-0.6	+1.3	+1.2
4	Southbound	9.0	-2.1	-1.3	-2.3	-1.3	-2.3	-0.7	-1.7	-2.2	-1.5	-2.0	-1.5	-1.9
Route 280														
5	Northbound	12.5	-0.1	-0.6	-2.0	-0.6	-1.5	-0.5	-1.7	-0.8	-1.2	-0.2	-0.3	-0.6
6	Southbound	16.9	-4.5	-2.2	-4.5	-3.2	-3.9	-2.3	-3.1	-3.0	-3.8	-3.3	-2.5	-2.7
Route 425 (Peak Direction Express Service)														
7	Northbound (from Seattle)	6.3	-0.8	+0.3	-1.1	-0.2	-1.1	-0.1	-0.7	-0.5	-0.5	-0.3	-0.9	-1.2

Results averaged from Vissim model output for 2040 PM peak hours conditions.

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5.7 TRANSPORTATION SYSTEM MANAGEMENT STRATEGIES

Transportation system management strategies may add capacity and improve operations without any geometric or design changes to the current roadway network. Some transportation systems management strategies include:

- Signal timing improvements and/or coordination
- Intersection lane configuration improvements
- Increased transit service to the existing road system

Transportation demand management options typically take the form of enhanced transit, carpooling, and travel demand reduction strategies without adding lanes to the corridor. These strategies can be applied in addition to the network changes from Preferred Alternative in order to further improve operations.

Transportation system management strategies and transportation demand management strategies alone, however, are not expected to be sufficient to make the SR 9/SR 204 intersection operate at acceptable levels in the future. The 2040 PM No Build Alternative travel forecasts show that vehicle demand on SR 9 is expected to increase by 30 percent, and the SR 204 corridor is expected to increase by 20 percent at the SR 9/SR 204 intersection compared to existing counts. With traffic signal timing optimized to match forecasted demand, the intersection will operate at unacceptable LOS E conditions at the SR 9/SR 204 intersection. The expected vehicle demand through the SR 9 corridor also results in LOS F conditions at the SR 9 and Market Place intersection to the south.

Transportation demand strategies such as expanding the park-and-ride or increasing transit service also are not likely to create a large enough mode shift to reach acceptable LOS operations at the horizon year of 2040. The park-and-ride is currently underutilized (existing average occupancy is about 60 percent), and WSDOT does not control the planned transit operations which are provided through Community Transit.

5.8 TEMPORARY CONSTRUCTION EFFECTS AND BENEFITS

Project construction will affect the transportation system in the form of temporary closures and construction vehicles traveling on the roadways. The project will be constructed and staged to minimize the effects whenever possible. The project team will coordinate with local agencies, stakeholders, and the project teams for relevant, nearby projects to prepare a Maintenance of Traffic Plan prior to making any changes to the traffic flow or allowing lane closure

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SECTION 7. APPENDIX

Appendix A. Needs Statement Technical Memorandum

Appendix B. Alternative Development and Screening Memorandum

Appendix C. Second-Level Screening Alternative Figures

Appendix D. Existing Conditions Memorandum

Appendix E. SR9/SR204 Travel Demand Forecast Memorandum

Appendix F. Travel Time Analysis Memorandum

Appendix G. Non-motorized Conditions Memorandum

Appendix H. Existing, 2021, and 2040 Vissim results

Appendix I. Collision Analysis

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APPENDIX A.
NEEDS STATEMENT TECHNICAL MEMORANDUM

November 2017

Date: September 14, 2017

To: Cathy George (WSDOT)

From: Michael Horntvedt (Parsons)

Cc: Tes Abraha (WSDOT), Jim Brown (WSDOT), Miguel Gavino (WSDOT), Lindsay Yamane (Parsons)

Subject: Final Baseline and Contextual Needs Statement Technical Memorandum

TECHNICAL MEMORANDUM

INTRODUCTION

The purpose of the needs statement memorandum is to identify the performance gap(s) that defines the project baseline need. In addition, this memo will address contextual needs and effects that will be consequential to any improvement. Each component of the need statement will include specific performance metrics and targets for evaluating alternative solutions.

As the only parallel regional route to the I-5 corridor, the SR 9 corridor is an important regional highway that provides several critical connections for the traveling public:

- Connectivity between local jurisdictions located east of I-5
- Connectivity to the US 2 corridor that crosses the Ebey Slough for access to I-5
- Freight connectivity between material sources and industry

This corridor is planned for continued regional service, providing reliable mobility for people and freight throughout the region.

Previous studies have been completed that included the SR 9/SR 204 intersection. The earlier work helps to identify local concerns and issues that stem from performance gaps. The studies completed include the following:

- SR 9 Corridor Planning Study (January, 2011)
- Lake Stevens Center Subarea Plan (September, 2012)
- SR 9/SR 204 Intersection Improvements Final Pre-Design Report (September, 2012)

We have identified measures that define an acceptable level of performance for each of the performance metrics. When a measure is not met for one of the metrics, we identify that as a performance gap. Each of these metrics is described in more detail in the SR 9/SR 204 Intersection Improvements Metrics and Measures Technical Memorandum. This memorandum is not intended to provide all existing or future traffic, environmental, or business conditions; rather, it is intended to illustrate the performance gaps identified through analysis to clearly define the project's baseline and contextual needs.

BASELINE NEEDS

Baseline needs are the primary reasons that the project has been proposed. The intersection has been identified as an improvement priority in the LEAP NL-1 Transportation Document for 2015-2017 funding as part of the Connecting WA effort. In addition to the statewide significance as a travel corridor, the SR 9 and SR 204 segments through Lake Stevens Center subarea represent a local transportation network that provides access to a large retail district which is key to the economic vitality of the community.

The following are specific performance needs which any viable alternative must address.

MOBILITY

Primary project area mobility needs include:

- Shorter travel times for evening peak hour period commuters and commercial drivers headed north of Lake Stevens using eastbound SR 204 to northbound SR 9, while maintaining SR 9 mobility.

The term congestion is used to describe the driver's experience on a roadway. High levels of congestion are experienced when there are longer levels of delay compared to a free flow condition. We will use three performance metrics to determine if the roadway is congested. Those metrics include intersection level of service, vehicle throughput to demand ratio, and regional travel time.

- Performance Metric: Intersection LOS
- Target: LOS D during the peak hour
- Performance Metric: Vehicle Throughput to Demand Ratio (SR 9/SR 204 intersection)
- Target: 1:1
- Performance Metric: Regional Travel Time
- Target: Improvement (compared to no-build)

Intersection Level of Service

For the Level of Service (LOS) metric, we will review the traffic operations analysis that was completed in 2011 using data from 2006, and the traffic operations analysis that was completed in 2016 using data from 2016. This comparison will help identify how traffic has changed over the past ten years and illustrate where there are needs at the SR 9/SR 204 intersection.

A traffic operations analysis was completed for the State Route 9 Corridor Planning Study in the year 2011. That study evaluated the SR 9 corridor between the cities of Bothell and Arlington in an effort to identity sections of the highway that demonstrated operational deficiencies (performance gaps) under existing and/or future traffic volumes. The evaluation examined the traffic operations for existing conditions (2006) and for the forecasted year 2030 traffic demand condition. Results from the SR 9 Corridor Planning study as they relate to the SR 9/204 Intersection Improvement project are illustrated in Table 1. By the year 2030, all intersections evaluated operate at LOS E or worse during the PM peak hour.

TABLE 1. TRAFFIC OPERATIONS ANALYSIS RESULTS FROM SR 9 CORRIDOR STUDY

Intersection	MP	Signal	2006 Existing (SR 9 Corridor Planning Study)				Year 2030 Baseline (SR 9 Corridor Planning Study)			
			AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
SR 9/Lundeen Pkwy	16.48	Y	23.1	C	35	D	23.9	C	62.4	E
SR 9/SR 204	15.76	Y	24.8	C	31.6	D	33.2	C	91.4	F
SR 9/Market Place	15.42	Y	28.6	C	51.2	D	50.2	D	259.3	F

The SR 9/SR 204 Intersection Improvement Project team has conducted an updated traffic operations analysis to consider a base year of 2016 for existing conditions and the year 2040 for the future analysis. The updated analysis includes additional intersections that were not part of the SR 9 Corridor Planning Study that will help identify the intersection area needs. Results from the updated analysis are illustrated in Table 2. The updated analysis was performed using the industry-accepted VISSIM micro simulation model for the traffic operations analysis. The VISSIM modeling provides a system-wide evaluation method that was not available in the previous modeling effort. Additional information about the analysis tool and the calibration effort can be found in the SR 9/SR 204 Intersection Improvement Existing Conditions Traffic Operations Memorandum.

Traffic operations during the AM peak hour for the years 2006, 2016, and 2030 are within standard operating criteria, with delays below 50 seconds per vehicle. PM peak hour operations begin to illustrate more of an operational traffic issue during the year 2030, with a LOS F at both the SR 204 and Market Place intersections.

TABLE 2. TRAFFIC OPERATIONS ANALYSIS RESULTS FROM SR 9 / SR 204 INTERSECTION STUDY

Intersection	MP	Signal	2016 Existing				Year 2040 No Build			
			AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
SR 9/Lundeen Pkwy	16.48	Y	20	C	24	C	30	C	40	D
SR 9/SR 204	15.76	Y	27	C	56	E	40	D	79	E
SR 9/Market Place	15.42	Y	21	C	62	E	37	D	129	F
SR 204/91st Ave NE	2.25	Y	21	C	67	E	26	C	69	E
SR 204/Lundeen Pkwy	1.99	Y	12	B	32	C	15	B	32	C

Traffic analysis for the existing year 2016 PM peak hour traffic (Table 2) shows the SR 9 and SR 204 intersection reaching LOS E. The SR 9 / Market Place and SR 204 / 91st Avenue NE intersections also operate at LOS E in the afternoon. Queuing data shown in Table 3 illustrates that traffic at the SR 9/SR 204 intersection exceeds the storage capacity for all turning lanes except northbound right and southbound left. It also shows that the SR 204/91st Ave intersection queuing is greater than the storage capacity for northbound, southbound and westbound left turning movements.

By the year 2040, population and employment in Lake Stevens Center are anticipated to increase from 2016 conditions by 41.7% and 60.0% respectively. This level of land use growth is forecast to result in a general increase in traffic volume of 43% compared to 2016.

TABLE 3. AVERAGE MAXIMUM QUEUE LENGTHS FROM SR 9 / SR 204 INTERSECTION STUDY

Intersection	Movement	Storage (ft)	Existing (2016) (ft)	No Build (2040) (ft)
SR 9/SR 204	NBL	160	187	158
	NBR	160	110	120
	SBL	350	229	414
	EBL	400	499	457
	EBT	400	499	457
	EBR	100	501	458
	WBL	300	352	515
	WBT	300	345	481
	WBR	75	330	468
SR 204/91st Ave	NBL	150	394	573
	SBL	200	250	195
	SBT	800	274	239
	EBL	400	115	213
	EBT	1250	638	599
	WBL	160	312	237
	WBT	350	277	257
	WBR	300	285	265
SR 204/Lundeen	NBL	200	104	200
	NBT	1500	135	145
	SBL	100	100	106
	SBT	100	100	106
	SBR	100	102	107
	EBL	325	207	239
	EBT	1250	682	568
	WBL	200	19	94
	WBT	1250	234	320

Note: EBL/EBT/EBR = Eastbound Left / Through / Right

Congestion performance gaps include level of service, delay, and queue length in the years 2016, 2030 and 2040 at the SR 9/SR 204 intersection and adjacent intersections.

Vehicle Throughput to Demand Ratio

Vehicle demand is forecast traffic volumes based on future land use changes that result in an estimated growth of existing traffic volume. The efficiency of an intersection can be measured by comparing the

number of vehicles passing through in an hour to the number of vehicles approaching the intersection. The alignment, lane number, signal timing, and adjacent conditions are all factors that affect driving speeds and maximum vehicle throughput. The target is to design the intersection to maximize the throughput to demand ratio.

Regional Travel Time – General Purpose

Travel time is the approximate amount of time for a general purpose vehicle to travel from one point to another in one direction. Table 4 shows the travel time for vehicles in the baseline (no-build) horizon year model during the afternoon peak hour with the regional travel times shaded in green. Node locations used for trips through the project area are displayed in Figure 1. Regional trips are those both originating and destined for locations 1, 2, and 3. The target is to improve regional travel time in the horizon year compared to predicted baseline trip times.

TABLE 4. ESTIMATED YEAR 2040 PM PEAK TRAVEL TIMES FOR NO-BUILD

		Destination						
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		5.12*	3.81*	4.82	4.42	3.52	1.66
SR 9 south of Market Place NE	2	4.42*		4.97*	3.70	2.41	4.13	4.14
SR 204 west of Market Pl NE / Lundeen Pkwy	3	3.63*	3.37*		3.52	3.77	1.49	2.17
N Davies Rd and Safeway access driveway	4	11.00	7.86	10.93		8.06	10.51	9.41
4th Street NE and 94th Drive NE	5	3.07	2.57	4.45	2.46		3.05	2.38
91st Avenue NE Commercial District	6	4.94	2.68	5.37	4.37	3.23		3.81
Lundeen Pkwy neighborhoods @ Vernon Rd/91st	7	3.19	4.18	2.02	2.64	2.58	1.38	

Note: All travel times are in minutes.
*-Regional travel times

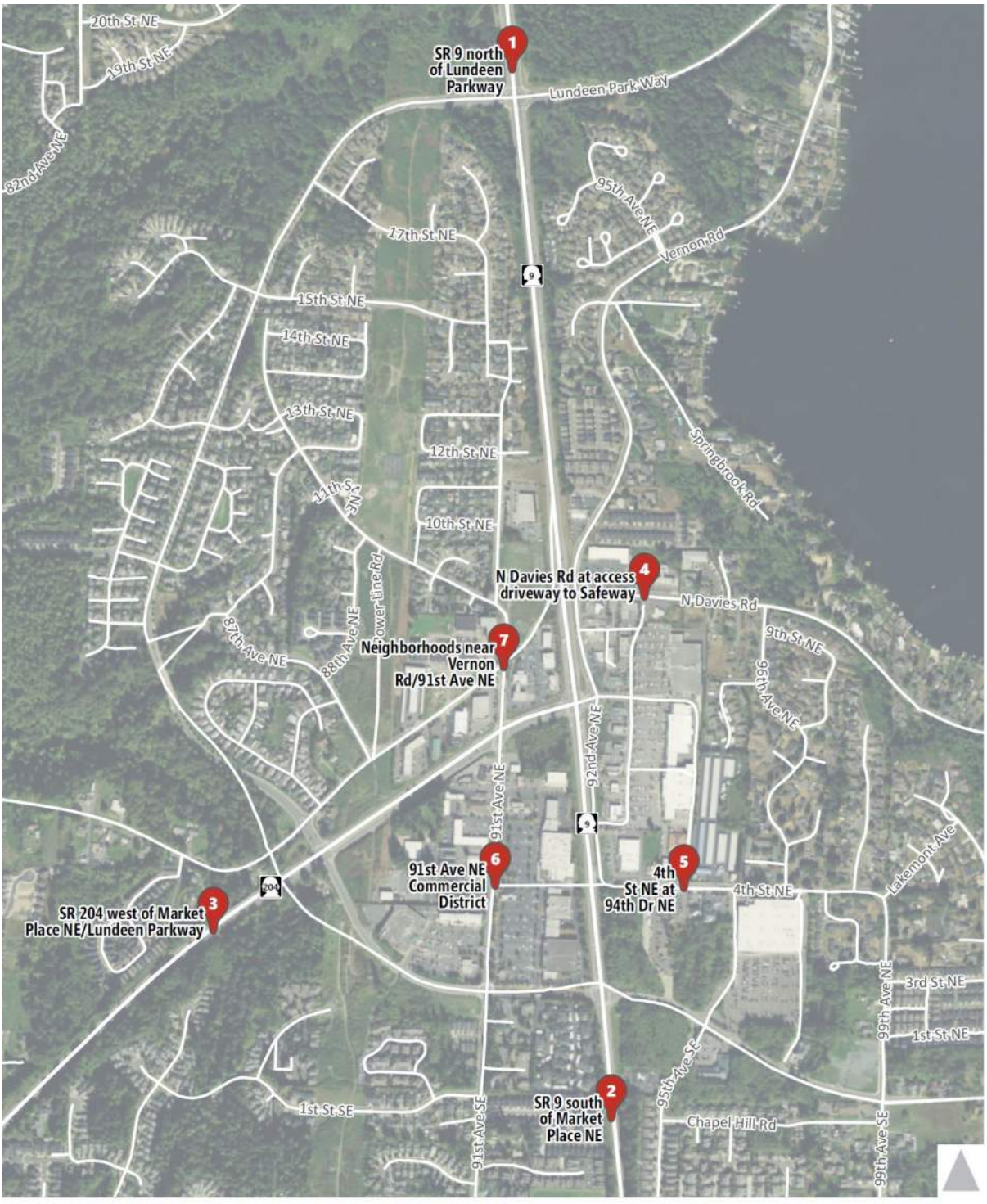


Figure 1: External and Internal Node Locations

ECONOMIC VITALITY

Economic vitality is one of the strategic goals of WSDOT, which expresses the understanding that the transportation network supports the local and state economy by moving people and goods. Economic vitality depends on people and goods reaching their desired destination safely and within a reasonable amount of time.

Land use surrounding both SR 9 and SR 204 in the project area is discussed in the Lake Stevens Center Subarea plan that was adopted in September of 2012. This area is defined as a commercial district consisting of several shopping centers at the heart of western Lake Stevens. The city plans to focus commercial growth in the area, making it a tourist draw and a destination for shopping, dining, and entertainment. The city planners envision an upgrade to pedestrian and vehicle circulation and the general appearance of the area, including streets and sidewalks.

The SR 9/SR 204 Intersection Improvements Pre-Design Report that was published in September 2012 highlights the fact that the current state of the area is not meeting this vision. They make their point in the opening sentence: “The SR 9/SR 204 intersection is a major chokepoint in the city of Lake Stevens and improvements are needed to relieve congestion and support future economic development in the community.”

As a travel corridor, state and local economic vitality depends on the ability to move freight through the corridor in a timely fashion. State Route 9 is monitored by WSDOT as a major thoroughfare for truck traffic, and is currently rated a T2 corridor. The SR 9/ SR 204 intersection has been allocated funds for improvement under the Connecting Washington program, indicating that it has already been recognized as a priority need at the state planning level.

To improve economic vitality, the primary intersection improvement needs to include:

- Shorter travel times for commercial drivers headed north of Lake Stevens using eastbound SR 204 to northbound SR 9.
- Reduced travel time between adjacent businesses to the east, northwest and southwest of the intersection during the evening commute period.
- Improved access to businesses while complying with state guidelines.

Performance metrics for the local and regional economy include freight travel time, local travel times, and commercial center egress/ingress accessibility. These are discussed individually below.

- Performance Metric: Freight Travel Time
- Target: Improvement (compared to no-build)
- Performance Metric: General Purpose Travel Time (Local)
- Target: Improvement (compared to no-build)
- Performance Metric: Ingress / Egress Accessibility
- Target: Visual Orientation Prior to Minimum Decision Sight Distance; Access Meets Driver Expectations

Freight Travel Time

Freight travel time will impact the cost of transporting goods locally and across a region, and increased travel times in the long run cause the price of goods to increase, which only hurts the economy.

Current average freight travel times are the same as those of general purpose travel. See Table 4 for travel time data. The target is to improve regional freight travel time over year 2040 No Build travel times.

General Purpose Travel Time

The ability of general purpose vehicles to move between residential areas and the various shopping centers is measured by travel time between several local origin and destination nodes. See Figure 1 for node locations.

Current local route options are circuitous due to the separation of destinations by the limited access highways. There are no grade-separated intersections, so local traffic must use highway intersections to traverse the network. This causes increased travel time in local trips. Table 4 summarizes local trip travel times (local travel times are unshaded). The target is to improve local travel time compared to forecast year 2040 No Build travel times.

Ingress / Egress Accessibility

Visibility

Visibility of the retail centers to drivers is crucial to maintaining the economic vitality of the area. Shopping destination indicators, such as business signs, should be visible enough to allow ample time for drivers to decide how to access the destination. Current sight distance measurements of the existing commercial facilities are shown below. Minimum decision sight distance values per AASHTO's Green Book are provided for comparison as shown in Table 5. Existing visibility ranges meet the target for all approaches except SR 9 NB visibility of the Lake Stevens Marketplace. Locations are illustrated in Figure 2.

TABLE 5. EXISTING RETAIL SIGHT DISTANCE TO APPROACHING DRIVERS

Retail Location	Driver Approach	Minimum Decision Sight Distance[1]	Existing Sight Distance	Figure 2 Reference
Lake Stevens Station	SR 9 NB	1030 ft	1300 ft	6
Frontier Village	SR 9 NB	825 ft	1300 ft	2
	SR 9 SB	825 ft	1200 ft	4
	SR 204	720 ft	1430 ft	1
Lake Stevens Marketplace	SR 9 NB	1030 ft	290 ft	3
	SR 9 SB	825	1500 ft	5
	SR 204	720 ft	0 ft	

1. Values for urban roads per Exhibit 1260-15, WSDOT Design Manual M 22-01.10, July 2013

Figure 2: Retail Visibility Locations

Driver Expectation

Access to the eastern shopping area, Frontier Village, is clearly defined and meets driver's expectations. Exiting from the same shopping area does not meet driver expectations as drivers must perform out of the way movements that are poorly signed to gain access to SR 9 or SR 204. This lack of navigational clarity at existing retail access points along the corridor could create driver distraction and could be a detriment to economic vitality. For the Frontier Village Shopping Center, there is one main entrance, which is at the intersection of SR 9 and SR 204. The main entrance is immediately adjacent (75' to the east) to the frontage roads 92nd Ave and Vernon Road, which converge with 7th Place to form the main ingress to Frontier Village in a semi-diamond intersection. The ingress from eastbound SR 204 and southbound SR 9 during the PM peak hour is rated LOS E. The egress route is complicated; drivers are required to exit the shopping center to the north, proceed west along N Davies Rd, and then proceed south along Vernon Road to the SR 9/204 intersection. This egress point operates at LOS F during the PM peak hour. Vehicles can also exit the shopping center to the south to 4th Street NE, using an on-ramp to

access SR 9 northbound. Either egress route requires vehicles to travel through the parking facilities to the extreme north or south end of the shopping center prior to exiting.

The access to Lake Stevens Marketplace is much more clear to drivers, as there are multiple ingress and egress points along 91st Ave and Market Place. All driveways allow for both ingress and egress traffic. However, those traveling on SR 9 who wish to access the Marketplace in the afternoon peak hour must pass through either SR 9/Market Place, or SR 9/SR 204 and SR 204/91st Ave, both of which are rated LOS E in the PM peak hour.

By improving the performance of the ingress and egress intersections, the shopping centers will become more accessible to drivers. It is noted in the Pre-Design Report that the access is not meeting current expectations: "The city wants to improve shopping center entrances to help local businesses thrive and prepare for future economic development."

SAFETY

The primary intersection improvement need to improve safety is:

- Lower the serious and fatal crash rate at the SR 9/SR 204 intersection from one to zero.

Collisions are any physical contact between a vehicle, bicycle, or pedestrian and either another vehicle or a fixed object along the roadway, resulting in personal injury or property damage. This is measured with two performance metrics, total and fatal crash frequency, and is compared to statewide averages and the Target Zero State Highway Safety Plan.

- Performance Metric: Fatal / Serious Crash Frequency
- Target: 0 fatal / serious injury crashes
- Performance Metric: Total Crash Frequency
- Target: Improvement (compared to No-Build)

Fatal / Serious Injury Crashes

In the recent 5 years, there has been one fatal crash at SR 9 / SR 204; one on SR 9 at 4th Street; two on SR 9 south of Lundeen; and one on SR 204 at 81st Ave. The Target Zero Washington State Highway Safety Plan goal is 0 fatal / serious injury crashes. These collisions were caused by driver inattention; DUI; failure to yield while executing a left turn; and failure to observe a pedestrian.

Total Crash Frequency

Although there is no statewide goal for overall crash frequency, the target is to improve crash frequency over predicted baseline crash frequency and rates. Tables 6 and 7 list current and predicted collision rates and total crash frequencies.

TABLE 6. INTERSECTION COLLISION RATE FROM SR 9 / SR 204 INTERSECTION STUDY

Intersection	Existing	No Build (2040)
SR 9 / Market Place NE	1.12	1.12
SR 204 / Market Place NE/Lundeen Parkway	0.93	0.93
SR 204 / 91st Avenue NE	0.85	0.85
SR 9 / SR 204	0.84	0.84
SR 9 / Lundeen Parkway	0.83	0.83

Note: Crash frequency is measured in incidents per million entering vehicles.

TABLE 7. INTERSECTION COLLISION FREQUENCY FROM SR 9 / SR 204 INTERSECTION STUDY

Intersection	Existing Average Crash Frequency	2040 Predicted Average Crash Frequency
SR 9 / Market Place NE	11.0	14.9
SR 204 / Market Place NE/Lundeen Parkway	11.4	14.4
SR 204 / 91st Avenue NE	11.1	12.3
SR 9 / SR 204	13.9	17.3
SR 9 / Lundeen Parkway	12.2	17.8

Note: Crash frequency is measure in incidents per year.

CONTEXTUAL NEEDS

Contextual needs will be affected by any development that is conducted in the area and should be addressed by any design solution that might affect the area surrounding the improvements. Unlike baseline needs, they don't warrant action independently as they are either less severe performance gaps or are not directly tied to the primary function of the network. These needs are identified by community engagement, environmental constraints, or general project area knowledge.

TRANSIT SYSTEM

SR 9 through the subject area has been identified as a Transit Emphasis Corridor by Community Transit, and recent implementation of two new transit lines along the route emphasize the action being taken to continue improving transit access in this location.

- Performance Metric: Transit Travel Time (external node to node)
- Target: Improvement over no-build conditions

MULTI-MODAL CONNECTIVITY

The Lake Stevens Transit center is within a mile of the SR 9 / SR 204 intersection, and there are bus stops along the SR 9 corridor, but there is limited existing infrastructure supporting a multimodal network. Pedestrians and cyclists are provided signalized crossings at the intersections, but there are no sidewalks for them to reach their ultimate destinations and they are forced onto the roadway shoulder to travel

through the area. The bicycle network consists of dedicated lanes only along Lundeen Parkway and Market Place NE, and the pedestrian sidewalks are intermittent along throughout the area. Signal timing is currently set to minimize time available for pedestrian crossing. As improvements are considered to meet the project baseline needs, the following metrics will also be reviewed to determine if a contextual benefit is realized.

- Performance Metric: Intermodal Network Gaps
- Target: Improvement over existing conditions
- Performance Metric: Bicycle Level of Comfort
- Target: Improvement over existing conditions
- Performance Metric: Walkability
- Target: Improvement over existing conditions

NEEDS STATEMENT

The economic center of the City of Lake Stevens surrounds the intersection of SR 9 and SR 204. By year 2040, traffic volumes are likely to grow by over 20 percent increasing congestion and travel delays beyond the state's acceptable limits and impacting local businesses. This project will study the travel problems and recommend possible improvements.

Improvements will:

- Shorten travel times for evening commuters and commercial drivers headed north of Lake Stevens using eastbound SR 204 to northbound SR 9.
- Reduce travel time between adjacent businesses to the east, northwest and southwest of the intersection during the evening commute period.
- Lower the serious and fatal crash rate at the intersection from one to zero.
- Improve access to businesses while complying with state guidelines.

APPENDIX B.
CONCEPT DEVELOPMENT AND SCREENING MEMORANDUM

November 2017

Date: November 7, 2017

To: Tes Abraha (WSDOT)

From: Michael Horntvedt (Parsons)

Cc: Cathy George (WSDOT), Lindsay Yamane (Parsons), Eric Ostfeld (Parsons)

Subject: Concept Development and Screening Memo

TECHNICAL MEMORANDUM

INTRODUCTION

This memorandum documents the actions taken by the SR 9/SR 204 Intersection Improvements Project team to develop preliminary concepts that meet project needs, and then to screen those concepts to identify several to be carried forward for further evaluation.

The process entailed reviewing the existing conditions to develop a list of project needs. This was followed by the team working collaboratively with stakeholders to develop a reasonable range of conceptual alternatives. Finally, the concepts were qualitatively reviewed for their ability to meet the project needs and were screened accordingly.

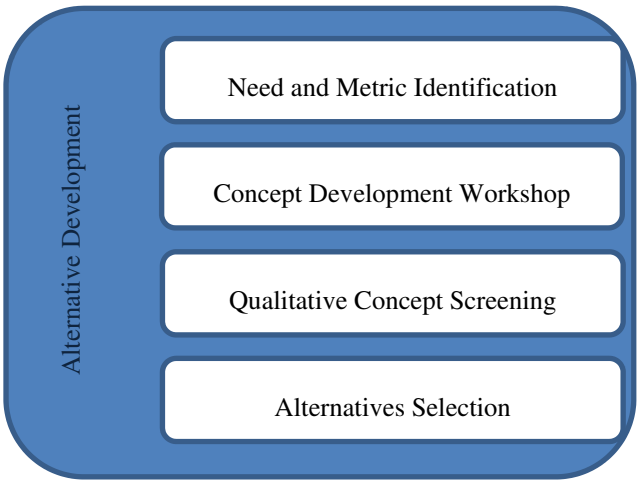


Figure 1. Alternative Development Process

The intent of the process was to select several working alternatives for the SR 9/SR 204 intersection that would capture as many of the project needs as possible by using different geometric solutions. The concepts selected were qualitatively evaluated and were found to meet the project needs. The next step after screening will be to quantitatively evaluate the concepts and recommend further modifications for a preferred alternative.

PROCESS

The purpose of the concept development and evaluation process was to identify a broad range of concepts that would meet the needs for the SR 9/SR 204 intersection improvement project and to screen them to result in several concepts that could be further refined through design and continued stakeholder and public involvement.

Project needs were identified and agreed upon through a collaborative process involving the project team and members of the stakeholder advisory group (SAG). The needs statement went through several iterations to clearly define needs as identified by performance gaps, jurisdiction plans, stakeholder needs, and State requirements. The project needs statement provided the team with the required framework to balance concept solutions with the issues being addressed. The project needs statement is shown below.

Needs statement:

The economic center of the City of Lake Stevens surrounds the intersection of SR 9 and SR 204. By year 2040, traffic volumes are likely to grow by over 20 percent, increasing congestion and travel delays beyond the state's acceptable limits and impacting local businesses. This project will study the travel problems and recommend possible improvements.

Improvements will

- Shorten travel times for evening commuters and commercial drivers headed north of Lake Stevens using eastbound SR 204 to northbound SR 9;
- Reduce travel time between adjacent businesses to the east, northwest, and southwest of the intersection during the evening commute period;
- Lower the serious and fatal crash rate at the intersection from one to zero; and
- Improve access to businesses while complying with state guidelines.

The project needs statement covers a variety of baseline and contextual needs that were identified in a set of quantifiable performance metrics presented at the second SAG meeting on October 26, 2016. The performance metrics were developed to provide a means for the team to evaluate all preliminary concepts through a qualitative first-level screening process, followed by a more detailed quantitative second-level screening process intended for a more refined set of project concepts. The qualitative metrics derived from this list are shown in the attachments to this technical memorandum.

CONCEPT DEVELOPMENT

A one-day design workshop with several key SAG members was held at the WSDOT NW Region offices on November 15 to develop concepts that would address the project needs. Representatives from the City of Lake Stevens, WSDOT, Snohomish County, and KIMCO were in attendance to generate concepts that address the project needs. The workshop members used information from the existing conditions analysis, future traffic volume forecasts, preliminary critical volume analyses, and extensive professional experience to guide their conversations. Prior to kicking off the concept development phase of the meeting, the members reviewed the project needs to ensure they could focus their attention on resolving the issues identified. After reviewing the project needs and reminding the participants that all ideas were good ideas, they broke into smaller groups to independently develop solutions. Concepts were hand-sketched onto tracing paper that was overlaid on the project-area aerial maps. At the end of the workshop, each team presented the goals and desired benefits for each concept and made notes on the tracing paper.

There were 15 concepts generated at the workshop that were then compiled by the project team and transferred into CAD graphics for presentation to the SAG on December 6th.

The team presented each of the concepts to the SAG and requested any new information that would improve the concepts or that could be identified as a new concept. One of the stakeholders came forward with a new concept that was a revision to Concept O as presented earlier in the meeting. The SAG agreed to accept the new concept for further qualitative evaluation. The SAG agreed that all 16 concepts

warranted the qualitative evaluation process to ensure that each was given fair treatment and that all stakeholders would understand how the concepts would meet project needs. The diagrams and summaries for each of the 16 concepts are presented in appendices A through P of this document.

QUALITATIVE SCREENING

A qualitative concept screening workshop with several key members of the SAG, their representatives, and project team members was held on December 21st. The workshop was attended by representatives from WSDOT, Snohomish County, the City of Lake Stevens, Snohomish Transit, and a representative from KIMCO's consultant team. The goal of the meeting was to discuss ratings for each of the qualitative metrics and to discuss each concept's ability to address the needs. It was noted during the screening workshop that there were several common elements among the concepts that would be carried forward. Those common elements include the following:

1. Full access to Frontier Village at SR 9/SR 204
2. Right in/right out at 4th Street NE
3. Cul-de-sac at Vernon Road and 92nd Avenue connections with 7th Street to improve the SR 9/SR 204 intersection
4. Provide full access at SR 204/91st Avenue NE

Screening results

After the qualitative concept screening workshop, 4 of the 16 concepts remained to be carried forward and presented to the full SAG team on February 1. Concepts B, C, E, and H were assessed to be the highest improvement value, meeting project needs in the most logical and efficient manner.

On January 15, the project team held a quality control meeting to review the concepts and determine what might have been missed during the concept development and screening phase. It was determined that Concept G was screened out primarily because of the visual impacts associated with a bridge being constructed through the view shed. As a result, the team asked whether the concept would still be screened if it provided a direct-access ramp from SR 204 to SR 9 via a tunnel. The team further developed the concept for presentation at the February 1st SAG meeting to determine if the SAG would agree to the new ratings for the concept Gv2.

The project team presented its final qualitative screening results to the SAG on February 1st and gained consent from the SAG members to carry forward five concepts for further design and evaluation. They provided consent with the understanding that when selecting a preferred alternative, they would have an opportunity to mix and match various concept elements. The final five concepts to be carried forward included concepts B, C, E, Gv2, and H. Each of these concepts, as they were updated, is illustrated in Attachment C. The outcome of further project team meetings and evaluation of the concepts as preliminary engineering design commenced resulted in another revision to concept Gv2 in which width for a second lane was added to the tunnel. The additional width was included to accommodate the potential for long term capacity needs for the eastbound SR 204-to-northound SR 9 traffic. This alteration is referenced as concept G2B.

Qualitative screening matrices for each of the 16 concepts are presented in appendices A through P of this document.

NEXT STEP

The concept development and screening process identified a range of project improvements that could meet the project needs while eliminating from consideration those concepts that did not meet the needs.

Concepts that met the project needs and were selected for further evaluation included concepts B, C, E, G2B, and H. They were further developed to include preliminary design, environmental evaluation, and traffic operations analysis. Each of the concepts was evaluated using a more quantitative second-level screening analysis to evaluate their performance using the same project metrics used for the first-level screening. Quantitative analysis results are documented in the Transportation Discipline Report.

CONCLUSION

Findings from the second-level screening process were presented at the SAG Meeting #6, where the SAG members agreed to not carry forward work with Concept H due to concerns about a three lane roundabout and potential issues with freight and pedestrians. The SAG agreed to continue to evaluate concept E with modifications that would improve the cost-benefit value. Modifications to Concept E included maintaining the existing lane configuration on SR 9 north of the SR 204 intersection. The new concept E was referred to as concept E2. The final preferred concept recommendation from the SAG occurred at SAG Meeting #7, where the Stakeholder Advisory Group concurred with a variation of concept E2 that maintained local access on the existing roadway network. The final concept is described in more detail and final operational analysis is summarized in the SR 9/SR 204 Intersection Improvement Project Transportation Discipline Report.

ATTACHMENT A: QUALITATIVE METRICS AND MEASURES

Baseline Needs

As part of the first-tier screening process, the team evaluated the baseline needs at the category level. This provides a general understanding about how the alternatives can meet the project needs using a high-level qualitative assessment.

Safety

○ – The project alternative reduces the safety of the corridor by introducing new conflict points or introducing more opportunities for more severe crashes.

◐ – The project alternative is similar to existing conditions because it does not change the potential conflict points for vehicles and pedestrians.

● – The project alternative improves the safety conditions by reducing conflict points for vehicles and pedestrians.

Mobility

○ – The project alternative reduces mobility by introducing additional delay for all modes.

◐ – The project alternative does not increase or improve delay for all modes.

● – The project alternative improves mobility by reducing delay for all modes.

Economic Vitality

○ – The project alternative reduces economic vitality by making access to adjacent land use unintuitive or increases travel time to reach land uses adjacent to the highway.

◐ – The project alternative does not change economic vitality because it maintains the same level of access and travel time to reach land uses adjacent to the highway.

● – The project alternative improves economic vitality by improving intuitive access to adjacent land use and improves the travel times.

Contextual Needs

Contextual needs are identified as those items that must be considered as the alternatives are developed such that planned improvements or future opportunities are not precluded. The contextual needs for the SR 9/SR 204 project are all addressed in the Mobility Category, which is addressed as part of the baseline needs. The team will consider whether any of the alternatives adversely affect the transit, bicycle, or pedestrian environment for the area and will rate the option as follows:

Multimodal Opportunities

○ – The project alternative adversely affects transit or nonmotorized opportunities.

◐ – The project alternative does not affect transit or nonmotorized opportunities.

● – The project alternative improves transit or nonmotorized opportunities.

Alternatives Analysis

The following items do not describe a shortfall that is driving the project; rather, they are parameters that must be met or additional impacts that must be considered in comparing the desirability of one concept or alternative to another.

Commercial Space Impacted

○ – The project footprint encroaches upon existing commercial locations or upon land proposed for commercial use.

◐ – The project alternative does not affect areas designated for commercial land use.

● – The project provides additional space to what is currently available for commercial use.

Consistency with State, Regional, and Local Plans

○ – The project does not meet existing long- and short-term plans currently in effect.

◐ – The project alternative does not conflict with existing modal plans.

● – The project alternative addresses improvements and meets goals identified in existing plans.

Visual Aesthetics

○ – The project alternative will degrade the general aesthetic feel of the area and will be displeasing to those in the surrounding area.

◐ – The project alternative maintains the aesthetic qualities of the existing project site.

● – The project alternative improves the visual appeal of the site both to roadway users and those in the surrounding area.

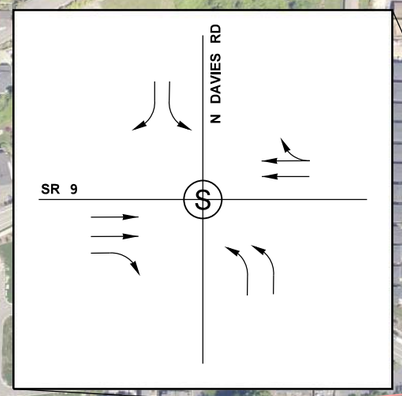
ATTACHMENT B – CONCEPTS A THROUGH P

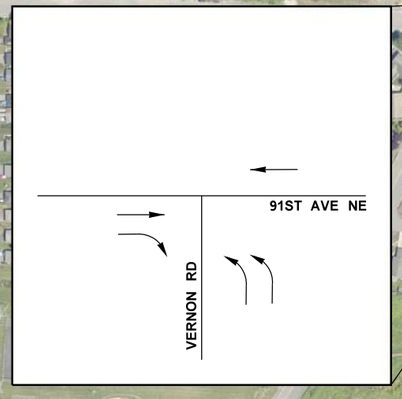
Concept A			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	By removing the westbound traffic movement on the east leg of the SR 9/SR 204 intersection, this concept removes some conflict points at the intersection. However, this concept relocates some traffic movements to a newly constructed intersection located at the Davies/Vernon roadway alignment that would intersect with SR 9. This concept rated about average regarding safety.
	Mobility	○	It was determined that the intersection of Lundeen Parkway and SR 204 would be adversely affected by this concept. Furthermore, added traffic along the Vernon Road alignment would likely result in traffic operations issues at the intersection with 91st Avenue NE. Also, a new intersection with SR 9 at the Davies alignment would result in possible increases in delay along SR 9. For these reasons, this concept was given a lower rating.
	Economic Vitality	○	This concept assumes a new roadway access point at the Davies/Vernon Road alignment. Even with a new connection point, drivers would use a different access point to enter the property as they would to exit. It was determined that this level of confusion for drivers would not enhance economic vitality within the City of Lake Stevens.
Contextual Needs	Multimodal	◐	Transit would operate as it does under a no-build condition. The new intersection on SR 9 at the Davies/Vernon Road alignment could cause delay for transit if not timed correctly, but the group felt that the delay would be nominal given the ability to coordinate signals and possibly include transit signal priority. Nonmotorized users would see a new crossing opportunity at Davies, thus improving their connectivity across the SR 9 corridor.
Alternatives Analysis	Commercial Space Impacted	○	The two concepts drafted at the SR 204/Lundeen Parkway intersection include substantial interruptions to right-of-way with potential property impacts for their construction. It is assumed that relocating over 1,000 vehicles per hour to the Vernon Road alignment would also require some level of roadway widening that could impact right-of-way along a city corridor. Constructing an at-grade intersection at the Davies/Vernon Road alignment would require the closure of the Vernon Road frontage road, thus impacting businesses along that corridor. Additional roadway widening on Davies could also be required and result in adverse effects on adjacent commercial space.
	Consistency with Plans	◐	This concept is consistent with local plans to improve local connectivity; however, it is not consistent with the state highway access control plans that limit the number of access points. This concept was given a neutral rating, with a clear understanding that access control considerations would be required if the concept moves forward.
	Visual Aesthetics	○	The aerial jug handle design at Lundeen Parkway would create a visual barrier that is not consistent with the Lake Stevens Center subarea plan. Concept provides opportunities for landscaping adjacent to SR 9 with repurposed Vernon Road property.
	Overall Score	○	

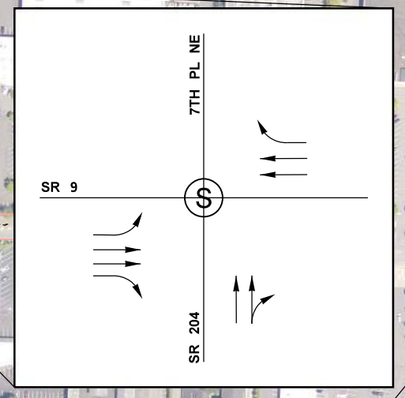
- GOAL: REDUCE CONGESTION AT THE SR 9/SR 204 INTERSECTION
- KEY ELEMENTS
  - RELOCATE SR 204 EAST-TO-SR 9 NORTH LEFT TURNS TO NEW SIGNALIZED VERNON RD/SR 9/N. DAVIES RD
  - IMPROVE ACCESS TO PROPERTIES EAST OF SR 9 VIA THE SR 9/SR 204 INTERSECTION AND CLOSE VERNON RD EAST OF SR 9 BETWEEN SR 204 AND JUST NORTH OF N. DAVIES RD.
  - OPPORTUNITY FOR "ROAD DIET" ON SR 204 BETWEEN SR 9 AND LUNDEEN PKWY
  - NEW SIGNALIZED INTERSECTION (2-LANE) OR OVERCROSSING (1-LANE) TO VERNON RD/87TH AVE NE
  - NO REVISIONS AT SR 204/91ST AVENUE NE INTERSECTION
  - LEVERAGE OPPORTUNITIES FOR NON-MOTORIZED CONNECTIVITY WHERE PRACTICAL

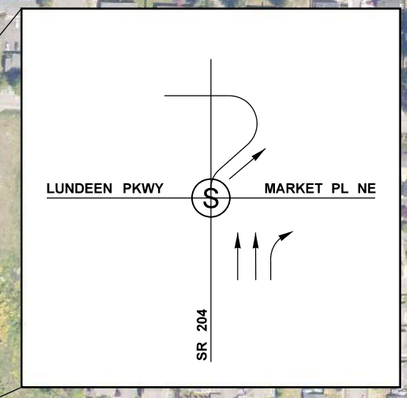
LEGEND

- S - SIGNALIZED
- ◯ - ROUNDABOUT
- DEPRESSED ROADWAY
- ROADWAY IMPROVEMENT
- CURRENT PLANNED LOCAL IMPROVEMENTS
- DESIRED
- STATE ROW LINE
- BRIDGE
- INTERSECTION TURNING MOVEMENT
- CLOSED AREA









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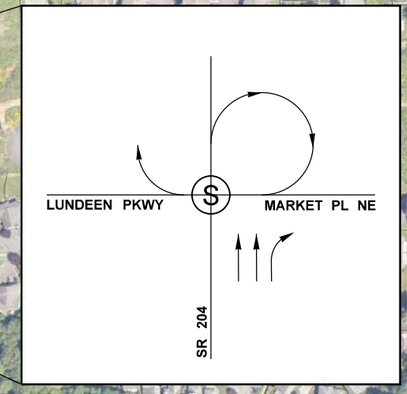
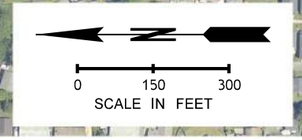


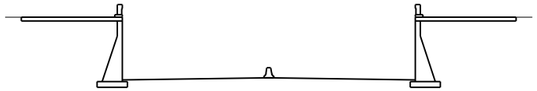


SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

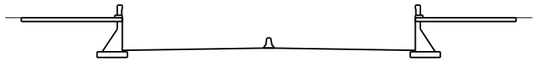
CONCEPT A - DRAFT

PARSONS

Concept B			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	●	Roundabouts are safer for vehicular traffic, given fewer conflict points, and reduce accident severity. If a different control measure were used, the new construction will be designed to meet/exceed current safety standards for pedestrian and vehicular safety.
	Mobility	●	This concept received a higher rating for mobility because of the total accessibility available resulting from the local roadway connectivity and an assumption that the intersections would operate within the state requirements on SR 9. Locations that show a dashed blue roundabout are assumed to continue under their current level of control until the local jurisdiction can make modifications as separate projects.
	Economic Vitality	◐	This concept provides improved accessibility by allowing access to the properties on the east side of SR 9 at the entry locations. The removal of left-turn functions at 91st Avenue NE introduces a barrier to properties on either side of SR 204. This would then require a circuitous route for people to use those properties.
Contextual Needs	Multimodal	◐	Roundabouts would be designed to adequately service transit routes through the intersections. The removal of the signal-controlled intersections would be assumed to provide an improvement for transit travel times. Nonmotorized access would be increased with the added access roundabout at the Davies/Vernon Road alignment. Average family cyclists don't understand roundabouts, so they could be confusing for people trying to traverse the roundabouts between the main street land use along 91st Avenue NE and the commercial land use east of SR 9. Pedestrians also find roundabouts confusing because they must travel out of their way to get to the crosswalks for safe travel. The new connectivity was assumed to counter the short-term issues for pedestrians and cyclists.
Alternatives Analysis	Commercial Space Impacted	○	Constructing the frontage roads on either side of SR 9 to connect the two roundabouts at SR 9/SR 204 and at SR 9/Davies/Vernon Road would require additional right-of-way. It is undetermined at this point how much private right-of-way would be affected, but it is likely some impacts would be recognized. It is further assumed that construction of a roundabout that would provide a level of service that meets the State's guidelines would require a large area and would likely push existing local roads into adjacent right-of-way, resulting in some level of impact.
	Consistency with Plans	●	This concept matches local plans with the additional connectivity for local roadways across SR 9; however, it does not match WSDOT managed-access guidelines for highways designated as partial limited-access highways.
	Visual Aesthetics	●	Concept provides opportunities for landscaping adjacent to SR 9 with repurposed 92nd Ave NE property. Roundabouts also provide opportunities for center landscape or are designed to match local context.
	Overall Score	●	



SECTION A-A



SECTION B-B

- GOAL: REDUCE CONGESTION AT THE SR 9/SR 204 INTERSECTION BY DEPRESSING SR 9 UNDER SR 204 FROM NORTH OF SR 9/4TH AVENUE NE INTERSECTION TO JUST NORTH OF A NEW SR 9/N. DAVIES RD INTERSECTION
- KEY ELEMENTS
  - MAINTAINS SR 9 REGIONAL FUNCTION (HIGHWAY OF STATEWIDE SIGNIFICANCE)
  - BUILDS ROUNDABOUTS AT SR 9/SR 204, SR 9/4TH AVENUE NE, AND SR 9/N. DAVIES RD.
    - AESTHETICS
    - AREA CIRCULATION AND OPTIONS
  - RE-ALIGNS/RE-PURPOSES VERNON RD BETWEEN 7TH PLACE NE AND N. DAVIES RD VICINITY
  - MAINTAINS REGIONAL TRAFFIC FLOW TO/FROM SR 9 TO/FROM SR 204 (FREE SR 9 SB RIGHT TO SR 204 WB) AT SR 9/SR 204 INTERSECTION
  - LIMITS MOVEMENTS AT SR 204/91ST AVENUE NE INTERSECTION TO RIGHT-IN/RIGHT-OUT ONLY (NO LEFT TURNS)
  - FOR SB SR 9, ACCESS TO PROPERTIES EAST OF SR 9 PROVIDED AT NEW SR 9/N. DAVIES RD INTERSECTION
  - FOR NB SR 9, ACCESS TO PROPERTIES EAST OF SR 9 PROVIDED AT NEW SR 9/4TH AVENUE NE INTERSECTION
  - IDENTIFIES POTENTIAL FUTURE CONNECTIONS/INTERSECTIONS PER THE LAKE STEVENS SUB AREA PLAN
  - LEVERAGE OPPORTUNITIES FOR NON-MOTORIZED CONNECTIVITY WHERE PRACTICAL

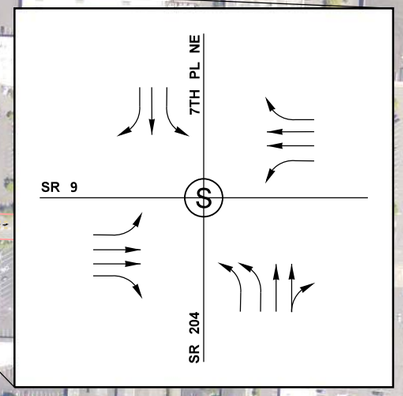
SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT B - DRAFT

PARSONS

Concept C			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Concept C proposes to close the frontage road access points from Vernon Road and to 92nd Avenue NE, thus it provides a marginal improvement in the number of conflict points for pedestrians on the east side of the SR 9/SR 204 intersection. By forcing traffic from Vernon Road to travel through a parking area, there could be an increase in conflict points between vehicles and pedestrians. This concept was rated as neutral because the new roadway would be designed to meet current safety design standards.
	Mobility	○	SR 9 mobility would be essentially the same as the no-build configuration. Mobility is rated poorly in this concept because traffic that normally would have a direct connection from Vernon Road to the SR 9/SR 204 intersection will be required to deviate their route through the development located east of the intersection. This would add distance and possibly delay their trip.
	Economic Vitality	◐	Full entrance and exit at the SR 9/SR 204 intersection improves driver expectation for ingress and egress to the eastern development; however, the businesses along the Vernon Road frontage might experience a decrease in business resulting from a reduction in pass by trips.
Contextual Needs	Multimodal	◐	There would be a slight improvement for pedestrians on the east side of the intersection because of the frontage road closure. No net benefits are assumed for the transit service.
Alternatives Analysis	Commercial Space Impacted	●	Repurposing 92nd Ave NE could make more property available for development or enhancements that make the area more desirable.
	Consistency with Plans	◐	This concept is consistent with local and regional plans.
	Visual Aesthetics	◐	Visual aesthetics would not be affected by this concept.
	Overall Score	◐	

N DAVIES RD
7TH PL NE
4TH ST NE
92ND AVE NE
VERNON RD
SR9
SR 204
MARKET PL
91ST AVE NE
LUNDEEN PKWY
MARKET PL NE



LEGEND

- S - SIGNALIZED
- ROUNDABOUT
- DEPRESSED ROADWAY
- ROADWAY IMPROVEMENT
- CURRENT PLANNED LOCAL IMPROVEMENTS
- DESIRED
- STATE ROW LINE
- BRIDGE
- INTERSECTION TURNING MOVEMENT
- CLOSED AREA

- GOAL: IMPROVE ACCESS TO PROPERTIES EAST OF SR 9 AT THE SR 9/SR 204 INTERSECTION
- KEY ELEMENTS:
  - CLOSES 92ND AVENUE NE (FRONTAGE ROAD) AND ADDS CUL-DE-SAC AT VERNON RD/7TH PLACE NE
  - IMPROVES ACCESS FROM N. DAVIES RD TO PROPERTIES EAST OF SR 9 ON NORTH
  - CREATES NEW ACCESS FROM 4TH AVENUE NE TO PROPERTIES EAST OF SR 9 ON SOUTH.
  - ASSUMES PROPOSED CONNECTOR FROM LAKE STEVENS SUBAREA PLAN
  - LEVERAGE OPPORTUNITIES FOR NON-MOTORIZED CONNECTIVITY WHERE PRACTICAL

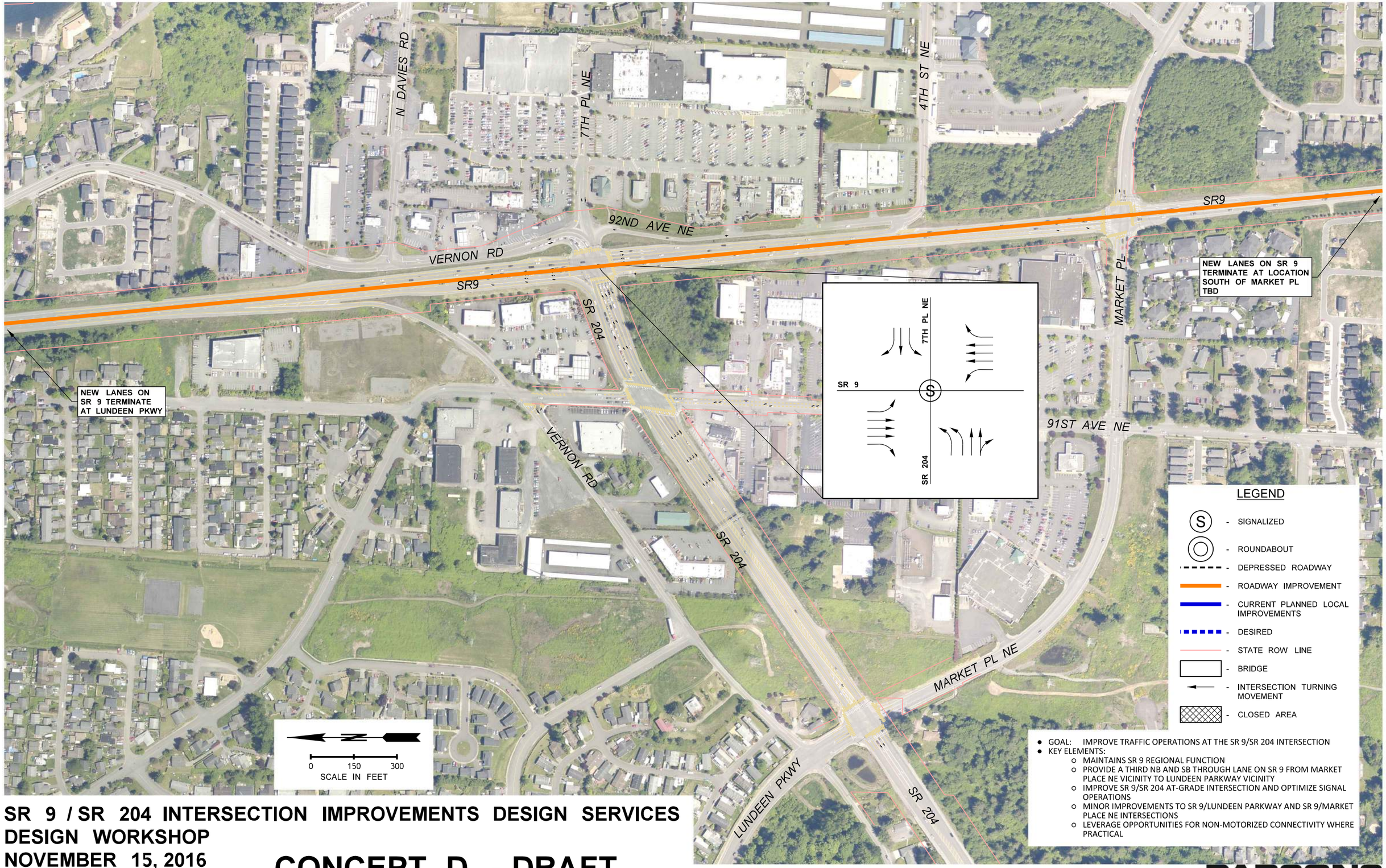
0 150 300
SCALE IN FEET

SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT C - DRAFT

PARSONS

Concept D			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Pedestrians would be required to walk across more lanes on SR 9; however, their crossing would be equally protected by a traffic signal. No change compared to no-build is assumed for this concept.
	Mobility	◐	Mobility would improve on SR 9 and possibly on SR 204 because of the new capacity on SR 9. Because this concept did not address the heavy eastbound-to-northbound left-turn function, it was rated as similar to the no-build.
	Economic Vitality	○	No changes to the access point at SR 9/SR 204 were proposed by this concept, so it would maintain a circuitous routing for business users of the eastern development.
Contextual Needs	Multimodal	○	Similar to the mobility rating, transit would see some improvements, but they are not likely to be substantial. Pedestrians would be required to walk an additional 20 to 24 feet across the state highway, and that would reduce the comfort even more. For this reason, the multimodal rating was poor compared to no-build.
Alternatives Analysis	Commercial Space Impacted	○	It was assumed that the western edge would be held constant to avoid impacting the wetland in the southwest corner of the intersection. Holding the western edge might force a widening of SR 9 all to the east and ultimately impact the frontage road alignment. It was assumed that moving this modification to an alignment could result in a right-of-way impact.
	Consistency with Plans	◐	This concept is consistent with local and regional plans.
	Visual Aesthetics	○	Adding 20 to 24 feet of pavement to the SR 9 corridor would degrade from the visual aesthetics in the area.
	Overall Score	○	

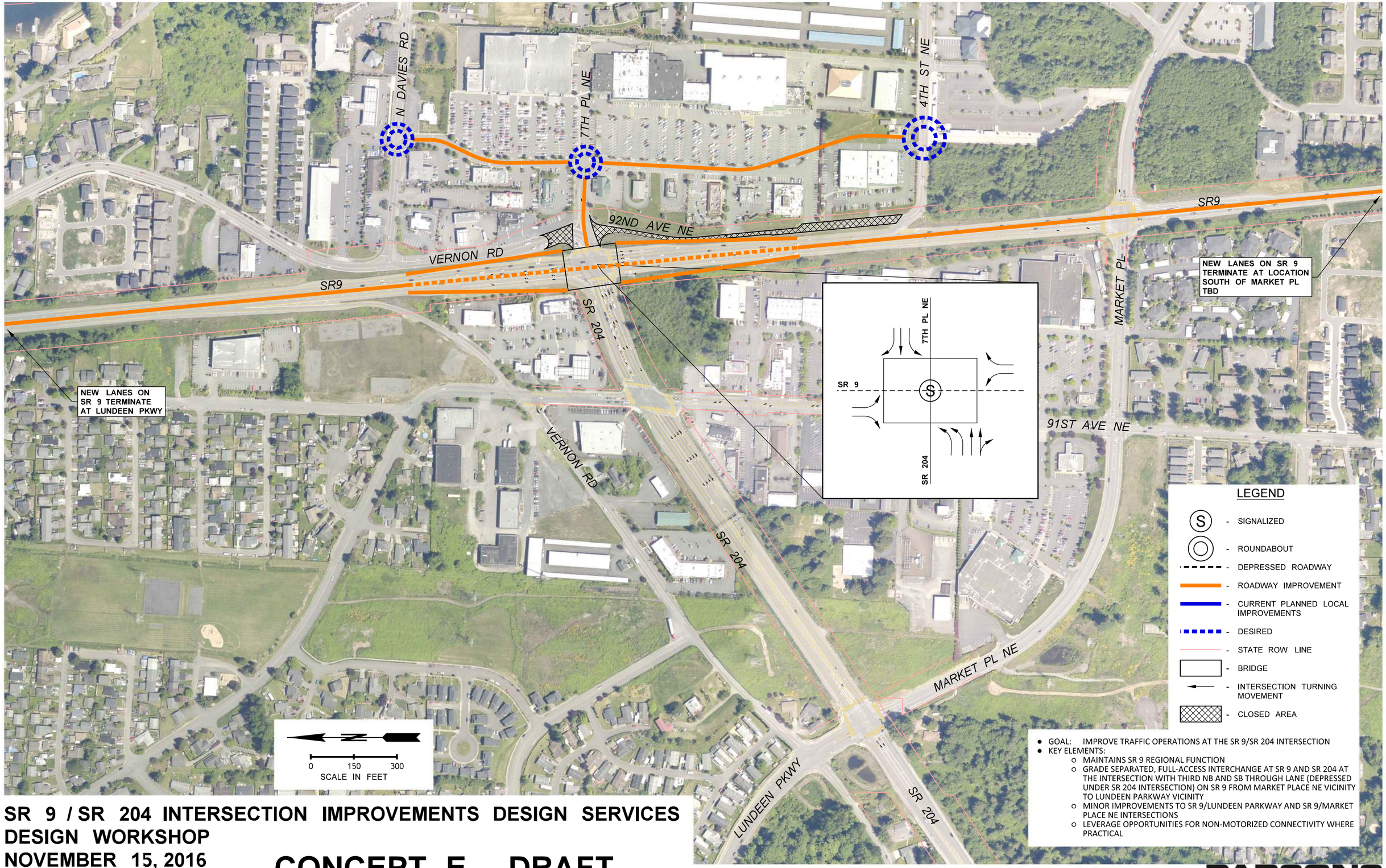


SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT D - DRAFT

PARSONS

Concept E			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Grade separating SR 9 removes the number of vehicles with potential conflict from the intersection crossing at SR 9/SR 204. However, a new tight diamond interchange creates two new intersections, thus keeping conflict points similar to a no-build configuration. Closing the existing frontage roads would also result in increased car trips through the eastern commercial area and could increase conflict points between vehicles and pedestrians.
	Mobility	●	It is assumed that removing all the SR 9 traffic from the intersection control would result in improved overall mobility. This concept also adds a full lane in each direction to the existing configuration. This added capacity would improve mobility for the intersection at SR 9/SR 204 and at SR 9/Market, thus improving mobility for more people. People who normally use the direct connection from Vernon Road to the SR 9/SR 204 intersection will be impacted by this concept. Those people will be required to deviate their route through the development located east of the intersection. This would add distance and possibly delay their trip. This concept was rated well because a higher number of people would likely receive benefit because of the grade separation on SR 9.
	Economic Vitality	●	Full entrance and exit at the SR 9/SR 204 intersection improves driver expectation for ingress and egress to the eastern development; however, the businesses along the Vernon Road frontage might experience a decrease in business resulting from a reduction in pass-by trips. Anticipated improvements to overall traffic operations and mobility in the area were assumed to benefit the economic vitality of the area.
Contextual Needs	Multimodal	◐	There would be a slight improvement for pedestrians on the east side of intersection because of the frontage road closure. No net benefits are assumed for the transit service. Transit stops would be provided on the northbound on-ramp and southbound on-ramp.
Alternatives Analysis	Commercial Space Impacted	○	It was assumed that the western edge would be held constant to avoid impacting the wetland in the southwest corner of the intersection. Holding the western edge might force the widening of SR 9 all to the east and ultimately impact the frontage road alignment. It was assumed that moving this modification to alignment could result in a right-of-way impact.
	Consistency with Plans	◐	This concept is consistent with local plans, but not fully consistent with regional plans because of the additional lane on SR 9.
	Visual Aesthetics	●	Even though SR 9 is being widened, the section of SR 9 between two Lake Stevens key land use areas will be depressed and a new interchange will be constructed to maintain a line of site from SR 204 across the highway. The interchange will also provide opportunities for plantings or architectural features consistent with Lake Stevens' land use context.
	Overall Score	●	



SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES

DESIGN WORKSHOP

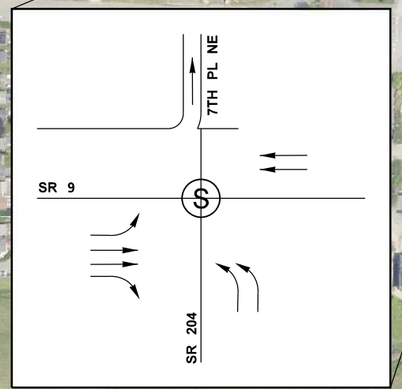
NOVEMBER 15, 2016

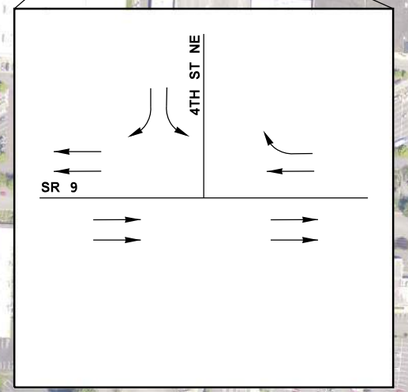
CONCEPT E - DRAFT

PARSONS

Concept F			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	By removing the westbound traffic movement on the east leg of the SR 9/SR 204 intersection, this concept removes some conflict points at the intersection. However, this concept relocates some traffic movements to a newly constructed intersection located at the Davies/Vernon roadway alignment that would intersect with SR 9. This concept rated about average regarding safety.
	Mobility	○	It was determined that the intersection of Lundeen Parkway and SR 204 would be adversely affected by this concept. Furthermore, added traffic along the Vernon Road alignment would likely result in traffic operations issues at the intersection with 91st Avenue NE. Furthermore, a new intersection with SR 9 at the Davies alignment would result in possible increases in delay along SR 9. For these reasons, this concept was given a lower rating.
	Economic Vitality	○	This concept assumes a new roadway access point at the Davies/Vernon Road alignment that provides full connectivity to/from the eastern commercial area. The proposed roundabout would likely be large and result in impacts to adjacent properties. It was determined that this level of confusion for drivers would not enhance economic vitality within the City of Lake Stevens. This concept does not maintain visibility from SR 204 to the eastern commercial area, so access would not be intuitive.
Contextual Needs	Multimodal	◐	Transit would benefit from the overall mobility improvement. Depressing SR 9 would impact the inline transit stops and require additional design or relocation of the stops. Pedestrians and cyclists would have a new crossing of SR 9 at Davies and possibly at 4th St NE. Further improvements would be needed on the eastern side of SR 9 to provide connectivity to the transit center and between the connections.
Alternatives Analysis	Commercial Space Impacted	○	The two concepts drafted at the SR 204/Lundeen Parkway intersection include substantial interruptions to right-of-way with potential property impacts for their construction. It is assumed that relocating over 1,000 vehicles per hour to the Vernon Road alignment would also require some level of roadway widening that could impact right-of-way along a city corridor. Constructing an at-grade intersection at the Davies/Vernon Road alignment would require the closure of the Vernon Road frontage road, thus impacting businesses along that corridor. Additional roadway widening on Davies could also be required and may result in adverse effects on adjacent commercial space.
	Consistency with Plans	○	Creating a thoroughfare on Vernon Road is not consistent with the City of Lake Stevens' land use plans for the northwestern corner of the SR 9/SR 204 intersection area.
	Visual Aesthetics	○	The aerial jug handle design at Lundeen Parkway would create a visual barrier that is not consistent with the Lake Stevens Center subarea plan. Concept provides opportunities for landscaping adjacent to SR 9 with repurposed Vernon Road property.
	Overall Score	○	

N DAVIES RD
7TH PL NE
4TH ST NE
92ND AVE NE
VERNON RD
SR9
SR 204
--91ST AVE NE --
MARKET PL
MARKET PL NE
LUNDEEN PKWY





INTERSECTION OPTIONS SIMILAR TO CONCEPT A

0 150 300
SCALE IN FEET

LEGEND

- S - SIGNALIZED
- ROUNDABOUT
- DEPRESSED ROADWAY
- ROADWAY IMPROVEMENT
- CURRENT PLANNED LOCAL IMPROVEMENTS
- DESIRED
- STATE ROW LINE
- BRIDGE
- INTERSECTION TURNING MOVEMENT
- CLOSED AREA

- GOAL: IMPROVE ACCESS AND REDUCE CONGESTION AT SR 9/SR 204 INTERSECTION
- KEY ELEMENTS:
  - REVISES ACCESS AT SR 9/SR 204 INTERSECTION (SB SR 9 TO PROPERTIES EAST OF SR 9 ONLY)
  - EB SR 204 TO DEPRESSED NB SR 9
  - ACCESS TO PROPERTIES EAST OF SR 9 PROVIDED VIA VERNON ROAD AND NEW OVERCROSSING/INTERSECTION
  - NEW OVERCROSSING/INTERSECTION PROVIDES ACCESS TO NB SR 9
  - LEVERAGE OPPORTUNITIES FOR NON-MOTORIZED CONNECTIVITY WHERE PRACTICAL

SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
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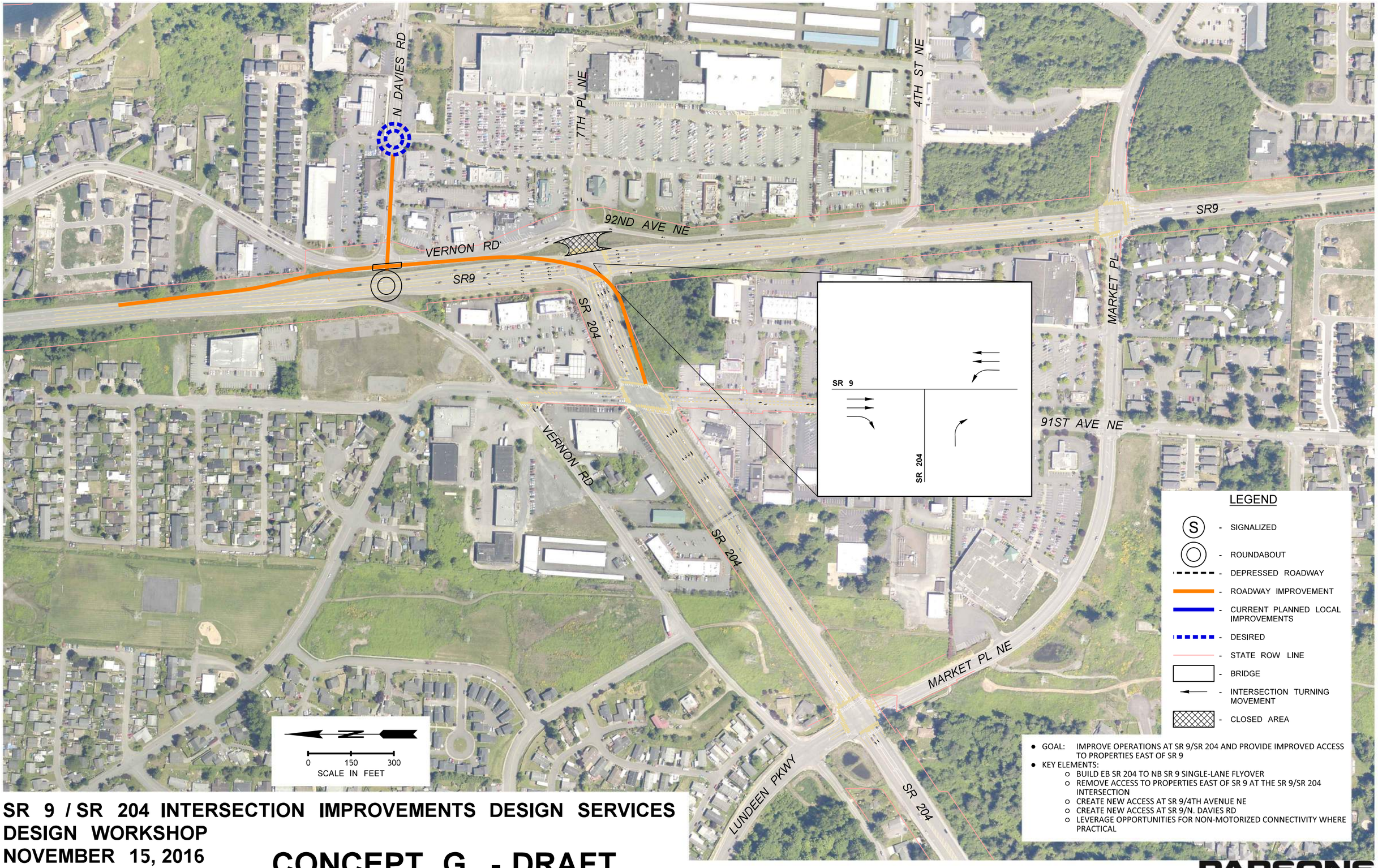
CONCEPT F - DRAFT

PARSONS

Concept G			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	●	SR 9/SR 204 is narrow and reduces traffic conflict by building a flyover. Roundabout or signal at Davies would be designed to provide safe connectivity.
	Mobility	◐	Removing the left-turn traffic from the SR 9/SR 204 intersection is anticipated to result in an improvement; however, the added intersection at SR 9 and the Davies/Vernon Road alignment could result in additional delay.
	Economic Vitality	○	Limits accessibility to the eastern commercial property by relocating the primary access point from SR 9/SR 204 to Davies Road. There is no line of sight access point, so it limits visibility and accessibility.
Contextual Needs	Multimodal	◐	Transit would operate as it does under a no-build condition. The new intersection on SR 9 at the Davies/Vernon Road alignment could cause delay for transit if not timed correctly, but the group felt that the delay would be nominal given that the roundabout would be designed to meet the state requirements for mobility. Nonmotorized users would see a new crossing opportunity at Davies, thus improving their connectivity across the SR 9 corridor.
Alternatives Analysis	Commercial Space Impacted	○	Wetland right-of-way could be impacted in the southwest corner of SR 9/SR 204 intersection. The realignment of Vernon Road might be required near the flyover touchdown point and could cause property impacts.
	Consistency with Plans	○	Elevated structures within the city limits is not consistent with local plans, nor is a new intersection on the state highway designated as partial limited access.
	Visual Aesthetics	○	The flyover at SR 9/SR 204 would create a visual barrier that is not consistent with local Lake Stevens Center subarea plan. Blocks view of the Cascade Mountains and further accentuates a division of the city.
	Overall Score	○	

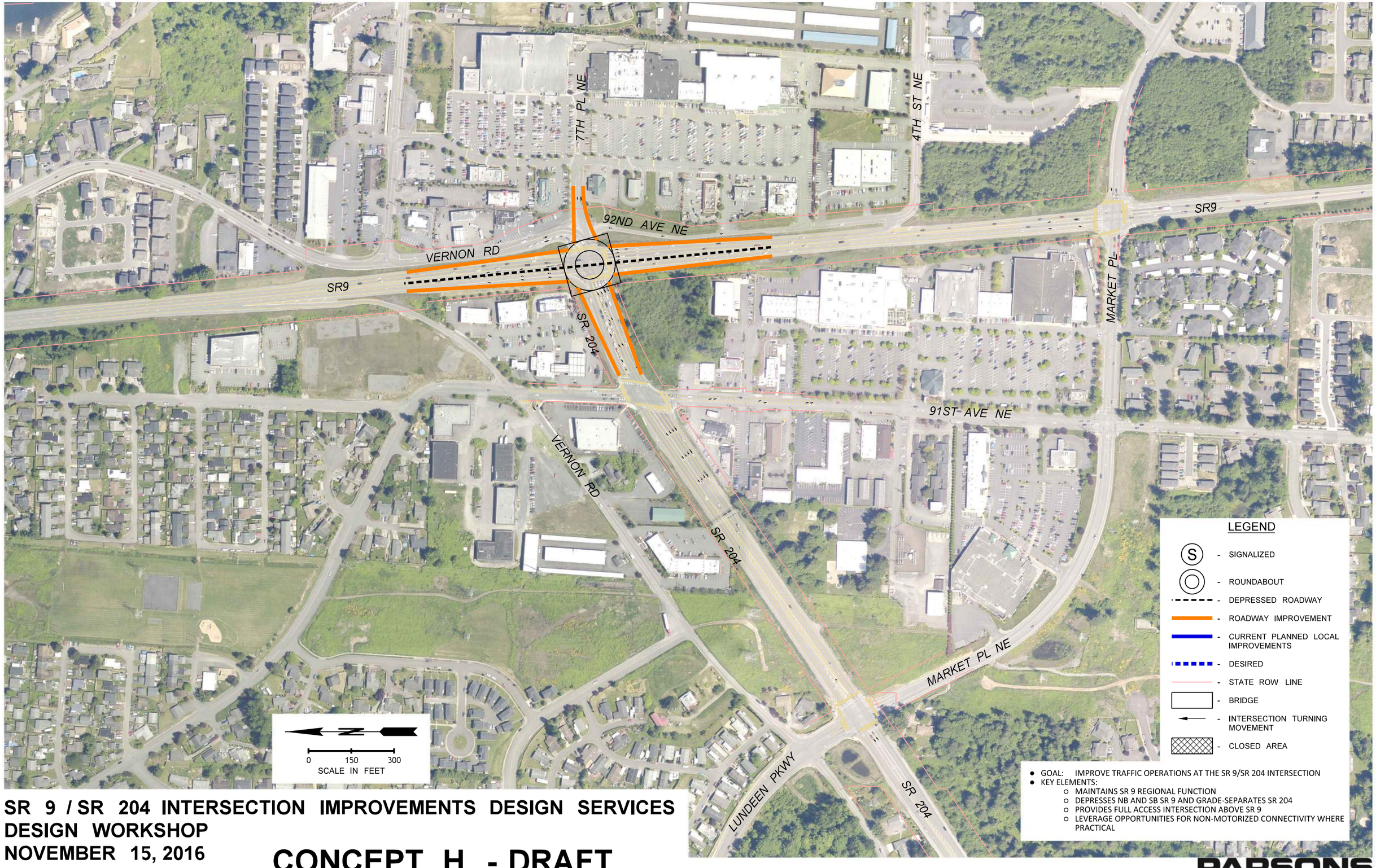


SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT G - DRAFT

PARSONS

Concept H			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	●	Grade separating SR 9 removes the number of vehicles with potential conflict from the intersection crossing at SR 9/SR 204. The roundabout proposed would provide improved safety for vehicles and pedestrians by removing the number of conflict points. Closing the existing frontage roads would also result in increased car trips through the eastern commercial area and could increase conflict points. It is anticipated that the improvements in this concept would be enough to rate it as an improvement.
	Mobility	●	It is assumed that removing all of the SR 9 traffic from the intersection control would result in improved overall mobility. This concept also adds a full lane in each direction to the existing configuration. This added capacity would improve mobility for the intersection at SR 9/SR 204 and at SR 9/Market, thus improving mobility for more people. People who normally use the direct connection from Vernon Road to the SR 9/SR 204 intersection will be impacted by this concept. Those people will be required to deviate their route through the development located east of the intersection. This would add distance and possibly delay their trip. This concept was rated well because the higher number of people would likely receive benefit as a result of the grade separation on SR 9.
	Economic Vitality	●	Full entrance and exit at the SR 9/SR 204 intersection improves driver expectation for ingress and egress to the eastern development; however, the businesses along the Vernon Road frontage might experience a decrease in business resulting from a reduction in pass by trips. Anticipated improvements to overall traffic operations and mobility in the area were assumed to benefit the economic vitality of the area.
Contextual Needs	Multi-Modal	◐	There would be a slight improvement for pedestrians on the east side of intersection as a result of the frontage road closure. No net benefits are assumed for the transit service. Transit stops would be provided on the northbound on-ramp and southbound on-ramp.
Alternatives Analysis	Commercial Space Impacted	○	It was assumed that the western edge would be held constant to avoid impacting the wetland in the southwest corner of the intersection. Holding the western edge might force widening of SR 9 all to the east and ultimate impacting the frontage road alignment. It was assumed that moving this modification to alignment could result in a right of way impact.
	Consistency with Plans	●	This concept is consistent with local and regional plans.
	Visual Aesthetics	●	Even though SR 9 is being widened, the section of SR 9 between two of Lake Stevens' key land use areas will be depressed and a new interchange will be constructed to maintain a line of site from SR 204 across the highway. The interchange will also provide opportunities for plantings or architectural features consistent with Lake Stevens' land use context.
	Overall Score	●	

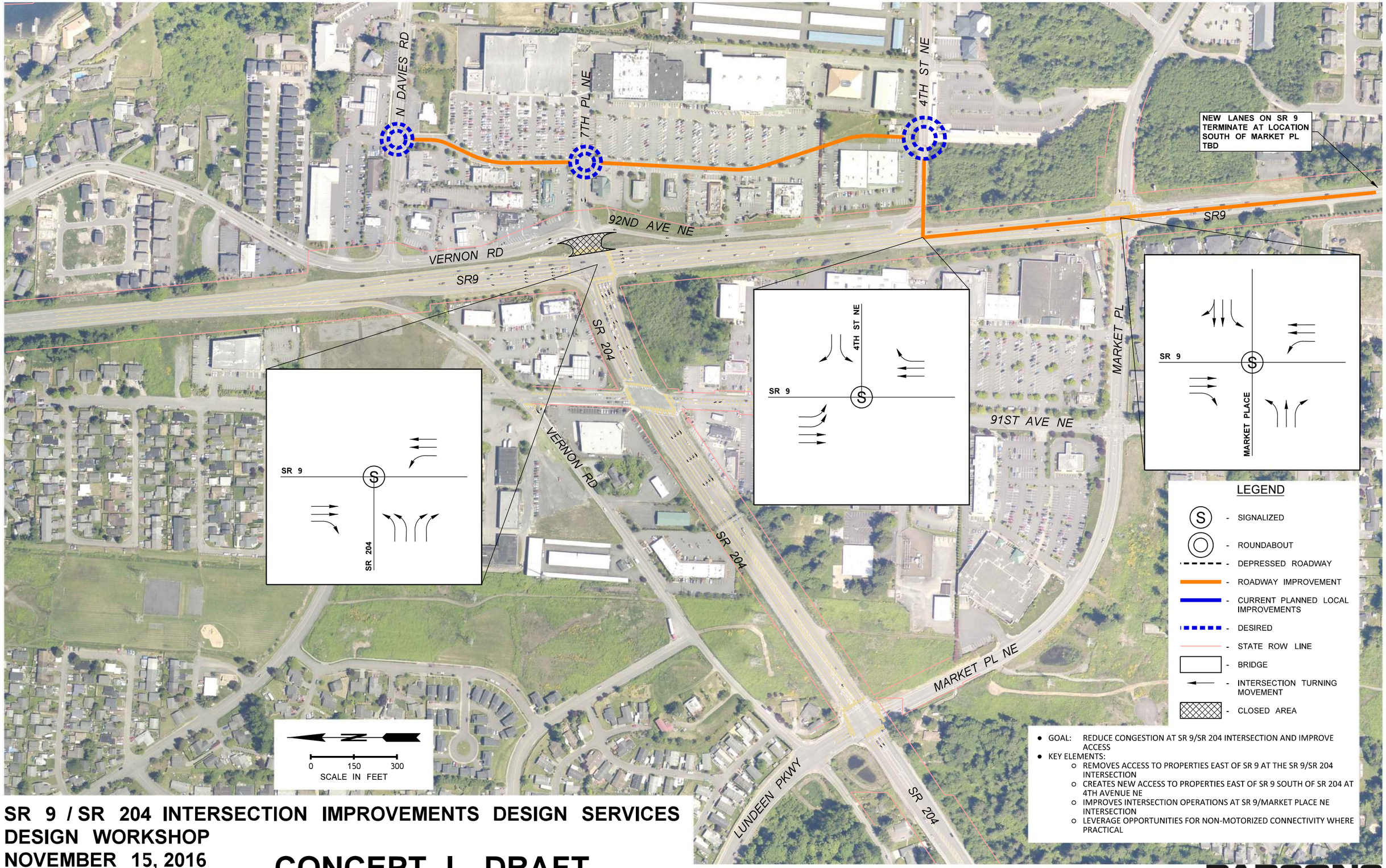


SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT H - DRAFT

PARSONS

Concept I			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	By removing the westbound traffic movement on the east leg of the SR 9/SR 204 intersection, this concept removes some conflict points at the intersection. However, this concept relocates some traffic movements to a newly constructed intersection located at the Davies/Vernon roadway alignment that would intersect with SR 9. This concept rated about average regarding safety.
	Mobility	○	No change compared to a no-build condition except to increase lanes on SR 9 to improve delay at the SR 9/Market intersection and provide lane continuity from Market through the project area. A weave condition between SR 9/SR 204 and SR 9/4th Street NE would likely create operational challenges for southbound SR 9 traffic.
	Economic Vitality	○	Limits accessibility to the eastern commercial property by relocating the primary access point from SR 9/SR 204 to SR 9/4th Street NE. There is no line-of-sight access point, so it limits visibility and accessibility.
Contextual Needs	Multimodal	●	Transit would benefit from additional access opportunities as 4th St NE and improved operations at Market. Nonmotorized would be improved at SR 9/SR 204 from the closure of the east access. Provides an opportunity for another crossing at 4th St NE on north side. Longer distance to cross at Market.
Alternatives Analysis	Commercial Space Impacted	○	Widening of SR 9 could result in additional right-of-way impacts between 4th Street NE and the southern terminus of the widening.
	Consistency with Plans	○	Local land use plans assume full commercial land use east of SR 9 between 4th Street NE and N Davies, and this concept would remove a primary access point by diverting people to 4th Street NE. This type of diversion is not consistent with accessibility for the planned commercial property.
	Visual Aesthetics	◐	Some opportunities could be available for improved visual aesthetics near the SR 9/SR 204 intersection, but the widening of SR 9 south of 4th Street NE could reduce visual aesthetics in that area. This results in a net no change compared to no-build.
	Overall Score	○	



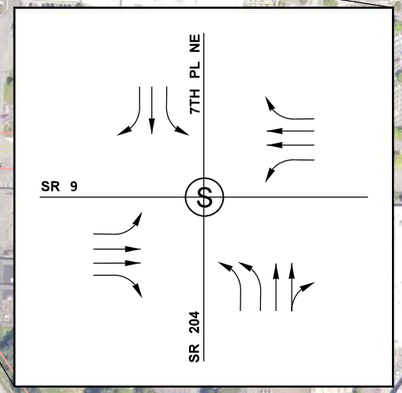
SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

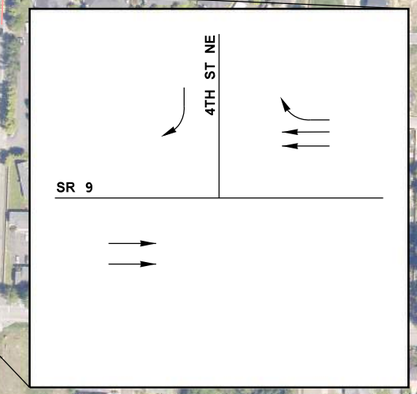
CONCEPT I - DRAFT

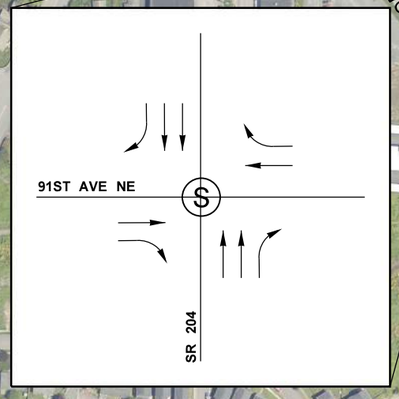
PARSONS

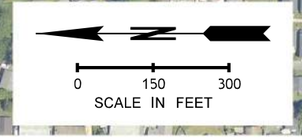
Concept J			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Concept J proposes to close the frontage road access points from Vernon Road and to 92nd Avenue NE; thus, it provides a marginal improvement in the number of conflict points for pedestrians on the east side of the SR 9/SR 204 intersection. By forcing traffic from Vernon Road to travel through a parking area, there could be an increase in conflict points between vehicles and pedestrians. This concept was rated as neutral because the new roadway would be designed to meet current safety design standards.
	Mobility	○	SR 9 mobility would be essentially the same as the no-build configuration. Mobility is rated poorly in this concept because traffic that normally would have a direct connection from Vernon Road to the SR 9/SR 204 intersection will be required to deviate their route through the development located east of the intersection. This would add distance and possibly delay their trip.
	Economic Vitality	○	Full entrance and exit at the SR 9/SR 204 intersection improves driver expectation for ingress and egress to the eastern development; however, the businesses along the Vernon Road frontage might experience a decrease in business resulting from a reduction in pass-by trips. Adding a right-turn access from northbound SR 9 to 4th Street NE would increase accessibility for those drivers who know their destination. This concept included a left-turn restriction at SR 204/91st Avenue NE that would adversely affect business accessibility along 91st Avenue NE both north and south of SR 204. This later restriction resulted in the lower rating for this concept.
Contextual Needs	Multimodal	◐	There would be a slight improvement for pedestrians on the east side of the intersection because of the frontage road closure. No net benefits are assumed for the transit service.
Alternatives Analysis	Commercial Space Impacted	◐	Repurposing 92nd Ave NE could make more property available for development or enhancements that make the area more desirable. Some widening at the intersection of SR 9/4th Street NE and along 4th Street NE might be required with the new access. This was assumed to keep the concept from getting an improvement rating.
	Consistency with Plans	○	This concept is consistent with local plans but would force local traffic using 91st Avenue to travel out of their way to access businesses. This would not be consistent with the local plans to improve accessibility to the area as a destination.
	Visual Aesthetics	◐	Visual aesthetics would not be affected by this concept.
	Overall Score	○	

N DAVIES RD
7TH PL NE
4TH ST NE
92ND AVE NE
VERNON RD
SR9
SR 204
MARKET PL
91ST AVE NE
LUNDEEN PKWY









LEGEND

- SIGNALIZED
- ROUNDABOUT
- DEPRESSED ROADWAY
- ROADWAY IMPROVEMENT
- CURRENT PLANNED LOCAL IMPROVEMENTS
- DESIRED
- STATE ROW LINE
- BRIDGE
- INTERSECTION TURNING MOVEMENT
- CLOSED AREA

- GOAL: REDUCE CONGESTION AT SR 9/SR 204 INTERSECTION AND IMPROVE ACCESS
- KEY ELEMENTS:
  - MAINTAINS SR 9/SR 204 INTERSECTION IN CURRENT CONFIGURATION
  - ADDS CUL-DE-SAC AT SOUTH END OF VERNON RD
  - REMOVES 92ND AVENUE NE BETWEEN 7TH PLACE NE AND 4TH AVENUE NE
  - LEVERAGE OPPORTUNITIES FOR NON-MOTORIZED CONNECTIVITY WHERE PRACTICAL

SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES

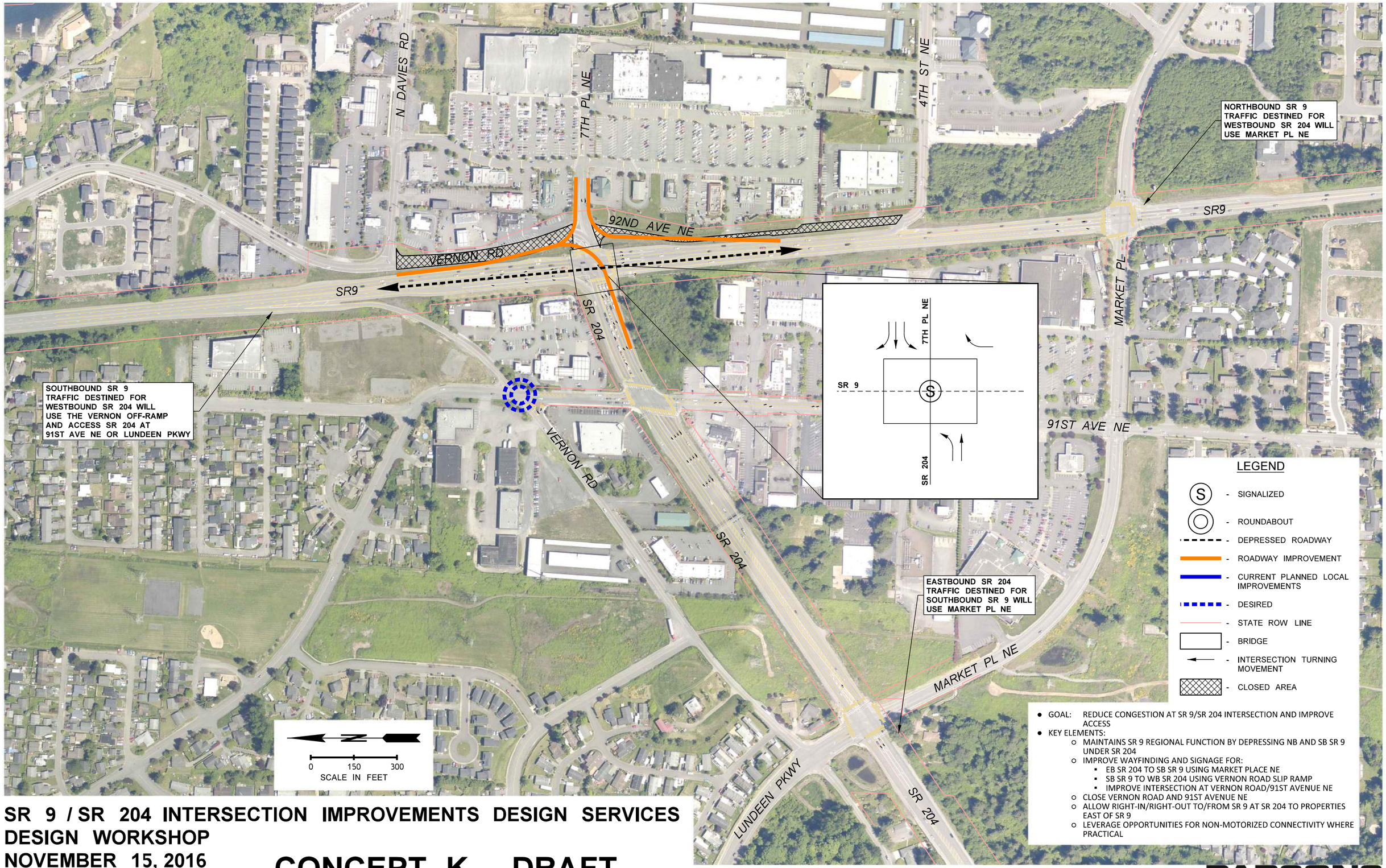
DESIGN WORKSHOP

NOVEMBER 15, 2016

CONCEPT J - DRAFT

PARSONS

Concept K			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	●	Depressing SR 9 would improve the width of the crossing from SR 204 to the eastern property. Signal control would provide a protected phase for pedestrians. Less traffic volume improves the risk for safety issues.
	Mobility	○	Would increase the number of southbound left turns at the SR 9/Market Place NE intersection, or it would increase the number of southbound left turns at SR 204/91st Avenue NE to accommodate the removal of southbound left turns at SR 9/SR 204. This redistribution of traffic without any capacity changes would likely result in higher levels of congestion at new locations.
	Economic Vitality	○	Removing the southbound left-turn access to the eastern commercial property could adversely affect the economic vitality in the area.
Contextual Needs	Multimodal	○	Transit stops on SR 9 would need to be relocated off of SR 9. The relocation of transit stops could adversely affect transit travel time and reliability. Increased traffic on Market Place NE and Vernon Road would make the pedestrian experience less comfortable along the mixed use and main street land use areas planned for the future.
Alternatives Analysis	Commercial Space Impacted	○	The interchange might require additional right-of-way east of the SR 9 corridor for construction.
	Consistency with Plans	○	Full closure of the Vernon Road alignment along with diverted highway traffic to the local roadway network is not consistent with local plans.
	Visual Aesthetics	●	Depressing SR 9 allows for the removal of turn-lane widths, so the SR 9 corridor could be narrowed and the crossing would be designed to meet Lake Stevens' subarea context.
	Overall Score	○	



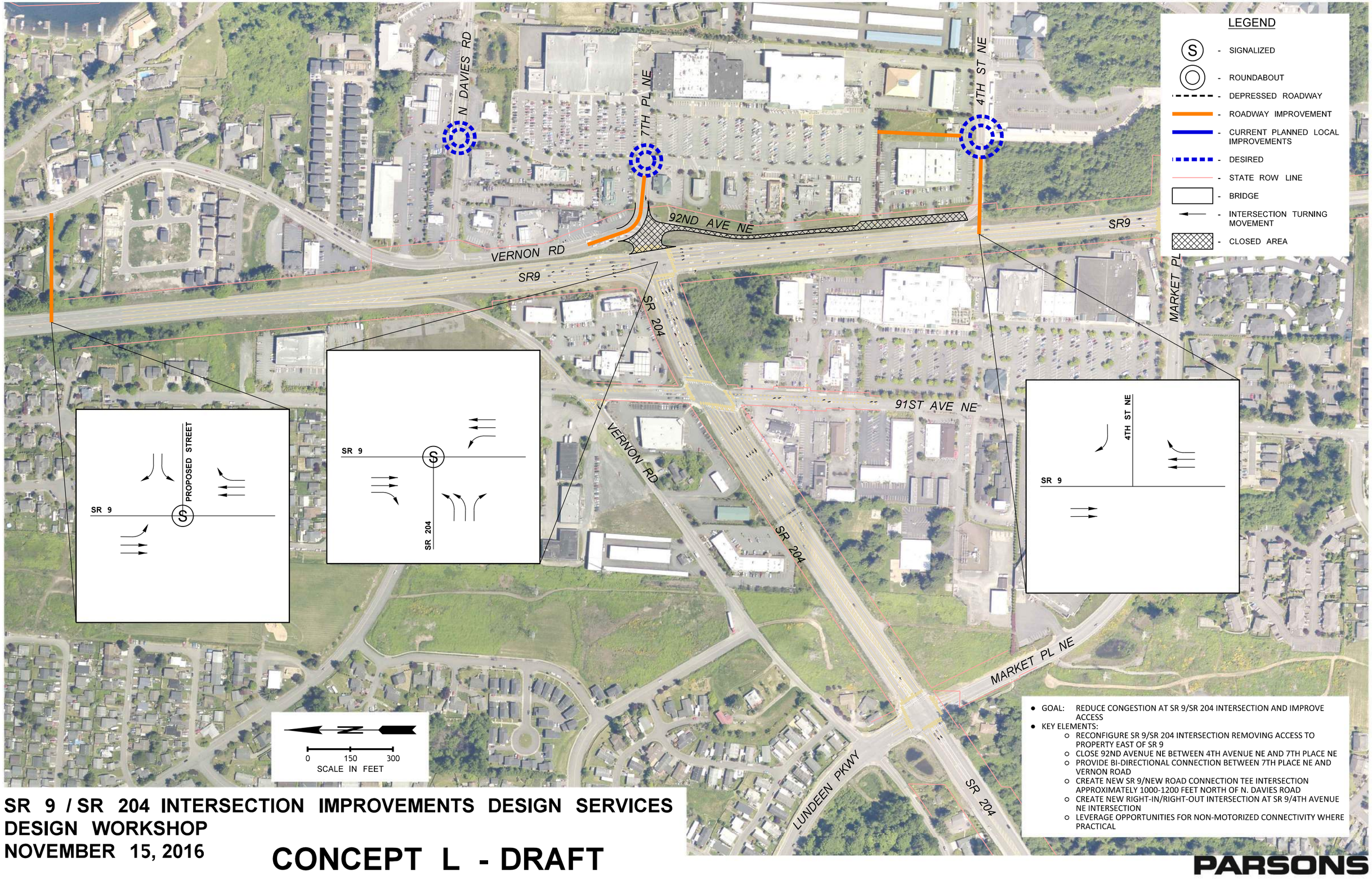
- GOAL: REDUCE CONGESTION AT SR 9/SR 204 INTERSECTION AND IMPROVE ACCESS
- KEY ELEMENTS:
  - MAINTAINS SR 9 REGIONAL FUNCTION BY DEPRESSING NB AND SB SR 9 UNDER SR 204
  - IMPROVE WAYFINDING AND SIGNAGE FOR:
    - EB SR 204 TO SB SR 9 USING MARKET PLACE NE
    - SB SR 9 TO WB SR 204 USING VERNON ROAD SLIP RAMP
    - IMPROVE INTERSECTION AT VERNON ROAD/91ST AVENUE NE
  - CLOSE VERNON ROAD AND 91ST AVENUE NE
  - ALLOW RIGHT-IN/RIGHT-OUT TO/FROM SR 9 AT SR 204 TO PROPERTIES EAST OF SR 9
  - LEVERAGE OPPORTUNITIES FOR NON-MOTORIZED CONNECTIVITY WHERE PRACTICAL

SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT K - DRAFT

PARSONS

Concept L			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	○	This concept proposed a new intersection located north of 13 Street NE that would create a new connection through private property and connect with Vernon Road. This connection would increase traffic on the collector roadway between the new intersection and Davies Road, thus increasing the potential for conflicts along that section of Vernon.
	Mobility	○	Creating a new intersection north of 13th Street NE could introduce additional delay along the corridor, and because of the longer signal spacing with SR 9/SR 204, signal coordination might be difficult to manage.
	Economic Vitality	○	Limits accessibility to the eastern commercial property by relocating the primary access point from SR 9/SR 204 to the new connection to the north. There is no line-of-sight access point, so it limits visibility and accessibility.
Contextual Needs	Multimodal	◐	Transit would receive benefits similar to general traffic. Nonmotorized would improve with the closure of the east leg of the intersection. No real benefits for nonmotorized access at the new connection point.
Alternatives Analysis	Commercial Space Impacted	◐	Impacts to homes along new connection point would possibly be offset by opportunities from repurposing 92nd Avenue NE.
	Consistency with Plans	○	Local land use plans assume full commercial land use east of SR 9 between 4th Street NE and N Davies, and this concept would remove a primary access point by diverting people to a new connection north of 13th Street NE. This type of diversion is not consistent with accessibility for the planned commercial property.
	Visual Aesthetics	◐	Visual aesthetics would not be affected by this concept.
	Overall Score	○	



SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
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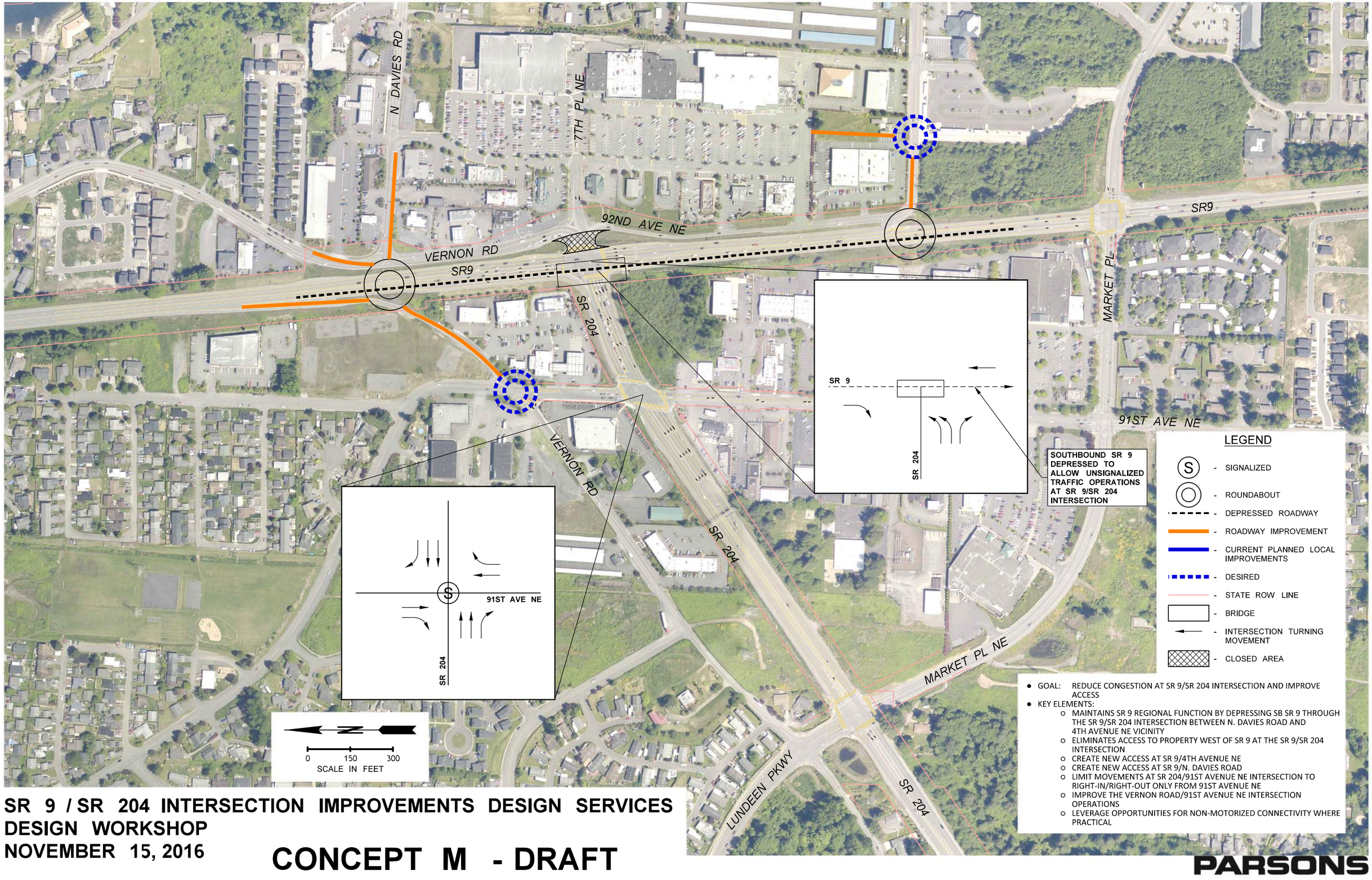
NOVEMBER 15, 2016

CONCEPT L - DRAFT

PARSONS

Concept M			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Removing SR 9 traffic from the intersections improves safety. Roundabouts provide improved safety by reducing conflict points. Increased traffic on Vernon Road, 91st Avenue, and Lundeen Parkway could require design improvements.
	Mobility	◐	No change compared to no-build condition, except to depress the southbound lanes on SR 9. Depressing a single direction on the state highway could result in wayfinding issues.
	Economic Vitality	○	Limits accessibility to the eastern commercial property by relocating the primary access point from SR 9/SR 204 to the new connection to the north and south. There is no line-of-sight access point, so it limits visibility and accessibility. Left-turn restrictions at SR 204/91st Avenue NE limits accessibility to properties west of SR 9.
Contextual Needs	Multimodal	○	Southbound transit would have a transit stop in a cut area along the highway. Or the transit would be diverted to the local grid, thus increasing travel time and possibly impacting trip reliability. Nonmotorized access would be increased with the added access roundabout at the Davies/Vernon Road alignment. Average family cyclists don't understand roundabouts, so they could be confusing for people trying to traverse the roundabouts between the main street land use along 91st Avenue NE and the commercial land use east of SR 9. Pedestrians also find roundabouts confusing because they must travel out of their way to get to the crosswalks for safe travel. The potential for higher impacts to transit resulted in the lower rating for this metric.
Alternatives Analysis	Commercial Space Impacted	○	Construction of a roadway and width potentially required by a roundabout at Davies would impact property that is permitted for construction. Similar impacts could be recognized at 4th Street NE.
	Consistency with Plans	◐	This concept is consistent with local plans to improve local connectivity; however, it is not consistent with the state highway access control plans that limit the number of access points. This concept was given a neutral rating with a clear understanding that access control considerations would be required if the concept moves forward.
	Visual Aesthetics	◐	Visual aesthetics would not be affected by this concept.
	Overall Score	○	



SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
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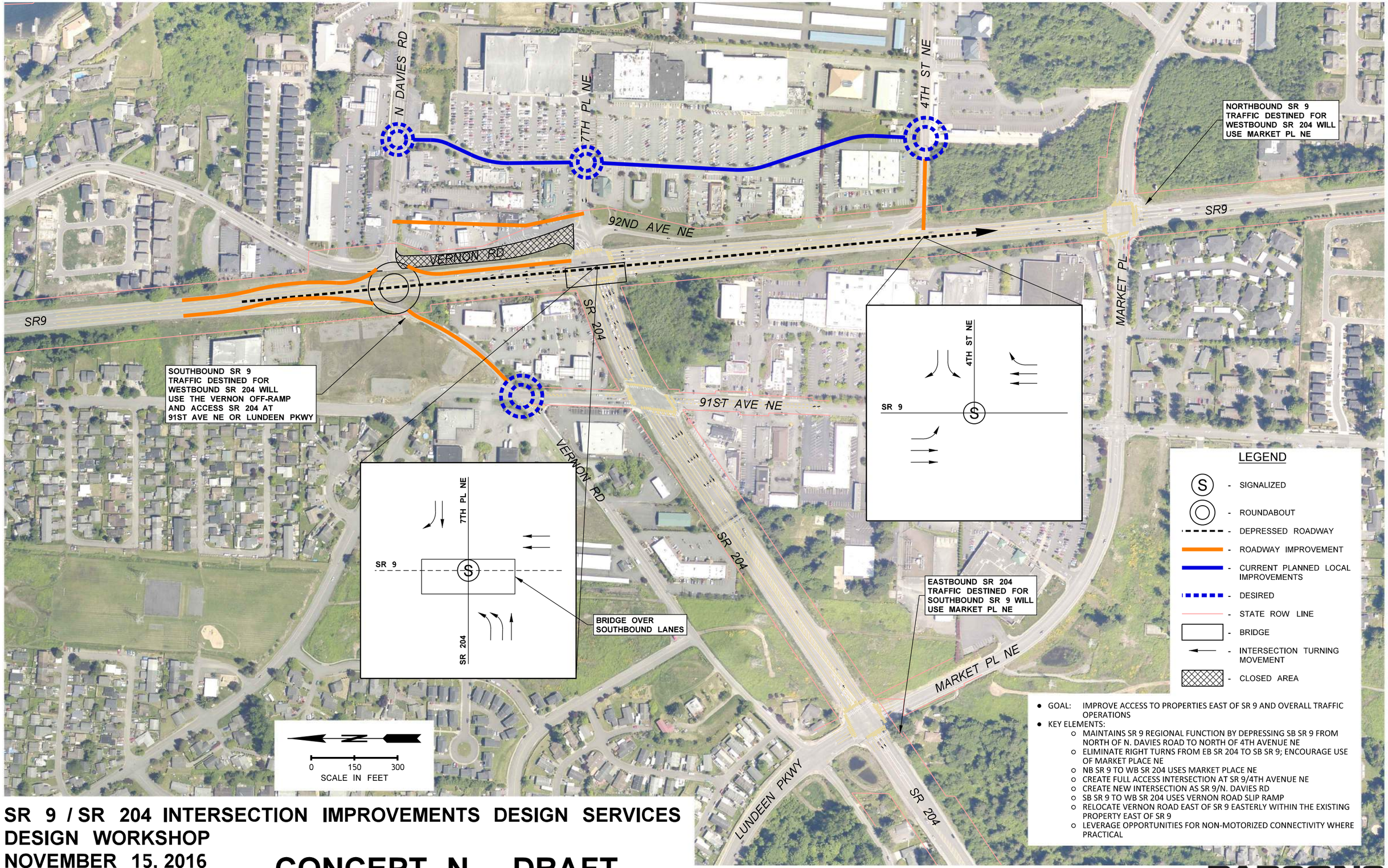
NOVEMBER 15, 2016

CONCEPT M - DRAFT

PARSONS

Concept N			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Concept N was not fully discussed and rated because it was acknowledged that it was simply a concept developed and refined to result in Concept P that was reviewed and evaluated.
	Mobility	◐	
	Economic Vitality	●	
Contextual Needs	Multimodal	○	
Alternatives Analysis	Commercial Space Impacted	○	
	Consistency with Plans	◐	
	Visual Aesthetics	◐	
	Overall Score	◐	

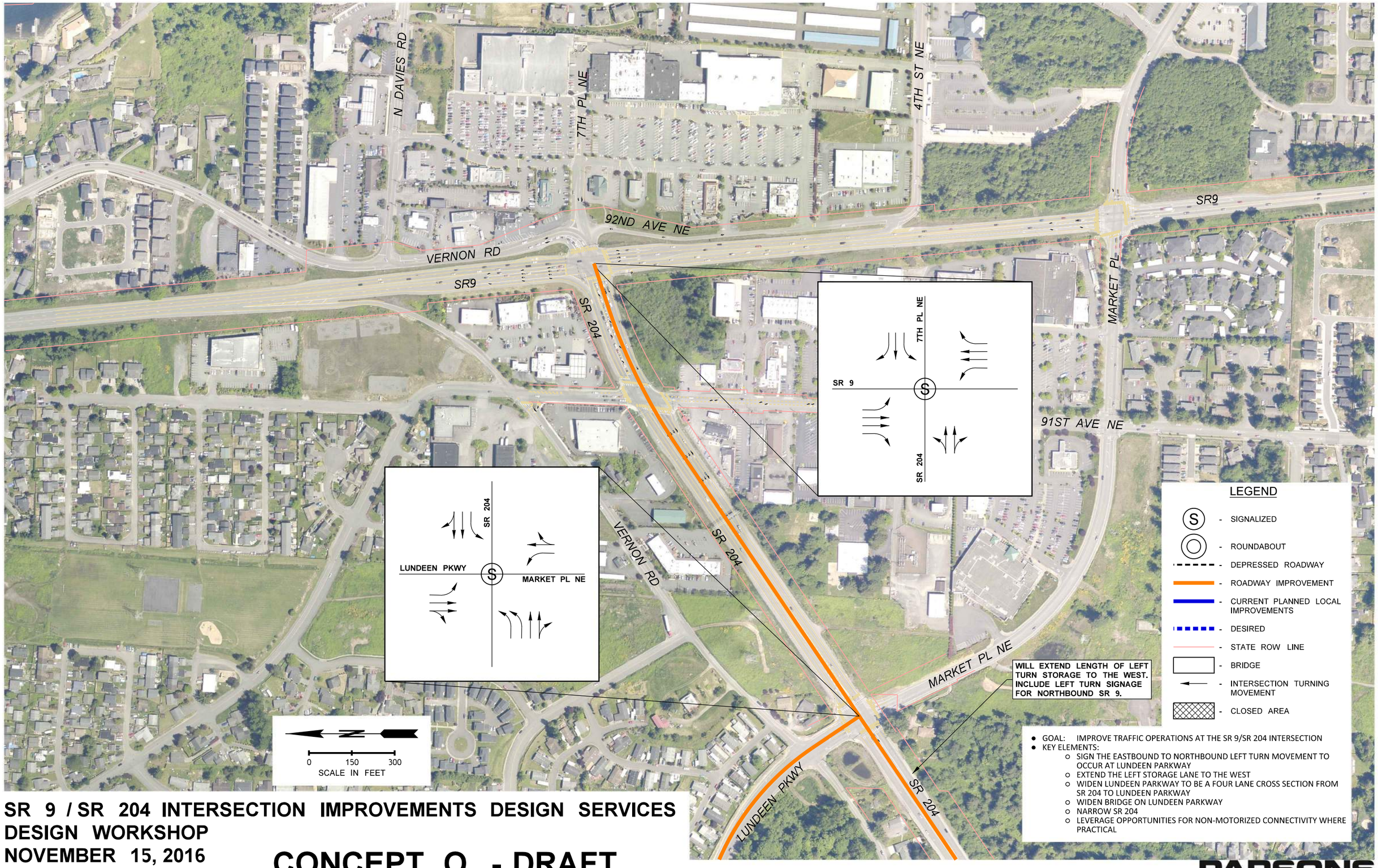


SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT N - DRAFT

PARSONS

Concept O			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	○	SR 9/SR 204 intersection could be narrowed on west leg.
	Mobility	○	Relocating the eastbound-to-northbound left turns from the SR 9/SR 204 intersection to the SR 204/Lundeen Parkway intersection would create additional delay at the SR 204/Lundeen Parkway intersection. There are two left-turn lanes at the intersection today with a high left-turn volume. Adding 800 to 1,000 vehicles per hour would require additional lanes or a grade-separated ramp.
	Economic Vitality	○	No improvements for the accessibility are proposed with this concept, except removing traffic volume from the intersection at SR 9/SR 204. Ingress/egress would continue to be confusing for travelers using the eastern commercial property.
Contextual Needs	Multimodal	◐	Some benefit to transit would be realized by removing the eastbound-to-northbound left-turn traffic from the signal. No additional benefits to transit or nonmotorized have been identified.
Alternatives Analysis	Commercial Space Impacted	○	Properties around the Lundeen/SR 204 intersection would likely be impacted to widen the intersection and Lundeen Parkway. Lundeen Parkway would likely need to be widened to two lanes between SR 204 and SR 9.
	Consistency with Plans	○	This concept is not consistent with local plans because it proposes repurposing the Lundeen Parkway corridor to carry regional traffic between SR 204 and SR 9 to areas north of Lake Stevens.
	Visual Aesthetics	◐	Visual aesthetics would not be affected by this concept.
	Overall Score	○	

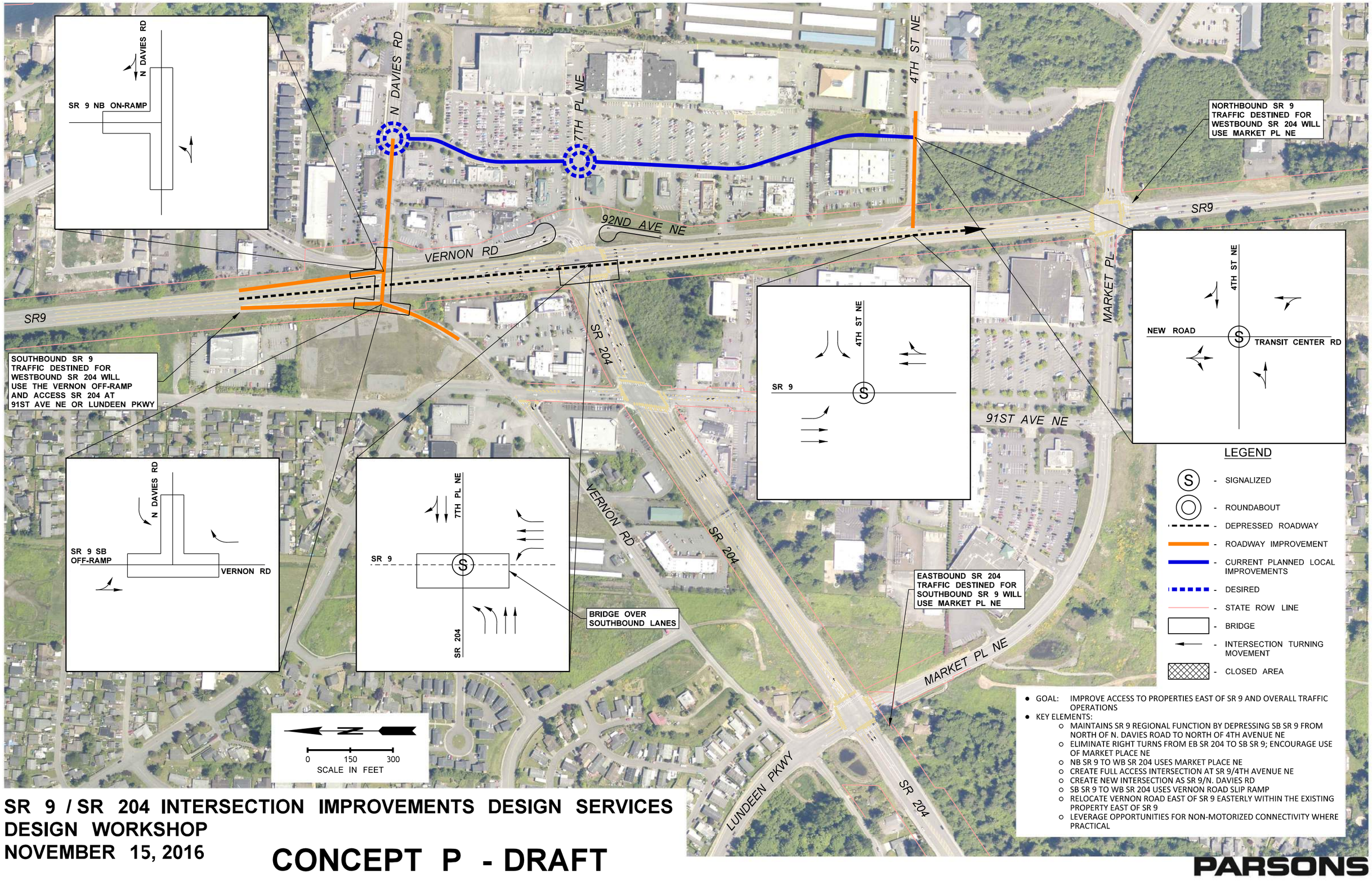


SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES
DESIGN WORKSHOP
NOVEMBER 15, 2016

CONCEPT O - DRAFT

PARSONS

Concept P			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Grade separating SR 9 in one direction reduces the number of potential conflict points at the SR 9/SR 204 intersection; however, the addition of two new intersection access points increase conflict points at new locations. This resulted in a neutral rating for safety.
	Mobility	◐	One of the heavy volumes was removed from the SR 9/SR 204 intersection, and an improvement there would be expected because of lower volumes and fewer signal phases. Additional delay on the SR 9 corridor could be experienced at the 4th Street NE intersection because of the new southbound left turn. This concept would introduce four closely spaced access points along SR 9 in just over a half mile.
	Economic Vitality	○	The elevated structure over Vernon Road would have adverse effects on local businesses and access points for construction. There is also a new roadway connection assumed between Vernon Road south of Davies into the eastern commercial property that would impact businesses along Vernon Road. This concept does provide full access at SR 9/SR 204, new access at 4th Street NE, and partial access at the Davies and Vernon Road alignment. It was determined that the adverse effects on local businesses would reduce this rating for economic vitality.
Contextual Needs	Multimodal	○	Southbound transit would have a transit stop in a cut area along the highway. Or the transit would be diverted to the local grid, thus increasing travel time and possibly impacting trip reliability. Nonmotorized access would be increased with the added access interchange at the Davies/Vernon Road alignment. The potential for higher impacts to transit resulted in the lower rating for this metric.
Alternatives Analysis	Commercial Space Impacted	○	Several features in this concept were combined to result in a lower rating. Those include the widening of Davies Road, a new access point between Vernon Road and the access roadway through the eastern commercial property, the possible widening of 4th Street NE, and improvement to the Vernon Road alignment west of SR 9.
	Consistency with Plans	◐	This concept is consistent with local plans to improve local connectivity; however, it is not consistent with the state highway access control plans that limit the number of access points. This concept was given a neutral rating with a clear understanding that access control considerations would be required if the concept moves forward.
	Visual Aesthetics	◐	The elevated structure at Davies is assumed to be unobtrusive to the key visual corridor on SR 204. No visual aesthetic opportunities were identified with this concept, so it was rated neutral.
	Overall Score	◐	



SR 9 / SR 204 INTERSECTION IMPROVEMENTS DESIGN SERVICES

DESIGN WORKSHOP

NOVEMBER 15, 2016

CONCEPT P - DRAFT

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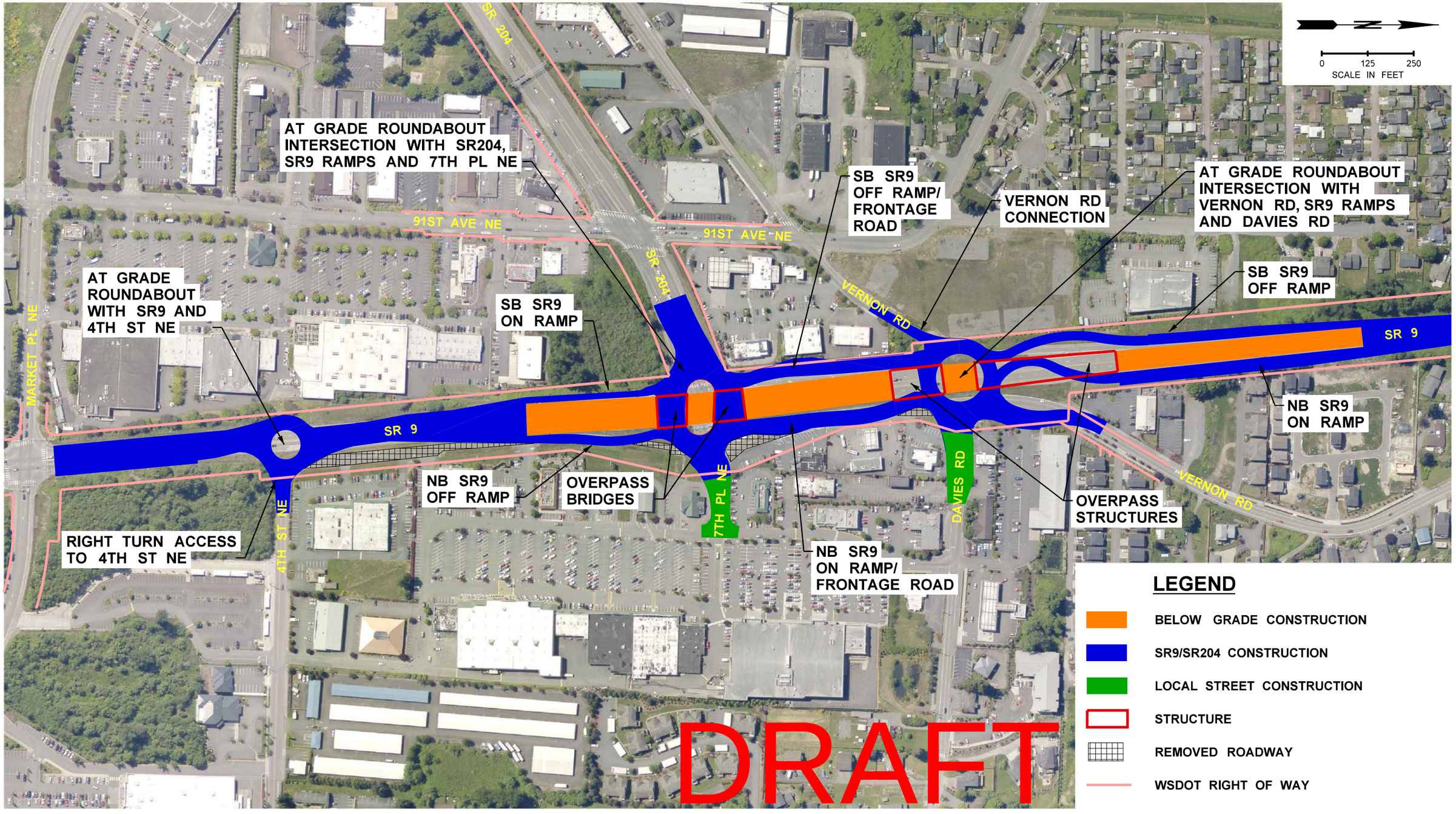
ATTACHMENT C – FINAL CONCEPTS FOR EVALUATION

Concept B			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	●	Roundabouts are safer for vehicular traffic, given fewer conflict points, and reduce accident severity. If a different control measure were used, the new construction will be designed to meet/exceed current safety standards for pedestrian and vehicular safety.
	Mobility	●	This concept received a higher rating for mobility because of the total accessibility available resulting from the local roadway connectivity and an assumption that the intersections would operate within the state requirements on SR 9. Locations that show a dashed blue roundabout are assumed to continue under their current level of control until the local jurisdiction can make modifications as separate projects.
	Economic Vitality	◐	This concept provides improved accessibility by allowing access to the properties on the east side of SR 9 at the entry locations. The removal of left-turn functions at 91st Avenue NE introduces a barrier to properties on either side of SR 204. This would then require a circuitous route for people to use those properties.
Contextual Needs	Multimodal	◐	Roundabouts would be designed to adequately service transit routes through the intersections. The removal of the signal-controlled intersections would be assumed to provide an improvement for transit travel times. Nonmotorized access would be increased with the added access roundabout at the Davies/Vernon Road alignment. Average family cyclists don't understand roundabouts, so they could be confusing for people trying to traverse the roundabouts between the main street land use along 91st Avenue NE and the commercial land use east of SR 9. Pedestrians also find roundabouts confusing because they must travel out of their way to get to the crosswalks for safe travel. The new connectivity was assumed to counter the short-term issues for pedestrians and cyclists.
Alternatives Analysis	Commercial Space Impacted	○	Constructing the frontage roads on either side of SR 9 to connect the two roundabouts at SR 9/SR 204 and at SR 9/Davies/Vernon Road would require additional right-of-way. It is undetermined at this point how much private right-of-way would be affected, but it is likely some impacts would be recognized. It is further assumed that construction of a roundabout that would provide a level of service that meets the State's guidelines would require a large area and would likely push existing local roads into adjacent right-of-way, resulting in some level of impact.
	Consistency with Plans	●	This concept matches local plans with the additional connectivity for local roadways across SR 9; however, it does not match WSDOT managed-access guidelines for highways designated as partial limited-access highways.
	Visual Aesthetics	●	Concept provides opportunities for landscaping adjacent to SR 9 with repurposed 92nd Ave NE property. Roundabouts also provide opportunities for center landscape or are designed to match local context.
	Overall Score	●	



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SR 9 / SR 204 INTERSECTION IMPROVEMENTS

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LINE & ASSOCIATES

CONCEPT B
LOCAL CONNECTIVITY IMPROVEMENTS

APRIL 6, 2017

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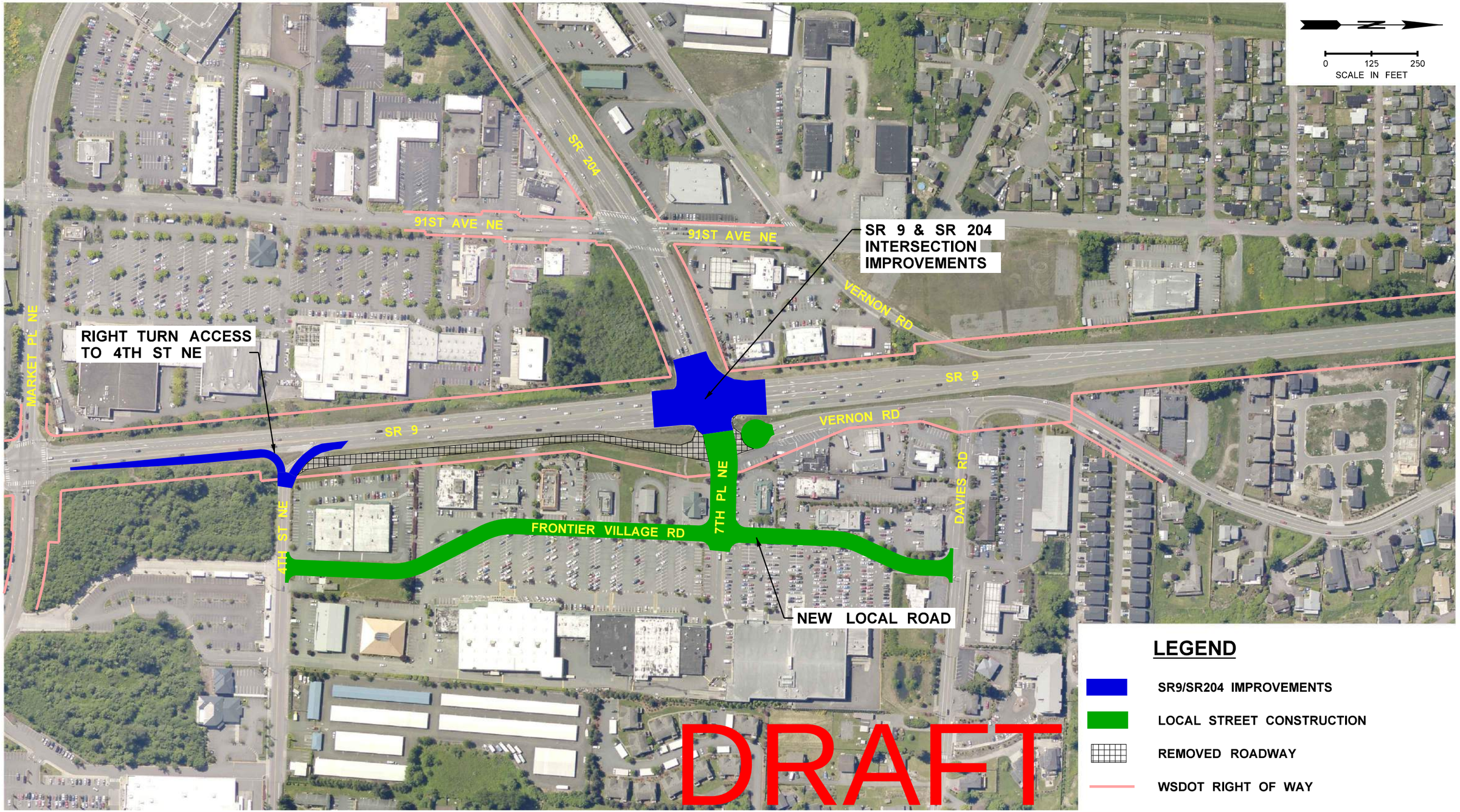
Concept C			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Concept C proposes to close the frontage road access points from Vernon Road and to 92nd Avenue NE, thus it provides a marginal improvement in the number of conflict points for pedestrians on the east side of the SR 9/SR 204 intersection. By forcing traffic from Vernon Road to travel through a parking area, there could be an increase in conflict points between vehicles and pedestrians. This concept was rated as neutral because the new roadway would be designed to meet current safety design standards.
	Mobility	○	SR 9 mobility would be essentially the same as the no-build configuration. Mobility is rated poorly in this concept because traffic that normally would have a direct connection from Vernon Road to the SR 9/SR 204 intersection will be required to deviate their route through the development located east of the intersection. This would add distance and possibly delay their trip.
	Economic Vitality	◐	Full entrance and exit at the SR 9/SR 204 intersection improves driver expectation for ingress and egress to the eastern development; however, the businesses along the Vernon Road frontage might experience a decrease in business resulting from a reduction in pass by trips.
Contextual Needs	Multimodal	◐	There would be a slight improvement for pedestrians on the east side of the intersection because of the frontage road closure. No net benefits are assumed for the transit service.
Alternatives Analysis	Commercial Space Impacted	●	Repurposing 92nd Ave NE could make more property available for development or enhancements that make the area more desirable.
	Consistency with Plans	◐	This concept is consistent with local and regional plans.
	Visual Aesthetics	◐	Visual aesthetics would not be affected by this concept.
	Overall Score	◐	



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SR 9 / SR 204 INTERSECTION IMPROVEMENTS

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CONCEPT C
INTERSECTION IMPROVEMENTS

APRIL 6, 2017

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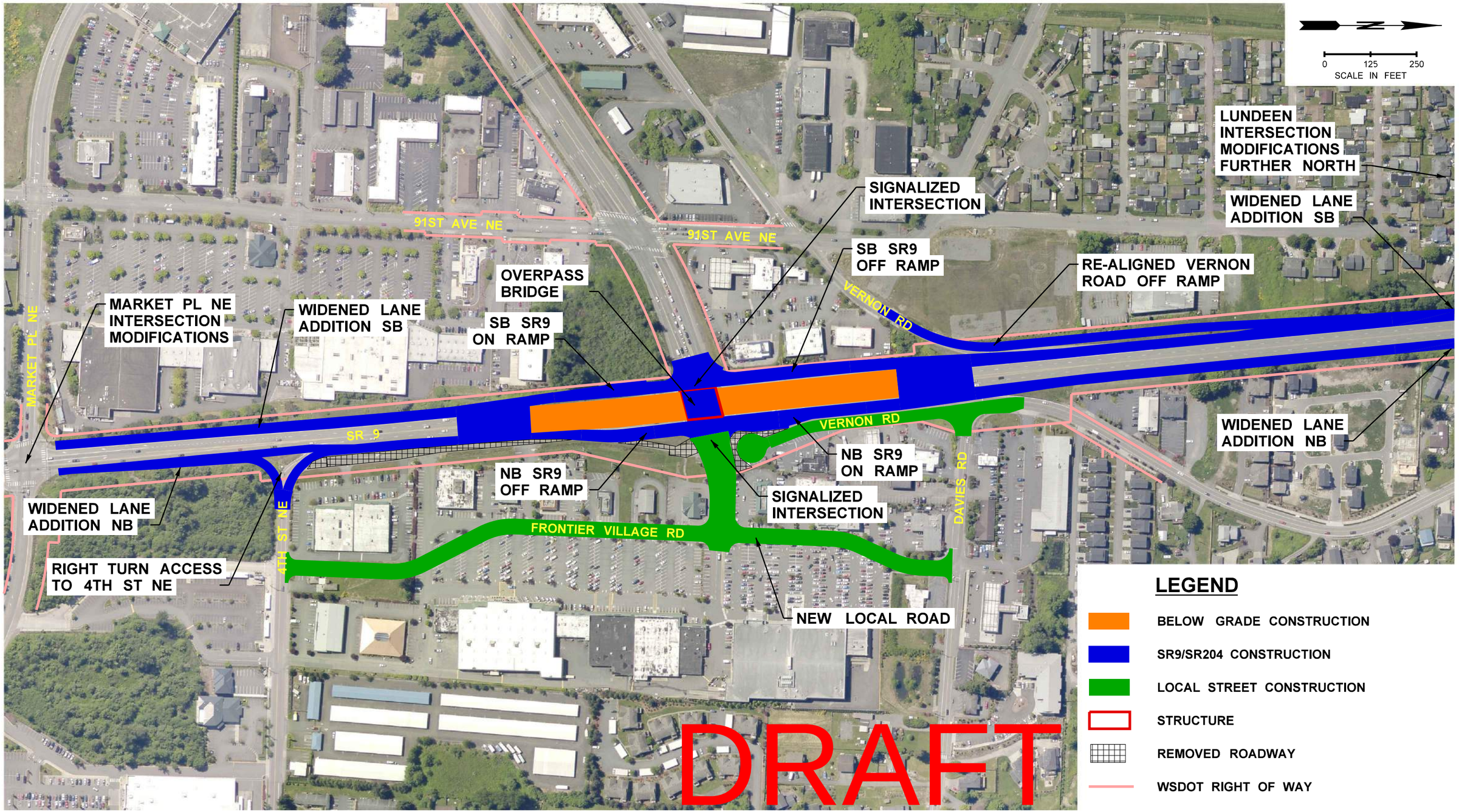
Concept E			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	◐	Grade separating SR 9 removes the number of vehicles with potential conflict from the intersection crossing at SR 9/SR 204. However, a new tight diamond interchange creates two new intersections, thus keeping conflict points similar to a no-build configuration. Closing the existing frontage roads would also result in increased car trips through the eastern commercial area and could increase conflict points between vehicles and pedestrians.
	Mobility	●	It is assumed that removing all the SR 9 traffic from the intersection control would result in improved overall mobility. This concept also adds a full lane in each direction to the existing configuration. This added capacity would improve mobility for the intersection at SR 9/SR 204 and at SR 9/Market, thus improving mobility for more people. People who normally use the direct connection from Vernon Road to the SR 9/SR 204 intersection will be impacted by this concept. Those people will be required to deviate their route through the development located east of the intersection. This would add distance and possibly delay their trip. This concept was rated well because a higher number of people would likely receive benefit because of the grade separation on SR 9.
	Economic Vitality	●	Full entrance and exit at the SR 9/SR 204 intersection improves driver expectation for ingress and egress to the eastern development; however, the businesses along the Vernon Road frontage might experience a decrease in business resulting from a reduction in pass-by trips. Anticipated improvements to overall traffic operations and mobility in the area were assumed to benefit the economic vitality of the area.
Contextual Needs	Multimodal	◐	There would be a slight improvement for pedestrians on the east side of intersection because of the frontage road closure. No net benefits are assumed for the transit service. Transit stops would be provided on the northbound on-ramp and southbound on-ramp.
Alternatives Analysis	Commercial Space Impacted	○	It was assumed that the western edge would be held constant to avoid impacting the wetland in the southwest corner of the intersection. Holding the western edge might force the widening of SR 9 all to the east and ultimately impact the frontage road alignment. It was assumed that moving this modification to alignment could result in a right-of-way impact.
	Consistency with Plans	◐	This concept is consistent with local plans, but not fully consistent with regional plans because of the additional lane on SR 9.
	Visual Aesthetics	●	Even though SR 9 is being widened, the section of SR 9 between two Lake Stevens key land use areas will be depressed and a new interchange will be constructed to maintain a line of site from SR 204 across the highway. The interchange will also provide opportunities for plantings or architectural features consistent with Lake Stevens' land use context.
	Overall Score	●	



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SR 9 / SR 204 INTERSECTION IMPROVEMENTS

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CONCEPT E
TIGHT DIAMOND INTERCHANGE

APRIL 6, 2017

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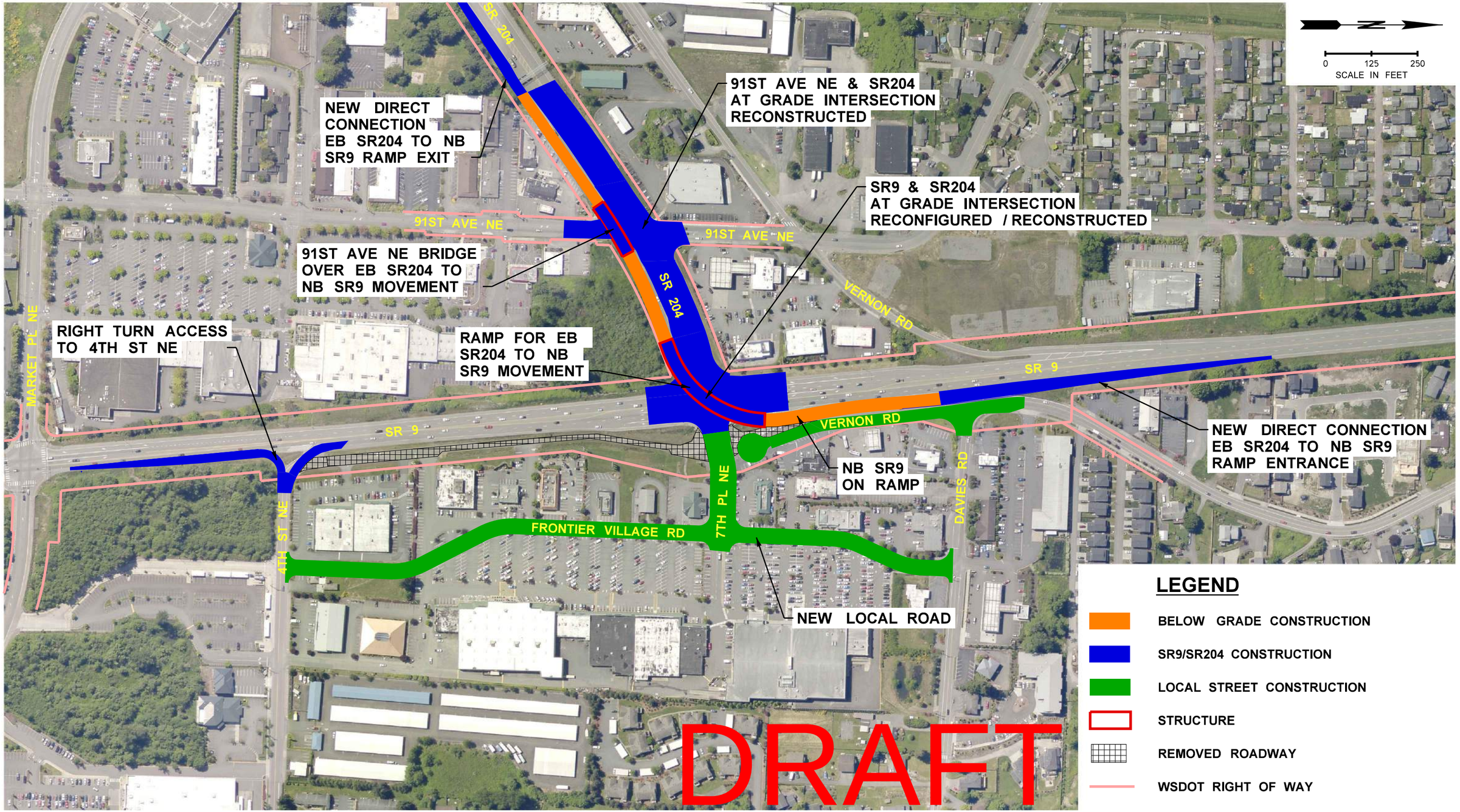
Concept G2B			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	●	SR 9/SR 204 is narrow and reduces traffic conflict by building a tunnel to remove traffic that would have been turning north onto SR 9 from SR 204 from the intersection. Improves business access point for eastern commercial property.
	Mobility	●	Removing the left-turn traffic from the SR 9/SR 204 intersection is anticipated to result in an improvement.
	Economic Vitality	●	Maintains existing accessibility to the eastern commercial property via the primary access point at SR 9/SR 204.Improves navigational clarity with a standard business egress point.
Contextual Needs	Multimodal	◐	Transit would operate as it does under a no-build condition.
Alternatives Analysis	Commercial Space Impacted	○	Wetland right-of-way could be impacted in the southwest corner of SR 9/SR 204 intersection. The realignment of Vernon Road might be required near the tunnel daylight point and could cause property impacts.
	Consistency with Plans	◐	This concept is consistent with local and regional plans.
	Visual Aesthetics	◐	The use of a tunnel for grade-separated roadways eliminates the negative visual impact that would be caused by installing a bridge.
	Overall Score	●	



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SR 9 / SR 204 INTERSECTION IMPROVEMENTS

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CONCEPT G2B
EB SR 204 TO NB SR 9 RAMP

APRIL 6, 2017

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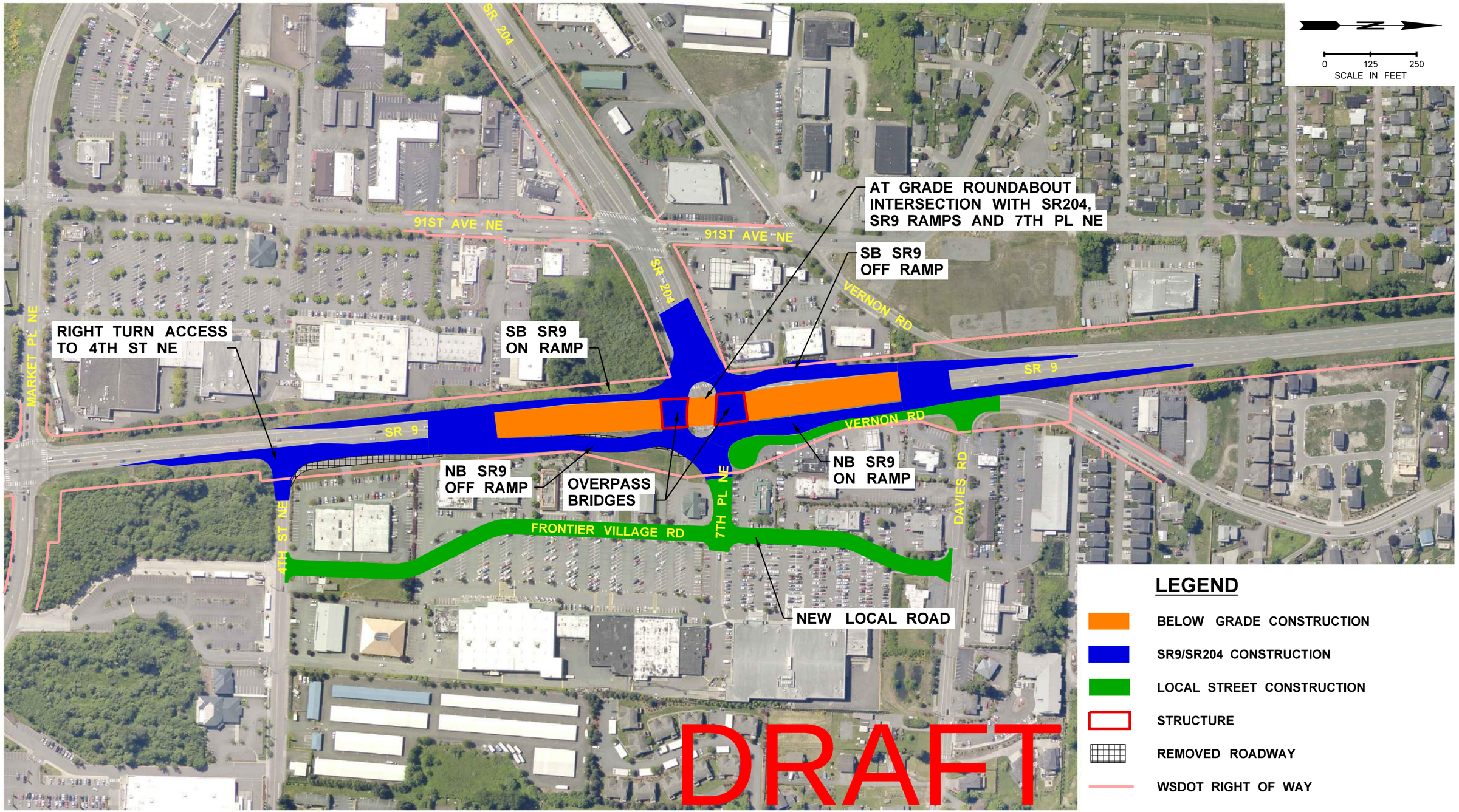
Concept H			
Category	**Criteria**		**Notes**
Baseline Needs	Safety	●	Grade separating SR 9 removes the number of vehicles with potential conflict from the intersection crossing at SR 9/SR 204. The roundabout proposed would provide improved safety for vehicles and pedestrians by removing the number of conflict points. Closing the existing frontage roads would also result in increased car trips through the eastern commercial area and could increase conflict points. It is anticipated that the improvements in this concept would be enough to rate it as an improvement.
	Mobility	●	It is assumed that removing all of the SR 9 traffic from the intersection control would result in improved overall mobility. This concept also adds a full lane in each direction to the existing configuration. This added capacity would improve mobility for the intersection at SR 9/SR 204 and at SR 9/Market, thus improving mobility for more people. People who normally use the direct connection from Vernon Road to the SR 9/SR 204 intersection will be impacted by this concept. Those people will be required to deviate their route through the development located east of the intersection. This would add distance and possibly delay their trip. This concept was rated well because the higher number of people would likely receive benefit as a result of the grade separation on SR 9.
	Economic Vitality	●	Full entrance and exit at the SR 9/SR 204 intersection improves driver expectation for ingress and egress to the eastern development; however, the businesses along the Vernon Road frontage might experience a decrease in business resulting from a reduction in pass by trips. Anticipated improvements to overall traffic operations and mobility in the area were assumed to benefit the economic vitality of the area.
Contextual Needs	Multi-Modal	◐	There would be a slight improvement for pedestrians on the east side of intersection as a result of the frontage road closure. No net benefits are assumed for the transit service. Transit stops would be provided on the northbound on-ramp and southbound on-ramp.
Alternatives Analysis	Commercial Space Impacted	○	It was assumed that the western edge would be held constant to avoid impacting the wetland in the southwest corner of the intersection. Holding the western edge might force widening of SR 9 all to the east and ultimate impacting the frontage road alignment. It was assumed that moving this modification to alignment could result in a right of way impact.
	Consistency with Plans	●	This concept is consistent with local and regional plans.
	Visual Aesthetics	●	Even though SR 9 is being widened, the section of SR 9 between two of Lake Stevens' key land use areas will be depressed and a new interchange will be constructed to maintain a line of site from SR 204 across the highway. The interchange will also provide opportunities for plantings or architectural features consistent with Lake Stevens' land use context.
	Overall Score	●	



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SR 9 / SR 204 INTERSECTION IMPROVEMENTS

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CONCEPT H
ROUNDABOUT INTERCHANGE

APRIL 6, 2017

DRAFT

APPENDIX C.
Alternatives Screening Matrix

November 2017

APPENDIX D.
EXISTING CONDITIONS MEMORANDUM

September 2017

Date:	February 3, 2017
To:	Miguel Gavino (WSDOT)
From :	Will Lisska and Nathan Chan (Fehr & Peers)
Subject:	Existing Conditions Traffic Memorandum

1.0 INTRODUCTION

The SR 9 and SR 204 intersection, located in Lake Stevens, Snohomish County, is a major regional crossroads. This intersection serves a wide variety of both regional and local traffic including commuters, freight, and local business access. Given existing and anticipated future traffic congestion at this intersection, WSDOT and the Consultant team is evaluating options to improve vehicle flow, safety, and local access through the intersection. This memorandum describes existing transportation conditions in the study area and considers the following:

- Prior studies – related projects that might affect the study area.
- Study area transportation network – current configuration of roadway facilities in the study area.
- Roadway operations for vehicles – vehicle level of service (LOS) and average delay calculations at intersections throughout the study area and daily volumes and vehicle classification information along SR 9 and SR 204.
- Safety – summary of collision data collected in the study area, including collision rates, incident type, and comparisons to historic state and local trends.
- Pedestrian and bicycle facilities – infrastructure and level of activity for walking and bicycling throughout the study area.
- Transit – summary of transit routes and stops through the study area, including daily boarding and alighting volumes.

These existing condition findings aid in identifying existing deficiencies in the study area, provide recommendations for potential intersection improvements, and guide the environmental documentation process.

2.0 PRIOR STUDIES

This section summarizes the existing plans and studies that could influence the planning process for the SR9/SR204 improvement project, including:

- SR 9 / SR 204 Intersection Improvements Pre-Design Report (September 2012)
- State Route 9 Corridor Planning Study (January 2011)
- Jurisdictional Plans and Transportation Improvement Programs
- Community Transit 2016 – 2021 Transit Development Plan

SR 9 / SR 204 INTERSECTION IMPROVEMENTS PRE-DESIGN REPORT

This September 2012 study used a stakeholder process with WSDOT, Lake Stevens, and community members to identify potential transportation investments to reduce congestion and improve Frontier Village access at the SR 9/SR 204 intersection. Several possible solutions were outlined, including adding lanes on SR 9, a diamond interchange with either signalized or roundabout ramp terminals, a single point urban interchange (SPUI), and a flyover ramp. The study did not identify a preferred concept.

STATE ROUTE 9 CORRIDOR PLANNING STUDY

The State Route 9 Corridor Planning Study (CPS) was published in January 2011 and provides a consensus-driven set of recommendations for the study corridor based on technical analysis and a stakeholder process. The CPS provides a 20+ year vision for the 30-mile study segment (from Bothell to Arlington) and establishes a blueprint for potential longer-range transportation improvements. A series of 5 improvement packages representing a total of 21 improvement projects were developed. These packages described the recommended improvements in sequence and combine improvements based on incremental funding levels. Several short- and long-term improvements were proposed at or in proximity to the SR9/SR204 intersection:

- Short-term
    - SR 204 intersection improvements – add third northbound through lane and third southbound through lane.
    - Market Place intersection improvements – add westbound right-turn lane, second northbound approach through lane, and second southbound receiving lane.
- Long-term
    - SR 204 to Lundeen Parkway widening – widen SR 9 from four to six lanes.
    - Lundeen Parkway intersection improvements – add third northbound through lane and third southbound through lane.
    - 20th Street SE to Market Place Widening – widen SR 9 from two to four lanes.
    - Market Place intersection improvements (Phase 2) – add third northbound through lane, third southbound through lane, and eastbound right-turn pocket.

To date, none of the projects listed above have been implemented, but the SR 9 widening projects have been included in the PSRC *Transportation 2040* plan as candidate projects, and the SR 9 / SR 204 intersection improvements are included as an unprogrammed project.

JURISDICTIONAL PLANS AND TRANSPORTATION IMPROVEMENT PROGRAMS

The project team reviewed the comprehensive plans, subarea plans, and TIPs for the Cities of Lake Stevens and Everett, as well as for Snohomish County, the Puget Sound Regional Council (*Transportation 2040*), and WSDOT. In addition, projects included in Sound Transit 2 (ST 2), Nickel, and TPA (Transportation Partnership Agreement) funding packages, and the Legislative Evaluation & Accountability Program (LEAP) transportation project list were reviewed. A list of planned and/or funded transportation capacity

improvements that are potentially relevant to demand and operations at the SR 9 / SR 204 was compiled from these documents and summarized as part of the Transportation Analysis Methods and Assumptions Memorandum. Some plans and programs included projects that would change capacity or access along SR 9 and SR 204 within the study area. In particular, the City of Lake Stevens TIP (2016 – 2021) specified several projects:

- SR 9 / 4th Street NE – Add a new northbound right-turn from SR 9 onto 4th Street NE. Construct new north-south connector road, Village Way Road, between 4th Street NE and Market Place.
- SR 9 / SR 204 System Improvements – Conversion of SR 9 / SE 204 and SR 204 / 91st Avenue NE intersections into roundabouts.
- 99th Avenue NE from Market Place to 4th Street NE – Enhance streetscape with non-motorized improvements and possible roundabout intersection at 4th Street NE.
- 90th Avenue NE Connector – Construction of new roadway segment from SR 204 to Vernon Road that would allow for right-in right-out movement on westbound SR 204 to the west of 91st Avenue NE.
- 91st Avenue NE from SR 204 to Vernon Road – Upgrade roadway to create a pedestrian friendly downtown-style streetscape.
- 91st Avenue NE / Vernon Road intersection – Minor widening and possible mini-roundabout to improve safety and circulation
- Lundeen Parkway / Vernon Road intersection – Channelization enhancements to improve safety and circulation. May restrict through movements for east-west crossing of Vernon Road.
- Vernon Road from 91st Avenue NE to SR 9 – Minor widening to provide for turn pocket and improved pedestrian movement.

To date, none of the improvement projects listed above have been implemented.

COMMUNITY TRANSIT 2016 – 2021 TRANSIT DEVELOPMENT PLAN

The 2016 – 2021 Transit Development Plan identified two new local bus route to serve the Lake Stevens Transit Center and SR 9 corridor. The Route 109 provides all-day service between the Ash Way Park and Ride and the Lake Stevens Transit Center. The Route 209 provides all-day service between the Lake Stevens Transit Center and Quil Ceda Village (via Marysville). Both routes began operation in September 2016 with 30 minute AM/PM peak headways and hourly service during the off-peak and on weekends.

3.0 STUDY AREA

The study focuses on the transportation system around the main project intersection: SR 9 / SR 204. The project limits of the study area include the following roadways:

- SR 204: from Lundeen Parkway to SR 9
- SR 9: from Lundeen Parkway to Market Place NE
- Vernon Road: from N Davies Road to SR 204

- 92nd Avenue NE: from 7th Place NE to 4th Street NE
- Lundeen Parkway: from Vernon Road to SR 204 (segment directly north of the SR 204 / Lundeen Parkway / Market Place NE intersection).
- Vernon Road: from Lundeen Parkway to SR 9 southbound slip ramp
- Market Place NE: from SR 204 to 99th Ave NE
- 91st Avenue NE: from Vernon Road to Market Place NE
- N Davies Road: from Vernon Road to 94th Drive NE (extension)
- 4th Street NE/99th Avenue NE: from 7th Place NE to Market Place

Figure 1 shows the overall study area and intersections evaluated under existing conditions.

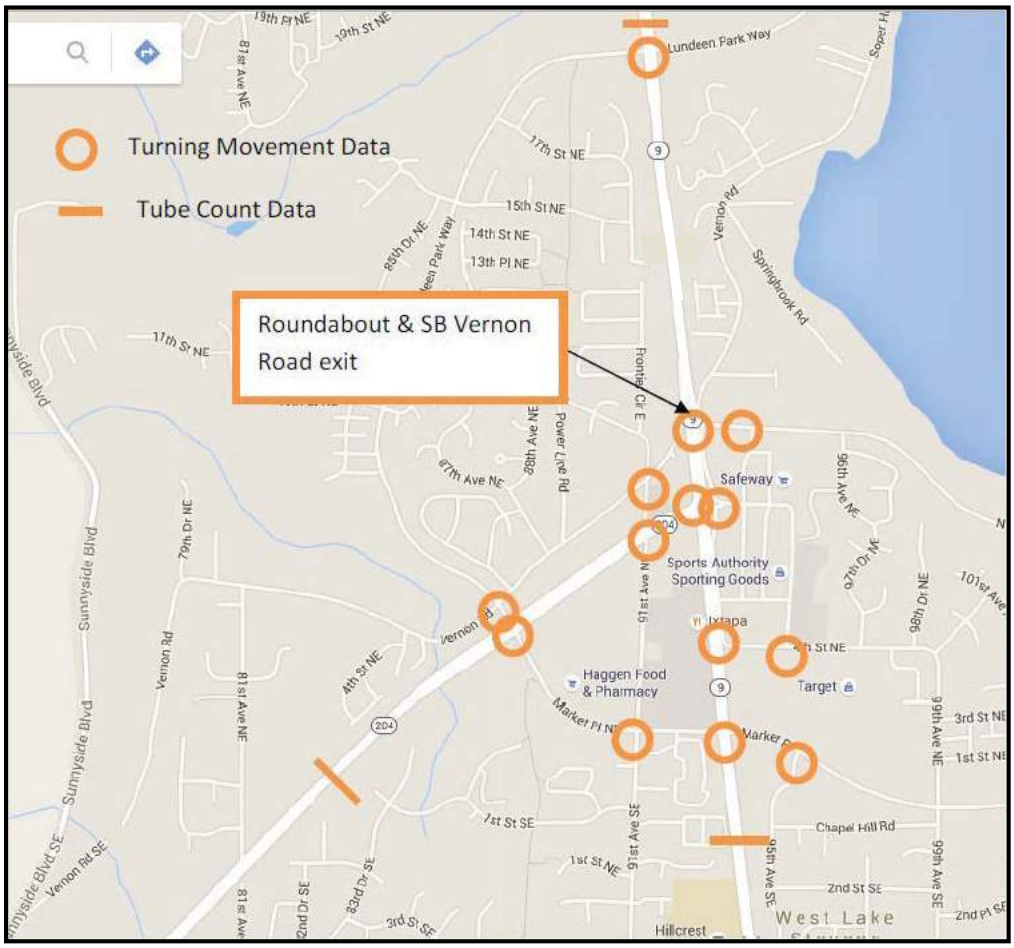


Figure 1: Study Intersections and Data Collection Locations

LAND USE

The study area includes a variety of land uses, including single and multifamily residential, auto-oriented commercial, and a transit center. **Figure 2** displays major land uses within the study area. The study area

is almost entirely contained within the Lake Stevens Center subarea, identified in 2012 by the City as local Growth Center for residential population and employment. The future land use pattern is envisioned to include a commercial core, mixed-use areas with an emphasis on multi-family residential, a main street area on 91st Avenue NE, and transit-oriented development around the transit center.

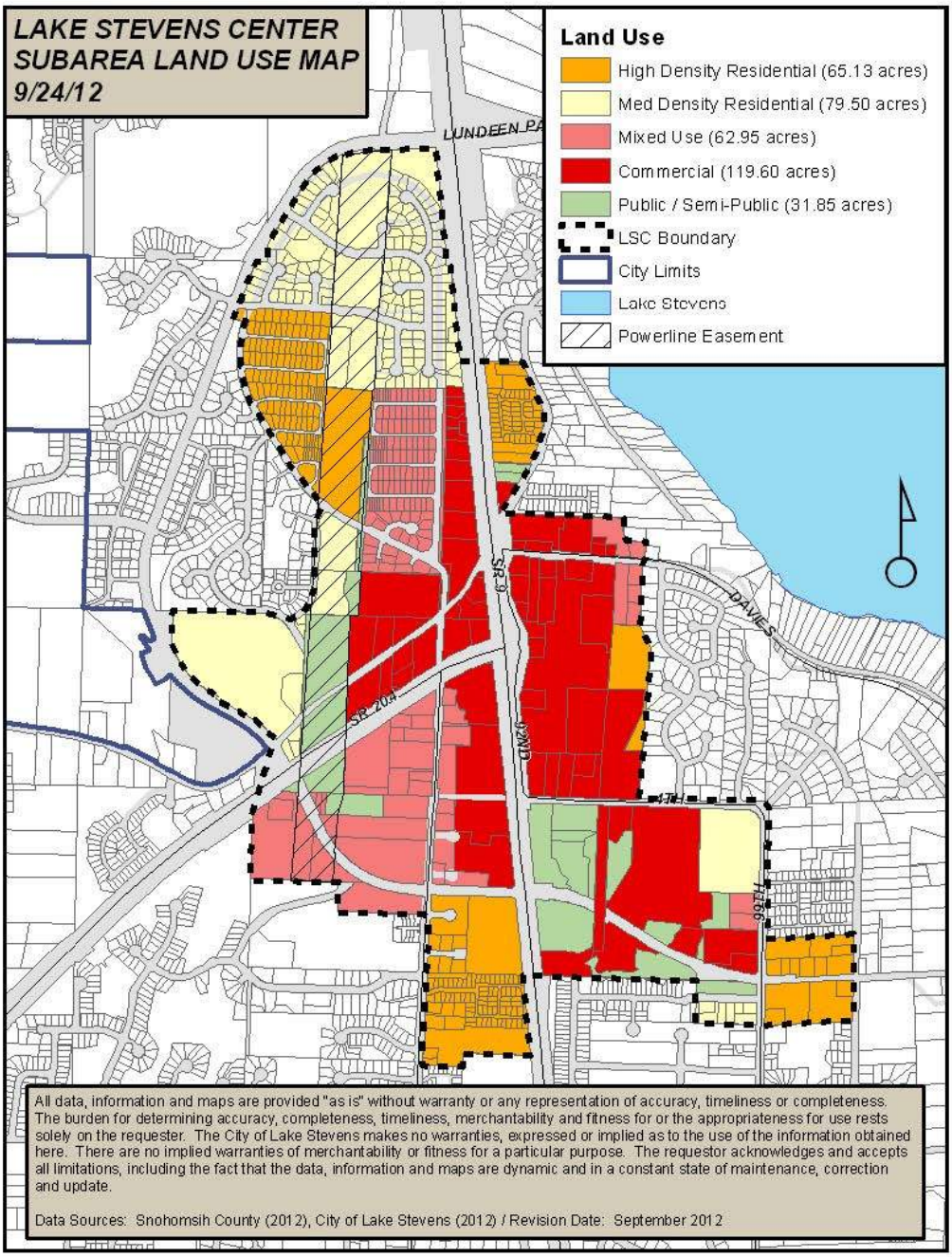


Figure 2: Lake Stevens Land Use

ROADWAY NETWORK

The roadway network in the study area consists of two state highways: SR 9 and SR 204 as well as minor arterials and collector streets. Both SR 9 and SR 204 are "partial control" limited access highways, as defined by WSDOT. This designation "provides a considerable level of protection from traffic interference and protects the highway from future strip-type development." Specific access control designations and requirements for the portions of SR 9 and SR 304 within the study area are defined in **Table 1**. Minor arterials, such as Lundeen Parkway and 91st Avenue NE (south of SR 204), serve to distribute traffic from the highways to local streets, which include collector arterials and local access streets. Collector streets in the study area include: Vernon Road, 91st Avenue NE (north of SR 204), Market Place NE, 4th Street NE, 92nd Avenue NE, and N Davies Road.

TABLE 1. ACCESS CONTROL DESIGNATIONS FOR STUDY AREA STATE ROUTES

Location Description	Milepost		Access Control Designation	
	Begin	End	Code	Control
SR 9 from Lake Avenue (98th Avenue SE) to N Davies Road	11.15	15.90	LP	Limited Partial Control
SR 9 from N Davies Road to 201st Street NE	15.90	27.94	LP	Limited Partial Control
SR 204 from US 2 ramps to 91st Avenue NE	0.08	2.25	LP	Limited Partial Control
SR 204 from 91st Avenue NE to SR 9	2.25	2.35	M2	Managed Access Class 2

Limited Partial Control

- At-grade intersections are allowed for selected public roads, and approaches for existing private driveways
- No commercial approaches allowed
- No direct access if alternate public road access is available

Managed Access Class 2

- Access spaced 660' apart
- No direct access unless property has no other reasonable access
- No additional approaches for created parcels from property divisions
- Permitted access goes away when alternate access available
- Variance permits may be allowed

Source: WSDOT Access Control Tracking System

Speed limits for SR 9 are posted at 40 miles per hour (mph) from Lundeen Parkway to Market Place NE. On SR 204, the posted speed limit is 35 mph from Market Place NE/Lundeen Parkway to SR 9. Speeds of minor and collector arterials in the study area range from a minimum speed of 15 mph to a maximum of 35 mph. The minor arterials intersect with smaller collector arterials, local access roads, and driveways.

On-street parking along the roadway network is limited, but some parking is available along Vernon Road (between Lundeen Parkway and 91st Avenue NE) and N Davies Road.

Some of the study area roadway segments are designated as truck routes under the Washington State Freight and Goods Transportation System (FGTS) and are classified by the annual tonnage carried on the segment. The FGTS classifications range from T2 roads (4,000 to 10,000 annual tons) to T3 (300 to 4,000 annual tons) to T4 (100 to 300 annual tons), as listed below:

- T2 – 4,000 to 10,000 annual tons
    - SR 9
- T3 – 300 to 4,000 annual tons
    - SR 204
    - Market Place
    - 91st Avenue NE
    - Vernon Road from SR 204 to N Davies Road
    - N Davies Road
- T4 – 100 to 300 annual tons
    - Vernon Road from 81st Avenue SE to SR 204

ACCESSIBILITY

The SR 9 / SR 204 intersection serves multiple businesses in the area and is a key intersection for the City of Lake Stevens. SR 9 provides access through Snohomish County and runs as a parallel alternate route to Interstate 5 (I-5). SR 204 provides an important connection between US 2 and SR 9 for users traveling west of Lake Stevens towards Everett and I-5.

Four Community Transit routes (routes 109, 209, 280, and 425) serve the area with primary access provided at the transit center. However, limited bicycle and pedestrian facilities present an obstacle to cross the SR 9 / SR 204 intersection by foot or by bicycle. Additionally, there are relatively few crossing opportunities along SR 9 between the commercial areas on either side of the highway. Within the study area, the only crossings of SR 9 are at Lundeen Parkway, SR 204, and Market Place.

4.0 DATA COLLECTION

To provide a better understanding of the existing conditions in the study area, the project team conducted intersection turning movement counts and field observations to examine driveway volumes and queue lengths. These data refined our transportation network assumptions and helped pinpoint potential intersection deficiencies and other notable conditions for further examination.

INTERSECTION TURNING MOVEMENT COUNTS

The turning movement counts consist of historic WSDOT data from 2013 to 2015 and new AM and PM peak period turning movement counts collected in June and July 2016. Additionally, seven-day, 24-hour

tube counts were collected at three State Route locations. The data collection dates for traffic counts at each study location are summarized in **Table 2**.

TABLE 2. INTERSECTION AND ROADWAY SEGMENT COUNT DATA

Int. #	Intersection Location	Count Date	
		AM	PM
1	SR 9 / Lundeen Parkway	10/22/13	2/5/14
2	SR 9 / Vernon Ramp	7/5/16	7/5/16
3	SR 9 / SR 204	4/22/15	4/22/15
4	SR 9 / Market Place NE	5/5/15	5/5/15
5	SR 204 / 91st Avenue NE	4/30/15	4/28/15
6	SR 204 / Market Place NE / Lundeen Parkway	4/16/15	4/16/15
7	Vernon Road / 7th Place NE / 92nd Avenue NE	7/6/16	7/6/16
8	Vernon Road / 91st Ave NE	7/7/16	7/7/16
9	N Davies Rd / Shopping Access Roundabout	7/13/16	6/30/16
10	4th Street NE slip ramp	7/13/16	6/28/16
11	4th Street NE / Transit Center Access	7/13/16	6/28/16
12	Market Place NE / Transit Center Access	7/13/16	7/5/16
13	Market Place NE / 91st Ave NE	7/12/16	7/12/16
14	Vernon Road / Market Pl NE	7/14/16	7/7/16
15	Vernon Road / N Davies Rd	7/14/16	6/30/16
Seg. #	**Segment Location**	**Count Dates**	
1	SR 9 north of Lundeen Parkway	7/13/16 through 7/19/16	
2	SR 204 south of Market Place NE	7/13/16 through 7/19/16	
3	SR 9 south of Market Place NE	7/13/16 through 7/19/16	

To address potential volume differences between intersections resulting from the varied dates of data collection, we employed seasonal factoring methods described in the WSDOT Short Count Factoring Guide (April 2016). The permanent traffic recorder (PTR) located north of the study area at SR 9 near Division Street in Arlington was used to adjust the turning movement counts to a consistent month. May was identified as the "standard" month as it represents conditions that are typical for the year (avoiding the low travel seasons during the summer and winter periods). Counts were also balanced along portions of SR 9 and SR 204 with limited/restricted access between intersections. These counts were balanced to the highest volume movement, which increased the through volumes on SR 9 and SR 204 and represents a conservative condition for traffic analysis. Some of the arterials were left unbalanced as the imbalances are generally in-line with observed driveway ingress and egress between study intersections.

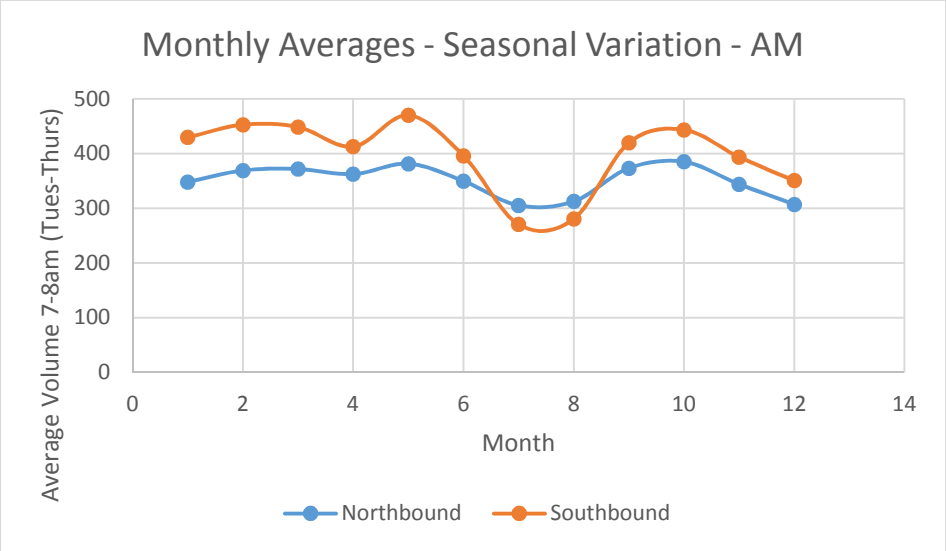


Figure 3. Average Monthly AM Peak Traffic Seasonal Variation

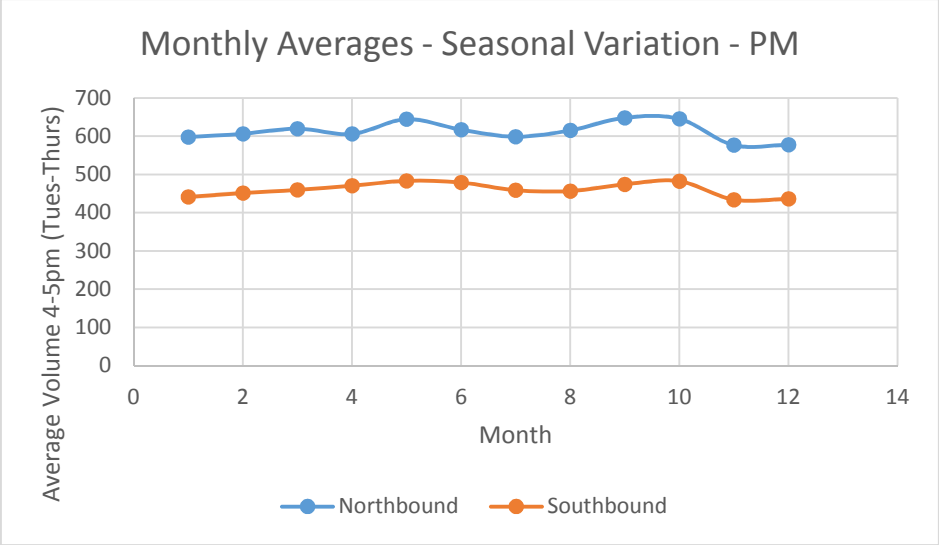


Figure 4. Average Monthly PM Peak Traffic Seasonal Variation

In addition to seasonal factoring and volume balancing, counts taken prior to 2016 conditions were factored to account for background growth in traffic. The annual growth rate for the AM and PM peak period was determined from the PTR data (AM peak: 1.2%, PM peak: 1.5%).

The lane configurations and seasonally adjusted and balanced counts for the AM and PM peak hours are shown in **Figures 5** and **6**.

DRIVEWAYS

Within the project area, several driveways generate high inbound/outbound volumes, especially during the PM peak period. Most businesses in the shopping centers open after 9:00 AM per our observations,

and PM peak period driveway volumes are assumed to be higher than AM volumes. Field observations were conducted on July 13, 2016, at the following driveway locations:

- North driveway onto 92nd Avenue NE (near McDonald's)
- Middle driveway onto 92nd Avenue NE (near Qdoba)
- South driveway onto 92nd Avenue NE (access to The Village shopping center)
- Haggen driveway onto Market Place
- Country Market driveway onto Market Place

The field observations confirmed our expectations that the PM peak period driveway volumes are higher than during the AM peak period. The middle driveway onto 92nd Avenue NE near Qdoba, the Haggen driveway, and Country Market driveway generated the highest number of inbound/outbound volumes in the PM peak period. These three driveways serve three major commercial business centers and provide access to large retail stores and other popular destinations. Also, these driveways provide access to impotant arterials which connect to SR 9 and SR 204.

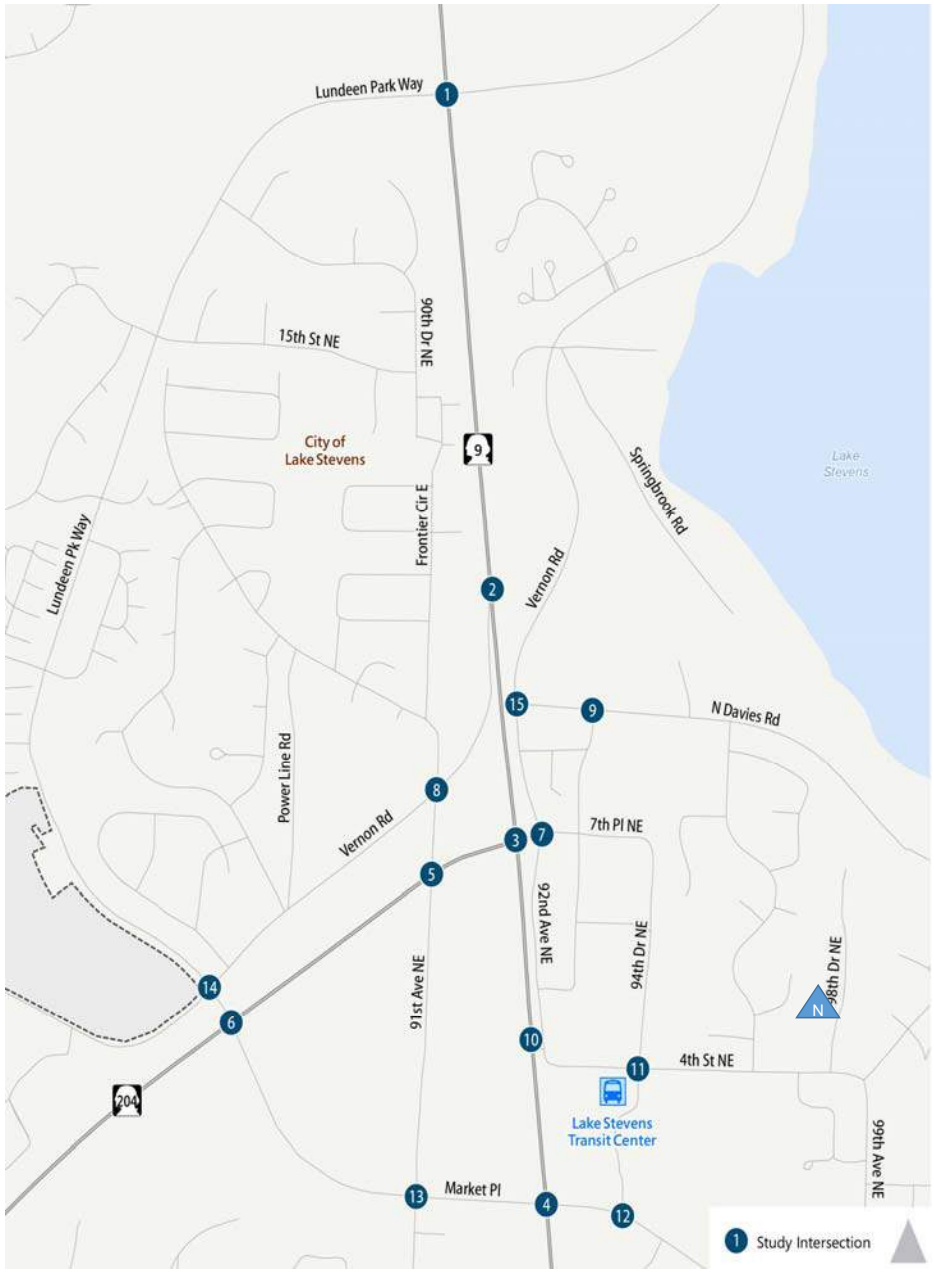
FREIGHT

The SR 9 and SR 204 corridors are integral parts of regional freight mobility. Trucks use these roadways to move goods throughout the region as well as to make deliveries to local businesses. SR 9 is classified by the Washington State Freight and Goods Transportation System (FGTS) as a T2 route (4,000 to 10,000 annual tons of freight), and SR 204 is a T3 route (300 to 4,000 annual tons). The percentage of trucks in relation to total corridor volumes are shown in **Table 3**. These volumes were recorded at the three segment count locations listed in **Table 2**, which constitute the three State Route entry/exits points for the study area. Two primary classifications of trucks are defined:

- **Light Trucks –** includes long two-axle, 4-tire vehicles (such as pickup trucks) and two-axle, 6-tire vehicles (such as flabed and single-unit box trucks).
- **Heavy Trucks –** vehicles with 3 or more axles, including single and multi unit tractor-trailer trucks.

Approximately 34% of all vehicles entering the study area during the AM peak are classificed as a truck, with 4% of that total comprised of heavy trucks (vehicles with 3-axles or more). The PM peak has an entering truck percentage of 32%, which is slightly less than the AM peak percentage but constitutes a greater total volume since general traffic volumes are much higher during the PM peak.

The high percentage of trucks influences the characteristics of roadway traffic flow. Larger trucks tend to travel at lower speeds than passenger cars and take up more lane space due to their size. This leads to more constrained sightlines and a decrease in overall vehicle speeds for drivers directly behind a truck. Additionally,lane change movements are more difficult, and start up times at signals are also reduced for vehicles behind a truck.



