OSBORN
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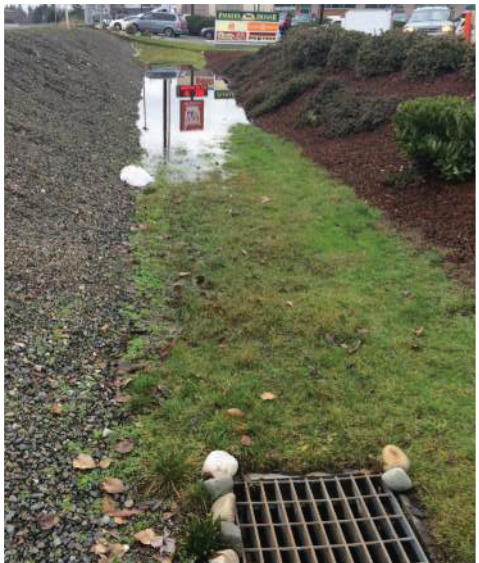
Washington State
Department of Transportation

SR 9 / SR 204
Intersection Improvements
Stage 3

FINAL
TYPE A HYDRAULIC REPORT

NOVEMBER 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

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WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

NW Region

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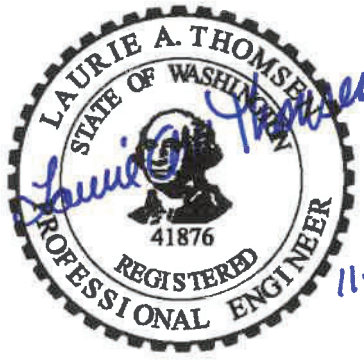

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TABLE OF CONTENTS

Section 1 PROJECT OVERVIEW 1
1.1 FUNDING 1
1.2 SITE LOCATION 3
1.3 VICINITY MAP 3
1.4 SCOPE OF WORK 4
1.5 SPECIALITY DESIGN 5
Section 2 SITE CONDITIONS 6
2.1 EXISTING CONDITIONS 6
2.2 EXISTING HYDRAULIC FEATURES 8
2.2.1 Existing Hydraulic Features 8
2.2.2 Existing Critical Areas 8
2.2.3 Existing Stormwater Facilities 8
2.2.4 Existing Conveyance 11
2.3 THRESHOLD DISCHARGE AREAS (TDAs) 13
2.4 SOILS 13
2.4.1 Infiltration Rate And Groundwater 14
2.4.2 Other Considerations 15
2.5 EXISTING STORMWATER DISCHARGE POINT INVENTORY 15
2.6 EXISTING UTILITIES 17
Section 3 DESIGN STANDARDS 19
3.1 DESIGN FREQUENCY 19
3.2 STORMWATER MANAGEMENT GUIDELINES 19
3.3 STORMWATER RETROFIT ANALYSIS 22
3.4 OTHER REQUIREMENTS 23
3.5 HYDRAULICS MANUAL DEVIATIONS 23
3.6 HIGHWAY RUNOFF MANUAL DEVIATONS 23
3.7 PIPE ALTERNATIVES 23
3.8 DOWNSTREAM ANALYSIS 23
3.9 NEW STORMWATER DISCHARGE POINTS 23
Section 4 DEVELOPED CONDITIONS 24
4.1 DRAINAGE BASINS 24
4.2 POST DEVELOPED TDAs 24
Section 5 HYDROLOGIC AND HYDRAULIC DESIGN 25

5.1 FLOW CONTROL AND RUNOFF TREATMENT BMPS 25
5.1.1 Runoff Treatment BMPs 25
5.1.2 Flow Control BMPs 26
5.2 CONVEYANCE DESIGN 27
5.2.1 Inlet Spacing 27
5.2.2 Storm Drain Piping 27
5.2.3 Ditch Design 27
5.2.4 Culvert Design 27
5.2.5 Pipe Outfall Protection 27
Section 6 PERMITS AND ASSOCIATED REPORTS 28
6.1 ENVIRONMENTAL ISSUES, FISH AND OTHER ENDANGERED HABITAT 28
6.1.1 Receiving Bodies 28
6.1.2 Flood Plains 28
6.1.3 Stream Crossings 28
6.1.4 Wetlands 28
6.1.5 Steep Slopes 28
6.1.6 Other Critical Areas 29
6.1.7 Endangered And Threatened Species 29
6.1.8 Fish Passage 29
6.1.9 Impaired Water Bodies 29
6.2 PERMITS/APPROVALS 29
6.3 EASEMENTS 29
6.4 ADDITIONAL REPORTS OR STUDIES 29
Section 7 INSPECTION AND MAINTENANCE SUMMARY 31
Section 8 REFERENCES 32

LIST OF APPENDICES

Appendix A | Stormwater Design Documentation Spreadsheet, LID Feasibility Checklist and RCEF Analysis

Appendix B | TDA Maps. Drainage Basin Maps and Area Calculations

Appendix C | Calculations and Program Output

Appendix C-1 | Flow Control Design

Appendix C-2 | Runoff Treatment Design

Appendix C-3 | Inlet Spacing Spreadsheets

Appendix C-4 | Sag Design

Appendix C-5 | Storm Drain Design

Appendix C-6 | Culvert Design

Appendix C-7 | Ditch Design

Appendix C-8 | Downstream Analysis

Appendix C-9 | Wetland Hydroperiod Analysis

Appendix D | Drainage Plan Sheets, Structure Notes and Details

Appendix E | Drainage Profile Sheets

Appendix F | Roadway Cross Sections and Profiles

Appendix G | Traffic Analysis Data

Appendix H| Deviations to the Hydraulics Manual or HRM

Appendix K | Supplements and Revisions

Appendix L | BMP Maintenance Manual

LIST OF TABLES

Table 1-1 | BMP Summary

Table 2-1 | Existing Cross Culverts

Table 2-2 | Summary of Threshold Discharge Areas (TDAs)

Table 2-3 | WSDOT Existing Stormwater Discharge Points

Table 2-4 | Additional Connections to WSDOT Drainage System

Table 3-1 | Summary of Areas

Table 5-1 | Runoff Treatment BMP and Treatment Area

Table 5-2 | Flow Control BMPs and Treatment Areas

LIST OF FIGURES

Figure 1-1 | Vicinity Map

Figure 2-1 | Existing Project TDA's

Figure 2-2 | Developed Project TDA's

Figure 2-3 | Wetlands and Streams

Figure 2-4 | Soils

Figure 2-5 | Soils Map Unit Legend

Figure 2-6 | WSDOT Stormwater Discharge Point Inventory Map

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	WSDOT0001364192	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	WSDOT0001348837	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	WSDOT0001348838	9,907CF (Storage Volume)	Part of the BMP Provides Retrofit
SR9	16.01	A 279+52 (52.5 LT) to A 281+52.8 (43.5 LT)	Snohomish	SR 9/SR 204 Intersection Improvements –Stage 3	RT.07 MFD Type 3	WSDOT0001364195	201 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

0 225 550
SCALE IN FEET

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SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE 2-2 : DEVELOPED PROJECT TDAs

N

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**.

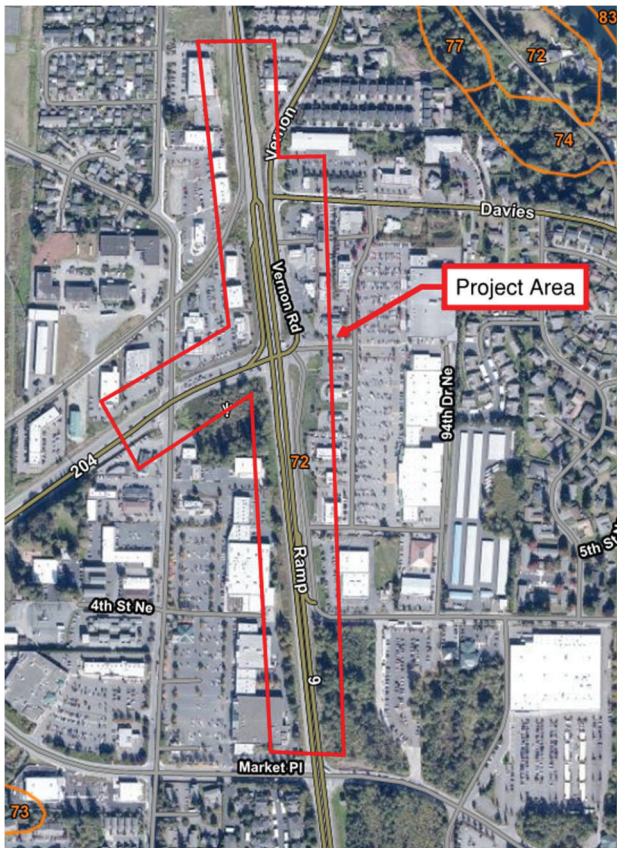


Figure 2-4 | Soils

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	0.85	0.63	1.52	1.03
3	6.77	4.55	2.22	0.59	0.58	2.32	1.72
4	1.11	0.91	0.20	0.07	0.07	0.33	0.28
5	0.84	0.34	0.50	-	-	-	-
6	0.06	0.06	-	-	-	0.03	0.01
Totals	**16.54**	**10.85**	**5.69**	**1.51**	**1.28**	**4.20**	**3.04**