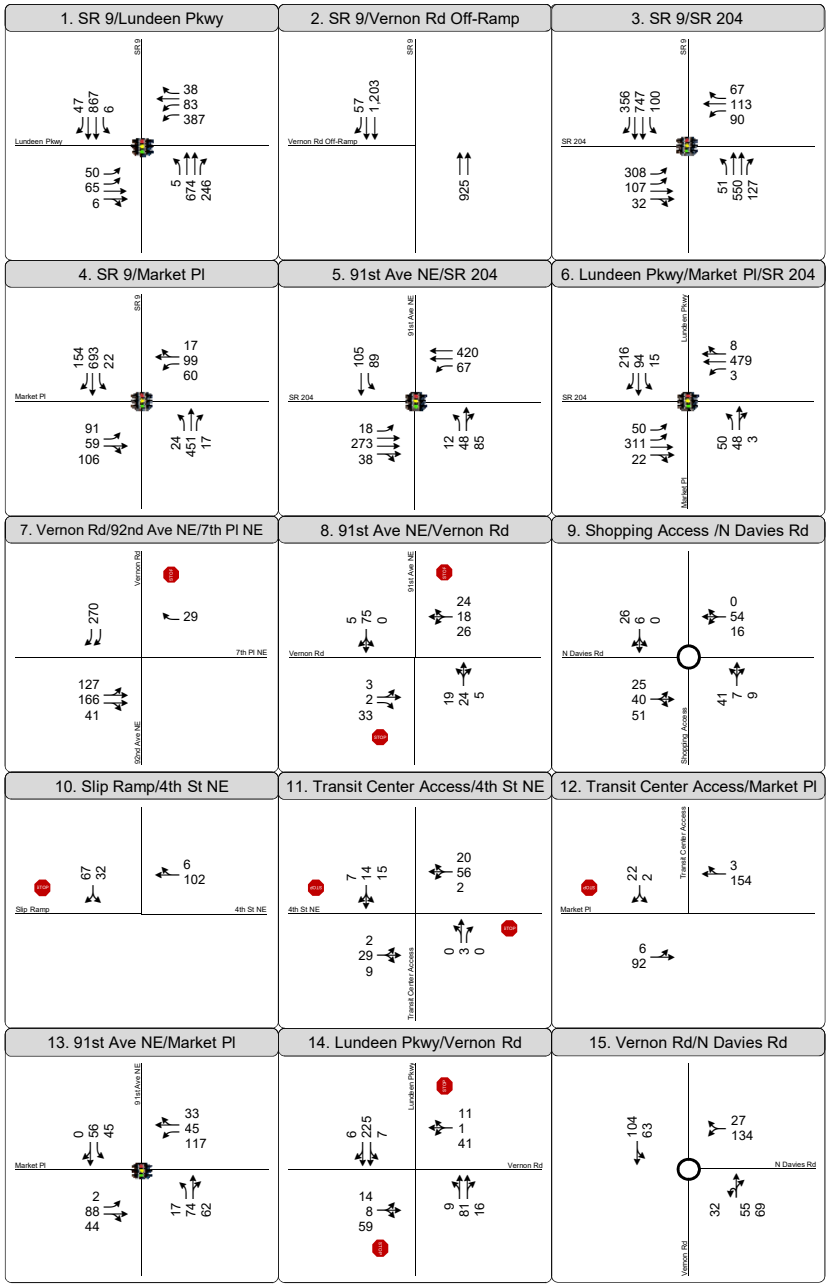
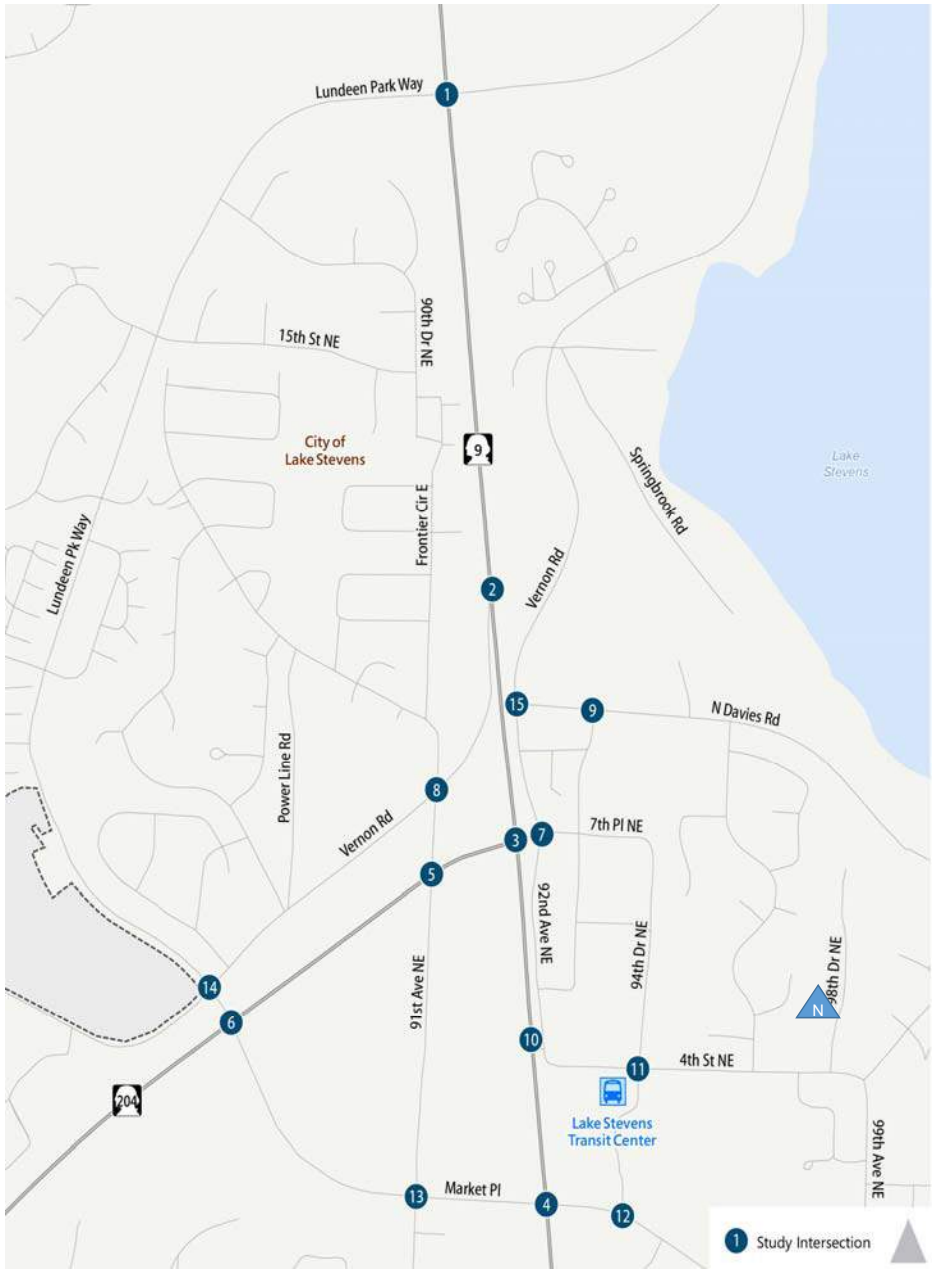


Figure 5

SR 9/SR 204 Intersection Improvement Project
Traffic Volumes and Lane Configurations
Existing Adjusted and Balanced - AM Peak Hour



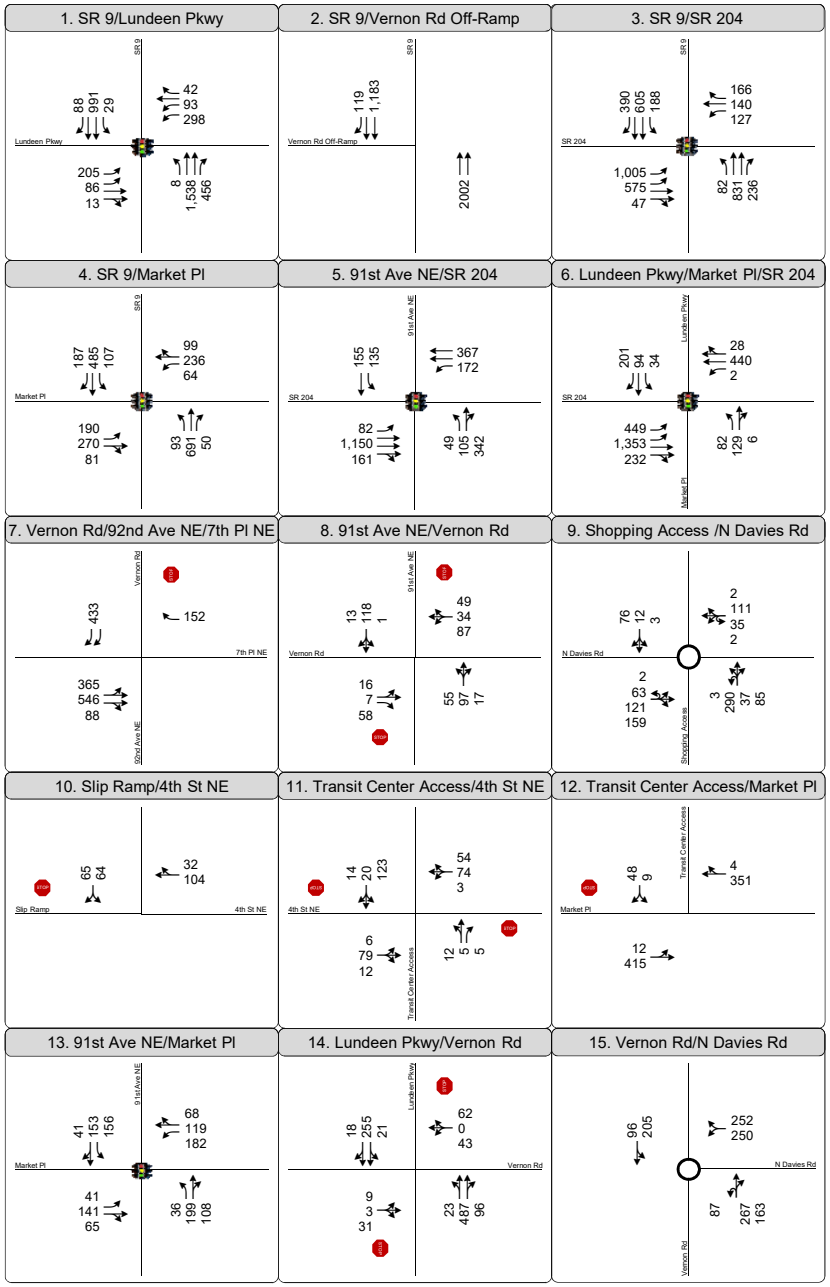


Figure 6

SR 9/SR 204 Intersection Improvement Project
Traffic Volumes and Lane Configurations
Existing Adjusted and Balanced - PM Peak Hour

Table 3. Truck Percentages

Measure	Northbound SR 9 south of Market Street	Southbound SR 9 north of Lundeen Parkway	Eastbound SR 204 at Market Street / Lundeen Parkway	TOTAL
AM Vehicles (7-8)	319	844	396	1,559
AM Trucks %[1]	40%	33%	31%	34%
Heavy AM Trucks %[2]	3%	4%	4%	4%
PM Vehicles (4-5)	771	1,048	1,246	3,065
PM Trucks %[1]	37%	34%	27%	32%
Heavy PM Trucks %[2]	3%	4%	1%	2%
Daily Vehicles	8,622	16,738	13,493	38,853
Daily Truck %[1]	36%	33%	25%	31%
Heavy Daily Truck %[2]	3%	4%	2%	3%

1. Includes both light and heavy trucks
2. Trucks with 3-axles or more

MAXIMUM QUEUES

Queuing was observed on Wednesday July 13, 2016, during the AM (6:45 AM – 8:30 AM) and PM (3:45 PM – 5:15 PM) peak periods. The observations were taken at the following intersections:

- SR 9 / SR 204
- SR 204 / 91st Avenue NE
- SR 204 / Lundeen Parkway and Market Place
- SR 9 / Market Place
- SR 9 / Lundeen Parkway

Observed volumes during the AM peak period indicate minimal queuing at all five intersections. Based on our observations, all vehicles in a queue waiting at a signal were able to progress through the intersection without any additional delay during the AM peak period.

During the PM peak period, there is high demand for the eastbound movements at the SR 9 / SR 204 intersection which results in substantial queuing through the SR 204 / 91st Avenue NE intersection. Although the signals at both intersections are coordinated, occasionally a driver will need to wait two cycles before proceeding through the SR 9 and SR 204 intersection in the PM peak period (i.e., the vehicle has to wait at both the 91st Avenue NE and SR 9 intersections since they cannot clear through both in a single coordinated cycle). Additionally, vehicles queuing in the eastbound direction at the SR 204 / Lundeen Parkway / Market Place intersection are often not able to progress through to the SR 9 / SR 204 intersection during a single coordinated east-west green cycle due to heavy queuing at the SR 204 / 91st Avenue NE intersection.

The SR 9 / Market Place NE intersection also experiences some PM peak period queueing with the eastbound queue extending back to the91st Avenue NE / Market Place NE intersection. Drivers traveling east ocassionally to wait two cycles before proceeding through the SR 9 / Market Place NE intersection. The queues are representative of the travel patterns as a majority of commuters return to this area from the west in the PM peak period.

5.0 TRAFFIC OPERATIONS ANALYSIS

This section documents the findings of the existing year (2016) traffic operations analysis. For this analysis, 15 intersections in the study area were analyzed as shown on **Figure 1**. The study intersections are located along SR 9, SR 204, Market Place, Lundeen Parkway, and key locations near the Frontier Village shopping center (located just east of SR 9). All intersections were analyzed using VISSIM microsimulation software to capture the effects of network-wide congestion, queue spillback to adjacent intersections, and interactions between travel modes.

VISSIM MODEL DEVELOPMENT AND VALIDATION

Intersection operations were assessed using VISSIM 8, a detailed micro-simulation modeling platform. VISSIM provides the ability to evaluate the interaction between different travel modes (such as pedestrians and heavy vehicles), the effects of congestion and queuing between intersections, and more accurately evaluate non-standard geometry throughout the study area, such as the east leg of the SR 9 / SR 204 intersection.

VISSIM simulation models were developed for the AM and PM peak hours and include the intersections and roadway network components listed in **Section 3** and illustrated in **Figure 1**. Model network coding, parameters, and data input were developed according to the *WSDOT VISSIM Protocol* (September 2014).

There are two separate criteria that must be met in order to justify the validity of a particular model and its usefulness in evaluating the transportation system:

- **Confidence** – Ensuring that the reported model results are representative of the model
- **Calibration** – Matching the model results to real world conditions

The following sections address how the VISSIM simulation model meets each of these two criteria.

Confidence

Given the varying results that inherently exist between micro-simulation runs (due to the random seed number), every model is required to evaluate its reported results in a way that confides that they are representative of the model and not skewed towards a statistical outlier. Per the WSDOT VISSIM Protocol, the VISSIM model runs used a simulation resolution of 10 time steps per second, and the intial results were based on an average of at least 11 model runs, each using a different random seed value.

For the existing conditions model, the statistical significance of 11 simulation runs was confirmed to ensure that the variation in model vehicle throughput was within the 95 percent confidence level. The detailed calculation is provided in **Attachment A**. As indicated by the results, there was a acceptable

amount of deviation between runs, and the average of the 11 runs produces statistically significant results. Based on these results, all subsequent model results will be based on an average of 11 VISSIM runs.

Calibration

Calibration is the process used to achieve adequate reliability or validity of the model by establishing suitable parameter values so that the model replicates local traffic conditions as closely as possible. The existing conditions VISSIM model was calibrated to match traffic counts and observed queues. Traffic count calibration was assessed using the GEH statistic for all segments in which there was accompanying field traffic count data. The GEH statistic summarizes the difference between the model output and observed volumes – the closer the model output is to ovserved conditions, the lower the GEH statistic. **Tables 4** and **5** provide the recommended calibration criteria for the GEH statistic, as well as the AM and PM calibration results. **Attachment B** shows more detailed calculations for the GEH statistic for both AM and PM peak periods.

TABLE 4: GEH STATISTIC CALIBRATION SUMMARY – AM

Criteria	Target Details	Segments in Study Area	Segments Meeting Criteria	
GEH < 3.0	All state facility segments within the calibration area	17	17	
GEH < 3.0	All entry and exit locations within the calibration area	18	18	
GEH < 5.0	At least 85% of applicable local roadway segments	59	59	100%
Sum of all segment flows within the calibration area.	Within 5%	**Model Volume Total**	**Field Volumes**	**% Difference**
		42,955	42,541	-0.97%

TABLE 5: GEH STATISTIC CALIBRATION SUMMARY – AM

Criteria	Target Details	Segments in Study Area	Segments Meeting Criteria	
GEH < 3.0	All state facility segments within the calibration area	17	17	
GEH < 3.0	All entry and exit locations within the calibration area	18	18	
GEH < 5.0	At least 85% of applicable local roadway segments	59	59	100%
Sum of all segment flows within the calibration area.	Within 5%	**Model Volume Total**	**Field Volumes**	**% Difference**
		21,889	21,705	0.89%

To achieve the results in **Tables 4** and **5**, the consultant team adjusted several VISSIM input parameters to reflect study-area driving conditions. The VISSIM default vehicle composition contained only standard sedans. However, a significant portion of vehicles in the study area are SUVs (including light trucks). As a result, the traffic composition parameters were revised according to the summary in **Table 6**.

TABLE 6: VISSIM CALIBRATION PARAMETER ADJUSTMENTS

Category	Parameter	Default Value	Adjusted Value
Vehicle Fleet Composition	SOV/HOV Vehicle Type – Sedans	100%	45%
	SOV/HOV Vehicle Type – SUVs	0%	45%
	SOV/HOV Vehicle Type – Sports Cars	0%	10%
	Truck Vehicle Type – 2 Axles	0%	67%
	Truck Vehicle Type – 3 or More Axles	100%	33%

Intersection timing parameters were specified using the Ring Barrier Controller (RBC) method in VISSIM. Synchro software (Version 9.1, build 905, revision 293) was used to store the signal timing settings and peak hour volume information.

The following volume and speed assumptions were used for developing the existing conditions traffic operations analysis model:

- Peak period traffic volume flow rates were entered in 15-minute intervals at the roadway network gateways. The variation in volume among the 15-minute intervals was derived by applying a peak-hour factor (PHF) to the turning movement counts in the third 15-minute interval, and applying an anti-PHF factor to the other three intervals. No PHF was applied to the seeding interval.
- Speeds for the model network were set based on the posted speed limit.

Traffic volumes were assigned in the VISSIM models using the origin-destination (O-D) matrix estimation processes described in the WSDOT VISSIM Protocol. Demand volume matrices corresponding to the study area were extracted from the 2016 travel demand forecasting model and adjusted to reflect the balanced peak hour traffic counts using O-D estimation (VISUM TFlowFuzzy function). All trips with the same origin and destination zone (internally captured trips) were removed since they do not travel through the study intersections.

To ensure consistency between models representing different times of day, the PM peak period model was constructed and calibrated first using the methods described above. The AM peak period model was built by modifying the PM peak period model and calibrating to AM traffic counts and queues, while using AM signal timing.

OPERATIONS ANALYSIS METHODOLOGY

Data produced from the calibrated VISSIM model, described in the previous section, was used to assess roadway conditions under existing conditions. Roadway operations are defined by how well intersections function, as intersections represent the points in the network with the most constrained capacity. The determination of quality and level of service for intersections within the study area used Highway Capacity Manual 2010 level of service (LOS) grades and 95th percentile queues as the primary metrics.

Level of Service (LOS) and Delay

LOS is a qualitative description of traffic flow based on such factors as speed, travel time, delay, and freedom to maneuver. Six levels are defined, from LOS A, with the least congested operating conditions, to LOS F, with the most congested operating conditions. LOS E represents “at-capacity” operations. Operations are designated as LOS F when volumes exceed capacity, resulting in stop-and-go conditions. LOS is measured differently, depending on whether an intersection is signalized or unsignalized. How LOS would be measured in each case is described as follows.

- **Signalized Intersections.** The method for measuring vehicle LOS at signalized intersections is based on average control delay, as described in Chapter 18 of the Transportation Research Board’s fifth edition of the Highway Capacity Manual (HCM 2010). Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. The average total delay per vehicle for signalized intersections will be calculated using VISSIM, a detailed micro-simulation tool. The delay value will then be correlated to the LOS designations shown in **Table 5**.
- **Unsignalized Intersections.** Operations of unsignalized study intersections were evaluated using the method contained in Chapters 19 and 20 of the HCM 2010. At two-way or side-street stop-

controlled intersections, control delay is reported for the minor movement with the highest control delay, not for the intersection as a whole. For all-way stop-controlled intersections, the LOS is based on the weighted average control delay of all movements. Similar to signalized facilities, LOS at unsignalized intersections was calculated using VISSIM and LOS designations correlate with those presented in **Table 7**. Chapter 21 contains methods necessary for determining LOS at a roundabout. These methods are similar to that of an all-way stop.

The LOS analysis considered the adopted LOS standards of the operating agencies (i.e. SR 9 and SR 204 intersections using WSDOT LOS standards and local street intersections using City of Lake Stevens LOS standards). As a Highway of Statewide Significance (HSS), SR 9 has a LOS standard of D. As a non-HSS in Tier 2 zone (i.e. the "outer" urban area beyond of a 3-mile buffer from I-5), SR 204 also uses a LOS D standard. The City of Lake Stevens has set a citywide standard of LOS E for major and minor arterials and collector roadways, which comprise all roadways within the study area.

TABLE 7: INTERSECTION LEVEL OF SERVICE THRESHOLDS

Level of Service	Signalized Intersection Control Delay (sec/veh)[a]	Unsignalized Intersection Control Delay (sec/veh)[a]	General Description
A	0 – 10.0	0 – 10.0	Little to no congestion or delays.
B	10.1 – 20.0	10.1 – 15.0	Limited congestion, short delays
C	20.1 – 35.0	15.1 – 25.0	Modest delays and stable flow
D	35.1 – 55.0	25.1 – 35.0	Long delays, but stable flow
E	55.1 – 80.0	35.1 – 50.0	Operations at or near capacity
F	> 80.0	> 50.0	Over-capacity, breakdown flow

a. Intersection vehicle delay results generated by micro-simulation models such as VISSIM are not HCM compliant. HCM calculations are based on control delay and stopped delay that directly contributes to the traffic control devices. VISSIM directly measures the total delay, which consists of control delay, stopped delay, and other delay incurred in the vicinity of the traffic control device, such as vehicles slowing down for turn movements. However, for simplicity, the differences are usually negligible. Per the WSDOT VISSIM protocol, the control delay-based LOS thresholds can be applied to the total delay-based outputs from VISSIM.

Source: Highway Capacity Manual 2010 (Transportation Research Board 2010).

INTERSECTION OPERATIONS RESULTS

This section presents the results of the intersection operations analysis. **Table 8** summarizes the AM peak period LOS results and **Table 9** summarizes the PM peak period results. Detailed VISSIM outputs are provided in **Attachment C**.

TABLE 8: AM PEAK PERIOD INTERSECTION LEVEL OF SERVICE RESULTS (APPROACH AND OVERALL)

#	Intersection	Control	Approach Delay (seconds) - LOS				Overall
			NB	SB	EB	WB	
1	SR 9/Lundeen Pkwy	Signal	14 (B)	16 (B)	41 (D)	33 (C)	20 (C)
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	n/a	n/a	n/a*
3	SR 9/SR 204	Signal	22 (C)	19 (B)	52 (D)	30 (C)	27 (C)
4	SR 9/Market Pl	Signal	16 (B)	20 (B)	28 (C)	33 (C)	21 (C)
5	91st Ave/SR 204	Signal	15 (B)	23 (C)	24 (C)	19 (B)	21 (C)
6	Lundeen Pkwy/SR 204	Signal	17 (B)	12 (B)	8 (A)	14 (B)	12 (B)
7	Vernon Rd/7th Pl	Side-street Stop			1 (A)	7 (A)	7 (A)
8	91st Ave/Vernon Rd	Side-street Stop	1 (A)	0 (A)	6 (A)	3 (A)	6 (A)
9	Safeway Dwy/Davies Rd	Roundabout	1 (A)	1 (A)	1 (A)	1 (A)	1 (A)
10	SR 9/4th St On-Ramp	Side-street Stop		2 (A)		0 (A)	2 (A)
11	Transit Center Dwy/4th St	Side-street Stop	0 (A)	7 (A)	0 (A)	0 (A)	7 (A)
12	Transit Dwy/Market Pl	Side-street Stop		5 (A)	1 (A)	0 (A)	1 (A)
13	91st Ave/Market Pl	Signal	7 (A)	7 (A)	2 (A)	6 (A)	6 (A)
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0 (A)	2 (A)	8 (A)	6 (A)	8 (A)
15	Vernon Rd/Davies Rd	Roundabout	1 (A)	2 (A)		2 (A)	2 (A)

* Location operates as an uncontrolled diverging off-ramp for southbound SR 9 traffic onto Vernon Road and 91st Avenue NE. By definition, this location does not create control delay from any approach.

All intersections operate at LOS C or better during the AM peak hour. The eastbound approach of the SR 9 / SR 204 intersection experiences some delay (operating at LOS D conditions with 52 seconds of delay), but this is not a result of high demand. Rather, this delay is caused by the long signal phases which favors north-south movement on SR 9.

TABLE 9: PM PEAK PERIOD INTERSECTION LEVEL OF SERVICE RESULTS (APPROACH AND OVERALL)

#	Intersection	Control	Approach Delay (seconds) - LOS				Overall
			NB	SB	EB	WB	
1	SR 9/Lundeen Pkwy	Signal	20 (C)	14 (B)	52 (D)	47 (D)	24 (C)
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	n/a	n/a	n/a*
3	SR 9/SR 204	Signal	45 (D)	31 (C)	74 (E)	72 (E)	56 (E)
4	SR 9/Market Pl	Signal	43 (D)	41 (D)	91 (F)	100 (F)	62 (E)
5	91st Ave/SR 204	Signal	69 (E)	61 (E)	80 (F)	42 (D)	67 (E)
6	Lundeen Pkwy/SR 204	Signal	28 (C)	16 (B)	35 (C)	34 (C)	32 (C)
7	Vernon Rd/7th Pl	Side-street Stop			1 (A)	11 (B)	11 (B)
8	91st Ave/Vernon Rd	Side-street Stop	1 (A)	8 (A)	15 (C)	8 (A)	15 (C)
9	Safeway Dwy/Davies Rd	Roundabout	7 (A)	5 (A)	2 (A)	5 (A)	7 (A)
10	SR 9/4th St On-Ramp	Side-street Stop		1 (A)		0 (A)	1 (A)
11	Transit Center Dwy/4th St	Side-street Stop	4 (A)	9 (A)	1 (A)	0 (A)	9 (A)
12	Transit Dwy/Market Pl	Side-street Stop		28 (D)	3 (A)	36 (E)	36 (E)
13	91st Ave/Market Pl	Signal	31 (C)	19 (B)	7 (A)	17 (B)	19 (B)
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	2 (A)	2 (A)	11 (B)	6 (A)	11 (B)
15	Vernon Rd/Davies Rd	Roundabout	5 (A)	5 (A)		9 (A)	9 (A)

* Location operates as an uncontrolled diverging off-ramp for southbound SR 9 traffic onto Vernon Road and 91st Avenue NE. By definition, this location does not create control delay from any approach.

As shown in the tables above, the PM peak period delays are higher than the AM peak period. This result is due to a considerable increase in traffic demand in the PM peak hour compared to the AM peak. The AM peak period has an approximate total of 21,700 vehicles traveling through the study area, while the PM peak period has 42,500, nearly double the AM total.

The SR 9 / SR 204, SR 9 / Market Place, and SR 204 / 91st Avenue intersections all operate at LOS E, exceeding the LOS D standard. In general, SR 9 intersection signals are timed in order to prioritize north-south throughput, so the delay on side street approaches, such as SR 204/7th Place NE/Vernon Road and Market Place, is often much higher than north-south delay. The largest delays vehicles experienced along SR 9 were at the Market Place intersection. At times, eastbound and westbound vehicle queues spill back past the access driveways for the Albertsons and Transit Center driveways.

Along SR 204, vehicles travelling eastbound through the Market Place, 91st Avenue NE, and SR 9 intersections experience heavy queuing and delay at each signalized intersection, resulting in LOS E or F at each eastbound approach. Drivers on this corridor are primarily turn left onto northbound SR 9 or continue straight into the Frontier Village shopping center, but this demand is metered by the north-south signal priority at the SR 9 / SR 204 intersection. At each intersection along the corridor, all queues typically clear during each signal cycle, with the exception of some eastbound queues at the 91st Avenue / SR 204 intersection (LOS F). However, a driver travelling eastbound on the SR 204 corridor during the PM peak hour (beginning west of Market Place) would typically get stopped by at least two signal red cycles before

clearing the SR 9 / SR 204 intersection, resulting in the perception of heavy corridor delays. Vehicles coming out of the shopping center from Vernon Rd (westbound at SR9 & SR 204) also operated at LOS E, due to the timing priority given to SR 9.

All the local street intersections operate at an acceptable level, with the exception of the Transit Center Driveway / Market Place intersection (LOS E). This intersection is shown to have heavy westbound delay because the queue from the SR 9 / Market Place intersection extends back through the Transit Center Driveway access, and VISSIM also includes the delay associated with these queued vehicles in the Transit Center Driveway / Market Place calculation. Therefore, the poor LOS at this intersection are a direct result of congestion at the SR 9 / Market Place intersection, and, independently, the Transit Center Driveway / Market Place intersection does not have any operational concerns.

6.0 SAFETY

This section describes the result of a vehicle collision analysis. The focus of the analysis is on the state facilities (SR 9 and SR 204) and covers the time from January 2011 to December 2015 to identify locations with safety concerns and the contributing circumstances.

DATA COLLECTION AND METHODOLOGY

Vehicle collision data were obtained from WSDOT. Over the five year study period, there were a total of 446 collisions in the study area The WSDOT data includes various details about the collisions: type, probably cause, severity, time of day, and weather conditions.

Using the data, the consultant team calculated collision rates for intersections and roadway segments along SR 9 and SR 204 using a methodology developed by the Federal Highway Administration (FHWA). The rates were calculated to allow comparison of collision rates between locations in the study area and around the state. The FHWA methodology for calculating collision rates at intersections considers the total number of collisions and average daily traffic (ADT) entering an intersection. This approach allows for an equal comparison between intersections in the study area. The following calculation provides the number of collisions per million entering vehicles (MEV) into the intersection.

$$R = \frac{1{,}000{,}000\ x\ total\ collisions}{365\ x\ number\ of\ years\ of\ data\ x\ ADT}$$

The collision rate calculation for road segments provides the number of collisions per 100 million vehicle miles traveled (MVMT) along a segment, accounting for length of segment and ADT carried.

$$R = \frac{100{,}000{,}000\ x\ total\ collisions}{365\ x\ number\ of\ years\ of\ data\ x\ ADT\ x\ length\ of\ roadway}$$

Similarly MEV and MVMT rates by collision types and severity were calculated to explore other collision patterns.

In addition to the FHWA Method, the methods identified in the AASHTO *Highway Safety Manual* (HSM) were also applied using the HSM spreadsheet for urban and suburban arterials. Per the HSM methodlogy, existing roadway data, including: roadway type, length of segment, ADT, lighting of the intersection, speed

limit, roadside fixed objects, and average annual crash history, was entered in the spreadsheet. The HSM spreadsheet calculates a predicted and expected average crash frequency for each roadway segment or intersection in the study area. This prediction spreadsheet, as well as the measures defined above, will be used as a base condition for comparison with future No Build and Build alternatives.

RESULTS – FHWA METHOD

Collision rates per million entering vehicles (MEVs) for intersections and million vehicle miles of travel (MVM) for road segments along SR 9 and SR 204 are summarized below in **Figure 7** as well as **Tables 10** and **11**.

TABLE 10. ANNUAL AVERAGE INTERSECTION COLLISION RATES 2011-2015

Intersection	Type of Collision			5-Year Total	ADT	Collision Rate (per MEV)
	Fatal	Injury	Property Damage Only			
SR 9 and Lundeen Parkway	0	17	41	58	38,470	0.83
SR 9 and Vernon Ramp	0	0	0	0	13,020	0.00
SR 9 and SR 204	1	14	52	67	43,920	0.84
SR 9 and Market Place NE	0	15	37	52	25,530	1.12
SR 204 and 91st Avenue NE	0	16	28	44	28,450	0.85
SR 204 and Market Place NE / Lundeen Parkway	0	17	35	52	30,500	0.93
Vernon Road and 7th Place NE / 92nd Avenue NE	0	0	2	2	13,520	0.08
SR 9 and 4th Street NE slip ramp	0	0	5	5	11,490	0.24

TABLE 11. ANNUAL AVERAGE ROADWAY SEGMENT COLLISION RATES 2011-2015

Segments	Segment Length (mi)	Type of Collision			5-Year Total	ADT	Collision Rate (per 100 MVMT)
		Fatal	Injury	Property Damage Only			
SR 9 from Soper Hill Road to Lundeen Parkway	0.6	0	22	28	70	28,930	221.0
SR 9 from Lundeen Park Way to Vernon Slip Ramp	0.5	2	10	6	16	33,040	53.1
SR 9 from Vernon Slip Ramp to SR 204	0.25	0	0	1	1	31,850	6.9
SR 9 from SR 204 to 4th St NE Slip Ramp	0.18	0	2	3	5	19,280	79.0
SR 9 from 4th St NE Slip Ramp to Market Place NE	0.16	0	3	3	6	19,280	106.6
SR 9 from Market Place NE to 4th Street SE	0.37	1	8	16	24	14,640	242.8
SR 204 from 81st Ave NE to Market Place NE	0.6	1	8	18	26	27,570	86.1
SR 204 from Market Place NE to 91st Avenue NE	0.3	0	2	2	4	18,630	39.2
Vernon Road from SR 204/92nd Avenue NE/7th Place NE to N Davies Road	0.1	0	0	1	1	8,630	63.5

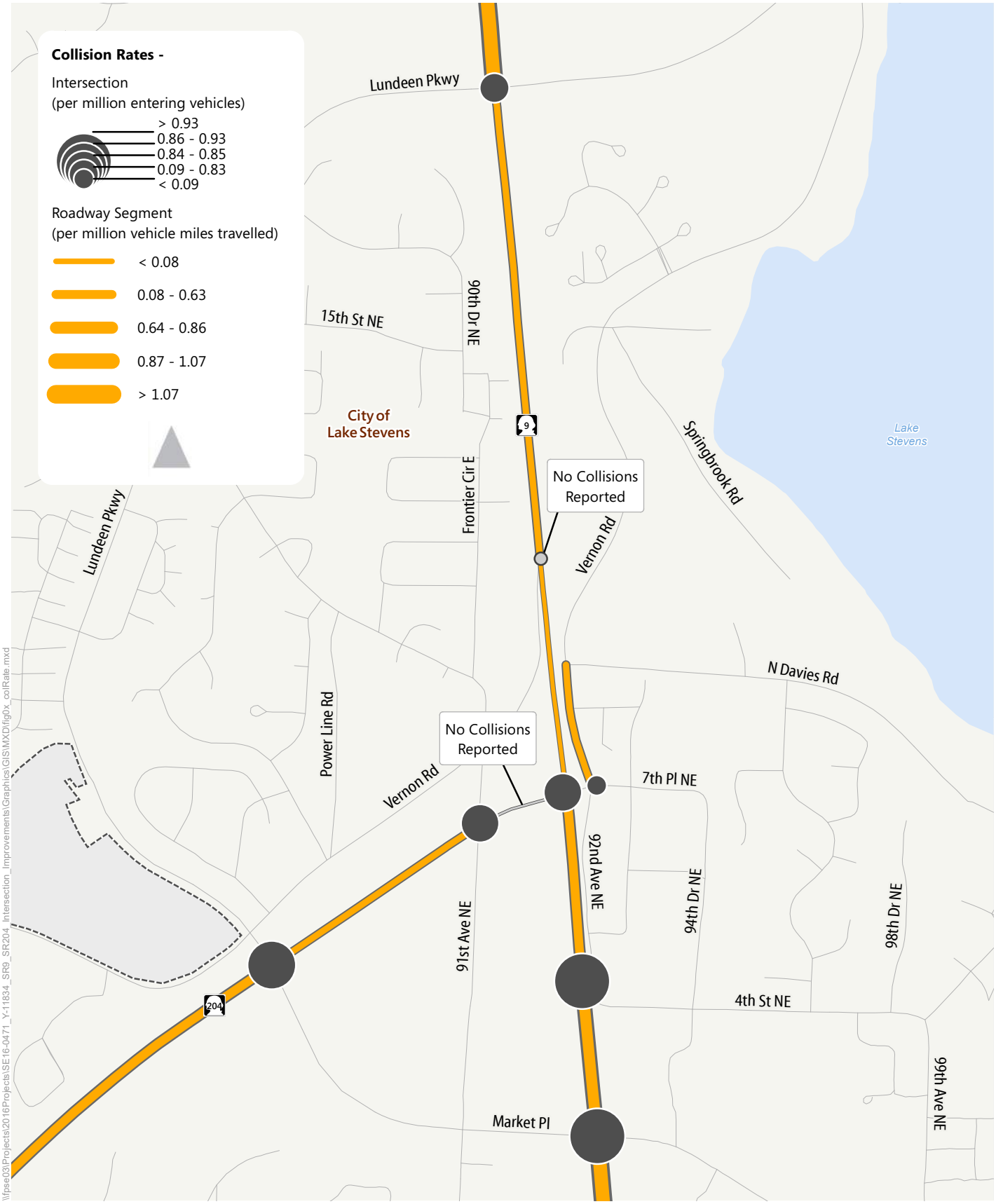


Figure 7

Collision Rates

Based on a previous study done by the University of Wisconsin for the Wisconsin Department of Transportation (WisDOT), the average collision rate for intersections that share similar characteristics as those evaluated in the study area is 0.82 MEV (WSDOT does not have statewide intersection collision rate data). These characteristics include intersections with 25,000 or more average daily entering volumes and in incorporated areas. For intersections with fewer than 15,000 daily entering vehicles (e.g. Vernon Road and 7th Place NE / 92nd Avenue NE), the average collision rate is 1.33.

The following intersections in the study area have a higher collision rate than 0.82 MEVs:

- SR 9 / Market Place NE (1.12 MEV)
- SR 204 / Market Place NE/Lundeen Parkway (0.93 MEV)
- SR 204 / 91st Avenue NE (0.85 MEV)
- SR 9 / SR 204 (0.84 MEV)
- SR 9 / Lundeen Parkway (0.83 MEV)

Along roadway segments, Snohomish County averages about 221.3 collisions per 100 million vehicle miles traveled according to the 2014 Statewide Annual Collision Summary published by WSDOT. The segments in the study area with collision rates equal to or greater than the county average are:

- SR 9 from Market Place NE to 4th Street SE (242.8 MVMT)
- SR 9 from Soper Hill Road to Lundeen Parkway (221.0 MVMT)

Both metrics will be used to prioritize which intersections and segments to address.

The detailed reports indicate that 446 collisions were reported in the study area where approximately 63 percent of the collisions were at an intersection, 34 percent of collisions were along roadway segments, and the remainder occurred at or near a driveway in the study area. More than 50 percent of all the collisions were rear-end collisions, mostly due to driver inattention.

Additional study area collision statistics are summarized in **Table 12**.

TABLE 12. COLLISION SUMMARY STATISTICS

Category	Number	Percent of Total*
Rear-End Collisions	242	54%
Single Vehicle Collisions	42	9%
Exceeding Reas. Safe Speed	34	8%
Under Influence of Alcohol/Drugs	15	3%
Bike Collisions	0	0%
Ped Collisions	6	1%
Injury Collisions	133	30%
Fatal Collisions	5	1%
Night Time Collisions	114	26%
Wet/ice/snow Conditions	184	41%
Total Collisions in study area	**446**	**100%**

* Column sums to more than 100% because several collision characteristics can occur simultaneously.

The table above shows that about 30 percent of the collisions resulted in an injury or fatality. Of the 446 collisions, 132 resulted in an injury, and 5 resulted in a fatality. This is slightly lower than the Lake Stevens citywide average for fatal and injury collisions from 2010 to 2014 – about 33 percent of all collisions recorded were fatal or injury collisions. The dates, locations, and contributing circumstances for each of the fatalities is listed below and is shown on **Figure 8**.

- December 7, 2012, 10:45 PM (two fatalities) – 230 feet N. of Vernon Road off-ramp; dry, nighttime conditions with no street lights, four vehicles involved, head-on collision, driver under influence of drugs
- October 23, 2013, 11:29 AM – At SR 204 / 81st Ave NE intersection; dry, daytime conditions, two vehicles involved, left turning vehicle did not grant right of way to through vehicle
- November 23, 2013, 6:46 PM – At SR 9 / SR 204 intersection; dry, nighttime conditions with street lights on, one vehicle involved, collision with street light pole or base.
- April 19, 2015, 1:21 PM – 770 feet S. of SR 9 / Lundeen Pkwy intersection; dry, daytime conditions, three vehicles involved, inattention, rear-end collision.
- September 8, 2015, 6:09 AM – At SR 9 / 4th St SE intersection; dry, dawn, one vehicle and one pedestrian involved, vehicle going straight hits pedestrian.

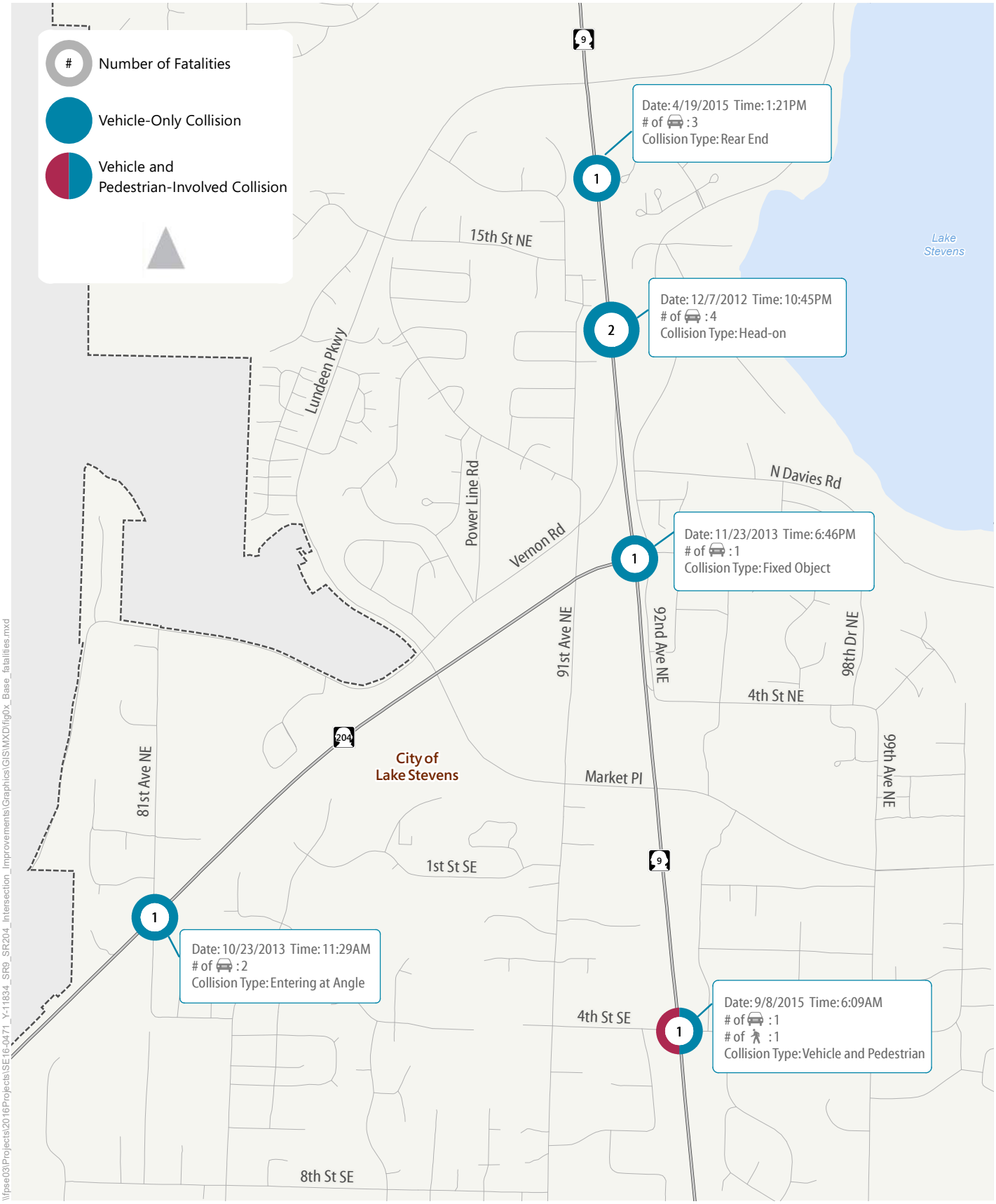


Figure 8

Fatal Collisions

RESULTS – HSM METHOD

The existing roadway was entered into the HSM spreadsheet for urban and suburban arterials for comparison with actual conditions. **Table 13** provides a summary of the predicted and expected average crash frequency calculated from the existing collision data. The "KABCO" injury scale used in Table 11 was developed by the National Safety Council and is used to classify injuries accordingly:

- K – Fatal
- A – Incapacitating injury
- B – Nonincapacitating injury
- C – Possible injury
- O – No injury / Property damage only

TABLE 13. SUMMARY OF ANTICIPATED PERFORMANCE BY SEGMENT AND INTERSECTION

PROJECT ELEMENT	SAFETY PERFORMANCE		
	PREDICTED AVERAGE CRASH FREQUENCY (CRASHES/YR) Npredicted (KABCO)	**EXPECTED AVERAGE CRASH FREQUENCY (CRASHES/YR)** Nexpected (KABCO)	**POTENTIAL FOR IMPROVEMENT (CRASHES/YR)**
INDIVIDUAL SEGMENTS			
SR 9 from Soper Hill Road to Lundeen Parkway	3.7	**11.7**	8.0
SR 9 from Lundeen Park Way to Vernon Slip Ramp	5.5	3.6	0.0
SR 9 from Vernon Slip Ramp to SR 204	2.6	1.3	0.0
SR 9 from SR 204 to 4th St NE Slip Ramp	1.0	1.0	0.0
SR 9 from 4th St NE Slip Ramp to Market Place NE	0.9	**1.0**	0.1
SR 9 from Market Place NE to 4th Street SE	1.3	**2.6**	1.3
SR 204 from 81st Ave NE to Market Place NE	5.2	4.7	0.0
SR 204 from Market Place NE to 91st Avenue NE	1.6	1.1	0.0
Vernon Road from SR 204/92nd Avenue NE/7th Place NE to N Davies Road	0.3	0.3	0.0
INDIVIDUAL INTERSECTIONS			
SR 9 and Lundeen Parkway	10.6	**12.2**	1.6

SR 9 and Vernon Ramp	0.1	0.1	0.0
SR 9 and SR 204	12.3	**13.9**	1.6
SR 9 and Market Place NE	9.5	**11.0**	1.5
SR 204 and 91st Avenue NE	10.0	**11.1**	1.1
SR 204 and Market Place NE / Lundeen Parkway	12.1	11.4	0.0
Vernon Road and 7th Place NE / 92nd Avenue NE	1.2	0.9	0.0
SR 9 and 4th Street NE slip ramp	0.2	0.2	0.0
COMBINED (sum of column)	78.1	88.1	10.0

From the results above, there is a potential for safety improvements in the study area most notably on roadway segments and at intersections along SR 9 and at the SR 204 / 91st Avenue NE intersection. For example, the HSM predicted annual crash rate for the segment of SR 9 between Market Place to the NE 4th Street ramp is 1.3, yet in the past five years there have been an average of 2.6 crashes per year, suggesting that there are a combination of factors present on SR 9 that could be leading to more crashes than would otherwise be expected for this highway. The HSM provides a brief list of countermeasures with Crash Modification Factors (CMFs) that can be implemented to potentially reduce the expected collision rate at intersections and along roadways segments. Additional CMFs are provided by the FHWA on their website which could also be applied to reduce the expected collision rate. It is important to note that the HSM methods can identify potential collision "hot spots" along the corridor, but there is no sure-fire solution to these hot-spots. Nor do these findings definitively identify areas that require immediate attention to address safety concerns as even with five-years worth of data, the sample size for these roadway segments and intersections is still relatively small and subject to random variations.

The HSM prediction spreadsheet will later be used as a base conditions for comparison with future No Build and Build alternatives and will also be used to prioritize safety improvements.

7.0 PEDESTRIAN AND BICYCLE FACILITIES

The project study area generally does not have high levels of pedestrian or bicycle activity. This lack of non-motorized activity may be due in part to the fact that both SR 9 and SR 204 lack pedestrian and bicycle facilities and have only limited crossing opportunities (particularly across SR 9). For other arterials, conditions vary as some areas have sidewalks on both sides, others with sidewalks only on one side, and others with no sidewalks. Most notably, Lundeen Parkway has sidewalks on both sides of the street from SR 9 to SR 204 which continues along Market Place NE from SR 204 to 99th Avenue NE. Some notable gaps in the existing pedestrian network are as follows:

- Along 92nd Avenue NE from the driveway near Qdoba to the Vernon Road / 7th Place NE intersection.

- Along Vernon Road from the Vernon Road / 7th Place NE intersection to the Vernon Road / N. Davies Road intersection.
- Along Vernon Road from Power Line Road to the driveway directly northeast of the Vernon Road / Lundeen Parkway intersection.

Bicycle facilities in the study area are limited to: bike lanes along both sides of Lundeen Parkway from SR 9 to SR 204 which continue along both sides of Market Place NE from SR 204 to 99th Avenue NE and sharrows on N. Davies Road between Venon Road and 96th Avenue NE. **Figure 9** shows the bicycle and pedestrian facilities in the study area.

Overall, pedestrian and bicycle activity in the area is somewhat minimal based on collected data and on field observations done July 13, 2016. From the collected data there is more pedestrian and bicycle activity near the transit center and the commercial area along 91st Avenue NE and Market Place NE where most transit users board and alight. Most of the activity is in the PM peak period. The data collection and field obsrevations identified:

- 23 pedestrians at the Transit Center Access Driveway / 4th Street NE intersection
- 7 pedestrians at the Transit Center Access Driveway / Market Place NE intersection
- 25 pedestrians crossing the 91st Avenue NE / Market Place NE intersection
- 10 pedestrians crossing the SR 204 / 91st Avenue NE intersection
- 10 pedestrians crossing the SR 9 / SR 204 intersection

During the AM peak hour pedestrian volumes are significantly lower with only one or two pedestrians crossing the key intersections.

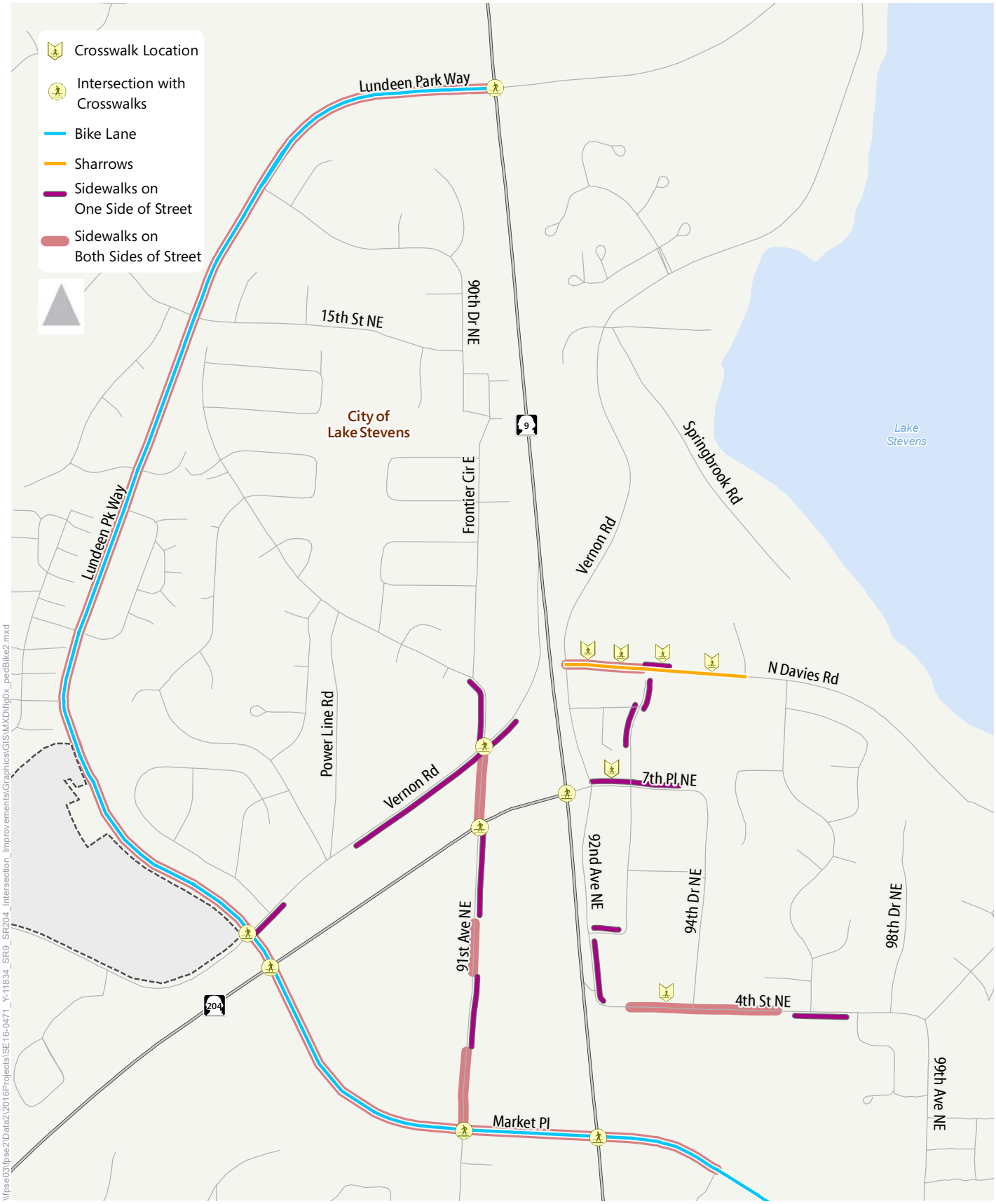


Figure 9

Existing Pedestrian and Bicycle Facilities

8.0 TRANSIT

The study area is served by four transit routes operated by Community Transit. These routes include:

- Route 109: connects Lake Stevens to the Ash Way Park & Ride. The route originates at the Lake Stevens Transit Center and runs along 4th Street NE, 99th Avenue NE, and Market Place NE en route to SR 9 toward the Ash Way Park & Ride.
- Route 209: connects Lake Stevens to the Quil Ceda Village in Tulalip. The route runs begins at the Lake Stevens Transit Center and runs along SR 9. The route accesses the transit center via Market Place NE and access SR 9 via 4th Street NE.
- Route 280: connects the Boeing Plant in Everett and the Granite Falls Park & Ride. This route runs along SR 9 to the Lake Stevens Transit Center, through Market Place NE and 91st Avenue NE.
- Route 425: connects Lake Stevens to Downtown Seattle. The route originates at the Lake Stevens Transit Center and runs along the following streets in the study area: 4th Street NE, 99th Avenue NE, Market Place NE, and 91st Avenue NE en route to Downtown Seattle via the Lynnwood Transit Center.

Figure 10 shows the transit routes, stops, and daily boarding/alighting activity in the study area. **Tables 14** and **15** summarize bus service information and the number of average daily boardings and alightings by stop, as reported by Community Transit for October 2016. The boarding/alighting data are typical for a low-density suburban area like Lake Stevens. Most of the activity is concentrated at the stops adjacent to Market Place / 91st Avenue and the Transit Center.

TABLE 14. COMMUNITY TRANSIT BUS SERVICE THROUGH STUDY AREA

Route Number	Route Name	Weekday Frequency (minutes)	Approximate Time of Service
CT 109	Lake Stevens to Ash Way Park & Ride	30	5:00 AM – 10:00 PM
CT 209	Lake Stevens to Quil Ceda Village	30	6:00 AM – 9:30 PM
CT 280	Lake Stevens/Granite Falls to Everett	30	5:00 AM – 9:30 PM
CT 425	Lake Stevens to Downtown Seattle	30 – 35	5:20 AM – 8:00 AM; 3:30 PM – 6:30 PM
Source: Community Transit, September 2016.			

TABLE 15. AVERAGE BOARDING AND ALIGHTING BY TRANSIT STOP

Stop ID	Stop Name	Route	Average Boardings	Average Alightings
454	Lundeen Pkwy & Hwy 9	280	0	3
469	Market Pl & 91st Ave NE	280	7	31
994	Hwy 9 & Lundeen Pkwy	209	1	0
995	Hwy 9 & Hwy 204	209	4	1
		280	6	5
1491	Hwy 9 & Lundeen Pkwy	209	0	1
		280	3	0
1492	Hwy 9 & Hwy 204	209	0	5
		280	4	11
1833	Market Pl & 91st Ave NE	425	10	0
		280	31	6
2665	Lake Stevens Transit Center Bay 1	209	40	43
		425	52	49
2666	Lake Stevens Transit Center Bay 2	280	49	43
		109	64	71
2669	4th St NE & 97th Dr NE	280	2	3
		109	0	0
		425	0	0
2670	99th Ave NE & 4th St NE	280	1	3
		109	0	0
		425	1	0
2671	Market Pl & 99th Ave NE	280	17	8
		109	4	1
		425	1	0

Source: Community Transit. Data collected in October 2015.

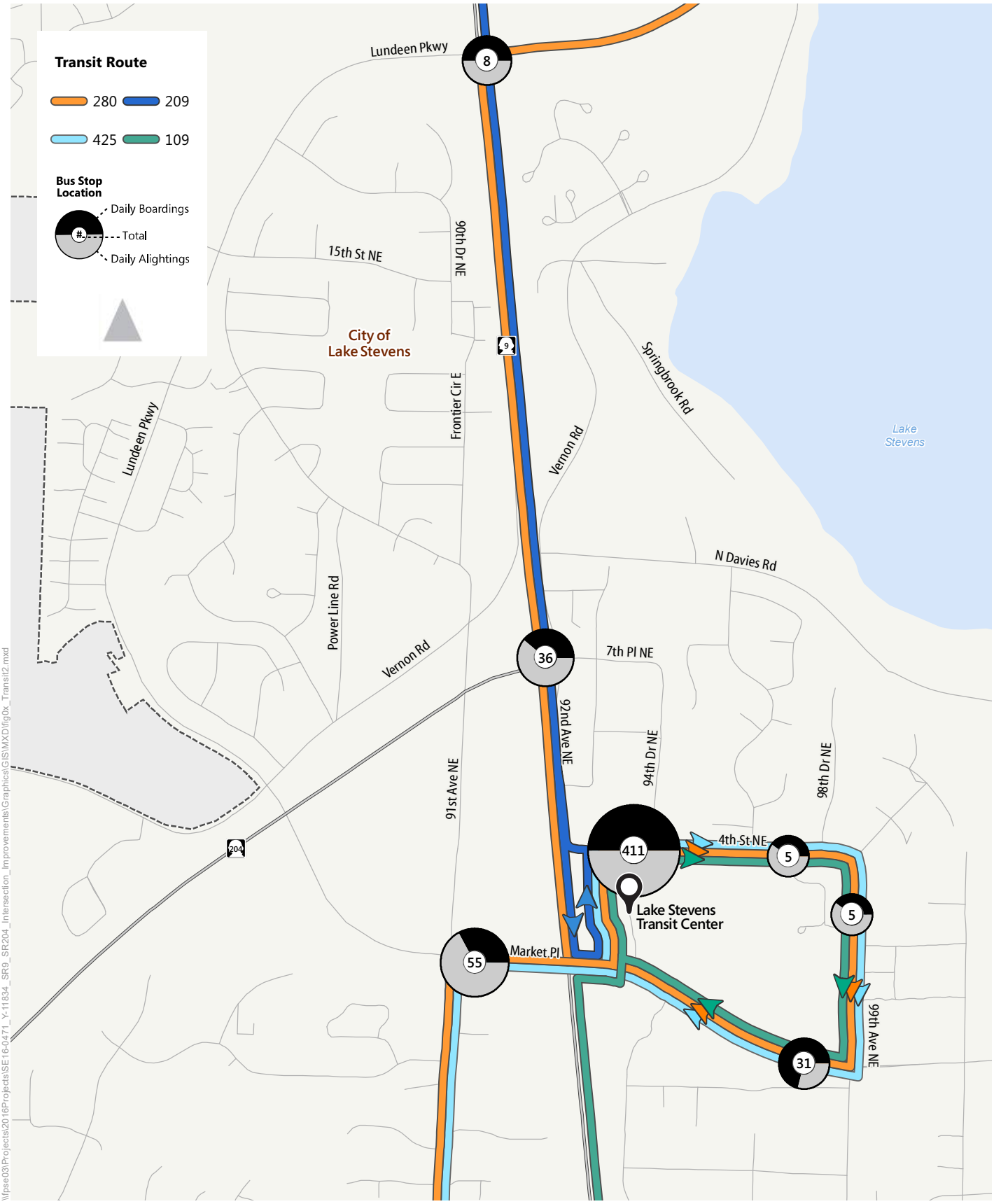


Figure 10

Transit Routes and Stops

ATTACHMENT A - Vissim Confidence Report

WSDOT VISSIM Throughput Volume Confidence Report
Model Results Confidence Test
Project: SR 9 & SR 204
Scenario: Existing Conditions - AM Peak Date: September 23, 2016

Confidence Interval for this analysis	95%
Confidence Interval Target (GEH)	3
Number of Sample Runs	11
Number of Sites Failing to meet the Confidence Interval Target	0

Location Description								Model Results				Confidence Interval Target		Model Results Confidence Test	
VISSIM Model Data Measurement	Route	Intersection #	Direction of Travel	Direction #	Number of Lanes	Additional Description	Facility Type (State, Entry/Exit, Local)	Total Volume (VPH)	Standard Deviation (Model)	Confidence Interval based on 95% Confidence Level (Volume Range)	Confidence Interval based on 95% Confidence Level (Percentage)	Confidence Interval based on GEH of 3 (Volume Range)	Confidence Interval based on GEH of 3 (Percentage)	TEST - Model Results meet the criteria	Number of runs required to meet Desired Confidence Criteria
1	SR 204	6	EB	5	2	Before Market/Lundeen	State	386	8.19	+ - 5	1.4%	+ - 61	15.9%	PASS	11
2	SR 204	6	WB	6	2	After Market/Lundeen	State	773	27.57	+ - 19	2.4%	+ - 86	11.1%	PASS	11
3	Market Pl	6	NB	1	1	Before SR 204	Local	104	10.24	+ - 7	6.6%	+ - 33	31.6%	PASS	11
4	Market PL	6	SB	2	1	After SR 204	Local	121	5.21	+ - 4	2.9%	+ - 35	29.2%	PASS	11
5	Lundeen PWY	6	SB	3	3	Before SR 204	Local	326	8.83	+ - 6	1.8%	+ - 56	17.3%	PASS	11
6	Lundeen PWY	6	NB	4	2	After SR 204	Local	103	10.11	+ - 7	6.6%	+ - 33	31.9%	PASS	11
7	SR 204	6	WB	7	2	Before Market/Lundeen	State	511	30.67	+ - 21	4.0%	+ - 70	13.7%	PASS	11
8	SR 204	6	EB	8	2	After Market/Lundeen	State	331	7.72	+ - 5	1.6%	+ - 57	17.2%	PASS	11
9	SR 9	1	NB	1	3	Before Lundeen	State	935	19.12	+ - 13	1.4%	+ - 94	10.1%	PASS	11
10	SR 9	1	SB	2	2	After Lundeen	State	1,258	17.45	+ - 12	0.9%	+ - 109	8.6%	PASS	11
11	SR 9	1	SB	3	2	Before Lundeen	State	919	13.64	+ - 9	1.0%	+ - 93	10.1%	PASS	11
12	SR 9	1	NB	4	2	After Lundeen	State	769	18.44	+ - 12	1.6%	+ - 85	11.1%	PASS	11
13	Lundeen PWY	1	EB	5	1	Before SR 9	Local	119	6.66	+ - 4	3.8%	+ - 35	29.4%	PASS	11
14	Lundeen PWY	1	WB	6	1	After SR 9	Local	134	15.52	+ - 10	7.8%	+ - 37	27.6%	PASS	11
15	Lundeen PWY	1	WB	7	1	Before SR 9	Local	516	8.42	+ - 6	1.1%	+ - 70	13.7%	PASS	11
16	Lundeen PWY	1	EB	8	1	After SR 9	Local	326	20.26	+ - 14	4.2%	+ - 56	17.3%	PASS	11
17	Vernon Rd	2	WB	6	1	Vernon Off Ramp	Entry/Exit	58	7.56	+ - 5	8.8%	+ - 25	43.5%	PASS	11
18	SR 9	3	NB	1	2	Before SR 204	State	746	22.00	+ - 15	2.0%	+ - 84	11.3%	PASS	11
19	SR 9	3	SB	2	2	After SR 204	State	864	15.22	+ - 10	1.2%	+ - 90	10.5%	PASS	11
20	SR 9	3	SB	3	2	Before SR 204	State	1,199	19.25	+ - 13	1.1%	+ - 106	8.9%	PASS	11
21	SR 9	3	NB	4	2	After SR 204	State	936	20.11	+ - 14	1.4%	+ - 94	10.0%	PASS	11
22	SR 204	3	EB	5	3	Before SR 9	State	434	9.53	+ - 6	1.5%	+ - 65	14.9%	PASS	11
23	SR 204	3	WB	6	2	After SR 9	State	531	29.32	+ - 20	3.7%	+ - 71	13.4%	PASS	11
24	Vernon Rd	3	WB	7	2	East of SR 9 & SR 204 Intersection	Local	275	14.38	+ - 10	3.5%	+ - 52	18.9%	PASS	11
25	7th Pl NE	3	EB	8	2	East of SR 9 & SR 204 Intersection	Local	323	12.94	+ - 9	2.7%	+ - 56	17.4%	PASS	11
26	SR 9	4	NB	1	2	Before Market Pl	State	493	7.81	+ - 5	1.1%	+ - 69	14.0%	PASS	11
27	SR 9	4	SB	2	2	After Market Pl	State	869	27.17	+ - 18	2.1%	+ - 91	10.4%	PASS	11
28	SR 9	4	NB	4	2	After Market Pl	State	562	16.08	+ - 11	1.9%	+ - 73	13.1%	PASS	11
29	Market PL NE	4	EB	5	1	Before SR 9	Local	265	6.22	+ - 4	1.6%	+ - 51	19.3%	PASS	11
30	Market PL NE	4	WB	6	1	After SR 9	Local	282	13.49	+ - 9	3.2%	+ - 53	18.7%	PASS	11
31	Market PL	4	WB	7	1	Before SR 9	Local	193	7.77	+ - 5	2.7%	+ - 44	22.8%	PASS	11
32	Market PL	4	EB	8	1	After SR 9	Local	100	10.72	+ - 7	7.2%	+ - 32	32.3%	PASS	11
33	91st Ave NE	5	NB	1	1	Before SR 204	Local	144	9.16	+ - 6	4.3%	+ - 38	26.6%	PASS	11
34	91st Ave NE	5	SB	2	1	After SR 204	Local	246	14.74	+ - 10	4.0%	+ - 49	20.1%	PASS	11
35	91st Ave NE	5	SB	3	1	Before SR 204	Local	275	11.78	+ - 8	2.9%	+ - 52	18.9%	PASS	11
36	91st Ave NE	5	NB	4	1	After SR 204	Local	93	7.65	+ - 5	5.5%	+ - 31	33.6%	PASS	11
37	92nd Ave NE	7	SB	2	1	South of SR 9 & SR 204 Intersection	Local	41	6.43	+ - 4	10.5%	+ - 22	52.6%	PASS	11
38	Vernon Rd	7	NB	4	1	North of SR 9 & SR 204 Intersection	Local	142	8.61	+ - 6	4.1%	+ - 38	26.9%	PASS	11
39	7th Pl NE	7	EB	5	2	Vehicles heading East from SR 9 & SR 204	Local	323	13.40	+ - 9	2.8%	+ - 56	17.4%	PASS	11
40	7th Pl NE	7	WB	7	1	Entering from the East	Local	29	3.36	+ - 2	7.9%	+ - 18	64.6%	PASS	11
41	7th Pl NE	7	EB	8	2	Exiting to the East	Local	169	7.74	+ - 5	3.1%	+ - 41	24.5%	PASS	11
42	91st Ave NE	8	NB	1	1	Before Vernon Rd	Local	48	4.70	+ - 3	6.5%	+ - 23	48.0%	PASS	11
43	91st Ave NE	8	SB	2	1	After Vernon Rd	Local	133	9.36	+ - 6	4.7%	+ - 37	27.8%	PASS	11
44	91st Ave NE	8	SB	3	1	Before Vernon Rd	Local	78	4.18	+ - 3	3.6%	+ - 29	37.0%	PASS	11
45	91st Ave NE	8	NB	4	1	After Vernon Rd	Local	54	8.36	+ - 6	10.5%	+ - 24	45.4%	PASS	11
46	Vernon Rd	8	EB	5	1	Before 91st Ave NE	Local	40	6.08	+ - 4	10.3%	+ - 21	53.6%	PASS	11
47	Vernon Rd	8	WB	6	1	After 91st Ave NE	Local	40	5.88	+ - 4	9.8%	+ - 21	53.2%	PASS	11
48	Vernon Rd	8	WB	7	1	Before 91st Ave NE	Local	71	6.12	+ - 4	5.8%	+ - 28	39.0%	PASS	11
49	Vernon Rd	8	EB	8	1	After 91st Ave NE	Local	10	4.00	+ - 3	26.2%	+ - 12	118.0%	PASS	11
50	Safeway Lot	9	NB	1	1	Before Davies	Entry/Exit	55	2.48	+ - 2	3.0%	+ - 25	44.8%	PASS	11
51	Safeway Lot	9	SB	2	1	After Davies	Entry/Exit	67	4.61	+ - 3	4.6%	+ - 27	40.1%	PASS	11
52	Les Schwab Lot	9	SB	3	1	Before Davies	Entry/Exit	31	2.01	+ - 1	4.4%	+ - 19	62.0%	PASS	11
53	Les Schwab Lot	9	NB	4	1	After Davies	Entry/Exit	33	4.06	+ - 3	8.2%	+ - 20	59.4%	PASS	11
54	N Davies Rd	9	EB	5	1	Before Shopping Center Driveway	Local	112	8.98	+ - 6	5.4%	+ - 34	30.5%	PASS	11
55	N Davies Rd	9	WB	6	1	After Shopping Center Driveway	Local	111	6.36	+ - 4	3.8%	+ - 34	30.6%	PASS	11
56	N Davies Rd	9	WB	7	1	Before Shopping Center Driveway	Entry/Exit	65	4.58	+ - 3	4.7%	+ - 27	40.8%	PASS	11
57	N Davies Rd	9	EB	8	1	After Shopping Center Driveway	Entry/Exit	51	8.96	+ - 6	11.9%	+ - 24	46.7%	PASS	11
58	92nd Ave NE	10	SB	3	1	Before SR 9 ramp	Local	107	8.19	+ - 6	5.1%	+ - 33	31.1%	PASS	11
59	92nd Ave NE	10	NB	4	1	After SR 9 Ramp	Local	7	2.04	+ - 1	20.1%	+ - 10	152.5%	PASS	11
60	SR 9 On Ramp	10	WB	6	1	Ramp onto SR 9	Entry/Exit	184	8.54	+ - 6	3.1%	+ - 43	23.3%	PASS	11
61	4th St NE	10	WB	7	1	East of ramp	Local	118	6.71	+ - 5	3.8%	+ - 35	29.6%	PASS	11
62	4th St NE	10	EB	8	1	East of ramp	Local	34	4.47	+ - 3	8.8%	+ - 20	58.5%	PASS	11
63	Transit Center	11	NB	1	2	Before 4th St NE	Local	1	0.87	+ - 1	71.7%	+ - 6	705.8%	PASS	11
64	Transit Center	11	SB	2	2	After 4th St NE	Local	23	4.60	+ - 3	13.5%	+ - 17	73.4%	PASS	11
65	94th Dr NE	11	SB	3	1	Before 4th St NE	Entry/Exit	39	4.18	+ - 3	7.2%	+ - 21	54.1%	PASS	11
66	94th Dr NE	11	NB	4	1	After 4th St NE	Entry/Exit	27	3.96	+ - 3	9.8%	+ - 18	66.5%	PASS	11
67	4th St NE	11	EB	5	1	Before Transit Driveway	Local	41	3.82	+ - 3	6.2%	+ - 22	52.5%	PASS	11
68	4th St NE	11	WB	6	1	After Transit Driveway	Local	66	7.28	+ - 5	7.4%	+ - 27	40.6%	PASS	11
69	4th St NE	11	WB	7	1	Before Transit Driveway	Local	85	6.59	+ - 4	5.2%	+ - 30	35.3%	PASS	11
70	4th St NE	11	EB	8	1	After Transit Driveway	Local	50	4.78	+ - 3	6.4%	+ - 24	47.0%	PASS	11
71	Transit Center	12	SB	3	1	Before Market Pl	Local	21	4.23	+ - 3	13.5%	+ - 16	76.9%	PASS	11
72	Transit Center	12	NB	4	1	After Market Pl	Local	18	4.45	+ - 3	16.6%	+ - 15	84.3%	PASS	11
73	Market Pl	12	WB	7	1	Before Transit Driveway	Local	177	6.08	+ - 4	2.3%	+ - 42	23.8%	PASS	11
74	Market Pl	12	EB	8	1	After Transit Driveway	Local	87	10.31	+ - 7	8.0%	+ - 30	35.0%	PASS	11
75	91st Ave NE	13	NB	1	1	Before Market	Entry/Exit	157	5.97	+ - 4	2.6%	+ - 40	25.5%	PASS	11
76	91st Ave NE	13	SB	2	1	After Market	Entry/Exit	237	11.85	+ - 8	3.4%	+ - 48	20.5%	PASS	11
77	91st Ave NE	13	SB	3	1	Before Market	Local	109	7.96	+ - 5	4.9%	+ - 34	30.9%	PASS	11
78	91st Ave NE	13	NB	4	1	After Market	Local	102	9.67	+ - 6	6.3%	+ - 33	31.9%	PASS	11
79	Market PL NE	13	EB	5	1	Before 91st Ave NE	Local	110	6.06	+ - 4	3.7%	+ - 34	30.7%	PASS	11
80	Market PL NE	13	WB	6	1	After 91st Ave NE	Local	65	8.83	+ - 6	9.2%	+ - 27	40.9%	PASS	11
81	Market PL NE	13	WB	7	1	Before 91st Ave NE	Local	204	10.01	+ - 7	3.3%	+ - 45	22.1%	PASS	11
82	Market PL NE	13	EB	8	1	After 91st Ave NE	Local	176	6.98	+ - 5	2.7%	+ - 42	23.9%	PASS	11
83	Lundeen Pwy	14	SB	3	2	Before Vernon Rd	Entry/Exit	237	6.98	+ - 5	2.0%	+ - 49	20.4%	PASS	11
84	Lundeen Pwy	14	NB	4	2	After Vernon Rd	Entry/Exit	107	8.15	+ - 5	5.1%	+ - 33	31.2%	PASS	11
85	Vernon Rd	14	EB	5	1	Before Lundeen	Entry/Exit	79	4.27	+ - 3	3.7%	+ - 29	36.8%	PASS	11
86	Vernon Rd	14	WB	6	1	After Lundeen	Entry/Exit	17	4.48	+ - 3	17.4%	+ - 15	86.4%	PASS	11
87	Vernon Rd	14	WB	7	1	Before Lundeen	Local	60	4.47	+ - 3	5.0%	+ - 26	42.6%	PASS	11
88	Vernon Rd	14	EB	8	1	After Lundeen	Local	29	5.24	+ - 4	12.2%	+ - 18	64.4%	PASS	11
89	Vernon Rd	15	NB	1	1	Before Davies	Local	135	9.45	+ - 6	4.7%	+ - 37	27.6%	PASS	11
90	Vernon Rd	15	SB	2	1	After Davies	Local	227	10.67	+ - 7	3.2%	+ - 48	20.9%	PASS	11
91	Vernon Rd	15	SB	3	1	Before Davies	Entry/Exit	177	11.24	+ - 8	4.3%	+ - 42	23.8%	PASS	11
92	Vernon Rd	15	NB	4	1	After Davies	Entry/Exit	79	8.76	+ - 6	7.5%	+ - 29	36.8%	PASS	11
93	N Davies Rd	15	WB	7	1	East of Roundabout	Local	152	7.23	+ - 5	3.2%	+ - 39	25.9%	PASS	11
94	N Davies Rd	15	EB	8	1	East of Roundabout	Local	134	11.28	+ - 8	5.7%	+ - 37	27.7%	PASS	11

WSDOT VISSIM Throughput Volume Confidence Report
Model Results Confidence Test

Project: SR 9 & SR 204

Scenario: Existing Conditions - PM Peak Date: September 23, 2016

Confidence Interval for this analysis	95%
Confidence Interval Target (GEH)	3
Number of Sample Runs	11
Number of Sites Failing to meet the Confidence Interval Target	0

Location Description						Model Results				Confidence Interval Target		Model Results Confidence Test	
VISSIM Model Data Measurement	Route	Direction of Travel	Number of Lanes	Additional Description	Facility Type (State, Entry/Exit, Local)	Total Volume (VPH)	Standard Deviation (Model)	Confidence Interval based on 95% Confidence Level (Volume Range)	Confidence Interval based on 95% Confidence Level (Percentage)	Confidence Interval based on GEH of 3 (Volume Range)	Confidence Interval based on GEH of 3 (Percentage)	TEST - Model Results meet the criteria	Number of runs required to meet Desired Confidence Criteria
1	SR 204	EB	2	Before Market/Lundeen	State	2,036	18.84	+ - 13	0.6%	+ - 138	6.8%	PASS	11
2	SR 204	WB	2	After Market/Lundeen	State	765	19.84	+ - 13	1.7%	+ - 85	11.1%	PASS	11
3	Market Pl	NB	1	Before SR 204	Local	223	17.44	+ - 12	5.3%	+ - 47	21.1%	PASS	11
4	Market PL	SB	1	After SR 204	Local	321	13.48	+ - 9	2.8%	+ - 56	17.4%	PASS	11
5	Lundeen PWY	SB	3	Before SR 204	Local	323	14.15	+ - 10	2.9%	+ - 56	17.4%	PASS	11
6	Lundeen PWY	NB	2	After SR 204	Local	591	30.61	+ - 21	3.5%	+ - 75	12.7%	PASS	11
7	SR 204	WB	2	Before Market/Lundeen	State	510	12.10	+ - 8	1.6%	+ - 70	13.7%	PASS	11
8	SR 204	EB	2	After Market/Lundeen	State	1,415	35.31	+ - 24	1.7%	+ - 115	8.1%	PASS	11
9	SR 9	NB	3	Before Lundeen	State	1,955	48.71	+ - 33	1.7%	+ - 135	6.9%	PASS	11
10	SR 9	SB	2	After Lundeen	State	1,280	25.56	+ - 17	1.3%	+ - 110	8.6%	PASS	11
11	SR 9	SB	2	Before Lundeen	State	1,107	20.96	+ - 14	1.3%	+ - 102	9.2%	PASS	11
12	SR 9	NB	2	After Lundeen	State	1,745	48.39	+ - 33	1.9%	+ - 128	7.3%	PASS	11
13	Lundeen PWY	EB	1	Before SR 9	Local	301	12.46	+ - 8	2.8%	+ - 54	18.1%	PASS	11
14	Lundeen PWY	WB	1	After SR 9	Local	204	16.09	+ - 11	5.3%	+ - 45	22.1%	PASS	11
15	Lundeen PWY	WB	1	Before SR 9	Local	436	7.10	+ - 5	1.1%	+ - 65	14.9%	PASS	11
16	Lundeen PWY	EB	1	After SR 9	Local	570	25.57	+ - 17	3.0%	+ - 74	13.0%	PASS	11
17	Vernon Rd	WB	1	Vernon Off Ramp	Entry/Exit	138	15.00	+ - 10	7.3%	+ - 38	27.3%	PASS	11
18	SR 9	NB	2	Before SR 204	State	1,147	38.68	+ - 26	2.3%	+ - 104	9.1%	PASS	11
19	SR 9	SB	2	After SR 204	State	768	30.70	+ - 21	2.7%	+ - 85	11.1%	PASS	11
20	SR 9	SB	2	Before SR 204	State	1,130	24.83	+ - 17	1.5%	+ - 103	9.1%	PASS	11
21	SR 9	NB	2	After SR 204	State	1,951	49.24	+ - 33	1.7%	+ - 135	6.9%	PASS	11
22	SR 204	EB	3	Before SR 9	State	1,626	44.27	+ - 30	1.8%	+ - 123	7.6%	PASS	11
23	SR 204	WB	2	After SR 9	State	662	30.42	+ - 20	3.1%	+ - 79	12.0%	PASS	11
24	Vernon Rd	WB	2	East of SR 9 & SR 204 Intersection	Local	464	11.69	+ - 8	1.7%	+ - 67	14.4%	PASS	11
25	7th Pl NE	EB	2	East of SR 9 & SR 204 Intersection	Local	986	35.76	+ - 24	2.4%	+ - 97	9.8%	PASS	11
26	SR 9	NB	2	Before Market Pl	State	828	18.45	+ - 12	1.5%	+ - 89	10.7%	PASS	11
27	SR 9	SB	2	After Market Pl	State	636	22.67	+ - 15	2.4%	+ - 78	12.3%	PASS	11
28	SR 9	NB	2	After Market Pl	State	979	37.48	+ - 25	2.6%	+ - 96	9.8%	PASS	11
29	Market PL NE	EB	1	Before SR 9	Local	547	18.80	+ - 13	2.3%	+ - 72	13.2%	PASS	11
30	Market PL NE	WB	1	After SR 9	Local	536	28.88	+ - 19	3.6%	+ - 72	13.4%	PASS	11
31	Market PL	WB	1	Before SR 9	Local	429	7.77	+ - 5	1.2%	+ - 64	15.0%	PASS	11
32	Market PL	EB	1	After SR 9	Local	439	16.62	+ - 11	2.5%	+ - 65	14.8%	PASS	11
33	91st Ave NE	NB	1	Before SR 204	Local	489	19.56	+ - 13	2.7%	+ - 69	14.0%	PASS	11
34	91st Ave NE	SB	1	After SR 204	Local	592	27.15	+ - 18	3.1%	+ - 75	12.7%	PASS	11
35	91st Ave NE	SB	1	Before SR 204	Local	407	15.64	+ - 11	2.6%	+ - 63	15.4%	PASS	11
36	91st Ave NE	NB	1	After SR 204	Local	263	14.47	+ - 10	3.7%	+ - 51	19.4%	PASS	11
37	92nd Ave NE	SB	1	South of SR 9 & SR 204 Intersection	Local	93	9.80	+ - 7	7.1%	+ - 31	33.6%	PASS	11
38	Vernon Rd	NB	1	North of SR 9 & SR 204 Intersection	Local	503	13.73	+ - 9	1.8%	+ - 70	13.8%	PASS	11
39	7th Pl NE	EB	2	Vehicles heading East from SR 9 & SR 204	Local	985	35.68	+ - 24	2.4%	+ - 96	9.8%	PASS	11
40	7th Pl NE	WB	1	Entering from the East	Local	152	7.87	+ - 5	3.5%	+ - 39	25.9%	PASS	11
41	7th Pl NE	EB	2	Exiting to the East	Local	541	27.88	+ - 19	3.5%	+ - 72	13.3%	PASS	11
42	91st Ave NE	NB	1	Before Vernon Rd	Local	172	9.86	+ - 7	3.8%	+ - 42	24.2%	PASS	11
43	91st Ave NE	SB	1	After Vernon Rd	Local	271	15.01	+ - 10	3.7%	+ - 52	19.1%	PASS	11
44	91st Ave NE	SB	1	Before Vernon Rd	Local	130	6.53	+ - 4	3.4%	+ - 36	28.1%	PASS	11
45	91st Ave NE	NB	1	After Vernon Rd	Local	161	12.10	+ - 8	5.0%	+ - 40	25.1%	PASS	11
46	Vernon Rd	EB	1	Before 91st Ave NE	Local	82	7.87	+ - 5	6.4%	+ - 30	35.9%	PASS	11
47	Vernon Rd	WB	1	After 91st Ave NE	Local	108	11.86	+ - 8	7.4%	+ - 34	31.0%	PASS	11
48	Vernon Rd	WB	1	Before 91st Ave NE	Local	184	16.12	+ - 11	5.9%	+ - 43	23.4%	PASS	11
49	Vernon Rd	EB	1	After 91st Ave NE	Local	28	6.32	+ - 4	15.1%	+ - 18	65.1%	PASS	11
50	Safeway Lot	NB	1	Before Davies	Entry/Exit	412	9.61	+ - 6	1.6%	+ - 63	15.3%	PASS	11
51	Safeway Lot	SB	1	After Davies	Entry/Exit	200	13.79	+ - 9	4.6%	+ - 45	22.3%	PASS	11
52	Les Schwab Lot	SB	1	Before Davies	Entry/Exit	91	5.20	+ - 3	3.8%	+ - 31	34.0%	PASS	11
53	Les Schwab Lot	NB	1	After Davies	Entry/Exit	109	9.65	+ - 6	5.9%	+ - 34	30.9%	PASS	11
54	N Davies Rd	EB	1	Before Shopping Center Driveway	Local	378	17.20	+ - 12	3.1%	+ - 61	16.0%	PASS	11
55	N Davies Rd	WB	1	After Shopping Center Driveway	Local	462	7.04	+ - 5	1.0%	+ - 67	14.4%	PASS	11
56	N Davies Rd	WB	1	Before Shopping Center Driveway	Entry/Exit	148	6.05	+ - 4	2.7%	+ - 39	26.2%	PASS	11
57	N Davies Rd	EB	1	After Shopping Center Driveway	Entry/Exit	225	13.35	+ - 9	4.0%	+ - 47	21.0%	PASS	11
58	92nd Ave NE	SB	1	Before SR 9 ramp	Local	136	8.26	+ - 6	4.1%	+ - 37	27.5%	PASS	11
59	92nd Ave NE	NB	1	After SR 9 Ramp	Local	33	4.82	+ - 3	9.7%	+ - 20	59.2%	PASS	11
60	SR 9 On Ramp	WB	1	Ramp onto SR 9	Entry/Exit	185	8.66	+ - 6	3.1%	+ - 43	23.3%	PASS	11
61	4th St NE	WB	1	East of ramp	Local	149	9.50	+ - 6	4.3%	+ - 39	26.1%	PASS	11
62	4th St NE	EB	1	East of ramp	Local	66	8.60	+ - 6	8.7%	+ - 27	40.5%	PASS	11
63	Transit Center	NB	2	Before 4th St NE	Local	28	5.95	+ - 4	14.4%	+ - 18	65.7%	PASS	11
64	Transit Center	SB	2	After 4th St NE	Local	37	3.53	+ - 2	6.4%	+ - 21	55.9%	PASS	11
65	94th Dr NE	SB	1	Before 4th St NE	Entry/Exit	172	7.24	+ - 5	2.8%	+ - 42	24.2%	PASS	11
66	94th Dr NE	NB	1	After 4th St NE	Entry/Exit	70	7.52	+ - 5	7.2%	+ - 27	39.3%	PASS	11
67	4th St NE	EB	1	Before Transit Driveway	Local	103	9.66	+ - 6	6.3%	+ - 33	31.8%	PASS	11
68	4th St NE	WB	1	After Transit Driveway	Local	110	7.62	+ - 5	4.7%	+ - 34	30.7%	PASS	11
69	4th St NE	WB	1	Before Transit Driveway	Local	141	7.14	+ - 5	3.4%	+ - 38	26.9%	PASS	11
70	4th St NE	EB	1	After Transit Driveway	Local	228	9.84	+ - 7	2.9%	+ - 48	20.9%	PASS	11
71	Transit Center	SB	1	Before Market Pl	Local	61	3.96	+ - 3	4.3%	+ - 26	42.1%	PASS	11
72	Transit Center	NB	1	After Market Pl	Local	30	5.14	+ - 3	11.5%	+ - 19	62.8%	PASS	11
73	Market Pl	WB	1	Before Transit Driveway	Local	388	7.94	+ - 5	1.4%	+ - 61	15.8%	PASS	11
74	Market Pl	EB	1	After Transit Driveway	Local	424	13.00	+ - 9	2.1%	+ - 64	15.1%	PASS	11
75	91st Ave NE	NB	1	Before Market	Entry/Exit	345	10.72	+ - 7	2.1%	+ - 58	16.8%	PASS	11
76	91st Ave NE	SB	1	After Market	Entry/Exit	425	15.07	+ - 10	2.4%	+ - 64	15.1%	PASS	11
77	91st Ave NE	SB	1	Before Market	Local	367	15.28	+ - 10	2.8%	+ - 60	16.3%	PASS	11
78	91st Ave NE	NB	1	After Market	Local	302	15.67	+ - 11	3.5%	+ - 54	18.0%	PASS	11
79	Market PL NE	EB	1	Before 91st Ave NE	Local	219	12.64	+ - 8	3.9%	+ - 47	21.3%	PASS	11
80	Market PL NE	WB	1	After 91st Ave NE	Local	206	16.21	+ - 11	5.3%	+ - 45	22.0%	PASS	11
81	Market PL NE	WB	1	Before 91st Ave NE	Local	389	21.59	+ - 15	3.7%	+ - 61	15.8%	PASS	11
82	Market PL NE	EB	1	After 91st Ave NE	Local	387	16.84	+ - 11	2.9%	+ - 61	15.8%	PASS	11
83	Lundeen Pwy	SB	2	Before Vernon Rd	Entry/Exit	295	8.38	+ - 6	1.9%	+ - 54	18.2%	PASS	11
84	Lundeen Pwy	NB	2	After Vernon Rd	Entry/Exit	546	29.41	+ - 20	3.6%	+ - 72	13.3%	PASS	11
85	Vernon Rd	EB	1	Before Lundeen	Entry/Exit	40	3.35	+ - 2	5.6%	+ - 21	53.2%	PASS	11
86	Vernon Rd	WB	1	After Lundeen	Entry/Exit	48	9.33	+ - 6	13.2%	+ - 23	48.4%	PASS	11
87	Vernon Rd	WB	1	Before Lundeen	Local	119	7.64	+ - 5	4.3%	+ - 35	29.5%	PASS	11
88	Vernon Rd	EB	1	After Lundeen	Local	127	15.12	+ - 10	8.0%	+ - 36	28.5%	PASS	11
89	Vernon Rd	NB	1	Before Davies	Local	489	16.48	+ - 11	2.3%	+ - 69	14.0%	PASS	11
90	Vernon Rd	SB	1	After Davies	Local	338	10.31	+ - 7	2.1%	+ - 57	17.0%	PASS	11
91	Vernon Rd	SB	1	Before Davies	Entry/Exit	314	8.99	+ - 6	1.9%	+ - 55	17.7%	PASS	11
92	Vernon Rd	NB	1	After Davies	Entry/Exit	520	11.81	+ - 8	1.5%	+ - 71	13.6%	PASS	11
93	N Davies Rd	WB	1	East of Roundabout	Local	497	7.78	+ - 5	1.1%	+ - 69	13.9%	PASS	11
94	N Davies Rd	EB	1	East of Roundabout	Local	386	19.43	+ - 13	3.4%	+ - 61	15.9%	PASS	11

ATTACHMENT B - Vissim Calibration Report

WSDOT VISSIM Throughput Volume Calibration
Model Results Confidence Test

Project: SR 9 & SR 204

Scenario: Existing Conditions - PM Peak Date: September 23, 2016

Criteria	Target Details	Segments	Segments Meeting Criteria	
GEH < 3.0	All state facility segments within the calibration area	17	17	
GEH < 3.0	All entry and exit locations within the calibration area	18	18	
GEH < 5.0	At least 85% of applicable local roadway segments	59	59	100%
Sum of all segment flows within the calibration area.	Within 5%	Model Volume Total	Field Volumes	% Difference
		21,899	21,705	0.89%

Number of Sample Runs

Location Description							"Field" Volumes		Model Volumes		Calibration Test		
VISSIM Model Data Measurement	Route	Intersection #	Direction of Travel	Number of Lanes	Additional Description	Facility Type (State, Entry/Exit, Local)	Total Volume (VPH)	Vehicles per Lane (VPHPL)	Total Volume (VPH)	Vehicles per Lane (VPHPL)	GEH Target	GEH	Calibration Test
1	SR 204	6	EB	2	Before Market/Lundeen	State	383	192	386	193	3	0.1	PASS
2	SR 204	6	WB	2	After Market/Lundeen	State	745	373	773	386	3	0.7	PASS
3	Market Pl	6	NB	1	Before SR 204	Local	101	101	104	104	5	0.3	PASS
4	Market PL	6	SB	1	After SR 204	Local	119	119	121	121	5	0.2	PASS
5	Lundeen PWY	6	SB	3	Before SR 204	Local	325	108	326	109	5	0.0	PASS
6	Lundeen PWY	6	NB	2	After SR 204	Local	106	53	103	51	5	0.2	PASS
7	SR 204	6	WB	2	Before Market/Lundeen	State	490	245	511	256	3	0.7	PASS
8	SR 204	6	EB	2	After Market/Lundeen	State	329	165	331	165	3	0.1	PASS
9	SR 9	1	NB	3	Before Lundeen	State	925	308	935	312	3	0.2	PASS
10	SR 9	1	SB	2	After Lundeen	State	1260	630	1,258	629	3	0.0	PASS
11	SR 9	1	SB	2	Before Lundeen	State	920	460	919	459	3	0.0	PASS
12	SR 9	1	NB	2	After Lundeen	State	762	381	769	385	3	0.2	PASS
13	Lundeen PWY	1	EB	1	Before SR 9	Local	121	121	119	119	5	0.2	PASS
14	Lundeen PWY	1	WB	1	After SR 9	Local	135	135	134	134	5	0.1	PASS
15	Lundeen PWY	1	WB	1	Before SR 9	Local	508	508	516	516	5	0.3	PASS
16	Lundeen PWY	1	EB	1	After SR 9	Local	317	317	326	326	5	0.5	PASS
17	Vernon Rd	2	WB	1	Vernon Off Ramp	Entry/Exit	57	57	58	58	3	0.1	PASS
18	SR 9	3	NB	2	Before SR 204	State	728	364	746	373	3	0.5	PASS
19	SR 9	3	SB	2	After SR 204	State	869	435	864	432	3	0.1	PASS
20	SR 9	3	SB	2	Before SR 204	State	1203	602	1,199	600	3	0.1	PASS
21	SR 9	3	NB	2	After SR 204	State	925	463	936	468	3	0.3	PASS
22	SR 204	3	EB	3	Before SR 9	State	447	149	434	145	3	0.4	PASS
23	SR 204	3	WB	2	After SR 9	State	520	260	531	266	3	0.3	PASS
24	Vernon Rd	3	WB	2	East of SR 9 & SR 204 Intersection	Local	270	135	275	137	5	0.2	PASS
25	7th Pl NE	3	EB	2	East of SR 9 & SR 204 Intersection	Local	334	167	323	162	5	0.4	PASS
26	SR 9	4	NB	2	Before Market Pl	State	492	246	493	246	3	0.0	PASS
27	SR 9	4	SB	2	After Market Pl	State	859	430	869	434	3	0.2	PASS
28	SR 9	4	NB	2	After Market Pl	State	559	280	562	281	3	0.1	PASS
29	Market PL NE	4	EB	1	Before SR 9	Local	256	256	265	265	5	0.5	PASS
30	Market PL NE	4	WB	1	After SR 9	Local	277	277	282	282	5	0.3	PASS
31	Market PL	4	WB	1	Before SR 9	Local	176	176	193	193	5	1.3	PASS
32	Market PL	4	EB	1	After SR 9	Local	98	98	100	100	5	0.2	PASS
33	91st Ave NE	5	NB	1	Before SR 204	Local	145	145	144	144	5	0.1	PASS
34	91st Ave NE	5	SB	1	After SR 204	Local	210	210	246	246	5	2.4	PASS
35	91st Ave NE	5	SB	1	Before SR 204	Local	252	252	275	275	5	1.4	PASS
36	91st Ave NE	5	NB	1	After SR 204	Local	99	99	93	93	5	0.6	PASS
37	92nd Ave NE	7	SB	1	South of SR 9 & SR 204 Intersection	Local	41	41	41	41	5	0.0	PASS
38	Vernon Rd	7	NB	1	North of SR 9 & SR 204 Intersection	Local	156	156	142	142	5	1.2	PASS
39	7th Pl NE	7	EB	2	Vehicles heading East from SR 9 & SR 204	Local	334	167	323	161	5	0.4	PASS
40	7th Pl NE	7	WB	1	Entering from the East	Local	29	29	29	29	5	0.1	PASS
41	7th Pl NE	7	EB	2	Exiting to the East	Local	166	83	169	84	5	0.1	PASS
42	91st Ave NE	8	NB	1	Before Vernon Rd	Local	48	48	48	48	5	0.1	PASS
43	91st Ave NE	8	SB	1	After Vernon Rd	Local	134	134	133	133	5	0.1	PASS
44	91st Ave NE	8	SB	1	Before Vernon Rd	Local	80	80	78	78	5	0.2	PASS
45	91st Ave NE	8	NB	1	After Vernon Rd	Local	51	51	54	54	5	0.4	PASS
46	Vernon Rd	8	EB	1	Before 91st Ave NE	Local	38	38	40	40	5	0.3	PASS
47	Vernon Rd	8	WB	1	After 91st Ave NE	Local	42	42	40	40	5	0.3	PASS
48	Vernon Rd	8	WB	1	Before 91st Ave NE	Local	68	68	71	71	5	0.3	PASS
49	Vernon Rd	8	EB	1	After 91st Ave NE	Local	7	7	10	10	5	1.1	PASS
50	Safeway Lot	9	NB	1	Before Davies	Entry/Exit	57	57	55	55	3	0.3	PASS
51	Safeway Lot	9	SB	1	After Davies	Entry/Exit	73	73	67	67	3	0.7	PASS
52	Les Schwab Lot	9	SB	1	Before Davies	Entry/Exit	32	32	31	31	3	0.2	PASS
53	Les Schwab Lot	9	NB	1	After Davies	Entry/Exit	32	32	33	33	3	0.2	PASS
54	N Davies Rd	9	EB	1	Before Shopping Center Driveway	Local	116	116	112	112	5	0.4	PASS
55	N Davies Rd	9	WB	1	After Shopping Center Driveway	Local	121	121	111	111	5	0.9	PASS
56	N Davies Rd	9	WB	1	Before Shopping Center Driveway	Entry/Exit	70	70	65	65	3	0.6	PASS
57	N Davies Rd	9	EB	1	After Shopping Center Driveway	Entry/Exit	49	49	51	51	3	0.3	PASS
58	92nd Ave NE	10	SB	1	Before SR 9 ramp	Local	99	99	107	107	5	0.8	PASS
59	92nd Ave NE	10	NB	1	After SR 9 Ramp	Local	6	6	7	7	5	0.3	PASS
60	SR 9 On Ramp	10	WB	1	Ramp onto SR 9	Entry/Exit	169	169	184	184	3	1.2	PASS
61	4th St NE	10	WB	1	East of ramp	Local	108	108	118	118	5	0.9	PASS
62	4th St NE	10	EB	1	East of ramp	Local	32	32	34	34	5	0.3	PASS
63	Transit Center	11	NB	2	Before 4th St NE	Local	3	2	1	0	5	1.1	PASS
64	Transit Center	11	SB	2	After 4th St NE	Local	25	13	23	11	5	0.3	PASS
65	94th Dr NE	11	SB	1	Before 4th St NE	Entry/Exit	36	36	39	39	3	0.5	PASS
66	94th Dr NE	11	NB	1	After 4th St NE	Entry/Exit	25	25	27	27	3	0.4	PASS
67	4th St NE	11	EB	1	Before Transit Driveway	Local	40	40	41	41	5	0.2	PASS
68	4th St NE	11	WB	1	After Transit Driveway	Local	63	63	66	66	5	0.4	PASS
69	4th St NE	11	WB	1	Before Transit Driveway	Local	78	78	85	85	5	0.8	PASS
70	4th St NE	11	EB	1	After Transit Driveway	Local	44	44	50	50	5	0.9	PASS
71	Transit Center	12	SB	1	Before Market Pl	Local	24	24	21	21	5	0.6	PASS
72	Transit Center	12	NB	1	After Market Pl	Local	9	9	18	18	5	2.4	PASS
73	Market Pl	12	WB	1	Before Transit Driveway	Local	157	157	177	177	5	1.6	PASS
74	Market Pl	12	EB	1	After Transit Driveway	Local	94	94	87	87	5	0.8	PASS
75	91st Ave NE	13	NB	1	Before Market	Entry/Exit	153	153	157	157	3	0.3	PASS
76	91st Ave NE	13	SB	1	After Market	Entry/Exit	217	217	237	237	3	1.3	PASS
77	91st Ave NE	13	SB	1	Before Market	Local	101	101	109	109	5	0.8	PASS
78	91st Ave NE	13	NB	1	After Market	Local	109	109	102	102	5	0.6	PASS
79	Market PL NE	13	EB	1	Before 91st Ave NE	Local	134	134	110	110	5	2.1	PASS
80	Market PL NE	13	WB	1	After 91st Ave NE	Local	62	62	65	65	5	0.4	PASS
81	Market PL NE	13	WB	1	Before 91st Ave NE	Local	195	195	204	204	5	0.7	PASS
82	Market PL NE	13	EB	1	After 91st Ave NE	Local	195	195	176	176	5	1.4	PASS
83	Lundeen Pwy	14	SB	2	Before Vernon Rd	Entry/Exit	238	119	237	119	3	0.0	PASS
84	Lundeen Pwy	14	NB	2	After Vernon Rd	Entry/Exit	106	53	107	54	3	0.1	PASS
85	Vernon Rd	14	EB	1	Before Lundeen	Entry/Exit	81	81	79	79	3	0.3	PASS
86	Vernon Rd	14	WB	1	After Lundeen	Entry/Exit	16	16	17	17	3	0.3	PASS
87	Vernon Rd	14	WB	1	Before Lundeen	Local	53	53	60	60	5	1.0	PASS
88	Vernon Rd	14	EB	1	After Lundeen	Local	31	31	29	29	5	0.4	PASS
89	Vernon Rd	15	NB	1	Before Davies	Local	156	156	135	135	5	1.8	PASS
90	Vernon Rd	15	SB	1	After Davies	Local	238	238	227	227	5	0.7	PASS
91	Vernon Rd	15	SB	1	Before Davies	Entry/Exit	167	167	177	177	3	0.8	PASS
92	Vernon Rd	15	NB	1	After Davies	Entry/Exit	82	82	79	79	3	0.4	PASS
93	N Davies Rd	15	WB	1	East of Roundabout	Local	161	161	152	152	5	0.8	PASS
94	N Davies Rd	15	EB	1	East of Roundabout	Local	132	132	134	134	5	0.1	PASS

WSDOT VISSIM Throughput Volume Calibration Test

Model Results Confidence Test

Project: SR 9 & SR 204

Scenario: Existing Conditions - PM Peak Date: September 23, 2016

Criteria	Target Details	Segments	Segments Meeting Criteria	
GEH < 3.0	All state facility segments within the calibration area	17	17	
GEH < 3.0	All entry and exit locations within the calibration area	18	18	
GEH < 5.0	At least 85% of applicable local roadway segments	59	59	100%
Sum of all segment flows within the calibration area.	Within 5%	Model Volume Total	Field Volumes	% Difference
		42,955	42,541	-0.97%

Location Description						"Field" Volumes		Model Volumes		Calibration Test		
VISSIM Model Data Measurement	Route	Direction of Travel	Number of Lanes	Additional Description	Facility Type (State, Entry/Exit, Local)	Total Volume (VPH)	Vehicles per Lane (VPHPL)	Total Volume (VPH)	Vehicles per Lane (VPHPL)	GEH Target	GEH	Calibration Test
1	SR 204	EB	2	Before Market/Lundeen	State	2034	1017	2,036	1018	3	0.0	PASS
2	SR 204	WB	2	After Market/Lundeen	State	723	362	765	383	3	1.1	PASS
3	Market Pl	NB	1	Before SR 204	Local	217	217	223	223	5	0.4	PASS
4	Market PL	SB	1	After SR 204	Local	328	328	321	321	5	0.4	PASS
5	Lundeen PWY	SB	3	Before SR 204	Local	329	110	323	108	5	0.2	PASS
6	Lundeen PWY	NB	2	After SR 204	Local	606	303	591	295	5	0.4	PASS
7	SR 204	WB	2	Before Market/Lundeen	State	470	235	510	255	3	1.3	PASS
8	SR 204	EB	2	After Market/Lundeen	State	1393	697	1,415	707	3	0.4	PASS
9	SR 9	NB	3	Before Lundeen	State	2002	667	1,955	652	3	0.6	PASS
10	SR 9	SB	2	After Lundeen	State	1302	651	1,280	640	3	0.4	PASS
11	SR 9	SB	2	Before Lundeen	State	1108	554	1,107	553	3	0.0	PASS
12	SR 9	NB	2	After Lundeen	State	1785	893	1,745	873	3	0.7	PASS
13	Lundeen PWY	EB	1	Before SR 9	Local	304	304	301	301	5	0.2	PASS
14	Lundeen PWY	WB	1	After SR 9	Local	189	189	204	204	5	1.1	PASS
15	Lundeen PWY	WB	1	Before SR 9	Local	433	433	436	436	5	0.2	PASS
16	Lundeen PWY	EB	1	After SR 9	Local	571	571	570	570	5	0.0	PASS
17	Vernon Rd	WB	1	Vernon Off Ramp	Entry/Exit	119	119	138	138	3	1.6	PASS
18	SR 9	NB	2	Before SR 204	State	1149	575	1,147	573	3	0.0	PASS
19	SR 9	SB	2	After SR 204	State	779	390	768	384	3	0.3	PASS
20	SR 9	SB	2	Before SR 204	State	1183	592	1,130	565	3	1.1	PASS
21	SR 9	NB	2	After SR 204	State	2002	1001	1,951	975	3	0.8	PASS
22	SR 204	EB	3	Before SR 9	State	1627	542	1,626	542	3	0.0	PASS
23	SR 204	WB	2	After SR 9	State	612	306	662	331	3	1.4	PASS
24	Vernon Rd	WB	2	East of SR 9 & SR 204 Intersection	Local	433	217	464	232	5	1.0	PASS
25	7th Pl NE	EB	2	East of SR 9 & SR 204 Intersection	Local	999	500	986	493	5	0.3	PASS
26	SR 9	NB	2	Before Market Pl	State	834	417	828	414	3	0.1	PASS
27	SR 9	SB	2	After Market Pl	State	630	315	636	318	3	0.2	PASS
28	SR 9	NB	2	After Market Pl	State	980	490	979	489	3	0.0	PASS
29	Market PL NE	EB	1	Before SR 9	Local	541	541	547	547	5	0.2	PASS
30	Market PL NE	WB	1	After SR 9	Local	516	516	536	536	5	0.9	PASS
31	Market PL	WB	1	Before SR 9	Local	399	399	429	429	5	1.5	PASS
32	Market PL	EB	1	After SR 9	Local	427	427	439	439	5	0.6	PASS
33	91st Ave NE	NB	1	Before SR 204	Local	496	496	489	489	5	0.3	PASS
34	91st Ave NE	SB	1	After SR 204	Local	488	488	592	592	5	4.5	PASS
35	91st Ave NE	SB	1	Before SR 204	Local	344	344	407	407	5	3.3	PASS
36	91st Ave NE	NB	1	After SR 204	Local	260	260	263	263	5	0.2	PASS
37	92nd Ave NE	SB	1	South of SR 9 & SR 204 Intersection	Local	88	88	93	93	5	0.5	PASS
38	Vernon Rd	NB	1	North of SR 9 & SR 204 Intersection	Local	517	517	503	503	5	0.6	PASS
39	7th Pl NE	EB	2	Vehicles heading East from SR 9 & SR 204	Local	999	500	985	493	5	0.3	PASS
40	7th Pl NE	WB	1	Entering from the East	Local	152	152	152	152	5	0.0	PASS
41	7th Pl NE	EB	2	Exiting to the East	Local	546	273	541	271	5	0.2	PASS
42	91st Ave NE	NB	1	Before Vernon Rd	Local	169	169	172	172	5	0.3	PASS
43	91st Ave NE	SB	1	After Vernon Rd	Local	263	263	271	271	5	0.5	PASS
44	91st Ave NE	SB	1	Before Vernon Rd	Local	132	132	130	130	5	0.2	PASS
45	91st Ave NE	NB	1	After Vernon Rd	Local	162	162	161	161	5	0.1	PASS
46	Vernon Rd	EB	1	Before 91st Ave NE	Local	81	81	82	82	5	0.1	PASS
47	Vernon Rd	WB	1	After 91st Ave NE	Local	102	102	108	108	5	0.6	PASS
48	Vernon Rd	WB	1	Before 91st Ave NE	Local	170	170	184	184	5	1.0	PASS
49	Vernon Rd	EB	1	After 91st Ave NE	Local	25	25	28	28	5	0.6	PASS
50	Safeway Lot	NB	1	Before Davies	Entry/Exit	415	415	412	412	3	0.1	PASS
51	Safeway Lot	SB	1	After Davies	Entry/Exit	206	206	200	200	3	0.4	PASS
52	Les Schwab Lot	SB	1	Before Davies	Entry/Exit	91	91	91	91	3	0.0	PASS
53	Les Schwab Lot	NB	1	After Davies	Entry/Exit	102	102	109	109	3	0.7	PASS
54	N Davies Rd	EB	1	Before Shopping Center Driveway	Local	345	345	378	378	5	1.8	PASS
55	N Davies Rd	WB	1	After Shopping Center Driveway	Local	477	477	462	462	5	0.7	PASS
56	N Davies Rd	WB	1	Before Shopping Center Driveway	Entry/Exit	150	150	148	148	3	0.1	PASS
57	N Davies Rd	EB	1	After Shopping Center Driveway	Entry/Exit	209	209	225	225	3	1.1	PASS
58	92nd Ave NE	SB	1	Before SR 9 ramp	Local	129	129	136	136	5	0.6	PASS
59	92nd Ave NE	NB	1	After SR 9 Ramp	Local	32	32	33	33	5	0.2	PASS
60	SR 9 On Ramp	WB	1	Ramp onto SR 9	Entry/Exit	169	169	185	185	3	1.2	PASS
61	4th St NE	WB	1	East of ramp	Local	136	136	149	149	5	1.1	PASS
62	4th St NE	EB	1	East of ramp	Local	64	64	66	66	5	0.3	PASS
63	Transit Center	NB	2	Before 4th St NE	Local	22	11	28	14	5	0.8	PASS
64	Transit Center	SB	2	After 4th St NE	Local	35	18	37	18	5	0.2	PASS
65	94th Dr NE	SB	1	Before 4th St NE	Entry/Exit	157	157	172	172	3	1.2	PASS
66	94th Dr NE	NB	1	After 4th St NE	Entry/Exit	65	65	70	70	3	0.6	PASS
67	4th St NE	EB	1	Before Transit Driveway	Local	97	97	103	103	5	0.6	PASS
68	4th St NE	WB	1	After Transit Driveway	Local	100	100	110	110	5	1.0	PASS
69	4th St NE	WB	1	Before Transit Driveway	Local	131	131	141	141	5	0.9	PASS
70	4th St NE	EB	1	After Transit Driveway	Local	207	207	228	228	5	1.4	PASS
71	Transit Center	SB	1	Before Market Pl	Local	57	57	61	61	5	0.6	PASS
72	Transit Center	NB	1	After Market Pl	Local	16	16	30	30	5	2.9	PASS
73	Market Pl	WB	1	Before Transit Driveway	Local	355	355	388	388	5	1.7	PASS
74	Market Pl	EB	1	After Transit Driveway	Local	424	424	424	424	5	0.0	PASS
75	91st Ave NE	NB	1	Before Market	Entry/Exit	343	343	345	345	3	0.1	PASS
76	91st Ave NE	SB	1	After Market	Entry/Exit	400	400	425	425	3	1.2	PASS
77	91st Ave NE	SB	1	Before Market	Local	350	350	367	367	5	0.9	PASS
78	91st Ave NE	NB	1	After Market	Local	308	308	302	302	5	0.4	PASS
79	Market PL NE	EB	1	Before 91st Ave NE	Local	247	247	219	219	5	1.8	PASS
80	Market PL NE	WB	1	After 91st Ave NE	Local	196	196	206	206	5	0.7	PASS
81	Market PL NE	WB	1	Before 91st Ave NE	Local	369	369	389	389	5	1.0	PASS
82	Market PL NE	EB	1	After 91st Ave NE	Local	405	405	387	387	5	0.9	PASS
83	Lundeen Pwy	SB	2	Before Vernon Rd	Entry/Exit	294	147	295	148	3	0.0	PASS
84	Lundeen Pwy	NB	2	After Vernon Rd	Entry/Exit	558	279	546	273	3	0.4	PASS
85	Vernon Rd	EB	1	Before Lundeen	Entry/Exit	43	43	40	40	3	0.4	PASS
86	Vernon Rd	WB	1	After Lundeen	Entry/Exit	41	41	48	48	3	1.0	PASS
87	Vernon Rd	WB	1	Before Lundeen	Local	105	105	119	119	5	1.3	PASS
88	Vernon Rd	EB	1	After Lundeen	Local	120	120	127	127	5	0.6	PASS
89	Vernon Rd	NB	1	Before Davies	Local	517	517	489	489	5	1.3	PASS
90	Vernon Rd	SB	1	After Davies	Local	346	346	338	338	5	0.5	PASS
91	Vernon Rd	SB	1	Before Davies	Entry/Exit	301	301	314	314	3	0.8	PASS
92	Vernon Rd	NB	1	After Davies	Entry/Exit	519	519	520	520	3	0.0	PASS
93	N Davies Rd	WB	1	East of Roundabout	Local	502	502	497	497	5	0.2	PASS
94	N Davies Rd	EB	1	East of Roundabout	Local	368	368	386	386	5	0.9	PASS

ATTACHMENT C - Vissim Model Traffic Operations Results

Vissim Post-Processor
Average Results from 11 Runs
Intersection Volume and Delay

SR 9 & SR 204 Intersection Improvements
Existing Conditions
AM Peak Hour

	Intersection	Control	Demand Volume (vph)	Served Volume (vph) Average	Percent Served	Standard Deviation	Minimum	Maximum	GEH Statistic	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	2,474	2,488	100.6%	27	2,443	2,532	0.3	20.1	2.8	16.4	26.5	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	2,185	2,195	100.5%	26	2,154	2,238	0.2	1.5	0.7	0.2	2.7	A	SB RT
3	SR 9/SR 204	Signal	2,648	2,654	100.2%	29	2,616	2,704	0.1	27.0	1.5	24.5	29.2	C	
4	SR 9/Market Pl	Signal	1,793	1,813	101.1%	24	1,769	1,854	0.5	21.3	1.8	18.3	25.4	C	
5	91st Ave/SR 204	Signal	1,246	1,283	103.0%	35	1,246	1,362	1.1	20.8	2.7	14.7	24.6	C	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	1,299	1,327	102.2%	29	1,284	1,368	0.8	11.7	1.3	9.4	14.1	B	
7	Vernon Rd/7th Pl	Side-street Stop	363	351	96.7%	16	334	376	0.6	7.4	0.7	6.5	8.8	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	234	237	101.2%	13	217	260	0.2	6.0	1.0	5.3	8.5	A	EB RT
9	Safeway Dwy/Davies Rd	Roundabout	275	262	95.3%	11	238	282	0.8	1.0	0.1	0.9	1.3	A	
10	SR 9/4th St On-Ramp	Side-street Stop	207	225	108.8%	12	208	246	1.2	2.2	0.8	1.0	3.9	A	SB RT
11	Transit Center Dwy/4th St	Side-street Stop	157	166	105.7%	10	152	182	0.7	6.8	0.9	5.9	8.9	A	SB LT
12	Transit Center Dwy/Market Pl	Side-street Stop	279	298	107.0%	14	273	323	1.1	5.5	0.7	4.9	7.2	A	SB RT
13	91st Ave/Market Pl	Signal	583	580	99.5%	18	548	609	0.1	5.9	0.6	4.9	7.1	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	478	479	100.2%	14	464	505	0.0	7.8	1.1	6.1	10.1	A	EB RT
15	Vernon Rd/Davies Rd	Roundabout	484	464	95.8%	19	429	491	0.9	1.6	0.2	1.2	2.0	A	

Network Summary	
Total Demand Volume (veh/hr)	14,705
Total Volume Served (veh/hr)	14,825
Percent Served	100.8%
GEH Statistic	1.0

Note: For Side-street Stop and Uncontrolled intersections, the highest delay by movement is reported. The movement with the highest delay is reported as the worst movement.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
Existing Conditions
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS
1	SR 9/Lundeen Pkwy	Signal	14.2	B	15.7	B	41.4	D	33.0	C	20.1	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.6	A	1.3	A					1.0	A
3	SR 9/SR 204	Signal	22.1	C	18.8	B	52.2	D	30.0	C	27.0	C
4	SR 9/Market Pl	Signal	15.8	B	19.8	B	27.8	C	33.4	C	21.3	C
5	91st Ave/SR 204	Signal	15.4	B	22.5	C	24.2	C	18.6	B	20.8	C
6	Lundeen Pkwy/Market Pl/SR 204	Signal	16.8	B	12.3	B	8.3	A	13.7	B	11.7	B
7	Vernon Rd/7th Pl	Side-street Stop					0.3	A	7.4	A	1.1	A
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.3	A	5.7	A	3.0	A	2.1	A
9	Safeway Dwy/Davies Rd	Roundabout	1.4	A	1.2	A	0.8	A	1.0	A	1.0	A
10	SR 9/4th St On-Ramp	Side-street Stop			1.8	A			0.5	A	1.1	A
11	Transit Center Dwy/4th St	Side-street Stop	0.5	A	6.6	A	0.5	A	0.3	A	1.8	A
12	Transit Center Dwy/Market Pl	Side-street Stop			5.0	A	0.8	A	0.5	A	0.9	A
13	91st Ave/Market Pl	Signal	7.2	A	6.9	A	2.2	A	6.2	A	5.9	A
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.4	A	1.7	A	7.6	A	6.1	A	2.8	A
15	Vernon Rd/Davies Rd	Roundabout	1.0	A	2.1	A			1.5	A	1.6	A

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **AM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	5	2	36.4%	1.8	0	6	1.7	3.0	4.0	0.0	9.9	A
	Through	674	680	100.9%	13.0	667	704	0.2	16.9	4.7	11.3	26.3	B
	Right Turn	246	253	102.8%	17.9	213	272	0.4	7.1	0.9	5.6	8.7	A
	Second Right		0										
	Subtotal	925	935	101.1%	19.1	901	960	0.3	14.2	3.7	10.1	21.2	B
SB	U Turn		0										
	Second Left		0										
	Left Turn	6	7	110.6%	3.3	2	12	0.3	22.1	20.1	0.0	46.9	C
	Through	867	863	99.6%	16.1	831	896	0.1	16.4	2.1	13.2	19.8	B
	Right Turn	47	49	103.7%	6.6	41	61	0.2	4.0	0.8	3.0	5.5	A
	Second Right		0										
	Subtotal	920	919	99.9%	13.6	895	942	0.0	15.7	1.9	13.0	19.2	B
EB	U Turn		0										
	Second Left		0										
	Left Turn	50	48	95.8%	5.0	38	56	0.3	43.9	7.7	31.3	57.2	D
	Through	65	67	102.8%	6.5	58	76	0.2	42.4	11.8	30.7	70.0	D
	Right Turn	6	4	74.2%	2.3	1	8	0.7	8.6	6.2	0.0	18.9	A
	Second Right		0										
	Subtotal	121	119	98.5%	6.7	111	131	0.2	41.4	7.5	31.4	54.9	D
WB	U Turn		0										
	Second Left		0										
	Left Turn	387	391	100.9%	12.6	371	410	0.2	37.2	4.1	32.7	47.4	D
	Through	83	84	100.9%	11.1	62	98	0.1	29.1	10.9	15.2	51.3	C
	Right Turn	38	41	108.6%	7.0	26	51	0.5	6.3	1.7	4.1	9.4	A
	Second Right		0										
	Subtotal	508	516	101.5%	8.4	504	532	0.3	33.0	3.9	28.5	42.8	C
Total		2,474	2,488	100.6%	26.7	2,443	2,532	0.3	20.1	2.8	16.4	26.5	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	925	938	101.4%	20.0	906	965	0.4	0.6	0.1	0.6	0.8	A
	Right Turn		0										
	Second Right		0										
	Subtotal	925	938	101.4%	20.0	906	965	0.4	0.6	0.1	0.6	0.8	A
SB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	1,203	1,199	99.7%	18.5	1,164	1,226	0.1	1.3	0.2	1.0	1.9	A
	Right Turn	57	58	101.6%	7.6	40	68	0.1	1.5	0.7	0.2	2.7	A
	Second Right		0										
	Subtotal	1,260	1,257	99.7%	15.6	1,232	1,278	0.1	1.3	0.3	1.1	2.0	A
EB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
Total		2,185	2,195	100.5%	26.1	2,154	2,238	0.2	1.0	0.2	0.8	1.4	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **AM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	51	55	108.4%	4.8	48	66	0.6	41.1	6.7	29.8	50.6	D
	Through	550	569	103.5%	20.4	537	611	0.8	23.5	2.1	20.0	25.8	C
	Right Turn	127	122	96.1%	6.1	113	134	0.4	6.3	0.8	4.9	7.4	A
	Second Right		0										
	Subtotal	728	746	102.5%	22.0	721	790	0.7	22.1	1.7	18.8	23.8	C
SB	U Turn		0										
	Second Left		0										
	Left Turn	100	99	99.0%	10.4	83	119	0.1	41.9	6.9	32.2	51.9	D
	Through	747	737	98.7%	18.1	702	755	0.4	23.7	4.3	17.3	31.4	C
	Right Turn	356	363	102.0%	26.1	327	414	0.4	2.8	0.4	2.2	3.4	A
	Second Right		0										
	Subtotal	1,203	1,199	99.7%	19.3	1,170	1,231	0.1	18.8	1.9	16.1	21.8	B
EB	U Turn		0										
	Second Left		0										
	Left Turn	308	300	97.5%	8.2	283	312	0.4	54.5	6.0	45.9	68.9	D
	Through	107	102	95.3%	9.9	87	118	0.5	49.7	4.6	40.8	56.6	D
	Right Turn	32	32	100.0%	6.1	23	44	0.0	33.1	4.9	23.8	40.2	C
	Second Right		0										
	Subtotal	447	434	97.1%	9.5	421	445	0.6	52.2	4.9	45.9	63.7	D
WB	U Turn		0										
	Second Left		0										
	Left Turn	90	95	105.4%	7.9	84	108	0.5	39.4	6.8	24.4	46.9	D
	Through	113	113	99.9%	8.4	103	122	0.0	36.8	5.3	25.8	45.6	D
	Right Turn	67	67	100.0%	7.3	57	82	0.0	7.2	2.2	4.7	11.0	A
	Second Right		0										
	Subtotal	270	275	101.8%	14.4	246	299	0.3	30.0	3.6	20.4	35.2	C
Total		2,648	2,654	100.2%	29.4	2,616	2,704	0.1	27.0	1.5	24.5	29.2	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **AM Peak Hour**

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	24	24	99.2%	5.3	16	34	0.0	41.6	9.7	24.2	55.4	D
	Through	451	448	99.3%	10.7	433	469	0.2	15.0	2.8	10.0	20.1	B
	Right Turn	17	21	124.6%	5.1	14	28	1.0	2.7	0.7	1.3	3.6	A
	Second Right		0										
	Subtotal	492	493	100.2%	7.8	478	504	0.0	15.8	2.7	12.0	21.3	B
SB	U Turn		0										
	Second Left		0										
	Left Turn	22	21	94.6%	3.3	17	27	0.3	61.3	15.8	32.2	79.7	E
	Through	693	689	99.4%	22.2	649	728	0.2	20.7	3.3	16.9	27.6	C
	Right Turn	154	153	99.3%	10.4	139	176	0.1	11.1	3.4	7.0	15.4	B
	Second Right		0										
	Subtotal	869	863	99.3%	16.8	832	885	0.2	19.8	3.4	15.2	26.8	B
EB	U Turn		0										
	Second Left		0										
	Left Turn	91	96	105.1%	9.2	83	112	0.5	27.8	5.3	22.5	38.0	C
	Through	59	58	98.8%	8.1	50	80	0.1	35.3	6.5	24.2	49.1	D
	Right Turn	106	111	104.5%	8.6	98	129	0.5	23.2	6.7	12.8	35.7	C
	Second Right		0										
	Subtotal	256	265	103.4%	6.2	251	272	0.5	27.8	4.6	22.2	36.0	C
WB	U Turn		0										
	Second Left		0										
	Left Turn	60	69	114.7%	5.8	60	80	1.1	23.9	4.4	15.7	31.8	C
	Through	99	106	106.7%	5.9	96	118	0.7	40.3	5.0	34.3	48.9	D
	Right Turn	17	19	110.2%	4.1	10	25	0.4	26.1	11.4	14.1	44.0	C
	Second Right		0										
	Subtotal	176	193	109.8%	7.8	182	204	1.3	33.4	3.3	29.7	39.2	C
Total		1,793	1,813	101.1%	23.7	1,769	1,854	0.5	21.3	1.8	18.3	25.4	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	12	10	81.1%	1.7	7	12	0.7	47.3	20.7	7.1	83.0	D
	Through	48	51	105.5%	6.7	41	58	0.4	20.2	6.2	7.8	29.4	C
	Right Turn	85	84	98.8%	7.3	72	93	0.1	8.9	2.3	5.8	14.2	A
	Second Right		0										
	Subtotal	145	144	99.6%	9.2	128	159	0.1	15.4	3.7	8.2	20.5	B
SB	U Turn		0										
	Second Left		0										
	Left Turn	89	75	83.8%	8.5	60	84	1.6	34.4	4.7	28.1	43.7	C
	Through	105	139	131.9%	11.9	112	154	3.0	19.2	3.2	14.8	25.2	B
	Right Turn	58	62	106.6%	7.1	54	77	0.5	16.1	4.9	7.2	26.9	B
	Second Right		0										
	Subtotal	252	275	109.1%	11.8	252	297	1.4	22.5	2.3	19.2	27.4	C
EB	U Turn		0										
	Second Left		0										
	Left Turn	18	17	92.4%	3.4	12	24	0.3	36.9	10.3	17.3	51.0	D
	Through	273	274	100.4%	8.8	266	290	0.1	25.2	4.6	16.0	32.7	C
	Right Turn	38	41	106.9%	7.3	29	49	0.4	11.7	2.6	6.4	15.2	B
	Second Right		0										
	Subtotal	329	331	100.7%	8.1	320	345	0.1	24.2	4.3	15.1	30.7	C
WB	U Turn		0										
	Second Left		0										
	Left Turn	67	66	99.2%	8.1	55	83	0.1	35.5	9.5	26.1	52.5	D
	Through	420	440	104.8%	27.8	398	505	1.0	16.5	2.8	11.3	21.1	B
	Right Turn	33	26	79.1%	4.0	21	33	1.3	16.3	6.0	10.0	30.2	B
	Second Right		0										
	Subtotal	520	533	102.5%	27.4	499	595	0.6	18.6	3.0	12.7	23.8	B
Total		1,246	1,283	103.0%	35.1	1,246	1,362	1.1	20.8	2.7	14.7	24.6	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	50	55	110.5%	5.9	48	67	0.7	18.9	4.5	13.7	28.7	B
	Through	48	47	97.9%	7.4	33	58	0.1	14.9	3.5	8.4	20.7	B
	Right Turn	3	2	60.6%	1.8	0	6	0.8	2.5	4.2	0.0	13.0	A
	Second Right		0										
	Subtotal	101	104	103.1%	10.2	88	125	0.3	16.8	2.4	12.4	20.6	B
SB	U Turn		0										
	Second Left		0										
	Left Turn	15	11	70.3%	2.8	5	15	1.2	19.3	9.5	4.8	37.5	B
	Through	94	99	105.6%	4.0	90	106	0.5	17.9	2.2	13.4	20.8	B
	Right Turn	216	216	100.0%	8.0	202	225	0.0	9.8	1.7	7.1	13.8	A
	Second Right		0										
	Subtotal	325	326	100.3%	8.8	309	338	0.0	12.3	1.6	10.0	15.5	B
EB	U Turn		0										
	Second Left		0										
	Left Turn	50	48	96.5%	6.0	40	59	0.2	21.8	5.2	12.8	28.4	C
	Through	311	318	102.3%	8.3	308	333	0.4	6.6	2.0	4.4	10.8	A
	Right Turn	22	19	88.4%	2.3	15	23	0.6	4.5	2.1	0.8	9.3	A
	Second Right		0										
	Subtotal	383	386	100.8%	8.2	375	405	0.2	8.3	2.1	5.0	12.7	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	3	2	69.7%	1.0	1	4	0.6	15.3	24.9	0.0	74.1	B
	Through	479	502	104.7%	30.4	456	565	1.0	13.8	2.2	9.9	18.0	B
	Right Turn	8	8	94.3%	2.2	4	12	0.2	7.6	9.2	0.0	27.7	A
	Second Right		0										
	Subtotal	490	511	104.3%	30.7	469	576	1.0	13.7	2.1	9.7	17.7	B
Total		1,299	1,327	102.2%	28.9	1,284	1,368	0.8	11.7	1.3	9.4	14.1	B

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
SB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
EB	U Turn		0										
	Second Left		0										
	Left Turn	127	113	89.0%	6.6	100	123	1.3	0.8	0.2	0.6	1.1	A
	Through	166	169	101.5%	7.7	156	182	0.2	0.1	0.0	0.1	0.2	A
	Right Turn	41	41	100.2%	6.4	28	51	0.0	0.0	0.0	0.0	0.1	A
	Second Right		0										
	Subtotal	334	323	96.6%	13.4	308	344	0.6	0.3	0.1	0.3	0.4	A
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn	29	29	98.4%	3.4	24	37	0.1	7.4	0.7	6.5	8.8	A
	Second Right		0										
	Subtotal	29	29	98.4%	3.4	24	37	0.1	7.4	0.7	6.5	8.8	A
Total		363	351	96.7%	15.7	334	376	0.6	1.1	0.1	0.9	1.2	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **AM Peak Hour**

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	19	17	90.4%	3.1	12	24	0.4	0.8	0.6	0.4	2.6	A
	Through	24	24	98.1%	4.7	17	33	0.1	0.3	0.2	0.1	0.7	A
	Right Turn	5	8	154.5%	3.3	3	13	1.1	0.7	0.3	0.5	1.5	A
	Second Right		0										
	Subtotal	48	48	100.9%	4.7	45	60	0.1	0.6	0.2	0.3	0.9	A
SB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	75	73	96.8%	4.7	64	79	0.3	0.2	0.2	0.1	0.5	A
	Right Turn	5	5	109.1%	1.6	3	9	0.2	0.6	0.3	0.0	1.1	A
	Second Right		0										
	Subtotal	80	78	97.6%	4.2	70	84	0.2	0.3	0.2	0.1	0.6	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	3	4	130.3%	1.8	1	6	0.5	2.3	3.3	0.0	7.1	A
	Through	2	3	127.3%	1.6	1	6	0.4	4.4	4.6	0.0	11.2	A
	Right Turn	33	33	100.8%	6.0	24	41	0.0	6.0	1.0	5.3	8.5	A
	Second Right		0										
	Subtotal	38	40	104.5%	6.1	31	50	0.3	5.7	1.1	4.7	8.4	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	26	27	102.8%	1.6	23	29	0.1	1.4	0.8	0.6	2.7	A
	Through	18	18	98.0%	4.3	10	24	0.1	2.9	1.8	0.3	6.0	A
	Right Turn	24	26	109.1%	4.2	20	34	0.4	4.8	0.3	4.5	5.6	A
	Second Right		0										
	Subtotal	68	71	103.7%	6.1	59	77	0.3	3.0	0.6	1.9	3.8	A
Total		234	237	101.2%	13.2	217	260	0.2	2.1	0.3	1.5	2.6	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **AM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	41	37	89.1%	3.3	32	41	0.7	1.7	0.6	1.0	2.7	A
	Through	7	7	102.6%	1.5	5	10	0.1	1.0	0.6	0.4	2.3	A
	Right Turn	9	11	123.2%	2.8	8	17	0.7	0.8	0.6	0.0	1.9	A
	Second Right		0										
	Subtotal	57	55	96.2%	2.5	50	58	0.3	1.4	0.3	1.0	1.9	A
SB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	6	6	106.1%	3.0	2	12	0.1	1.3	1.2	0.0	3.8	A
	Right Turn	26	24	93.4%	4.1	17	31	0.3	1.1	0.3	0.8	1.7	A
	Second Right		0										
	Subtotal	32	31	95.7%	2.0	28	35	0.2	1.2	0.4	0.7	2.0	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	25	26	103.6%	2.9	21	30	0.2	0.6	0.2	0.3	0.9	A
	Through	40	40	99.3%	6.8	30	51	0.0	0.9	0.3	0.5	1.4	A
	Right Turn	51	46	90.0%	6.8	38	59	0.7	0.8	0.4	0.5	1.6	A
	Second Right		0										
	Subtotal	116	112	96.2%	9.0	94	127	0.4	0.8	0.1	0.5	1.0	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	16	15	93.8%	4.7	9	23	0.3	1.1	1.1	0.2	3.4	A
	Through	54	50	92.9%	4.3	44	58	0.5	0.9	0.4	0.4	1.5	A
	Right Turn		0										
	Second Right		0										
	Subtotal	70	65	93.1%	4.6	57	72	0.6	1.0	0.5	0.5	1.8	A
Total		275	262	95.3%	10.8	238	282	0.8	1.0	0.1	0.9	1.3	A

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
SB	U Turn		0										
	Second Left		0										
	Left Turn	32	34	106.3%	4.5	25	40	0.3	0.8	0.5	0.2	1.9	A
	Through		0										
	Right Turn	67	73	109.5%	4.6	68	81	0.8	2.2	0.8	1.0	3.9	A
	Second Right		0										
	Subtotal	99	107	108.4%	8.2	93	119	0.8	1.8	0.5	0.9	2.9	A
EB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	102	111	108.9%	6.6	101	124	0.9	0.5	0.0	0.4	0.6	A
	Right Turn	6	7	113.6%	2.0	2	9	0.3	0.1	0.1	0.0	0.4	A
	Second Right		0										
	Subtotal	108	118	109.2%	6.7	107	130	0.9	0.5	0.0	0.4	0.5	A
Total		207	225	108.8%	11.5	208	246	1.2	1.1	0.3	0.6	1.7	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **AM Peak Hour**

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	3	1	27.3%	0.9	0	2	1.6	0.5	1.6	0.0	5.3	A
	Right Turn		0										
	Second Right		0										
	Subtotal	3	1	27.3%	0.9	0	2	1.6	0.5	1.6	0.0	5.3	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	15	19	123.6%	3.1	13	22	0.9	6.8	0.9	5.9	8.9	A
	Through	14	14	100.6%	3.6	7	20	0.0	6.5	0.7	5.7	8.2	A
	Right Turn	7	6	92.2%	2.6	2	10	0.2	5.8	1.0	4.6	8.1	A
	Second Right		0										
	Subtotal	36	39	108.6%	4.2	35	47	0.5	6.6	0.5	5.9	7.3	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	2	2	90.9%	1.3	0	4	0.1	0.9	1.5	0.0	5.4	A
	Through	29	32	109.4%	4.3	24	37	0.5	0.4	0.4	0.0	1.5	A
	Right Turn	9	8	85.9%	2.9	3	12	0.4	0.4	0.4	0.0	1.4	A
	Second Right		0										
	Subtotal	40	41	103.2%	3.8	36	50	0.2	0.5	0.5	0.0	1.5	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	2	1	50.0%	0.8	0	2	0.8	0.0	0.0	0.0	0.0	A
	Through	56	59	106.0%	6.2	49	70	0.4	0.1	0.2	0.0	0.5	A
	Right Turn	20	24	122.3%	3.8	18	31	0.9	0.5	0.2	0.4	0.9	A
	Second Right		0										
	Subtotal	78	85	108.7%	6.6	74	97	0.8	0.3	0.1	0.1	0.5	A
Total		157	166	105.7%	10.5	152	182	0.7	1.8	0.2	1.5	2.0	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
SB	U Turn		0										
	Second Left		0										
	Left Turn	2	0	13.6%	0.5	0	1	1.6	0.0	0.0	0.0	0.0	A
	Through		0										
	Right Turn	22	21	94.6%	4.2	12	28	0.3	5.5	0.7	4.9	7.2	A
	Second Right		0										
	Subtotal	24	21	87.9%	4.2	12	28	0.6	5.0	0.7	4.3	6.7	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	6	14	230.3%	3.1	9	20	2.5	2.6	1.5	0.7	5.9	A
	Through	92	86	93.8%	10.3	71	108	0.6	0.3	0.2	0.1	0.8	A
	Right Turn		0										
	Second Right		0										
	Subtotal	98	100	102.1%	10.9	83	125	0.2	0.8	0.4	0.4	1.6	A
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	154	173	112.4%	7.6	162	185	1.5	0.5	0.2	0.3	0.9	A
	Right Turn	3	4	139.4%	2.9	2	10	0.6	0.5	0.3	0.2	0.8	A
	Second Right		0										
	Subtotal	157	177	112.9%	6.1	166	187	1.6	0.5	0.2	0.4	0.9	A
Total		279	298	107.0%	13.7	273	323	1.1	0.9	0.2	0.6	1.4	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **AM Peak Hour**

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	17	19	109.6%	3.6	13	27	0.4	5.4	2.4	0.5	8.9	A
	Through	74	66	89.7%	9.5	53	77	0.9	7.4	1.1	5.8	9.9	A
	Right Turn	62	72	115.4%	6.6	63	87	1.2	7.3	1.4	5.2	10.0	A
	Second Right		0										
	Subtotal	153	157	102.3%	6.0	149	166	0.3	7.2	1.1	5.6	8.8	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	45	48	107.7%	2.8	44	53	0.5	7.4	3.0	4.3	15.6	A
	Through	56	60	107.8%	7.7	49	73	0.6	6.4	1.7	4.1	9.4	A
	Right Turn		0										
	Second Right		0										
	Subtotal	101	109	107.7%	8.0	96	120	0.8	6.9	1.4	4.7	9.6	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	2	1	68.2%	1.3	0	4	0.5	0.9	2.2	0.0	7.5	A
	Through	88	56	63.7%	6.2	49	70	3.8	1.1	0.7	0.2	2.3	A
	Right Turn	44	53	120.5%	6.1	41	60	1.3	3.3	0.8	2.2	4.2	A
	Second Right		0										
	Subtotal	134	110	82.4%	6.1	101	118	2.1	2.2	0.4	1.5	2.7	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	117	124	105.6%	8.5	108	135	0.6	6.7	1.0	5.5	8.2	A
	Through	45	46	102.6%	6.7	38	55	0.2	5.9	2.3	2.3	9.1	A
	Right Turn	33	35	105.2%	3.3	30	40	0.3	4.3	1.3	2.0	6.1	A
	Second Right		0										
	Subtotal	195	204	104.8%	10.0	187	218	0.7	6.2	0.9	4.6	7.5	A
Total		583	580	99.5%	18.0	548	609	0.1	5.9	0.6	4.9	7.1	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **AM Peak Hour**

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	9	9	94.9%	2.3	5	13	0.2	1.5	1.7	0.0	5.3	A
	Through	81	80	98.8%	7.6	70	91	0.1	0.2	0.2	0.0	0.8	A
	Right Turn	16	14	87.5%	3.8	7	20	0.5	0.8	0.2	0.5	1.1	A
	Second Right		0										
	Subtotal	106	103	96.7%	10.0	86	114	0.3	0.4	0.3	0.2	1.4	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	7	7	101.3%	2.1	4	10	0.0	1.4	1.0	0.6	4.0	A
	Through	225	222	98.8%	6.8	210	234	0.2	1.7	0.8	1.1	3.9	A
	Right Turn	6	8	134.8%	2.6	4	12	0.8	2.2	3.0	0.5	11.2	A
	Second Right		0										
	Subtotal	238	237	99.8%	7.0	225	250	0.0	1.7	0.8	1.1	3.9	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	14	14	102.6%	3.6	9	20	0.1	7.4	2.2	6.0	13.8	A
	Through	8	8	95.5%	2.9	1	11	0.1	7.1	4.1	0.0	12.5	A
	Right Turn	59	57	95.8%	3.3	52	61	0.3	7.8	1.1	6.1	10.1	A
	Second Right		0										
	Subtotal	81	79	97.0%	4.3	74	87	0.3	7.6	1.0	6.1	10.0	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	41	47	114.6%	3.0	43	51	0.9	7.7	1.2	6.4	10.2	A
	Through	1	1	63.6%	0.9	0	3	0.4	0.0	0.0	0.0	0.0	A
	Right Turn	11	13	114.9%	4.8	6	23	0.5	1.0	0.9	0.4	3.2	A
	Second Right		0										
	Subtotal	53	60	113.7%	4.5	51	68	1.0	6.1	1.4	4.4	9.1	A
Total		478	479	100.2%	13.5	464	505	0.0	2.8	0.5	2.3	4.2	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **AM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn	32	24	75.9%	3.7	20	32	1.5	0.8	0.4	0.3	1.4	A
	Second Left		0										
	Left Turn		0										
	Through	55	48	88.1%	4.9	39	57	0.9	1.2	0.5	0.5	2.0	A
	Right Turn	69	62	90.0%	7.1	49	72	0.9	1.0	0.5	0.6	2.0	A
	Second Right		0										
	Subtotal	156	135	86.4%	9.5	121	149	1.8	1.0	0.3	0.7	1.6	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	63	71	113.4%	7.2	57	83	1.0	2.0	0.6	0.9	3.0	A
	Through	104	106	101.7%	6.0	94	117	0.2	2.2	0.7	1.2	3.9	A
	Right Turn		0										
	Second Right		0										
	Subtotal	167	177	106.2%	11.2	160	192	0.8	2.1	0.5	1.4	3.0	A
EB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
WB	U Turn		0										
	Second Left		0										
	Left Turn	134	121	90.6%	7.6	111	135	1.1	1.6	0.4	1.2	2.4	A
	Through		0										
	Right Turn	27	30	111.4%	5.8	23	43	0.6	1.2	0.7	0.4	2.5	A
	Second Right		0										
	Subtotal	161	152	94.1%	7.2	140	161	0.8	1.5	0.3	1.1	2.1	A
Total		484	464	95.8%	18.5	429	491	0.9	1.6	0.2	1.2	2.0	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal** **Location** 1

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	150	0	0	0	0	0	0	0	0	NO	25	#DIV/0!
	Through	2,000	26	4	21	34	204	17	183	232	NO	275	135%
	Right Turn												
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	300	2	1	1	3	26	7	14	37	NO	50	191%
	Through	3,700	35	2	32	38	241	18	211	270	NO	450	187%
	Right Turn												
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	350	9	1	6	10	51	5	45	64	NO	75	147%
	Through	2,000	14	2	9	19	83	19	58	125	NO	75	90%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	350	44	3	40	48	174	21	139	208	NO	175	100%
	Through	2,000	11	1	8	13	70	12	56	91	NO	100	143%
	Right Turn	80	0	0	0	1	26	3	22	32	NO		
	Second Right												

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
AM Peak Hour

Location

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled** **2**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
AM Peak Hour

Intersection 3 **SR 9/SR 204**

Signal **Location** 3

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	160	11	1	9	13	76	12	62	102	NO	125	164%
	Through	2,000	34	4	28	39	216	27	177	254	NO	250	116%
	Right Turn	160	1	0	1	2	54	8	46	72	NO	100	186%
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	350	21	3	15	26	119	13	104	138	NO	175	147%
	Through	2,000	43	4	38	49	237	20	208	272	NO	300	127%
	Right Turn												
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	400	36	2	31	40	172	17	144	195	NO	225	131%
	Through	400	36	2	31	40	172	17	144	195	NO	150	87%
	Right Turn	100	25	2	23	28	166	19	142	193	MAX		
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	300	19	3	15	26	109	20	87	153	NO	175	160%
	Through	300	23	2	20	27	145	19	120	180	NO	100	69%
	Right Turn	75	6	2	4	11	129	16	103	152	MAX	75	58%
	Second Right												

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Intersection 4 **SR 9/Market Pl** **Signal** **Location** 4

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	300	5	2	3	8	49	8	39	63	NO	100	205%
	Through	2,000	31	5	25	42	272	35	211	332	NO	225	83%
	Right Turn	400	0	0	0	0	16	5	10	24	NO	50	310%
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	245	5	1	4	7	51	5	44	59	NO	50	99%
	Through	2,000	74	11	51	94	530	50	454	626	NO	100	19%
	Right Turn	300	3	1	2	4	79	7	65	89	NO	25	32%
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	90	12	2	9	15	95	12	75	111	MAX	50	53%
	Through	600	18	3	13	25	143	20	109	173	NO	225	158%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	250	7	1	6	9	62	8	52	80	NO	50	81%
	Through	1,000	19	3	15	24	132	9	119	143	NO	75	57%
	Right Turn	600	15	3	12	20	131	9	118	142	NO		
	Second Right												

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
AM Peak Hour

Intersection 5 **91st Ave/SR 204**

Signal **Location** **5**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	150	2	1	1	3	23	3	17	27	NO	50	214%
	Through	2,000	7	2	4	10	78	17	52	113	NO	75	97%
	Right Turn												
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	200	11	2	9	13	80	14	64	106	NO	100	124%
	Through	800	16	3	13	22	125	17	105	158	NO	125	100%
	Right Turn												
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	400	3	1	2	4	30	5	22	36	NO	75	250%
	Through	1,250	9	1	7	12	77	12	67	102	NO	125	162%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	160	10	2	8	16	81	12	65	103	NO	125	155%
	Through	350	21	3	18	26	141	21	109	175	NO	175	124%
	Right Turn	300	21	3	18	28	149	21	117	183	NO		
	Second Right												

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal** **Location 6**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	200	3	1	2	5	54	9	39	76	NO	125	233%
	Through	1,500	3	1	1	4	56	10	38	68	NO	75	133%
	Right Turn												
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	100	10	1	8	12	92	12	82	121	NO	50	55%
	Through	100	10	1	8	12	92	12	82	121	NO	200	218%
	Right Turn	100	11	1	9	12	94	12	84	124	NO	175	186%
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	325	3	1	2	4	36	5	30	44	NO	75	210%
	Through	2,000	5	1	4	6	72	8	62	87	NO	175	244%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	200	0	0	0	0	12	5	5	23	NO	25	214%
	Through	1,250	12	1	10	14	147	23	118	189	NO	225	154%
	Right Turn												
	Second Right												

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop** **7**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	2	0	1	2	104	15	87	133	MAX
	Through	25	2	0	1	2	104	15	87	133	MAX
	Right Turn	25	2	0	1	2	104	15	87	133	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop** **8**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	4	4	0	8	NO
	Through	350	0	0	0	0	1	4	0	12	NO
	Right Turn	350	0	0	0	0	1	4	0	12	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	0	8	8	0	15	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	34	7	21	46	NO
	Through	400	0	0	0	1	57	11	34	72	NO
	Right Turn	400	1	0	1	1	32	5	27	45	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	43	10	28	61	NO
	Through	400	0	0	0	0	43	10	28	62	NO
	Right Turn	400	1	0	1	1	57	5	50	66	NO
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout** **9**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop** **10**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop** **11**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	39	3	33	46	NO
	Through										
	Right Turn	400	1	0	1	1	40	3	34	47	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
AM Peak Hour

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Location 12

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	1	27	2	25	32	NO
	Through										
	Right Turn	400	0	0	0	1	26	2	24	32	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	0	0	0	0	18	5	11	26	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 13 **91st Ave/Market Pl** **Signal** **13**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	0	0	0	1	25	5	17	35	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	1	0	1	1	47	4	41	53	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	0	0	0	0	3	4	0	11	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	2	1	1	3	62	11	50	80	NO

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop** **14**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **AM Peak Hour**

Location

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout** **15**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
Existing Conditions
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS
1	SR 9/Lundeen Pkwy	Signal	20.2	C	14.1	B	52.1	D	46.9	D	23.9	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.1	A	1.4	A					1.2	A
3	SR 9/SR 204	Signal	44.8	D	31.3	C	74.0	E	72.4	E	55.9	E
4	SR 9/Market Pl	Signal	43.2	D	41.2	D	90.7	F	99.7	F	62.4	E
5	91st Ave/SR 204	Signal	69.4	E	60.6	E	80.2	F	42.1	D	67.2	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	28.0	C	15.7	B	34.7	C	34.0	C	32.3	C
7	Vernon Rd/7th Pl	Side-street Stop					0.6	A	11.5	B	2.2	A
8	91st Ave/Vernon Rd	Side-street Stop	1.1	A	7.7	A	15.4	C	7.8	A	6.9	A
9	Safeway Dwy/Davies Rd	Roundabout	6.9	A	4.7	A	2.1	A	4.6	A	4.7	A
10	SR 9/4th St On-Ramp	Side-street Stop			1.3	A			0.4	A	0.8	A
11	Transit Center Dwy/4th St	Side-street Stop	4.5	A	9.2	A	0.6	A	0.4	A	4.2	A
12	Transit Center Dwy/Market Pl	Side-street Stop			27.8	D	2.8	A	36.1	E	18.7	C
13	91st Ave/Market Pl	Signal	31.3	C	19.4	B	7.5	A	17.0	B	19.2	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.8	A	1.6	A	10.8	B	5.5	A	2.6	A
15	Vernon Rd/Davies Rd	Roundabout	5.0	A	4.9	A			9.2	A	6.6	A

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor
Average Results from 11 Runs
Intersection Volume and Delay

SR 9 & SR 204 Intersection Improvements
Existing Conditions
PM Peak Hour

	Intersection	Control	Demand Volume (vph)	Served Volume (vph) Average	Percent Served	Standard Deviation	Minimum	Maximum	GEH Statistic	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	3,847	3,799	98.8%	57	3,715	3,885	0.8	23.9	1.3	21.6	26.4	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	3,304	3,246	98.2%	53	3,147	3,310	1.0	2.0	0.7	1.3	3.4	A	SB RT
3	SR 9/SR 204	Signal	4,392	4,367	99.4%	67	4,255	4,499	0.4	55.9	3.1	50.7	60.9	E	
4	SR 9/Market Pl	Signal	2,553	2,591	101.5%	33	2,547	2,650	0.7	62.4	15.7	42.1	83.4	E	
5	91st Ave/SR 204	Signal	2,845	2,988	105.0%	52	2,900	3,069	2.7	67.2	6.7	59.9	79.7	E	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	3,050	3,092	101.4%	34	3,029	3,147	0.8	32.3	4.6	25.8	41.4	C	
7	Vernon Rd/7th Pl	Side-street Stop	1,151	1,137	98.8%	36	1,099	1,212	0.4	11.5	1.0	10.1	13.3	B	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	552	568	102.9%	25	531	624	0.7	17.2	13.9	7.7	55.7	C	EB RT
9	Safeway Dwy/Davies Rd	Roundabout	1,001	1,030	102.9%	25	972	1,068	0.9	4.7	0.5	3.9	5.8	A	
10	SR 9/4th St On-Ramp	Side-street Stop	265	285	107.4%	12	265	307	1.2	1.7	0.4	1.0	2.3	A	SB RT
11	Transit Center Dwy/4th St	Side-street Stop	407	444	109.2%	16	408	464	1.8	9.3	1.2	7.6	12.5	A	SB LT
12	Transit Center Dwy/Market Pl	Side-street Stop	839	888	105.9%	12	876	920	1.7	36.4	31.0	2.6	81.1	E	WB TH
13	91st Ave/Market Pl	Signal	1,309	1,320	100.8%	25	1,282	1,358	0.3	19.2	11.1	11.1	46.3	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1,048	1,044	99.7%	29	986	1,081	0.1	12.3	2.8	7.0	17.2	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout	1,320	1,299	98.4%	16	1,277	1,323	0.6	6.6	1.2	4.8	8.3	A	

Network Summary	
Total Demand Volume (veh/hr)	27,883
Total Volume Served (veh/hr)	28,099
Percent Served	100.8%
GEH Statistic	1.3

Note: For Side-street Stop and Uncontrolled intersections, the highest delay by movement is reported. The movement with the highest delay is reported as the worst movement.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	8	7	93.2%	3.6	4	17	0.2	3.9	7.5	0.0	24.6	A
	Through	1,538	1,503	97.7%	44.0	1,427	1,579	0.9	22.5	2.7	19.8	27.2	C
	Right Turn	456	445	97.6%	22.0	417	478	0.5	12.2	3.3	7.8	17.3	B
	Second Right		0										
	Subtotal	2,002	1,955	97.7%	48.7	1,899	2,028	1.0	20.2	2.5	16.8	24.8	C
SB	U Turn		0										
	Second Left		0										
	Left Turn	29	33	115.0%	6.6	24	47	0.8	58.9	13.9	37.9	76.1	E
	Through	991	976	98.5%	23.2	945	1,027	0.5	13.5	1.5	9.8	14.9	B
	Right Turn	88	97	110.5%	10.4	84	115	1.0	3.9	1.1	2.4	6.3	A
	Second Right		0										
	Subtotal	1,108	1,107	99.9%	21.0	1,084	1,151	0.0	14.1	1.4	10.6	15.9	B
EB	U Turn		0										
	Second Left		0										
	Left Turn	205	198	96.5%	10.5	179	221	0.5	53.1	4.8	44.6	63.5	D
	Through	86	91	106.1%	10.9	74	106	0.6	54.6	6.1	46.6	68.0	D
	Right Turn	13	12	88.8%	3.5	5	19	0.4	11.2	1.9	8.9	15.1	B
	Second Right		0										
	Subtotal	304	301	98.9%	12.5	285	324	0.2	52.1	4.3	45.3	61.4	D
WB	U Turn		0										
	Second Left		0										
	Left Turn	298	292	98.0%	14.2	264	319	0.3	51.1	5.9	44.2	61.2	D
	Through	93	100	107.0%	12.1	84	119	0.7	48.8	10.6	30.8	60.3	D
	Right Turn	42	45	106.5%	6.9	35	58	0.4	13.2	2.9	8.6	18.9	B
	Second Right		0										
	Subtotal	433	436	100.8%	7.1	424	452	0.2	46.9	4.4	41.2	54.8	D
Total		3,847	3,799	98.8%	57.0	3,715	3,885	0.8	23.9	1.3	21.6	26.4	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	2,002	1,963	98.1%	49.3	1,885	2,020	0.9	1.1	0.2	0.8	1.5	A
	Right Turn		0										
	Second Right		0										
	Subtotal	2,002	1,963	98.1%	49.3	1,885	2,020	0.9	1.1	0.2	0.8	1.5	A
SB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	1,183	1,145	96.8%	22.8	1,107	1,183	1.1	1.3	0.3	1.0	1.8	A
	Right Turn	119	138	115.6%	15.0	124	176	1.6	2.0	0.7	1.3	3.4	A
	Second Right		0										
	Subtotal	1,302	1,283	98.5%	21.1	1,246	1,315	0.5	1.4	0.3	1.0	1.8	A
EB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
Total		3,304	3,246	98.2%	53.2	3,147	3,310	1.0	1.2	0.1	1.0	1.4	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **PM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	82	101	123.7%	9.2	88	114	2.0	71.8	15.8	52.6	108.8	E
	Through	831	809	97.4%	26.4	766	848	0.8	49.0	17.4	32.0	94.2	D
	Right Turn	236	236	100.1%	16.5	207	269	0.0	17.6	12.3	8.6	51.2	B
	Second Right		0										
	Subtotal	1,149	1,147	99.8%	38.7	1,098	1,211	0.1	44.8	16.3	30.9	88.6	D
SB	U Turn		0										
	Second Left		0										
	Left Turn	188	161	85.9%	10.6	138	172	2.0	67.4	6.0	56.8	76.9	E
	Through	605	571	94.4%	30.0	517	622	1.4	40.5	4.1	32.3	45.4	D
	Right Turn	390	397	101.9%	22.8	370	449	0.4	2.8	0.6	1.8	3.9	A
	Second Right		0										
	Subtotal	1,183	1,130	95.5%	24.8	1,098	1,170	1.6	31.3	3.4	23.5	35.6	C
EB	U Turn		0										
	Second Left		0										
	Left Turn	1,005	987	98.2%	33.2	929	1,024	0.6	75.0	9.9	55.0	90.3	E
	Through	575	589	102.4%	21.8	558	625	0.6	71.4	8.9	54.4	86.5	E
	Right Turn	47	50	106.8%	7.1	38	61	0.5	84.8	11.2	66.2	97.7	F
	Second Right		0										
	Subtotal	1,627	1,626	99.9%	44.3	1,531	1,697	0.0	74.0	9.4	55.1	89.2	E
WB	U Turn		0										
	Second Left		0										
	Left Turn	127	147	115.5%	11.4	127	161	1.7	76.6	17.3	53.8	115.2	E
	Through	140	163	116.6%	10.1	150	175	1.9	93.4	40.5	55.9	166.5	F
	Right Turn	166	155	93.1%	9.6	134	167	0.9	45.9	35.8	12.5	116.8	D
	Second Right		0										
	Subtotal	433	464	107.2%	11.7	447	479	1.5	72.4	32.4	44.1	136.6	E
Total		4,392	4,367	99.4%	67.2	4,255	4,499	0.4	55.9	3.1	50.7	60.9	E

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **PM Peak Hour**

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	93	93	99.7%	11.3	70	109	0.0	81.7	16.6	56.5	105.8	F
	Through	691	678	98.1%	28.9	630	723	0.5	40.7	11.2	28.5	66.3	D
	Right Turn	50	58	115.8%	7.9	51	75	1.1	13.2	8.8	5.6	32.6	B
	Second Right		0										
	Subtotal	834	828	99.3%	18.5	805	866	0.2	43.2	10.8	32.1	68.3	D
SB	U Turn		0										
	Second Left		0										
	Left Turn	107	109	102.0%	8.8	90	120	0.2	91.4	19.4	68.8	133.2	F
	Through	485	488	100.6%	17.0	468	522	0.1	37.9	14.7	11.0	53.1	D
	Right Turn	187	189	101.2%	17.3	145	212	0.2	20.5	8.2	4.0	31.2	C
	Second Right		0										
	Subtotal	779	786	100.9%	28.2	739	836	0.3	41.2	9.7	21.8	51.0	D
EB	U Turn		0										
	Second Left		0										
	Left Turn	190	193	101.7%	10.9	170	208	0.2	109.5	46.8	57.3	172.1	F
	Through	270	272	100.8%	12.3	250	295	0.1	91.7	39.3	40.3	149.7	F
	Right Turn	81	81	100.4%	7.0	73	99	0.0	46.0	8.9	29.2	57.1	D
	Second Right		0										
	Subtotal	541	547	101.1%	18.8	516	567	0.2	90.7	36.1	47.1	141.9	F
WB	U Turn		0										
	Second Left		0										
	Left Turn	64	67	104.4%	6.2	54	75	0.3	94.4	36.4	50.5	156.0	F
	Through	236	254	107.8%	9.3	244	274	1.2	108.8	35.7	58.2	164.6	F
	Right Turn	99	108	109.1%	6.1	97	116	0.9	79.7	20.3	41.8	109.0	E
	Second Right		0										
	Subtotal	399	429	107.6%	7.8	413	441	1.5	99.7	31.9	56.6	148.2	F
Total		2,553	2,591	101.5%	32.8	2,547	2,650	0.7	62.4	15.7	42.1	83.4	E

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **PM Peak Hour**

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	49	52	105.9%	7.5	41	63	0.4	114.7	43.1	67.3	230.3	F
	Through	105	117	111.2%	12.6	96	143	1.1	74.9	38.2	47.1	184.3	E
	Right Turn	342	320	93.7%	13.0	298	345	1.2	61.2	37.4	32.1	168.9	E
	Second Right		0										
	Subtotal	496	489	98.6%	19.6	467	539	0.3	69.4	37.1	41.5	175.7	E
SB	U Turn		0										
	Second Left		0										
	Left Turn	135	120	88.8%	9.9	105	137	1.3	85.4	12.4	63.7	101.4	F
	Through	155	232	149.6%	10.3	218	255	5.5	53.1	10.5	32.1	66.5	D
	Right Turn	54	55	102.7%	8.7	47	71	0.2	42.2	17.9	18.3	69.6	D
	Second Right		0										
	Subtotal	344	407	118.4%	15.6	390	433	3.3	60.6	11.1	39.6	75.6	E
EB	U Turn		0										
	Second Left		0										
	Left Turn	82	74	90.6%	7.7	56	84	0.9	70.1	10.9	55.3	85.7	E
	Through	1,150	1,178	102.4%	43.9	1,110	1,248	0.8	84.5	15.4	63.9	116.1	F
	Right Turn	161	174	108.4%	11.5	152	188	1.0	57.2	16.3	42.5	99.1	E
	Second Right		0										
	Subtotal	1,393	1,426	102.4%	37.9	1,371	1,499	0.9	80.2	14.5	63.3	112.3	F
WB	U Turn		0										
	Second Left		0										
	Left Turn	172	185	107.7%	14.0	159	215	1.0	81.6	6.6	74.4	94.3	F
	Through	367	409	111.4%	19.4	382	440	2.1	25.6	4.0	19.2	33.7	C
	Right Turn	73	72	98.3%	8.5	59	83	0.1	43.9	9.8	31.0	61.2	D
	Second Right		0										
	Subtotal	612	666	108.8%	29.0	626	727	2.1	42.1	4.4	36.6	50.5	D
Total		2,845	2,988	105.0%	52.3	2,900	3,069	2.7	67.2	6.7	59.9	79.7	E

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	82	89	108.1%	8.9	74	109	0.7	31.4	6.1	21.1	42.9	C
	Through	129	127	98.8%	14.0	100	150	0.1	26.1	5.8	17.2	36.4	C
	Right Turn	6	7	110.6%	2.2	4	10	0.3	15.7	16.5	0.0	47.7	B
	Second Right		0										
	Subtotal	217	223	102.6%	17.4	203	256	0.4	28.0	5.0	21.6	38.4	C
SB	U Turn		0										
	Second Left		0										
	Left Turn	34	31	92.0%	4.5	23	41	0.5	30.9	8.1	13.7	44.7	C
	Through	94	91	97.2%	11.2	79	111	0.3	23.1	5.0	15.7	34.4	C
	Right Turn	201	200	99.7%	9.0	184	215	0.0	9.4	1.9	6.5	11.8	A
	Second Right		0										
	Subtotal	329	323	98.2%	14.1	305	353	0.3	15.7	2.9	12.4	21.4	B
EB	U Turn		0										
	Second Left		0										
	Left Turn	449	433	96.4%	24.8	393	473	0.8	53.0	7.0	44.0	66.3	D
	Through	1,353	1,377	101.8%	33.0	1,312	1,413	0.6	30.0	7.1	18.9	43.9	C
	Right Turn	232	227	97.6%	18.2	199	256	0.4	30.6	7.0	19.7	42.2	C
	Second Right		0										
	Subtotal	2,034	2,036	100.1%	18.8	2,001	2,064	0.0	34.7	6.7	24.4	47.9	C
WB	U Turn		0										
	Second Left		0										
	Left Turn	2	4	177.3%	1.7	1	6	0.9	33.1	35.8	0.0	85.1	C
	Through	440	476	108.2%	14.1	459	501	1.7	34.9	4.4	28.1	40.2	C
	Right Turn	28	31	109.1%	6.5	22	42	0.5	18.5	8.9	5.7	30.8	B
	Second Right		0										
	Subtotal	470	510	108.5%	12.1	490	528	1.8	34.0	4.2	28.2	39.4	C
Total		3,050	3,092	101.4%	34.0	3,029	3,147	0.8	32.3	4.6	25.8	41.4	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
SB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
EB	U Turn		0										
	Second Left		0										
	Left Turn	365	351	96.2%	16.9	321	375	0.7	1.3	0.2	0.9	1.6	A
	Through	546	541	99.1%	27.9	506	592	0.2	0.3	0.1	0.2	0.3	A
	Right Turn	88	93	105.6%	9.8	77	109	0.5	0.1	0.1	0.0	0.4	A
	Second Right		0										
	Subtotal	999	985	98.6%	35.7	935	1,057	0.4	0.6	0.1	0.4	0.7	A
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn	152	152	100.1%	7.9	138	169	0.0	11.5	1.0	10.1	13.3	B
	Second Right		0										
	Subtotal	152	152	100.1%	7.9	138	169	0.0	11.5	1.0	10.1	13.3	B
Total		1,151	1,137	98.8%	35.7	1,099	1,212	0.4	2.2	0.2	2.0	2.6	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **PM Peak Hour**

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	55	58	105.3%	7.1	48	70	0.4	1.5	0.6	0.8	3.1	A
	Through	97	93	95.8%	9.0	78	107	0.4	0.8	0.7	0.3	2.9	A
	Right Turn	17	22	127.3%	5.2	13	31	1.1	1.0	0.7	0.6	3.2	A
	Second Right		0										
	Subtotal	169	172	102.0%	9.9	154	187	0.3	1.1	0.7	0.6	3.0	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	1	0	9.1%	0.3	0	1	1.2	0.1	0.4	0.0	1.3	A
	Through	118	116	98.4%	5.9	106	124	0.2	8.4	7.2	0.9	24.0	A
	Right Turn	13	14	104.2%	3.2	8	21	0.1	1.1	0.6	0.6	2.1	A
	Second Right		0										
	Subtotal	132	130	98.3%	6.5	118	138	0.2	7.7	6.5	0.9	21.3	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	16	15	92.6%	3.0	10	19	0.3	10.1	5.5	6.3	25.5	B
	Through	7	6	92.2%	2.0	4	10	0.2	7.7	3.2	0.0	10.9	A
	Right Turn	58	61	105.0%	6.7	47	72	0.4	17.2	13.9	7.7	55.7	C
	Second Right		0										
	Subtotal	81	82	101.5%	7.9	65	96	0.1	15.4	11.9	7.6	48.3	C
WB	U Turn		0										
	Second Left		0										
	Left Turn	87	94	107.5%	7.0	83	107	0.7	10.4	7.4	3.7	27.5	B
	Through	34	37	108.6%	6.7	28	51	0.5	4.1	1.5	1.5	6.6	A
	Right Turn	49	53	108.5%	6.7	44	67	0.6	5.5	0.3	5.1	6.1	A
	Second Right		0										
	Subtotal	170	184	108.0%	16.1	169	225	1.0	7.8	4.1	4.1	17.6	A
Total		552	568	102.9%	24.7	531	624	0.7	6.9	4.2	3.3	17.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn	3	0	0.0%	0.0	0	0	2.4	0.0	0.0	0.0	0.0	A
	Second Left		0										
	Left Turn	290	284	98.1%	8.3	274	301	0.3	7.3	1.2	5.5	9.0	A
	Through	37	37	100.0%	6.8	29	50	0.0	6.7	2.4	3.6	11.4	A
	Right Turn	85	91	106.6%	7.6	79	108	0.6	6.5	1.3	4.5	8.4	A
	Second Right		0										
	Subtotal	415	412	99.3%	9.6	393	424	0.1	6.9	0.9	5.3	7.9	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	3	7	227.3%	2.0	4	11	1.7	3.7	2.8	1.0	9.7	A
	Through	12	12	100.0%	2.3	8	15	0.0	4.4	2.4	1.6	9.0	A
	Right Turn	76	72	95.0%	4.4	64	79	0.4	5.1	2.0	3.3	10.6	A
	Second Right		0										
	Subtotal	91	91	100.0%	5.2	83	99	0.0	4.7	1.5	3.4	8.5	A
EB	U Turn	2	33	1636.4%	4.1	27	38	7.4	1.7	0.6	0.9	2.7	A
	Second Left		0										
	Left Turn	63	66	104.2%	6.7	56	76	0.3	1.9	0.4	1.2	2.4	A
	Through	121	128	105.7%	9.8	109	141	0.6	2.1	0.2	1.8	2.6	A
	Right Turn	159	152	95.7%	12.2	133	171	0.5	2.4	0.6	1.6	3.4	A
	Second Right		0										
	Subtotal	345	378	109.7%	17.2	350	408	1.8	2.1	0.3	1.7	2.5	A
WB	U Turn	2	0	0.0%	0.0	0	0	2.0	0.0	0.0	0.0	0.0	A
	Second Left		0										
	Left Turn	35	36	103.6%	4.6	26	41	0.2	4.1	1.6	1.5	7.2	A
	Through	111	106	95.2%	6.0	91	114	0.5	4.8	1.7	2.7	8.3	A
	Right Turn	2	6	322.7%	3.0	2	12	2.2	4.2	5.2	0.0	17.8	A
	Second Right		0										
	Subtotal	150	148	98.9%	6.1	137	159	0.1	4.6	1.6	3.0	8.2	A
Total		1,001	1,030	102.9%	25.3	972	1,068	0.9	4.7	0.5	3.9	5.8	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **PM Peak Hour**

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
SB	U Turn		0										
	Second Left		0										
	Left Turn	64	66	103.3%	8.6	48	72	0.3	0.8	0.4	0.1	1.7	A
	Through		0										
	Right Turn	65	69	106.9%	3.8	64	76	0.5	1.7	0.4	1.0	2.3	A
	Second Right		0										
	Subtotal	129	136	105.1%	8.3	120	148	0.6	1.3	0.3	0.8	1.8	A
EB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	104	116	111.5%	7.1	105	127	1.1	0.5	0.1	0.5	0.6	A
	Right Turn	32	33	104.0%	4.8	23	42	0.2	0.1	0.1	0.0	0.3	A
	Second Right		0										
	Subtotal	136	149	109.7%	9.5	137	165	1.1	0.4	0.1	0.3	0.6	A
Total		265	285	107.4%	12.3	265	307	1.2	0.8	0.1	0.7	1.1	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **PM Peak Hour**

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	12	13	107.6%	4.2	5	18	0.3	5.5	0.5	4.9	6.5	A
	Through	5	5	103.6%	2.3	1	9	0.1	4.0	2.6	0.0	6.9	A
	Right Turn	5	10	192.7%	1.6	7	12	1.7	2.9	2.8	0.0	6.4	A
	Second Right		0										
	Subtotal	22	28	126.0%	6.0	19	39	1.1	4.5	0.9	3.6	6.3	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	123	133	108.1%	5.5	121	139	0.9	9.3	1.2	7.6	12.5	A
	Through	20	21	104.1%	3.8	15	29	0.2	8.7	2.8	5.9	15.7	A
	Right Turn	14	19	133.8%	3.9	12	25	1.2	8.5	1.8	5.9	11.4	A
	Second Right		0										
	Subtotal	157	172	109.8%	7.2	163	189	1.2	9.2	1.4	7.7	12.8	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	6	5	90.9%	2.3	2	10	0.2	1.4	1.4	0.1	3.6	A
	Through	79	85	107.6%	7.0	71	95	0.7	0.5	0.3	0.1	1.0	A
	Right Turn	12	12	103.8%	4.8	5	21	0.1	0.4	0.3	0.1	1.0	A
	Second Right		0										
	Subtotal	97	103	106.1%	9.7	83	112	0.6	0.6	0.3	0.1	1.0	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	3	4	121.2%	2.4	0	8	0.3	0.9	1.1	0.0	3.0	A
	Through	74	78	106.0%	6.5	65	89	0.5	0.3	0.2	0.0	0.7	A
	Right Turn	54	59	109.6%	6.6	51	68	0.7	0.6	0.2	0.4	1.0	A
	Second Right		0										
	Subtotal	131	141	107.8%	7.1	127	155	0.9	0.4	0.1	0.3	0.7	A
Total		407	444	109.2%	15.8	408	464	1.8	4.2	0.5	3.6	5.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **PM Peak Hour**

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
SB	U Turn		0										
	Second Left		0										
	Left Turn	9	10	111.1%	3.3	4	16	0.3	11.5	11.2	0.0	37.6	B
	Through		0										
	Right Turn	48	51	107.0%	4.0	45	60	0.5	30.4	20.1	7.4	64.4	D
	Second Right		0										
	Subtotal	57	61	107.7%	4.0	54	67	0.6	27.8	19.1	6.6	61.9	D
EB	U Turn		0										
	Second Left		0										
	Left Turn	12	25	207.6%	4.4	20	35	3.0	15.4	13.2	4.2	42.8	C
	Through	415	414	99.7%	15.0	399	448	0.1	1.7	2.2	0.5	6.8	A
	Right Turn		0										
	Second Right		0										
	Subtotal	427	439	102.8%	17.5	422	483	0.6	2.8	3.3	0.7	10.3	A
WB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through	351	383	109.1%	8.6	373	399	1.7	36.4	31.0	2.6	81.1	E
	Right Turn	4	5	127.3%	2.9	0	9	0.5	11.1	11.8	0.4	34.9	B
	Second Right		0										
	Subtotal	355	388	109.3%	7.9	375	399	1.7	36.1	30.8	2.6	80.5	E
Total		839	888	105.9%	12.1	876	920	1.7	18.7	14.7	2.2	39.3	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **PM Peak Hour**

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	36	41	114.9%	6.0	29	50	0.9	16.3	18.5	5.6	70.4	B
	Through	199	184	92.6%	14.1	151	207	1.1	32.3	38.2	9.4	141.2	C
	Right Turn	108	120	110.8%	10.6	105	136	1.1	35.5	34.6	12.1	127.6	D
	Second Right		0										
	Subtotal	343	345	100.7%	10.7	329	365	0.1	31.3	33.9	10.0	126.5	C
SB	U Turn		0										
	Second Left		0										
	Left Turn	156	166	106.6%	8.8	154	186	0.8	29.2	21.1	11.4	71.1	C
	Through	153	167	109.0%	9.0	154	184	1.1	11.4	3.1	6.7	15.6	B
	Right Turn	41	34	82.9%	3.4	28	41	1.1	9.1	1.3	7.1	12.6	A
	Second Right		0										
	Subtotal	350	367	104.9%	15.3	343	399	0.9	19.4	10.1	10.6	39.8	B
EB	U Turn		0										
	Second Left		0										
	Left Turn	41	44	107.5%	5.7	32	51	0.5	12.1	3.8	6.8	19.8	B
	Through	141	102	72.0%	8.8	92	119	3.6	6.7	7.7	0.3	22.4	A
	Right Turn	65	73	112.6%	8.8	58	87	1.0	5.7	1.4	3.9	8.4	A
	Second Right		0										
	Subtotal	247	219	88.6%	12.6	200	238	1.8	7.5	4.5	3.1	15.7	A
WB	U Turn		0										
	Second Left		0										
	Left Turn	182	185	101.6%	12.9	163	206	0.2	17.7	5.7	9.2	26.2	B
	Through	119	131	109.8%	11.4	113	151	1.0	17.7	4.7	10.2	27.5	B
	Right Turn	68	73	107.8%	5.8	68	84	0.6	13.7	5.3	7.4	28.2	B
	Second Right		0										
	Subtotal	369	389	105.4%	21.6	363	420	1.0	17.0	4.7	9.2	26.2	B
Total		1,309	1,320	100.8%	24.5	1,282	1,358	0.3	19.2	11.1	11.1	46.3	B

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs | **Existing Conditions**

Volume and Delay by Movement | **PM Peak Hour**

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn		0										
	Second Left		0										
	Left Turn	23	24	105.1%	6.3	17	39	0.2	1.8	2.2	0.3	8.0	A
	Through	487	461	94.6%	28.1	416	507	1.2	1.7	0.5	1.0	2.7	A
	Right Turn	96	106	109.9%	13.9	82	130	1.0	2.1	0.8	0.9	3.4	A
	Second Right		0										
	Subtotal	606	590	97.4%	30.6	534	636	0.6	1.8	0.4	1.2	2.4	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	21	19	92.6%	2.3	16	24	0.3	4.2	3.2	0.7	10.4	A
	Through	255	252	98.9%	9.9	241	266	0.2	1.5	0.5	1.0	2.5	A
	Right Turn	18	23	130.3%	4.9	14	30	1.2	1.0	0.3	0.6	1.6	A
	Second Right		0										
	Subtotal	294	295	100.3%	8.4	284	311	0.1	1.6	0.5	1.0	2.9	A
EB	U Turn		0										
	Second Left		0										
	Left Turn	9	19	215.2%	4.5	14	26	2.8	12.3	2.8	7.0	17.2	B
	Through	3	2	57.6%	1.6	0	5	0.8	7.1	10.9	0.0	26.9	A
	Right Turn	31	19	61.9%	4.3	13	26	2.4	8.3	2.6	5.5	13.0	A
	Second Right		0										
	Subtotal	43	40	93.7%	3.3	35	48	0.4	10.8	1.7	8.7	13.8	B
WB	U Turn		0										
	Second Left		0										
	Left Turn	43	53	122.4%	6.5	44	63	1.4	11.4	2.6	7.1	15.1	B
	Through		0										
	Right Turn	62	66	106.7%	3.4	62	73	0.5	1.7	0.9	0.8	3.2	A
	Second Right		0										
	Subtotal	105	119	113.2%	7.6	107	131	1.3	5.5	1.5	3.9	8.0	A
Total		1,048	1,044	99.7%	28.6	986	1,081	0.1	2.6	0.4	2.1	3.2	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing Conditions**

Volume and Delay by Movement **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Percent	Std. Dev.	Minimum	Maximum	GEH	Total Delay (sec/veh) Average	Std. Dev.	Minimum	Maximum	LOS
NB	U Turn	87	56	64.5%	8.0	45	69	3.7	4.6	1.8	2.1	7.3	A
	Second Left		0										
	Left Turn		0										
	Through	267	266	99.7%	12.0	249	287	0.1	5.3	1.4	3.7	7.2	A
	Right Turn	163	166	102.1%	12.9	145	183	0.3	4.8	1.2	3.1	7.1	A
	Second Right		0										
	Subtotal	517	489	94.5%	16.5	467	523	1.3	5.0	1.3	3.4	7.1	A
SB	U Turn		0										
	Second Left		0										
	Left Turn	205	219	107.0%	8.0	207	234	1.0	4.9	0.9	3.1	6.6	A
	Through	96	95	98.9%	6.0	85	105	0.1	4.7	0.8	3.3	5.5	A
	Right Turn		0										
	Second Right		0										
	Subtotal	301	314	104.4%	9.0	297	326	0.8	4.9	0.7	3.4	5.9	A
EB	U Turn		0										
	Second Left		0										
	Left Turn		0										
	Through		0										
	Right Turn		0										
	Second Right		0										
	Subtotal		0										
WB	U Turn		0										
	Second Left		0										
	Left Turn	250	243	97.1%	7.8	234	257	0.5	9.3	2.3	6.1	12.0	A
	Through		0										
	Right Turn	252	254	100.8%	7.7	243	270	0.1	9.2	2.4	6.1	13.3	A
	Second Right		0										
	Subtotal	502	497	98.9%	7.8	486	510	0.2	9.2	2.2	6.1	12.5	A
Total		1,320	1,299	98.4%	15.6	1,277	1,323	0.6	6.6	1.2	4.8	8.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal** **Location** 1

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	150	0	0	0	0	0	0	0	0	NO	25	#DIV/0!
	Through	2,000	94	10	81	111	500	48	434	594	NO	450	90%
	Right Turn												
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	300	12	2	9	16	67	13	49	93	NO	50	74%
	Through	3,700	36	3	29	40	256	26	221	295	NO	625	244%
	Right Turn												
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	350	37	2	35	42	121	8	108	136	NO	200	165%
	Through	2,000	26	5	19	36	126	13	105	142	NO	275	218%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	350	50	3	46	55	166	10	155	184	NO	175	105%
	Through	2,000	27	3	21	31	119	17	92	149	NO	125	105%
	Right Turn	80	1	0	1	1	26	4	22	35	NO		
	Second Right												

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
PM Peak Hour

Location

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled** **2**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
PM Peak Hour

Intersection 3 **SR 9/SR 204**

Signal **Location** **3**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	160	42	11	34	73	187	67	132	373	MAX	150	80%
	Through	2,000	158	29	123	236	476	54	423	617	NO	625	131%
	Right Turn	160	11	3	6	15	110	16	81	129	NO	100	91%
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	350	67	6	57	78	229	18	201	257	NO	375	164%
	Through	2,000	78	6	66	87	297	16	263	323	NO	500	168%
	Right Turn												
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	400	94	6	82	101	499	21	472	529	MAX	400	80%
	Through	400	94	6	82	101	499	21	472	529	MAX	250	50%
	Right Turn	100	93	6	82	102	501	21	474	530	MAX		
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	300	73	14	51	94	352	36	292	408	MAX	150	43%
	Through	300	113	36	78	182	345	34	288	398	MAX	250	72%
	Right Turn	75	88	36	55	153	330	36	275	385	AVG	100	30%
	Second Right												

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Intersection 4 **SR 9/Market Pl** **Signal** **Location** 4

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	300	37	7	27	48	164	39	127	267	NO	225	137%
	Through	2,000	200	47	161	313	881	86	742	1,057	NO	625	71%
	Right Turn	400	0	0	0	1	36	11	21	60	NO	50	141%
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	245	51	8	38	66	203	44	160	284	NO	50	25%
	Through	2,000	92	31	35	129	487	64	380	592	NO	450	92%
	Right Turn	300	9	5	5	17	122	32	73	183	NO	50	41%
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	90	128	36	84	198	515	52	397	594	AVG	150	29%
	Through	600	165	37	119	242	544	35	468	593	NO	500	92%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	250	15	4	12	26	86	38	60	199	NO	150	174%
	Through	1,000	232	46	153	308	529	20	502	555	NO	475	90%
	Right Turn	600	231	46	151	307	528	20	501	554	NO		
	Second Right												

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Intersection 5 **91st Ave/SR 204** **Signal** **Location 5**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	150	75	56	27	227	394	150	174	656	MAX	100	25%
	Through	2,000	203	106	126	499	624	127	499	909	NO	375	60%
	Right Turn												
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	200	69	9	57	81	250	24	191	269	MAX	150	60%
	Through	800	92	12	74	110	274	3	269	281	NO	200	73%
	Right Turn												
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	400	26	4	18	33	115	9	104	133	NO	150	131%
	Through	1,250	175	29	132	217	638	91	514	754	NO	625	98%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	160	101	16	86	128	312	47	256	421	MAX	250	80%
	Through	350	47	4	39	55	277	20	253	324	NO	225	81%
	Right Turn	300	50	4	42	58	285	20	260	331	NO		
	Second Right												

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Location **6**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?	Observed Q (ft)	% of Max Avg
NB	U Turn												
	Second Left												
	Left Turn	200	14	3	8	19	104	23	68	162	NO	125	120%
	Through	1,500	19	4	11	24	135	20	103	165	NO	150	111%
	Right Turn												
	Second Right												
SB	U Turn												
	Second Left												
	Left Turn	100	16	1	14	18	100	11	83	121	NO	125	125%
	Through	100	16	1	14	18	100	11	83	121	NO	125	125%
	Right Turn	100	16	1	14	18	102	11	86	124	MAX	150	147%
	Second Right												
EB	U Turn												
	Second Left												
	Left Turn	325	58	5	47	65	207	24	180	272	NO	275	133%
	Through	2,000	145	39	82	205	682	154	450	983	NO	625	92%
	Right Turn												
	Second Right												
WB	U Turn												
	Second Left												
	Left Turn	200	1	1	0	2	19	9	10	39	NO	25	133%
	Through	1,250	42	6	30	51	234	17	214	264	NO	350	150%
	Right Turn												
	Second Right												

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Location

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop** **7**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	9	2	7	12	148	15	123	170	MAX
	Through	25	9	2	7	12	148	15	123	170	MAX
	Right Turn	25	9	2	7	12	148	15	123	170	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Location

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop** **8**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	28	8	15	40	NO
	Through	350	0	1	0	2	41	14	22	70	NO
	Right Turn	350	0	1	0	2	41	14	22	70	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	1	0	3	13	10	0	27	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	1	1	0	4	63	15	43	95	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	1	1	1	3	44	13	31	75	NO
	Through	400	1	0	1	1	63	5	57	73	NO
	Right Turn	400	3	1	2	7	56	10	41	74	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	2	1	1	3	83	9	70	98	NO
	Through	400	2	1	1	3	83	9	70	98	NO
	Right Turn	400	2	1	2	4	79	10	66	96	NO
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Location

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout** **9**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Location

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop** **10**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
PM Peak Hour

Location

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop** **11**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	9	1	8	10	87	10	76	103	NO
	Through										
	Right Turn	400	9	1	8	10	88	10	77	104	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Queue Length

SR 9 & SR 204 Intersection Improvements
Existing Conditions
PM Peak Hour

Location

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop** **12**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	4	2	2	9	55	9	40	67	NO
	Through										
	Right Turn	400	5	2	2	10	54	9	39	67	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	3	4	1	13	57	41	32	144	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Location

Intersection 13 **91st Ave/Market Pl** **Signal** **13**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	1	0	1	2	36	5	29	45	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	9	5	4	19	108	17	89	140	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	2	0	1	2	36	6	27	43	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	11	2	8	15	147	26	122	212	NO

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Location

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop** **14**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **Existing Conditions**
Queue Length | **PM Peak Hour**

Location

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout** **15**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

APPENDIX E.
SR 9 / SR 204 TRAVEL DEMAND FORECAST MEMORANDUM

September 2017

Date: September 12, 2017

To: Michael Horntvedt (Parsons)

From : Will Lisska (Fehr & Peers)

Subject: Travel Demand Forecast Memorandum – SR 9/SR 204 Intersection Improvement Project

INTRODUCTION

This memorandum documents the development and post-processing of the travel demand forecasts for the SR 9 / SR 204 Intersection Improvement Project. Included in this documentation is background on the modeling tool (the SnoCo Model); description of the model update and validation for 2016 existing conditions; description of the updates and assumptions for model years 2021 and 2040; forecast and post-processing methodologies; and summary of of the finalized forecasts for no build and each alternative concept. The finalized forecasts will be used as input to the VISSIM simulation models, which will assess operations and travel times.

SNOHOMISH COUNTY TRAVEL MODEL

The travel demand forecasting framework for this study is based on the Snohomish County Travel Model (SnoCo Model). As described in the Methods & Assumptions Memo, the SnoCo Model is the most appropriate travel demand forecasting tool for the study area for the following reasons:

- Based on the 4,000 zone version of the Puget Sound Regional Council's travel demand model (PSRC 4k Model, Version 4.0.1).
- Includes the most up-to-date comprehensive planned land use and transportation assumptions within Snohomish County jurisdictions and unincorporated areas.
- Incorporates the land use and transportation assumptions of the recently adopted sub area plans in Lake Stevens (Lake Stevens Center and 20th Street SE).
- Consistency with PSRC Land Use Targets across region.

The SnoCo Model is implemented using the transportation planning software package EMME, version 4.2.5. This is the same software package used for applying the PSRC 4k Model.

EXISTING YEAR MODEL UPDATE

As described in the following sections, key travel demand model inputs and parameters including the traffic analysis zone (TAZ) system, the transportation network, and land use, were adjusted to better represent the existing study area.

TRAFFIC ANALYSIS ZONE (TAZ) SYSTEM

Compared to the traditional 1,000 zone version of the PSRC regional model, the Snohomish County Model contains a more detailed Transportation Analysis Zone (TAZ) system in the vicinity of Lake Stevens Center. **Figure 1** shows the traffic analysis zones (TAZs) within the study area. The PSRC TAZs are shown in the red outline and the Snohomish County Model TAZs are shown in a black outline. The Snohomish County model has a slightly more refined TAZ structure than the 4K version of the PSRC model, specifically more detail around the Lake Stevens Center area and the neighborhoods to the south of SR 204.

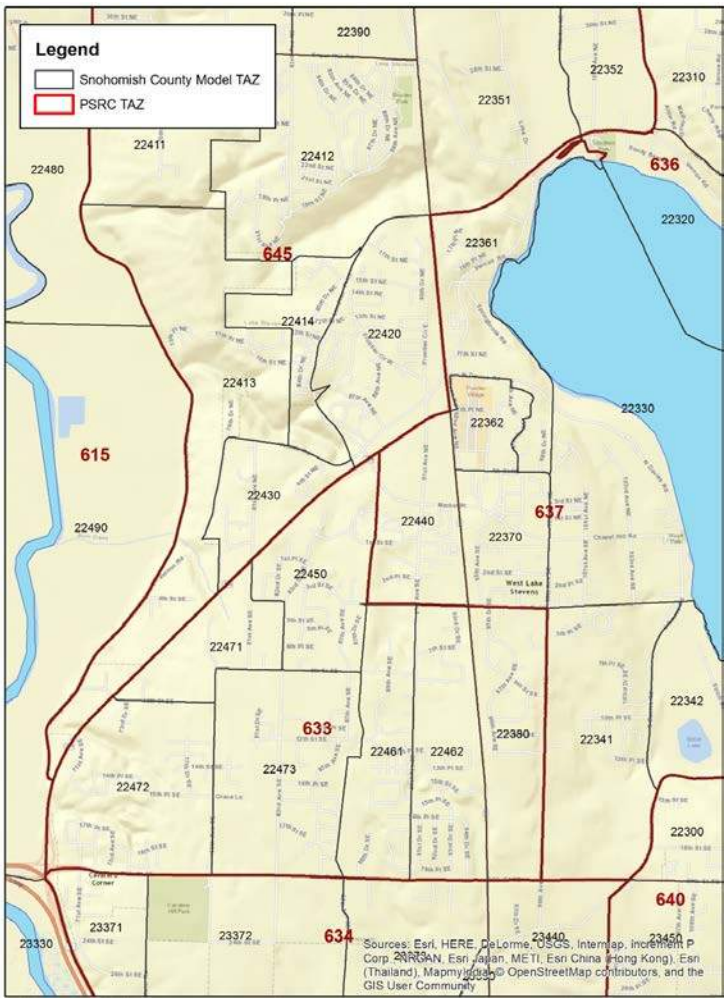


Figure 1: SnoCo Model Traffic Analysis Zone System within the Study Area

Due to the amount of zonal detail in the vicinity of the study area, it was determined that no additions or refinements to the TAZ system were necessary as part of the validation. Instead, refinements to the locations of centroid connectors that link TAZs with the model roadway network would result in similar routing improvement compared to the addition of zones. In other words, modifying centroid loading onto the network is a much more efficient method of improving the accuracy of traffic routing on a local

network compared to modifying the TAZ system, and the centroid loading modification method provides comparable output improvements. This process is described in the following section.

NETWORK MODIFICATIONS

The SnoCo Model transportation network is a detailed representation of streets and transit service within Snohomish County and the surrounding region. The network consists of the following elements:

- **Traffic analysis zones (TAZs):** small geographic areas which serve as trip origins and destinations. In the model, TAZs are more explicitly represented by **Centroids** – points that represents the area's center of "mass" (or the majority of its origins and destinations).
- **Links:** street and railway segments, each direction coded separately, with lengths, posted speeds, number of travel lanes, and capacities in maximum vehicles per hour as attributes.
- **Centroid Connectors:** special links that connect TAZ centroids to the street system, representing local access or in some cases driveways consolidated to a single segment.
- **Nodes:** points representing intersections, curvature, or locations where centroid connectors join the street network.
- **Turn penalties:** a nodal attribute that specifies vehicle turning movement limitations or restrictions.

The current SnoCo Model baseline network includes all major intersections and roadway segments within the traffic analysis study area, as defined in the Methods and Assumptions Memo. Our review of the network included confirmation that number of lanes, posted speeds, and turn penalties reflect actual "on-the-ground" conditions. To improve the accuracy of network representation and local traffic routing, several modifications were made to the SR9 / SR204 study area network. In particular, several centroid connector were modified to better represent current access patterns to shopping centers and residential neighborhoods, improving the model's representation of local traffic routing and driver origin-destination patterns. These network modifications are summarized below and depicted in **Figures 2** and **3**.

- The centroid and connector for TAZ 22413 are incorrectly depicted outside of the actual TAZ boundaries. The centroid was moved to more accurately reflect the location of TAZ, and the network tie-in location of the centroid connector was maintained at Vernon Road / 81st Avenue NE.
- The slip ramp from 4th Street NE / 92nd Avenue NE onto northbound SR 9 was added (omitted from baseline SnoCo Model network). This slip ramp provides egress onto northbound SR 9 from the Frontier Village Shopping Center, Target, the Lake Stevens Transit Center, and residential neighborhoods along 4th Street NE.

- Additional centroid connectors were added to represent existing driveway access points at the Frontier Village Shopping Center (TAZ 22362) and the various 91st Avenue NE commercial properties (TAZ 22440).

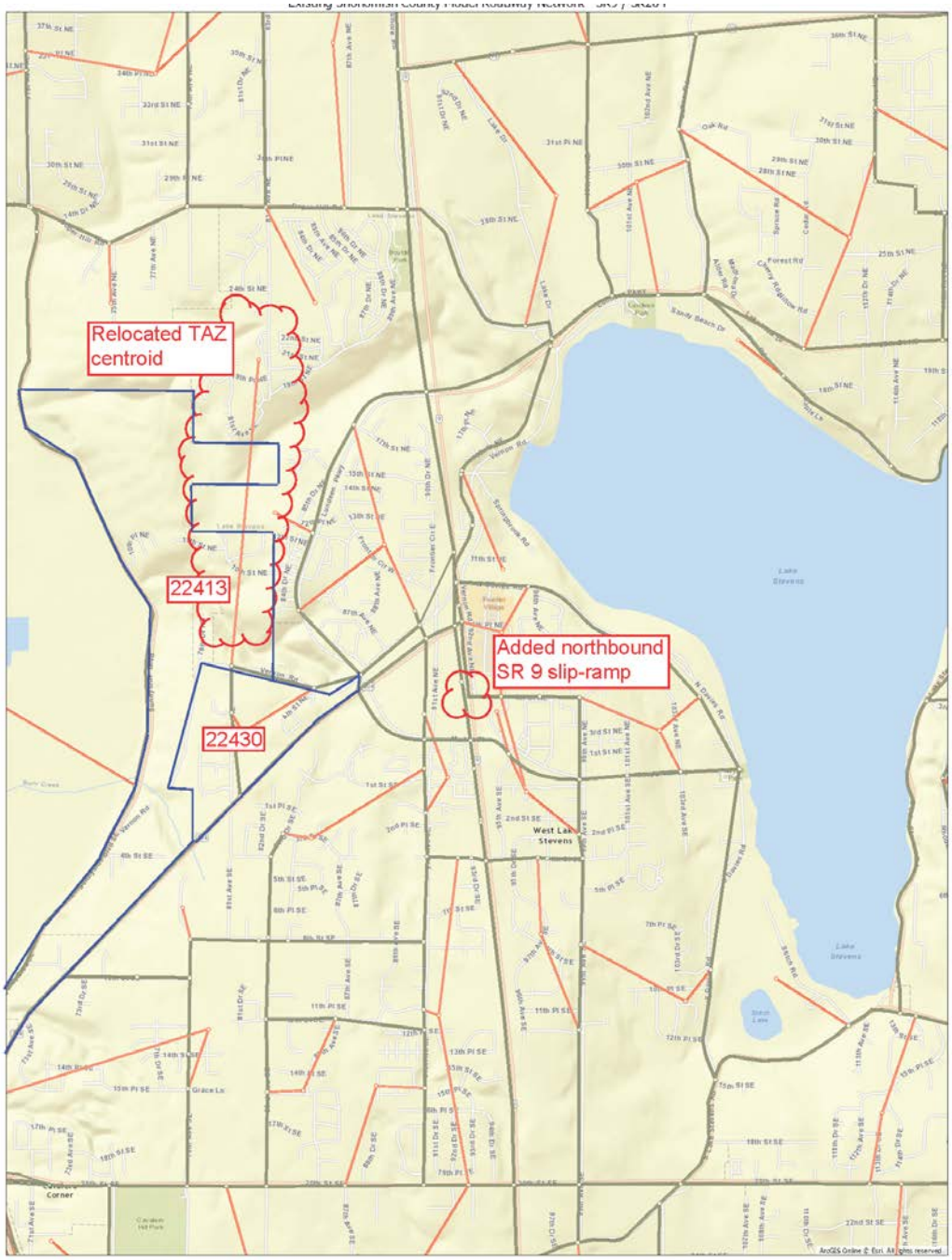


Figure 2: SnoCo Model Baseline Scenario Network – Before Modifications

Figure 3: SnoCo Model Baseline Scenario Network – After Modifications

LAND USE

Model Contents

The SnoCo Model contains land use scenarios for a 2012 base year and the 2035 Comprehensive Plan horizon. For the 2012 base year, population and housing data are based on information from the PSRC regional land use estimates and input from Snohomish County planning staff. The household information contains estimates of housing units, households, household population, housing by income quartile, group quarter population, and total population. The employment information contains total employment and the individual sector groupings, Manufacturing-WTU (wholesale, transportation & utilities), retail-food services, FIRES (finance, insurance, real estate, & services), government-higher education, education-K12, and construction-resources.

The 2035 forecast was previously developed using the official PSRC release of regional land use forecasts, known as the Land Use Targets (September 2013). This dataset was explicitly designed to align

with jurisdictional growth targets, and contains household and employment data for the years 2010, 2025, 2031, and 2035. The Land Use Targets were developed using a set of allocation methods that distribute jurisdictional growth targets to sub-jurisdictional zones based on available net development capacities and a series of policy-based preferential weights for certain centers, such as designated regional growth centers and other locally defined activity centers. Future year land use input assumptions for the 2035 SnoCo Model also reflect the Comprehensive Plan land use assumptions for Snohomish County and jurisdictions contained therein.

Due to privacy restrictions imposed by the Washington State Employment Security Department, direct access to the detailed land use input files by non-Snohomish County Staff is prohibited. For outside parties to run the model, Snohomish County Staff perform the SnoCo Model trip generation component using the land use files described above and provide the outputs needed to run all subsequent model steps. More specifically, they provide trip productions and attractions by TAZ, stratified by trip type, which can be input into the trip distribution component and used to complete the model run. Modifying these production and attraction files can be performed as a proxy to modifying the land use inputs. This process is described in the following section.

Review and Update

A vital component of calibrating the baseline model from 2012 to 2016 conditions is ensuring that land use input assumptions meet local and regional expectations. Snohomish County Staff provided aggregated households and employment totals (baseline 2012 and horizon year 2035) for the Lake Stevens Center subarea, the Lake Stevens city limits, and the entire County. This land use summary was reviewed by the Lake Stevens planning and public works staff, and updates were suggested to make the baseline and future year inputs consistent with the 2015 Lake Stevens Comprehensive Plan. As previously mentioned, the countywide land use is already consistent with the 2015 Snohomish County Comprehensive Plan, so only the local changes to Lake Stevens needed to be incorporated. Baseline model land use totals and suggested revisions are summarized in **Table 1**.

TABLE 1. BASELINE LAND USE SUMMARY – SNOCO MODEL CALIBRATION

Area	2015 Comprehensive Plan Baseline		Revised 2016 Baseline	
	Households	Employment	Households	Employment
Lake Stevens Center Subarea	1,710	2,120	1,771	1,863
Lake Stevens Citywide	9,220	4,090	9,550	3,594
All Snohomish County	268,325	244,879	268,325	244,879

The 2016 baseline model land use was created by scaling the 2012 production and attraction file tables by the relative increase or decrease in land use indicated by Lake Stevens staff, both for the Lake Stevens Center Subarea and the remaining citywide areas. As previously described, direct access to the

detailed model land use files by non-Snohomish County Staff is prohibited due to privacy restrictions imposed by the Washington State Employment Security Department. This process of directly modifying the production and attraction files can replicate the same outcome of adding or removing generalized land use totals to the model inputs while retaining privacy requirements for the actual land use totals.

EXISTING YEAR MODEL VALIDATION

After updating the SnoCo model to a 2016 existing year baseline, as described in the previous section, model outputs were validated against available data at key locations. The validation process compared the PM peak hour model traffic volume outputs to observed counts on SR 9 north of the Lundeen Parkway intersection, south of the 20th Street SE intersection, on the US 2 trestle, and on a screenline crossing SR 204, 20th Street SE, and US 2.

The key segment locations were checked for reasonable replication of existing conditions. All locations were within ±16% of actual baseline traffic counts, though most segments were also within ±10% of counts. FHWA guidelines suggest that volume-to-count percent error should be within ±15% on principal arterials, so the SnoCo model results within the study area can be considered acceptable (2010. Travel Model Validation and Reasonableness Checking Manual – Second Edition). Key location validation results are summarized in **Table 2**.

The screenline validation statistics for the SnoCo model are shown in **Table 3**. The validation target for the SR204/20th Street SE/US 2 screenline was set to ±10% of actual traffic. As indicated by the results, the directional totals for the screenline are within a ±5% of observed counts, which meets the validation target. It should be noted that certain locations comprising the screenline exceed the ±10% observed-to-model threshold in the eastbound directions, including the portions of 20th Street SE and SR 204 to the east of US 2 (+29% and -14%, respectively). The model is closely replicating the total number of east-west PM peak hour trips to the east of the US 2 Trestle, but a noticeable share of these eastbound trips are being assigned to the 20th Street SE corridor instead of SR 204. As specified in the Methods and Assumptions Memo, a technique known as the “difference method” will be used to develop future year traffic forecasts and minimize the influence of localized model error (like that observed on the screenline). Rather than take the direct output from the future year model (which generally carries forward assignment error from the 2016 existing year model), the difference method calculates the growth between the existing year and the future year models, and adds that growth to an observed traffic count. For example, assume a road has an existing hourly volume of 500 vehicles. If the existing year model showed a volume of 400 vehicles, and the future year model showed a volume of 650 vehicles, 250 vehicles would be added to the existing count for a future volume forecast of 750 vehicles.

Prior to import into the Vissim operations model, output from the SnoCo Model will be further calibrated to match observed roadway segment and turning movement count data within the study area model using origin-destination (O-D) matrix estimation methods. This process is described in further detail in the Post-Processing and Forecast Development section.

TABLE 2. COMPARISON OF OBSERVED AND ESTIMATED EXISTING (YEAR 2016) PM PEAK HOUR VOLUMES AT KEY LOCATIONS - SR9/SR204 INTERSECTION IMPROVEMENT PROJECT

		Observed Volumes		*Model Volumes*		*Ratio (Model/Obs)*	
#	Street	WB/NB	EB/SB	WB/NB	EB/SB	WB/NB	EB/SB
1	SR 9 north of Lundeen Parkway	1,785	1,108	1,501	1,143	-15.9%	3.2%
2	SR 9 south of 20th Street SE	850	693	810	755	-4.8%	9.0%
3	US 2 Eastbound east of I-5 interchange	-	4,483	-	3,982	NA	-11.2%
4	US 2 Westbound east of I-5 interchange	2,102	-	2,059	-	-2.0%	NA
	Total	**4,737**	**6,284**	**4,370**	**5,880**	**-7.8%**	**-6.4%**

Count sources by location #:
1. February 5, 2014, adjusted to May 2016
2. May 5, 2015, adjusted to May 2016
3. Permanent Recorder Data, May 2016
4. Permanent Recorder Data, May 2016

TABLE 3. COMPARISON OF OBSERVED AND ESTIMATED EXISTING (YEAR 2016) PM PEAK HOUR VOLUMES AT EAST/WEST SCREENLINE, EAST OF US 2 TRESTLE - SR9/SR204 INTERSECTION IMPROVEMENT PROJECT

		Observed Volumes		*Model Volumes*		*Ratio (Model/Obs)*	
#	Street	WB	EB	WB	EB	WB	EB
1	SR 204 east of US 2	840	2,268	920	1,943	9.6%	-14.3%
2	20th Street SE east of US 2	454	759	475	982	4.5%	29.4%
3	US 2 Westbound east of SR204 interchange	1,500	-	1,532	-	2.1%	NA
4	US 2 Eastbound east of SR204 interchange	-	1,833	-	1,822	NA	-0.6%
	Total	**2,794**	**4,860**	**2,927**	**4,747**	**4.8%**	**-2.3%**

Count sources by location #:
1. 2011 Snohomish County Screenline Count, adjusted to 2016
2. 2010 Snohomish County Screenline Count, adjusted to 2016
3. Year 2015 WSDOT Count, adjusted to 2016
4. Year 2015 WSDOT Count, adjusted to 2016

Legend

	Validation results within ±10%
	Validation results > ±10% and < ±20%
	Validation results > ±20%

FUTURE YEAR MODEL DEVELOPMENT

This section presents future year transportation network and land use assumptions for 2021 (design year) and 2040 (horizon year).

Tolling/congestion pricing for major state highways was not assumed for any of the future year modelling scenarios. The PSRC indicates that recent efforts with their 2040 Futures model show that regional highway tolling would result in less overall traffic on SR 9 and SR 204 compared to a non-tolled scenario. This suggests that the non-tolled SnoCo model is a more conservative reflection of demand. WSDOT project team members agreed to this approach in by email correspondence (September 13, 2017).

NETWORK MODIFICATIONS

The future year scenario of the Snohomish County Model uses a 2035 transportation network that includes capacity expansion projects included in regional and local transportation improvement programs (TIPs). To identify necessary network modifications for the 2021 design and 2040 horizon years, the project team reviewed the comprehensive plans and TIPs for the Cities of Lake Stevens and Everett, as well as for Snohomish County, Puget Sound Regional Council (Transportation 2040), and WSDOT. In addition, projects included in Sound Transit 2 (ST 2), Nickel, and TPA (Transportation Partnership Agreement) funding packages, and the Legislative Evaluation & Accountability Program (LEAP) transportation project list were reviewed. No changes to capacity or access along SR 9 and SR 204 within the study area were assumed for the 2021 design and 2040 horizon year no build models.

Table 4 includes a list of reasonably foreseeable roadway projects in the local area that were included in the 2021 design and 2040 horizon year travel demand model networks. The regional projects are identified by their Transportation 2040 Capacity Project ID numbers as well as their current approval status. Projects that are considered “Candidate” or “Approved” are included in the plan’s financial strategy and able to have funds programmed by PSRC for any project phase. Further, an “Approved” project has been cleared by the PSRC Executive board to proceed towards implementation, but a “Candidate” project still needs additional analysis performed before the Executive Board can take action. “Unprogrammed” projects are not included in the Transportation 2040 financial strategy and may only receive PSRC funds for planning and pre-design activities. WSDOT has noted that one of the Transportation 2040 projects along SR 9, a widening to 4/5 lanes from US 2 to Lake Stevens Road, could likely extend to Market Place. A sensitivity test including this modification was run and documented in the SR 9 Widening Model Sensitivity Memorandum.

Several major transit improvements were also included in the 2040 horizon year travel demand model network. These improvements included expansion of Community Transit’s Swift BRT system, expansion of local transit service to Lake Stevens as specified in the 2016 – 2021 Transit Development Plan (new Routes 109 and 209), and eventual light rail extensions, including the segment between Seattle and Everett.

Table 4: Planned / Funded Projects Included in Future Models

ID	Project Description	Design (2021)	Horizon (2040)	Current Status
Regional Projects[1]				
4206	SR 9 from 176th Street SE to SR 96 – widen to 4/5 lanes	✓	✓	Candidate
4208	SR 9 from US 2 to Lake Stevens Road – widen to 4/5 lanes		✓	Candidate
5433	SR 9 / US 2 interchange improvements – reconstruct interchange as tight diamond		✓	Candidate
5432	SR 9 from Snohomish River Bridge to US 2 – widen to 4 lanes		✓	Candidate
5431	Snohomish River Bridge Replacement – replace existing 2 lane structure with 4 lane bridge		✓	Candidate
4207	SR 9 from Marsh Road to Snohomish River Bridge – widen to 4 lanes		✓	Candidate
4415	SR 99 from 148th Street SW to Airport Road – add BAT lanes	✓	✓	Candidate
4412	US 2 Trestle Phase 1 – build new westbound structure with 2 general purpose and 1 HOV lane from SR 204 to I-5	✓	✓	Candidate
5324	US 2 Trestle Phase 2 – build new eastbound structure with 2 general purpose and 1 HOV lane from I-5 to SR 204		✓	Unprogrammed
5444	US 2 Monroe Bypass Phase 1 – construct 2 lane extension from US 2 (west of SR 522 interchange) to Chain Lake Road		✓	Candidate
1620	US 2 Monroe Bypass Phases 2 and 3 – complete bypass from Chain Lake Road to US 2 near east City limits and widen to 4 lanes		✓	Unprogrammed
4175	US 2 from SR 204 to Bickford Road – widen mainline from 2 to 4 lanes		✓	Candidate
4176	US 2 from Bickford Road to future Monroe Bypass (west) – widen mainline from 2 to 4 lanes		✓	Unprogrammed
4177	US 2 from Monroe Bypass (east) to Sultan west City limits – widen from 2 to 4 lanes		✓	Unprogrammed
4178	US 2 within Sultan – widen from 2 to 4 lanes		✓	Unprogrammed
1704	US 2 from Sultan east City limits to Gold Bar west City limits – widen from 2 to 4 lanes		✓	Unprogrammed
5419	US 2 within Gold Bar – widen from 2 to 4 lanes		✓	Unprogrammed
4257	SR 522 / Paradise Lake Road Interchange – construct grade separated diamond interchange	✓	✓	Candidate
2380	SR 522 / NE 195th Street Interchange – construct second half of existing half-diamond interchange		✓	Unprogrammed
1698	SR 522 from Paradise Lake Road to Snohomish River – widen from 2 to 4 lanes		✓	Candidate
4260	SR 524 from 35th / 39th Street to SR 522 – widen to 5 lanes		✓	Unprogrammed
4259	SR 524 from SR 527 to 35th / 39th Street – widen to 5 lanes		✓	Unprogrammed
1714	SR 524 from 24th Avenue to SR 527 – widen to 5 lanes		✓	Approved

ID	Project Description	Design (2021)	Horizon (2040)	Current Status
1639	SR 531 from 43rd Avenue to SR 9 – widen to 4 lanes		✓	Candidate
4396	I-405 Corridor from SR 522 to I-5 – (a) Add 2 lanes NB and SB, except 1 lane NB between NE 195th Street and SR 527 where NB lane previously built, resulting in 5 lanes (1 HOV & 4 GP or 2 HOV & 3 GP) in each direction.		✓	Candidate
1624	I-5 from 220th Street SW to 44th Avenue W – add northbound auxiliary lane		✓	Candidate
4631	I-5 / 44th Avenue N interchange improvements – Completion of existing half diamond interchange by adding access to the north; includes two braided ramps.	✓	✓	Candidate
4278	I-5 / 196th Street / SR 524 interchange improvements – adds a braided ramp NB		✓	Candidate
1706	I-5 / SR 96 / 128th Street SW interchange improvements – Reconstruct interchange as SPUI		✓	Unprogrammed
4006	I-5 / 100th Street SE / Everett Mall interchange – construct new under crossing along 100th Street SE with NB/SB direct access ramp to I-5 for HOV		✓	Candidate
1945	I-5 / 88th Street N interchange improvements – Reconstructs an existing diamond interchange into a Single Point Urban Interchange with greater capacity	✓	✓	Candidate
	I-5 Hard Shoulder Running between Everett and Marysville		✓	
4410	I-5 / SR 529 interchange improvements – Complete current half interchange by constructing a new I-5 northbound off-ramp onto SR 529 and new southbound on-ramps from SR 529 to I-5		✓	Candidate
5429	I-5 / 116th Street NE interchange improvements – Reconstructs an existing diamond interchange into a Single Point Urban Interchange with greater capacity	✓	✓	Candidate
Local Projects[2]				
D(1C)	SR 92 / Grade Road intersection – convert to roundabout		✓	Six-year TIP: finish by 2021
7(1)	20th Street SE – widen from 2 to 4 lanes from 83rd Avenue SE to 91st Avenue SE	✓	✓	Six-year TIP: finish by 2020
7(3)	20th Street SE – widen from 2 to 4 lanes from US 2 to 83rd Avenue SE		✓	Six-year TIP: finish after 2021
2(2)	91st Avenue SE – widen from 2 to 3 lanes from 20th Street SE to 4th Street SE		✓	Six-year TIP: finish after 2021
2(3)	91st Avenue SE – new 2 lane connector from 20th Street SE to 24th Street SE	✓	✓	Six-year TIP: finish by 2020
14(7)	99th Avenue SE – widen from 2 to 3 lanes from 20th Street SE to 4th Street SE		✓	Six-year TIP: finish after 2021

ID	Project Description	Design (2021)	Horizon (2040)	Current Status
14(8)	99th Avenue SE – widen from 2 to 3 lanes from 20th Street SE to Lake Stevens Road		✓	Six-year TIP: finish after 2021
D(1A)	20th Street NE / Grade Road intersection – provide additional turn pockets or convert to roundabout		✓	Six-year TIP: finish after 2021
D(1B)	Grade Road – widen from 2 to 3 lanes from 20th Street SE to SR 92		✓	Six-year TIP: finish after 2021
12(5)	91st Avenue NE / Vernon Road intersection – minor widening and safety improvements	✓	✓	Six-year TIP: finish by 2018
15(2)	Lundeen Parkway / Vernon Road intersection – safety improvements, may restrict E/W traffic		✓	Six-year TIP: finish by 2021
15(1)	Vernon Road – widen segment from 91st Avenue NE to SR 9 to provide turn pocket		✓	Six-year TIP: finish after 2021
N/A[3]	20th Street Extension from Bickford Avenue to Lake Avenue – new 2 lane roadway with signalized intersection at SR 9	✓[3]	✓[3]	Six-year TIP: finish by 2017
Local Access Projects to Occur with Development (or Redevelopment)[2]				
3	90th Avenue NE – new connector providing right-in right-out movement on EB SR 204		✓	Six-year TIP: finish after 2021
6(2)	24th Street SE – new 2 lane roadway segment from 73rd Avenue SE to 79th Avenue SE		✓	Six-year TIP: finish after 2021
6(3)	24th Street SE – new 2 lane roadway segment from 91st Avenue SE to SR 9	✓	✓	Six-year TIP: finish by 2017

[1] As listed in Transportation 2040 Appendix N: Regional Capacity Projects. Last amended in 2015. Some projects like ramp metering in Marysville are not listed because they do not impact the regional travel demand forecasting modeling results.
[2] As listed in City of Lake Stevens Six-Year Transportation Improvement Program (2016 – 2021), unless otherwise noted.
[3] As listed in City of Snohomish Six-Year Transportation Improvement Program (2015 – 2020).

LAND USE

The 2021 and 2040 year land use estimates for the travel demand model were derived using annualized growth assumptions between current year and the 2035 planning horizon of the Snohomish County Comprehensive Plan. The 2035 land us forecast was reviewed for consistency with the official PSRC release of regional land use forecasts (the Land Use Targets) and revised to include input from Lake Stevens staff. Snohomish County Staff provided year 2035 aggregated households and employment estimates for the Lake Stevens Center subarea, the Lake Stevens city limits, and the entire County. This land use summary was reviewed by the Lake Stevens planning and public works staff, and updates were suggested to make the 2035 forecasts consistent with the Lake Stevens Comprehensive Plan and the Lake Stevens Center Subarea Plan. 2035 model land use totals and suggested revisions are summarized in **Table 5**.

TABLE 5. 2016 AND 2035 LAND USE SUMMARY – SNOCO MODEL UPDATE

Area	2015 SnoCo Comprehensive Plan Baseline		Revised 2016		2035 SnoCo Comprehensive Plan		Revised 2035	
	HH	EMP	HH	EMP	HH	EMP	HH	EMP
Lake Stevens Center Subarea	1,710	2,120	1,771	1,863	2,270	2,900	2,510	2,981
Lake Stevens Citywide	9,220	4,090	9,550	3,594	13,460	7,210	14,883	7,412
All Snohomish County	268,325	244,879	268,325	244,879	364,463	396,273	364,463	396,273
Notes: HH = total households EMP = total employment								

The 2021 and 2040 land use inputs were derived using the average annual growth rate (by TAZ) for the period between the revised 2016 and revised 2035 land use. The 2040 land use was created by scaling the 2035 production and attraction file tables by the TAZ average annual growth rates for a period of five years. Similarly, the 2021 land use was created by scaling the 2016 productions and attractions tables. As previously described, direct access to the detailed model land use files by non-Snohomish County Staff is prohibited due to privacy restrictions imposed by the Washington State Employment Security Department. This process of directly modifying the production and attraction files can replicate the same outcome of adding or removing generalized land use totals to the model inputs while retaining privacy requirements for the actual land use totals.

FORECAST YEARS AND PROJECT ALTERNATIVES

The analysis years for this project include an existing year (2016), opening year (2021), and horizon year (2040). The following project alternatives were analyzed as part of the second-level alternatives screening process:

- **No Build Alternative** – Includes planned projects, but no additional improvements in the study area.
- **Concept B** – Includes three roundabouts intersections along SR 9 at Vernon Road/Davies Road, SR 204, and 4th Street NE, as well as grade separation of north-south SR 9 through lanes at at Vernon Road/Davies Road and SR 204. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the exsiting shopping center drive ailses from Davies Road to 4th Street NE.

- **Concept C** – Addition of a northbound right-turn slip ramp from SR9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the exsiting shopping center drive ailses from Davies Road to 4th Street NE.
- **Concept E** – Includes addition of through lane on SR9 from Lundeen Parkway to south of Market Place and a tight diamond interchange at SR 204 with grade-separation for the north-south through lanes. Addition of a northbound right-turn slip ramp from SR9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the exsiting shopping center drive ailses from Davies Road to 4th Street NE.
- **Concept E2A** – Same at Concept E with no widening of SR 9.
- **Concept E2B** – Same at Concept E with no widening of SR 9 to the north of SR 204.
- **Concept E2B Variation 4 (Preferred Alternative)**– Same at Concept E2B but Vernon Road would remain connected to the east leg of the SR 9 / SR 204 intersection in similar manner to existing conditions. Village way would not be added under this concept, but 92nd Avenue NE would be closed and removed.
- **Concept E2C** – Same at Concept E with no widening of SR 9 and an added half interchange at Davies Road with a two-way overcrossing to Vernon Road on the west side of SR 9. Village way would not be added under this concept, but 92nd Avenue NE would still be closed and Vernon Road would still be terminated in a cul-de-sac to the north of 7th Place NE.
- **Concept E2D** – Same at Concept E2C with widening on SR9 from Lundeen Parkway to south of Market Place.
- **Concept H** – Includes grade-separation for the north-south through lanes on SR 9 through the SR 204 intersection with and a roundabout interchange. Addition of a northbound right-turn slip ramp from SR9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the exsiting shopping center drive ailses from Davies Road to 4th Street NE.
- **Concept G2B** – Includes grade-separation of the left-turn lane from eastbound SR 204 to northbound SR 9, diverging upstream of the 91st Avenue NE intersection. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the exsiting shopping center drive ailses from Davies Road to 4th Street NE.

None of these alternatives was expected to reduce or induce travel demand into the study area compared to the 2040 No Build condition. While demand into and out of the study area was assumed to be the same as No Build for all project alternatives, distribution and routing through the study area network differed for each scenario. The post-processing and routing methodology used for each alternative is described in the following section.

FORECAST DEVELOPMENT AND POST-PROCESSING

Traffic volume forecasts were developed for input into the VISSIM models using origin-destination (O-D) matrix estimation processes described in the WSDOT VISSIM Protocol. As part of this process, a VISUM model is developed to translate trip growth from the travel demand model (SnoCo Model) to route inputs that can be used for the VISSIM operations model. The steps used to develop these forecasts are detailed in the following sections.

STEP 1: EMME SUBAREA EXTRACTION

Subarea networks models were extracted from the 2016 existing, 2021 design, and 2040 horizon year Emme forecasting model (SnoCo Model). These subarea networks correspond with the limits of the study area and allow for the output of simplified zone-to-zone O-D demand matrices for the 3-hour AM and PM peak periods. An example of the extracted subarea network model is shown in **Figure 4**. In total, the subarea model has 21 internal and external zones.

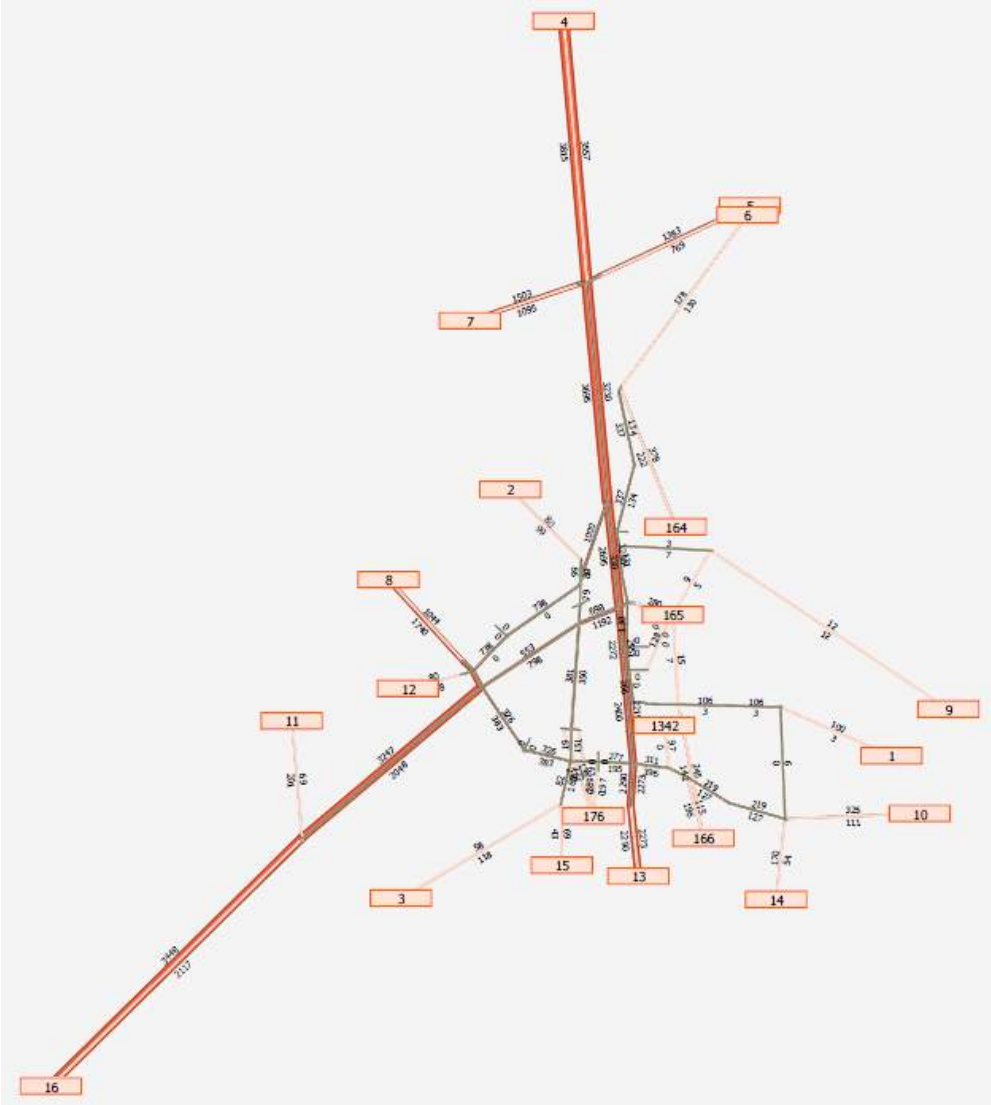


Figure 4: Emme Subarea Extraction Network

STEP 2: VISUM ORIGIN-DESTINATION MATRIX ESTIMATION

A detailed VISUM model was developed, representing all study area public roadways and internal/external access points, also known as gateways. In this model, shown in **Figure 5**, external gateways, which connect to regional and local facilities outside of the study area, are numbered 1 – 17. The remaining gateways (17 – 35) are internal access points and driveways to local land uses, such as retail plazas and apartment complexes.

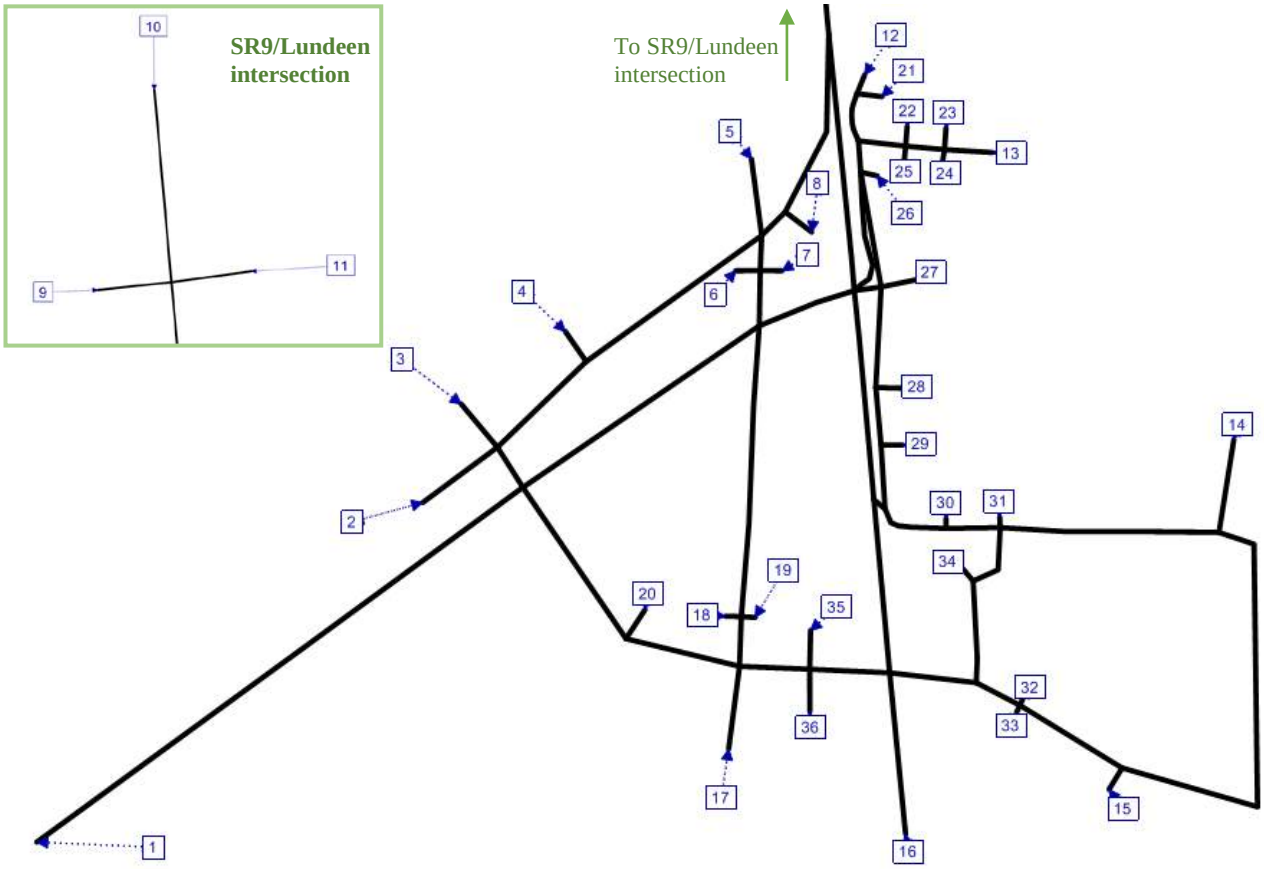


Figure 5: Visum Model Network and Gateways

Next, the O-D matrix from the Emme subarea extraction was converted from the 21 zone travel demand model structure to the 35 gateway VISUM structure. To do this, O-D matrix demand for internal zones in the Emme subarea model was split amongst corresponding internal gateways in the VISUM model, using driveway counts and field observations to guide distribution, where available. The matrices were scaled from a 3-hour peak period to a 1-hour peak using a factor of 0.365.

For the 2016 condition, a base year O-D matrix reflecting existing counts was developed by taking the O-D matrix from the Emme subarea (expanded to the 35 gateway format) and running the TFlowFuzzy function in Visum. TFlowFuzzy recalculates the O-D matrix to match observed turning movement counts at network intersections as closely as possible.

To generate 2021 and 2040 O-D matrices, a technique know as the “difference method” was used. The difference method minimizes the influence of localized model error (like that observed for the existing 2016 screenline validation). Rather than taking the direct output from the future year model (which generally carries forward assignment error from the existing year model), the difference method calculates the growth between the existing year and the future year models, and adds that growth to an observed traffic count. For example, assume a road has an existing hourly volume of 500 vehicles. If the

existing year model showed a volume of 400 vehicles, and the future year model showed a volume of 650 vehicles, 250 vehicles would be added to the existing count for a future volume forecast of 750 vehicles. Similarly, the difference between the existing and future year model O-D matrices was calculated and added to the "observed" existing year O-D matrix (estimated with TFlowFuzzy).

The resulting 2021 and 2040 O-D matrices were reviewed to ensure reasonable growth levels. Initial O-D pair values with negative growth were set to zero, assuming that traffic would not decrease between any two gateways. The final peak hour O-D matrices are provided in the Forecast Summary section.

STEP 3: VISSIM ROUTES AND TURNING MOVEMENTS

The final future year peak hour matrices described in the previous section were assigned to the VISUM study network to determine routing inputs for the VISSIM model and generate turning movements forecasts for display. The gateway and node numbers in the VISUM network needed to exactly match the the equivalent components of the VISSIM model networks. Because each alternative would allow for somewhat different routing patterns compared to No Build (such as the added northbound right slip ramp from SR 9 to 4th Street NE) and would require a distinct VISSIM network, a separate VISUM network was constructed for each alternative in order to conduct the routing assignments. Turning movement forecasts were extracted from the VISUM network for each scenario. These results are provided in the Forecast Summary section.

FORECAST SUMMARY

Summaries of Origin-Destination (O-D) demand matrices and turning movement forecasts are provided in the following sections.

ORIGIN-DESTINATION MATRICES

The final O-D demand matrices are output from Step 2 of the forecast development process. Each matrix represents a peak hour vehicle demand volumes between the and internal and external model gateways, shown in **Figure 5**. The AM peak hour matrices for existing year 2016, opening year2021, and horizon year 2040 are shown, respectively in **Figures 6**, **7**, and **8**. Likewise, PM peak hour matrices for are shown in **Figures 9**, **10**, and **11**. The total number of O-D trip ends is expected to grow by 7% during the PM peak hour between 2016 and 2021 and by a total of 24% by 2040.

Figure 6

2016 Origin-Destination Matrix - AM Peak Hour | Determined using TFlowFuzzy | SR9/SR204 Intersection Improvement Project

		Destination Zone																																			
	VISUM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	**TOTAL**
Origin Zone	1	0.00	0.01	51.83	0.05	1.74	2.02	2.02	0.36	0.04	154.19	80.37	0.20	0.22	0.00	1.43	7.37	0.41	0.94	0.94	6.01	12.02	0.09	0.30	6.92	1.70	1.79	26.39	1.60	1.60	0.83	0.25	2.35	2.35	0.02	0.22	0.22	368.84
	2	0.13	0.00	14.04	7.98	2.25	2.62	2.62	0.47	0.05	0.69	0.23	0.26	0.29	0.00	0.06	12.67	33.21	0.11	0.11	0.68	0.26	0.00	0.01	0.26	0.06	0.07	1.01	0.06	0.06	0.03	0.02	0.26	0.26	0.06	0.03	0.03	80.96
	3	216.08	5.97	0.00	6.94	0.72	0.84	0.84	0.15	0.02	0.03	0.04	0.08	0.09	0.00	0.08	1.17	4.95	0.02	0.02	0.15	0.08	0.00	0.00	0.08	0.02	0.02	0.32	0.02	0.02	0.01	0.01	0.04	0.04	0.00	0.01	0.01	238.90
	4	0.40	1.00	11.05	0.00	3.01	0.63	0.63	2.00	0.59	1.12	1.31	3.01	3.32	9.98	0.40	27.11	11.06	0.11	0.11	0.71	3.01	0.02	0.08	1.50	0.37	0.39	5.74	0.35	0.35	0.18	0.15	0.40	0.40	0.04	0.03	0.03	90.60
	5	15.55	0.21	2.12	4.94	0.00	0.11	0.11	0.07	0.10	0.20	0.23	0.52	0.58	1.74	0.16	8.73	17.18	11.67	11.67	0.77	0.52	0.00	0.01	0.26	0.06	0.07	1.00	0.06	0.06	0.03	0.03	0.16	0.16	0.02	0.67	0.67	80.46
	6	14.06	0.19	1.92	0.69	0.09	0.00	0.10	0.02	0.09	0.18	0.21	0.47	0.52	1.57	0.14	7.90	15.54	10.55	10.55	0.70	0.47	0.00	0.01	0.24	0.06	0.06	0.90	0.05	0.05	0.03	0.02	0.14	0.14	0.02	0.61	0.61	68.90
	7	14.06	0.19	1.92	0.69	0.09	0.10	0.00	0.02	0.09	0.18	0.21	0.47	0.52	1.57	0.14	7.90	15.54	10.55	10.55	0.70	0.47	0.00	0.01	0.24	0.06	0.06	0.90	0.05	0.05	0.03	0.02	0.14	0.14	0.02	0.61	0.61	68.90
	8	4.28	0.06	0.58	0.21	0.27	0.03	0.03	0.00	0.03	0.05	0.06	0.14	0.16	0.48	0.04	2.40	4.73	3.21	3.21	0.21	0.14	0.00	0.00	0.07	0.02	0.02	0.27	0.02	0.02	0.01	0.01	0.04	0.04	0.00	0.18	0.18	21.25
	9	0.02	0.00	0.00	1.66	2.21	0.24	0.24	0.80	0.00	50.00	64.99	0.06	0.07	0.21	0.01	0.02	0.10	0.02	0.02	0.00	0.06	0.00	0.00	0.03	0.01	0.01	0.12	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.03	0.03	121.03
	10	181.37	0.14	0.01	7.18	9.53	1.06	1.06	3.47	47.05	0.00	5.98	0.28	0.31	0.93	2.38	456.59	44.06	15.28	15.28	0.32	0.28	0.00	0.01	11.72	2.88	3.03	44.71	2.71	2.71	1.40	1.20	5.03	5.03	0.57	23.78	23.78	921.10
	11	135.21	0.01	0.01	9.28	12.32	1.36	1.36	4.48	83.10	37.79	0.00	0.36	0.40	1.20	0.69	150.68	12.05	6.05	6.05	0.13	0.36	0.00	0.01	3.97	0.97	1.03	15.14	0.92	0.92	0.47	0.41	1.46	1.46	0.09	9.42	9.42	508.59
	12	0.28	0.00	0.04	1.70	0.21	0.25	0.25	0.04	0.45	0.86	1.01	0.00	10.38	0.00	0.83	0.37	10.34	0.66	0.66	0.01	9.77	6.62	23.10	4.70	1.15	0.42	1.45	0.09	0.01	0.00	0.02	0.21	0.21	0.02	0.89	0.89	77.90
	13	0.89	0.01	0.12	5.34	0.66	0.77	0.77	0.14	1.42	2.71	3.16	1.23	0.00	0.01	0.33	1.17	4.63	1.04	1.04	0.02	2.45	1.99	1.03	16.36	0.83	3.93	12.93	0.78	0.06	0.00	0.16	0.33	0.33	0.07	1.40	1.40	69.50
	14	0.17	0.00	0.02	2.01	0.25	0.29	0.29	0.05	0.09	31.24	15.00	0.76	0.83	0.00	0.10	0.06	0.48	0.42	0.42	0.01	0.76	0.01	0.02	0.38	0.09	0.10	1.44	0.09	2.04	0.06	20.12	0.10	0.10	0.29	0.15	0.15	78.37
	15	10.77	0.10	3.95	0.57	0.03	0.03	0.03	0.01	0.02	0.07	0.04	0.15	0.17	0.10	0.00	0.16	5.02	7.66	7.66	0.12	0.15	0.00	0.00	0.08	0.02	0.02	0.29	0.02	0.04	0.00	0.10	2.19	2.19	2.34	2.65	2.65	49.42
	16	0.16	0.49	4.30	2.79	1.14	1.33	1.33	0.24	0.03	313.66	61.77	0.27	0.29	0.00	0.06	0.00	15.21	0.41	0.41	0.01	13.02	0.09	0.33	9.82	2.41	2.54	37.46	2.27	2.27	0.01	0.76	7.82	7.82	0.70	0.14	0.14	491.52
	17	0.12	5.13	3.42	7.83	14.87	17.33	17.33	3.09	0.04	13.75	6.14	0.30	0.33	0.01	4.96	31.18	0.00	8.59	8.59	0.06	0.30	0.00	0.01	0.30	0.07	0.08	1.13	0.07	0.07	0.00	0.23	4.96	4.96	0.15	0.05	0.05	155.49
	18	1.05	0.05	0.25	0.14	0.04	0.05	0.05	0.01	0.15	25.13	12.00	0.77	0.85	0.02	3.63	5.32	0.10	0.00	0.10	0.00	0.77	0.01	0.02	0.38	0.09	0.10	1.46	0.09	0.09	0.00	0.20	2.42	2.42	0.26	0.08	0.08	58.18
	19	1.05	0.05	0.25	0.14	0.04	0.05	0.05	0.01	0.15	25.13	12.00	0.77	0.85	0.02	3.63	5.32	0.10	0.10	0.00	0.00	0.77	0.01	0.02	0.38	0.09	0.10	1.46	0.09	0.09	0.00	0.20	2.42	2.42	0.26	0.08	0.08	58.18
	20	23.11	1.12	5.57	3.19	0.28	0.33	0.33	0.06	0.01	1.09	0.52	0.03	0.04	0.00	0.17	0.25	1.04	0.02	0.02	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.06	0.00	0.00	0.00	0.01	0.11	0.11	0.01	0.00	0.00	37.56
	21	39.30	0.02	0.04	1.70	0.21	0.25	0.25	0.04	0.45	0.86	1.01	11.57	10.38	0.00	0.10	27.28	1.48	0.66	0.66	0.01	0.00	0.07	0.24	4.70	1.15	0.42	1.38	0.08	0.01	0.00	0.02	0.21	0.21	0.02	0.45	0.45	105.67
	22	12.37	0.00	0.01	0.54	0.07	0.08	0.08	0.01	0.14	0.27	0.32	14.28	0.25	0.00	0.03	8.59	0.46	0.21	0.21	0.00	0.12	0.00	0.01	0.11	0.03	0.13	0.43	0.03	0.00	0.00	0.01	0.07	0.07	0.01	0.14	0.14	39.22
	23	7.89	0.00	0.01	0.34	0.04	0.05	0.05	0.01	0.09	0.17	0.20	9.10	0.83	0.00	0.02	5.47	0.30	0.13	0.13	0.00	0.08	0.06	0.00	6.10	0.02	0.08	0.28	0.02	0.00	0.00	0.00	0.04	0.04	0.00	0.18	0.18	31.94
	24	5.32	0.00	0.02	0.67	0.08	0.10	0.10	0.02	0.18	15.24	7.51	0.15	9.17	0.00	0.04	7.32	1.16	0.13	0.13	0.00	0.15	0.12	7.02	0.00	0.03	0.16	0.54	0.03	0.00	0.00	0.01	0.08	0.08	0.01	0.35	0.35	56.27
	25	0.25	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.72	0.35	0.01	0.90	0.00	0.00	0.34	0.05	0.01	0.01	0.00	0.01	0.01	0.02	0.41	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	3.21
	26	3.24	0.00	0.01	0.41	0.05	0.06	0.06	0.01	0.11	9.28	4.57	0.77	0.85	0.00	0.02	4.46	0.70	0.08	0.08	0.00	0.77	0.01	0.02	0.39	0.09	0.00	0.33	0.02	0.00	0.00	0.00	0.02	0.02	0.01	0.11	0.11	26.66
	27	3.40	0.00	0.01	0.43	0.05	0.06	0.06	0.01	0.11	9.75	4.80	1.02	1.13	0.00	0.03	4.68	0.74	0.08	0.08	0.00	1.02	0.01	0.03	0.51	0.13	0.13	0.00	0.02	0.00	0.00	0.00	0.03	0.03	0.01	0.11	0.11	28.59
	28	10.00	0.00	0.03	1.25	0.16	0.18	0.18	0.03	0.12	10.03	4.94	0.94	1.04	2.86	0.07	1.38	0.48	0.24	0.24	0.01	0.94	0.01	0.02	0.47	0.12	0.12	1.80	0.00	0.10	0.05	0.04	0.07	0.07	0.13	0.07	0.07	38.26
	29	10.00	0.00	0.03	1.25	0.16	0.18	0.18	0.03	0.12	10.03	4.94	0.94	1.04	2.86	0.07	1.38	0.48	0.24	0.24	0.01	0.94	0.01	0.02	0.47	0.12	0.12	1.80	0.11	0.00	0.05	0.04	0.07	0.07	0.13	0.07	0.07	38.27
	30	12.71	0.00	0.04	1.59	0.20	0.23	0.23	0.04	0.15	12.75	6.28	1.20	1.32	5.54	0.13	2.68	0.84	0.37	0.37	0.01	1.20	0.01	0.03	0.60	0.15	0.15	2.28	0.14	3.24	0.00	0.09	0.13	0.13	0.25	0.13	0.13	55.34
	31	2.00	0.00	0.01	0.25	0.03	0.04	0.04	0.01	0.02	2.01	0.99	0.19	0.21	15.06	0.36	7.17	2.25	0.98	0.98	0.02	0.19	0.00	0.00	0.09	0.02	0.02	0.36	0.02	0.51	0.02	0.00	0.36	0.36	0.66	0.34	0.34	35.90
	32	5.93	0.59	1.98	0.57	0.03	0.03	0.03	0.01	0.02	4.71	2.20	0.15	0.17	0.10	1.00	23.81	7.53	3.28	3.28	0.05	0.15	0.00	0.00	0.08	0.02	0.02	0.29	0.02	0.04	0.00	0.10	0.00	0.10	0.13	0.38	0.38	57.17
	33	5.93	0.59	1.98	0.57	0.03	0.03	0.03	0.01	0.02	4.71	2.20	0.15	0.17	0.10	1.00	23.81	7.53	3.28	3.28	0.05	0.15	0.00	0.00	0.08	0.02	0.02	0.29	0.02	0.04	0.00	0.10	0.10	0.00	0.13	0.38	0.38	57.17
	34	0.00	0.01	0.13	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.05	0.02	0.17	0.15	0.15	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.03	0.00	0.08	0.05	0.05	0.00	0.15	0.15	1.36
	35	1.08	0.05	0.26	0.15	0.27	0.32	0.32	0.06	0.08	13.11	6.26	0.63	0.70	0.03	4.52	6.62	0.33	0.29	0.29	0.00	0.63	0.00	0.02	0.32	0.08	0.08	1.20	0.07	0.07	0.00	0.25	1.51	1.51	0.66	0.00	0.30	42.06
	36	1.08	0.05	0.26	0.15	0.26	0.30	0.30	0.05	0.08	13.11	6.26	0.63	0.70	0.03	4.52	6.62	0.33	0.29	0.29	0.00	0.63	0.00	0.02	0.32	0.08	0.08	1.20	0.07	0.07	0.00	0.25	1.51	1.51	0.33	0.10	0.00	41.49
	TOTAL	739.23	16.07	106.23	73.30	51.39	31.38	31.38	15.83	135.21	764.85	318.12	51.91	49.07	44.43	31.22	858.03	220.57	87.86	87.86	10.79	52.73	9.16	32.41	72.36	13.04	15.39	166.43	10.00	14.63	3.23	24.91	34.83	34.83	7.42	43.98	44.18	4304.25

Figure 7

2021 Origin-Destination Matrix - AM Peak Hour | Determined using Difference Method Calculation | SR9/SR204 Intersection Improvement Project

		Destination Zone																																		
	VISUM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	**TOTAL**
Origin Zone	1	0.00	0.01	64.33	0.05	1.74	2.02	2.02	0.36	0.04	335.69	85.47	0.20	0.22	0.00	1.53	7.37	0.41	1.74	1.74	6.81	12.82	0.89	2.10	8.72	3.50	2.29	26.89	2.10	2.10	1.33	0.75	2.85	2.85	5.42	5.62	1.72	593.74
	2	0.13	0.00	27.04	7.98	2.25	2.62	2.62	0.47	0.05	0.69	0.33	0.26	0.29	0.00	1.06	12.67	34.11	0.21	0.21	0.78	0.36	0.10	0.01	0.26	0.06	0.17	1.11	0.16	0.16	0.13	0.12	0.36	0.36	0.06	0.03	0.73	97.96
	3	218.18	9.87	0.00	6.94	0.72	0.84	0.84	0.15	0.02	0.03	0.04	0.08	0.09	0.00	0.18	1.17	5.15	0.02	0.02	0.15	0.08	0.00	0.00	0.08	0.02	0.02	0.32	0.02	0.02	0.01	0.01	0.04	0.04	0.10	0.11	0.31	245.70
	4	0.40	1.00	11.05	0.00	3.01	0.63	0.63	2.00	0.59	1.12	1.31	3.01	3.32	9.98	0.90	27.11	12.06	0.11	0.11	0.71	3.01	0.02	0.08	1.50	0.37	0.39	5.74	0.35	0.35	0.18	0.15	0.40	0.40	0.04	0.03	0.03	92.10
	5	15.55	0.21	2.12	4.94	0.00	0.11	0.11	0.07	0.10	0.20	0.23	0.52	0.58	1.74	0.66	8.73	18.18	11.67	11.67	0.77	0.52	0.00	0.01	0.26	0.06	0.07	1.00	0.06	0.06	0.03	0.03	0.16	0.16	0.02	0.67	0.67	81.96
	6	14.06	0.19	1.92	0.69	0.09	0.00	0.10	0.02	0.09	0.18	0.21	0.47	0.52	1.57	0.64	7.90	16.54	10.55	10.55	0.70	0.47	0.00	0.01	0.24	0.06	0.06	0.90	0.05	0.05	0.03	0.02	0.14	0.14	0.02	0.61	0.61	70.40
	7	14.06	0.19	1.92	0.69	0.09	0.10	0.00	0.02	0.09	0.18	0.21	0.47	0.52	1.57	0.64	7.90	16.54	10.55	10.55	0.70	0.47	0.00	0.01	0.24	0.06	0.06	0.90	0.05	0.05	0.03	0.02	0.14	0.14	0.02	0.61	0.61	70.40
	8	4.28	0.06	0.58	0.21	0.27	0.03	0.03	0.00	0.03	0.05	0.06	0.14	0.16	0.48	0.54	2.40	5.73	3.21	3.21	0.21	0.14	0.00	0.00	0.07	0.02	0.02	0.27	0.02	0.02	0.01	0.01	0.04	0.04	0.00	0.18	0.18	22.75
	9	0.02	0.00	0.00	1.66	2.21	0.24	0.24	0.80	0.00	53.00	92.59	0.06	0.07	0.21	0.01	0.02	0.10	0.02	0.02	0.00	0.06	0.00	0.00	0.03	0.01	0.01	0.12	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.03	0.03	151.63
	10	189.67	0.14	0.01	7.18	9.53	1.06	1.06	3.47	51.55	0.00	5.98	0.28	0.31	0.93	17.98	456.59	44.46	17.18	17.18	2.22	2.18	1.90	0.01	11.72	2.88	3.13	44.81	2.81	2.81	1.50	1.30	5.13	5.13	0.57	23.78	31.68	968.10
	11	141.21	0.41	0.01	9.28	12.32	1.36	1.36	4.48	89.30	37.79	0.00	0.36	0.40	1.20	3.69	186.78	12.05	6.25	6.25	0.33	0.56	0.20	0.01	3.97	0.97	1.03	15.14	0.92	0.92	0.47	0.41	1.46	1.46	0.29	9.62	12.62	564.89
	12	0.28	0.00	0.04	1.70	0.21	0.25	0.25	0.04	0.45	0.86	1.01	0.00	12.18	0.00	0.83	0.67	10.44	0.76	0.76	0.11	9.87	6.72	24.40	6.00	2.45	0.62	1.65	0.29	0.21	0.20	0.22	0.41	0.41	0.32	1.19	0.89	86.70
	13	0.89	0.01	0.12	5.34	0.66	0.77	0.77	0.14	1.42	2.71	3.16	1.33	0.00	0.01	0.33	1.17	4.63	1.04	1.04	0.02	2.45	1.99	1.13	16.46	0.93	4.03	13.03	0.88	0.16	0.10	0.26	0.43	0.43	0.07	1.40	1.40	70.70
	14	0.17	0.00	0.02	2.11	0.35	0.39	0.39	0.15	0.09	37.44	16.90	0.76	0.83	0.00	0.10	0.06	0.48	0.42	0.42	0.01	0.76	0.01	0.02	0.38	0.09	0.20	1.54	0.19	2.14	0.16	20.22	0.20	0.20	0.29	0.15	0.15	87.77
	15	23.77	1.50	3.95	0.57	0.03	0.03	0.03	0.01	0.02	2.87	0.44	0.15	0.17	0.10	0.00	0.16	5.02	8.86	8.86	1.32	1.35	1.20	0.00	0.08	0.02	0.12	0.39	0.12	0.14	0.10	0.20	2.29	2.29	2.54	2.85	3.85	75.42
	16	0.36	1.59	4.60	2.89	1.24	1.43	1.43	0.34	0.03	467.26	62.87	0.27	0.29	0.00	0.06	0.00	15.51	0.51	0.51	0.11	13.12	0.19	0.63	10.12	2.71	2.54	37.46	2.27	2.27	0.01	0.76	7.82	7.82	1.60	1.04	1.24	652.92
	17	0.12	5.13	4.82	8.03	15.07	17.53	17.53	3.29	0.04	32.85	9.14	0.40	0.33	0.01	4.96	31.18	0.00	8.59	8.59	0.06	0.30	0.00	0.41	0.70	0.47	0.28	1.33	0.27	0.27	0.20	0.43	5.16	5.16	0.15	0.05	0.35	183.19
	18	1.15	0.15	0.25	0.14	0.04	0.05	0.05	0.01	0.15	25.83	12.00	0.77	0.85	0.02	4.03	5.32	0.10	0.00	0.10	0.00	0.77	0.01	0.12	0.48	0.19	0.10	1.46	0.09	0.09	0.00	0.20	2.42	2.42	0.36	0.18	0.08	59.98
	19	1.15	0.15	0.25	0.14	0.04	0.05	0.05	0.01	0.15	25.83	12.00	0.77	0.85	0.02	4.03	5.32	0.10	0.10	0.00	0.00	0.77	0.01	0.12	0.48	0.19	0.10	1.46	0.09	0.09	0.00	0.20	2.42	2.42	0.36	0.18	0.08	59.98
	20	23.21	1.22	5.57	3.19	0.28	0.33	0.33	0.06	0.01	1.79	0.52	0.03	0.04	0.00	0.57	0.25	1.04	0.02	0.02	0.00	0.03	0.00	0.10	0.12	0.10	0.00	0.06	0.00	0.00	0.00	0.01	0.11	0.11	0.11	0.10	0.00	39.36
	21	39.40	0.12	0.04	1.70	0.21	0.25	0.25	0.04	0.45	1.56	1.01	11.57	10.38	0.00	0.50	27.28	1.48	0.66	0.66	0.01	0.00	0.07	0.34	4.80	1.25	0.42	1.38	0.08	0.01	0.00	0.02	0.21	0.21	0.12	0.55	0.45	107.47
	22	12.47	0.10	0.01	0.54	0.07	0.08	0.08	0.01	0.14	0.97	0.32	14.28	0.25	0.00	0.43	8.59	0.46	0.21	0.21	0.00	0.12	0.00	0.11	0.21	0.13	0.13	0.43	0.03	0.00	0.00	0.01	0.07	0.07	0.11	0.24	0.14	41.02
	23	10.09	0.10	0.01	0.34	0.04	0.05	0.05	0.01	0.09	0.17	0.20	13.00	0.93	0.00	0.22	8.67	0.50	0.23	0.23	0.10	0.18	0.16	0.00	6.10	0.02	0.08	0.28	0.02	0.00	0.00	0.00	0.04	0.04	0.00	0.18	0.18	42.34
	24	7.52	0.10	0.02	0.67	0.08	0.10	0.10	0.02	0.18	15.24	7.51	4.05	9.27	0.00	0.24	10.52	1.36	0.23	0.23	0.10	0.25	0.22	7.02	0.00	0.03	0.16	0.54	0.03	0.00	0.00	0.01	0.08	0.08	0.01	0.35	0.35	66.67
	25	2.45	0.10	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.72	0.35	3.91	1.00	0.00	0.20	3.54	0.25	0.11	0.11	0.10	0.11	0.11	0.02	0.41	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	13.61
	26	3.94	0.10	0.01	0.41	0.05	0.06	0.06	0.01	0.11	9.28	4.67	0.77	0.95	0.10	0.02	4.46	0.70	0.08	0.08	0.00	0.77	0.01	0.02	0.39	0.09	0.00	0.33	0.02	0.00	0.00	0.00	0.02	0.02	0.01	0.11	0.11	27.76
	27	4.10	0.10	0.01	0.43	0.05	0.06	0.06	0.01	0.11	9.75	4.90	1.02	1.23	0.10	0.03	4.68	0.74	0.08	0.08	0.00	1.02	0.01	0.03	0.51	0.13	0.13	0.00	0.02	0.00	0.00	0.00	0.03	0.03	0.01	0.11	0.11	29.69
	28	10.70	0.10	0.03	1.25	0.16	0.18	0.18	0.03	0.12	10.03	5.04	0.94	1.14	2.96	0.07	1.38	0.48	0.24	0.24	0.01	0.94	0.01	0.02	0.47	0.12	0.12	1.80	0.00	0.10	0.05	0.04	0.07	0.07	0.13	0.07	0.07	39.36
	29	10.70	0.10	0.03	1.25	0.16	0.18	0.18	0.03	0.12	10.03	5.04	0.94	1.14	2.96	0.07	1.38	0.48	0.24	0.24	0.01	0.94	0.01	0.02	0.47	0.12	0.12	1.80	0.11	0.00	0.05	0.04	0.07	0.07	0.13	0.07	0.07	39.37
	30	13.41	0.10	0.04	1.59	0.20	0.23	0.23	0.04	0.15	12.75	6.38	1.20	1.42	5.64	0.13	2.68	0.84	0.37	0.37	0.01	1.20	0.01	0.03	0.60	0.15	0.15	2.28	0.14	3.24	0.00	0.09	0.13	0.13	0.25	0.13	0.13	56.44
	31	2.70	0.10	0.01	0.25	0.03	0.04	0.04	0.01	0.02	2.01	1.09	0.19	0.31	15.16	0.36	7.17	2.25	0.98	0.98	0.02	0.19	0.00	0.00	0.09	0.02	0.02	0.36	0.02	0.51	0.02	0.00	0.36	0.36	0.66	0.34	0.34	37.00
	32	6.63	0.69	1.98	0.57	0.03	0.03	0.03	0.01	0.02	4.71	2.30	0.15	0.27	0.20	1.00	23.81	7.53	3.28	3.28	0.05	0.15	0.00	0.00	0.08	0.02	0.02	0.29	0.02	0.04	0.00	0.10	0.00	0.10	0.13	0.38	0.38	58.27
	33	6.63	0.69	1.98	0.57	0.03	0.03	0.03	0.01	0.02	4.71	2.30	0.15	0.27	0.20	1.00	23.81	7.53	3.28	3.28	0.05	0.15	0.00	0.00	0.08	0.02	0.02	0.29	0.02	0.04	0.00	0.10	0.10	0.00	0.13	0.38	0.38	58.27
	34	3.80	0.01	0.13	0.18	0.10	0.10	0.10	0.10	0.00	1.40	0.00	0.01	0.01	0.01	0.15	0.22	0.17	0.25	0.25	0.10	0.11	0.10	0.00	0.00	0.00	0.00	0.02	0.00	0.03	0.00	0.08	0.05	0.05	0.00	0.15	0.15	7.86
	35	4.88	0.05	0.26	0.25	0.37	0.42	0.42	0.16	0.08	14.51	6.26	0.63	0.70	0.03	4.62	6.82	0.33	0.39	0.39	0.10	0.73	0.10	0.02	0.32	0.08	0.08	1.20	0.07	0.07	0.00	0.25	1.51	1.51	0.66	0.00	0.30	48.56
	36	1.08	0.05	0.26	0.15	0.26	0.30	0.30	0.05	0.08	13.11	6.26	0.63	0.70	0.03	4.52	6.62	0.33	0.29	0.29	0.00	0.63	0.00	0.02	0.32	0.08	0.08	1.20	0.07	0.07	0.00	0.25	1.51	1.51	0.33	0.10	0.00	41.49
	TOTAL	789.13	24.47	133.43	73.90	51.99	31.98	31.98	16.43	145.91	1137.35	358.12	63.81	51.97	45.23	56.32	904.43	228.07	92.76	92.76	15.69	57.63	14.06	36.81	76.76	17.44	16.79	167.83	11.40	16.03	4.63	26.31	36.23	36.23	15.02	51.58	60.38	4990.85

Figure 8

2040 Origin-Destination Matrix - AM Peak Hour | Determined using Difference Method Calculation | SR9/SR204 Intersection Improvement Project

		Destination Zone																																		
	VISUM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	**TOTAL**
Origin Zone	1	0.00	0.01	64.33	0.05	1.74	2.02	2.02	0.36	0.04	544.19	240.27	13.10	0.22	0.00	1.83	7.67	0.41	3.24	3.24	8.31	14.32	2.39	3.70	10.32	5.10	3.49	28.09	3.30	3.30	2.53	1.95	4.05	4.05	5.42	5.62	3.32	994.04
	2	0.13	0.00	42.34	7.98	2.25	2.62	2.62	0.47	0.05	1.39	0.53	0.26	0.29	0.00	2.76	16.67	34.61	0.61	0.61	1.18	0.76	0.50	0.31	0.56	0.36	0.17	1.11	0.16	0.16	0.13	0.12	0.36	0.36	0.26	0.23	1.23	124.16
	3	218.18	22.87	0.00	6.94	0.72	0.84	0.84	0.15	0.02	0.03	0.04	0.08	0.09	0.00	1.08	1.37	6.15	0.12	0.12	0.25	0.18	0.10	0.00	0.08	0.02	0.02	0.32	0.02	0.02	0.01	0.01	0.04	0.04	0.10	0.11	0.81	261.80
	4	0.40	1.00	11.05	0.00	3.01	0.63	0.63	2.00	0.59	1.12	1.31	3.01	3.32	9.98	2.20	34.91	12.76	0.21	0.21	0.81	3.11	0.12	0.18	1.60	0.47	0.39	5.74	0.35	0.35	0.18	0.15	0.40	0.40	0.14	0.13	0.23	103.10
	5	15.55	0.21	2.12	4.94	0.00	0.11	0.11	0.07	0.10	0.20	0.23	0.52	0.58	1.74	1.96	16.53	18.88	11.77	11.77	0.87	0.62	0.10	0.11	0.36	0.16	0.07	1.00	0.06	0.06	0.03	0.03	0.16	0.16	0.12	0.77	0.87	92.96
	6	14.06	0.19	1.92	0.69	0.09	0.00	0.10	0.02	0.09	0.18	0.21	0.47	0.52	1.57	1.94	15.70	17.24	10.65	10.65	0.80	0.57	0.10	0.11	0.34	0.16	0.06	0.90	0.05	0.05	0.03	0.02	0.14	0.14	0.12	0.71	0.81	81.40
	7	14.06	0.19	1.92	0.69	0.09	0.10	0.00	0.02	0.09	0.18	0.21	0.47	0.52	1.57	1.94	15.70	17.24	10.65	10.65	0.80	0.57	0.10	0.11	0.34	0.16	0.06	0.90	0.05	0.05	0.03	0.02	0.14	0.14	0.12	0.71	0.81	81.40
	8	4.28	0.06	0.58	0.21	0.27	0.03	0.03	0.00	0.03	0.05	0.06	0.14	0.16	0.48	1.84	10.20	6.43	3.31	3.31	0.31	0.24	0.10	0.10	0.17	0.12	0.02	0.27	0.02	0.02	0.01	0.01	0.04	0.04	0.10	0.28	0.38	33.75
	9	0.02	0.00	0.00	1.66	2.21	0.24	0.24	0.80	0.00	73.10	97.19	0.06	0.07	0.21	0.01	0.02	0.10	0.02	0.02	0.00	0.06	0.00	0.00	0.03	0.01	0.01	0.12	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.03	0.03	176.33
	10	275.27	0.14	0.01	7.18	9.53	1.06	1.06	3.47	73.75	0.00	5.98	0.28	0.31	0.93	63.08	456.59	80.36	17.88	17.88	2.92	2.88	2.60	0.01	11.72	2.88	3.13	44.81	2.81	2.81	1.50	1.30	5.13	5.13	0.57	23.78	53.38	1182.10
	11	141.41	1.91	0.01	9.28	12.32	1.36	1.36	4.48	96.40	37.79	0.00	0.36	0.40	1.20	6.09	187.48	18.35	6.95	6.95	1.03	1.26	0.90	0.01	3.97	0.97	1.93	16.04	1.82	1.82	1.37	1.31	2.36	2.36	4.89	14.22	18.22	608.59
	12	4.58	0.00	0.04	1.70	0.21	0.25	0.25	0.04	0.45	0.86	1.01	0.00	14.08	0.00	3.43	54.47	14.34	0.96	0.96	0.31	10.07	6.92	29.10	10.70	7.15	2.22	3.25	1.89	1.81	1.80	1.82	2.01	2.01	2.82	3.69	5.19	190.40
	13	0.89	0.01	0.12	5.34	0.66	0.77	0.77	0.14	1.42	2.71	3.16	25.33	0.00	0.01	0.33	1.17	4.63	1.04	1.04	0.02	2.45	1.99	1.43	16.76	1.23	4.13	13.13	0.98	0.26	0.20	0.36	0.53	0.53	0.07	1.40	1.40	96.40
	14	0.17	0.00	0.02	2.41	0.65	0.69	0.69	0.45	0.09	37.74	17.40	0.76	0.83	0.00	0.10	0.06	0.48	0.42	0.42	0.01	0.76	0.01	0.02	0.38	0.09	0.30	1.64	0.29	2.24	0.26	20.32	0.30	0.30	0.29	0.15	0.15	90.87
	15	36.67	2.50	4.65	0.87	0.33	0.33	0.33	0.31	0.02	27.27	4.54	2.45	0.17	0.10	0.00	0.16	5.52	9.46	9.46	1.92	1.95	1.80	0.20	0.28	0.22	1.22	1.49	1.22	1.24	1.20	1.30	3.39	3.39	3.64	3.95	15.25	148.82
	16	1.56	1.59	6.00	2.89	1.24	1.43	1.43	0.34	0.03	479.46	65.47	2.77	0.29	0.00	0.06	0.00	15.51	0.71	0.71	0.31	13.32	0.39	0.83	10.32	2.91	2.74	37.66	2.47	2.47	0.21	0.96	8.02	8.02	1.60	1.04	12.94	687.72
	17	0.12	5.83	5.12	8.43	15.47	17.93	17.93	3.69	0.04	64.55	14.64	8.30	0.33	0.01	5.16	31.58	0.00	8.59	8.59	0.06	0.30	0.00	0.61	0.90	0.67	0.68	1.73	0.67	0.67	0.60	0.83	5.56	5.56	0.25	0.15	1.65	237.19
	18	1.25	0.45	0.45	0.14	0.04	0.05	0.05	0.01	0.15	26.23	12.00	1.97	0.85	0.02	4.33	5.42	0.10	0.00	0.10	0.00	0.77	0.01	0.12	0.48	0.19	0.10	1.46	0.09	0.09	0.00	0.20	2.42	2.42	0.36	0.18	0.18	62.68
	19	1.25	0.45	0.45	0.14	0.04	0.05	0.05	0.01	0.15	26.23	12.00	1.97	0.85	0.02	4.33	5.42	0.10	0.10	0.00	0.00	0.77	0.01	0.12	0.48	0.19	0.10	1.46	0.09	0.09	0.00	0.20	2.42	2.42	0.36	0.18	0.18	62.68
	20	23.31	1.52	5.77	3.19	0.28	0.33	0.33	0.06	0.01	2.19	0.52	1.23	0.04	0.00	0.87	0.35	1.04	0.02	0.02	0.00	0.03	0.00	0.10	0.12	0.10	0.00	0.06	0.00	0.00	0.00	0.01	0.11	0.11	0.11	0.10	0.10	42.06
	21	39.50	0.42	0.24	1.70	0.21	0.25	0.25	0.04	0.45	1.96	1.01	12.77	10.38	0.00	0.80	27.38	1.48	0.66	0.66	0.01	0.00	0.07	0.34	4.80	1.25	0.42	1.38	0.08	0.01	0.00	0.02	0.21	0.21	0.12	0.55	0.55	110.17
	22	12.57	0.40	0.21	0.54	0.07	0.08	0.08	0.01	0.14	1.37	0.32	15.48	0.25	0.00	0.73	8.69	0.46	0.21	0.21	0.00	0.12	0.00	0.11	0.21	0.13	0.13	0.43	0.03	0.00	0.00	0.01	0.07	0.07	0.11	0.24	0.24	43.72
	23	14.19	0.10	0.01	0.34	0.04	0.05	0.05	0.01	0.09	0.17	0.20	21.70	1.33	0.00	0.92	13.87	1.30	0.23	0.23	0.10	0.18	0.16	0.00	6.10	0.02	0.08	0.28	0.02	0.00	0.00	0.00	0.04	0.04	0.10	0.28	0.68	62.94
	24	11.62	0.10	0.02	0.67	0.08	0.10	0.10	0.02	0.18	15.24	7.51	12.75	9.67	0.00	0.94	15.72	2.16	0.23	0.23	0.10	0.25	0.22	7.02	0.00	0.03	0.16	0.54	0.03	0.00	0.00	0.01	0.08	0.08	0.11	0.45	0.85	87.27
	25	6.55	0.10	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.72	0.35	12.61	1.40	0.00	0.90	8.74	1.05	0.11	0.11	0.10	0.11	0.11	0.02	0.41	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.12	0.52	34.21
	26	4.44	0.30	0.01	0.41	0.05	0.06	0.06	0.01	0.11	9.48	4.67	0.87	0.95	0.20	0.32	4.76	1.10	0.08	0.08	0.00	0.77	0.01	0.02	0.39	0.09	0.00	0.33	0.02	0.00	0.00	0.00	0.02	0.02	0.01	0.11	0.11	29.86
	27	4.60	0.30	0.01	0.43	0.05	0.06	0.06	0.01	0.11	9.95	4.90	1.12	1.23	0.20	0.33	4.98	1.14	0.08	0.08	0.00	1.02	0.01	0.03	0.51	0.13	0.13	0.00	0.02	0.00	0.00	0.00	0.03	0.03	0.01	0.11	0.11	31.79
	28	11.20	0.30	0.03	1.25	0.16	0.18	0.18	0.03	0.12	10.23	5.04	1.04	1.14	3.06	0.37	1.68	0.88	0.24	0.24	0.01	0.94	0.01	0.02	0.47	0.12	0.12	1.80	0.00	0.10	0.05	0.04	0.07	0.07	0.13	0.07	0.07	41.46
	29	11.20	0.30	0.03	1.25	0.16	0.18	0.18	0.03	0.12	10.23	5.04	1.04	1.14	3.06	0.37	1.68	0.88	0.24	0.24	0.01	0.94	0.01	0.02	0.47	0.12	0.12	1.80	0.11	0.00	0.05	0.04	0.07	0.07	0.13	0.07	0.07	41.47
	30	13.91	0.30	0.04	1.59	0.20	0.23	0.23	0.04	0.15	12.95	6.38	1.30	1.42	5.74	0.43	2.98	1.24	0.37	0.37	0.01	1.20	0.01	0.03	0.60	0.15	0.15	2.28	0.14	3.24	0.00	0.09	0.13	0.13	0.25	0.13	0.13	58.54
	31	3.20	0.30	0.01	0.25	0.03	0.04	0.04	0.01	0.02	2.21	1.09	0.29	0.31	15.26	0.66	7.47	2.65	0.98	0.98	0.02	0.19	0.00	0.00	0.09	0.02	0.02	0.36	0.02	0.51	0.02	0.00	0.36	0.36	0.66	0.34	0.34	39.10
	32	7.13	0.89	1.98	0.57	0.03	0.03	0.03	0.01	0.02	4.91	2.30	0.25	0.27	0.30	1.30	24.11	7.93	3.28	3.28	0.05	0.15	0.00	0.00	0.08	0.02	0.02	0.29	0.02	0.04	0.00	0.10	0.00	0.10	0.13	0.38	0.38	60.37
	33	7.13	0.89	1.98	0.57	0.03	0.03	0.03	0.01	0.02	4.91	2.30	0.25	0.27	0.30	1.30	24.11	7.93	3.28	3.28	0.05	0.15	0.00	0.00	0.08	0.02	0.02	0.29	0.02	0.04	0.00	0.10	0.10	0.00	0.13	0.38	0.38	60.37
	34	5.30	0.11	0.13	0.18	0.10	0.10	0.10	0.10	0.00	5.70	0.10	2.41	0.01	0.01	1.15	0.32	1.67	0.25	0.25	0.10	0.11	0.10	0.10	0.10	0.10	0.00	0.02	0.00	0.03	0.00	0.08	0.05	0.05	0.00	0.15	0.55	19.56
	35	6.38	0.15	0.26	0.25	0.37	0.42	0.42	0.16	0.08	18.81	6.36	3.03	0.70	0.03	5.62	6.92	1.83	0.39	0.39	0.10	0.73	0.10	0.12	0.42	0.18	0.08	1.20	0.07	0.07	0.00	0.25	1.51	1.51	0.66	0.00	0.70	60.26
	36	1.08	0.05	0.26	0.15	0.26	0.30	0.30	0.05	0.08	13.11	6.26	0.63	0.70	0.03	4.52	6.62	0.33	0.29	0.29	0.00	0.63	0.00	0.02	0.32	0.08	0.08	1.20	0.07	0.07	0.00	0.25	1.51	1.51	0.33	0.10	0.00	41.49
	TOTAL	913.13	43.97	152.13	74.90	52.99	32.98	32.98	17.43	175.21	1447.45	530.62	151.11	55.07	46.03	124.02	1021.53	288.27	97.66	97.66	20.59	62.53	18.96	45.01	84.96	25.64	22.39	173.43	17.00	21.63	10.23	31.91	41.83	41.83	24.32	60.88	122.78	6181.05

Figure 9

2016 Origin-Destination Matrix - PM Peak Hour | Determined using TFlowFuzzy | SR9/SR204 Intersection Improvement Project

		Destination Zone																																	
	VISUM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	**TOTAL**
Origin Zone	1	0.00	0.03	455.83	0.60	23.49	10.14	10.14	4.19	0.13	499.97	276.68	63.67	0.28	0.01	27.36	26.55	26.20	20.28	20.28	91.31	27.97	1.29	3.01	57.56	5.17	11.88	246.38	12.99	12.99	4.67	0.63	11.46	11.46	0.00	0.67	0.67	1965.95
	2	0.02	0.00	24.14	0.14	1.43	3.09	3.09	0.64	0.04	1.84	0.65	0.07	0.08	0.01	0.88	2.95	7.02	0.43	0.43	1.92	0.11	0.01	0.01	0.29	0.03	0.06	1.26	0.07	0.07	0.02	0.01	0.40	0.40	0.00	0.01	0.01	51.66
	3	205.05	17.73	0.00	1.35	13.37	8.38	8.38	5.97	0.11	0.09	0.10	0.10	0.23	0.03	0.66	4.60	16.95	1.16	1.16	5.22	0.10	0.00	0.01	0.80	0.07	0.17	3.42	0.18	0.18	0.06	0.03	0.44	0.44	0.01	0.04	0.04	296.62
	4	0.12	0.51	60.38	0.00	1.32	2.71	2.71	0.59	1.02	0.87	0.93	0.96	2.19	18.47	2.21	10.19	21.40	1.41	1.41	6.33	0.96	0.04	0.10	3.84	0.34	0.79	16.43	0.87	0.87	0.31	0.73	0.66	0.66	0.02	0.05	0.05	162.44
	5	12.42	2.19	4.41	12.98	0.00	0.20	0.20	0.15	0.07	0.06	0.07	0.07	0.16	1.34	2.01	9.25	53.29	12.10	12.10	0.52	0.07	0.00	0.01	0.28	0.03	0.06	1.19	0.06	0.06	0.02	0.05	0.60	0.60	0.01	2.84	2.84	132.34
	6	8.43	1.49	2.99	6.91	0.31	0.00	0.13	0.06	0.05	0.04	0.05	0.05	0.11	0.91	1.36	6.27	36.16	8.21	8.21	0.35	0.05	0.00	0.01	0.19	0.02	0.04	0.81	0.04	0.04	0.02	0.04	0.41	0.41	0.01	1.93	1.93	88.01
	7	8.43	1.49	2.99	6.91	0.31	0.13	0.00	0.06	0.05	0.04	0.05	0.05	0.11	0.91	1.36	6.27	36.16	8.21	8.21	0.35	0.05	0.00	0.01	0.19	0.02	0.04	0.81	0.04	0.04	0.02	0.04	0.41	0.41	0.01	1.93	1.93	88.01
	8	6.33	1.12	2.24	0.26	0.37	0.10	0.10	0.00	0.04	0.03	0.03	0.04	0.08	0.68	1.02	4.71	27.14	6.16	6.16	0.27	0.04	0.00	0.00	0.14	0.01	0.03	0.61	0.03	0.03	0.01	0.03	0.31	0.31	0.01	1.45	1.45	61.34
	9	0.02	0.00	0.01	2.90	4.12	1.12	1.12	1.50	0.00	205.24	86.09	0.01	0.02	0.19	0.01	0.01	0.03	0.04	0.04	0.00	0.01	0.00	0.00	0.04	0.00	0.01	0.17	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.03	0.03	302.83
	10	186.69	2.27	0.03	16.98	24.19	6.59	6.59	8.78	90.76	0.00	30.43	0.06	0.13	1.11	33.68	299.25	48.16	42.32	42.32	0.21	0.06	0.00	0.01	18.50	1.66	3.82	79.20	4.18	4.18	1.50	3.53	16.14	16.14	0.00	29.30	29.30	1048.07
	11	73.93	0.41	0.03	14.66	20.88	5.69	5.69	7.58	94.92	43.53	0.00	0.05	0.11	0.96	6.30	46.41	12.93	11.36	11.36	0.06	0.05	0.00	0.01	5.39	0.48	1.11	23.08	1.22	1.22	0.44	1.03	3.82	3.82	0.00	7.86	7.86	414.26
	12	0.17	0.03	0.06	2.94	0.13	0.06	0.06	0.02	0.59	0.51	0.55	0.00	49.38	0.06	0.55	0.28	2.00	0.48	0.48	0.00	25.64	23.80	55.78	10.82	0.97	0.26	9.53	0.50	0.17	0.01	0.03	0.28	0.28	0.02	0.70	0.70	187.80
	13	0.15	0.03	0.05	2.70	0.12	0.05	0.05	0.02	0.55	0.47	0.50	77.81	0.00	0.06	0.25	0.25	0.61	0.44	0.44	0.00	5.19	4.72	4.76	36.05	0.20	0.24	9.54	0.50	0.15	0.01	0.03	0.25	0.25	0.02	0.64	0.64	147.75
	14	0.21	0.04	0.07	14.79	0.66	0.29	0.29	0.12	0.19	30.44	1.58	0.08	0.19	0.00	0.13	0.04	0.46	0.70	0.70	0.07	0.08	0.00	0.01	1.02	0.09	0.21	4.38	0.23	18.04	0.61	54.09	0.13	0.13	0.07	0.48	0.48	131.12
	15	15.78	1.18	1.19	2.84	0.13	0.06	0.06	0.02	0.15	0.25	0.14	0.20	0.15	0.13	0.00	0.11	8.14	10.78	10.78	1.12	0.07	0.00	0.01	0.26	0.02	0.05	1.13	0.06	0.99	0.03	0.20	4.27	4.27	0.12	7.33	7.33	79.33
	16	1.58	1.81	2.02	22.29	7.33	3.16	3.16	1.31	0.16	459.68	86.56	32.63	0.16	0.02	0.08	0.00	64.03	0.53	0.53	0.06	5.46	0.25	0.59	15.65	1.41	3.23	66.99	3.53	1.30	0.09	0.57	24.46	24.46	0.02	0.36	0.36	835.84
	17	0.07	4.27	6.31	26.64	59.71	25.78	25.78	10.66	0.14	25.06	4.49	2.43	0.14	0.35	37.46	10.53	0.00	32.10	32.10	0.16	0.31	0.01	0.03	0.75	0.07	0.15	3.21	0.17	0.33	0.09	0.55	14.98	14.98	0.11	0.11	0.11	340.14
	18	9.60	0.79	1.19	5.69	0.07	0.03	0.03	0.01	0.53	104.51	19.36	17.85	1.13	0.57	21.86	7.32	0.12	0.00	0.13	0.12	1.49	0.07	0.16	3.98	0.36	0.82	17.03	0.90	0.90	0.10	0.59	12.14	12.14	0.17	0.17	0.17	242.09
	19	9.60	0.79	1.19	5.69	0.07	0.03	0.03	0.01	0.53	104.51	19.36	17.85	1.13	0.57	21.86	7.32	0.12	0.13	0.00	0.12	1.49	0.07	0.16	3.98	0.36	0.82	17.03	0.90	0.90	0.10	0.59	12.14	12.14	0.17	0.17	0.17	242.09
	20	10.29	0.84	1.27	6.09	2.32	1.00	1.00	0.41	0.00	0.84	0.15	0.14	0.01	0.00	0.13	0.04	0.09	0.03	0.03	0.00	0.01	0.00	0.00	0.03	0.00	0.01	0.14	0.01	0.01	0.00	0.00	0.07	0.07	0.00	0.00	0.00	25.04
	21	18.93	0.09	0.24	2.94	0.13	0.06	0.06	0.02	0.59	0.51	0.55	22.70	37.03	0.06	0.55	19.84	3.34	0.95	0.95	0.00	0.00	0.37	0.87	21.64	1.94	0.52	12.75	0.67	0.33	0.01	0.07	1.38	1.38	0.02	0.70	0.70	152.88
	22	2.46	0.01	0.03	0.38	0.02	0.01	0.01	0.00	0.08	0.07	0.07	24.94	0.64	0.01	0.07	2.57	0.43	0.12	0.12	0.00	0.44	0.00	0.01	0.37	0.03	0.07	1.59	0.08	0.04	0.00	0.01	0.18	0.18	0.00	0.09	0.09	35.24
	23	5.34	0.02	0.07	0.83	0.04	0.02	0.02	0.01	0.17	0.14	0.15	54.19	6.09	0.02	0.16	5.59	0.94	0.27	0.27	0.00	0.32	0.29	0.00	12.21	0.04	0.07	1.99	0.10	0.05	0.00	0.01	0.23	0.23	0.01	0.40	0.40	90.68
	24	24.82	0.18	0.19	4.63	0.21	0.09	0.09	0.04	0.93	80.13	8.57	90.67	86.55	0.41	0.87	40.74	4.20	1.50	1.50	0.01	1.78	1.62	37.41	0.00	0.22	0.41	10.28	0.54	0.26	0.01	0.05	1.30	1.30	0.03	2.20	2.20	405.91
	25	0.26	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.01	0.84	0.09	0.95	4.24	0.00	0.01	0.43	0.04	0.02	0.02	0.00	0.02	0.02	0.04	1.49	0.00	0.00	0.16	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.02	0.02	8.79
	26	8.18	0.06	0.06	1.52	0.07	0.03	0.03	0.01	0.31	26.41	2.83	8.22	1.84	0.13	0.29	13.43	1.38	0.49	0.49	0.00	0.16	0.01	0.02	0.65	0.06	0.00	5.08	0.27	0.09	0.00	0.02	0.29	0.29	0.01	0.73	0.73	74.18
	27	8.14	0.06	0.06	1.52	0.07	0.03	0.03	0.01	0.31	26.26	2.81	68.52	15.37	0.13	0.28	13.35	1.38	0.49	0.49	0.00	1.34	0.06	0.14	5.39	0.48	1.11	0.00	0.28	0.09	0.00	0.02	0.28	0.28	0.01	0.72	0.72	150.25
	28	11.93	0.09	0.09	2.22	0.10	0.04	0.04	0.02	0.11	9.84	1.05	2.61	0.58	11.39	0.13	0.95	1.27	0.72	0.72	0.00	0.05	0.00	0.01	0.20	0.02	0.04	0.88	0.00	0.13	0.05	0.11	0.13	0.13	0.02	0.23	0.23	46.15
	29	11.93	0.09	0.09	2.22	0.10	0.04	0.04	0.02	0.11	9.84	1.05	2.61	0.58	11.39	0.13	0.95	1.27	0.72	0.72	0.00	0.05	0.00	0.01	0.20	0.02	0.04	0.88	0.05	0.00	0.05	0.11	0.13	0.13	0.02	0.23	0.23	46.07
	30	13.03	0.10	0.10	2.43	0.11	0.05	0.05	0.02	0.13	10.74	1.15	2.84	0.64	31.69	0.37	2.63	1.24	0.96	0.96	0.10	0.06	0.00	0.01	0.22	0.02	0.05	0.96	0.05	3.95	0.00	0.31	0.37	0.37	0.05	0.65	0.65	77.02
	31	4.94	0.04	0.04	0.92	0.04	0.02	0.02	0.01	0.05	4.07	0.44	1.08	0.24	123.36	0.88	6.29	2.96	2.29	2.29	0.24	0.02	0.00	0.00	0.08	0.01	0.02	0.36	0.02	1.50	0.05	0.00	0.88	0.88	0.12	1.56	1.56	157.27
	32	17.15	1.62	0.89	11.37	0.51	0.22	0.22	0.09	0.15	35.73	6.48	2.82	0.15	0.13	5.47	25.53	12.80	8.99	8.99	0.93	0.07	0.00	0.01	0.26	0.02	0.05	1.13	0.06	0.99	0.03	0.20	0.00	0.27	0.12	2.44	2.44	148.33
	33	17.15	1.62	0.89	11.37	0.51	0.22	0.22	0.09	0.15	35.73	6.48	2.82	0.15	0.13	5.47	25.53	12.80	8.99	8.99	0.93	0.07	0.00	0.01	0.26	0.02	0.05	1.13	0.06	0.99	0.03	0.20	0.27	0.00	0.12	2.44	2.44	148.33
	34	0.06	0.11	0.21	2.05	0.03	0.01	0.01	0.01	0.04	2.21	0.53	0.24	0.04	0.44	3.49	3.25	0.84	1.29	1.29	0.13	0.06	0.00	0.01	0.13	0.01	0.03	0.56	0.03	2.29	0.08	0.46	0.50	0.50	0.00	4.39	4.39	29.74
	35	1.57	0.13	0.19	0.93	0.58	0.25	0.25	0.10	0.18	35.11	6.51	2.84	0.18	0.44	17.10	5.72	0.13	0.20	0.20	0.02	0.32	0.01	0.03	0.63	0.06	0.13	2.71	0.14	0.28	0.08	0.47	1.90	1.90	0.13	0.00	0.67	82.09
	36	1.57	0.13	0.19	0.93	0.58	0.25	0.25	0.10	0.18	35.11	6.51	2.84	0.18	0.44	17.10	5.72	0.13	0.20	0.20	0.02	0.08	0.00	0.01	0.32	0.03	0.07	1.35	0.07	0.14	0.04	0.23	3.80	3.80	0.13	0.13	0.00	82.83
	TOTAL	696.36	41.34	569.72	199.68	163.42	69.95	69.95	42.65	193.50	1790.76	573.03	504.99	210.31	206.58	211.55	614.87	406.16	185.07	185.07	110.62	74.02	32.69	103.25	203.84	14.30	26.45	544.12	28.92	53.57	8.55	65.07	115.04	115.04	1.56	73.01	73.54	8578.50

Figure 10

2021 Origin-Destination Matrix - PM Peak Hour | Determined using Difference Method Calculation | SR9/SR204 Intersection Improvement Project

		Destination Zone																																		
	VISUM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	**TOTAL**
Origin Zone	1	0.00	0.03	474.43	0.60	23.49	10.14	10.14	4.19	0.13	500.77	277.98	77.57	0.28	0.01	29.06	26.65	26.20	20.28	20.28	91.31	27.97	1.29	7.71	62.26	9.87	12.48	246.98	13.59	13.59	5.27	1.23	12.06	12.06	8.60	9.27	0.67	2038.45
	2	0.02	0.00	41.04	0.14	1.43	3.09	3.09	0.64	0.04	2.04	0.65	0.37	0.08	0.01	3.38	3.75	9.32	0.63	0.63	2.12	0.31	0.21	0.21	0.49	0.23	0.16	1.36	0.17	0.17	0.12	0.11	0.50	0.50	0.10	0.11	0.01	77.26
	3	267.05	29.33	0.00	1.35	13.37	8.38	8.38	5.97	0.11	0.09	0.10	0.10	0.23	0.03	1.16	4.60	17.55	1.16	1.16	5.22	0.10	0.00	0.01	0.80	0.07	0.17	3.42	0.18	0.18	0.06	0.03	0.44	0.44	0.21	0.24	0.04	371.72
	4	0.12	0.51	60.38	0.00	1.32	2.71	2.71	0.59	1.02	0.87	0.93	0.96	2.19	18.47	2.71	10.19	21.70	1.41	1.41	6.33	0.96	0.04	0.20	3.94	0.44	0.79	16.43	0.87	0.87	0.31	0.73	0.66	0.66	0.12	0.15	0.05	163.74
	5	12.42	2.19	4.41	12.98	0.00	0.20	0.20	0.15	0.07	0.06	0.07	0.07	0.16	1.34	2.51	9.25	53.59	12.10	12.10	0.52	0.07	0.00	0.11	0.38	0.13	0.06	1.19	0.06	0.06	0.02	0.05	0.60	0.60	0.11	2.94	2.84	133.64
	6	8.43	1.49	2.99	6.91	0.31	0.00	0.13	0.06	0.05	0.04	0.05	0.05	0.11	0.91	1.86	6.27	36.46	8.21	8.21	0.35	0.05	0.00	0.11	0.29	0.12	0.04	0.81	0.04	0.04	0.02	0.04	0.41	0.41	0.11	2.03	1.93	89.31
	7	8.43	1.49	2.99	6.91	0.31	0.13	0.00	0.06	0.05	0.04	0.05	0.05	0.11	0.91	1.86	6.27	36.46	8.21	8.21	0.35	0.05	0.00	0.11	0.29	0.12	0.04	0.81	0.04	0.04	0.02	0.04	0.41	0.41	0.11	2.03	1.93	89.31
	8	6.33	1.12	2.24	0.26	0.37	0.10	0.10	0.00	0.04	0.03	0.03	0.04	0.08	0.68	1.52	4.71	27.44	6.16	6.16	0.27	0.04	0.00	0.10	0.24	0.11	0.03	0.61	0.03	0.03	0.01	0.03	0.31	0.31	0.11	1.55	1.45	62.64
	9	0.02	0.00	0.01	2.90	4.12	1.12	1.12	1.50	0.00	224.94	98.89	0.01	0.02	0.19	0.01	0.01	0.03	0.04	0.04	0.00	0.01	0.00	0.00	0.04	0.00	0.01	0.17	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.03	0.03	335.33
	10	186.79	2.37	0.03	17.08	24.29	6.69	6.69	8.88	91.86	0.00	30.43	0.06	0.13	1.11	26.88	412.75	62.86	42.32	42.32	0.21	0.06	0.00	0.01	18.50	1.66	3.82	79.20	4.18	4.18	1.50	3.53	16.14	16.14	4.10	33.40	29.30	1179.47
	11	74.03	2.21	0.03	14.66	20.88	5.69	5.69	7.58	144.82	43.53	0.00	0.05	0.11	0.96	6.60	46.91	15.83	11.36	11.36	0.06	0.05	0.00	0.01	5.39	0.48	1.21	23.18	1.32	1.32	0.54	1.13	3.92	3.92	0.70	8.56	7.86	471.96
	12	0.17	0.03	0.06	2.94	0.13	0.06	0.06	0.02	0.59	0.51	0.55	0.00	61.08	0.06	0.65	0.28	5.10	0.78	0.78	0.30	25.94	24.10	62.28	17.32	7.47	0.26	9.53	0.50	0.17	0.01	0.03	0.28	0.28	0.02	0.70	0.70	223.70
	13	0.15	0.03	0.05	2.70	0.12	0.05	0.05	0.02	0.55	0.47	0.50	79.21	0.00	0.06	0.25	0.25	0.61	0.44	0.44	0.00	5.19	4.72	5.06	36.35	0.50	0.24	9.54	0.50	0.15	0.01	0.03	0.25	0.25	0.02	0.64	0.64	150.05
	14	0.21	0.04	0.07	14.89	0.76	0.39	0.39	0.22	0.19	35.84	1.78	0.08	0.19	0.00	0.13	0.04	0.46	0.70	0.70	0.07	0.08	0.00	0.01	1.02	0.09	0.21	4.38	0.23	18.04	0.61	54.09	0.13	0.13	0.07	0.48	0.48	137.22
	15	17.18	2.08	1.69	3.04	0.33	0.26	0.26	0.22	0.15	0.95	0.14	0.40	0.15	0.13	0.00	0.11	9.14	10.88	10.88	1.22	0.17	0.10	0.01	0.26	0.02	0.15	1.23	0.16	1.09	0.13	0.30	4.37	4.37	0.52	7.73	7.33	87.13
	16	2.48	2.41	2.12	22.29	7.33	3.16	3.16	1.31	0.16	460.58	110.66	36.13	0.16	0.02	0.08	0.00	64.03	0.63	0.63	0.16	5.56	0.35	2.49	17.55	3.31	4.03	67.79	4.33	2.10	0.89	1.37	25.26	25.26	3.92	4.26	0.36	886.34
	17	0.17	5.87	6.81	26.84	59.91	25.98	25.98	10.86	0.14	29.46	5.39	2.63	0.14	0.35	38.06	11.13	0.00	32.10	32.10	0.16	0.31	0.01	0.13	0.85	0.17	0.15	3.21	0.17	0.33	0.09	0.55	14.98	14.98	0.11	0.11	0.11	350.34
	18	9.70	0.89	1.19	5.69	0.07	0.03	0.03	0.01	0.53	104.61	19.76	17.85	1.13	0.57	22.06	7.52	0.12	0.00	0.13	0.12	1.49	0.07	0.26	4.08	0.46	0.82	17.03	0.90	0.90	0.10	0.59	12.14	12.14	0.17	0.17	0.17	243.49
	19	9.70	0.89	1.19	5.69	0.07	0.03	0.03	0.01	0.53	104.61	19.76	17.85	1.13	0.57	22.06	7.52	0.12	0.13	0.00	0.12	1.49	0.07	0.26	4.08	0.46	0.82	17.03	0.90	0.90	0.10	0.59	12.14	12.14	0.17	0.17	0.17	243.49
	20	10.39	0.94	1.27	6.09	2.32	1.00	1.00	0.41	0.00	0.94	0.55	0.14	0.01	0.00	0.33	0.24	0.09	0.03	0.03	0.00	0.01	0.00	0.10	0.13	0.10	0.01	0.14	0.01	0.01	0.00	0.00	0.07	0.07	0.00	0.00	0.00	26.44
	21	19.03	0.19	0.24	2.94	0.13	0.06	0.06	0.02	0.59	0.61	0.95	22.70	37.03	0.06	0.75	20.04	3.34	0.95	0.95	0.00	0.00	0.37	0.97	21.74	2.04	0.52	12.75	0.67	0.33	0.01	0.07	1.38	1.38	0.02	0.70	0.70	154.28
	22	2.56	0.11	0.03	0.38	0.02	0.01	0.01	0.00	0.08	0.17	0.47	24.94	0.64	0.01	0.27	2.77	0.43	0.12	0.12	0.00	0.44	0.00	0.11	0.47	0.13	0.07	1.59	0.08	0.04	0.00	0.01	0.18	0.18	0.00	0.09	0.09	36.64
	23	7.34	0.12	0.07	0.93	0.14	0.12	0.12	0.11	0.17	0.14	0.15	58.69	6.59	0.02	0.46	6.39	1.14	0.27	0.27	0.00	0.32	0.29	0.00	12.21	0.04	0.07	1.99	0.10	0.05	0.00	0.01	0.23	0.23	0.11	0.50	0.40	99.78
	24	26.82	0.28	0.19	4.73	0.31	0.19	0.19	0.14	0.93	80.13	8.57	95.17	87.05	0.41	1.17	41.54	4.40	1.50	1.50	0.01	1.78	1.62	37.41	0.00	0.22	0.41	10.28	0.54	0.26	0.01	0.05	1.30	1.30	0.13	2.30	2.20	415.01
	25	2.26	0.10	0.00	0.15	0.10	0.10	0.10	0.10	0.01	0.84	0.09	5.45	4.74	0.00	0.31	1.23	0.24	0.02	0.02	0.00	0.02	0.02	0.04	1.49	0.00	0.00	0.16	0.01	0.00	0.00	0.00	0.01	0.01	0.10	0.12	0.02	17.89
	26	8.28	0.06	0.06	1.52	0.07	0.03	0.03	0.01	0.31	26.71	2.83	8.32	1.94	0.13	0.49	13.53	1.48	0.49	0.49	0.00	0.16	0.01	0.12	0.75	0.16	0.00	5.08	0.27	0.09	0.00	0.02	0.29	0.29	0.01	0.73	0.73	75.48
	27	8.24	0.06	0.06	1.52	0.07	0.03	0.03	0.01	0.31	26.56	2.81	68.62	15.47	0.13	0.48	13.45	1.48	0.49	0.49	0.00	1.34	0.06	0.24	5.49	0.58	1.11	0.00	0.28	0.09	0.00	0.02	0.28	0.28	0.01	0.72	0.72	151.55
	28	12.03	0.09	0.09	2.22	0.10	0.04	0.04	0.02	0.11	10.14	1.05	2.71	0.68	11.39	0.33	1.05	1.37	0.72	0.72	0.00	0.05	0.00	0.11	0.30	0.12	0.04	0.88	0.00	0.13	0.05	0.11	0.13	0.13	0.02	0.23	0.23	47.45
	29	12.03	0.09	0.09	2.22	0.10	0.04	0.04	0.02	0.11	10.14	1.05	2.71	0.68	11.39	0.33	1.05	1.37	0.72	0.72	0.00	0.05	0.00	0.11	0.30	0.12	0.04	0.88	0.05	0.00	0.05	0.11	0.13	0.13	0.02	0.23	0.23	47.37
	30	13.13	0.10	0.10	2.43	0.11	0.05	0.05	0.02	0.13	11.04	1.15	2.94	0.74	31.69	0.57	2.73	1.34	0.96	0.96	0.10	0.06	0.00	0.11	0.32	0.12	0.05	0.96	0.05	3.95	0.00	0.31	0.37	0.37	0.05	0.65	0.65	78.32
	31	5.04	0.04	0.04	0.92	0.04	0.02	0.02	0.01	0.05	4.37	0.44	1.18	0.34	123.36	1.08	6.39	3.06	2.29	2.29	0.24	0.02	0.00	0.10	0.18	0.11	0.02	0.36	0.02	1.50	0.05	0.00	0.88	0.88	0.12	1.56	1.56	158.57
	32	17.25	1.62	0.89	11.37	0.51	0.22	0.22	0.09	0.15	36.03	6.48	2.92	0.25	0.13	5.67	25.63	12.90	8.99	8.99	0.93	0.07	0.00	0.11	0.36	0.12	0.05	1.13	0.06	0.99	0.03	0.20	0.00	0.27	0.12	2.44	2.44	149.63
	33	17.25	1.62	0.89	11.37	0.51	0.22	0.22	0.09	0.15	36.03	6.48	2.92	0.25	0.13	5.67	25.63	12.90	8.99	8.99	0.93	0.07	0.00	0.11	0.36	0.12	0.05	1.13	0.06	0.99	0.03	0.20	0.27	0.00	0.12	2.44	2.44	149.63
	34	2.86	0.21	0.51	2.05	0.03	0.01	0.01	0.01	0.04	5.91	0.63	0.64	0.04	0.44	4.99	4.05	1.34	1.29	1.29	0.13	0.06	0.00	0.11	0.23	0.11	0.03	0.56	0.03	2.29	0.08	0.46	0.50	0.50	0.00	4.39	4.39	40.24
	35	4.37	0.23	0.49	0.93	0.58	0.25	0.25	0.10	0.18	38.81	6.61	3.24	0.18	0.44	18.60	6.52	0.63	0.20	0.20	0.02	0.32	0.01	0.13	0.73	0.16	0.13	2.71	0.14	0.28	0.08	0.47	1.90	1.90	0.13	0.00	0.67	92.59
	36	3.67	0.13	0.19	0.93	0.58	0.25	0.25	0.10	0.18	43.81	7.11	3.74	0.18	0.44	20.40	8.62	0.53	0.20	0.20	0.02	0.08	0.00	0.01	0.32	0.03	0.07	1.35	0.07	0.14	0.04	0.23	3.80	3.80	0.13	0.13	0.00	101.73
	TOTAL	775.96	58.94	606.92	200.58	164.32	70.85	70.85	43.55	244.50	1841.86	615.13	540.49	224.31	206.58	222.75	739.07	435.06	185.77	185.77	111.32	74.72	33.39	118.95	219.54	30.00	28.15	545.82	30.62	55.27	10.25	66.77	116.74	116.74	20.36	91.81	73.54	9177.20

Figure 11

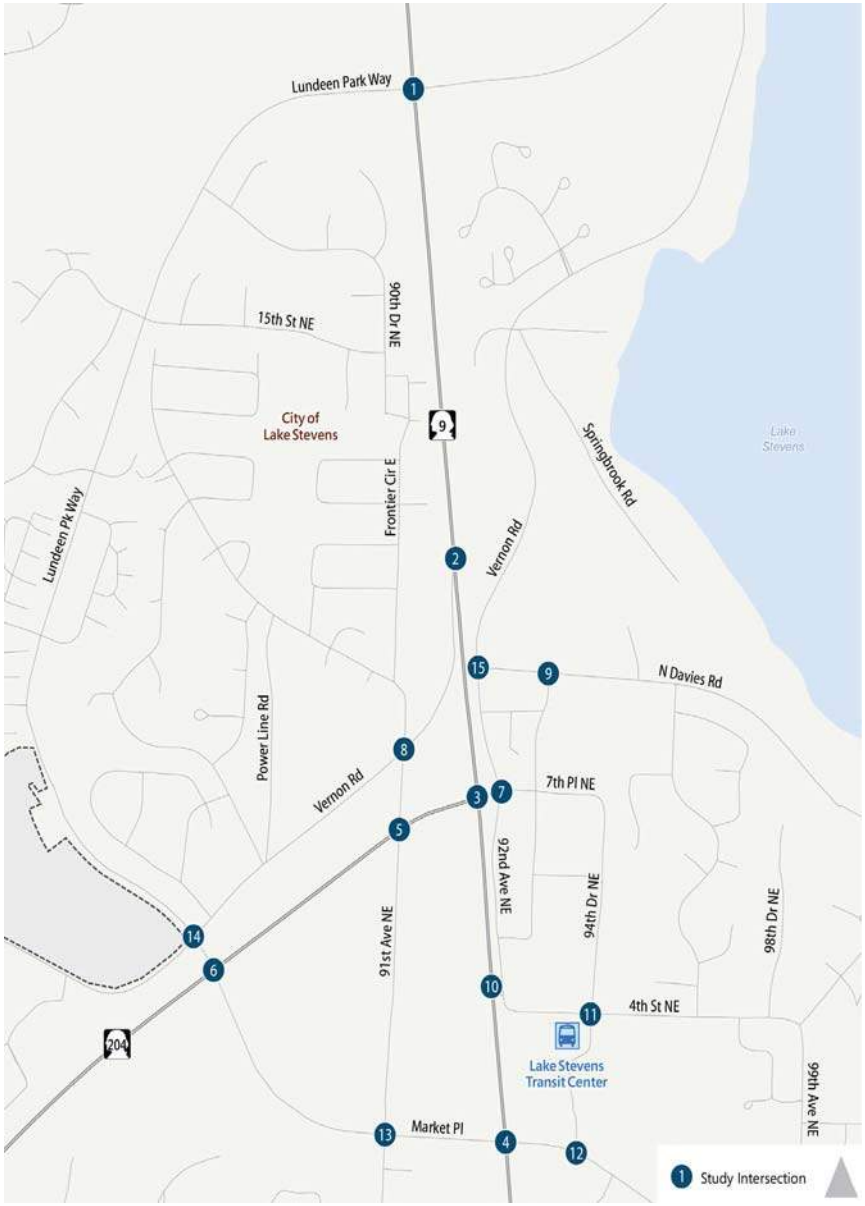
2040 Origin-Destination Matrix - PM Peak Hour | Determined using Difference Method Calculation | SR9/SR204 Intersection Improvement Project

		Destination Zone																																		
	VISUM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	**TOTAL**
Origin Zone	1	0.00	0.03	519.63	6.90	29.79	16.44	16.44	10.49	0.13	501.57	292.18	90.57	0.28	0.01	34.66	27.65	27.40	22.88	22.88	93.91	30.57	3.89	14.01	68.56	16.17	12.68	247.18	13.79	13.79	5.47	1.43	12.26	12.26	12.60	13.27	0.67	2192.45
	2	0.02	0.00	51.84	0.14	1.43	3.09	3.09	0.64	0.04	3.94	1.05	0.47	0.08	0.01	11.48	5.05	11.02	0.93	0.93	2.42	0.61	0.51	0.51	0.79	0.53	0.26	1.46	0.27	0.27	0.22	0.21	0.60	0.60	0.40	0.41	0.01	105.36
	3	287.85	62.33	0.00	1.35	13.37	8.38	8.38	5.97	0.11	0.09	0.10	0.10	0.23	0.03	1.86	4.60	18.05	1.16	1.16	5.22	0.10	0.00	0.11	0.90	0.17	0.17	3.42	0.18	0.18	0.06	0.03	0.44	0.44	0.21	0.24	0.04	427.02
	4	0.12	0.51	60.38	0.00	1.32	2.71	2.71	0.59	1.02	0.87	0.93	1.06	2.19	18.97	3.81	10.19	22.40	1.41	1.41	6.33	0.96	0.04	0.20	3.94	0.44	0.79	16.43	0.87	0.87	0.31	0.73	0.66	0.66	0.22	0.25	0.05	166.34
	5	12.42	2.19	4.41	12.98	0.00	0.20	0.20	0.15	0.07	0.06	0.07	0.17	0.16	1.84	3.61	9.25	54.29	12.10	12.10	0.52	0.07	0.00	0.11	0.38	0.13	0.06	1.19	0.06	0.06	0.02	0.05	0.60	0.60	0.21	3.04	2.84	136.24
	6	8.43	1.49	2.99	6.91	0.31	0.00	0.13	0.06	0.05	0.04	0.05	0.15	0.11	1.41	2.96	6.27	37.16	8.21	8.21	0.35	0.05	0.00	0.11	0.29	0.12	0.04	0.81	0.04	0.04	0.02	0.04	0.41	0.41	0.21	2.13	1.93	91.91
	7	8.43	1.49	2.99	6.91	0.31	0.13	0.00	0.06	0.05	0.04	0.05	0.15	0.11	1.41	2.96	6.27	37.16	8.21	8.21	0.35	0.05	0.00	0.11	0.29	0.12	0.04	0.81	0.04	0.04	0.02	0.04	0.41	0.41	0.21	2.13	1.93	91.91
	8	6.33	1.12	2.24	0.26	0.37	0.10	0.10	0.00	0.04	0.03	0.03	0.14	0.08	1.18	2.62	4.71	28.14	6.16	6.16	0.27	0.04	0.00	0.10	0.24	0.11	0.03	0.61	0.03	0.03	0.01	0.03	0.31	0.31	0.21	1.65	1.45	65.24
	9	0.02	0.00	0.01	2.90	4.12	1.12	1.12	1.50	0.00	240.34	123.69	0.01	0.02	0.19	0.01	0.01	0.03	0.04	0.04	0.00	0.01	0.00	0.00	0.04	0.00	0.01	0.17	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.03	0.03	375.53
	10	188.99	3.07	0.03	17.08	24.29	6.69	6.69	8.88	92.86	0.00	31.03	0.06	0.13	8.21	46.58	641.35	140.76	42.32	42.32	0.21	0.06	0.00	0.11	18.60	1.76	3.82	79.20	4.18	4.18	1.50	3.53	16.14	16.14	5.20	34.50	29.60	1520.07
	11	158.43	4.01	0.03	14.66	20.88	5.69	5.69	7.58	232.42	43.53	0.00	0.05	0.11	1.16	8.40	50.51	23.43	11.86	11.86	0.56	0.55	0.50	0.01	5.39	0.48	1.21	23.18	1.32	1.32	0.54	1.13	3.92	3.92	1.00	8.86	7.86	662.06
	12	3.47	0.03	0.06	2.94	0.13	0.06	0.06	0.02	0.59	0.51	0.55	0.00	127.48	0.06	6.25	16.78	17.00	1.78	1.78	1.30	26.94	25.10	71.68	26.72	16.87	5.26	14.53	5.50	5.17	5.01	5.03	5.28	5.28	14.62	15.30	0.70	429.80
	13	0.15	0.03	0.05	2.70	0.12	0.05	0.05	0.02	0.55	0.47	0.50	88.71	0.00	0.06	0.25	0.25	0.61	0.44	0.44	0.00	5.19	4.72	5.76	37.05	1.20	0.64	9.94	0.90	0.55	0.41	0.43	0.65	0.65	0.02	0.64	0.64	164.85
	14	0.21	0.04	0.07	15.19	1.06	0.69	0.69	0.52	0.19	44.44	1.88	0.08	0.19	0.00	0.13	0.04	0.46	0.70	0.70	0.07	0.08	0.00	0.01	1.02	0.09	0.31	4.48	0.33	18.14	0.71	54.19	0.23	0.23	0.07	0.48	0.48	148.22
	15	20.68	5.38	3.29	3.44	0.73	0.66	0.66	0.62	0.15	4.75	0.34	0.60	0.15	0.13	0.00	0.11	9.74	12.68	12.68	3.02	1.97	1.90	0.11	0.36	0.12	0.45	1.53	0.46	1.39	0.43	0.60	4.67	4.67	0.92	8.13	7.33	114.83
	16	3.38	2.91	2.22	22.39	7.43	3.26	3.26	1.41	0.16	550.18	154.86	41.73	0.16	0.02	0.08	0.00	64.53	0.63	0.63	0.16	5.56	0.35	11.39	26.45	12.21	5.43	69.19	5.73	3.50	2.29	2.77	26.66	26.66	8.42	8.76	0.36	1075.14
	17	0.17	9.27	8.21	27.84	60.91	26.98	26.98	11.86	0.14	31.06	6.69	2.93	0.14	0.35	39.16	11.23	0.00	32.10	32.10	0.16	0.31	0.01	0.13	0.85	0.17	0.25	3.31	0.27	0.43	0.19	0.65	15.08	15.08	0.41	0.41	0.41	366.24
	18	10.00	1.29	1.29	5.79	0.17	0.13	0.13	0.11	0.53	104.61	20.66	17.95	1.13	0.57	22.56	9.82	0.12	0.00	0.13	0.12	1.49	0.07	0.36	4.18	0.56	0.82	17.03	0.90	0.90	0.10	0.59	12.14	12.14	0.17	0.17	0.17	248.89
	19	10.00	1.29	1.29	5.79	0.17	0.13	0.13	0.11	0.53	104.61	20.66	17.95	1.13	0.57	22.56	9.82	0.12	0.13	0.00	0.12	1.49	0.07	0.36	4.18	0.56	0.82	17.03	0.90	0.90	0.10	0.59	12.14	12.14	0.17	0.17	0.17	248.89
	20	10.69	1.34	1.37	6.19	2.42	1.10	1.10	0.51	0.00	0.94	1.45	0.24	0.01	0.00	0.83	2.54	0.09	0.03	0.03	0.00	0.01	0.00	0.20	0.23	0.20	0.01	0.14	0.01	0.01	0.00	0.00	0.07	0.07	0.00	0.00	0.00	31.84
	21	19.33	0.59	0.34	3.04	0.23	0.16	0.16	0.12	0.59	0.61	1.85	22.80	37.03	0.06	1.25	22.34	3.34	0.95	0.95	0.00	0.00	0.37	1.07	21.84	2.14	0.52	12.75	0.67	0.33	0.01	0.07	1.38	1.38	0.02	0.70	0.70	159.68
	22	2.86	0.51	0.13	0.48	0.12	0.11	0.11	0.10	0.08	0.17	1.37	25.04	0.64	0.01	0.77	5.07	0.43	0.12	0.12	0.00	0.44	0.00	0.21	0.57	0.23	0.07	1.59	0.08	0.04	0.00	0.01	0.18	0.18	0.00	0.09	0.09	42.04
	23	8.14	0.42	0.17	1.03	0.24	0.22	0.22	0.21	0.17	0.14	0.15	67.89	8.89	0.02	1.06	8.69	2.34	0.37	0.37	0.10	0.42	0.39	0.00	12.21	0.04	0.07	1.99	0.10	0.05	0.00	0.01	0.23	0.23	0.21	0.60	0.40	117.78
	24	27.62	0.58	0.29	4.83	0.41	0.29	0.29	0.24	0.93	80.13	8.57	104.37	89.35	0.41	1.77	43.84	5.60	1.60	1.60	0.11	1.88	1.72	37.41	0.00	0.22	0.41	10.28	0.54	0.26	0.01	0.05	1.30	1.30	0.23	2.40	2.20	433.01
	25	3.06	0.40	0.10	0.25	0.20	0.20	0.20	0.20	0.01	0.84	0.09	14.65	7.04	0.00	0.91	3.53	1.44	0.12	0.12	0.10	0.12	0.12	0.04	1.49	0.00	0.00	0.16	0.01	0.00	0.00	0.00	0.01	0.01	0.20	0.22	0.02	35.89
	26	8.38	0.26	0.06	1.52	0.07	0.03	0.03	0.01	0.31	27.61	2.93	8.32	2.54	0.33	1.49	13.63	2.48	0.49	0.49	0.00	0.16	0.01	0.12	0.75	0.16	0.00	5.08	0.27	0.09	0.00	0.02	0.29	0.29	0.01	0.73	0.73	79.68
	27	8.34	0.26	0.06	1.52	0.07	0.03	0.03	0.01	0.31	27.46	2.91	68.62	16.07	0.33	1.48	13.55	2.48	0.49	0.49	0.00	1.34	0.06	0.24	5.49	0.58	1.11	0.00	0.28	0.09	0.00	0.02	0.28	0.28	0.01	0.72	0.72	155.75
	28	12.13	0.29	0.09	2.22	0.10	0.04	0.04	0.02	0.11	11.04	1.15	2.71	1.28	11.59	1.33	1.15	2.37	0.72	0.72	0.00	0.05	0.00	0.11	0.30	0.12	0.04	0.88	0.00	0.13	0.05	0.11	0.13	0.13	0.02	0.23	0.23	51.65
	29	12.13	0.29	0.09	2.22	0.10	0.04	0.04	0.02	0.11	11.04	1.15	2.71	1.28	11.59	1.33	1.15	2.37	0.72	0.72	0.00	0.05	0.00	0.11	0.30	0.12	0.04	0.88	0.05	0.00	0.05	0.11	0.13	0.13	0.02	0.23	0.23	51.57
	30	13.23	0.30	0.10	2.43	0.11	0.05	0.05	0.02	0.13	11.94	1.25	2.94	1.34	31.89	1.57	2.83	2.34	0.96	0.96	0.10	0.06	0.00	0.11	0.32	0.12	0.05	0.96	0.05	3.95	0.00	0.31	0.37	0.37	0.05	0.65	0.65	82.52
	31	5.14	0.24	0.04	0.92	0.04	0.02	0.02	0.01	0.05	5.27	0.54	1.18	0.94	123.56	2.08	6.49	4.06	2.29	2.29	0.24	0.02	0.00	0.10	0.18	0.11	0.02	0.36	0.02	1.50	0.05	0.00	0.88	0.88	0.12	1.56	1.56	162.77
	32	17.35	1.82	0.89	11.37	0.51	0.22	0.22	0.09	0.15	36.93	6.58	2.92	0.85	0.33	6.67	25.73	13.90	8.99	8.99	0.93	0.07	0.00	0.11	0.36	0.12	0.05	1.13	0.06	0.99	0.03	0.20	0.00	0.27	0.12	2.44	2.44	153.83
	33	17.35	1.82	0.89	11.37	0.51	0.22	0.22	0.09	0.15	36.93	6.58	2.92	0.85	0.33	6.67	25.73	13.90	8.99	8.99	0.93	0.07	0.00	0.11	0.36	0.12	0.05	1.13	0.06	0.99	0.03	0.20	0.27	0.00	0.12	2.44	2.44	153.83
	34	4.16	0.71	0.61	2.15	0.13	0.11	0.11	0.11	0.04	8.51	3.23	0.94	0.04	0.44	5.19	5.25	4.34	1.29	1.29	0.13	0.06	0.00	0.21	0.33	0.21	0.03	0.56	0.03	2.29	0.08	0.46	0.50	0.50	0.00	4.39	4.39	52.84
	35	5.67	0.73	0.59	1.03	0.68	0.35	0.35	0.20	0.18	41.41	9.21	3.54	0.18	0.44	18.80	7.72	3.63	0.20	0.20	0.02	0.32	0.01	0.23	0.83	0.26	0.13	2.71	0.14	0.28	0.08	0.47	1.90	1.90	0.13	0.00	0.67	105.19
	36	4.57	1.53	0.89	1.13	0.78	0.45	0.45	0.30	0.18	60.81	12.21	6.54	0.18	0.44	28.00	17.32	4.23	0.30	0.30	0.12	0.18	0.10	0.51	0.82	0.53	0.07	1.35	0.07	0.14	0.04	0.23	3.80	3.80	0.63	0.63	0.00	153.63
	TOTAL	899.26	108.54	667.72	209.88	173.62	80.15	80.15	52.85	333.10	1992.96	716.53	601.19	302.41	217.98	291.15	1020.47	561.76	192.37	192.37	117.92	81.32	39.99	146.05	246.64	57.10	35.75	553.42	38.22	62.87	17.85	74.37	124.34	124.34	47.16	118.61	74.14	10654.50

TURNING MOVEMENT FORECASTS

Intersection turning movement vehicle counts (2016) and forecasts (2021 and 2040) within the study area are output from Step 3 of the forecast development process. Turning movement volumes for the No Build condition and each of the second-level screening alternatives are depicted on the following pages.

- 2016 Turning Movement Counts
  - **Figure 12**: Existing PM Peak Hour
  - **Figure 13**: Existing AM Peak Hour
- 2040 Turning Movement Forecast
  - **Figure 14**: 2040 No Build PM Peak Hour
  - **Figure 15**: 2040 Concept B PM Peak Hour
  - **Figure 16**: 2040 Concept C PM Peak Hour
  - **Figure 17**: 2040 Concept E PM Peak Hour
  - **Figure 18**: 2040 Concept E2A PM Peak Hour
  - **Figure 19**: 2040 Concept E2B PM Peak Hour
  - **Figure 20**: 2040 Concept E2B Variation 4 PM Peak Hour – Preferred Alternative
  - **Figure 21**: 2040 Concept E2C PM Peak Hour
  - **Figure 22**: 2040 Concept E2D PM Peak Hour
  - **Figure 23**: 2040 Concept G2B PM Peak Hour
  - **Figure 24**: 2040 Concept H PM Peak Hour
  - **Figure 25**: 2040 No Build AM Peak Hour
  - **Figure 26**: 2040 Concept E2B Variation 4 AM Peak Hour – Preferred Alternative
- 2021 Turning Movement Forecast
  - **Figure 27**: 2021 No Build PM Peak Hour
  - **Figure 28**: 2021 Concept E2B Variation 4 PM Peak Hour – Preferred Alternative
  - **Figure 29**: 2021 No Build AM Peak Hour
  - **Figure 30**: 2021 Concept E2B Variation 4 AM Peak Hour – Preferred Alternative



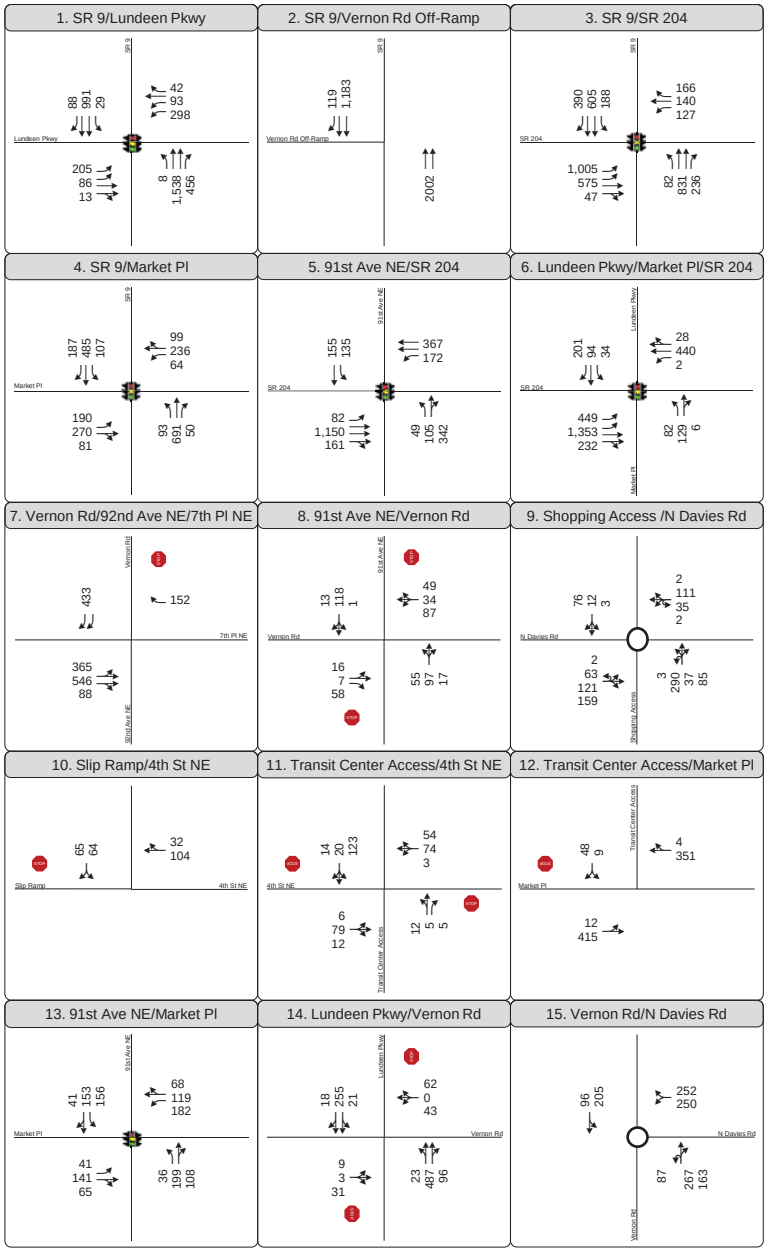
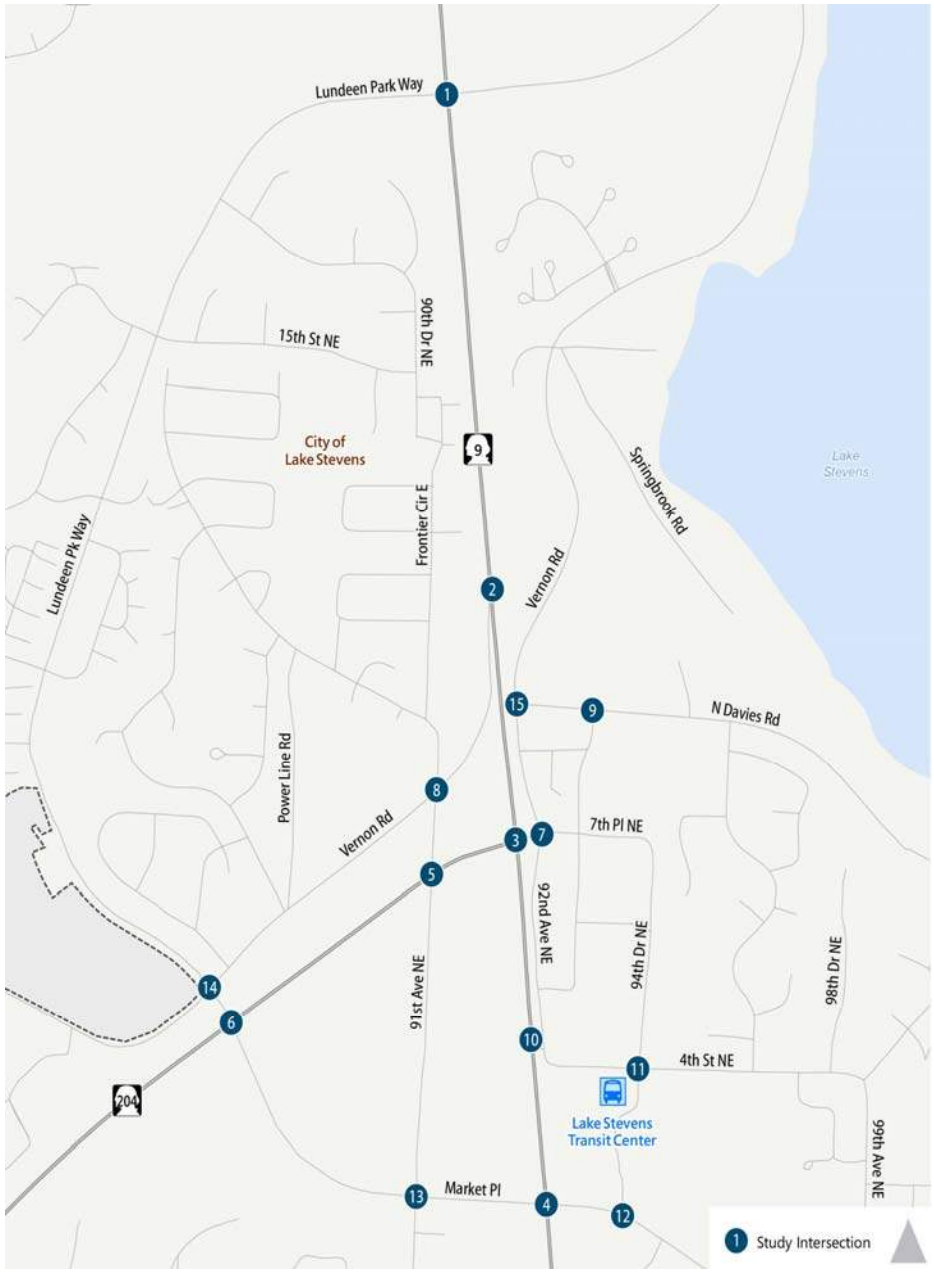


Figure 12
Traffic Volumes and Lane Geometry
Existing Adjusted and Balanced - PM Peak Hour



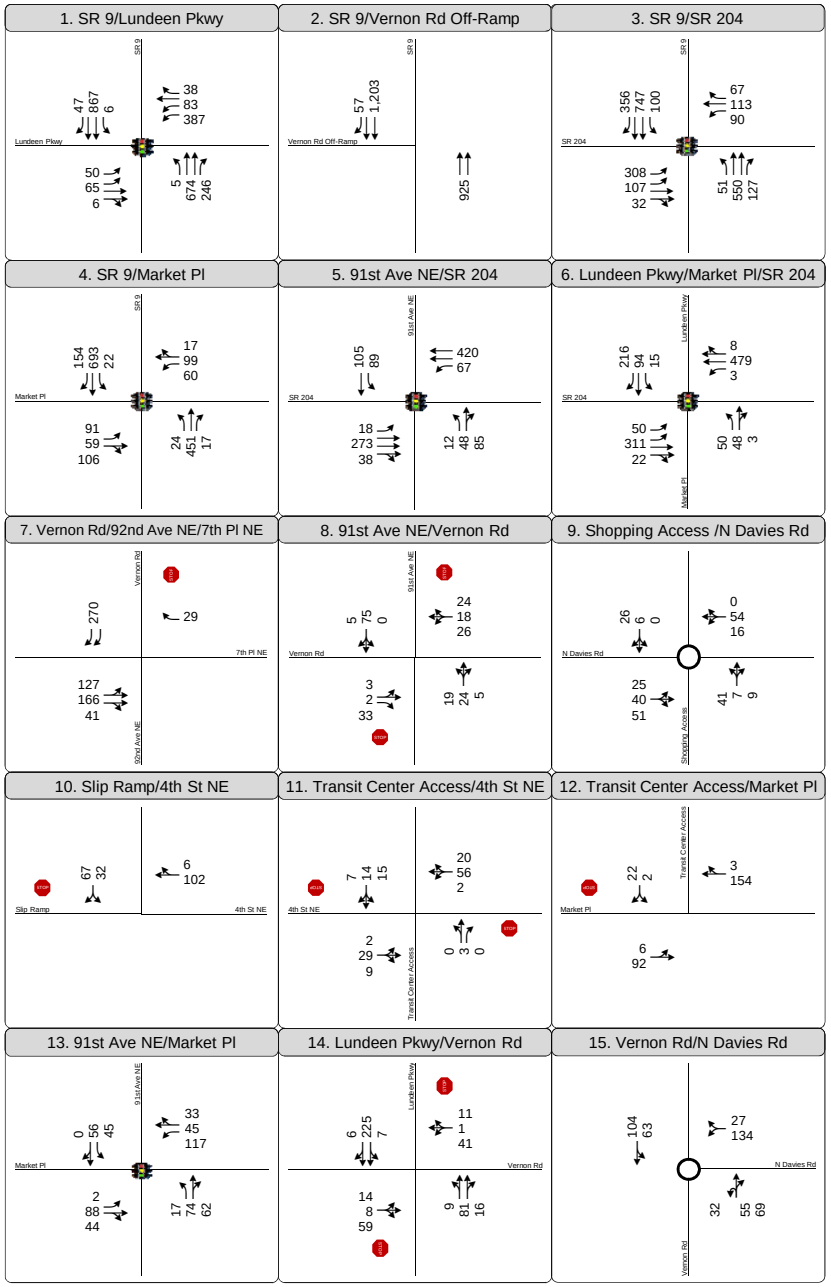
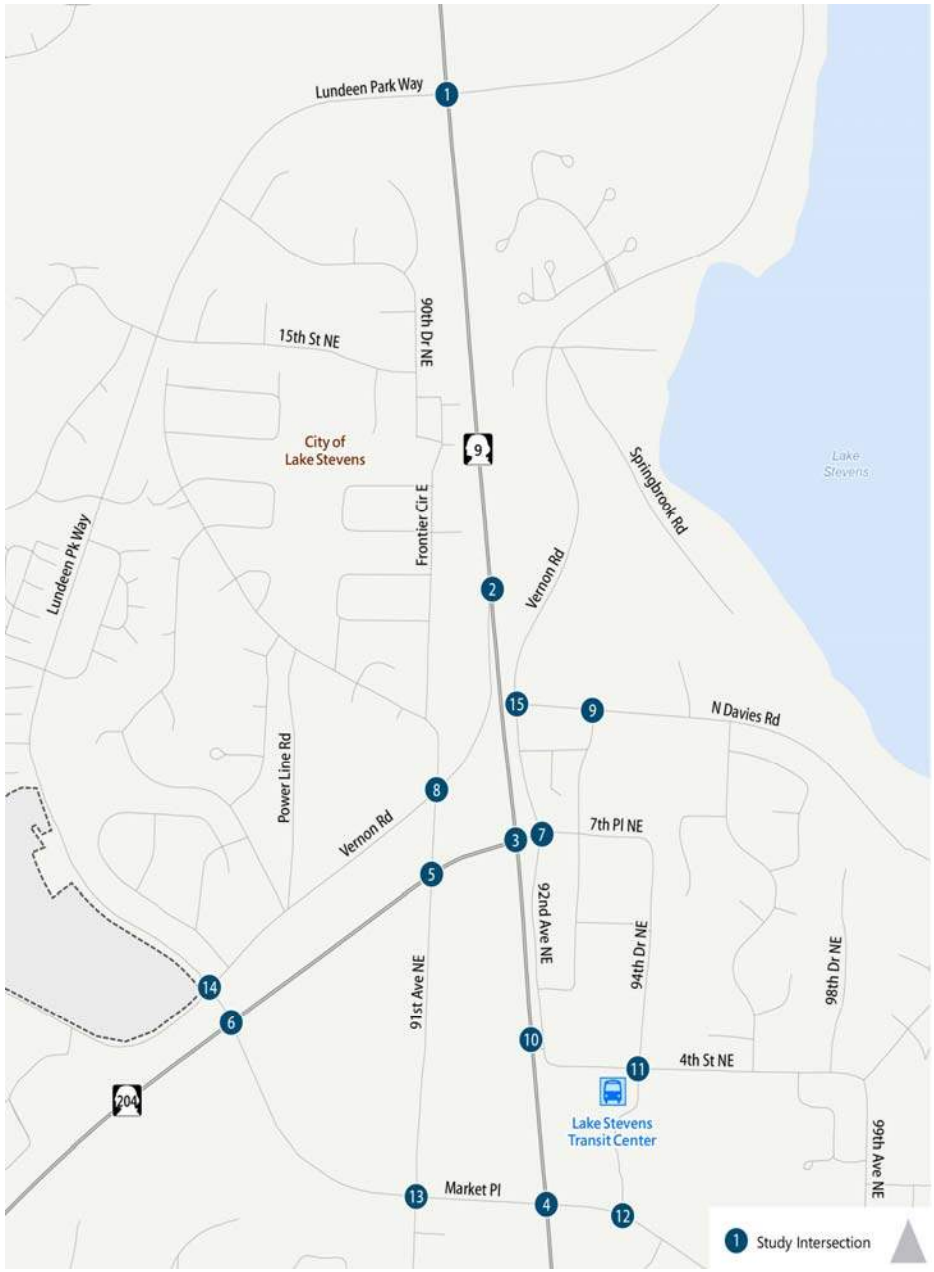


Figure 13
Traffic Volumes and Lane Geometry
Existing Adjusted and Balanced - AM Peak Hour



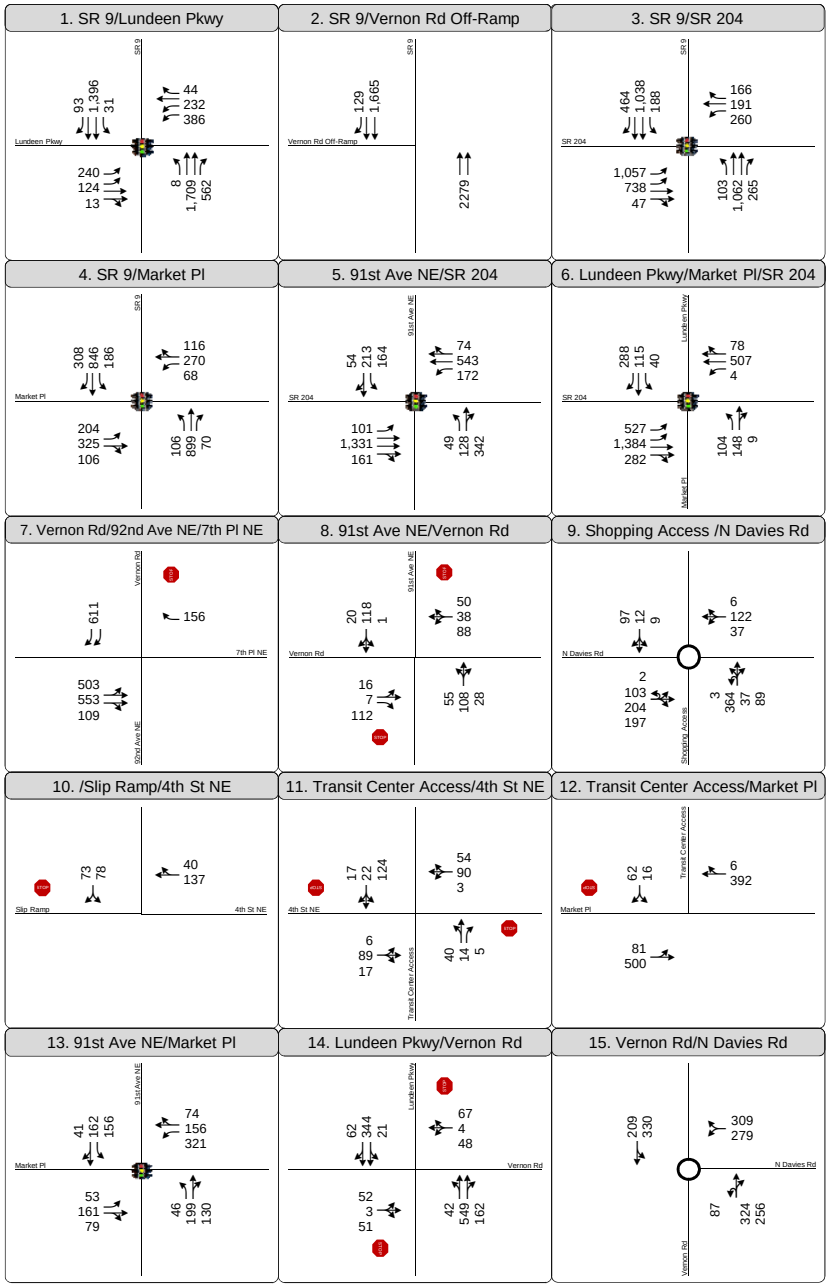
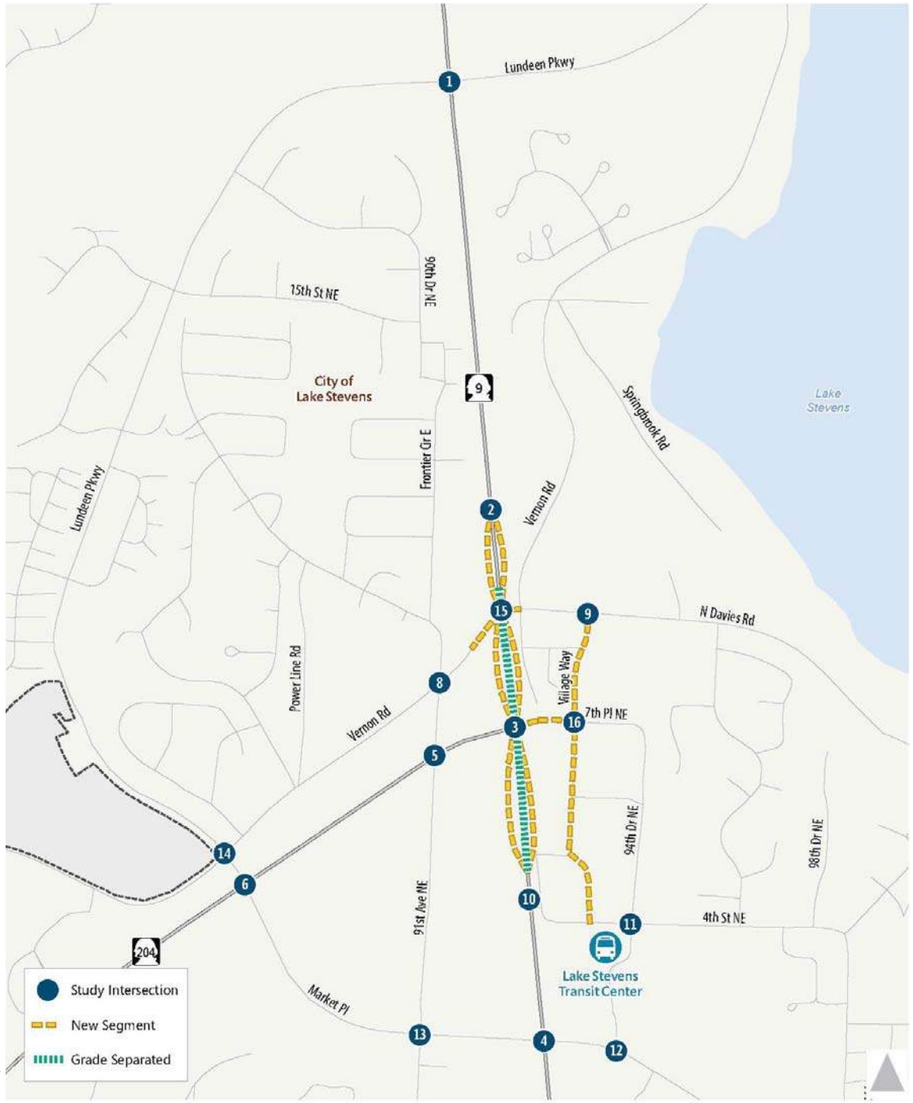
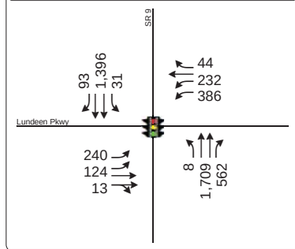


Figure 14
Traffic Volumes and Lane Geometry
2040 No Build - PM Peak Hour



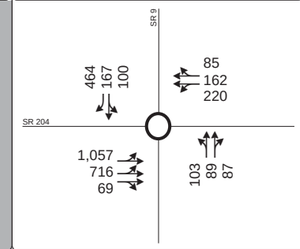
Source: path:

1. SR 9/Lundeen Pkwy

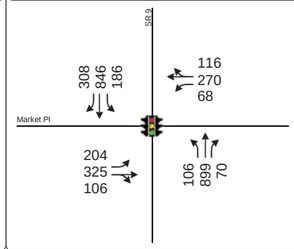


2. SR 9/Vernon Rd Off-Ramp

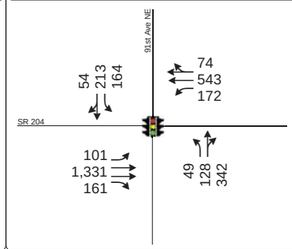
3. SR 9 Frontage Rd/SR 204



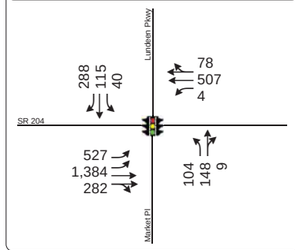
4. SR 9/Market Pl



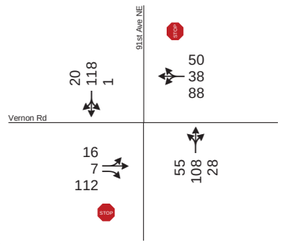
5. 91st Ave NE/SR 204



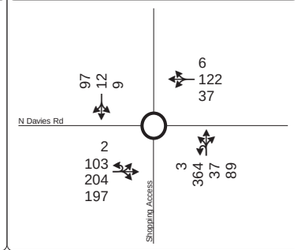
6. Lundeen Pkwy/Market Pl/SR 204



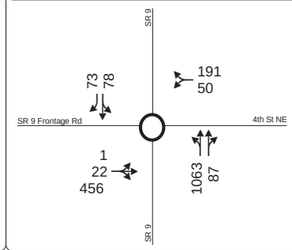
8. 91st Ave NE/Vernon Rd



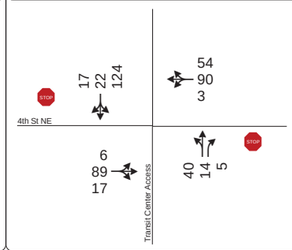
9. Shopping Access /N Davies Rd



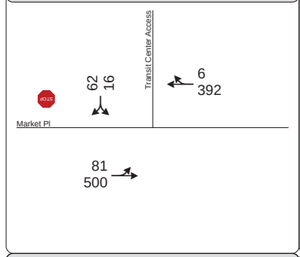
10. SR 9/SB SR 9 Frontage/4th St NE



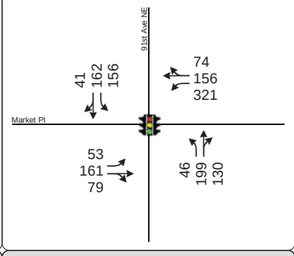
11. Transit Center Access/4th St NE



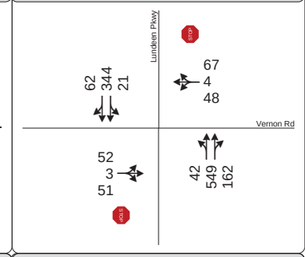
12. Transit Center Access/Market Pl



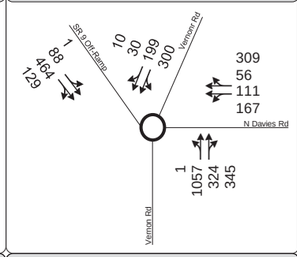
13. 91st Ave NE/Market Pl



14. Lundeen Pkwy/Vernon Rd



15. SR 9 Frontage Rd/Vernon Rd/N Davies Rd



16. Frontier Ln/7th Pl NE

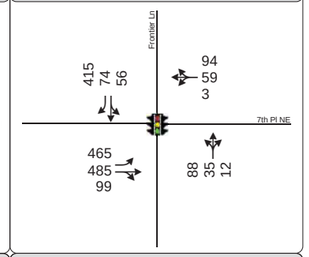


Figure 15
Traffic Volumes and Lane Geometry
2040 Concept B - PM Peak Hour

Source: path:

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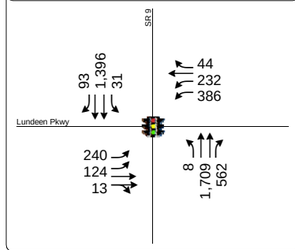
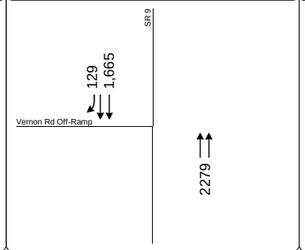
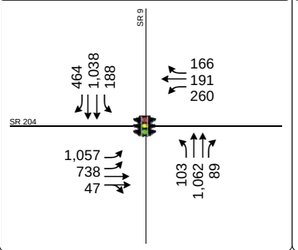
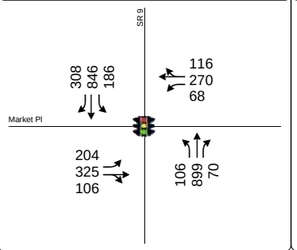
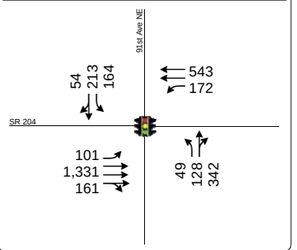
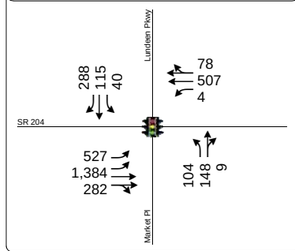
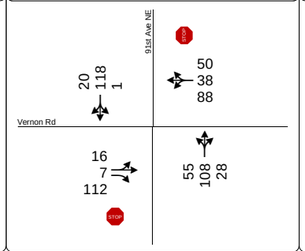
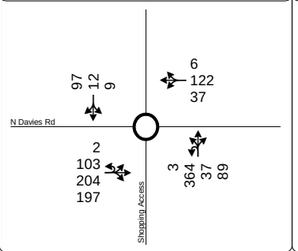
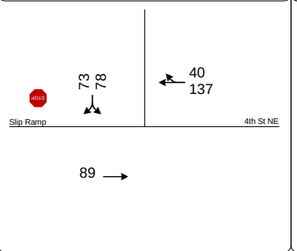
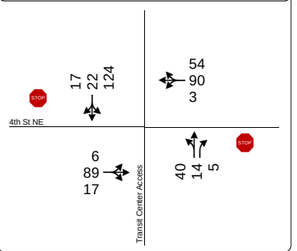
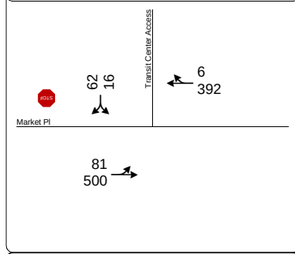
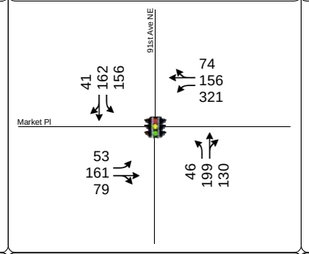
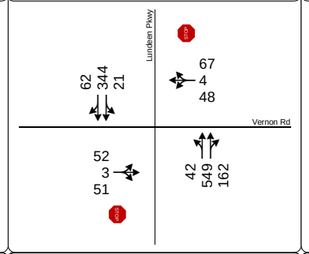
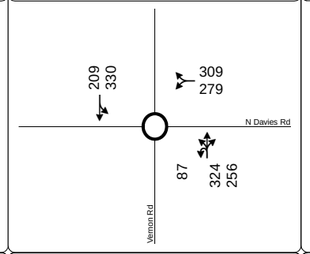
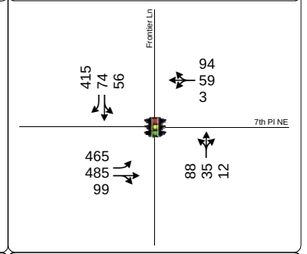
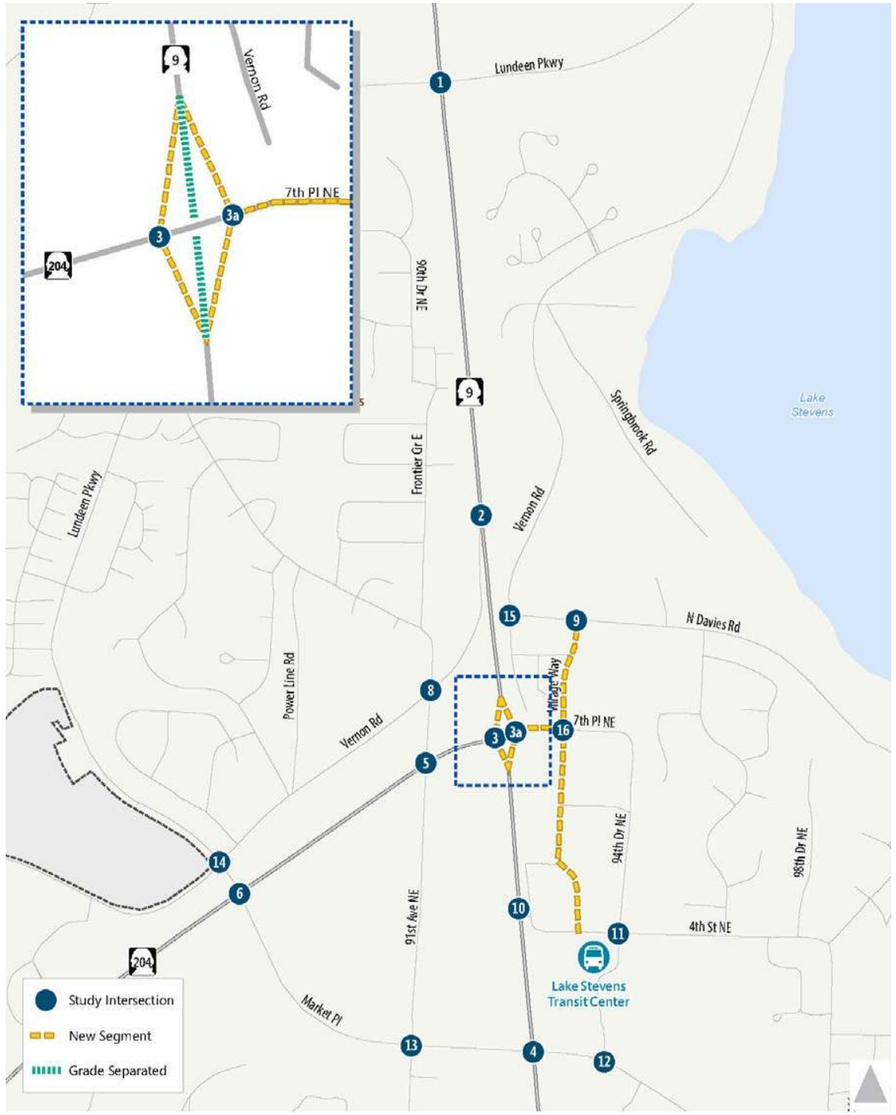
				
6. Lundeen Pkwy/Market Pl/SR 204	8. 91st Ave NE/Vernon Rd	9. Shopping Access /N Davies Rd	10. /Slip Ramp/4th St NE	11. Transit Center Access/4th St NE
				
12. Transit Center Access/Market Pl	13. 91st Ave NE/Market Pl	14. Lundeen Pkwy/Vernon Rd	15. Vernon Rd/N Davies Rd	16. Frontier Ln/7th Pl NE
				

Figure 16
Traffic Volumes and Lane Geometry
2040 Concept C - PM Peak Hour



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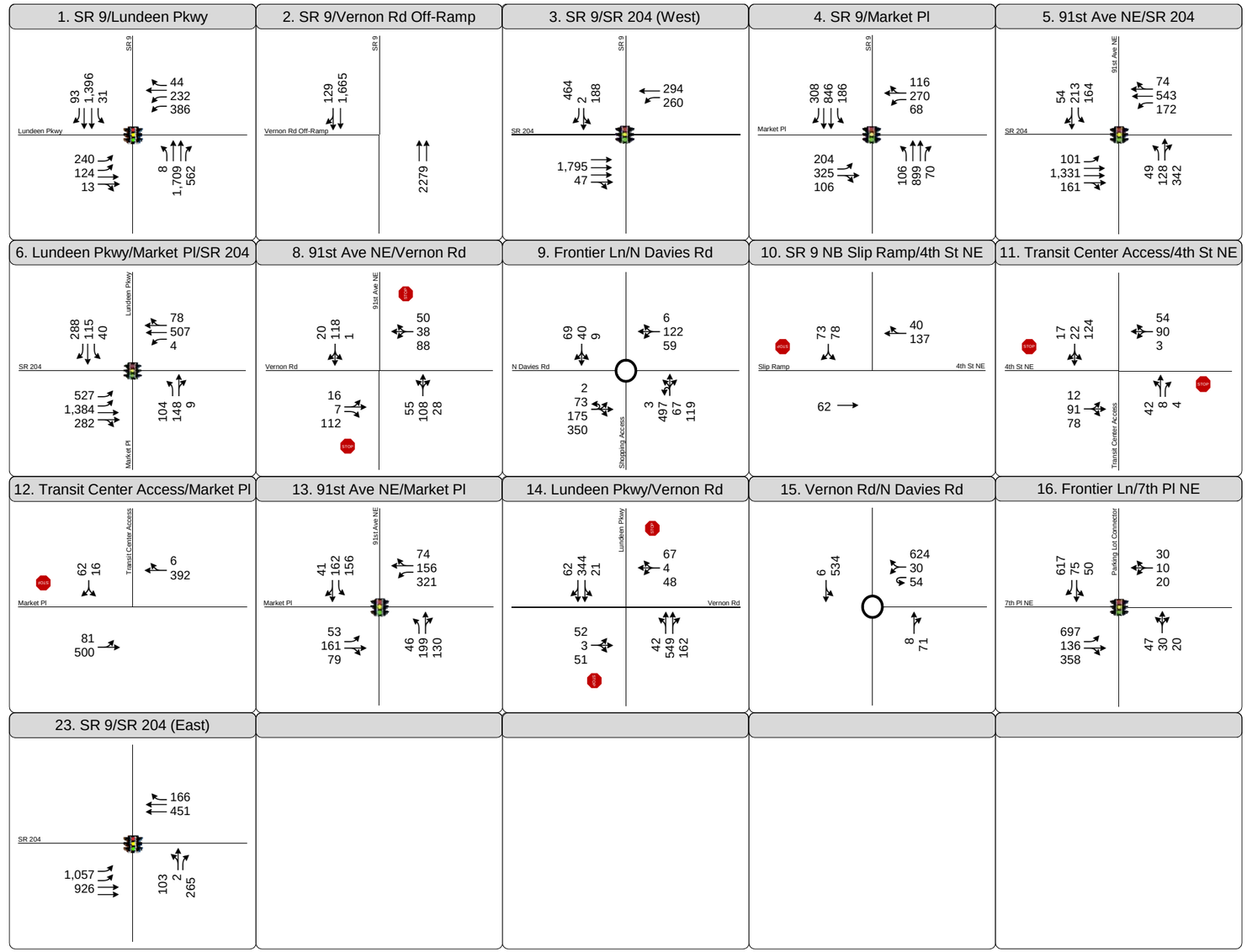
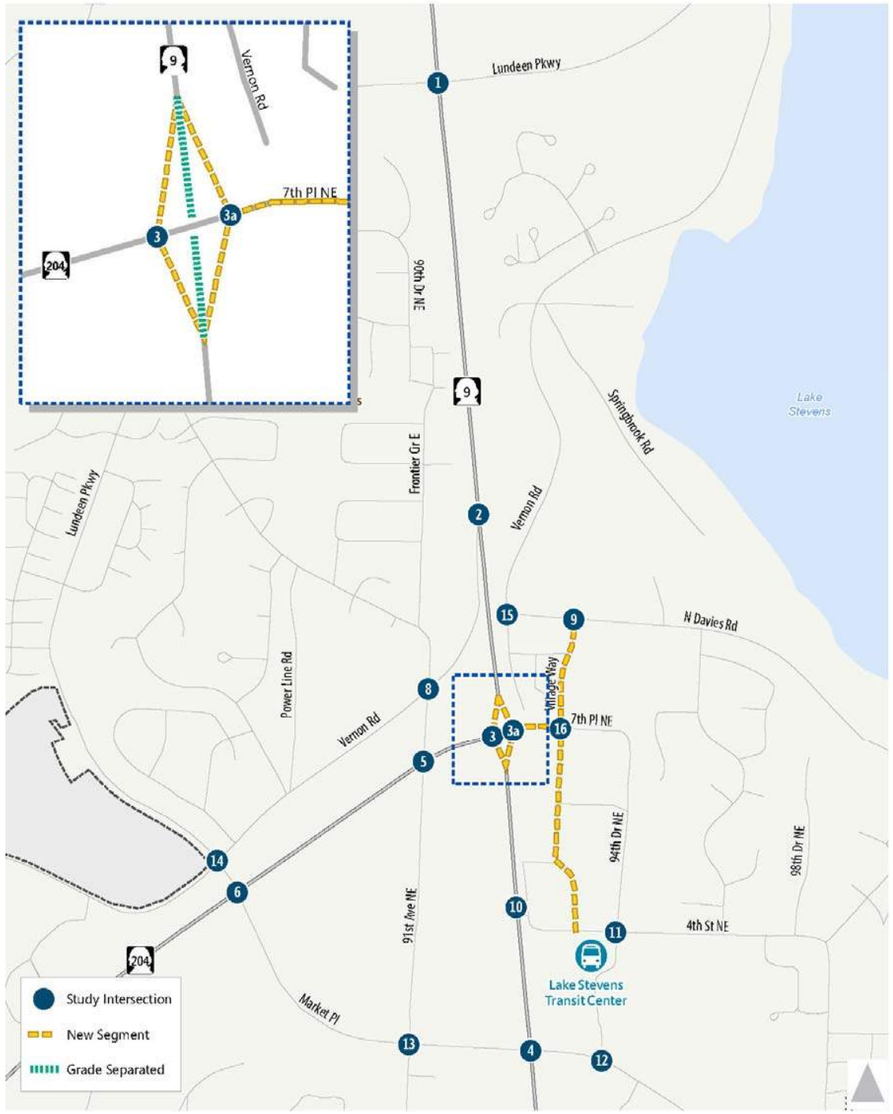


Figure 17
Traffic Volumes and Lane Geometry
2040 Concept E - PM Peak Hour



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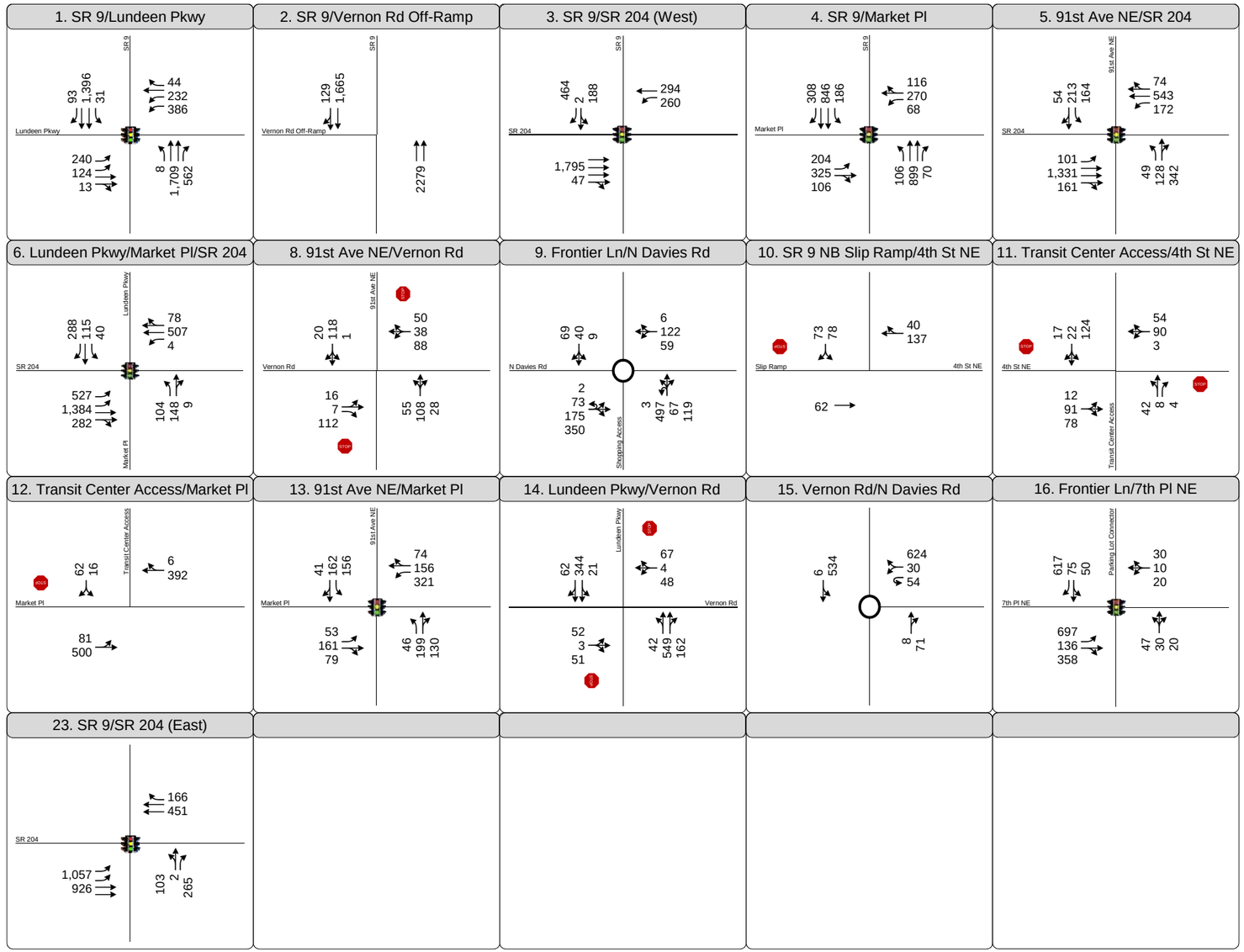
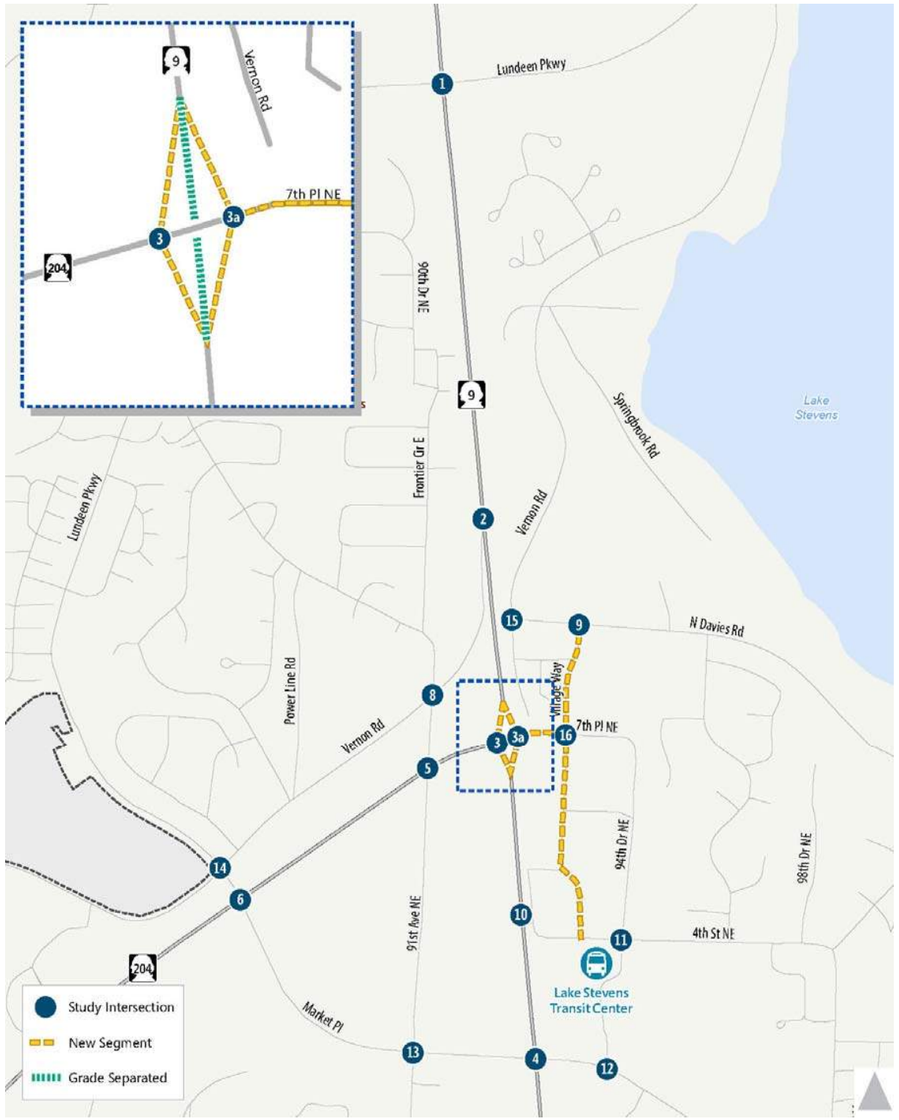


Figure 18
Traffic Volumes and Lane Geometry
2040 Concept E2A - PM Peak Hour



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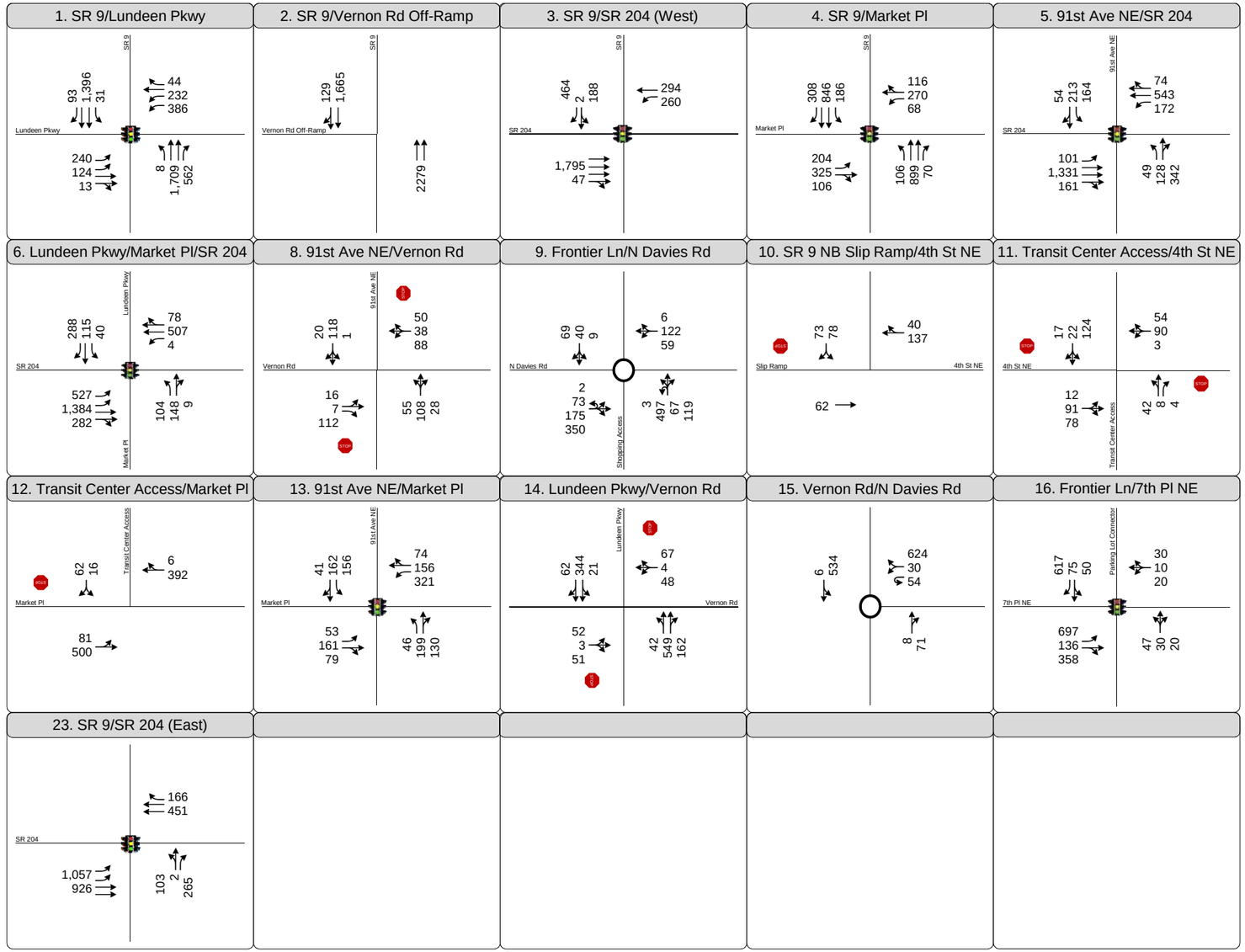
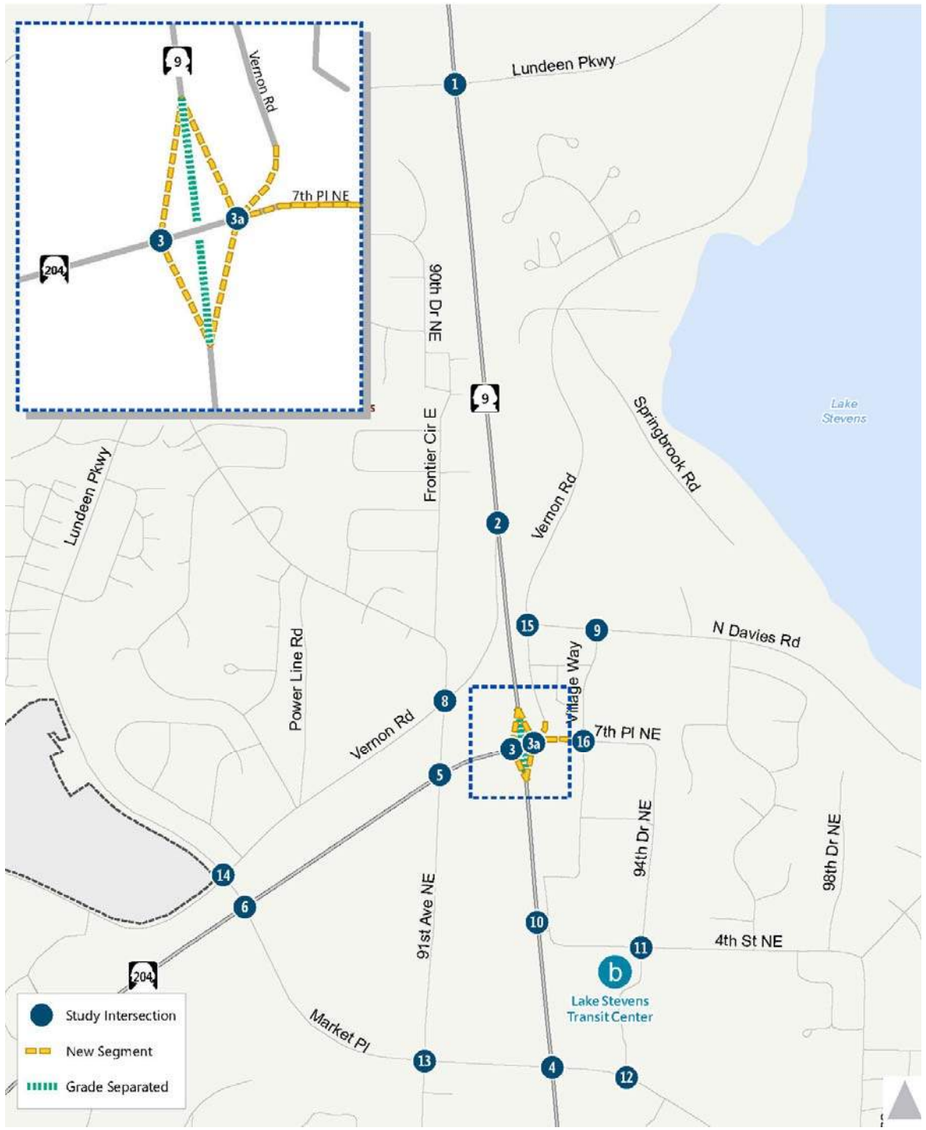