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 21% 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 281+52.8 (43.5 LT)	MFD Type 3	0.18	201 LF
			Total TDA 2	**1.18**	
			Total TDA 3	**1.93**	
			Total TDA 5	**0.18**	
			Project Total	**3.29**	

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)	65,667
acres =	1.508

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)	183,073
acres =	4.203

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	248,740	≥ 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	65,667	≥ 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)	444,312
acres =	10.200

New PGIS

Total Project Area (ft^2)	55,620
acres =	1.277

Conversion of Native Vegetation to PGPS

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

Replaced PGIS

Total Project Area (ft^2)	132,907
acres =	3.051

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	55,620	≥ 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	13%	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	27,118	44,632	0	27,118	0	YES	NO	27,118	0	21,000	YES	YES	Enhanced RT	NO	NO	
3	A Sta 267+50 to A Sta 279+18	25,174	75,043	0	25,174	0	YES	NO	25,174	0	21,000	YES	YES	Enhanced RT	NO	NO	
4	A Sta 273+42 to A Sta 276+58	3,328	12,017	0	3,328	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	1,215	0	0	0	NO	NO	0	0	21,000	YES	YES	N/A	NO	NO	

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 (ft^2)	Reverted Impervious Surface** Area (ft^2)	Net-New Impervious Surface Area (ft^2)	Replaced Impervious Surface Area (ft^2)	Non-Effective Impervious Surface Area (ft^2)	Effective Impervious Surface Area (ft^2)	Conversion of Native Vegetation to Lawn or Landscape per TDA Area (ft^2)	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 (ft^2)	FC needed for TDA? Converted Pervious Surfaces Area (ft^2)	Comments
2	A Sta 255+07 to A Sta 269+42	37,843	0	37,843	66,036	0	37,843	0	NO	YES	NO	NO	37,843	0	New and Effective Impervious surface areas include 961 SF of new impervious surface shifting from TDA 3 into TDA 2.
3	A Sta 267+50 to A Sta 279+18	26,546	0	26,546	101,272	0	26,546	0	NO	YES	NO	NO	26,546	0	New and Effective Impervious surface areas include 888 SF of new impervious surface shifting from TDA 4 into TDA 3.
4	A Sta 273+42 to A Sta 276+58	4,046	0	4,046	14,283	0	4,046	0	NO	NO	NO	NO	0	0	New and Effective Impervious surface areas include 919 SF of new impervious surface shifting from TDA 3 into TDA 4.
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	0	0	0	1,482	0	0	0	NO	NO	NO	NO	0	0	
	Area Totals for Project	68,435	0	68,435	183,073	0	68,435	0					64,389	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?	0.08	acres
How much area of existing PGIS was retrofitted onsite for runoff treatment in the project?	1.84	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)?	NO	
Leave Blank ---------->		
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				0.41	Facility Name: RT 2-6 MFD Type 3; this facility provides an additional 0.06 ac of treatment for an equivalent area of PGIS entering TDA 2 from TDA 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		0.63		0.08	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		0.17			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			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		0.03		0.12	Facility Name: RT 3-4 MFD Type 1; this facility provides an additional 0.22 ac of treatment for an equivalent area of PGIS entering TDA 3 from TDA 2 and 4.
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				0.18	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; this facility provides detention for an equivalent area of 961 sf of new impervious surface entering TDA 2 from TDA 3.
009	015.78	48°00'11.7"N	122°06'22.0"W	015.78			3	Detention Pond	New	YES	YES		WSDOT0001348838	Full	0.61		0.07		Facility Name: FC 3-1 Pond; this facility provides detention for an equivalent area of 888 sf of new impervious surface entering TDA 3 from TDA 4.

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	Existing Stormwater BMP Type	Is this an existing BMP going to be modified or completely removed by project?	Existing WSDOT Feature Number (See WSDOT HATS*** web application to determine Feature Number)	If this is an existing BMP being modified, please describe the proposed modification	List the amount of existing Impervious surface (flow control) mitigated by the existing BMP before the project (Acres)	List the amount of existing PGIS (runoff treatment) mitigated by the existing BMP before the project (Acres)	Is the amount of existing impervious surface and PGIS receiving treatment and flow control re-established by a new or modified BMP?	Comments
009	015.58	48.000125000	-122.106127000				2	Detention Pond		WSDOT0001341154	N/A	0.740		NO	Facility Name: Pond B; Location: Southbound SR 9. Pond B will not be modified or removed.
009	015.53	47.999403000	-122.106023000	015.55	47.999758000	-122.106081000	2	CABS		WSDOT0001341155	N/A		1.160	NO	Facility Name: CABS A; Location: Southbound SR 9. CABS A will not be modified or removed.