Figure 19
Traffic Volumes and Lane Geometry
2040 Concept E2B - PM Peak Hour



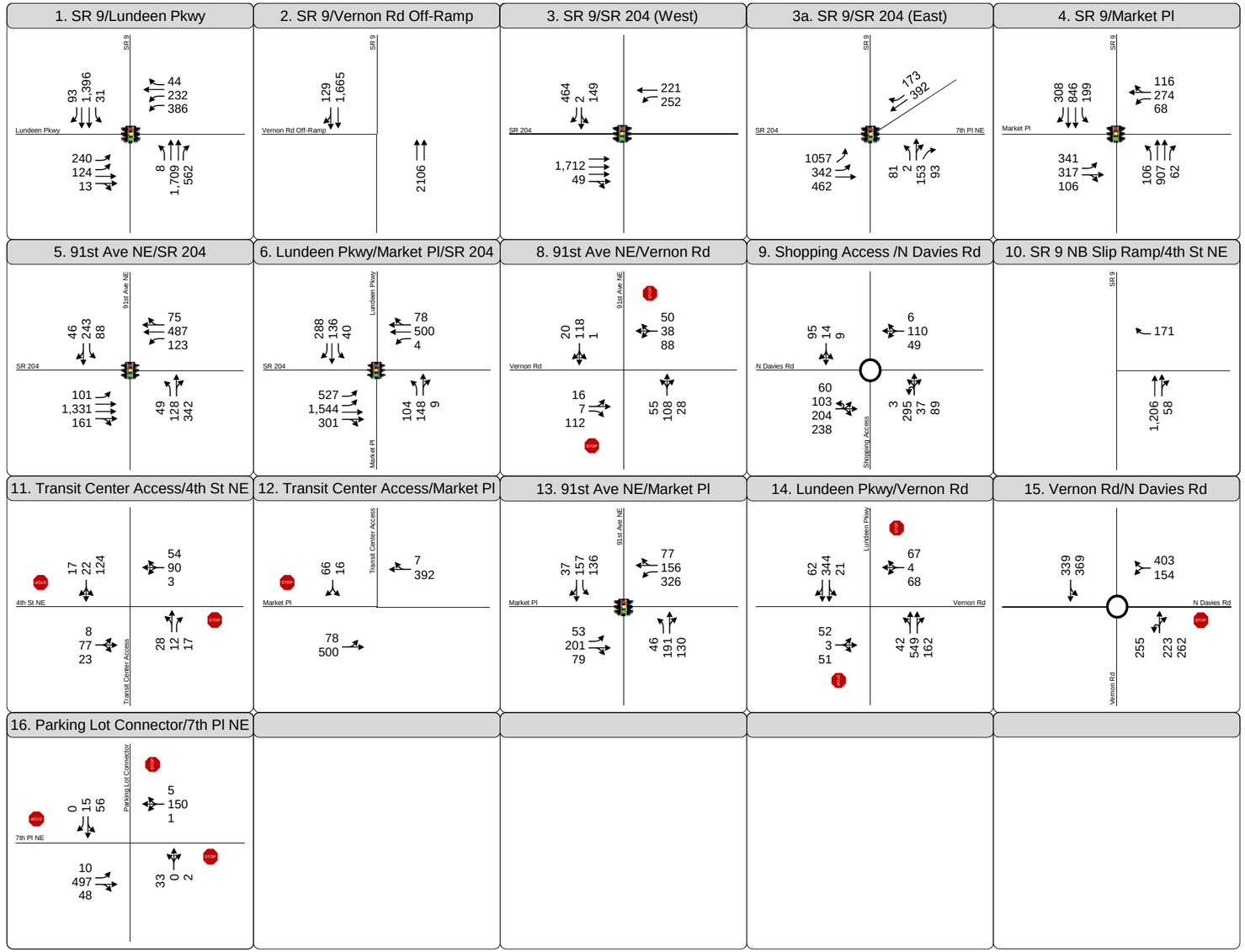
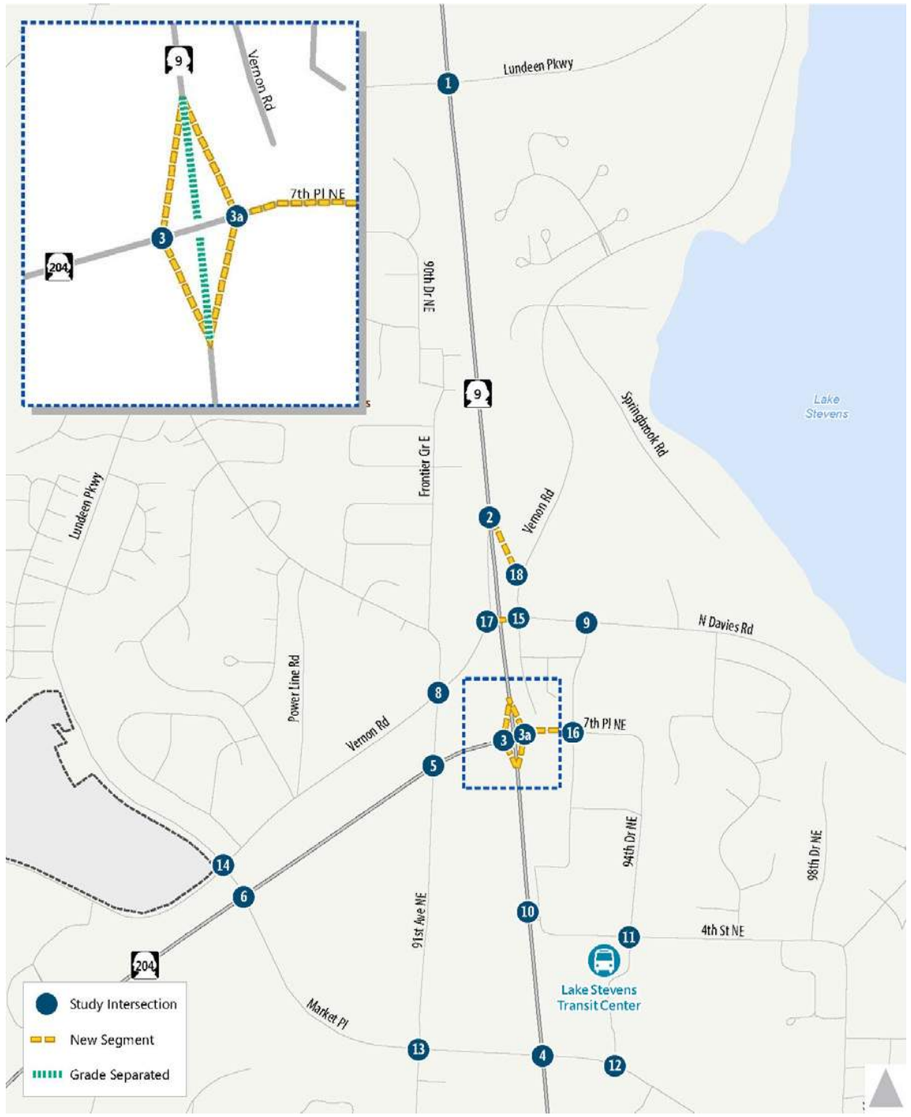


Figure 20
Traffic Volumes and Lane Geometry
2040 Concept E2B V4 - PM Peak Hour



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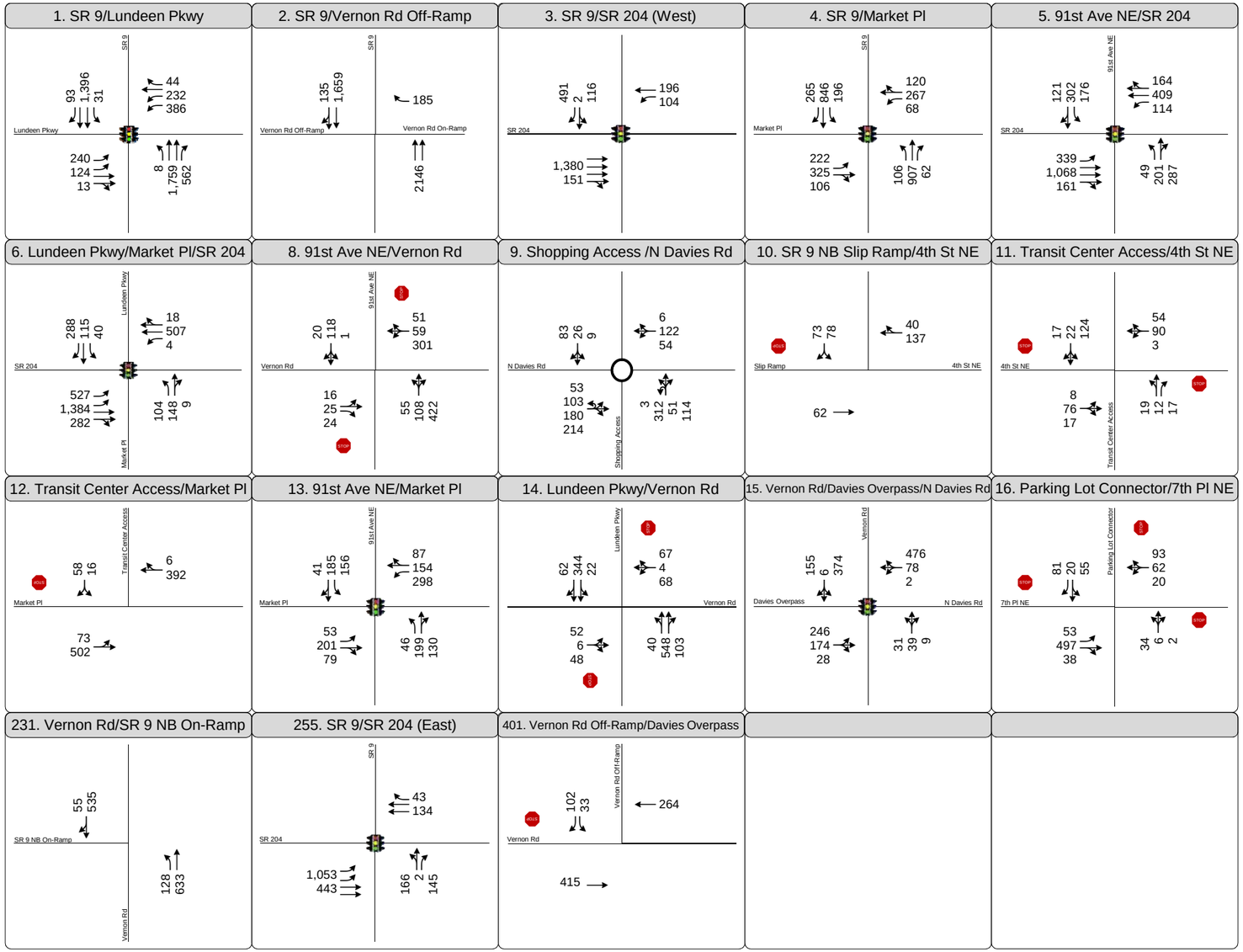
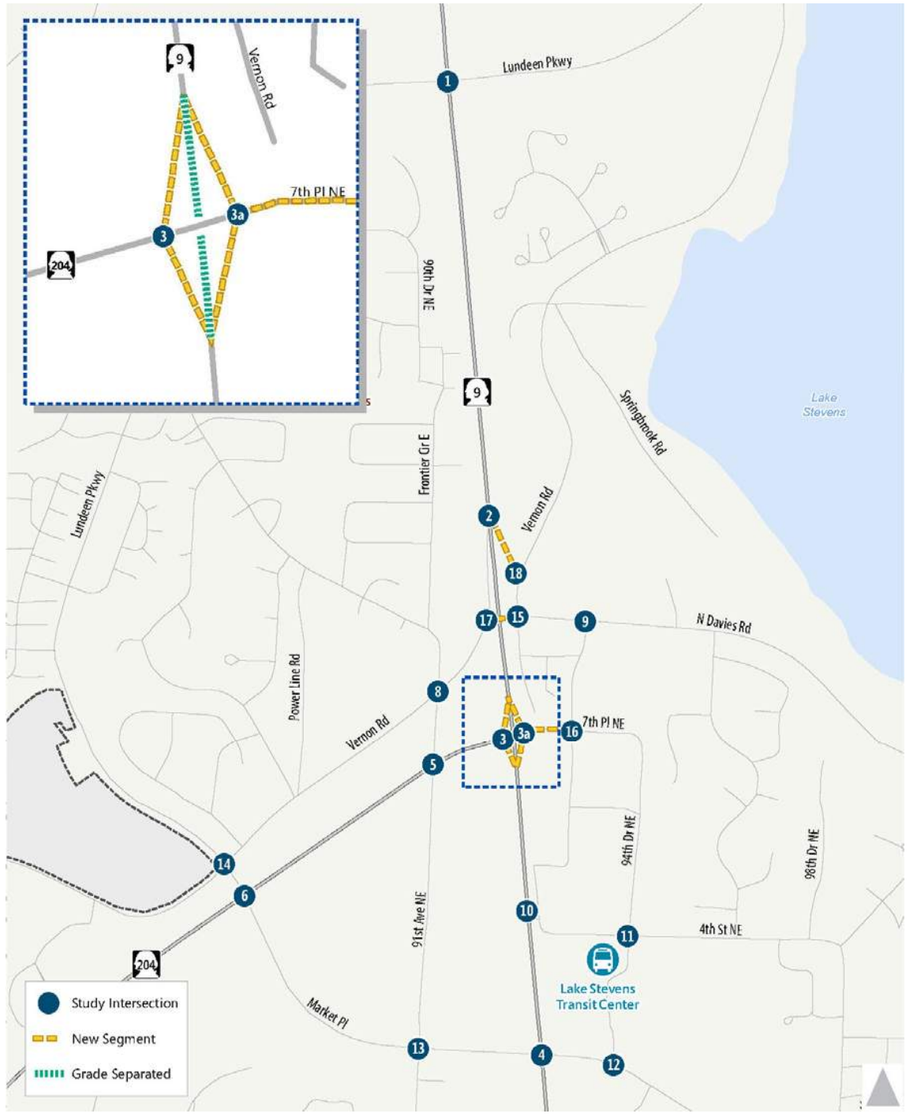
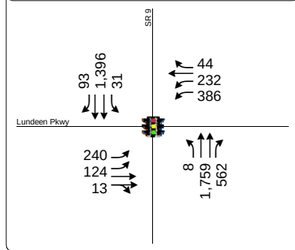


Figure 21
Traffic Volumes and Lane Geometry
2040 Concept E2C - PM Peak Hour

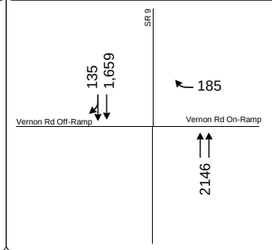


Source: path:

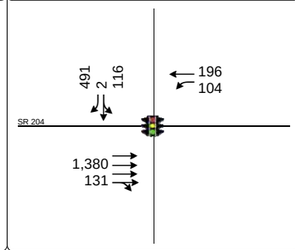
1. SR 9/Lundeen Pkwy



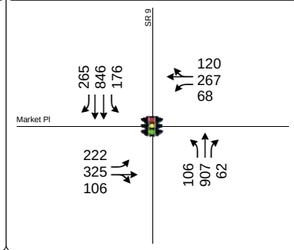
2. SR 9/Vernon Rd Off-Ramp



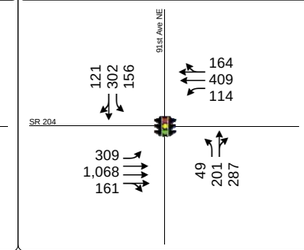
3. SR 9/SR 204 (West)



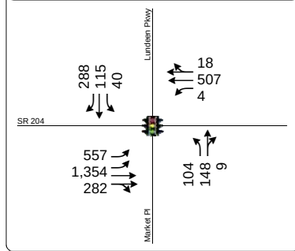
4. SR 9/Market Pl



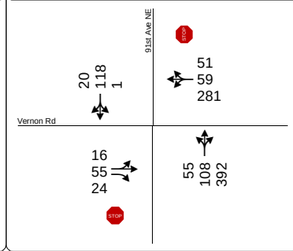
5. 91st Ave NE/SR 204



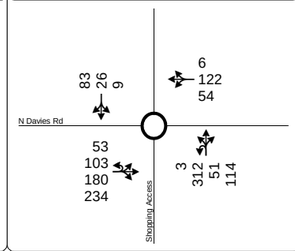
6. Lundeen Pkwy/Market Pl/SR 204



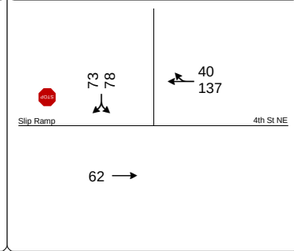
8. 91st Ave NE/Vernon Rd



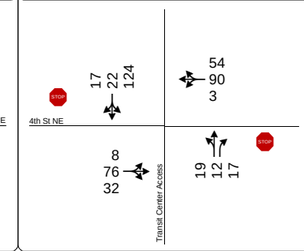
9. Shopping Access /N Davies Rd



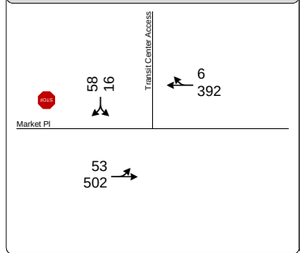
10. SR 9 NB Slip Ramp/4th St NE



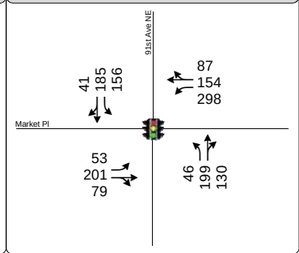
11. Transit Center Access/4th St NE



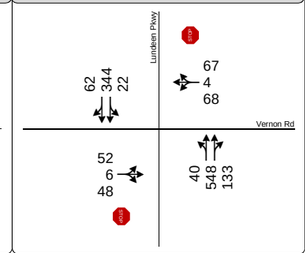
12. Transit Center Access/Market Pl



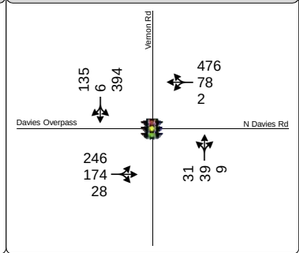
13. 91st Ave NE/Market Pl



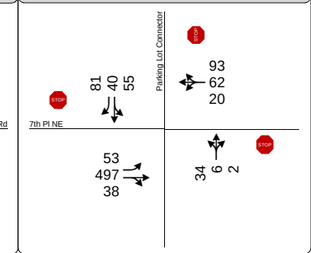
14. Lundeen Pkwy/Vernon Rd



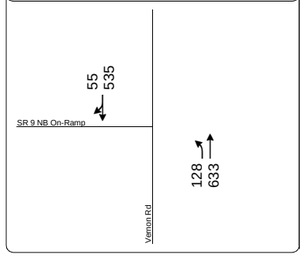
15. Vernon Rd/Davies Overpass/N Davies Rd



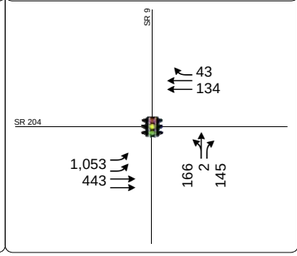
16. Parking Lot Connector/7th Pl NE



231. Vernon Rd/SR 9 NB On-Ramp



255. SR 9/SR 204 (East)



401. Vernon Rd Off-Ramp/Davies Overpass

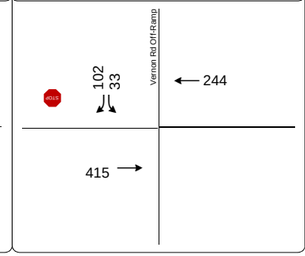


Figure 22
Traffic Volumes and Lane Geometry
2040 Concept E2D - PM Peak Hour

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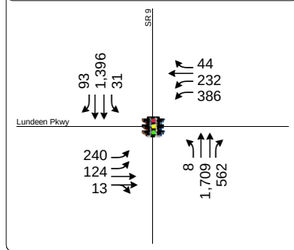
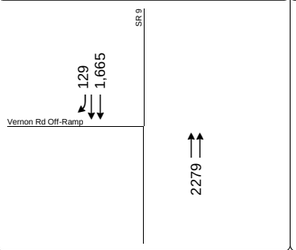


2. SR 9/Vernon Rd Off-Ramp



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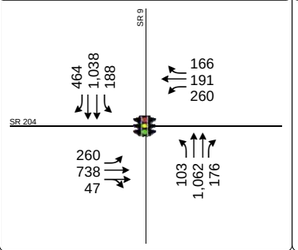
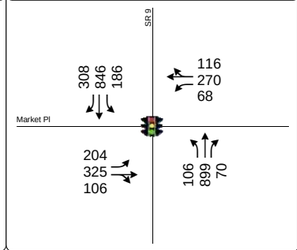
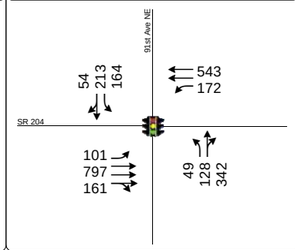


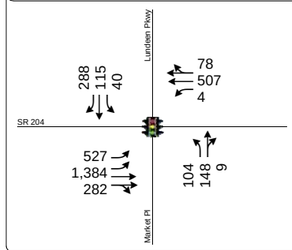
4. SR 9/Market Pl



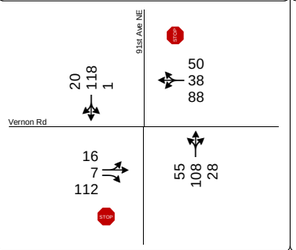
5. 91st Ave NE/SR 204



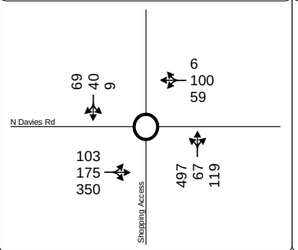
6. Lundeen Pkwy/Market Pl/SR 204



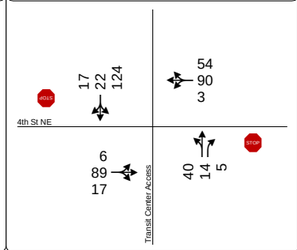
8. 91st Ave NE/Vernon Rd



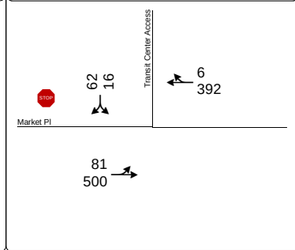
9. Shopping Access /N Davies Rd



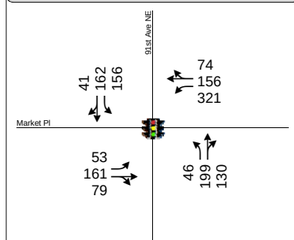
11. Transit Center Access/4th St NE



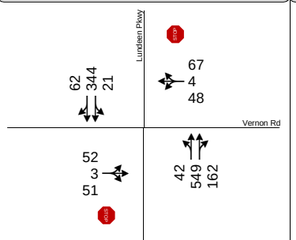
12. Transit Center Access/Market Pl



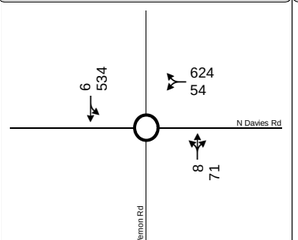
13. 91st Ave NE/Market Pl



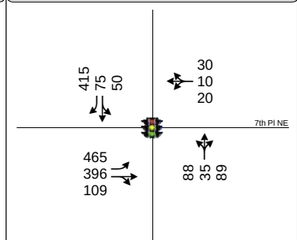
14. Lundeen Pkwy/Vernon Rd



15. Vernon Rd/N Davies Rd



16. Frontier Ln/7th Pl NE



30. SR 9/ 4th St Slip Ramp

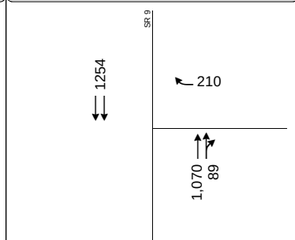
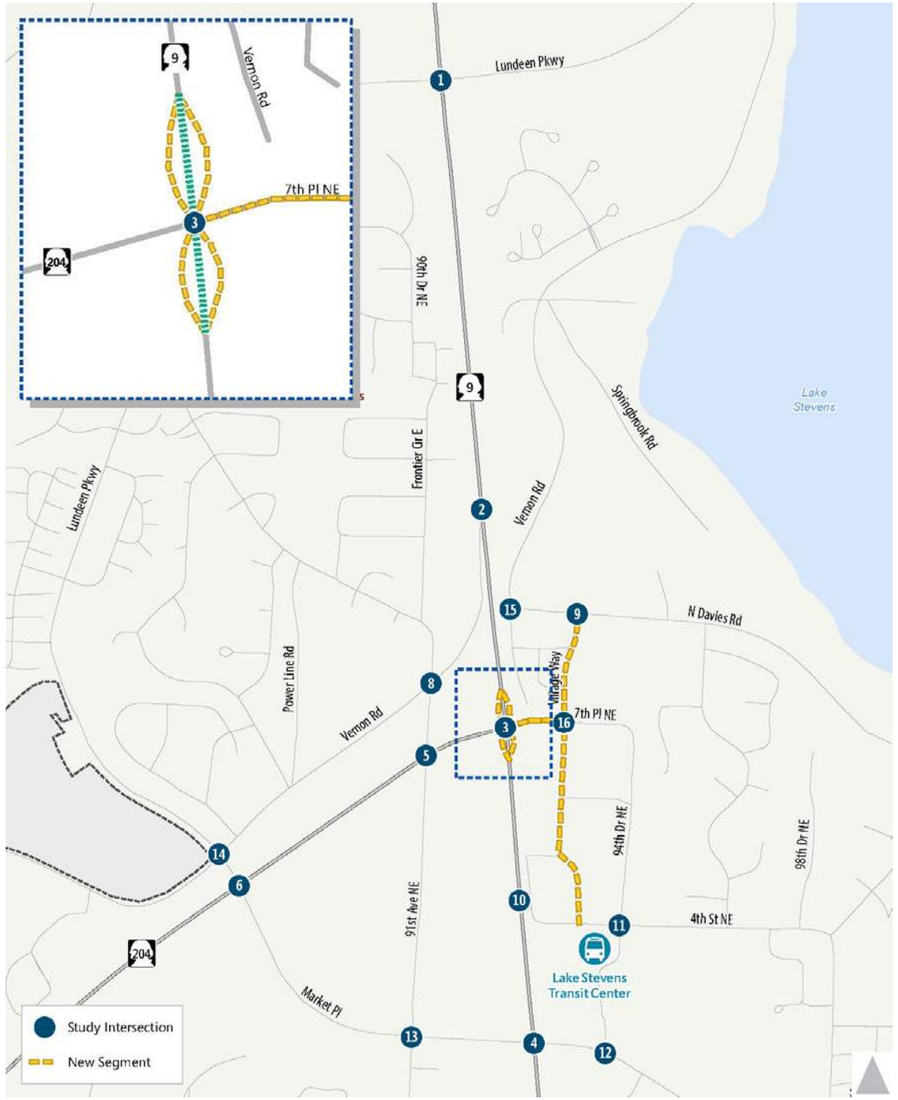


Figure 23
Traffic Volumes and Lane Geometry
2040 Concept G2B - PM Peak Hour



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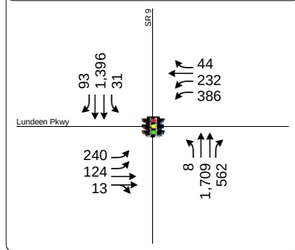
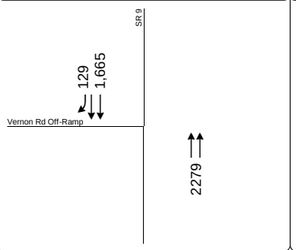
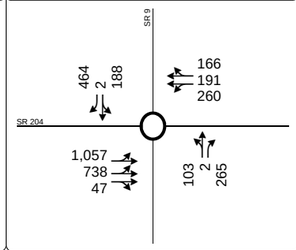


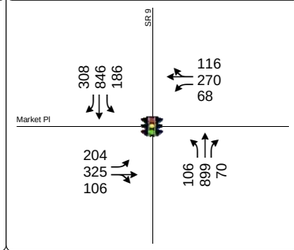
2. SR 9/Vernon Rd Off-Ramp



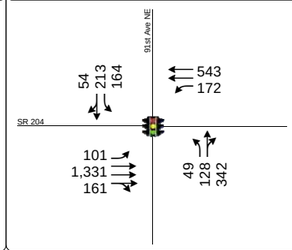
3. SR 9/SR 204



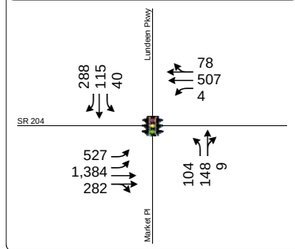
4. SR 9/Market Pl



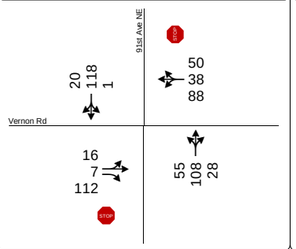
5. 91st Ave NE/SR 204



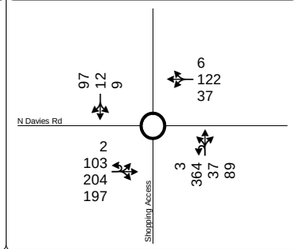
6. Lundeen Pkwy/Market Pl/SR 204



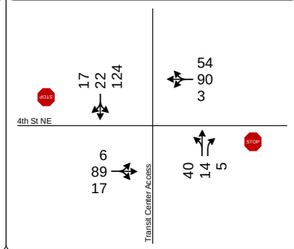
8. 91st Ave NE/Vernon Rd



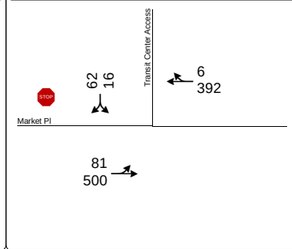
9. Shopping Access /N Davies Rd



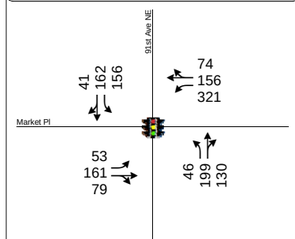
11. Transit Center Access/4th St NE



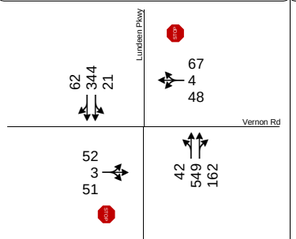
12. Transit Center Access/Market Pl



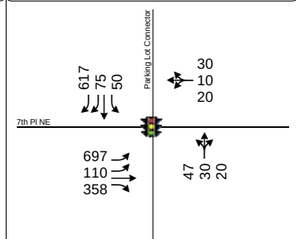
13. 91st Ave NE/Market Pl



14. Lundeen Pkwy/Vernon Rd



16. Parking Lot Connector/7th Pl NE



216. Slip Ramp/4th St NE

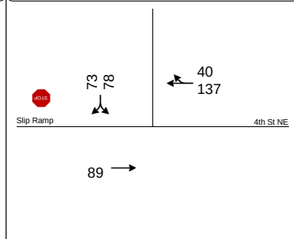
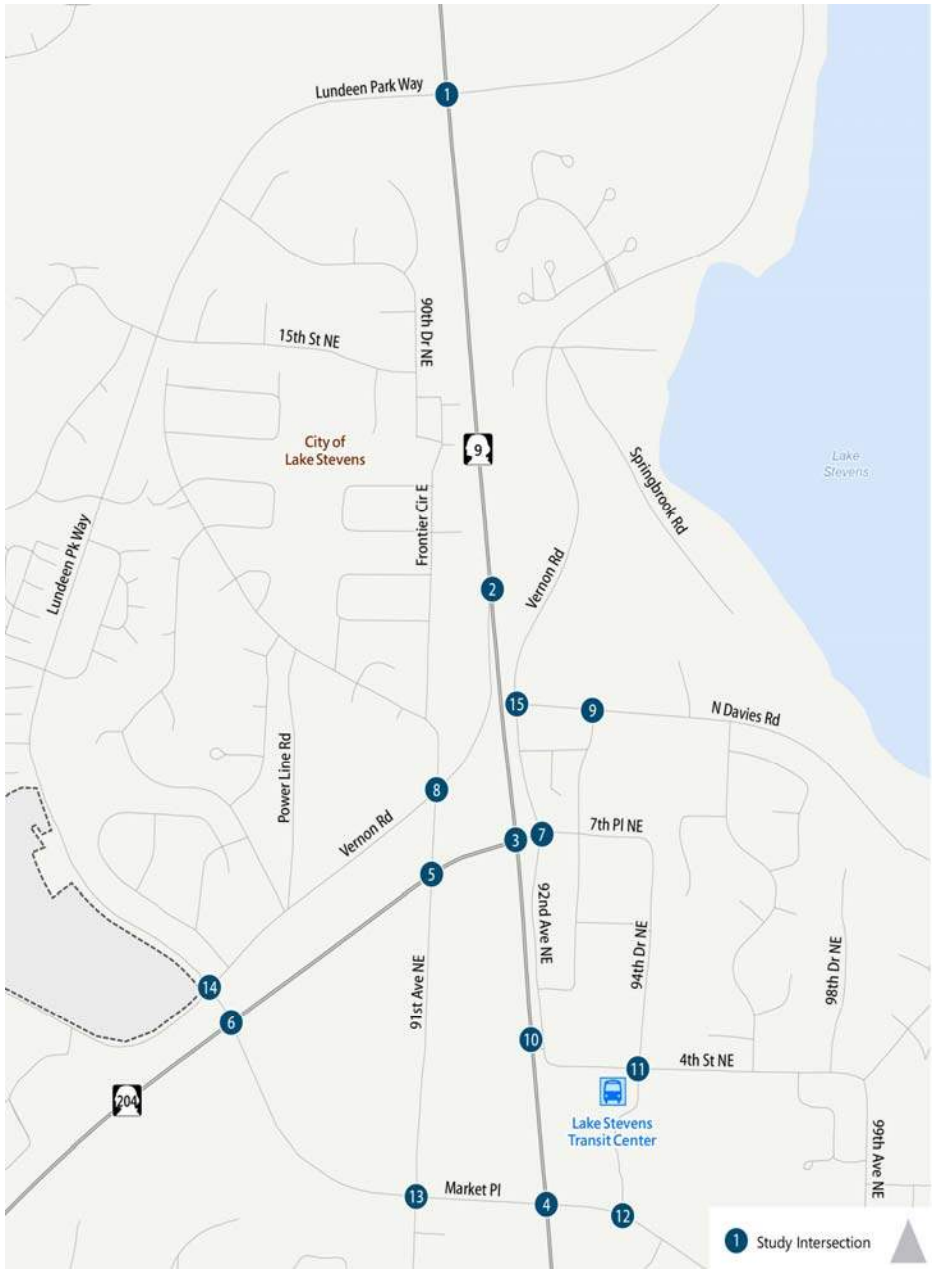


Figure 24
Traffic Volumes and Lane Geometry
2040 Concept H - PM Peak Hour



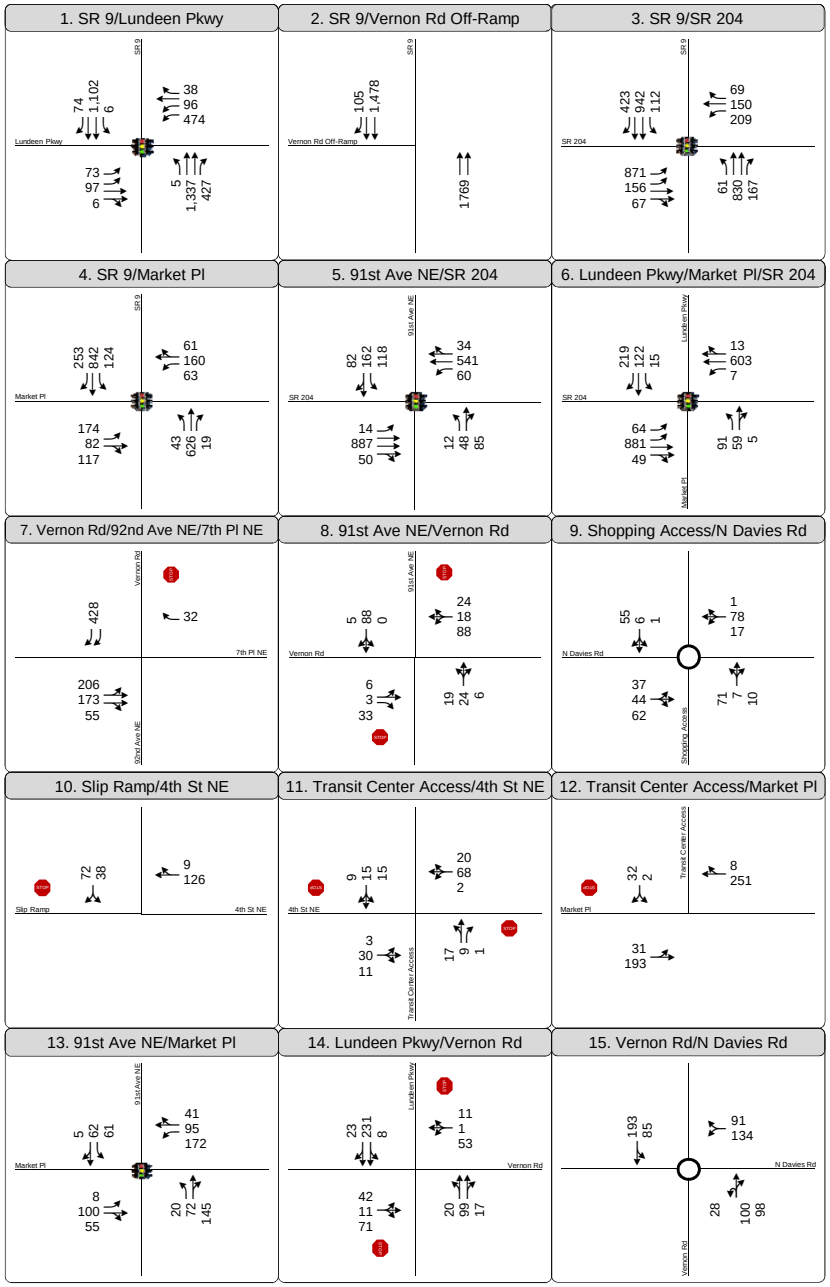
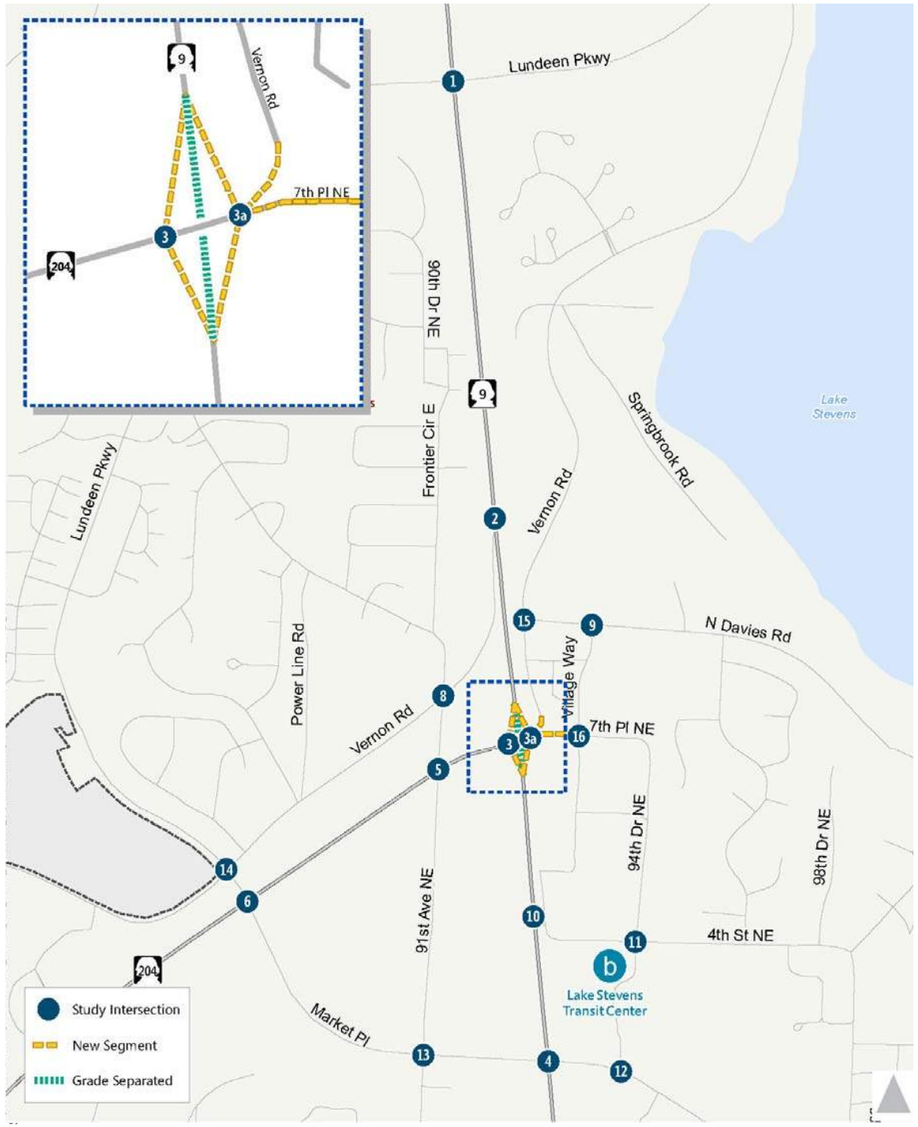


Figure 25
Traffic Volumes and Lane Geometry
2040 No Build - AM Peak Hour



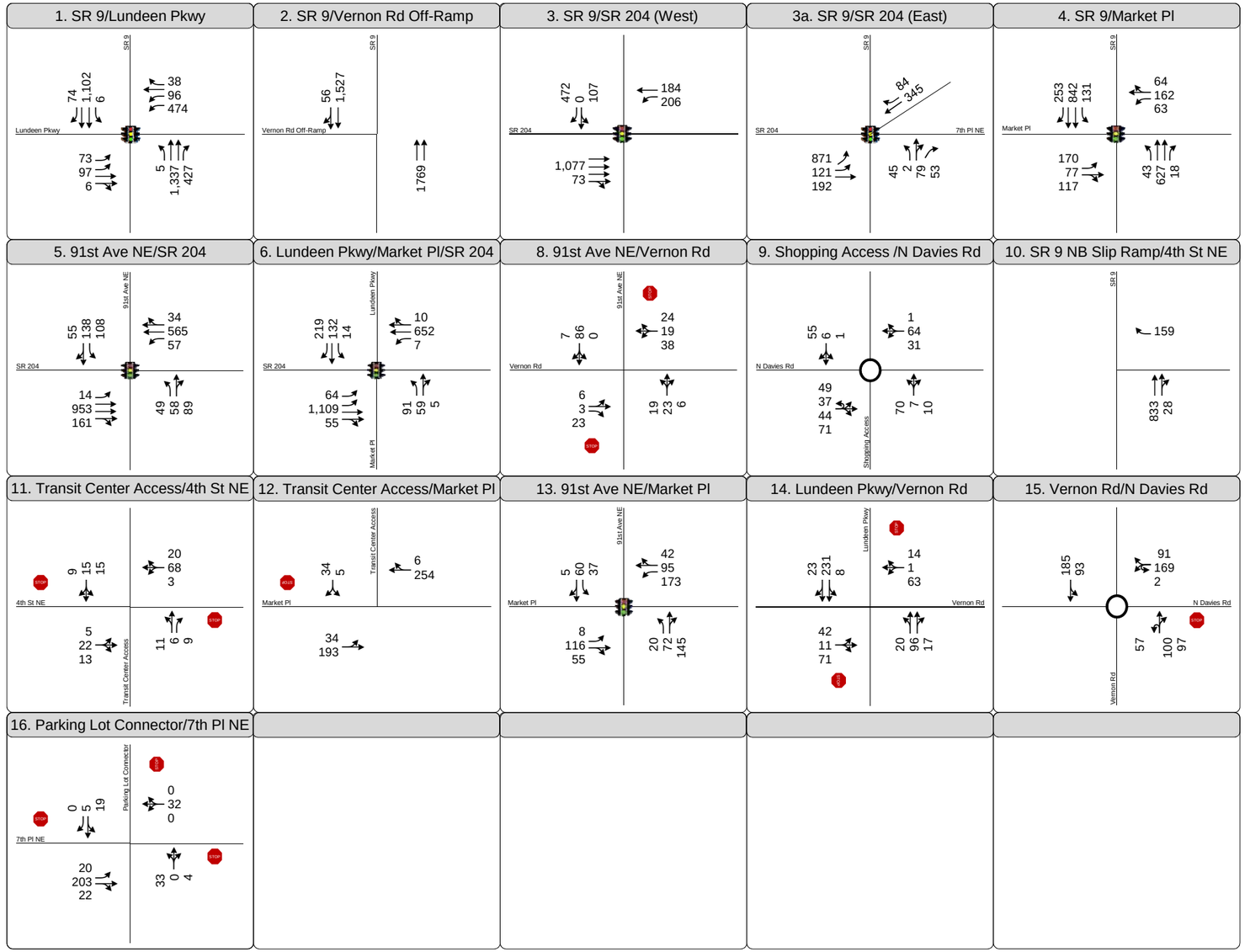
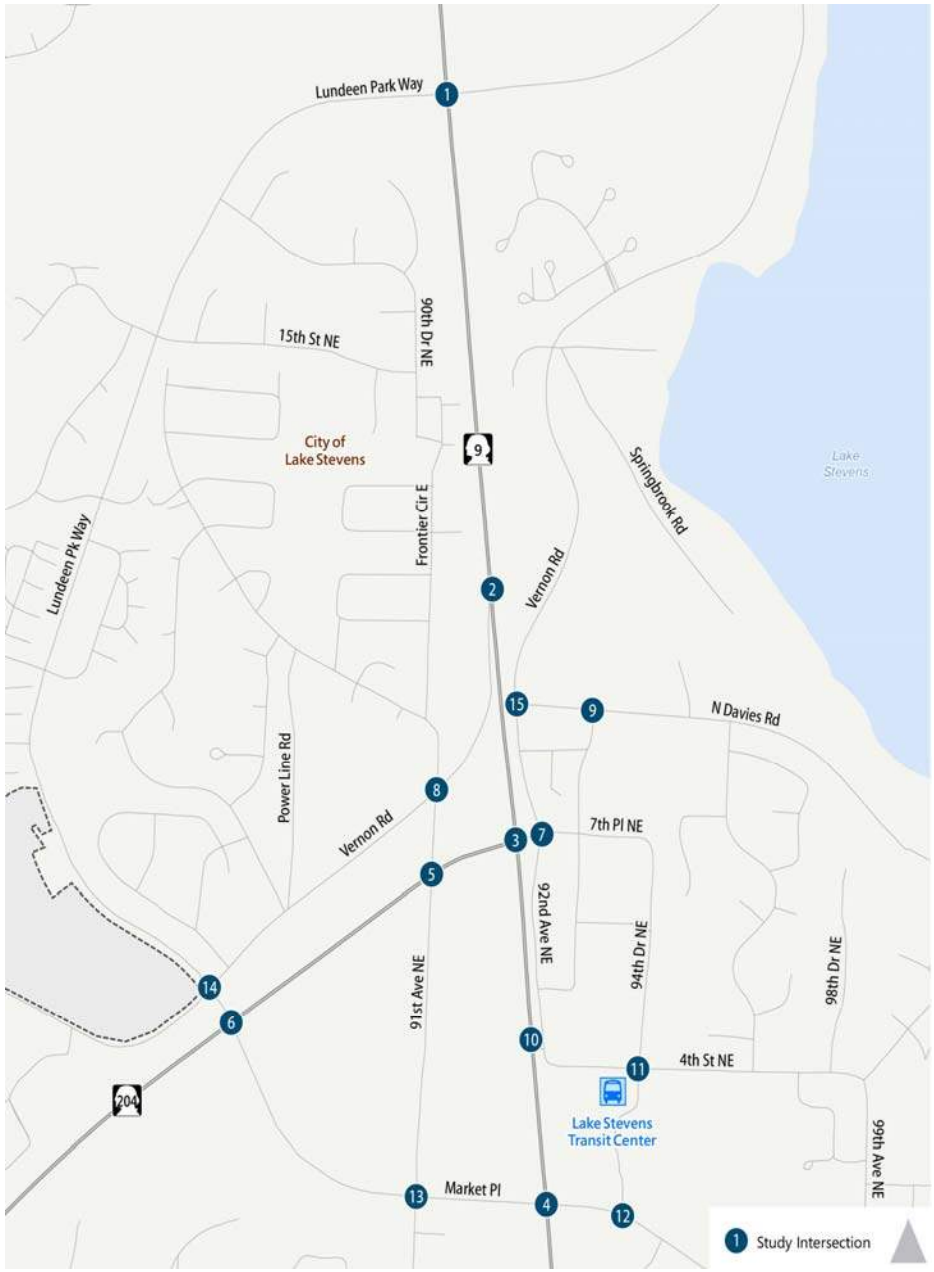


Figure 26
Traffic Volumes and Lane Geometry
2040 Concept E2B V4 - AM Peak Hour



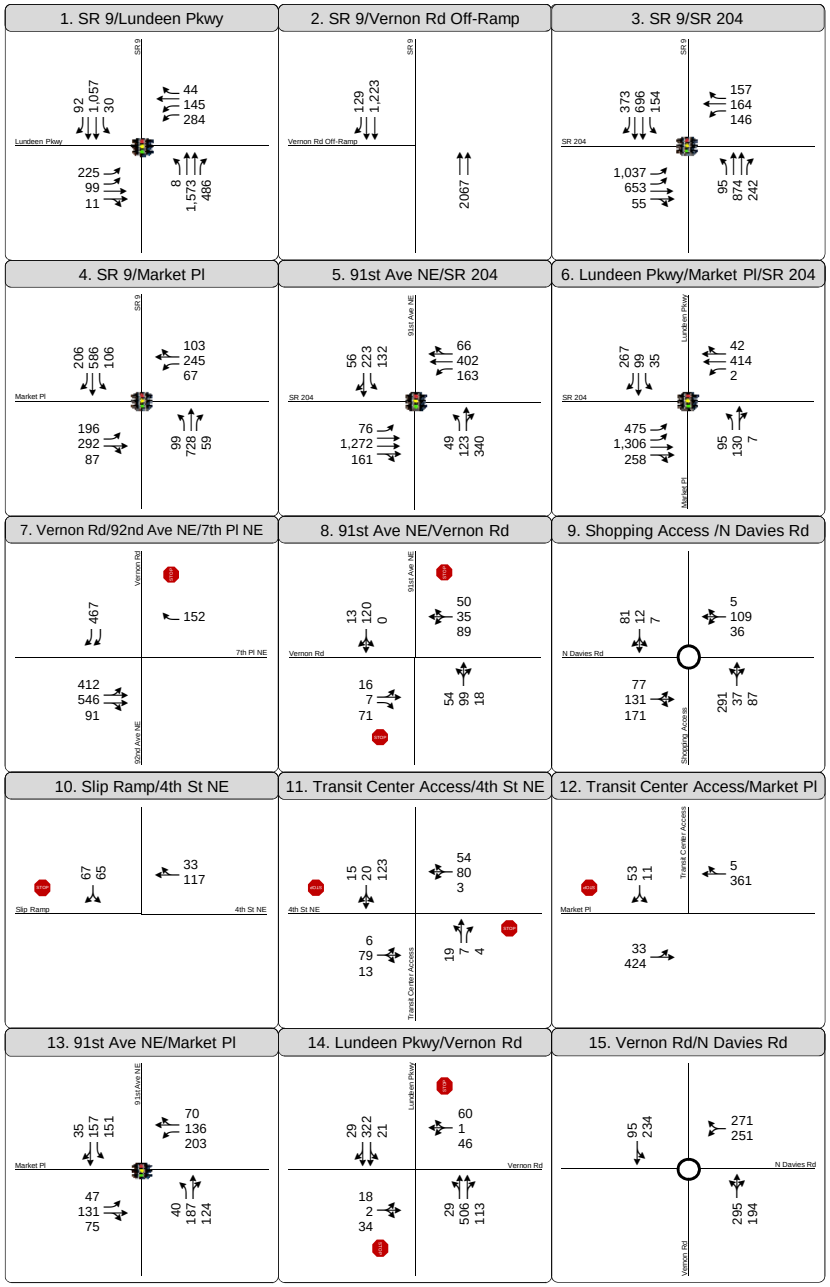
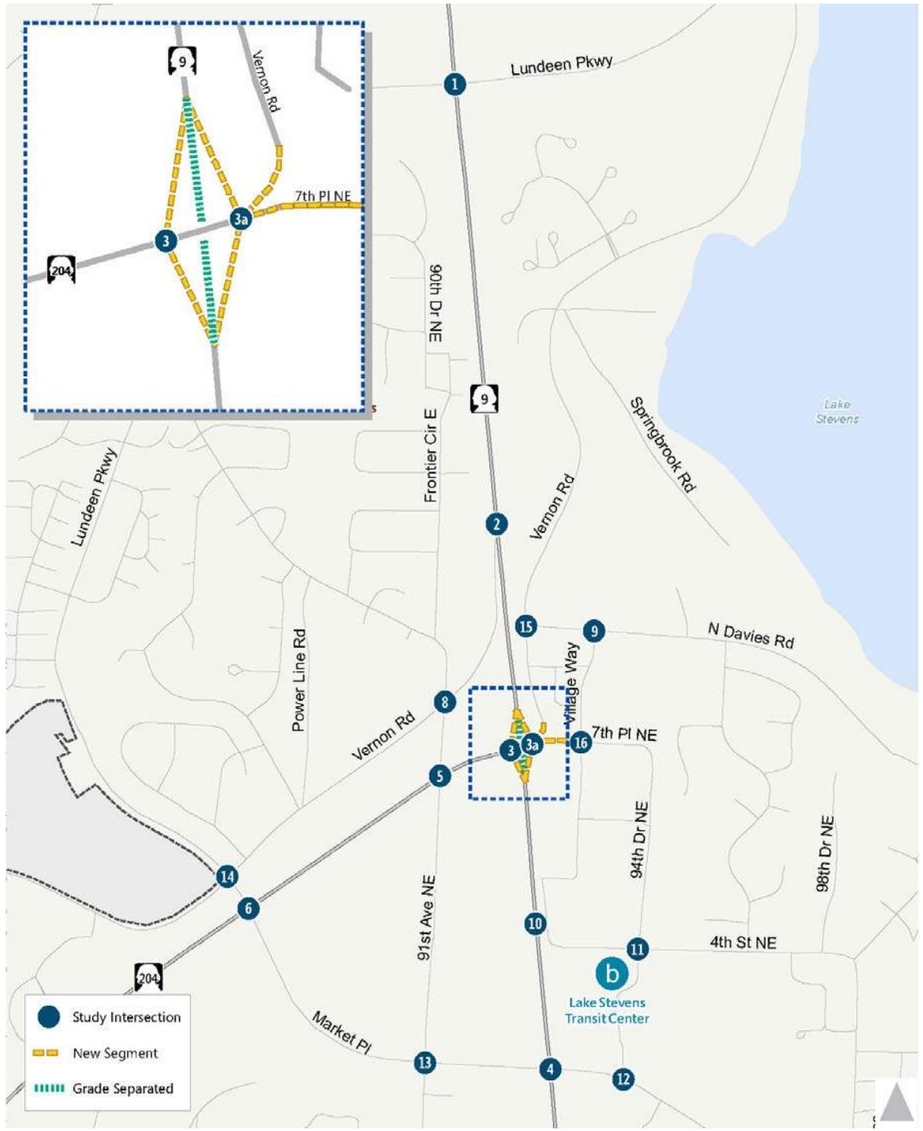


Figure 27
Traffic Volumes and Lane Geometry
2021 No Build - PM Peak Hour



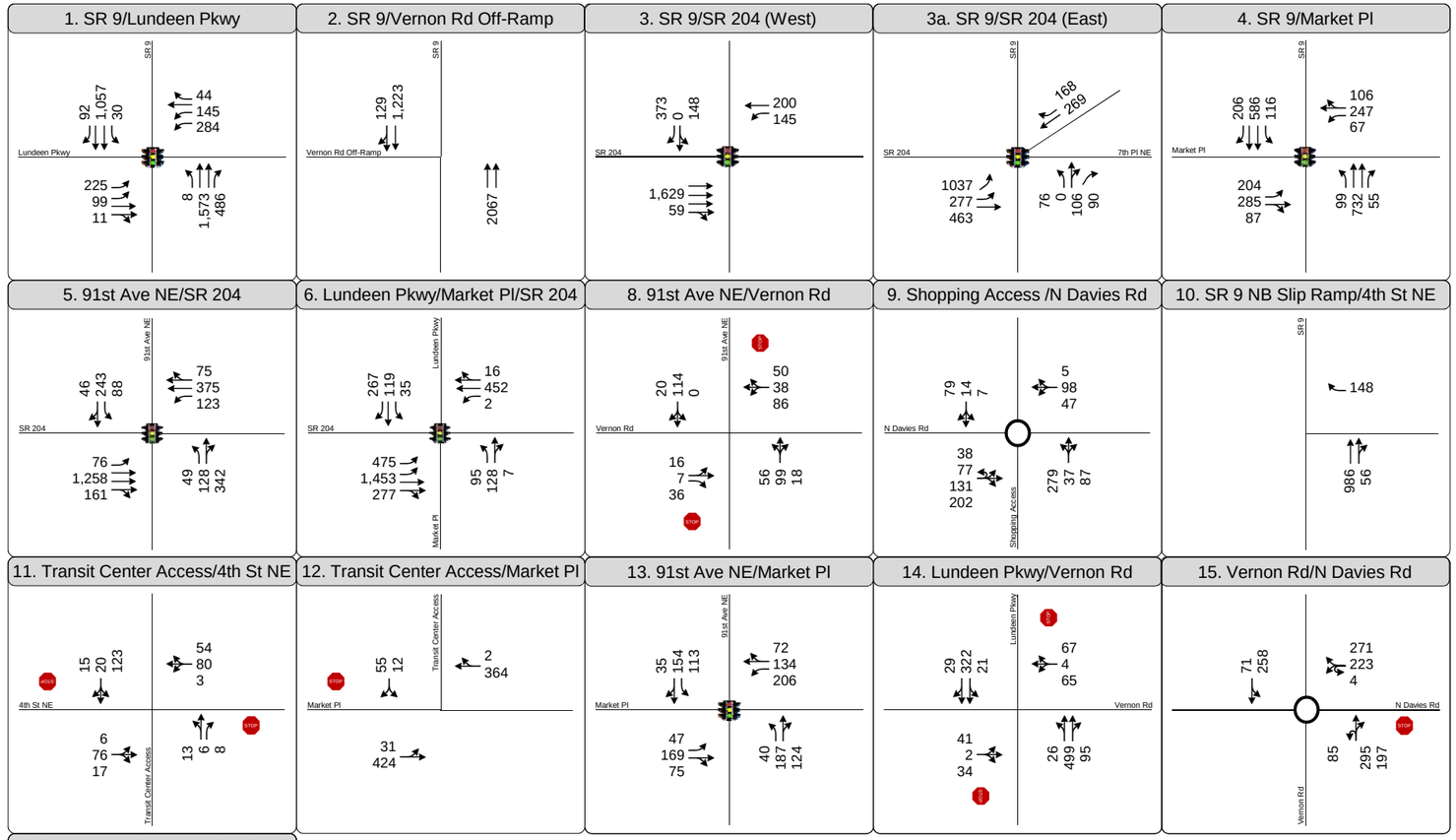
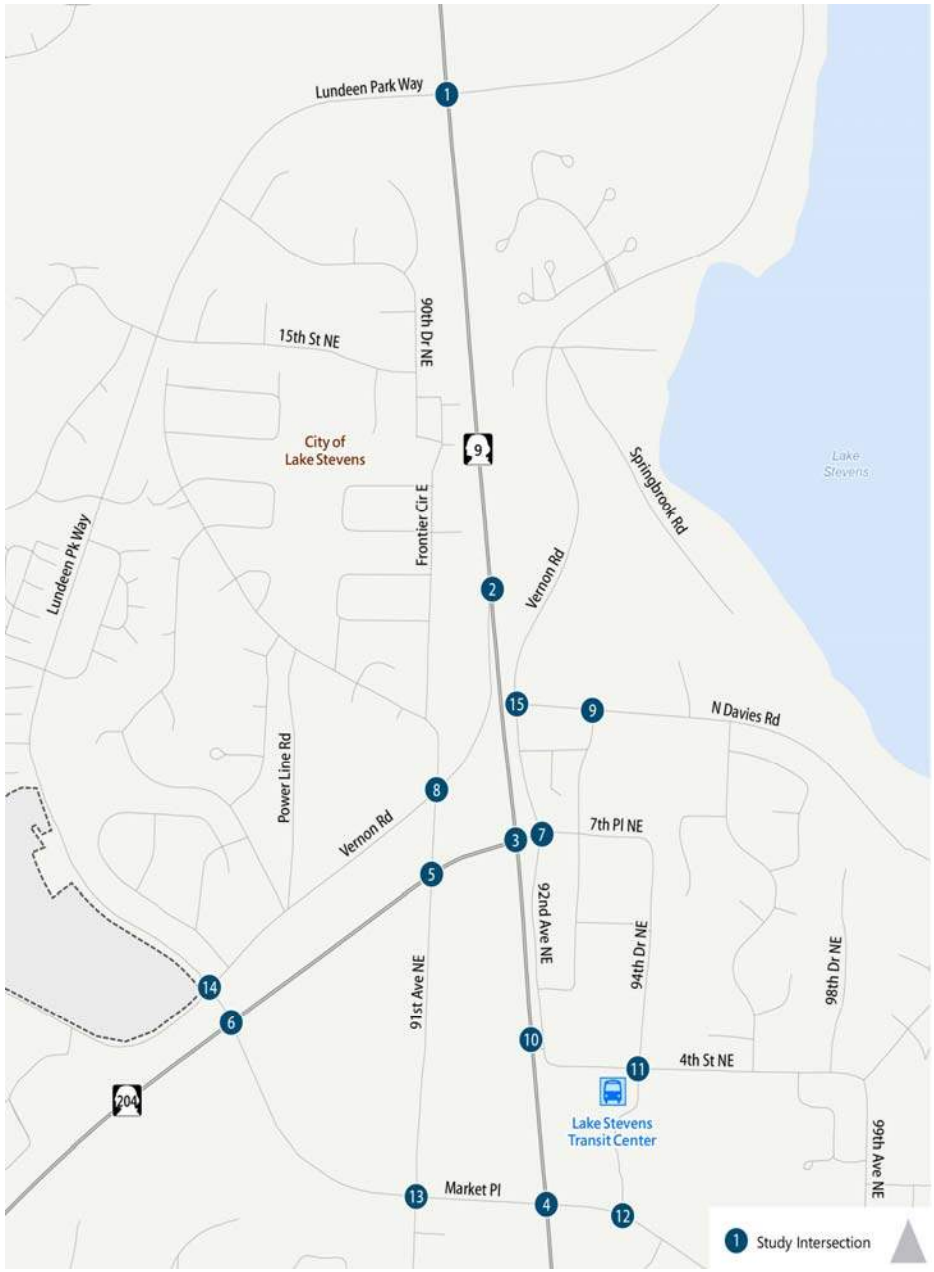


Figure 28
Traffic Volumes and Lane Geometry
2021 Concept E2B V4 - PM Peak Hour



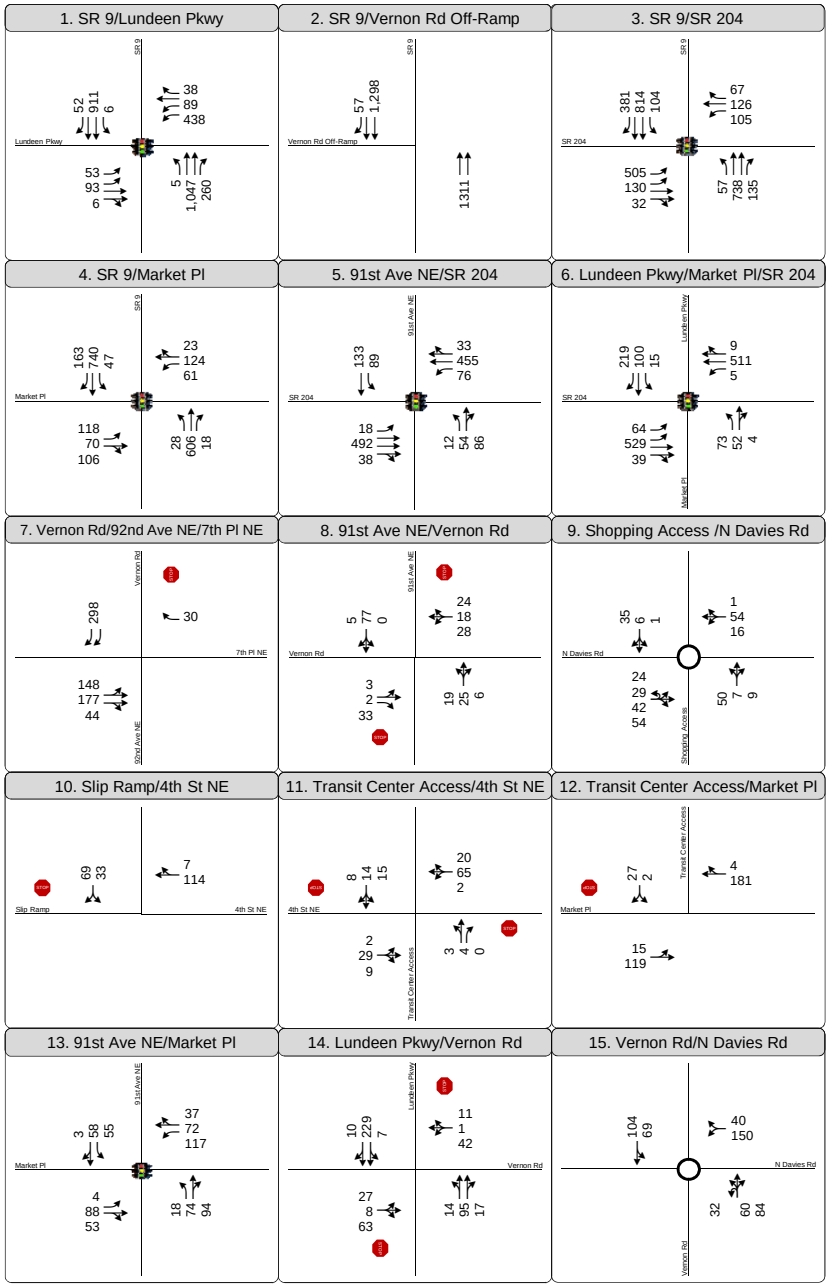
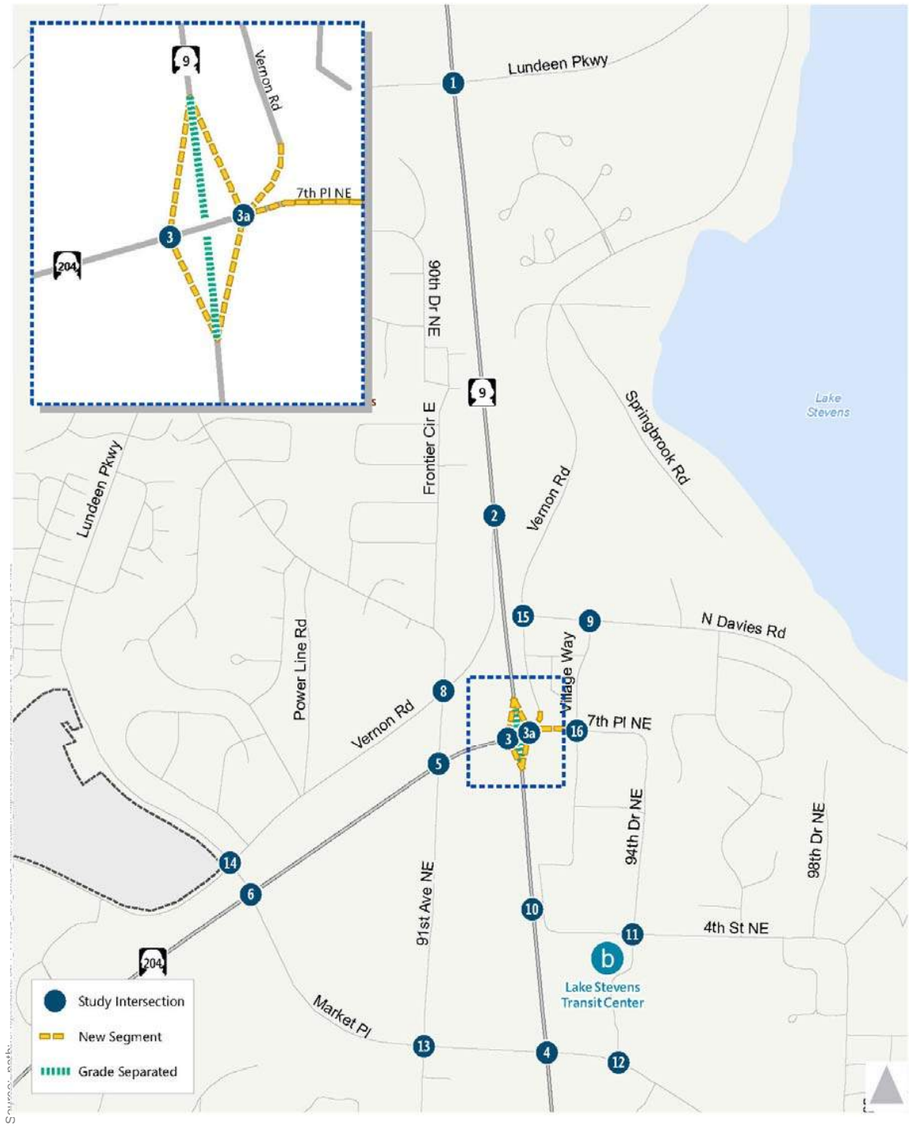


Figure 29
Traffic Volumes and Lane Geometry
2021 No Build - AM Peak Hour



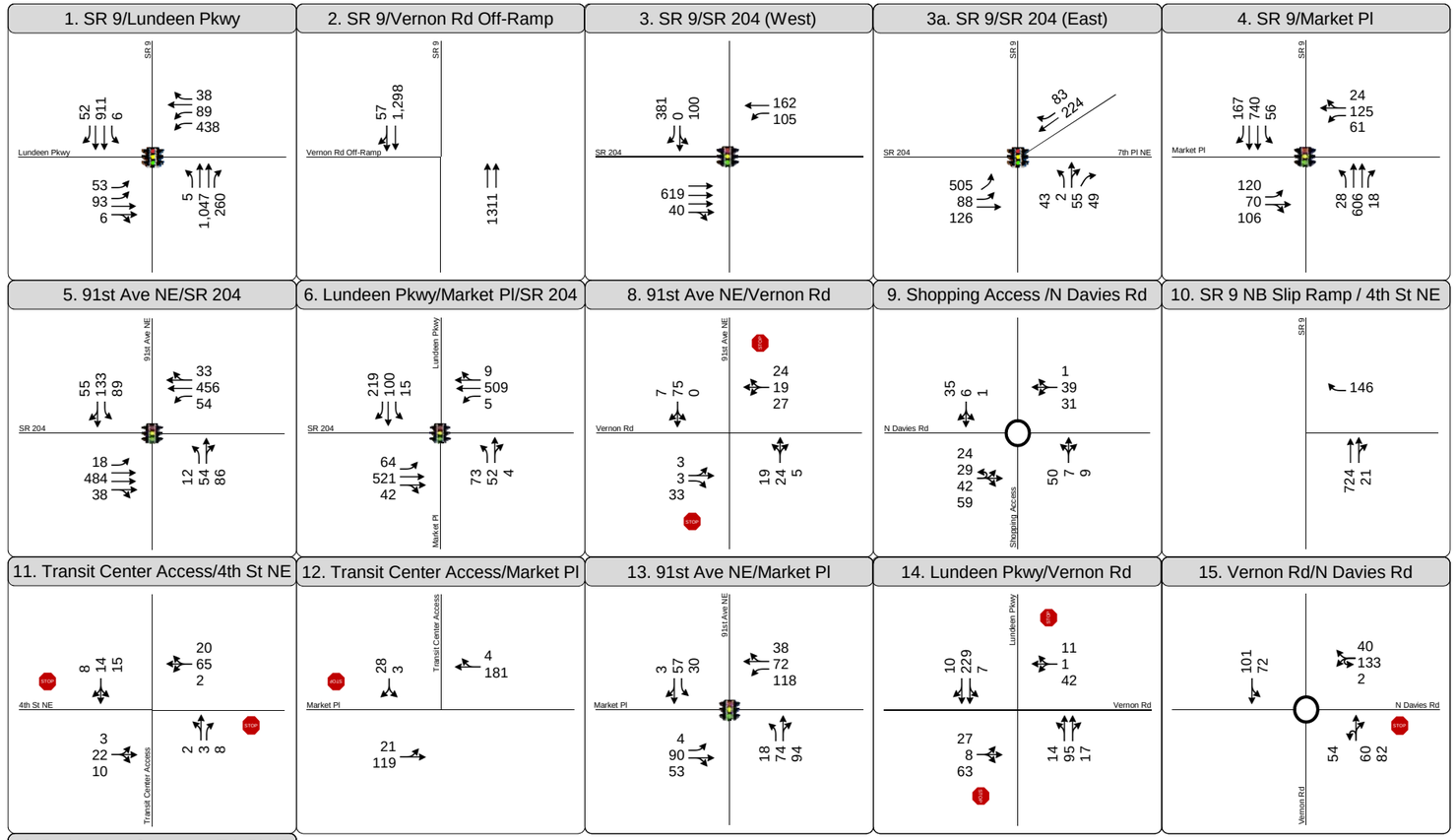


Figure 30
Traffic Volumes and Lane Geometry
2021 Concept E2B V4 - AM Peak Hour

APPENDIX F.
TRAVEL TIME ANALYSIS MEMORANDUM

November 2017

Date: October 27, 2017

To: Michael Horntvedt (Parsons)

From : Will Lisska, Dan Grayuski, and Carmen Kwan (Fehr & Peers)

Subject: Travel Time Analysis Memorandum

1.0 INTRODUCTION

The SR 9 and SR 204 intersection serves a wide variety of both regional and local traffic including commuters, freight, and local business access. Given existing and anticipated future traffic congestion at this intersection, WSDOT and the Consultant team are evaluating options to improve vehicle flow, safety, non-motorized, transit, and local access through the intersection.

One of the performance metrics to evaluate proposed concepts is travel time between key locations within the study area. This helps evaluate the performance of each concept compared to the 2040 PM No Build scenario. Both auto and transit travel times were extracted from the 2040 PM VISSIM models for each concept. The non-motorized travel time under each concept was estimated based on the pedestrian facilities that would be added and the changes in traffic signal cycle lengths (as these relate to time spent waiting for crossing signals).

The following sections summarize the key location pairs analyzed, the project alternative definitions, the travel time analysis methodologies, and major findings.

2.0 STUDY AREA AND TRAVEL TIME LOCATIONS

For the purposes of comparing the approximate travel time benefits provided by each concept, travel time between the following seven key locations was measured:

1. SR 9 north of Lundeen Parkway
2. SR 9 south of Market Place NE
3. SR 204 west of Market Place NE / Lundeen Parkway
4. N Davies Road and access driveway to the Safeway parking area
5. 4th Street NE and 94th Drive NE
6. 91st Avenue NE Commercial District (near Ace Hardware)
7. Lundeen Parkway neighborhoods (near Vernon Road / 91st Avenue NE intersection)

Figure 1 shows the overall study area and the seven key locations between which travel times were evaluated. These locations were selected to illustrate how regional vehicle travel times would change (locations 1 through 3), as well as between key neighborhood origins and destinations within the study area (locations 4 through 7). Transit travel time impact and benefits were measured by route. Currently,

four routes run through the study area during the PM peak hour (CT 109, CT 209, CT 280, and CT 425). Additionally, the analysis of non-motorized travel times focused on internal neighborhood origins/destination (locations 4 through 7), because there are no sidewalks or dedicated bike facilities leading into or out of the study area along SR 9 and SR 204.

Figure 1: Key Locations to Evaluate Travel Time

3.0 PROJECT ALTERNATIVES

The following project alternatives were analyzed:

- **No Build Alternative** – Includes planned projects, but no additional improvements in the study area.
- **Concept B** – Includes three roundabouts intersections along SR 9 at Vernon Road/Davies Road, SR 204, and 4th Street NE, as well as grade separation of north-south SR 9 through lanes at Vernon Road/Davies Road and SR 204. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.
- **Concept C** – Addition of a northbound right-turn slip ramp from SR9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.
- **Concept E** – Includes addition of through lane on SR9 from Lundeen Parkway to south of Market Place and a tight diamond interchange at SR 204 with grade-separation for the north-south through lanes. Addition of a northbound right-turn slip ramp from SR9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.
- **Concept E2A** – Same as Concept E with no widening of SR 9.
- **Concept E2B** – Same as Concept E with no widening of SR 9 to the north of SR 204.
- **Concept E2B Variation 4**– Same as Concept E2B, but maintains Vernon Road connection to SR 9 / SR 204 intersection and does not construct Village Way connection. Additionally, 92nd Avenue NE connection from 7th Place NE to 4th Street NE would be removed.
- **Concept E2C** – Same at Concept E with no widening of SR 9 and an added half interchange at Davies Road with a two-way overcrossing to Vernon Road on the west side of SR 9. Village Way would not be added under this concept, but 92nd Avenue NE would still be closed and Vernon Road would still be terminated in a cul-de-sac to the north of 7th Place NE.
- **Concept E2D** – Same at Concept E2C with widening on SR9 from Lundeen Parkway to south of Market Place.
- **Concept H** – Includes grade-separation for the north-south through lanes on SR 9 through the SR 204 intersection with and a roundabout interchange. Addition of a northbound right-turn slip ramp from SR9 to 4th Street NE. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local

access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.

- **Concept G2B** – Includes grade-separation of the left-turn lane from eastbound SR 204 to northbound SR 9, diverging upstream of the 91st Avenue NE intersection. To the east of SR 9, 92nd Avenue NE would be closed and Vernon Road would be terminated in a cul-de-sac to the north of 7th Place NE. A new north-south local access road (Village Way) would be constructed through the existing shopping center drive aisles from Davies Road to 4th Street NE.

4.0 TRAVEL TIME ANALYSIS

This section documents the travel time analysis methods and results for each proposed option compared to the 2040 PM No Build conditions.

ANALYSIS METHODOLOGIES

Auto and Transit Methods – All auto and transit travel times were evaluated using the VISSIM model developed for each concept under the 2040 PM conditions. Within each model, an inbound and outbound travel time marker was placed on the roadway link at each location. VISSIM records the travel time for each car that crossed the origin marker and destination marker. Each concept's model was run 11 times to account for random vehicle arrival rates throughout the analysis hour. For each 15-minute period in the analysis peak hour, the travel time of the vehicles that crossed one origin marker to a destination marker was averaged over the 11 model runs. A vehicle weighted average travel time during each 15-minute period in the analysis peak hour was then calculated to reach the final travel time results under each concept.

Some limitations of this analysis approach is that the average travel time between each origin-destination pair includes all vehicles that crossed each marker. That means the average travel time considers vehicles that travel on parallel routes. An intersection to intersection travel time marker along a specified route between each origin-destination pair however would have been too time intensive.

The transit travel times are an average of the transit vehicles travel through the network over the analysis hour. The reported transit travel times are the average of the 11 model runs for each concept.

Non-Motorized Methods – The non-motorized travel times were estimated using the following assumptions:

- Measured distance between neighborhood origin/destinations locations along the existing and proposed pedestrian network. Walking speed was assumed to be 4.5 feet per second, an average walking pace for an adult.
- Maximum potential time spent waiting to cross at intersection legs was added to the distance-based travel time. Different calculation methods were applied for signalized intersections and rapid rectangular flashing beacons (RRFB).

- **Signalized intersection crossing locations** – For all signalized intersection locations, crossing delay was based on signal cycle length and phasing. For example, the SR 204/91st intersection runs on a 120 second cycle length under most of the concepts, with a max green time of 40 seconds dedicated to north/south movement and 80 seconds to east/west movement. Starting from the end of the north/south through movement, it would take about 80 seconds reach the beginning of this phase again, so maximum waiting time for pedestrians crossing in the north/south direction at this intersection is about 80 seconds. Because signal cycle and phasing lengths were optimized for traffic flow in under each alternative, maximum potential time spent waiting for a pedestrian can also vary at signalized intersection locations.
- **RRFB crossing locations** – at the proposed roundabouts, pedestrians would actuate RRFB crossings, and vehicles would yield to them (research indicates that vehicles yield over 80 percent of the time at most RRFBs). Theoretically, crossing delay for pedestrians should be fairly consistent at an RRFB. The total delay time represents the time it takes to actuate the flashing signals, the reaction/stopping time for oncoming vehicles, and pedestrian reaction/volition time. This delay time was estimated as about 15 seconds.

TRAVEL TIME RESULTS

The full list of model vehicle travel times between each key location and the transit travel times are in **Attachment A**. Each concept's Origin-Destination travel time matrices were compared to the No Action scenario. The calculation and comparison of non-motorized travel times is provided in **Attachment B**. The major findings are summarized below:

- Concept B and Concept H proposed roundabouts along SR 9, which would require vehicles to drive at slower speeds. Travel times for regional trips from SR 204 to southbound or northbound SR 9 generally increased by up to two minutes under these concepts.
- Grade separation at the SR 9 / SR 204 intersection resulted in northbound and southbound through travel times decreasing by up to three minutes.
- All options that had revised access into and out of Frontier Village, as well as Village Way, experienced vehicle travel times savings. The most pronounced improvement were for trips originating at the Safeway Driveway (node 4) to all other locations, where travel time could decrease by more than eight minutes. Travel between locations within Frontier Village also improved with the proposed Village Way.
- Concept G, with the eastbound left tunnel from SR 204 to northbound SR 9, had travel time improvements of up to one minute from SR 204 west of Market Place to north of Lundeen Parkway on SR 9.
- Concept C generally had travel time savings similar to Concept G, with the eastbound left movement from SR 204 to northbound SR 9 similar to No Build conditions.

- Concept E2B had very similar results to Concept E, as the only difference is the lack of widening of SR 9 north of SR 9 /SR 204 intersection.
- Concept E2C included a new overpass connection between Davies Road to Vernon Road west of SR 9, but did not include Village Way. Concept E2C also did not include widening of SR 9 near Market Street, and, similar to E2A, vehicles heading southbound on SR 9 experience increased delays. Without Village Way, there was not much travel time savings between locations within Frontier Village. However, travel between neighborhoods on either side of SR 9 to the north of SR 204 improved with the new connection.
- Concept E2D is similar to E2C, but SR 9 would be widened near Market Street. This option performed similar to E2B and Concept E. This generally had the highest travel time savings as traffic could disperse through a more connected roadway system.
- Concept E2B Variation 4 – Similar to other grade separated SR 9 and SR 204 concepts, travel times are expected to decrease for through travel on SR 9. The grade separation allows more green time to be allocated to east-west movements through the study intersection, which can decrease the travel time out of the north end of Frontier Village. Travel times generally increased into and out of the south end of Frontier Village (4th Street NE and 94th Drive NE). The increase in travel time is due to the removal of the 92nd Avenue NE connection between 7th Place NE and 4th Street NE. Slower travel times through Frontier Village are also expected as Village Way is not included in this concept.
- The non-motorized travel time estimates indicate that all concepts would provide better connectivity and shorter walking times compared to No Build. Pedestrian trips from N Davies Road to 4th Street NE through Frontier Village would be over 4 minutes faster under Concepts including the Village Way connection. All alternative concepts would improve travel time between 91st Avenue NE and Frontier Village by providing sidewalks on both side of SR 204 between these locations.
- Dedicated biking infrastructure such as bike lanes and trails are not currently provided on SR 204 or SR 9 under existing conditions and is not proposed by the alternative concepts. Because of this, travel time by bike was not expected to significantly differ between concepts and therefore was not quantified. Exceptions include concepts E2C and E2D, which would provide a more direct biking connection between the Lundeen Parkway neighborhoods and the Davies Road via the Vernon Road overcrossing concept.

ATTACHMENT A: MODEL VEHICLE TRAVEL TIME RESULT

Travel Time Results

9/14/2017

Travel Time (min)

2040 PM - No Build

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		5.21	3.77	5.13	4.57	3.66	1.66
SR 9 south of Market Place NE	2	4.35		4.88	3.71	2.53	3.94	4.09
SR 204 west of Market Place NE / Lundeen Parkway	3	3.64	2.92		3.51	3.79	1.47	2.18
N Davies Road and access driveway to the Safeway	4	11.57	8.33	11.60		7.51	10.98	9.85
4th Street NE and 94th Drive NE	5	3.00	2.38	4.05	2.37		3.10	2.81
91st Avenue NE Commercial District	6	5.08	2.07	5.38	4.55	2.51		5.27
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.12	4.36	1.97	2.65	2.63	1.42	

2040 PM - Concept B

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		3.44	3.94	2.15	2.49	3.95	2.41
SR 9 south of Market Place NE	2	3.90		4.64	3.39	2.27	3.62	3.66
SR 204 west of Market Place NE / Lundeen Parkway	3	5.52	3.10		3.20	3.43	1.59	2.26
N Davies Road and access driveway to the Safeway	4	3.27	3.23	2.92		1.75	3.00	1.66
4th Street NE and 94th Drive NE	5	2.56	2.34	3.86	1.56		2.87	1.93
91st Avenue NE Commercial District	6	7.90	2.27	1.83	6.20	2.54		5.90
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	4.71	3.32	1.88	2.51	2.55	1.33	

2040 PM - Concept G

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		4.16	3.86	3.07	3.75	4.02	1.64
SR 9 south of Market Place NE	2	4.05		4.95	2.97	2.08	3.39	5.94
SR 204 west of Market Place NE / Lundeen Parkway	3	3.17	3.21		3.85	3.24	1.52	2.26
N Davies Road and access driveway to the Safeway	4	2.43	3.25	4.06		2.09	3.77	2.30
4th Street NE and 94th Drive NE	5	2.82	2.25	3.71	1.63		2.79	2.46
91st Avenue NE Commercial District	6	5.32	2.37	2.03	4.37	2.62		2.82
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.66	3.81	1.71	2.44	2.36	1.21	

2040 PM - Concept E

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		2.75	3.99	3.63	3.41	2.79	1.70
SR 9 south of Market Place NE	2	2.63		4.93	2.52	1.67	4.03	3.03
SR 204 west of Market Place NE / Lundeen Parkway	3	3.80	2.75		2.57	3.00	1.38	2.07
N Davies Road and access driveway to the Safeway	4	3.06	3.67	4.51		2.07	3.47	2.97
4th Street NE and 94th Drive NE	5	2.41	2.25	4.08	1.95		2.44	2.94
91st Avenue NE Commercial District	6	5.04	1.86	1.86	4.41	2.39		2.06
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.17	2.72	1.84	2.31	3.05	1.27	

2040 PM - Concept H

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		2.52	3.90	3.01	3.38	3.56	1.97
SR 9 south of Market Place NE	2	3.62		5.09	3.31	2.33	3.89	3.85
SR 204 west of Market Place NE / Lundeen Parkway	3	4.79	3.54		3.57	3.70	1.79	2.22
N Davies Road and access driveway to the Safeway	4	2.56	2.83	3.17		1.88	3.31	1.70
4th Street NE and 94th Drive NE	5	2.22	2.24	4.01	1.99		2.70	2.90
91st Avenue NE Commercial District	6	7.24	2.73	1.76	5.65	2.86		4.96
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.86	2.84	1.90	2.56	2.67	1.38	

2040 PM - Concept C

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		4.27	3.64	5.49	4.86	3.78	1.74
SR 9 south of Market Place NE	2	4.29		4.66	3.29	2.17	4.13	6.01
SR 204 west of Market Place NE / Lundeen Parkway	3	4.48	3.11		3.31	3.59	1.43	2.20
N Davies Road and access driveway to the Safeway	4	4.01	5.16	4.78		2.63	4.50	4.07
4th Street NE and 94th Drive NE	5	3.15	2.20	3.71	1.89		3.15	2.74
91st Avenue NE Commercial District	6	5.00	2.30	1.92	3.92	1.96		3.81
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.34	3.70	1.83	2.29	3.08	1.24	

Travel Time Change from No Build (min)

2040 PM - Concept B

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-1.77	0.17	-2.98	-2.08	0.28	0.75
SR 9 south of Market Place NE	2	-0.45		-0.24	-0.32	-0.26	-0.32	-0.44
SR 204 west of Market Place NE / Lundeen Parkway	3	1.89	0.18		-0.32	-0.36	0.12	0.07
N Davies Road and access driveway to the Safeway	4	-8.30	-5.10	-8.67		-5.76	-7.98	-8.19
4th Street NE and 94th Drive NE	5	-0.43	-0.04	-0.19	-0.81		-0.24	-0.88
91st Avenue NE Commercial District	6	2.82	0.20	-3.55	1.65	0.03		0.62
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	1.59	-1.05	-0.10	-0.15	-0.09	-0.09	

2040 PM - Concept G

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-1.05	0.10	-2.06	-0.82	0.36	-0.03
SR 9 south of Market Place NE	2	-0.30		0.07	-0.74	-0.45	-0.55	1.85
SR 204 west of Market Place NE / Lundeen Parkway	3	-0.47	0.29		0.34	-0.55	0.05	0.08
N Davies Road and access driveway to the Safeway	4	-9.14	-5.07	-7.54		-5.41	-7.21	-7.55
4th Street NE and 94th Drive NE	5	-0.17	-0.13	-0.34	-0.74		-0.32	-0.34
91st Avenue NE Commercial District	6	0.25	0.30	-3.36	-0.18	0.11		-2.45
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	0.54	-0.55	-0.26	-0.22	-0.28	-0.21	

2040 PM - Concept E

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-2.46	0.22	-1.50	-1.16	-0.87	0.03
SR 9 south of Market Place NE	2	-1.72		0.05	-1.19	-0.86	0.09	-1.07
SR 204 west of Market Place NE / Lundeen Parkway	3	0.16	-0.17		-0.95	-0.79	-0.08	-0.12
N Davies Road and access driveway to the Safeway	4	-8.51	-4.65	-7.09		-5.44	-7.51	-6.88
4th Street NE and 94th Drive NE	5	-0.59	-0.13	0.04	-0.42		-0.67	0.13
91st Avenue NE Commercial District	6	-0.04	-0.21	-3.52	-0.13	-0.12		-3.21
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	0.04	-1.65	-0.13	-0.34	0.42	-0.15	

2040 PM - Concept H

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-2.69	0.14	-2.12	-1.19	-0.10	0.31
SR 9 south of Market Place NE	2	-0.73		0.21	-0.40	-0.20	-0.05	-0.25
SR 204 west of Market Place NE / Lundeen Parkway	3	1.15	0.61		0.06	-0.09	0.33	0.04
N Davies Road and access driveway to the Safeway	4	-9.01	-5.49	-8.43		-5.63	-7.67	-8.15
4th Street NE and 94th Drive NE	5	-0.78	-0.14	-0.04	-0.37		-0.41	0.09
91st Avenue NE Commercial District	6	2.16	0.66	-3.62	1.10	0.36		-0.31
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	0.74	-1.53	-0.07	-0.09	0.04	-0.04	

2040 PM - Concept C

Origin		Destination: SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-0.94	-0.13	0.36	0.29	0.11	0.08
SR 9 south of Market Place NE	2	-0.06		-0.22	-0.43	-0.36	0.19	1.92
SR 204 west of Market Place NE / Lundeen Parkway	3	0.84	0.18		-0.21	-0.20	-0.04	0.01
N Davies Road and access driveway to the Safeway	4	-7.56	-3.16	-6.82		-4.87	-6.48	-5.77
4th Street NE and 94th Drive NE	5	0.15	-0.18	-0.34	-0.48		0.05	-0.07
91st Avenue NE Commercial District	6	-0.07	0.23	-3.46	-0.63	-0.55		-1.46
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	0.22	-0.67	-0.14	-0.36	0.45	-0.19	

Travel Time (min)

2040 PM - Concept E2A

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		3.44	3.94	3.70	3.78	3.44	1.69
SR 9 south of Market Place NE	2	3.60		4.57	3.17	2.06	3.69	3.91
SR 204 west of Market Place NE / Lundeen Parkway	3	4.06	3.65		2.75	3.65	1.42	2.04
N Davies Road and access driveway to the Safeway	4	3.07	4.15	4.46		2.20	3.99	3.12
4th Street NE and 94th Drive NE	5	2.25	2.41	4.01	1.96		2.71	2.94
91st Avenue NE Commercial District	6	4.84	3.06	1.85	3.77	3.53		2.27
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.06	3.47	1.83	2.24	3.03	1.34	

2040 PM - Concept E2B

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		2.76	3.90	3.60	3.71	2.79	1.64
SR 9 south of Market Place NE	2	2.80		4.72	2.45	1.63	3.35	3.13
SR 204 west of Market Place NE / Lundeen Parkway	3	3.99	2.74		2.68	2.94	1.38	2.03
N Davies Road and access driveway to the Safeway	4	3.11	3.70	4.37		2.08	3.67	3.02
4th Street NE and 94th Drive NE	5	2.36	2.14	3.91	2.03		2.42	2.90
91st Avenue NE Commercial District	6	4.76	1.82	1.86	4.01	2.41		2.17
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.35	2.80	1.85	2.30	3.09	1.28	

2040 PM - Concept E2C

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		4.36	4.03	2.61	6.63	3.96	2.58
SR 9 south of Market Place NE	2	3.60		5.31	2.84	2.29	4.68	3.74
SR 204 west of Market Place NE / Lundeen Parkway	3	3.59	3.62		3.22	4.09	1.54	2.00
N Davies Road and access driveway to the Safeway	4	2.42	3.93	4.58		6.00	4.38	1.89
4th Street NE and 94th Drive NE	5	2.23	2.29	3.94	1.42		2.40	2.67
91st Avenue NE Commercial District	6	3.88	3.10	3.01	3.16	3.97		1.68
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	2.50	3.90	2.04	1.69	3.21	1.55	

2040 PM - Concept E2D

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		2.80	3.97	2.78	4.83	3.75	2.32
SR 9 south of Market Place NE	2	2.74		4.36	2.02	1.46	2.25	2.88
SR 204 west of Market Place NE / Lundeen Parkway	3	3.58	3.03		3.27	3.77	1.34	1.94
N Davies Road and access driveway to the Safeway	4	2.38	3.07	4.26		5.45	3.09	1.83
4th Street NE and 94th Drive NE	5	2.13	2.09	3.89	1.41		2.35	2.58
91st Avenue NE Commercial District	6	4.00	2.06	1.89	3.39	2.50		1.74
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	2.99	2.93	1.94	2.52	3.62	1.27	

2040 PM - Concept E2B Var 4

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		2.89	3.76	3.92	5.23	3.63	1.66
SR 9 south of Market Place NE	2	2.84		4.91	3.64	1.23	3.34	2.60
SR 204 west of Market Place NE / Lundeen Parkway	3	3.92	3.57		3.92	4.19	1.67	1.97
N Davies Road and access driveway to the Safeway	4	5.65	5.66	6.07		7.81	6.73	4.54
4th Street NE and 94th Drive NE	5	2.29	2.24	3.51	2.84		3.24	1.94
91st Avenue NE Commercial District	6	4.95	2.51	5.10	4.29	3.33		2.57
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	2.84	2.79	1.93	3.16	5.79	1.46	

Travel Time Change from No Build (min)

2040 PM - Concept E2A

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-1.77	0.17	-1.43	-0.79	-0.23	0.02
SR 9 south of Market Place NE	2	-0.74		-0.31	-0.54	-0.47	-0.25	-0.18
SR 204 west of Market Place NE / Lundeen Parkway	3	0.43	0.73		-0.76	-0.14	-0.04	-0.15
N Davies Road and access driveway to the Safeway	4	-8.50	-4.18	-7.14		-5.30	-6.99	-6.73
4th Street NE and 94th Drive NE	5	-0.75	0.03	-0.04	-0.41		-0.40	0.13
91st Avenue NE Commercial District	6	-0.24	0.99	-3.53	-0.78	1.02		-3.00
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	-0.06	-0.89	-0.14	-0.42	0.40	-0.08	

2040 PM - Concept E2B

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-2.46	0.14	-1.53	-0.87	-0.88	-0.02
SR 9 south of Market Place NE	2	-1.55		-0.16	-1.26	-0.90	-0.58	-0.96
SR 204 west of Market Place NE / Lundeen Parkway	3	0.36	-0.19		-0.83	-0.85	-0.09	-0.15
N Davies Road and access driveway to the Safeway	4	-8.46	-4.62	-7.23		-5.43	-7.31	-6.83
4th Street NE and 94th Drive NE	5	-0.64	-0.24	-0.14	-0.34		-0.68	0.09
91st Avenue NE Commercial District	6	-0.31	-0.25	-3.52	-0.54	-0.10		-3.11
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	0.23	-1.56	-0.13	-0.35	0.45	-0.14	

2040 PM - Concept E2C

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-0.85	0.27	-2.53	2.05	0.29	0.92
SR 9 south of Market Place NE	2	-0.75		0.43	-0.87	-0.25	0.74	-0.35
SR 204 west of Market Place NE / Lundeen Parkway	3	-0.05	0.70		-0.29	0.30	0.07	-0.18
N Davies Road and access driveway to the Safeway	4	-9.15	-4.39	-7.02		-1.50	-6.60	-7.96
4th Street NE and 94th Drive NE	5	-0.77	-0.09	-0.11	-0.95		-0.70	-0.13
91st Avenue NE Commercial District	6	-1.20	1.03	-2.38	-1.39	1.46		-3.59
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	-0.63	-0.47	0.07	-0.96	0.57	0.13	

2040 PM - Concept E2D

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-2.41	0.20	-2.35	0.26	0.08	0.66
SR 9 south of Market Place NE	2	-1.61		-0.52	-1.69	-1.07	-1.69	-1.21
SR 204 west of Market Place NE / Lundeen Parkway	3	-0.06	0.10		-0.25	-0.03	-0.12	-0.25
N Davies Road and access driveway to the Safeway	4	-9.19	-5.25	-7.34		-2.06	-7.89	-8.02
4th Street NE and 94th Drive NE	5	-0.87	-0.29	-0.16	-0.96		-0.75	-0.23
91st Avenue NE Commercial District	6	-1.08	-0.01	-3.49	-1.16	-0.01		-3.54
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	-0.13	-1.43	-0.03	-0.13	0.98	-0.15	

2040 PM - Concept E2B Var 4

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		-2.32	-0.01	-1.21	0.66	-0.03	0.00
SR 9 south of Market Place NE	2	-1.50		0.03	-0.07	-1.30	-0.60	-1.50
SR 204 west of Market Place NE / Lundeen Parkway	3	0.28	0.65		0.41	0.40	0.21	-0.21
N Davies Road and access driveway to the Safeway	4	-5.93	-2.67	-5.53		0.30	-4.25	-5.31
4th Street NE and 94th Drive NE	5	-0.71	-0.14	-0.54	0.47		0.14	-0.87
91st Avenue NE Commercial District	6	-0.12	0.43	-0.28	-0.26	0.82		-2.70
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	-0.28	-1.57	-0.05	0.50	3.16	0.04	

Transit Travel Time (min)

Transit Travel Time		No Build	B	G	E	H	C	E2A	E2B	E2C	E2D	E2B Var 4
RT 109 NB Travel Time		2.48	2.09	1.92	1.26	1.93	1.87	1.95	1.22	2.42	1.20	1.22
RT 109 SB Travel Time		6.22	5.44	5.38	5.05	5.02	6.15	5.58	5.14	5.68	5.13	5.45
RT 209 NB Travel Time		4.54	5.24	3.83	4.28	3.89	4.49	4.24	4.16	4.49	4.12	4.59
RT 209 SB Travel Time		9.00	6.91	7.46	6.69	7.00	7.75	7.66	6.67	8.33	7.33	6.81
RT 280 NB Travel Time		12.48	12.38	11.24	10.48	12.31	11.88	11.86	10.99	11.96	10.75	11.69
RT 280 SB Travel Time		16.86	12.37	13.05	12.35	13.61	14.69	13.67	12.93	14.56	13.78	13.83
RT 425 NB Travel Time		6.30	5.48	5.85	5.22	5.97	6.59	6.12	5.20	6.23	5.60	5.77

Travel Time Change from No Build (min)

Transit Travel Time			B	G	E	H	C	E2A	E2B	E2C	E2D	E2B Var 4
RT 109 NB Travel Time			-0.4	-0.6	-1.2	-0.5	-0.6	-0.5	-1.3	-0.1	-1.3	-1.3
RT 109 SB Travel Time			-0.8	-0.8	-1.2	-1.2	-0.1	-0.6	-1.1	-0.5	-1.1	-0.8
RT 209 NB Travel Time			0.7	-0.7	-0.3	-0.6	-0.1	-0.3	-0.4	-0.1	-0.4	0.0
RT 209 SB Travel Time			-2.1	-1.5	-2.3	-2.0	-1.3	-1.3	-2.3	-0.7	-1.7	-2.2
RT 280 NB Travel Time			-0.1	-1.2	-2.0	-0.2	-0.6	-0.6	-1.5	-0.5	-1.7	-0.8
RT 280 SB Travel Time			-4.5	-3.8	-4.5	-3.3	-2.2	-3.2	-3.9	-2.3	-3.1	-3.0
RT 425 NB Travel Time			-0.8	-0.5	-1.1	-0.3	0.3	-0.2	-1.1	-0.1	-0.7	-0.5

ATTACHMENT B: NON-MOTORIZED TRAVEL TIME ANALYSIS

Scenario	Walk time by Origin-Destination Pair (min)						Total Walk Time (min)	Difference Compared to No Build (min)
	1	2	3	4	5	6		
	From: N Davies Road and access driveway to the Safeway	From: 4th Street NE and 94th Drive NE	From: 91st Avenue NE Commercial District	From: Lundeen Parkway neighborhoods near Vernon Road / 91st	From: N Davies Road and access driveway to the Safeway	From: 4th Street NE and 94th Drive NE		
	To: 4th Street NE and 94th Drive NE	To: 91st Avenue NE Commercial District	To: Lundeen Parkway neighborhoods near Vernon Road / 91st	To: N Davies Road and access driveway to the Safeway	To: 91st Avenue NE Commercial District	To: Lundeen Parkway neighborhoods near Vernon Road / 91st		
No Build	9.5	11.5	6.5	10.7	12.2	15.3	65.7	n/a
Concept B	9.1	11.2	6.5	4.6	9.9	12.1	53.4	12.3
Concept G	9.1	12.0	6.5	9.1	11.7	13.9	62.4	3.3
Concept E	9.1	11.2	6.5	8.7	11.4	13.6	60.6	5.2
Concept E2A	9.1	11.5	6.5	8.7	11.4	13.6	60.9	4.8
Concept E2B	9.1	11.2	6.5	8.7	11.4	13.6	60.6	5.2
Concept E2B Variation 4	9.5	11.2	6.5	9.7	11.9	13.6	62.4	3.3
Concept E2C	9.5	11.5	6.5	5.1	12.5	13.6	58.6	7.1
Concept E2D	9.5	11.2	6.5	5.1	12.5	13.6	58.3	7.4
Concept H	9.1	12.0	6.5	7.9	9.9	12.1	57.6	8.2
Concept C	9.1	12.0	6.5	10.7	12.2	14.9	65.6	0.2

At least half of walking route does not provide sidewalks (walking may occur on roadway shoulder or parking lot drive aisle).
May not impact travel time compared to the same route with a sidewalk provided, but may create discomfort for the person walking.

Walking Travel Time - Calculations

Walking Speed
4.5 ft/s

No Build

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	1.000	90	568	9.5
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	80	691	11.5
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	2000	0.575	200	644	10.7
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.458	200	733	12.2
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.630	250	917	15.3
					total	**3944**	**65.7**

Concept B

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	0.000	70	548	9.1
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	60	671	11.2
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	1100	0.000	30	274	4.6
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.000	60	593	9.9
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.000	60	727	12.1
					total	**3204**	**53.4**

Concept G

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	0.000	70	548	9.1
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	110	721	12.0
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	2000	0.000	100	544	9.1
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.000	170	703	11.7
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.000	170	837	13.9
					total	**3744**	**62.4**

Concept E

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	0.000	70	548	9.1
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	60	671	11.2
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	2000	0.000	80	524	8.7
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.000	150	683	11.4
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.000	150	817	13.6
					total	**3634**	**60.6**

Concept H

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	0.000	70	548	9.1
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	110	721	12.0
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	2000	0.000	30	474	7.9
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.000	60	593	9.9
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.000	60	727	12.1
					total	**3454**	**57.6**

Concept C

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	0.000	70	548	9.1
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	110	721	12.0
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	2000	0.000	200	644	10.7
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.000	200	733	12.2
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.000	230	897	14.9
					total	**3934**	**65.6**

Concept E2A

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	0.000	70	548	9.1
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	80	691	11.5
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	2000	0.000	80	524	8.7
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.000	150	683	11.4
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.000	150	817	13.6
					total	**3654**	**60.9**

Concept E2B

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	0.000	70	548	9.1
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	60	671	11.2
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	2000	0.000	80	524	8.7
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2400	0.000	150	683	11.4
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.000	150	817	13.6
					total	**3634**	**60.6**

Concept E2C

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	1.000	90	568	9.5
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	80	691	11.5
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	1100	0.000	60	304	5.1
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2600	0.000	170	748	12.5
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.506	150	817	13.6
					total	**3519**	**58.6**

Concept E2D

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	1.000	90	568	9.5
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	60	671	11.2
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	1100	0.000	60	304	5.1
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2600	0.000	170	748	12.5
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.506	150	817	13.6
					total	**3499**	**58.3**

Concept E2B Variation 4

	From	To	Distance (ft)	Percent Without Sidewalks	Signal Delay (s)	Total Walking Time (s)	Total Walking Time (min)
1	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	2150	1.000	90	568	9.5
2	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	2750	0.000	60	671	11.2
3	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st	1400	0.000	80	391	6.5
4	Lundeen Parkway neighborhoods near Vernon Road / 91st	N Davies Road and access driveway to the Safeway	1950	0.000	150	583	9.7
5	N Davies Road and access driveway to the Safeway	91st Avenue NE Commercial District	2550	0.000	150	717	11.9
6	4th Street NE and 94th Drive NE	Lundeen Parkway neighborhoods near Vernon Road / 91st	3000	0.506	150	817	13.6
					total	**3747**	**62.4**

APPENDIX G.
NON-MOTORIZED CONDITIONS MEMORANDUM

November 2017

Date:	June 8, 2017
To:	Michael Horntvedt (Parsons)
From :	Nathan Chan, Chris Breiland, and Will Lisska (Fehr & Peers)
Subject:	Non-Motorized Conditions Memorandum

1.0 INTRODUCTION

The SR 9 and SR 204 intersection, located in Lake Stevens, Snohomish County, is a major regional crossroads. This intersection serves a wide variety of both regional and local traffic including commuters, freight, and local business access. Surrounding this intersection are a variety of commercial and residential uses. As this area is expected to transition into more of a mixed-use center in the future, walking and biking accommodations (i.e. non-motoroized infrastructure) are important components of community connectivity and vitality. This memorandum describes existing non-motorized transportation conditions in the study area as well as the conditions for each future (2040) alternative. Recommendations to improve non-motorized connectivity are also included.

2.0 PREVIOUS STUDIES

This section summarizes the existing plans and studies that address non-motorized facilities and access in the study area:

- Lake Stevens Center Subarea Plan (December 2011)
- Jurisdictional Plans and Transportation Improvement Programs
- Community Transit 2016 – 2021 Transit Development Plan

LAKE STEVENS CENTER SUBAREA PLAN

In September 2012, the City of Lake Stevens developed a stakeholder process with WSDOT, Lake Stevens City staff, and community members. The goal of the Lake Stevens Center Subarea Plan was to identify potential investments to reduce congestion, improve Frontier Village access at the SR 9/SR 204 intersection, and identify improvements to the pedestrian and bicycle system. Several possible solutions were outlined, including promoting the creation of a traditional “main street” along 91st Avenue NE (that would include pedestrian-orinted land uses and buildings reoriented to the street), rezoning and redeveloping existing low density areas into higher-denisty mixed-use and transit-oriented developments, and providing bicycle connections to the surrounding neighborhoods through new bicycle lanes and routes. The study did not identify a preferred concept.

JURISDICTIONAL PLANS AND TRANSPORTATION IMPROVEMENT PROGRAMS

The project team reviewed the comprehensive plans, subarea plans, and TIPs for Lake Stevens and Snohomish County, the Puget Sound Regional Council *Transportation 2040* Plan, and WSDOT plans. In

addition, projects included in Sound Transit 2 (ST 2), Nickel, and TPA (Transportation Partnership Agreement) funding packages, and the Legislative Evaluation & Accountability Program (LEAP – now called Connecting Washington) transportation project list were reviewed. A list of planned and/or funded transportation capacity improvements that are potentially relevant to demand and operations at the SR 9 / SR 204 are summarized as part of the Transportation Analysis Methods and Assumptions Memorandum. Some plans and projects include changes to non-motorized facilites or access along SR 9 and SR 204 within the study area. In particular, the City of Lake Stevens TIP (2017 – 2022) specified several projects related to non-motorized access:

- SR 9 / 4th Street NE – Add a new northbound right-turn from SR 9 onto 4th Street NE. Construct new north-south connector road with pedestrian facilities (Village Way), between 4th Street NE and Market Place.
- 99th Avenue NE from Market Place to 4th Street NE – Enhance streetscape with non-motorized improvements and possible roundabout intersection at 4th Street NE.
- 91st Avenue NE from SR 204 to Vernon Road – Upgrade roadway to create a pedestrian friendly downtown-style streetscape.
- 4th St NE from 91st Avenue NE / SR 204 – New internal connector and circulation roadway with pedestrian facilities.
- 91st Avenue NE / Vernon Road intersection – Minor widening and possible mini-roundabout to improve safety and circulation.
- Lundeen Parkway / Vernon Road intersection – Channelization enhancements to improve safety and circulation.
- Vernon Road from 91st Avenue NE to SR 9 – Minor widening to provide for turn pocket and improved pedestrian movement.

To date, none of the improvement projects listed above have been implemented.

COMMUNITY TRANSIT 2016 – 2021 TRANSIT DEVELOPMENT PLAN

The 2016 – 2021 Transit Development Plan identified two new local bus routes to serve the Lake Stevens Transit Center and SR 9 corridor in addition to current Routes 280 and 425.

- Route 109 provides all-day service between the Ash Way Park and Ride and the Lake Stevens Transit Center.
- Route 209 provides all-day service between the Lake Stevens Transit Center and Quil Ceda Village (via Marysville).

Both routes began operation in September 2016 with 30 minute AM/PM peak headways and hourly service during the off-peak and on weekends.

Four Community Transit routes (routes 109, 209, 280, and 425) serve the study area with primary access provided at the transit center. Based on boarding and alighting data provided by Community Transit for October 2016, most of the activity is concentrated at the stops serving the Market Place / 91st Avenue NE

intersection with about 40 average daily boardings and the Transit Center with about 200 average daily boardings.

3.0 STUDY AREA

The study focuses on the transportation system around the main project intersection: SR 9 / SR 204. The project limits of the study area are shown in Figure 1:

Figure 1: Study Area and Study Intersections

4.0 EXISTING PEDESTRIAN AND BICYCLE FACILITIES

The project study area generally does not have high levels of pedestrian or bicycle activity, despite the commercial nature of the area. This lack of non-motorized activity may be due in part to the fact that both SR 9 and SR 204 lack pedestrian and bicycle facilities and have only limited crossing opportunities (particularly across SR 9). Within the study area, the only crossings of SR 9 are at Lundeen Parkway, SR 204, and Market Place. Conditions vary on other arterials: some streets have sidewalks on both sides, others have sidewalks only on one side, and others have no sidewalks. Most notably, Lundeen Parkway has sidewalks on both sides of the street from SR 9 to SR 204 which continues along Market Place NE from SR 204 to 99th Avenue NE. Some notable gaps in the existing pedestrian network are as follows:

- Along 92nd Avenue NE from the driveway near Qdoba to the Vernon Road / 7th Place NE intersection.
- Along Vernon Road from the Vernon Road / 7th Place NE intersection to the Vernon Road / N. Davies Road intersection.
- Along Vernon Road from 87th Avenue NE to the driveway directly northeast of the Vernon Road / Lundeen Parkway intersection.

Bicycle facilities in the study area are limited to:

- Bike lanes along both sides of Lundeen Parkway from SR 9 to SR 204
- Bike lanes on Market Place NE from SR 204 to 99th Avenue NE
- Sharrows on N. Davies Road between Vernon Road and 96th Avenue NE.

Figure 2 shows the existing bicycle and pedestrian facilities in the study area.

Pedestrian and bicycle activity data was collected on July 13, 2016. These field observations indicated that most of the pedestrian and bicycle activity is near the transit center and the commercial area along 91st Avenue NE. Most of the activity was observed in the PM peak period. Key PM peak period observations include:

- 23 pedestrians at the Transit Center Access Driveway / 4th Street NE intersection
- 7 pedestrians at the Transit Center Access Driveway / Market Place NE intersection
- 25 pedestrians crossing the 91st Avenue NE / Market Place NE intersection
- 10 pedestrians crossing the SR 204 / 91st Avenue NE intersection
- 10 pedestrians crossing the SR 9 / SR 204 intersection

AM peak hour pedestrian volumes are significantly lower with only one or two pedestrians crossing the key intersections.

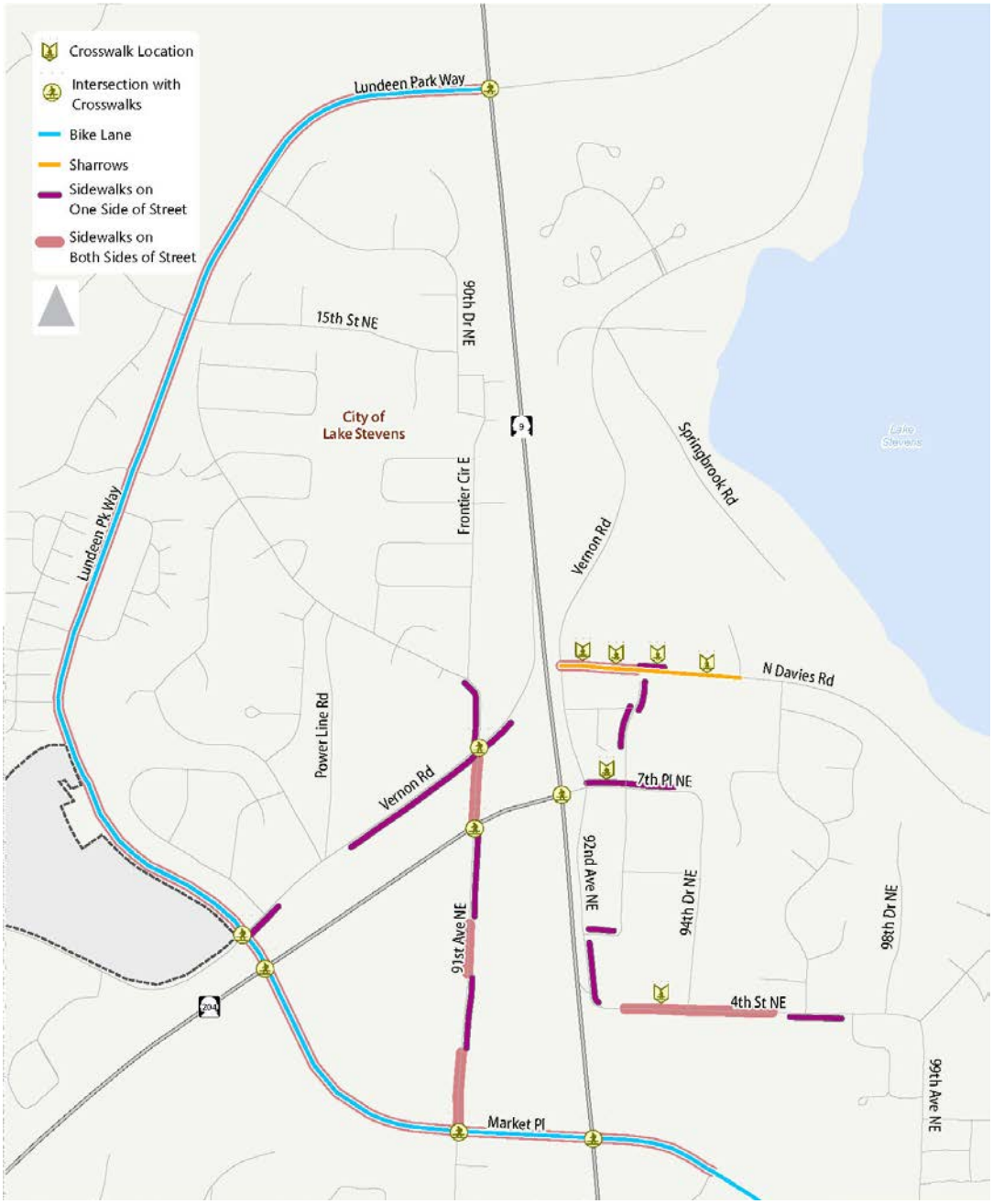


Figure 2: Existing Bicycle and Pedestrian Facilities

5.0 CONCEPTS – PEDESTRIAN AND BICYCLE FACILITIES

The Project Team and stakeholder group developed several concepts for the SR 9 / SR 204 intersection and surrounding study area in order to improve vehicle operations and pedestrian / bicycle connectivity. Eight concepts were evaluated for this project and any proposed changes to the non-motorized facilities in the study area are presented in this section. The concepts are provided as Attachments.

All design concepts propose the following improvements unless otherwise noted:

- New sidewalks on both sides of SR 204 between 91st Avenue NE and SR 9.
- The Vernon Road / 7th Place NE / 92nd Avenue NE intersection will be replaced. Vernon Road south of N. Davies Road will end as a cul-de-sac and 92nd Avenue NE will also be closed just south of 7th Place NE.
- The existing north-south drive aisle through the Frontier Village parking lot will be converted to a minor arterial known as Village Way providing access between N. Davies Road and 4th Street NE with a signalized intersection at 7th Place NE / Village Way with crosswalks along all legs of the intersection except in Concept E4. Sidewalks will be provided along both sides of 7th Place NE between

NO BUILD CONCEPT

This concept assumes a background growth in vehicle volumes and no improvements to the pedestrian, bicycle, or vehicle network..

CONCEPT B

Concept B proposes three new roundabouts located at the following intersections:

- Vernon Road / N. Davies Road / SR 9 ramps (grade separated from SR 9)
- SR 9 / SR 204 (grade separated from SR 9 mainline)
- SR 9 / 4th Street NE (at-grade with SR 9)

Although the roundabout at Vernon Road / N. Davies Road / SR 9 ramps provides access across SR 9 for vehicles, there is no east-west bicycle or pedestrian crossing. There would be a crosswalk along the east leg of the roundabout with a median refuge and Rectangular Rapid Flashing Beacons (RRFBs).

At the SR 9 / SR 204 intersection, crosswalks would be provided along the east, west, and north legs of the intersection to connect the Frontier Village Shopping Center to the commercial areas to the west of SR 9. RRFBs will be located at each leg to enhance the safety of the crossing and visibility of pedestrian and bicyclists. This is the only access point across SR 9 between Lundeen Parkway to the north and Market Place to the south. The crosswalks on the east and west legs would also provide access to key transit stops on SR 9 serving routes 209 and 280.

CONCEPT C

Concept C is similar to the No Build Alternative but with the following design modification (in addition to those listed as common to all alterantives above):

- SR 9 / 4th Street NE intersection includes a right turn pocket from northbound SR 9 to 4th Street

CONCEPT E

Concept E consists of a new tight diamond interchange at the SR 9 / SR 204 intersection where the SR 9 mainline is grade separated from SR 204. There are four variations of Concept E which are denoted as E2A, E2B, E2C, and E2D. E2A and E2B differ only in the lane geometry along SR 9 where there are no pedestrian or bicycle facilities. The only effect these two concepts would have on the pedestrian and bicycle network would be in the number of lanes pedestrians would need to cross east-west at certain intersections (SR 9 / SR 204 and SR 9 / Market Place NE).

Concept E2A

The new diamond interchange configuration consists of a pair of closely spaced intersections, one for each on/off-ramp. Although this reduces the north-south vehicle traffic that traverses the intersection, it does create additional conflict points between pedestrians, bicyclists, and vehicles due to the two new intersections.

This concept would provide crosswalks across all legs of the intersection to allow pedestrians to travel across SR 9 on SR 204 from 91st Avenue NE to the Frontier Village Shopping Center and to the transit stops located on the southbound and northbound on-ramps to SR 9.

Concept E2B

Concept E2B differs from Concept E2A in that it adds travel lanes on SR 9 south of SR 204 to about 1000 feet south of the Market Place NE intersection. Non-motorized access would be the same as Concept E2A.

Concept E2C

Concept E2C is similar to Concept E2A except it includes a new crossing over SR 9 that connects N. Davies Road in the east to Vernon Road in the west. This new connection over SR 9 provides travelers with an option to reach the SR 9 and SR 204 corridor. This concept would not include the Village Way connector (the private drive aislethrough the Frontier Village parking lot would remain). Accordingly, non-motorized access would be the same as Concept E2A.

The new overpass crossing at the Vernon Road / N. Davies Road intersection provides another connection across SR 9. This connection would also create three new intersections:

- SR 9 Southbound Off-Ramp / N. Davies Road & Vernon Road
- Vernon Road / N. Davies Road
- SR 9 Northbound On-Ramp / Vernon Road

This concept would complete the sidewalks on Vernon Road west of SR 9 across the overpass to N. Davies Road. There would be crosswalks at each of the three intersections providing connectivity of pedestrian facilities. Additionally, a crosswalk along the east leg of the 91st Avenue NE / Vernon Road intersection is included in this concept.

Concept E2D

Concept E2D is a combination of Concepts E2B and E2C. The additional lanes would be included on SR 9 south of SR 204, as well as the new overpass connecting N. Davies Road and Vernon Road, and Village Way would not be implemented in this concept (the private drive aisle through the Frontier Village parking lot would remain).

CONCEPT G

This alternative includes a tunnel bypass for traffic traveling from SR 204 eastbound to SR 9 northbound. This tunnel is designed to begin west of 91st Avenue NE and merge with SR 9 approximately 1,200 feet north of the SR 9 / SR 204 intersection. No changes beyond those common to all scenarios would be made to the non-motorized facilities in this concept; however, a significant number of vehicles would be diverted from the SR 9 / SR 204 intersection, potentially improving the overall comfort and reducing the wait times (via a potentially shorter signal cycle length) of pedestrians crossing the SR 9 / SR 204 intersection.

CONCEPT H

Similar to Concept E, this concept redesigns the SR 9 / SR 204 intersection with a roundabout while grade-separating the SR 9 mainline to allow for better operations through the corridor. This roundabout would have the same configuration as the roundabout in Concept B at SR 9 / SR 204.

SUMMARY OF CONCEPTS

Table 1 summarizes the impacts and benefits to pedestrian and bicyle travel related to each of the concepts described in the prior section. The No Build Concept serves as the baseline concept to compare all of the other concepts.

The table includes three different categories by which each concept was evaluated: non-motorized connectivity, potential for conflicts, and consistency with existing plans.

- Non-motorized connectivity: evaluates each concept on whether it improves, degrades or does not change the non-motorized network by adding new facilities or improving connections.
- Potential for conflicts: whether the concept increases, decreases, or does not change the number of potential conflict points between vehicles, pedestrians, and bicycles.
- Implementation of existing plans: examines if this concept supports the implementation of existing plans.

TABLE 1. NON-MOTORIZED NETWORK SUMMARY

Concept	Non-motorized connectivity	Potential for conflicts	Implementation of existing plans
	++ = improves both pedestrian and bicycle connection + = improves pedestrian or bicycle connection 0 = stays the same - = degrades	+ = decreases 0 = does not change - = increases	+ = helps implement existing plans 0 = does not hinder or help implementation - = hinders implementation
No Build			
Concept B	+	+	+
Concept C	0	-	0
Concept E2A	+	-	+
Concept E2B	+	-	+
Concept E2C	++	-	+
Concept E2D	++	-	+
Concept G	0	+	+
Concept H	+	+	+

6.0 RECOMMENDATIONS

While the majority of the concepts improve pedestrian and bicycle connectivity in at least one of the evaluation criteria, there are opportunities of each concept to further improve. The City of Lake Stevens has an opportunity to work with WSDOT to connect key pieces of its non-motorized network to supplement the WSDOT plans to improve circulation and access through the study area. The recommendations below provide a framework to continue improving the non-motorized network.

The following recommendations can be applied to all concepts unless otherwise noted:

1. Begin to implement the City's TIP project to upgrade 91st Avenue NE to a pedestrian friendly downtown style streetscape. The project can continue along 91st Avenue NE between SR 204 and Market Place NE by filling in sidewalk gaps along this section. Additional pedestrian enhancements can be made along 91st Avenue NE between Vernon Road and Market Place NE consistent with the City's TIP to improve connectivity to key destinations, transit stops and across SR 204.
2. Ensure the new Village Way connector has non-motorized connections such as sidewalks or bicycle lanes/sharrows between N Davies Road and 4th Street NE (does not apply to the No Build Concept and Concepts E2C, and E2D).
3. For Concepts E2C and E2D, provide bike lanes or route markers (such as sharrows) along Vernon Road between Lundeen Parkway and N. Davies Road, including the overpass. This would provide a consistent bicycle friendly route in the east-west direction, connecting the Frontier Village shopping center to the existing bike lanes on Lundeen Parkway and Market Place.

7.0 CONCLUSIONS

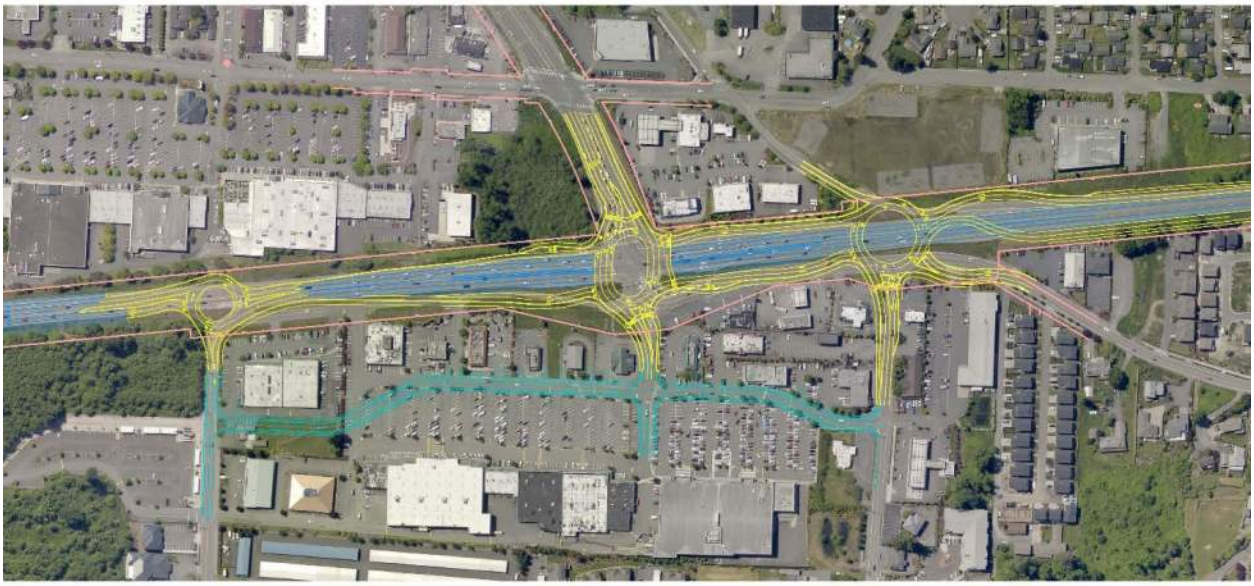
Non-motorized accommodations at the SR 9 / SR 204 intersection are important to provide connectivity between the two main commercial areas especially as the area begins to transition into the mixed-use center envisioned by the City of Lake Stevens. Each concept maintains the existing pedestrian and bicycle network with some concepts improving connectivity at certain intersection locations, namely at SR 9 / SR 204, Vernon Road / 7th Place NE / 92nd Avenue NE, Frontier Lane / 7th Place NE, and Vernon Road / N. Davies Road.

As shown in Table 1, Concepts B and H rank the highest because they do the most to improve non-motorized connectivity in the study area, decrease the potential for conflicts, and help implement the city's existing plans.

Concepts E2C, E2D, and G have the next highest ranking as they improve the non-motorized network in two of the three categories.

The No Build Alternative and Concept C rank the lowest as they do not make significant changes to the existing non-motorized network.

ATTACHMENTS



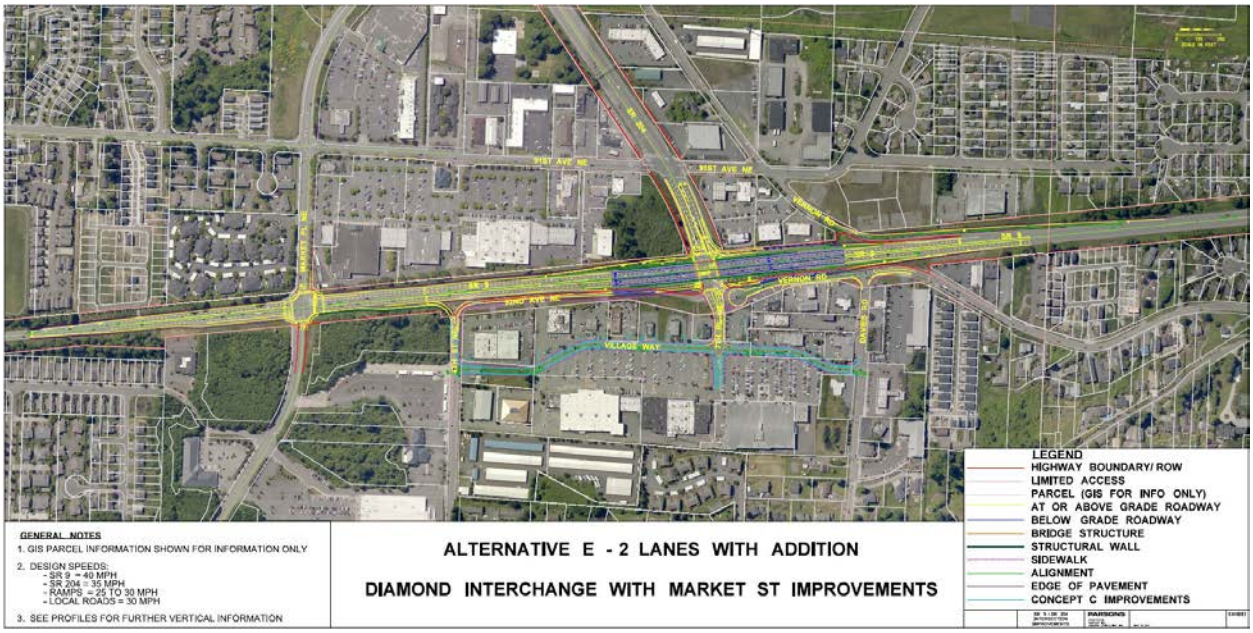
N

Scale: 1"= 200'

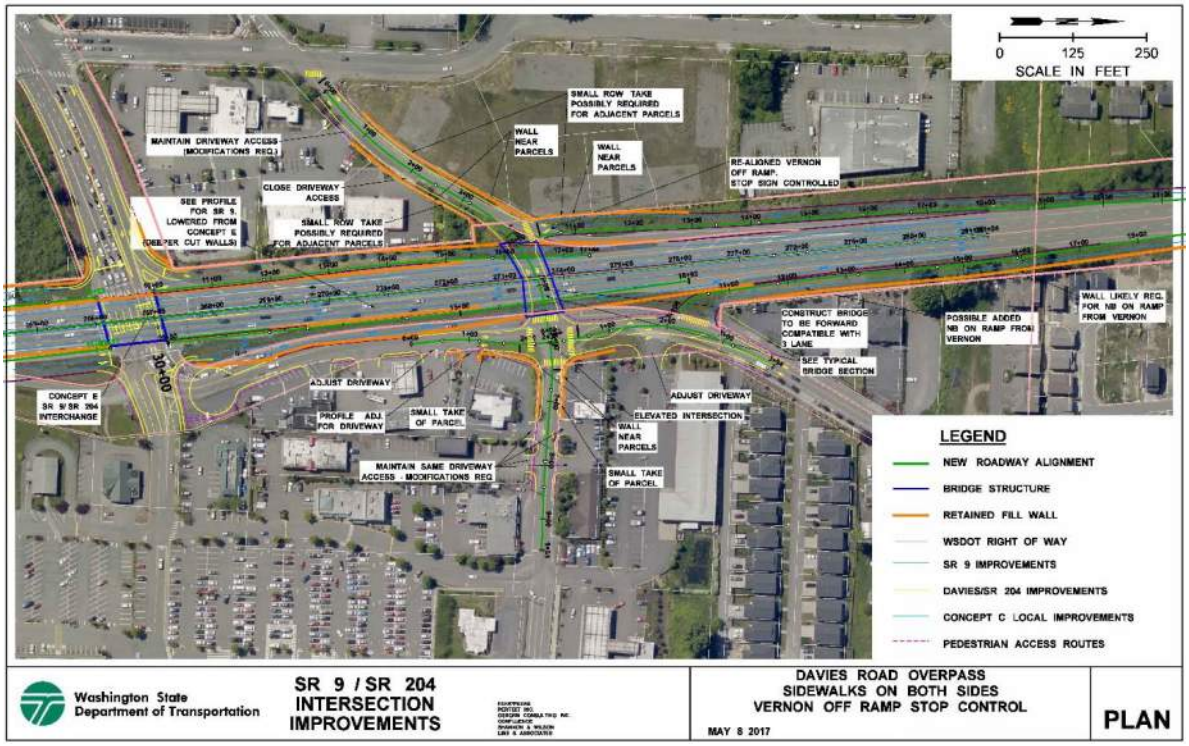
Concept B

Concept C

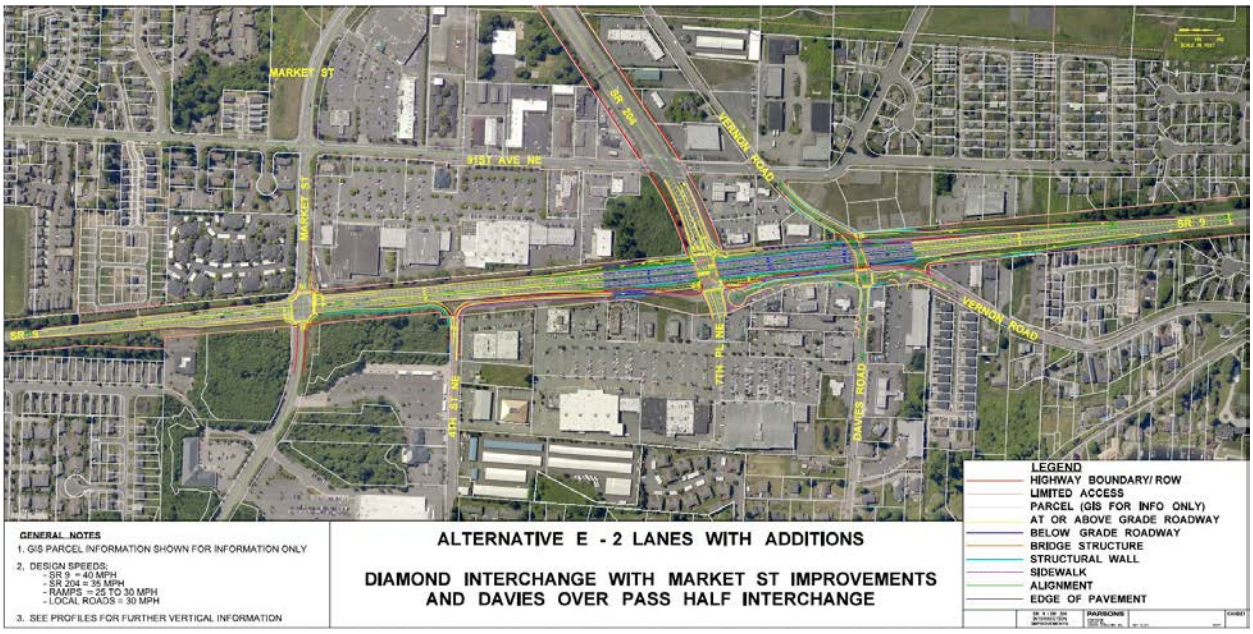
Concept E2A



Concept E2B



Concept E2C



Concept E2D

Concept G

N

Scale: 1"= 200'

Concept H

APPENDIX H.
Existing, 2021, and 2040 VISSIM Results

November 2017

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
Existing Conditions
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	20.2	C	14.1	B	52.1	D	46.9	D	23.0	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.1	A	1.4	A					1.8	A
3	SR 9/SR 204	Signal	44.8	D	31.3	C	74.0	E	72.4	E	52.7	D
4	SR 9/Market Pl	Signal	43.2	D	41.2	D	90.7	F	99.7	F	51.6	D
5	91st Ave/SR 204	Signal	69.4	E	60.6	E	80.2	F	42.1	D	59.7	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	28.0	C	15.7	B	34.7	C	34.0	C	26.2	C
7	Vernon Rd/7th Pl	Side-street Stop					0.6	A	11.5	B	11.0	B
8	91st Ave/Vernon Rd	Side-street Stop	1.1	A	7.7	A	15.4	C	7.8	A	12.7	B
9	Safeway Dwy/Davies Rd	Roundabout	6.9	A	4.7	A	2.1	A	4.6	A	4.0	A
10	SR 9/4th St On-Ramp	Side-street Stop			1.3	A			0.4	A	1.8	A
11	Transit Center Dwy/4th St	Side-street Stop	4.5	A	9.2	A	0.6	A	0.4	A	9.2	A
12	Transit Center Dwy/Market Pl	Side-street Stop			27.8	D	2.8	A	36.1	E	32.8	D
13	91st Ave/Market Pl	Signal	31.3	C	19.4	B	7.5	A	17.0	B	13.4	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.8	A	1.6	A	10.8	B	5.5	A	11.3	B
15	Vernon Rd/Davies Rd	Roundabout	5.0	A	4.9	A			9.2	A	5.6	A

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	7	93.2%	3.4	7.8	A
	Through	1,538	1,503	97.7%	22.6	2.9	C
	Right Turn	456	445	97.6%	12.7	3.1	B
	Subtotal	2,002	1,955	97.7%	20.3	2.6	C
SB	Left Turn	29	33	115.0%	60.8	13.0	E
	Through	991	976	98.5%	13.5	1.6	B
	Right Turn	88	97	110.5%	3.9	1.2	A
	Subtotal	1,108	1,107	99.9%	14.2	1.5	B
EB	Left Turn	205	198	96.5%	53.6	4.7	D
	Through	86	91	106.1%	54.6	6.4	D
	Right Turn	13	12	88.8%	11.1	2.0	B
	Subtotal	304	301	98.9%	52.5	4.4	D
WB	Left Turn	298	292	98.0%	51.7	5.9	D
	Through	93	100	107.0%	48.1	10.9	D
	Right Turn	42	45	106.5%	13.1	3.1	B
	Subtotal	433	436	100.8%	47.2	4.5	D
Total		3,847	3,799	98.8%	24.0	1.4	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,002	1,963	98.1%	1.1	0.2	A
	Right Turn						
	Subtotal	2,002	1,963	98.1%	1.1	0.2	A
SB	Left Turn						
	Through	1,183	1,145	96.8%	1.3	0.3	A
	Right Turn	119	138	115.6%	1.8	0.5	A
	Subtotal	1,302	1,283	98.5%	1.4	0.3	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,304	3,246	98.2%	1.2	0.1	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **PM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	82	101	123.7%	73.2	16.0	E
	Through	831	809	97.4%	50.3	17.8	D
	Right Turn	236	236	100.1%	18.1	12.8	B
	Subtotal	1,149	1,147	99.8%	46.0	16.7	D
SB	Left Turn	188	161	85.9%	67.6	6.3	E
	Through	605	571	94.4%	40.6	4.2	D
	Right Turn	390	397	101.9%	2.8	0.6	A
	Subtotal	1,183	1,130	95.5%	31.4	3.6	C
EB	Left Turn	1,005	987	98.2%	73.5	8.9	E
	Through	575	589	102.4%	69.9	7.8	E
	Right Turn	47	50	106.8%	83.6	11.1	F
	Subtotal	1,627	1,626	99.9%	72.5	8.4	E
WB	Left Turn	127	147	115.5%	77.7	17.8	E
	Through	140	163	116.6%	94.5	42.5	F
	Right Turn	166	155	93.1%	47.1	37.5	D
	Subtotal	433	464	107.2%	73.3	34.0	E
Total		4,392	4,367	99.4%	55.6	3.2	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	93	93	99.7%	84.2	15.2	F
	Through	691	678	98.1%	41.5	11.5	D
	Right Turn	50	58	115.8%	14.0	8.9	B
	Subtotal	834	828	99.3%	44.0	11.0	D
SB	Left Turn	107	109	102.0%	93.7	18.8	F
	Through	485	488	100.6%	36.6	14.8	D
	Right Turn	187	189	101.2%	19.8	8.2	B
	Subtotal	779	786	100.9%	40.5	9.9	D
EB	Left Turn	190	193	101.7%	114.6	46.0	F
	Through	270	272	100.8%	96.8	37.3	F
	Right Turn	81	81	100.4%	46.0	9.4	D
	Subtotal	541	547	101.1%	95.1	34.9	F
WB	Left Turn	64	67	104.4%	98.3	35.9	F
	Through	236	254	107.8%	112.6	35.2	F
	Right Turn	99	108	109.1%	83.4	16.8	F
	Subtotal	399	429	107.6%	103.6	30.7	F
Total		2,553	2,591	101.5%	64.1	15.4	E

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	52	105.9%	115.6	45.3	F
	Through	105	117	111.2%	74.8	40.3	E
	Right Turn	342	320	93.7%	61.6	39.4	E
	Subtotal	496	489	98.6%	69.5	39.1	E
SB	Left Turn	135	120	88.8%	87.1	11.6	F
	Through	155	232	149.6%	53.4	11.0	D
	Right Turn	54	55	102.7%	42.5	18.8	D
	Subtotal	344	407	118.4%	61.2	11.6	E
EB	Left Turn	82	74	90.6%	71.2	10.9	E
	Through	1,150	1,178	102.4%	85.2	16.0	F
	Right Turn	161	174	108.4%	58.1	16.8	E
	Subtotal	1,393	1,426	102.4%	81.1	15.0	F
WB	Left Turn	172	185	107.7%	82.2	6.6	F
	Through	367	409	111.4%	25.5	4.3	C
	Right Turn	73	72	98.3%	43.2	10.0	D
	Subtotal	612	666	108.8%	42.4	4.6	D
Total		2,845	2,988	105.0%	67.8	6.7	E

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	82	89	108.1%	32.4	5.4	C
	Through	129	127	98.8%	26.4	6.1	C
	Right Turn	6	7	110.6%	15.0	17.2	B
	Subtotal	217	223	102.6%	28.7	4.8	C
SB	Left Turn	34	31	92.0%	30.5	8.4	C
	Through	94	91	97.2%	23.5	5.2	C
	Right Turn	201	200	99.7%	9.5	2.0	A
	Subtotal	329	323	98.2%	15.8	3.0	B
EB	Left Turn	449	433	96.4%	53.5	7.3	D
	Through	1,353	1,377	101.8%	30.1	7.5	C
	Right Turn	232	227	97.6%	31.1	7.2	C
	Subtotal	2,034	2,036	100.1%	35.0	7.0	C
WB	Left Turn	2	4	177.3%	36.4	35.9	D
	Through	440	476	108.2%	34.4	4.3	C
	Right Turn	28	31	109.1%	18.2	9.3	B
	Subtotal	470	510	108.5%	33.6	4.1	C
Total		3,050	3,092	101.4%	32.5	4.8	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **PM Peak Hour**

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	365	351	96.2%	1.3	0.3	A
	Through	546	541	99.1%	0.3	0.1	A
	Right Turn	88	93	105.6%	0.1	0.1	A
	Subtotal	999	985	98.6%	0.6	0.1	A
WB	Left Turn						
	Through						
	Right Turn	152	152	100.1%	11.5	1.1	B
	Subtotal	152	152	100.1%	11.5	1.1	B
Total		1,151	1,137	98.8%	2.2	0.2	A

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	55	58	105.3%	1.5	0.6	A
	Through	97	93	95.8%	0.8	0.8	A
	Second Right						
	Subtotal	169	172	102.0%	1.1	0.7	A
SB	Left Turn	1	0	9.1%	0.1	0.4	A
	Through	118	116	98.4%	8.9	7.4	A
	Second Right						
	Subtotal	132	130	98.3%	8.1	6.7	A
EB	Left Turn	16	15	92.6%	10.2	5.7	B
	Through	7	6	92.2%	7.5	3.3	A
	Second Right						
	Subtotal	81	82	101.5%	16.1	12.5	C
WB	Left Turn	87	94	107.5%	10.7	7.7	B
	Through	34	37	108.6%	4.3	1.4	A
	Second Right						
	Subtotal	170	184	108.0%	8.0	4.2	A
Total		552	568	102.9%	7.2	4.4	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	293	284	97.1%	7.3	1.2	A
	Through	37	37	100.0%	6.8	2.5	A
	Right Turn	85	91	106.6%	6.5	1.4	A
	Subtotal	415	412	99.3%	7.0	0.9	A
SB	Left Turn	3	7	227.3%	3.6	2.9	A
	Through	12	12	100.0%	4.7	2.3	A
	Right Turn	76	72	95.0%	5.2	2.1	A
	Subtotal	91	91	100.0%	4.9	1.5	A
EB	Left Turn	65	98	151.3%	1.8	0.4	A
	Through	121	128	105.7%	2.1	0.2	A
	Right Turn	159	152	95.7%	2.5	0.6	A
	Subtotal	345	378	109.7%	2.2	0.3	A
WB	Left Turn	37	36	98.0%	4.1	1.7	A
	Through	111	106	95.2%	4.9	1.8	A
	Right Turn	2	6	322.7%	4.2	5.5	A
	Subtotal	150	148	98.9%	4.8	1.7	A
Total		1,001	1,030	102.9%	4.7	0.6	A

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	64	66	103.3%	0.7	0.4	A
	Through						
	Right Turn	65	69	106.9%	2.1	1.0	A
	Subtotal	129	136	105.1%	1.3	0.6	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through	104	116	111.5%	0.5	0.1	A
	Right Turn	32	33	104.0%	0.2	0.2	A
	Subtotal	136	149	109.7%	0.4	0.1	A
Total		265	285	107.4%	0.8	0.3	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **PM Peak Hour**

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	12	13	107.6%	5.5	0.5	A
	Through	5	5	103.6%	3.9	2.8	A
	Right Turn	5	10	192.7%	2.7	2.9	A
	Subtotal	22	28	126.0%	5.5	0.5	A
SB	Left Turn	123	133	108.1%	9.3	1.3	A
	Through	20	21	104.1%	8.9	2.9	A
	Right Turn	14	19	133.8%	8.5	1.9	A
	Subtotal	157	172	109.8%	9.3	1.5	A
EB	Left Turn	6	5	90.9%	1.6	1.4	A
	Through	79	85	107.6%	0.5	0.3	A
	Right Turn	12	12	103.8%	0.5	0.2	A
	Subtotal	97	103	106.1%	0.6	0.3	A
WB	Left Turn	3	4	121.2%	1.0	1.1	A
	Through	74	78	106.0%	0.3	0.2	A
	Right Turn	54	59	109.6%	0.6	0.2	A
	Subtotal	131	141	107.8%	0.4	0.2	A
Total		407	444	109.2%	4.3	0.5	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	9	10	111.1%	11.7	11.8	B
	Through						
	Right Turn	48	51	107.0%	32.7	19.7	D
	Subtotal	57	61	107.7%	30.7	19.0	D
EB	Left Turn	12	25	207.6%	16.1	13.7	C
	Through	415	414	99.7%	1.7	2.3	A
	Right Turn						
	Subtotal	427	439	102.8%	2.9	3.4	A
WB	Left Turn						
	Through	351	383	109.1%	39.8	30.5	E
	Right Turn	4	5	127.3%	12.1	11.9	B
	Subtotal	355	388	109.3%	39.6	30.4	E
Total		839	888	105.9%	20.4	14.5	C

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	36	41	114.9%	16.9	19.4	B
	Through	199	184	92.6%	34.5	39.5	C
	Right Turn	108	120	110.8%	37.3	36.0	D
	Subtotal	343	345	100.7%	33.2	35.1	C
SB	Left Turn	156	166	106.6%	30.9	21.4	C
	Through	153	167	109.0%	11.3	3.2	B
	Right Turn	41	34	82.9%	9.1	1.4	A
	Subtotal	350	367	104.9%	20.2	10.3	C
EB	Left Turn	41	44	107.5%	12.7	3.6	B
	Through	141	102	72.0%	7.4	7.8	A
	Right Turn	65	73	112.6%	5.8	1.5	A
	Subtotal	247	219	88.6%	7.9	4.5	A
WB	Left Turn	182	185	101.6%	17.7	6.0	B
	Through	119	131	109.8%	17.4	4.9	B
	Right Turn	68	73	107.8%	13.9	5.6	B
	Subtotal	369	389	105.4%	16.9	5.0	B
Total		1,309	1,320	100.8%	19.9	11.5	B

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	23	24	105.1%	1.7	2.3	A
	Through	487	461	94.6%	1.7	0.5	A
	Right Turn	96	106	109.9%	2.1	0.8	A
	Subtotal	606	590	97.4%	1.8	0.4	A
SB	Left Turn	21	19	92.6%	4.5	3.2	A
	Through	255	252	98.9%	1.4	0.5	A
	Right Turn	18	23	130.3%	1.0	0.3	A
	Subtotal	294	295	100.3%	1.6	0.6	A
EB	Left Turn	9	19	215.2%	12.3	3.0	B
	Through	3	2	57.6%	7.8	11.2	A
	Right Turn	31	19	61.9%	8.4	2.8	A
	Subtotal	43	40	93.7%	11.2	1.6	B
WB	Left Turn	43	53	122.4%	11.1	2.5	B
	Through						
	Right Turn	62	66	106.7%	1.6	0.9	A
	Subtotal	105	119	113.2%	5.3	1.3	A
Total		1,048	1,044	99.7%	2.6	0.4	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	87	56	64.5%	4.4	1.9	A
	Through	267	266	99.7%	5.1	1.4	A
	Right Turn	163	166	102.1%	4.8	1.3	A
	Subtotal	517	489	94.5%	4.9	1.3	A
SB	Left Turn	205	219	107.0%	5.0	1.0	A
	Through	96	95	98.9%	4.6	0.8	A
	Right Turn						
	Subtotal	301	314	104.4%	4.9	0.7	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	250	243	97.1%	9.1	2.4	A
	Through						
	Right Turn	252	254	100.8%	9.2	2.5	A
	Subtotal	502	497	98.9%	9.1	2.3	A
Total		1,320	1,299	98.4%	6.6	1.3	A

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	0	0	0	0	0	NO
	Through	2,000	94	10	81	111	500	48	434	594	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	12	2	9	16	67	13	49	93	NO
	Through	3,700	36	3	29	40	256	26	221	295	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	37	2	35	42	121	8	108	136	NO
	Through	2,000	26	5	19	36	126	13	105	142	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	50	3	46	55	166	10	155	184	NO
	Through	2,000	27	3	21	31	119	17	92	149	NO
	Right Turn	80	1	0	1	1	26	4	22	35	NO
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	42	11	34	73	187	67	132	373	MAX
	Through	2,000	158	29	123	236	476	54	423	617	NO
	Right Turn	160	11	3	6	15	110	16	81	129	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	67	6	57	78	229	18	201	257	NO
	Through	2,000	78	6	66	87	297	16	263	323	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	94	6	82	101	499	21	472	529	MAX
	Through	400	94	6	82	101	499	21	472	529	MAX
	Right Turn	100	93	6	82	102	501	21	474	530	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	73	14	51	94	352	36	292	408	MAX
	Through	300	113	36	78	182	345	34	288	398	MAX
	Right Turn	75	88	36	55	153	330	36	275	385	AVG
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	37	7	27	48	164	39	127	267	NO
	Through	2,000	200	47	161	313	881	86	742	1,057	NO
	Right Turn	400	0	0	0	1	36	11	21	60	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	51	8	38	66	203	44	160	284	NO
	Through	2,000	92	31	35	129	487	64	380	592	NO
	Right Turn	300	9	5	5	17	122	32	73	183	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	128	36	84	198	515	52	397	594	AVG
	Through	600	165	37	119	242	544	35	468	593	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	15	4	12	26	86	38	60	199	NO
	Through	1,000	232	46	153	308	529	20	502	555	NO
	Right Turn	600	231	46	151	307	528	20	501	554	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	75	56	27	227	394	150	174	656	MAX
	Through	2,000	203	106	126	499	624	127	499	909	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	69	9	57	81	250	24	191	269	MAX
	Through	800	92	12	74	110	274	3	269	281	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	26	4	18	33	115	9	104	133	NO
	Through	1,250	175	29	132	217	638	91	514	754	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	101	16	86	128	312	47	256	421	MAX
	Through	350	47	4	39	55	277	20	253	324	NO
	Right Turn	300	50	4	42	58	285	20	260	331	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	14	3	8	19	104	23	68	162	NO
	Through	1,500	19	4	11	24	135	20	103	165	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	16	1	14	18	100	11	83	121	NO
	Through	100	16	1	14	18	100	11	83	121	NO
	Right Turn	100	16	1	14	18	102	11	86	124	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	58	5	47	65	207	24	180	272	NO
	Through	2,000	145	39	82	205	682	154	450	983	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	2	19	9	10	39	NO
	Through	1,250	42	6	30	51	234	17	214	264	NO
	Right Turn										
	Second Right										

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	9	2	7	12	148	15	123	170	MAX
	Through	25	9	2	7	12	148	15	123	170	MAX
	Right Turn	25	9	2	7	12	148	15	123	170	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	28	8	15	40	NO
	Through	350	0	1	0	2	41	14	22	70	NO
	Right Turn	350	0	1	0	2	41	14	22	70	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	1	0	3	13	10	0	27	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	1	1	0	4	63	15	43	95	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	1	1	1	3	44	13	31	75	NO
	Through	400	1	0	1	1	63	5	57	73	NO
	Right Turn	400	3	1	2	7	56	10	41	74	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	2	1	1	3	83	9	70	98	NO
	Through	400	2	1	1	3	83	9	70	98	NO
	Right Turn	400	2	1	2	4	79	10	66	96	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	9	1	8	10	87	10	76	103	NO
	Through										
	Right Turn	400	9	1	8	10	88	10	77	104	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	4	2	2	9	55	9	40	67	NO
	Through										
	Right Turn	400	5	2	2	10	54	9	39	67	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	3	4	1	13	57	41	32	144	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	1	0	1	2	36	5	29	45	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	9	5	4	19	108	17	89	140	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	2	0	1	2	36	6	27	43	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	11	2	8	15	147	26	122	212	NO
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
Existing Conditions
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	14.2	B	15.7	B	41.4	D	33.0	C	18.2	B
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.6	A	1.3	A					1.4	A
3	SR 9/SR 204	Signal	22.1	C	18.8	B	52.2	D	30.0	C	23.7	C
4	SR 9/Market Pl	Signal	15.8	B	19.8	B	27.8	C	33.4	C	19.1	B
5	91st Ave/SR 204	Signal	15.4	B	22.5	C	24.2	C	18.6	B	18.2	B
6	Lundeen Pkwy/Market Pl/SR 204	Signal	16.8	B	12.3	B	8.3	A	13.7	B	10.3	B
7	Vernon Rd/7th Pl	Side-street Stop					0.3	A	7.4	A	7.5	A
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.3	A	5.7	A	3.0	A	5.9	A
9	Safeway Dwy/Davies Rd	Roundabout	1.4	A	1.2	A	0.8	A	1.0	A	0.9	A
10	SR 9/4th St On-Ramp	Side-street Stop			1.8	A			0.5	A	1.9	A
11	Transit Center Dwy/4th St	Side-street Stop	0.5	A	6.6	A	0.5	A	0.3	A	6.7	A
12	Transit Center Dwy/Market Pl	Side-street Stop			5.0	A	0.8	A	0.5	A	5.8	A
13	91st Ave/Market Pl	Signal	7.2	A	6.9	A	2.2	A	6.2	A	5.6	A
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.4	A	1.7	A	7.6	A	6.1	A	7.6	A
15	Vernon Rd/Davies Rd	Roundabout	1.0	A	2.1	A			1.5	A	1.3	A

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **AM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	5	2	36.4%	2.6	4.0	A
	Through	674	680	100.9%	16.1	4.1	B
	Right Turn	246	253	102.8%	6.9	0.8	A
	Subtotal	925	935	101.1%	13.6	3.1	B
SB	Left Turn	6	7	110.6%	19.6	19.3	B
	Through	867	863	99.6%	16.3	2.2	B
	Right Turn	47	49	103.7%	4.0	0.8	A
	Subtotal	920	919	99.9%	15.7	2.0	B
EB	Left Turn	50	48	95.8%	43.6	8.1	D
	Through	65	67	102.8%	42.3	12.4	D
	Right Turn	6	4	74.2%	9.5	5.8	A
	Subtotal	121	119	98.5%	41.5	7.6	D
WB	Left Turn	387	391	100.9%	37.0	4.3	D
	Through	83	84	100.9%	29.6	11.3	C
	Right Turn	38	41	108.6%	6.1	1.7	A
	Subtotal	508	516	101.5%	32.9	4.1	C
Total		2,474	2,488	100.6%	19.8	2.8	B

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	925	938	101.4%	0.6	0.1	A
	Right Turn						
	Subtotal	925	938	101.4%	0.6	0.1	A
SB	Left Turn						
	Through	1,203	1,199	99.7%	1.3	0.3	A
	Right Turn	57	58	101.6%	1.5	0.7	A
	Subtotal	1,260	1,257	99.7%	1.3	0.3	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		2,185	2,195	100.5%	1.0	0.2	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **AM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	51	55	108.4%	40.3	6.5	D
	Through	550	569	103.5%	23.6	2.2	C
	Right Turn	127	122	96.1%	6.3	0.9	A
	Subtotal	728	746	102.5%	22.0	1.8	C
SB	Left Turn	100	99	99.0%	42.4	7.0	D
	Through	747	737	98.7%	23.7	4.5	C
	Right Turn	356	363	102.0%	2.8	0.4	A
	Subtotal	1,203	1,199	99.7%	18.8	2.0	B
EB	Left Turn	308	300	97.5%	55.1	6.0	E
	Through	107	102	95.3%	49.3	4.6	D
	Right Turn	32	32	100.0%	33.4	5.1	C
	Subtotal	447	434	97.1%	52.5	5.1	D
WB	Left Turn	90	95	105.4%	39.8	7.0	D
	Through	113	113	99.9%	37.1	5.5	D
	Right Turn	67	67	100.0%	7.4	2.2	A
	Subtotal	270	275	101.8%	30.0	3.8	C
Total		2,648	2,654	100.2%	27.1	1.5	C

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	24	24	99.2%	40.2	9.0	D
	Through	451	448	99.3%	15.1	3.0	B
	Right Turn	17	21	124.6%	2.7	0.7	A
	Subtotal	492	493	100.2%	15.8	2.8	B
SB	Left Turn	22	21	94.6%	64.3	13.1	E
	Through	693	689	99.4%	21.1	3.2	C
	Right Turn	154	153	99.3%	11.5	3.3	B
	Subtotal	869	863	99.3%	20.3	3.2	C
EB	Left Turn	91	96	105.1%	26.8	4.3	C
	Through	59	58	98.8%	34.8	6.6	C
	Right Turn	106	111	104.5%	23.2	7.0	C
	Subtotal	256	265	103.4%	27.2	4.4	C
WB	Left Turn	60	69	114.7%	24.0	4.6	C
	Through	99	106	106.7%	40.5	5.3	D
	Right Turn	17	19	110.2%	26.8	11.8	C
	Subtotal	176	193	109.8%	33.6	3.4	C
Total		1,793	1,813	101.1%	21.4	1.8	C

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	12	10	81.1%	49.1	21.0	D
	Through	48	51	105.5%	21.4	4.8	C
	Right Turn	85	84	98.8%	9.1	2.3	A
	Subtotal	145	144	99.6%	16.2	2.9	B
SB	Left Turn	89	75	83.8%	34.1	4.8	C
	Through	105	139	131.9%	19.3	3.4	B
	Right Turn	58	62	106.6%	17.0	4.2	B
	Subtotal	252	275	109.1%	22.7	2.2	C
EB	Left Turn	18	17	92.4%	36.8	10.9	D
	Through	273	274	100.4%	25.6	4.7	C
	Right Turn	38	41	106.9%	11.5	2.7	B
	Subtotal	329	331	100.7%	24.4	4.5	C
WB	Left Turn	67	66	99.2%	36.5	9.5	D
	Through	420	440	104.8%	16.8	2.7	B
	Right Turn	33	26	79.1%	16.1	6.3	B
	Subtotal	520	533	102.5%	18.9	2.9	B
Total		1,246	1,283	103.0%	21.1	2.6	C

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	50	55	110.5%	19.5	4.4	B
	Through	48	47	97.9%	15.2	3.5	B
	Right Turn	3	2	60.6%	2.8	4.4	A
	Subtotal	101	104	103.1%	17.4	2.3	B
SB	Left Turn	15	11	70.3%	18.9	9.9	B
	Through	94	99	105.6%	18.2	2.1	B
	Right Turn	216	216	100.0%	9.6	1.7	A
	Subtotal	325	326	100.3%	12.2	1.7	B
EB	Left Turn	50	48	96.5%	21.4	5.3	C
	Through	311	318	102.3%	6.6	2.1	A
	Right Turn	22	19	88.4%	4.7	2.2	A
	Subtotal	383	386	100.8%	8.3	2.2	A
WB	Left Turn	3	2	69.7%	16.9	25.7	B
	Through	479	502	104.7%	13.7	2.3	B
	Right Turn	8	8	94.3%	8.3	9.4	A
	Subtotal	490	511	104.3%	13.7	2.3	B
Total		1,299	1,327	102.2%	11.7	1.4	B

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	127	113	89.0%	0.7	0.1	A
	Through	166	169	101.5%	0.1	0.0	A
	Right Turn	41	41	100.2%	0.0	0.0	A
	Subtotal	334	323	96.6%	0.3	0.1	A
WB	Left Turn						
	Through						
	Right Turn	29	29	98.4%	7.3	0.6	A
	Subtotal	29	29	98.4%	7.3	0.6	A
Total		363	351	96.7%	1.0	0.1	A

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	19	17	90.4%	0.8	0.7	A
	Through	24	24	98.1%	0.2	0.2	A
	Second Right						
	Subtotal	48	48	100.9%	0.5	0.2	A
SB	Left Turn						
	Through	75	73	96.8%	0.3	0.2	A
	Second Right						
	Subtotal	80	78	97.6%	0.3	0.2	A
EB	Left Turn	3	4	130.3%	2.6	3.4	A
	Through	2	3	127.3%	4.9	4.5	A
	Second Right						
	Subtotal	38	40	104.5%	6.2	1.0	A
WB	Left Turn	26	27	102.8%	1.3	0.8	A
	Through	18	18	98.0%	3.1	1.7	A
	Second Right						
	Subtotal	68	71	103.7%	3.0	0.6	A
Total		234	237	101.2%	2.2	0.3	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **AM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	41	37	89.1%	1.7	0.5	A
	Through	7	7	102.6%	0.8	0.5	A
	Right Turn	9	11	123.2%	0.8	0.6	A
	Subtotal	57	55	96.2%	1.4	0.3	A
SB	Left Turn						
	Through	6	6	106.1%	1.3	1.3	A
	Right Turn	26	24	93.4%	1.1	0.3	A
	Subtotal	32	31	95.7%	1.2	0.4	A
EB	Left Turn	25	26	103.6%	0.6	0.2	A
	Through	40	40	99.3%	0.9	0.3	A
	Right Turn	51	46	90.0%	0.8	0.4	A
	Subtotal	116	112	96.2%	0.8	0.2	A
WB	Left Turn	16	15	93.8%	0.9	0.9	A
	Through	54	50	92.9%	0.9	0.4	A
	Right Turn						
	Subtotal	70	65	93.1%	0.9	0.4	A
Total		275	262	95.3%	1.0	0.1	A

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	32	34	106.3%	0.8	0.6	A
	Through						
	Right Turn	67	73	109.5%	2.0	0.6	A
	Subtotal	99	107	108.4%	1.6	0.4	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through	102	111	108.9%	0.5	0.0	A
	Right Turn	6	7	113.6%	0.1	0.1	A
	Subtotal	108	118	109.2%	0.5	0.0	A
Total		207	225	108.8%	1.0	0.2	A

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	3	1	27.3%	1.6	2.6	A
	Right Turn						
	Subtotal	3	1	27.3%	1.6	2.6	A
SB	Left Turn	15	19	123.6%	6.2	0.5	A
	Through	14	14	100.6%	6.8	0.7	A
	Right Turn	7	6	92.2%	3.4	4.0	A
	Subtotal	36	39	108.6%	6.5	0.4	A
EB	Left Turn	2	2	90.9%	0.2	0.2	A
	Through	29	32	109.4%	0.2	0.2	A
	Right Turn	9	8	85.9%	0.2	0.2	A
	Subtotal	40	41	103.2%	0.2	0.2	A
WB	Left Turn	2	1	50.0%	0.1	0.2	A
	Through	56	59	106.0%	0.2	0.1	A
	Right Turn	20	24	122.3%	0.4	0.0	A
	Subtotal	78	85	108.7%	0.2	0.1	A
Total		157	166	105.7%	1.8	0.5	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	2	0	13.6%	0.0	0.0	A
	Through						
	Right Turn	22	21	94.6%	5.5	0.7	A
	Subtotal	24	21	87.9%	5.5	0.7	A
EB	Left Turn	6	14	230.3%	2.4	1.4	A
	Through	92	86	93.8%	0.3	0.2	A
	Right Turn						
	Subtotal	98	100	102.1%	0.7	0.4	A
WB	Left Turn						
	Through	154	173	112.4%	0.5	0.2	A
	Right Turn	3	4	139.4%	0.5	0.3	A
	Subtotal	157	177	112.9%	0.5	0.2	A
Total		279	298	107.0%	0.9	0.3	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	17	19	109.6%	5.6	2.5	A
	Through	74	66	89.7%	7.5	1.2	A
	Right Turn	62	72	115.4%	7.6	1.3	A
	Subtotal	153	157	102.3%	7.3	1.0	A
SB	Left Turn	45	48	107.7%	7.6	3.1	A
	Through	56	60	107.8%	6.4	1.7	A
	Right Turn						
	Subtotal	101	109	107.7%	7.1	1.4	A
EB	Left Turn	2	1	68.2%	1.0	2.3	A
	Through	88	56	63.7%	1.1	0.7	A
	Right Turn	44	53	120.5%	3.4	0.8	A
	Subtotal	134	110	82.4%	2.3	0.3	A
WB	Left Turn	117	124	105.6%	6.7	1.0	A
	Through	45	46	102.6%	6.2	2.2	A
	Right Turn	33	35	105.2%	4.4	1.3	A
	Subtotal	195	204	104.8%	6.3	0.9	A
Total		583	580	99.5%	6.0	0.5	A

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	9	9	94.9%	1.5	1.8	A
	Through	81	80	98.8%	0.2	0.2	A
	Right Turn	16	14	87.5%	0.8	0.2	A
	Subtotal	106	103	96.7%	0.5	0.3	A
SB	Left Turn	7	7	101.3%	1.4	1.1	A
	Through	225	222	98.8%	1.6	0.8	A
	Right Turn	6	8	134.8%	2.3	3.2	A
	Subtotal	238	237	99.8%	1.6	0.8	A
EB	Left Turn	14	14	102.6%	7.4	2.3	A
	Through	8	8	95.5%	7.1	4.3	A
	Right Turn	59	57	95.8%	7.7	1.1	A
	Subtotal	81	79	97.0%	7.7	1.0	A
WB	Left Turn	41	47	114.6%	7.8	1.3	A
	Through	1	1	63.6%	0.0	0.0	A
	Right Turn	11	13	114.9%	1.0	0.9	A
	Subtotal	53	60	113.7%	6.4	1.4	A
Total		478	479	100.2%	2.8	0.5	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **Existing Conditions**
Volume and Delay by Movement **AM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	32	24	75.9%	0.8	0.4	A
	Through	55	48	88.1%	1.2	0.5	A
	Right Turn	69	62	90.0%	0.9	0.4	A
	Subtotal	156	135	86.4%	1.0	0.3	A
SB	Left Turn	63	71	113.4%	2.0	0.7	A
	Through	104	106	101.7%	2.1	0.8	A
	Right Turn						
	Subtotal	167	177	106.2%	2.1	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	134	121	90.6%	1.6	0.4	A
	Through						
	Right Turn	27	30	111.4%	1.3	0.7	A
	Subtotal	161	152	94.1%	1.5	0.3	A
Total		484	464	95.8%	1.6	0.2	A

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	0	0	0	0	0	NO
	Through	2,000	26	4	21	34	204	17	183	232	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	2	1	1	3	26	7	14	37	NO
	Through	3,700	35	2	32	38	241	18	211	270	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	9	1	6	10	51	5	45	64	NO
	Through	2,000	14	2	9	19	83	19	58	125	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	44	3	40	48	174	21	139	208	NO
	Through	2,000	11	1	8	13	70	12	56	91	NO
	Right Turn	80	0	0	0	1	26	3	22	32	NO
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	11	1	9	13	76	12	62	102	NO
	Through	2,000	34	4	28	39	216	27	177	254	NO
	Right Turn	160	1	0	1	2	54	8	46	72	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	21	3	15	26	119	13	104	138	NO
	Through	2,000	43	4	38	49	237	20	208	272	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	36	2	31	40	172	17	144	195	NO
	Through	400	36	2	31	40	172	17	144	195	NO
	Right Turn	100	25	2	23	28	166	19	142	193	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	19	3	15	26	109	20	87	153	NO
	Through	300	23	2	20	27	145	19	120	180	NO
	Right Turn	75	6	2	4	11	129	16	103	152	MAX
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	5	2	3	8	49	8	39	63	NO
	Through	2,000	31	5	25	42	272	35	211	332	NO
	Right Turn	400	0	0	0	0	16	5	10	24	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	5	1	4	7	51	5	44	59	NO
	Through	2,000	74	11	51	94	530	50	454	626	NO
	Right Turn	300	3	1	2	4	79	7	65	89	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	12	2	9	15	95	12	75	111	MAX
	Through	600	18	3	13	25	143	20	109	173	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	7	1	6	9	62	8	52	80	NO
	Through	1,000	19	3	15	24	132	9	119	143	NO
	Right Turn	600	15	3	12	20	131	9	118	142	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	2	1	1	3	23	3	17	27	NO
	Through	2,000	7	2	4	10	78	17	52	113	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	11	2	9	13	80	14	64	106	NO
	Through	800	16	3	13	22	125	17	105	158	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	1	2	4	30	5	22	36	NO
	Through	1,250	9	1	7	12	77	12	67	102	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	10	2	8	16	81	12	65	103	NO
	Through	350	21	3	18	26	141	21	109	175	NO
	Right Turn	300	21	3	18	28	149	21	117	183	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	3	1	2	5	54	9	39	76	NO
	Through	1,500	3	1	1	4	56	10	38	68	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	10	1	8	12	92	12	82	121	NO
	Through	100	10	1	8	12	92	12	82	121	NO
	Right Turn	100	11	1	9	12	94	12	84	124	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	3	1	2	4	36	5	30	44	NO
	Through	2,000	5	1	4	6	72	8	62	87	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	0	0	0	0	12	5	5	23	NO
	Through	1,250	12	1	10	14	147	23	118	189	NO
	Right Turn										
	Second Right										

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	2	0	1	2	104	15	87	133	MAX
	Through	25	2	0	1	2	104	15	87	133	MAX
	Right Turn	25	2	0	1	2	104	15	87	133	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	4	4	0	8	NO
	Through	350	0	0	0	0	1	4	0	12	NO
	Right Turn	350	0	0	0	0	1	4	0	12	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	0	8	8	0	15	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	34	7	21	46	NO
	Through	400	0	0	0	1	57	11	34	72	NO
	Right Turn	400	1	0	1	1	32	5	27	45	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	43	10	28	61	NO
	Through	400	0	0	0	0	43	10	28	62	NO
	Right Turn	400	1	0	1	1	57	5	50	66	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	39	3	33	46	NO
	Through										
	Right Turn	400	1	0	1	1	40	3	34	47	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	1	27	2	25	32	NO
	Through										
	Right Turn	400	0	0	0	1	26	2	24	32	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	0	0	0	0	18	5	11	26	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	0	0	0	1	25	5	17	35	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	1	0	1	1	47	4	41	53	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	0	3	4	0	11	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	2	1	1	3	62	11	50	80	NO
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 NB
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	34.1	C	26.7	C	56.4	E	69.0	E	36.1	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.8	A	14.7	B					7.6	A
3	SR 9/SR 204	Signal	42.8	D	69.3	E	70.4	E	286.7	F	74.0	E
4	SR 9/Market Pl	Signal	152.6	F	91.7	F	80.4	F	91.3	F	99.8	F
5	91st Ave/SR 204	Signal	164.8	F	37.1	D	78.8	E	28.7	C	64.5	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	35.0	D	21.0	C	33.0	C	47.5	D	29.3	C
7	Vernon Rd/7th Pl	Side-street Stop					1.7	A	22.1	C	17.6	C
8	91st Ave/Vernon Rd	Side-street Stop	0.8	A	2.6	A	9.6	A	10.3	B	12.4	B
9	Safeway Dwy/Davies Rd	Roundabout	106.6	F	396.6	F	9.7	A	693.2	F	106.8	F
10	SR 9/4th St On-Ramp	Side-street Stop			1.5	A			0.4	A	2.1	A
11	Transit Center Dwy/4th St	Side-street Stop	6.8	A	9.0	A	0.3	A	0.5	A	9.0	A
12	Transit Center Dwy/Market Pl	Side-street Stop			31.1	D	1.6	A	28.7	D	28.5	D
13	91st Ave/Market Pl	Signal	30.3	C	23.6	C	24.0	C	27.9	C	23.8	C
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.5	A	2.8	A	13.0	B	6.8	A	13.6	B
15	Vernon Rd/Davies Rd	Roundabout	26.2	D	359.5	F			70.5	F	94.6	F

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Volume and Delay by Movement **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	8	94.3%	105.7	50.0	F
	Through	1,709	1,535	89.8%	30.0	2.2	C
	Right Turn	562	511	91.0%	46.2	16.3	D
	Subtotal	2,279	2,054	90.1%	34.5	5.2	C
SB	Left Turn	31	34	108.5%	102.8	36.6	F
	Through	1,396	1,394	99.8%	26.6	2.7	C
	Right Turn	93	94	101.6%	7.0	1.8	A
	Subtotal	1,520	1,522	100.1%	27.0	2.9	C
EB	Left Turn	240	238	99.4%	65.5	4.5	E
	Through	124	125	100.7%	44.6	7.8	D
	Right Turn	13	11	85.3%	12.0	2.6	B
	Subtotal	377	374	99.3%	57.0	3.9	E
WB	Left Turn	386	391	101.4%	84.5	17.3	F
	Through	232	226	97.2%	53.8	7.8	D
	Right Turn	44	41	93.2%	23.7	10.9	C
	Subtotal	662	658	99.4%	70.0	12.1	E
Total		4,838	4,608	95.2%	38.7	3.6	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,279	2,052	90.0%	0.9	0.0	A
	Right Turn						
	Subtotal	2,279	2,052	90.0%	0.9	0.0	A
SB	Left Turn						
	Through	1,665	1,654	99.3%	15.4	44.8	C
	Right Turn	129	131	101.7%	11.9	34.2	B
	Subtotal	1,794	1,785	99.5%	15.2	44.2	C
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		4,073	3,836	94.2%	6.8	18.2	A

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	103	101	98.2%	80.1	13.3	F
	Through	1,062	977	92.0%	43.2	2.9	D
	Right Turn	265	240	90.5%	20.6	5.8	C
	Subtotal	1,430	1,318	92.2%	42.1	4.0	D
SB	Left Turn	188	161	85.9%	153.9	104.3	F
	Through	1,038	1,021	98.4%	52.0	9.7	D
	Right Turn	464	464	100.1%	6.4	2.1	A
	Subtotal	1,690	1,647	97.5%	48.4	15.1	D
EB	Left Turn	1,057	964	91.2%	74.9	30.1	E
	Through	738	665	90.1%	78.8	42.6	E
	Right Turn	47	40	85.1%	77.5	37.2	E
	Subtotal	1,842	1,668	90.6%	76.6	35.1	E
WB	Left Turn	260	173	66.5%	228.5	46.5	F
	Through	191	126	66.2%	357.3	23.9	F
	Right Turn	166	112	67.4%	367.1	27.0	F
	Subtotal	617	411	66.7%	310.0	35.1	F
Total		5,579	5,045	90.4%	77.2	11.4	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	98	92.5%	209.9	27.8	F
	Through	899	831	92.4%	146.7	6.7	F
	Right Turn	70	79	113.0%	142.9	8.4	F
	Subtotal	1,075	1,008	93.8%	152.1	7.4	F
SB	Left Turn	186	155	83.6%	194.8	25.6	F
	Through	846	783	92.6%	80.1	9.0	F
	Right Turn	308	276	89.8%	62.4	7.0	E
	Subtotal	1,340	1,215	90.7%	90.8	9.4	F
EB	Left Turn	204	161	79.0%	89.0	31.0	F
	Through	325	305	94.0%	77.7	27.9	E
	Right Turn	106	95	89.3%	48.1	12.4	D
	Subtotal	635	561	88.4%	75.8	24.1	E
WB	Left Turn	68	62	91.7%	90.2	17.3	F
	Through	270	265	98.0%	97.9	17.8	F
	Right Turn	116	116	99.8%	71.3	11.2	E
	Subtotal	454	443	97.5%	90.3	14.2	F
Total		3,504	3,227	92.1%	107.6	6.2	F

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	64	131.0%	273.2	101.1	F
	Through	128	122	95.5%	145.3	89.5	F
	Right Turn	342	307	89.8%	137.7	83.0	F
	Subtotal	519	494	95.1%	157.9	88.8	F
SB	Left Turn	164	136	82.6%	50.4	7.8	D
	Through	213	243	114.3%	33.4	6.1	C
	Right Turn	54	45	83.5%	21.3	6.3	C
	Subtotal	431	424	98.4%	37.2	4.1	D
EB	Left Turn	101	99	97.9%	63.8	19.2	E
	Through	1,331	1,225	92.0%	85.5	73.7	F
	Right Turn	161	171	106.3%	62.4	30.9	E
	Subtotal	1,593	1,495	93.8%	81.4	64.1	F
WB	Left Turn	172	132	76.5%	56.0	7.4	E
	Through	543	493	90.7%	21.6	4.6	C
	Right Turn	74	66	89.3%	12.6	3.5	B
	Subtotal	789	690	87.5%	28.4	4.5	C
Total		3,332	3,103	93.1%	77.2	32.8	E

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	101	96.7%	35.4	7.8	D
	Through	148	147	99.5%	34.7	5.3	C
	Right Turn	9	13	141.4%	23.4	17.9	C
	Subtotal	261	261	99.8%	35.0	6.2	C
SB	Left Turn	40	41	102.3%	49.8	17.9	D
	Through	115	113	98.3%	33.4	5.3	C
	Right Turn	288	281	97.5%	12.5	1.8	B
	Subtotal	443	435	98.1%	21.2	2.8	C
EB	Left Turn	527	479	90.8%	43.5	38.0	D
	Through	1,384	1,444	104.3%	33.0	53.4	C
	Right Turn	282	262	92.8%	26.8	35.8	C
	Subtotal	2,193	2,184	99.6%	34.6	47.9	C
WB	Left Turn	4	4	106.8%	27.6	40.7	C
	Through	507	542	106.9%	47.0	7.2	D
	Right Turn	78	56	71.9%	36.8	10.3	D
	Subtotal	589	603	102.3%	46.1	7.2	D
Total		3,486	3,482	99.9%	35.4	31.2	D

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	503	455	90.5%	2.9	1.9	A
	Through	553	504	91.2%	0.3	0.1	A
	Right Turn	109	105	96.7%	0.0	0.0	A
	Subtotal	1,165	1,065	91.4%	1.4	0.9	A
WB	Left Turn						
	Through						
	Right Turn	156	152	97.6%	17.5	5.8	C
	Subtotal	156	152	97.6%	17.5	5.8	C
Total		1,321	1,218	92.2%	3.5	1.4	A

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	55	46	84.5%	1.3	0.5	A
	Through	108	104	96.0%	0.5	0.2	A
	Second Right						
	Subtotal	191	181	94.8%	0.8	0.2	A
SB	Left Turn	1	0	27.3%	0.0	0.2	A
	Through	118	117	98.8%	2.8	5.6	A
	Second Right						
	Subtotal	139	136	97.9%	2.7	5.1	A
EB	Left Turn	16	15	96.6%	8.7	1.3	A
	Through	7	7	103.9%	9.3	3.3	A
	Second Right						
	Subtotal	135	109	80.9%	9.8	3.9	A
WB	Left Turn	88	86	97.5%	11.4	4.4	B
	Through	38	39	103.3%	12.2	2.1	B
	Second Right						
	Subtotal	176	177	100.3%	10.2	2.3	B
Total		641	603	94.1%	5.8	2.8	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Volume and Delay by Movement **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	367	207	56.5%	118.8	26.9	F
	Through	37	25	67.8%	63.2	18.4	F
	Right Turn	89	64	72.3%	70.6	24.4	F
	Subtotal	493	297	60.2%	103.8	24.4	F
SB	Left Turn	9	6	68.7%	263.0	224.8	F
	Through	12	7	59.1%	313.6	169.9	F
	Right Turn	97	60	62.0%	390.1	119.8	F
	Subtotal	118	73	62.2%	388.4	118.4	F
EB	Left Turn	105	101	96.4%	28.0	10.7	D
	Through	204	132	64.8%	6.2	3.6	A
	Right Turn	197	168	85.5%	2.8	1.1	A
	Subtotal	506	402	79.4%	9.8	4.0	A
WB	Left Turn	37	28	74.9%	655.0	239.6	F
	Through	122	91	74.4%	667.6	251.0	F
	Right Turn	6	6	100.0%	640.7	297.2	F
	Subtotal	165	125	75.5%	663.2	248.8	F
Total		1,282	896	69.9%	163.3	48.9	F

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	78	76	97.6%	0.9	0.6	A
	Through						
	Right Turn	73	70	95.4%	2.0	0.6	A
	Subtotal	151	146	96.5%	1.4	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through	137	137	100.3%	0.5	0.0	A
	Right Turn	40	35	87.0%	0.1	0.1	A
	Subtotal	177	172	97.3%	0.4	0.0	A
Total		328	318	97.0%	0.9	0.2	A

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	32	79.1%	5.8	0.7	A
	Through	14	14	98.7%	5.7	4.1	A
	Right Turn	5	10	201.8%	9.9	2.0	A
	Subtotal	59	56	94.1%	7.0	0.8	A
SB	Left Turn	124	121	97.7%	9.2	0.7	A
	Through	22	21	94.2%	8.7	2.6	A
	Right Turn	17	20	116.0%	8.5	2.9	A
	Subtotal	163	162	99.1%	9.1	0.7	A
EB	Left Turn	6	7	110.6%	0.9	0.9	A
	Through	89	87	98.1%	0.3	0.1	A
	Right Turn	17	17	101.1%	0.2	0.1	A
	Subtotal	112	111	99.2%	0.3	0.1	A
WB	Left Turn	3	4	118.2%	0.5	0.7	A
	Through	90	87	97.2%	0.4	0.2	A
	Right Turn	54	54	100.5%	0.6	0.1	A
	Subtotal	147	145	98.8%	0.5	0.2	A
Total		481	473	98.4%	4.1	0.2	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	16	15	92.6%	13.2	11.7	B
	Through						
	Right Turn	62	58	94.1%	29.2	16.3	D
	Subtotal	78	73	93.8%	27.0	15.6	D
EB	Left Turn	81	81	99.4%	5.1	2.2	A
	Through	500	459	91.7%	0.4	0.1	A
	Right Turn						
	Subtotal	581	539	92.8%	1.1	0.4	A
WB	Left Turn						
	Through	392	384	98.0%	25.4	15.5	D
	Right Turn	6	6	107.6%	9.3	8.6	A
	Subtotal	398	391	98.1%	25.2	15.5	D
Total		1,057	1,003	94.9%	12.7	7.2	B

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Volume and Delay by Movement **PM Peak Hour**

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	106.5%	14.1	8.6	B
	Through	199	188	94.5%	26.0	12.8	C
	Right Turn	130	132	101.3%	27.6	14.9	C
	Subtotal	375	369	98.4%	25.1	12.9	C
SB	Left Turn	156	140	90.0%	21.3	6.0	C
	Through	162	162	100.1%	15.5	4.0	B
	Right Turn	41	34	83.1%	10.2	2.5	B
	Subtotal	359	337	93.8%	17.5	2.0	B
EB	Left Turn	53	49	93.1%	16.1	6.7	B
	Through	161	149	92.7%	26.2	22.6	C
	Right Turn	79	77	97.9%	18.8	19.9	B
	Subtotal	293	276	94.2%	22.3	18.2	C
WB	Left Turn	321	290	90.5%	28.5	5.6	C
	Through	156	145	92.9%	22.6	5.0	C
	Right Turn	74	72	97.9%	16.3	5.1	B
	Subtotal	551	508	92.2%	25.0	4.1	C
Total		1,578	1,489	94.4%	22.6	6.2	C

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	42	99.6%	2.0	0.8	A
	Through	549	502	91.4%	1.3	0.6	A
	Right Turn	162	140	86.6%	1.9	0.5	A
	Subtotal	753	684	90.8%	1.5	0.5	A
SB	Left Turn	21	22	103.9%	4.7	3.4	A
	Through	344	334	97.2%	3.0	1.3	A
	Right Turn	62	68	109.2%	1.2	0.1	A
	Subtotal	427	424	99.3%	2.8	1.1	A
EB	Left Turn	52	50	97.0%	14.0	3.7	B
	Through	3	2	78.8%	6.4	6.8	A
	Right Turn	51	50	98.0%	11.3	3.6	B
	Subtotal	106	103	97.0%	12.8	2.5	B
WB	Left Turn	48	50	104.2%	13.7	4.8	B
	Through	4	4	90.9%	7.0	7.8	A
	Right Turn	67	67	100.0%	1.9	0.7	A
	Subtotal	119	121	101.4%	6.9	2.4	A
Total		1,405	1,331	94.7%	3.3	0.8	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Volume and Delay by Movement **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	87	58	67.0%	60.7	16.8	F
	Through	324	295	90.9%	22.2	7.5	C
	Right Turn	256	238	92.9%	18.7	8.2	C
	Subtotal	667	591	88.6%	25.0	8.6	C
SB	Left Turn	330	179	54.2%	355.1	78.1	F
	Through	209	123	58.9%	376.4	61.4	F
	Right Turn						
	Subtotal	539	302	56.0%	364.2	70.7	F
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	279	182	65.1%	93.6	20.0	F
	Through						
	Right Turn	309	196	63.4%	50.0	14.1	E
	Subtotal	588	378	64.2%	69.0	15.2	F
Total		1,794	1,270	70.8%	109.1	17.5	F

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	4	1	2	6	27	7	17	39	NO
	Through	2,000	144	13	122	159	635	38	579	688	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	23	10	11	39	95	13	73	118	NO
	Through	3,700	113	9	103	130	543	41	483	607	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	53	3	49	58	169	10	153	184	NO
	Through	2,000	34	4	25	40	158	15	142	185	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	97	12	87	123	256	52	213	389	NO
	Through	2,000	71	6	63	80	301	34	240	367	NO
	Right Turn	80	1	1	0	3	30	13	21	65	NO
	Second Right										

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	45	12	29	67	141	16	111	166	NO
	Through	2,000	159	17	133	186	533	44	458	584	NO
	Right Turn	160	15	6	8	25	122	39	84	189	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	144	83	50	339	363	134	233	679	MAX
	Through	2,000	211	81	148	418	657	122	480	850	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	94	30	51	147	438	36	388	501	MAX
	Through	400	94	30	51	147	438	36	388	501	MAX
	Right Turn	100	89	31	46	144	439	36	389	502	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	424	45	344	476	518	2	516	522	AVG
	Through	300	446	4	437	451	484	2	482	487	AVG
	Right Turn	75	434	4	425	439	472	2	470	476	AVG
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	204	304	39	848	409	420	131	1,339	MAX
	Through	2,000	1,379	156	1,111	1,599	1,942	60	1,840	2,000	NO
	Right Turn	400	18	3	15	27	121	13	97	142	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	381	146	220	653	935	23	892	964	AVG
	Through	2,000	441	71	348	576	943	13	910	956	NO
	Right Turn	300	36	21	16	86	456	103	346	593	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	76	20	48	110	322	85	176	466	MAX
	Through	600	247	74	144	429	571	27	525	604	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	16	4	9	23	72	33	40	167	NO
	Through	1,000	250	38	197	316	550	13	513	561	NO
	Right Turn	600	248	38	195	314	548	13	511	559	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	346	214	108	792	735	188	434	1,048	AVG
	Through	2,000	379	198	140	745	779	161	514	1,026	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	45	9	33	60	207	24	168	244	MAX
	Through	800	61	5	54	72	274	5	264	282	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	29	4	23	39	138	19	107	174	NO
	Through	1,250	245	162	122	655	669	199	479	994	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	43	5	36	50	221	27	190	272	MAX
	Through	350	42	4	35	47	263	34	221	334	NO
	Right Turn	300	44	4	37	49	271	34	229	342	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	20	4	15	28	122	26	88	165	NO
	Through	1,500	29	3	23	33	145	25	114	198	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	28	3	25	36	127	18	102	158	MAX
	Through	100	28	3	25	36	127	18	102	158	MAX
	Right Turn	100	28	3	25	37	128	17	104	160	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	45	6	38	59	192	15	173	217	NO
	Through	2,000	163	243	73	896	703	342	527	1,712	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	3	19	5	11	27	NO
	Through	1,250	73	5	67	81	302	17	273	335	NO
	Right Turn										
	Second Right										

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	16	2	13	20	158	9	139	170	MAX
	Through	25	16	2	13	20	158	9	139	170	MAX
	Right Turn	25	16	2	13	20	158	9	139	170	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	27	7	15	36	NO
	Through	350	0	0	0	1	44	7	37	55	NO
	Right Turn	350	0	0	0	1	44	7	37	55	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	1	2	6	0	21	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	1	54	17	29	85	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	2	66	11	44	79	NO
	Through	400	1	0	1	2	66	4	61	74	NO
	Right Turn	400	3	1	2	5	62	7	52	72	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	6	1	5	8	85	14	66	108	NO
	Through	400	6	1	5	8	85	14	67	109	NO
	Right Turn	400	3	1	2	5	79	15	61	103	NO
	Second Right										

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Queue Length **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	0	7	8	83	9	70	102	NO
	Through										
	Right Turn	400	8	0	7	8	84	9	71	103	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	5	3	16	68	12	51	90	NO
	Through										
	Right Turn	400	9	4	4	17	67	12	51	89	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	2	1	1	5	58	23	31	119	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	2	0	2	3	46	6	40	55	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	12	13	6	52	102	32	72	182	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	3	1	2	6	57	9	44	70	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	52	38	24	159	414	79	277	557	MAX

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right										
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right										
WB	U Turn Second Left Left Turn Through Right Turn Second Right										

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Queue Length **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft)				Maximum Queue (ft)				Exceeds Storage?
			Average	Std. Dev.	Minimum	Maximum	Average	Std. Dev.	Minimum	Maximum	
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 NB
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	15.9	B	15.5	B	47.4	D	41.7	D	20.8	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.1	A	1.0	A					1.6	A
3	SR 9/SR 204	Signal	31.7	C	29.5	C	35.6	D	131.1	F	41.0	D
4	SR 9/Market Pl	Signal	28.7	C	31.6	C	113.1	F	38.4	D	39.4	D
5	91st Ave/SR 204	Signal	29.6	C	34.3	C	25.1	C	14.7	B	21.9	C
6	Lundeen Pkwy/Market Pl/SR 204	Signal	23.7	C	14.4	B	10.0	B	15.7	B	12.3	B
7	Vernon Rd/7th Pl	Side-street Stop					0.4	A	7.9	A	7.8	A
8	91st Ave/Vernon Rd	Side-street Stop	0.7	A	0.5	A	5.9	A	8.0	A	10.2	B
9	Safeway Dwy/Davies Rd	Roundabout	2.1	A	2.0	A	1.0	A	1.4	A	1.4	A
10	SR 9/4th St On-Ramp	Side-street Stop			1.7	A			0.5	A	2.1	A
11	Transit Center Dwy/4th St	Side-street Stop	6.7	A	6.3	A	0.4	A	0.3	A	9.7	A
12	Transit Center Dwy/Market Pl	Side-street Stop			5.8	A	0.7	A	0.7	A	5.9	A
13	91st Ave/Market Pl	Signal	46.0	D	19.6	B	29.3	C	15.5	B	17.4	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.6	A	1.3	A	9.1	A	7.4	A	9.6	A
15	Vernon Rd/Davies Rd	Roundabout	1.6	A	3.2	A			1.7	A	2.1	A

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Volume and Delay by Movement **AM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	5	1	27.3%	13.3	29.9	B
	Through	1,337	1,327	99.3%	18.2	3.5	B
	Right Turn	427	430	100.8%	9.6	2.4	A
	Subtotal	1,769	1,759	99.4%	16.1	2.5	B
SB	Left Turn	6	6	95.5%	35.5	31.1	D
	Through	1,102	1,097	99.5%	16.5	1.8	B
	Right Turn	74	76	103.2%	3.8	1.1	A
	Subtotal	1,182	1,179	99.7%	15.8	1.6	B
EB	Left Turn	73	69	95.1%	49.3	6.2	D
	Through	97	100	103.0%	48.7	7.8	D
	Right Turn	6	4	74.2%	6.6	4.7	A
	Subtotal	176	174	98.8%	48.0	5.4	D
WB	Left Turn	474	472	99.6%	46.0	5.0	D
	Through	96	99	102.9%	36.4	6.6	D
	Right Turn	38	38	101.2%	7.3	1.5	A
	Subtotal	608	609	100.2%	41.7	3.7	D
Total		3,735	3,721	99.6%	21.8	1.1	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,769	1,769	100.0%	1.1	0.1	A
	Right Turn						
	Subtotal	1,769	1,769	100.0%	1.1	0.1	A
SB	Left Turn						
	Through	1,478	1,470	99.5%	0.9	0.4	A
	Right Turn	105	104	98.7%	1.8	0.9	A
	Subtotal	1,583	1,574	99.4%	1.0	0.4	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,352	3,343	99.7%	1.0	0.2	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 NB**
Volume and Delay by Movement **AM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	61	58	95.7%	70.2	16.6	E
	Through	830	833	100.3%	33.1	1.8	C
	Right Turn	167	158	94.5%	8.3	0.7	A
	Subtotal	1,058	1,049	99.1%	31.5	2.6	C
SB	Left Turn	112	112	100.2%	67.2	13.6	E
	Through	942	939	99.7%	36.8	3.3	D
	Right Turn	423	430	101.7%	3.2	0.9	A
	Subtotal	1,477	1,482	100.3%	29.7	3.0	C
EB	Left Turn	871	858	98.5%	33.5	4.3	C
	Through	156	141	90.2%	48.6	6.1	D
	Right Turn	67	65	97.4%	40.8	5.6	D
	Subtotal	1,094	1,064	97.2%	36.0	4.0	D
WB	Left Turn	209	203	97.0%	164.5	82.9	F
	Through	150	140	93.5%	83.6	31.7	F
	Right Turn	69	66	95.9%	95.0	30.5	F
	Subtotal	428	409	95.6%	130.3	54.9	F
Total		4,057	4,003	98.7%	42.3	5.6	D

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	43	43	99.6%	111.8	76.3	F
	Through	626	618	98.7%	23.4	5.2	C
	Right Turn	19	25	130.6%	18.7	3.9	B
	Subtotal	688	686	99.7%	29.2	7.4	C
SB	Left Turn	124	120	96.7%	105.7	32.9	F
	Through	842	828	98.4%	25.5	12.5	C
	Right Turn	253	249	98.5%	18.2	6.2	B
	Subtotal	1,219	1,197	98.2%	32.2	12.5	C
EB	Left Turn	174	166	95.5%	174.6	126.8	F
	Through	82	80	97.0%	88.6	67.8	F
	Right Turn	117	118	100.9%	39.1	12.7	D
	Subtotal	373	364	97.5%	112.1	75.3	F
WB	Left Turn	63	63	100.7%	35.6	7.9	D
	Through	160	157	98.3%	41.9	3.9	D
	Right Turn	61	62	102.4%	32.0	7.8	C
	Subtotal	284	283	99.7%	38.3	3.8	D
Total		2,564	2,530	98.7%	44.0	11.7	D

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	12	0	2.3%	11.3	35.8	B
	Through	48	53	110.2%	51.1	12.4	D
	Right Turn	85	87	102.8%	21.1	8.3	C
	Subtotal	145	141	96.9%	31.4	9.8	C
SB	Left Turn	118	109	92.5%	45.3	8.9	D
	Through	162	163	100.5%	32.1	5.4	C
	Right Turn	82	80	98.0%	22.4	4.0	C
	Subtotal	362	352	97.3%	33.6	5.2	C
EB	Left Turn	14	12	87.7%	55.6	15.1	E
	Through	887	884	99.6%	25.8	2.4	C
	Right Turn	50	0	0.0%	0.0	0.0	A
	Subtotal	951	896	94.2%	26.3	2.4	C
WB	Left Turn	60	52	87.3%	48.0	11.5	D
	Through	541	547	101.2%	12.5	2.2	B
	Right Turn	34	30	88.8%	9.5	5.3	A
	Subtotal	635	630	99.2%	14.9	2.4	B
Total		2,093	2,019	96.5%	24.4	1.8	C

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	91	88	96.8%	26.3	5.0	C
	Through	59	58	98.9%	21.1	7.0	C
	Right Turn	5	4	87.3%	7.7	6.0	A
	Subtotal	155	151	97.3%	23.6	4.5	C
SB	Left Turn	15	11	71.5%	22.0	9.1	C
	Through	122	122	100.4%	22.5	2.1	C
	Right Turn	219	218	99.4%	9.5	2.0	A
	Subtotal	356	351	98.5%	14.5	1.2	B
EB	Left Turn	64	62	97.6%	30.4	9.0	C
	Through	881	880	99.8%	8.6	1.2	A
	Right Turn	49	51	103.3%	8.0	2.7	A
	Subtotal	994	993	99.9%	9.8	1.3	A
WB	Left Turn	7	8	114.3%	26.8	17.2	C
	Through	603	606	100.5%	15.7	3.9	B
	Right Turn	13	11	81.1%	4.6	4.8	A
	Subtotal	623	624	100.2%	15.8	3.7	B
Total		2,128	2,119	99.6%	13.4	1.5	B

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	206	185	89.9%	0.9	0.1	A
	Through	173	172	99.5%	0.1	0.0	A
	Right Turn	55	53	97.2%	0.1	0.1	A
	Subtotal	434	411	94.7%	0.4	0.1	A
WB	Left Turn						
	Through						
	Right Turn	32	29	90.9%	7.8	1.0	A
	Subtotal	32	29	90.9%	7.8	1.0	A
Total		466	440	94.4%	1.0	0.1	A

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	19	18	95.7%	0.9	0.5	A
	Through	24	19	81.1%	0.4	0.3	A
	Second Right						
	Subtotal	49	45	92.8%	0.8	0.4	A
SB	Left Turn						
	Through	88	86	97.5%	0.5	0.5	A
	Second Right						
	Subtotal	93	91	97.8%	0.5	0.4	A
EB	Left Turn	6	6	104.5%	5.2	4.2	A
	Through	3	3	106.1%	7.4	7.2	A
	Second Right						
	Subtotal	42	39	93.9%	6.4	1.1	A
WB	Left Turn	88	86	98.0%	8.4	1.5	A
	Through	18	17	92.9%	9.8	0.8	A
	Second Right						
	Subtotal	130	129	98.9%	7.9	0.8	A
Total		314	304	97.0%	4.6	0.5	A

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	71	68	95.6%	2.1	0.6	A
	Through	7	7	101.3%	1.7	1.2	A
	Right Turn	10	11	111.8%	1.5	0.8	A
	Subtotal	88	86	97.9%	2.0	0.5	A
SB	Left Turn	1	1	90.9%	0.0	0.0	A
	Through	6	6	106.1%	0.9	1.0	A
	Right Turn	55	55	99.8%	2.0	0.4	A
	Subtotal	62	62	100.3%	1.9	0.4	A
EB	Left Turn	37	35	93.4%	0.7	0.4	A
	Through	44	43	98.3%	0.9	0.3	A
	Right Turn	62	58	93.1%	1.1	0.5	A
	Subtotal	143	136	94.8%	0.9	0.3	A
WB	Left Turn	17	18	104.3%	1.8	1.6	A
	Through	78	76	97.0%	1.4	0.5	A
	Right Turn	1	2	181.8%	0.2	0.3	A
	Subtotal	96	95	99.1%	1.5	0.3	A
Total		389	379	97.5%	1.5	0.1	A

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	38	39	103.3%	0.5	0.4	A
	Through						
	Right Turn	72	70	97.2%	2.4	0.9	A
	Subtotal	110	109	99.3%	1.7	0.6	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through	126	122	96.9%	0.5	0.1	A
	Right Turn	9	8	92.9%	0.1	0.1	A
	Subtotal	135	130	96.6%	0.5	0.1	A
Total		245	240	97.8%	1.0	0.3	A

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	17	15	88.2%	5.5	0.5	A
	Through	9	6	71.7%	5.4	2.4	A
	Right Turn	1	10	1000.0%	9.4	0.4	A
	Subtotal	27	31	116.5%	7.0	0.6	A
SB	Left Turn	15	16	109.7%	6.6	0.8	A
	Through	15	14	90.3%	6.4	1.2	A
	Right Turn	9	7	81.8%	5.2	2.2	A
	Subtotal	39	37	95.8%	6.5	0.7	A
EB	Left Turn	3	4	118.2%	0.8	1.3	A
	Through	30	31	104.8%	0.3	0.3	A
	Right Turn	11	9	83.5%	0.3	0.3	A
	Subtotal	44	44	100.4%	0.4	0.4	A
WB	Left Turn	2	1	54.5%	0.0	0.1	A
	Through	68	65	95.7%	0.3	0.2	A
	Right Turn	20	23	115.0%	0.5	0.2	A
	Subtotal	90	89	99.1%	0.3	0.2	A
Total		200	202	101.1%	2.7	0.3	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	2	3	168.2%	6.5	3.6	A
	Through						
	Right Turn	32	28	87.5%	5.7	0.5	A
	Subtotal	34	31	92.2%	6.0	1.0	A
EB	Left Turn	31	37	119.6%	2.6	2.7	A
	Through	193	187	96.9%	0.3	0.1	A
	Right Turn						
	Subtotal	224	224	100.1%	0.7	0.5	A
WB	Left Turn						
	Through	251	253	100.8%	0.7	0.3	A
	Right Turn	8	8	104.5%	0.8	0.3	A
	Subtotal	259	261	100.9%	0.7	0.3	A
Total		517	517	100.0%	1.1	0.4	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	20	23	114.1%	29.5	58.0	C
	Through	72	66	91.9%	45.6	63.0	D
	Right Turn	145	144	99.4%	46.9	65.7	D
	Subtotal	237	233	98.4%	44.6	63.3	D
SB	Left Turn	61	56	92.1%	24.7	28.0	C
	Through	62	63	101.0%	7.1	1.9	A
	Right Turn	5	4	74.5%	3.9	3.0	A
	Subtotal	128	123	95.7%	15.1	12.3	B
EB	Left Turn	8	8	105.7%	3.5	5.7	A
	Through	100	98	97.6%	34.7	48.5	C
	Right Turn	55	56	102.0%	24.0	34.2	C
	Subtotal	163	162	99.5%	29.5	41.6	C
WB	Left Turn	172	173	100.8%	17.8	15.9	B
	Through	95	89	93.8%	14.5	9.1	B
	Right Turn	41	39	94.7%	11.1	7.6	B
	Subtotal	308	301	97.8%	15.7	11.6	B
Total		836	819	98.0%	27.4	33.7	C

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	20	19	96.4%	1.3	0.6	A
	Through	99	94	95.0%	0.2	0.1	A
	Right Turn	17	18	105.9%	0.9	0.3	A
	Subtotal	136	131	96.6%	0.5	0.2	A
SB	Left Turn	8	8	101.1%	1.5	1.2	A
	Through	231	227	98.4%	1.4	0.3	A
	Right Turn	23	24	105.9%	0.8	0.2	A
	Subtotal	262	260	99.1%	1.3	0.3	A
EB	Left Turn	42	44	103.7%	9.7	2.1	A
	Through	11	11	100.8%	8.1	4.4	A
	Right Turn	71	68	95.4%	8.7	1.1	A
	Subtotal	124	122	98.7%	9.1	1.2	A
WB	Left Turn	53	56	105.1%	8.8	3.4	A
	Through	1	0	36.4%	0.5	1.6	A
	Right Turn	11	12	105.8%	1.3	1.1	A
	Subtotal	65	68	104.2%	7.3	3.1	A
Total		587	581	99.0%	3.5	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 NB**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	28	25	87.7%	2.0	0.9	A
	Through	100	94	93.5%	1.7	0.6	A
	Right Turn	98	88	90.1%	1.3	0.5	A
	Subtotal	226	206	91.3%	1.6	0.4	A
SB	Left Turn	85	83	98.1%	3.1	1.1	A
	Through	193	186	96.4%	3.1	0.7	A
	Right Turn						
	Subtotal	278	269	96.9%	3.1	0.7	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	134	179	133.7%	1.8	0.3	A
	Through						
	Right Turn	91	89	98.1%	1.7	0.5	A
	Subtotal	225	268	119.3%	1.7	0.4	A
Total		729	744	102.1%	2.2	0.3	A

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	1	1	0	2	10	4	5	17	NO
	Through	2,000	63	7	51	72	376	26	320	406	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	3	2	1	7	22	8	11	36	NO
	Through	3,700	50	3	44	56	307	25	258	341	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	15	2	12	18	66	8	53	77	NO
	Through	2,000	25	4	19	32	116	12	99	129	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	68	3	65	76	215	16	194	243	NO
	Through	2,000	18	2	15	21	128	10	112	144	NO
	Right Turn	80	0	0	0	1	31	3	27	38	NO
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	23	6	15	38	96	16	73	132	NO
	Through	2,000	95	5	88	103	400	17	366	422	NO
	Right Turn	160	3	1	2	4	61	9	48	78	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	47	11	33	71	156	25	129	222	NO
	Through	2,000	112	7	101	121	392	23	357	424	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	66	5	57	73	350	26	317	398	NO
	Through	400	66	5	57	73	350	26	317	398	NO
	Right Turn	100	56	6	49	67	350	28	316	400	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	200	74	111	310	419	47	352	500	MAX
	Through	300	158	71	75	260	384	50	287	466	MAX
	Right Turn	75	150	72	63	254	371	50	274	452	AVG
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	32	17	14	58	87	19	60	115	NO
	Through	2,000	78	9	67	101	475	48	387	566	NO
	Right Turn	400	2	1	2	4	47	11	28	70	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	83	56	26	208	278	148	155	577	MAX
	Through	2,000	102	68	10	268	499	104	230	597	NO
	Right Turn	300	3	1	2	5	100	17	78	126	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	195	115	63	426	388	92	237	525	AVG
	Through	600	43	15	28	71	236	76	152	379	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	11	2	8	14	72	10	61	96	NO
	Through	1,000	48	4	39	53	228	17	204	258	NO
	Right Turn	600	46	4	37	51	227	17	203	257	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	1	3	7	0	22	NO
	Through	2,000	24	4	19	32	150	41	109	252	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	29	3	23	33	143	34	95	190	NO
	Through	800	44	3	39	50	251	18	215	271	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	4	2	1	7	33	9	16	52	NO
	Through	1,250	33	5	26	41	229	19	194	253	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	13	2	10	16	92	12	77	113	NO
	Through	350	19	2	17	22	192	21	161	226	NO
	Right Turn	300	19	2	17	22	200	21	168	234	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	10	1	8	12	89	6	75	96	NO
	Through	1,500	6	1	3	8	59	11	43	83	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	16	1	13	18	104	13	91	127	MAX
	Through	100	16	1	13	18	104	13	91	127	MAX
	Right Turn	100	16	1	14	19	107	13	93	129	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	7	1	4	8	47	7	37	57	NO
	Through	2,000	19	2	17	22	178	23	146	213	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	0	0	2	29	6	21	39	NO
	Through	1,250	18	3	13	22	194	19	166	220	NO
	Right Turn										
	Second Right										

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	3	1	2	4	111	12	90	124	MAX
	Through	25	3	1	2	4	111	12	90	124	MAX
	Right Turn	25	3	1	2	4	111	12	90	124	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	12	8	7	29	NO
	Through	350	0	0	0	0	3	6	0	14	NO
	Right Turn	350	0	0	0	0	3	6	0	14	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	0	24	13	14	49	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	1	29	7	16	44	NO
	Through	400	1	0	0	1	53	11	29	70	NO
	Right Turn	400	1	0	1	1	33	8	27	56	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	4	1	3	5	77	17	60	111	NO
	Through	400	4	1	3	5	77	17	60	111	NO
	Right Turn	400	2	1	1	3	64	17	49	96	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	39	4	32	46	NO
	Through										
	Right Turn	400	1	0	1	1	40	4	33	47	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	32	3	28	39	NO
	Through										
	Right Turn	400	1	0	1	1	31	3	27	38	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	0	0	0	1	27	10	15	39	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	0	0	0	1	33	6	28	45	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	3	3	1	10	43	13	25	72	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	1	16	7	5	27	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	8	5	4	19	111	28	81	172	NO
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 No Build
PM Peak Hour

	Intersection	Control	Northbound		Southbound		Eastbound		Westbound		Overall Average Hour	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	30.0	C	41.7	D	41.8	D	45.8	D	31.4	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.0	A	0.8	A					1.0	A
3	SR 9/SR 204	Signal	36.4	D	51.4	D	48.2	D	264.2	F	64.2	E
4	SR 9/Market Pl	Signal	110.3	F	38.1	D	77.7	E	80.2	F	53.4	D
5	91st Ave/SR 204	Signal	53.7	D	45.7	D	76.3	E	26.6	C	41.0	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	37.4	D	28.0	C	19.1	B	61.1	E	21.7	C
7	Vernon Rd/7th Pl	Side-street Stop			40.1	E	1.4	A	14.6	B	31.7	D
8	91st Ave/Vernon Rd	Side-street Stop	0.9	A	2.1	A	8.4	A	9.9	A	13.8	B
9	Safeway Dwy/Davies Rd	Roundabout	85.2	F	251.3	F	5.0	A	243.1	F	44.8	E
10	SR 9/4th St On-Ramp	Side-street Stop			1.4	A			0.4	A	1.8	A
11	Transit Center Dwy/4th St	Side-street Stop	11.9	B	9.1	A	0.4	A	0.4	A	18.2	C
12	Transit Center Dwy/Market Pl	Side-street Stop			10.4	B	6.2	A	3.2	A	10.1	B
13	91st Ave/Market Pl	Signal	15.9	B	16.2	B	14.3	B	20.6	C	14.8	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	7.0	A	1.6	A	6.4	A	0.8	A	9.6	A
15	Vernon Rd/Davies Rd	Roundabout	15.5	C	290.0	F			33.9	D	56.1	F

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 No Build**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	13	167.0%	63.2	9.2	E
	Through	1,573	1,256	79.9%	26.7	5.8	C
	Right Turn	486	405	83.4%	39.3	11.0	D
	Subtotal	2,067	1,675	81.0%	31.6	6.6	C
SB	Left Turn	30	36	119.1%	343.3	52.2	F
	Through	1,057	909	86.0%	20.6	4.4	C
	Right Turn	92	112	121.3%	10.6	2.8	B
	Subtotal	1,179	1,057	89.6%	41.9	5.8	D
EB	Left Turn	225	244	108.5%	45.4	5.3	D
	Through	99	82	82.9%	49.3	39.4	D
	Right Turn	11	8	76.9%	1.1	3.4	A
	Subtotal	335	335	99.9%	45.9	4.8	D
WB	Left Turn	284	325	114.5%	51.0	9.0	D
	Through	145	113	77.9%	50.3	35.3	D
	Right Turn	44	31	70.9%	6.2	10.1	A
	Subtotal	473	469	99.2%	50.9	8.8	D
Total		4,054	3,536	87.2%	40.8	3.7	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,067	1,658	80.2%	1.1	0.1	A
	Right Turn						
	Subtotal	2,067	1,658	80.2%	1.1	0.1	A
SB	Left Turn						
	Through	1,223	1,147	93.8%	0.8	0.2	A
	Right Turn	129	104	80.8%	1.0	0.3	A
	Subtotal	1,352	1,251	92.5%	0.8	0.2	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,419	2,910	85.1%	1.0	0.1	A

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	95	107	112.8%	57.4	11.3	E
	Through	874	680	77.8%	38.2	2.8	D
	Right Turn	242	214	88.6%	15.6	3.4	B
	Subtotal	1,211	1,001	82.7%	35.5	3.0	D
SB	Left Turn	154	168	109.1%	93.4	34.3	F
	Through	696	582	83.6%	43.0	4.2	D
	Right Turn	373	390	104.4%	3.6	0.4	A
	Subtotal	1,223	1,139	93.2%	36.0	6.5	D
EB	Left Turn	1,037	846	81.6%	63.8	15.9	E
	Through	653	537	82.2%	60.8	20.7	E
	Right Turn	54	47	86.2%	61.0	16.8	E
	Subtotal	1,744	1,429	81.9%	62.6	17.6	E
WB	Left Turn	146	111	76.2%	237.8	28.9	F
	Through	164	122	74.4%	378.9	42.6	F
	Right Turn	157	111	70.6%	387.8	38.9	F
	Subtotal	467	344	73.7%	337.1	42.3	F
Total		4,645	3,914	84.3%	69.8	7.2	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	99	78	78.4%	110.1	29.8	F
	Through	728	557	76.6%	61.7	24.3	E
	Right Turn	59	219	370.6%	116.5	32.0	F
	Subtotal	886	854	96.3%	111.1	27.5	F
SB	Left Turn	106	104	98.4%	90.4	20.8	F
	Through	586	465	79.3%	29.6	17.1	C
	Right Turn	206	188	91.1%	11.4	6.5	B
	Subtotal	898	756	84.2%	38.8	14.0	D
EB	Left Turn	196	185	94.3%	81.9	29.8	F
	Through	292	232	79.4%	86.1	27.6	F
	Right Turn	87	71	81.7%	53.0	32.7	D
	Subtotal	575	488	84.8%	79.4	26.6	E
WB	Left Turn	67	48	71.6%	74.4	39.6	E
	Through	245	189	77.1%	103.9	17.6	F
	Right Turn	103	84	81.1%	73.4	38.2	E
	Subtotal	415	321	77.2%	92.5	20.7	F
Total		2,774	2,418	87.2%	84.5	15.9	F

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	21	42.1%	57.3	14.2	E
	Through	123	93	75.5%	54.3	20.4	D
	Right Turn	340	259	76.1%	43.5	13.9	D
	Subtotal	512	372	72.7%	53.3	12.4	D
SB	Left Turn	132	119	90.5%	53.1	11.5	D
	Through	223	170	76.4%	41.7	21.2	D
	Right Turn	56	42	74.8%	28.1	30.6	C
	Subtotal	411	332	80.7%	51.6	10.8	D
EB	Left Turn	76	116	152.0%	126.8	14.7	F
	Through	1,272	1,043	82.0%	39.9	4.8	D
	Right Turn	161	8	4.7%	15.5	6.2	B
	Subtotal	1,509	1,166	77.2%	76.0	4.7	E
WB	Left Turn	164	154	93.6%	72.7	9.5	E
	Through	402	354	88.0%	13.6	2.5	B
	Right Turn	66	114	173.4%	7.7	1.5	A
	Subtotal	632	622	98.4%	26.6	3.4	C
Total		3,064	2,491	81.3%	49.9	2.7	D

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	95	111	117.1%	40.5	8.7	D
	Through	130	103	79.6%	31.1	15.2	C
	Right Turn	7	5	75.3%	3.9	12.2	A
	Subtotal	232	220	94.8%	39.7	8.4	D
SB	Left Turn	35	36	102.1%	26.9	8.5	C
	Through	99	79	79.3%	47.3	15.4	D
	Right Turn	267	204	76.5%	14.5	6.7	B
	Subtotal	401	319	79.4%	27.9	4.6	C
EB	Left Turn	475	587	123.6%	29.2	2.5	C
	Through	1,467	1,114	75.9%	12.1	2.2	B
	Right Turn	258	332	128.8%	9.0	1.4	A
	Subtotal	2,200	2,033	92.4%	19.2	1.8	B
WB	Left Turn	2	16	777.3%	215.9	33.1	F
	Through	463	335	72.5%	38.1	17.8	D
	Right Turn	42	51	120.6%	19.4	5.1	B
	Subtotal	507	402	79.2%	62.5	12.2	E
Total		3,340	2,973	89.0%	26.4	1.6	C

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn	467	3,536	757.1%	40.8	3.7	E
	Subtotal	467	3,536	757.1%	40.8	3.7	E
EB	Left Turn	412	338	82.0%	1.3	1.3	A
	Through	546	445	81.6%	0.2	0.0	A
	Right Turn	91	136	149.0%	0.4	0.1	A
	Subtotal	1,049	919	87.6%	0.6	0.2	A
WB	Left Turn						
	Through						
	Right Turn	152	149	98.0%	9.6	1.0	A
	Subtotal	152	149	98.0%	9.6	1.0	A
Total		1,668	4,604	276.0%	31.3	2.9	D

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	54	41	76.8%	1.3	0.4	A
	Through	99	76	76.4%	0.6	0.3	A
	Second Right						
	Subtotal	171	269	157.6%	0.9	0.2	A
SB	Left Turn						
	Through	120	91	75.8%	2.0	3.1	A
	Second Right						
	Subtotal	133	132	99.2%	2.0	2.9	A
EB	Left Turn	16	13	82.4%	9.1	3.4	A
	Through	7	6	88.3%	5.9	3.5	A
	Second Right						
	Subtotal	94	74	78.2%	8.6	2.6	A
WB	Left Turn	89	69	77.2%	10.1	2.0	B
	Through	35	28	80.5%	14.2	2.2	B
	Second Right						
	Subtotal	174	151	86.9%	9.7	1.1	A
Total		572	626	109.5%	5.3	1.5	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2021 No Build**
Volume and Delay by Movement **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	291	191	65.5%	99.3	40.9	F
	Through	37	24	65.6%	60.8	23.2	F
	Right Turn	87	197	227.0%	58.4	29.5	F
	Subtotal	415	412	99.4%	86.0	35.6	F
SB	Left Turn	7	5	68.8%	193.6	215.1	F
	Through	12	8	62.9%	260.6	177.8	F
	Right Turn	81	87	106.8%	282.9	205.6	F
	Subtotal	100	99	98.9%	282.8	195.8	F
EB	Left Turn	77	54	69.8%	10.7	3.1	B
	Through	131	100	76.7%	5.5	3.6	A
	Right Turn	171	139	81.0%	3.0	2.0	A
	Subtotal	379	293	77.2%	5.0	2.5	A
WB	Left Turn	36	27	75.8%	255.4	227.1	F
	Through	109	81	74.1%	257.5	229.8	F
	Right Turn	5	41	816.4%	141.4	175.6	F
	Subtotal	150	149	99.3%	257.3	228.8	F
Total		1,044	953	91.3%	84.3	46.7	F

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	65	50	76.2%	0.8	0.4	A
	Through						
	Right Turn	67	60	90.0%	2.0	0.6	A
	Subtotal	132	110	83.2%	1.4	0.3	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through	117	105	89.7%	0.5	0.1	A
	Right Turn	33	23	68.3%	0.1	0.1	A
	Subtotal	150	128	85.0%	0.4	0.1	A
Total		282	237	84.2%	0.9	0.2	A

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	19	15	78.0%	17.8	3.1	C
	Through	7	16	222.1%	6.2	0.6	A
	Right Turn	4	10	261.4%	11.2	10.0	B
	Subtotal	30	41	136.1%	8.0	0.8	A
SB	Left Turn	123	92	75.0%	2.9	3.1	A
	Through	20	15	76.8%	1.5	4.9	A
	Right Turn	15	50	334.5%	6.9	0.4	A
	Subtotal	158	158	99.9%	6.9	0.4	A
EB	Left Turn	6	8	130.3%	0.2	0.2	A
	Through	79	59	74.9%	0.1	0.2	A
	Right Turn	13	10	74.8%	0.1	0.2	A
	Subtotal	98	77	78.3%	0.2	0.2	A
WB	Left Turn	3	2	78.8%	0.0	0.0	A
	Through	80	57	71.6%	0.0	0.0	A
	Right Turn	54	42	78.1%	0.1	0.2	A
	Subtotal	137	102	74.3%	0.1	0.2	A
Total		423	377	89.2%	4.9	1.2	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	11	10	87.6%	0.2	0.4	A
	Through						
	Right Turn	53	39	72.7%	21.3	30.1	C
	Subtotal	64	48	75.3%	21.3	30.1	C
EB	Left Turn	33	217	658.7%	7.0	0.8	A
	Through	424	335	79.1%	0.4	0.1	A
	Right Turn						
	Subtotal	457	553	120.9%	6.1	0.6	A
WB	Left Turn						
	Through	361	276	76.6%	18.5	19.3	C
	Right Turn	5	39	778.2%	0.9	0.6	A
	Subtotal	366	315	86.1%	3.5	3.6	A
Total		887	916	103.3%	5.8	0.6	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	116	290.2%	9.6	1.5	A
	Through	187	140	74.7%	17.4	4.8	B
	Right Turn	124	99	79.5%	16.1	4.8	B
	Subtotal	351	354	101.0%	16.1	4.2	B
SB	Left Turn	151	213	141.1%	19.3	6.3	B
	Through	157	124	78.9%	15.9	3.5	B
	Right Turn	35	26	73.0%	11.3	3.3	B
	Subtotal	343	362	105.6%	16.8	4.0	B
EB	Left Turn	47	35	73.5%	13.1	4.8	B
	Through	131	103	78.3%	18.2	7.5	B
	Right Turn	75	62	82.2%	9.2	2.5	A
	Subtotal	253	199	78.6%	14.4	4.8	B
WB	Left Turn	203	167	82.4%	23.3	4.6	C
	Through	136	105	77.1%	20.4	6.1	C
	Right Turn	70	54	77.8%	15.9	6.0	B
	Subtotal	409	327	79.9%	21.0	4.1	C
Total		1,356	1,242	91.6%	17.3	3.3	B

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	29	133	459.9%	9.1	1.4	A
	Through	506	390	77.1%	1.2	0.8	A
	Right Turn	113	213	188.4%	6.1	0.6	A
	Subtotal	648	736	113.6%	7.1	0.7	A
SB	Left Turn	21	44	208.2%	2.9	0.7	A
	Through	322	240	74.4%	1.3	0.6	A
	Right Turn	29	86	295.9%	1.0	0.1	A
	Subtotal	372	369	99.3%	1.6	0.2	A
EB	Left Turn	18	31	172.7%	6.7	8.0	A
	Through	2	2	81.8%	1.5	4.8	A
	Right Turn	34	42	123.5%	6.8	0.8	A
	Subtotal	54	75	138.4%	7.1	1.1	A
WB	Left Turn	46	37	81.4%	2.3	3.9	A
	Through	1	0	18.2%	0.0	0.0	A
	Right Turn	60	82	137.4%	0.9	0.2	A
	Subtotal	107	120	112.2%	1.0	0.2	A
Total		1,181	1,300	110.1%	5.3	0.5	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2021 No Build**
Volume and Delay by Movement **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	295	229	77.5%	22.1	13.7	C
	Right Turn	194	171	88.4%	7.6	5.1	A
	Subtotal	489	400	81.8%	12.8	8.2	B
SB	Left Turn	234	171	72.9%	287.9	95.0	F
	Through	95	68	71.6%	293.5	105.1	F
	Right Turn						
	Subtotal	329	239	72.5%	289.6	97.3	F
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	251	170	67.8%	62.7	13.7	F
	Through						
	Right Turn	271	200	73.9%	17.8	5.0	C
	Subtotal	522	371	71.0%	32.9	5.0	D
Total		1,340	1,009	75.3%	90.4	34.7	F

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	5	2	3	8	33	7	17	45	NO
	Through	2,000	100	6	91	109	570	53	515	695	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	106	9	94	125	168	14	153	196	NO
	Through	3,700	54	5	44	63	338	34	310	412	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	47	2	44	51	148	11	136	174	NO
	Through	2,000	22	3	16	26	123	16	110	155	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	62	4	54	68	207	16	181	234	NO
	Through	2,000	30	5	21	39	157	31	123	238	NO
	Right Turn	80	1	0	0	1	21	6	10	31	NO
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	31	3	27	36	124	13	106	149	NO
	Through	2,000	89	7	80	101	411	50	344	515	NO
	Right Turn	160	9	4	5	18	96	15	79	129	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	140	32	106	208	300	27	265	350	NO
	Through	2,000	81	6	71	91	361	24	323	396	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	70	15	52	109	452	26	404	500	MAX
	Through	400	70	15	52	109	452	26	404	500	MAX
	Right Turn	100	66	16	49	106	454	26	405	501	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	227	103	70	395	492	49	375	520	MAX
	Through	300	371	32	293	401	480	6	464	486	AVG
	Right Turn	75	362	30	296	390	468	6	452	474	AVG
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	36	11	26	66	152	80	89	383	NO
	Through	2,000	235	122	148	572	790	161	625	1,183	NO
	Right Turn	400	207	60	134	360	522	71	366	614	MAX
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	57	13	39	77	334	70	259	475	MAX
	Through	2,000	111	8	101	127	597	59	485	685	NO
	Right Turn	300	8	2	5	13	139	21	113	181	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	73	28	44	140	375	76	281	545	MAX
	Through	600	127	40	76	188	458	67	344	545	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	9	2	6	12	62	9	48	75	NO
	Through	1,000	108	16	80	139	458	55	387	534	NO
	Right Turn	600	106	16	79	137	456	55	385	532	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	7	2	4	10	31	7	22	45	NO
	Through	2,000	90	17	69	115	362	44	291	430	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	37	5	30	46	192	23	156	229	NO
	Through	800	37	4	32	46	232	20	201	272	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	70	8	53	79	173	11	154	187	NO
	Through	1,250	95	15	78	122	386	52	296	496	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	63	12	38	82	240	36	198	314	MAX
	Through	350	32	9	23	55	227	39	176	303	NO
	Right Turn	300	34	10	24	57	234	39	183	311	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	32	6	25	43	163	29	125	226	NO
	Through	1,500	17	3	12	23	119	20	87	155	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	18	2	15	22	90	10	77	106	NO
	Through	100	18	2	15	22	90	10	77	106	NO
	Right Turn	100	18	2	14	22	91	10	79	108	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	46	2	44	49	218	18	188	250	NO
	Through	2,000	56	10	44	80	398	52	333	511	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	37	2	33	40	89	7	77	98	NO
	Through	1,250	44	4	38	52	214	13	192	241	NO
	Right Turn										
	Second Right										

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	10	3	7	16	144	15	121	171	MAX
	Through	25	10	3	7	16	144	15	121	171	MAX
	Right Turn	25	10	3	7	16	144	15	121	171	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	29	12	15	47	NO
	Through	350	0	0	0	0	51	8	31	62	NO
	Right Turn	350	0	0	0	0	51	8	31	62	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	1	51	14	29	67	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	1	0	0	1	38	13	25	69	NO
	Through	400	1	0	1	2	53	10	44	69	NO
	Right Turn	400	2	0	1	3	47	8	38	65	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	5	1	4	8	97	13	74	115	NO
	Through	400	5	1	4	8	97	13	74	115	NO
	Right Turn	400	4	1	3	6	96	12	77	111	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	7	1	7	9	79	6	67	89	NO
	Through										
	Right Turn	400	7	0	7	9	80	6	68	90	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	2	1	1	3	43	8	30	60	NO
	Through										
	Right Turn	400	2	1	1	3	43	8	29	59	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	6	1	4	7	100	16	83	131	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	5	1	4	7	86	13	66	110	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	11	3	8	20	107	22	90	157	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	1	1	1	3	37	13	26	68	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	14	3	10	19	174	38	125	233	MAX
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 NB
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	21.2	C	21.7	C	49.6	D	43.5	D	24.0	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.9	A	0.8	A					1.3	A
3	SR 9/SR 204	Signal	25.9	C	22.8	C	54.9	D	49.2	D	29.8	C
4	SR 9/Market Pl	Signal	23.0	C	26.9	C	32.3	C	36.2	D	25.5	C
5	91st Ave/SR 204	Signal	17.6	B	16.9	B	29.0	C	19.1	B	18.9	B
6	Lundeen Pkwy/Market Pl/SR 204	Signal	21.7	C	12.4	B	13.0	B	18.0	B	13.6	B
7	Vernon Rd/7th Pl	Side-street Stop					0.4	A	7.7	A	7.5	A
8	91st Ave/Vernon Rd	Side-street Stop	0.8	A	0.3	A	5.7	A	7.1	A	9.8	A
9	Safeway Dwy/Davies Rd	Roundabout	1.5	A	1.7	A	0.8	A	1.0	A	1.0	A
10	SR 9/4th St On-Ramp	Side-street Stop			1.7	A			0.5	A	1.9	A
11	Transit Center Dwy/4th St	Side-street Stop	2.9	A	6.8	A	0.2	A	0.3	A	6.8	A
12	Transit Center Dwy/Market Pl	Side-street Stop			5.4	A	0.7	A	0.5	A	5.7	A
13	91st Ave/Market Pl	Signal	8.1	A	8.0	A	6.8	A	9.8	A	7.8	A
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.5	A	1.7	A	8.6	A	6.4	A	8.1	A
15	Vernon Rd/Davies Rd	Roundabout	1.2	A	2.2	A			1.5	A	1.4	A

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 NB**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	5	3	50.9%	71.4	37.6	E
	Through	1,047	1,042	99.6%	24.3	3.0	C
	Right Turn	260	261	100.2%	8.7	1.9	A
	Subtotal	1,312	1,306	99.5%	21.2	2.5	C
SB	Left Turn	6	7	118.2%	57.8	49.0	E
	Through	911	906	99.4%	22.4	3.0	C
	Right Turn	52	53	102.6%	4.3	1.0	A
	Subtotal	969	966	99.7%	21.7	3.0	C
EB	Left Turn	53	51	96.4%	58.4	6.8	E
	Through	93	95	102.2%	45.2	5.5	D
	Right Turn	6	5	86.4%	7.4	5.9	A
	Subtotal	152	151	99.5%	48.7	3.9	D
WB	Left Turn	438	438	99.9%	48.5	4.5	D
	Through	89	91	102.3%	36.6	9.8	D
	Right Turn	38	39	102.9%	10.5	3.6	B
	Subtotal	565	568	100.5%	43.5	4.1	D
Total		2,998	2,991	99.8%	27.2	1.4	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,311	1,310	99.9%	0.9	0.1	A
	Right Turn						
	Subtotal	1,311	1,310	99.9%	0.9	0.1	A
SB	Left Turn						
	Through	1,298	1,289	99.3%	0.7	0.2	A
	Right Turn	57	59	103.0%	1.5	1.0	A
	Subtotal	1,355	1,348	99.5%	0.8	0.2	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		2,666	2,658	99.7%	0.9	0.1	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2021 NB**
Volume and Delay by Movement **AM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	57	52	90.6%	56.9	10.5	E
	Through	738	733	99.3%	27.8	5.3	C
	Right Turn	135	128	94.8%	8.0	1.3	A
	Subtotal	930	913	98.1%	26.2	4.4	C
SB	Left Turn	104	105	100.6%	54.8	7.5	D
	Through	814	805	98.8%	27.9	5.0	C
	Right Turn	381	384	100.7%	3.8	1.2	A
	Subtotal	1,299	1,293	99.5%	22.6	3.0	C
EB	Left Turn	505	506	100.2%	56.6	5.4	E
	Through	130	110	84.9%	47.9	8.6	D
	Right Turn	32	28	87.2%	33.4	6.0	C
	Subtotal	667	644	96.6%	54.4	5.4	D
WB	Left Turn	105	98	93.2%	51.7	8.3	D
	Through	126	119	94.7%	49.3	3.5	D
	Right Turn	67	65	97.0%	43.9	7.9	D
	Subtotal	298	282	94.7%	48.4	2.7	D
Total		3,194	3,132	98.1%	33.8	2.1	C

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	28	27	95.5%	59.4	14.1	E
	Through	606	599	98.8%	21.7	2.6	C
	Right Turn	18	26	142.4%	15.7	7.3	B
	Subtotal	652	651	99.8%	23.0	2.2	C
SB	Left Turn	47	45	94.8%	72.7	21.2	E
	Through	740	726	98.1%	26.9	7.7	C
	Right Turn	163	159	97.8%	16.6	5.2	B
	Subtotal	950	930	97.9%	27.1	6.7	C
EB	Left Turn	118	112	95.1%	31.2	5.5	C
	Through	70	69	99.0%	38.8	10.5	D
	Right Turn	106	109	102.6%	26.7	6.3	C
	Subtotal	294	290	98.7%	31.9	4.9	C
WB	Left Turn	61	65	106.0%	30.6	8.9	C
	Through	124	124	100.2%	41.3	4.7	D
	Right Turn	23	26	111.9%	27.4	6.6	C
	Subtotal	208	215	103.2%	36.7	3.1	D
Total		2,104	2,086	99.1%	27.5	2.7	C

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	12	0	0.0%	0.0	0.0	A
	Through	54	51	95.1%	28.0	8.0	C
	Right Turn	86	82	95.9%	13.8	4.5	B
	Subtotal	152	134	88.0%	19.4	5.9	B
SB	Left Turn	89	70	78.3%	24.7	6.7	C
	Through	133	137	103.0%	15.7	3.2	B
	Right Turn	58	58	100.5%	9.8	3.8	A
	Subtotal	280	265	94.6%	16.9	3.4	B
EB	Left Turn	18	14	77.3%	31.0	12.4	C
	Through	492	490	99.7%	30.1	5.3	C
	Right Turn	38	0	0.0%	0.0	0.0	A
	Subtotal	548	504	92.0%	30.1	5.3	C
WB	Left Turn	76	68	90.0%	30.6	6.4	C
	Through	455	458	100.6%	17.8	4.6	B
	Right Turn	33	28	84.8%	14.7	7.8	B
	Subtotal	564	554	98.2%	19.1	4.6	B
Total		1,544	1,457	94.4%	23.2	3.2	C

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	73	74	101.0%	23.2	5.2	C
	Through	52	49	94.9%	20.2	8.3	C
	Right Turn	4	2	52.3%	8.0	11.8	A
	Subtotal	129	125	97.0%	21.9	6.0	C
SB	Left Turn	15	11	70.3%	20.3	13.9	C
	Through	100	101	101.2%	20.5	3.9	C
	Right Turn	219	218	99.6%	9.0	1.4	A
	Subtotal	334	330	98.8%	12.5	1.4	B
EB	Left Turn	64	66	102.8%	35.4	4.3	D
	Through	529	492	93.1%	10.6	1.5	B
	Right Turn	39	38	96.5%	9.1	2.1	A
	Subtotal	632	596	94.3%	13.0	1.2	B
WB	Left Turn	5	4	83.6%	26.1	30.0	C
	Through	511	505	98.8%	17.8	4.5	B
	Right Turn	9	7	77.8%	3.1	3.1	A
	Subtotal	525	516	98.3%	17.8	4.3	B
Total		1,620	1,567	96.7%	14.8	1.4	B

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	148	133	89.7%	0.9	0.1	A
	Through	177	166	93.9%	0.1	0.0	A
	Right Turn	44	43	98.1%	0.0	0.0	A
	Subtotal	369	342	92.7%	0.4	0.1	A
WB	Left Turn						
	Through						
	Right Turn	30	29	97.0%	7.7	0.8	A
	Subtotal	30	29	97.0%	7.7	0.8	A
Total		399	371	93.0%	1.2	0.2	A

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	19	17	87.1%	0.7	0.3	A
	Through	25	21	84.7%	0.2	0.2	A
	Second Right						
	Subtotal	50	45	90.9%	0.5	0.2	A
SB	Left Turn						
	Through	77	76	98.7%	0.3	0.2	A
	Second Right						
	Subtotal	82	82	99.9%	0.4	0.2	A
EB	Left Turn	3	3	115.2%	4.1	2.9	A
	Through	2	2	109.1%	3.9	2.8	A
	Second Right						
	Subtotal	38	36	93.5%	6.0	0.4	A
WB	Left Turn	28	28	98.7%	6.7	0.7	A
	Through	18	19	103.0%	9.2	3.4	A
	Second Right						
	Subtotal	70	72	102.2%	7.3	1.3	A
Total		240	234	97.7%	3.4	0.5	A

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	50	46	92.9%	1.5	0.3	A
	Through	7	7	102.6%	1.6	1.2	A
	Right Turn	9	11	126.3%	1.5	0.9	A
	Subtotal	66	65	98.5%	1.5	0.3	A
SB	Left Turn	1	1	90.9%	0.4	0.9	A
	Through	6	6	106.1%	1.3	1.0	A
	Right Turn	35	34	96.6%	1.8	0.5	A
	Subtotal	42	41	97.8%	1.8	0.4	A
EB	Left Turn	53	47	88.3%	0.8	0.2	A
	Through	42	40	96.3%	0.8	0.2	A
	Right Turn	54	52	97.1%	0.8	0.3	A
	Subtotal	149	140	93.8%	0.8	0.1	A
WB	Left Turn	16	15	94.9%	0.6	0.3	A
	Through	54	53	97.6%	1.1	0.4	A
	Right Turn	1	1	136.4%	0.2	0.3	A
	Subtotal	71	69	97.6%	1.0	0.4	A
Total		328	315	96.1%	1.2	0.1	A

Intersection 10 **SR 9/4th St On-Ramp** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	33	31	94.8%	0.6	0.8	A
	Through						
	Right Turn	69	65	94.7%	2.0	0.6	A
	Subtotal	102	97	94.7%	1.6	0.6	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through	114	110	96.3%	0.5	0.1	A
	Right Turn	7	7	94.8%	0.0	0.0	A
	Subtotal	121	116	96.2%	0.5	0.1	A
Total		223	213	95.6%	1.0	0.3	A

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	3	2	81.8%	1.7	2.7	A
	Through	4	2	61.4%	2.7	2.8	A
	Right Turn						
	Subtotal	7	5	70.1%	4.3	2.3	A
SB	Left Turn	15	18	117.6%	6.8	0.7	A
	Through	14	12	87.0%	7.5	1.3	A
	Right Turn	8	7	93.2%	6.2	1.6	A
	Subtotal	37	37	100.7%	6.8	0.4	A
EB	Left Turn	2	2	109.1%	0.3	0.5	A
	Through	29	28	96.9%	0.2	0.2	A
	Right Turn	9	7	78.8%	0.2	0.2	A
	Subtotal	40	37	93.4%	0.2	0.2	A
WB	Left Turn	2	1	50.0%	0.0	0.1	A
	Through	65	62	95.1%	0.2	0.2	A
	Right Turn	20	23	115.5%	0.4	0.0	A
	Subtotal	87	86	98.7%	0.2	0.1	A
Total		171	165	96.8%	1.9	0.2	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	2	0	0.0%	0.1	0.2	A
	Through						
	Right Turn	27	25	93.9%	6.0	1.0	A
	Subtotal	29	25	87.5%	6.0	1.0	A
EB	Left Turn	15	24	162.4%	2.9	2.2	A
	Through	119	115	96.9%	0.4	0.1	A
	Right Turn						
	Subtotal	134	140	104.3%	0.8	0.3	A
WB	Left Turn						
	Through	181	189	104.2%	0.5	0.2	A
	Right Turn	4	4	90.9%	0.6	0.4	A
	Subtotal	185	192	103.9%	0.5	0.2	A
Total		348	357	102.7%	1.0	0.2	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	18	22	121.7%	7.4	3.5	A
	Through	74	69	92.6%	7.8	2.3	A
	Right Turn	94	94	99.5%	8.4	1.9	A
	Subtotal	186	184	98.9%	8.1	1.2	A
SB	Left Turn	55	52	95.4%	8.3	1.1	A
	Through	58	61	105.3%	7.7	2.0	A
	Right Turn	3	2	81.8%	3.5	2.3	A
	Subtotal	116	116	100.0%	7.9	1.2	A
EB	Left Turn	4	4	111.4%	3.9	3.8	A
	Through	88	74	84.3%	7.4	2.5	A
	Right Turn	53	55	103.1%	6.3	2.8	A
	Subtotal	145	133	91.9%	6.9	1.9	A
WB	Left Turn	117	121	103.0%	10.2	1.6	B
	Through	72	69	95.8%	10.0	2.6	B
	Right Turn	37	35	95.3%	7.7	2.4	A
	Subtotal	226	225	99.5%	9.7	1.4	A
Total		673	658	97.8%	8.3	0.7	A

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	14	10	70.8%	1.2	1.7	A
	Through	95	99	104.1%	0.4	0.2	A
	Right Turn	17	13	78.1%	0.9	0.5	A
	Subtotal	126	122	96.9%	0.5	0.2	A
SB	Left Turn	7	7	101.3%	2.6	1.7	A
	Through	229	225	98.5%	1.7	0.5	A
	Right Turn	10	12	122.7%	1.1	0.3	A
	Subtotal	246	245	99.5%	1.7	0.4	A
EB	Left Turn	27	28	102.4%	9.3	1.8	A
	Through	8	9	109.1%	8.1	2.5	A
	Right Turn	63	60	95.7%	7.9	1.2	A
	Subtotal	98	97	98.6%	8.5	0.8	A
WB	Left Turn	42	44	105.6%	8.0	2.0	A
	Through	1	0	36.4%	1.3	2.7	A
	Right Turn	11	11	100.0%	1.1	0.9	A
	Subtotal	54	56	103.2%	6.6	2.0	A
Total		524	519	99.1%	3.1	0.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 NB**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	32	24	76.4%	0.9	0.4	A
	Through	60	54	90.8%	1.3	0.8	A
	Right Turn	84	76	90.2%	1.3	0.5	A
	Subtotal	176	155	87.9%	1.2	0.5	A
SB	Left Turn	69	67	97.4%	2.3	0.7	A
	Through	104	97	93.7%	2.1	0.7	A
	Right Turn						
	Subtotal	173	165	95.2%	2.2	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	150	142	94.6%	1.6	0.3	A
	Through						
	Right Turn	40	40	99.1%	1.3	0.4	A
	Subtotal	190	182	95.6%	1.5	0.2	A
Total		539	501	92.9%	1.6	0.2	A

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	1	0	0	2	14	4	5	20	NO
	Through	2,000	63	6	53	71	419	46	370	497	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	3	2	1	5	33	8	21	42	NO
	Through	3,700	53	5	45	60	321	21	283	357	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	13	2	11	17	57	6	44	67	NO
	Through	2,000	21	2	18	26	119	15	94	145	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	66	5	60	73	232	24	195	286	NO
	Through	2,000	15	3	11	20	93	18	61	121	NO
	Right Turn	80	1	0	0	1	24	3	20	28	NO
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	14	2	9	16	87	9	75	103	NO
	Through	2,000	55	2	52	58	283	20	247	317	NO
	Right Turn	160	2	0	1	2	56	8	45	73	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	28	4	23	34	165	22	126	203	NO
	Through	2,000	58	7	49	69	347	25	311	380	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	64	6	56	76	272	17	240	294	NO
	Through	400	64	6	56	76	272	17	240	294	NO
	Right Turn	100	50	6	40	62	268	16	238	289	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	25	2	22	29	124	18	96	161	NO
	Through	300	32	4	26	38	184	20	162	222	NO
	Right Turn	75	25	4	16	29	172	20	142	209	MAX
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	8	2	5	11	58	12	42	81	NO
	Through	2,000	80	7	66	89	525	66	440	694	NO
	Right Turn	400	3	2	1	5	47	14	29	73	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	16	3	12	22	88	14	66	109	NO
	Through	2,000	113	25	65	157	633	39	570	682	NO
	Right Turn	300	3	1	2	6	95	26	65	154	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	16	2	13	18	105	11	87	122	MAX
	Through	600	23	3	17	27	154	15	133	189	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	9	2	7	13	58	9	44	72	NO
	Through	1,000	30	3	24	35	156	17	118	179	NO
	Right Turn	600	26	4	20	32	155	17	117	178	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	0	0	0	0	0	NO
	Through	2,000	9	2	6	14	85	16	62	114	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	8	2	5	11	67	8	54	80	NO
	Through	800	11	1	10	14	100	9	92	114	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	2	1	1	3	25	7	15	38	NO
	Through	1,250	23	2	21	27	164	20	138	187	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	9	2	6	11	91	13	66	109	NO
	Through	350	22	3	16	28	179	26	153	235	NO
	Right Turn	300	22	3	17	28	186	26	160	243	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	7	2	5	11	67	10	54	84	NO
	Through	1,500	4	1	3	6	51	10	37	70	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	11	1	9	13	84	6	76	94	NO
	Through	100	11	1	9	13	84	6	76	94	NO
	Right Turn	100	12	2	9	14	86	6	78	96	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	7	1	5	9	51	6	43	63	NO
	Through	2,000	14	2	11	16	124	10	111	143	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	0	0	1	12	4	6	23	NO
	Through	1,250	19	2	15	22	161	20	137	210	NO
	Right Turn										
	Second Right										

Intersection 7 **Vernon Rd/7th Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	25	2	0	2	3	133	14	106	151	MAX
	Through	25	2	0	2	3	133	14	106	151	MAX
	Right Turn	25	2	0	2	3	133	14	106	151	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	4	4	0	9	NO
	Through	350	0	0	0	0	5	9	0	20	NO
	Right Turn	350	0	0	0	0	5	9	0	20	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	0	8	8	0	15	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	27	5	15	32	NO
	Through	400	0	0	0	0	50	10	28	58	NO
	Right Turn	400	1	0	0	1	34	5	30	45	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	2	0	1	2	52	7	42	63	NO
	Through	400	2	0	1	2	53	7	42	63	NO
	Right Turn	400	1	0	1	1	48	6	39	59	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	39	4	32	46	NO
	Through										
	Right Turn	400	1	0	1	1	40	4	33	47	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	0	1	31	4	25	35	NO
	Through										
	Right Turn	400	1	0	0	1	30	4	25	34	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	0	0	0	1	25	6	15	37	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	1	0	0	1	29	5	22	35	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	1	0	1	2	42	5	34	50	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	0	11	4	5	17	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	3	1	2	4	84	12	70	111	NO
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 PM - Concept E2B Variation 4
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	34.9	C	23.3	C	55.5	E	56.4	E	35.9	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.0	A	1.7	A					1.7	A
3	SR 9/SR 204 (west signal)	Signal			16.8	B	70.4	E	78.9	E	57.8	E
4	SR 9/Market Pl	Signal	38.8	D	46.7	D	89.4	F	71.7	E	48.0	D
5	91st Ave/SR 204	Signal	134.5	F	37.1	D	61.0	E	26.7	C	55.6	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	34.2	C	19.6	B	19.4	B	40.3	D	23.7	C
8	91st Ave/Vernon Rd	Side-street Stop	0.9	A	1.0	A	6.8	A	9.5	A	10.5	B
9	Safeway Dwy/Davies Rd	Roundabout	27.6	D	55.9	F	4.6	A	57.2	F	12.5	D
11	Transit Center Dwy/4th St	Side-street Stop	9.6	A	8.6	A	0.3	A	0.5	A	11.2	B
12	Transit Center Dwy/Market Pl	Side-street Stop			20.5	C	1.0	A	19.9	C	17.0	C
13	91st Ave/Market Pl	Signal	59.0	E	69.0	E	62.1	E	33.2	C	31.6	C
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.1	A	2.2	A	11.0	B	6.8	A	12.9	B
15	Vernon Rd/Davies Rd	Roundabout	29.9	D	280.1	F			42.6	E	60.0	F
16	Parking Lot Connector/7th Place	Side-street Stop	7.5	A	5.6	A	2.2	A	19.0	C	12.6	B
221	SR 9/4th St NE	Side-street Stop	2.7	A					0.8	A	2.4	A
255	SR 9/SR 204 (east signal)	Signal	55.5	E			13.2	B	114.5	F	36.9	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 PM - Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	3	40.9%	52.3	42.1	D
	Through	1,709	1,522	89.1%	30.9	4.0	C
	Right Turn	562	499	88.7%	47.8	11.6	D
	Subtotal	2,279	2,024	88.8%	35.2	5.2	D
SB	Left Turn	31	32	103.5%	89.0	37.8	F
	Through	1,396	1,313	94.0%	21.9	3.2	C
	Right Turn	93	89	95.4%	5.8	1.3	A
	Subtotal	1,520	1,433	94.3%	23.0	5.0	C
EB	Left Turn	240	238	99.3%	59.3	6.4	E
	Through	124	125	100.8%	52.3	8.1	D
	Right Turn	13	10	75.5%	11.0	5.4	B
	Subtotal	377	373	99.0%	55.9	4.7	E
WB	Left Turn	386	366	94.9%	63.8	3.1	E
	Through	232	217	93.5%	51.8	5.4	D
	Right Turn	44	40	91.1%	21.1	10.7	C
	Subtotal	662	623	94.1%	56.8	3.4	E
Total		4,838	4,454	92.1%	36.3	2.9	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,106	968	46.0%	1.0	0.3	A
	Right Turn						
	Subtotal	2,106	968	46.0%	1.0	0.3	A
SB	Left Turn						
	Through	1,665	1,551	93.2%	1.7	0.4	A
	Right Turn	129	124	95.8%	1.6	0.5	A
	Subtotal	1,794	1,675	93.3%	1.7	0.4	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,900	2,643	67.8%	1.4	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 PM - Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	149	133	89.0%	49.8	4.5	D
	Through	2	4	186.4%	51.9	31.9	D
	Right Turn	464	430	92.7%	7.1	2.2	A
	Subtotal	615	566	92.1%	17.8	3.3	B
EB	Left Turn						
	Through	1,712	1,441	84.2%	64.9	13.8	E
	Right Turn	49	42	85.2%	58.3	16.5	E
	Subtotal	1,761	1,483	84.2%	64.7	13.9	E
WB	Left Turn	252	201	79.9%	81.0	10.2	F
	Through	221	185	83.7%	81.1	10.2	F
	Right Turn						
	Subtotal	473	386	81.7%	81.1	10.2	F
Total		2,849	2,435	85.5%	56.8	7.6	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	100	94.3%	142.2	83.4	F
	Through	907	860	94.8%	24.8	9.1	C
	Right Turn	62	72	115.4%	21.3	8.7	C
	Subtotal	1,075	1,031	95.9%	37.1	15.5	D
SB	Left Turn	199	177	88.8%	166.7	100.0	F
	Through	846	775	91.6%	30.3	27.2	C
	Right Turn	308	273	88.6%	18.6	14.6	B
	Subtotal	1,353	1,224	90.5%	48.3	33.9	D
EB	Left Turn	341	185	54.3%	118.6	69.4	F
	Through	317	274	86.6%	88.3	49.0	F
	Right Turn	106	92	86.6%	38.7	18.9	D
	Subtotal	764	552	72.2%	90.2	49.2	F
WB	Left Turn	68	61	89.4%	71.8	46.4	E
	Through	274	254	92.6%	80.2	44.6	F
	Right Turn	116	106	91.2%	54.0	30.4	D
	Subtotal	458	420	91.8%	72.7	41.2	E
Total		3,650	3,228	88.4%	55.3	23.9	E

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	60	123.2%	216.9	129.8	F
	Through	128	111	86.8%	124.5	87.6	F
	Right Turn	342	291	85.2%	112.5	90.1	F
	Subtotal	519	463	89.2%	129.2	95.8	F
SB	Left Turn	88	69	78.8%	46.1	19.6	D
	Through	243	233	95.8%	36.6	19.7	D
	Right Turn	46	43	92.9%	28.0	14.2	C
	Subtotal	377	345	91.5%	37.5	18.0	D
EB	Left Turn	101	93	92.5%	50.2	19.0	D
	Through	1,331	1,126	84.6%	57.6	25.3	E
	Right Turn	161	160	99.4%	55.7	37.3	E
	Subtotal	1,593	1,379	86.6%	56.8	25.5	E
WB	Left Turn	123	109	88.3%	59.6	27.4	E
	Through	487	443	91.0%	20.8	8.0	C
	Right Turn	75	61	81.9%	7.4	4.2	A
	Subtotal	685	613	89.5%	26.8	10.2	C
Total		3,174	2,800	88.2%	60.6	23.5	E

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	99	95.2%	39.2	6.9	D
	Through	148	138	93.5%	36.1	6.4	D
	Right Turn	9	11	123.2%	16.7	14.7	B
	Subtotal	261	248	95.2%	36.4	5.3	D
SB	Left Turn	40	34	83.9%	37.4	14.0	D
	Through	136	124	90.8%	32.1	4.4	C
	Right Turn	288	270	93.6%	12.0	3.1	B
	Subtotal	464	427	92.0%	20.0	3.7	B
EB	Left Turn	527	451	85.5%	30.7	3.4	C
	Through	1,544	1,335	86.5%	14.5	2.4	B
	Right Turn	301	264	87.6%	15.6	3.1	B
	Subtotal	2,372	2,050	86.4%	18.3	2.2	B
WB	Left Turn	4	3	70.5%	33.9	36.9	C
	Through	507	527	104.0%	46.2	7.4	D
	Right Turn	78	17	21.8%	24.0	12.2	C
	Subtotal	589	547	92.9%	43.9	9.8	D
Total		3,686	3,272	88.8%	24.3	2.3	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 PM - Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	51	93.4%	1.3	0.5	A
	Through	108	93	86.4%	0.7	0.2	A
	Second Right						
	Subtotal	191	170	88.9%	1.0	0.2	A
SB	Left Turn	1	0	27.3%	0.0	0.1	A
	Through	118	109	92.0%	1.0	0.9	A
	Second Right						
	Subtotal	139	127	91.5%	1.0	0.8	A
EB	Left Turn	16	15	94.9%	7.1	2.6	A
	Through	7	6	85.7%	5.8	4.1	A
	Second Right						
	Subtotal	135	53	38.9%	7.3	0.6	A
WB	Left Turn	88	81	91.5%	9.8	1.2	A
	Through	38	36	95.7%	11.9	1.5	B
	Second Right						
	Subtotal	176	167	94.7%	9.7	1.2	A
Total		641	516	80.5%	4.5	0.5	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 PM - Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	298	266	89.1%	30.9	30.5	D
	Through	37	34	92.6%	21.5	23.8	C
	Right Turn	89	83	93.1%	19.4	23.4	C
	Subtotal	424	383	90.2%	27.6	28.3	D
SB	Left Turn	9	9	99.0%	72.0	91.6	F
	Through	14	13	90.3%	47.2	57.5	E
	Right Turn	95	85	89.0%	55.7	60.3	F
	Subtotal	118	106	89.9%	55.2	59.6	F
EB	Left Turn	163	120	73.5%	8.1	7.3	A
	Through	204	156	76.4%	3.7	2.1	A
	Right Turn	238	193	81.2%	3.0	1.4	A
	Subtotal	605	469	77.5%	4.5	2.7	A
WB	Left Turn	49	45	90.9%	56.8	88.3	F
	Through	110	99	89.7%	57.8	83.2	F
	Right Turn	6	7	113.6%	32.5	96.3	D
	Subtotal	165	150	90.9%	57.0	84.9	F
Total		1,312	1,108	84.4%	26.6	30.6	D

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	28	26	91.6%	6.3	0.9	A
	Through	12	10	80.3%	7.4	2.0	A
	Right Turn	17	24	139.0%	14.0	2.5	B
	Subtotal	57	59	103.3%	9.7	0.9	A
SB	Left Turn	124	117	94.4%	8.7	1.2	A
	Through	22	20	89.3%	8.2	1.6	A
	Right Turn	17	18	106.4%	8.2	1.6	A
	Subtotal	163	155	95.0%	8.6	0.9	A
EB	Left Turn	8	8	98.9%	0.6	0.5	A
	Through	77	72	93.9%	0.2	0.1	A
	Right Turn	23	23	100.0%	0.2	0.1	A
	Subtotal	108	103	95.5%	0.3	0.2	A
WB	Left Turn	3	0	15.2%	0.0	0.1	A
	Through	90	85	94.3%	0.3	0.3	A
	Right Turn	54	55	101.0%	0.7	0.2	A
	Subtotal	147	140	95.2%	0.5	0.2	A
Total		475	457	96.2%	4.4	0.5	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	16	14	84.7%	7.3	5.4	A
	Through						
	Right Turn	66	58	88.0%	23.0	21.8	C
	Subtotal	82	72	87.4%	21.1	19.3	C
EB	Left Turn	78	83	106.6%	4.2	2.3	A
	Through	500	440	87.9%	0.4	0.1	A
	Right Turn						
	Subtotal	578	523	90.5%	1.0	0.5	A
WB	Left Turn						
	Through	392	364	92.9%	21.6	28.2	C
	Right Turn	7	6	89.6%	7.5	10.9	A
	Subtotal	399	371	92.9%	21.5	28.2	C
Total		1,059	965	91.1%	10.1	12.0	B

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	45	97.4%	34.4	48.6	C
	Through	191	177	92.6%	66.9	77.7	E
	Right Turn	130	120	92.2%	65.8	77.9	E
	Subtotal	367	342	93.1%	61.9	72.7	E
SB	Left Turn	136	126	92.4%	95.2	142.4	F
	Through	157	151	96.0%	59.9	94.3	E
	Right Turn	37	33	88.5%	56.3	93.1	E
	Subtotal	330	309	93.7%	74.8	114.7	E
EB	Left Turn	53	44	83.7%	53.2	101.3	D
	Through	201	170	84.6%	74.5	127.4	E
	Right Turn	79	72	90.6%	60.2	129.0	E
	Subtotal	333	286	85.9%	68.3	123.1	E
WB	Left Turn	326	290	89.0%	36.8	24.8	D
	Through	156	136	87.4%	31.7	28.1	C
	Right Turn	77	69	89.6%	33.0	46.4	C
	Subtotal	559	496	88.7%	34.7	27.7	C
Total		1,589	1,432	90.1%	58.7	71.2	E

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	38	89.4%	2.2	1.6	A
	Through	549	469	85.5%	1.0	0.5	A
	Right Turn	162	100	61.6%	1.0	0.6	A
	Subtotal	753	607	80.6%	1.1	0.5	A
SB	Left Turn	21	22	102.6%	3.6	3.0	A
	Through	344	318	92.3%	1.4	0.7	A
	Right Turn	62	65	105.1%	4.2	9.4	A
	Subtotal	427	404	94.7%	2.6	3.1	A
EB	Left Turn	52	50	96.9%	12.5	5.1	B
	Through	3	1	48.5%	3.4	3.7	A
	Right Turn	51	46	90.6%	9.4	4.9	A
	Subtotal	106	98	92.5%	10.9	4.4	B
WB	Left Turn	68	64	94.4%	11.4	4.4	B
	Through	4	3	75.0%	5.7	5.3	A
	Right Turn	67	64	95.7%	2.5	1.5	A
	Subtotal	139	131	94.4%	7.0	2.8	A
Total		1,425	1,240	87.0%	2.7	0.8	A

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	47	103	218.6%	47.8	16.9	E
	Through	398	271	68.0%	27.0	15.1	D
	Right Turn	262	207	78.8%	24.1	13.7	C
	Subtotal	707	580	82.0%	28.8	15.6	D
SB	Left Turn	369	270	73.2%	278.1	148.3	F
	Through	166	126	76.0%	279.6	147.1	F
	Right Turn						
	Subtotal	535	396	74.1%	279.0	147.7	F
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	154	213	138.1%	49.9	23.6	E
	Through						
	Right Turn	403	275	68.2%	36.0	17.2	E
	Subtotal	557	488	87.5%	41.9	19.8	E
Total		1,799	1,464	81.4%	89.6	39.8	F

Intersection 16 **Parking Lot Connector/7th Place** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	33	30	89.8%	8.2	11.5	A
	Through						
	Right Turn	2	2	95.5%	2.9	4.4	A
	Subtotal	35	32	90.1%	8.3	11.4	A
SB	Left Turn	56	46	82.8%	4.4	1.6	A
	Through	15	13	89.7%	11.0	11.2	B
	Right Turn						
	Subtotal	71	60	84.3%	5.6	3.1	A
EB	Left Turn	10	0	0.9%	1.0	2.0	A
	Through	506	436	86.2%	2.3	4.2	A
	Right Turn	48	33	68.2%	2.0	4.5	A
	Subtotal	564	469	83.1%	2.3	4.3	A
WB	Left Turn	1	0	36.4%	0.8	2.4	A
	Through	150	134	89.2%	21.0	35.8	C
	Right Turn	5	7	130.9%	8.9	3.9	A
	Subtotal	156	141	90.2%	20.3	33.5	C
Total		826	701	84.9%	6.1	6.7	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 PM - Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,206	1,094	90.7%	2.8	5.0	A
	Right Turn	58	51	88.1%	1.0	0.1	A
	Subtotal	1,264	1,145	90.6%	2.7	4.8	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	171	159	92.8%	0.8	0.1	A
	Subtotal	171	159	92.8%	0.8	0.1	A
Total		1,435	1,304	90.9%	2.6	4.6	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	81	69	85.5%	45.5	19.3	D
	Through	2	3	168.2%	45.8	61.0	D
	Right Turn	246	168	68.3%	56.9	30.0	E
	Subtotal	329	241	73.1%	54.2	27.7	D
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,399	1,188	84.9%	9.2	4.5	A
	Through	463	385	83.1%	24.4	11.2	C
	Right Turn						
	Subtotal	1,862	1,573	84.5%	13.0	5.9	B
WB	Left Turn						
	Through	392	317	80.9%	131.8	47.3	F
	Right Turn	178	146	81.8%	76.5	28.1	E
	Subtotal	570	463	81.2%	113.8	40.6	F
Total		2,761	2,276	82.4%	40.3	14.7	D

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	2	1	0	4	20	8	5	30	NO
	Through	2,000	138	34	46	176	688	104	410	774	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	20	10	10	46	98	23	56	128	NO
	Through	3,700	237	445	86	1,579	646	371	492	1,755	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	52	5	41	57	159	11	137	177	NO
	Through	2,000	36	6	27	47	165	13	145	188	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	122	109	81	450	267	75	226	491	NO
	Through	2,000	69	13	33	81	279	50	142	332	NO
	Right Turn	80	1	0	0	1	26	7	10	37	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	173	407	40	1,400	323	283	203	1,172	NO
	Through	2,000	173	407	40	1,400	323	283	203	1,172	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	160	93	72	409	497	31	419	522	MAX
	Right Turn	100	116	102	29	399	487	35	415	518	AVG
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	0	1	0	4	27	17	8	60	NO
	Through	300	0	1	0	4	27	17	8	60	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	158	214	44	788	312	255	159	1,056	MAX
	Through	2,000	144	200	74	747	425	226	325	1,102	NO
	Right Turn	400	10	2	5	13	86	15	62	116	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	184	86	27	317	395	128	136	563	MAX
	Through	2,000	67	49	23	207	371	70	202	435	NO
	Right Turn	300	14	6	4	27	136	34	62	187	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	181	84	90	356	492	69	318	544	AVG
	Through	600	187	73	41	264	491	89	244	546	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	12	5	4	23	79	12	45	91	NO
	Through	1,000	212	69	121	370	482	29	424	509	NO
	Right Turn	600	210	69	119	368	481	29	423	507	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	315	241	25	716	628	212	232	915	AVG
	Through	2,000	435	265	164	949	776	151	547	968	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	37	55	17	201	151	34	118	224	NO
	Through	800	59	17	14	76	258	41	135	273	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	27	7	11	37	130	28	62	161	NO
	Through	1,250	262	244	118	975	641	166	483	922	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	39	10	12	49	232	36	135	269	MAX
	Through	350	40	12	7	55	279	44	178	333	NO
	Right Turn	300	42	12	8	57	286	45	182	341	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	19	5	8	27	108	27	49	151	NO
	Through	1,500	37	32	23	132	174	24	132	228	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	37	30	25	129	125	22	98	158	MAX
	Through	100	37	30	25	129	125	22	98	158	MAX
	Right Turn	100	38	31	25	131	127	22	98	161	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	40	10	13	48	179	37	78	218	NO
	Through	2,000	252	504	77	1,770	707	333	450	1,637	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	2	23	6	12	34	NO
	Through	1,250	64	19	13	87	292	53	149	356	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	28	12	14	48	NO
	Through	350	0	0	0	0	12	13	0	34	NO
	Right Turn	350	0	0	0	0	12	13	0	34	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	41	136	0	450	37	118	0	393	NO
	Through	400	29	95	0	315	27	89	0	294	NO
	Right Turn	400	43	143	0	473	89	117	29	438	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	20	62	0	208	53	58	32	228	NO
	Through	400	1	0	0	2	58	9	31	65	NO
	Right Turn	400	19	59	1	197	55	55	32	220	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	14	27	5	95	107	16	90	135	NO
	Through	400	14	27	5	95	107	16	91	135	NO
	Right Turn	400	12	26	3	91	105	16	85	131	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	21	43	7	151	97	51	72	249	NO
	Through										
	Right Turn	400	21	43	7	152	98	51	73	250	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	11	21	2	73	58	16	45	101	NO
	Through										
	Right Turn	400	11	21	2	73	57	16	44	100	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	2	1	1	3	66	20	31	108	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	2	1	1	3	44	13	22	75	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	21	23	3	73	110	40	51	183	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	2	1	1	5	40	10	16	55	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	51	29	10	107	378	86	166	476	MAX

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	365	110	244	19	844	230	167	152	728	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right	110 110	16 16	37 37	2 2	128 128	128 128	9 9	117 117	143 143	MAX MAX
WB	U Turn Second Left Left Turn Through Right Turn Second Right	285	348	104	51	416	512	82	266	541	AVG

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Concept E2B Variation 4
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	29.3	C	19.5	B	58.7	E	49.1	D	29.1	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.1	A	1.5	A					1.3	A
3	SR 9/SR 204 (west signal)	Signal			31.7	C	63.7	E	61.6	E	48.9	D
4	SR 9/Market Pl	Signal	27.3	C	22.2	C	36.2	D	42.5	D	25.7	C
5	91st Ave/SR 204	Signal	14.1	B	22.5	C	29.1	C	16.3	B	20.9	C
6	Lundeen Pkwy/Market Pl/SR 204	Signal	26.9	C	15.8	B	9.2	A	13.9	B	12.3	B
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.4	A	5.9	A	7.3	A	8.0	A
9	Safeway Dwy/Davies Rd	Roundabout	2.0	A	1.9	A	1.2	A	1.5	A	1.5	A
11	Transit Center Dwy/4th St	Side-street Stop	10.9	B	6.7	A	0.4	A	0.3	A	13.9	B
12	Transit Center Dwy/Market Pl	Side-street Stop			7.4	A	0.8	A	1.5	A	6.8	A
13	91st Ave/Market Pl	Signal	9.0	A	9.1	A	7.9	A	9.9	A	8.9	A
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.3	A	0.6	A	8.9	A	5.7	A	9.2	A
15	Vernon Rd/Davies Rd	Roundabout	2.3	A	2.9	A			1.9	A	2.2	A
16	Parking Lot Connector/7th Place	Side-street Stop	4.5	A	4.3	A	0.7	A	7.9	A	7.9	A
221	SR 9/4th St NE	Side-street Stop	0.9	A					0.8	A	1.0	A
255	SR 9/SR 204 (east signal)	Signal	46.8	D			9.5	A	60.4	E	26.0	C

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	5	5	90.9%	56.3	44.1	E
	Through	1,337	1,325	99.1%	26.0	5.5	C
	Right Turn	427	426	99.7%	39.0	10.1	D
	Subtotal	1,769	1,755	99.2%	29.2	5.1	C
SB	Left Turn	6	6	104.5%	38.2	45.5	D
	Through	1,102	1,099	99.7%	20.5	1.7	C
	Right Turn	74	76	103.2%	4.3	1.2	A
	Subtotal	1,182	1,182	100.0%	19.6	1.6	B
EB	Left Turn	73	69	94.5%	62.9	9.8	E
	Through	97	98	101.5%	58.3	9.0	E
	Right Turn	6	6	95.5%	9.1	5.3	A
	Subtotal	176	173	98.4%	58.6	6.3	E
WB	Left Turn	474	470	99.1%	53.8	4.2	D
	Through	96	98	102.4%	40.0	8.8	D
	Right Turn	38	39	101.4%	10.6	4.2	B
	Subtotal	608	607	99.8%	48.7	3.5	D
Total		3,735	3,717	99.5%	30.8	2.8	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,769	800	45.2%	1.1	0.3	A
	Right Turn						
	Subtotal	1,769	800	45.2%	1.1	0.3	A
SB	Left Turn						
	Through	1,527	1,517	99.3%	1.5	0.5	A
	Right Turn	56	58	102.8%	1.0	0.5	A
	Subtotal	1,583	1,574	99.4%	1.5	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,352	2,374	70.8%	1.4	0.4	A

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	107	106	99.3%	64.5	9.5	E
	Through						
	Right Turn	472	475	100.6%	25.2	7.0	C
	Subtotal	579	581	100.4%	31.9	6.7	C
EB	Left Turn						
	Through	1,077	995	92.4%	65.4	6.2	E
	Right Turn	73	71	96.6%	35.7	5.6	D
	Subtotal	1,150	1,066	92.7%	63.5	6.3	E
WB	Left Turn	206	206	100.1%	61.4	15.8	E
	Through	184	175	95.4%	60.9	15.7	E
	Right Turn						
	Subtotal	390	382	97.9%	61.2	15.8	E
Total		2,119	2,029	95.7%	54.4	5.8	D

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	43	45	104.2%	60.9	8.7	E
	Through	627	624	99.5%	25.5	3.0	C
	Right Turn	18	22	121.7%	23.2	15.5	C
	Subtotal	688	690	100.3%	27.5	2.8	C
SB	Left Turn	131	134	102.4%	60.6	10.5	E
	Through	842	829	98.4%	20.2	4.1	C
	Right Turn	253	255	100.9%	7.1	2.1	A
	Subtotal	1,226	1,218	99.3%	22.0	3.4	C
EB	Left Turn	170	168	98.8%	40.0	5.0	D
	Through	77	78	101.9%	42.0	8.9	D
	Right Turn	117	117	100.3%	25.1	4.4	C
	Subtotal	364	364	99.9%	35.9	4.6	D
WB	Left Turn	63	60	95.1%	31.5	6.6	C
	Through	162	160	98.5%	49.9	4.4	D
	Right Turn	64	66	103.4%	35.6	7.6	D
	Subtotal	289	286	98.9%	43.1	4.1	D
Total		2,567	2,558	99.6%	27.8	2.1	C

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	0	0.4%	0.0	0.0	A
	Through	58	54	93.1%	29.3	7.4	C
	Right Turn	89	86	96.1%	12.9	5.2	B
	Subtotal	196	140	71.3%	18.9	6.2	B
SB	Left Turn	108	104	96.0%	33.0	3.5	C
	Through	138	135	97.9%	18.7	4.1	B
	Right Turn	55	53	95.5%	13.7	3.3	B
	Subtotal	301	291	96.8%	22.3	2.7	C
EB	Left Turn	14	13	96.1%	35.4	16.5	D
	Through	953	879	92.2%	34.0	6.1	C
	Right Turn	161	0	0.0%	0.0	0.0	A
	Subtotal	1,128	892	79.1%	34.1	6.1	C
WB	Left Turn	57	53	92.3%	39.4	8.2	D
	Through	565	561	99.2%	14.6	3.0	B
	Right Turn	34	36	106.7%	10.8	6.0	B
	Subtotal	656	650	99.0%	16.2	3.1	B
Total		2,281	1,973	86.5%	25.4	3.2	C

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	91	84	92.0%	30.9	4.6	C
	Through	59	61	102.9%	22.9	2.2	C
	Right Turn	5	6	118.2%	11.8	13.3	B
	Subtotal	155	150	97.0%	26.6	2.9	C
SB	Left Turn	14	13	96.1%	19.5	13.3	B
	Through	132	132	100.1%	23.7	3.3	C
	Right Turn	219	216	98.8%	10.8	2.1	B
	Subtotal	365	362	99.1%	16.0	1.9	B
EB	Left Turn	64	62	97.3%	30.4	8.9	C
	Through	1,109	873	78.7%	7.8	1.0	A
	Right Turn	55	58	105.1%	6.8	1.5	A
	Subtotal	1,228	993	80.9%	9.1	0.9	A
WB	Left Turn	7	8	111.7%	27.6	22.2	C
	Through	652	598	91.7%	14.0	2.0	B
	Right Turn	10	9	91.8%	5.0	3.5	A
	Subtotal	669	615	91.9%	14.1	1.7	B
Total		2,417	2,121	87.7%	13.0	0.8	B

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	19	20	104.8%	0.8	0.2	A
	Through	23	23	98.0%	0.4	0.3	A
	Second Right						
	Subtotal	48	51	106.1%	0.6	0.1	A
SB	Left Turn						
	Through	86	84	97.6%	0.4	0.2	A
	Second Right						
	Subtotal	93	91	97.8%	0.4	0.2	A
EB	Left Turn	6	7	110.6%	6.4	2.8	A
	Through	3	3	90.9%	3.0	3.5	A
	Second Right						
	Subtotal	32	31	97.4%	6.5	0.6	A
WB	Left Turn	38	38	101.0%	7.1	0.9	A
	Through	19	18	94.3%	8.6	1.6	A
	Second Right						
	Subtotal	81	82	101.2%	7.1	0.8	A
Total		254	255	100.4%	3.6	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	70	68	96.9%	2.1	0.7	A
	Through	7	7	94.8%	1.5	1.3	A
	Right Turn	10	10	103.6%	1.3	1.2	A
	Subtotal	87	85	97.5%	2.1	0.6	A
SB	Left Turn	1	2	154.5%	0.0	0.0	A
	Through	6	6	100.0%	0.9	0.8	A
	Right Turn	55	55	99.3%	2.1	0.6	A
	Subtotal	62	62	100.3%	2.0	0.6	A
EB	Left Turn	86	83	96.9%	1.1	0.3	A
	Through	44	43	97.1%	1.4	0.4	A
	Right Turn	71	71	99.4%	1.2	0.4	A
	Subtotal	201	197	97.8%	1.2	0.2	A
WB	Left Turn	31	31	99.4%	1.7	0.8	A
	Through	64	63	98.0%	1.4	0.6	A
	Right Turn	1	2	172.7%	1.4	2.0	A
	Subtotal	96	95	99.2%	1.6	0.4	A
Total		446	439	98.4%	1.6	0.2	A

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	11	11	99.2%	5.6	0.6	A
	Through	6	7	116.7%	10.3	7.1	B
	Right Turn	9	21	230.3%	14.4	3.0	B
	Subtotal	26	39	148.6%	11.3	1.8	B
SB	Left Turn	15	15	101.8%	6.8	1.0	A
	Through	15	14	95.2%	6.9	0.7	A
	Right Turn	9	8	86.9%	5.7	0.9	A
	Subtotal	39	37	95.8%	6.7	0.6	A
EB	Left Turn	5	5	90.9%	1.0	1.4	A
	Through	22	23	103.7%	0.3	0.2	A
	Right Turn	13	12	95.1%	0.3	0.2	A
	Subtotal	40	40	99.3%	0.4	0.3	A
WB	Left Turn	3	3	103.0%	0.2	0.3	A
	Through	68	64	94.1%	0.1	0.1	A
	Right Turn	20	22	109.5%	0.5	0.1	A
	Subtotal	91	89	97.8%	0.2	0.1	A
Total		196	205	104.5%	3.6	0.5	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	5	5	94.5%	4.5	5.3	A
	Through						
	Right Turn	34	31	90.9%	8.6	7.8	A
	Subtotal	39	36	91.4%	8.6	7.8	A
EB	Left Turn	34	46	136.4%	2.7	1.2	A
	Through	193	188	97.4%	0.3	0.1	A
	Right Turn						
	Subtotal	227	234	103.2%	0.8	0.3	A
WB	Left Turn						
	Through	254	254	100.0%	1.5	2.1	A
	Right Turn	6	8	125.8%	1.0	0.5	A
	Subtotal	260	262	100.6%	1.5	2.1	A
Total		526	532	101.1%	1.6	1.3	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	20	23	114.5%	7.1	3.6	A
	Through	72	66	92.0%	9.5	2.5	A
	Right Turn	145	148	102.2%	9.1	1.3	A
	Subtotal	237	237	100.2%	9.1	1.2	A
SB	Left Turn	37	38	103.9%	10.0	2.8	A
	Through	60	58	97.3%	8.8	2.2	A
	Right Turn	5	4	81.8%	4.7	4.7	A
	Subtotal	102	101	98.9%	9.3	1.5	A
EB	Left Turn	8	8	104.5%	3.7	3.5	A
	Through	116	116	100.3%	8.7	2.6	A
	Right Turn	55	54	97.7%	6.2	2.1	A
	Subtotal	179	178	99.7%	7.7	2.1	A
WB	Left Turn	173	176	101.9%	11.4	2.3	B
	Through	95	90	94.8%	8.4	2.4	A
	Right Turn	42	40	95.9%	6.9	2.2	A
	Subtotal	310	307	98.9%	9.9	1.0	A
Total		828	823	99.5%	9.1	0.4	A

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	20	19	94.5%	0.6	0.8	A
	Through	96	93	97.3%	0.2	0.2	A
	Right Turn	17	19	113.9%	0.2	0.3	A
	Subtotal	133	132	99.0%	0.3	0.2	A
SB	Left Turn	8	8	100.0%	1.2	1.1	A
	Through	231	227	98.4%	0.6	0.1	A
	Right Turn	23	24	105.1%	0.8	0.2	A
	Subtotal	262	260	99.1%	0.6	0.1	A
EB	Left Turn	42	43	101.3%	10.0	2.4	B
	Through	11	11	97.5%	9.8	4.2	A
	Right Turn	71	69	97.4%	8.2	1.5	A
	Subtotal	124	122	98.8%	9.0	1.8	A
WB	Left Turn	63	65	103.8%	6.7	0.6	A
	Through	1	1	72.7%	1.1	2.4	A
	Right Turn	14	13	91.6%	1.5	1.1	A
	Subtotal	78	79	101.2%	5.8	0.7	A
Total		597	593	99.3%	3.0	0.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	57	54	94.9%	2.6	1.5	A
	Through	100	99	98.5%	2.5	0.6	A
	Right Turn	97	97	100.0%	2.0	0.9	A
	Subtotal	254	250	98.3%	2.4	0.5	A
SB	Left Turn	93	89	95.9%	3.2	0.8	A
	Through	185	181	97.9%	2.7	0.6	A
	Right Turn						
	Subtotal	278	270	97.2%	2.9	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	171	168	98.2%	2.1	0.5	A
	Through						
	Right Turn	91	86	94.8%	1.5	0.4	A
	Subtotal	262	254	97.0%	1.9	0.4	A
Total		794	774	97.5%	2.4	0.4	A

Intersection 16 **Parking Lot Connector/7th Place** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	33	34	103.6%	4.8	0.8	A
	Through						
	Right Turn	4	3	86.4%	3.2	2.4	A
	Subtotal	37	38	101.7%	4.7	0.7	A
SB	Left Turn	19	18	97.1%	4.0	0.3	A
	Through	5	6	116.4%	4.6	2.3	A
	Right Turn						
	Subtotal	24	24	101.1%	4.4	0.7	A
EB	Left Turn	20	0	0.0%	0.4	0.2	A
	Through	203	149	73.3%	0.7	0.2	A
	Right Turn	22	19	85.1%	0.7	0.6	A
	Subtotal	245	168	68.4%	0.7	0.2	A
WB	Left Turn						
	Through	32	28	88.9%	7.9	0.4	A
	Right Turn						
	Subtotal	32	28	88.9%	7.9	0.4	A
Total		338	258	76.3%	2.5	0.2	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	833	826	99.2%	0.9	0.2	A
	Right Turn	28	29	102.6%	1.1	0.3	A
	Subtotal	861	855	99.3%	0.9	0.2	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	159	152	95.4%	0.8	0.1	A
	Subtotal	159	152	95.4%	0.8	0.1	A
Total		1,020	1,007	98.7%	0.9	0.1	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	45	44	97.4%	53.6	7.4	D
	Through	2	3	150.0%	0.0	0.0	A
	Right Turn	132	105	79.9%	55.0	14.2	E
	Subtotal	179	152	85.1%	54.3	10.9	D
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	992	987	99.5%	6.9	1.3	A
	Through	192	115	59.8%	34.5	4.6	C
	Right Turn						
	Subtotal	1,184	1,102	93.0%	9.8	1.5	A
WB	Left Turn						
	Through	345	337	97.7%	60.3	15.3	E
	Right Turn	84	79	94.2%	56.8	9.0	E
	Subtotal	429	416	97.0%	59.5	13.5	E
Total		1,792	1,670	93.2%	27.4	4.9	C

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	2	1	1	3	20	5	11	28	NO
	Through	2,000	85	10	73	99	498	40	439	562	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	3	2	1	7	22	8	11	34	NO
	Through	3,700	70	4	64	79	384	26	348	421	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	20	3	15	24	68	5	61	78	NO
	Through	2,000	28	3	22	33	125	13	108	146	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	83	3	79	91	262	17	245	304	NO
	Through	2,000	21	2	16	24	117	16	93	140	NO
	Right Turn	80	1	0	0	1	31	3	28	37	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	30	4	24	36	149	19	123	181	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	106	8	91	119	406	27	358	440	MAX
	Right Turn	100	13	5	6	22	295	59	168	378	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	0	1	0	2	34	19	10	80	NO
	Through	300	0	1	0	2	34	19	10	80	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	13	2	9	16	70	8	59	82	NO
	Through	2,000	49	3	43	52	245	30	217	318	NO
	Right Turn	400	3	1	2	4	32	10	22	56	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	46	6	33	54	188	35	134	255	NO
	Through	2,000	51	6	41	58	298	32	239	345	NO
	Right Turn	300	7	2	4	10	119	25	80	165	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	29	6	21	44	236	34	196	297	MAX
	Through	600	27	5	20	39	182	39	126	264	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	9	2	6	11	71	11	57	89	NO
	Through	1,000	54	9	47	79	290	38	247	372	NO
	Right Turn	600	51	9	44	76	289	38	245	370	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	1	1	3	0	11	NO
	Through	2,000	12	3	9	17	108	12	96	132	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	17	2	13	22	99	13	87	121	NO
	Through	800	16	3	11	20	135	18	106	165	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	1	1	4	38	7	24	49	NO
	Through	1,250	54	8	45	65	286	19	261	320	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	10	2	6	12	78	11	61	98	NO
	Through	350	27	3	22	32	182	22	150	212	NO
	Right Turn	300	27	3	22	32	189	22	158	220	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	11	2	8	13	97	15	79	133	NO
	Through	1,500	6	1	5	9	68	11	49	82	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	18	2	14	21	111	17	93	141	MAX
	Through	100	18	2	14	21	111	17	93	141	MAX
	Right Turn	100	19	2	15	22	113	17	95	143	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	7	1	5	8	45	7	33	55	NO
	Through	2,000	18	2	15	21	190	13	166	209	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	2	23	3	16	28	NO
	Through	1,250	16	2	14	20	199	19	172	239	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	5	8	0	23	NO
	Through	350	0	0	0	0	1	3	0	9	NO
	Right Turn	350	0	0	0	0	1	3	0	9	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	0	9	15	0	43	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	30	6	21	40	NO
	Through	400	0	0	0	1	55	9	41	66	NO
	Right Turn	400	1	0	0	1	29	4	26	38	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	2	0	2	3	52	10	41	79	NO
	Through	400	2	0	2	3	52	10	41	79	NO
	Right Turn	400	1	0	1	1	49	10	39	75	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	39	4	32	46	NO
	Through										
	Right Turn	400	1	0	1	1	40	4	33	47	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	32	4	27	42	NO
	Through										
	Right Turn	400	1	0	1	2	32	4	26	41	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	0	0	0	1	37	5	31	46	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	1	0	0	1	20	7	16	39	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	1	0	1	2	34	9	22	50	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	0	0	0	0	17	6	10	27	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	6	1	5	8	104	19	82	143	NO

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	365	15	4	8	24	71	10	48	86	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right	110 110	4 4	1 1	2 2	6 6	121 121	10 10	93 93	131 131	MAX MAX
WB	U Turn Second Left Left Turn Through Right Turn Second Right	285	118	34	83	184	434	54	348	534	MAX

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 Concept E2B Variation 4
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	34.2	C	22.9	C	54.6	D	55.1	E	32.9	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.1	A	1.4	A					1.3	A
3	SR 9/SR 204 (west signal)	Signal			25.7	C	63.3	E	58.6	E	51.2	D
4	SR 9/Market Pl	Signal	31.2	C	23.8	C	58.8	E	46.4	D	33.1	C
5	91st Ave/SR 204	Signal	60.7	E	44.5	D	50.0	D	37.9	D	46.2	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	33.1	C	19.3	B	17.2	B	42.7	D	20.8	C
8	91st Ave/Vernon Rd	Side-street Stop	1.0	A	2.7	A	8.0	A	9.4	A	10.7	B
9	Safeway Dwy/Davies Rd	Roundabout	3.2	A	1.9	A	1.9	A	1.2	A	2.3	A
11	Transit Center Dwy/4th St	Side-street Stop	10.3	B	9.3	A	0.5	A	0.4	A	12.7	B
12	Transit Center Dwy/Market Pl	Side-street Stop			9.0	A	1.1	A	3.1	A	8.5	A
13	91st Ave/Market Pl	Signal	15.3	B	16.3	B	13.8	B	19.6	B	14.5	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.9	A	1.2	A	9.5	A	5.7	A	11.2	B
15	Vernon Rd/Davies Rd	Roundabout	7.0	A	3.1	A			2.9	A	4.6	A
16	Parking Lot Connector/7th Place	Side-street Stop	4.6	A	5.2	A	0.8	A	9.3	A	9.0	A
221	SR 9/4th St NE	Side-street Stop	1.1	A					0.8	A	1.2	A
255	SR 9/SR 204 (east signal)	Signal	75.0	E			29.2	C			32.4	C

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	8	102.3%	74.6	39.9	E
	Through	1,573	1,378	87.6%	31.0	4.3	C
	Right Turn	486	467	96.1%	42.3	6.9	D
	Subtotal	2,067	1,853	89.6%	34.1	4.6	C
SB	Left Turn	30	27	89.1%	85.5	23.6	F
	Through	1,057	1,080	102.1%	22.5	3.1	C
	Right Turn	92	73	79.8%	4.5	1.0	A
	Subtotal	1,179	1,180	100.1%	22.4	2.9	C
EB	Left Turn	225	210	93.3%	58.9	4.2	E
	Through	99	113	114.0%	51.4	7.1	D
	Right Turn	11	9	82.6%	8.2	4.6	A
	Subtotal	335	332	99.1%	55.1	3.0	E
WB	Left Turn	284	278	98.0%	60.9	2.9	E
	Through	145	165	113.6%	50.8	5.1	D
	Right Turn	44	28	64.0%	20.5	9.2	C
	Subtotal	473	471	99.6%	55.1	3.3	E
Total		4,054	3,836	94.6%	35.2	2.5	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,067	889	43.0%	1.1	0.1	A
	Right Turn						
	Subtotal	2,067	889	43.0%	1.1	0.1	A
SB	Left Turn						
	Through	1,223	1,264	103.4%	1.3	0.5	A
	Right Turn	129	101	78.6%	1.2	0.5	A
	Subtotal	1,352	1,366	101.0%	1.3	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,419	2,255	65.9%	1.3	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	148	115	77.5%	60.8	7.3	E
	Through						
	Right Turn	373	343	92.1%	15.6	3.3	B
	Subtotal	521	458	87.9%	25.9	3.0	C
EB	Left Turn						
	Through	1,629	1,443	88.6%	63.6	7.8	E
	Right Turn	59	45	76.3%	50.7	8.8	D
	Subtotal	1,688	1,488	88.1%	63.2	7.7	E
WB	Left Turn	145	144	99.3%	58.7	5.4	E
	Through	200	149	74.5%	58.6	5.2	E
	Right Turn						
	Subtotal	345	293	84.9%	58.7	5.3	E
Total		2,554	2,239	87.7%	55.3	4.8	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	99	89	89.6%	71.6	16.7	E
	Through	732	738	100.8%	26.9	3.7	C
	Right Turn	55	58	106.1%	24.6	5.9	C
	Subtotal	886	885	99.9%	31.2	4.6	C
SB	Left Turn	116	148	127.4%	76.8	27.4	E
	Through	586	627	107.0%	17.4	5.2	B
	Right Turn	206	229	111.2%	7.9	2.2	A
	Subtotal	908	1,004	110.6%	23.7	4.9	C
EB	Left Turn	204	191	93.4%	80.6	21.8	F
	Through	285	276	96.8%	54.6	13.6	D
	Right Turn	87	89	102.7%	35.6	9.3	D
	Subtotal	576	556	96.5%	60.5	14.2	E
WB	Left Turn	67	61	90.8%	45.0	11.7	D
	Through	247	234	94.7%	51.0	7.5	D
	Right Turn	106	107	100.9%	39.6	8.8	D
	Subtotal	420	402	95.6%	46.8	7.2	D
Total		2,790	2,846	102.0%	36.4	3.2	D

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	62	125.6%	121.7	22.6	F
	Through	128	118	92.5%	63.9	29.1	E
	Right Turn	342	285	83.4%	48.1	25.6	D
	Subtotal	519	465	89.6%	61.3	25.1	E
SB	Left Turn	88	73	83.0%	59.5	5.6	E
	Through	243	238	98.0%	41.4	5.8	D
	Right Turn	46	43	94.3%	30.8	10.5	C
	Subtotal	377	355	94.0%	44.5	4.8	D
EB	Left Turn	76	87	114.8%	73.3	7.3	E
	Through	1,258	1,121	89.1%	50.2	4.9	D
	Right Turn	161	162	100.9%	33.7	2.8	C
	Subtotal	1,495	1,371	91.7%	49.7	4.0	D
WB	Left Turn	123	102	83.1%	68.8	10.0	E
	Through	375	345	92.0%	31.0	4.0	C
	Right Turn	75	52	69.3%	33.4	4.3	C
	Subtotal	573	499	87.1%	38.1	2.8	D
Total		2,964	2,690	90.8%	48.6	4.4	D

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	95	89	93.7%	36.5	8.4	D
	Through	128	131	102.3%	31.4	5.0	C
	Right Turn	7	6	90.9%	17.2	9.0	B
	Subtotal	230	226	98.4%	33.2	4.7	C
SB	Left Turn	35	30	84.4%	34.6	8.8	C
	Through	119	116	97.9%	33.7	4.9	C
	Right Turn	267	246	92.2%	10.4	1.9	B
	Subtotal	421	392	93.2%	19.4	2.5	B
EB	Left Turn	475	448	94.3%	27.5	3.4	C
	Through	1,453	1,325	91.2%	14.4	1.6	B
	Right Turn	277	259	93.6%	14.9	2.7	B
	Subtotal	2,205	2,032	92.2%	17.3	1.9	B
WB	Left Turn	2	3	131.8%	40.3	38.4	D
	Through	452	431	95.4%	43.1	7.9	D
	Right Turn	16	15	92.0%	28.8	19.5	C
	Subtotal	470	448	95.4%	42.8	7.5	D
Total		3,326	3,099	93.2%	22.2	1.8	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	56	44	78.4%	1.2	0.4	A
	Through	99	93	93.8%	0.8	0.3	A
	Second Right						
	Subtotal	173	163	94.1%	0.9	0.3	A
SB	Left Turn						
	Through	114	113	98.7%	1.9	2.0	A
	Second Right						
	Subtotal	134	132	98.3%	1.8	1.8	A
EB	Left Turn	16	14	86.4%	6.7	3.8	A
	Through	7	6	80.5%	5.0	3.7	A
	Second Right						
	Subtotal	59	53	89.1%	8.6	1.7	A
WB	Left Turn	86	80	93.2%	11.1	2.4	B
	Through	38	31	81.1%	11.0	1.6	B
	Second Right						
	Subtotal	174	150	86.3%	9.8	1.7	A
Total		540	497	92.1%	4.7	1.1	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	279	0	0.0%	0.1	0.3	A
	Through	37	0	0.0%	0.1	0.3	A
	Right Turn	87	414	476.4%	5.4	0.7	A
	Subtotal	403	414	102.8%	5.4	0.7	A
SB	Left Turn	7	9	123.4%	1.8	1.2	A
	Through	14	12	88.3%	2.7	1.7	A
	Right Turn	79	78	98.7%	1.8	0.4	A
	Subtotal	100	99	99.0%	1.9	0.3	A
EB	Left Turn	115	91	78.7%	1.4	0.5	A
	Through	131	134	102.4%	2.1	0.6	A
	Right Turn	202	185	91.5%	2.1	0.8	A
	Subtotal	448	410	91.4%	1.9	0.6	A
WB	Left Turn	47	43	92.1%	1.2	0.6	A
	Through	98	98	100.5%	1.1	0.4	A
	Right Turn	5	7	140.0%	1.0	1.4	A
	Subtotal	150	149	99.2%	1.2	0.3	A
Total		1,101	1,072	97.3%	3.2	0.3	A

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	13	21	158.0%	6.0	0.8	A
	Through	6	8	137.9%	9.9	7.8	A
	Right Turn	8	21	268.2%	13.9	1.8	B
	Subtotal	27	50	186.2%	10.2	0.9	B
SB	Left Turn	123	119	97.0%	9.6	1.3	A
	Through	20	20	100.0%	8.1	1.8	A
	Right Turn	15	18	121.8%	8.8	1.9	A
	Subtotal	158	158	99.8%	9.4	1.2	A
EB	Left Turn	6	25	413.6%	0.9	0.7	A
	Through	76	41	54.2%	0.4	0.3	A
	Right Turn	17	11	66.8%	0.3	0.3	A
	Subtotal	99	77	78.1%	0.5	0.3	A
WB	Left Turn	3	0	15.2%	0.0	0.0	A
	Through	80	80	100.2%	0.3	0.2	A
	Right Turn	54	53	98.8%	0.6	0.1	A
	Subtotal	137	134	97.8%	0.4	0.1	A
Total		421	419	99.6%	5.0	0.5	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	12	10	82.6%	8.0	2.5	A
	Through						
	Right Turn	55	46	83.6%	8.1	1.2	A
	Subtotal	67	56	83.4%	8.1	1.3	A
EB	Left Turn	31	71	229.3%	4.6	1.7	A
	Through	424	410	96.8%	0.5	0.1	A
	Right Turn						
	Subtotal	455	481	105.8%	1.1	0.3	A
WB	Left Turn						
	Through	364	358	98.4%	2.8	1.3	A
	Right Turn	2	6	277.3%	1.3	1.1	A
	Subtotal	366	364	99.3%	2.8	1.3	A
Total		888	901	101.4%	2.2	0.5	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	47	117.5%	10.6	2.4	B
	Through	187	181	96.8%	15.3	2.9	B
	Right Turn	124	125	101.1%	17.1	3.6	B
	Subtotal	351	353	100.7%	15.3	2.5	B
SB	Left Turn	113	125	110.2%	16.9	4.7	B
	Through	154	155	100.7%	16.9	3.5	B
	Right Turn	35	30	86.8%	10.4	3.6	B
	Subtotal	302	310	102.6%	16.5	2.8	B
EB	Left Turn	47	44	93.6%	11.9	3.0	B
	Through	169	166	98.4%	14.6	2.7	B
	Right Turn	75	70	93.0%	12.0	3.9	B
	Subtotal	291	280	96.3%	13.5	2.3	B
WB	Left Turn	206	248	120.3%	21.2	3.0	C
	Through	134	131	98.1%	18.0	3.9	B
	Right Turn	72	62	86.7%	11.8	4.3	B
	Subtotal	412	442	107.2%	18.9	2.4	B
Total		1,356	1,385	102.2%	16.3	1.6	B

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	26	34	131.1%	2.1	1.2	A
	Through	499	464	93.0%	0.8	0.3	A
	Right Turn	95	96	100.9%	1.3	0.6	A
	Subtotal	620	594	95.8%	0.9	0.2	A
SB	Left Turn	21	19	91.3%	2.9	1.3	A
	Through	322	290	90.1%	1.2	0.5	A
	Right Turn	29	61	209.4%	1.0	0.2	A
	Subtotal	372	370	99.5%	1.2	0.5	A
EB	Left Turn	41	38	93.1%	11.9	4.0	B
	Through	2	2	77.3%	1.4	2.8	A
	Right Turn	34	35	102.9%	8.0	2.7	A
	Subtotal	77	75	97.0%	9.8	3.1	A
WB	Left Turn	65	66	102.0%	9.2	1.6	A
	Through	4	3	77.3%	5.3	5.7	A
	Right Turn	67	66	98.9%	1.7	0.8	A
	Subtotal	136	136	99.7%	5.7	1.1	A
Total		1,205	1,175	97.5%	2.1	0.4	A

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	85	109	128.0%	6.4	2.4	A
	Through	295	277	93.8%	6.4	1.4	A
	Right Turn	197	205	104.1%	6.1	1.9	A
	Subtotal	577	591	102.3%	6.3	1.4	A
SB	Left Turn	258	226	87.6%	2.9	0.5	A
	Through	71	112	158.3%	2.7	0.8	A
	Right Turn						
	Subtotal	329	338	102.8%	2.8	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	227	47	20.6%	3.7	1.3	A
	Through						
	Right Turn	271	174	64.1%	3.5	0.7	A
	Subtotal	498	221	44.3%	3.5	0.6	A
Total		1,404	1,149	81.9%	4.8	0.8	A

Intersection 16 **Parking Lot Connector/7th Place** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	31	30	95.3%	4.6	0.8	A
	Through						
	Right Turn	2	2	95.5%	4.4	6.0	A
	Subtotal	33	31	95.3%	4.8	0.8	A
SB	Left Turn	51	37	73.4%	4.9	1.2	A
	Through	4	7	179.5%	4.7	4.5	A
	Right Turn						
	Subtotal	55	45	81.2%	5.2	1.3	A
EB	Left Turn						
	Through	493	418	84.8%	0.9	0.3	A
	Right Turn	36	30	84.1%	0.8	0.4	A
	Subtotal	529	448	84.7%	0.9	0.3	A
WB	Left Turn	1	0	36.4%	0.0	0.0	A
	Through	151	142	93.7%	9.3	0.5	A
	Right Turn						
	Subtotal	152	142	93.4%	9.3	0.5	A
Total		769	666	86.6%	3.2	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	986	988	100.2%	1.0	0.2	A
	Right Turn	56	50	89.4%	1.2	0.3	A
	Subtotal	1,042	1,038	99.6%	1.1	0.2	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	148	179	121.3%	0.8	0.1	A
	Subtotal	148	179	121.3%	0.8	0.1	A
Total		1,190	1,218	102.3%	1.0	0.2	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	76	78	102.0%	64.7	5.5	E
	Through						
	Right Turn	196	155	78.9%	81.2	17.8	F
	Subtotal	272	232	85.4%	76.1	11.7	E
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,314	1,193	90.8%	30.1	6.0	C
	Through	463	371	80.2%	28.0	5.7	C
	Right Turn						
	Subtotal	1,777	1,564	88.0%	29.6	6.0	C
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		2,049	1,797	87.7%	35.9	5.5	D

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	8	102.3%	74.6	39.9	E
	Through	1,573	1,378	87.6%	31.0	4.3	C
	Right Turn	486	467	96.1%	42.3	6.9	D
	Subtotal	2,067	1,853	89.6%	34.1	4.6	C
SB	Left Turn	30	27	89.1%	85.5	23.6	F
	Through	1,057	1,080	102.1%	22.5	3.1	C
	Right Turn	92	73	79.8%	4.5	1.0	A
	Subtotal	1,179	1,180	100.1%	22.4	2.9	C
EB	Left Turn	225	210	93.3%	58.9	4.2	E
	Through	99	113	114.0%	51.4	7.1	D
	Right Turn	11	9	82.6%	8.2	4.6	A
	Subtotal	335	332	99.1%	55.1	3.0	E
WB	Left Turn	284	278	98.0%	60.9	2.9	E
	Through	145	165	113.6%	50.8	5.1	D
	Right Turn	44	28	64.0%	20.5	9.2	C
	Subtotal	473	471	99.6%	55.1	3.3	E
Total		4,054	3,836	94.6%	35.2	2.5	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,067	889	43.0%	1.1	0.1	A
	Right Turn						
	Subtotal	2,067	889	43.0%	1.1	0.1	A
SB	Left Turn						
	Through	1,223	1,264	103.4%	1.3	0.5	A
	Right Turn	129	101	78.6%	1.2	0.5	A
	Subtotal	1,352	1,366	101.0%	1.3	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,419	2,255	65.9%	1.3	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	148	115	77.5%	60.8	7.3	E
	Through						
	Right Turn	373	343	92.1%	15.6	3.3	B
	Subtotal	521	458	87.9%	25.9	3.0	C
EB	Left Turn						
	Through	1,629	1,443	88.6%	63.6	7.8	E
	Right Turn	59	45	76.3%	50.7	8.8	D
	Subtotal	1,688	1,488	88.1%	63.2	7.7	E
WB	Left Turn	145	144	99.3%	58.7	5.4	E
	Through	200	149	74.5%	58.6	5.2	E
	Right Turn						
	Subtotal	345	293	84.9%	58.7	5.3	E
Total		2,554	2,239	87.7%	55.3	4.8	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	99	89	89.6%	71.6	16.7	E
	Through	732	738	100.8%	26.9	3.7	C
	Right Turn	55	58	106.1%	24.6	5.9	C
	Subtotal	886	885	99.9%	31.2	4.6	C
SB	Left Turn	116	148	127.4%	76.8	27.4	E
	Through	586	627	107.0%	17.4	5.2	B
	Right Turn	206	229	111.2%	7.9	2.2	A
	Subtotal	908	1,004	110.6%	23.7	4.9	C
EB	Left Turn	204	191	93.4%	80.6	21.8	F
	Through	285	276	96.8%	54.6	13.6	D
	Right Turn	87	89	102.7%	35.6	9.3	D
	Subtotal	576	556	96.5%	60.5	14.2	E
WB	Left Turn	67	61	90.8%	45.0	11.7	D
	Through	247	234	94.7%	51.0	7.5	D
	Right Turn	106	107	100.9%	39.6	8.8	D
	Subtotal	420	402	95.6%	46.8	7.2	D
Total		2,790	2,846	102.0%	36.4	3.2	D

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	62	125.6%	121.7	22.6	F
	Through	128	118	92.5%	63.9	29.1	E
	Right Turn	342	285	83.4%	48.1	25.6	D
	Subtotal	519	465	89.6%	61.3	25.1	E
SB	Left Turn	88	73	83.0%	59.5	5.6	E
	Through	243	238	98.0%	41.4	5.8	D
	Right Turn	46	43	94.3%	30.8	10.5	C
	Subtotal	377	355	94.0%	44.5	4.8	D
EB	Left Turn	76	87	114.8%	73.3	7.3	E
	Through	1,258	1,121	89.1%	50.2	4.9	D
	Right Turn	161	162	100.9%	33.7	2.8	C
	Subtotal	1,495	1,371	91.7%	49.7	4.0	D
WB	Left Turn	123	102	83.1%	68.8	10.0	E
	Through	375	345	92.0%	31.0	4.0	C
	Right Turn	75	52	69.3%	33.4	4.3	C
	Subtotal	573	499	87.1%	38.1	2.8	D
Total		2,964	2,690	90.8%	48.6	4.4	D

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	95	89	93.7%	36.5	8.4	D
	Through	128	131	102.3%	31.4	5.0	C
	Right Turn	7	6	90.9%	17.2	9.0	B
	Subtotal	230	226	98.4%	33.2	4.7	C
SB	Left Turn	35	30	84.4%	34.6	8.8	C
	Through	119	116	97.9%	33.7	4.9	C
	Right Turn	267	246	92.2%	10.4	1.9	B
	Subtotal	421	392	93.2%	19.4	2.5	B
EB	Left Turn	475	448	94.3%	27.5	3.4	C
	Through	1,453	1,325	91.2%	14.4	1.6	B
	Right Turn	277	259	93.6%	14.9	2.7	B
	Subtotal	2,205	2,032	92.2%	17.3	1.9	B
WB	Left Turn	2	3	131.8%	40.3	38.4	D
	Through	452	431	95.4%	43.1	7.9	D
	Right Turn	16	15	92.0%	28.8	19.5	C
	Subtotal	470	448	95.4%	42.8	7.5	D
Total		3,326	3,099	93.2%	22.2	1.8	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	56	44	78.4%	1.2	0.4	A
	Through	99	93	93.8%	0.8	0.3	A
	Second Right						
	Subtotal	173	163	94.1%	0.9	0.3	A
SB	Left Turn						
	Through	114	113	98.7%	1.9	2.0	A
	Second Right						
	Subtotal	134	132	98.3%	1.8	1.8	A
EB	Left Turn	16	14	86.4%	6.7	3.8	A
	Through	7	6	80.5%	5.0	3.7	A
	Second Right						
	Subtotal	59	53	89.1%	8.6	1.7	A
WB	Left Turn	86	80	93.2%	11.1	2.4	B
	Through	38	31	81.1%	11.0	1.6	B
	Second Right						
	Subtotal	174	150	86.3%	9.8	1.7	A
Total		540	497	92.1%	4.7	1.1	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	279	0	0.0%	0.1	0.3	A
	Through	37	0	0.0%	0.1	0.3	A
	Right Turn	87	414	476.4%	5.4	0.7	A
	Subtotal	403	414	102.8%	5.4	0.7	A
SB	Left Turn	7	9	123.4%	1.8	1.2	A
	Through	14	12	88.3%	2.7	1.7	A
	Right Turn	79	78	98.7%	1.8	0.4	A
	Subtotal	100	99	99.0%	1.9	0.3	A
EB	Left Turn	115	91	78.7%	1.4	0.5	A
	Through	131	134	102.4%	2.1	0.6	A
	Right Turn	202	185	91.5%	2.1	0.8	A
	Subtotal	448	410	91.4%	1.9	0.6	A
WB	Left Turn	47	43	92.1%	1.2	0.6	A
	Through	98	98	100.5%	1.1	0.4	A
	Right Turn	5	7	140.0%	1.0	1.4	A
	Subtotal	150	149	99.2%	1.2	0.3	A
Total		1,101	1,072	97.3%	3.2	0.3	A

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	13	21	158.0%	6.0	0.8	A
	Through	6	8	137.9%	9.9	7.8	A
	Right Turn	8	21	268.2%	13.9	1.8	B
	Subtotal	27	50	186.2%	10.2	0.9	B
SB	Left Turn	123	119	97.0%	9.6	1.3	A
	Through	20	20	100.0%	8.1	1.8	A
	Right Turn	15	18	121.8%	8.8	1.9	A
	Subtotal	158	158	99.8%	9.4	1.2	A
EB	Left Turn	6	25	413.6%	0.9	0.7	A
	Through	76	41	54.2%	0.4	0.3	A
	Right Turn	17	11	66.8%	0.3	0.3	A
	Subtotal	99	77	78.1%	0.5	0.3	A
WB	Left Turn	3	0	15.2%	0.0	0.0	A
	Through	80	80	100.2%	0.3	0.2	A
	Right Turn	54	53	98.8%	0.6	0.1	A
	Subtotal	137	134	97.8%	0.4	0.1	A
Total		421	419	99.6%	5.0	0.5	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	12	10	82.6%	8.0	2.5	A
	Through						
	Right Turn	55	46	83.6%	8.1	1.2	A
	Subtotal	67	56	83.4%	8.1	1.3	A
EB	Left Turn	31	71	229.3%	4.6	1.7	A
	Through	424	410	96.8%	0.5	0.1	A
	Right Turn						
	Subtotal	455	481	105.8%	1.1	0.3	A
WB	Left Turn						
	Through	364	358	98.4%	2.8	1.3	A
	Right Turn	2	6	277.3%	1.3	1.1	A
	Subtotal	366	364	99.3%	2.8	1.3	A
Total		888	901	101.4%	2.2	0.5	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	47	117.5%	10.6	2.4	B
	Through	187	181	96.8%	15.3	2.9	B
	Right Turn	124	125	101.1%	17.1	3.6	B
	Subtotal	351	353	100.7%	15.3	2.5	B
SB	Left Turn	113	125	110.2%	16.9	4.7	B
	Through	154	155	100.7%	16.9	3.5	B
	Right Turn	35	30	86.8%	10.4	3.6	B
	Subtotal	302	310	102.6%	16.5	2.8	B
EB	Left Turn	47	44	93.6%	11.9	3.0	B
	Through	169	166	98.4%	14.6	2.7	B
	Right Turn	75	70	93.0%	12.0	3.9	B
	Subtotal	291	280	96.3%	13.5	2.3	B
WB	Left Turn	206	248	120.3%	21.2	3.0	C
	Through	134	131	98.1%	18.0	3.9	B
	Right Turn	72	62	86.7%	11.8	4.3	B
	Subtotal	412	442	107.2%	18.9	2.4	B
Total		1,356	1,385	102.2%	16.3	1.6	B

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	26	34	131.1%	2.1	1.2	A
	Through	499	464	93.0%	0.8	0.3	A
	Right Turn	95	96	100.9%	1.3	0.6	A
	Subtotal	620	594	95.8%	0.9	0.2	A
SB	Left Turn	21	19	91.3%	2.9	1.3	A
	Through	322	290	90.1%	1.2	0.5	A
	Right Turn	29	61	209.4%	1.0	0.2	A
	Subtotal	372	370	99.5%	1.2	0.5	A
EB	Left Turn	41	38	93.1%	11.9	4.0	B
	Through	2	2	77.3%	1.4	2.8	A
	Right Turn	34	35	102.9%	8.0	2.7	A
	Subtotal	77	75	97.0%	9.8	3.1	A
WB	Left Turn	65	66	102.0%	9.2	1.6	A
	Through	4	3	77.3%	5.3	5.7	A
	Right Turn	67	66	98.9%	1.7	0.8	A
	Subtotal	136	136	99.7%	5.7	1.1	A
Total		1,205	1,175	97.5%	2.1	0.4	A

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	85	109	128.0%	6.4	2.4	A
	Through	295	277	93.8%	6.4	1.4	A
	Right Turn	197	205	104.1%	6.1	1.9	A
	Subtotal	577	591	102.3%	6.3	1.4	A
SB	Left Turn	258	226	87.6%	2.9	0.5	A
	Through	71	112	158.3%	2.7	0.8	A
	Right Turn						
	Subtotal	329	338	102.8%	2.8	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	227	47	20.6%	3.7	1.3	A
	Through						
	Right Turn	271	174	64.1%	3.5	0.7	A
	Subtotal	498	221	44.3%	3.5	0.6	A
Total		1,404	1,149	81.9%	4.8	0.8	A

Intersection 16 **Parking Lot Connector/7th Place** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	31	30	95.3%	4.6	0.8	A
	Through						
	Right Turn	2	2	95.5%	4.4	6.0	A
	Subtotal	33	31	95.3%	4.8	0.8	A
SB	Left Turn	51	37	73.4%	4.9	1.2	A
	Through	4	7	179.5%	4.7	4.5	A
	Right Turn						
	Subtotal	55	45	81.2%	5.2	1.3	A
EB	Left Turn						
	Through	493	418	84.8%	0.9	0.3	A
	Right Turn	36	30	84.1%	0.8	0.4	A
	Subtotal	529	448	84.7%	0.9	0.3	A
WB	Left Turn	1	0	36.4%	0.0	0.0	A
	Through	151	142	93.7%	9.3	0.5	A
	Right Turn						
	Subtotal	152	142	93.4%	9.3	0.5	A
Total		769	666	86.6%	3.2	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	986	988	100.2%	1.0	0.2	A
	Right Turn	56	50	89.4%	1.2	0.3	A
	Subtotal	1,042	1,038	99.6%	1.1	0.2	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	148	179	121.3%	0.8	0.1	A
	Subtotal	148	179	121.3%	0.8	0.1	A
Total		1,190	1,218	102.3%	1.0	0.2	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	76	78	102.0%	64.7	5.5	E
	Through						
	Right Turn	196	155	78.9%	81.2	17.8	F
	Subtotal	272	232	85.4%	76.1	11.7	E
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,314	1,193	90.8%	30.1	6.0	C
	Through	463	371	80.2%	28.0	5.7	C
	Right Turn						
	Subtotal	1,777	1,564	88.0%	29.6	6.0	C
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		2,049	1,797	87.7%	35.9	5.5	D

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 Concept E2B Variation 4
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	20.8	C	18.2	B	47.4	D	43.6	D	24.6	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.7	A	1.0	A					0.9	A
3	SR 9/SR 204 (west signal)	Signal			23.3	C	42.1	D	54.9	D	37.1	D
4	SR 9/Market Pl	Signal	19.3	B	16.9	B	26.6	C	31.4	C	19.2	B
5	91st Ave/SR 204	Signal	14.8	B	15.7	B	25.3	C	15.5	B	18.0	B
6	Lundeen Pkwy/Market Pl/SR 204	Signal	22.2	C	12.9	B	11.0	B	15.7	B	13.4	B
8	91st Ave/Vernon Rd	Side-street Stop	0.4	A	0.3	A	5.8	A	6.8	A	7.9	A
9	Safeway Dwy/Davies Rd	Roundabout	1.6	A	1.3	A	1.0	A	1.0	A	1.1	A
11	Transit Center Dwy/4th St	Side-street Stop	12.7	B	6.6	A	0.2	A	0.2	A	15.9	C
12	Transit Center Dwy/Market Pl	Side-street Stop			5.4	A	0.7	A	0.6	A	5.8	A
13	91st Ave/Market Pl	Signal	8.2	A	7.7	A	6.8	A	9.8	A	7.9	A
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.1	A	0.8	A	7.5	A	5.9	A	8.2	A
15	Vernon Rd/Davies Rd	Roundabout	1.4	A	1.9	A			1.7	A	1.6	A
16	Parking Lot Connector/7th Place	Side-street Stop	4.7	A	0.3	A	0.6	A	7.9	A	7.9	A
221	SR 9/4th St NE	Side-street Stop	0.7	A					0.8	A	1.1	A
255	SR 9/SR 204 (east signal)	Signal	54.8	D			25.0	C	57.7	E	36.4	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	5	2	49.1%	51.0	42.3	D
	Through	1,047	1,041	99.5%	19.5	4.0	B
	Right Turn	260	258	99.3%	24.5	5.2	C
	Subtotal	1,312	1,302	99.2%	20.7	4.2	C
SB	Left Turn	6	7	124.2%	42.3	39.0	D
	Through	911	909	99.8%	18.7	2.8	B
	Right Turn	52	54	103.0%	4.2	1.2	A
	Subtotal	969	970	100.1%	18.1	2.8	B
EB	Left Turn	53	51	95.4%	50.0	7.5	D
	Through	93	94	101.4%	47.2	6.3	D
	Right Turn	6	5	84.8%	9.1	7.8	A
	Subtotal	152	150	98.6%	47.1	5.0	D
WB	Left Turn	438	438	99.9%	48.2	5.0	D
	Through	89	91	101.9%	31.9	7.1	C
	Right Turn	38	39	103.3%	8.0	2.2	A
	Subtotal	565	568	100.5%	43.1	4.8	D
Total		2,998	2,989	99.7%	25.9	2.6	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,311	716	54.6%	0.7	0.1	A
	Right Turn						
	Subtotal	1,311	716	54.6%	0.7	0.1	A
SB	Left Turn						
	Through	1,298	1,295	99.8%	1.0	0.6	A
	Right Turn	57	59	103.0%	0.7	0.2	A
	Subtotal	1,355	1,354	99.9%	1.0	0.5	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		2,666	2,070	77.6%	0.9	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	100	101	100.8%	53.1	7.6	D
	Through						
	Right Turn	381	384	100.7%	16.2	3.3	B
	Subtotal	481	485	100.8%	23.5	3.1	C
EB	Left Turn						
	Through	619	592	95.6%	43.6	6.1	D
	Right Turn	40	35	88.4%	26.3	4.0	C
	Subtotal	659	627	95.2%	42.6	5.9	D
WB	Left Turn	105	99	94.2%	56.2	8.0	E
	Through	162	146	90.2%	56.2	8.0	E
	Right Turn						
	Subtotal	267	245	91.8%	56.2	8.0	E
Total		1,407	1,357	96.4%	38.1	2.8	D

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	28	29	102.6%	46.6	11.4	D
	Through	606	604	99.6%	17.8	2.3	B
	Right Turn	18	22	122.7%	16.6	7.4	B
	Subtotal	652	654	100.4%	19.1	2.2	B
SB	Left Turn	56	54	95.9%	50.6	8.7	D
	Through	740	728	98.3%	17.4	3.1	B
	Right Turn	167	162	97.0%	5.6	1.9	A
	Subtotal	963	943	98.0%	17.0	2.6	B
EB	Left Turn	120	106	88.4%	26.7	7.4	C
	Through	70	68	97.1%	34.9	10.5	C
	Right Turn	106	109	102.8%	19.9	6.6	B
	Subtotal	296	283	95.6%	26.3	6.6	C
WB	Left Turn	61	64	104.3%	26.6	5.8	C
	Through	125	125	99.6%	35.3	7.9	D
	Right Turn	24	25	106.1%	20.5	6.5	C
	Subtotal	210	214	101.7%	31.2	5.2	C
Total		2,121	2,094	98.7%	20.4	2.0	C

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	12	0	0.0%	0.0	0.0	A
	Through	54	52	96.8%	24.0	6.0	C
	Right Turn	86	82	95.9%	10.6	2.5	B
	Subtotal	152	135	88.6%	16.1	4.1	B
SB	Left Turn	89	61	68.3%	24.0	3.4	C
	Through	133	133	100.3%	15.2	3.6	B
	Right Turn	55	55	100.0%	8.8	3.5	A
	Subtotal	277	249	90.0%	16.0	2.0	B
EB	Left Turn	18	12	66.7%	28.1	11.0	C
	Through	484	485	100.2%	27.2	4.8	C
	Right Turn	38	0	0.0%	0.0	0.0	A
	Subtotal	540	497	92.1%	27.2	4.7	C
WB	Left Turn	54	48	88.6%	28.6	3.8	C
	Through	456	455	99.8%	14.0	2.6	B
	Right Turn	33	27	81.0%	13.6	6.9	B
	Subtotal	543	530	97.5%	15.2	2.4	B
Total		1,512	1,411	93.3%	19.5	2.2	B

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	73	75	102.5%	23.1	7.0	C
	Through	52	50	95.6%	20.3	5.1	C
	Right Turn	4	2	52.3%	3.1	4.9	A
	Subtotal	129	127	98.2%	22.1	5.1	C
SB	Left Turn	15	8	56.4%	17.8	14.3	B
	Through	100	111	111.2%	20.9	2.8	C
	Right Turn	219	218	99.7%	8.8	1.1	A
	Subtotal	334	338	101.2%	13.2	1.5	B
EB	Left Turn	64	65	101.6%	29.9	4.9	C
	Through	521	486	93.2%	8.6	1.4	A
	Right Turn	42	40	94.4%	6.7	2.0	A
	Subtotal	627	590	94.1%	11.0	1.7	B
WB	Left Turn	5	4	87.3%	21.1	21.4	C
	Through	509	502	98.7%	16.1	3.6	B
	Right Turn	9	4	49.5%	5.0	4.8	A
	Subtotal	523	511	97.7%	16.2	3.7	B
Total		1,613	1,566	97.1%	14.2	1.9	B

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	19	16	85.2%	0.6	0.2	A
	Through	24	19	80.7%	0.2	0.1	A
	Second Right						
	Subtotal	48	42	87.7%	0.4	0.2	A
SB	Left Turn						
	Through	75	72	95.9%	0.3	0.2	A
	Second Right						
	Subtotal	82	79	96.2%	0.3	0.2	A
EB	Left Turn	3	5	175.8%	4.9	2.7	A
	Through	3	2	81.8%	5.7	4.2	A
	Second Right						
	Subtotal	39	28	70.6%	6.1	0.8	A
WB	Left Turn	27	27	99.7%	7.0	1.5	A
	Through	19	19	100.5%	8.1	3.2	A
	Second Right						
	Subtotal	70	71	101.9%	6.9	0.8	A
Total		239	220	92.0%	3.3	0.4	A

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	50	47	93.5%	1.6	0.5	A
	Through	7	7	102.6%	2.0	2.2	A
	Right Turn	9	11	126.3%	1.4	0.7	A
	Subtotal	66	65	98.9%	1.7	0.5	A
SB	Left Turn	1	1	90.9%	0.2	0.7	A
	Through	6	6	106.1%	1.3	1.5	A
	Right Turn	35	34	96.6%	1.4	0.6	A
	Subtotal	42	41	97.8%	1.4	0.5	A
EB	Left Turn	53	46	87.7%	0.9	0.4	A
	Through	42	41	96.5%	1.2	0.3	A
	Right Turn	59	56	94.5%	1.0	0.5	A
	Subtotal	154	143	92.7%	1.0	0.2	A
WB	Left Turn	31	29	95.0%	1.0	0.6	A
	Through	39	40	101.4%	0.8	0.5	A
	Right Turn	1	1	127.3%	0.1	0.1	A
	Subtotal	71	70	99.0%	0.9	0.4	A
Total		333	319	95.9%	1.2	0.2	A

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	2	2	109.1%	2.0	2.6	A
	Through	3	2	72.7%	4.3	9.6	A
	Right Turn	8	16	202.3%	17.4	2.9	C
	Subtotal	13	21	158.0%	16.3	2.6	C
SB	Left Turn	15	18	118.2%	6.4	0.8	A
	Through	14	12	87.0%	6.4	1.2	A
	Right Turn	8	7	93.2%	5.1	2.0	A
	Subtotal	37	37	101.0%	6.4	0.6	A
EB	Left Turn	3	3	97.0%	0.2	0.3	A
	Through	22	22	100.4%	0.2	0.4	A
	Right Turn	10	8	77.3%	0.2	0.3	A
	Subtotal	35	33	93.5%	0.2	0.3	A
WB	Left Turn	2	1	63.6%	0.1	0.1	A
	Through	65	62	95.1%	0.3	0.3	A
	Right Turn	20	23	115.5%	0.5	0.1	A
	Subtotal	87	86	99.1%	0.3	0.2	A
Total		172	177	102.8%	3.4	0.3	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	3	0	9.1%	0.1	0.2	A
	Through						
	Right Turn	28	26	93.2%	6.0	0.8	A
	Subtotal	31	26	85.0%	6.0	0.8	A
EB	Left Turn	21	28	135.1%	2.5	2.0	A
	Through	119	116	97.1%	0.2	0.0	A
	Right Turn						
	Subtotal	140	144	102.8%	0.7	0.5	A
WB	Left Turn						
	Through	181	188	104.1%	0.6	0.2	A
	Right Turn	4	4	90.9%	0.6	0.3	A
	Subtotal	185	192	103.8%	0.6	0.2	A
Total		356	362	101.8%	1.1	0.3	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	18	22	123.2%	7.7	2.0	A
	Through	74	69	93.5%	8.3	1.8	A
	Right Turn	94	95	100.6%	8.7	1.7	A
	Subtotal	186	186	100.0%	8.3	1.0	A
SB	Left Turn	30	31	104.2%	8.1	2.8	A
	Through	57	59	104.3%	7.7	1.9	A
	Right Turn	3	2	81.8%	2.5	3.0	A
	Subtotal	90	93	103.5%	7.9	1.8	A
EB	Left Turn	4	4	111.4%	2.3	2.8	A
	Through	90	87	96.4%	8.2	3.1	A
	Right Turn	53	54	101.7%	5.4	1.6	A
	Subtotal	147	145	98.7%	7.1	2.1	A
WB	Left Turn	118	121	102.5%	10.9	1.9	B
	Through	72	69	95.8%	9.4	2.8	A
	Right Turn	38	35	92.6%	7.3	2.5	A
	Subtotal	228	225	98.7%	9.8	1.6	A
Total		651	649	99.7%	8.5	0.6	A

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	14	10	70.8%	0.5	0.8	A
	Through	95	95	100.3%	0.1	0.1	A
	Right Turn	17	14	81.3%	0.0	0.0	A
	Subtotal	126	119	94.4%	0.1	0.1	A
SB	Left Turn	7	7	103.9%	1.2	1.0	A
	Through	229	225	98.4%	0.7	0.3	A
	Right Turn	10	12	120.0%	1.2	0.4	A
	Subtotal	246	245	99.4%	0.8	0.3	A
EB	Left Turn	27	28	102.0%	8.2	2.0	A
	Through	8	11	133.0%	7.7	2.0	A
	Right Turn	63	58	91.5%	6.9	1.4	A
	Subtotal	98	96	97.8%	7.5	1.1	A
WB	Left Turn	42	54	129.4%	7.1	2.2	A
	Through	1	0	45.5%	1.8	4.0	A
	Right Turn	11	13	121.5%	1.3	1.2	A
	Subtotal	54	68	126.3%	6.0	2.3	A
Total		524	528	100.7%	2.5	0.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	54	53	98.8%	1.4	0.5	A
	Through	60	55	91.5%	1.6	0.7	A
	Right Turn	82	74	90.7%	1.3	0.4	A
	Subtotal	196	183	93.2%	1.4	0.4	A
SB	Left Turn	72	71	98.0%	2.1	0.9	A
	Through	101	96	94.6%	1.9	0.8	A
	Right Turn						
	Subtotal	173	166	96.0%	1.9	0.8	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	135	129	95.8%	1.9	0.8	A
	Through						
	Right Turn	40	39	98.2%	1.5	1.0	A
	Subtotal	175	169	96.4%	1.8	0.7	A
Total		544	517	95.1%	1.7	0.4	A

Intersection 16 **Parking Lot Connector/7th Place** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	32	32	99.1%	4.3	0.4	A
	Through						
	Right Turn	4	4	102.3%	2.1	2.2	A
	Subtotal	36	36	99.5%	4.3	0.4	A
SB	Left Turn						
	Through	2	2	104.5%	4.2	4.4	A
	Right Turn	18	0	0.0%	0.0	0.0	A
	Subtotal	20	2	10.5%	4.2	4.4	A
EB	Left Turn	3	0	0.0%	0.3	0.1	A
	Through	152	144	95.0%	0.6	0.2	A
	Right Turn	20	15	77.3%	0.5	0.1	A
	Subtotal	175	160	91.4%	0.6	0.2	A
WB	Left Turn						
	Through	30	29	95.8%	7.9	0.7	A
	Right Turn						
	Subtotal	30	29	95.8%	7.9	0.7	A
Total		261	227	86.8%	2.1	0.2	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2021 Concept E2B Variation 4**
Volume and Delay by Movement | **AM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	724	715	98.7%	0.7	0.2	A
	Right Turn	21	19	90.9%	0.9	0.1	A
	Subtotal	745	734	98.5%	0.7	0.2	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	146	139	95.4%	0.8	0.1	A
	Subtotal	146	139	95.4%	0.8	0.1	A
Total		891	873	98.0%	0.8	0.2	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	43	37	85.4%	50.0	11.9	D
	Through	2	3	163.6%	12.0	18.2	B
	Right Turn	104	95	90.9%	55.6	13.1	E
	Subtotal	149	135	90.3%	53.6	10.9	D
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	593	582	98.1%	25.4	3.9	C
	Through	126	112	89.2%	24.6	3.8	C
	Right Turn						
	Subtotal	719	694	96.6%	25.3	3.9	C
WB	Left Turn						
	Through	224	209	93.2%	58.0	10.7	E
	Right Turn	83	79	94.9%	58.4	16.0	E
	Subtotal	307	288	93.7%	58.2	12.0	E
Total		1,175	1,117	95.0%	37.8	4.3	D

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	1	0	0	2	13	5	6	20	NO
	Through	2,000	52	6	41	63	347	36	298	432	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	3	1	1	5	31	6	22	44	NO
	Through	3,700	49	2	46	52	319	39	278	387	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	12	2	10	16	57	4	51	63	NO
	Through	2,000	24	3	19	29	112	15	85	136	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	70	5	60	77	229	20	199	251	NO
	Through	2,000	16	3	11	20	99	17	68	125	NO
	Right Turn	80	0	0	0	1	25	4	21	37	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	28	5	23	37	194	34	160	273	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	39	5	34	50	199	16	173	227	NO
	Right Turn	100	0	1	0	1	19	27	0	80	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	4	3	1	11	71	27	26	102	NO
	Through	300	4	3	1	11	71	27	26	102	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	8	2	4	11	57	12	39	79	NO
	Through	2,000	33	3	28	36	191	12	169	213	NO
	Right Turn	400	2	1	1	5	30	11	17	51	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	16	4	10	22	111	18	84	136	NO
	Through	2,000	36	4	32	44	246	19	222	279	NO
	Right Turn	300	3	1	2	4	73	10	48	83	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	13	2	11	16	108	17	77	142	MAX
	Through	600	19	4	12	25	151	33	110	216	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	8	2	5	10	73	10	56	93	NO
	Through	1,000	25	4	21	31	169	14	151	203	NO
	Right Turn	600	22	4	18	27	168	14	149	202	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	0	0	0	0	0	NO
	Through	2,000	9	2	5	12	83	11	69	103	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	7	1	5	8	63	10	50	83	NO
	Through	800	11	2	8	15	113	14	98	147	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	2	1	1	3	29	7	22	43	NO
	Through	1,250	22	3	17	27	157	21	132	201	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	7	2	4	9	62	10	48	79	NO
	Through	350	21	2	16	24	154	22	129	208	NO
	Right Turn	300	21	2	16	23	162	22	136	216	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	7	1	5	9	66	10	52	81	NO
	Through	1,500	5	1	4	5	51	8	42	63	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	13	1	12	15	92	17	76	140	NO
	Through	100	13	1	12	15	92	17	76	140	NO
	Right Turn	100	14	1	13	16	94	17	78	142	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	7	1	5	9	46	9	35	63	NO
	Through	2,000	13	1	11	15	121	9	104	133	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	0	0	1	13	5	5	23	NO
	Through	1,250	18	3	13	23	169	16	151	200	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	11	5	8	22	NO
	Through	350	0	0	0	0	2	5	0	18	NO
	Right Turn	350	0	0	0	0	2	5	0	18	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	0	21	10	14	43	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	28	3	21	30	NO
	Through	400	0	0	0	1	53	6	41	57	NO
	Right Turn	400	0	0	0	1	33	4	30	45	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	2	0	1	2	53	10	35	73	NO
	Through	400	2	0	1	2	54	10	36	73	NO
	Right Turn	400	1	0	1	2	48	8	33	66	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	39	4	32	46	NO
	Through										
	Right Turn	400	1	0	1	1	40	4	33	47	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	0	0	1	30	4	25	36	NO
	Through										
	Right Turn	400	1	0	0	1	29	4	24	35	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	0	0	0	1	34	10	20	53	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	1	0	0	1	35	4	28	40	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	1	0	0	2	28	6	23	41	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	0	0	0	0	5	4	0	11	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	3	1	3	4	67	10	52	79	NO

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	365	15	3	12	20	88	15	73	125	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right	110 110	0 0	0 0	0 0	1 1	48 48	22 22	17 17	88 88	NO NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	285	61	8	51	76	231	24	189	271	NO

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 - Concept B
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	31.4	C	22.4	C	56.3	E	59.7	E	33.5	C
2	SR 9/	Uncontrolled	5.2	A	3.9	A					4.9	A
3	SR 9/SR 204	Roundabout	28.7	D	6.1	A	73.3	F	59.4	F	52.7	F
4	SR 9/Market Pl	Signal	150.7	F	45.7	D	73.3	E	54.9	D	78.0	E
5	91st Ave/SR 204	Signal	243.8	F	32.1	C	69.2	E	45.1	D	74.5	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	36.0	D	21.4	C	26.8	C	43.1	D	24.9	C
8	91st Ave/Vernon Rd	Side-street Stop	1.2	A	4.3	A	15.5	C	39.4	E	34.2	D
9	Safeway Dwy/Davies Rd	Roundabout	9.8	A	11.0	B	2.9	A	9.1	A	5.8	A
11	Transit Center Dwy/4th St	Side-street Stop	9.4	A	9.4	A	0.5	A	0.6	A	15.1	C
12	Transit Center Dwy/Market Pl	Side-street Stop			16.2	C	0.9	A	8.7	A	14.1	B
13	91st Ave/Market Pl	Signal	43.1	D	20.2	C	20.7	C	23.9	C	19.2	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.1	A	2.7	A	12.7	B	8.8	A	14.9	B
15	Vernon Rd/Davies Rd	Roundabout	59.9	F	562.8	F	25.8	D	40.8	E	56.2	F
16	Parking Lot Connector/7th Place	Signal	35.6	D	10.0	B	32.1	C	39.1	D	28.6	C
221	SR 9/4th St NE	Roundabout	3.0	A	39.5	E			5.8	A	12.3	B

D *Using signalized intersection LOS thresholds

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept B**
Volume and Delay by Movement **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	6	80.7%	66.5	45.9	E
	Through	1,709	1,543	90.3%	27.3	3.8	C
	Right Turn	562	529	94.1%	42.6	8.2	D
	Subtotal	2,279	2,078	91.2%	31.4	4.2	C
SB	Left Turn	31	34	108.2%	74.9	32.8	E
	Through	1,396	1,391	99.7%	22.4	1.9	C
	Right Turn	93	95	102.1%	5.8	1.1	A
	Subtotal	1,520	1,520	100.0%	22.5	2.6	C
EB	Left Turn	240	239	99.4%	62.5	6.2	E
	Through	124	125	100.5%	49.8	5.2	D
	Right Turn	13	11	84.6%	10.8	2.8	B
	Subtotal	377	374	99.3%	56.6	4.1	E
WB	Left Turn	386	392	101.6%	69.3	7.7	E
	Through	232	227	97.7%	53.0	4.3	D
	Right Turn	44	42	94.4%	21.3	6.7	C
	Subtotal	662	660	99.8%	60.7	4.8	E
Total		4,838	4,632	95.7%	35.0	2.1	D

Intersection 2 **SR 9/** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,709	2,076	121.5%	5.2	0.4	A
	Right Turn						
	Subtotal	1,709	2,076	121.5%	5.2	0.4	A
SB	Left Turn						
	Through	1,396	1,792	128.4%	4.3	12.2	A
	Right Turn						
	Subtotal	1,396	1,792	128.4%	4.3	12.2	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,105	3,868	124.6%	4.7	5.2	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept B**
Volume and Delay by Movement **PM Peak Hour**

Intersection 3 **SR 9/SR 204** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	191	42	21.9%	32.8	12.0	D
	Through	986	80	8.1%	28.0	12.2	D
	Right Turn	89	113	127.3%	22.3	11.2	C
	Subtotal	1,266	235	18.6%	26.4	10.4	D
SB	Left Turn	169	146	86.7%	12.1	4.9	B
	Through	868	89	10.2%	6.5	7.3	A
	Right Turn	438	405	92.5%	3.6	3.6	A
	Subtotal	1,475	640	43.4%	6.1	4.4	A
EB	Left Turn	1,094	1,240	113.4%	74.8	31.1	F
	Through	738	486	65.8%	71.6	30.0	F
	Right Turn	47	65	138.7%	61.2	29.8	F
	Subtotal	1,879	1,791	95.3%	73.4	30.6	F
WB	Left Turn	155	100	64.3%	68.6	10.0	F
	Through	209	143	68.6%	69.1	11.4	F
	Right Turn	198	91	45.9%	19.4	4.2	C
	Subtotal	562	334	59.4%	55.6	8.8	F
Total		5,182	3,001	57.9%	53.2	17.7	F

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	99	93.6%	215.4	23.7	F
	Through	905	839	92.7%	143.2	9.0	F
	Right Turn	70	74	106.4%	134.2	9.3	F
	Subtotal	1,081	1,013	93.7%	149.7	9.0	F
SB	Left Turn	186	134	72.2%	101.4	15.7	F
	Through	846	815	96.3%	40.3	5.9	D
	Right Turn	308	108	34.9%	22.1	7.5	C
	Subtotal	1,340	1,057	78.9%	46.8	6.1	D
EB	Left Turn	204	111	54.3%	76.1	37.5	E
	Through	325	304	93.7%	82.7	38.2	F
	Right Turn	106	102	95.9%	48.3	12.9	D
	Subtotal	635	517	81.4%	74.1	31.9	E
WB	Left Turn	68	66	97.5%	61.5	14.5	E
	Through	270	268	99.3%	59.2	10.8	E
	Right Turn	116	108	92.8%	42.7	5.8	D
	Subtotal	454	442	97.4%	56.1	9.0	E
Total		3,510	3,028	86.3%	87.6	6.8	F

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	1	1.3%	63.2	135.9	E
	Through	128	122	95.2%	263.9	21.3	F
	Right Turn	342	352	102.8%	259.0	21.1	F
	Subtotal	519	474	91.3%	260.4	20.8	F
SB	Left Turn	164	100	60.8%	52.1	4.9	D
	Through	213	370	173.6%	28.8	3.3	C
	Right Turn	54	48	88.7%	20.0	7.7	B
	Subtotal	431	517	120.0%	32.2	2.9	C
EB	Left Turn	101	33	32.4%	65.7	18.4	E
	Through	1,331	1,332	100.1%	68.8	49.1	E
	Right Turn	161	0	0.2%	6.8	16.5	A
	Subtotal	1,593	1,365	85.7%	68.6	47.7	E
WB	Left Turn	172	177	102.9%	88.7	36.2	F
	Through	543	365	67.2%	26.3	6.8	C
	Right Turn	74	51	68.3%	23.3	11.0	C
	Subtotal	789	592	75.1%	45.4	17.3	D
Total		3,332	2,949	88.5%	90.5	21.9	F

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	102	98.1%	41.2	5.1	D
	Through	148	150	101.4%	34.1	6.2	C
	Right Turn	9	0	0.0%	0.0	0.0	A
	Subtotal	261	252	96.6%	37.0	4.6	D
SB	Left Turn	40	18	44.5%	49.8	26.4	D
	Through	115	116	100.5%	34.7	5.4	C
	Right Turn	288	365	126.8%	14.9	2.9	B
	Subtotal	443	498	112.5%	21.3	3.3	C
EB	Left Turn	527	560	106.3%	32.2	10.1	C
	Through	1,384	1,345	97.2%	26.1	26.1	C
	Right Turn	282	282	99.9%	24.2	16.8	C
	Subtotal	2,193	2,187	99.7%	27.4	20.5	C
WB	Left Turn	4	4	88.6%	37.9	35.1	D
	Through	507	405	80.0%	46.3	6.6	D
	Right Turn	78	3	3.3%	16.4	26.4	B
	Subtotal	589	412	69.9%	46.2	6.2	D
Total		3,486	3,349	96.1%	29.6	12.9	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept B**
Volume and Delay by Movement **PM Peak Hour**

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	49	89.9%	1.6	0.6	A
	Through	108	65	60.4%	0.9	1.2	A
	Second Right						
	Subtotal	191	132	69.3%	1.2	0.8	A
SB	Left Turn	1	0	27.3%	0.0	0.2	A
	Through	118	105	88.8%	5.7	9.5	A
	Second Right						
	Subtotal	139	136	97.9%	4.7	7.5	A
EB	Left Turn	16	46	288.1%	9.7	1.2	A
	Through	7	19	267.5%	12.3	5.5	B
	Second Right						
	Subtotal	135	139	103.0%	16.0	10.1	C
WB	Left Turn	264	239	90.5%	42.4	29.0	E
	Through	52	135	259.6%	39.6	26.5	E
	Second Right						
	Subtotal	366	427	116.8%	40.7	28.3	E
Total		831	835	100.5%	24.1	16.3	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept B**
Volume and Delay by Movement **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	500	252	50.4%	11.3	15.3	B
	Through	67	65	97.2%	9.4	10.9	A
	Right Turn	119	128	107.3%	8.1	8.9	A
	Subtotal	686	445	64.8%	10.2	13.2	B
SB	Left Turn	9	10	108.1%	20.1	52.4	C
	Through	40	37	91.4%	6.9	11.0	A
	Right Turn	97	70	71.8%	14.3	34.4	B
	Subtotal	146	116	79.4%	11.8	26.5	B
EB	Left Turn	105	82	78.2%	5.3	12.0	A
	Through	204	100	49.2%	2.0	0.7	A
	Right Turn	350	55	15.8%	2.8	1.1	A
	Subtotal	659	238	36.1%	2.9	2.9	A
WB	Left Turn	59	54	91.8%	10.5	20.8	B
	Through	100	103	103.1%	9.4	18.6	A
	Right Turn	6	7	121.2%	3.3	4.4	A
	Subtotal	165	165	99.7%	9.8	19.2	A
Total		1,656	963	58.2%	9.4	15.8	A

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	31	78.0%	6.1	0.8	A
	Through	14	9	64.9%	5.4	3.7	A
	Right Turn	5	10	207.3%	18.2	3.3	C
	Subtotal	59	51	85.8%	9.5	1.0	A
SB	Left Turn	124	121	97.7%	9.5	1.2	A
	Through	22	21	94.2%	8.7	2.3	A
	Right Turn	17	20	116.0%	9.2	3.3	A
	Subtotal	163	162	99.2%	9.4	1.1	A
EB	Left Turn	6	10	168.2%	0.8	0.5	A
	Through	89	99	110.9%	0.4	0.1	A
	Right Turn	17	54	318.7%	0.4	0.1	A
	Subtotal	112	163	145.5%	0.5	0.2	A
WB	Left Turn	3	4	139.4%	0.8	1.0	A
	Through	90	87	97.2%	0.5	0.2	A
	Right Turn	54	54	100.5%	0.6	0.1	A
	Subtotal	147	146	99.3%	0.6	0.1	A
Total		481	521	108.4%	4.2	0.4	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	50	28	55.3%	10.3	6.4	B
	Through						
	Right Turn	62	65	104.1%	14.9	5.9	B
	Subtotal	112	92	82.3%	13.9	6.1	B
EB	Left Turn	81	51	63.3%	3.9	1.6	A
	Through	500	463	92.5%	0.6	0.2	A
	Right Turn						
	Subtotal	581	514	88.5%	0.9	0.3	A
WB	Left Turn						
	Through	392	378	96.5%	7.0	4.5	A
	Right Turn	6	15	254.5%	2.2	1.4	A
	Subtotal	398	394	98.9%	6.8	4.4	A
Total		1,091	1,000	91.6%	4.6	2.4	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	106.1%	25.1	21.6	C
	Through	237	233	98.4%	49.5	34.6	D
	Right Turn	130	87	66.6%	44.8	33.1	D
	Subtotal	413	369	89.2%	45.3	32.2	D
SB	Left Turn	156	138	88.6%	28.9	16.3	C
	Through	162	239	147.3%	15.9	3.4	B
	Right Turn	41	34	84.0%	12.5	3.3	B
	Subtotal	359	411	114.6%	20.0	7.1	C
EB	Left Turn	53	60	112.5%	20.4	5.7	C
	Through	161	161	100.0%	24.0	16.7	C
	Right Turn	79	80	100.9%	15.5	8.8	B
	Subtotal	293	300	102.5%	21.2	11.4	C
WB	Left Turn	321	118	36.7%	23.7	5.0	C
	Through	156	146	93.5%	22.5	5.9	C
	Right Turn	74	78	105.3%	26.8	11.3	C
	Subtotal	551	342	62.0%	23.9	4.4	C
Total		1,616	1,422	88.0%	27.4	11.5	C

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	30	71.4%	1.6	1.7	A
	Through	549	536	97.6%	1.0	0.4	A
	Right Turn	162	147	90.8%	1.2	0.4	A
	Subtotal	753	713	94.7%	1.0	0.3	A
SB	Left Turn	21	38	182.7%	4.4	1.5	A
	Through	344	317	92.3%	2.4	1.4	A
	Right Turn	62	68	109.7%	1.8	1.3	A
	Subtotal	427	424	99.2%	2.5	1.2	A
EB	Left Turn	52	50	96.7%	14.2	2.7	B
	Through	3	9	284.8%	9.1	5.7	A
	Right Turn	51	44	85.9%	10.7	3.1	B
	Subtotal	106	103	96.8%	12.4	1.7	B
WB	Left Turn	48	137	286.4%	12.0	2.4	B
	Through	4	16	390.9%	16.2	11.0	C
	Right Turn	67	75	111.5%	2.9	1.2	A
	Subtotal	119	228	191.4%	8.8	1.8	A
Total		1,405	1,467	104.4%	3.4	0.7	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	13	1,053	8102.1%	80.1	57.7	F
	Through	1,125	310	27.5%	17.2	10.7	C
	Right Turn	361	64	17.6%	9.7	6.3	A
	Subtotal	1,499	1,427	95.2%	63.4	44.5	F
SB	Left Turn	574	190	33.1%	856.8	714.9	F
	Through	171	89	51.9%	748.6	668.6	F
	Right Turn	39	1	3.7%	278.3	312.1	F
	Subtotal	784	280	35.7%	862.5	742.3	F
EB	Left Turn	27	1	2.7%	12.5	39.2	B
	Through	704	27	3.8%	30.2	50.7	D
	Right Turn	1,064	1,085	102.0%	27.6	48.7	D
	Subtotal	1,795	1,112	62.0%	27.7	48.8	D
WB	Left Turn	9	10	108.1%	71.7	100.9	F
	Through	18	122	677.3%	105.0	76.7	F
	Right Turn	343	610	177.9%	28.5	20.4	D
	Subtotal	370	742	200.5%	42.9	33.6	E
Total		4,448	3,561	80.1%	72.8	19.5	F

Intersection 16 **Parking Lot Connector/7th Place** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	88	71	80.5%	38.1	4.3	D
	Through	35	13	37.7%	36.9	22.0	D
	Right Turn	12	14	114.4%	16.9	11.6	B
	Subtotal	135	98	72.4%	36.2	4.7	D
SB	Left Turn	56	25	43.8%	31.4	9.2	C
	Through	74	13	17.9%	25.7	17.0	C
	Right Turn	415	148	35.7%	4.6	0.4	A
	Subtotal	545	186	34.1%	9.9	2.8	A
EB	Left Turn	564	181	32.1%	38.9	5.2	D
	Through	305	502	164.6%	28.9	5.6	C
	Right Turn	296	63	21.4%	32.4	5.7	C
	Subtotal	1,165	746	64.1%	31.8	5.3	C
WB	Left Turn	3	4	139.4%	37.7	37.4	D
	Through	59	115	195.1%	43.5	6.5	D
	Right Turn	94	32	34.4%	26.9	10.3	C
	Subtotal	156	152	97.2%	39.8	6.2	D
Total		2,001	1,182	59.1%	29.9	3.5	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept B**
Volume and Delay by Movement **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,133	1,042	91.9%	3.0	0.5	A
	Right Turn	89	15	16.3%	2.5	1.8	A
	Subtotal	1,222	1,056	86.4%	3.0	0.5	A
SB	Left Turn						
	Through	1,065	1,051	98.7%	42.5	30.7	E
	Right Turn						
	Subtotal	1,065	1,051	98.7%	42.5	30.7	E
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	92	96	104.6%	5.7	1.8	A
	Subtotal	92	96	104.6%	5.7	1.8	A
Total		2,379	2,204	92.6%	22.5	15.4	C

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	3	1	1	5	30	8	22	40	NO
	Through	2,000	125	12	104	144	596	34	521	645	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	23	10	11	48	96	14	73	117	NO
	Through	3,700	95	9	80	110	543	89	461	765	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	52	3	49	58	155	10	140	169	NO
	Through	2,000	36	4	29	43	165	16	133	187	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	87	8	74	99	235	20	210	273	NO
	Through	2,000	72	6	61	83	290	33	232	339	NO
	Right Turn	80	1	0	0	1	26	6	20	38	NO
	Second Right										

Intersection 2 **SR 9/** **Uncontrolled**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept B**
Queue Length | **PM Peak Hour**

Intersection 3 **SR 9/SR 204** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	21	10	12	47	135	39	104	248	NO
	Through	2,000	21	10	12	47	135	39	104	248	NO
	Right Turn	160	21	10	11	47	140	39	110	254	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	10	10	4	39	137	30	99	207	NO
	Through	2,000	10	10	4	39	137	30	99	207	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	148	40	103	244	506	19	466	519	MAX
	Through	400	148	40	103	244	506	19	466	519	MAX
	Right Turn	100	151	41	106	251	530	18	490	543	AVG
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	18	4	13	23	124	18	92	158	NO
	Through	300	18	4	13	23	124	18	92	158	NO
	Right Turn	75	18	4	13	23	124	18	92	158	MAX
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	461	516	38	1,383	709	544	126	1,455	AVG
	Through	2,000	1,289	236	896	1,528	1,850	89	1,660	1,901	NO
	Right Turn	400	13	2	10	18	127	21	99	180	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	92	28	60	129	376	122	199	556	MAX
	Through	2,000	292	43	224	356	760	16	737	798	NO
	Right Turn	300	3	1	2	6	68	11	53	94	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	29	12	18	58	237	62	158	343	MAX
	Through	600	216	49	127	272	517	42	427	559	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	16	4	11	22	90	21	71	130	NO
	Through	1,000	136	21	105	173	463	34	426	526	NO
	Right Turn	600	15	9	5	32	196	34	158	258	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	24	79	0	263	33	97	0	326	NO
	Through	2,000	895	171	535	1,095	1,126	78	985	1,224	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	31	8	21	48	161	34	112	223	NO
	Through	800	78	7	69	93	273	2	271	277	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	10	3	7	15	64	9	51	77	NO
	Through	1,250	268	240	133	956	705	211	524	1,176	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	98	34	63	182	316	48	239	393	MAX
	Through	350	36	10	24	60	245	40	191	339	NO
	Right Turn	300	36	10	24	59	246	40	193	340	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	20	2	16	26	119	19	91	167	NO
	Through	1,500	26	3	22	32	141	25	104	174	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	29	3	24	34	132	14	108	154	MAX
	Through	100	29	3	24	34	132	14	108	154	MAX
	Right Turn	100	30	3	26	36	135	14	110	157	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	45	4	39	51	199	19	168	228	NO
	Through	2,000	98	75	59	321	594	209	413	1,198	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	2	1	0	3	17	6	11	29	NO
	Through	1,250	52	7	43	67	215	16	195	239	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	27	6	22	35	NO
	Through	350	0	0	0	1	19	17	0	48	NO
	Right Turn	350	0	0	0	1	19	17	0	48	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	1	0	4	26	16	14	69	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	11	19	0	65	185	76	106	317	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	4	2	2	8	77	11	55	99	NO
	Through	400	4	1	3	5	93	9	81	113	NO
	Right Turn	400	4	2	2	9	64	8	53	81	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	90	26	68	160	291	24	240	337	NO
	Through	400	90	26	68	160	292	24	240	337	NO
	Right Turn	400	84	26	61	155	287	24	236	333	NO
	Second Right										

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept B**
Queue Length | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** | **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	0	7	9	83	6	72	93	NO
	Through										
	Right Turn	400	8	0	7	8	82	6	72	93	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	5	2	2	8	68	10	52	86	NO
	Through										
	Right Turn	400	5	2	3	9	67	10	52	86	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	1	0	0	1	42	7	28	52	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	2	1	1	3	43	6	34	51	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	8	4	4	20	96	26	68	143	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	3	1	2	4	47	10	29	67	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	8	2	4	11	127	28	81	168	NO
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 PM Peak Hour - Concept C
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	36.8	D	24.2	C	56.5	E	56.7	E	36.3	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.2	A	1.7	A					1.4	A
3	SR 9/SR 204	Signal	38.3	D	46.9	D	138.5	F	165.5	F	73.0	E
4	SR 9/Market Pl	Signal	143.7	F	95.2	F	74.2	E	68.2	E	82.2	F
5	91st Ave/SR 204	Signal	123.7	F	30.2	C	120.7	F	29.5	C	65.5	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	37.0	D	18.4	B	26.1	C	42.8	D	24.5	C
8	91st Ave/Vernon Rd	Side-street Stop	1.0	A	0.7	A	7.4	A	10.3	B	11.3	B
9	Safeway Dwy/Davies Rd	Roundabout	11.6	B	10.1	B	12.3	B	8.2	A	9.4	B
11	Transit Center Dwy/4th St	Side-street Stop	8.6	A	8.7	A	4.4	A	0.4	A	20.8	C
12	Transit Center Dwy/Market Pl	Side-street Stop			24.6	C	0.8	A	9.9	A	17.9	C
13	91st Ave/Market Pl	Signal	23.5	C	22.5	C	17.3	B	24.6	C	19.1	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.7	A	2.6	A	12.4	B	7.5	A	13.8	B
15	Vernon Rd/Davies Rd	Roundabout	9.6	A	12.6	B			2.7	A	4.7	A
16	Frontier Lane/7th Place	Signal	36.3	D	82.6	F	7.9	A	32.3	C	25.6	C
221	SR 9/4th St NE	Side-street Stop	0.8	A	58.0	F			0.6	A	34.6	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	4	50.0%	38.0	38.2	D
	Through	1,709	1,622	94.9%	30.1	3.8	C
	Right Turn	562	540	96.2%	56.8	20.6	E
	Subtotal	2,279	2,166	95.0%	37.1	6.8	D
SB	Left Turn	31	34	110.3%	113.5	56.7	F
	Through	1,396	1,392	99.7%	22.6	3.4	C
	Right Turn	93	95	101.8%	5.8	1.6	A
	Subtotal	1,520	1,521	100.0%	23.7	4.5	C
EB	Left Turn	240	239	99.6%	61.3	6.5	E
	Through	124	126	101.2%	50.5	7.2	D
	Right Turn	13	11	82.5%	12.8	5.6	B
	Subtotal	377	375	99.5%	56.4	4.0	E
WB	Left Turn	386	392	101.5%	64.0	7.4	E
	Through	232	228	98.4%	51.1	6.9	D
	Right Turn	44	41	94.0%	24.8	6.9	C
	Subtotal	662	661	99.9%	57.1	3.9	E
Total		4,838	4,723	97.6%	37.3	3.7	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,279	2,173	95.3%	1.2	0.1	A
	Right Turn						
	Subtotal	2,279	2,173	95.3%	1.2	0.1	A
SB	Left Turn						
	Through	1,665	1,634	98.1%	1.4	0.6	A
	Right Turn	129	155	120.2%	1.6	1.0	A
	Subtotal	1,794	1,789	99.7%	1.4	0.6	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		4,073	3,962	97.3%	1.3	0.3	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 PM Peak Hour - Concept C**
Volume and Delay by Movement **PM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	103	26	24.9%	71.4	14.4	E
	Through	1,062	901	84.8%	41.6	3.5	D
	Right Turn	265	168	63.5%	15.6	3.3	B
	Subtotal	1,430	1,095	76.5%	38.5	3.1	D
SB	Left Turn	188	165	87.8%	148.1	93.0	F
	Through	1,038	1,021	98.4%	44.4	8.6	D
	Right Turn	464	451	97.1%	5.8	1.5	A
	Subtotal	1,690	1,637	96.8%	45.9	13.0	D
EB	Left Turn	1,057	1,108	104.9%	135.7	46.3	F
	Through	738	692	93.8%	134.5	46.7	F
	Right Turn	47	40	84.1%	131.4	50.9	F
	Subtotal	1,842	1,840	99.9%	135.2	46.5	F
WB	Left Turn	260	137	52.6%	183.8	95.3	F
	Through	191	176	92.3%	197.7	83.4	F
	Right Turn	166	160	96.7%	132.3	78.6	F
	Subtotal	617	473	76.7%	172.6	85.0	F
Total		5,579	5,045	90.4%	86.5	21.3	F

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	116	109.6%	203.4	27.4	F
	Through	899	841	93.5%	137.0	8.1	F
	Right Turn	70	77	110.3%	129.6	6.7	F
	Subtotal	1,075	1,034	96.2%	144.2	9.1	F
SB	Left Turn	186	117	63.0%	174.0	33.5	F
	Through	846	811	95.8%	102.5	41.1	F
	Right Turn	308	260	84.4%	33.9	7.7	C
	Subtotal	1,340	1,188	88.6%	95.8	31.8	F
EB	Left Turn	204	81	39.7%	76.7	34.7	E
	Through	325	316	97.3%	85.1	43.1	F
	Right Turn	106	109	102.4%	51.7	12.9	D
	Subtotal	635	506	79.6%	75.7	33.1	E
WB	Left Turn	68	66	96.8%	72.2	15.2	E
	Through	270	273	101.3%	72.5	18.3	E
	Right Turn	116	97	83.6%	54.3	13.1	D
	Subtotal	454	436	96.1%	69.0	15.5	E
Total		3,504	3,164	90.3%	104.7	13.6	F

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	0	0.9%	47.2	100.2	D
	Through	128	139	108.7%	145.1	53.5	F
	Right Turn	342	429	125.5%	134.7	54.3	F
	Subtotal	519	569	109.6%	137.4	54.2	F
SB	Left Turn	164	95	58.2%	52.4	11.4	D
	Through	213	266	124.7%	25.1	4.1	C
	Right Turn	54	46	84.5%	18.6	5.0	B
	Subtotal	431	407	94.4%	30.0	3.2	C
EB	Left Turn	101	78	77.0%	78.8	35.1	E
	Through	1,331	1,314	98.7%	133.4	61.3	F
	Right Turn	161	0	0.1%	9.7	30.6	A
	Subtotal	1,593	1,391	87.3%	129.9	59.5	F
WB	Left Turn	172	140	81.6%	55.4	7.4	E
	Through	543	465	85.7%	23.6	4.3	C
	Right Turn	74	47	62.9%	9.8	2.6	A
	Subtotal	789	652	82.7%	30.0	3.8	C
Total		3,332	3,019	90.6%	97.6	29.4	F

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	106	102.1%	40.1	7.7	D
	Through	148	149	100.6%	34.8	6.8	C
	Right Turn	9	10	114.1%	36.2	39.0	D
	Subtotal	261	265	101.7%	37.1	7.2	D
SB	Left Turn	40	12	31.1%	41.6	15.1	D
	Through	115	113	98.1%	33.4	6.7	C
	Right Turn	288	281	97.6%	11.7	1.8	B
	Subtotal	443	406	91.7%	18.4	2.3	B
EB	Left Turn	527	525	99.6%	31.6	7.8	C
	Through	1,384	1,381	99.8%	24.8	23.6	C
	Right Turn	282	282	100.2%	19.0	10.9	B
	Subtotal	2,193	2,188	99.8%	25.9	18.3	C
WB	Left Turn	4	4	104.5%	65.3	20.2	E
	Through	507	497	98.0%	43.0	9.7	D
	Right Turn	78	11	13.8%	16.3	13.4	B
	Subtotal	589	512	86.9%	42.9	9.5	D
Total		3,486	3,372	96.7%	28.6	13.2	C

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	55	53	96.7%	1.5	0.7	A
	Through	108	97	89.7%	0.7	0.1	A
	Second Right						
	Subtotal	191	180	94.2%	1.0	0.2	A
SB	Left Turn	1	0	0.0%	0.0	0.0	A
	Through	118	116	98.5%	0.7	0.3	A
	Second Right						
	Subtotal	139	136	97.9%	0.7	0.3	A
EB	Left Turn	16	15	93.8%	7.8	3.2	A
	Through	7	8	114.3%	10.3	6.8	B
	Second Right						
	Subtotal	135	97	71.9%	7.7	1.0	A
WB	Left Turn	88	104	117.8%	10.7	1.5	B
	Through	38	45	117.7%	12.0	1.9	B
	Second Right						
	Subtotal	176	200	113.8%	10.2	1.2	B
Total		641	613	95.7%	5.0	0.5	A

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	367	438	119.3%	12.0	2.0	B
	Through	37	50	135.9%	8.3	2.8	A
	Right Turn	89	88	99.4%	8.4	3.3	A
	Subtotal	493	577	116.9%	11.1	1.9	B
SB	Left Turn	9	10	109.1%	14.4	15.9	B
	Through	12	38	312.9%	13.3	9.6	B
	Right Turn	97	69	70.7%	8.1	3.2	A
	Subtotal	118	116	98.2%	10.2	5.2	B
EB	Left Turn	105	110	104.7%	9.2	6.2	A
	Through	204	175	85.8%	17.2	16.1	C
	Right Turn	197	336	170.8%	11.6	8.0	B
	Subtotal	506	621	122.8%	12.7	9.9	B
WB	Left Turn	37	57	153.8%	10.1	6.1	B
	Through	122	101	82.5%	7.3	2.4	A
	Right Turn	6	7	116.7%	5.3	5.6	A
	Subtotal	165	165	99.7%	8.3	3.1	A
Total		1,282	1,478	115.3%	11.5	4.6	B

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	38	95.7%	8.0	0.7	A
	Through	14	6	45.5%	6.0	2.9	A
	Right Turn	5	8	161.8%	19.4	3.7	C
	Subtotal	59	53	89.4%	8.9	0.7	A
SB	Left Turn	124	122	98.2%	8.7	0.9	A
	Through	22	20	93.0%	8.7	2.4	A
	Right Turn	17	19	113.4%	8.5	2.7	A
	Subtotal	163	161	99.1%	8.7	0.9	A
EB	Left Turn	6	15	251.5%	4.2	6.7	A
	Through	89	90	101.5%	3.5	6.8	A
	Right Turn	17	71	420.3%	3.5	6.8	A
	Subtotal	112	177	158.0%	3.5	6.8	A
WB	Left Turn	3	1	33.3%	0.5	1.2	A
	Through	90	89	98.5%	0.3	0.2	A
	Right Turn	54	56	104.5%	0.6	0.1	A
	Subtotal	147	146	99.4%	0.4	0.1	A
Total		481	537	111.7%	4.6	2.4	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	16	44	275.6%	24.7	19.1	C
	Through						
	Right Turn	62	59	94.9%	26.4	21.5	D
	Subtotal	78	103	131.9%	25.7	20.3	D
EB	Left Turn	81	48	59.3%	4.5	2.1	A
	Through	500	463	92.6%	0.4	0.1	A
	Right Turn						
	Subtotal	581	511	87.9%	0.8	0.2	A
WB	Left Turn						
	Through	392	374	95.3%	10.5	9.4	B
	Right Turn	6	19	316.7%	7.7	12.6	A
	Subtotal	398	393	98.6%	10.4	9.4	B
Total		1,057	1,006	95.2%	7.1	6.2	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	106.1%	11.4	4.2	B
	Through	199	234	117.7%	25.2	13.4	C
	Right Turn	130	86	65.8%	30.4	23.3	C
	Subtotal	375	369	98.3%	24.3	13.5	C
SB	Left Turn	156	151	96.7%	32.6	35.0	C
	Through	162	214	132.2%	16.6	4.4	B
	Right Turn	41	39	94.5%	12.1	5.9	B
	Subtotal	359	404	112.4%	22.9	17.3	C
EB	Left Turn	53	51	96.2%	15.7	8.8	B
	Through	161	161	99.8%	21.8	22.4	C
	Right Turn	79	80	101.4%	11.4	9.7	B
	Subtotal	293	292	99.6%	18.2	15.5	B
WB	Left Turn	321	256	79.9%	27.8	11.9	C
	Through	156	146	93.8%	24.9	12.6	C
	Right Turn	74	140	189.1%	19.2	13.7	B
	Subtotal	551	543	98.5%	24.9	11.2	C
Total		1,578	1,607	101.8%	23.3	12.4	C

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	33	79.2%	1.8	1.1	A
	Through	549	543	98.9%	1.6	0.6	A
	Right Turn	162	107	66.3%	2.5	1.0	A
	Subtotal	753	684	90.8%	1.7	0.5	A
SB	Left Turn	21	39	184.8%	4.6	1.7	A
	Through	344	316	92.0%	2.7	0.5	A
	Right Turn	62	69	110.6%	1.3	0.2	A
	Subtotal	427	424	99.3%	2.7	0.5	A
EB	Left Turn	52	54	103.0%	13.5	2.2	B
	Through	3	8	275.8%	9.2	7.3	A
	Right Turn	51	41	79.9%	11.2	3.3	B
	Subtotal	106	103	96.7%	12.7	1.9	B
WB	Left Turn	48	49	102.7%	13.1	2.2	B
	Through	4	9	227.3%	15.5	9.5	C
	Right Turn	67	68	100.9%	2.1	1.2	A
	Subtotal	119	126	105.9%	7.1	1.3	A
Total		1,405	1,336	95.1%	3.4	0.2	A

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	87	0	0.0%	#DIV/0!	#DIV/0!	#DIV/0!
	Through	324	10	3.1%	18.8	33.7	C
	Right Turn	256	68	26.5%	21.2	23.4	C
	Subtotal	667	78	11.7%	20.9	23.1	C
SB	Left Turn	330	525	159.2%	13.9	17.8	B
	Through	209	5	2.6%	11.1	18.6	B
	Right Turn						
	Subtotal	539	531	98.5%	13.8	17.8	B
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	279	31	11.1%	3.7	1.3	A
	Through						
	Right Turn	309	574	185.8%	2.6	0.5	A
	Subtotal	588	605	102.9%	2.7	0.4	A
Total		1,794	1,214	67.7%	8.9	9.1	A

Intersection 16 **Frontier Lane/7th Place** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	88	85	96.3%	40.1	14.7	D
	Through	35	27	76.4%	35.6	22.2	D
	Right Turn	12	11	94.7%	25.6	33.2	C
	Subtotal	135	123	91.0%	37.7	16.1	D
SB	Left Turn	56	51	91.9%	93.2	64.2	F
	Through	74	66	89.1%	94.2	55.5	F
	Right Turn	415	344	83.0%	84.3	65.1	F
	Subtotal	545	462	84.7%	86.5	63.2	F
EB	Left Turn	564	441	78.3%	12.1	2.7	B
	Through	305	489	160.3%	4.7	1.0	A
	Right Turn	296	97	32.6%	4.4	1.6	A
	Subtotal	1,165	1,027	88.2%	7.9	1.3	A
WB	Left Turn	3	2	60.6%	8.8	27.9	A
	Through	59	56	94.9%	50.0	8.5	D
	Right Turn	94	95	101.3%	23.1	7.2	C
	Subtotal	156	153	98.1%	32.9	7.7	C
Total		2,001	1,764	88.2%	29.5	14.1	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 PM Peak Hour - Concept C**
Volume and Delay by Movement **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,133	1,000	88.3%	0.8	0.1	A
	Right Turn	89	15	17.4%	1.3	1.2	A
	Subtotal	1,222	1,016	83.1%	0.8	0.2	A
SB	Left Turn						
	Through	1,065	1,189	111.7%	58.8	36.0	F
	Right Turn						
	Subtotal	1,065	1,189	111.7%	58.8	36.0	F
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	92	95	103.3%	0.6	0.1	A
	Subtotal	92	95	103.3%	0.6	0.1	A
Total		2,379	2,300	96.7%	31.3	19.4	D

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	3	1	1	5	31	12	16	50	NO
	Through	2,000	158	13	130	172	703	45	632	774	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	25	13	11	54	94	16	72	123	NO
	Through	3,700	107	7	98	115	638	62	560	800	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	54	3	51	59	163	10	148	176	NO
	Through	2,000	35	5	26	41	166	16	142	187	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	91	9	80	112	255	52	212	366	NO
	Through	2,000	72	7	61	81	266	19	234	294	NO
	Right Turn	80	1	1	0	2	27	9	20	48	NO
	Second Right										

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	9	2	5	12	47	7	34	59	NO
	Through	2,000	130	9	118	150	475	21	434	501	NO
	Right Turn	160	7	2	3	10	92	18	58	120	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	183	84	72	292	433	105	314	596	MAX
	Through	2,000	158	25	122	208	707	90	584	874	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	246	54	167	337	543	9	533	561	MAX
	Through	400	246	54	167	337	543	9	533	561	MAX
	Right Turn	100	237	57	156	336	545	9	535	563	AVG
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	162	31	108	221	337	14	310	356	MAX
	Through	300	162	31	108	221	337	14	310	356	MAX
	Right Turn	75	82	39	33	162	335	21	286	362	AVG
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	219	271	46	797	965	354	591	1,520	MAX
	Through	2,000	1,121	206	831	1,438	1,900	68	1,785	2,002	NO
	Right Turn	400	16	4	10	25	135	24	107	181	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	91	21	67	128	364	84	215	535	MAX
	Through	2,000	437	60	317	517	933	18	889	948	NO
	Right Turn	300	22	6	15	34	220	57	147	335	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	20	3	17	25	115	35	81	189	MAX
	Through	600	215	55	151	334	550	23	519	590	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	16	4	11	24	95	52	55	237	NO
	Through	1,000	163	29	123	233	520	19	493	549	NO
	Right Turn	600	161	29	122	232	519	19	492	548	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	1	0	2	4	6	0	12	NO
	Through	2,000	484	192	286	887	883	159	596	1,083	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	30	6	22	45	137	23	107	187	NO
	Through	800	47	5	34	55	263	6	250	271	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	22	3	16	25	107	13	83	134	NO
	Through	1,250	307	134	158	549	705	134	519	909	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	42	7	31	57	175	29	144	235	MAX
	Through	350	37	6	29	46	207	35	167	286	NO
	Right Turn	300	39	6	29	48	215	35	175	294	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	22	3	17	27	126	20	97	154	NO
	Through	1,500	28	5	22	35	162	22	136	201	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	24	2	21	28	116	17	95	154	MAX
	Through	100	24	2	21	28	116	17	95	154	MAX
	Right Turn	100	25	2	22	29	118	17	98	156	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	44	3	39	48	201	19	172	229	NO
	Through	2,000	97	35	69	190	604	96	502	770	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	2	18	6	10	28	NO
	Through	1,250	58	6	50	68	258	18	227	286	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	29	12	15	48	NO
	Through	350	0	0	0	0	45	10	25	56	NO
	Right Turn	350	0	0	0	0	45	10	25	56	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	0	0	0	0	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	1	54	21	29	87	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	1	0	1	1	46	5	35	54	NO
	Through	400	1	0	1	2	63	3	60	68	NO
	Right Turn	400	2	0	2	3	51	5	45	59	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	8	1	7	9	112	10	96	131	NO
	Through	400	8	1	8	9	112	10	97	131	NO
	Right Turn	400	5	1	4	6	109	11	90	127	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	1	7	10	86	9	72	103	NO
	Through										
	Right Turn	400	8	1	8	10	87	9	73	104	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	4	5	19	84	14	63	119	NO
	Through										
	Right Turn	400	8	4	5	19	83	14	63	118	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	1	0	0	2	46	8	32	60	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	2	1	1	3	38	7	29	51	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	12	8	6	30	105	23	70	140	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	2	1	2	4	50	11	36	76	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	31	13	18	64	281	70	186	444	MAX
	Through										
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 - Concept E
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	34.7	C	24.7	C	59.9	E	67.2	E	35.5	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	4.8	A	2.7	A					4.5	A
3	SR 9/SR 204 (west signal)	Signal			25.3	C	64.9	E	72.0	E	51.4	D
4	SR 9/Market Pl	Signal	37.5	D	19.9	B	68.7	E	56.0	E	36.3	D
5	91st Ave/SR 204	Signal	145.6	F	32.6	C	40.3	D	41.7	D	52.7	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	34.9	C	20.1	C	18.3	B	44.0	D	22.6	C
8	91st Ave/Vernon Rd	Side-street Stop	1.1	A	1.2	A	8.1	A	9.1	A	10.6	B
9	Safeway Dwy/Davies Rd	Roundabout	33.5	D	8.2	A	10.1	B	10.1	B	18.0	C
11	Transit Center Dwy/4th St	Side-street Stop	9.2	A	9.4	A	0.1	A	0.5	A	18.5	C
12	Transit Center Dwy/Market Pl	Side-street Stop			11.8	B	1.1	A	6.8	A	12.6	B
13	91st Ave/Market Pl	Signal	24.6	C	18.8	B	14.9	B	21.6	C	16.5	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.1	A	1.6	A	12.6	B	6.4	A	13.3	B
15	Vernon Rd/Davies Rd	Roundabout	13.1	B	11.5	B			2.1	A	4.6	A
16	Parking Lot Connector/7th Place	Signal	40.8	D	43.1	D	10.9	B	32.1	C	21.3	C
221	SR 9/4th St NE	Side-street Stop	1.3	A	0.3	A			0.8	A	1.3	A
255	SR 9/SR 204 (east signal)	Signal	21.8	C			25.6	C	86.2	F	35.6	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept E**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	8	105.7%	78.2	44.9	E
	Through	1,709	1,660	97.1%	28.0	4.6	C
	Right Turn	562	549	97.8%	54.3	15.0	D
	Subtotal	2,279	2,217	97.3%	34.7	4.8	C
SB	Left Turn	31	33	107.6%	96.2	36.4	F
	Through	1,396	1,398	100.1%	24.4	3.2	C
	Right Turn	93	94	101.6%	6.5	2.0	A
	Subtotal	1,520	1,526	100.4%	24.9	3.2	C
EB	Left Turn	240	238	99.2%	66.8	5.6	E
	Through	124	124	100.3%	50.9	6.6	D
	Right Turn	13	11	85.3%	14.5	6.2	B
	Subtotal	377	374	99.1%	59.9	4.0	E
WB	Left Turn	386	391	101.4%	80.4	18.2	F
	Through	232	224	96.7%	54.5	7.8	D
	Right Turn	44	41	93.6%	30.5	14.4	C
	Subtotal	662	657	99.2%	68.2	13.4	E
Total		4,838	4,774	98.7%	38.0	3.7	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,279	2,210	97.0%	4.9	0.8	A
	Right Turn						
	Subtotal	2,279	2,210	97.0%	4.9	0.8	A
SB	Left Turn						
	Through	1,475	1,659	112.5%	2.7	1.2	A
	Right Turn	129	139	107.8%	2.1	1.7	A
	Subtotal	1,604	1,798	112.1%	2.7	1.2	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,883	4,008	103.2%	3.8	0.5	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept E**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	169	167	98.5%	46.2	7.4	D
	Through	868	4	0.5%	62.8	23.9	E
	Right Turn	438	482	110.1%	7.8	3.0	A
	Subtotal	1,475	653	44.3%	18.0	2.7	B
EB	Left Turn						
	Through	1,832	1,757	95.9%	65.5	12.0	E
	Right Turn	47	40	84.3%	54.5	11.4	D
	Subtotal	1,879	1,796	95.6%	65.3	11.9	E
WB	Left Turn	155	154	99.4%	69.4	8.4	E
	Through	209	250	119.6%	70.4	9.4	E
	Right Turn						
	Subtotal	364	404	111.0%	70.0	9.0	E
Total		3,718	2,853	76.7%	55.3	8.6	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	107	100.8%	146.7	97.7	F
	Through	905	896	99.0%	25.0	3.0	C
	Right Turn	70	77	109.6%	21.6	4.5	C
	Subtotal	1,081	1,079	99.8%	36.5	10.3	D
SB	Left Turn	186	119	63.9%	75.9	12.9	E
	Through	846	838	99.0%	16.0	4.6	B
	Right Turn	308	250	81.2%	8.4	2.8	A
	Subtotal	1,340	1,207	90.1%	20.5	3.7	C
EB	Left Turn	204	114	55.8%	81.8	23.8	F
	Through	325	314	96.7%	70.8	29.8	E
	Right Turn	106	104	98.0%	41.0	7.6	D
	Subtotal	635	532	83.8%	67.4	23.4	E
WB	Left Turn	68	64	93.7%	62.4	15.6	E
	Through	270	268	99.1%	57.5	9.2	E
	Right Turn	116	99	85.3%	44.7	6.3	D

	Subtotal	454	430	94.8%	55.2	9.1	E
Total		3,510	3,248	92.5%	38.3	4.9	D

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	0	0.7%	50.5	108.0	D
	Through	128	127	99.2%	163.0	59.7	F
	Right Turn	342	400	116.8%	152.1	58.8	F
	Subtotal	519	527	101.5%	154.9	59.1	F
SB	Left Turn	164	100	61.0%	50.6	9.3	D
	Through	213	243	113.9%	26.9	5.9	C
	Right Turn	54	17	31.3%	19.2	17.0	B
	Subtotal	431	360	83.4%	32.4	5.5	C
EB	Left Turn	101	32	31.9%	63.3	13.0	E
	Through	1,331	1,302	97.8%	44.7	3.1	D
	Right Turn	161	0	0.0%	0.0	0.0	A
	Subtotal	1,593	1,334	83.7%	45.2	3.0	D
WB	Left Turn	172	178	103.5%	75.9	17.3	E
	Through	543	481	88.5%	29.0	10.5	C
	Right Turn	74	72	96.9%	23.2	14.2	C
	Subtotal	789	731	92.6%	41.0	12.6	D
Total		3,332	2,951	88.6%	63.3	13.6	E

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	104	100.3%	39.3	7.1	D
	Through	148	153	103.3%	33.5	4.3	C
	Right Turn	9	0	0.0%	0.0	0.0	A
	Subtotal	261	257	98.5%	36.1	3.8	D
SB	Left Turn	40	17	43.2%	45.7	19.2	D
	Through	115	114	99.5%	35.3	6.0	D
	Right Turn	288	298	103.5%	12.6	1.7	B
	Subtotal	443	430	97.0%	20.0	2.1	C
EB	Left Turn	527	549	104.3%	29.0	3.3	C
	Through	1,384	1,310	94.7%	14.5	1.8	B
	Right Turn	282	278	98.7%	15.9	3.2	B
	Subtotal	2,193	2,138	97.5%	18.3	1.9	B
WB	Left Turn	4	4	88.6%	19.0	32.7	B
	Through	507	485	95.8%	44.5	11.6	D
	Right Turn	78	7	8.7%	28.5	24.6	C
	Subtotal	589	496	84.2%	44.4	11.6	D
Total		3,486	3,321	95.3%	23.9	1.8	C

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	63	115.4%	1.7	0.6	A
	Through	108	71	65.3%	0.4	0.1	A
	Second Right						
	Subtotal	191	154	80.8%	1.1	0.4	A
SB	Left Turn	1	0	27.3%	0.0	0.2	A
	Through	118	105	88.8%	1.4	2.5	A
	Second Right						
	Subtotal	139	136	97.9%	1.3	1.8	A
EB	Left Turn	16	46	285.8%	9.3	1.5	A
	Through	7	18	257.1%	9.6	2.5	A
	Second Right						
	Subtotal	135	138	102.2%	8.2	0.7	A
WB	Left Turn	264	80	30.3%	9.1	0.5	A
	Through	52	52	99.5%	10.7	1.8	B
	Second Right						
	Subtotal	366	184	50.2%	8.9	0.7	A
Total		831	612	73.7%	5.1	0.6	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept E**
Volume and Delay by Movement **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	500	476	95.3%	34.5	10.4	D
	Through	67	65	97.0%	32.9	9.0	D
	Right Turn	119	118	99.2%	31.6	10.6	D
	Subtotal	686	660	96.1%	33.8	10.3	D
SB	Left Turn	9	10	106.1%	7.3	3.6	A
	Through	40	39	96.4%	8.4	2.9	A
	Right Turn	97	68	69.8%	8.4	3.5	A
	Subtotal	146	116	79.3%	8.3	2.8	A
EB	Left Turn	105	110	104.8%	9.0	5.5	A
	Through	204	175	85.7%	11.4	8.5	B
	Right Turn	350	340	97.3%	9.6	5.2	A
	Subtotal	659	625	94.9%	10.0	5.9	A
WB	Left Turn	59	59	99.2%	10.9	3.8	B
	Through	100	98	98.4%	9.3	2.5	A
	Right Turn	6	7	121.2%	6.3	11.5	A
	Subtotal	165	164	99.5%	9.9	2.2	A
Total		1,656	1,565	94.5%	20.2	5.5	C

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	41	102.3%	6.2	0.6	A
	Through	14	9	67.5%	6.3	3.3	A
	Right Turn	5	11	225.5%	19.1	2.6	C
	Subtotal	59	62	104.5%	9.2	0.7	A
SB	Left Turn	124	121	97.7%	9.5	1.4	A
	Through	22	21	94.2%	8.8	2.3	A
	Right Turn	17	20	116.0%	8.8	2.8	A
	Subtotal	163	162	99.1%	9.4	1.3	A
EB	Left Turn	6	11	190.9%	0.7	0.9	A
	Through	89	89	99.9%	0.0	0.0	A
	Right Turn	17	75	441.2%	0.0	0.0	A
	Subtotal	112	175	156.6%	0.1	0.1	A
WB	Left Turn	3	4	139.4%	0.5	0.7	A
	Through	90	87	97.2%	0.4	0.2	A
	Right Turn	54	54	100.5%	0.6	0.1	A
	Subtotal	147	146	99.3%	0.5	0.1	A
Total		481	544	113.2%	4.1	0.4	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	50	48	95.6%	10.5	3.1	B
	Through						
	Right Turn	62	60	97.2%	11.1	4.9	B
	Subtotal	112	108	96.5%	11.4	3.7	B
EB	Left Turn	81	51	63.3%	5.4	1.9	A
	Through	500	459	91.9%	0.6	0.1	A
	Right Turn						
	Subtotal	581	511	87.9%	1.0	0.2	A
WB	Left Turn						
	Through	392	369	94.2%	6.8	4.5	A
	Right Turn	6	25	416.7%	2.0	1.6	A
	Subtotal	398	394	99.1%	6.6	4.4	A
Total		1,091	1,013	92.9%	4.2	2.0	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	106.3%	14.8	11.1	B
	Through	237	233	98.5%	26.2	26.1	C
	Right Turn	130	87	66.6%	27.5	26.7	C
	Subtotal	413	369	89.3%	25.4	24.7	C
SB	Left Turn	156	152	97.7%	22.5	11.4	C
	Through	162	286	176.3%	17.6	3.2	B
	Right Turn	41	39	96.0%	14.2	2.9	B
	Subtotal	359	477	132.9%	19.0	4.4	B
EB	Left Turn	53	59	110.8%	13.1	5.0	B
	Through	161	162	100.7%	18.6	16.4	B
	Right Turn	79	79	100.0%	11.0	8.3	B
	Subtotal	293	300	102.4%	15.1	10.0	B
WB	Left Turn	321	188	58.6%	25.2	5.9	C
	Through	156	147	94.3%	24.2	6.5	C
	Right Turn	74	148	200.4%	16.0	5.9	B
	Subtotal	551	484	87.8%	22.1	5.2	C
Total		1,616	1,630	100.8%	20.5	8.7	C

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	33	78.6%	1.6	1.4	A
	Through	549	529	96.3%	1.0	0.6	A
	Right Turn	162	149	91.9%	1.2	0.8	A
	Subtotal	753	711	94.4%	1.1	0.5	A
SB	Left Turn	21	38	181.8%	4.5	2.0	A
	Through	344	317	92.3%	1.4	0.6	A
	Right Turn	62	68	110.0%	1.2	0.3	A
	Subtotal	427	424	99.2%	1.7	0.5	A
EB	Left Turn	52	50	96.9%	15.0	1.8	C
	Through	3	9	284.8%	9.1	5.7	A
	Right Turn	51	44	86.1%	10.2	3.6	B
	Subtotal	106	103	97.0%	12.7	1.5	B
WB	Left Turn	48	69	143.2%	9.8	1.1	A
	Through	4	13	322.7%	21.0	10.8	C
	Right Turn	67	73	109.0%	1.9	0.6	A
	Subtotal	119	155	129.9%	6.4	0.7	A
Total		1,405	1,392	99.1%	2.8	0.4	A

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept E**
Volume and Delay by Movement **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	87	0	0.0%	#DIV/0!	#DIV/0!	#DIV/0!
	Through	324	8	2.4%	17.3	20.8	C
	Right Turn	256	71	27.6%	41.1	77.4	E
	Subtotal	667	78	11.8%	41.4	77.3	E
SB	Left Turn	330	526	159.3%	11.7	17.4	B
	Through	209	6	2.9%	9.2	15.5	A
	Right Turn						
	Subtotal	539	532	98.7%	11.7	17.4	B
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	279	31	11.1%	3.9	5.2	A
	Through						
	Right Turn	309	601	194.4%	2.0	0.4	A
	Subtotal	588	632	107.4%	2.1	0.5	A
Total		1,794	1,242	69.2%	9.2	14.0	A

Intersection 16 **Parking Lot Connector/7th Place** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	88	85	96.3%	42.5	6.5	D
	Through	35	32	91.2%	44.9	18.9	D
	Right Turn	12	12	103.8%	21.6	7.4	C
	Subtotal	135	129	95.6%	40.9	7.0	D
SB	Left Turn	56	54	95.8%	56.1	16.9	E
	Through	74	71	95.5%	53.7	22.0	D
	Right Turn	415	410	98.8%	39.8	21.8	D
	Subtotal	545	534	98.0%	43.0	20.7	D
EB	Left Turn	564	452	80.1%	17.3	3.2	B
	Through	305	484	158.8%	6.2	1.1	A
	Right Turn	296	94	31.8%	4.0	1.5	A
	Subtotal	1,165	1,030	88.4%	11.0	1.7	B
WB	Left Turn	3	3	100.0%	6.7	13.8	A
	Through	59	56	94.3%	51.1	6.6	D
	Right Turn	94	94	99.8%	23.4	8.4	C
	Subtotal	156	152	97.7%	33.1	7.7	C
Total		2,001	1,846	92.3%	23.9	5.7	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 - Concept E**
Volume and Delay by Movement **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,133	1,087	95.9%	1.4	0.4	A
	Right Turn	89	21	23.1%	1.2	0.2	A
	Subtotal	1,222	1,107	90.6%	1.4	0.4	A
SB	Left Turn						
	Through	1,065	1,200	112.7%	0.3	0.0	A
	Right Turn						
	Subtotal	1,065	1,200	112.7%	0.3	0.0	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	92	94	102.3%	0.8	0.1	A
	Subtotal	92	94	102.3%	0.8	0.1	A
Total		2,379	2,401	100.9%	0.8	0.2	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	114	47	40.8%	51.6	10.4	D
	Through	2	4	186.4%	65.5	33.3	E
	Right Turn	255	185	72.4%	13.2	3.4	B
	Subtotal	371	235	63.3%	21.4	4.1	C
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,057	1,079	102.1%	26.6	4.9	C
	Through	209	844	403.9%	24.6	3.9	C
	Right Turn						
	Subtotal	1,266	1,923	151.9%	25.7	4.4	C
WB	Left Turn						
	Through	515	357	69.4%	97.5	39.0	F
	Right Turn	300	191	63.6%	52.0	37.8	D
	Subtotal	815	548	67.3%	82.1	38.7	F
Total		2,452	2,706	110.4%	36.8	8.3	D

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept E**
Queue Length | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	3	2	1	6	36	9	17	46	NO
	Through	2,000	143	18	110	172	658	46	589	721	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	23	10	11	42	91	16	66	117	NO
	Through	3,700	110	8	103	123	632	77	551	776	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	54	3	50	59	163	14	141	190	NO
	Through	2,000	35	5	29	42	161	14	141	187	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	92	10	83	117	257	44	228	380	NO
	Through	2,000	71	7	58	82	272	27	221	304	NO
	Right Turn	80	1	0	0	2	26	6	20	37	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	75	71	45	286	496	93	432	766	MAX
	Through	2,000	75	71	45	286	496	93	432	766	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	116	16	93	152	516	9	505	539	MAX
	Right Turn	100	67	12	51	91	495	13	467	521	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	1	2	0	6	72	24	47	119	NO
	Through	300	1	2	0	6	72	24	47	119	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	101	57	32	192	264	86	164	455	NO
	Through	2,000	72	5	61	81	345	24	295	381	NO
	Right Turn	400	9	1	7	11	88	13	70	103	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	53	9	42	65	189	25	148	232	NO
	Through	2,000	48	9	31	62	296	39	233	372	NO
	Right Turn	300	9	2	5	12	119	24	79	166	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	40	8	27	53	238	68	113	354	MAX
	Through	600	164	40	122	255	490	36	439	545	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	14	4	10	23	78	26	57	151	NO
	Through	1,000	131	17	93	149	487	29	435	518	NO
	Right Turn	600	129	17	91	147	486	29	434	517	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	1	0	1	4	6	0	12	NO
	Through	2,000	495	159	270	755	968	120	776	1,143	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	31	6	24	46	143	19	112	167	NO
	Through	800	43	5	33	50	256	12	233	273	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	11	2	8	17	58	11	43	78	NO
	Through	1,250	112	15	88	137	371	34	332	445	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	101	33	71	179	346	34	299	400	MAX
	Through	350	88	34	56	173	365	25	326	398	MAX
	Right Turn	300	91	35	58	178	373	25	333	406	MAX
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	21	3	17	26	122	27	101	190	NO
	Through	1,500	27	4	20	35	157	20	130	191	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	26	2	23	31	126	21	100	158	MAX
	Through	100	26	2	23	31	126	21	100	158	MAX
	Right Turn	100	27	2	25	32	128	21	102	161	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	47	4	40	52	209	33	167	290	NO
	Through	2,000	64	6	57	77	461	50	385	543	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	3	14	7	5	28	NO
	Through	1,250	60	6	49	69	279	18	247	310	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	29	9	15	40	NO
	Through	350	0	0	0	0	19	13	0	50	NO
	Right Turn	350	0	0	0	0	19	13	0	50	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	0	0	0	0	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	1	52	14	29	68	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	0	2	3	63	9	50	80	NO
	Through	400	4	1	3	5	85	10	75	106	NO
	Right Turn	400	2	0	2	3	62	10	49	83	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	7	1	6	8	98	16	81	133	NO
	Through	400	7	1	6	8	99	16	81	133	NO
	Right Turn	400	4	1	3	5	97	17	77	129	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	1	7	10	83	7	70	93	NO
	Through										
	Right Turn	400	8	1	7	9	83	7	71	94	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	6	1	4	8	73	7	65	87	NO
	Through										
	Right Turn	400	5	1	4	7	72	7	65	86	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	1	0	1	2	50	9	37	67	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	2	0	1	3	47	7	33	56	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	7	1	5	9	101	15	79	135	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	3	1	2	4	46	8	38	62	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	16	5	12	24	159	56	98	255	MAX

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right										
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right										
WB	U Turn Second Left Left Turn Through Right Turn Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Concept E2A
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	41.4	D	23.6	C	58.9	E	62.6	E	38.3	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	5.2	A	2.4	A					4.9	A
3	SR 9/SR 204 (west signal)	Signal			27.6	C	75.4	E	74.0	E	58.2	E
4	SR 9/Market Pl	Signal	142.1	F	92.7	F	107.8	F	78.1	E	85.5	F
5	91st Ave/SR 204	Signal	112.7	F	36.7	D	57.5	E	43.5	D	54.3	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	35.3	D	19.2	B	21.3	C	39.1	D	23.0	C
8	91st Ave/Vernon Rd	Side-street Stop	0.9	A	0.6	A	8.6	A	9.2	A	11.1	B
9	Safeway Dwy/Davies Rd	Roundabout	31.4	D	11.1	B	11.8	B	11.2	B	16.8	C
11	Transit Center Dwy/4th St	Side-street Stop	9.3	A	9.3	A	0.1	A	0.5	A	17.0	C
12	Transit Center Dwy/Market Pl	Side-street Stop			21.7	C	1.1	A	19.2	C	20.1	C
13	91st Ave/Market Pl	Signal	39.7	D	68.2	E	24.4	C	29.7	C	32.7	C
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.1	A	1.6	A	12.7	B	6.6	A	13.6	B
15	Vernon Rd/Davies Rd	Roundabout	8.3	A	13.1	B			2.2	A	4.0	A
16	Parking Lot Connector/7th Place	Signal	38.2	D	41.5	D	10.7	B	29.8	C	20.4	C
221	SR 9/4th St NE	Side-street Stop	0.9	A	20.1	C			0.5	A	9.0	A
255	SR 9/SR 204 (east signal)	Signal	20.8	C			26.0	C	88.5	F	35.7	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	8	104.5%	78.8	61.2	E
	Through	1,709	1,644	96.2%	35.9	3.9	D
	Right Turn	562	546	97.2%	57.6	6.2	E
	Subtotal	2,279	2,198	96.4%	41.5	3.9	D
SB	Left Turn	31	34	108.5%	111.8	50.1	F
	Through	1,396	1,393	99.8%	21.9	3.1	C
	Right Turn	93	94	101.4%	5.1	1.0	A
	Subtotal	1,520	1,521	100.0%	23.2	2.7	C
EB	Left Turn	240	240	100.1%	64.0	5.2	E
	Through	124	125	101.0%	50.9	8.4	D
	Right Turn	13	11	85.3%	15.8	9.3	B
	Subtotal	377	376	99.9%	58.7	3.9	E
WB	Left Turn	386	393	101.8%	73.4	14.7	E
	Through	232	227	97.7%	53.1	5.3	D
	Right Turn	44	41	93.4%	27.5	7.8	C
	Subtotal	662	661	99.8%	63.7	9.7	E
Total		4,838	4,756	98.3%	40.5	2.5	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,279	2,199	96.5%	5.3	0.5	A
	Right Turn						
	Subtotal	2,279	2,199	96.5%	5.3	0.5	A
SB	Left Turn						
	Through	1,475	1,658	112.4%	2.4	0.7	A
	Right Turn	129	138	107.3%	1.8	0.7	A
	Subtotal	1,604	1,797	112.0%	2.3	0.7	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,883	3,996	102.9%	3.9	0.4	A

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	169	167	98.5%	48.0	6.2	D
	Through	868	4	0.5%	73.7	21.7	E
	Right Turn	438	483	110.3%	7.4	3.1	A
	Subtotal	1,475	654	44.3%	18.0	2.9	B
EB	Left Turn						
	Through	1,832	1,785	97.4%	75.3	15.2	E
	Right Turn	47	40	84.5%	61.5	11.2	E
	Subtotal	1,879	1,824	97.1%	75.0	15.0	E
WB	Left Turn	155	154	99.2%	71.9	8.0	E
	Through	209	250	119.6%	72.1	8.6	E
	Right Turn						
	Subtotal	364	404	110.9%	72.1	8.4	E
Total		3,718	2,882	77.5%	61.9	9.8	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	100	94.0%	195.3	27.7	F
	Through	905	861	95.1%	136.6	8.6	F
	Right Turn	70	77	109.6%	128.9	8.2	F
	Subtotal	1,081	1,037	96.0%	141.4	8.8	F
SB	Left Turn	186	113	60.8%	173.8	43.3	F
	Through	846	828	97.8%	94.9	28.8	F
	Right Turn	308	252	81.9%	56.3	15.8	E
	Subtotal	1,340	1,193	89.0%	95.6	25.2	F
EB	Left Turn	204	113	55.2%	134.9	33.4	F
	Through	325	314	96.6%	124.7	29.6	F
	Right Turn	106	105	98.9%	54.4	8.1	D
	Subtotal	635	531	83.7%	112.4	23.6	F
WB	Left Turn	68	64	93.6%	82.4	42.9	F
	Through	270	264	97.8%	85.9	47.0	F
	Right Turn	116	97	83.9%	58.4	21.7	E
	Subtotal	454	425	93.6%	79.4	40.3	E
Total		3,510	3,187	90.8%	111.6	10.6	F

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	0	0.9%	39.0	95.0	D
	Through	128	127	99.3%	122.8	46.1	F
	Right Turn	342	403	117.9%	109.9	44.0	F
	Subtotal	519	531	102.3%	113.3	44.2	F
SB	Left Turn	164	100	60.9%	53.3	9.0	D
	Through	213	243	114.0%	31.7	14.8	C
	Right Turn	54	17	31.5%	21.7	15.8	C
	Subtotal	431	360	83.5%	36.8	11.1	D
EB	Left Turn	101	33	33.0%	59.7	12.3	E
	Through	1,331	1,330	99.9%	61.8	23.3	E
	Right Turn	161	0	0.0%	0.0	0.0	A
	Subtotal	1,593	1,363	85.6%	61.8	22.7	E
WB	Left Turn	172	179	103.9%	79.2	17.2	E
	Through	543	482	88.8%	29.5	7.4	C
	Right Turn	74	71	96.1%	24.3	14.4	C
	Subtotal	789	732	92.8%	42.2	9.5	D
Total		3,332	2,986	89.6%	63.8	14.1	E

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	103	99.0%	41.2	7.4	D
	Through	148	151	101.9%	33.6	4.0	C
	Right Turn	9	0	0.0%	0.0	0.0	A
	Subtotal	261	254	97.2%	37.1	5.0	D
SB	Left Turn	40	17	43.0%	44.8	17.4	D
	Through	115	114	99.2%	33.1	4.6	C
	Right Turn	288	298	103.3%	12.2	1.7	B
	Subtotal	443	429	96.8%	19.1	1.9	B
EB	Left Turn	527	562	106.6%	32.7	4.2	C
	Through	1,384	1,343	97.0%	17.0	2.9	B
	Right Turn	282	285	101.2%	18.8	3.2	B
	Subtotal	2,193	2,190	99.9%	21.3	2.6	C
WB	Left Turn	4	4	97.7%	23.1	40.9	C
	Through	507	492	97.1%	42.4	9.2	D
	Right Turn	78	7	9.0%	17.3	20.0	B
	Subtotal	589	503	85.4%	42.5	9.2	D
Total		3,486	3,375	96.8%	25.0	2.5	C

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	64	115.9%	1.2	0.2	A
	Through	108	71	65.5%	0.7	0.3	A
	Second Right						
	Subtotal	191	155	81.2%	0.9	0.2	A
SB	Left Turn	1	0	27.3%	0.0	0.0	A
	Through	118	105	88.8%	0.5	0.3	A
	Second Right						
	Subtotal	139	136	97.9%	0.6	0.3	A
EB	Left Turn	16	46	288.1%	9.6	1.9	A
	Through	7	19	266.2%	10.9	3.2	B
	Second Right						
	Subtotal	135	139	102.9%	8.6	1.3	A
WB	Left Turn	264	80	30.3%	9.8	1.3	A
	Through	52	52	99.5%	11.2	2.1	B
	Second Right						
	Subtotal	366	184	50.2%	9.3	1.2	A
Total		831	614	73.9%	5.2	0.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2A**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	500	474	94.9%	31.2	8.6	D
	Through	67	64	95.7%	29.2	8.1	D
	Right Turn	119	118	99.5%	28.5	9.4	D
	Subtotal	686	657	95.8%	30.5	8.4	D
SB	Left Turn	9	10	107.1%	11.2	8.5	B
	Through	40	39	96.4%	13.4	9.5	B
	Right Turn	97	68	69.6%	9.7	5.1	A
	Subtotal	146	116	79.3%	11.4	7.0	B
EB	Left Turn	105	110	104.5%	9.7	7.9	A
	Through	204	174	85.3%	15.8	21.6	C
	Right Turn	350	339	96.8%	11.7	11.5	B
	Subtotal	659	623	94.5%	12.3	13.3	B
WB	Left Turn	59	58	99.1%	13.2	10.1	B
	Through	100	98	98.3%	10.8	5.2	B
	Right Turn	6	7	121.2%	4.3	5.3	A
	Subtotal	165	164	99.4%	11.6	7.3	B
Total		1,656	1,559	94.2%	20.0	7.0	C

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	41	101.8%	6.3	0.6	A
	Through	14	9	67.5%	6.4	4.1	A
	Right Turn	5	11	214.5%	18.8	2.9	C
	Subtotal	59	61	103.2%	9.4	0.9	A
SB	Left Turn	124	121	97.7%	9.4	1.6	A
	Through	22	21	94.2%	9.0	2.4	A
	Right Turn	17	20	116.0%	8.6	2.7	A
	Subtotal	163	162	99.2%	9.3	1.4	A
EB	Left Turn	6	11	189.4%	0.6	0.8	A
	Through	89	89	100.0%	0.0	0.0	A
	Right Turn	17	75	442.8%	0.0	0.0	A
	Subtotal	112	176	156.8%	0.1	0.1	A
WB	Left Turn	3	4	139.4%	0.5	0.7	A
	Through	90	87	97.2%	0.4	0.2	A
	Right Turn	54	54	100.5%	0.6	0.1	A
	Subtotal	147	146	99.3%	0.5	0.2	A
Total		481	544	113.1%	4.0	0.4	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	50	48	95.3%	19.2	15.0	C
	Through						
	Right Turn	62	60	97.2%	23.9	21.2	C
	Subtotal	112	108	96.3%	22.5	19.1	C
EB	Left Turn	81	53	65.0%	7.3	6.2	A
	Through	500	451	90.3%	0.5	0.1	A
	Right Turn						
	Subtotal	581	504	86.7%	1.2	0.6	A
WB	Left Turn						
	Through	392	365	93.2%	20.8	35.2	C
	Right Turn	6	25	413.6%	19.4	40.1	C
	Subtotal	398	390	98.1%	20.8	35.3	C
Total		1,091	1,002	91.9%	10.1	13.5	B

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	106.3%	26.8	18.0	C
	Through	237	233	98.5%	43.5	21.3	D
	Right Turn	130	86	66.4%	46.6	21.3	D
	Subtotal	413	369	89.3%	42.2	20.5	D
SB	Left Turn	156	152	97.2%	93.9	124.8	F
	Through	162	284	175.2%	64.2	102.2	E
	Right Turn	41	39	94.9%	58.9	102.0	E
	Subtotal	359	474	132.1%	73.4	109.5	E
EB	Left Turn	53	60	112.5%	13.8	6.0	B
	Through	161	164	102.1%	33.2	21.9	C
	Right Turn	79	80	101.4%	18.8	14.6	B
	Subtotal	293	304	103.8%	25.8	15.2	C
WB	Left Turn	321	187	58.1%	35.9	20.2	D
	Through	156	144	92.3%	31.4	14.3	C
	Right Turn	74	147	198.9%	23.4	13.9	C
	Subtotal	551	478	86.7%	31.0	16.9	C
Total		1,616	1,625	100.6%	45.9	42.8	D

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	33	77.5%	1.6	0.9	A
	Through	549	538	98.0%	1.0	0.4	A
	Right Turn	162	148	91.4%	1.1	0.3	A
	Subtotal	753	719	95.4%	1.0	0.3	A
SB	Left Turn	21	39	184.8%	4.1	1.4	A
	Through	344	317	92.3%	1.3	0.5	A
	Right Turn	62	68	108.9%	1.2	0.2	A
	Subtotal	427	424	99.2%	1.6	0.4	A
EB	Left Turn	52	50	96.7%	15.1	2.8	C
	Through	3	9	284.8%	9.1	4.6	A
	Right Turn	51	44	86.1%	9.7	4.1	A
	Subtotal	106	103	96.9%	12.5	2.5	B
WB	Left Turn	48	68	142.6%	10.7	2.4	B
	Through	4	13	325.0%	13.4	5.5	B
	Right Turn	67	73	109.0%	1.9	0.8	A
	Subtotal	119	154	129.8%	6.5	1.3	A
Total		1,405	1,399	99.6%	2.7	0.4	A

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	87	0	0.0%	#DIV/0!	#DIV/0!	#DIV/0!
	Through	324	8	2.4%	10.9	5.4	B
	Right Turn	256	70	27.3%	35.2	65.0	E
	Subtotal	667	78	11.7%	35.1	65.0	E
SB	Left Turn	330	522	158.2%	14.5	30.5	B
	Through	209	6	2.9%	3.1	3.6	A
	Right Turn						
	Subtotal	539	528	98.0%	14.3	29.9	B
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	279	31	11.1%	5.9	12.4	A
	Through						
	Right Turn	309	598	193.6%	2.0	0.5	A
	Subtotal	588	629	107.0%	2.2	0.4	A
Total		1,794	1,235	68.8%	9.1	15.9	A

Intersection 16 **Parking Lot Connector/7th Place** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	88	85	96.3%	40.9	6.1	D
	Through	35	32	90.9%	39.1	12.0	D
	Right Turn	12	12	103.8%	20.8	7.4	C
	Subtotal	135	129	95.6%	38.4	5.0	D
SB	Left Turn	56	54	95.8%	51.0	22.8	D
	Through	74	71	95.6%	52.4	22.1	D
	Right Turn	415	410	98.9%	40.6	35.2	D
	Subtotal	545	535	98.1%	43.1	31.9	D
EB	Left Turn	564	451	79.9%	17.1	6.6	B
	Through	305	487	159.6%	5.5	1.6	A
	Right Turn	296	95	32.1%	3.2	1.1	A
	Subtotal	1,165	1,033	88.6%	10.5	3.5	B
WB	Left Turn	3	3	100.0%	6.5	14.1	A
	Through	59	55	93.8%	47.9	4.3	D
	Right Turn	94	94	99.7%	21.2	7.6	C
	Subtotal	156	152	97.5%	30.5	6.4	C
Total		2,001	1,849	92.4%	22.7	7.8	C

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,133	1,051	92.7%	1.0	0.4	A
	Right Turn	89	20	22.0%	1.0	0.3	A
	Subtotal	1,222	1,070	87.6%	1.0	0.4	A
SB	Left Turn						
	Through	1,065	1,202	112.8%	21.3	14.0	C
	Right Turn						
	Subtotal	1,065	1,202	112.8%	21.3	14.0	C
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	92	94	101.9%	0.6	0.1	A
	Subtotal	92	94	101.9%	0.6	0.1	A
Total		2,379	2,366	99.4%	11.2	7.0	B

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	114	46	40.4%	55.8	10.6	E
	Through	2	3	163.6%	5.7	12.8	A
	Right Turn	255	179	70.0%	11.2	2.9	B
	Subtotal	371	228	61.4%	20.8	3.6	C
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,057	1,096	103.7%	26.4	6.3	C
	Through	209	855	409.2%	24.5	6.1	C
	Right Turn						
	Subtotal	1,266	1,951	154.1%	25.6	6.2	C
WB	Left Turn						
	Through	515	358	69.4%	114.6	40.7	F
	Right Turn	300	192	64.1%	67.9	43.7	E
	Subtotal	815	550	67.5%	98.2	41.9	F
Total		2,452	2,729	111.3%	38.7	8.7	D

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	3	1	2	5	31	8	17	41	NO
	Through	2,000	158	15	139	183	743	45	692	853	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	23	10	11	39	98	16	72	124	NO
	Through	3,700	108	9	92	126	585	40	521	669	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	53	3	50	58	170	9	156	183	NO
	Through	2,000	37	6	29	46	184	17	157	212	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	93	7	81	105	252	32	229	338	NO
	Through	2,000	73	7	63	86	283	33	237	333	NO
	Right Turn	80	1	0	0	1	26	7	20	42	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	83	97	45	374	549	113	478	879	MAX
	Through	2,000	83	97	45	374	549	113	478	879	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	144	27	97	181	520	10	493	531	MAX
	Right Turn	100	90	29	41	131	499	13	473	513	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	1	3	0	11	71	18	48	97	NO
	Through	300	1	3	0	11	71	18	48	97	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	184	239	36	661	359	352	127	1,031	MAX
	Through	2,000	1,114	215	759	1,476	1,827	90	1,667	1,911	NO
	Right Turn	400	16	3	12	24	116	20	93	149	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	115	60	50	265	471	191	185	761	MAX
	Through	2,000	398	89	293	567	894	28	822	927	NO
	Right Turn	300	25	17	10	54	190	87	108	341	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	69	19	42	111	345	86	232	480	MAX
	Through	600	310	72	176	430	584	16	552	599	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	16	4	10	26	84	58	60	257	NO
	Through	1,000	182	34	122	226	519	18	474	537	NO
	Right Turn	600	180	35	120	225	518	18	473	536	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	1	0	2	4	6	0	12	NO
	Through	2,000	415	191	181	813	918	128	668	1,074	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	30	6	22	44	140	19	102	161	NO
	Through	800	43	3	39	49	250	14	224	273	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	11	2	8	15	71	7	61	82	NO
	Through	1,250	150	36	102	201	485	109	369	701	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	104	40	72	210	349	34	287	408	MAX
	Through	350	89	38	58	190	368	26	329	418	MAX
	Right Turn	300	92	38	60	195	376	26	337	425	MAX
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	20	3	16	26	116	12	97	135	NO
	Through	1,500	27	4	22	33	159	32	121	244	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	25	3	20	29	116	22	93	171	MAX
	Through	100	25	3	20	29	116	22	93	171	MAX
	Right Turn	100	26	3	22	30	119	22	95	174	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	49	4	42	54	217	28	183	284	NO
	Through	2,000	77	12	61	101	512	78	411	689	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	5	15	10	5	41	NO
	Through	1,250	55	7	40	67	243	16	217	269	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	23	6	15	33	NO
	Through	350	0	0	0	0	7	7	0	19	NO
	Right Turn	350	0	0	0	0	7	7	0	19	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	0	0	0	0	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	1	1	0	2	51	13	28	79	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	0	2	4	69	10	55	84	NO
	Through	400	4	1	4	5	87	13	73	110	NO
	Right Turn	400	2	0	2	3	61	11	44	83	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	7	1	6	9	88	14	67	115	NO
	Through	400	7	1	6	9	88	14	67	116	NO
	Right Turn	400	4	1	3	5	86	13	68	111	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	0	7	9	83	8	70	98	NO
	Through										
	Right Turn	400	8	0	7	9	84	8	71	99	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	4	3	17	81	11	67	104	NO
	Through										
	Right Turn	400	8	4	3	17	80	11	66	103	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	1	1	1	3	50	5	41	61	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	130	2	0	1	2	48	5	39	56	NO
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	150	26	24	4	76	136	37	79	204	NO
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	150	3	1	2	5	56	9	34	69	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	150	29	18	15	77	245	40	188	323	MAX
	Through										
	Right Turn										
	Second Right										

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through	650	20	4	14	27	110	11	92	129	NO
	Right Turn	365	20	4	14	27	110	11	92	129	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	110	6	1	4	7	127	4	124	135	MAX
	Through	110	6	1	4	7	127	4	124	135	MAX
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through	285	132	19	97	157	328	4	317	333	MAX
	Right Turn										
	Second Right										

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Concept E2B
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	42.7	D	23.8	C	58.9	E	62.5	E	39.0	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	5.6	A	2.2	A					5.3	A
3	SR 9/SR 204 (west signal)	Signal			26.9	C	67.2	E	72.6	E	54.4	D
4	SR 9/Market Pl	Signal	35.9	D	19.7	B	63.2	E	58.3	E	36.0	D
5	91st Ave/SR 204	Signal	113.6	F	33.2	C	46.3	D	45.5	D	51.3	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	32.0	C	17.9	B	18.9	B	40.7	D	22.0	C
8	91st Ave/Vernon Rd	Side-street Stop	1.2	A	1.3	A	8.2	A	9.2	A	11.2	B
9	Safeway Dwy/Davies Rd	Roundabout	30.6	D	8.5	A	10.4	B	6.5	A	16.9	C
11	Transit Center Dwy/4th St	Side-street Stop	9.2	A	9.3	A	0.1	A	0.5	A	17.8	C
12	Transit Center Dwy/Market Pl	Side-street Stop			12.8	B	1.1	A	7.2	A	12.6	B
13	91st Ave/Market Pl	Signal	22.7	C	18.6	B	15.1	B	19.3	B	16.3	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.1	A	1.6	A	12.5	B	6.6	A	13.6	B
15	Vernon Rd/Davies Rd	Roundabout	7.6	A	7.6	A			2.1	A	3.4	A
16	Parking Lot Connector/7th Place	Signal	40.5	D	34.4	C	10.4	B	33.0	C	21.1	C
221	SR 9/4th St NE	Side-street Stop	1.3	A	0.3	A			0.8	A	1.6	A
255	SR 9/SR 204 (east signal)	Signal	20.5	C			26.4	C	84.4	F	35.1	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	9	108.0%	95.3	51.9	F
	Through	1,709	1,654	96.8%	35.9	4.9	D
	Right Turn	562	547	97.3%	62.8	16.0	E
	Subtotal	2,279	2,210	97.0%	42.8	4.9	D
SB	Left Turn	31	34	108.5%	83.1	29.2	F
	Through	1,396	1,393	99.8%	23.8	3.0	C
	Right Turn	93	94	101.6%	6.1	1.2	A
	Subtotal	1,520	1,521	100.1%	23.9	2.8	C
EB	Left Turn	240	238	99.3%	64.5	6.8	E
	Through	124	125	100.4%	51.9	5.7	D
	Right Turn	13	11	85.3%	12.6	4.7	B
	Subtotal	377	374	99.2%	58.8	3.8	E
WB	Left Turn	386	394	102.0%	74.7	6.6	E
	Through	232	226	97.4%	52.2	3.8	D
	Right Turn	44	41	93.2%	23.8	10.5	C
	Subtotal	662	660	99.8%	63.5	4.6	E
Total		4,838	4,766	98.5%	40.6	2.8	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,279	2,193	96.2%	5.7	0.7	A
	Right Turn						
	Subtotal	2,279	2,193	96.2%	5.7	0.7	A
SB	Left Turn						
	Through	1,475	1,653	112.1%	2.3	0.9	A
	Right Turn	129	138	107.0%	1.8	0.8	A
	Subtotal	1,604	1,791	111.7%	2.3	0.9	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		3,883	3,984	102.6%	4.2	0.7	A

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	169	163	96.3%	48.1	3.0	D
	Through	868	4	0.5%	72.7	24.0	E
	Right Turn	438	478	109.2%	8.0	5.5	A
	Subtotal	1,475	645	43.7%	18.6	3.9	B
EB	Left Turn						
	Through	1,832	1,724	94.1%	67.3	8.0	E
	Right Turn	47	39	83.0%	55.3	9.5	E
	Subtotal	1,879	1,763	93.9%	67.1	8.0	E
WB	Left Turn	155	151	97.2%	69.5	7.7	E
	Through	209	245	117.3%	70.9	8.2	E
	Right Turn						
	Subtotal	364	396	108.7%	70.4	8.0	E
Total		3,718	2,804	75.4%	56.8	5.6	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	106	100.2%	130.2	85.8	F
	Through	905	893	98.7%	25.4	3.1	C
	Right Turn	70	76	108.2%	21.0	5.1	C
	Subtotal	1,081	1,075	99.5%	36.0	10.9	D
SB	Left Turn	186	117	63.0%	79.9	7.1	E
	Through	846	829	98.0%	15.0	4.1	B
	Right Turn	308	247	80.0%	7.0	2.3	A
	Subtotal	1,340	1,192	89.0%	19.7	3.2	B
EB	Left Turn	204	114	56.1%	77.6	27.0	E
	Through	325	316	97.3%	68.7	28.3	E
	Right Turn	106	104	97.9%	40.6	10.3	D
	Subtotal	635	535	84.2%	65.2	23.7	E
WB	Left Turn	68	64	93.7%	60.8	15.4	E
	Through	270	264	97.7%	60.5	7.1	E
	Right Turn	116	98	84.7%	47.9	6.6	D
	Subtotal	454	426	93.8%	57.8	6.6	E
Total		3,510	3,228	92.0%	38.3	5.0	D

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	0	0.7%	49.9	106.6	D
	Through	128	125	97.7%	136.5	51.2	F
	Right Turn	342	398	116.3%	121.1	53.7	F
	Subtotal	519	523	100.8%	125.0	53.2	F
SB	Left Turn	164	98	60.0%	54.0	11.4	D
	Through	213	241	113.0%	27.3	5.3	C
	Right Turn	54	17	31.1%	19.3	17.2	B
	Subtotal	431	356	82.6%	32.8	4.4	C
EB	Left Turn	101	32	31.6%	63.3	16.0	E
	Through	1,331	1,280	96.2%	52.3	10.9	D
	Right Turn	161	0	0.0%	0.0	0.0	A
	Subtotal	1,593	1,312	82.4%	52.6	10.8	D
WB	Left Turn	172	177	102.6%	82.8	19.3	F
	Through	543	477	87.8%	32.2	8.5	C
	Right Turn	74	72	96.7%	28.5	14.2	C
	Subtotal	789	725	91.9%	45.1	11.5	D
Total		3,332	2,916	87.5%	60.8	11.1	E

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	103	99.2%	34.6	5.5	C
	Through	148	152	102.8%	31.5	4.5	C
	Right Turn	9	0	0.0%	0.0	0.0	A
	Subtotal	261	255	97.8%	32.9	3.6	C
SB	Left Turn	40	17	43.2%	35.6	16.7	D
	Through	115	114	99.1%	29.7	5.2	C
	Right Turn	288	297	103.1%	11.6	1.5	B
	Subtotal	443	428	96.7%	17.7	2.0	B
EB	Left Turn	527	547	103.8%	30.4	4.6	C
	Through	1,384	1,299	93.9%	15.1	2.5	B
	Right Turn	282	277	98.2%	16.1	2.0	B
	Subtotal	2,193	2,123	96.8%	19.1	2.1	B
WB	Left Turn	4	3	84.1%	10.7	22.6	B
	Through	507	489	96.4%	41.2	7.7	D
	Right Turn	78	7	9.0%	25.8	23.8	C
	Subtotal	589	499	84.7%	41.2	7.8	D
Total		3,486	3,306	94.8%	23.2	1.4	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 Concept E2B**
Volume and Delay by Movement **PM Peak Hour**

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	63	115.4%	1.9	0.7	A
	Through	108	71	65.3%	0.5	0.2	A
	Second Right						
	Subtotal	191	154	80.9%	1.2	0.4	A
SB	Left Turn	1	0	27.3%	0.0	0.2	A
	Through	118	104	88.2%	1.6	2.6	A
	Second Right						
	Subtotal	139	135	97.3%	1.4	1.9	A
EB	Left Turn	16	46	285.2%	8.6	1.2	A
	Through	7	18	257.1%	10.5	4.0	B
	Second Right						
	Subtotal	135	137	101.8%	8.2	0.7	A
WB	Left Turn	264	80	30.1%	9.4	0.7	A
	Through	52	51	98.4%	10.9	1.5	B
	Second Right						
	Subtotal	366	183	49.9%	9.1	0.6	A
Total		831	610	73.4%	5.2	0.6	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	500	463	92.7%	31.0	14.7	D
	Through	67	63	93.6%	29.8	14.3	D
	Right Turn	119	116	97.2%	29.8	14.7	D
	Subtotal	686	642	93.6%	30.6	14.6	D
SB	Left Turn	9	9	100.0%	10.5	7.8	B
	Through	40	37	92.3%	7.9	3.1	A
	Right Turn	97	66	68.0%	7.2	4.4	A
	Subtotal	146	112	76.7%	7.7	3.5	A
EB	Left Turn	105	107	102.3%	6.2	4.2	A
	Through	204	170	83.5%	7.4	4.5	A
	Right Turn	350	330	94.3%	7.1	4.3	A
	Subtotal	659	608	92.2%	7.0	4.2	A
WB	Left Turn	59	56	95.5%	10.2	6.4	B
	Through	100	96	95.6%	8.6	5.3	A
	Right Turn	6	7	119.7%	3.5	3.8	A
	Subtotal	165	159	96.5%	9.0	5.2	A
Total		1,656	1,521	91.8%	17.5	7.9	C

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	41	101.8%	6.3	0.7	A
	Through	14	9	67.5%	7.1	4.0	A
	Right Turn	5	11	225.5%	18.8	2.6	C
	Subtotal	59	61	104.2%	9.3	0.7	A
SB	Left Turn	124	121	97.6%	9.3	1.1	A
	Through	22	21	94.2%	9.1	2.3	A
	Right Turn	17	20	116.0%	8.7	2.8	A
	Subtotal	163	161	99.1%	9.2	1.1	A
EB	Left Turn	6	11	187.9%	0.9	1.0	A
	Through	89	88	99.1%	0.0	0.0	A
	Right Turn	17	73	430.5%	0.0	0.0	A
	Subtotal	112	173	154.1%	0.1	0.1	A
WB	Left Turn	3	4	139.4%	1.1	1.9	A
	Through	90	87	97.2%	0.4	0.2	A
	Right Turn	54	54	100.5%	0.6	0.1	A
	Subtotal	147	146	99.3%	0.5	0.2	A
Total		481	541	112.6%	4.0	0.4	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	50	47	93.6%	10.4	2.5	B
	Through						
	Right Turn	62	60	96.9%	13.2	5.0	B
	Subtotal	112	107	95.5%	12.4	3.8	B
EB	Left Turn	81	51	62.4%	5.3	1.7	A
	Through	500	458	91.5%	0.5	0.1	A
	Right Turn						
	Subtotal	581	508	87.5%	1.0	0.3	A
WB	Left Turn						
	Through	392	367	93.6%	7.5	5.3	A
	Right Turn	6	25	413.6%	2.0	1.8	A
	Subtotal	398	392	98.4%	7.3	5.2	A
Total		1,091	1,007	92.3%	4.5	2.2	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	105.7%	15.8	10.2	B
	Through	237	231	97.3%	23.9	23.2	C
	Right Turn	130	86	65.9%	24.3	21.7	C
	Subtotal	413	365	88.4%	23.1	21.2	C
SB	Left Turn	156	151	96.9%	22.4	9.4	C
	Through	162	283	175.0%	17.2	3.7	B
	Right Turn	41	39	94.7%	13.6	2.7	B
	Subtotal	359	473	131.9%	18.7	3.0	B
EB	Left Turn	53	58	109.1%	12.7	2.9	B
	Through	161	161	100.2%	18.2	9.1	B
	Right Turn	79	79	99.5%	11.9	3.7	B
	Subtotal	293	298	101.6%	15.4	6.1	B
WB	Left Turn	321	187	58.4%	22.8	6.7	C
	Through	156	145	93.0%	21.7	5.2	C
	Right Turn	74	146	197.7%	13.4	2.6	B
	Subtotal	551	479	86.9%	19.5	4.1	B
Total		1,616	1,615	99.9%	19.4	7.5	B

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	33	78.4%	1.6	1.4	A
	Through	549	525	95.6%	1.1	0.3	A
	Right Turn	162	148	91.5%	1.0	0.3	A
	Subtotal	753	706	93.8%	1.1	0.2	A
SB	Left Turn	21	39	183.5%	4.2	2.0	A
	Through	344	317	92.3%	1.2	0.3	A
	Right Turn	62	68	109.4%	1.1	0.2	A
	Subtotal	427	424	99.2%	1.5	0.3	A
EB	Left Turn	52	50	96.7%	15.0	3.4	C
	Through	3	9	284.8%	10.6	5.8	B
	Right Turn	51	44	86.1%	9.9	4.4	A
	Subtotal	106	103	96.9%	12.8	3.0	B
WB	Left Turn	48	68	142.6%	10.6	1.7	B
	Through	4	13	322.7%	13.0	7.3	B
	Right Turn	67	73	109.0%	2.1	0.7	A
	Subtotal	119	154	129.7%	6.4	1.1	A
Total		1,405	1,387	98.7%	2.7	0.2	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	87	0	0.0%	#DIV/0!	#DIV/0!	#DIV/0!
	Through	324	8	2.4%	11.1	5.6	B
	Right Turn	256	68	26.6%	17.6	8.5	C
	Subtotal	667	76	11.4%	17.2	7.6	C
SB	Left Turn	330	509	154.4%	7.8	11.1	A
	Through	209	6	2.7%	7.5	16.2	A
	Right Turn						
	Subtotal	539	515	95.6%	7.8	11.1	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	279	30	10.7%	2.2	0.8	A
	Through						
	Right Turn	309	584	188.9%	2.1	0.3	A
	Subtotal	588	614	104.3%	2.1	0.3	A
Total		1,794	1,205	67.1%	5.6	5.2	A

Intersection 16 **Parking Lot Connector/7th Place** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	88	85	96.3%	41.6	6.4	D
	Through	35	32	90.4%	36.3	14.1	D
	Right Turn	12	13	104.5%	21.0	7.2	C
	Subtotal	135	129	95.5%	39.1	5.2	D
SB	Left Turn	56	52	93.3%	45.1	24.9	D
	Through	74	69	92.8%	50.4	27.7	D
	Right Turn	415	398	96.0%	34.0	29.6	C
	Subtotal	545	519	95.3%	37.2	28.2	D
EB	Left Turn	564	438	77.7%	21.8	16.0	C
	Through	305	475	155.6%	14.0	24.3	B
	Right Turn	296	92	31.0%	6.7	9.1	A
	Subtotal	1,165	1,005	86.2%	16.3	17.6	B
WB	Left Turn	3	3	100.0%	7.3	15.4	A
	Through	59	54	92.3%	43.3	16.1	D
	Right Turn	94	91	96.8%	19.2	9.0	B
	Subtotal	156	148	95.2%	27.7	11.3	C
Total		2,001	1,801	90.0%	21.0	9.0	C

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 Concept E2B**
Volume and Delay by Movement **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,133	1,086	95.8%	1.3	0.4	A
	Right Turn	89	21	23.6%	1.5	0.8	A
	Subtotal	1,222	1,107	90.6%	1.4	0.4	A
SB	Left Turn						
	Through	1,065	1,193	112.0%	0.3	0.0	A
	Right Turn						
	Subtotal	1,065	1,193	112.0%	0.3	0.0	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	92	94	102.2%	0.8	0.1	A
	Subtotal	92	94	102.2%	0.8	0.1	A
Total		2,379	2,394	100.6%	0.8	0.2	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	114	46	40.6%	50.4	7.8	D
	Through	2	4	186.4%	59.4	29.7	E
	Right Turn	255	182	71.3%	13.0	3.1	B
	Subtotal	371	232	62.5%	21.0	2.6	C
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,057	1,062	100.5%	27.3	4.5	C
	Through	209	824	394.0%	25.2	4.2	C
	Right Turn						
	Subtotal	1,266	1,886	149.0%	26.4	4.4	C
WB	Left Turn						
	Through	515	349	67.8%	97.1	36.1	F
	Right Turn	300	189	62.9%	51.8	36.3	D
	Subtotal	815	538	66.0%	81.8	36.1	F
Total		2,452	2,656	108.3%	37.3	8.3	D

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	4	2	2	7	37	8	21	49	NO
	Through	2,000	157	17	134	183	701	55	629	784	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	23	13	10	48	104	19	73	129	NO
	Through	3,700	109	11	95	129	612	48	534	702	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	53	3	49	58	166	11	152	190	NO
	Through	2,000	36	6	27	47	164	17	137	187	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	91	11	78	113	251	37	220	343	NO
	Through	2,000	72	5	63	79	291	22	258	321	NO
	Right Turn	80	1	0	0	1	26	6	21	37	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	89	77	47	282	476	124	378	705	MAX
	Through	2,000	89	77	47	282	476	124	378	705	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	134	31	96	185	516	16	482	539	MAX
	Right Turn	100	83	31	42	140	491	21	458	520	MAX
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	2	2	0	5	77	24	45	117	NO
	Through	300	2	2	0	5	77	24	45	117	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	87	50	34	170	220	61	148	331	NO
	Through	2,000	73	4	65	79	334	25	305	378	NO
	Right Turn	400	9	2	6	13	97	14	83	124	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	53	6	45	60	183	17	156	206	NO
	Through	2,000	48	10	27	59	305	38	252	367	NO
	Right Turn	300	10	7	5	30	108	18	91	149	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	35	14	19	64	205	66	103	312	MAX
	Through	600	165	52	87	247	491	41	417	554	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	13	3	9	18	73	10	58	88	NO
	Through	1,000	137	23	113	196	493	30	437	532	NO
	Right Turn	600	135	23	111	194	492	30	436	531	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	1	0	2	3	5	0	12	NO
	Through	2,000	411	178	221	799	871	140	706	1,151	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	34	10	25	56	146	25	113	199	NO
	Through	800	43	5	33	49	254	11	239	271	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	10	2	8	14	63	9	49	79	NO
	Through	1,250	140	59	105	313	459	102	372	716	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	109	41	78	216	339	39	275	394	MAX
	Through	350	96	44	63	215	364	26	328	407	MAX
	Right Turn	300	100	45	65	220	372	26	336	415	MAX
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	20	3	12	24	117	18	98	163	NO
	Through	1,500	26	3	22	33	158	23	128	212	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	24	2	21	29	120	20	92	154	MAX
	Through	100	24	2	21	29	120	20	92	154	MAX
	Right Turn	100	26	3	22	30	123	20	94	156	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	48	5	39	57	208	17	178	234	NO
	Through	2,000	80	34	50	179	584	172	459	1,079	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	3	11	6	5	22	NO
	Through	1,250	51	7	41	60	251	21	221	278	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	1	38	7	28	48	NO
	Through	350	0	0	0	0	13	11	0	31	NO
	Right Turn	350	0	0	0	0	13	11	0	31	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	1	0	5	5	15	0	51	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	1	2	0	7	69	18	49	117	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	1	2	5	67	10	53	87	NO
	Through	400	4	1	3	5	86	8	77	106	NO
	Right Turn	400	2	1	2	4	61	8	50	75	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	7	1	6	9	110	14	90	137	NO
	Through	400	7	1	6	9	110	14	90	137	NO
	Right Turn	400	4	1	3	6	107	14	86	133	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	1	7	9	82	7	70	96	NO
	Through										
	Right Turn	400	8	0	8	9	83	7	71	97	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	6	2	4	10	81	7	74	97	NO
	Through										
	Right Turn	400	5	2	4	9	80	7	74	96	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	1	0	0	2	49	12	31	65	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	2	0	1	2	50	6	39	60	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	7	3	5	14	95	17	74	125	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	4	3	2	14	48	11	33	67	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	14	3	10	19	127	34	84	186	NO

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	365	28	21	19	90	128	42	97	246	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right	110 110	9 9	10 10	5 5	40 40	126 126	3 3	122 122	133 133	MAX MAX
WB	U Turn Second Left Left Turn Through Right Turn Second Right	285	127	18	93	146	321	19	268	333	MAX

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Concept E2C
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	29.8	C	23.0	C	59.0	E	64.5	E	33.6	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	3.9	A	3.4	A			10.7	B	9.6	A
3	SR 9/SR 204 (west signal)	Signal			15.1	B	55.7	E	46.3	D	42.0	D
4	SR 9/Market Pl	Signal	157.9	F	87.7	F	120.5	F	86.8	F	98.6	F
5	91st Ave/SR 204	Signal	52.3	D	49.7	D	48.1	D	50.6	D	47.3	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	37.2	D	22.1	C	20.6	C	42.3	D	24.1	C
8	91st Ave/Vernon Rd	Side-street Stop	3.1	A	21.8	C	23.6	C	41.6	E	58.5	F
9	Safeway Dwy/Davies Rd	Roundabout	12.9	B	4.9	A	3.9	A	4.0	A	6.2	A
11	Transit Center Dwy/4th St	Side-street Stop	10.6	B	9.2	A	0.3	A	0.5	A	12.5	B
12	Transit Center Dwy/Market Pl	Side-street Stop			26.4	D	1.5	A	25.8	D	20.4	C
13	91st Ave/Market Pl	Signal	106.1	F	148.9	F	64.9	E	41.4	D	45.9	D
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.0	A	1.8	A	12.5	B	6.6	A	12.8	B
15	Vernon Rd/Davies Rd	Signal	29.9	C	28.8	C	33.2	C	8.9	A	21.3	C
16	Parking Lot Connector/7th Place	Side-street Stop	3.3	A	6.9	A	1.7	A	9.2	A	10.6	B
221	SR 9/4th St NE	Side-street Stop	1.1	A					0.6	A	1.1	A
255	SR 9/SR 204 (east signal)	Signal	30.3	C			21.6	C	43.1	D	23.7	C
401	SR 9 Off-ramp/Vernon-Davies	Side-street Stop			16.5	C	13.6	B	18.0	C	26.0	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2C**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	5	56.8%	41.6	39.0	D
	Through	1,759	1,634	92.9%	26.8	5.5	C
	Right Turn	562	517	92.0%	39.1	11.7	D
	Subtotal	2,329	2,155	92.5%	29.9	4.3	C
SB	Left Turn	31	34	108.5%	89.8	42.1	F
	Through	1,396	1,395	99.9%	22.6	2.4	C
	Right Turn	93	95	101.9%	5.3	1.3	A
	Subtotal	1,520	1,523	100.2%	23.0	3.5	C
EB	Left Turn	240	237	98.6%	62.4	4.5	E
	Through	124	125	100.9%	55.3	9.0	E
	Right Turn	13	11	81.1%	12.8	3.9	B
	Subtotal	377	372	98.7%	58.7	3.2	E
WB	Left Turn	386	390	101.1%	74.6	12.3	E
	Through	232	226	97.5%	54.2	4.1	D
	Right Turn	44	42	94.8%	28.9	10.0	C
	Subtotal	662	658	99.4%	64.5	7.0	E
Total		4,888	4,709	96.3%	35.0	3.2	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,146	1,968	91.7%	3.8	0.8	A
	Right Turn						
	Subtotal	2,146	1,968	91.7%	3.8	0.8	A
SB	Left Turn						
	Through	1,659	1,655	99.7%	3.8	10.3	A
	Right Turn	135	141	104.7%	2.3	5.4	A
	Subtotal	1,794	1,796	100.1%	3.7	10.0	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	185	184	99.7%	9.8	4.3	A
	Subtotal	185	184	99.7%	9.8	4.3	A
Total		4,125	3,949	95.7%	3.9	4.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2C**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	116	113	97.5%	44.9	4.4	D
	Through	2	4	200.0%	63.1	28.4	E
	Right Turn	491	484	98.5%	8.2	1.9	A
	Subtotal	609	601	98.6%	15.0	1.7	B
EB	Left Turn						
	Through	1,380	1,284	93.0%	56.4	5.2	E
	Right Turn	151	123	81.7%	48.9	4.5	D
	Subtotal	1,531	1,407	91.9%	55.7	5.1	E
WB	Left Turn	104	104	99.6%	45.6	5.4	D
	Through	196	177	90.5%	46.5	5.1	D
	Right Turn						
	Subtotal	300	281	93.6%	46.2	5.2	D
Total		2,440	2,289	93.8%	44.0	3.3	D

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	97	91.7%	238.2	49.5	F
	Through	907	830	91.5%	149.1	6.0	F
	Right Turn	62	69	111.7%	138.9	5.9	F
	Subtotal	1,075	996	92.7%	157.0	7.7	F
SB	Left Turn	196	171	87.0%	178.3	17.2	F
	Through	846	804	95.0%	82.5	13.1	F
	Right Turn	265	248	93.4%	63.5	17.2	E
	Subtotal	1,307	1,222	93.5%	92.5	11.0	F
EB	Left Turn	222	180	81.3%	158.7	43.3	F
	Through	325	284	87.4%	116.1	34.0	F
	Right Turn	106	96	90.3%	50.6	11.3	D
	Subtotal	653	560	85.8%	119.3	32.4	F
WB	Left Turn	68	64	94.4%	102.0	24.4	F
	Through	267	265	99.2%	98.1	36.0	F
	Right Turn	120	115	95.5%	62.5	19.3	E
	Subtotal	455	444	97.5%	91.0	30.1	F
Total		3,490	3,222	92.3%	117.3	5.4	F

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2C**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	66	134.1%	72.0	26.1	E
	Through	201	179	89.1%	57.2	17.9	E
	Right Turn	287	263	91.5%	42.5	18.0	D
	Subtotal	537	507	94.5%	50.8	17.9	D
SB	Left Turn	176	165	93.6%	53.9	13.2	D
	Through	302	289	95.5%	54.8	22.5	D
	Right Turn	121	117	96.8%	33.9	4.8	C
	Subtotal	599	570	95.2%	49.6	8.3	D
EB	Left Turn	309	282	91.2%	55.5	12.7	E
	Through	1,068	979	91.7%	48.3	5.8	D
	Right Turn	161	167	104.0%	41.7	29.8	D
	Subtotal	1,538	1,429	92.9%	48.7	6.2	D
WB	Left Turn	114	109	95.2%	92.3	22.1	F
	Through	409	403	98.4%	46.9	8.7	D
	Right Turn	164	145	88.1%	26.8	13.9	C
	Subtotal	687	656	95.4%	50.6	8.8	D
Total		3,361	3,162	94.1%	49.8	5.7	D

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	104	99.7%	39.6	7.4	D
	Through	148	143	96.7%	37.5	5.1	D
	Right Turn	9	12	129.3%	21.4	13.7	C
	Subtotal	261	258	99.0%	37.5	5.1	D
SB	Left Turn	40	33	83.4%	36.5	11.9	D
	Through	115	130	113.1%	34.0	5.7	C
	Right Turn	288	282	97.8%	14.5	1.7	B
	Subtotal	443	445	100.5%	22.2	2.2	C
EB	Left Turn	557	508	91.2%	32.2	2.2	C
	Through	1,354	1,398	103.3%	16.7	3.8	B
	Right Turn	282	282	99.9%	19.4	3.8	B
	Subtotal	2,193	2,188	99.8%	20.6	3.0	C
WB	Left Turn	4	3	75.0%	15.3	26.2	B
	Through	507	569	112.2%	43.4	6.2	D
	Right Turn	18	17	92.4%	24.0	15.8	C
	Subtotal	529	588	111.2%	42.9	6.2	D
Total		3,426	3,480	101.6%	25.7	1.7	C

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS

NB	Left Turn			
	Through			
	Right Turn			
	Subtotal			
SB	Left Turn			
	Through			
	Right Turn			
	Subtotal			
EB	Left Turn			
	Through			
	Right Turn			
	Subtotal			
WB	Left Turn			
	Through			
	Right Turn			
	Subtotal			
Total				

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	55	38	69.6%	2.9	1.0	A
	Through	108	97	89.9%	3.0	1.3	A
	Second Right						
	Subtotal	555	477	85.9%	3.1	1.2	A
SB	Left Turn	1	0	45.5%	2.2	6.8	A
	Through	118	114	96.8%	25.0	9.0	C
	Second Right						
	Subtotal	139	134	96.4%	22.7	7.9	C
EB	Left Turn	16	15	94.9%	14.6	8.3	B
	Through	55	46	83.3%	19.3	12.8	C
	Second Right						
	Subtotal	95	84	88.2%	25.0	21.5	C
WB	Left Turn	301	276	91.6%	40.2	9.4	E
	Through	59	58	98.0%	65.1	24.8	F
	Second Right						
	Subtotal	411	389	94.5%	41.4	9.8	E
Total		1,200	1,083	90.3%	21.0	5.2	C

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	315	291	92.3%	13.6	3.1	B
	Through	51	49	96.1%	14.6	2.8	B
	Right Turn	114	111	97.1%	11.8	3.5	B
	Subtotal	480	450	93.8%	13.2	3.0	B
SB	Left Turn	9	10	106.1%	4.1	3.1	A
	Through	26	24	93.4%	4.2	1.3	A
	Right Turn	83	80	96.2%	5.3	1.9	A
	Subtotal	118	114	96.3%	5.0	1.3	A
EB	Left Turn	156	131	84.3%	3.1	1.0	A
	Through	180	178	98.7%	4.2	0.9	A
	Right Turn	214	201	93.9%	3.9	1.0	A
	Subtotal	550	510	92.8%	3.8	0.8	A
WB	Left Turn	54	52	96.0%	3.7	1.4	A
	Through	122	102	83.6%	4.0	1.3	A
	Right Turn	6	7	121.2%	6.1	4.7	A
	Subtotal	182	161	88.5%	4.1	1.2	A
Total		1,330	1,235	92.9%	7.4	1.2	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2C**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 | **Transit Center Dwy/4th St** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	19	20	104.8%	7.4	2.9	A
	Through	12	7	61.4%	13.0	5.1	B
	Right Turn	17	22	131.0%	12.9	1.9	B
	Subtotal	48	50	103.2%	10.6	1.4	B
SB	Left Turn	124	122	98.3%	9.5	1.0	A
	Through	22	20	93.0%	8.3	2.0	A
	Right Turn	17	19	113.4%	8.1	2.7	A
	Subtotal	163	162	99.2%	9.3	0.8	A
EB	Left Turn	8	12	154.5%	1.8	2.9	A
	Through	76	75	98.9%	0.3	0.2	A
	Right Turn	17	28	165.8%	0.3	0.2	A
	Subtotal	101	116	114.6%	0.4	0.2	A
WB	Left Turn	3	2	78.8%	1.3	2.2	A
	Through	90	88	97.5%	0.4	0.2	A
	Right Turn	54	56	103.2%	0.7	0.1	A
	Subtotal	147	146	99.2%	0.5	0.2	A
Total		459	473	103.0%	4.6	0.3	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	16	13	79.5%	19.4	19.7	C
	Through						
	Right Turn	58	55	94.2%	29.8	30.4	D
	Subtotal	74	67	91.0%	28.5	28.4	D
EB	Left Turn	73	68	93.0%	11.7	17.4	B
	Through	502	455	90.7%	0.5	0.2	A
	Right Turn						
	Subtotal	575	523	91.0%	1.5	1.3	A
WB	Left Turn						
	Through	392	391	99.8%	28.3	28.1	D
	Right Turn	6	3	53.0%	15.8	21.2	C
	Subtotal	398	394	99.1%	28.3	28.0	D
Total		1,047	985	94.1%	14.0	13.3	B

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	47	102.2%	55.4	50.9	E
	Through	199	187	94.0%	110.5	98.2	F
	Right Turn	130	122	93.9%	123.1	109.0	F
	Subtotal	375	356	95.0%	108.9	97.3	F
SB	Left Turn	156	150	96.0%	189.6	299.6	F
	Through	185	175	94.7%	129.9	243.0	F
	Right Turn	41	34	83.4%	125.8	244.8	F
	Subtotal	382	359	94.1%	161.3	282.1	F
EB	Left Turn	53	47	89.2%	32.4	32.9	C
	Through	201	182	90.5%	80.0	85.2	F
	Right Turn	79	77	98.0%	63.2	80.4	E
	Subtotal	333	307	92.1%	68.4	75.8	E
WB	Left Turn	298	276	92.6%	50.9	31.0	D
	Through	154	145	94.3%	34.6	19.9	C
	Right Turn	87	78	89.8%	25.6	16.7	C
	Subtotal	539	499	92.6%	42.2	25.1	D
Total		1,629	1,521	93.4%	83.6	82.0	F

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	38	96.1%	1.9	1.0	A
	Through	548	499	91.1%	1.0	0.4	A
	Right Turn	133	130	97.9%	1.0	0.3	A
	Subtotal	721	668	92.6%	1.1	0.3	A
SB	Left Turn	22	24	107.0%	5.4	2.1	A
	Through	344	332	96.4%	1.6	0.6	A
	Right Turn	62	68	110.3%	1.3	0.2	A
	Subtotal	428	424	99.0%	1.8	0.4	A
EB	Left Turn	52	53	101.6%	14.3	3.1	B
	Through	6	3	54.5%	7.8	8.6	A
	Right Turn	48	47	97.5%	11.3	4.0	B
	Subtotal	106	103	97.1%	12.8	2.7	B
WB	Left Turn	68	68	99.5%	11.3	2.2	B
	Through	4	5	113.6%	7.5	6.9	A
	Right Turn	67	69	103.3%	2.0	1.0	A
	Subtotal	139	141	101.7%	6.7	1.3	A
Total		1,394	1,336	95.8%	2.8	0.3	A

Intersection 15 **Vernon Rd/Davies Rd** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	31	30	97.9%	36.7	12.3	D
	Through	39	38	98.1%	28.6	13.0	C
	Right Turn	9	9	105.1%	15.6	8.9	B
	Subtotal	79	78	98.8%	30.1	9.9	C
SB	Left Turn	374	365	97.5%	30.3	6.7	C
	Through	6	6	106.1%	23.0	12.7	C
	Right Turn	155	143	92.5%	27.9	6.8	C
	Subtotal	535	514	96.2%	29.6	6.7	C
EB	Left Turn	246	210	85.4%	36.3	14.4	D
	Through	174	153	88.0%	31.8	12.2	C
	Right Turn	28	25	88.3%	33.7	18.5	C
	Subtotal	448	388	86.6%	34.4	13.5	C
WB	Left Turn	2	2	100.0%	2.4	1.9	A
	Through	78	67	85.5%	11.5	2.7	B
	Right Turn	476	453	95.1%	8.6	0.9	A
	Subtotal	556	522	93.8%	9.0	1.1	A
Total		1,618	1,502	92.8%	23.4	5.1	C

Intersection 16 **Parking Lot Connector/7th Place** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	34	33	97.3%	3.6	1.0	A
	Through	6	5	81.8%	2.1	1.7	A
	Right Turn	2	2	95.5%	2.0	3.5	A
	Subtotal	42	40	95.0%	3.6	0.8	A
SB	Left Turn	55	52	94.0%	7.4	1.9	A
	Through	20	20	101.4%	6.4	2.4	A
	Right Turn	81	80	99.1%	6.5	1.1	A
	Subtotal	156	152	97.6%	6.8	1.1	A
EB	Left Turn	53	43	80.8%	1.9	0.5	A
	Through	497	463	93.2%	1.6	0.6	A
	Right Turn	38	53	138.8%	1.8	1.2	A
	Subtotal	588	559	95.0%	1.7	0.6	A
WB	Left Turn	20	15	74.5%	12.3	3.1	B
	Through	62	54	87.5%	9.9	0.8	A
	Right Turn	93	84	90.2%	8.2	1.2	A
	Subtotal	175	153	87.5%	9.2	0.8	A
Total		961	904	94.1%	4.0	0.3	A

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,188	1,067	89.8%	1.1	0.3	A
	Right Turn	62	56	90.0%	1.1	0.2	A
	Subtotal	1,250	1,123	89.8%	1.1	0.3	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	172	171	99.3%	0.7	0.1	A
	Subtotal	172	171	99.3%	0.7	0.1	A
Total		1,422	1,294	91.0%	1.0	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2C**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	166	151	90.7%	48.6	6.0	D
	Through	2	3	154.5%	73.6	28.4	E
	Right Turn	145	127	87.6%	6.2	1.2	A
	Subtotal	313	281	89.7%	29.9	2.9	C
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,053	965	91.7%	22.7	3.4	C
	Through	443	431	97.4%	19.7	2.9	B
	Right Turn						
	Subtotal	1,496	1,397	93.4%	21.7	3.3	C
WB	Left Turn						
	Through	134	131	97.6%	51.0	5.6	D
	Right Turn	43	38	87.7%	12.4	2.6	B
	Subtotal	177	169	95.2%	43.1	4.3	D
Total		1,986	1,846	93.0%	25.2	2.8	C

Intersection 401 **SR 9 Off-ramp/Vernon-Davies** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	33	31	93.4%	27.6	30.4	D
	Through						
	Right Turn	102	108	105.5%	13.0	8.4	B
	Subtotal	135	138	102.6%	16.4	10.2	C
EB	Left Turn						
	Through	415	356	85.8%	13.9	23.1	B
	Right Turn						
	Subtotal	415	356	85.8%	13.9	23.1	B
WB	Left Turn						
	Through	264	240	90.8%	18.9	10.1	C
	Right Turn						
	Subtotal	264	240	90.8%	18.9	10.1	C
Total		814	735	90.2%	14.8	9.8	B

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 Concept E2C**
Volume and Delay by Movement **PM Peak Hour**

Intersection 231 **Vernon/SR 9 NB Onramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	128	124	96.6%	6.1	1.7	A
	Through	633	578	91.3%	0.1	0.0	A
	Right Turn						
	Subtotal	761	702	92.2%	1.1	0.3	A
SB	Left Turn						
	Through	535	514	96.1%	8.4	4.3	A
	Right Turn	55	60	109.4%	4.7	2.6	A
	Subtotal	590	574	97.4%	8.0	3.9	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		1,351	1,276	94.5%	4.3	1.8	A

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	3	1	1	4	24	7	15	36	NO
	Through	2,000	144	12	124	168	616	44	532	682	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	23	12	11	48	89	17	62	117	NO
	Through	3,700	104	10	86	123	590	66	506	747	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	52	2	49	54	165	13	141	185	NO
	Through	2,000	35	5	27	46	169	12	152	187	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	91	8	80	110	248	25	226	313	NO
	Through	2,000	71	7	60	82	292	32	231	352	NO
	Right Turn	80	1	0	0	1	26	6	20	37	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	37	8	26	53	198	59	144	302	NO
	Through	2,000	37	8	26	53	198	59	144	302	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	60	9	48	71	356	39	294	409	NO
	Right Turn	100	1	1	0	3	45	26	5	93	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	1	1	0	2	37	32	11	126	NO
	Through	300	1	1	0	2	37	32	11	126	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	768	617	39	1,476	890	579	152	1,492	AVG
	Through	2,000	1,353	178	962	1,532	1,861	83	1,628	1,918	NO
	Right Turn	400	14	3	12	22	114	11	101	145	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	290	108	110	431	857	115	625	953	AVG
	Through	2,000	463	118	264	672	927	34	861	965	NO
	Right Turn	300	24	28	7	105	183	125	93	550	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	217	62	150	330	571	32	491	605	AVG
	Through	600	267	70	145	355	584	17	549	605	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	19	7	11	36	92	34	60	175	NO
	Through	1,000	204	29	167	260	523	18	495	546	NO
	Right Turn	600	202	29	165	259	522	18	494	545	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	38	26	18	108	211	84	118	384	MAX
	Through	2,000	155	35	114	222	541	107	409	767	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	52	11	36	72	257	14	228	268	MAX
	Through	800	134	8	118	146	277	1	275	279	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	95	11	83	122	332	31	280	383	NO
	Through	1,250	104	25	86	168	375	75	312	576	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	61	16	39	95	282	26	244	330	MAX
	Through	350	80	12	62	98	310	23	258	343	NO
	Right Turn	300	85	12	67	103	317	23	265	351	MAX
	Second Right										

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2C**
Queue Length | **PM Peak Hour**

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	20	3	16	25	116	19	92	145	NO
	Through	1,500	27	4	21	31	166	21	120	192	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	28	2	26	32	119	14	101	140	MAX
	Through	100	28	2	26	32	119	14	101	140	MAX
	Right Turn	100	30	2	28	34	121	14	103	142	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	45	3	39	50	194	15	170	215	NO
	Through	2,000	81	15	57	108	575	85	436	712	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	2	14	9	0	27	NO
	Through	1,250	66	7	53	76	257	10	237	267	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	3	10	0	32	28	22	8	79	NO
	Through	350	3	4	0	14	54	12	33	68	NO
	Right Turn	350	3	4	0	14	54	12	33	68	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	15	9	10	42	107	30	92	198	NO
	Through	400	1	3	0	8	5	16	0	55	NO
	Right Turn	400	30	18	6	50	169	35	120	229	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	6	8	2	29	62	24	36	121	NO
	Through	400	9	9	4	36	86	24	62	147	NO
	Right Turn	400	5	8	1	27	49	23	32	110	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	102	11	84	120	173	5	166	180	NO
	Through	400	103	11	84	120	173	5	166	180	NO
	Right Turn	400	97	11	78	115	169	5	161	176	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	0	7	9	84	8	71	98	NO
	Through										
	Right Turn	400	8	0	7	9	85	8	72	99	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	5	3	2	10	54	11	42	77	NO
	Through										
	Right Turn	400	5	3	2	11	53	11	41	76	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	2	2	1	7	59	18	44	110	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	4	5	1	18	55	34	33	151	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	33	30	10	103	144	38	99	228	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	3	1	2	4	54	9	39	69	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	62	40	29	155	329	68	213	416	MAX

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	365	48	5	41	58	176	21	153	212	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right	110 110	2 2	1 1	2 2	3 3	119 119	8 8	105 105	126 126	MAX MAX
WB	U Turn Second Left Left Turn Through Right Turn Second Right	285	27	3	23	33	122	14	102	141	NO

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Concept E2D
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	
1	SR 9/Lundeen Pkwy	Signal	31.5	C	20.0	B	56.9	E	60.5	E	31.4	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.2	A	0.6	A			10.5	B	9.5	A
3	SR 9/SR 204 (west signal)	Signal			12.8	B	59.9	E	47.7	D	42.8	D
4	SR 9/Market Pl	Signal	35.8	D	43.6	D	71.8	E	54.8	D	43.9	D
5	91st Ave/SR 204	Signal	39.4	D	39.7	D	45.1	D	42.1	D	41.1	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	38.7	D	20.1	C	16.6	B	46.5	D	22.1	C
8	91st Ave/Vernon Rd	Side-street Stop	3.1	A	15.7	C	18.7	C	34.0	D	47.5	E
9	Safeway Dwy/Davies Rd	Roundabout	13.8	B	5.0	A	4.4	A	4.2	A	6.7	A
11	Transit Center Dwy/4th St	Side-street Stop	10.6	B	9.1	A	0.4	A	0.5	A	12.3	B
12	Transit Center Dwy/Market Pl	Side-street Stop			14.3	B	1.5	A	9.1	A	12.5	B
13	91st Ave/Market Pl	Signal	46.5	D	55.9	E	24.3	C	29.0	C	26.4	C
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.9	A	1.6	A	12.2	B	6.9	A	13.5	B
15	Vernon Rd/Davies Rd	Signal	28.8	C	39.4	D	37.0	D	11.4	B	24.9	C
16	Parking Lot Connector/7th Place	Side-street Stop	3.7	A	6.2	A	1.6	A	8.2	A	9.8	A
221	SR 9/4th St NE	Side-street Stop	1.6	A					0.8	A	1.4	A
255	SR 9/SR 204 (east signal)	Signal	32.9	C			29.1	C	44.3	D	27.1	C
401	SR 9 Off-ramp/Vernon-Davies	Side-street Stop			21.4	C	13.1	B	21.9	C	45.0	E
231	Vernon/SR 9 NB Onramp	Uncontrolled	1.0	A	15.1	C						

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2D**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	5	56.8%	50.1	70.2	D
	Through	1,759	1,700	96.7%	26.8	5.3	C
	Right Turn	562	561	99.8%	44.2	14.2	D
	Subtotal	2,329	2,266	97.3%	31.2	5.3	C
SB	Left Turn	31	34	109.1%	86.7	36.8	F
	Through	1,396	1,399	100.2%	19.5	2.8	B
	Right Turn	93	95	101.9%	5.2	1.1	A
	Subtotal	1,520	1,528	100.5%	20.1	2.7	C
EB	Left Turn	240	237	98.7%	60.7	3.6	E
	Through	124	125	100.5%	52.4	7.4	D
	Right Turn	13	11	81.1%	15.9	5.4	B
	Subtotal	377	372	98.7%	56.5	4.2	E
WB	Left Turn	386	389	100.8%	67.7	6.3	E
	Through	232	226	97.3%	54.7	4.8	D
	Right Turn	44	42	94.4%	27.8	11.2	C
	Subtotal	662	656	99.1%	60.7	3.9	E
Total		4,888	4,822	98.6%	33.7	2.6	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,146	2,130	99.3%	1.2	0.4	A
	Right Turn						
	Subtotal	2,146	2,130	99.3%	1.2	0.4	A
SB	Left Turn						
	Through	1,659	1,655	99.8%	0.6	0.2	A
	Right Turn	135	141	104.1%	0.7	0.6	A
	Subtotal	1,794	1,796	100.1%	0.6	0.2	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	185	133	72.1%	10.7	3.5	B
	Subtotal	185	133	72.1%	10.7	3.5	B
Total		4,125	4,060	98.4%	1.3	0.3	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2D**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	116	114	98.0%	41.1	4.4	D
	Through	2	4	200.0%	68.4	24.6	E
	Right Turn	491	491	100.0%	6.4	1.4	A
	Subtotal	609	609	100.0%	12.8	1.8	B
EB	Left Turn						
	Through	1,380	1,402	101.6%	63.0	11.1	E
	Right Turn	151	145	96.0%	49.2	6.9	D
	Subtotal	1,531	1,547	101.1%	61.7	10.7	E
WB	Left Turn	104	104	100.0%	47.6	5.0	D
	Through	196	183	93.5%	48.5	5.0	D
	Right Turn						
	Subtotal	300	287	95.8%	48.2	5.0	D
Total		2,440	2,443	100.1%	48.2	6.2	D

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	108	102.3%	102.6	45.1	F
	Through	907	895	98.7%	27.5	2.4	C
	Right Turn	62	73	117.0%	25.5	6.3	C
	Subtotal	1,075	1,076	100.1%	35.4	6.9	D
SB	Left Turn	196	197	100.3%	157.9	82.6	F
	Through	846	837	98.9%	27.8	16.0	C
	Right Turn	265	259	97.8%	10.8	5.1	B
	Subtotal	1,307	1,293	98.9%	44.9	23.2	D
EB	Left Turn	222	188	84.9%	90.3	47.0	F
	Through	325	316	97.2%	77.8	38.0	E
	Right Turn	106	107	100.9%	37.0	10.1	D
	Subtotal	653	611	93.6%	75.2	36.2	E
WB	Left Turn	68	65	94.9%	55.0	10.5	E
	Through	267	265	99.3%	60.8	10.8	E
	Right Turn	120	115	96.1%	42.4	5.9	D
	Subtotal	455	445	97.8%	55.4	9.0	E
Total		3,490	3,425	98.1%	48.9	12.0	D

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	0	0.7%	13.5	30.0	B
	Through	201	190	94.7%	47.0	10.9	D
	Right Turn	287	309	107.5%	41.4	10.7	D
	Subtotal	537	499	93.0%	43.4	10.6	D
SB	Left Turn	176	168	95.5%	63.1	8.6	E
	Through	302	300	99.5%	31.2	6.6	C
	Right Turn	121	121	99.8%	25.6	5.0	C
	Subtotal	599	589	98.4%	40.2	7.1	D
EB	Left Turn	309	309	99.9%	53.4	3.2	D
	Through	1,068	1,070	100.2%	49.2	6.3	D
	Right Turn	161	0	0.0%	0.0	0.0	A
	Subtotal	1,538	1,378	89.6%	50.1	5.4	D
WB	Left Turn	114	111	97.0%	76.7	13.3	E
	Through	409	409	100.1%	40.2	4.8	D
	Right Turn	164	151	92.0%	21.2	3.9	C
	Subtotal	687	671	97.6%	42.6	5.8	D
Total		3,361	3,138	93.4%	45.6	3.1	D

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	107	103.3%	44.1	5.8	D
	Through	148	150	101.3%	36.1	5.9	D
	Right Turn	9	12	129.3%	21.2	12.8	C
	Subtotal	261	269	103.1%	38.7	3.5	D
SB	Left Turn	40	33	83.4%	36.6	15.1	D
	Through	115	130	113.4%	31.8	3.9	C
	Right Turn	288	282	97.8%	12.2	1.6	B
	Subtotal	443	445	100.5%	20.2	2.5	C
EB	Left Turn	557	552	99.1%	25.6	1.8	C
	Through	1,354	1,334	98.5%	12.9	1.1	B
	Right Turn	282	304	107.9%	14.5	2.2	B
	Subtotal	2,193	2,190	99.9%	16.2	1.3	B
WB	Left Turn	4	4	93.2%	21.9	29.1	C
	Through	507	508	100.2%	46.1	6.5	D
	Right Turn	18	16	87.4%	27.6	14.1	C
	Subtotal	529	528	99.7%	45.6	6.5	D
Total		3,426	3,432	100.2%	22.9	1.4	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2D**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	39	70.2%	2.8	1.0	A
	Through	108	99	91.6%	2.8	0.7	A
	Second Right						
	Subtotal	555	517	93.1%	3.0	0.6	A
SB	Left Turn	1	0	45.5%	5.4	17.0	A
	Through	118	115	97.7%	17.1	10.7	C
	Second Right						
	Subtotal	139	136	97.5%	16.3	9.6	C
EB	Left Turn	16	15	96.6%	14.8	9.6	B
	Through	55	49	89.9%	18.3	5.4	C
	Second Right						
	Subtotal	95	88	92.8%	19.1	7.5	C
WB	Left Turn	301	290	96.3%	31.3	9.2	D
	Through	59	60	101.2%	62.1	28.2	F
	Second Right						
	Subtotal	411	405	98.6%	34.2	10.6	D
Total		1,200	1,146	95.5%	16.9	5.0	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2D**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	315	306	97.2%	14.7	4.0	B
	Through	51	52	101.2%	12.8	3.5	B
	Right Turn	114	112	98.6%	12.8	4.6	B
	Subtotal	480	470	98.0%	14.0	4.0	B
SB	Left Turn	9	10	108.1%	4.1	2.9	A
	Through	26	24	94.1%	4.5	1.2	A
	Right Turn	83	82	98.4%	5.3	1.6	A
	Subtotal	118	116	98.2%	5.0	1.3	A
EB	Left Turn	156	135	86.4%	3.6	1.2	A
	Through	180	182	100.9%	5.1	1.4	A
	Right Turn	214	217	101.4%	4.3	1.1	A
	Subtotal	550	533	96.9%	4.4	1.1	A
WB	Left Turn	54	53	98.5%	4.4	1.5	A
	Through	122	104	85.2%	4.0	1.3	A
	Right Turn	6	7	124.2%	6.1	5.0	A
	Subtotal	182	165	90.4%	4.2	1.3	A
Total		1,330	1,284	96.5%	7.9	1.5	A

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	19	20	106.2%	5.8	0.8	A
	Through	12	12	100.8%	11.0	6.5	B
	Right Turn	17	24	139.6%	14.4	2.3	B
	Subtotal	48	56	116.7%	10.3	1.4	B
SB	Left Turn	124	122	98.3%	9.2	0.9	A
	Through	22	20	93.0%	8.7	2.3	A
	Right Turn	17	19	113.4%	8.1	2.5	A
	Subtotal	163	162	99.2%	9.1	0.8	A
EB	Left Turn	8	8	98.9%	1.8	3.4	A
	Through	76	76	100.1%	0.3	0.3	A
	Right Turn	17	14	81.8%	0.3	0.3	A
	Subtotal	101	98	96.9%	0.4	0.4	A
WB	Left Turn	3	0	15.2%	0.0	0.0	A
	Through	90	89	98.6%	0.4	0.2	A
	Right Turn	54	57	105.4%	0.6	0.1	A
	Subtotal	147	146	99.4%	0.5	0.1	A
Total		459	462	100.6%	4.8	0.4	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	16	13	79.5%	9.9	4.5	A
	Through						
	Right Turn	58	53	91.4%	14.4	8.3	B
	Subtotal	74	66	88.8%	13.4	7.2	B
EB	Left Turn	73	89	121.9%	6.1	2.8	A
	Through	502	496	98.7%	0.5	0.0	A
	Right Turn						
	Subtotal	575	585	101.7%	1.4	0.6	A
WB	Left Turn						
	Through	392	391	99.8%	7.7	4.3	A
	Right Turn	6	3	53.0%	1.5	0.9	A
	Subtotal	398	394	99.1%	7.7	4.3	A
Total		1,047	1,045	99.8%	4.6	2.0	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	105.9%	33.7	41.2	C
	Through	199	192	96.3%	51.7	69.5	D
	Right Turn	130	126	96.9%	54.7	74.8	D
	Subtotal	375	366	97.7%	49.9	66.5	D
SB	Left Turn	156	169	108.5%	76.8	114.7	E
	Through	185	183	99.2%	47.3	65.7	D
	Right Turn	41	39	95.3%	41.8	67.5	D
	Subtotal	382	392	102.6%	60.4	88.4	E
EB	Left Turn	53	50	94.7%	13.5	7.4	B
	Through	201	199	98.9%	31.6	36.7	C
	Right Turn	79	81	102.2%	20.4	23.9	C
	Subtotal	333	330	99.0%	25.8	28.3	C
WB	Left Turn	298	293	98.4%	35.9	25.8	D
	Through	154	148	96.2%	24.8	14.1	C
	Right Turn	87	79	90.3%	18.3	13.6	B
	Subtotal	539	520	96.5%	30.1	20.3	C
Total		1,629	1,608	98.7%	40.8	47.5	D

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	38	96.1%	1.2	1.1	A
	Through	548	541	98.7%	0.9	0.4	A
	Right Turn	133	139	104.4%	0.9	0.4	A
	Subtotal	721	718	99.6%	0.9	0.4	A
SB	Left Turn	22	24	107.4%	5.0	1.2	A
	Through	344	332	96.4%	1.3	0.4	A
	Right Turn	62	68	110.4%	1.2	0.2	A
	Subtotal	428	424	99.0%	1.5	0.3	A
EB	Left Turn	52	53	101.4%	14.6	2.4	B
	Through	6	3	54.5%	10.0	9.5	A
	Right Turn	48	47	97.5%	9.6	3.0	A
	Subtotal	106	103	97.0%	12.3	2.2	B
WB	Left Turn	68	68	99.5%	11.7	1.7	B
	Through	4	5	122.7%	5.8	5.3	A
	Right Turn	67	69	103.1%	2.2	1.2	A
	Subtotal	139	142	101.9%	7.0	1.3	A
Total		1,394	1,387	99.5%	2.6	0.3	A

Intersection 15 **Vernon Rd/Davies Rd** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	31	31	100.0%	38.2	8.4	D
	Through	39	38	98.6%	22.9	5.6	C
	Right Turn	9	10	106.1%	17.5	13.4	B
	Subtotal	79	79	100.0%	28.9	6.2	C
SB	Left Turn	374	375	100.3%	41.5	20.3	D
	Through	6	6	98.5%	40.4	26.0	D
	Right Turn	155	151	97.7%	38.9	26.6	D
	Subtotal	535	533	99.5%	40.6	21.8	D
EB	Left Turn	246	235	95.4%	39.9	12.3	D
	Through	174	167	96.0%	35.6	11.9	D
	Right Turn	28	29	102.6%	28.3	9.4	C
	Subtotal	448	430	96.1%	37.7	12.1	D
WB	Left Turn	2	2	118.2%	10.6	13.0	B
	Through	78	69	88.2%	19.1	8.1	B
	Right Turn	476	473	99.4%	10.6	3.7	B
	Subtotal	556	544	97.9%	11.8	4.1	B
Total		1,618	1,586	98.0%	29.0	10.7	C

Intersection 16 **Parking Lot Connector/7th Place** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	34	33	97.3%	4.2	1.5	A
	Through	6	5	81.8%	2.1	1.9	A
	Right Turn	2	2	100.0%	2.4	5.9	A
	Subtotal	42	40	95.2%	4.0	1.2	A
SB	Left Turn	55	55	100.2%	6.4	1.1	A
	Through	20	21	103.6%	7.3	2.0	A
	Right Turn	81	81	99.7%	5.8	0.7	A
	Subtotal	156	157	100.3%	6.2	0.6	A
EB	Left Turn	53	46	86.4%	1.7	0.4	A
	Through	497	505	101.5%	1.6	0.7	A
	Right Turn	38	37	97.4%	1.1	0.6	A
	Subtotal	588	587	99.9%	1.6	0.7	A
WB	Left Turn	20	0	1.4%	1.4	3.0	A
	Through	62	58	93.5%	10.2	0.9	B
	Right Turn	93	95	102.0%	8.1	0.6	A
	Subtotal	175	153	87.5%	8.9	0.5	A
Total		961	937	97.5%	3.7	0.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept E2D**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,188	1,138	95.8%	1.7	0.8	A
	Right Turn	62	60	96.6%	1.4	0.4	A
	Subtotal	1,250	1,198	95.9%	1.7	0.7	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	172	173	100.3%	0.8	0.1	A
	Subtotal	172	173	100.3%	0.8	0.1	A
Total		1,422	1,371	96.4%	1.6	0.6	A

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	166	155	93.6%	52.6	8.3	D
	Through	2	3	172.7%	63.6	31.0	E
	Right Turn	145	136	93.7%	9.9	2.3	A
	Subtotal	313	295	94.2%	32.9	4.0	C
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn	1,053	1,065	101.1%	31.1	5.7	C
	Through	443	451	101.9%	27.3	5.3	C
	Right Turn						
	Subtotal	1,496	1,516	101.4%	29.9	5.6	C
WB	Left Turn						
	Through	134	132	98.4%	53.0	5.0	D
	Right Turn	43	40	93.4%	14.5	3.7	B
	Subtotal	177	172	97.2%	44.8	4.5	D
Total		1,986	1,983	99.9%	31.7	4.5	C

Intersection 401 **SR 9 Off-ramp/Vernon-Davies** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	33	31	95.0%	60.9	66.6	F
	Through						
	Right Turn	102	109	107.2%	11.4	5.1	B
	Subtotal	135	141	104.2%	21.5	15.2	C
EB	Left Turn						
	Through	415	399	96.2%	13.1	8.6	B
	Right Turn						
	Subtotal	415	399	96.2%	13.1	8.6	B
WB	Left Turn						
	Through	264	252	95.3%	23.6	16.4	C
	Right Turn						
	Subtotal	264	252	95.3%	23.6	16.4	C
Total		814	792	97.3%	18.1	11.5	C

Intersection 231 **Vernon/SR 9 NB Onramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	128	126	98.8%	5.4	1.2	A
	Through	633	620	97.9%	0.2	0.0	A
	Right Turn						
	Subtotal	761	746	98.0%	1.0	0.2	A
SB	Left Turn						
	Through	535	529	98.9%	16.0	16.6	C
	Right Turn	55	7	13.4%	21.3	40.0	C
	Subtotal	590	537	91.0%	16.1	16.9	C
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		1,351	1,283	95.0%	7.2	6.6	A

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	4	2	1	8	32	9	10	44	NO
	Through	2,000	134	19	104	164	648	47	596	750	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	22	11	8	45	96	18	70	123	NO
	Through	3,700	84	7	76	100	522	56	460	667	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	51	3	46	56	157	9	147	178	NO
	Through	2,000	38	3	33	44	155	15	137	188	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	83	6	73	93	231	13	204	247	NO
	Through	2,000	74	8	58	88	288	25	245	331	NO
	Right Turn	80	1	0	0	1	27	7	20	41	NO
	Second Right										

Intersection 3 **SR 9/SR 204 (west signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	40	17	25	79	183	38	148	287	NO
	Through	2,000	40	17	25	79	183	38	148	287	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through	400	85	14	66	107	397	34	339	438	NO
	Right Turn	100	3	3	0	7	84	72	0	190	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	1	1	0	2	38	25	11	90	NO
	Through	300	1	1	0	2	38	25	11	90	NO
	Right Turn										
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	77	35	39	165	206	54	132	328	NO
	Through	2,000	84	8	75	105	348	40	304	430	NO
	Right Turn	400	10	2	7	15	93	12	78	111	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	179	59	114	305	448	82	322	617	MAX
	Through	2,000	76	45	49	194	434	64	363	564	NO
	Right Turn	300	12	5	7	25	131	16	116	165	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	104	43	63	171	449	58	356	527	AVG
	Through	600	204	68	129	361	548	20	509	574	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	12	3	7	16	63	10	50	82	NO
	Through	1,000	142	21	114	186	498	26	452	534	NO
	Right Turn	600	141	21	112	184	497	26	450	533	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	0	4	6	0	12	NO
	Through	2,000	156	28	115	197	487	68	399	628	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	63	7	52	75	256	11	236	268	MAX
	Through	800	85	8	76	106	276	1	274	278	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	103	16	84	146	353	66	306	534	NO
	Through	1,250	84	8	70	94	312	16	292	350	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	54	12	40	81	236	46	173	321	MAX
	Through	350	75	14	55	98	264	42	212	328	NO
	Right Turn	300	80	15	59	103	272	42	219	336	NO
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	23	4	15	29	142	18	108	171	NO
	Through	1,500	29	4	21	34	161	21	129	191	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	29	2	23	31	120	21	97	160	MAX
	Through	100	29	2	23	31	120	21	97	160	MAX
	Right Turn	100	30	2	25	33	123	21	100	162	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	39	3	33	42	201	16	160	216	NO
	Through	2,000	58	9	42	73	456	48	405	557	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	0	1	2	15	7	5	28	NO
	Through	1,250	65	7	52	79	269	17	250	300	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	1	38	15	16	65	NO
	Through	350	2	2	0	6	109	28	71	147	NO
	Right Turn	350	2	2	0	6	109	28	71	147	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	11	1	9	14	97	6	87	110	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	14	8	5	27	151	18	121	185	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	1	2	4	59	10	49	76	NO
	Through	400	6	1	5	9	83	9	75	102	NO
	Right Turn	400	1	1	1	3	43	8	32	56	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	87	16	68	118	175	6	169	189	NO
	Through	400	87	16	68	118	175	6	169	189	NO
	Right Turn	400	82	17	62	114	171	6	164	185	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	0	7	9	83	7	72	98	NO
	Through										
	Right Turn	400	8	0	7	9	84	7	73	99	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	3	1	2	4	51	6	41	61	NO
	Through										
	Right Turn	400	3	1	2	5	50	6	40	60	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	2	1	1	4	71	14	48	91	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	2	1	1	3	41	10	22	57	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	21	19	7	64	126	35	85	214	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	2	1	1	3	45	8	33	61	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	55	43	19	146	272	80	154	467	MAX

Intersection 255 **SR 9/SR 204 (east signal)** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	365	49	3	44	56	187	15	163	207	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right										
EB	U Turn Second Left Left Turn Through Right Turn Second Right	110 110	4 4	2 2	3 3	8 8	125 125	2 2	122 122	130 130	MAX MAX
WB	U Turn Second Left Left Turn Through Right Turn Second Right	285	28	3	23	33	123	18	94	146	NO

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Concept G2B
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	27.6	C	20.2	C	56.6	E	57.5	E	30.0	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.3	A	1.4	A					1.5	A
3	SR 9/SR 204	Signal	38.7	D	32.7	C	141.8	F	49.7	D	56.9	E
4	SR 9/Market Pl	Signal	138.0	F	101.6	F	74.7	E	58.7	E	82.1	F
5	91st Ave/SR 204	Signal	119.4	F	34.5	C	81.3	F	45.5	D	59.8	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	42.3	D	20.6	C	32.3	C	48.5	D	31.4	C
8	91st Ave/Vernon Rd	Side-street Stop	0.9	A	1.2	A	8.9	A	9.5	A	11.1	B
9	Safeway Dwy/Davies Rd	Roundabout	12.0	B	7.2	A	7.0	A	6.5	A	8.1	A
11	Transit Center Dwy/4th St	Side-street Stop	9.2	A	9.7	A	2.3	A	0.5	A	17.7	C
12	Transit Center Dwy/Market Pl	Side-street Stop			13.6	B	1.0	A	11.3	B	13.0	B
13	91st Ave/Market Pl	Signal	25.3	C	24.6	C	24.5	C	22.6	C	18.7	B
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	2.3	A	3.2	A	15.6	C	9.5	A	16.0	C
15	Vernon Rd/Davies Rd	Roundabout	3.7	A	4.5	A			3.4	A	3.4	A
16	Frontier Lane/7th Place	Signal	48.2	D	22.6	C	3.9	A	35.3	D	14.3	B
221	SR 9/4th St NE	Side-street Stop	0.8	A	63.3	F			0.6	A	34.3	D

Note: Assumes default directions (N, S, E, & W) at all intersections.

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept G2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	9	106.8%	52.4	31.6	D
	Through	1,709	1,623	94.9%	22.4	5.7	C
	Right Turn	562	546	97.2%	34.6	12.0	C
	Subtotal	2,279	2,177	95.5%	25.7	6.0	C
SB	Left Turn	31	33	107.9%	85.3	27.7	F
	Through	1,396	1,392	99.7%	20.6	3.3	C
	Right Turn	93	95	101.7%	4.8	1.0	A
	Subtotal	1,520	1,520	100.0%	21.0	3.7	C
EB	Left Turn	240	240	100.0%	59.8	4.2	E
	Through	124	126	101.5%	52.3	8.4	D
	Right Turn	13	11	86.0%	14.8	6.2	B
	Subtotal	377	377	100.0%	55.8	4.3	E
WB	Left Turn	386	396	102.7%	67.1	8.0	E
	Through	232	228	98.2%	53.4	3.5	D
	Right Turn	44	41	93.6%	25.9	6.9	C
	Subtotal	662	665	100.5%	59.9	5.3	E
Total		4,838	4,740	98.0%	31.7	3.2	C

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,279	1,401	61.5%	1.3	0.2	A
	Right Turn						
	Subtotal	2,279	1,401	61.5%	1.3	0.2	A
SB	Left Turn						
	Through	1,665	1,661	99.7%	1.3	1.8	A
	Right Turn	129	141	109.0%	1.2	1.5	A
	Subtotal	1,794	1,801	100.4%	1.3	1.8	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		4,073	3,202	78.6%	1.3	1.0	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept G2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	103	26	25.6%	54.8	21.0	D
	Through	1,062	895	84.2%	42.0	5.4	D
	Right Turn	265	171	64.5%	13.5	4.6	B
	Subtotal	1,430	1,092	76.4%	38.1	4.7	D
SB	Left Turn	188	171	90.9%	68.2	9.2	E
	Through	1,038	986	95.0%	37.1	13.4	D
	Right Turn	464	518	111.6%	12.9	12.6	B
	Subtotal	1,690	1,675	99.1%	32.6	8.8	C
EB	Left Turn	270	330	122.1%	143.7	18.5	F
	Through	738	693	93.9%	126.8	25.9	F
	Right Turn	47	39	83.0%	104.9	27.5	F
	Subtotal	1,055	1,061	100.6%	131.2	23.3	F
WB	Left Turn	260	147	56.4%	52.1	8.6	D
	Through	191	191	100.2%	60.5	13.7	E
	Right Turn	166	174	104.7%	37.1	17.3	D
	Subtotal	617	512	83.0%	50.1	11.7	D
Total		4,792	4,340	90.6%	61.0	7.9	E

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	114	107.7%	193.8	32.8	F
	Through	899	844	93.9%	130.8	16.1	F
	Right Turn	70	77	110.6%	126.8	18.7	F
	Subtotal	1,075	1,036	96.4%	137.5	17.9	F
SB	Left Turn	186	115	61.8%	188.1	35.5	F
	Through	846	821	97.1%	113.6	36.8	F
	Right Turn	308	211	68.6%	31.5	8.2	C
	Subtotal	1,340	1,148	85.7%	107.0	30.1	F
EB	Left Turn	204	68	33.1%	74.4	29.6	E
	Through	325	317	97.5%	85.9	32.7	F
	Right Turn	106	105	99.3%	52.0	15.8	D
	Subtotal	635	490	77.1%	76.4	27.7	E
WB	Left Turn	68	63	92.9%	63.7	12.6	E
	Through	270	271	100.2%	61.6	11.9	E
	Right Turn	116	93	80.5%	47.0	10.7	D
	Subtotal	454	427	94.1%	58.9	10.0	E
Total		3,504	3,101	88.5%	106.3	11.9	F

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	0	0.6%	26.2	82.9	C
	Through	128	146	113.7%	129.9	62.4	F
	Right Turn	342	445	130.1%	121.4	60.4	F
	Subtotal	519	591	113.8%	123.6	60.7	F
SB	Left Turn	164	101	61.5%	63.5	7.2	E
	Through	213	246	115.7%	24.3	2.0	C
	Right Turn	54	17	31.8%	19.2	11.8	B
	Subtotal	431	364	84.6%	34.6	2.0	C
EB	Left Turn	101	36	35.7%	71.3	8.3	E
	Through	1,331	534	40.1%	89.1	19.4	F
	Right Turn	161	0	0.1%	13.3	28.2	B
	Subtotal	1,593	570	35.8%	87.8	17.7	F
WB	Left Turn	172	213	124.1%	74.6	19.9	E
	Through	543	469	86.5%	36.1	12.4	D
	Right Turn	74	51	68.9%	24.1	14.5	C
	Subtotal	789	734	93.0%	46.1	14.6	D
Total		3,332	2,259	67.8%	74.8	12.6	E

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	106	101.6%	46.8	6.3	D
	Through	148	154	104.2%	41.3	4.8	D
	Right Turn	9	8	93.9%	15.3	8.8	B
	Subtotal	261	268	102.8%	42.7	4.7	D
SB	Left Turn	40	18	44.5%	45.4	29.7	D
	Through	115	117	101.5%	36.1	7.4	D
	Right Turn	288	299	103.9%	13.1	2.2	B
	Subtotal	443	434	97.9%	21.0	2.3	C
EB	Left Turn	527	568	107.9%	57.8	4.4	E
	Through	1,384	1,336	96.5%	22.9	3.7	C
	Right Turn	282	279	99.1%	25.1	4.3	C
	Subtotal	2,193	2,184	99.6%	32.1	2.7	C
WB	Left Turn	4	3	77.3%	22.1	38.3	C
	Through	507	476	93.8%	50.4	9.6	D
	Right Turn	78	7	8.4%	36.3	36.1	D
	Subtotal	589	485	82.4%	50.6	9.4	D
Total		3,486	3,371	96.7%	33.9	1.8	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept G2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	63	114.0%	1.3	0.4	A
	Through	108	71	65.9%	0.7	0.5	A
	Second Right						
	Subtotal	191	156	81.7%	0.9	0.4	A
SB	Left Turn	1	0	27.3%	0.0	0.2	A
	Through	118	105	88.8%	1.4	2.5	A
	Second Right						
	Subtotal	139	136	97.9%	1.3	1.9	A
EB	Left Turn	16	46	288.1%	9.4	1.5	A
	Through	7	19	267.5%	8.6	2.2	A
	Second Right						
	Subtotal	135	139	103.0%	8.9	1.5	A
WB	Left Turn	88	80	90.8%	10.2	2.5	B
	Through	38	54	141.1%	11.3	1.9	B
	Second Right						
	Subtotal	176	185	105.2%	9.5	1.4	A
Total		641	616	96.2%	5.5	1.2	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept G2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	367	458	124.9%	12.9	2.3	B
	Through	37	56	151.6%	11.2	2.9	B
	Right Turn	89	99	111.0%	9.6	2.8	A
	Subtotal	493	613	124.4%	12.2	2.3	B
SB	Left Turn	9	10	107.1%	5.7	2.6	A
	Through	12	39	321.2%	5.9	1.4	A
	Right Turn	97	68	69.8%	7.7	3.7	A
	Subtotal	118	116	98.2%	6.9	2.2	A
EB	Left Turn	105	111	105.3%	5.5	1.3	A
	Through	204	176	86.1%	7.4	2.2	A
	Right Turn	197	342	173.7%	6.5	1.8	A
	Subtotal	506	628	124.2%	6.6	1.7	A
WB	Left Turn	37	59	158.5%	6.0	2.0	A
	Through	122	99	80.9%	7.1	2.5	A
	Right Turn	6	7	122.7%	5.1	2.1	A
	Subtotal	165	165	99.8%	6.6	2.1	A
Total		1,282	1,522	118.7%	8.7	1.2	A

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept G2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	41	102.5%	6.2	0.6	A
	Through	14	9	66.9%	7.4	3.8	A
	Right Turn	5	11	214.5%	19.0	4.4	C
	Subtotal	59	61	103.5%	9.3	0.8	A
SB	Left Turn	124	121	97.6%	10.0	1.5	A
	Through	22	21	94.2%	9.1	2.3	A
	Right Turn	17	20	116.0%	9.6	4.1	A
	Subtotal	163	161	99.1%	9.8	1.5	A
EB	Left Turn	6	16	262.1%	2.7	4.4	A
	Through	89	90	100.8%	2.5	4.4	A
	Right Turn	17	74	436.4%	2.5	4.4	A
	Subtotal	112	180	160.4%	2.5	4.4	A
WB	Left Turn	3	4	139.4%	0.3	0.3	A
	Through	90	87	97.2%	0.4	0.2	A
	Right Turn	54	54	100.5%	0.6	0.1	A
	Subtotal	147	146	99.3%	0.5	0.1	A
Total		481	548	113.9%	4.9	1.6	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	16	48	297.7%	11.2	2.5	B
	Through						
	Right Turn	62	60	97.4%	12.4	4.6	B
	Subtotal	78	108	138.5%	12.1	3.5	B
EB	Left Turn	81	52	64.5%	4.9	1.2	A
	Through	500	457	91.4%	0.5	0.1	A
	Right Turn						
	Subtotal	581	509	87.7%	0.9	0.2	A
WB	Left Turn						
	Through	392	368	93.9%	8.9	5.8	A
	Right Turn	6	25	416.7%	6.5	6.4	A
	Subtotal	398	393	98.7%	8.8	5.8	A
Total		1,057	1,010	95.6%	5.2	2.4	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	106.3%	15.3	5.7	B
	Through	199	235	118.2%	26.6	16.1	C
	Right Turn	130	87	66.7%	30.4	20.2	C
	Subtotal	375	371	98.9%	26.2	15.8	C
SB	Left Turn	156	153	97.8%	34.2	27.7	C
	Through	162	287	177.1%	21.8	6.2	C
	Right Turn	41	39	95.3%	16.7	7.2	B
	Subtotal	359	479	133.3%	25.6	13.5	C
EB	Left Turn	53	51	96.2%	18.7	8.5	B
	Through	161	161	100.2%	29.7	26.3	C
	Right Turn	79	80	101.0%	22.4	22.3	C
	Subtotal	293	292	99.7%	25.6	21.2	C
WB	Left Turn	321	182	56.6%	25.5	7.5	C
	Through	156	144	92.3%	24.4	6.0	C
	Right Turn	74	179	242.0%	18.5	4.8	B
	Subtotal	551	505	91.6%	22.8	4.9	C
Total		1,578	1,646	104.3%	24.9	11.6	C

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	33	78.4%	3.2	1.6	A
	Through	549	545	99.3%	2.3	0.7	A
	Right Turn	162	151	93.1%	2.4	0.7	A
	Subtotal	753	729	96.8%	2.4	0.5	A
SB	Left Turn	21	39	183.5%	5.4	2.3	A
	Through	344	318	92.3%	3.3	1.2	A
	Right Turn	62	68	109.5%	1.2	0.3	A
	Subtotal	427	424	99.3%	3.2	1.0	A
EB	Left Turn	52	50	96.9%	16.5	3.7	C
	Through	3	9	284.8%	11.6	6.5	B
	Right Turn	51	44	86.1%	15.9	7.5	C
	Subtotal	106	103	97.0%	16.2	4.4	C
WB	Left Turn	48	71	147.0%	16.8	4.3	C
	Through	4	13	320.5%	15.9	8.0	C
	Right Turn	67	73	109.0%	2.5	0.7	A
	Subtotal	119	156	131.4%	9.5	1.7	A
Total		1,405	1,412	100.5%	4.4	0.9	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept G2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	87	0	0.0%	#DIV/0!	#DIV/0!	#DIV/0!
	Through	324	9	2.8%	6.2	3.3	A
	Right Turn	256	69	27.0%	8.1	4.1	A
	Subtotal	667	78	11.7%	8.2	4.0	A
SB	Left Turn	330	526	159.4%	4.8	1.1	A
	Through	209	6	2.9%	3.2	3.3	A
	Right Turn						
	Subtotal	539	532	98.8%	4.8	1.1	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	279	32	11.5%	4.4	1.4	A
	Through						
	Right Turn	309	583	188.5%	3.2	0.6	A
	Subtotal	588	615	104.5%	3.3	0.6	A
Total		1,794	1,225	68.3%	4.3	0.7	A

Intersection 16 **Frontier Lane/7th Place** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	88	86	97.6%	57.3	7.8	E
	Through	35	32	92.5%	30.0	7.3	C
	Right Turn	12	13	104.5%	25.3	16.4	C
	Subtotal	135	131	96.9%	47.5	7.0	D
SB	Left Turn	56	52	93.2%	62.0	9.5	E
	Through	74	71	96.3%	53.5	9.8	D
	Right Turn	415	376	90.5%	11.2	11.0	B
	Subtotal	545	499	91.6%	22.9	8.1	C
EB	Left Turn	564	451	80.0%	6.0	1.0	A
	Through	305	486	159.3%	1.9	0.7	A
	Right Turn	296	99	33.3%	2.3	1.0	A
	Subtotal	1,165	1,036	88.9%	3.7	0.6	A
WB	Left Turn	3	3	100.0%	22.9	29.1	C
	Through	59	57	96.1%	52.4	9.8	D
	Right Turn	94	95	100.8%	27.6	10.1	C
	Subtotal	156	154	99.0%	36.7	9.6	D
Total		2,001	1,820	91.0%	15.3	2.3	B

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 Concept G2B**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,133	989	87.3%	0.8	0.1	A
	Right Turn	89	17	18.9%	1.3	1.2	A
	Subtotal	1,222	1,006	82.3%	0.8	0.1	A
SB	Left Turn						
	Through	1,065	1,159	108.8%	68.6	32.6	F
	Right Turn						
	Subtotal	1,065	1,159	108.8%	68.6	32.6	F
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	92	94	102.1%	0.6	0.1	A
	Subtotal	92	94	102.1%	0.6	0.1	A
Total		2,379	2,259	95.0%	35.9	17.0	E

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2040 Concept G2B**
Queue Length **PM Peak Hour**

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	3	1	1	5	35	7	21	45	NO
	Through	2,000	118	24	77	164	684	43	602	733	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	22	10	8	45	91	15	69	118	NO
	Through	3,700	87	8	77	105	500	46	445	571	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	51	3	47	56	160	10	142	177	NO
	Through	2,000	36	5	30	45	152	10	135	175	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	82	6	72	90	229	19	205	264	NO
	Through	2,000	75	6	67	90	293	25	263	342	NO
	Right Turn	80	1	0	0	1	26	5	21	36	NO
	Second Right										

Intersection 3 **SR 9/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	7	3	3	12	48	7	34	59	NO
	Through	2,000	132	7	122	143	469	21	430	508	NO
	Right Turn	160	6	2	4	9	101	16	70	120	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	76	17	52	113	263	35	219	336	NO
	Through	2,000	120	31	92	196	604	138	470	945	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	241	37	196	307	517	19	482	553	MAX
	Through	400	241	37	196	307	517	19	482	553	MAX
	Right Turn	100	243	38	197	310	521	19	486	556	AVG
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	100	12	86	128	276	11	255	287	NO
	Through	300	100	12	86	128	276	11	255	287	NO
	Right Turn	75	15	6	6	24	208	34	152	258	MAX
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	309	349	46	972	720	447	309	1,521	AVG
	Through	2,000	1,090	238	720	1,503	1,877	96	1,697	2,010	NO
	Right Turn	400	15	2	11	18	134	13	113	156	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	93	20	58	128	463	98	266	645	MAX
	Through	2,000	434	66	340	525	948	22	887	975	NO
	Right Turn	300	20	17	9	67	186	87	121	370	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	16	3	12	20	83	13	69	112	NO
	Through	600	221	54	133	298	546	30	485	577	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	15	2	11	18	80	9	65	95	NO
	Through	1,000	152	18	114	179	509	35	421	546	NO
	Right Turn	600	150	18	113	177	508	35	420	545	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	0	0	1	3	5	0	12	NO
	Through	2,000	480	162	285	832	894	140	704	1,133	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	33	7	27	54	158	22	138	192	NO
	Through	800	39	4	32	44	249	19	209	275	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	13	3	9	20	64	8	52	78	NO
	Through	1,250	98	36	69	189	276	61	231	439	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	108	35	67	175	400	42	343	483	MAX
	Through	350	83	39	42	160	394	53	332	496	MAX
	Right Turn	300	86	40	44	164	401	53	339	504	MAX
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	26	4	20	32	132	18	109	157	NO
	Through	1,500	34	4	27	41	186	27	146	244	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	30	4	26	37	135	26	102	186	MAX
	Through	100	30	4	26	37	135	26	102	186	MAX
	Right Turn	100	31	4	28	39	137	26	105	185	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	97	11	83	117	353	60	269	457	MAX
	Through	2,000	133	23	110	197	746	101	619	1,013	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	1	3	12	7	5	29	NO
	Through	1,250	73	8	61	86	251	33	206	304	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	22	7	15	39	NO
	Through	350	0	0	0	0	47	8	37	56	NO
	Right Turn	350	0	0	0	0	47	8	37	56	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	0	0	0	0	1	5	0	16	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	0	0	0	1	42	11	29	60	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	0	2	3	72	11	48	85	NO
	Through	400	4	1	4	5	90	11	74	111	NO
	Right Turn	400	2	0	2	3	60	10	47	81	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	7	1	5	9	93	16	68	120	NO
	Through	400	7	1	5	9	93	16	68	121	NO
	Right Turn	400	4	1	2	6	90	16	63	116	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	1	7	9	85	8	73	102	NO
	Through										
	Right Turn	400	8	1	7	9	86	8	74	103	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	6	2	3	11	83	7	71	92	NO
	Through										
	Right Turn	400	6	2	3	11	83	7	70	92	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	1	1	1	2	47	7	38	55	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	2	1	1	3	44	7	33	55	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	10	6	5	24	104	35	65	190	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	3	0	2	4	44	10	33	64	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	16	2	12	21	199	31	152	265	MAX

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 - Concept H
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Average Hour Delay	Overall Average Hour LOS
1	SR 9/Lundeen Pkwy	Signal	35.5	D	23.7	C	57.2	E	63.9	E	36.8	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	8.0	A	3.3	A					8.4	A
3	SR 9/SR 204	Roundabout	34.3	D	6.7	A	108.4	F	64.0	F	65.6	F
4	SR 9/Market Pl	Signal	142.9	F	144.1	F	78.3	E	65.2	E	94.3	F
5	91st Ave/SR 204	Signal	237.9	F	31.2	C	71.8	E	45.1	D	73.7	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	36.7	D	19.6	B	22.0	C	44.9	D	24.3	C
8	91st Ave/Vernon Rd	Side-street Stop	1.0	A	4.4	A	13.8	B	20.3	C	21.2	C
9	Safeway Dwy/Davies Rd	Roundabout	32.7	D	6.8	A	5.9	A	8.7	A	15.9	C
11	Transit Center Dwy/4th St	Side-street Stop	9.7	A	9.6	A	0.1	A	0.5	A	15.3	C
12	Transit Center Dwy/Market Pl	Side-street Stop			15.9	C	1.6	A	14.7	B	15.9	C
13	91st Ave/Market Pl	Signal	38.7	D	19.8	B	23.6	C	43.5	D	26.9	C
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.0	A	1.8	A	13.2	B	6.7	A	14.2	B
15	Vernon Rd/Davies Rd	Roundabout	6.6	A	4.2	A			2.1	A	2.9	A
16	Parking Lot Connector/7th Place	Signal	41.0	D	20.3	C	46.2	D	34.8	C	34.0	C
221	SR 9/4th St NE	Side-street Stop	1.2	A					0.7	A	1.1	A

Note: Assumes default directions (N, S, E, & W) at all intersections.

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	8	9	108.0%	90.2	39.6	F
	Through	1,709	1,610	94.2%	30.8	2.0	C
	Right Turn	562	538	95.8%	48.7	9.6	D
	Subtotal	2,279	2,157	94.7%	35.6	3.5	D
SB	Left Turn	31	34	108.5%	90.5	24.5	F
	Through	1,396	1,390	99.6%	23.9	2.9	C
	Right Turn	93	95	101.7%	6.4	1.4	A
	Subtotal	1,520	1,518	99.9%	24.2	2.6	C
EB	Left Turn	240	239	99.5%	65.3	4.1	E
	Through	124	125	100.7%	50.9	3.3	D
	Right Turn	13	11	84.6%	11.4	4.1	B
	Subtotal	377	375	99.4%	58.9	3.1	E
WB	Left Turn	386	392	101.6%	77.2	10.6	E
	Through	232	226	97.4%	53.7	6.3	D
	Right Turn	44	41	93.6%	26.2	9.5	C
	Subtotal	662	659	99.6%	65.7	7.5	E
Total		4,838	4,710	97.4%	37.6	2.1	D

Intersection 2 **SR 9/Vernon Rd Off-Ramp** **Uncontrolled**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	2,279	2,164	95.0%	8.7	2.9	A
	Right Turn						
	Subtotal	2,279	2,164	95.0%	8.7	2.9	A
SB	Left Turn						
	Through	1,475	1,492	101.1%	2.0	0.6	A
	Right Turn	319	301	94.5%	2.5	0.9	A
	Subtotal	1,794	1,793	100.0%	2.1	0.7	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total		4,073	3,958	97.2%	5.7	1.8	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept H**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 3 **SR 9/SR 204** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	191	45	23.8%	54.6	31.1	F
	Through	986	30	3.0%	50.7	25.1	F
	Right Turn	89	177	198.5%	26.1	10.2	D
	Subtotal	1,266	252	19.9%	33.8	8.9	D
SB	Left Turn	169	168	99.3%	21.8	5.0	C
	Through	868	0	0.0%	0.0	0.0	A
	Right Turn	438	420	95.8%	8.0	1.7	A
	Subtotal	1,475	587	39.8%	12.0	2.1	B
EB	Left Turn	1,094	40	3.6%	82.5	31.2	F
	Through	738	685	92.8%	103.9	34.9	F
	Right Turn	47	1,059	2252.6%	108.1	35.4	F
	Subtotal	1,879	1,783	94.9%	106.0	35.0	F
WB	Left Turn	155	197	127.2%	58.6	20.4	F
	Through	209	203	97.2%	75.0	24.0	F
	Right Turn	198	153	77.2%	56.2	17.7	F
	Subtotal	562	553	98.4%	64.3	21.7	F
Total		5,182	3,176	61.3%	75.3	20.6	F

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	106	99	93.7%	189.3	28.5	F
	Through	905	853	94.2%	137.9	6.5	F
	Right Turn	70	75	107.8%	131.7	7.4	F
	Subtotal	1,081	1,027	95.0%	142.8	8.4	F
SB	Left Turn	186	144	77.4%	235.2	50.1	F
	Through	846	809	95.6%	127.1	39.9	F
	Right Turn	308	138	44.8%	136.3	67.6	F
	Subtotal	1,340	1,091	81.4%	142.6	43.4	F
EB	Left Turn	204	114	56.0%	83.9	31.4	F
	Through	325	307	94.5%	90.5	37.8	F
	Right Turn	106	104	97.9%	55.1	7.6	E
	Subtotal	635	525	82.7%	81.2	29.1	F
WB	Left Turn	68	64	94.3%	65.5	9.5	E
	Through	270	267	98.9%	72.4	20.2	E
	Right Turn	116	98	84.7%	46.9	11.8	D
	Subtotal	454	429	94.6%	65.9	15.3	E
Total		3,510	3,073	87.5%	122.3	15.7	F

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	49	1	1.1%	60.6	130.1	E
	Through	128	122	95.4%	253.2	44.6	F
	Right Turn	342	354	103.4%	246.3	44.6	F
	Subtotal	519	476	91.7%	248.0	44.7	F
SB	Left Turn	164	100	60.7%	64.5	12.3	E
	Through	213	334	156.8%	28.9	4.0	C
	Right Turn	54	90	166.7%	20.5	6.0	C
	Subtotal	431	524	121.5%	35.3	6.2	D
EB	Left Turn	101	33	32.8%	69.5	20.1	E
	Through	1,331	1,328	99.8%	87.0	32.8	F
	Right Turn	161	0	0.1%	0.0	0.0	A
	Subtotal	1,593	1,361	85.4%	86.6	32.4	F
WB	Left Turn	172	190	110.3%	75.9	19.4	E
	Through	543	410	75.5%	24.7	5.1	C
	Right Turn	74	70	95.0%	17.9	5.0	B
	Subtotal	789	670	84.9%	37.9	9.0	D
Total		3,332	3,031	91.0%	88.8	17.7	F

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	104	101	97.4%	41.7	4.6	D
	Through	148	149	100.7%	34.9	6.7	C
	Right Turn	9	0	0.0%	0.0	0.0	A
	Subtotal	261	250	95.9%	38.0	4.2	D
SB	Left Turn	40	18	43.9%	40.7	17.3	D
	Through	115	115	99.6%	31.6	7.7	C
	Right Turn	288	297	103.3%	13.2	2.5	B
	Subtotal	443	430	97.0%	19.5	2.3	B
EB	Left Turn	527	562	106.6%	31.5	3.0	C
	Through	1,384	1,342	97.0%	19.4	5.7	B
	Right Turn	282	285	101.1%	17.3	3.5	B
	Subtotal	2,193	2,189	99.8%	22.2	4.2	C
WB	Left Turn	4	4	88.6%	22.9	33.6	C
	Through	507	486	95.8%	47.8	9.3	D
	Right Turn	78	7	9.0%	16.4	17.1	B
	Subtotal	589	496	84.2%	47.6	9.3	D
Total		3,486	3,364	96.5%	26.6	2.4	C

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept H**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 0 | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 8 | **91st Ave/Vernon Rd** | **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	55	63	115.4%	1.4	0.4	A
	Through	108	68	62.5%	0.7	0.4	A
	Second Right						
	Subtotal	191	151	78.9%	1.0	0.3	A
SB	Left Turn	1	0	27.3%	0.0	0.2	A
	Through	118	105	88.8%	5.9	6.6	A
	Second Right						
	Subtotal	139	136	97.9%	4.7	4.8	A
EB	Left Turn	16	46	289.8%	9.8	1.7	A
	Through	7	18	263.6%	11.6	2.9	B
	Second Right						
	Subtotal	135	139	103.0%	14.2	5.4	B
WB	Left Turn	264	244	92.3%	21.3	6.4	C
	Through	52	52	99.7%	26.1	6.1	D
	Second Right						
	Subtotal	366	348	95.0%	20.7	5.4	C
Total		831	774	93.1%	12.8	3.5	B

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept H**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 9 **Safeway Dwy/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	500	475	95.0%	31.1	10.7	D
	Through	67	65	97.0%	28.7	11.3	D
	Right Turn	119	119	100.1%	29.6	12.0	D
	Subtotal	686	659	96.1%	30.6	10.9	D
SB	Left Turn	9	10	107.1%	8.7	6.8	A
	Through	40	38	96.1%	7.0	1.5	A
	Right Turn	97	68	69.8%	6.6	1.8	A
	Subtotal	146	116	79.3%	6.9	1.5	A
EB	Left Turn	105	111	105.5%	5.3	0.8	A
	Through	204	176	86.1%	5.8	1.5	A
	Right Turn	350	343	97.9%	5.9	0.9	A
	Subtotal	659	629	95.5%	5.8	0.9	A
WB	Left Turn	59	59	99.4%	8.9	3.4	A
	Through	100	99	98.6%	8.9	4.3	A
	Right Turn	6	7	121.2%	5.8	6.3	A
	Subtotal	165	165	99.7%	9.0	3.8	A
Total		1,656	1,569	94.7%	17.0	5.0	C

Intersection 0 **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
Total							

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	40	72	179.8%	7.6	0.7	A
	Through	14	9	65.6%	6.8	4.8	A
	Right Turn	5	11	210.9%	19.4	3.0	C
	Subtotal	59	92	155.3%	9.5	0.8	A
SB	Left Turn	124	121	97.7%	9.6	1.2	A
	Through	22	21	94.2%	8.7	2.3	A
	Right Turn	17	20	116.0%	8.8	2.7	A
	Subtotal	163	162	99.1%	9.5	1.2	A
EB	Left Turn	6	12	207.6%	0.7	0.6	A
	Through	89	89	99.8%	0.0	0.0	A
	Right Turn	17	77	454.5%	0.0	0.0	A
	Subtotal	112	179	159.4%	0.1	0.1	A
WB	Left Turn	3	4	139.4%	1.0	1.2	A
	Through	90	87	97.2%	0.4	0.2	A
	Right Turn	54	54	100.5%	0.6	0.1	A
	Subtotal	147	146	99.3%	0.5	0.2	A
Total		481	578	120.1%	4.4	0.3	A

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
SB	Left Turn	50	48	96.7%	12.4	2.7	B
	Through						
	Right Turn	62	60	97.1%	17.8	6.7	C
	Subtotal	112	109	96.9%	15.5	4.2	C
EB	Left Turn	81	83	102.6%	6.9	2.0	A
	Through	500	443	88.6%	0.5	0.1	A
	Right Turn						
	Subtotal	581	526	90.5%	1.5	0.4	A
WB	Left Turn						
	Through	392	368	93.9%	11.6	7.5	B
	Right Turn	6	25	415.2%	7.8	7.3	A
	Subtotal	398	393	98.7%	11.4	7.3	B
Total		1,091	1,027	94.2%	6.8	3.3	A

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	46	49	106.3%	19.8	14.0	B
	Through	237	234	98.7%	46.7	44.9	D
	Right Turn	130	87	66.7%	35.1	31.5	D
	Subtotal	413	369	89.5%	41.0	38.8	D
SB	Left Turn	156	139	89.0%	26.8	16.9	C
	Through	162	352	217.1%	18.3	6.5	B
	Right Turn	41	35	85.6%	13.5	7.1	B
	Subtotal	359	526	146.4%	20.3	7.5	C
EB	Left Turn	53	59	111.7%	33.4	31.4	C
	Through	161	164	101.8%	23.2	17.3	C
	Right Turn	79	80	101.0%	19.0	19.5	B
	Subtotal	293	303	103.4%	25.0	16.6	C
WB	Left Turn	321	116	36.2%	41.3	39.9	D
	Through	156	143	91.7%	48.4	52.8	D
	Right Turn	74	111	149.6%	48.7	56.6	D
	Subtotal	551	370	67.2%	46.4	50.3	D
Total		1,616	1,568	97.0%	32.2	23.1	C

Intersection 14 **Lundeen Pkwy/Vernon Rd** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn	42	32	76.8%	2.0	1.5	A
	Through	549	538	98.0%	0.9	0.4	A
	Right Turn	162	147	90.5%	1.1	0.4	A
	Subtotal	753	717	95.2%	1.0	0.3	A
SB	Left Turn	21	39	183.5%	4.2	1.9	A
	Through	344	317	92.3%	1.6	0.7	A
	Right Turn	62	68	109.4%	1.4	0.5	A
	Subtotal	427	424	99.2%	1.9	0.7	A
EB	Left Turn	52	50	96.5%	15.8	3.6	C
	Through	3	9	284.8%	10.0	5.4	A
	Right Turn	51	44	85.9%	10.7	3.7	B
	Subtotal	106	103	96.7%	13.3	2.6	B
WB	Left Turn	48	69	142.8%	10.5	2.0	B
	Through	4	13	322.7%	12.6	4.4	B
	Right Turn	67	73	108.8%	2.2	1.4	A
	Subtotal	119	154	129.7%	6.5	1.3	A
Total		1,405	1,397	99.5%	2.8	0.4	A

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept H**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 15 **Vernon Rd/Davies Rd** **Roundabout**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	87	0	0.0%	#DIV/0!	#DIV/0!	#DIV/0!
	Through	324	8	2.3%	9.3	4.5	A
	Right Turn	256	71	27.7%	14.7	3.9	B
	Subtotal	667	78	11.8%	14.5	3.8	B
SB	Left Turn	330	526	159.5%	4.5	1.1	A
	Through	209	6	2.9%	3.0	3.9	A
	Right Turn						
	Subtotal	539	532	98.8%	4.5	1.1	A
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn	279	32	11.5%	2.0	1.2	A
	Through						
	Right Turn	309	599	193.7%	2.0	0.3	A
	Subtotal	588	631	107.2%	2.0	0.3	A
Total		1,794	1,241	69.2%	4.0	0.6	A

Intersection 16 **Parking Lot Connector/7th Place** **Signal**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	Total Delay (sec/veh) LOS
NB	Left Turn	88	89	100.7%	45.3	7.9	D
	Through	35	32	91.9%	37.3	10.7	D
	Right Turn	12	13	104.5%	23.9	9.2	C
	Subtotal	135	133	98.8%	41.2	7.0	D
SB	Left Turn	56	54	96.4%	38.7	9.3	D
	Through	74	72	97.3%	35.9	7.5	D
	Right Turn	415	414	99.8%	13.6	9.0	B
	Subtotal	545	540	99.1%	19.2	7.8	B
EB	Left Turn	564	444	78.7%	55.0	12.0	E
	Through	305	487	159.5%	42.8	10.8	D
	Right Turn	296	100	33.8%	7.6	2.2	A
	Subtotal	1,165	1,031	88.5%	44.3	9.8	D
WB	Left Turn	3	3	100.0%	32.1	29.2	C
	Through	59	56	95.2%	47.5	15.4	D
	Right Turn	94	95	100.8%	26.5	9.2	C
	Subtotal	156	154	98.7%	34.8	10.5	C
Total		2,001	1,858	92.9%	36.0	6.9	D

Vissim Post-Processor | **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs | **2040 - Concept H**
Volume and Delay by Movement | **PM Peak Hour**

Intersection 221 **SR 9/4th St NE** **Side-street Stop**

Direction	Movement	Demand Volume (vph)	Served Volume (vph) Average	Served Volume (vph) Percent	Total Delay (sec/veh) Average	Total Delay (sec/veh) Std. Dev.	LOS
NB	Left Turn						
	Through	1,133	1,044	92.2%	1.2	0.4	A
	Right Turn	89	23	26.3%	1.3	0.6	A
	Subtotal	1,222	1,068	87.4%	1.2	0.4	A
SB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
EB	Left Turn						
	Through						
	Right Turn						
	Subtotal						
WB	Left Turn						
	Through						
	Right Turn	92	128	139.4%	0.7	0.1	A
	Subtotal	92	128	139.4%	0.7	0.1	A
Total		1,314	1,196	91.0%	1.1	0.4	A

Intersection 1 **SR 9/Lundeen Pkwy** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	4	1	3	5	27	7	17	39	NO
	Through	2,000	148	12	133	164	658	39	615	722	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	300	23	11	10	48	97	17	68	123	NO
	Through	3,700	111	8	98	124	626	61	544	746	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	350	54	4	50	59	160	10	148	177	NO
	Through	2,000	35	5	29	44	151	19	129	185	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	350	93	12	82	119	272	58	226	400	NO
	Through	2,000	72	6	64	80	285	27	246	322	NO
	Right Turn	80	1	0	0	1	25	9	15	48	NO
	Second Right										

Intersection 3 **SR 9/SR 204** **Roundabout**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	160	34	13	18	58	135	22	96	170	NO
	Through	2,000	34	13	18	58	135	22	96	170	NO
	Right Turn	160	36	13	19	61	149	22	110	184	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	350	35	53	7	189	499	115	412	810	MAX
	Through	2,000	35	53	7	189	499	115	412	810	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	240	37	185	291	540	19	502	570	MAX
	Through	400	228	36	175	278	506	19	467	536	MAX
	Right Turn	100	228	36	175	278	506	19	467	536	AVG
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	300	48	13	32	65	214	19	177	238	NO
	Through	300	48	13	32	65	214	19	177	238	NO
	Right Turn	75	48	13	32	65	214	19	177	238	MAX
	Second Right										

Intersection 4 **SR 9/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	300	259	338	40	833	912	450	558	1,758	MAX
	Through	2,000	1,128	238	851	1,460	1,813	90	1,679	1,905	NO
	Right Turn	400	15	4	10	25	104	15	84	138	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	245	454	266	152	1,028	1,163	228	774	1,466	AVG
	Through	2,000	497	194	286	1,010	1,262	130	1,105	1,542	NO
	Right Turn	300	9	8	3	31	114	75	61	332	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	90	35	6	24	42	199	70	76	289	MAX
	Through	600	264	68	139	364	558	34	472	591	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	250	15	3	10	19	68	11	51	85	NO
	Through	1,000	166	26	132	219	527	32	443	549	NO
	Right Turn	600	30	13	15	60	260	32	175	282	NO
	Second Right										

Intersection 5 **91st Ave/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	150	0	1	0	2	4	6	0	12	NO
	Through	2,000	917	185	600	1,155	1,221	83	1,080	1,313	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	200	32	8	25	52	154	24	112	188	NO
	Through	800	78	6	68	93	279	6	274	291	NO
	Right Turn										
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	10	2	6	14	67	11	53	90	NO
	Through	1,250	217	94	134	394	637	178	434	969	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	160	115	33	79	180	372	60	284	510	MAX
	Through	350	78	32	41	131	367	52	298	461	MAX
	Right Turn	300	80	33	43	135	375	52	306	468	MAX
	Second Right										

Intersection 6 **Lundeen Pkwy/Market Pl/SR 204** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	200	20	2	16	23	127	16	99	149	NO
	Through	1,500	26	4	21	34	161	32	127	212	NO
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	100	25	3	21	32	120	19	92	145	MAX
	Through	100	25	3	21	32	120	19	92	145	MAX
	Right Turn	100	26	3	22	33	122	19	94	148	MAX
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	325	49	4	43	56	216	18	187	239	NO
	Through	2,000	80	22	63	140	550	98	416	764	NO
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	200	1	1	0	3	15	7	5	24	NO
	Through	1,250	61	7	48	69	271	25	233	314	NO
	Right Turn										
	Second Right										

Intersection 8 **91st Ave/Vernon Rd** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn	350	0	0	0	0	29	4	22	35	NO
	Through	350	0	0	0	0	21	13	0	50	NO
	Right Turn	350	0	0	0	0	21	13	0	50	NO
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	1	1	0	3	15	23	0	75	NO
	Through	400	0	0	0	0	0	0	0	0	NO
	Right Turn	400	2	2	0	6	71	21	44	114	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	400	3	1	2	5	71	13	57	101	NO
	Through	400	4	1	3	5	88	9	76	109	NO
	Right Turn	400	4	1	2	6	60	10	52	86	NO
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn	400	41	6	32	53	177	5	172	186	NO
	Through	400	41	6	32	53	177	5	172	186	NO
	Right Turn	400	35	6	26	47	173	5	167	182	NO
	Second Right										

Intersection 11 **Transit Center Dwy/4th St** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	8	0	7	9	83	8	70	98	NO
	Through										
	Right Turn	400	8	1	7	9	84	8	71	99	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 12 **Transit Center Dwy/Market Pl** **Side-street Stop**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										
SB	U Turn										
	Second Left										
	Left Turn	400	6	2	4	11	84	12	73	107	NO
	Through										
	Right Turn	400	6	2	4	11	83	12	73	107	NO
	Second Right										
EB	U Turn										
	Second Left										
	Left Turn	1,000	2	1	1	4	73	14	50	103	NO
	Through										
	Right Turn										
	Second Right										
WB	U Turn										
	Second Left										
	Left Turn										
	Through										
	Right Turn										
	Second Right										

Intersection 13 **91st Ave/Market Pl** **Signal**

Direction	Movement	Storage (ft)	Average Queue (ft) Average	Std. Dev.	Minimum	Maximum	Maximum Queue (ft) Average	Std. Dev.	Minimum	Maximum	Exceeds Storage?
NB	U Turn Second Left Left Turn Through Right Turn Second Right	130	2	0	1	2	43	6	33	50	NO
SB	U Turn Second Left Left Turn Through Right Turn Second Right	150	15	17	4	55	110	42	60	178	NO
EB	U Turn Second Left Left Turn Through Right Turn Second Right	150	4	1	2	6	51	13	34	75	NO
WB	U Turn Second Left Left Turn Through Right Turn Second Right	150	14	9	7	38	156	43	117	258	MAX

APPENDIX I.
Collision Analysis

November 2017

Collision Analysis - Future Year Concepts			Concept Totals	
Intersection	**SR 9 / 204 Intersection Only**		**All Study Area Intersections**	
Collision Type	**KABCO**	**KABC**	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing	12.3	4.7	56.6	21.4
2040 No Build	17.3	6.6	77.9	29.5
2040 Concept B - Roundabout[1]	6.9	0.7	78.2	26.4
2040 Concept C - Same as no build	17.3	6.6	86.0	32.5
2040 Concept E - Two intersections (SB Ramps)	10.9	3.8		
2040 Concept E - Two intersections (NB Ramps)	8.9	3.4		
2040 Concept E - As two intersections	19.8	7.2	88.5	33.1
2040 Concept E2A - As two intersections	19.8	7.2	88.9	33.3
2040 Concept E2B - As two intersections w Village	19.8	7.2	88.5	33.1
2040 Concept E2B-V4 - As two intersections w/o Village	19.8	7.2	79.9	30.0
2040 Concept E2C - As two intersections	12.8	5.0	83.8	31.6
2040 Concept E2D - As two intersections	12.8	5.0	83.8	31.6
2040 Concept G - Tunnel	15.8	6.0	81.7	30.8
2040 Concept H - Roundabout[1]	6.9	0.7	75.6	26.6

1. Roundabout predicted average crash frequencies were calculated by applying percent reductions provided by WSDOT to the 2040 Concept E scenario because of the similar design where SR 9 mainline is depressed beneath the study intersections. Injury and Fatal Collision Reduction percentages were averaged to produce a percent reduction for KABC. Reduction percentages can be found at the following link:
http://www.wsdot.wa.gov/Safety/roundabouts/benefits.htm
2. All calculations are used solely for the comparison of the concepts

Collision Analysis - Future Year Concepts		
Intersection	**91st Ave NE / SR 204**	
Collision Type	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing	10.0	3.8
2040 No Build	12.3	4.6
2040 Concepts B, C, E, and H	12.3	4.6
2040 Concept E4	13.3	5.0
2040 Concept G[1]	9.5	3.5

1. Only Concept G changes the geometry of the 91st Ave NE/SR 204 intersection due to the underground bypass connecting SR 204 with SR 9. This design change also results in lower volumes through the intersection as compared with the Existing and 2040 No Build Scenarios

Collision Analysis - Future Year Concepts		
Intersection	**SR 9 / Vernon Rd / N. Davies Rd**	
Collision Type	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing[1]	0.7	0.3
2040 No Build[2]	1.0	0.4
2040 Concept B - Roundabout[3]	2.6	0.3
2040 Concept E4	1.2	0.4
2040 Concepts C, E, G, and H	1.0	0.4

1. The existing intersection only consists of a SB off-ramp to Vernon Road
2. 2040 No Build maintains the existing lane geometry of a SB off-ramp to Vernon Road
3. Roundabout predicted average crash frequencies were calculated by applying percent reductions provided by WSDOT to analysis provided by the HSM spreadsheet since the HSM spreadsheet provides crash frequencies for a traditional stop-controlled intersection. Injury and Fatal Collision Reduction percentages were averaged to produce a percent reduction for KABC. Reduction percentages can be found at the following link:
http://www.wsdot.wa.gov/Safety/roundabouts/benefits.htm

Collision Analysis - Future Year Concepts		
Intersection	**Frontier Lane / 7th Pl NE**	
Collision Type	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing[1]	1.2	0.4
2040 No Build[1]	1.7	0.5
2040 Concept B[2]	9.2	3.3
2040 Concept E2B-V4[3]	0.8	0.3
2040 Concept E2C	0.5	0.2
2040 Concepts C, E, G, and H	9.7	3.5

1. Existing and 2040 No Build analysis applies to the Vernon Rd/92nd Ave/7th Pl intersection whereas all other concepts analyze the Frontier Lane/7th Pl intersection as the replacement for the Vernon/92nd/7th intersection
2. Concept B has lower volumes through the Frontier Ln/7th Pl NE intersection than the other concepts
3. Concept E2B-V4 does not include Frontier Ln but includes the Parking Lot Connector

Collision Analysis - Future Year Concepts		
Intersection	**SR 9 / 4th St NE**	
Collision Type	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing	0.2	0.1
2040 No Build	0.2	0.1
2040 Concept B - Roundabout[1]	1.8	0.2
2040 Concept E4	0.2	0.1
2040 Concepts C, E, G, and H[2]	0.3	0.1

1. Roundabout predicted average crash frequencies were calculated by applying percent reductions provided by WSDOT to analysis provided by the HSM spreadsheet since the HSM spreadsheet provides crash frequencies for a traditional stop-controlled intersection. Injury and Fatal Collision Reduction percentages were averaged to produce a percent reduction for KABC. Reduction percentages can be found at the following link:
http://www.wsdot.wa.gov/Safety/roundabouts/benefits.htm
2. Concepts C, E, G, and H include the right turning volumes from NB SR 9 at the SR 9/4th St intersection

Collision Analysis - Future Year Concepts		
Intersection	**SR 9 / Market Pl**	
Collision Type	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing	9.5	3.6
2040 No Build	13.2	5.0
2040 Concepts B, C, G, and H	13.2	5.0
2040 Concept E2,4	13.6	5.2
2040 Concept E[1]	13.2	5.0

1. Concept E adds a through lane for both directions along SR 9 at the intersection. This increases the number of lanes a pedestrian would have to cross which is taken into account in the HSM tool; however, that change does not have a noteable effect on the predicted average crash frequency

Collision Analysis - Future Year Concepts		
Intersection	**SR 204 / Market Pl & Lundeen Pkwy**	
Collision Type	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing	12.1	4.5
2040 No Build	14.4	5.4
2040 Concept E4	14.1	5.2
2040 Concepts B, C, E, G, and H	14.4	5.4

The geometry of this intersection doesn't change in the future but the increased volumes leads to an increase in the predicted average crash frequency

Collision Analysis - Future Year Concepts		
Intersection	**SR 9 / Lundeen Pkwy**	
Collision Type	**KABCO**	**KABC**
Scenarios	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
Existing	10.6	4.0
2040 No Build	17.8	6.9
2040 Concept E4	18.1	7.0
2040 Concepts, B, C, E, G, and H	17.8	6.9

The geometry of this intersection doesn't change in the future but the increased volumes leads to an increase in the predicted average crash frequency

Collision Analysis - Future Year Concepts		
Concepts E2C and E2D		
Collision Type	**KABCO**	**KABC**
Intersections	**Predicted Average Crash Frequency**	**Predicted Average Crash Frequency**
N. Davies / Vernon Rd	9.4	3.3
N. Davies / Vernon SB Ramp	0.3	0.1
Vernon Rd / Vernon NB Ramp	0.3	0.1

The geometry of this intersection doesn't change in the future but the increased volumes leads to an increase in the predicted average crash frequency

Collision Analysis - Future Year Concepts

Segment	Soper Hill Rd to Lundeen Pkwy on SR 9		Lundeen Pkwy to Vernon Slip Ramp on SR 9		Vernon Slip Ramp to SR 204 on SR 9		SR 204 to 4th St NE Ramp on SR 9		4th St NE Ramp to Market Pl NE on SR 9		Market Pl NE to 4th St SE on SR 9	
Collision Type	KABCO	KABC	KABCO	KABC	KABCO	KABC	KABCO	KABC	KABCO	KABC	KABCO	KABC
Concept	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency
Existing	3.7	1.0	5.5	1.6	2.6	0.7	1.0	0.3	0.9	0.3	1.3	0.3
2040 No Build	4.7	1.3	7.1	2.0	3.4	1.4	1.6	0.5	1.4	0.4	2.1	0.6
2040 Concept B[1]	4.7	1.3	3.4	1.2	1.1	0.4	1.9	0.7	1.3	0.4	2.1	0.6
2040 Concept C	4.7	1.3	7.1	2.0	3.4	1.4	1.5	0.4	1.4	0.4	2.1	0.6
2040 Concept E	4.7	1.3	3.9	1.2	3.1	1.2	4.2	2.0	1.8	0.5	2.3	0.7
2040 Concept E2A	4.7	1.3	4.1	1.3	3.9	1.3	4.5	2.1	1.3	0.4	2.1	0.6
2040 Concept E2B	4.7	1.3	4.1	1.3	3.9	1.3	4.2	2.0	1.8	0.5	2.3	0.7
2040 Concept E2B-V4	4.7	1.3	4.1	1.3	3.9	1.3	4.2	2.0	1.8	0.5	2.3	0.7
2040 Concept E2C	4.7	1.3	7.3	2.5	6.1	2.1	4.4	2.0	1.3	0.4	2.1	0.6
2040 Concept E2D	4.7	1.3	7.3	2.5	6.1	2.1	4.4	2.0	1.3	0.4	2.3	0.7
2040 Concept G[2]	4.7	1.3	4.8	1.8	2.6	0.7	1.5	0.4	1.4	0.4	2.1	0.6
2040 Concept H	4.7	1.3	7.1	2.0	0.8	0.3	1.4	0.5	1.4	0.4	2.1	0.6

All concepts include standard shoulders and an offset from fixed objects on the side of the road, as well as medians as shown according to the design plans. These design elements do not have a notable effect on the average crash frequency. For Concepts B, E, and H mainline volumes along SR 9 were analyzed to provide a comparison with Existing conditions
1. In Concept B it is assumed that the ramps from the Vernon Rd/N. Davies Roundabout will connect with SR 9 before the Soper Hill Rd to Lundeen Pkwy segment on SR 9
2. Since the diverge for the tunnel begins somewhere between Lundeen Pkwy and 91st Ave NE on SR 204 that segment analysis includes the volumes before vehicles begin diverging
3. Concepts B and H have higher crash frequencies between 91st Ave NE and SR 9 on SR 204 due to the additional lane from the west leg of the roundabout at SR 9/SR 204
4. Segment calculations for Concepts B, E, E2A, E2B, E2B-V4, E2C, E2D, and G are a combination of the HSM and ISAT tools
5. All calculations are used solely for the comparison of the concepts

Segment	Market Pl NE to 4th St SE on SR 9		81st Ave NE to Market Pl NE on SR 204		Market Pl NE to 91st Ave NE on SR 204		91st Ave NE to SR 9 on SR 2043		SR 9 to Frontier Ln or Parking Drwy on 7th Pl		Segment & Merge/Ramp Totals	
Collision Type	KABCO	KABC	KABCO	KABC	KABCO	KABC	KABCO	KABC	KABCO	KABC	KABCO	KABC
Concept	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency
Existing	1.3	0.3	5.2	1.6	1.6	0.5	0.7	0.2	0.3	0.1	22.8	6.6
2040 No Build	2.1	0.6	6.0	1.9	2.0	0.6	0.8	0.2	0.5	0.2	29.6	9.1
2040 Concept B[1]	2.1	0.6	6.0	1.9	2.0	0.6	0.7	0.2	0.5	0.2	26.8	8.7
2040 Concept C	2.1	0.6	6.0	1.9	2.0	0.6	0.8	0.2	0.8	0.3	29.8	9.1
2040 Concept E	2.3	0.7	6.0	1.9	2.0	0.6	0.8	0.2	0.8	0.3	31.5	10.7
2040 Concept E2A	2.1	0.6	6.0	1.9	2.0	0.6	0.8	0.2	0.8	0.3	32.1	10.7
2040 Concept E2B	2.3	0.7	6.0	1.9	2.0	0.6	0.8	0.2	0.8	0.3	32.5	10.8
2040 Concept E2B-V4	2.3	0.7	6.0	1.9	2.0	0.6	0.8	0.2	0.4	0.2	32.1	10.6
2040 Concept E2C	2.1	0.6	6.0	1.9	1.8	0.5	0.7	0.2	0.3	0.1	37.7	13.1
2040 Concept E2D	2.3	0.7	6.0	1.9	1.8	0.5	0.7	0.2	0.3	0.1	37.8	13.1
2040 Concept G[2]	2.1	0.6	6.0	1.9	2.0	0.6	0.5	0.1	0.8	0.3	28.1	8.9
2040 Concept H	2.1	0.6	6.0	1.9	2.0	0.6	0.7	0.2	0.6	0.2	29.4	8.9

All concepts include standard shoulders and an offset from fixed objects on the side of the road, as well as medians as shown according to the design plans. These design elements do not have a notable effect on the average crash frequency. For Concepts B, E, and H mainline volumes along SR 9 were analyzed to provide a comparison with Existing conditions
1. In Concept B it is assumed that the ramps from the Vernon Rd/N. Davies Roundabout will connect with SR 9 before the Soper Hill Rd to Lundeen Pkwy segment on SR 9
2. Since the diverge for the tunnel begins somewhere between Lundeen Pkwy and 91st Ave NE on SR 204 that segment analysis includes the volumes before vehicles begin diverging
3. Concepts B and H have higher crash frequencies between 91st Ave NE and SR 9 on SR 204 due to the additional lane from the west leg of the roundabout at SR 9/SR 204
4. Segment calculations for Concepts B, E, E2A, E2B, E2B-V4, E2C, E2D, and G are a combination of the HSM and ISAT tools
5. All calculations are used solely for the comparison of the concepts

Collision Analysis - Future Year Concepts	Concept B	
Collision Type	KABCO	KABC
Additional Segments (i.e. ramps)	Predicted Average Crash Frequency	Predicted Average Crash Frequency
NB Diverge (NB Off-Ramp to SR 204)	0.11	0.04
NB Off-Ramp (SR 9 to SR 204)	0.27	0.12
Frontage Road	0.50	0.20
NB On-Ramp (N. Davies to SR 9)	0.77	0.28
NB Merge (NB On-Ramp to SR 9)	0.29	0.11
SB Diverge (SB Off-Ramp to N.Davies)	0.10	0.04
SB Off-Ramp (SR 9 to N. Davies)	0.56	0.21
SB On-Ramp (SR 204 to SR 9)	0.19	0.09
SB Merge (SB On-Ramp to SR 9)	0.30	0.10

Collision Analysis - Future Year Concepts	Concept G	
Collision Type	KABCO	KABC
Additional Segments (i.e. ramps)	Predicted Average Crash Frequency	Predicted Average Crash Frequency
Tunnel	1.4	0.7
NB Merge (Tunnel to SR 9)	0.2	0.1

Collision Analysis - Future Year Concepts	Concept E		Concept H	
Collision Type	KABCO	KABC	KABCO	KABC
Additional Segments (i.e. ramps)	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency	Predicted Average Crash Frequency
NB Diverge (NB Off-Ramp to SR 204)	0.11	0.04	0.25	0.08
NB Off-Ramp (SR 9 to SR 204)	0.27	0.12	0.27	0.12
NB On-Ramp (SR 204 to SR 9)	0.77	0.28	0.77	0.28
NB Merge (NB On-Ramp to SR 9)	0.00	0.00	0.00	0.00
SB Diverge (SB Off-Ramp to SR 204)	0.00	0.00	0.30	0.09
SB Off-Ramp (SR 9 to SR 204)	0.56	0.21	0.56	0.21
SB On-Ramp (SR 204 to SR 9)	0.19	0.09	0.19	0.09
SB Merge (SB On-Ramp to SR 9)	0.00	0.00	0.22	0.07
NB On-Ramp (N. Davies to SR 9) - E4	0.15	0.07		
SB Off-Ramp (SR 9 to Vernon Rd) - E4	0.52	0.48		
Vernon Road between N Davies to Vernon NB Ramp - E4	0.20	0.10		
Vernon Rd between N Davies to 91st - E4	0.10	0.00		
N. Davies between Vernon SB Ramp to Vernon NB Ramp - E4	0.00	0.00		

All concepts include standard shoulders and an offset from fixed objects on the side of the road, as well as medians as shown according to the design plans. These design elements do not have a notable effect on the average crash frequency. For Concepts B, E, and H mainline volumes along SR 9 were analyzed to provide a comparison with Existing conditions

1. In Concept B it is assumed that the ramps from the Vernon Rd/N. Davies Roundabout will connect with SR 9 before the Soper Hill Rd to Lundeen Pkwy segment on SR 9
2. Since the diverge for the tunnel begins somewhere between Lundeen Pkwy and 91st Ave NE on SR 204 that segment analysis includes the volumes before vehicles begin diverging
3. Concepts B and H have higher crash frequencies between 91st Ave NE and SR 9 on SR 204 due to the additional lane from the west leg of the roundabout at SR 9/SR 204
4. Segment calculations for Concepts B, E, E2A, E2B, E2B-V4, E2C, E2D, and G are a combination of the HSM and ISAT tools
5. All calculations are used solely for the comparison of the concepts

The following spreadsheets are a sample of the HSM spreadsheets for the Preferred Alternative

WORKSHEET 1A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9
Agency or Company	Fehr & Peers	Roadway Section	Soper Hill Road to Lundeen Parkway
Date Performed	04/04/17	Jurisdiction	WSDOT
Segment for Analysis	Segment 1	Analysis Year	2040

Input Data		**Site Conditions**	**Base Conditions**
Roadway type (2U, 3T, 4U, 4D, 5T)		**4D**	--
Length of segment, L (mi)		0.6	--
AADT (veh/day) is within range	$AADT_{MAX}$ = 66,000 (veh/day)	35,130	--
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		0	--
Median width (ft) - for divided only		10	15
Lighting (present / not present)		Not Present	Not Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)			--
Minor commercial driveways (number)			--
Major industrial / institutional driveways (number)			--
Minor industrial / institutional driveways (number)			--
Major residential driveways (number)			--
Minor residential driveways (number)			--
Other driveways (number)			--
Speed Category		Posted Speed Greater than 30 mph	--
Roadside fixed object density (fixed objects / mi)		20	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		15	30
Calibration Factor, Cr		1.00	1.00

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle driveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Multiple vehicle nondriveway crashes	KABC	Fatal and Injury Only	4.4
	PDO	Property Damage Only	8.4
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	1.2

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 1B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.01	1.01	1.00	1.00	1.02

WORKSHEET 1C -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-12.34	1.36	1.32	3.991	1.000	3.991	1.02	1.00	4.082
Fatal and Injury (FI)	-12.76	1.28	1.31	1.135	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.270	1.076	1.02	1.00	1.100
Property Damage Only (PDO)	-12.81	1.38	1.34	3.075	$(5)_{TOTAL}-(5)_{FI}$ = 0.730	2.915	1.02	1.00	2.982

WORKSHEET 1D -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brmv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brmv* (PDO) (crashes/year)**	**Predicted N *brmv* (TOTAL) (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	1.100	1.000	2.982	4.082
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.832	0.916	0.662	1.974	2.889
Head-on collision	0.020	0.022	0.007	0.021	0.043
Angle collision	0.040	0.044	0.036	0.107	0.151
Sideswipe, same direction	0.050	0.055	0.223	0.665	0.720
Sideswipe, opposite direction	0.010	0.011	0.001	0.003	0.014
Other multiple-vehicle collision	0.048	0.053	0.071	0.212	0.265

WORKSHEET 1E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.05	0.47	0.86	0.527	1.000	0.527	1.02	1.00	0.539
Fatal and Injury (FI)	-8.71	0.66	0.28	0.099	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.187	0.098	1.02	1.00	0.101
Property Damage Only (PDO)	-5.04	0.45	1.06	0.431	$(5)_{TOTAL}-(5)_{FI}$ = 0.813	0.428	1.02	1.00	0.438

WORKSHEET 1F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brsv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brsv* (PDO) (crashes/year)**	**Predicted N *brsv* (TOTAL) (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.101	1.000	0.438	0.539
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.063	0.028	0.028
Collision with fixed object	0.500	0.050	0.813	0.356	0.406

Collision with other object	0.028	0.003	0.016	0.007	0.010
Other single-vehicle collision	0.471	0.047	0.108	0.047	0.095

WORKSHEET 1G -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY DRIVEWAY TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	0	0.033	1.106	0.000	--
Minor commercial	0	0.011	1.106	0.000	
Major industrial/institutional	0	0.036	1.106	0.000	
Minor industrial/institutional	0	0.005	1.106	0.000	
Major residential	0	0.018	1.106	0.000	
Minor residential	0	0.003	1.106	0.000	
Other	0	0.005	1.106	0.000	
Total	--	--	--	0.000	1.39

WORKSHEET 1H -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL} * (3)$	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.000	1.000	0.000	1.02	1.00	0.000
Fatal and injury (FI)	--	0.284	0.000	1.02	1.00	0.000
Property damage only (PDO)	--	0.716	0.000	1.02	1.00	0.000

WORKSHEET 1I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	4.082	0.539	0.000	4.621	0.019	1.00	0.088
Fatal and injury (FI)	--	--	--	--	--	1.00	0.088

WORKSHEET 1J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	4.082	0.539	0.000	4.621	0.005	1.00	0.023
Fatal and injury (FI)	--	--	--	--	--	1.00	0.023

WORKSHEET 1K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.916	1.974	2.889
Head-on collisions (from Worksheet 1D)	0.022	0.021	0.043
Angle collisions (from Worksheet 1D)	0.044	0.107	0.151
Sideswipe, same direction (from Worksheet 1D)	0.055	0.665	0.720
Sideswipe, opposite direction (from Worksheet 1D)	0.011	0.003	0.014
Driveway-related collisions (from Worksheet 1H)	0.000	0.000	0.000
Other multiple-vehicle collision (from Worksheet 1D)	0.053	0.212	0.265
Subtotal	1.100	2.982	4.082
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.028	0.028
Collision with fixed object (from Worksheet 1F)	0.050	0.356	0.406
Collision with other object (from Worksheet 1F)	0.003	0.007	0.010
Other single-vehicle collision (from Worksheet 1F)	0.047	0.047	0.095
Collision with pedestrian (from Worksheet 1I)	0.088	0.000	0.088
Collision with bicycle (from Worksheet 1J)	0.023	0.000	0.023
Subtotal	0.211	0.438	0.649
Total	1.312	3.420	4.731

WORKSHEET 1L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	4.7	0.60	7.9
Fatal and injury (FI)	1.3	0.60	2.2
Property damage only (PDO)	3.4	0.60	5.7

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	4.7	12.3	7.6	1.3	3.4	2.1	3.4	8.9	5.5

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 1A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9
Agency or Company	Fehr & Peers	Roadway Section	4th St NE Slip Ramp to Market Place NE
Date Performed	04/04/17	Jurisdiction	WSDOT
Segment for Analysis	Segment 5	Analysis Year	2040

Input Data		**Site Conditions**	**Base Conditions**
Roadway type (2U, 3T, 4U, 4D, 5T)		**4U**	--
Length of segment, L (mi)		0.16	--
AADT (veh/day) is within range	$AADT_{MAX}$ = 40,100 (veh/day)	27,350	--
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		0	--
Median width (ft) - for divided only		Not Present	15
Lighting (present / not present)		Not Present	Not Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)			--
Minor commercial driveways (number)			--
Major industrial / institutional driveways (number)			--
Minor industrial / institutional driveways (number)			--
Major residential driveways (number)			--
Minor residential driveways (number)			--
Other driveways (number)			--
Speed Category		Posted Speed Greater than 30 mph	--
Roadside fixed object density (fixed objects / mi)		10	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		15	30
Calibration Factor, Cr		1.00	1.00

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle driveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Multiple vehicle nondriveway crashes	KABC	Fatal and Injury Only	0.2
	PDO	Property Damage Only	0.8
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.2

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 1B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	1.00	1.00	1.00

WORKSHEET 1C -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-11.63	1.33	1.01	1.134	1.000	1.134	1.00	1.00	1.134
Fatal and Injury (FI)	-12.08	1.25	0.99	0.319	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.333	1.00	1.00	0.333
					0.294				
Property Damage Only (PDO)	-12.53	1.38	1.08	0.768	$(5)_{TOTAL}-(5)_{FI}$	0.801	1.00	1.00	0.801
					0.706				

WORKSHEET 1D -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brmv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brmv* (PDO) (crashes/year)**	**Predicted N *brmv* (TOTAL) (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.333	1.000	0.801	1.134
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.511	0.170	0.506	0.405	0.575
Head-on collision	0.077	0.026	0.004	0.003	0.029
Angle collision	0.181	0.060	0.130	0.104	0.164
Sideswipe, same direction	0.093	0.031	0.249	0.199	0.230
Sideswipe, opposite direction	0.082	0.027	0.031	0.025	0.052
Other multiple-vehicle collision	0.056	0.019	0.080	0.064	0.083

WORKSHEET 1E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-7.99	0.81	0.91	0.213	1.000	0.213	1.00	1.00	0.213
Fatal and Injury (FI)	-7.37	0.61	0.54	0.051	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.049	1.00	1.00	0.049
					0.228				
Property Damage Only (PDO)	-8.50	0.84	0.97	0.174	$(5)_{TOTAL}-(5)_{FI}$	0.164	1.00	1.00	0.164
					0.772				

WORKSHEET 1F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brsv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brsv* (PDO) (crashes/year)**	**Predicted N *brsv* (TOTAL) (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.049	1.000	0.164	0.213
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.000
Collision with fixed object	0.612	0.030	0.809	0.133	0.163

Collision with other object	0.020	0.001	0.029	0.005	0.006
Other single-vehicle collision	0.367	0.018	0.161	0.026	0.044

WORKSHEET 1G -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY DRIVEWAY TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	0	0.182	1.172	0.000	--
Minor commercial	0	0.058	1.172	0.000	
Major industrial/institutional	0	0.198	1.172	0.000	
Minor industrial/institutional	0	0.026	1.172	0.000	
Major residential	0	0.096	1.172	0.000	
Minor residential	0	0.018	1.172	0.000	
Other	0	0.029	1.172	0.000	
Total	--	--	--	0.000	0.81

WORKSHEET 1H -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.000	1.000	0.000	1.00	1.00	0.000
Fatal and injury (FI)	--	0.342	0.000	1.00	1.00	0.000
Property damage only (PDO)	--	0.658	0.000	1.00	1.00	0.000

WORKSHEET 1I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	1.134	0.213	0.000	1.346	0.009	1.00	0.012
Fatal and injury (FI)	--	--	--	--	--	1.00	0.012

WORKSHEET 1J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	1.134	0.213	0.000	1.346	0.002	1.00	0.003
Fatal and injury (FI)	--	--	--	--	--	1.00	0.003

WORKSHEET 1K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.170	0.405	0.575
Head-on collisions (from Worksheet 1D)	0.026	0.003	0.029
Angle collisions (from Worksheet 1D)	0.060	0.104	0.164
Sideswipe, same direction (from Worksheet 1D)	0.031	0.199	0.230
Sideswipe, opposite direction (from Worksheet 1D)	0.027	0.025	0.052
Driveway-related collisions (from Worksheet 1H)	0.000	0.000	0.000
Other multiple-vehicle collision (from Worksheet 1D)	0.019	0.064	0.083
Subtotal	0.333	0.801	1.134
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 1F)	0.030	0.133	0.163
Collision with other object (from Worksheet 1F)	0.001	0.005	0.006
Other single-vehicle collision (from Worksheet 1F)	0.018	0.026	0.044
Collision with pedestrian (from Worksheet 1I)	0.012	0.000	0.012
Collision with bicycle (from Worksheet 1J)	0.003	0.000	0.003
Subtotal	0.063	0.164	0.228
Total	0.396	0.965	1.361

WORKSHEET 1L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	1.4	0.16	8.5
Fatal and injury (FI)	0.4	0.16	2.5
Property damage only (PDO)	1.0	0.16	6.0

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	1.4	1.3	0.0	0.4	0.4	0.0	1.0	0.9	0.0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 1A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9
Agency or Company	Fehr & Peers	Roadway Section	Market Place NE to 4th Street SE
Date Performed	04/04/17	Jurisdiction	WSDOT
Segment for Analysis	Segment 6	Analysis Year	2040

Input Data		**Site Conditions**	**Base Conditions**
Roadway type (2U, 3T, 4U, 4D, 5T)		**2U**	--
Length of segment, L (mi)		0.37	--
AADT (veh/day) is within range	$AADT_{MAX}$ = 32,600 (veh/day)	20,950	--
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		0	--
Median width (ft) - for divided only		Not Present	15
Lighting (present / not present)		Not Present	Not Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)			--
Minor commercial driveways (number)			--
Major industrial / institutional driveways (number)			--
Minor industrial / institutional driveways (number)			--
Major residential driveways (number)			--
Minor residential driveways (number)			--
Other driveways (number)			--
Speed Category		Posted Speed Greater than 30 mph	--
Roadside fixed object density (fixed objects / mi)		15	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		15	30
Calibration Factor, Cr		1.00	1.00

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle driveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Multiple vehicle nondriveway crashes	KABC	Fatal and Injury Only	1.2
	PDO	Property Damage Only	2.4
Single-vehicle crashes	KABC	Fatal and Injury Only	0.6
	PDO	Property Damage Only	0.6

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 1B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	1.00	1.00	1.00

WORKSHEET 1C -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-15.22	1.68	0.84	1.651	1.000	1.651	1.00	1.00	1.653
Fatal and Injury (FI)	-16.22	1.66	0.65	0.498	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.478	1.00	1.00	0.478
					0.289				
Property Damage Only (PDO)	-15.62	1.69	0.87	1.223	$(5)_{TOTAL}-(5)_{FI}$	1.173	1.00	1.00	1.174
					0.711				

WORKSHEET 1D -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brmv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brmv* (PDO) (crashes/year)**	**Predicted N *brmv* (TOTAL) (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.478	1.000	1.174	1.653
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.730	0.349	0.778	0.914	1.263
Head-on collision	0.068	0.033	0.004	0.005	0.037
Angle collision	0.085	0.041	0.079	0.093	0.133
Sideswipe, same direction	0.015	0.007	0.031	0.036	0.044
Sideswipe, opposite direction	0.073	0.035	0.055	0.065	0.100
Other multiple-vehicle collision	0.029	0.014	0.053	0.062	0.076

WORKSHEET 1E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.410	1.000	0.410	1.00	1.00	0.410
Fatal and Injury (FI)	-3.96	0.23	0.50	0.070	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.073	1.00	1.00	0.073
					0.178				
Property Damage Only (PDO)	-6.51	0.64	0.87	0.321	$(5)_{TOTAL}-(5)_{FI}$	0.337	1.00	1.00	0.337
					0.822				

WORKSHEET 1F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brsv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brsv* (PDO) (crashes/year)**	**Predicted N *brsv* (TOTAL) (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.073	1.000	0.337	0.410
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Collision with animal	0.026	0.002	0.066	0.022	0.024
Collision with fixed object	0.723	0.053	0.759	0.256	0.309

Collision with other object	0.010	0.001	0.013	0.004	0.005
Other single-vehicle collision	0.241	0.018	0.162	0.055	0.072

WORKSHEET 1G -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY DRIVEWAY TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	0	0.050	1.000	0.000	
Major industrial/institutional	0	0.172	1.000	0.000	
Minor industrial/institutional	0	0.023	1.000	0.000	
Major residential	0	0.083	1.000	0.000	
Minor residential	0	0.016	1.000	0.000	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.000	0.81

WORKSHEET 1H -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL} * (3)$	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.000	1.000	0.000	1.00	1.00	0.000
Fatal and injury (FI)	--	0.323	0.000	1.00	1.00	0.000
Property damage only (PDO)	--	0.677	0.000	1.00	1.00	0.000

WORKSHEET 1I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	1.653	0.410	0.000	2.063	0.005	1.00	0.010
Fatal and injury (FI)	--	--	--	--	--	1.00	0.010

WORKSHEET 1J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	1.653	0.410	0.000	2.063	0.004	1.00	0.008
Fatal and injury (FI)	--	--	--	--	--	1.00	0.008

WORKSHEET 1K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.349	0.914	1.263
Head-on collisions (from Worksheet 1D)	0.033	0.005	0.037
Angle collisions (from Worksheet 1D)	0.041	0.093	0.133
Sideswipe, same direction (from Worksheet 1D)	0.007	0.036	0.044
Sideswipe, opposite direction (from Worksheet 1D)	0.035	0.065	0.100
Driveway-related collisions (from Worksheet 1H)	0.000	0.000	0.000
Other multiple-vehicle collision (from Worksheet 1D)	0.014	0.062	0.076
Subtotal	0.478	1.174	1.653
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.002	0.022	0.024
Collision with fixed object (from Worksheet 1F)	0.053	0.256	0.309
Collision with other object (from Worksheet 1F)	0.001	0.004	0.005
Other single-vehicle collision (from Worksheet 1F)	0.018	0.055	0.072
Collision with pedestrian (from Worksheet 1I)	0.010	0.000	0.010
Collision with bicycle (from Worksheet 1J)	0.008	0.000	0.008
Subtotal	0.092	0.337	0.429
Total	0.570	1.512	2.081

WORKSHEET 1L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	2.1	0.37	5.6
Fatal and injury (FI)	0.6	0.37	1.5
Property damage only (PDO)	1.5	0.37	4.1

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	2.1	3.4	1.3	0.6	0.9	0.4	1.5	2.5	1.0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 1A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 204
Agency or Company	Fehr & Peers	Roadway Section	81st Ave NE to Market Place NE
Date Performed	04/04/17	Jurisdiction	WSDOT
Segment for Analysis	Segment 7	Analysis Year	2040

Input Data		**Site Conditions**	**Base Conditions**
Roadway type (2U, 3T, 4U, 4D, 5T)		**3T**	--
Length of segment, L (mi)		0.6	--
AADT (veh/day) is within range	$AADT_{MAX}$ = 32,900 (veh/day)	30,920	--
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		0	--
Median width (ft) - for divided only		Not Present	15
Lighting (present / not present)		Not Present	Not Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)			--
Minor commercial driveways (number)			--
Major industrial / institutional driveways (number)			--
Minor industrial / institutional driveways (number)			--
Major residential driveways (number)			--
Minor residential driveways (number)			--
Other driveways (number)			--
Speed Category		Posted Speed Greater than 30 mph	--
Roadside fixed object density (fixed objects / mi)		20	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		15	30
Calibration Factor, Cr		1.00	1.00

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle driveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Multiple vehicle nondriveway crashes	KABC	Fatal and Injury Only	1.0
	PDO	Property Damage Only	2.0
Single-vehicle crashes	KABC	Fatal and Injury Only	0.8
	PDO	Property Damage Only	1.4

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 1B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.01	1.00	1.00	1.00	1.01

WORKSHEET 1C -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-12.40	1.41	0.66	5.298	1.000	5.298	1.01	1.00	5.362
Fatal and Injury (FI)	-16.45	1.69	0.59	1.669	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	1.668	1.01	1.00	1.688
					0.315				
Property Damage Only (PDO)	-11.95	1.33	0.59	3.634	$(5)_{TOTAL}-(5)_{FI}$	3.631	1.01	1.00	3.674
					0.685				

WORKSHEET 1D -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brmv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brmv* (PDO) (crashes/year)**	**Predicted N *brmv* (TOTAL) (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	1.688	1.000	3.674	5.362
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.845	1.426	0.842	3.094	4.520
Head-on collision	0.034	0.057	0.020	0.073	0.131
Angle collision	0.069	0.116	0.020	0.073	0.190
Sideswipe, same direction	0.001	0.002	0.078	0.287	0.288
Sideswipe, opposite direction	0.017	0.029	0.020	0.073	0.102
Other multiple-vehicle collision	0.034	0.057	0.020	0.073	0.131

WORKSHEET 1E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.74	0.54	1.37	0.513	1.000	0.513	1.01	1.00	0.519
Fatal and Injury (FI)	-6.37	0.47	1.06	0.132	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.137	1.01	1.00	0.139
					0.267				
Property Damage Only (PDO)	-6.29	0.56	1.93	0.364	$(5)_{TOTAL}-(5)_{FI}$	0.376	1.01	1.00	0.381
					0.733				

WORKSHEET 1F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brsv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brsv* (PDO) (crashes/year)**	**Predicted N *brsv* (TOTAL) (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.139	1.000	0.381	0.519
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.001
Collision with fixed object	0.688	0.095	0.963	0.366	0.462

Collision with other object	0.001	0.000	0.001	0.000	0.001
Other single-vehicle collision	0.310	0.043	0.035	0.013	0.056

WORKSHEET 1G -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY DRIVEWAY TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	0	0.102	1.000	0.000	--
Minor commercial	0	0.032	1.000	0.000	
Major industrial/institutional	0	0.110	1.000	0.000	
Minor industrial/institutional	0	0.015	1.000	0.000	
Major residential	0	0.053	1.000	0.000	
Minor residential	0	0.010	1.000	0.000	
Other	0	0.016	1.000	0.000	
Total	--	--	--	0.000	1.10

WORKSHEET 1H -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL} * (3)$	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.000	1.000	0.000	1.01	1.00	0.000
Fatal and injury (FI)	--	0.243	0.000	1.01	1.00	0.000
Property damage only (PDO)	--	0.757	0.000	1.01	1.00	0.000

WORKSHEET 1I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	5.362	0.519	0.000	5.881	0.013	1.00	0.076
Fatal and injury (FI)	--	--	--	--	--	1.00	0.076

WORKSHEET 1J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	5.362	0.519	0.000	5.881	0.007	1.00	0.041
Fatal and injury (FI)	--	--	--	--	--	1.00	0.041

WORKSHEET 1K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	1.426	3.094	4.520
Head-on collisions (from Worksheet 1D)	0.057	0.073	0.131
Angle collisions (from Worksheet 1D)	0.116	0.073	0.190
Sideswipe, same direction (from Worksheet 1D)	0.002	0.287	0.288
Sideswipe, opposite direction (from Worksheet 1D)	0.029	0.073	0.102
Driveway-related collisions (from Worksheet 1H)	0.000	0.000	0.000
Other multiple-vehicle collision (from Worksheet 1D)	0.057	0.073	0.131
Subtotal	1.688	3.674	5.362
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.000	0.001
Collision with fixed object (from Worksheet 1F)	0.095	0.366	0.462
Collision with other object (from Worksheet 1F)	0.000	0.000	0.001
Other single-vehicle collision (from Worksheet 1F)	0.043	0.013	0.056
Collision with pedestrian (from Worksheet 1I)	0.076	0.000	0.076
Collision with bicycle (from Worksheet 1J)	0.041	0.000	0.041
Subtotal	0.256	0.381	0.637
Total	1.944	4.055	5.998

WORKSHEET 1L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	6.0	0.60	10.0
Fatal and injury (FI)	1.9	0.60	3.2
Property damage only (PDO)	4.1	0.60	6.8

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	6.0	4.9	0.0	1.9	1.6	0.0	4.1	3.3	0.0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 1A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 204
Agency or Company	Fehr & Peers	Roadway Section	91st Ave NE to SR 9
Date Performed	04/13/17	Jurisdiction	WSDOT - Concept E
Segment for Analysis	Segment 5	Analysis Year	2040

Input Data		**Site Conditions**	**Base Conditions**
Roadway type (2U, 3T, 4U, 4D, 5T)		**4U**	--
Length of segment, L (mi)		0.1	--
AADT (veh/day) is within range	$AADT_{MAX}$ = 40,100 (veh/day)	26,310	--
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking			--
Median width (ft) - for divided only			15
Lighting (present / not present)		Not Present	Not Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)			--
Minor commercial driveways (number)			--
Major industrial / institutional driveways (number)			--
Minor industrial / institutional driveways (number)			--
Major residential driveways (number)			--
Minor residential driveways (number)			--
Other driveways (number)			--
Speed Category		Posted Speed Greater than 30 mph	--
Roadside fixed object density (fixed objects / mi)		20	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		20	30
Calibration Factor, Cr		1.00	1.00

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle driveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Multiple vehicle nondriveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 1B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	1.00	1.00	1.00

WORKSHEET 1C -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-11.63	1.33	1.01	0.673	1.000	0.673	1.00	1.00	0.676
Fatal and Injury (FI)	-12.08	1.25	0.99	0.190	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.198	1.00	1.00	0.199
					0.295				
Property Damage Only (PDO)	-12.53	1.38	1.08	0.455	$(5)_{TOTAL}-(5)_{FI}$	0.475	1.00	1.00	0.477
					0.705				

WORKSHEET 1D -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brmv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brmv* (PDO) (crashes/year)**	**Predicted N *brmv* (TOTAL) (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.199	1.000	0.477	0.676
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.511	0.102	0.506	0.241	0.343
Head-on collision	0.077	0.015	0.004	0.002	0.017
Angle collision	0.181	0.036	0.130	0.062	0.098
Sideswipe, same direction	0.093	0.019	0.249	0.119	0.137
Sideswipe, opposite direction	0.082	0.016	0.031	0.015	0.031
Other multiple-vehicle collision	0.056	0.011	0.080	0.038	0.049

WORKSHEET 1E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-7.99	0.81	0.91	0.129	1.000	0.129	1.00	1.00	0.130
Fatal and Injury (FI)	-7.37	0.61	0.54	0.031	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.030	1.00	1.00	0.030
					0.230				
Property Damage Only (PDO)	-8.50	0.84	0.97	0.105	$(5)_{TOTAL}-(5)_{FI}$	0.099	1.00	1.00	0.100
					0.770				

WORKSHEET 1F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brsv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brsv* (PDO) (crashes/year)**	**Predicted N *brsv* (TOTAL) (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.030	1.000	0.100	0.130
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.000
Collision with fixed object	0.612	0.018	0.809	0.081	0.099

Collision with other object	0.020	0.001	0.029	0.003	0.003
Other single-vehicle collision	0.367	0.011	0.161	0.016	0.027

WORKSHEET 1G -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY DRIVEWAY TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	0	0.182	1.172	0.000	
Minor commercial	0	0.058	1.172	0.000	
Major industrial/institutional	0	0.198	1.172	0.000	
Minor industrial/institutional	0	0.026	1.172	0.000	--
Major residential	0	0.096	1.172	0.000	
Minor residential	0	0.018	1.172	0.000	
Other	0	0.029	1.172	0.000	
Total	--	--	--	0.000	0.81

WORKSHEET 1H -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.000	1.000	0.000	1.00	1.00	0.000
Fatal and injury (FI)	--	0.342	0.000	1.00	1.00	0.000
Property damage only (PDO)	--	0.658	0.000	1.00	1.00	0.000

WORKSHEET 1I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.676	0.130	0.000	0.806	0.009	1.00	0.007
Fatal and injury (FI)	--	--	--	--	--	1.00	0.007

WORKSHEET 1J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.676	0.130	0.000	0.806	0.002	1.00	0.002
Fatal and injury (FI)	--	--	--	--	--	1.00	0.002

WORKSHEET 1K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.102	0.241	0.343
Head-on collisions (from Worksheet 1D)	0.015	0.002	0.017
Angle collisions (from Worksheet 1D)	0.036	0.062	0.098
Sideswipe, same direction (from Worksheet 1D)	0.019	0.119	0.137
Sideswipe, opposite direction (from Worksheet 1D)	0.016	0.015	0.031
Driveway-related collisions (from Worksheet 1H)	0.000	0.000	0.000
Other multiple-vehicle collision (from Worksheet 1D)	0.011	0.038	0.049
Subtotal	0.199	0.477	0.676
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 1F)	0.018	0.081	0.099
Collision with other object (from Worksheet 1F)	0.001	0.003	0.003
Other single-vehicle collision (from Worksheet 1F)	0.011	0.016	0.027
Collision with pedestrian (from Worksheet 1I)	0.007	0.000	0.007
Collision with bicycle (from Worksheet 1J)	0.002	0.000	0.002
Subtotal	0.039	0.100	0.138
Total	0.238	0.577	0.815

WORKSHEET 1L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	0.8	0.10	8.1
Fatal and injury (FI)	0.2	0.10	2.4
Property damage only (PDO)	0.6	0.10	5.8

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	0.8	0.0	0.0	0.2	0.0	0.0	0.6	0.0	0.0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 1A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	7th Pl
Agency or Company	Fehr & Peers	Roadway Section	SR 9 to Parking Lot Connector
Date Performed	04/07/17	Jurisdiction	Lake Stevens
Segment for Analysis	Segment 9	Analysis Year	2040

Input Data		**Site Conditions**	**Base Conditions**
Roadway type (2U, 3T, 4U, 4D, 5T)		**4U**	--
Length of segment, L (mi)		0.06	--
AADT (veh/day) is within range	$AADT_{MAX}$ = 40,100 (veh/day)	7,460	--
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking			--
Median width (ft) - for divided only			15
Lighting (present / not present)		Present	Not Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)			--
Minor commercial driveways (number)		8	--
Major industrial / institutional driveways (number)			--
Minor industrial / institutional driveways (number)			--
Major residential driveways (number)			--
Minor residential driveways (number)			--
Other driveways (number)			--
Speed Category		Posted Speed 30 mph or Lower	--
Roadside fixed object density (fixed objects / mi)		0	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		5	30
Calibration Factor, Cr		1.00	1.00

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle driveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Multiple vehicle nondriveway crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 1B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.92	1.00	0.92

WORKSHEET 1C -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-11.63	1.33	1.01	0.076	1.000	0.076	0.92	1.00	0.069
Fatal and Injury (FI)	-12.08	1.25	0.99	0.024	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.025	0.92	1.00	0.023
					0.330				
Property Damage Only (PDO)	-12.53	1.38	1.08	0.048	$(5)_{TOTAL}-(5)_{FI}$	0.051	0.92	1.00	0.046
					0.670				

WORKSHEET 1D -- MULTIPLE-VEHICLE NONDRIVEWAY COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brmv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brmv* (PDO) (crashes/year)**	**Predicted N *brmv* (TOTAL) (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.023	1.000	0.046	0.069
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.511	0.012	0.506	0.023	0.035
Head-on collision	0.077	0.002	0.004	0.000	0.002
Angle collision	0.181	0.004	0.130	0.006	0.010
Sideswipe, same direction	0.093	0.002	0.249	0.012	0.014
Sideswipe, opposite direction	0.082	0.002	0.031	0.001	0.003
Other multiple-vehicle collision	0.056	0.001	0.080	0.004	0.005

WORKSHEET 1E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-7.99	0.81	0.91	0.028	1.000	0.028	0.92	1.00	0.026
Fatal and Injury (FI)	-7.37	0.61	0.54	0.009	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$	0.008	0.92	1.00	0.007
					0.285				
Property Damage Only (PDO)	-8.50	0.84	0.97	0.022	$(5)_{TOTAL}-(5)_{FI}$	0.020	0.92	1.00	0.018
					0.715				

WORKSHEET 1F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type(FI)**	**Predicted N *brsv* (FI) (crashes/year)**	**Proportion of Collision Type (PDO)**	**Predicted N *brsv* (PDO) (crashes/year)**	**Predicted N *brsv* (TOTAL) (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.007	1.000	0.018	0.026
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.000
Collision with fixed object	0.612	0.004	0.809	0.015	0.019

Collision with other object	0.020	0.000	0.029	0.001	0.001
Other single-vehicle collision	0.367	0.003	0.161	0.003	0.006

WORKSHEET 1G -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY DRIVEWAY TYPE FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15,000)^t$	from Table 12-7
Major commercial	0	0.182	1.172	0.000	--
Minor commercial	8	0.058	1.172	0.205	
Major industrial/institutional	0	0.198	1.172	0.000	
Minor industrial/institutional	0	0.026	1.172	0.000	
Major residential	0	0.096	1.172	0.000	
Minor residential	0	0.018	1.172	0.000	
Other	0	0.029	1.172	0.000	
Total	--	--	--	0.205	0.81

WORKSHEET 1H -- MULTIPLE-VEHICLE DRIVEWAY-RELATED COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.205	1.000	0.205	0.92	1.00	0.188
Fatal and injury (FI)	--	0.342	0.070	0.92	1.00	0.064
Property damage only (PDO)	--	0.658	0.135	0.92	1.00	0.124

WORKSHEET 1I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.069	0.026	0.188	0.283	0.022	1.00	0.006
Fatal and injury (FI)	--	--	--	--	--	1.00	0.006

WORKSHEET 1J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.069	0.026	0.188	0.283	0.011	1.00	0.003
Fatal and injury (FI)	--	--	--	--	--	1.00	0.003

WORKSHEET 1K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.012	0.023	0.035
Head-on collisions (from Worksheet 1D)	0.002	0.000	0.002
Angle collisions (from Worksheet 1D)	0.004	0.006	0.010
Sideswipe, same direction (from Worksheet 1D)	0.002	0.012	0.014
Sideswipe, opposite direction (from Worksheet 1D)	0.002	0.001	0.003
Driveway-related collisions (from Worksheet 1H)	0.064	0.124	0.188
Other multiple-vehicle collision (from Worksheet 1D)	0.001	0.004	0.005
Subtotal	0.087	0.170	0.257
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 1F)	0.004	0.015	0.019
Collision with other object (from Worksheet 1F)	0.000	0.001	0.001
Other single-vehicle collision (from Worksheet 1F)	0.003	0.003	0.006
Collision with pedestrian (from Worksheet 1I)	0.006	0.000	0.006
Collision with bicycle (from Worksheet 1J)	0.003	0.000	0.003
Subtotal	0.017	0.018	0.035
Total	0.104	0.188	0.292

WORKSHEET 1L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	0.3	0.06	4.9
Fatal and injury (FI)	0.1	0.06	1.7
Property damage only (PDO)	0.2	0.06	3.1

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	0.3	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9
Agency or Company	Fehr & Peers	Location Information	Lundeen Pkwy
Date Performed	4/4/2017	Jurisdiction	WSDOT
Intersection	Intersection 1	Analysis Year	2040
Signalized/Unsignalized	Signalized	Ped Volume (after Intx Type)	Not Known

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				4SG	--
AADT $_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	67,700	(veh/day)	37,990	--
AADT $_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	33,400	(veh/day)	10,390	--
Intersection lighting (present/not present)				Present	Not Present
Calibration factor, C_i				3.42	1.00
Data for unsignalized intersections only:					
~~Number of major road approaches with left-turn lanes (0,1,2)~~				~~0~~	~~0~~
~~Number of major road approaches with right-turn lanes (0,1,2)~~				~~0~~	~~0~~
Data for signalized intersections only:					
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]				4	0
Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)				3	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]				4	--
Type of left-turn signal phasing for Leg #1				Protected	Permissive
Type of left-turn signal phasing for Leg #2				Protected	--
Type of left-turn signal phasing for Leg #3				Protected	--
Type of left-turn signal phasing for Leg #4 (if applicable)				Protected	--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]				0	0
Intersection red light cameras (present/not present)				Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				50	--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})				6	--
Number of bus stops within 300 m (1,000 ft) of the intersection				1 or 2	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)				Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection				0	0

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	3.8
	PDO	Property Damage Only	7.6
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.2

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.6600	0.7807	0.8800	1.0000	0.9107	1.0000	0.4130

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-10.99	1.07	0.23	0.39	11.250	1.000	11.250	0.41	3.42	15.890
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	3.811	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.350	3.941	0.41	3.42	5.566
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	7.068	$(5)_{TOTAL}-(5)_{FI}$ = 0.650	7.310	0.41	3.42	10.324

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	5.566	1.000	10.324	15.890
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	2.505	0.483	4.986	7.491
Head-on collision	0.049	0.273	0.030	0.310	0.582
Angle collision	0.347	1.931	0.244	2.519	4.450
Sideswipe	0.099	0.551	0.032	0.330	0.881
Other multiple-vehicle collision	0.055	0.306	0.211	2.178	2.484

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.581	1.000	0.581	0.41	3.42	0.821
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.131	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.226	0.131	0.41	3.42	0.186
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.448	$(5)_{TOTAL}-(5)_{FI}$ = 0.774	0.450	0.41	3.42	0.636

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.186	1.000	0.636	0.821
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.001	0.001
Collision with animal	0.002	0.000	0.002	0.001	0.002
Collision with fixed object	0.744	0.138	0.870	0.553	0.691
Collision with other object	0.072	0.013	0.070	0.044	0.058
Other single-vehicle collision	0.040	0.007	0.023	0.015	0.022
Single-vehicle noncollision	0.141	0.026	0.034	0.022	0.048

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	3.42	--
Fatal and injury (FI)	--	--	--	--	3.42	--

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
2.78	1.00	1.00	2.78

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.029	2.78	3.42	0.273
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	3.42	0.273

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	15.890	0.821	16.711	0.015	3.42	0.857
Fatal and injury (FI)	--	--	--	--	3.42	0.857

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	2.505	4.986	7.491
Head-on collisions (from Worksheet 2D)	0.273	0.310	0.582
Angle collisions (from Worksheet 2D)	1.931	2.519	4.450
Sideswipe (from Worksheet 2D)	0.551	0.330	0.881
Other multiple-vehicle collision (from Worksheet 2D)	0.306	2.178	2.484
Subtotal	5.566	10.324	15.890
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.001	0.001
Collision with animal (from Worksheet 2F)	0.000	0.001	0.002
Collision with fixed object (from Worksheet 2F)	0.138	0.553	0.691
Collision with other object (from Worksheet 2F)	0.013	0.044	0.058
Other single-vehicle collision (from Worksheet 2F)	0.007	0.015	0.022
Single-vehicle noncollision (from Worksheet 2F)	0.026	0.022	0.048
Collision with pedestrian (from Worksheet 2G or 2I)	0.273	0.000	0.273
Collision with bicycle (from Worksheet 2J)	0.857	0.000	0.857
Subtotal	1.315	0.636	1.951
Total	6.881	10.959	17.841

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	17.8
Fatal and injury (FI)	6.9
Property damage only (PDO)	11.0

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	17.8	13.83310979	0	6.9	5.335671042	0	11.0	8.49743875	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9
Agency or Company	Fehr & Peers	Location Information	Vernon Ramp
Date Performed	4/4/2017	Jurisdiction	WSDOT
Intersection	Intersection 2	Analysis Year	2040
Signalized/Unsignalized	Unsignalized		Not Known

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				3ST	--
AADT $_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	45,700	(veh/day)	16,650	--
AADT $_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	9,300	(veh/day)	1,290	--
Intersection lighting (present/not present)				Present	Not Present
Calibration factor, C_i				0.74	1.00
Data for unsignalized intersections only:					
Number of major-road approaches with left-turn lanes (0,1,2)				0	0
Number of major-road approaches with right-turn lanes (0,1,2)				1	0
Data for signalized intersections only:					
~~Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]~~				~~0~~	~~0~~
~~Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)~~				~~0~~	~~0~~
~~Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]~~				~~0~~	~~--~~
~~Type of left-turn signal phasing for Leg #1~~					~~Permissive~~
~~Type of left-turn signal phasing for Leg #2~~					~~--~~
~~Type of left-turn signal phasing for Leg #3~~					~~--~~
~~Type of left-turn signal phasing for Leg #4 (if applicable)~~					~~--~~
~~Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]~~				~~0~~	~~0~~
~~Intersection red light cameras (present/not present)~~				~~Not Present~~	~~Not Present~~
~~Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only~~					~~--~~
~~Maximum number of lanes crossed by a pedestrian (n_{lanesx})~~					~~--~~
~~Number of bus stops within 300 m (1,000 ft) of the intersection~~				~~0~~	~~0~~
~~Schools within 300 m (1,000 ft) of the intersection (present/not present)~~				~~Not Present~~	~~Not Present~~
~~Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection~~				~~0~~	~~0~~

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.0000	1.0000	0.8600	1.0000	0.9096	1.0000	0.7822

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-13.36	1.11	0.41	0.80	1.442	1.000	1.442	0.78	0.74	0.835
Fatal and Injury (FI)	-14.01	1.16	0.30	0.69	0.557	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.372	0.537	0.78	0.74	0.311
Property Damage Only (PDO)	-15.38	1.20	0.51	0.77	0.939	$(5)_{TOTAL}-(5)_{FI}$ = 0.628	0.905	0.78	0.74	0.524

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.311	1.000	0.524	0.835
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.421	0.131	0.440	0.231	0.361
Head-on collision	0.045	0.014	0.023	0.012	0.026
Angle collision	0.343	0.107	0.262	0.137	0.244
Sideswipe	0.126	0.039	0.040	0.021	0.060
Other multiple-vehicle collision	0.065	0.020	0.235	0.123	0.143

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-6.81	0.16	0.51	1.14	0.202	1.000	0.202	0.78	0.74	0.117
Fatal and Injury (FI)	--	--	--	--	0.062	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.314	0.063	0.78	0.74	0.037
Property Damage Only (PDO)	-8.36	0.25	0.55	1.29	0.137	$(5)_{TOTAL}-(5)_{FI}$ = 0.686	0.138	0.78	0.74	0.080

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.037	1.000	0.080	0.117
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.003	0.000	0.000
Collision with animal	0.003	0.000	0.018	0.001	0.002
Collision with fixed object	0.762	0.028	0.834	0.067	0.095
Collision with other object	0.090	0.003	0.092	0.007	0.011
Other single-vehicle collision	0.039	0.001	0.023	0.002	0.003
Single-vehicle noncollision	0.105	0.004	0.030	0.002	0.006

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	0.835	0.117	0.951	0.021	0.74	0.015
Fatal and injury (FI)	--	--	--	--	0.74	0.015

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	0.74	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	0.74	--

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.835	0.117	0.951	0.016	0.74	0.011
Fatal and injury (FI)	--	--	--	--	0.74	0.011

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.131	0.231	0.361
Head-on collisions (from Worksheet 2D)	0.014	0.012	0.026
Angle collisions (from Worksheet 2D)	0.107	0.137	0.244
Sideswipe (from Worksheet 2D)	0.039	0.021	0.060
Other multiple-vehicle collision (from Worksheet 2D)	0.020	0.123	0.143
Subtotal	0.311	0.524	0.835
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.001	0.002
Collision with fixed object (from Worksheet 2F)	0.028	0.067	0.095
Collision with other object (from Worksheet 2F)	0.003	0.007	0.011
Other single-vehicle collision (from Worksheet 2F)	0.001	0.002	0.003
Single-vehicle noncollision (from Worksheet 2F)	0.004	0.002	0.006
Collision with pedestrian (from Worksheet 2G or 2I)	0.015	0.000	0.015
Collision with bicycle (from Worksheet 2J)	0.011	0.000	0.011
Subtotal	0.063	0.080	0.143
Total	0.373	0.604	0.977

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	1.0
Fatal and injury (FI)	0.4
Property damage only (PDO)	0.6

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	1.0	0.629465621	0	0.4	0.240413198	0	0.6	0.389052423	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9 SB
Agency or Company	Fehr & Peers	Location Information	SR 204
Date Performed	4/7/2017	Jurisdiction	WSDOT
Intersection	Intersection 3	Analysis Year	2040
Signalized/Unsignalized	Signalized	Ped Volume (after Intx Type)	Not Known

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				4SG	--
$AADT_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	67,700	(veh/day)	24,590	--
$AADT_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	33,400	(veh/day)	10,240	--
Intersection lighting (present/not present)				Present	Not Present
Calibration factor, C_i				3.42	1.00
Data for unsignalized intersections only:					
Number of major-road approaches with left-turn lanes (0,1,2)				0	0
Number of major-road approaches with right-turn lanes (0,1,2)				0	0
Data for signalized intersections only:					
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]				4	0
Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)				4	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]				4	--
Type of left-turn signal phasing for Leg #1				Protected	Permissive
Type of left-turn signal phasing for Leg #2				Protected	--
Type of left-turn signal phasing for Leg #3				Protected	--
Type of left-turn signal phasing for Leg #4 (if applicable)				Protected	--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]				0	0
Intersection red light cameras (present/not present)				Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				50	--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})				4	--
Number of bus stops within 300 m (1,000 ft) of the intersection				1 or 2	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)				Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection				1 to 8	0

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	2.6
	PDO	Property Damage Only	10.0
Single-vehicle crashes	KABC	Fatal and Injury Only	0.4
	PDO	Property Damage Only	0.4

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	CMF_{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.6600	0.7807	0.8500	1.0000	0.9107	1.0000	0.3989

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-10.99	1.07	0.23	0.39	7.040	1.000	7.040	0.40	3.42	9.604
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	2.274	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.335	2.356	0.40	3.42	3.214
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	4.520	$(5)_{TOTAL}-(5)_{FI}$ = 0.665	4.684	0.40	3.42	6.390

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	3.214	1.000	6.390	9.604
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	1.446	0.483	3.086	4.533
Head-on collision	0.049	0.158	0.030	0.192	0.349
Angle collision	0.347	1.115	0.244	1.559	2.674
Sideswipe	0.099	0.318	0.032	0.204	0.523
Other multiple-vehicle collision	0.055	0.177	0.211	1.348	1.525

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.431	1.000	0.431	0.40	3.42	0.588
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.108	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.254	0.109	0.40	3.42	0.149
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.318	$(5)_{TOTAL}-(5)_{FI}$ = 0.746	0.322	0.40	3.42	0.439

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.149	1.000	0.439	0.588
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.001
Collision with animal	0.002	0.000	0.002	0.001	0.001
Collision with fixed object	0.744	0.111	0.870	0.382	0.493
Collision with other object	0.072	0.011	0.070	0.031	0.041
Other single-vehicle collision	0.040	0.006	0.023	0.010	0.016
Single-vehicle noncollision	0.141	0.021	0.034	0.015	0.036

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	3.42	--
Fatal and injury (FI)	--	--	--	--	3.42	--

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
2.78	1.00	1.12	3.11

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.026	3.11	3.42	0.276
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	3.42	0.276

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	9.604	0.588	10.192	0.015	3.42	0.523
Fatal and injury (FI)	--	--	--	--	3.42	0.523

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	1.446	3.086	4.533
Head-on collisions (from Worksheet 2D)	0.158	0.192	0.349
Angle collisions (from Worksheet 2D)	1.115	1.559	2.674
Sideswipe (from Worksheet 2D)	0.318	0.204	0.523
Other multiple-vehicle collision (from Worksheet 2D)	0.177	1.348	1.525
Subtotal	3.214	6.390	9.604
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.001
Collision with animal (from Worksheet 2F)	0.000	0.001	0.001
Collision with fixed object (from Worksheet 2F)	0.111	0.382	0.493
Collision with other object (from Worksheet 2F)	0.011	0.031	0.041
Other single-vehicle collision (from Worksheet 2F)	0.006	0.010	0.016
Single-vehicle noncollision (from Worksheet 2F)	0.021	0.015	0.036
Collision with pedestrian (from Worksheet 2G or 2I)	0.276	0.000	0.276
Collision with bicycle (from Worksheet 2J)	0.523	0.000	0.523
Subtotal	0.948	0.439	1.386
Total	4.162	6.828	10.990

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	11.0
Fatal and injury (FI)	4.2
Property damage only (PDO)	6.8

PROJECT ELEMENT RESULTS SUMMARY[1]

Summary for the project element	Total Crashes/yr (KABCO)			Fatal and Injury Crashes/yr (KABC)			Property Damage Only Crashes/yr (PDO)		
	Predicted average crash frequency $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	11.0	0.7984918	0	4.2	0.302380824	0	6.8	0.496110976	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9 NB
Agency or Company	Fehr & Peers	Location Information	SR 204
Date Performed	4/7/2017	Jurisdiction	WSDOT
Intersection	Intersection 4	Analysis Year	2040
Signalized/Unsignalized	Signalized	Ped Volume (after Intx Type)	

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				3SG	--
$AADT_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	58,100	(veh/day)	24,120	--
$AADT_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	16,400	(veh/day)	3,800	--
Intersection lighting (present/not present)				Present	Not Present
Calibration factor, C_i				3.74	1.00
Data for unsignalized intersections only:					
Number of major-road approaches with left-turn lanes (0,1,2)				0	0
Number of major-road approaches with right-turn lanes (0,1,2)				0	0
Data for signalized intersections only:					
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]				2	0
Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)				2	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]				2	--
Type of left-turn signal phasing for Leg #1				Protected	Permissive
Type of left-turn signal phasing for Leg #2				Protected	--
Type of left-turn signal phasing for Leg #3					--
Type of left-turn signal phasing for Leg #4 (if applicable)					--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]				0	0
Intersection red light cameras (present/not present)				Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				50	--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})				4	--
Number of bus stops within 300 m (1,000 ft) of the intersection				1 or 2	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)				Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection				1 to 8	0

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	2.6
	PDO	Property Damage Only	10.0
Single-vehicle crashes	KABC	Fatal and Injury Only	0.4
	PDO	Property Damage Only	0.4

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	CMF_{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.8600	0.8748	0.9200	1.0000	0.9107	1.0000	0.6303

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-12.13	1.11	0.26	0.33	3.367	1.000	3.367	0.63	3.74	7.936
Fatal and Injury (FI)	-11.58	1.02	0.17	0.30	1.121	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.349	1.176	0.63	3.74	2.772
Property Damage Only (PDO)	-13.24	1.14	0.30	0.36	2.088	$(5)_{TOTAL}-(5)_{FI}$ = 0.651	2.191	0.63	3.74	5.165

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	2.772	1.000	5.165	7.936
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.549	1.522	0.546	2.820	4.341
Head-on collision	0.038	0.105	0.020	0.103	0.209
Angle collision	0.280	0.776	0.204	1.054	1.830
Sideswipe	0.076	0.211	0.032	0.165	0.376
Other multiple-vehicle collision	0.057	0.158	0.198	1.023	1.181

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-9.02	0.42	0.40	0.36	0.227	1.000	0.227	0.63	3.74	0.534
Fatal and Injury (FI)	-9.75	0.27	0.51	0.24	0.060	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.268	0.061	0.63	3.74	0.143
Property Damage Only (PDO)	-9.08	0.45	0.33	0.53	0.162	$(5)_{TOTAL}-(5)_{FI}$ = 0.732	0.166	0.63	3.74	0.391

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.143	1.000	0.391	0.534
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.001
Collision with animal	0.001	0.000	0.003	0.001	0.001
Collision with fixed object	0.653	0.094	0.895	0.350	0.443
Collision with other object	0.091	0.013	0.069	0.027	0.040
Other single-vehicle collision	0.045	0.006	0.018	0.007	0.013
Single-vehicle noncollision	0.209	0.030	0.014	0.005	0.035

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	3.74	--
Fatal and injury (FI)	--	--	--	--	3.74	--

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
2.78	1.00	1.12	3.11

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-6.60	0.05	0.24	0.41	0.09	0.52	0.010	3.11	3.74	0.121
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	3.74	0.121

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	7.936	0.534	8.470	0.011	3.74	0.348
Fatal and injury (FI)	--	--	--	--	3.74	0.348

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	1.522	2.820	4.341
Head-on collisions (from Worksheet 2D)	0.105	0.103	0.209
Angle collisions (from Worksheet 2D)	0.776	1.054	1.830
Sideswipe (from Worksheet 2D)	0.211	0.165	0.376
Other multiple-vehicle collision (from Worksheet 2D)	0.158	1.023	1.181
Subtotal	2.772	5.165	7.936
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.001
Collision with animal (from Worksheet 2F)	0.000	0.001	0.001
Collision with fixed object (from Worksheet 2F)	0.094	0.350	0.443
Collision with other object (from Worksheet 2F)	0.013	0.027	0.040
Other single-vehicle collision (from Worksheet 2F)	0.006	0.007	0.013
Single-vehicle noncollision (from Worksheet 2F)	0.030	0.005	0.035
Collision with pedestrian (from Worksheet 2G or 2I)	0.121	0.000	0.121
Collision with bicycle (from Worksheet 2J)	0.348	0.000	0.348
Subtotal	0.613	0.391	1.003
Total	3.384	5.555	8.940

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	8.9
Fatal and injury (FI)	3.4
Property damage only (PDO)	5.6

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	8.9	0.46935778	0	3.4	0.177681902	0	5.6	0.291675877	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 9
Agency or Company	Fehr & Peers	Location Information	Market Pl
Date Performed	4/4/2017	Jurisdiction	WSDOT
Intersection	Intersection 4	Analysis Year	2040
Signalized/Unsignalized	Signalized	Ped Volume (after Intx Type)	Not Known

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				4SG	--
$AADT_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	67,700	(veh/day)	24,150	--
$AADT_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	33,400	(veh/day)	10,890	--
Intersection lighting (present/not present)				Present	Not Present
Calibration factor, C_i				3.42	1.00
Data for unsignalized intersections only:					
~~Number of major road approaches with left-turn lanes (0,1,2)~~				~~0~~	~~0~~
~~Number of major road approaches with right-turn lanes (0,1,2)~~				~~0~~	~~0~~
Data for signalized intersections only:					
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]				4	0
Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)				2	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]				4	--
Type of left-turn signal phasing for Leg #1				Protected	Permissive
Type of left-turn signal phasing for Leg #2				Protected	--
Type of left-turn signal phasing for Leg #3				Protected/Permissive	--
Type of left-turn signal phasing for Leg #4 (if applicable)				Protected/Permissive	--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]				0	0
Intersection red light cameras (present/not present)				Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				50	--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})				4	--
Number of bus stops within 300 m (1,000 ft) of the intersection				1 or 2	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)				Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection				1 to 8	0

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	3.0
	PDO	Property Damage Only	7.2
Single-vehicle crashes	KABC	Fatal and Injury Only	0.2
	PDO	Property Damage Only	0.0

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	CMF_{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.6600	0.8660	0.9200	1.0000	0.9107	1.0000	0.4789

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-10.99	1.07	0.23	0.39	7.004	1.000	7.004	0.48	3.42	11.471
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	2.256	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.334	2.338	0.48	3.42	3.829
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	4.503	$(5)_{TOTAL}-(5)_{FI}$ = 0.666	4.666	0.48	3.42	7.642

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	3.829	1.000	7.642	11.471
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	1.723	0.483	3.691	5.414
Head-on collision	0.049	0.188	0.030	0.229	0.417
Angle collision	0.347	1.329	0.244	1.865	3.193
Sideswipe	0.099	0.379	0.032	0.245	0.624
Other multiple-vehicle collision	0.055	0.211	0.211	1.613	1.823

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.433	1.000	0.433	0.48	3.42	0.709
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.109	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.255	0.110	0.48	3.42	0.181
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.318	$(5)_{TOTAL}-(5)_{FI}$ = 0.745	0.322	0.48	3.42	0.528

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.181	1.000	0.528	0.709
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.001	0.001
Collision with animal	0.002	0.000	0.002	0.001	0.001
Collision with fixed object	0.744	0.135	0.870	0.459	0.594
Collision with other object	0.072	0.013	0.070	0.037	0.050
Other single-vehicle collision	0.040	0.007	0.023	0.012	0.019
Single-vehicle noncollision	0.141	0.026	0.034	0.018	0.043

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	3.42	--
Fatal and injury (FI)	--	--	--	--	3.42	--

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
2.78	1.35	1.12	4.20

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.026	4.20	3.42	0.381
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	3.42	0.381

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	11.471	0.709	12.180	0.015	3.42	0.625
Fatal and injury (FI)	--	--	--	--	3.42	0.625

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	1.723	3.691	5.414
Head-on collisions (from Worksheet 2D)	0.188	0.229	0.417
Angle collisions (from Worksheet 2D)	1.329	1.865	3.193
Sideswipe (from Worksheet 2D)	0.379	0.245	0.624
Other multiple-vehicle collision (from Worksheet 2D)	0.211	1.613	1.823
Subtotal	3.829	7.642	11.471
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.001	0.001
Collision with animal (from Worksheet 2F)	0.000	0.001	0.001
Collision with fixed object (from Worksheet 2F)	0.135	0.459	0.594
Collision with other object (from Worksheet 2F)	0.013	0.037	0.050
Other single-vehicle collision (from Worksheet 2F)	0.007	0.012	0.019
Single-vehicle noncollision (from Worksheet 2F)	0.026	0.018	0.043
Collision with pedestrian (from Worksheet 2G or 2I)	0.381	0.000	0.381
Collision with bicycle (from Worksheet 2J)	0.625	0.000	0.625
Subtotal	1.187	0.528	1.714
Total	5.015	8.170	13.185

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	13.2
Fatal and injury (FI)	5.0
Property damage only (PDO)	8.2

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	13.2	12.04316567	0	5.0	4.580807717	0	8.2	7.462357949	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 204
Agency or Company	Fehr & Peers	Location Information	91st Ave NE
Date Performed	4/4/2017	Jurisdiction	WSDOT
Intersection	Intersection 5	Analysis Year	2040
Signalized/Unsignalized	Signalized	Ped Volume (after Intx Type)	Not Known

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				4SG	--
AADT $_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	67,700	(veh/day)	23,820	--
AADT $_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	33,400	(veh/day)	9,500	--
Intersection lighting (present/not present)				Present	Not Present
Calibration factor, C_i				3.42	1.00
Data for unsignalized intersections only:					
~~Number of major road approaches with left turn lanes (0,1,2)~~				~~0~~	~~0~~
~~Number of major road approaches with right turn lanes (0,1,2)~~				~~0~~	~~0~~
Data for signalized intersections only:					
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]				4	0
Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)				0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]				4	--
Type of left-turn signal phasing for Leg #1				Protected	Permissive
Type of left-turn signal phasing for Leg #2				Protected	--
Type of left-turn signal phasing for Leg #3				Protected	--
Type of left-turn signal phasing for Leg #4 (if applicable)				Protected	--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]				0	0
Intersection red light cameras (present/not present)				Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				50	--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})				6	--
Number of bus stops within 300 m (1,000 ft) of the intersection				1 or 2	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)				Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection				1 to 8	0

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	3.4
	PDO	Property Damage Only	6.8
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.2

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.6600	0.7807	1.0000	1.0000	0.9107	1.0000	0.4693

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-10.99	1.07	0.23	0.39	6.688	1.000	6.688	0.47	3.42	10.734
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	2.154	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.334	2.233	0.47	3.42	3.584
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	4.297	$(5)_{TOTAL}-(5)_{FI}$ = 0.666	4.455	0.47	3.42	7.150

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	3.584	1.000	7.150	10.734
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	1.613	0.483	3.454	5.066
Head-on collision	0.049	0.176	0.030	0.215	0.390
Angle collision	0.347	1.244	0.244	1.745	2.988
Sideswipe	0.099	0.355	0.032	0.229	0.584
Other multiple-vehicle collision	0.055	0.197	0.211	1.509	1.706

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.413	1.000	0.413	0.47	3.42	0.663
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.104	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.255	0.105	0.47	3.42	0.169
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.304	$(5)_{TOTAL}-(5)_{FI}$ = 0.745	0.308	0.47	3.42	0.494

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.169	1.000	0.494	0.663
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.001
Collision with animal	0.002	0.000	0.002	0.001	0.001
Collision with fixed object	0.744	0.126	0.870	0.430	0.556
Collision with other object	0.072	0.012	0.070	0.035	0.047
Other single-vehicle collision	0.040	0.007	0.023	0.011	0.018
Single-vehicle noncollision	0.141	0.024	0.034	0.017	0.041

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	3.42	--
Fatal and injury (FI)	--	--	--	--	3.42	--

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
2.78	1.00	1.12	3.11

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.027	3.11	3.42	0.290
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	3.42	0.290

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	10.734	0.663	11.397	0.015	3.42	0.585
Fatal and injury (FI)	--	--	--	--	3.42	0.585

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	1.613	3.454	5.066
Head-on collisions (from Worksheet 2D)	0.176	0.215	0.390
Angle collisions (from Worksheet 2D)	1.244	1.745	2.988
Sideswipe (from Worksheet 2D)	0.355	0.229	0.584
Other multiple-vehicle collision (from Worksheet 2D)	0.197	1.509	1.706
Subtotal	3.584	7.150	10.734
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.001
Collision with animal (from Worksheet 2F)	0.000	0.001	0.001
Collision with fixed object (from Worksheet 2F)	0.126	0.430	0.556
Collision with other object (from Worksheet 2F)	0.012	0.035	0.047
Other single-vehicle collision (from Worksheet 2F)	0.007	0.011	0.018
Single-vehicle noncollision (from Worksheet 2F)	0.024	0.017	0.041
Collision with pedestrian (from Worksheet 2G or 2I)	0.290	0.000	0.290
Collision with bicycle (from Worksheet 2J)	0.585	0.000	0.585
Subtotal	1.044	0.494	1.538
Total	4.628	7.644	12.272

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	12.3
Fatal and injury (FI)	4.6
Property damage only (PDO)	7.6

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	12.3	11.75162807	0	4.6	4.431731364	0	7.6	7.319896701	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	SR 204
Agency or Company	Fehr & Peers	Location Information	Market Pl/Lundeen Pkwy
Date Performed	4/4/2017	Jurisdiction	WSDOT
Intersection	Intersection 6	Analysis Year	2040
Signalized/Unsignalized	Signalized	Ped Volume (after Intx Type)	Not Known

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				4SG	--
AADT $_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	67,700	(veh/day)	27,820	--
AADT $_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	33,400	(veh/day)	7,040	--
Intersection lighting (present/not present)				Present	Not Present
Calibration factor, C_i				3.42	1.00
Data for unsignalized intersections only:					
~~Number of major road approaches with left-turn lanes (0,1,2)~~				~~0~~	~~0~~
~~Number of major road approaches with right-turn lanes (0,1,2)~~				~~0~~	~~0~~
Data for signalized intersections only:					
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]				4	0
Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)				1	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]				4	--
Type of left-turn signal phasing for Leg #1				Protected	Permissive
Type of left-turn signal phasing for Leg #2				Protected	--
Type of left-turn signal phasing for Leg #3				Permissive	--
Type of left-turn signal phasing for Leg #4 (if applicable)				Permissive	--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]				0	0
Intersection red light cameras (present/not present)				Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				50	--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})				6	--
Number of bus stops within 300 m (1,000 ft) of the intersection				0	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)				Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection				1 to 8	0

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	3.4
	PDO	Property Damage Only	6.6
Single-vehicle crashes	KABC	Fatal and Injury Only	0.2
	PDO	Property Damage Only	0.2

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.6600	0.8836	0.9600	1.0000	0.9107	1.0000	0.5099

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-10.99	1.07	0.23	0.39	7.371	1.000	7.371	0.51	3.42	12.852
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	2.422	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.341	2.512	0.51	3.42	4.380
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	4.685	$(5)_{TOTAL}-(5)_{FI}$ = 0.659	4.859	0.51	3.42	8.472

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	4.380	1.000	8.472	12.852
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	1.971	0.483	4.092	6.063
Head-on collision	0.049	0.215	0.030	0.254	0.469
Angle collision	0.347	1.520	0.244	2.067	3.587
Sideswipe	0.099	0.434	0.032	0.271	0.705
Other multiple-vehicle collision	0.055	0.241	0.211	1.788	2.029

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.424	1.000	0.424	0.51	3.42	0.738
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.102	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.243	0.103	0.51	3.42	0.179
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.319	$(5)_{TOTAL}-(5)_{FI}$ = 0.757	0.321	0.51	3.42	0.559

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.179	1.000	0.559	0.738
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.001	0.001
Collision with animal	0.002	0.000	0.002	0.001	0.001
Collision with fixed object	0.744	0.133	0.870	0.486	0.620
Collision with other object	0.072	0.013	0.070	0.039	0.052
Other single-vehicle collision	0.040	0.007	0.023	0.013	0.020
Single-vehicle noncollision	0.141	0.025	0.034	0.019	0.044

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	3.42	--
Fatal and injury (FI)	--	--	--	--	3.42	--

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
1.00	1.00	1.12	1.12

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.025	1.12	3.42	0.094
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	3.42	0.094

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	12.852	0.738	13.591	0.015	3.42	0.697
Fatal and injury (FI)	--	--	--	--	3.42	0.697

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	1.971	4.092	6.063
Head-on collisions (from Worksheet 2D)	0.215	0.254	0.469
Angle collisions (from Worksheet 2D)	1.520	2.067	3.587
Sideswipe (from Worksheet 2D)	0.434	0.271	0.705
Other multiple-vehicle collision (from Worksheet 2D)	0.241	1.788	2.029
Subtotal	4.380	8.472	12.852
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.001	0.001
Collision with animal (from Worksheet 2F)	0.000	0.001	0.001
Collision with fixed object (from Worksheet 2F)	0.133	0.486	0.620
Collision with other object (from Worksheet 2F)	0.013	0.039	0.052
Other single-vehicle collision (from Worksheet 2F)	0.007	0.013	0.020
Single-vehicle noncollision (from Worksheet 2F)	0.025	0.019	0.044
Collision with pedestrian (from Worksheet 2G or 2I)	0.094	0.000	0.094
Collision with bicycle (from Worksheet 2J)	0.697	0.000	0.697
Subtotal	0.971	0.559	1.530
Total	5.351	9.032	14.382

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	14.4
Fatal and injury (FI)	5.4
Property damage only (PDO)	9.0

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	14.4	11.93338549	0	5.4	4.4395979	0	9.0	7.493787593	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	92nd Ave NE/4th St NE
Agency or Company	Fehr & Peers	Location Information	4th St NE slip ramp
Date Performed	4/4/2017	Jurisdiction	Lake Stevens
Intersection	Intersection 8	Analysis Year	2040
Signalized/Unsignalized	Unsignalized		Not Known

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				3ST	--
AADT $_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	45,700	(veh/day)	1,770	--
AADT $_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	9,300	(veh/day)	1,510	--
Intersection lighting (present/not present)				Not Present	Not Present
Calibration factor, C_i				0.74	1.00
Data for unsignalized intersections only:					
Number of major-road approaches with left-turn lanes (0,1,2)				0	0
Number of major-road approaches with right-turn lanes (0,1,2)				0	0
Data for signalized intersections only:					
~~Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]~~				~~0~~	~~0~~
~~Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)~~				~~0~~	~~0~~
~~Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]~~				~~0~~	~~--~~
~~Type of left-turn signal phasing for Leg #1~~					~~Permissive~~
~~Type of left-turn signal phasing for Leg #2~~					~~--~~
~~Type of left-turn signal phasing for Leg #3~~					~~--~~
~~Type of left-turn signal phasing for Leg #4 (if applicable)~~					~~--~~
~~Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]~~				~~0~~	~~0~~
~~Intersection red light cameras (present/not present)~~				~~Not Present~~	~~Not Present~~
~~Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only~~					~~--~~
~~Maximum number of lanes crossed by a pedestrian (n_{lanesx})~~					~~--~~
~~Number of bus stops within 300 m (1,000 ft) of the intersection~~				~~0~~	~~0~~
~~Schools within 300 m (1,000 ft) of the intersection (present/not present)~~				~~Not Present~~	~~Not Present~~
~~Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection~~				~~0~~	~~0~~

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	0.2
	PDO	Property Damage Only	0.6
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.2

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-13.36	1.11	0.41	0.80	0.128	1.000	0.128	1.00	0.74	0.095
Fatal and Injury (FI)	-14.01	1.16	0.30	0.69	0.043	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.385	0.049	1.00	0.74	0.036
Property Damage Only (PDO)	-15.38	1.20	0.51	0.77	0.069	$(5)_{TOTAL}-(5)_{FI}$ = 0.615	0.079	1.00	0.74	0.058

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.036	1.000	0.058	0.095
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.421	0.015	0.440	0.026	0.041
Head-on collision	0.045	0.002	0.023	0.001	0.003
Angle collision	0.343	0.013	0.262	0.015	0.028
Sideswipe	0.126	0.005	0.040	0.002	0.007
Other multiple-vehicle collision	0.065	0.002	0.235	0.014	0.016

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-6.81	0.16	0.51	1.14	0.153	1.000	0.153	1.00	0.74	0.113
Fatal and Injury (FI)	--	--	--	--	0.047	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.357	0.055	1.00	0.74	0.040
Property Damage Only (PDO)	-8.36	0.25	0.55	1.29	0.085	$(5)_{TOTAL}-(5)_{FI}$ = 0.643	0.098	1.00	0.74	0.073

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.040	1.000	0.073	0.113
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.003	0.000	0.000
Collision with animal	0.003	0.000	0.018	0.001	0.001
Collision with fixed object	0.762	0.031	0.834	0.061	0.091
Collision with other object	0.090	0.004	0.092	0.007	0.010
Other single-vehicle collision	0.039	0.002	0.023	0.002	0.003
Single-vehicle noncollision	0.105	0.004	0.030	0.002	0.006

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	0.095	0.113	0.207	0.021	0.74	0.003
Fatal and injury (FI)	--	--	--	--	0.74	0.003

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	0.74	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	0.74	--

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.095	0.113	0.207	0.016	0.74	0.002
Fatal and injury (FI)	--	--	--	--	0.74	0.002

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.015	0.026	0.041
Head-on collisions (from Worksheet 2D)	0.002	0.001	0.003
Angle collisions (from Worksheet 2D)	0.013	0.015	0.028
Sideswipe (from Worksheet 2D)	0.005	0.002	0.007
Other multiple-vehicle collision (from Worksheet 2D)	0.002	0.014	0.016
Subtotal	0.036	0.058	0.095
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.001	0.001
Collision with fixed object (from Worksheet 2F)	0.031	0.061	0.091
Collision with other object (from Worksheet 2F)	0.004	0.007	0.010
Other single-vehicle collision (from Worksheet 2F)	0.002	0.002	0.003
Single-vehicle noncollision (from Worksheet 2F)	0.004	0.002	0.006
Collision with pedestrian (from Worksheet 2G or 2I)	0.003	0.000	0.003
Collision with bicycle (from Worksheet 2J)	0.002	0.000	0.002
Subtotal	0.046	0.073	0.119
Total	0.082	0.131	0.213

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	0.2
Fatal and injury (FI)	0.1
Property damage only (PDO)	0.1

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	0.2	0.272664457	0.059535565	0.1	0.105500856	0.023035834	0.1	0.167163601	0.036499732

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

WORKSHEET 2A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		**Location Information**	
Analyst	Nathan Chan	Roadway	Parking Lot Connector
Agency or Company	Fehr & Peers	Location Information	7th Pl NE
Date Performed	4/7/2017	Jurisdiction	Lake Stevens
Intersection	Intersection 9	Analysis Year	2040
Signalized/Unsignalized	Unsignalized		

Input Data				**Site Conditions**	**Base Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)				4ST	--
AADT $_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	46,800	(veh/day)	7,200	--
AADT $_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	5,900	(veh/day)	1,060	--
Intersection lighting (present/not present)				Not Present	Not Present
Calibration factor, C_i				0.74	1.00
Data for unsignalized intersections only:					
Number of major-road approaches with left-turn lanes (0,1,2)				1	0
Number of major-road approaches with right-turn lanes (0,1,2)				0	0
Data for signalized intersections only:					
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]				0	0
Number of approaches with right-turn lanes: for 4SG, use maximum value of 4, all other, max 2)				0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]				0	--
Type of left-turn signal phasing for Leg #1					Permissive
Type of left-turn signal phasing for Leg #2					--
Type of left-turn signal phasing for Leg #3					--
Type of left-turn signal phasing for Leg #4 (if applicable)					--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]				0	0
Intersection red light cameras (present/not present)				Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only					--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})					--
Number of bus stops within 300 m (1,000 ft) of the intersection				0	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)				Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection				0	0

Average Annual Crash History (3 or 5-yr average)			
Multiple vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0
Single-vehicle crashes	KABC	Fatal and Injury Only	0.0
	PDO	Property Damage Only	0.0

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

WORKSHEET 2B -- CRASH MODIFICATION FACTORS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.7300	1.0000	1.0000	1.0000	1.0000	1.0000	0.7300

WORKSHEET 2C -- MULTIPLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(6)*(7)*(8)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		
	a	b	c							
Total	-8.90	0.82	0.25	0.40	1.133	1.000	1.133	0.73	0.74	0.612
Fatal and Injury (FI)	-11.13	0.93	0.28	0.48	0.399	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.350	0.396	0.73	0.74	0.214
Property Damage Only (PDO)	-8.74	0.77	0.23	0.40	0.742	$(5)_{TOTAL}-(5)_{FI}$ = 0.650	0.737	0.73	0.74	0.398

WORKSHEET 2D -- MULTIPLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.214	1.000	0.398	0.612
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.338	0.072	0.374	0.149	0.221
Head-on collision	0.041	0.009	0.030	0.012	0.021
Angle collision	0.440	0.094	0.335	0.133	0.227
Sideswipe	0.121	0.026	0.044	0.018	0.043
Other multiple-vehicle collision	0.060	0.013	0.217	0.086	0.099

WORKSHEET 2E -- SINGLE-VEHICLE COLLISIONS BY SEVERITY LEVEL FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-5.33	0.33	0.12	0.65	0.209	1.000	0.209	0.73	0.74	0.113
Fatal and Injury (FI)	--	--	--	--	0.059	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.324	0.068	0.73	0.74	0.037
Property Damage Only (PDO)	-7.04	0.36	0.25	0.54	0.122	$(5)_{TOTAL}-(5)_{FI}$ = 0.676	0.142	0.73	0.74	0.076

WORKSHEET 2F -- SINGLE-VEHICLE COLLISIONS BY COLLISION TYPE FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.037	1.000	0.076	0.113
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.001	0.000	0.026	0.002	0.002
Collision with fixed object	0.679	0.025	0.847	0.065	0.090
Collision with other object	0.089	0.003	0.070	0.005	0.009
Other single-vehicle collision	0.051	0.002	0.007	0.001	0.002
Single-vehicle noncollision	0.179	0.007	0.049	0.004	0.010

WORKSHEET 2G -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL STOP-CONTROLLED INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	0.612	0.113	0.725	0.022	0.74	0.012
Fatal and injury (FI)	--	--	--	--	0.74	0.012

WORKSHEET 2H -- CRASH MODIFICATION FACTORS FOR VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

WORKSHEET 2I -- VEHICLE-PEDESTRIAN COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL SIGNALIZED INTERSECTIONS

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	0.74	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	0.74	--

WORKSHEET 2J -- VEHICLE-BICYCLE COLLISIONS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.612	0.113	0.725	0.018	0.74	0.010
Fatal and injury (FI)	--	--	--	--	0.74	0.010

WORKSHEET 2K -- CRASH SEVERITY DISTRIBUTION FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.072	0.149	0.221
Head-on collisions (from Worksheet 2D)	0.009	0.012	0.021
Angle collisions (from Worksheet 2D)	0.094	0.133	0.227
Sideswipe (from Worksheet 2D)	0.026	0.018	0.043
Other multiple-vehicle collision (from Worksheet 2D)	0.013	0.086	0.099
Subtotal	0.214	0.398	0.612
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.002	0.002
Collision with fixed object (from Worksheet 2F)	0.025	0.065	0.090
Collision with other object (from Worksheet 2F)	0.003	0.005	0.009
Other single-vehicle collision (from Worksheet 2F)	0.002	0.001	0.002
Single-vehicle noncollision (from Worksheet 2F)	0.007	0.004	0.010
Collision with pedestrian (from Worksheet 2G or 2I)	0.012	0.000	0.012
Collision with bicycle (from Worksheet 2J)	0.010	0.000	0.010
Subtotal	0.058	0.076	0.135
Total	0.272	0.474	0.747

WORKSHEET 2L -- SUMMARY RESULTS FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	0.7
Fatal and injury (FI)	0.3
Property damage only (PDO)	0.5

PROJECT ELEMENT RESULTS SUMMARY[1]

	Total Crashes/yr (KABCO)			**Fatal and Injury Crashes/yr (KABC)**			**Property Damage Only Crashes/yr (PDO)**		
Summary for the project element	**Predicted average crash frequency** $N_{predicted\ (KABCO)}$	**Expected average crash frequency** $N_{expected\ (KABCO)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (KABC)}$	**Expected average crash frequency** $N_{expected\ (KABC)}$	**Potential for Improvement**	**Predicted average crash frequency** $N_{predicted\ (O)}$	**Expected average crash frequency** $N_{expected\ (O)}$	**Potential for Improvement**
	0.7	0.021461677	0	0.3	0.007822101	0	0.5	0.013639575	0

Special Note: When the project element is not included in the analysis the results will all be zeros. In addition if only the analysis only includes determining the predicted average crash frequency (i.e. EB analysis is not carried out), the results will show zero values where EB results are usually displayed.

[1] The values in this table are **rounded** values. For unrounded values, refer to Workdheet 1L.

PARSONS

SPECIFICATION/REPORT CHECK PRINT

COVER SHEET

Contract Package	648774 – SR 9/SR 204 Intersection Improvement Project
Title	Supplemental Transportation Impact Discipline Report
Phase	4.4

ACTION	**NAME** (First Initial, Last Name)	**DATE**
Originated by:	D. Dye, C. Kwan	9/12/19
Checked by:	J. Pierson, A. Davis, D. Grayuski	9/24/19
Corrected by:	D. Dye	9/26/19
Reviewed by:	L. Barben-Price	10/15/19
Corrected by:	D. Dye	10/18/19
Verified by:	C. Kwan	10/30/19
Checked by:		
Response by:		
Verified by:		

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SR 9/SR 204 Intersection Improvement Project Supplemental Transportation Impact Discipline Report

FINAL

(10/2019)

WSDOT
Washington State
Department of Transportation
15700 Dayton Avenue N
Shoreline WA 98133-9710

Submitted by:
PARSONS

Prepared by:
FEHR & PEERS

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SR 9/SR 204 Intersection Improvements

SUPPLEMENTAL TRANSPORTATION IMPACT DISCIPLINE REPORT

Agreement No. 14-034

FINAL

October 2019

The SR 9/SR 204 Intersection Improvements Project is an effort between the Washington State Department of Transportation (WSDOT), and Parsons Transportation Group, Inc. To conduct this project, WSDOT contracted with:

Parsons Transportation Group, Inc.

600 University Street
Suite 700
Seattle, WA 98101

In association with:

Confluence
Fehr & Peers
Lin & Associates
Osborn
Perteet
PRR
Shannon & Wilson
Traffic Data Gathering

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WSDOT

Supplemental Transportation Impact Discipline Report

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ADT	average daily traffic
CT	Community Transit route indicator
FGTS	Freight and Goods Transportation System
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HSM	Highway Safety Manual
HSS	highway of statewide significance
LOS	level of service
MEV	million entering vehicles
mph	miles per hour (speed)
MVMT	million vehicle miles of travel
O-D	origin-destination
PSRC	Puget Sound Regional Council
SAG	Stakeholder Advisory Group
SnoCo Model	Snohomish County Travel Demand Model
SR	State Route
State	State of Washington
TIP	Transportation Improvement Program
WSDOT	Washington State Department of Transportation

DEFINITIONS

Access/accessibility	The ability to reach desired goods, services, activities, and destinations via entry/exit points along a transportation network
Arterial	A major street that primarily serves through traffic but also can provide access to abutting properties and destinations. Arterials are often divided into principal and minor classifications depending on the number of lanes, connections made, volume of traffic, nature of traffic, speeds, intersection frequency, and length.
Capacity	The maximum sustained traffic flow of a roadway under prevailing conditions in a specified direction.
Congestion	For a corridor, the condition when unstable traffic flows constrain travel speeds to less that the posted limit. Recurring corridor congestion is caused by constant excess traffic volume compared with the highway's capacity. No recurring corridor congestion is caused by unusual or unpredictable events such as traffic accidents. For an intersection, the condition when demand at one or more movements at the intersection is greater that the processing capacity of that control scheme. Sustained periods of higher demand than capacity will cause delay and queuing at a given approach.
Delay	The increased travel time experienced because of circumstances that imped the desirable movement of traffic.
Demand	The desire for travel by potential users of the transportation system. Often specified at a specific location or along a specific route.
Emergency vehicle	Any vehicle used to responding to an incident or accident, such as police, fire department, ambulance, maintenance, and towing vehicles.
EMME	A travel demand forecasting software package used by the PSRC and Snohomish County to develop their travel demand modeling platforms.
Jurisdiction	A municipal government agency, such as a city or count, and as appropriate, federal and state agencies and federally recognized tribes. Can also mean, "to have authority over."
Level of service	A measure of how well a freeway or intersection operates. For freeways, it is a measure of traffic congestion typically based on vehicle volume-to-capacity and density calculations. For intersections, it is based on how long it takes a typical vehicle to clear the intersection. Typically reported as a letter grade from A to F. Industry standard thresholds are described in the *Highway Capacity Manual*.

Measure of effectiveness	An indicator or criterion used to assess how a transportation system performs.
Mobility	The efficient movement of people or goods from place-to-place.
Modeling	The use of statistics and mathematical equations to simulate and/or predict real events, processes, and probable outcomes.
Non-motorized	Bicycle, pedestrian, and other modes of transportation not involving a motor vehicle.
Peak direction	The direction of roadway travel with the highest demand for a given period of time.
Peak hour	The hour in the morning or in the afternoon when the maximum demand for travel occurs on a given transportation facility, often due to commuting schedules.
Person trips	The number of persons that pass through a section of roadway during a given time period, including passenger cars, bicyclists, and transit riders. For example, one vehicle carry four people comprises four person trips.
Puget Sound Regional Council (PSRC)	The Metropolitan Planning Organization (MPO) and Regional Transportation Planning Organization (RTPO) for the counties of King, Snohomish, Pierce, and Kitsap.
Queue	A line of vehicles waiting to move through an access point on a roadway, such as signal or turn lane.
State Environmental Policy Act (SEPA)	Washington State legislation adopted in 1974, that establishes an environmental review process for all development proposals and major planning studies prior to taking any action. SEPA includes early coordination to identify and mitigate any substantial issues or significant effects that may result from a project or study.
Throughput	The number of vehicles or persons being carried on a transportation facility. Usually measured at a specific point on the roadway facility for a predetermined period of time.
Travel demand forecasting	Methods for estimating the desire for travel by potential users of the transportation system, including the number of travelers, the time of day, travel mode, and travel routes.
Vehicle	Any car, truck, van, motorcycle, or bus designed to carry passengers and/or goods. Bicycles and other pedestrian-oriented vehicles (e.g. mobility aids, compact personal transporter) are not included in this definition.

Vehicle trips	The number of vehicles that pass a section of roadway over a given period of time.
Vissim	A traffic analysis software package used for the modeling and simulation operation of the transportation system and its elements.
Visum	A travel demand forecasting software package often used to develop routing inputs for Vissim.

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SECTION 1. EXECUTIVE SUMMARY

The Washington State Department of Transportation (WSDOT) is proposing to construct the SR 9/SR 204 Intersection Improvements Project to improve traffic operations at this intersection in the City of Lake Stevens. A previous Transportation Impact Discipline Report (TIDR) documented the evaluation of a No Build Alternative and twelve Build Alternatives. Upon further study, the construction costs for the previously selected preferred alternative were estimated to exceed the project budget. This supplemental TIDR documents refinements to the study methodology and the analysis of a No Build Alternative, the previously preferred alternative, and two new alternatives.

1.1 INTRODUCTION

The purpose of this document is to evaluate and compare the traffic operations of the No Build, Tight Diamond, At-Grade Widening, and At-Grade Roundabouts Alternatives of the SR 9/SR 204 Intersection Improvement Project located in Lake Stevens. This Supplemental TIDR (STIDR) compares these four alternatives. More detailed information and background on this project as well as the results for the previously evaluated alternatives can be found in the TIDR.

The scope of this report covers the analysis methodology, affected environment, and potential transportation impacts and benefits of the four alternatives. The outline is as follows:

- Section 1 Executive Summary
- Section 2 Introduction
- Section 3 Methodology and Coordination
- Section 4 Affected Environment
- Section 5 Potential Effects

The appendices provide technical outputs and supporting information created for this analysis.

1.1.1 Study Area

The study area for this STIDR is consistent with the study area in the TIDR and is shown in **Figure 1-1**.

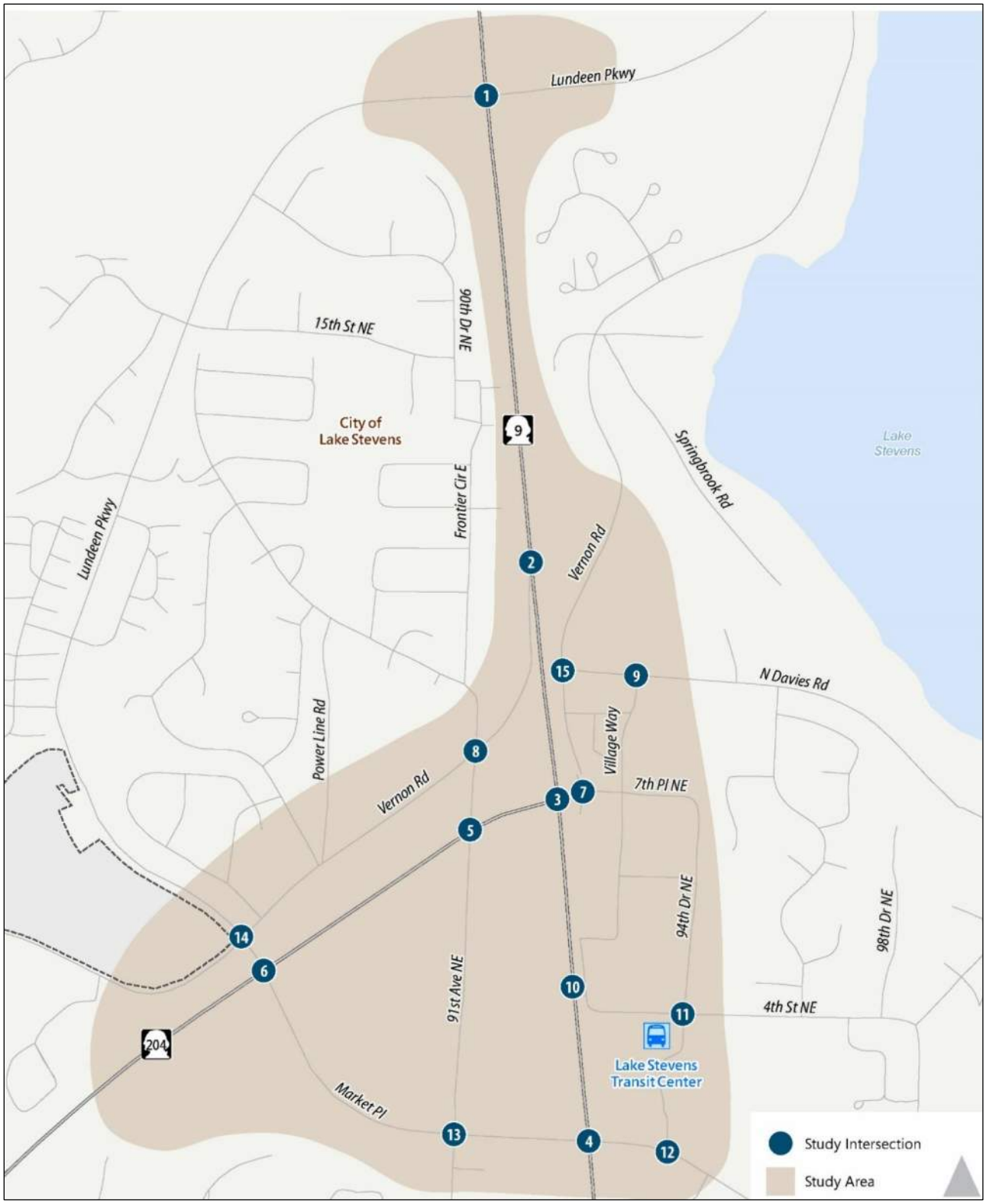

Figure 1-1. Study Area and Study Intersections

1.2 EXISTING TRANSPORTATION CONDITIONS

The roadway network in the study area consists of two state highways: SR 9 and SR 204, as well as local arterials and collector streets. Both SR 9 and SR 204 are "partial control limited access highways", as defined by WSDOT[1]. During peak commute hours long queues and delays are observed along the east-west approaches to SR 9.

1.3 BASELINE CONDITIONS

The No Build Alternative served as the baseline conditions for the 2021 and 2040 analysis. This alternative was evaluated using the same project transportation network assumptions as the existing conditions analysis, with no changes in the transportation network to accommodate increased demand. In the analyses, volumes were updated to reflect forecasted vehicle demand through the study area. Traffic congestion is expected to increase under the No Build Alternative due to this increased demand.

1.4 DEVELOPMENT OF ALTERNATIVES AND SELECTION OF THE PREFERRED ALTERNATIVE

The previous TIDR analyzed twelve build alternatives and selected the Grade-Separated Tight Diamond configuration (Modified E2B-V4) as the Preferred Alternative. Upon further study, it was determined that the construction costs of this alternative exceeded the project budget. The proposed layout for the previously Preferred Alternative is shown in **Figure 1-2**. Two new at-grade concepts were developed by the project team, vetted by stakeholders, and analyzed as additional build alternatives.

[1] A "partial control limited access highway" is a highway with at-grade intersections with selected permitted public roads. There may be some crossings and some driveway approaches at-grade. Direct commercial access is not permitted.

Figure 1-2: Tight Diamond Alternative

The At-Grade Widening Alternative would include the following changes to the existing configuration:

- Added southbound through lane on SR 9 from Lundeen Parkway to approximately 1,200 feet south of the Market Place intersection. Southbound SR 9 will still have a southbound right turn lane at SR 204 in addition to the three through lanes and one left turn lane.
- Added northbound through lane on SR 9 from approximately 1,200 feet south of the Market Place intersection to Lundeen Parkway. The added lane would become a northbound right turn lane (trap right) prior to the intersection with Lundeen Parkway.
- Added SR 9 northbound right-turn pocket to 4th Street NE.

The At-Grade Roundabouts Alternative would include the following changes to the existing configuration:

- The SR 9/SR 204 intersection would be converted to a 2-lane roundabout.
- A new crossing of SR 9 would be created at SR 9/N Davies Road via a two-lane roundabout and the current SB SR 9 to Vernon Road off-ramp would be replaced with a two way segment between the SR 9/N Davies Road and 91st Avenue NE/Vernon Road intersection.
- The 91st Avenue NE/Vernon Road intersection would be converted to a single lane roundabout
- Vernon Road east of SR 9 between N Davies Road and 7th Place NE will serve local business access but is not intended to serve through trips.
- 7th Place NE will directly intersect with the SR 9/SR 204 roundabout, providing more direct connections for Frontier Village.
- 92nd Avenue NE will be closed at 7th Place NE and 4th Street NE.
- Two northbound and two southbound through lanes will extend from south of Market Place to SR 204.
- Added SR 9 northbound right-turn pocket to 4th Street NE.

While both new At-Grade alternatives were fully analyzed, a full conceptual layout was not created for the At-Grade Widening Alternative. The conceptual layout for the At-Grade Roundabouts Alternative can be seen in **Figure 1-3**.

The At-Grade Roundabouts Alternative was selected as the new Preferred Alternative by the project team based on a variety of factors, including traffic operations, stakeholder input, and constructability.

Figure 1-3. At-Grade Roundabouts Alternative

1.5 POTENTIAL IMPACTS AND BENEFITS OF THE NEW PREFERRED ALTERNATIVE

The new Preferred Alternative includes three new roundabouts at SR 9/SR 204, SR 9/Davies Road, and 91st Avenue NE/Vernon Road. New circulation patterns created by this network serve to spread vehicle demand between the two SR 9 roundabouts in order to balance delay across the network. The new network provides improved intersection operations and more direct connections from Frontier Village and across SR 9 for communities and businesses north of SR 204.

The system of roundabouts will improve intersection operations at SR 9/SR 204 and the additional lanes on SR 9 south of SR 204 would improve operations at SR 9/Market Place intersection. The roundabouts alternative is expected to reduce travel time for local trips under 2040 PM conditions compared to No Build Alternative. The construction of a new controlled intersection (SR 9/Davies Road roundabout) will increase travel time for the major PM commute movement from EB SR 204 to NB SR 9. However, the network will provide additional travel time and connectivity benefits outside of the PM peak commute period.

The project will also improve non-motorized connections throughout the study area with the addition of crosswalks with Rectangular Rapid Flash Beacons across the SR 9 roundabouts, new sidewalk connections on either side of SR 9, and an additional pedestrian crossing of SR 9 close to the residential and commercial areas to the north of SR 204.

The new Preferred Alternative (At-Grade Roundabouts) could have a higher potential for collisions as compared with the No Build. However, this higher potential is mainly due to additional intersections associated with this alternative. Focusing on the SR 9/SR 204 intersection, the Roundabout alternative has a 15% reduction in predicted collision rates compared to No Build.

The operational analysis for the alternatives were evaluated and the impacts on the non-motorized and transit facilities of these alternatives are detailed in **Section 5**.

The project will be constructed and staged to minimize the effects of project construction whenever possible. The project team will coordinate with local agencies, stakeholders, and the project teams for relevant, nearby projects prior to making any lane changes or lane closures.

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SECTION 2. INTRODUCTION

The traffic operations of the SR 9 and SR 204 project intersection, located in the City of Lake Stevens in Snohomish County, affects commuter traffic, regional goods movement, and local business access. Due to existing congestion and anticipated growth in vehicular demand at this intersection, WSDOT and the project team evaluated multiple alternatives to improve vehicular operations, reduce collision rates, and increase local accessibility.

2.1 PURPOSE OF THE REPORT

This Supplemental Transportation Impact Discipline Report (STIDR) studies two new alternatives for the SR 9/SR 204 Intersection Improvements Project in addition to the Preferred Alternative identified in the TIDR (September 2018). The STIDR evaluates the differences between those three build alternatives and the No Build Alternative and identifies a new Preferred Alternative. The evaluation includes highway and arterial traffic operations, transit operations, non-motorized access, and safety performance.

This report is required to inform the NEPA/SEPA process.

2.2 PURPOSE AND NEEDS STATEMENT

The Purpose and Needs Statement can be found in the TIDR (September 2018).

2.3 PROJECT DESCRIPTION

The Washington State Department of Transportation (WSDOT) proposes to construct the SR 9/SR 204 Intersection Improvements Project to improve traffic operations at this intersection in the City of Lake Stevens. The TIDR evaluated twelve alternatives and selected a Grade-Separated Tight Diamond configuration (Modified E2B-V4) as the Preferred Alternative. Further study determined that the costs to construct the Preferred Alternative exceeded the project budget. This alternative will now be referred to as the Tight Diamond Alternative. Two new at-grade alternatives were developed and analyzed in this STIDR.

2.4 PROJECT ALTERNATIVES

Due to the cost implications of the Tight Diamond Alternative, the project team developed two new at-grade build alternatives for further study. This STIDR focuses on the four alternatives shown below.

2.4.1 No Build Alternative

The No Build Alternative is detailed in the TIDR (September 2018).

2.4.2 Tight Diamond Alternative

The Tight Diamond Alternative (Modified E2B-V4 and previously identified as the Preferred Alternative) is detailed in the TIDR (September 2018).

2.4.3 At-Grade Widening Alternative

The At-Grade Widening Alternative would modify SR 9 geometry to include the following changes:

- Additional southbound through lane on SR 9 from Lundeen Parkway to approximately 1,200 feet south of the Market Place intersection. Southbound SR 9 would still have a dedicated southbound right turn lane at SR 204 in addition to the three through lanes and one left turn lane.
- Additional northbound through lane on SR 9 from approximately 1,200 feet south of the Market Place intersection to Lundeen Parkway. The added lane would become a northbound right turn lane (trap right) prior to the intersection with Lundeen Parkway.
- Additional SR 9 northbound right-turn pocket to 4th Street NE.

2.4.4 At Grade Roundabouts Alternative

The At-Grade Roundabouts Alternative would include the following changes to the transportation network:

- The SR 9/SR 204 intersection would be converted to a 2-lane roundabout.
- A new crossing of SR 9 would be created at SR 9/N Davies Road via a two-lane roundabout and the current southbound SR 9 to Vernon Road off-ramp would be replaced with a two-way segment between the SR 9/N Davies Road and 91st Avenue NE/Vernon Road intersection.
- The 91st Avenue NE/Vernon Road intersection would be converted to a single lane roundabout.
- Vernon Road east of SR 9 between N Davies Road and 7th Place NE would serve local business access but is not intended to serve through trips.
- 7th Place NE would directly intersect with the SR 9/SR 204 roundabout.
- 92nd Avenue NE would be closed at 7th Place NE and 4th Street NE.
- Two northbound and two southbound through lanes would extend from south of Market Place to SR 204.
- Added SR 9 northbound right-turn pocket to 4th Street NE.

The At-Grade Roundabouts Alternative is shown in **Figure 2-1**.

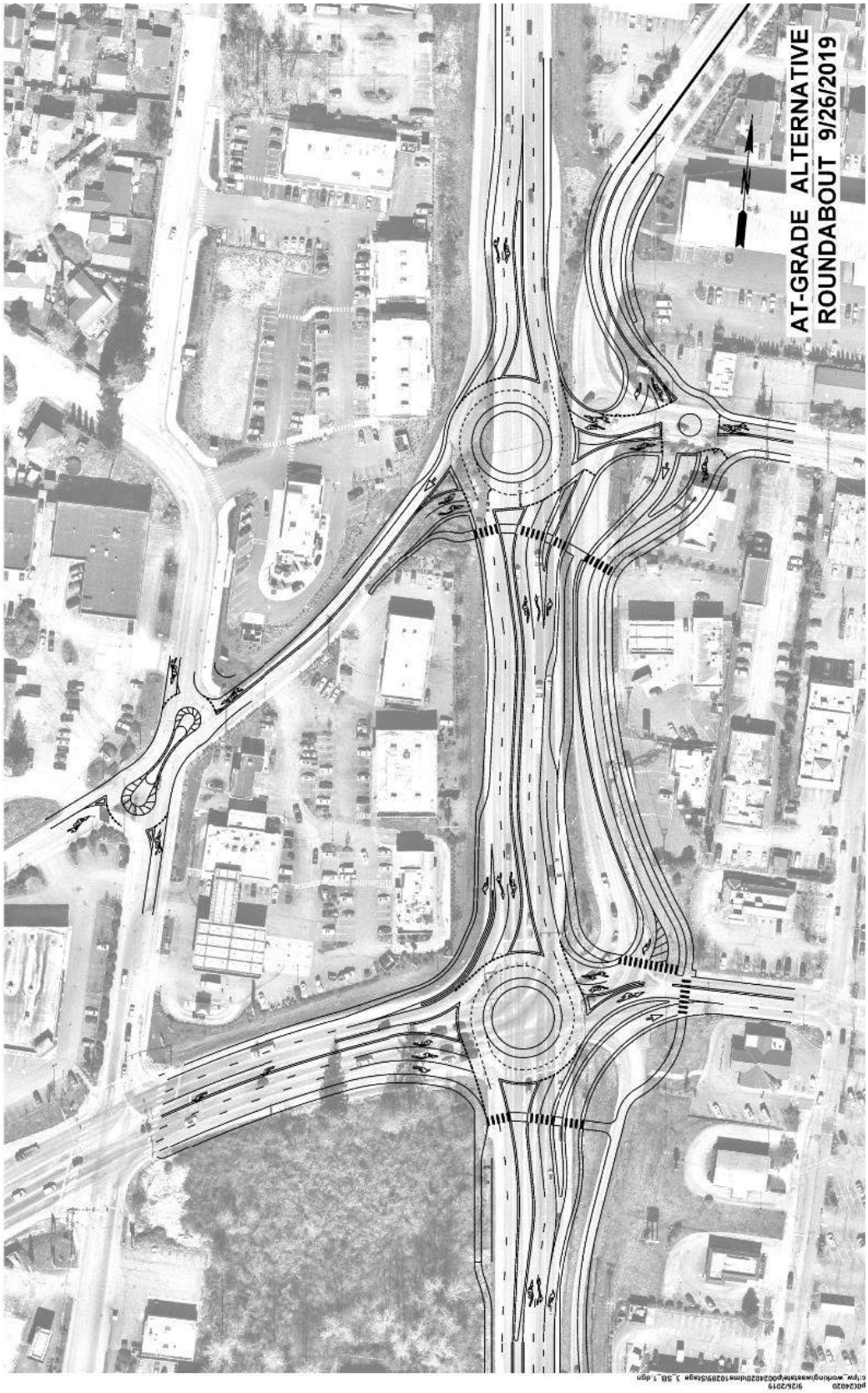

Figure 2-1. At-Grade Roundabouts Alternative

SECTION 3. METHODOLOGY AND COORDINATION

3.1 ANALYSIS YEARS AND TIME PERIODS

The analysis years for this project were set by the project team at the beginning of the study and include an existing year (2016), future year (2021), and design year (2040).

Future Year: The project future year was established as year 2021 as that was the year the project was initially assumed to be completed. While this is no longer assumed to be the opening year for the project, this analysis period is retained to maintain consistency between the TIDR and STIDR.

Design Year: The project design year is 2040.This is approximately 20 years beyond the year of opening for the project.

3.2 TRAVEL DEMAND FORECASTING

The travel demand forecasting process for this project is summarized in the TIDR and was not updated for the STIDR.

Forecasts for the At-Grade Roundabouts Alternative were based on the No Build volumes. Due to changes to the transportation network and additional connections across SR 9, some volume was shifted onto new routes that are not possible under existing conditions or under other alternatives. For example, some PM commute traffic may travel via Lundeen Parkway or 91st Avenue to Vernon Road and access SR 9 via the new roundabout at Davies Road. These shifts in volume were analyzed in an iterative fashion in order to roughly balance delay and queuing across parallel routes.

Turning movement figures are shown in **Section 4** & **Appendix A**.

3.3 ANALYSIS METHODOLOGY

The primary traffic operations metrics for this project are intersection level-of-service (LOS) and travel time. These metrics are estimated using a microsimulation traffic model and a roundabout analysis software for both the AM and PM peak hours.

3.3.1 Level of Service

LOS is a qualitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to maneuver. Six levels are defined, from LOS A with the least congested operating conditions, to LOS F with the most congested operating conditions. LOS E represents “at-capacity” operations. Operations are designated as LOS F when volumes exceed capacity, resulting in a breakdown in traffic operations. The LOS grade is determined based on the average control delay for vehicles with separate thresholds set by intersection type. **Table 3-1** shows the delay thresholds as outlined in the Highway Capacity Manual.

TABLE 3-1. INTERSECTION LEVEL OF SERVICE THRESHOLDS

Level of Service	General Description	Signalized/Roundabout Intersection Control Delay (sec/veh)[a,b]	Unsignalized Intersection Control Delay (sec/veh)[a,b,c]
A	Little to no congestion or delays.	0 – 10.0	0 – 10.0
B	Limited congestion, short delays	10.1 – 20.0	10.1 – 15.0
C	Modest delays and stable flow	20.1 – 35.0	15.1 – 25.0
D	Long delays, but stable flow	35.1 – 55.0	25.1 – 35.0
E	Operations at or near capacity	55.1 – 80.0	35.1 – 50.0
F	Over-capacity, breakdown flow	> 80.0	> 50.0

Source: Highway Capacity Manual 2010 (Transportation Research Board 2010).

a. Intersection vehicle delay results generated by micro-simulation models such as Vissim are not HCM compliant. HCM calculations are based on control delay and stopped delay that directly contributes to the traffic control devices. Vissim directly measures the total delay, which consists of control delay, stopped delay, and other delay incurred in the vicinity of the traffic control device, such as vehicles slowing down for turn movements. However, for simplicity, the differences are usually negligible. Per the WSDOT Vissim protocol, the control delay-based LOS thresholds can be applied to the total delay-based outputs from Vissim.

b. HCM typically measures delay and intersection LOS for the peak 15-minute period of the peak hour. For the project analysis, LOS was measured and averaged over the entire one-hour simulation model. The Vissim model did include a 15-minute peaking factor to simulate higher vehicle arrival rates. The peak 15-minute period queues and delays, along with any remaining queues that continue into the following period were incorporated into the one-hour average delay analysis to determine LOS.

c. For side-street stop-controlled intersections, the worst movement is reported as the LOS for the entire intersection.

For signalized and unsignalized locations, average control delay is determined using the Vissim microsimulation software. For roundabout locations, average control delay and LOS is evaluated using SIDRA software.

3.3.2 Travel Time

Travel times within the study area were estimated between the following seven locations:

1. SR 9 north of Lundeen Parkway
2. SR 9 south of Market Place NE
3. SR 204 west of Market Place NE/Lundeen Parkway
4. N Davies Road and access driveway to the Safeway parking area
5. 4th Street NE and 94th Drive NE
6. 91st Avenue NE Commercial District (near Ace Hardware)
7. Lundeen Parkway neighborhoods (near Vernon Road/91st Avenue NE intersection)

These locations are shown in **Figure 3-1**. They were selected to measure how regional vehicle travel times would change (locations 1 through 3), as well as between local origins and destinations within the study area (locations 4 through 7). Transit travel time impacts and benefits were measured by route. Non-motorized travel times were also estimated for local travel (locations 4 through 7). Detailed information on how the travel times were estimated is included in the TIDR.

Figure 3-1. Locations to Evaluate Travel Time

3.3.3 Collision Analysis

The Highway Safety Manual (HSM) spreadsheet for urban and suburban arterials published by the American Association of State Highway and Transportation Officials (AASHTO) was used to forecast the collision rate for the each alternative The Interchange Safety Analysis Tool (ISAT), published by the Federal Highway Administration (FHWA), was applied for the Tight Diamond Alternative to estimate collision rates at merge and diverge points, ramps, and for highway-like segments. The collision rates are generated based on roadway type, forecasted Annual Average Daily Traffic (AADT), geometric features of a roadway segment or an intersection (i.e. number of lanes, median width, shoulder width), speed limit, roadside fixed objects, type of intersection control, proximity to alcohol establishments, proximity to schools, proximity to transit stops, and street lighting.

3.4 TRAFFIC ANALYSIS TOOLS

3.4.1 Vissim Microsimulation Model

Traffic operations within the study area were evaluated using Vissim 8. Development of the microsimulation models, including calibration and validation, are discussed in **Section 3** of the TIDR. Subsequent to the analysis in the TIDR, the project team continued to update and refine the microsimulation models to improve their ability to estimate traffic conditions within the study area for each of the alternatives. Many of these updates were incorporated based on comments from WSDOT's review and include:

- Adding network detail to the Frontier Village Shopping Center and updating vehicle routes.
- Adjusting traffic controls and driver parameters to reduce unrealistic driver behavior and the number of errors. Updated components included conflict areas, priority rules, desired speed decisions, lane change distances, connector locations, and turn pocket lengths.

These edits were applied to all scenarios analyzed in this STIDR including those previously reported in the TIDR. After incorporating these changes into the Existing AM and PM peak hour models, the model outputs were compared to the validation criteria to ensure that the models were still valid. These results were consistent. Due to the model refinements, the results for the Existing, No Build, and Tight Diamond Alternative in this report differ from those in the TIDR.

3.4.2 SIDRA Roundabout Software

Roundabout intersections were evaluated using SIDRA 8, WSDOT's preferred roundabout analysis tool. SIDRA has multiple roundabout capacity models available within the software. These include the SIDRA standard capacity model and the HCM capacity model. Through a comparative analysis of these capacity models, the project team determined that the SIDRA model may overstate the capacity of multi-lane roundabout while the HCM may underestimate the capacity.

3.4.2.1 LOS Results

Vehicle delay results from SIDRA standard and HCM roundabout capacity models were averaged to provide LOS results for each roundabout. For example, under 2040 PM conditions, the SIDRA standard capacity model provided an average vehicle delay of 6 seconds for the SR 9/204 roundabout, while the HCM capacity model provided delay of 50 seconds. The average of these two models resulted in a reported LOS of 28 seconds.

3.4.2.2 Travel Time Results

The results from SIDRA and the results from the No Build VISSIM model were combined to estimate the travel time results. The difference method was used to evaluate how the At-Grade Roundabouts Alternative travel time compares against the three previously studied alternatives: No Build, At-grade Widening, and Tight Diamond. The difference method applies the delta between two models to a known or trusted value. In this application, the difference between a SIDRA No Build and a SIDRA Roundabout Alternative model was applied to the No Build Vissim model travel time results. This method allows a direct comparison across alternatives and between modeling tools.

SECTION 4. AFFECTED ENVIRONMENT

4.1 STUDY AREA

The transportation study area includes classified state and local roadways that may be impacted by or may benefit from improvements proposed for the SR 9/SR 204 intersection or the surrounding roadway network:

- SR 204: from Lundeen Parkway to SR 9
- SR 9: from Market Place NE to Lundeen Parkway
- Vernon Road: from SR 204 to N Davies Road
- 92nd Avenue NE: from 4th Street NE to 7th Place NE
- Lundeen Parkway: from Vernon Road to SR 204 (segment directly north of the SR 204/Lundeen Parkway/Market Place NE intersection).
- Vernon Road: from Lundeen Parkway to SR 9 southbound slip ramp
- Market Place NE: from SR 204 to 99th Ave NE
- 91st Avenue NE: from Market Place NE to Vernon Road
- N Davies Road: from Vernon Road to 94th Drive NE (extension)
- 4th Street NE/99th Ave NE: from Market Place to 7th Place NE

The study intersections for the traffic operations analysis are shown in **Figure 4-1**. More detail on the study area, including vehicular and non-motorized facilities, is included in the TIDR, **Section 4.1**.

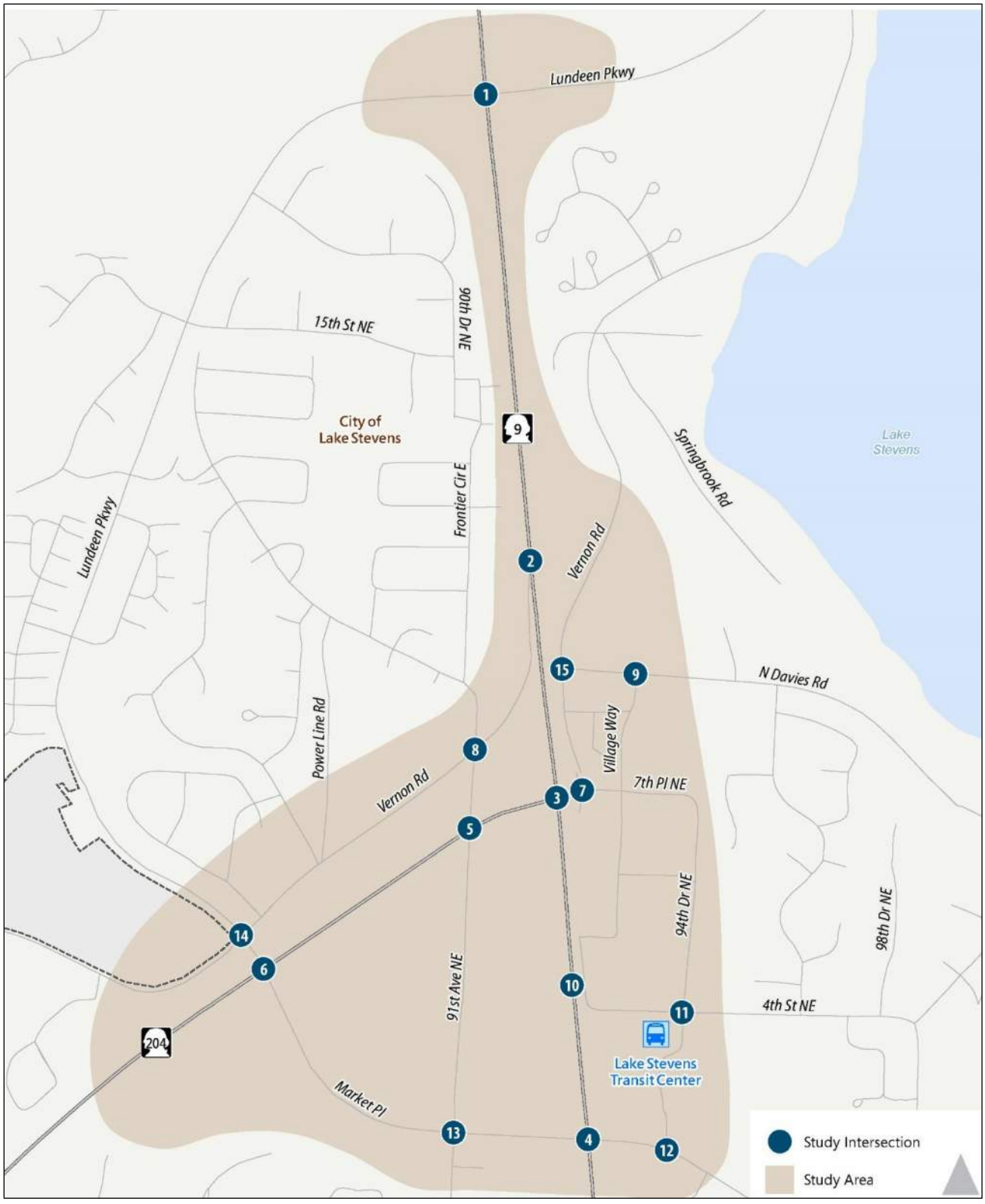

Figure 4-1. Study Area and Study Intersections

4.2 EXISTING OPERATING CONDITIONS

The existing operating conditions for intersections in the SR 9/SR 204 study were analyzed for AM and PM peak hour conditions. As described in **Section 3**, traffic operations were analyzed using a validated Vissim microsimulation model. Results reported in the STIDR vary from the TIDR in some cases due to the methodology updates described in **Section 3.4.1**.

4.2.1 Intersection Counts

Intersection turning movement counts were compiled from 2013-2015 WSDOT data and AM/PM peak period turning movement counts were collected in June and July 2016. These counts vary slightly from the TIDR due to updates in Frontier Village internalization and other routing updates consistent with future year project models. The intersection lane configurations and adjusted/balanced counts for the AM and PM peak hours are shown in **Figures 4-2** and **4-3**.

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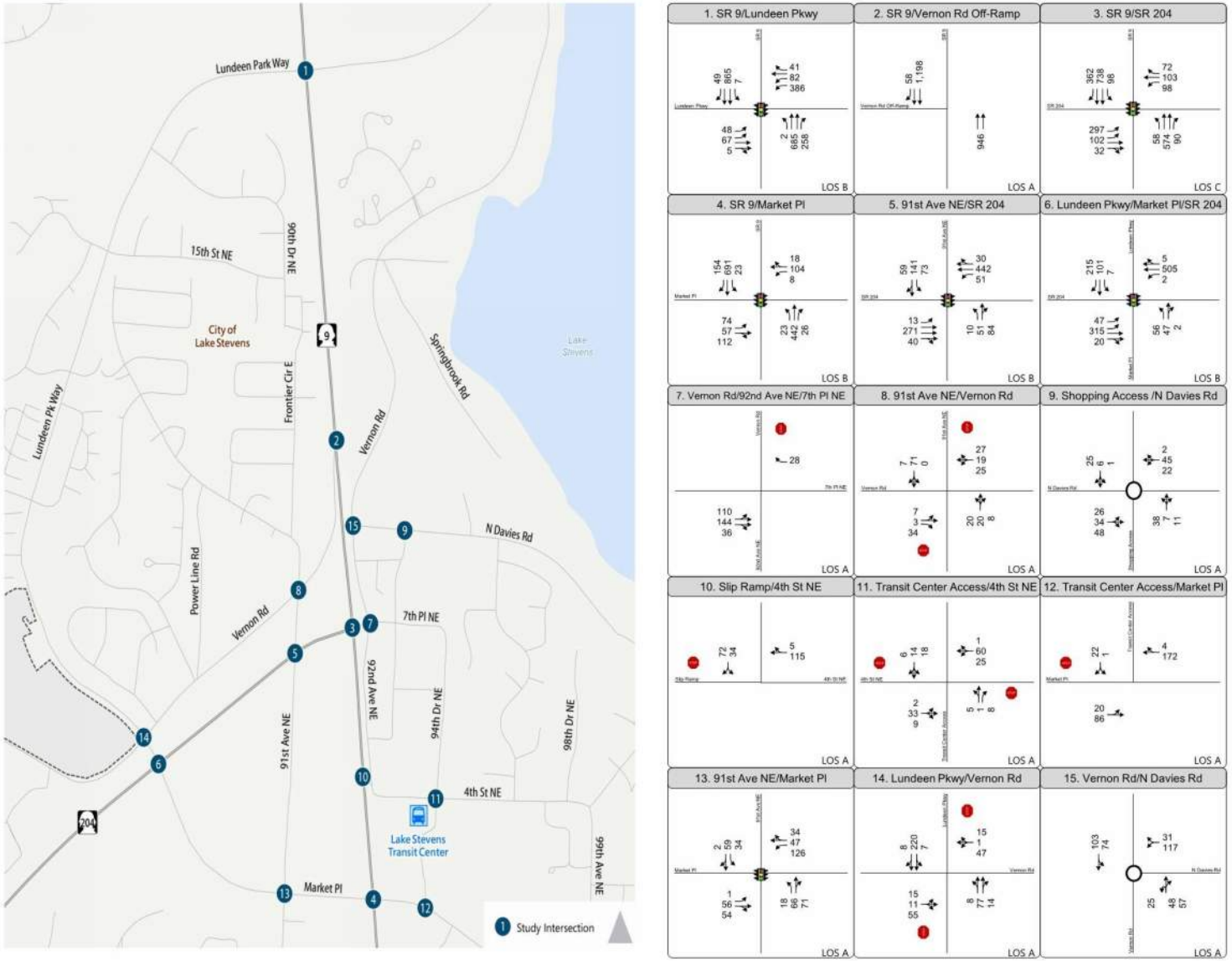

Figure 4-2. AM Existing Peak Hour Turning Movement Counts

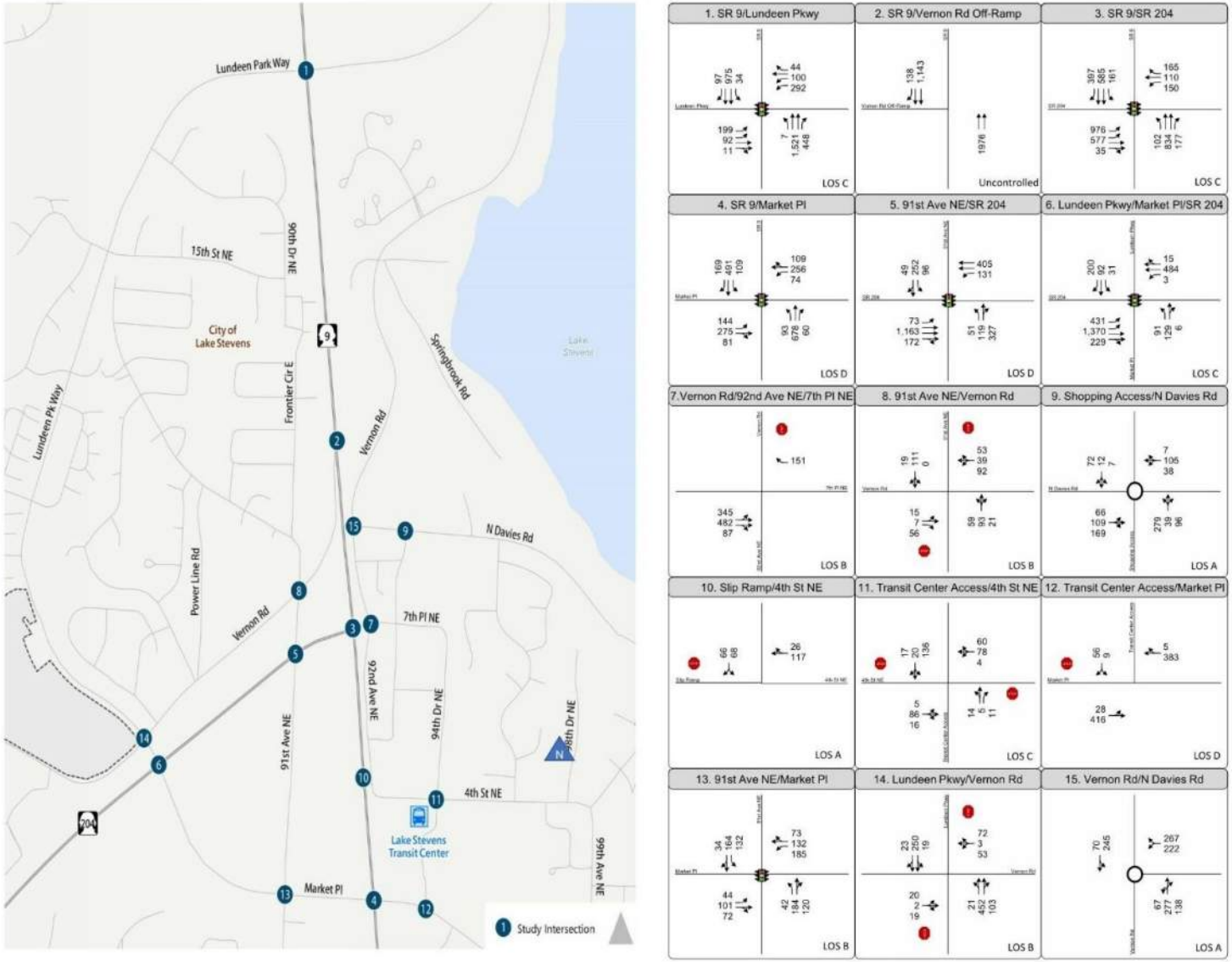

Figure 4-3. PM Existing Peak Hour Turning Movement Counts

4.2.2 Intersection Operations Results

This section presents the results of the intersection operations analysis. **Table 4-1** summarizes the AM peak hour LOS results and **Table 4-2** summarizes the PM peak hour results. A detailed description of Vissim model validation is provided in the TIDR. Full model outputs are included as **Appendix B** of this STIDR. All delay results are rounded to the nearest second in this document.

TABLE 4-1. EXISTING AM PEAK HOUR INTERSECTION LEVEL OF SERVICE RESULTS (APPROACH AND OVERALL)

			Approach Delay (seconds) and Level of Service				Overall
#	Intersection	Control	NB	SB	EB	WB	
1	SR 9/Lundeen Pkwy	Signal	17 (B)	17 (B)	38 (D)	34 (C)	21 (C)
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	n/a	n/a	n/a[a]
3	SR 9/SR 204	Signal	18 (B)	16 (B)	33 (C)	31 (C)	21 (C)
4	SR 9/Market Pl	Signal	18 (B)	19 (B)	26 (C)	28 (C)	21 (C)
5	91st Ave/SR 204	Signal	11 (B)	15 (B)	24 (C)	15 (B)	17 (B)
6	Lundeen Pkwy/SR 204	Signal	17 (B)	11 (B)	11 (B)	15 (B)	13 (B)
7	Vernon Rd/7th Pl	Side-street Stop	n/a	n/a	n/a	8 (A)	8 (A)
8	91st Ave/Vernon Rd	Side-street Stop	1 (A)	n/a	5 (A)	7 (A)	10 (B)
9	Safeway Dwy/Davies Rd	Roundabout	1 (A)	1 (A)	1 (A)	1 (A)	1 (A)
10	SR 9/4th St On-Ramp	Side-street Stop	n/a	7 (A)	n/a	n/a	8 (A)
11	Transit Center Dwy/4th St	Side-street Stop	11 (B)	6 (A)	0 (A)	0 (A)	20 (C)
12	Transit Dwy/Market Pl	Side-street Stop	n/a	4 (A)	2 (A)	n/a	6 (A)
13	91st Ave/Market Pl	Signal	8 (A)	7 (A)	4 (A)	7 (A)	7 (A)
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1 (A)	1 (A)	8 (A)	6 (A)	8 (A)
15	Vernon Rd/Davies Rd	Roundabout	1 (A)	2 (A)	n/a	1 (A)	1 (A)

a. Location operates as an uncontrolled diverging off-ramp for southbound SR 9 traffic onto Vernon Road and 91st Avenue NE. By definition, this location does not create control delay from any approach.

All intersections currently operate at an overall LOS of C or better during the AM peak hour.

TABLE 4-2. EXISTING PM PEAK HOUR INTERSECTION LEVEL OF SERVICE RESULTS (APPROACH AND OVERALL)

			Approach Delay (seconds) and Level of Service				Overall
#	Intersection	Control	NB	SB	EB	WB	
1	SR 9/Lundeen Pkwy	Signal	29 (C)	18 (B)	55 (E)	52 (D)	30 (C)
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	n/a	n/a	n/a[a]
3	SR 9/SR 204	Signal	47 (D)	33 (C)	21 (C)	50 (D)	34 (C)
4	SR 9/Market Pl	Signal	39 (D)	30 (C)	55 (E)	87 (F)	48 (D)
5	91st Ave/SR 204	Signal	50 (D)	50 (D)	54 (D)	35 (D)	49 (D)
6	Lundeen Pkwy/SR 204	Signal	32 (C)	18 (B)	20 (B)	27 (C)	22 (C)
7	Vernon Rd/7th Pl	Side-street Stop	n/a	n/a	n/a	11 (B)	11 (B)
8	91st Ave/Vernon Rd	Side-street Stop	1 (A)	0 (A)	9 (A)	10 (B)	13 (B)
9	Safeway Dwy/Davies Rd	Roundabout	5 (A)	5 (A)	2 (A)	4 (A)	4 (A)
10	SR 9/4th St On-Ramp	Side-street Stop		8 (A)		n/a	8 (A)
11	Transit Center Dwy/4th St	Side-street Stop	11 (B)	9 (A)	1 (A)	1 (A)	17 (C)
12	Transit Dwy/Market Pl	Side-street Stop		26 (D)	7 (A)	n/a	27 (D)
13	91st Ave/Market Pl	Signal	13 (C)	14 (B)	<10 (A)	14 (B)	13 (B)
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	2 (A)	3 (A)	9 (A)	6 (A)	12 (B)
15	Vernon Rd/Davies Rd	Roundabout	5 (A)	4 (A)		8 (A)	6 (A)

a. Location operates as an uncontrolled diverging off-ramp for southbound SR 9 traffic onto Vernon Road and 91st Avenue NE. By definition, this location does not create control delay from any approach.

As shown in the tables above, the PM peak hour delays are higher than those in the AM peak hour. This is due to considerably higher traffic demand in the PM peak hour compared to the AM peak hour.

The LOS analysis considered the adopted LOS standards of the operating agencies; SR 9 and SR 204 intersections use WSDOT LOS standards and local street intersections use City of Lake Stevens LOS standards. As a Highway of Statewide Significance (HSS), SR 9 has a LOS standard of D. SR 204 is a non-HSS in a Tier 2 zone (i.e. the "outer" urban area beyond a 3-mile buffer from I-5), and also has a LOS D standard. The City of Lake Stevens has set a citywide standard of LOS E for major and minor arterials and collector roadways, which comprise all local roadways within the study area.

No intersections exceed the WSDOT or City of Lake Stevens LOS standards in either the AM or PM periods.

SECTION 5. POTENTIAL EFFECTS

This section describes the potential effects of each alternative on LOS, travel time, collisions, non-motorized facilities, transportation system management strategies, and construction.

5.1 SELECTION OF THE PREFERRED ALTERNATIVE

The roundabouts alternative was selected by the project team as the new Preferred Alternative. This alternative provides transportation network connectivity improvements, predicted collision rate reductions, and non-motorized improvements compared with the No Build alternative. Complete analysis results for all alternatives are summarized below.

5.2 2040 OPERATIONS

Traffic operations were analyzed in the 2040 horizon year for the No Build Alternative, Tight Diamond Alternative, and two new At-Grade Alternatives. The microsimulation analysis methodology used to evaluate operations is described in the TIDR. Updates to the methodology, including the use of SIDRA software for roundabout analysis, are discussed in **Section 3.4**. Turning movement figures and lane configurations are included in **Appendix A**. Detailed operational outputs from the Vissim and SIDRA models, including intersection delay/LOS, approach delay/LOS, and queuing, are included in **Appendix B**. The following sections provide a summary of intersection delay and LOS results.

5.2.1 No Build Alternative

5.2.1.1 Future Network

The No Build alternative was evaluated using the same transportation network assumptions as existing conditions. The vehicle volume inputs and routings to the Vissim traffic operations model were updated to reflect the forecasted 2040 vehicle demand throughout the study area (described in **Section 3**).

5.2.1.2 Level of Service and Delay

The intersection level of service results for the AM and PM peak hour are shown in **Table 5-1**. All intersections operate at an overall average LOS D or better during the 2040 AM peak hour. The westbound approach of the SR 9/SR 204 intersection experiences long delays (operating at LOS F conditions), as the signal timing favors the eastbound left movement.

Similar to existing conditions, 2040 PM peak period delays are higher than the AM peak period. This result is due to a considerable increase in traffic demand in the PM peak hour compared to the AM peak. The 2040 AM peak period has an approximate total of 3,700 vehicles traveling through the study intersection, while the PM peak period has 5,200 vehicles, over one-third more than the AM total.

By 2040, PM peak hour vehicle demand is forecasted to increase to a level where operations at certain intersections exceed the LOS standard and threshold of LOS D. The SR 204/91st Avenue and Market Place/Transit Center Driveway intersections operate at LOS E, while the SR 9/Market Place intersection operates at LOS F. The Market Place/Transit Center Driveway intersection does not exceed LOS standards

as this is set at LOS E by the City of Lake Stevens. The other two intersections do exceed the WSDOT LOS D standard. Impacted intersections are identified and described below:

- The SR 9/Market Place intersection operates at LOS F during the PM peak hour, which suggests that the intersection is over capacity. This intersection creates a bottleneck with two southbound through lanes dropping to one lane approaching the Market Place intersection, with the outside lane becoming a right-turn only lane. The demand on this southbound approach is expected to increase by approximately 550 vehicles during the PM peak hour compared to existing conditions. Modeling of the 2040 No Build scenario showed that during the peak 15 minutes of the analysis hour southbound queues occasionally extend to the SR 9/SR 204 intersection, blocking the flow of southbound-through, eastbound-right, and westbound-left traffic through that intersection.
- The SR 204/91st Ave NE intersection experiences additional delay as the incremental increase in traffic volumes over existing are enough to increase delay to the threshold of LOS E. The borderline LOS delay means that any small change in the overall intersection volume or the balance of individual turning movements could change the LOS to D.

In addition to the LOS that exceeds the standard for these two intersections, queuing occurs at some intersections. Signal timing on SR 9 is set to provide more time to the higher north-south vehicle demand so side-street approaches such as at Market Place may experience queueing back to the immediately adjacent intersections. Likewise, the intersections along SR 204 have signal timings with more green time to serve the major eastbound and westbound through movements. The intersection at 91st Avenue NE is coordinated with the SR 9 signal, and meters the amount of vehicle demand approaching the SR 9/SR 204 intersection. Generally, queues clear at 91st Avenue NE and SR 9 within one or two cycles. A slight increase in the eastbound left traffic volumes and a larger increase in the eastbound through volumes into Frontier Village can cause queues at the SR 9/SR 204 intersection to extend past 91st Avenue NE at times.

TABLE 5-1. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2040 NO BUILD

ID	Location	Control[a]	AM Peak Hour				PM Peak Hour			
			Existing AM		2040 No Build		Existing		2040 No Build	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	21	C	25	C	30	C	31	D
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	SR 9/SR 204	Signal	21	C	36	D	34	C	49	D
4	SR 9/Market Pl	Signal	21	C	30	C	48	D	97	F
5	91st Ave/SR 204	Signal	17	B	27	C	49	D	55	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	13	B	15	B	22	C	26	C
7	Vernon Rd/7th Pl	SSSC	8	A	8	A	11	B	14	B
8	91st Ave/Vernon Rd	SSSC	10	B	30	D	13	B	13	B
9	Safeway Dwy/Davies Rd	RAB	1	A	1	A	4	A	6	A
10	SR 9/4th St On-Ramp	SSSC	8	A	8	A	8	A	8	A
11	Transit Center Dwy/4th St	SSSC	20	C	20	C	17	C	16	C
12	Transit Center Dwy/Market Pl	SSSC	6	A	6	A	27	D	39	E
13	91st Ave/Market Pl	Signal	7	A	9	A	13	B	18	B
14	Lundeen Pkwy/Vernon Rd	SSSC	8	A	9	A	12	B	13	B
15	Vernon Rd/Davies Rd	RAB	1	A	2	A	6	A	12	B

a. SSSC = side-street stop controlled
RAB = roundabout

n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

5.2.2 Build Alternatives

5.2.2.1 Alternative Concepts

An overview of the Build Alternatives analyzed for potential impacts under 2040 PM peak hour conditions is provided above in **Section 2.4**.

5.2.2.2 Level of Service and Delay

2040 PM Peak hour delay and LOS results are summarized in **Table 5-2**. Results for the AM peak hour analysis are summarized in **Table 5-3**.

The 2040 PM analysis results show improved operations compared to the No Build scenario. Results are organized by alternative below:

- **Tight Diamond**– Under this alternative, all intersections operate at LOS D or better. The highest delays occur at the SR 9/SR 204, SR 9/Market Place, and SR 204/91st Avenue intersections. SR 9 northbound and southbound through traffic experiences no delay due to the grade separation. Operations at SR 9/Market Place are greatly improved with the addition of a through lane in the northbound and southbound direction. This widening is also included in the two At-Grade Alternatives.
- **At-Grade Widening** – Under this alternative, all intersections except one operate at LOS C or better. SR 204/91st Avenue is forecasted to operate with LOS D conditions. The additional through lanes on SR 9 allows for a higher proportion of green time to be allocated for eastbound and westbound traffic, which reduces overall delay.
- **At-Grade Roundabouts** – Under this alternative, most intersections operate at LOS C or better. SR 9/Market Place operates at LOS D, while SR 204/91st Avenue operates at LOS E. The traffic signal at SR 204/91st Avenue meters eastbound traffic entering the main SR 9/SR 204 and helps to improve roundabout operations on SR 9.

The 2040 AM period forecasted traffic volumes are significantly lower than the PM period. As such, all study intersections are forecasted to operate at LOS C or better for all three build alternatives and therefore meet the LOS thresholds set by WSDOT and the City of Lake Stevens.

TABLE 5-2. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2040 PM PEAK HOUR

		No Build			Tight Diamond			At-Grade Widening			At-Grade Roundabouts		
ID	Location	Control[a]	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	31	D	Signal	39	D	Signal	32	C	Signal	32	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	RAB	17	B
3	SR 9/SR 204	Signal	49	D	Signal	47	D	Signal	34	C	RAB	28	C
4	SR 9/Market Pl	Signal	97	F	Signal	44	D	Signal	30	C	Signal	39	D
5	91st Ave/SR 204	Signal	55	E	Signal	44	D	Signal	50	D	Signal	75	E
6	Lundeen Pkwy/Market Pl/SR 204	Signal	26	C	Signal	25	C	Signal	25	C	Signal	30	C
7	Vernon Rd/7th Pl	SSSC	14	B	SSSC	8	A	SSSC	13	B	n/a	n/a	n/a
8	91st Ave/Vernon Rd	SSSC	13	B	SSSC	12	B	SSSC	13	B	SSSC	12	B
9	Safeway Dwy/Davies Rd	RAB	6	A	RAB	5	A	RAB	5	A	RAB	<10	A
10	SR 9/4th St On-Ramp	SSSC	8	A	SSSC	1[b]	A[b]	SSSC	8	A	Uncontrolled	n/a	n/a
11	Transit Center Dwy/4th St	SSSC	16	C	SSSC	14	B	SSSC	17	C	SSSC	<10	A
12	Transit Center Dwy/Market Pl	SSSC	39	E	SSSC	<15	B	SSSC	9	A	SSSC	11	B
13	91st Ave/Market Pl	Signal	18	B	Signal	21	C	Signal	36	C	Signal	17	B
14	Lundeen Pkwy/Vernon Rd	SSSC	13	B	SSSC	13	B	SSSC	14	B	SSSC	14	B
15	Vernon Rd/Davies Rd	RAB	12	B	RAB	6	A	RAB	10	A	RAB	6	A

a. SSSC = side-street stop controlled
RAB = roundabout
n/a = Intersection not applicable under this alternative
Uncontrolled = Intersection is uncontrolled under this alternative and therefore does not experience control delay

b. This represents intersection operations at 92nd/4th St

TABLE 5-3 INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2040 AM PEAK HOUR

		No Build			Tight Diamond			At-Grade Widening			At-Grade Roundabouts		
ID	Location	Control[a]	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	25	C	Signal	30	C	Signal	23	C	Signal	25	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	RAB	7	A
3	SR 9/SR 204	Signal	36	D	Signal	34	C	Signal	34	C	RAB	10	B
4	SR 9/Market Pl	Signal	30	C	Signal	27	C	Signal	21	C	Signal	30	C
5	91st Ave/SR 204	Signal	27	C	Signal	29	C	Signal	26	C	Signal	27	C
6	Lundeen Pkwy/Market Pl/SR 204	Signal	15	B	Signal	14	B	Signal	15	B	Signal	15	B
7	Vernon Rd/7th Pl	SSSC	8	A	SSSC	6	A	SSSC	8	A	n/a	n/a	n/a
8	91st Ave/Vernon Rd	SSSC	30	D	SSSC	8	A	SSSC	10	B	SSSC	1	A
9	Safeway Dwy/Davies Rd	RAB	1	A	RAB	2	A	RAB	1	A	RAB	1	A
10	SR 9/4th St On-Ramp	SSSC	8	A	SSSC	1[b]	A[b]	SSSC	8	A	Uncontrolled	n/a	n/a
11	Transit Center Dwy/4th St	SSSC	20	C	SSSC	17	C	SSSC	20	C	SSSC	11	B
12	Transit Center Dwy/Market Pl	SSSC	6	A	SSSC	7	A	SSSC	6	A	SSSC	6	A
13	91st Ave/Market Pl	Signal	9	A	Signal	9	A	Signal	16	B	Signal	9	A
14	Lundeen Pkwy/Vernon Rd	SSSC	9	A	SSSC	9	A	SSSC	9	A	SSSC	9	A
15	Vernon Rd/Davies Rd	RAB	2	A	RAB	2	A	RAB	2	A	RAB	4	A

a. SSSC = side-street stop controlled
RAB = roundabout
n/a = Intersection not applicable under this alternative
Uncontrolled = Intersection is uncontrolled under this alternative and therefore does not experience control delay
b. This represents intersection operations at 92nd/4th St

5.2.2.3 4th Access Management

Access Management changes associated with the At-Grade Roundabout (new Preferred Alternative) are detailed in the *SR 9/SR 204 Interchange Improvements Limited Access Report* (WSDOT).

5.2.2.4 Emergency Services

Access through the roadway network improves compared to existing conditions under all Build Alternatives due to reduced delay compared to No Build. All three alternatives include a new access point from northbound SR 9 to 4th Street NE that may shorten driving distances as vehicles do not have to enter through the SR 9/SR 204 intersection into Frontier Village. Under the At-Grade Roundabouts option, the additional connection across SR 9 at Davies Road could also shorten travel times.

5.2.3 Travel Time Analysis

This section documents travel time analysis results for each proposed alternative compared to the 2040 No Build. Travel times are reported from Vissim and Sidra as described in **Section 3.4.2.2.** The transit travel times are an average of the transit vehicles travel through the network over the analysis hour. The detailed methods used to simulate and calculate travel time are documented in the TIDR.

Automobile travel times between points on the regional network (SR 9 and SR 204) are summarized and compared to No Build in **Table 5-4**. The major findings are summarized below:

- The Tight Diamond provides the greatest benefit to through trips on SR 9 due to the grade separation. Moderate changes in travel time are shown for the remaining routes.
- The At-Grade Widening Alternative provides the greatest benefit to southbound SR 9 trips and northbound SR 9 to westbound SR 204 trips due to increases in capacity at the SR 9/Market Place and SR 9/SR 204 intersections.
- The At-Grade Roundabouts Alternative increases the travel time for the eastbound SR 204 to northbound SR 9 major commute movement. This increase is expected due to the addition of a new controlled intersection at SR 9/Davies that is not present in the other alternatives.

TABLE 5-4. AUTO TRAVEL TIME RESULTS ON REGIONAL FACILITIES (IN MINUTES) – 2040 PM PEAK HOUR

#	Route	No Build	Difference Compared to No Build		
			Tight Diamond	At-Grade Widening	At-Grade Roundabouts
SR 9 between North of Lundeen Parkway and south of Market Place					
1	Northbound (Major movement)	4.3	-1.4	-0.8	-0.2
2	Southbound (Major movement)	5.9	-3.0	-2.6	-0.9
SR 9 and SR 204 between North of Lundeen Parkway and west of Market Place/Lundeen Parkway					
3	Eastbound to northbound (Major movement)	3.5	+0.4	-0.1	+1.3
4	Southbound to westbound (Minor movement)	3.9	+0.2	-0.1	-0.6
SR 9 and SR 204 between South of Market Place and west of Market Place/Lundeen Parkway					
5	Northbound to westbound (Minor movement)	5.0	-0.2	-1.8	-0.1
6	Eastbound to southbound (Minor movement)	3.1	-0.3	-0.8	+0.3

Results averaged from Vissim model output for 2040 PM peak hours conditions.

5.2.4 Transit

The potential impacts and benefits to study area transit routes were evaluated by comparing average route travel times under No Build and Build Alternatives conditions. Transit travel times were evaluated using the Vissim model developed for each alternative under the 2040 PM conditions. The transit travel times are an average of the transit vehicles travel through the network over the analysis hour. Analysis results are summarized in **Table 5-5**.

In 2040, all Build Alternatives will improve most travel times for transit routes within the study area. One notable exception is the Route 209 northbound under the Tight Diamond alternative. Under this configuration, buses travel onto the SR 9 northbound off-ramp and then must travel through the grade-separated interchange intersection to return to SR 9. Because of this extra travel, travel times are forecasted as 2.2 minutes longer than the No Build conditions.

TABLE 5-5. TRANSIT TRAVEL TIME RESULTS ON REGIONAL FACILITIES (IN MINUTES) – 2040 PM PEAK HOUR

#	Route	No Build	Difference Compared to No Build		
			Tight Diamond	At-Grade Widening	At-Grade Roundabouts
Route 109					
1	Northbound	2.2	-1.1	-1.0	-1.0
2	Southbound	6.6	-1.2	-1.4	-1.4
Route 209					
3	Northbound	4.3	+2.2	+0.2	-1.0
4	Southbound	9.9	-2.2	-3.5	-4.4
Route 280					
5	Northbound	12.3	+0.1	-1.1	-1.3
6	Southbound	17.0	-2.7	-4.3	-5.2
Route 425 (Peak Direction Express Service)					
7	Northbound (from Seattle)	6.6	-1.5	0	0

5.3 2021 OPERATIONS

Traffic operations in the 2021 year of opening were analyzed to understand potential traffic conditions under the Build Alternatives compared to the No Build Alternative. Detailed operational outputs from Vissim and SIDRA, including intersection delay/LOS, approach delay/LOS, and queuing, are included in **Appendix B**. The following sections provide a summary of intersections level delay and LOS results.

5.3.1 No Build Alternative

5.3.1.1 Future Network

The 2021 No Build Alternative was evaluated using the same project transportation network assumptions as the existing conditions analysis. The vehicle volume input and routing were updated to reflect forecasted vehicle demand through the study area (described in **Section 3**).

5.3.1.2 Level of Service and Delay

The 2021 No Build intersection operations for the AM and PM peak hours are summarized in **Table 5-6**. Under AM peak hour conditions, delay would increase in some locations compared to existing conditions,

but all intersections would continue to operate at an overall LOS of C or better. Under PM peak hour conditions, overall delay is similar or in some cases reduced due to optimized signal timing.

TABLE 5-6. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2021 NO BUILD

ID	Location	Control[a]	AM Peak Hour				PM Peak Hour			
			Existing		2021 No Build		Existing		2021 No Build	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	21	C	26	C	30	C	31	C
2	SR 9/Vernon Rd Off-Ramp	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	SR 9/SR 204	Signal	21	C	28	C	34	C	30	C
4	SR 9/Market Pl	Signal	21	C	28	C	48	D	49	D
5	91st Ave/SR 204	Signal	17	B	19	B	49	D	35	C
6	Lundeen Pkwy/Market Pl/SR 204	Signal	13	B	14	B	22	C	21	C
7	Vernon Rd/7th Pl	SSSC	8	A	8	A	11	B	12	B
8	91st Ave/Vernon Rd	SSSC	10	B	10	B	13	B	13	B
9	Safeway Dwy/Davies Rd	RAB	1	A	1	A	4	A	4	a
10	SR 9/4th St On-Ramp	SSSC	8	A	8	A	8	A	8	A
11	Transit Center Dwy/4th St	SSSC	20	C	10	B	17	C	17	C
12	Transit Center Dwy/Market Pl	SSSC	6	A	6	A	27	D	14	B
13	91st Ave/Market Pl	Signal	7	A	8	A	13	B	15	B
14	Lundeen Pkwy/Vernon Rd	SSSC	8	A	8	A	12	B	12	B
15	Vernon Rd/Davies Rd	RAB	1	A	1	A	6	A	7	A

a. SSSC = side-street stop controlled
RAB = roundabout
n/a = Location operates as an uncontrolled diverging ramp. This location does not create control delay from any approach.

5.3.2 Build Alternatives

5.3.2.1 Alternative Concepts

An overview of the Build Alternatives analyzed for potential effects under 2021 PM peak hour conditions is provided above in **Section 2.4**.

5.3.2.2 Level of Service and Delay

2021 PM Peak hour delay and LOS results are summarized in **Table 5-7**. Results for the AM peak hour analysis are summarized in **Table 5-8**. For 2021 PM, delay is similar between No Build and each Build Alternative. All intersections operate at LOS D or better, within the LOS standards. For 2021 AM, all intersections operate at LOS C or better.

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TABLE 5-7. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2021 PM PEAK HOUR

		No Build			Previously Preferred Alternative (Modified E2B V4)			At-Grade Widening			At-Grade Roundabouts		
ID	Location	Control[a]	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	31	C	Signal	32	C	Signal	29	C	Signal	27	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	RAB	10	B
3	SR 9/SR 204	Signal	30	C	Signal	34	C	Signal	29	C	RAB	13	B
4	SR 9/Market Pl	Signal	49	D	Signal	33	C	Signal	27	C	Signal	33	C
5	91st Ave/SR 204	Signal	35	C	Signal	42	D	Signal	38	D	Signal	42	D
6	Lundeen Pkwy/Market Pl/SR 204	Signal	21	C	Signal	21	C	Signal	21	C	Signal	21	C
7	Vernon Rd/7th Pl	SSSC	12	B	SSSC	7	A	SSSC	12	B	n/a	n/a	n/a
8	91st Ave/Vernon Rd	SSSC	13	B	SSSC	11	B	SSSC	14	B	SSSC	7	A
9	Safeway Dwy/Davies Rd	RAB	4	a	RAB	3	A	RAB	4	A	RAB	6	A
10	SR 9/4th St On-Ramp	SSSC	8	A	SSSC	1[b]	A[b]	SSSC	8	A	Uncontrolled	n/a	n/a
11	Transit Center Dwy/4th St	SSSC	17	C	SSSC	15	B	SSSC	17	C	SSSC	<10	A
12	Transit Center Dwy/Market Pl	SSSC	14	B	SSSC	9	A	SSSC	8	A	SSSC	9	A
13	91st Ave/Market Pl	Signal	15	B	Signal	15	B	Signal	25	C	Signal	13	B
14	Lundeen Pkwy/Vernon Rd	SSSC	12	B	SSSC	11	B	SSSC	12	B	SSSC	12	B
15	Vernon Rd/Davies Rd	RAB	7	A	RAB	3	A	RAB	7	A	RAB	6	A

a. SSSC = side-street stop controlled
RAB = roundabout
n/a = Intersection not applicable under this alternative
Uncontrolled = Intersection is uncontrolled under this alternative and therefore does not experience control delay

b. This represents intersection operations at 92nd/4th St

TABLE 5-8. INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS – 2021 AM PEAK HOUR

		No Build			Previously Preferred Alternative (Modified E2B V4)			At-Grade Widening			At-Grade Roundabouts		
ID	Location	Control[a]	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS	Control	Delay	LOS
1	SR 9/Lundeen Pkwy	Signal	26	C	Signal	25	C	Signal	23	C	Signal	25	C
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	Uncontrolled	n/a	n/a	RAB	6	A
3	SR 9/SR 204	Signal	28	C	Signal	30	C	Signal	27	C	RAB	5	A
4	SR 9/Market Pl	Signal	28	C	Signal	19	B	Signal	18	B	Signal	23	C
5	91st Ave/SR 204	Signal	19	B	Signal	18	B	Signal	23	C	Signal	19	B
6	Lundeen Pkwy/Market Pl/SR 204	Signal	14	B	Signal	14	B	Signal	14	B	Signal	16	B
7	Vernon Rd/7th Pl	SSSC	8	A	SSSC	5	A	SSSC	7	A	n/a	n/a	n/a
8	91st Ave/Vernon Rd	SSSC	10	B	SSSC	7	A	SSSC	<10	A	SSSC	2	A
9	Safeway Dwy/Davies Rd	RAB	1	A	RAB	1	A	RAB	1	A	RAB	1	A
10	SR 9/4th St On-Ramp	SSSC	8	A	SSSC	1[b]	A[b]	SSSC	8	A	Uncontrolled	n/a	n/a
11	Transit Center Dwy/4th St	SSSC	10	B	SSSC	19	C	SSSC	10	B	SSSC	12	B
12	Transit Center Dwy/Market Pl	SSSC	6	A	SSSC	6	A	SSSC	6	A	SSSC	6	A
13	91st Ave/Market Pl	Signal	8	A	Signal	7	A	Signal	13	B	Signal	8	A
14	Lundeen Pkwy/Vernon Rd	SSSC	8	A	SSSC	8	A	SSSC	8	A	SSSC	9	A
15	Vernon Rd/Davies Rd	RAB	1	A	RAB	1	A	RAB	1	A	RAB	4	A

a. SSSC = side-street stop controlled
RAB = roundabout
n/a = Intersection not applicable under this alternative
Uncontrolled = Intersection is uncontrolled under this alternative and therefore does not experience control delay

b. This represents intersection operations at 92nd/4th St

5.4 COLLISION ANALYSIS

This section describes the result of the vehicle collision analysis for Alternative Concepts under 2040 traffic conditions. The Highway Safety Manual's predictive methodology was applied to the study area in order to estimate the collision rate in the study area.

5.4.1 Results

All roadway geometries were assumed to follow WSDOT standards. Roadway information was entered into the HSM spreadsheet for urban and suburban arterials and the ISAT spreadsheet for freeway-like facilities for comparison with forecasted No Build conditions in 2040. The analysis is a combination of two separate tools specific to arterial or freeway-like conditions. Detailed HSM and ISAT results are provided in **Appendix I**. **Table 5-9** provides a summary of the predicted average crash frequency calculated for each alternative, including the predicted collisions rates for all intersections and segments for each alternative. The segments correspond to those listed previously in Section 4.3.3 and include any new segments or intersections as a part of the alternatives. **Table 5-10** provides a summary of the predicted average crash frequency for each 2040 alternative broken down for segments and intersections and compares each 2040 alternative to No Build.

The Tight Diamond Alternative includes a reconfiguration of the SR 9/4th Street NE Slip Ramp, where the 4th Street NE Slip Ramp is now an off-ramp from SR 9 to 4th Street NE.

The Roundabout Alternative includes a reconfiguration of the SR 9/4th Street NE Slip Ramp intersection, under this alternative there is an added off ramp to 4th Street NE, as well as the existing slip on-ramp to SR 9. This alternative also includes the addition of a new intersection, SR 9/Vernon Road, previously an off-ramp, this is now a multi-lane roundabout intersection on SR 9.

TABLE 5-9. SUMMARY OF ANTICIPATED PERFORMANCE FOR EACH 2040 ALTERNATIVE

Predicted Collision Totals[a]			
Scenario	Predicted Average Crash Frequency (crash/yr)		
	All Collision Types KABCO[b]	Fatal, Serious and possible Injury KABC	Property Damage Only (PDO)
Existing	28.5	10.1	20.1
2040 No Build	36.9	12.2	24.7
2040 At-Grade Widening	37.0	12.3	24.8
2040 Tight Diamond	35.1	10.5	20.3
2040 Roundabout	37.4	12.6	24.8

a. Collision totals include intersections, segments, ramps, and merge/diverge points
b. K – Fatal
A – Incapacitating injury
B – Nonincapacitating injury
C – Possible injury
O – No injury/Property damage only

TABLE 5-10. SUMMARY OF 2040 ALTERNATIVES COMPARED TO NO BUILD AGGREGATED BY SEGMENTS & INTERSECTIONS

	No Build	At-Grade Widening		Tight Diamond		Roundabout	
	$N_{predicted}$ (KABCO)	Percent Change from No Build	$N_{predicted}$ (KABCO)	Percent Change from No Build	$N_{predicted}$ (KABCO)	Percent Change from No Build	$N_{predicted}$ (KABCO)
Segment Sum	14.2	1.0%	14.3	2.4%	14.5	-15.0%	12.3
Intersection Sum	22.7	0.0%	22.7	-10.5%	20.5	9.5%	25.1
Total Sum	36.9		37.0		35.1		37.4

There is no change from No Build in predicted collision rates with the At-Grade Widening scenario. Parameters including roadway type and segment length remain unchanged since the HSM relies upon the SPF for 4-lane undivided arterials for all arterials greater than 4 lanes. In this alternative, SR 9 becomes 6 lanes north of SR 204, and 5 lanes south, which is equivalent to the No Build scenario of 4 travel lanes under HSM methodology. There is no validated research that supports a reduction in collision rates with the addition of a travel lane. Furthermore, this alternative includes no other safety improvements to any intersections or segments in the project study area.

The grade-separated Tight Diamond Interchange alternative provides the greatest safety benefit for the project study area. The total predicted collision rate for all segments increases slightly because the segments now include new grade-separated on and off ramps which are not included in the No Build and other alternatives. The total intersection predicted collision rate decreases by 11% from No Build. The greatest reduction in predicted collisions occurs at the SR 9/SR 204 intersection, which is expected to see a reduction of 41% in the total predicted collision rate from No Build. This decrease is due to the grade that eliminates conflicting movements with the SR 9 through traffic. Fatal/injury collisions (KABC) are reduced even further; the predicted collision rate for fatal/injury collisions is expected to decrease by 84% from No Build.

Under the Roundabout Intersections alternative, the total predicted collision rate for segments decreases, while the total predicted collision rate for intersections increases, resulting in the total predicted collision rate for the alternative higher than No Build. Collision rates decrease along the study segments because volumes are shifted off SR 9 with the addition of a north/south route along Vernon Road facilitated by the new SR 9/Vernon Road roundabout. Collision rates at intersection are expected to increase due to the addition of the SR 9/Vernon Road intersection, which is a new intersection across SR 9 where the intersection was previously an off-ramp to Vernon Road from SR 9. While the intersection collision rate is expected to increase overall, the predicted collision rate for the intersection of SR 9/SR 204 decreases by 15% from No Build. The predicted fatal/injury (KABC) collision rate also decreases by 18% from No Build at SR 9/SR 204 under the roundabout alternative.

The results in **Table 5-9** and **Table 5-10** suggest the At-Grade Widening alternative is equivalent to No Build, as it provides no safety improvements to the project study area. The Tight Diamond interchange alternative is expected to have the greatest reduction in collision rate due to the grade separation of turning movements at the SR 9/SR 204 intersection reducing the volume crossing and conflicting with the SR 9 through volumes. The Roundabout alternative could have a higher potential for collisions as compared with the No Build. However, this higher potential is mainly due to additional intersections associated with this alternative. Focusing on the SR 9/SR 204 intersection, the Roundabout alternative has a 15% reduction in predicted collision rates compared to No Build.

5.5 WALKING AND BIKING FACILITIES

As the study area is expected to transition into more of a mixed-use center in the future, walking and biking accommodations (i.e. non-motorized infrastructure) will be essential to improving community connectivity and enhancing vitality. This section describes the walking and biking improvements provided with each Alternative Concept and assesses the relative improvement over the No Build condition.

5.5.1 Future Network

The No Build condition assumes no improvements to the walking or biking networks. However, improvements would be included in each of the Build Alternatives. Walking and biking improvements specific to each Build Alternative are described below:

- The **Tight Diamond Alternative** includes several changes at the SR 9/SR 204 intersection. Only the crossing of SR 9 on the south side of the intersection is retained due to the lack of pedestrian infrastructure and destinations on the north side of the intersection (the bus stop is moved to the south side of the intersection). New sidewalks on SR 204 from 91st Avenue to SR 9 would provide opportunities to travel north of SR 204. The Tight Diamond configuration would allow pedestrians to cross each interchange ramp separately. This configuration may be more comfortable for pedestrians as opposed to crossing 6 lanes at once under the current configuration but could cause longer travel times if pedestrians have to wait for a pedestrian phase at each ramp.
- The **At-Grade Widening Alternative** would be similar to the Tight Diamond Alternative, but pedestrians would need to cross eight lanes of traffic at once on SR 9. This may feel unsafe to some pedestrians and could cause long phase timing to allow for a safe crossing.
- The **At-Grade Roundabouts Alternative** makes several changes to the pedestrian and bike infrastructure across SR 9. Crosswalks with Rectangular Rapid Flash Beacons (RRFBs) would be provided on the south side of each SR 9 roundabout. The new crossing at the SR 9/Davies roundabout allows for much less out of direction travel for origins and destinations north of SR 204. New sidewalks on either side of SR 9 and Vernon Road from SR 204 to Davies Road provide new connections for non-motorized travel. New sidewalk on the east side of 92nd Avenue would also be provided between 4th Street NE and 7th Place NE, as well as on the south side of SR204 between 91st Avenue and SR9, further increasing neighborhood connectivity.

5.5.2 Results

The impacts and benefits to walking and biking travel related to each of the alternatives described in the prior section are summarized in **Table 5-11**. The No Build Alternative serves as the baseline alternative to compare all Build Alternatives.

The table includes two different categories by which each alternative was evaluated: non-motorized connectivity and potential for conflicts.

- Non-motorized connectivity: evaluates each alternative on whether it improves, degrades or does not change the non-motorized network by adding new facilities or improving connections.
- Potential for conflicts: whether the alternative increases, decreases, or does not change the number of potential conflict points between vehicles, pedestrians, and bicycles.

TABLE 5-11. NON-MOTORIZED NETWORK SUMMARY

Alternative	Non-motorized connectivity ++ = improves both pedestrian and bicycle connection + = improves pedestrian or bicycle connection 0 = stays the same - = degrades	Potential for conflicts + = decreases 0 = does not change - = increases
No Build		
Tight Diamond	+	+
At-Grade Widening	+	0
At-Grade Roundabouts	+	+

As shown in **Table 5-9**, the Tight Diamond and At-Grade Roundabouts Alternatives rank the highest because they do the most to improve non-motorized connectivity in the study area and decrease the potential for conflicts. While removal of the crosswalk on the north side of the SR 9/SR 204 intersection may seem counterintuitive, this can simplify the signal timing and can more efficiently serve vehicles through the intersection. In addition, the relocation of the transit stop to the south side of SR 204 means there is little reason for a pedestrian to be on the north side of SR 204. The At-Grade Widening Alternative ranks lower due to the pedestrian experience of crossing eight lanes of traffic at once.

5.6 TRANSPORTATION SYSTEM MANAGEMENT STRATEGIES

Transportation system management strategies are discussed in **Section 5** of the TIDR.

5.7 TEMPORARY CONSTRUCTION EFFECTS AND BENEFITS

Project construction will affect the transportation system in the form of temporary closures and construction vehicles traveling on the roadways. The project will be constructed and staged to minimize the effects whenever possible. The project team will coordinate with local agencies, stakeholders, and the project teams for relevant, nearby projects to prepare a Maintenance of Traffic Plan prior to making any changes to the traffic flow or allowing lane closure

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SECTION 6. APPENDIX

Appendix A. 2040 and 2021 Turning Movement Figures and Lane Configurations

Appendix B. Vissim and SIDRA Model Output Reports

Appendix C. STIDR Safety Analysis

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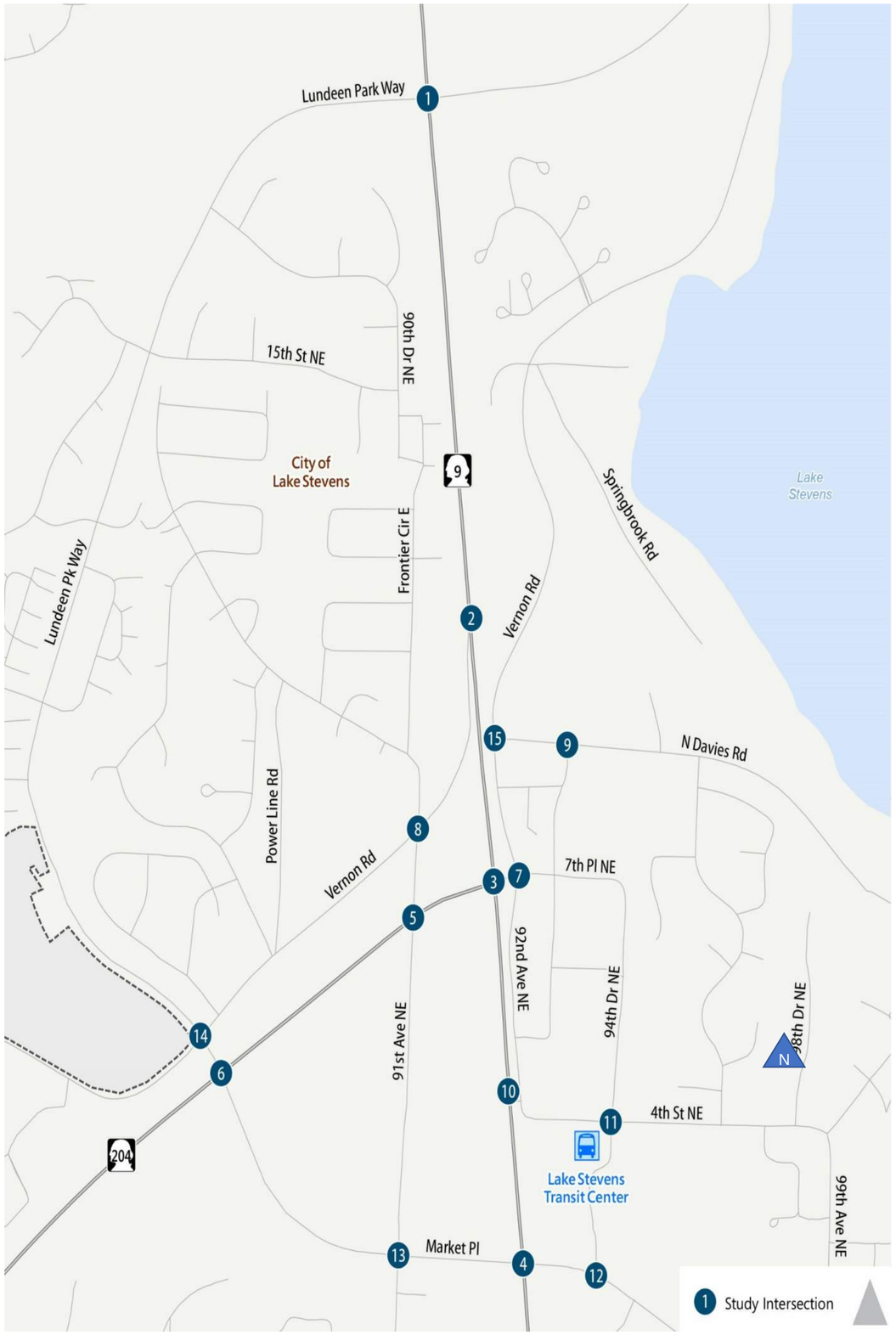
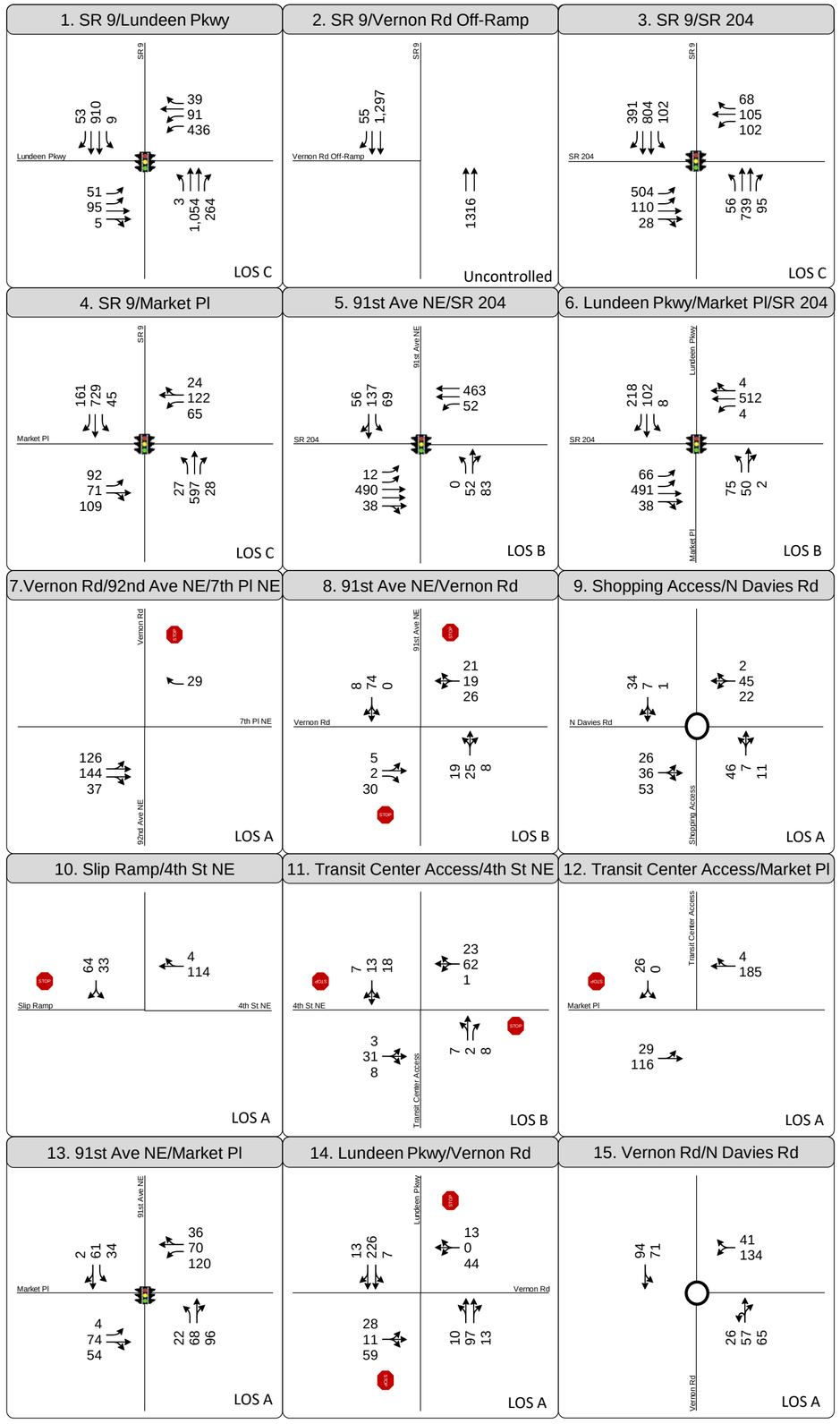
APPENDIX A. 2040 AND 2021 TURNING MOVEMENT FIGURES AND LANE CONFIGURATIONS

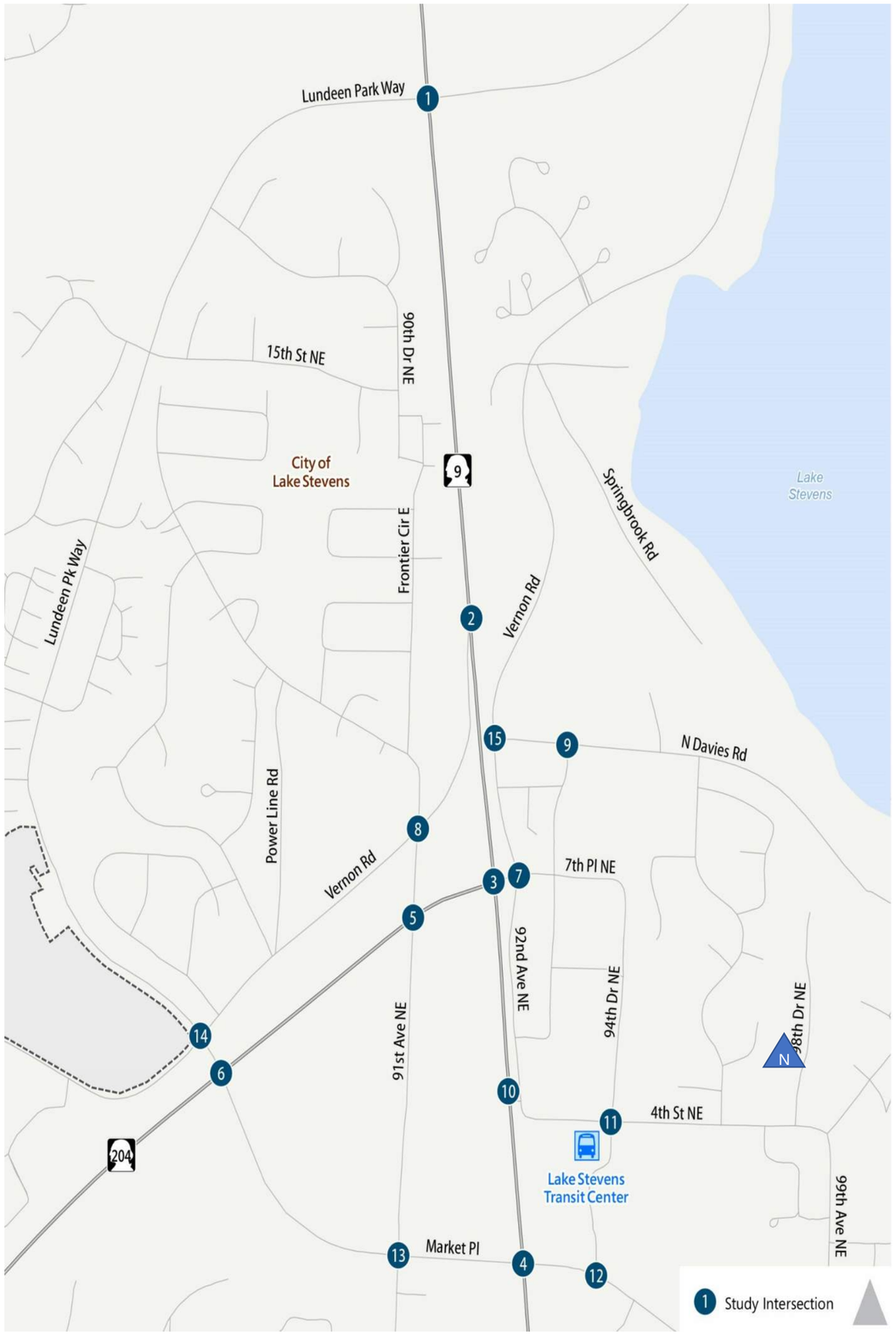
October 2019

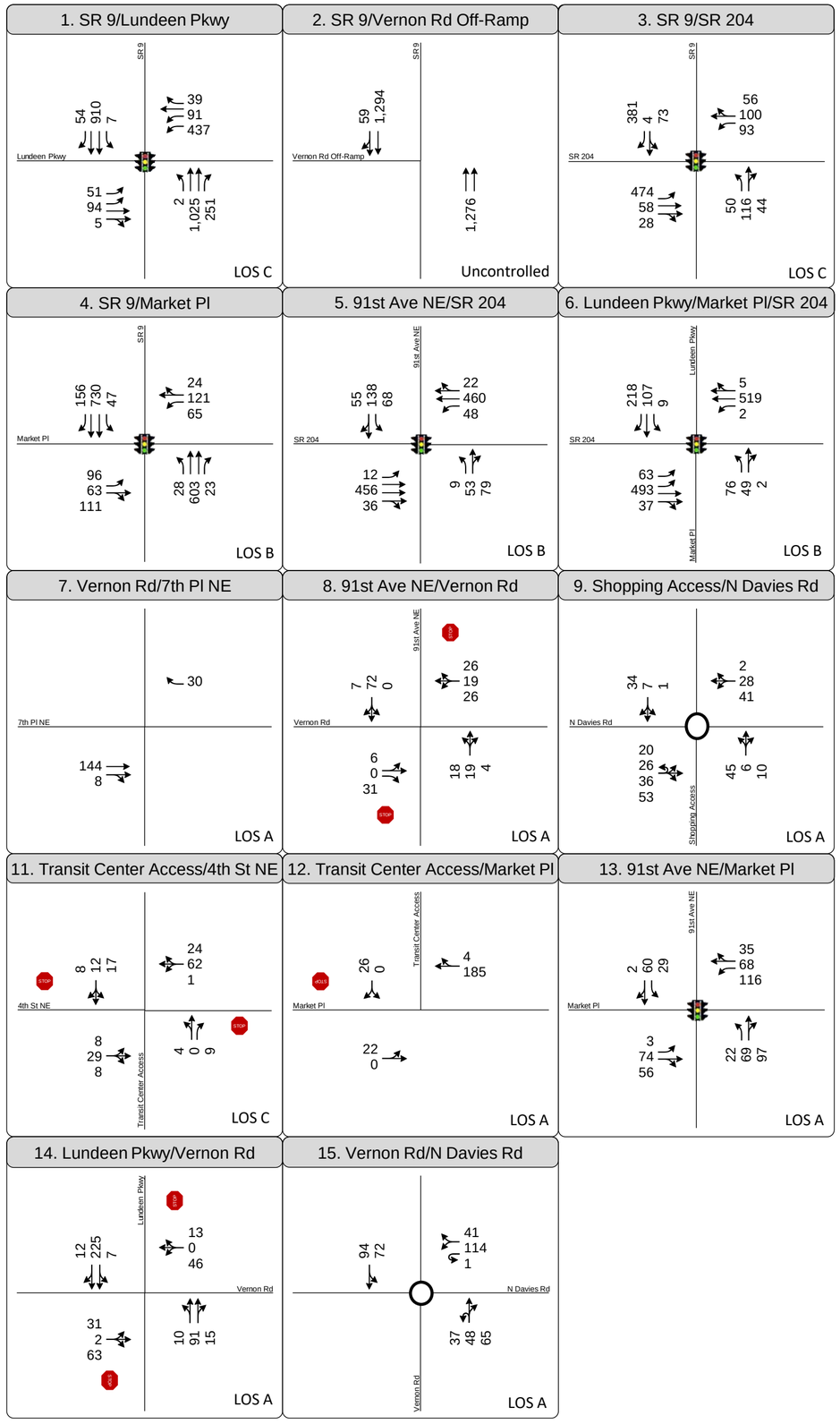
2021 AM



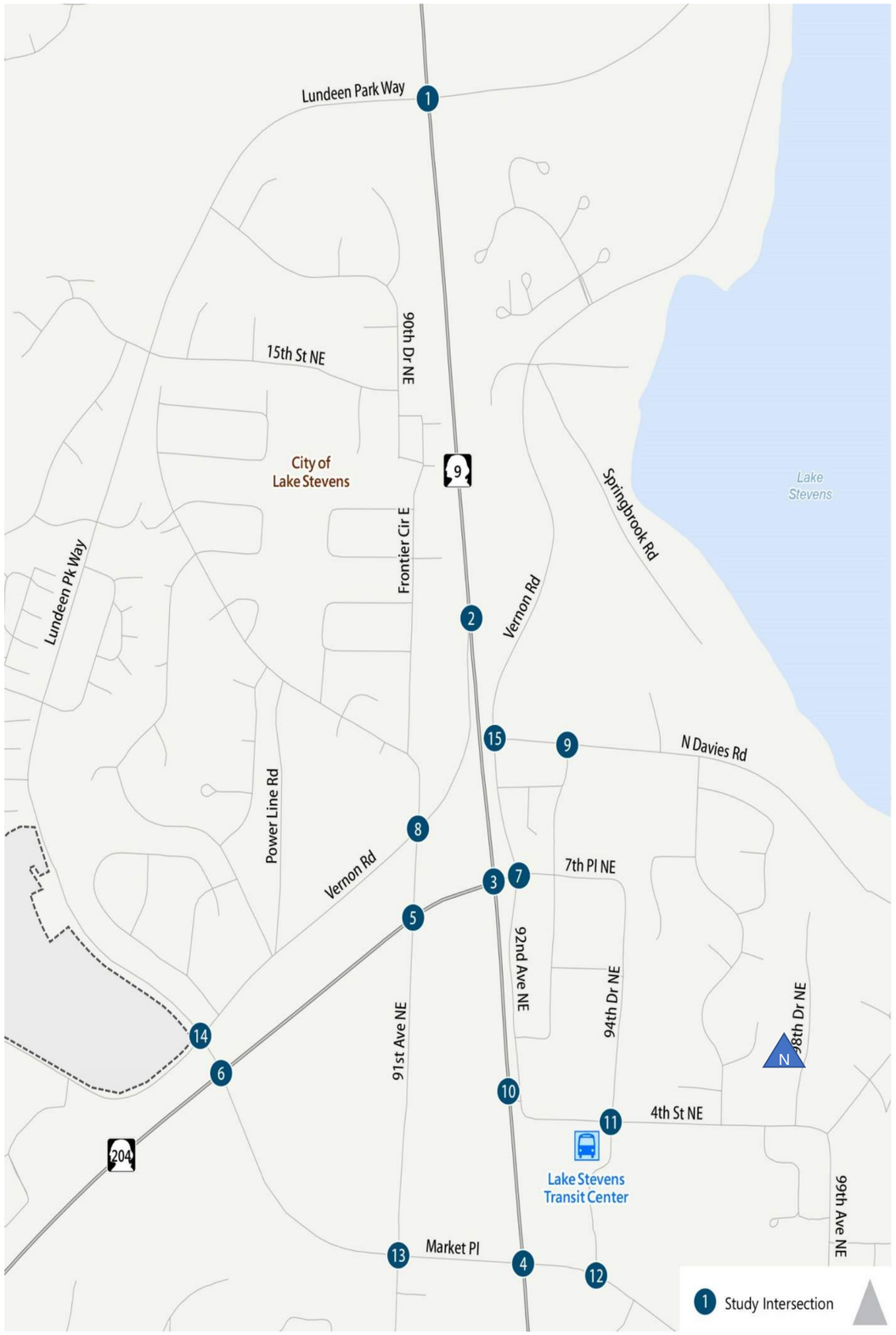


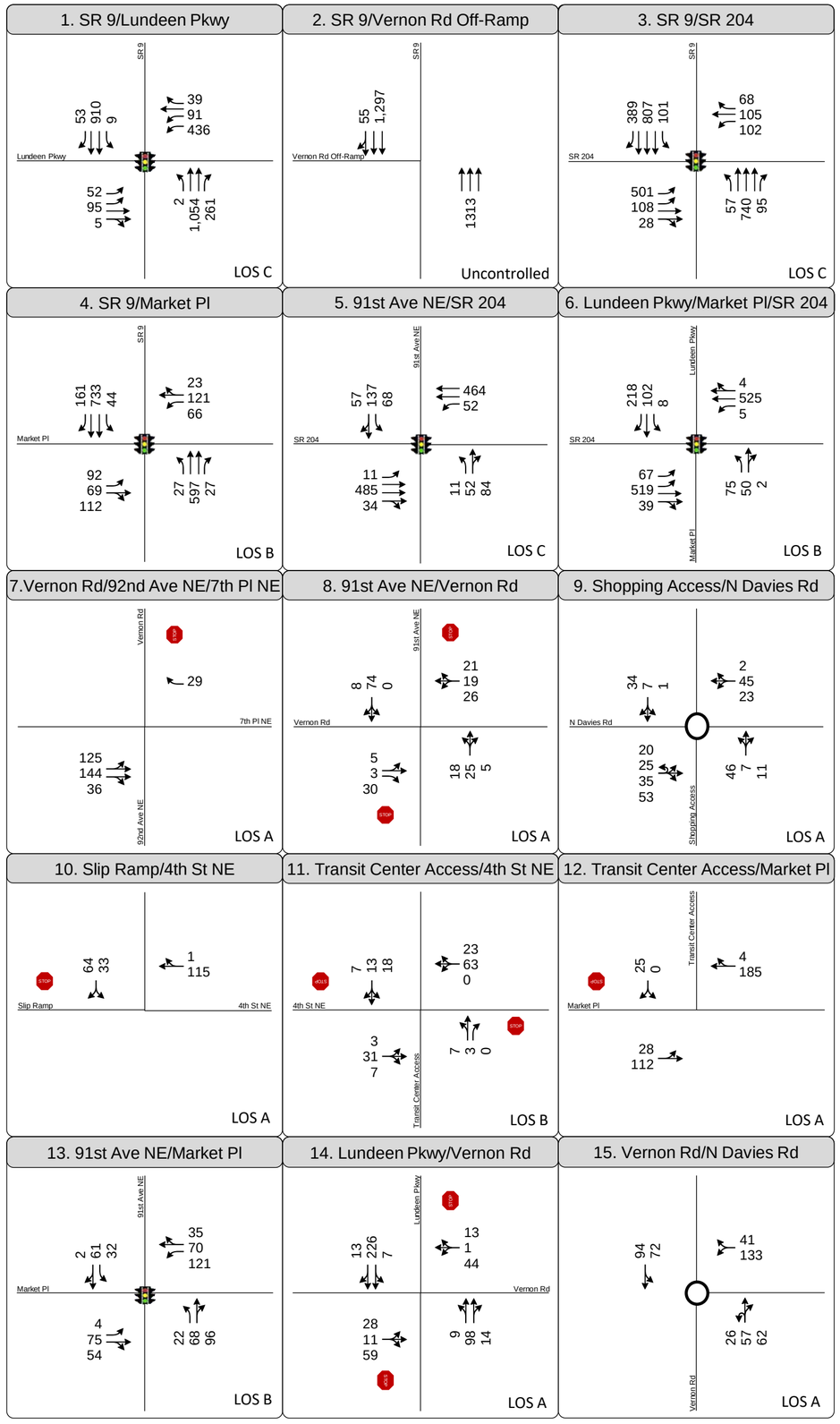
Traffic Volumes and Lane Geometry
2021 No Build Alternative- AM Peak Hour



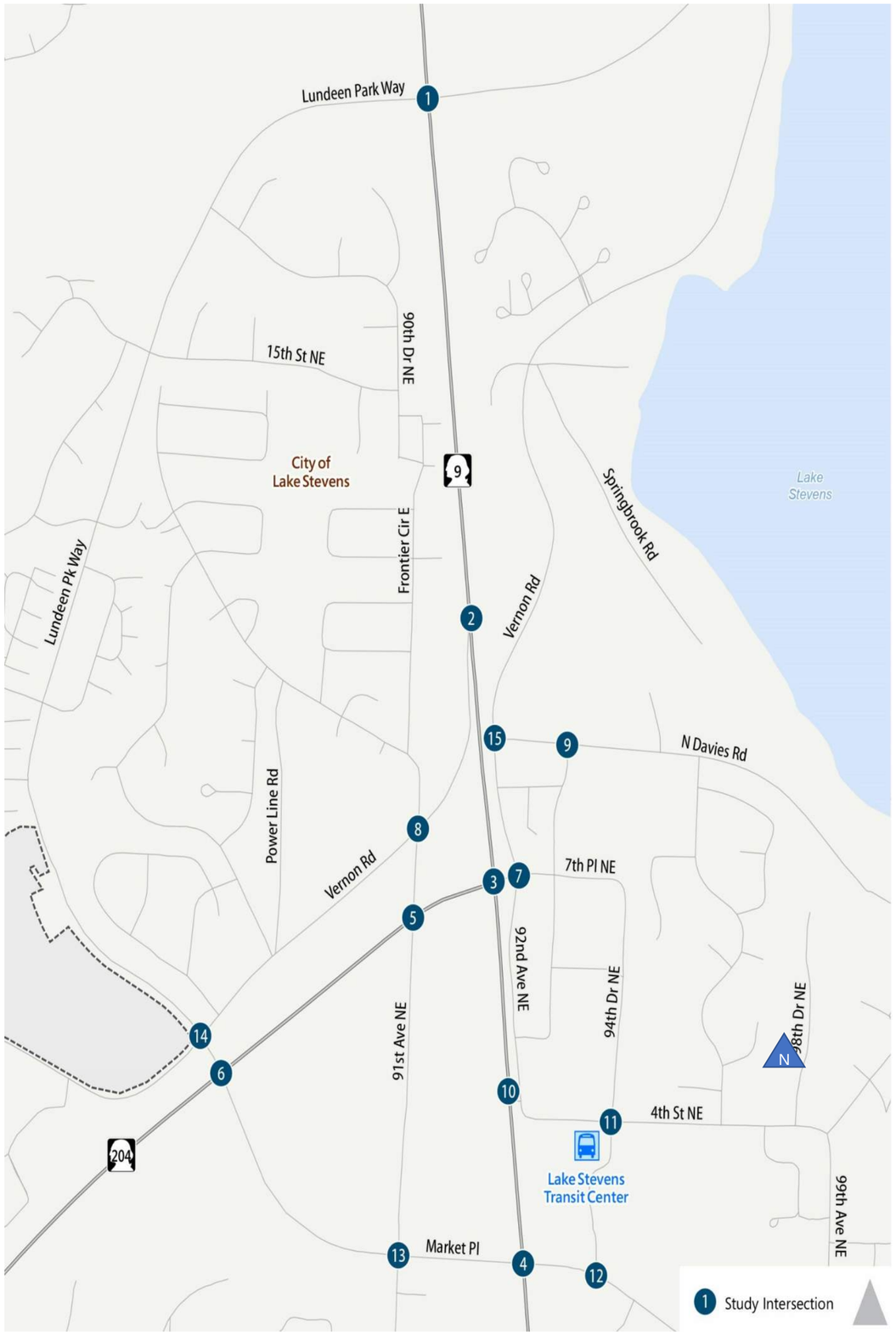


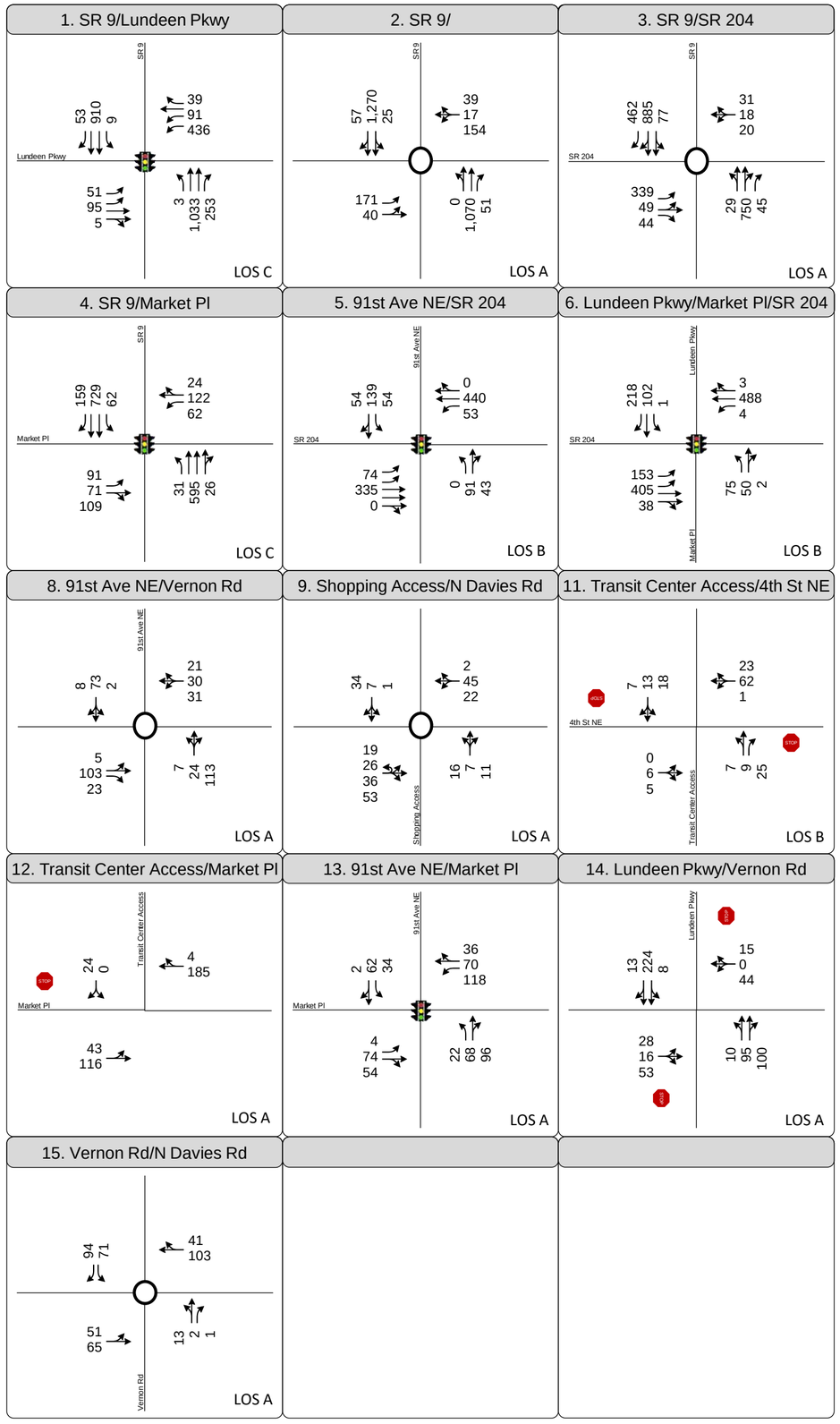
Traffic Volumes and Lane Geometry
2021 **Previously** Preferred Alternative- AM





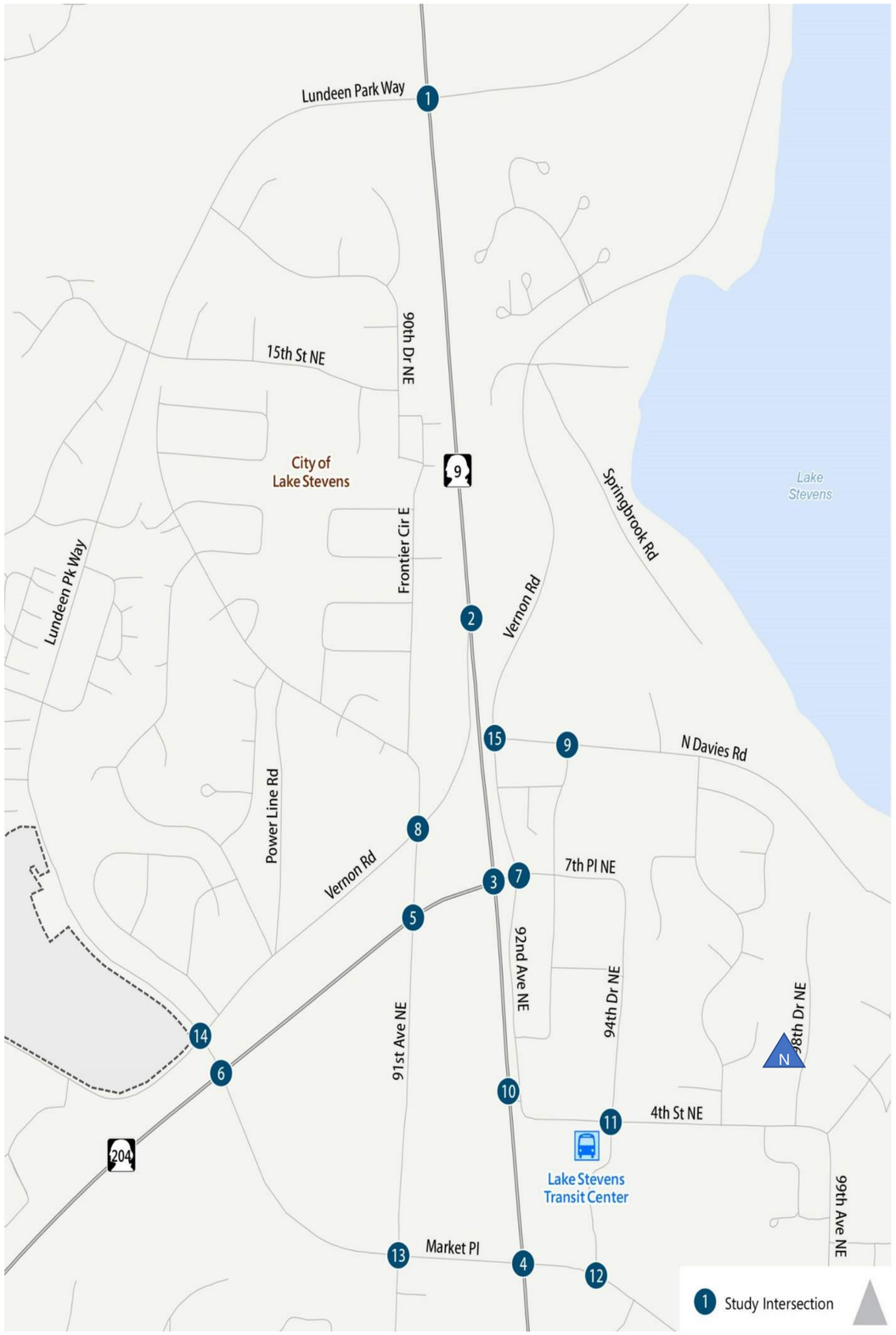
Traffic Volumes and Lane Geometry
2021 At Grade Alternative - AM Peak Hour

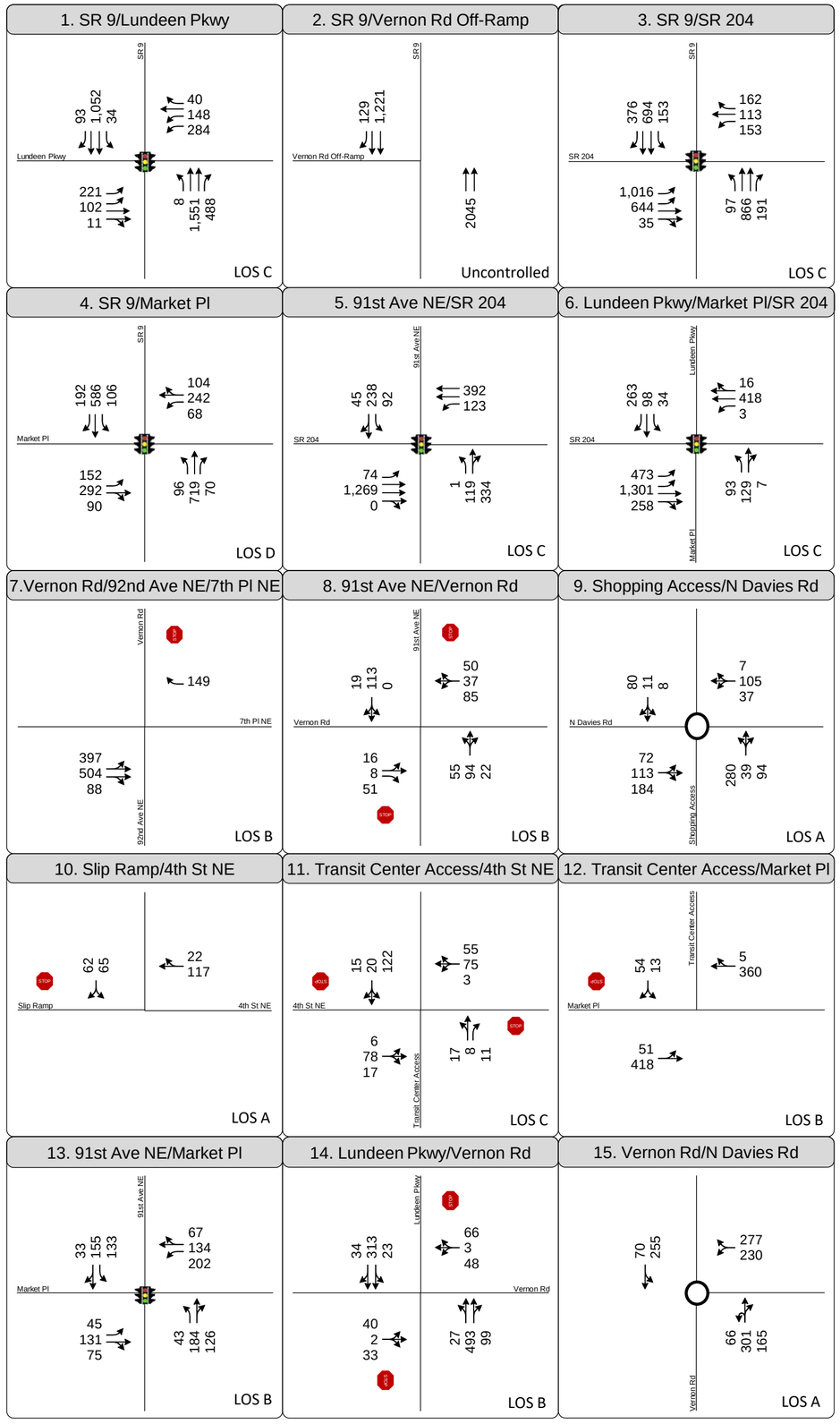




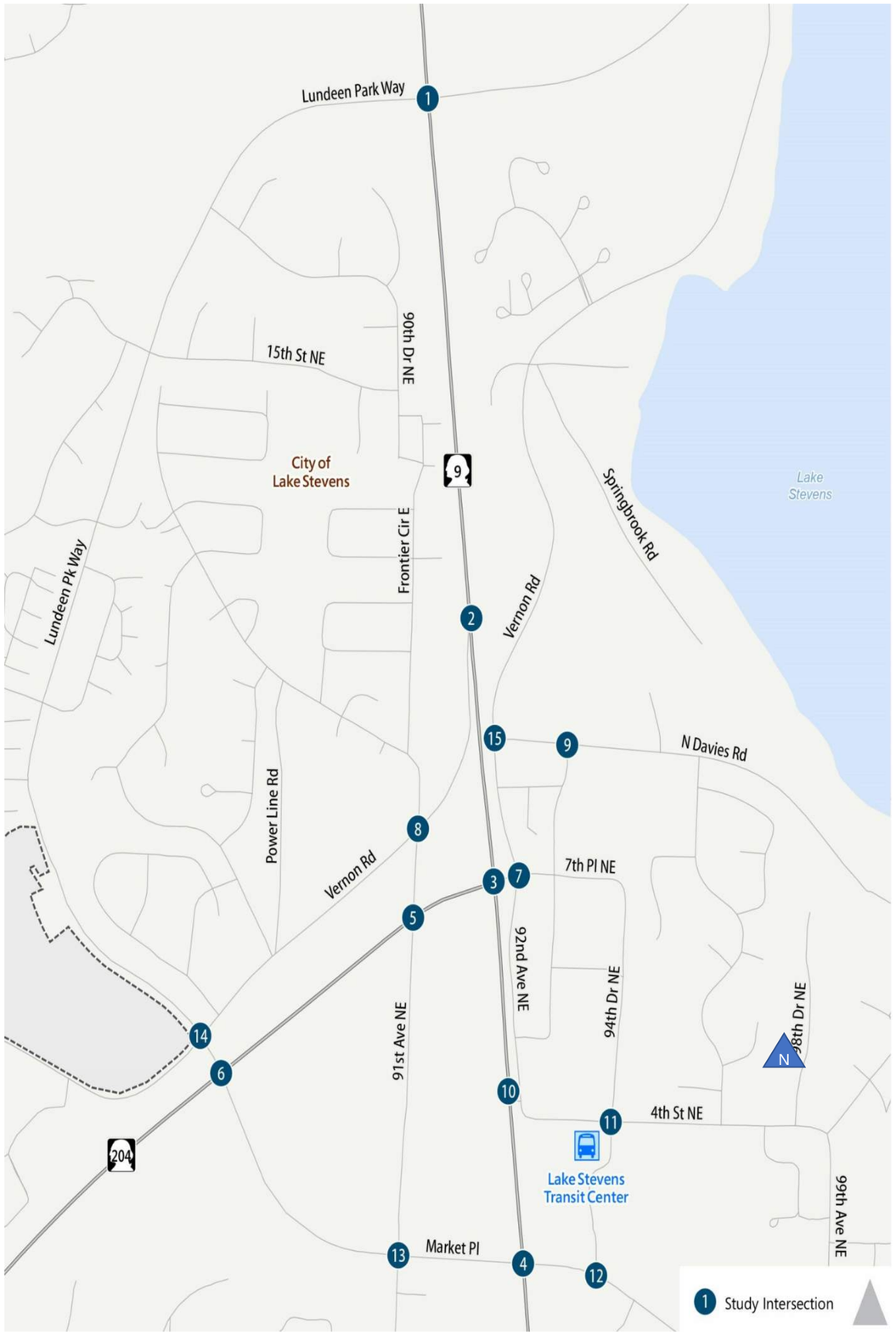
Traffic Volumes and Lane Geometry
2021 Roundabout Alternative - AM Peak Hour

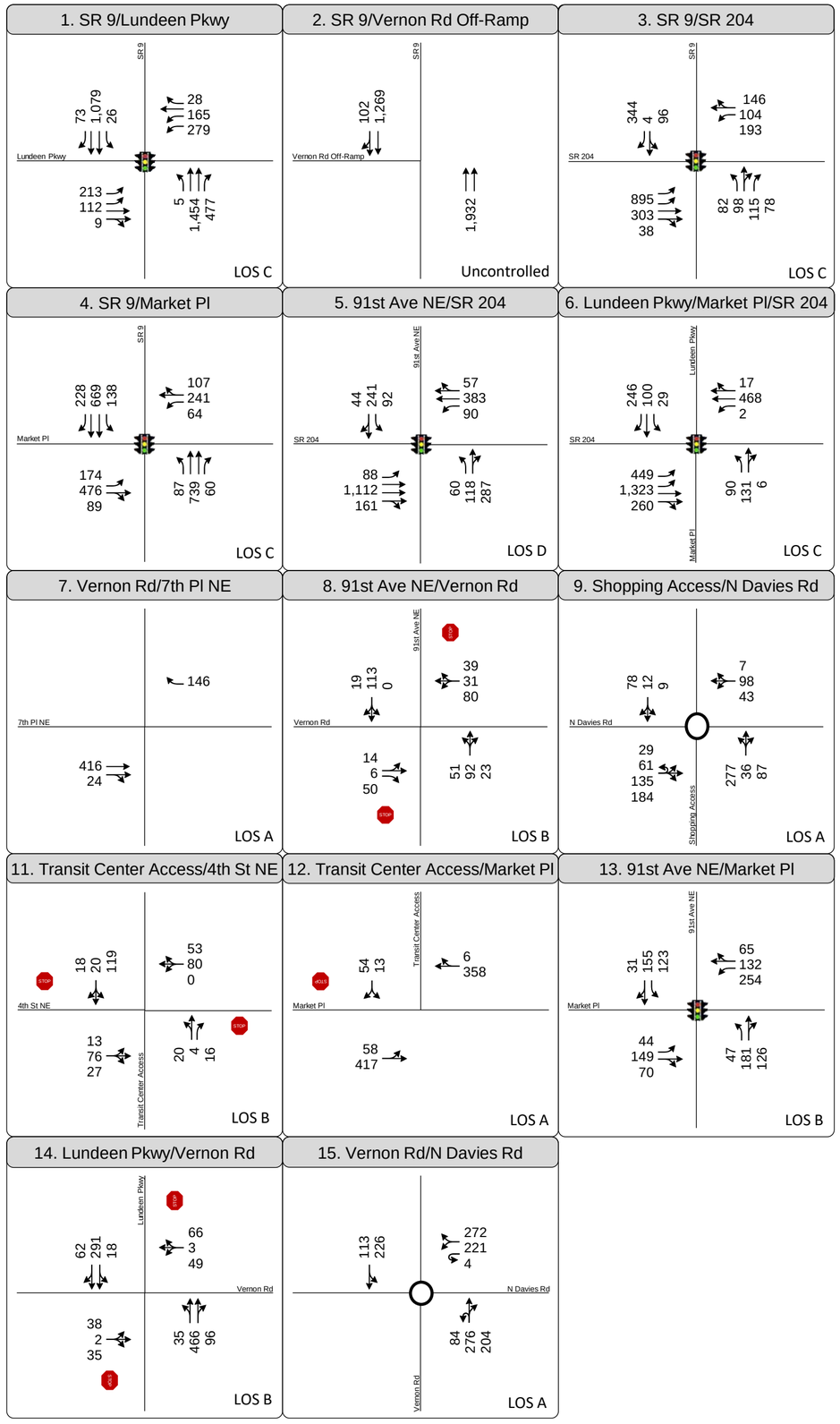
2021 PM





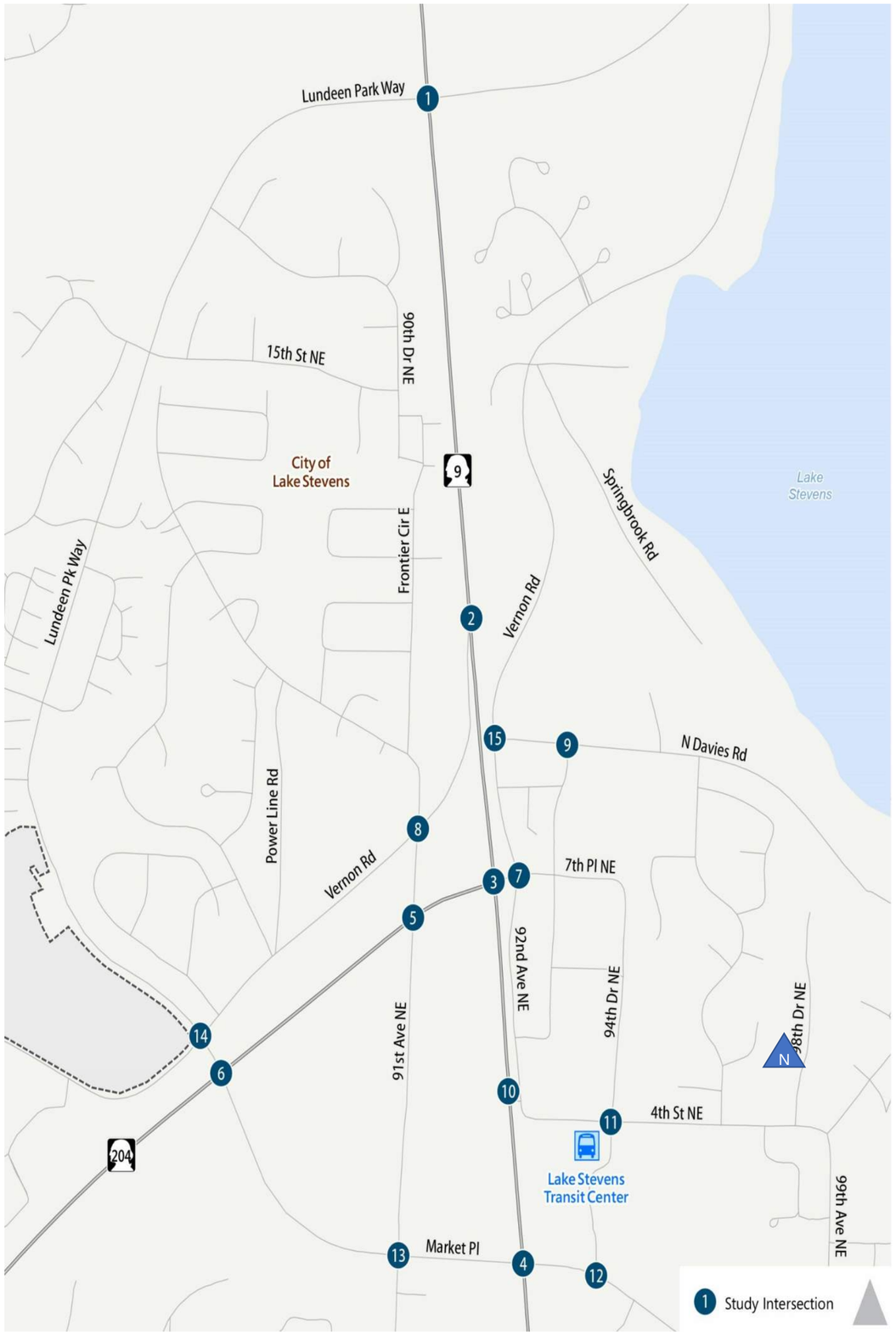
Traffic Volumes and Lane Geometry
2021 No Build Alternative - PM Peak Hour

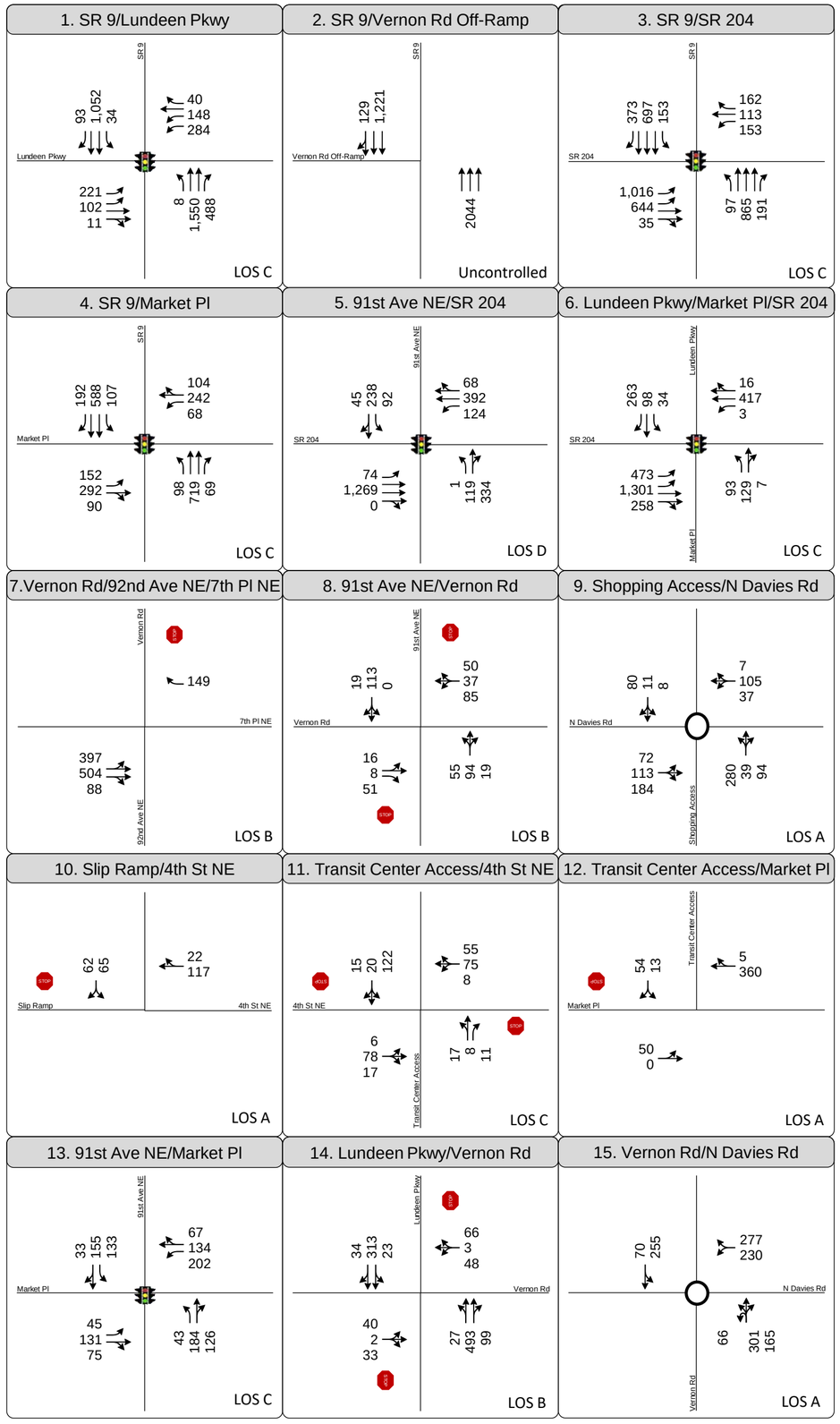




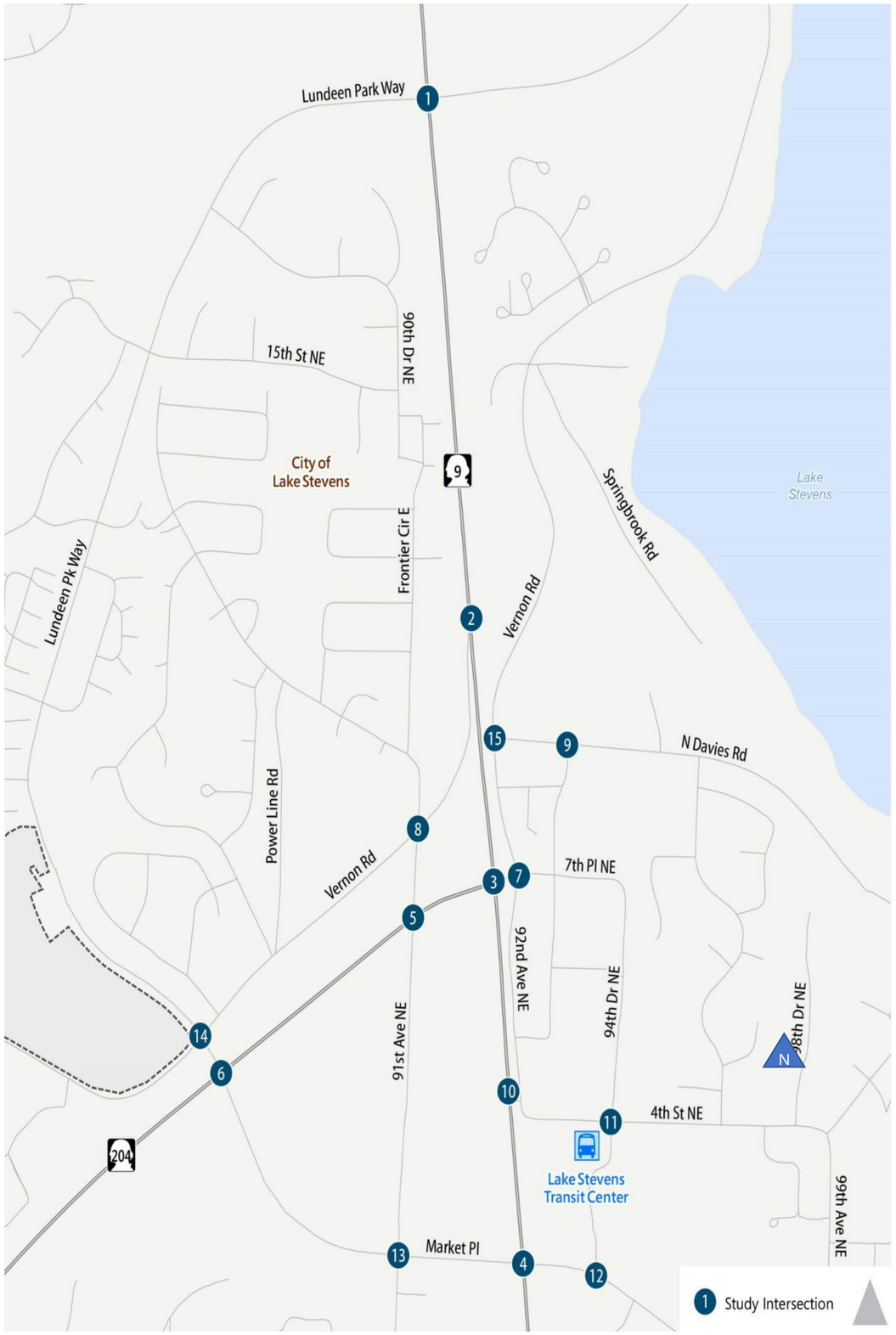
Traffic Volumes and Lane Geometry

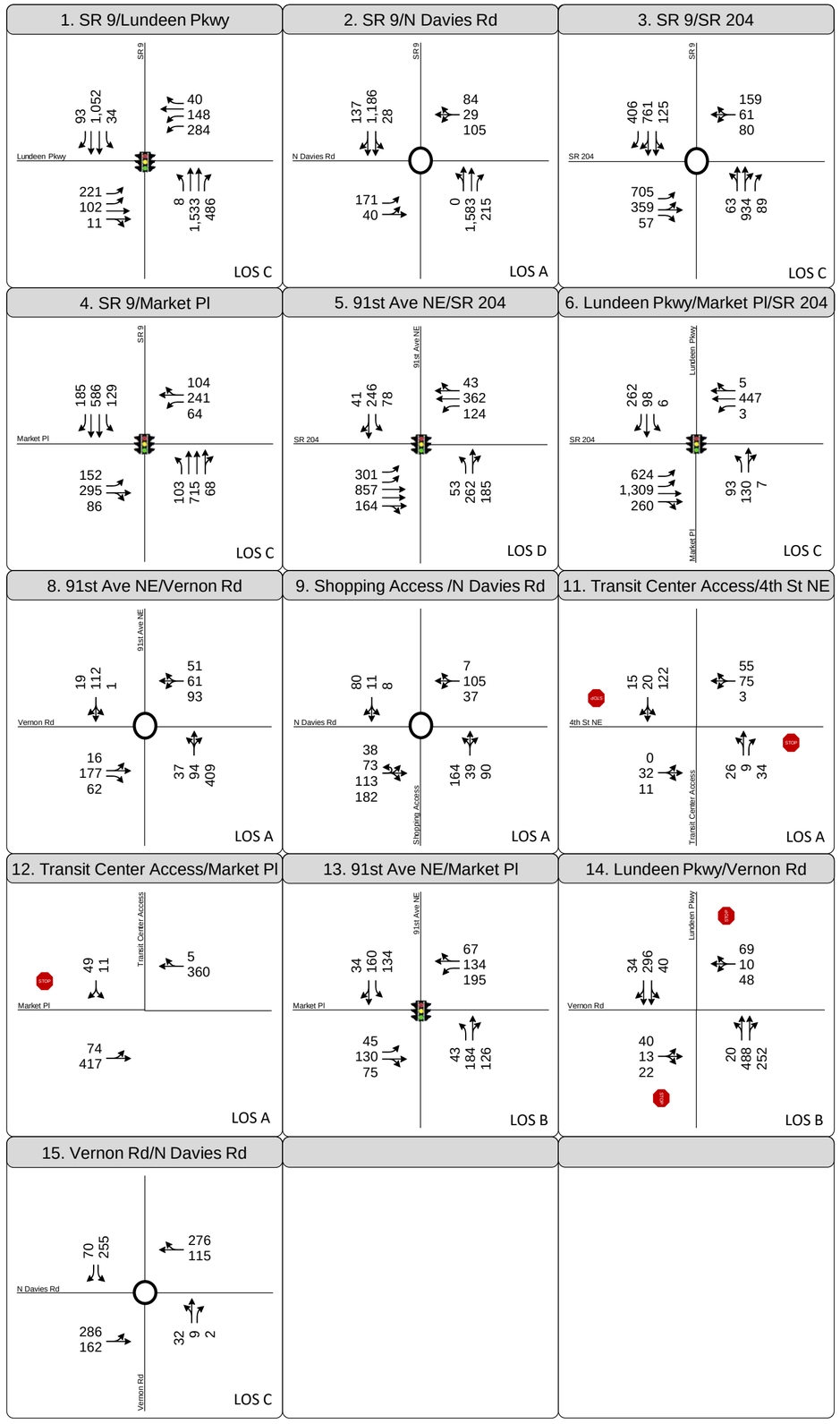
2021 **Previously** Preferred Alternative- PM Peak





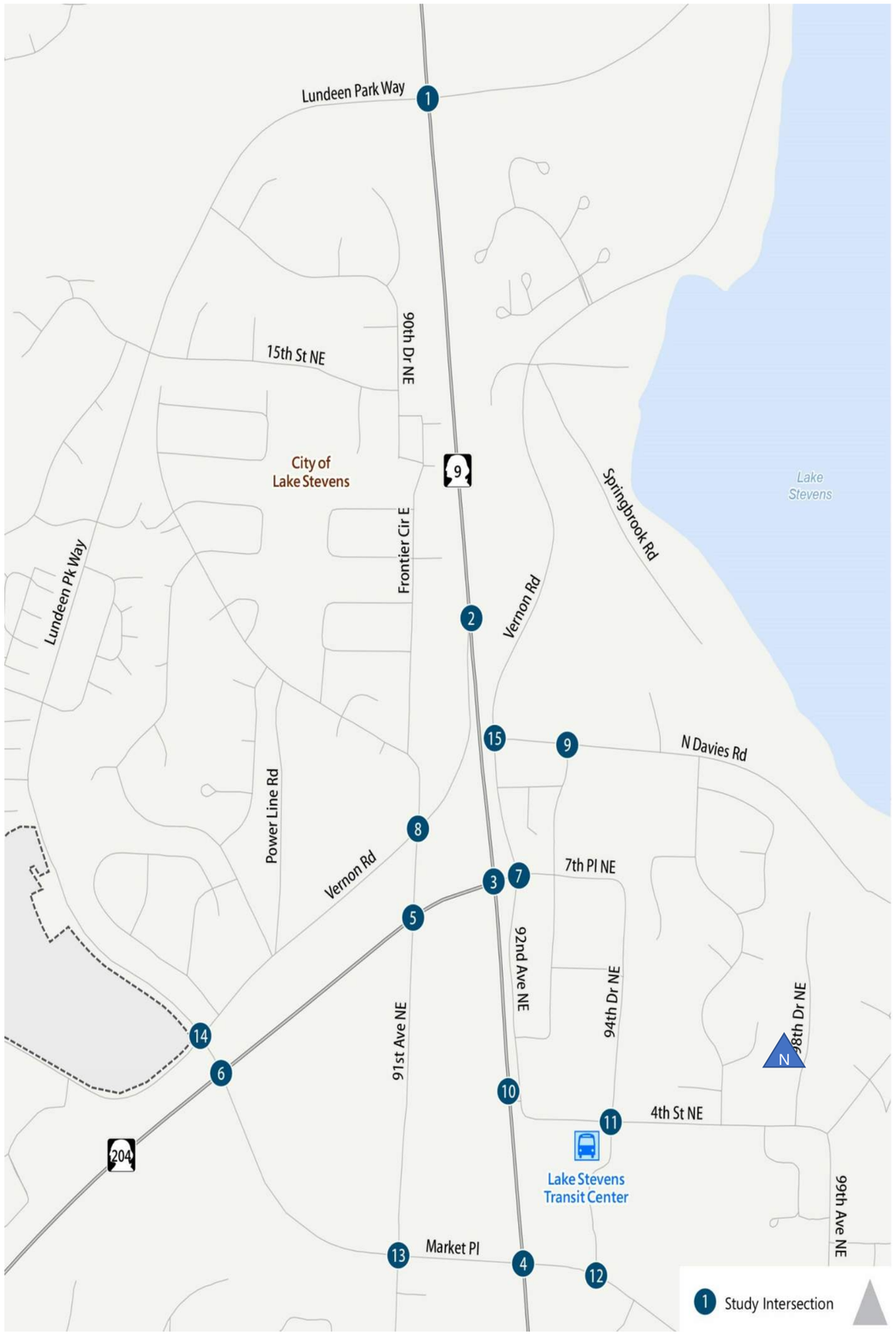
Traffic Volumes and Lane Geometry
2021 At Grade Alternative - PM Peak Hour

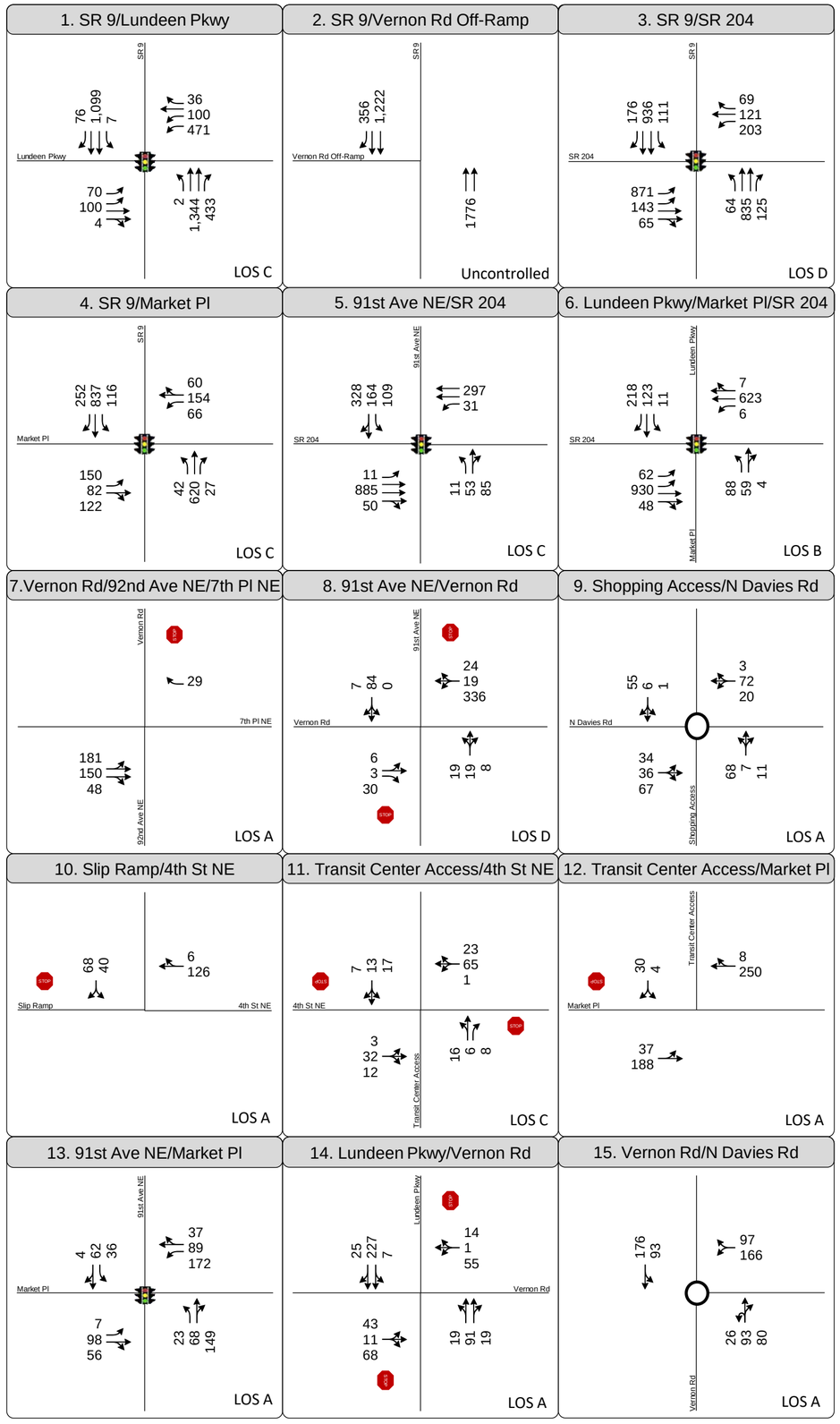




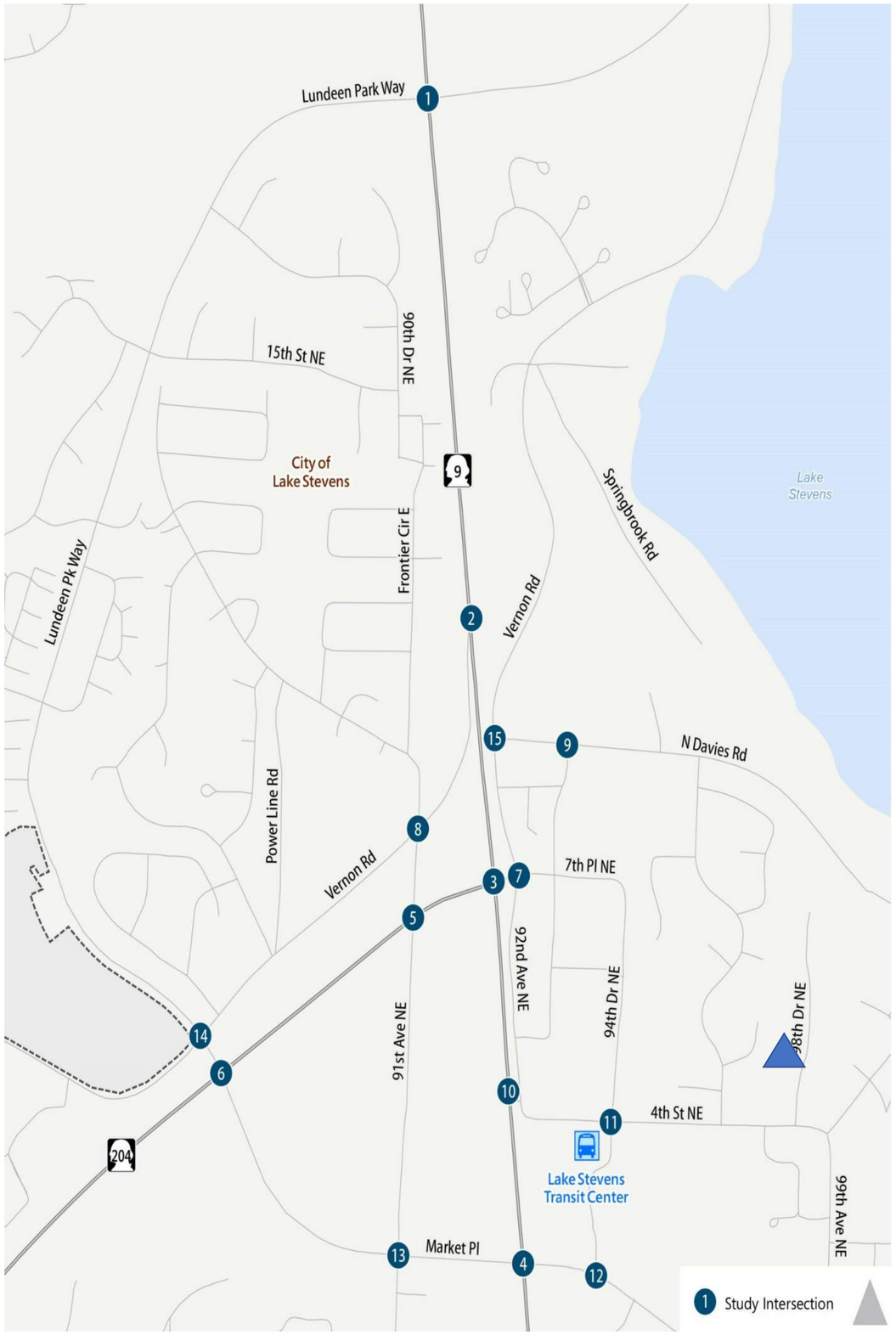
Traffic Volumes and Lane Geometry
2021 Roundabout Alternative - PM Peak Hour

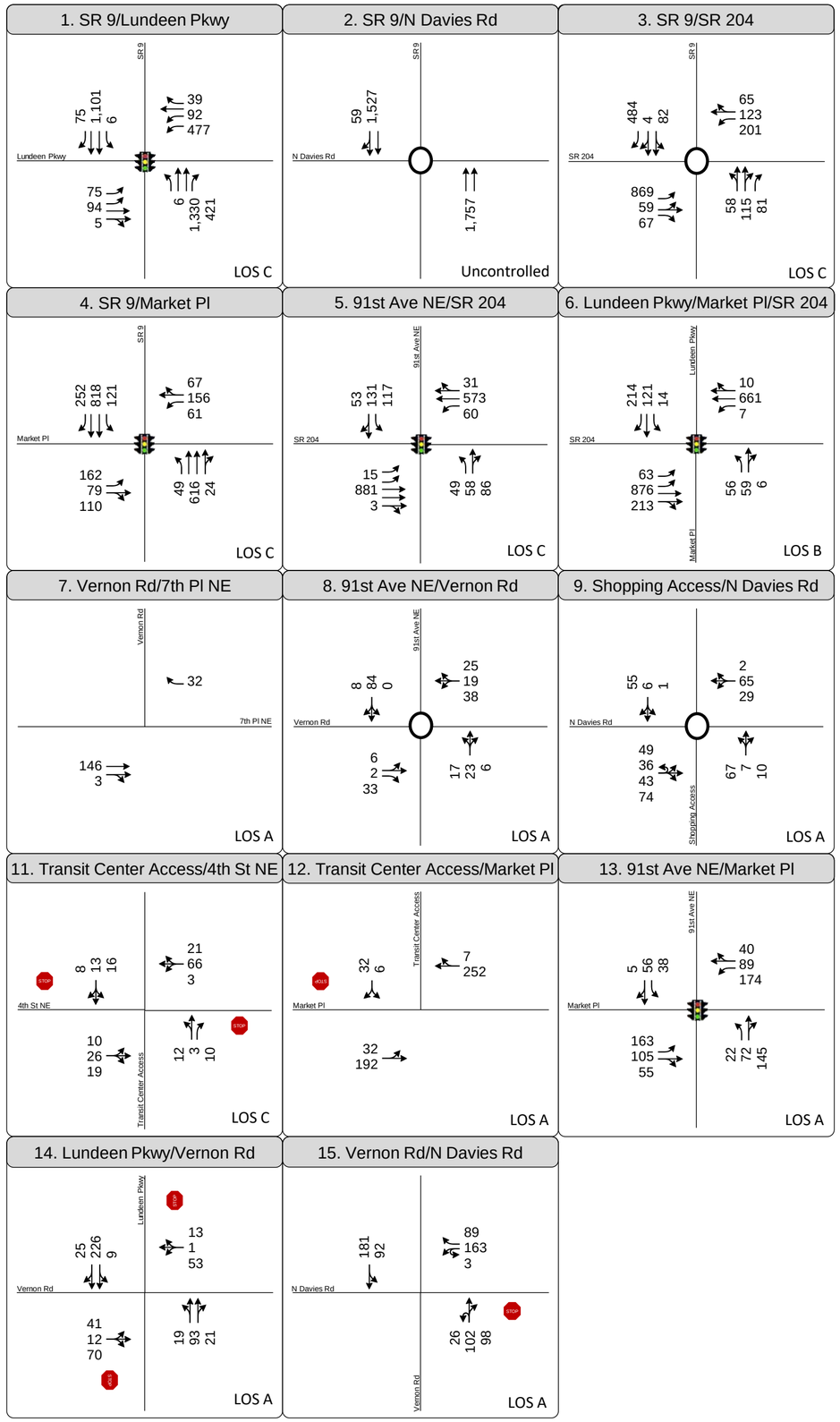
2040 AM



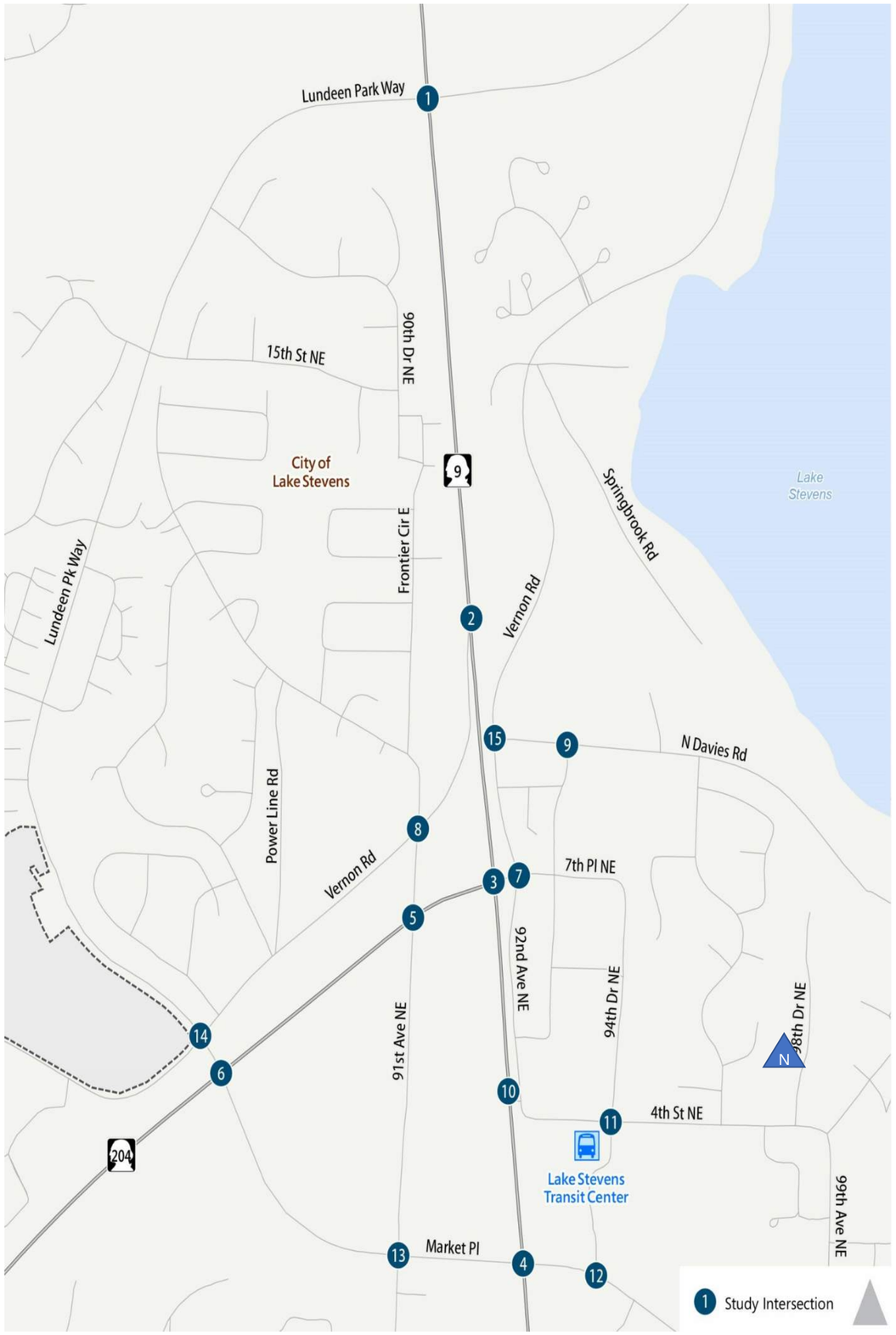


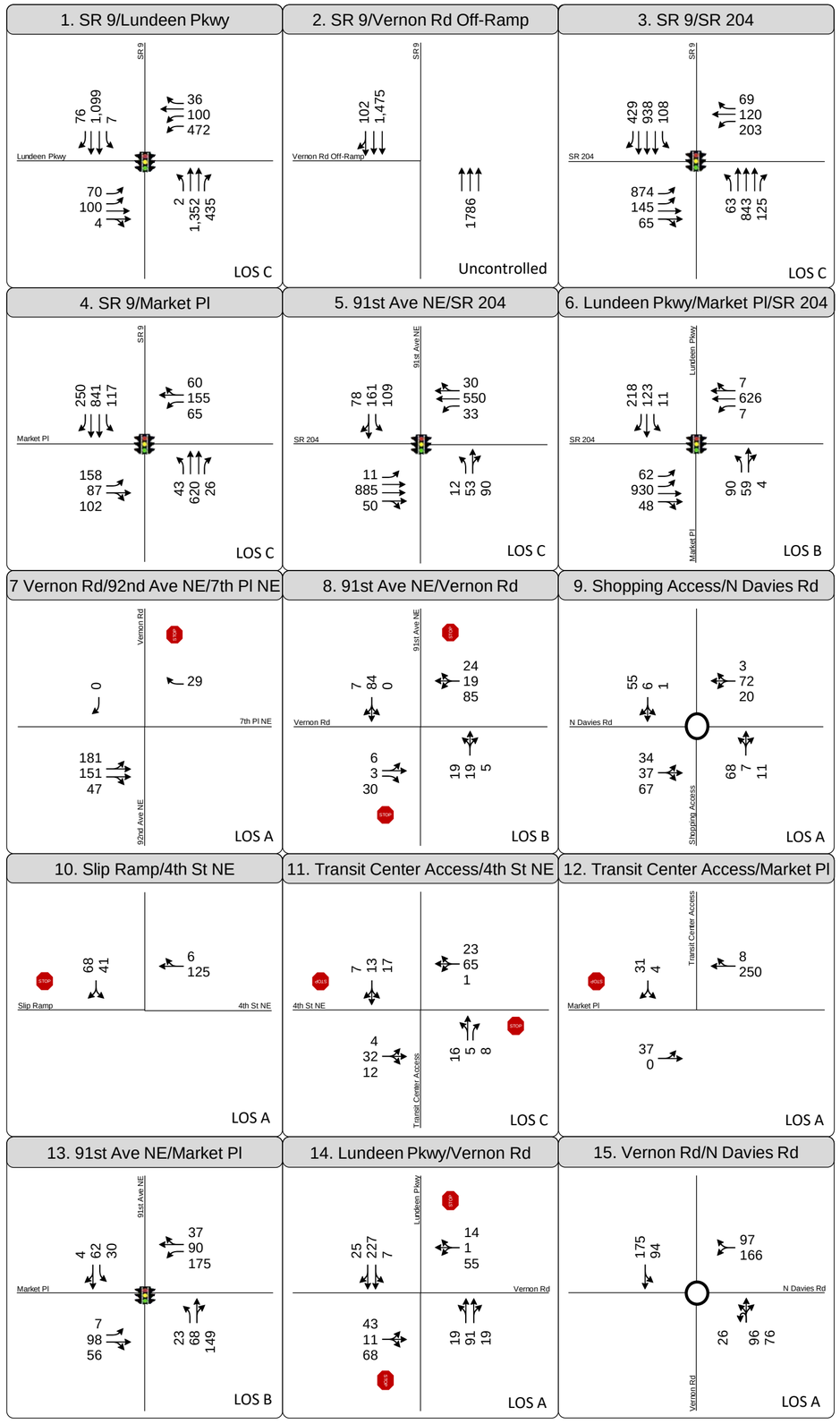
Traffic Volumes and Lane Geometry
2040 No Build Alternative - AM Peak Hour



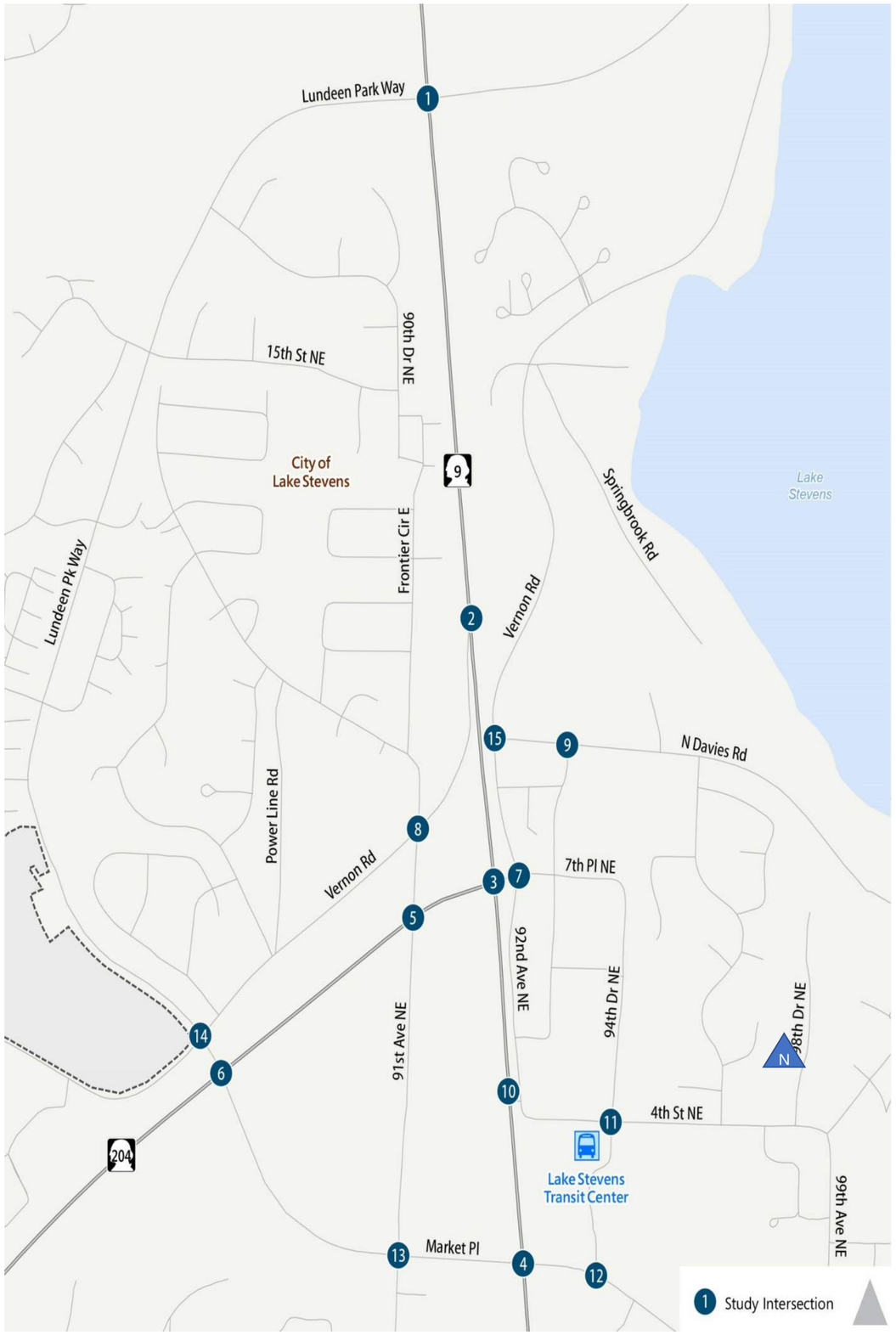


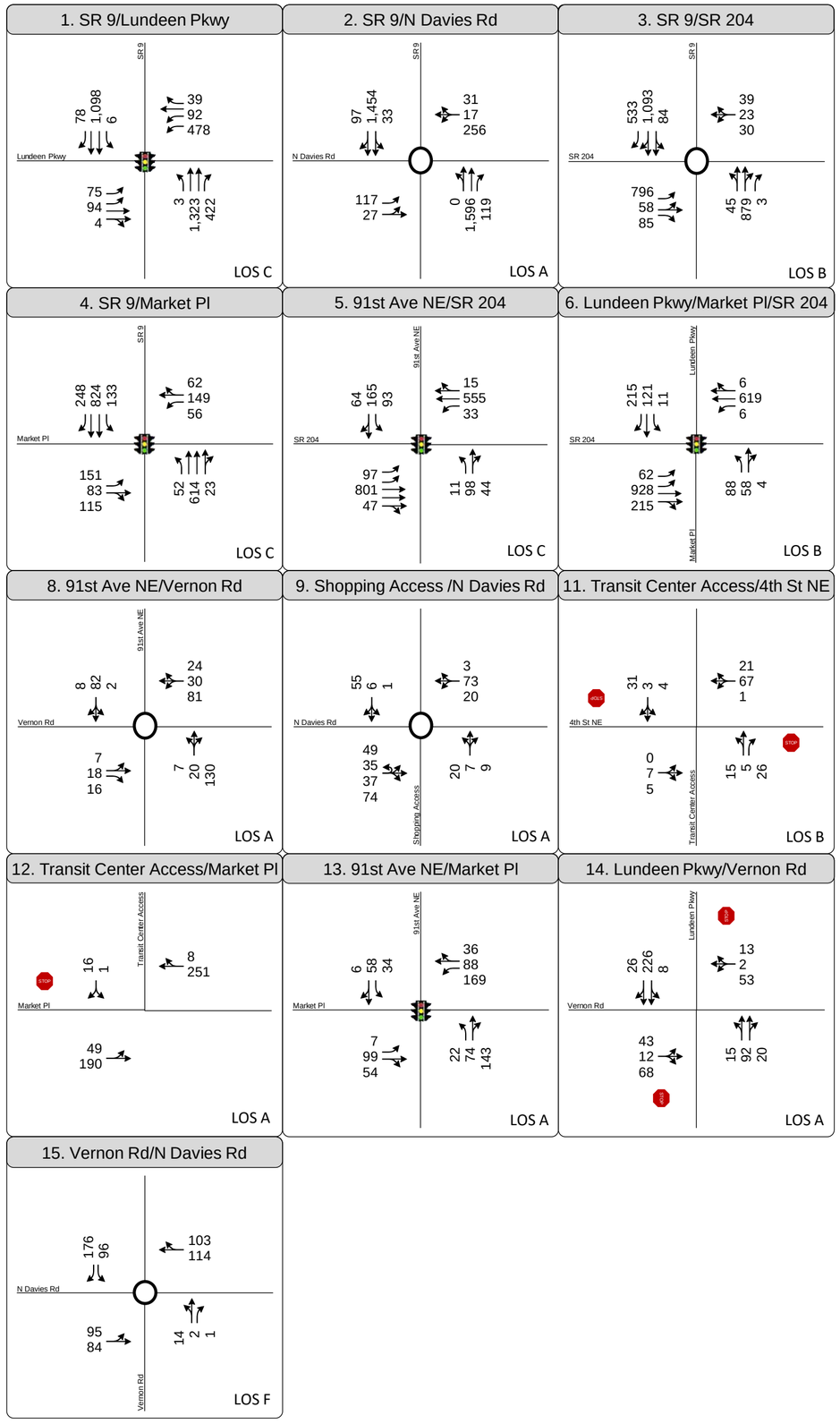
Traffic Volumes and Lane Geometry
2040 **Previously** Preferred Alternative - AM Peak





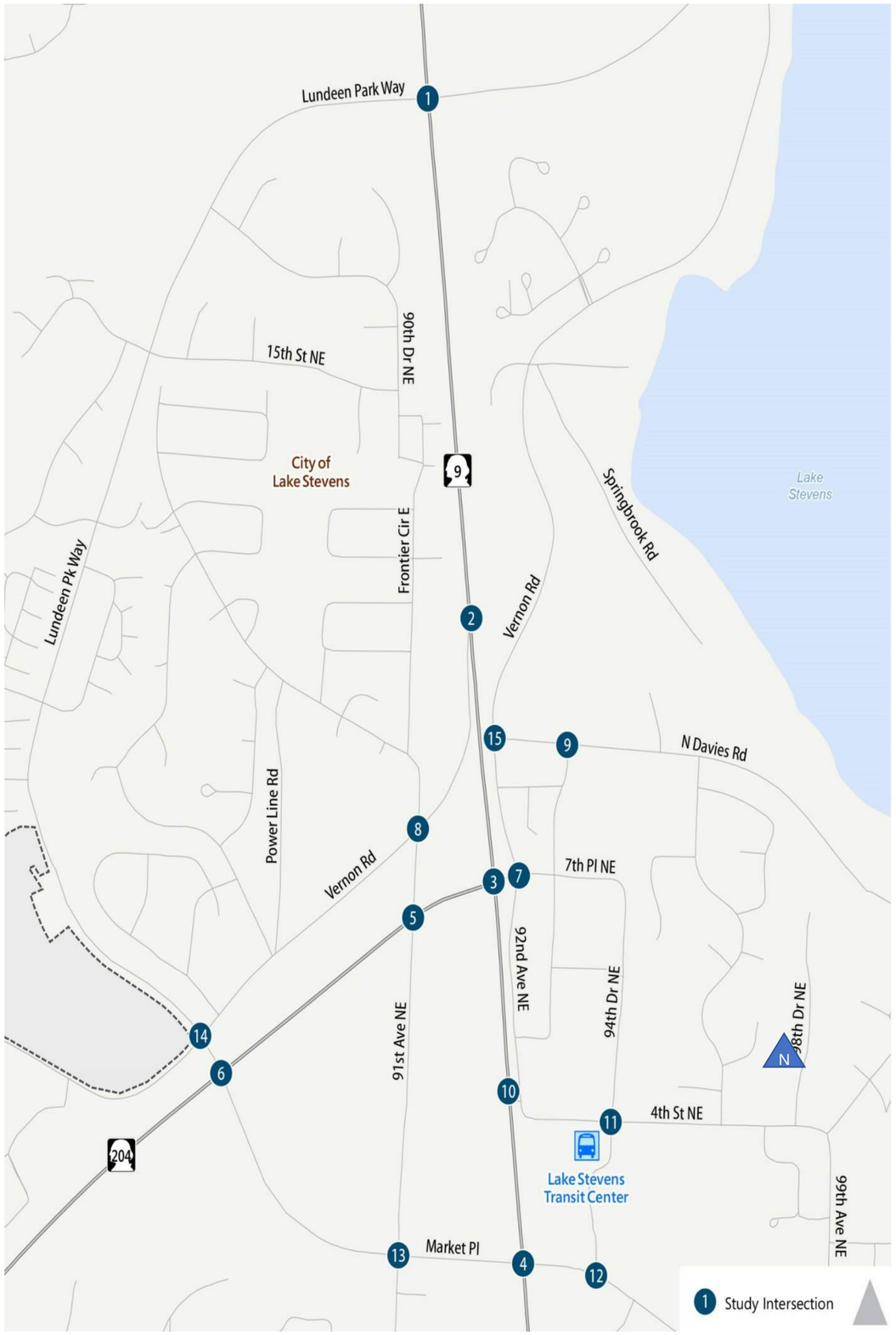
Traffic Volumes and Lane Geometry
2040 At Grade Alternative - AM Peak Hour

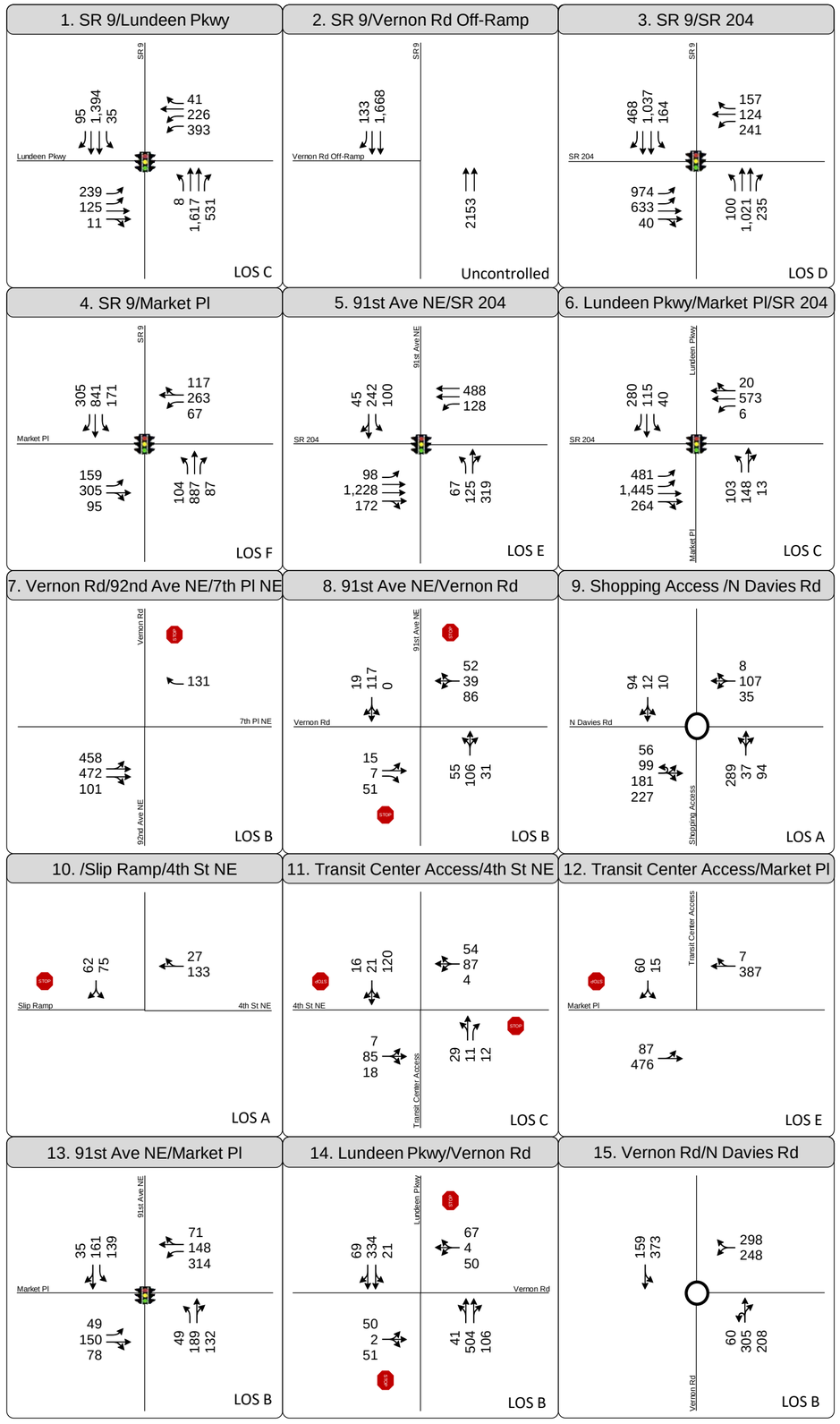




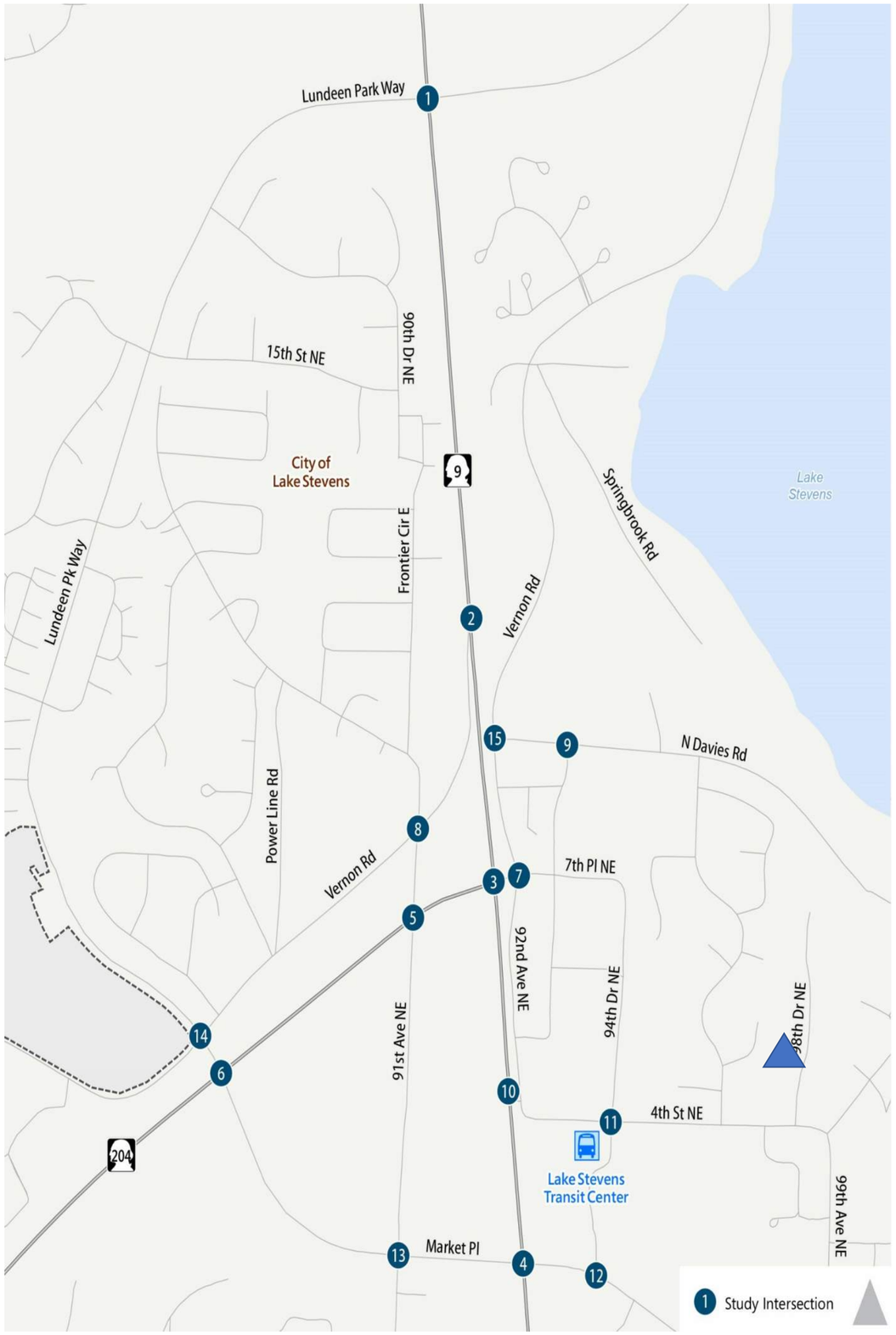
Traffic Volumes and Lane Geometry
2040 Roundabout Alternative - AM Peak Hour

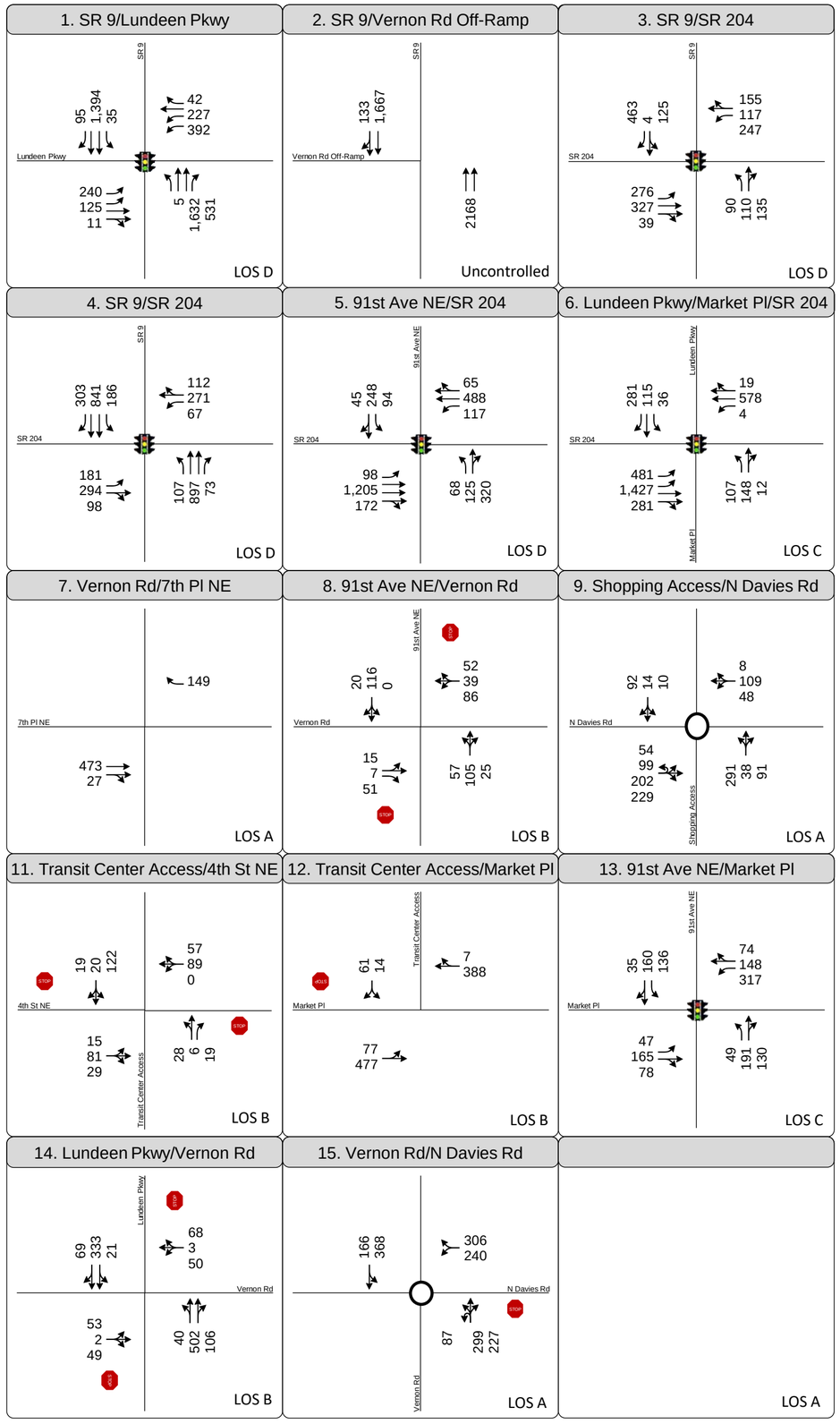
2040 PM





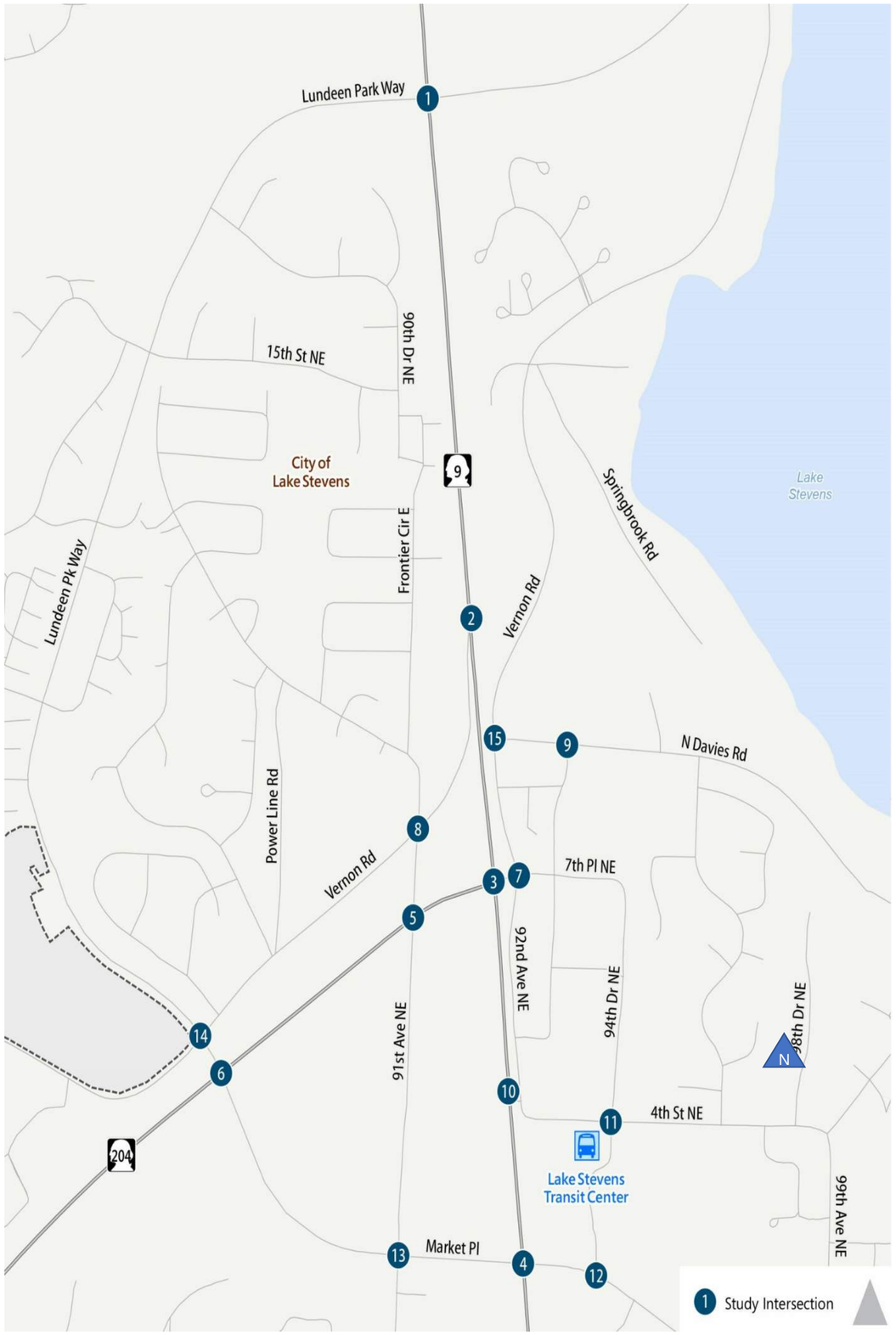
Traffic Volumes and Lane Geometry
2040 No Build Alternative - PM Peak Hour

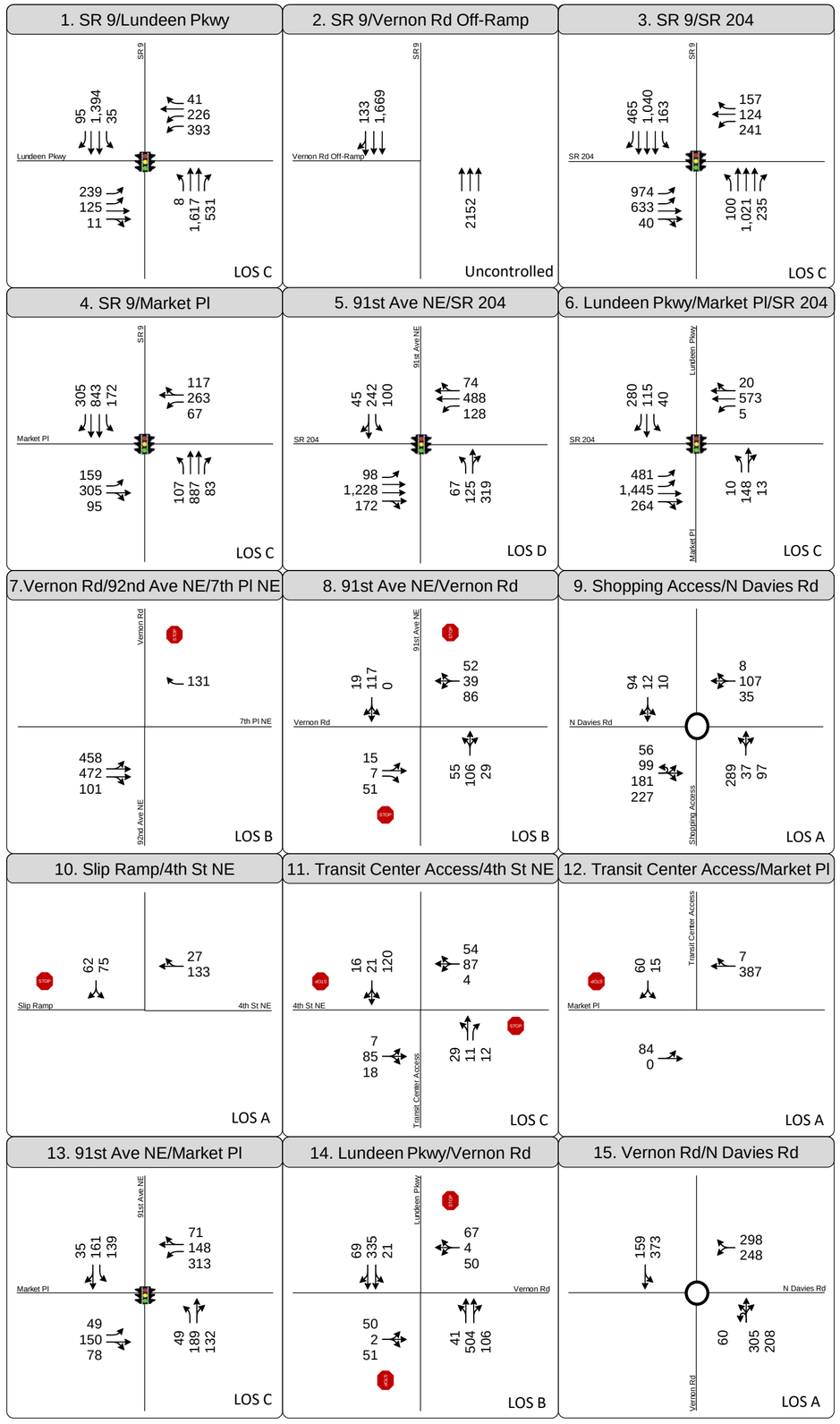




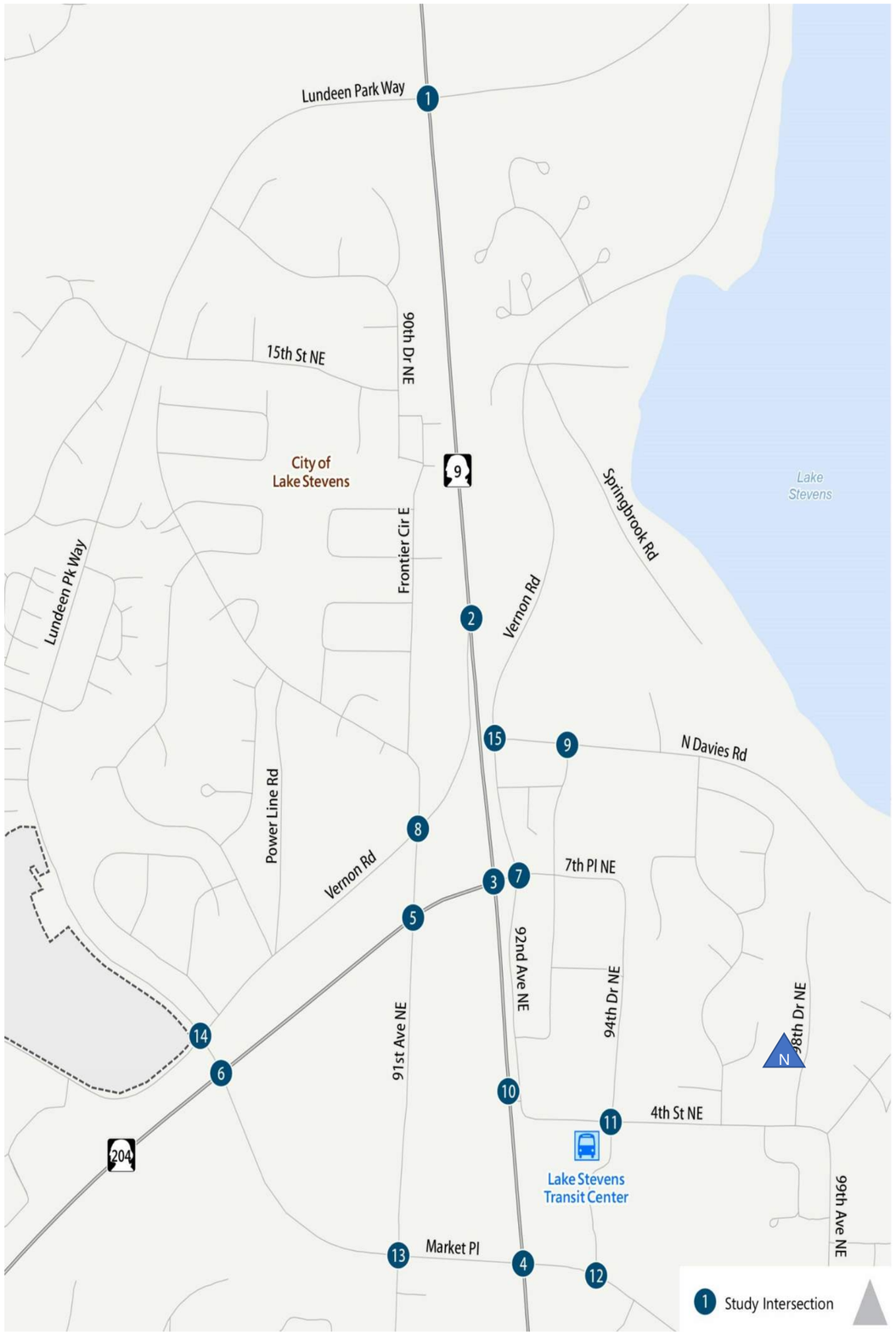
Traffic Volumes and Lane Geometry

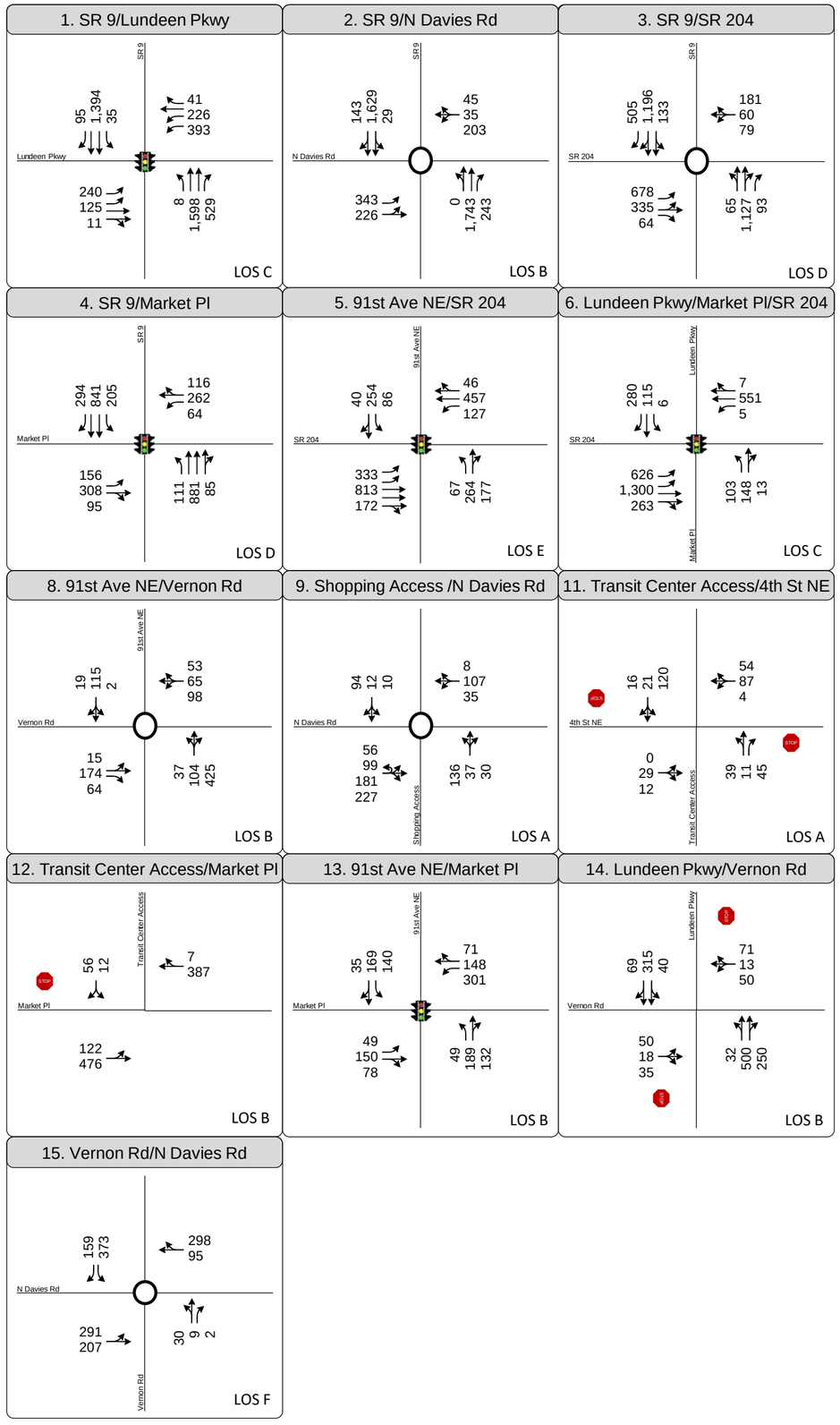
2040 **Previously** Preferred Alternative - PM Peak





Traffic Volumes and Lane Geometry
2040 At Grade Alternative - PM Peak Hour





Traffic Volumes and Lane Geometry
2040 Roundabout Alternative - PM Peak Hour

APPENDIX B.
VISSIM AND SIDRA MODEL OUTPUT REPORTS

October 2019

LOS Reports

Existing AM

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing**

Approach Delay and LOS **AM Peak Hour**

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	16.6	B	16.8	B	37.6	D	34.1	C	21.2	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	18.1	B	15.9	B	33.0	C	30.9	C	20.9	C	
4	SR 9/Market Pl	Signal	17.6	B	19.2	B	25.6	C	27.8	C	20.6	C	
5	91st Ave/SR 204	Signal	11.4	B	15.0	B	23.6	C	15.3	B	16.9	B	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	16.7	B	10.9	B	10.7	B	15.0	B	12.9	B	
7	Vernon Rd/7th Pl	Side-street Stop							7.5	A	7.5	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	0.8	A			5.4	A	7.1	A	10.3	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	1.1	A	1.0	A	0.8	A	0.7	A	0.9	A	
10	SR 9/4th St On-Ramp	Side-street Stop			6.9	A					7.6	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	11.2	B	6.2	A	0.4	A	0.2	A	20.0	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			4.0	A	2.0	A			5.5	A	SB RT
13	91st Ave/Market Pl	Signal	8.1	A	6.5	A	4.2	A	7.4	A	6.9	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.0	A	1.2	A	7.6	A	5.6	A	7.6	A	EB LT
15	Vernon Rd/Davies Rd	Roundabout	1.1	A	1.8	A			1.2	A	1.4	A	

Notes:

Assumes default directions (N, S, E, & W) at all intersections.

For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.

LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Existing PM

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **Existing**

Approach Delay and LOS **PM Peak Hour**

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	28.5	C	18.3	B	55.2	E	51.9	D	30.3	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	46.7	D	32.9	C	21.3	C	50.2	D	33.8	C	
4	SR 9/Market Pl	Signal	39.3	D	30.1	C	55.3	E	87.3	F	47.8	D	
5	91st Ave/SR 204	Signal	50.0	D	49.5	D	54.2	D	35.1	D	48.9	D	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	31.8	C	17.5	B	19.6	B	26.9	C	21.5	C	
7	Vernon Rd/7th Pl	Side-street Stop							11.4	B	11.4	B	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	1.2	A	0.1	A	8.9	A	10.3	B	13.4	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	5.2	A	4.5	A	2.1	A	3.9	A	3.8	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.4	A					8.0	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	10.7	B	9.0	A	0.7	A	0.5	A	17.1	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			25.5	D	6.5	A			27.1	D	SB RT
13	91st Ave/Market Pl	Signal	12.9	B	13.8	B	9.7	A	14.3	B	13.0	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.5	A	3.2	A	8.9	A	5.8	A	11.5	B	WB LT
15	Vernon Rd/Davies Rd	Roundabout	5.0	A	4.3	A			8.0	A	6.0	A	

Notes:

Assumes default directions (N, S, E, & W) at all intersections.

For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.

LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

2021 AM

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2021 No Build**
Approach Delay and LOS **AM Peak Hour**

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	22.8	C	19.3	B	45.3	D	40.8	D	26.2	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.9	A	0.5	A					0.9	A	NB TH
3	SR 9/SR 204	Signal	26.9	C	22.7	C	34.3	C	39.2	D	27.8	C	
4	SR 9/Market Pl	Signal	23.2	C	26.9	C	32.5	C	36.4	D	27.5	C	
5	91st Ave/SR 204	Signal	13.4	B	17.4	B	25.7	C	14.8	B	18.9	B	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	21.6	C	13.0	B	11.2	B	16.8	B	14.3	B	
7	Vernon Rd/7th Pl	Side-street Stop					0.1	A	7.6	A	7.6	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.4	A	5.7	A	7.2	A	10.0	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	1.3	A	1.3	A	0.9	A	0.9	A	1.0	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.0	A			0.5	A	7.7	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	7.7	A	6.4	A	0.2	A	0.3	A	10.3	B	NB LT
12	Transit Center Dwy/Market Pl	Side-street Stop			5.2	A	2.0	A	0.5	A	5.6	A	SB RT
13	91st Ave/Market Pl	Signal	8.7	A	8.5	A	7.0	A	7.5	A	7.9	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.4	A	1.4	A	8.3	A	5.8	A	8.3	A	EB RT
15	Vernon Rd/Davies Rd	Roundabout	1.1	A	1.9	A			1.2	A	1.4	A	

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 Tight Diamond
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	19.4	B	17.1	B	47.1	D	43.6	D	24.7	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	51.5	D	15.7	B	24.4	C	48.8	D	30.0	C	
4	SR 9/Market Pl	Signal	18.1	B	15.5	B	23.3	C	29.3	C	18.8	B	
5	91st Ave/SR 204	Signal	16.7	B	14.9	B	24.2	C	14.7	B	18.3	B	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	19.8	B	12.2	B	10.5	B	16.1	B	13.5	B	
7	Vernon Rd/7th Pl	Side-street Stop					0.3	A	5.3	A	5.3	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.3	A	5.4	A	6.6	A	7.4	A	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	1.5	A	1.4	A	0.9	A	0.8	A	1.1	A	
11	Transit Center Dwy/4th St	Side-street Stop	13.1	B	6.4	A	0.3	A	0.3	A	18.5	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			5.1	A	2.1	A	0.5	A	5.7	A	SB RT
13	91st Ave/Market Pl	Signal	7.9	A	7.5	A	6.4	A	7.3	A	7.3	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.2	A	0.6	A	7.3	A	5.1	A	8.2	A	EB LT
15	Vernon Rd/Davies Rd	Roundabout	1.2	A	1.7	A			0.8	A	1.3	A	
16	Parking Lot Connector/7th Place	Side-street Stop	2.0	A	1.1	A	0.3	A	7.8	A	7.8	A	WB TH
17	92nd Ave/Slip Ramp	All-way Stop	7.2	A	6.3	A			6.1	A	6.8	A	
221	SR 9/4th St NE	Side-street Stop	0.6	A	0.2	A					0.7	A	NB RT

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 At Grade Widening
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	16.5	B	15.8	B	28.9	C	47.8	D	22.8	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.6	A	0.2	A					0.6	A	SB RT
3	SR 9/SR 204	Signal	21.9	C	24.1	C	20.2	C	74.2	E	27.0	C	
4	SR 9/Market Pl	Signal	17.9	B	13.0	B	26.9	C	31.3	C	18.3	B	
5	91st Ave/SR 204	Signal	22.9	C	32.3	C	26.5	C	14.1	B	22.6	C	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	21.2	C	12.9	B	10.3	B	18.4	B	14.3	B	
7	Vernon Rd/7th Pl	Side-street Stop					0.1	A	7.4	A	7.4	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.4	A	5.8	A	7.1	A	9.6	A	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	1.4	A	1.3	A	0.9	A	0.8	A	1.0	A	
10	SR 9/4th St On-Ramp	Side-street Stop			6.7	A			0.5	A	7.6	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	7.5	A	6.3	A	0.2	A	0.3	A	10.3	B	NB LT
12	Transit Center Dwy/Market Pl	Side-street Stop			5.1	A	2.0	A	0.5	A	5.6	A	SB RT
13	91st Ave/Market Pl	Signal	21.5	C	19.3	B	5.7	A	7.1	A	12.9	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.4	A	1.4	A	8.3	A	5.5	A	8.3	A	EB RT
15	Vernon Rd/Davies Rd	Roundabout	1.0	A	1.9	A			1.3	A	1.4	A	

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 Roundabout Concept
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	18.5	B	18.6	B	49.6	D	45.2	D	25.3	C	
2	SR 9/Davies Rd	Roundabout											
3	SR 9/SR 204	Roundabout											
4	SR 9/Market Pl	Signal	19.8	B	19.0	B	33.0	C	39.0	D	23.1	C	
5	91st Ave/SR 204	Signal	13.3	B	16.3	B	20.7	C	20.2	C	18.9	B	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	22.2	C	12.5	B	13.5	B	18.3	B	15.5	B	
7	Access Road/7th Place	Side-street Stop											
8	91st Ave/Vernon Rd	Roundabout											
9	Safeway Dwy/Davies Rd	Roundabout	0.9	A	1.0	A	0.8	A	0.7	A	0.8	A	
11	Transit Center Dwy/4th St	Side-street Stop	8.4	A	6.2	A	0.3	A	0.2	A	12.0	B	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			3.3	A	2.1	A			5.7	A	SB RT
13	91st Ave/Market Pl	Signal	8.1	A	7.3	A	6.1	A	7.9	A	7.5	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.0	A	1.1	A	8.5	A	6.0	A	8.5	A	EB RT
15	Vernon Rd/Davies Rd	Roundabout											

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.
Intersections 2, 3, 8, and 15 are analyzed and reported from SIDRA

Sidra Roundabout LOS Results

2021 AM

#	Intersection	Sidra Model		HCM Model		Average	
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
2	9/Davies	5	A	6	A	6	A
3	9/204	4	A	5	A	5	A
8	91st/Vernon	4	A	4	A	4	A
15	Davies/Vernon	4	A	4	A	4	A

MOVEMENT SUMMARY

Site: 1 [2021AM-P2 SR9 & Davies]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1070	3.0	1070	3.0	0.370	2.2	LOS A	0.8	20.6	0.38	0.26	0.38	28.2
18	R2	51	3.0	51	3.0	0.030	2.3	LOS A	0.0	1.2	0.14	0.32	0.14	24.5
Approach		1121	3.0	1121	3.0	0.370	2.2	LOS A	0.8	20.6	0.37	0.26	0.37	28.1
East: WB Davies														
1	L2	154	3.0	154	3.0	0.123	7.2	LOS A	0.2	5.1	0.59	0.78	0.59	14.3
1a	L1	17	3.0	17	3.0	0.123	6.0	LOS A	0.2	5.1	0.59	0.74	0.59	14.7
16	R2	39	3.0	39	3.0	0.123	3.0	LOS A	0.2	5.1	0.59	0.74	0.59	21.6
Approach		210	3.0	210	3.0	0.123	6.3	LOS A	0.2	5.1	0.59	0.77	0.59	16.3
North: SB SR 9														
7	L2	25	3.0	25	3.0	0.522	12.6	LOS B	1.3	32.8	0.42	0.56	0.42	27.0
4	T1	1270	3.0	1270	3.0	0.522	6.5	LOS A	1.3	33.3	0.41	0.55	0.41	27.2
14a	R1	57	3.0	57	3.0	0.522	5.9	LOS A	1.3	33.3	0.40	0.54	0.40	27.4
Approach		1352	3.0	1352	3.0	0.522	6.6	LOS A	1.3	33.3	0.41	0.55	0.41	27.2
SouthWest: NE Vernon W														
5ax	L1	171	3.0	171	3.0	0.208	7.7	LOS A	0.4	10.1	0.71	0.82	0.71	21.6
12ax	R1	40	3.0	40	3.0	0.072	4.5	LOS A	0.1	3.0	0.68	0.68	0.68	18.9
Approach		211	3.0	211	3.0	0.208	7.1	LOS A	0.4	10.1	0.70	0.79	0.70	21.3
All Vehicles		2894	3.0	2894	3.0	0.522	4.9	LOS A	1.3	33.3	0.43	0.47	0.43	26.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2 [2021AM-P2 SR9 & SR204]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	29	3.0	29	3.0	0.279	11.0	LOS B	0.5	12.9	0.44	0.51	0.44	29.2
8	T1	750	3.0	750	3.0	0.279	5.0	LOS A	0.5	13.8	0.42	0.47	0.42	29.5
18	R2	45	3.0	45	3.0	0.028	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		824	3.0	824	3.0	0.279	5.1	LOS A	0.5	13.8	0.40	0.48	0.40	29.8
East: WB 7th														
1	L2	20	3.0	20	3.0	0.035	4.4	LOS A	0.1	1.5	0.55	0.46	0.55	17.1
6	T1	18	3.0	18	3.0	0.035	1.8	LOS A	0.1	1.5	0.55	0.46	0.55	17.1
16	R2	31	3.0	31	3.0	0.037	2.3	LOS A	0.1	1.5	0.55	0.47	0.55	17.6
Approach		69	3.0	69	3.0	0.037	2.8	LOS A	0.1	1.5	0.55	0.46	0.55	17.3
North: SB SR 9														
7	L2	77	3.0	77	3.0	0.306	7.4	LOS A	0.7	18.3	0.22	0.28	0.22	28.9
4	T1	885	3.0	885	3.0	0.306	1.6	LOS A	0.7	18.6	0.21	0.23	0.21	24.9
14	R2	462	3.0	462	3.0	0.284	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.3
Approach		1424	3.0	1424	3.0	0.306	2.0	LOS A	0.7	18.6	0.15	0.25	0.15	25.6
West: EB 7th														
5	L2	339	3.0	339	3.0	0.155	10.2	LOS B	0.2	5.8	0.42	0.73	0.42	19.2
2	T1	49	3.0	49	3.0	0.155	5.9	LOS A	0.2	5.8	0.40	0.69	0.40	19.7
12	R2	44	3.0	44	3.0	0.036	4.8	LOS A	0.0	1.1	0.39	0.56	0.39	22.1
Approach		432	3.0	432	3.0	0.155	9.1	LOS A	0.2	5.8	0.42	0.71	0.42	19.5
All Vehicles		2749	3.0	2749	3.0	0.306	4.1	LOS A	0.7	18.6	0.27	0.39	0.27	25.9

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101vv [2021AM-P2 91st & Vernon]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	7	3.0	7	3.0	0.127	4.3	LOS A	0.2	5.1	0.19	0.10	0.19	22.6
8	T1	24	3.0	24	3.0	0.127	4.3	LOS A	0.2	5.1	0.19	0.10	0.19	23.5
18	R2	113	3.0	113	3.0	0.127	4.3	LOS A	0.2	5.1	0.19	0.10	0.19	16.0
Approach		144	3.0	144	3.0	0.127	4.3	LOS A	0.2	5.1	0.19	0.10	0.19	18.2
East: WB Vernon														
1	L2	31	3.0	31	3.0	0.058	3.0	LOS A	0.1	2.9	0.12	0.03	0.12	19.4
6	T1	30	3.0	30	3.0	0.058	3.0	LOS A	0.1	2.9	0.12	0.03	0.12	25.6
16	R2	21	3.0	21	3.0	0.058	3.0	LOS A	0.1	2.9	0.12	0.03	0.12	25.2
Approach		82	3.0	82	3.0	0.058	3.0	LOS A	0.1	2.9	0.12	0.03	0.12	23.7
North: SB 91st														
7	L2	2	3.0	2	3.0	0.071	3.6	LOS A	0.1	3.1	0.18	0.07	0.18	21.5
4	T1	73	3.0	73	3.0	0.071	3.6	LOS A	0.1	3.1	0.18	0.07	0.18	21.5
14	R2	8	3.0	8	3.0	0.071	3.6	LOS A	0.1	3.1	0.18	0.07	0.18	24.4
Approach		83	3.0	83	3.0	0.071	3.6	LOS A	0.1	3.1	0.18	0.07	0.18	22.0
West: EB Vernon														
5	L2	5	3.0	5	3.0	0.097	3.4	LOS A	0.2	4.4	0.22	0.10	0.22	27.6
2	T1	103	3.0	103	3.0	0.097	3.4	LOS A	0.2	4.4	0.22	0.10	0.22	22.0
12	R2	23	3.0	23	3.0	0.097	3.4	LOS A	0.2	4.4	0.22	0.10	0.22	22.0
Approach		131	3.0	131	3.0	0.097	3.4	LOS A	0.2	4.4	0.22	0.10	0.22	22.3
All Vehicles		440	3.0	440	3.0	0.127	3.7	LOS A	0.2	5.1	0.19	0.08	0.19	21.3

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1a [2021AM-P2 Davies & Vernon]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	13	3.0	13	3.0	0.017	5.3	LOS A	0.0	0.8	0.36	0.52	0.36	15.9
8	T1	2	3.0	2	3.0	0.017	2.9	LOS A	0.0	0.8	0.36	0.52	0.36	19.2
18	R2	1	3.0	1	3.0	0.017	4.1	LOS A	0.0	0.8	0.36	0.52	0.36	17.4
Approach		16	3.0	16	3.0	0.017	4.9	LOS A	0.0	0.8	0.36	0.52	0.36	16.6
East: WB Davies														
6	T1	103	3.0	103	3.0	0.129	3.2	LOS A	0.2	6.0	0.20	0.45	0.20	16.7
16	R2	41	3.0	41	3.0	0.129	4.3	LOS A	0.2	6.0	0.20	0.45	0.20	20.6
Approach		144	3.0	144	3.0	0.129	3.5	LOS A	0.2	6.0	0.20	0.45	0.20	18.5
North: SB Vernon														
7	L2	71	3.0	71	3.0	0.120	6.0	LOS A	0.2	5.8	0.22	0.52	0.22	20.8
14	R2	94	0.0	94	0.0	0.120	3.0	LOS A	0.2	5.8	0.22	0.52	0.22	19.2
Approach		165	1.3	165	1.3	0.120	4.3	LOS A	0.2	5.8	0.22	0.52	0.22	20.0
West: EB Davies														
5	L2	51	3.0	51	3.0	0.097	4.8	LOS A	0.2	4.5	0.20	0.50	0.20	20.7
2	T1	65	3.0	65	3.0	0.097	2.5	LOS A	0.2	4.5	0.20	0.50	0.20	18.7
Approach		116	3.0	116	3.0	0.097	3.5	LOS A	0.2	4.5	0.20	0.50	0.20	19.8
All Vehicles		441	2.4	441	2.4	0.129	3.9	LOS A	0.2	6.0	0.21	0.49	0.21	19.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2021AM-P2 SR9 & Davies]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1070	3.0	1070	3.0	0.493	2.9	LOS A	1.1	28.9	0.51	0.35	0.51	27.4
18	R2	51	3.0	51	3.0	0.039	2.4	LOS A	0.1	1.5	0.15	0.33	0.15	24.4
Approach		1121	3.0	1121	3.0	0.493	2.9	LOS A	1.1	28.9	0.49	0.35	0.49	27.3
East: WB Davies														
1	L2	154	3.0	154	3.0	0.242	11.9	LOS B	0.3	8.4	0.74	0.87	0.74	11.0
1a	L1	17	3.0	17	3.0	0.242	10.3	LOS B	0.3	8.4	0.72	0.84	0.72	11.1
16	R2	39	3.0	39	3.0	0.242	7.3	LOS A	0.3	8.4	0.72	0.84	0.72	18.4
Approach		210	3.0	210	3.0	0.242	10.9	LOS B	0.3	8.4	0.73	0.86	0.74	12.8
North: SB SR 9														
7	L2	25	3.0	25	3.0	0.587	13.1	LOS B	1.6	41.5	0.52	0.60	0.52	26.0
4	T1	1270	3.0	1270	3.0	0.587	7.0	LOS A	1.6	41.5	0.51	0.59	0.51	26.2
14a	R1	57	3.0	57	3.0	0.587	6.3	LOS A	1.6	41.0	0.50	0.58	0.50	26.4
Approach		1352	3.0	1352	3.0	0.587	7.1	LOS A	1.6	41.5	0.51	0.59	0.51	26.2
SouthWest: NE Vernon W														
5ax	L1	171	3.0	171	3.0	0.441	14.9	LOS B	0.7	17.5	0.82	1.00	1.08	18.0
12ax	R1	40	3.0	40	3.0	0.120	9.2	LOS A	0.2	3.9	0.77	0.77	0.77	15.1
Approach		211	3.0	211	3.0	0.441	13.8	LOS B	0.7	17.5	0.81	0.96	1.02	17.7
All Vehicles		2894	3.0	2894	3.0	0.587	6.2	LOS A	1.6	41.5	0.54	0.55	0.56	24.8

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2 [2021AM-P2 SR9 & SR204]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	29	3.0	29	3.0	0.426	12.1	LOS B	0.8	20.7	0.59	0.62	0.62	28.2
8	T1	750	3.0	750	3.0	0.426	6.1	LOS A	0.8	20.7	0.58	0.59	0.60	28.4
18	R2	45	3.0	45	3.0	0.028	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		824	3.0	824	3.0	0.426	6.2	LOS A	0.8	20.7	0.54	0.58	0.57	28.7
East: WB 7th														
1	L2	20	3.0	20	3.0	0.071	7.3	LOS A	0.1	2.3	0.63	0.71	0.63	16.0
6	T1	18	3.0	18	3.0	0.071	4.6	LOS A	0.1	2.3	0.63	0.71	0.63	16.0
16	R2	31	3.0	31	3.0	0.066	5.5	LOS A	0.1	2.2	0.66	0.66	0.66	15.5
Approach		69	3.0	69	3.0	0.071	5.8	LOS A	0.1	2.3	0.64	0.68	0.64	15.8
North: SB SR 9														
7	L2	77	3.0	77	3.0	0.372	7.5	LOS A	0.8	21.5	0.24	0.28	0.24	28.8
4	T1	885	3.0	885	3.0	0.372	1.7	LOS A	0.8	21.5	0.24	0.24	0.24	24.6
14	R2	462	3.0	462	3.0	0.284	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.3
Approach		1424	3.0	1424	3.0	0.372	2.0	LOS A	0.8	21.5	0.16	0.26	0.16	25.4
West: EB 7th														
5	L2	339	3.0	339	3.0	0.353	14.6	LOS B	0.6	14.4	0.69	0.92	0.80	16.3
2	T1	49	3.0	49	3.0	0.353	10.0	LOS A	0.6	14.4	0.68	0.91	0.78	18.1
12	R2	44	3.0	44	3.0	0.085	8.5	LOS A	0.1	2.9	0.63	0.78	0.63	18.1
Approach		432	3.0	432	3.0	0.353	13.4	LOS B	0.6	14.4	0.68	0.90	0.78	16.8
All Vehicles		2749	3.0	2749	3.0	0.426	5.2	LOS A	0.8	21.5	0.37	0.47	0.39	24.7

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101vv [2021AM-P2 91st & Vernon]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	7	3.0	7	3.0	0.118	3.9	LOS A	0.2	5.5	0.26	0.13	0.26	22.9
8	T1	24	3.0	24	3.0	0.118	3.9	LOS A	0.2	5.5	0.26	0.13	0.26	23.8
18	R2	113	3.0	113	3.0	0.118	3.9	LOS A	0.2	5.5	0.26	0.13	0.26	16.3
Approach		144	3.0	144	3.0	0.118	3.9	LOS A	0.2	5.5	0.26	0.13	0.26	18.5
East: WB Vernon														
1	L2	31	3.0	31	3.0	0.062	3.2	LOS A	0.1	2.3	0.11	0.03	0.11	19.2
6	T1	30	3.0	30	3.0	0.062	3.2	LOS A	0.1	2.3	0.11	0.03	0.11	25.4
16	R2	21	3.0	21	3.0	0.062	3.2	LOS A	0.1	2.3	0.11	0.03	0.11	25.0
Approach		82	3.0	82	3.0	0.062	3.2	LOS A	0.1	2.3	0.11	0.03	0.11	23.5
North: SB 91st														
7	L2	2	3.0	2	3.0	0.065	3.3	LOS A	0.1	2.9	0.18	0.07	0.18	21.9
4	T1	73	3.0	73	3.0	0.065	3.3	LOS A	0.1	2.9	0.18	0.07	0.18	21.9
14	R2	8	3.0	8	3.0	0.065	3.3	LOS A	0.1	2.9	0.18	0.07	0.18	24.7
Approach		83	3.0	83	3.0	0.065	3.3	LOS A	0.1	2.9	0.18	0.07	0.18	22.3
West: EB Vernon														
5	L2	5	3.0	5	3.0	0.107	3.8	LOS A	0.2	5.0	0.25	0.12	0.25	27.2
2	T1	103	3.0	103	3.0	0.107	3.8	LOS A	0.2	5.0	0.25	0.12	0.25	21.6
12	R2	23	3.0	23	3.0	0.107	3.8	LOS A	0.2	5.0	0.25	0.12	0.25	21.6
Approach		131	3.0	131	3.0	0.107	3.8	LOS A	0.2	5.0	0.25	0.12	0.25	21.9
All Vehicles		440	3.0	440	3.0	0.118	3.6	LOS A	0.2	5.5	0.21	0.10	0.21	21.3

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1a [2021AM-P2 Davies & Vernon]

Network: N101 [2021AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	13	3.0	13	3.0	0.015	4.9	LOS A	0.0	0.6	0.32	0.52	0.32	16.0
8	T1	2	3.0	2	3.0	0.015	2.5	LOS A	0.0	0.6	0.32	0.52	0.32	19.3
18	R2	1	3.0	1	3.0	0.015	3.7	LOS A	0.0	0.6	0.32	0.52	0.32	17.5
Approach		16	3.0	16	3.0	0.015	4.5	LOS A	0.0	0.6	0.32	0.52	0.32	16.7
East: WB Davies														
6	T1	103	3.0	103	3.0	0.115	3.1	LOS A	0.2	5.3	0.20	0.44	0.20	16.8
16	R2	41	3.0	41	3.0	0.115	4.2	LOS A	0.2	5.3	0.20	0.44	0.20	20.6
Approach		144	3.0	144	3.0	0.115	3.4	LOS A	0.2	5.3	0.20	0.44	0.20	18.6
North: SB Vernon														
7	L2	71	3.0	71	3.0	0.113	5.8	LOS A	0.2	5.1	0.22	0.52	0.22	20.8
14	R2	94	0.0	94	0.0	0.113	2.9	LOS A	0.2	5.1	0.22	0.52	0.22	19.3
Approach		165	1.3	165	1.3	0.113	4.2	LOS A	0.2	5.1	0.22	0.52	0.22	20.0
West: EB Davies														
5	L2	51	3.0	51	3.0	0.093	4.8	LOS A	0.2	4.2	0.20	0.49	0.20	20.7
2	T1	65	3.0	65	3.0	0.093	2.5	LOS A	0.2	4.2	0.20	0.49	0.20	18.7
Approach		116	3.0	116	3.0	0.093	3.5	LOS A	0.2	4.2	0.20	0.49	0.20	19.8
All Vehicles		441	2.4	441	2.4	0.115	3.8	LOS A	0.2	5.3	0.21	0.49	0.21	19.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2021 PM

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**
Average Results from 11 Runs **2021 No Build**
Approach Delay and LOS **PM Peak Hour**

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	28.5	C	20.1	C	53.2	D	51.3	D	30.8	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	35.9	D	36.0	D	16.5	B	49.7	D	30.0	C	
4	SR 9/Market Pl	Signal	45.7	D	39.8	D	58.0	E	62.3	E	48.8	D	
5	91st Ave/SR 204	Signal	30.3	C	32.9	C	40.3	D	26.4	C	34.8	C	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	34.0	C	17.7	B	16.2	B	41.0	D	21.2	C	
7	Vernon Rd/7th Pl	Side-street Stop							12.2	B	12.2	B	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	1.3	A	0.5	A	7.6	A	9.3	A	12.8	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	5.4	A	4.0	A	2.3	A	3.8	A	3.9	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.5	A					7.9	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	10.4	B	8.5	A	1.1	A	0.5	A	17.3	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			13.0	B	4.9	A			13.6	B	SB RT
13	91st Ave/Market Pl	Signal	16.0	B	14.3	B	11.9	B	16.6	B	15.0	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.6	A	3.6	A	11.0	B	5.8	A	12.3	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout	6.4	A	4.6	A			8.7	A	6.8	A	

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 Tight Diamond
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	29.9	C	18.8	B	54.4	D	52.9	D	31.5	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	79.7	E	18.8	B	22.5	C	51.7	D	34.3	C	
4	SR 9/Market Pl	Signal	31.5	C	22.8	C	44.7	D	48.4	D	33.3	C	
5	91st Ave/SR 204	Signal	41.2	D	37.4	D	44.8	D	36.0	D	41.5	D	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	35.1	D	18.3	B	15.9	B	39.6	D	21.3	C	
7	Vernon Rd/7th Pl	Side-street Stop							7.0	A	7.0	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	1.3	A	0.2	A	7.3	A	8.7	A	10.6	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	4.1	A	4.4	A	2.3	A	2.7	A	3.2	A	
11	Transit Center Dwy/4th St	Side-street Stop	9.0	A	8.7	A	0.5	A	0.1	A	14.8	B	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			8.8	A	4.0	A			8.9	A	SB RT
13	91st Ave/Market Pl	Signal	14.4	B	14.3	B	9.0	A	17.9	B	14.7	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.9	A	1.0	A	9.1	A	4.7	A	10.9	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout	5.2	A	4.9	A			2.0	A	3.1	A	
16	Parking Lot Connector/7th Place	Side-street Stop	3.1	A	5.5	A			8.8	A	9.0	A	WB TH
17	92nd Ave/Slip Ramp	All-way Stop	7.5	A	6.9	A			6.3	A	7.1	A	
221	SR 9/4th St NE	Side-street Stop			0.3	A					0.3	A	SB TH

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 At Grade Widening
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	24.5	C	19.7	B	53.1	D	51.1	D	28.6	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	28.2	C	35.3	D	18.3	B	51.0	D	28.6	C	
4	SR 9/Market Pl	Signal	32.8	C	9.8	A	35.1	D	38.4	D	26.6	C	
5	91st Ave/SR 204	Signal	34.4	C	34.5	C	41.7	D	32.7	C	37.7	D	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	33.8	C	17.4	B	16.0	B	42.4	D	21.2	C	
7	Vernon Rd/7th Pl	Side-street Stop							11.8	B	11.8	B	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	1.3	A	0.0	A	7.5	A	9.4	A	13.5	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	5.3	A	4.3	A	2.2	A	3.8	A	3.8	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.5	A					8.0	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	10.1	B	8.6	A	0.8	A	0.6	A	17.1	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			7.4	A	3.8	A			7.8	A	SB LT
13	91st Ave/Market Pl	Signal	40.7	D	32.3	C	10.9	B	14.1	B	25.1	C	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.5	A	3.3	A	10.4	B	5.4	A	11.8	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout	6.0	A	4.5	A			8.5	A	6.6	A	

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2021 Roundabout Concept
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	21.3	C	19.9	B	56.0	E	51.0	D	27.2	C	
2	SR 9/Davies Rd	Roundabout											
3	SR 9/SR 204	Roundabout											
4	SR 9/Market Pl	Signal	31.2	C	26.4	C	36.3	D	45.0	D	32.7	C	
5	91st Ave/SR 204	Signal	43.5	D	32.6	C	43.0	D	43.5	D	41.8	D	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	34.7	C	16.2	B	17.7	B	37.0	D	21.3	C	
8	91st Ave/Vernon Rd	Roundabout											
9	Safeway Dwy/Davies Rd	Roundabout	6.8	A	11.6	B	2.2	A	8.3	A	5.6	A	
11	Transit Center Dwy/4th St	Side-street Stop	8.4	A	8.3	A	0.0	A	0.5	A	9.5	A	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			8.4	A	3.4	A			8.5	A	SB RT
13	91st Ave/Market Pl	Signal	12.8	B	12.5	B	11.5	B	14.7	B	13.1	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.7	A	4.4	A	11.3	B	5.9	A	11.9	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout											

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.
Intersections 2, 3, 8, and 15 are analyzed and reported from SIDRA

Sidra Roundabout LOS Results

2021 PM

#	Intersection	Sidra Model		HCM Model		Average	
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
2	9/Davies	5.4	A	14.2	B	10	B
3	9/204	5.8	A	19.9	B	13	B
8	91st/Vernon	6.8	A	6.6	A	7	A
15	Davies/Vernon	5.8	A	5.6	A	6	A

MOVEMENT SUMMARY

Site: 2 [2021PM-P2 SR9 & SR204]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	63	3.0	55	3.0	0.415	13.1	LOS B	1.0	25.9	0.75	0.74	0.80	26.9
8	T1	934	3.0	815	3.0	0.415	6.8	LOS A	1.2	30.5	0.78	0.65	0.79	27.1
18	R2	89	3.0	78	3.0	0.048	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		1086	3.0	947[N1]	3.0	0.415	6.9	LOS A	1.2	30.5	0.71	0.64	0.73	27.6
East: WB 7th														
1	L2	80	3.0	80	3.0	0.219	6.7	LOS A	0.4	10.5	0.72	0.76	0.72	16.2
6	T1	61	3.0	61	3.0	0.219	4.0	LOS A	0.4	10.5	0.72	0.76	0.72	16.2
16	R2	159	3.0	159	3.0	0.179	3.1	LOS A	0.4	9.9	0.74	0.65	0.74	16.9
Approach		300	3.0	300	3.0	0.219	4.2	LOS A	0.4	10.5	0.73	0.70	0.73	16.6
North: SB SR 9														
7	L2	125	3.0	125	3.0	0.310	8.0	LOS A	0.8	19.3	0.41	0.40	0.41	27.2
4	T1	761	3.0	761	3.0	0.310	2.0	LOS A	0.8	20.3	0.40	0.30	0.40	23.2
14	R2	406	3.0	406	3.0	0.250	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.3
Approach		1292	3.0	1292	3.0	0.310	2.5	LOS A	0.8	20.3	0.28	0.31	0.28	24.6
West: EB 7th														
5	L2	705	3.0	705	3.0	0.440	10.8	LOS B	0.9	22.2	0.55	0.78	0.59	18.8
2	T1	359	3.0	359	3.0	0.440	6.2	LOS A	0.9	22.2	0.53	0.70	0.55	19.8
12	R2	57	3.0	57	3.0	0.048	4.8	LOS A	0.1	1.6	0.41	0.58	0.41	21.9
Approach		1121	3.0	1121	3.0	0.440	9.0	LOS A	0.9	22.2	0.54	0.74	0.57	19.3
All Vehicles		3799	3.0	3660[N1]	3.1	0.440	5.8	LOS A	1.2	30.5	0.51	0.56	0.52	23.1

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101vv [2021PM-P2 91st & Vernon]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	37	3.0	37	3.0	0.510	9.4	LOS A	1.3	32.6	0.34	0.24	0.34	19.0
8	T1	94	3.0	94	3.0	0.510	9.4	LOS A	1.3	32.6	0.34	0.24	0.34	19.6
18	R2	409	3.0	409	3.0	0.510	9.4	LOS A	1.3	32.6	0.34	0.24	0.34	12.2
Approach		540	3.0	539[N1]	3.0	0.510	9.4	LOS A	1.3	32.6	0.34	0.24	0.34	14.5
East: WB Vernon														
1	L2	93	3.0	93	3.0	0.155	4.0	LOS A	0.4	9.5	0.31	0.15	0.31	18.2
6	T1	61	3.0	61	3.0	0.155	4.0	LOS A	0.4	9.5	0.31	0.15	0.31	24.4
16	R2	51	3.0	51	3.0	0.155	4.0	LOS A	0.4	9.5	0.31	0.15	0.31	24.1
Approach		205	3.0	205	3.0	0.155	4.0	LOS A	0.4	9.5	0.31	0.15	0.31	22.1
North: SB 91st														
7	L2	1	3.0	1	3.0	0.124	4.4	LOS A	0.2	6.1	0.34	0.21	0.34	20.6
4	T1	112	3.0	112	3.0	0.124	4.4	LOS A	0.2	6.1	0.34	0.21	0.34	20.6
14	R2	19	3.0	19	3.0	0.124	4.4	LOS A	0.2	6.1	0.34	0.21	0.34	23.8
Approach		132	3.0	132	3.0	0.124	4.4	LOS A	0.2	6.1	0.34	0.21	0.34	21.3
West: EB Vernon														
5	L2	16	3.0	16	3.0	0.203	4.6	LOS A	0.4	10.4	0.35	0.22	0.35	26.4
2	T1	177	3.0	177	3.0	0.203	4.6	LOS A	0.4	10.4	0.35	0.22	0.35	20.6
12	R2	62	3.0	62	3.0	0.203	4.6	LOS A	0.4	10.4	0.35	0.22	0.35	20.6
Approach		255	3.0	255	3.0	0.203	4.6	LOS A	0.4	10.4	0.35	0.22	0.35	21.1
All Vehicles		1132	3.0	1131[N1]	3.0	0.510	6.8	LOS A	1.3	32.6	0.34	0.22	0.34	18.0

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1a [2021PM-P2 Davies & Vernon]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	32	3.0	32	3.0	0.076	9.6	LOS A	0.2	4.2	0.70	0.74	0.70	13.5
8	T1	9	3.0	9	3.0	0.076	7.3	LOS A	0.2	4.2	0.70	0.74	0.70	17.3
18	R2	2	3.0	2	3.0	0.076	8.5	LOS A	0.2	4.2	0.70	0.74	0.70	15.4
Approach		43	3.0	43	3.0	0.076	9.1	LOS A	0.2	4.2	0.70	0.74	0.70	14.7
East: WB Davies														
6	T1	115	3.0	115	3.0	0.444	5.3	LOS A	1.1	28.7	0.61	0.70	0.61	14.0
16	R2	276	3.0	276	3.0	0.444	6.4	LOS A	1.1	28.7	0.61	0.70	0.61	19.0
Approach		391	3.0	391	3.0	0.444	6.1	LOS A	1.1	28.7	0.61	0.70	0.61	18.1
North: SB Vernon														
7	L2	255	3.0	255	3.0	0.287	6.3	LOS A	0.7	18.1	0.38	0.60	0.38	19.7
14	R2	70	0.0	70	0.0	0.287	3.5	LOS A	0.7	18.1	0.38	0.60	0.38	18.0
Approach		325	2.4	325	2.4	0.287	5.7	LOS A	0.7	18.1	0.38	0.60	0.38	19.4
West: EB Davies														
5	L2	286	3.0	277	3.0	0.427	6.3	LOS A	1.1	27.6	0.53	0.66	0.53	19.3
2	T1	162	3.0	157	3.0	0.427	3.9	LOS A	1.1	27.6	0.53	0.66	0.53	16.9
Approach		448	3.0	434 N1	3.0	0.427	5.4	LOS A	1.1	27.6	0.53	0.66	0.53	18.6
All Vehicles		1207	2.8	1193 N1	2.9	0.444	5.8	LOS A	1.1	28.7	0.52	0.66	0.52	18.5

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1 [2021PM-P2 SR9 & Davies]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1583	3.0	1478	3.0	0.600	3.7	LOS A	1.8	44.8	0.67	0.49	0.75	26.4
18	R2	215	3.0	201	3.0	0.127	2.7	LOS A	0.3	6.4	0.33	0.39	0.33	23.2
Approach		1798	3.0	1679 N1	3.0	0.600	3.6	LOS A	1.8	44.8	0.63	0.48	0.70	26.2
East: WB Davies														
1	L2	105	3.0	105	3.0	0.193	10.0	LOS B	0.4	10.5	0.78	0.89	0.78	12.2
1a	L1	29	3.0	29	3.0	0.193	8.3	LOS A	0.4	10.5	0.81	0.87	0.81	12.1
16	R2	84	3.0	84	3.0	0.193	5.2	LOS A	0.4	10.5	0.81	0.87	0.81	20.5
Approach		218	3.0	218	3.0	0.193	7.9	LOS A	0.4	10.5	0.79	0.88	0.79	16.0
North: SB SR 9														
7	L2	28	3.0	28	3.0	0.515	12.4	LOS B	1.4	35.2	0.40	0.55	0.40	27.1
4	T1	1186	3.0	1186	3.0	0.515	6.4	LOS A	1.4	35.9	0.39	0.54	0.39	27.4
14a	R1	137	3.0	137	3.0	0.515	5.8	LOS A	1.4	35.9	0.39	0.53	0.39	27.6
Approach		1351	3.0	1351	3.0	0.515	6.5	LOS A	1.4	35.9	0.39	0.54	0.39	27.4
SouthWest: NE Vernon W														
5ax	L1	357	3.0	357	3.0	0.425	8.7	LOS A	1.0	24.9	0.76	0.93	0.87	21.1
12ax	R1	205	3.0	205	3.0	0.338	5.1	LOS A	0.6	16.4	0.74	0.76	0.79	18.3
Approach		562	3.0	562	3.0	0.425	7.4	LOS A	1.0	24.9	0.75	0.87	0.84	20.5
All Vehicles		3929	3.0	3809 N1	3.1	0.600	5.4	LOS A	1.8	44.8	0.57	0.58	0.62	24.9

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1 [2021PM-P2 SR9 & Davies]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1583	3.0	1478	3.0	0.940	19.8	LOS D	6.3	161.3	1.00	1.61	2.38	18.1
18	R2	215	3.0	201	3.0	0.179	3.1	LOS A	0.3	7.3	0.35	0.45	0.35	23.0
Approach		1798	3.0	1679[N1]	3.0	0.940	17.8	LOS B	6.3	161.3	0.92	1.47	2.14	18.3
East: WB Davies														
1	L2	105	3.0	105	3.0	0.430	23.0	LOS C	0.6	15.5	0.89	1.05	1.18	7.3
1a	L1	29	3.0	29	3.0	0.430	19.0	LOS B	0.6	15.5	0.87	1.01	1.16	6.3
16	R2	84	3.0	84	3.0	0.430	15.9	LOS B	0.6	15.5	0.87	1.01	1.16	14.1
Approach		218	3.0	218	3.0	0.430	19.8	LOS B	0.6	15.5	0.88	1.03	1.17	10.0
North: SB SR 9														
7	L2	28	3.0	28	3.0	0.568	12.8	LOS B	1.6	40.3	0.46	0.57	0.46	26.5
4	T1	1186	3.0	1186	3.0	0.568	6.7	LOS A	1.6	40.3	0.45	0.56	0.45	26.8
14a	R1	137	3.0	137	3.0	0.568	6.1	LOS A	1.5	39.6	0.44	0.55	0.44	27.1
Approach		1351	3.0	1351	3.0	0.568	6.8	LOS A	1.6	40.3	0.45	0.56	0.45	26.8
SouthWest: NE Vernon W														
5ax	L1	357	3.0	357	3.0	0.821	23.2	LOS C	2.2	56.1	0.91	1.36	1.94	15.0
12ax	R1	205	3.0	205	3.0	0.545	12.7	LOS B	1.0	24.4	0.84	0.99	1.22	13.2
Approach		562	3.0	562	3.0	0.821	19.3	LOS B	2.2	56.1	0.89	1.23	1.68	14.6
All Vehicles		3929	3.0	3809[N1]	3.1	0.940	14.2	LOS B	6.3	161.3	0.75	1.09	1.42	18.7

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 2 [2021PM-P2 SR9 & SR204]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	63	3.0	55	3.0	0.934	39.8	LOS D	3.8	96.8	0.96	1.49	2.81	14.5
8	T1	934	3.0	815	3.0	0.934	31.9	LOS D	3.9	101.0	0.96	1.49	2.80	15.2
18	R2	89	3.0	78	3.0	0.048	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		1086	3.0	947[N1]	3.0	0.934	30.1	LOS C	3.9	101.0	0.88	1.40	2.57	16.1
East: WB 7th														
1	L2	80	3.0	80	3.0	0.471	17.4	LOS B	0.7	18.5	0.86	1.04	1.18	12.0
6	T1	61	3.0	61	3.0	0.471	14.7	LOS B	0.7	18.5	0.86	1.04	1.18	12.0
16	R2	159	3.0	159	3.0	0.452	11.9	LOS B	0.7	17.6	0.84	0.97	1.12	12.4
Approach		300	3.0	300	3.0	0.471	13.9	LOS B	0.7	18.5	0.85	1.00	1.15	12.2
North: SB SR 9														
7	L2	125	3.0	125	3.0	0.386	8.2	LOS A	0.8	21.2	0.43	0.41	0.43	27.3
4	T1	761	3.0	761	3.0	0.386	2.3	LOS A	0.8	21.2	0.43	0.34	0.43	23.0
14	R2	406	3.0	406	3.0	0.250	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.3
Approach		1292	3.0	1292	3.0	0.386	2.7	LOS A	0.8	21.2	0.29	0.33	0.29	24.4
West: EB 7th														
5	L2	705	3.0	705	3.0	0.953	36.3	LOS E	5.1	129.7	0.95	1.63	2.93	9.0
2	T1	359	3.0	359	3.0	0.953	30.0	LOS E	5.1	129.7	0.96	1.63	2.92	12.4
12	R2	57	3.0	57	3.0	0.109	8.5	LOS A	0.1	3.8	0.63	0.78	0.63	18.1
Approach		1121	3.0	1121	3.0	0.953	32.8	LOS C	5.1	129.7	0.94	1.59	2.81	10.4
All Vehicles		3799	3.0	3660[N1]	3.1	0.953	19.9	LOS B	5.1	129.7	0.69	1.05	1.72	15.0

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101vv [2021PM-P2 91st & Vernon]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	37	3.0	37	3.0	0.482	8.6	LOS A	1.3	32.9	0.52	0.37	0.52	19.5
8	T1	94	3.0	94	3.0	0.482	8.6	LOS A	1.3	32.9	0.52	0.37	0.52	20.2
18	R2	409	3.0	409	3.0	0.482	8.6	LOS A	1.3	32.9	0.52	0.37	0.52	12.7
Approach		540	3.0	539[N1]	3.0	0.482	8.6	LOS A	1.3	32.9	0.52	0.37	0.52	15.0
East: WB Vernon														
1	L2	93	3.0	93	3.0	0.170	4.5	LOS A	0.3	7.3	0.28	0.16	0.28	17.7
6	T1	61	3.0	61	3.0	0.170	4.5	LOS A	0.3	7.3	0.28	0.16	0.28	24.0
16	R2	51	3.0	51	3.0	0.170	4.5	LOS A	0.3	7.3	0.28	0.16	0.28	23.7
Approach		205	3.0	205	3.0	0.170	4.5	LOS A	0.3	7.3	0.28	0.16	0.28	21.7
North: SB 91st														
7	L2	1	3.0	1	3.0	0.117	4.2	LOS A	0.2	5.2	0.34	0.21	0.34	20.8
4	T1	112	3.0	112	3.0	0.117	4.2	LOS A	0.2	5.2	0.34	0.21	0.34	20.8
14	R2	19	3.0	19	3.0	0.117	4.2	LOS A	0.2	5.2	0.34	0.21	0.34	24.0
Approach		132	3.0	132	3.0	0.117	4.2	LOS A	0.2	5.2	0.34	0.21	0.34	21.5
West: EB Vernon														
5	L2	16	3.0	16	3.0	0.230	5.4	LOS A	0.5	11.7	0.40	0.27	0.40	25.7
2	T1	177	3.0	177	3.0	0.230	5.4	LOS A	0.5	11.7	0.40	0.27	0.40	19.8
12	R2	62	3.0	62	3.0	0.230	5.4	LOS A	0.5	11.7	0.40	0.27	0.40	19.8
Approach		255	3.0	255	3.0	0.230	5.4	LOS A	0.5	11.7	0.40	0.27	0.40	20.3
All Vehicles		1132	3.0	1131[N1]	3.0	0.482	6.6	LOS A	1.3	32.9	0.43	0.29	0.43	18.1

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1a [2021PM-P2 Davies & Vernon]

Network: N101 [2021PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	32	3.0	32	3.0	0.066	7.8	LOS A	0.1	2.6	0.59	0.75	0.59	14.5
8	T1	9	3.0	9	3.0	0.066	5.5	LOS A	0.1	2.6	0.59	0.75	0.59	18.1
18	R2	2	3.0	2	3.0	0.066	6.7	LOS A	0.1	2.6	0.59	0.75	0.59	16.2
Approach		43	3.0	43	3.0	0.066	7.3	LOS A	0.1	2.6	0.59	0.75	0.59	15.6
East: WB Davies														
6	T1	115	3.0	115	3.0	0.408	4.9	LOS A	0.9	22.7	0.57	0.70	0.57	14.4
16	R2	276	3.0	276	3.0	0.408	6.0	LOS A	0.9	22.7	0.57	0.70	0.57	19.2
Approach		391	3.0	391	3.0	0.408	5.7	LOS A	0.9	22.7	0.57	0.70	0.57	18.4
North: SB Vernon														
7	L2	255	3.0	255	3.0	0.259	6.1	LOS A	0.6	14.8	0.35	0.59	0.35	19.8
14	R2	70	0.0	70	0.0	0.259	3.4	LOS A	0.6	14.8	0.35	0.59	0.35	18.1
Approach		325	2.4	325	2.4	0.259	5.5	LOS A	0.6	14.8	0.35	0.59	0.35	19.5
West: EB Davies														
5	L2	286	3.0	277	3.0	0.423	6.2	LOS A	1.0	24.9	0.54	0.68	0.54	19.3
2	T1	162	3.0	157	3.0	0.423	3.9	LOS A	1.0	24.9	0.54	0.68	0.54	16.9
Approach		448	3.0	434 N1	3.0	0.423	5.4	LOS A	1.0	24.9	0.54	0.68	0.54	18.6
All Vehicles		1207	2.8	1193 N1	2.9	0.423	5.6	LOS A	1.0	24.9	0.50	0.67	0.50	18.7

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

2040 AM

Vissim Post-Processor **SR 9 & SR 204 Intersection Improvements**

Average Results from 11 Runs **2040 No Build**

Approach Delay and LOS **AM Peak Hour**

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	20.0	C	18.9	B	46.5	D	43.1	D	24.6	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	1.0	A	1.2	A					1.7	A	SB RT
3	SR 9/SR 204	Signal	31.5	C	37.1	D	16.5	B	99.9	F	36.2	D	
4	SR 9/Market Pl	Signal	29.4	C	27.3	C	35.7	D	35.9	D	30.1	C	
5	91st Ave/SR 204	Signal	29.8	C	23.8	C	31.4	C	21.9	C	27.4	C	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	24.0	C	14.5	B	11.8	B	17.4	B	14.7	B	
7	Vernon Rd/7th Pl	Side-street Stop					0.2	A	8.1	A	8.1	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	2.9	A	10.9	B	19.4	C	29.6	D	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	1.8	A	1.7	A	1.0	A	1.3	A	1.4	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.2	A			0.5	A	7.8	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	10.3	B	6.5	A	0.2	A	0.3	A	19.7	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			6.0	A	2.7	A	0.7	A	6.0	A	SB RT
13	91st Ave/Market Pl	Signal	9.2	A	8.1	A	7.2	A	9.2	A	8.6	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.5	A	1.3	A	8.7	A	6.6	A	8.9	A	EB LT
15	Vernon Rd/Davies Rd	Roundabout	1.6	A	2.7	A			1.7	A	2.1	A	

Notes:

Assumes default directions (N, S, E, & W) at all intersections.

For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.

LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Tight Diamond
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	27.3	C	20.2	C	56.0	E	49.0	D	29.9	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	55.8	E	13.6	B	32.0	C	49.4	D	33.5	C	
4	SR 9/Market Pl	Signal	26.8	C	21.7	C	31.9	C	42.4	D	26.9	C	
5	91st Ave/SR 204	Signal	31.7	C	26.3	C	34.3	C	21.2	C	28.6	C	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	30.5	C	17.6	B	9.3	A	15.8	B	13.8	B	
7	Vernon Rd/7th Pl	Side-street Stop					0.3	A	5.5	A	5.5	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.4	A	5.8	A	6.6	A	7.6	A	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	2.0	A	2.1	A	1.2	A	1.3	A	1.5	A	
11	Transit Center Dwy/4th St	Side-street Stop	10.8	B	6.7	A	0.5	A	0.3	A	17.3	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			6.4	A	2.7	A	1.1	A	6.6	A	SB RT
13	91st Ave/Market Pl	Signal	10.3	B	9.2	A	7.2	A	10.4	B	9.2	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.2	A	0.7	A	8.5	A	5.8	A	9.1	A	EB LT
15	Vernon Rd/Davies Rd	Roundabout	1.9	A	2.4	A			1.0	A	1.8	A	
16	Parking Lot Connector/7th Place	Side-street Stop	2.7	A	4.3	A	0.3	A	7.8	A	7.8	A	WB TH
17	92nd Ave/Slip Ramp	All-way Stop	7.5	A	6.4	A			6.2	A	6.7	A	
221	SR 9/4th St NE	Side-street Stop	0.7	A	0.3	A					0.8	A	NB RT

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 At Grade Widening
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	19.2	B	17.9	B	37.8	D	37.0	D	22.5	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled	0.7	A	0.3	A					0.7	A	SB RT
3	SR 9/SR 204	Signal	30.9	C	25.4	C	20.1	C	118.1	F	34.3	C	
4	SR 9/Market Pl	Signal	24.2	C	11.0	B	34.8	C	37.7	D	20.9	C	
5	91st Ave/SR 204	Signal	28.7	C	34.4	C	28.4	C	17.8	B	26.3	C	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	25.4	C	14.9	B	11.6	B	19.5	B	15.4	B	
7	Vernon Rd/7th Pl	Side-street Stop					0.2	A	7.7	A	7.7	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	0.6	A	0.6	A	6.2	A	8.0	A	10.3	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	1.8	A	1.8	A	0.9	A	1.3	A	1.4	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.0	A			0.5	A	7.8	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	10.4	B	6.5	A	0.3	A	0.3	A	19.9	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			6.0	A	2.6	A	0.7	A	6.1	A	SB RT
13	91st Ave/Market Pl	Signal	27.8	C	23.6	C	6.6	A	8.1	A	15.6	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	0.5	A	1.2	A	8.9	A	6.6	A	9.2	A	EB TH
15	Vernon Rd/Davies Rd	Roundabout	1.5	A	2.7	A			1.8	A	2.1	A	

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Roundabout Concept
AM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	18.7	B	19.1	B	49.9	D	45.0	D	24.6	C	
2	SR 9/Davies Rd	Roundabout											
3	SR 9/SR 204	Roundabout											
4	SR 9/Market Pl	Signal	31.4	C	25.6	C	36.8	D	36.2	D	29.9	C	
5	91st Ave/SR 204	Signal	29.7	C	27.4	C	27.6	C	23.5	C	26.5	C	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	26.0	C	15.4	B	11.9	B	18.4	B	15.3	B	
8	91st Ave/Vernon Rd	Roundabout											
9	Safeway Dwy/Davies Rd	Roundabout	1.4	A	1.4	A	1.0	A	1.0	A	1.1	A	
11	Transit Center Dwy/4th St	Side-street Stop	8.5	A	3.6	A	0.2	A	0.1	A	10.7	B	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			3.5	A	2.9	A			6.0	A	SB RT
13	91st Ave/Market Pl	Signal	9.5	A	8.2	A	7.2	A	8.9	A	8.7	A	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.0	A	1.1	A	9.1	A	6.5	A	9.4	A	EB TH
15	Vernon Rd/Davies Rd	Roundabout											

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.
Intersections 2, 3, 8, and 15 are analyzed and reported from SIDRA

Sidra Roundabout LOS Results

2040 AM

#	Intersection	Sidra Model		HCM Model		Average	
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
2	9/Davies	5	A	8	A	7	A
3	9/204	5	A	14	B	10	B
8	91st/Vernon	4	A	4	A	4	A
15	Davies/Vernon	4	A	4	A	4	A

MOVEMENT SUMMARY

Site: 1 [2040AM-P2 SR9 & Davies]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1596	3.0	1492	3.0	0.502	2.1	LOS A	1.3	32.8	0.39	0.25	0.39	28.2
18	R2	119	3.0	111	3.0	0.064	2.3	LOS A	0.1	2.6	0.13	0.32	0.13	24.6
Approach		1715	3.0	1603 N1	3.0	0.502	2.1	LOS A	1.3	32.8	0.37	0.26	0.37	28.0
East: WB Davies														
1	L2	256	3.0	256	3.0	0.205	8.2	LOS A	0.4	9.6	0.69	0.85	0.69	13.4
1a	L1	17	3.0	17	3.0	0.205	6.9	LOS A	0.4	9.6	0.69	0.84	0.69	13.8
16	R2	31	3.0	31	3.0	0.205	3.9	LOS A	0.4	9.6	0.69	0.84	0.69	20.5
Approach		304	3.0	304	3.0	0.205	7.7	LOS A	0.4	9.6	0.69	0.85	0.69	14.5
North: SB SR 9														
7	L2	33	3.0	33	3.0	0.652	13.6	LOS B	2.0	51.4	0.60	0.67	0.64	25.3
4	T1	1454	3.0	1454	3.0	0.652	7.5	LOS A	2.0	51.4	0.59	0.65	0.62	25.5
14a	R1	97	3.0	97	3.0	0.652	6.7	LOS A	2.0	51.4	0.58	0.63	0.61	25.7
Approach		1584	3.0	1584	3.0	0.652	7.5	LOS A	2.0	51.4	0.59	0.64	0.62	25.5
SouthWest: NE Vernon W														
5ax	L1	117	3.0	117	3.0	0.170	8.4	LOS A	0.3	8.9	0.78	0.88	0.78	21.3
12ax	R1	27	3.0	27	3.0	0.055	5.1	LOS A	0.1	2.5	0.75	0.73	0.75	18.3
Approach		144	3.0	144	3.0	0.170	7.8	LOS A	0.3	8.9	0.77	0.85	0.77	21.0
All Vehicles		3747	3.0	3635 N1	3.1	0.652	5.2	LOS A	2.0	51.4	0.51	0.50	0.52	25.9

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 2 [2040AM-P2 SR9 & SR204]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	45	3.0	39	3.0	0.352	12.0	LOS B	0.7	18.9	0.66	0.62	0.66	27.7
8	T1	879	3.0	767	3.0	0.352	5.9	LOS A	0.9	22.2	0.66	0.56	0.66	27.8
18	R2	53	3.0	46	3.0	0.028	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		977	3.0	852[N1]	3.0	0.352	6.1	LOS A	0.9	22.2	0.63	0.56	0.63	28.2
East: WB 7th														
1	L2	30	3.0	30	3.0	0.063	6.2	LOS A	0.1	3.4	0.73	0.66	0.73	16.3
6	T1	23	3.0	23	3.0	0.063	3.6	LOS A	0.1	3.4	0.73	0.66	0.73	16.3
16	R2	39	3.0	39	3.0	0.061	4.4	LOS A	0.1	2.9	0.70	0.64	0.70	16.3
Approach		92	3.0	92	3.0	0.063	4.8	LOS A	0.1	3.4	0.72	0.65	0.72	16.3
North: SB SR 9														
7	L2	84	3.0	84	3.0	0.382	7.6	LOS A	1.0	25.6	0.30	0.29	0.30	28.5
4	T1	1093	3.0	1093	3.0	0.382	1.7	LOS A	1.0	26.3	0.29	0.24	0.29	24.3
14	R2	533	3.0	533	3.0	0.382	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.2
Approach		1710	3.0	1710	3.0	0.382	2.0	LOS A	1.0	26.3	0.20	0.26	0.20	25.1
West: EB 7th														
5	L2	796	3.0	796	3.0	0.379	11.1	LOS B	0.7	18.8	0.59	0.82	0.61	18.4
2	T1	58	3.0	58	3.0	0.379	6.7	LOS A	0.7	18.8	0.58	0.79	0.59	19.2
12	R2	85	3.0	85	3.0	0.071	5.2	LOS A	0.1	2.6	0.47	0.62	0.47	21.5
Approach		939	3.0	939	3.0	0.379	10.3	LOS B	0.7	18.8	0.58	0.80	0.59	18.7
All Vehicles		3718	3.0	3593[N1]	3.1	0.382	5.2	LOS A	1.0	26.3	0.41	0.48	0.42	24.0

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101vv [2040AM-P2 91st & Vernon]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	7	3.0	7	3.0	0.129	4.0	LOS A	0.2	5.2	0.09	0.03	0.09	22.7
8	T1	20	3.0	20	3.0	0.129	4.0	LOS A	0.2	5.2	0.09	0.03	0.09	23.7
18	R2	130	3.0	130	3.0	0.129	4.0	LOS A	0.2	5.2	0.09	0.03	0.09	16.1
Approach		157	3.0	157	3.0	0.129	4.0	LOS A	0.2	5.2	0.09	0.03	0.09	17.9
East: WB Vernon														
1	L2	81	3.0	81	3.0	0.095	3.3	LOS A	0.2	4.9	0.12	0.03	0.12	18.4
6	T1	30	3.0	30	3.0	0.095	3.3	LOS A	0.2	4.9	0.12	0.03	0.12	24.5
16	R2	24	3.0	24	3.0	0.095	3.3	LOS A	0.2	4.9	0.12	0.03	0.12	24.2
Approach		135	3.0	135	3.0	0.095	3.3	LOS A	0.2	4.9	0.12	0.03	0.12	21.4
North: SB 91st														
7	L2	2	3.0	2	3.0	0.081	3.9	LOS A	0.1	3.6	0.25	0.12	0.25	21.3
4	T1	82	3.0	82	3.0	0.081	3.9	LOS A	0.1	3.6	0.25	0.12	0.25	21.3
14	R2	8	3.0	8	3.0	0.081	3.9	LOS A	0.1	3.6	0.25	0.12	0.25	24.3
Approach		92	3.0	92	3.0	0.081	3.9	LOS A	0.1	3.6	0.25	0.12	0.25	21.7
West: EB Vernon														
5	L2	7	3.0	7	3.0	0.032	3.0	LOS A	0.1	1.4	0.27	0.13	0.27	27.6
2	T1	18	3.0	18	3.0	0.032	3.0	LOS A	0.1	1.4	0.27	0.13	0.27	22.0
12	R2	16	3.0	16	3.0	0.032	3.0	LOS A	0.1	1.4	0.27	0.13	0.27	22.0
Approach		41	3.0	41	3.0	0.032	3.0	LOS A	0.1	1.4	0.27	0.13	0.27	23.3
All Vehicles		425	3.0	425	3.0	0.129	3.7	LOS A	0.2	5.2	0.15	0.06	0.15	20.5

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1a [2040AM-P2 Davies & Vernon]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	14	3.0	14	3.0	0.020	5.8	LOS A	0.0	0.9	0.43	0.55	0.43	15.5
8	T1	2	3.0	2	3.0	0.020	3.5	LOS A	0.0	0.9	0.43	0.55	0.43	19.0
18	R2	1	3.0	1	3.0	0.020	4.7	LOS A	0.0	0.9	0.43	0.55	0.43	17.1
Approach		17	3.0	17	3.0	0.020	5.5	LOS A	0.0	0.9	0.43	0.55	0.43	16.2
East: WB Davies														
6	T1	114	3.0	114	3.0	0.202	3.5	LOS A	0.4	10.1	0.28	0.49	0.28	16.1
16	R2	103	3.0	103	3.0	0.202	4.6	LOS A	0.4	10.1	0.28	0.49	0.28	20.2
Approach		217	3.0	217	3.0	0.202	4.0	LOS A	0.4	10.1	0.28	0.49	0.28	18.8
North: SB Vernon														
7	L2	96	3.0	96	3.0	0.191	6.1	LOS A	0.4	9.4	0.23	0.51	0.23	20.9
14	R2	176	0.0	176	0.0	0.191	3.0	LOS A	0.4	9.4	0.23	0.51	0.23	19.4
Approach		272	1.1	272	1.1	0.191	4.1	LOS A	0.4	9.4	0.23	0.51	0.23	20.0
West: EB Davies														
5	L2	95	3.0	91	3.0	0.147	5.0	LOS A	0.3	7.1	0.25	0.52	0.25	20.4
2	T1	84	3.0	80	3.0	0.147	2.7	LOS A	0.3	7.1	0.25	0.52	0.25	18.3
Approach		179	3.0	171[N1]	3.0	0.147	3.9	LOS A	0.3	7.1	0.25	0.52	0.25	19.6
All Vehicles		685	2.2	677[N1]	2.3	0.202	4.1	LOS A	0.4	10.1	0.25	0.51	0.25	19.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1 [2040AM-P2 SR9 & Davies]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1596	3.0	1492	3.0	0.652	3.0	LOS A	2.1	53.0	0.58	0.37	0.59	26.9
18	R2	119	3.0	111	3.0	0.085	2.4	LOS A	0.1	3.3	0.15	0.33	0.15	24.4
Approach		1715	3.0	1603 N1	3.0	0.652	3.0	LOS A	2.1	53.0	0.55	0.37	0.56	26.8
East: WB Davies														
1	L2	256	3.0	256	3.0	0.488	19.2	LOS B	0.8	19.4	0.86	1.06	1.20	8.2
1a	L1	17	3.0	17	3.0	0.488	17.0	LOS B	0.8	19.4	0.85	1.05	1.18	8.4
16	R2	31	3.0	31	3.0	0.488	13.9	LOS B	0.8	19.4	0.85	1.05	1.18	15.0
Approach		304	3.0	304	3.0	0.488	18.6	LOS B	0.8	19.4	0.86	1.06	1.20	9.1
North: SB SR 9														
7	L2	33	3.0	33	3.0	0.755	16.3	LOS B	3.3	84.2	0.80	0.85	0.98	23.6
4	T1	1454	3.0	1454	3.0	0.755	10.1	LOS B	3.3	84.2	0.79	0.84	0.96	23.8
14a	R1	97	3.0	97	3.0	0.755	9.2	LOS A	3.2	83.1	0.78	0.82	0.94	24.0
Approach		1584	3.0	1584	3.0	0.755	10.1	LOS B	3.3	84.2	0.79	0.84	0.96	23.8
SouthWest: NE Vernon W														
5ax	L1	117	3.0	117	3.0	0.390	17.6	LOS B	0.5	14.0	0.85	1.01	1.09	16.9
12ax	R1	27	3.0	27	3.0	0.107	12.5	LOS B	0.1	3.3	0.82	0.83	0.82	13.2
Approach		144	3.0	144	3.0	0.390	16.7	LOS B	0.5	14.0	0.85	0.97	1.04	16.5
All Vehicles		3747	3.0	3635 N1	3.1	0.755	7.9	LOS A	3.3	84.2	0.69	0.65	0.80	23.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 2 [2040AM-P2 SR9 & SR204]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	45	3.0	39	3.0	0.697	20.5	LOS C	1.7	44.0	0.82	1.05	1.34	22.6
8	T1	879	3.0	767	3.0	0.697	13.9	LOS B	1.8	45.2	0.82	1.04	1.32	23.3
18	R2	53	3.0	46	3.0	0.028	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		977	3.0	852[N1]	3.0	0.697	13.6	LOS B	1.8	45.2	0.77	1.01	1.25	23.8
East: WB 7th														
1	L2	30	3.0	30	3.0	0.161	11.5	LOS B	0.2	4.9	0.78	0.83	0.78	14.0
6	T1	23	3.0	23	3.0	0.161	8.9	LOS A	0.2	4.9	0.78	0.83	0.78	14.0
16	R2	39	3.0	39	3.0	0.134	10.7	LOS B	0.2	4.2	0.80	0.80	0.80	12.8
Approach		92	3.0	92	3.0	0.161	10.5	LOS B	0.2	4.9	0.79	0.82	0.79	13.5
North: SB SR 9														
7	L2	84	3.0	84	3.0	0.465	7.7	LOS A	1.2	30.3	0.33	0.30	0.33	28.4
4	T1	1093	3.0	1093	3.0	0.465	1.9	LOS A	1.2	30.3	0.33	0.26	0.33	24.0
14	R2	533	3.0	533	3.0	0.382	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.2
Approach		1710	3.0	1710	3.0	0.465	2.1	LOS A	1.2	30.3	0.23	0.27	0.23	24.9
West: EB 7th														
5	L2	796	3.0	796	3.0	0.952	40.7	LOS E	4.3	109.7	0.96	1.63	3.04	8.3
2	T1	58	3.0	58	3.0	0.952	34.5	LOS E	4.3	109.7	0.96	1.63	3.04	11.5
12	R2	85	3.0	85	3.0	0.204	10.7	LOS B	0.3	7.0	0.73	0.84	0.73	16.1
Approach		939	3.0	939	3.0	0.952	37.6	LOS D	4.3	109.7	0.94	1.56	2.83	8.8
All Vehicles		3718	3.0	3593[N1]	3.1	0.952	14.3	LOS B	4.3	109.7	0.56	0.80	1.17	17.3

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101vv [2040AM-P2 91st & Vernon]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	7	3.0	7	3.0	0.118	3.7	LOS A	0.2	5.7	0.12	0.03	0.12	23.1
8	T1	20	3.0	20	3.0	0.118	3.7	LOS A	0.2	5.7	0.12	0.03	0.12	24.0
18	R2	130	3.0	130	3.0	0.118	3.7	LOS A	0.2	5.7	0.12	0.03	0.12	16.4
Approach		157	3.0	157	3.0	0.118	3.7	LOS A	0.2	5.7	0.12	0.03	0.12	18.2
East: WB Vernon														
1	L2	81	3.0	81	3.0	0.102	3.5	LOS A	0.2	3.9	0.11	0.03	0.11	18.2
6	T1	30	3.0	30	3.0	0.102	3.5	LOS A	0.2	3.9	0.11	0.03	0.11	24.3
16	R2	24	3.0	24	3.0	0.102	3.5	LOS A	0.2	3.9	0.11	0.03	0.11	24.0
Approach		135	3.0	135	3.0	0.102	3.5	LOS A	0.2	3.9	0.11	0.03	0.11	21.2
North: SB 91st														
7	L2	2	3.0	2	3.0	0.076	3.6	LOS A	0.1	3.4	0.26	0.13	0.26	21.6
4	T1	82	3.0	82	3.0	0.076	3.6	LOS A	0.1	3.4	0.26	0.13	0.26	21.6
14	R2	8	3.0	8	3.0	0.076	3.6	LOS A	0.1	3.4	0.26	0.13	0.26	24.5
Approach		92	3.0	92	3.0	0.076	3.6	LOS A	0.1	3.4	0.26	0.13	0.26	22.0
West: EB Vernon														
5	L2	7	3.0	7	3.0	0.036	3.4	LOS A	0.1	1.5	0.30	0.15	0.30	27.2
2	T1	18	3.0	18	3.0	0.036	3.4	LOS A	0.1	1.5	0.30	0.15	0.30	21.6
12	R2	16	3.0	16	3.0	0.036	3.4	LOS A	0.1	1.5	0.30	0.15	0.30	21.6
Approach		41	3.0	41	3.0	0.036	3.4	LOS A	0.1	1.5	0.30	0.15	0.30	22.9
All Vehicles		425	3.0	425	3.0	0.118	3.6	LOS A	0.2	5.7	0.16	0.06	0.16	20.5

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1a [2040AM-P2 Davies & Vernon]

Network: N101 [2040AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	14	3.0	14	3.0	0.017	5.3	LOS A	0.0	0.7	0.38	0.55	0.38	15.8
8	T1	2	3.0	2	3.0	0.017	2.9	LOS A	0.0	0.7	0.38	0.55	0.38	19.2
18	R2	1	3.0	1	3.0	0.017	4.1	LOS A	0.0	0.7	0.38	0.55	0.38	17.4
Approach		17	3.0	17	3.0	0.017	4.9	LOS A	0.0	0.7	0.38	0.55	0.38	16.5
East: WB Davies														
6	T1	114	3.0	114	3.0	0.181	3.4	LOS A	0.3	8.9	0.27	0.49	0.27	16.1
16	R2	103	3.0	103	3.0	0.181	4.5	LOS A	0.3	8.9	0.27	0.49	0.27	20.2
Approach		217	3.0	217	3.0	0.181	3.9	LOS A	0.3	8.9	0.27	0.49	0.27	18.8
North: SB Vernon														
7	L2	96	3.0	96	3.0	0.182	6.0	LOS A	0.3	8.1	0.22	0.51	0.22	20.9
14	R2	176	0.0	176	0.0	0.182	2.9	LOS A	0.3	8.1	0.22	0.51	0.22	19.4
Approach		272	1.1	272	1.1	0.182	4.0	LOS A	0.3	8.1	0.22	0.51	0.22	20.1
West: EB Davies														
5	L2	95	3.0	91	3.0	0.141	5.0	LOS A	0.3	6.7	0.25	0.52	0.25	20.4
2	T1	84	3.0	80	3.0	0.141	2.6	LOS A	0.3	6.7	0.25	0.52	0.25	18.3
Approach		179	3.0	171 N1	3.0	0.141	3.9	LOS A	0.3	6.7	0.25	0.52	0.25	19.6
All Vehicles		685	2.2	677 N1	2.3	0.182	4.0	LOS A	0.3	8.9	0.25	0.51	0.25	19.5

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

2040 PM

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 No Build
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	24.4	C	23.4	C	56.9	E	57.4	E	31.4	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	42.9	D	70.5	E	18.1	B	99.7	F	49.0	D	
4	SR 9/Market Pl	Signal	124.8	F	87.5	F	70.6	E	95.1	F	97.2	F	
5	91st Ave/SR 204	Signal	81.4	F	39.3	D	63.3	E	26.1	C	55.0	E	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	35.1	D	20.0	C	22.0	C	42.9	D	26.4	C	
7	Vernon Rd/7th Pl	Side-street Stop							13.7	B	13.7	B	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	1.3	A	0.3	A	7.5	A	9.7	A	13.0	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	10.3	B	7.0	A	2.8	A	5.8	A	6.1	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.5	A					7.9	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	8.4	A	8.6	A	1.0	A	0.6	A	16.4	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			35.6	E	7.1	A			38.5	E	SB RT
13	91st Ave/Market Pl	Signal	18.5	B	16.1	B	14.2	B	19.9	B	17.7	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	2.6	A	3.4	A	11.5	B	6.2	A	12.6	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout	12.7	B	11.5	B			10.3	B	11.5	B	

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Tight Diamond
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	40.6	D	23.5	C	57.9	E	61.2	E	39.3	D	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	156.7	F	23.9	C	27.0	C	55.1	E	47.4	D	
4	SR 9/Market Pl	Signal	40.7	D	33.0	C	63.0	E	61.7	E	44.3	D	
5	91st Ave/SR 204	Signal	40.2	D	39.4	D	48.9	D	40.3	D	44.4	D	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	36.7	D	20.5	C	19.3	B	42.4	D	24.8	C	
7	Vernon Rd/7th Pl	Side-street Stop							7.7	A	7.7	A	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	1.4	A	0.1	A	8.7	A	9.5	A	11.5	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	7.5	A	5.3	A	3.2	A	3.9	A	4.9	A	
11	Transit Center Dwy/4th St	Side-street Stop	9.3	A	8.8	A	0.5	A	0.1	A	13.7	B	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			14.0	B	5.2	A			14.6	B	SB RT
13	91st Ave/Market Pl	Signal	19.1	B	22.7	C	10.8	B	24.3	C	20.8	C	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	1.1	A	1.3	A	11.0	B	5.4	A	13.1	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout	12.8	B	9.8	A			2.1	A	5.9	A	
16	Parking Lot Connector/7th Place	Side-street Stop	3.2	A	5.7	A			8.9	A	9.0	A	WB TH
17	92nd Ave/Slip Ramp	All-way Stop	7.6	A	6.8	A			6.2	A	7.1	A	
221	SR 9/4th St NE	Side-street Stop			0.4	A					0.4	A	SB TH

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 At Grade Widening
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	26.2	C	23.2	C	57.0	E	57.8	E	32.1	C	
2	SR 9/Vernon Rd Off-Ramp	Uncontrolled											
3	SR 9/SR 204	Signal	32.5	C	38.0	D	16.8	B	75.6	E	33.7	C	
4	SR 9/Market Pl	Signal	36.2	D	19.8	B	34.6	C	41.4	D	30.3	C	
5	91st Ave/SR 204	Signal	70.5	E	38.0	D	54.3	D	34.2	C	50.4	D	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	35.1	D	21.1	C	18.9	B	47.4	D	25.3	C	
7	Vernon Rd/7th Pl	Side-street Stop							13.1	B	13.1	B	WB RT
8	91st Ave/Vernon Rd	Side-street Stop	1.4	A	0.2	A	8.2	A	9.7	A	13.4	B	WB TH
9	Safeway Dwy/Davies Rd	Roundabout	9.4	A	5.1	A	2.7	A	4.8	A	5.4	A	
10	SR 9/4th St On-Ramp	Side-street Stop			7.6	A					8.1	A	SB LT
11	Transit Center Dwy/4th St	Side-street Stop	9.4	A	8.6	A	0.9	A	0.6	A	17.3	C	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			9.2	A	4.0	A			9.2	A	SB RT
13	91st Ave/Market Pl	Signal	43.4	D	32.9	C	11.8	B	17.8	B	26.4	C	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	2.5	A	3.4	A	11.9	B	7.0	A	13.5	B	WB LT
15	Vernon Rd/Davies Rd	Roundabout	11.2	B	8.4	A			9.8	A	9.8	A	

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.

Vissim Post-Processor
Average Results from 11 Runs
Approach Delay and LOS

SR 9 & SR 204 Intersection Improvements
2040 Roundabout Concept
PM Peak Hour

	Intersection	Control	Northbound Delay	Northbound LOS	Southbound Delay	Southbound LOS	Eastbound Delay	Eastbound LOS	Westbound Delay	Westbound LOS	Overall Delay	Overall LOS	Worst Mvmt.
1	SR 9/Lundeen Pkwy	Signal	23.8	C	24.0	C	58.6	E	61.5	E	31.9	C	
2	SR 9/Davies Rd	Roundabout											
3	SR 9/SR 204	Roundabout											
4	SR 9/Market Pl	Signal	35.1	D	36.6	D	41.6	D	48.3	D	38.5	D	
5	91st Ave/SR 204	Signal	87.5	F	47.5	D	91.9	F	46.8	D	75.2	E	
6	Lundeen Pkwy/Market Pl/SR 204	Signal	37.0	D	18.3	B	27.6	C	43.5	D	29.6	C	
8	91st Ave/Vernon Rd	Roundabout											
9	Safeway Dwy/Davies Rd	Roundabout	9.8	A	23.8	C	3.4	A	14.3	B	9.9	A	
11	Transit Center Dwy/4th St	Side-street Stop	8.3	A	8.4	A	0.1	A	0.4	A	9.6	A	NB RT
12	Transit Center Dwy/Market Pl	Side-street Stop			10.9	B	4.5	A			11.2	B	SB RT
13	91st Ave/Market Pl	Signal	17.0	B	16.2	B	13.6	B	18.7	B	16.9	B	
14	Lundeen Pkwy/Vernon Rd	Side-street Stop	2.8	A	4.1	A	12.7	B	7.2	A	13.6	B	EB LT
15	Vernon Rd/Davies Rd	Roundabout											

Notes:
Assumes default directions (N, S, E, & W) at all intersections.
For Side-street Stop and Uncontrolled intersections, the movement with the highest delay is reported for the overall delay.
LOS is reported as the average delay over the 1-hour simulation, not the peak 15 minutes as defined by HCM.
Intersections 2, 3, 8, and 15 are analyzed and reported from SIDRA

Sidra Roundabout LOS Results

2040 PM

#	Intersection	Sidra Model		HCM Model		Average	
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
2	9/Davies	6.9	A	26.4	C	17	B
3	9/204	5.9	A	50.3	D	28	C
8	91st/Vernon	7	A	9.5	A	8	A
15	Davies/Vernon	6.3	A	5.9	A	6	A

MOVEMENT SUMMARY

Site: 1 [2040PM-P2 SR9 & Davies]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Aver. Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1743	3.0	1617	3.0	0.671	4.1	LOS A	2.2	57.4	0.73	0.56	0.86	26.0
18	R2	243	3.0	225	3.0	0.152	2.8	LOS A	0.3	7.9	0.37	0.40	0.37	23.0
Approach		1986	3.0	1842 [N1]	3.0	0.671	3.9	LOS A	2.2	57.4	0.69	0.54	0.80	25.8
East: WB Davies														
1	L2	203	3.0	203	3.0	0.279	10.5	LOS B	0.6	16.1	0.83	0.92	0.84	11.8
1a	L1	35	3.0	35	3.0	0.279	9.0	LOS A	0.6	16.1	0.86	0.92	0.86	12.0
16	R2	45	3.0	45	3.0	0.279	6.0	LOS A	0.6	16.1	0.86	0.92	0.86	19.2
Approach		283	3.0	283	3.0	0.279	9.6	LOS A	0.6	16.1	0.84	0.92	0.85	13.5
North: SB SR 9														
7	L2	29	3.0	29	3.0	0.734	14.0	LOS B	2.8	73.0	0.67	0.70	0.73	24.7
4	T1	1629	3.0	1629	3.0	0.734	7.8	LOS A	2.9	73.1	0.66	0.68	0.71	24.9
14a	R1	143	3.0	143	3.0	0.734	7.0	LOS A	2.9	73.1	0.65	0.66	0.70	25.1
Approach		1801	3.0	1801	3.0	0.734	7.8	LOS A	2.9	73.1	0.66	0.68	0.71	24.9
SouthWest: NE Vernon W														
5ax	L1	343	3.0	343	3.0	0.567	12.8	LOS B	1.6	40.9	0.91	1.09	1.21	19.0
12ax	R1	226	3.0	226	3.0	0.582	11.8	LOS B	1.3	34.1	0.88	1.03	1.21	13.6
Approach		569	3.0	569	3.0	0.582	12.4	LOS B	1.6	40.9	0.90	1.07	1.21	17.4
All Vehicles		4639	3.0	4495 [N1]	3.1	0.734	6.9	LOS A	2.9	73.1	0.71	0.69	0.82	23.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 2 [2040PM-P2 SR9 & SR204]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	65	3.0	57	3.0	0.525	13.5	LOS B	1.4	35.0	0.79	0.80	0.92	26.7
8	T1	1127	3.0	983	3.0	0.525	7.2	LOS A	1.6	42.1	0.81	0.73	0.92	26.8
18	R2	93	3.0	81	3.0	0.050	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		1285	3.0	1121[N1]	3.0	0.525	7.3	LOS A	1.6	42.1	0.75	0.71	0.86	27.4
East: WB 7th														
1	L2	79	3.0	79	3.0	0.241	7.1	LOS A	0.4	11.4	0.75	0.80	0.75	16.0
6	T1	60	3.0	60	3.0	0.241	4.4	LOS A	0.4	11.4	0.75	0.80	0.75	16.0
16	R2	181	3.0	181	3.0	0.227	3.5	LOS A	0.5	12.7	0.79	0.75	0.79	16.8
Approach		320	3.0	320	3.0	0.241	4.6	LOS A	0.5	12.7	0.77	0.77	0.77	16.4
North: SB SR 9														
7	L2	133	3.0	133	3.0	0.466	8.2	LOS A	1.3	34.3	0.49	0.39	0.49	27.2
4	T1	1196	3.0	1196	3.0	0.466	2.2	LOS A	1.4	35.9	0.47	0.31	0.47	22.8
14	R2	505	3.0	505	3.0	0.316	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.2
Approach		1834	3.0	1834	3.0	0.466	2.5	LOS A	1.4	35.9	0.34	0.31	0.34	24.0
West: EB 7th														
5	L2	678	3.0	678	3.0	0.523	12.5	LOS B	1.4	34.7	0.73	0.92	0.86	17.8
2	T1	335	3.0	335	3.0	0.523	8.1	LOS A	1.4	34.7	0.73	0.88	0.85	19.1
12	R2	64	3.0	64	3.0	0.060	5.6	LOS A	0.1	2.6	0.57	0.66	0.57	20.8
Approach		1077	3.0	1077	3.0	0.523	10.8	LOS B	1.4	34.7	0.72	0.90	0.84	18.5
All Vehicles		4516	3.0	4352[N1]	3.1	0.525	5.9	LOS A	1.6	42.1	0.57	0.59	0.63	22.9

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101vv [2040PM-P2 91st & Vernon]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	37	3.0	37	3.0	0.534	9.9	LOS A	1.4	35.4	0.35	0.25	0.35	18.7
8	T1	104	3.0	104	3.0	0.534	9.9	LOS A	1.4	35.4	0.35	0.25	0.35	19.4
18	R2	425	3.0	425	3.0	0.534	9.9	LOS A	1.4	35.4	0.35	0.25	0.35	12.0
Approach		566	3.0	565 N1	3.0	0.534	9.9	LOS A	1.4	35.4	0.35	0.25	0.35	14.3
East: WB Vernon														
1	L2	98	3.0	98	3.0	0.167	4.1	LOS A	0.4	10.3	0.32	0.16	0.32	18.1
6	T1	65	3.0	65	3.0	0.167	4.1	LOS A	0.4	10.3	0.32	0.16	0.32	24.3
16	R2	53	3.0	53	3.0	0.167	4.1	LOS A	0.4	10.3	0.32	0.16	0.32	23.9
Approach		216	3.0	216	3.0	0.167	4.1	LOS A	0.4	10.3	0.32	0.16	0.32	22.0
North: SB 91st														
7	L2	2	3.0	2	3.0	0.131	4.6	LOS A	0.2	6.4	0.36	0.22	0.36	20.4
4	T1	115	3.0	115	3.0	0.131	4.6	LOS A	0.2	6.4	0.36	0.22	0.36	20.4
14	R2	19	3.0	19	3.0	0.131	4.6	LOS A	0.2	6.4	0.36	0.22	0.36	23.7
Approach		136	3.0	136	3.0	0.131	4.6	LOS A	0.2	6.4	0.36	0.22	0.36	21.1
West: EB Vernon														
5	L2	15	3.0	15	3.0	0.204	4.6	LOS A	0.4	10.4	0.36	0.23	0.36	26.4
2	T1	174	3.0	174	3.0	0.204	4.6	LOS A	0.4	10.4	0.36	0.23	0.36	20.6
12	R2	64	3.0	64	3.0	0.204	4.6	LOS A	0.4	10.4	0.36	0.23	0.36	20.6
Approach		253	3.0	253	3.0	0.204	4.6	LOS A	0.4	10.4	0.36	0.23	0.36	21.1
All Vehicles		1171	3.0	1170 N1	3.0	0.534	7.0	LOS A	1.4	35.4	0.35	0.22	0.35	17.8

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1a [2040PM-P2 Davies & Vernon]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	30	3.0	30	3.0	0.088	11.9	LOS B	0.2	5.1	0.78	0.81	0.78	12.5
8	T1	9	3.0	9	3.0	0.088	9.5	LOS A	0.2	5.1	0.78	0.81	0.78	16.4
18	R2	2	3.0	2	3.0	0.088	10.7	LOS B	0.2	5.1	0.78	0.81	0.78	14.5
Approach		41	3.0	41	3.0	0.088	11.3	LOS B	0.2	5.1	0.78	0.81	0.78	13.8
East: WB Davies														
6	T1	95	3.0	95	3.0	0.452	5.3	LOS A	1.2	30.1	0.63	0.71	0.63	13.9
16	R2	298	3.0	298	3.0	0.452	6.4	LOS A	1.2	30.1	0.63	0.71	0.63	18.9
Approach		393	3.0	393	3.0	0.452	6.2	LOS A	1.2	30.1	0.63	0.71	0.63	18.2
North: SB Vernon														
7	L2	373	3.0	373	3.0	0.444	6.4	LOS A	1.4	34.9	0.42	0.59	0.42	19.8
14	R2	159	0.0	159	0.0	0.444	3.6	LOS A	1.4	34.9	0.42	0.59	0.42	18.1
Approach		532	2.1	532	2.1	0.444	5.5	LOS A	1.4	34.9	0.42	0.59	0.42	19.4
West: EB Davies														
5	L2	291	3.0	281	3.0	0.521	7.7	LOS A	1.5	38.9	0.68	0.77	0.72	18.2
2	T1	207	3.0	200	3.0	0.521	5.3	LOS A	1.5	38.9	0.68	0.77	0.72	15.6
Approach		498	3.0	480 N1	3.0	0.521	6.7	LOS A	1.5	38.9	0.68	0.77	0.72	17.3
All Vehicles		1464	2.7	1446 N1	2.7	0.521	6.3	LOS A	1.5	38.9	0.57	0.69	0.58	18.2

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1 [2040PM-P2 SR9 & Davies]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
8	T1	1743	3.0	1458	3.0	0.881	13.4	LOS D	4.7	120.3	0.98	1.36	1.80	21.2
18	R2	243	3.0	203	3.0	0.184	3.2	LOS A	0.3	7.6	0.37	0.46	0.37	22.9
Approach		1986	3.0	1661 N1	3.0	0.881	12.1	LOS B	4.7	120.3	0.90	1.25	1.62	21.3
East: WB Davies														
1	L2	203	3.0	203	3.0	0.511	21.8	LOS C	0.8	19.8	0.88	1.08	1.26	7.4
1a	L1	35	3.0	35	3.0	0.511	19.0	LOS B	0.8	19.8	0.87	1.07	1.24	7.4
16	R2	45	3.0	45	3.0	0.511	15.9	LOS B	0.8	19.8	0.87	1.07	1.24	14.2
Approach		283	3.0	283	3.0	0.511	20.5	LOS C	0.8	19.8	0.88	1.08	1.26	8.7
North: SB SR 9														
7	L2	29	3.0	29	3.0	0.832	17.6	LOS B	4.8	123.0	0.91	0.89	1.15	22.5
4	T1	1629	3.0	1629	3.0	0.832	11.3	LOS B	4.8	123.0	0.90	0.87	1.12	22.8
14a	R1	143	3.0	143	3.0	0.832	10.3	LOS B	4.7	121.6	0.89	0.86	1.10	23.2
Approach		1801	3.0	1801	3.0	0.832	11.3	LOS B	4.8	123.0	0.90	0.87	1.12	22.8
SouthWest: NE Vernon W														
5ax	L1	343	3.0	343	3.0	1.268	152.9	LOS F	11.7	299.7	1.00	3.45	7.79	4.1
12ax	R1	226	3.0	226	3.0	1.005	66.9	LOS F	3.6	91.4	1.00	1.91	3.55	4.4
Approach		569	3.0	569	3.0	1.268	118.7	LOS F	11.7	299.7	1.00	2.84	6.10	4.2
All Vehicles		4639	3.0	4314 N1	3.2	1.268	26.4	LOS C	11.7	299.7	0.91	1.29	1.98	13.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 2 [2040PM-P2 SR9 & SR204]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB SR 9														
3	L2	65	3.0	57	3.0	0.855	26.2	LOS D	3.2	81.7	0.91	1.27	1.96	19.4
8	T1	1127	3.0	983	3.0	0.855	19.2	LOS D	3.3	83.4	0.91	1.26	1.93	20.1
18	R2	93	3.0	81	3.0	0.050	4.1	LOS A	0.0	0.0	0.00	0.47	0.00	33.7
Approach		1285	3.0	1121[N1]	3.0	0.855	18.5	LOS B	3.3	83.4	0.85	1.20	1.79	20.9
East: WB 7th														
1	L2	79	3.0	79	3.0	0.452	16.7	LOS B	0.7	17.7	0.86	1.02	1.15	12.2
6	T1	60	3.0	60	3.0	0.452	14.1	LOS B	0.7	17.7	0.86	1.02	1.15	12.2
16	R2	181	3.0	181	3.0	0.502	12.4	LOS B	0.8	20.7	0.85	1.00	1.19	12.2
Approach		320	3.0	320	3.0	0.502	13.8	LOS B	0.8	20.7	0.85	1.01	1.17	12.2
North: SB SR 9														
7	L2	133	3.0	133	3.0	0.579	8.5	LOS A	1.6	41.0	0.55	0.42	0.55	26.9
4	T1	1196	3.0	1196	3.0	0.579	2.7	LOS A	1.6	41.0	0.55	0.37	0.55	22.2
14	R2	505	3.0	505	3.0	0.316	1.8	LOS A	0.0	0.0	0.00	0.28	0.00	26.2
Approach		1834	3.0	1834	3.0	0.579	2.9	LOS A	1.6	41.0	0.40	0.35	0.40	23.6
West: EB 7th														
5	L2	678	3.0	678	3.0	1.356	187.6	LOS F	15.6	399.8	1.00	3.69	10.13	2.1
2	T1	335	3.0	335	3.0	1.356	181.4	LOS F	15.6	399.8	1.00	3.92	10.83	3.5
12	R2	64	3.0	64	3.0	0.185	12.5	LOS B	0.2	6.1	0.77	0.87	0.77	14.7
Approach		1077	3.0	1077	3.0	1.356	175.3	LOS F	15.6	399.8	0.99	3.59	9.79	2.7
All Vehicles		4516	3.0	4352[N1]	3.1	1.356	50.3	LOS D	15.6	399.8	0.69	1.42	3.14	8.1

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101vv [2040PM-P2 91st & Vernon]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB 91st														
3	L2	37	3.0	37	3.0	0.653	13.9	LOS B	1.8	47.0	0.53	0.43	0.63	16.7
8	T1	104	3.0	104	3.0	0.653	13.9	LOS B	1.8	47.0	0.53	0.43	0.63	17.2
18	R2	425	3.0	425	3.0	0.653	13.9	LOS B	1.8	47.0	0.53	0.43	0.63	10.2
Approach		566	3.0	565 N1	3.0	0.653	13.9	LOS B	1.8	47.0	0.53	0.43	0.63	12.3
East: WB Vernon														
1	L2	98	3.0	98	3.0	0.183	4.6	LOS A	0.3	7.8	0.29	0.17	0.29	17.6
6	T1	65	3.0	65	3.0	0.183	4.6	LOS A	0.3	7.8	0.29	0.17	0.29	23.9
16	R2	53	3.0	53	3.0	0.183	4.6	LOS A	0.3	7.8	0.29	0.17	0.29	23.5
Approach		216	3.0	216	3.0	0.183	4.6	LOS A	0.3	7.8	0.29	0.17	0.29	21.5
North: SB 91st														
7	L2	2	3.0	2	3.0	0.125	4.3	LOS A	0.2	5.5	0.35	0.22	0.35	20.7
4	T1	115	3.0	115	3.0	0.125	4.3	LOS A	0.2	5.5	0.35	0.22	0.35	20.7
14	R2	19	3.0	19	3.0	0.125	4.3	LOS A	0.2	5.5	0.35	0.22	0.35	23.9
Approach		136	3.0	136	3.0	0.125	4.3	LOS A	0.2	5.5	0.35	0.22	0.35	21.4
West: EB Vernon														
5	L2	15	3.0	15	3.0	0.295	6.5	LOS A	0.5	11.7	0.41	0.29	0.41	24.7
2	T1	174	3.0	174	3.0	0.295	6.5	LOS A	0.5	11.7	0.41	0.29	0.41	18.8
12	R2	64	3.0	64	3.0	0.295	6.5	LOS A	0.5	11.7	0.41	0.29	0.41	18.8
Approach		253	3.0	253	3.0	0.295	6.5	LOS A	0.5	11.7	0.41	0.29	0.41	19.3
All Vehicles		1171	3.0	1170 N1	3.0	0.653	9.5	LOS A	1.8	47.0	0.44	0.33	0.49	16.1

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 1a [2040PM-P2 Davies & Vernon]

Network: N101 [2040PM-P2]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	Aver. Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	ft				mph
South: NB Vernon														
3	L2	30	3.0	30	3.0	0.073	8.9	LOS A	0.1	2.8	0.63	0.81	0.63	13.9
8	T1	9	3.0	9	3.0	0.073	6.5	LOS A	0.1	2.8	0.63	0.81	0.63	17.7
18	R2	2	3.0	2	3.0	0.073	7.7	LOS A	0.1	2.8	0.63	0.81	0.63	15.8
Approach		41	3.0	41	3.0	0.073	8.3	LOS A	0.1	2.8	0.63	0.81	0.63	15.1
East: WB Davies														
6	T1	95	3.0	95	3.0	0.404	4.8	LOS A	0.9	22.6	0.56	0.69	0.56	14.4
16	R2	298	3.0	298	3.0	0.404	5.9	LOS A	0.9	22.6	0.56	0.69	0.56	19.2
Approach		393	3.0	393	3.0	0.404	5.7	LOS A	0.9	22.6	0.56	0.69	0.56	18.6
North: SB Vernon														
7	L2	373	3.0	373	3.0	0.405	6.2	LOS A	1.1	28.3	0.39	0.58	0.39	19.9
14	R2	159	0.0	159	0.0	0.405	3.4	LOS A	1.1	28.3	0.39	0.58	0.39	18.2
Approach		532	2.1	532	2.1	0.405	5.3	LOS A	1.1	28.3	0.39	0.58	0.39	19.5
West: EB Davies														
5	L2	291	3.0	266	3.0	0.504	7.7	LOS A	1.3	32.7	0.66	0.82	0.73	18.3
2	T1	207	3.0	190	3.0	0.504	5.3	LOS A	1.3	32.7	0.66	0.82	0.73	15.6
Approach		498	3.0	456 N1	3.0	0.504	6.7	LOS A	1.3	32.7	0.66	0.82	0.73	17.4
All Vehicles		1464	2.7	1422 N1	2.8	0.504	5.9	LOS A	1.3	32.7	0.53	0.70	0.55	18.4

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
Intersection and Approach LOS values are based on average delay for all movements (v/c not used).
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

2040 PM Travel Time Reports

2040 PM Travel Time Results-Vissim

Travel Time (min)

No Build

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		5.90	3.86	4.87	4.81	3.76	1.56
SR 9 south of Market Place NE	2	4.30		4.99	3.36	2.32	3.85	4.18
SR 204 west of Market Place NE / Lundeen Parkway	3	3.52	3.14		3.20	4.07	1.43	2.08
N Davies Road and access driveway to the Safeway	4	3.10	6.50	3.97		#DIV/0!	4.67	2.47
4th Street NE and 94th Drive NE	5	2.92	2.49	3.89	#DIV/0!		3.40	2.99
91st Avenue NE Commercial District	6	4.28	2.48	4.87	3.24	2.86		3.16
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	2.83	4.75	1.97	2.73	3.09	1.39	

Tight Diamond

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		2.86	3.71	3.57	3.96	3.78	1.72
SR 9 south of Market Place NE	2	2.92		4.76	5.32	1.24	2.83	4.26
SR 204 west of Market Place NE / Lundeen Parkway	3	3.92	2.85		3.30	3.43	1.38	1.99
N Davies Road and access driveway to the Safeway	4	4.00	3.60	4.50		2.05	4.67	2.84
4th Street NE and 94th Drive NE	5	5.66	2.15	5.21	5.19		2.39	4.50
91st Avenue NE Commercial District	6	3.85	2.15	3.25	3.01	3.91		1.48
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	2.91	2.86	2.01	2.70	2.47	1.38	

At-Grade Widen

Origin		Destination						
		SR 9 north of Lundeen Parkway	SR 9 south of Market Place NE	SR 204 west of Market Place NE / Lundeen Parkway	N Davies Road and access driveway to the Safeway	4th Street NE and 94th Drive NE	91st Avenue NE Commercial District	Lundeen Parkway neighborhoods near Vernon Road / 91st
Origin		1	2	3	4	5	6	7
SR 9 north of Lundeen Parkway	1		3.33	3.76	3.94	4.11	3.39	1.43
SR 9 south of Market Place NE	2	3.49		3.24	2.59	1.58	1.86	2.69
SR 204 west of Market Place NE / Lundeen Parkway	3	3.45	2.32		2.86	3.03	1.40	1.98
N Davies Road and access driveway to the Safeway	4	3.13	3.27	4.73		#DIV/0!	4.61	3.20
4th Street NE and 94th Drive NE	5	2.80	1.82	3.64	#DIV/0!		2.32	2.42
91st Avenue NE Commercial District	6	3.99	1.87	4.72	3.24	2.35		3.38
Lundeen Parkway neighborhoods near Vernon Road / 91st	7	3.45	3.24	2.00	2.28	3.02	1.41	

2040 PM Roundabouts Alternative Travel Time Calculations

		Travel Time Pair	Model Travel Time Results (min) No Build	Revised PA (Tight Diamond)	At-Grade	Roundabouts*
1	1-2	SB SR 9 (1-2)	5.9	2.9	3.3	5.0
2	2-1	NB SR 9 (2-1)	4.3	2.9	3.5	4.1
3	3-1	EB SR 204 to NB SR 9 (3-1)	3.5	3.9	3.5	4.8
4	3-4	EB SR 204 to Davies (3-4)	3.2	3.3	2.9	4.2
5	2-4	NB SR 9 to Davies (2-4)	3.4	5.3	2.6	2.9
6	1-4	SB SR 9 to Davies (1-4)	4.9	3.6	3.9	3.4
7	4-7	Safeway/Davies to Vernon/91st (4-7)	2.5	2.8	3.2	1.2
8	7-4	Vernon/91st to Safeway/Davies (7-4)	2.7	2.7	2.3	1.9
9	1-3	SB SR 9 to WB SR 204 (1-3)	3.9	3.7	3.8	3.2
10	2-3	NB SR 9 to WB SR 204 (2-3)	5.0	4.8	3.2	4.9
11	3-2	EB SR 204 to SB SR 9 (3-2)	3.1	2.9	2.9	3.5

Vissim Results
Sidra Results
Combined

*Estimated model travel times based on a combination of SIDRA and VISSIM model analysis.

		Sidra Roundabout Build Models† — Sidra Capacity Method: Route Distance (ft)	Travel Time (s)	Signal 1 Vissim Adjustment*	Adjusted Travel Time	Travel Time (min)	HCM Capacity Method: Travel Time (s)	Signal 1 Vissim Adjustment*	Adjusted Travel Time	Travel Time (min)	Roundabout Adjusted Average Travel Time (min)
1	1-2	1316	37.7		37.7	0.63	39.9		39.9	0.67	**0.65**
2	2-1	2312	59.7		59.7	1.00	76.4		76.4	1.27	**1.13**
3	3-1	3030	114.9	5.9	120.8	2.01	317.5	-11.5	306	5.10	**3.56**
4	3-4	2841	119	5.9	124.9	2.08	314.7	-11.5	303.2	5.05	**3.57**
5	2-4	2123	63.7		63.7	1.06	73.6		73.6	1.23	**1.14**
6	1-4	1064	35.9		35.9	0.60	37.6		37.6	0.63	**0.61**
7	4-7	576	30.4		30.4	0.51	39.7		39.7	0.66	**0.58**
8	7-4	921	43.6		43.6	0.73	98.7		98.7	1.65	**1.19**
9	1-3		122.5	-10.7	111.8	1.86	123.9	-10.4	113.5	1.89	**1.88**
10	2-3		132.5	-10.7	121.8	2.03	143.4	-10.4	133	2.22	**2.12**
11	3-2		93.5	56.2	149.7	2.50	117.3	38.8	156.1	2.60	**2.55**

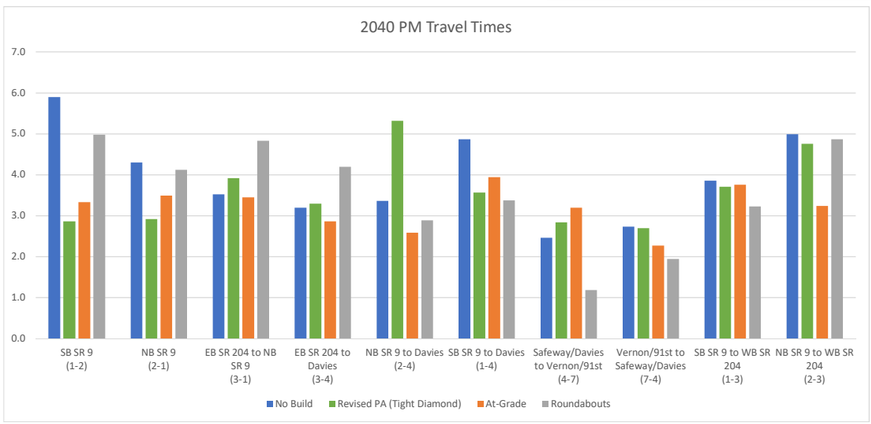
†The estimated SIDRA model results were assumed to be the average of the results using the Sidra Capacity Method and the Sidra HCM Capacity Method. Through discussion between consultants and WSDOT staff, we felt the SIDRA capacity method was too high. This approach was chosen after reviewing results from various analysis tools (SIDRA, NCHRP Report 672/HCM) and our professional judgement. The Sidra models did not include the entire travel time route that was analyzed for the other concepts modeled in Vissim. To estimate the SIDRA Roundabout concept travel time results in a comparable manner to the other concepts, the Difference Method was used. The delta in travel time between estimated SIDRA Roundabout concept and the Sidra No Build model was applied to the Vissim No Build model travel times.

*Vissim is the preferred modeling tool for all SR 9/204 alternatives (except the roundabout). Sidra model approach delay at signalized intersections were adjusted to match the intersection delay in the Vissim models. The SIDRA Roundabout concept required adjustments only at the SR 204/91st signalized intersection. The SDIRA No Build model required signalized intersection delay adjustments at both the SR 204/91st and SR 9/SR 204 signalized intersections.

		Sidra No Build Model† — No Build: Initial Sidra Travel Time Results (s)	Signal 1 Vissim Adjustment*	Signal 2 Vissim Adjustment*	Adjusted Travel Time	SIDRA No Build Adjusted Travel Time (min)
1	1-2	128	-34		94	**1.57**
2	2-1	62.1	16.9		79	**1.32**
3	3-1	199.5	-70.7	6	134.8	**2.25**
4	3-4	216.7	-70.7	8.2	154.2	**2.57**
5	2-4	73.1	24.1		97.2	**1.62**
6	1-4	88.8	37.6		126.4	**2.11**
7	4-7	124.1	39.7	10.8	174.6	**2.91**
8	7-4	132.4	-22.3	8.2	118.3	**1.97**
9	1-3	76.7	63.2	10.6	150.5	**2.51**
10	2-3	101.5	22.4	10.6	134.5	**2.24**
11	3-2	199.1	-70.7	4.2	132.6	**2.21**

		Roundabout Concept Adjusted Overall Travel Time Results — **Delta** = Sidra Roundabout Average- Sidra No Build (min)	**Vissim NB + Sidra Delta**
1	1-2	-0.92	**5.0**
2	2-1	-0.18	**4.1**
3	3-1	1.31	**4.8**
4	3-4	1.00	**4.2**
5	2-4	-0.48	**2.9**
6	1-4	-1.49	**3.4**
7	4-7	-2.33	**1.2**
8	7-4	-0.79	**1.9**
9	1-3	-0.63	**3.2**
10	2-3	-0.12	**4.9**
11	3-2	0.34	**3.5**

Route 4-7: Safeway/Davies to Vernon/91st:
Manually adjusted to average of SIDRA Capacity and HCM Capacity route travel speeds over 1,200 feet (total route distance). Sidra model only included 570 feet.



APPENDIX C.
STIDR SAFETY ANALYSIS

October 2019

FEHR PEERS

Memorandum

Date: September 24, 2019

To: Project Team

From: Marissa Milam, Simon Zhang, and Chris Grgich, PE, PTOE

Subject: SR 9/SR 204 STIDR Safety Analysis

SE16-0471

Introduction

This memo describes the methodology for the safety analysis of four updated alternatives at the intersection of SR 9 and SR 204 in the City of Lake Stevens, Snohomish County. The analysis was completed using the Highway Safety Manual (HSM) Part C extended spreadsheet and Interchange Safety Analysis Tool (ISAT). The four updated alternatives are:

- no build;
- at-grade widening;
- grade-separated tight diamond design; and,
- roundabout intersections.

Sketches of the updated alternatives are included electronically for reference.

Collision data was acquired from Washington State Department of Transportation (WSDOT) for the project study area. The collision reports provided data from 2011 to 2015 and indicated a total of 431 collisions in the study area. Discussions on observed trends in collision types and severity are included in previous project documents.

The primary study area for this project includes the interchange of SR 9 and SR 204 as well as portions of local arterials connecting to those state routes. A total of nine study intersections are included in the safety analysis. A map of the project location is shown in **Figure 1**.

Figure 1. Overview map of the project location

Methodology

Collision Categorization

The collision data obtained from WSDOT was categorized by segment and intersection using HSM methodology. Collisions were assigned to each study intersection if the collisions were tagged as "at intersection" or "intersection-related". Collisions along the segments were identified from the remaining location tags, such as "not at intersection and not related". The number of collisions on each segment was verified using the WSDOT-provided GIS shapefile of the collision data. After collisions were assigned to segments or intersections, average collision rates were calculated for multiple-vehicle fatal/injury, multiple-vehicle property damage only, single-vehicle fatal/injury, and single-vehicle property damage only collisions for input into the HSM spreadsheets.

Based on FHWA KABCO Injury Classification, injury type "no apparent injury" and "unknown" are categorized as Property Damage Only (PDO), while "fatal", "suspected serious", "suspected minor" and "possible injury" are categorized as KABC (death and injury).

HSM Analysis

The HSM Part C provides a predictive method for estimating expected average crash frequency at an individual site. The predictive method relies on safety performance functions (SPF), which are equations that estimate predicted average crash frequency as a function of traffic volume and roadway characteristics (e.g., number of lanes, median type, intersection control, number of approach legs).

For this analysis, the HSM Part C Chapter 12 was used, which predicts average crash frequency for urban and suburban arterials. For each alternative, the study segments and intersections were input into HSM, along with 2040 traffic volumes, roadway characteristics, and intersection geometry changes. A total of eight segments and nine intersections are included for each alternative analysis except for tight diamond design, which only included at-grade segments and intersections in the HSM analysis.

After running all four alternatives in the HSM spreadsheets, Crash Modification Factors (CMFs) were used as multipliers with the predicted crash frequencies to more accurately depict roadway and intersection conditions. CMFs quantify the change in average crash frequency as a result of geometric or operational modifications to a site that differs from set base conditions in the HSM and are obtained from the Crash Modification Factors Clearinghouse. The CMFs used in this analysis were applicable to all crash types and severities; therefore, the CMFs were multiplied by the total predicted crash frequencies for the segments and intersections in each alternative that differed

from HSM base conditions. For the complete list of CMFs used and which segments and intersections were adjusted, see the assumptions document in the Appendix.

ISAT Analysis

The ISAT spreadsheet was used to predict the safety performance for the new grade-separated interchange of SR 9/SR 204 in the tight diamond design alternative, as well as the new mainline freeway segments of SR 9 between Vernon St and 4th St NE. These segments and interchanges were analyzed in ISAT rather than HSM because HSM cannot be used for grade-separated interchanges or ramps. The ISAT methodology was followed to input freeway mainline, ramp segments, and interchange information, including 2040 traffic volumes, roadway characteristics, and ramp terminal configurations. The predicted crash frequencies given by the ISAT analysis were added to the HSM analysis for the other segments and intersections in the tight diamond analysis.

Changes from Previous Analysis

The HSM methodology and assumptions used in this analysis vary slightly compared to previous safety analysis and predictive studies completed for this project. The same collision data was used, however the segmentation differed due to the different alternatives present in this analysis. An updated version of the HSM spreadsheet was also used per WSDOT recommendations. While the results of this updated analysis are similar to those previously presented, due to the updated methodology and assumptions, the results should not be compared directly to previously completed alternative analysis.

Results

Table 1 provides a summary of the predicted average crash frequency calculated for each alternative, including the predicted collision rates for all intersections and segments for each alternative. **Table 2** provides a summary of the predicted average crash frequency for each 2040 alternative broken down for segments and intersections and compares each 2040 alternative to No Build. Some alternatives affect segment lengths, which greatly influence HSM predictions of collision rates along that segment. All alternatives have slightly different volumes across each segment and intersection, which is another important factor in HSM collision rate prediction. **Figure 2** illustrates the comparison of predicted crash rates for each alternative compared to No Build.

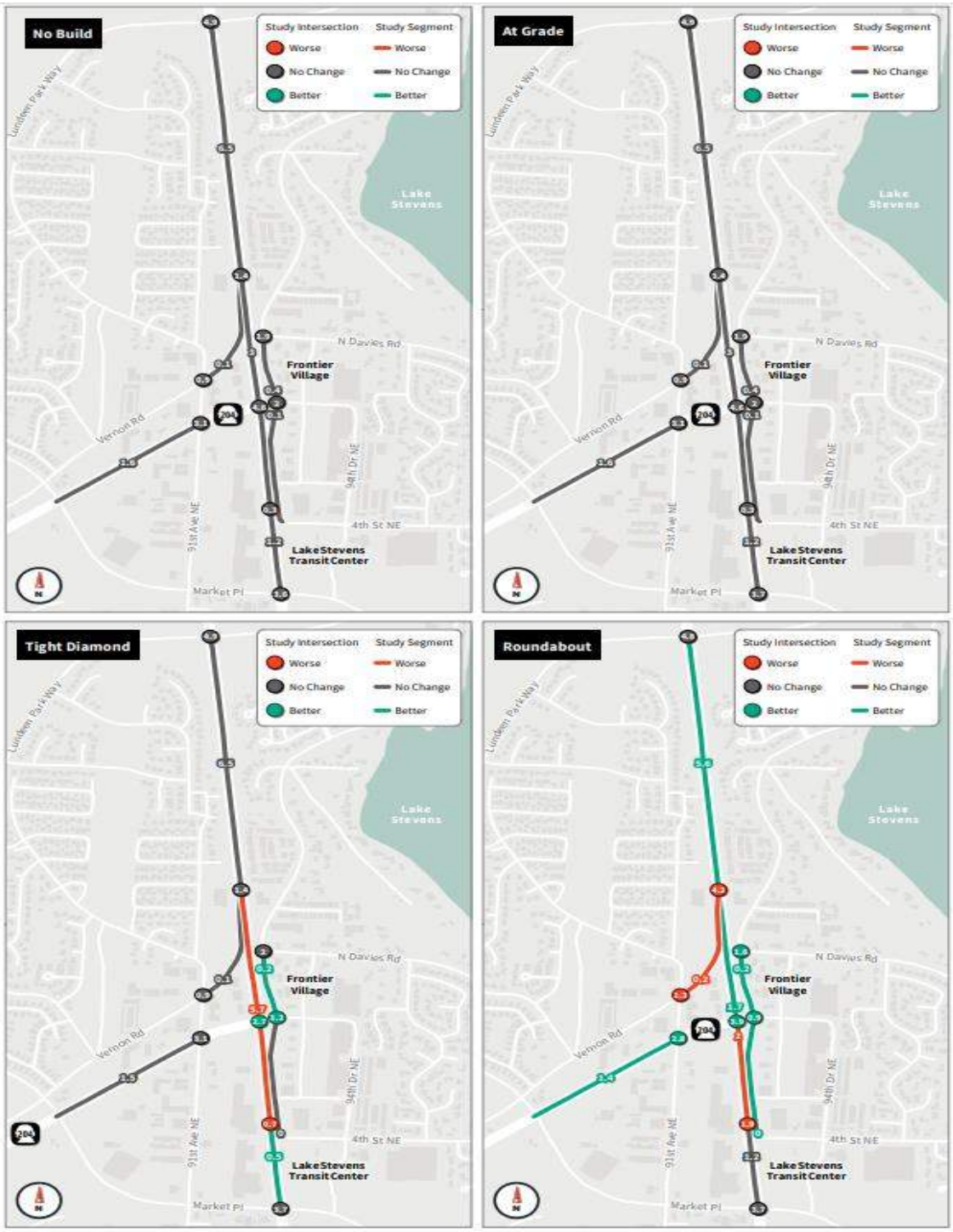


Figure 2. Predicted Collision Rate Comparison across Four Alternatives

TABLE 1. ANTICIPATED PERFORMANCE FOR EACH 2040 ALTERNATIVE

$N_{predicted}$ (KABCO)[1]				
	No Build	At Grade	Tight Diamond	Roundabout
INDIVIDUAL SEGMENTS				
1. SR 9 from Lundeen Pkwy to Vernon St	6.5	6.5	6.5	5.6
2. SR 9 from Vernon Ramp to SR 204	3.0	3.0	5.7[2]	1.7
3. SR 9 from SR 204 to 4th St NE	1.3	1.5		2.0
4. SR 9 from 4th St to Market Pl	1.2	1.2	0.5	1.2
5. SR 204 from Market Pl to 91st Ave NE	1.6	1.6	1.5	1.4
6. Vernon Rd from 7th to N Davies Rd	0.4	0.4	0.2	0.2
7. Vernon Rd from SR 9 to 91st Ave	0.1	0.1	0.1	0.2
8. 92nd Ave NE from 4th St to 7th Pl NE	0.1	0.1	0.0	0.0
Segment Sum	***14.2***	***14.3***	***14.5***	***12.3***
INDIVIDUAL INTERSECTIONS				
1. SR 9/Lundeen Pkwy	4.9	4.9	4.9	4.8
2. SR 9/Vernon Rd Slip Ramp	1.4	1.4	1.4	4.2[3]
3. SR 9/SR 204	4.6	4.6	2.7	3.9

4. SR 9/Market Pl	3.6	3.7	3.7	3.7
5. SR 204/91st Ave NE	3.1	3.1	3.1	2.8
7. Vernon Rd/7th Pl NE/92nd Ave NE	2.0	2.0	1.2	0.9
8. Vernon Rd/91st Ave NE	0.9	0.9	0.9	1.3
10. SR 9/4th St NE Slip Ramp	0.3	0.3	0.7[4]	1.9[5]
15. Vernon Rd/N Davies Rd	1.9	1.9	2.0	1.6
Intersection Sum	***22.7***	***22.7***	***20.5***	***25.1***
Total Sum	***36.9***	***37.0***	***35.1***	***37.4***

1. K – Fatal
   A – Incapacitating injury
   B – Nonincapacitating injury
   C – Possible injury
   O – No injury/Property damage only
2. Segments 2 & 3 include grade-separated SR 9 on and off ramps
3. New intersection 2A – reconfiguration from off-ramp to 4-leg roundabout
4. New intersection 10B – removal of SR 9 slip on-ramp, addition of NB off-ramp to 4th Street NE from SR 9
5. New intersection 10A – addition of NB off-ramp to 4th Street NE from SR 9

TABLE 2. SUMMARY OF 2040 ALTERNATIVES COMPARED TO NO BUILD BY SEGMENTS AND INTERSECTIONS

	No Build	At-Grade Widening		Tight Diamond		Roundabout	
	$N_{predicted}$ (KABCO)	Percent Change from No Build	$N_{predicted}$ (KABCO)	Percent Change from No Build	$N_{predicted}$ (KABCO)	Percent Change from No Build	$N_{predicted}$ (KABCO)
Segment Sum	14.2	1.0%	14.3	2.4%	14.5	-15.0%	12.3
Intersection Sum	22.7	0.0%	22.7	-10.5%	20.5	9.5%	25.1
Total Sum	36.9		37.0		35.1		37.4

At-Grade Widening

There is no change from No Build in predicted collision rates with the At-Grade Widening scenario. Parameters including roadway type and segment length remain unchanged since the HSM relies upon the SPF for 4-lane undivided arterials for all arterials greater than 4 lanes. In this alternative, SR 9 becomes 6 lanes north of SR 204, and 5 lanes south, which is equivalent to the No Build scenario of 4 travel lanes under HSM methodology. There is no validated research that supports a reduction in collision rates with the addition of a travel lane. Furthermore, this alternative includes no other safety improvements to any intersections or segments in the project study area.

Tight Diamond Interchange Alternative

The grade-separated Tight Diamond Interchange alternative provides the greatest safety benefit for the project study area. The total predicted collision rate for all segments increases slightly because the segments now include new grade-separated on and off ramps which are not included in the No Build and other alternatives. The total intersection predicted collision rate decreases by 11% from No Build. The greatest reduction in predicted collisions occurs at the SR 9/SR 204 intersection, which is expected to see a reduction of 41% in the total predicted collision rate from No Build. This decrease is due to the grade that eliminates conflicting movements with the SR 9 through traffic. Fatal/injury collisions (KABC) are reduced even further; the predicted collision rate for fatal/injury collisions is expected to decrease by 84% from No Build.

Roundabout Intersections

Under the Roundabout Intersections alternative, the total predicted collision rate for segments decreases, while the total predicted collision rate for intersections increases, resulting in the total predicted collision rate for the alternative higher than No Build.

Collision rates decrease along the study segments because volumes are shifted off SR 9 with the addition of a north/south route along Vernon Road facilitated by the new SR 9/Vernon Road roundabout.

Collision rates at intersection are expected to increase due to the addition of the SR 9/Vernon Road intersection, which is a new intersection across SR 9 where the intersection was previously an off-ramp to Vernon Road from SR 9. While the intersection collision rate is expected to increase overall, the predicted collision rate for the intersection of SR 9/SR 204 decreases by 15% from No Build. The predicted fatal/injury (KABC) collision rate also decreases by 18% from No Build at SR 9/SR 204 under the roundabout alternative.

Conclusions

The At-Grade Widening alternative is equivalent to No Build, as it provides no safety improvements to the project study area.

The Tight Diamond interchange alternative is expected to have the greatest reduction in collision rate due to the grade separation of turning movements at the SR 9/SR 204 intersection reducing the volume crossing and conflicting with the SR 9 through volumes.

The Roundabout alternative could have a higher potential for collisions as compared with the No Build. However, this higher potential is mainly due to additional intersections associated with this alternative. Focusing on the SR 9/SR 204 intersection, the Roundabout alternative has a 15% reduction in predicted collision rates compared to No Build.

APPENDIX H

DEVIATIONS TO THE HYDRAULICS MANUAL OR HRM

To be reviewed separately before inclusion

APPENDIX I

ENVIRONMENTAL DOCUMENTATION

NOT USED

APPENDIX J

SPECIALTY DESIGN REPORTS

NOT USED

APPENDIX K

SUPPLEMENTS AND REVISIONS

NOT USED

APPENDIX L

BMP MAINTENANCE MANUAL