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	$ 750,693	$ 83,769	$ 834,462	$ 2,214	$ 10,871	$ -	$ 13,085
MFD	$ -	$ 72,880	$ 72,880	$ 55,415	$ 68,596	$ 23,265	$ 147,276
CABS	$ 20,800	$ -	$ 20,800	$ 2,475.00	$ -	$ -	$ 2,475
Wet Biofiltration Swale	$ -	$ -	$ -	$ -	$ 11,700.00	$ -	$ 11,700
Conveyance	$ 267,775.00	$ 147,185.00	$ 414,960	$ 8,530.00	$ 82,363.00	$ -	$ 90,893
Estimated Construction Total[2],[3]	$ 1,039,268	$ 303,834	**$ 1,343,102**	$ 68,634	$ 173,530	$ 23,265	**$ 265,429**
Preliminary Engineering[4]			**$ 63,249**				**$ 31,624**
Right-of-Way[5]	$ -		**$ -**				**$ -**
TOTAL COST			**$ 1,406,351**				**$ 297,054**

TOTAL COST OF PROPOSED DESIGN	**$ 1,703,404**

% Retrofit by Cost	**21%**

TDA 1 does not trigger HRM minimum requirement thresholds.

Note:

1 The Retrofit analysis is an approximate analysis based on 100% 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 BMPs. 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	$ 77,068.80	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% contigency
Common Borrow Incl. Haul	0	CY	$ 12.00	$ -	Assumed excavated material is common borrow
Walled Detention Pond					60% Contingency added to all Walled Detention Pond item totals
Inverted Short Span Bridges (Delivered)	1	EACH	$ 179,714.29	$ 287,542.86	
Span Installed	1	EACH	$ 53,914.29	$ 86,262.86	Installation estimated at 25% of delivered price.
Footing	23	CY	$ 500.00	$ 18,488.89	For resistance to buoyant forces due to high GW
End Walls	13	CY	$ 500.00	$ 10,400.00	
Galv. Steel bolt on ladders	3	EACH	$ 650.00	$ 3,120.00	Provided at ~50 ft
CS-231 Mastic	1850	LF	$ 3.00	$ 8,880.00	Joint sealant
Joint Wrap	1850	LF	$ 4.00	$ 11,840.00	Joint wrap to prevent inflow from GW
Shop Drawings	1	LS	$ 20,000.00	$ 32,000.00	
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	$ 200.00	$ 88,000.00	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 Stabilization	5310	SY	$ 7.50	$ 39,825.00	For access road
Double 20' FT Chain Link Fence Gate	1	EACH	$ 1,100.00	$ 1,100.00	for fence
Estimated Construction Cost				**$ 750,693**	

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 Stabilization	25.35	SY	$ 7.50	$ 191.00	
Topsoil Type A	0.08	Acres	$ 150,000.00	$ 12,677.00	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				**$ 20,800.00**	

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.	933	LF	$ 85.00	$ 79,305.00	UBA from SoQ Updated 9/18/19
Schedule A Storm Sewer Pipe 12 In. Diam. Concrete CL III	149	LF	$ 150.00	$ 22,350.00	UBA from SoQ Updated 9/18/20
Schedule A Storm Sewer Pipe 12 In. Diam. Concrete CL IV	193	LF	$ 100.00	$ 19,300.00	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		$ 5,500.00	$ 5,500.00	UBA from SoQ Updated 9/18/20
Catch Basin Type 2 48 In. Diam. w/ solid lid	2	Each	$ 5,500.00	$ 11,000.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 54 In. Diam. w/ solid lid and FC	1	Each	$ 10,300.00	$ 10,300.00	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	1060	CY	$ 60.00	$ 63,600.00	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	6940	SF	$ 3.00	$ 20,820.00	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				**$ 267,775**	

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	$ 864.00	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	$ 200.00	$ -	Mounted at the top of pond wall
Chain Link Fence Type 3	0	LF	$ 60.00	$ -	Around the walled pond
Construction Geotextile for Soil Stabilization	0	SY	$ 7.50	$ -	For access road
Double 20' FT Chain Link Fence Gate	0	EACH	$ 1,100.00	$ -	for fence
Estimated Construction Cost				**$ 2,214**	

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

TDA 2 - RUNOFF TREATMENT COST (RETROFIT)

MEDIA FILTER DRAIN (MFD) Bid Item	Qty	Unit	Unit Price	Total	Notes
MEDIA FILTER DRAIN	480	LF	$ 115.00	$ 55,200.00	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				**$ 55,415.00**	
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 Stabilization	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 retrofit

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	$ 5,500.00	$ 5,500.00	UBA from SoQ Updated 9/18/20
Catch Basin Type 2 48 In. Diam. w/ cage		Each	$ 5,500.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 54 In. Diam. w/ solid lid and FC		Each	$ 10,300.00	$ -	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	20	CY	$ 60.00	$ 1,200.00	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	100	SF	$ 3.00	$ 300.00	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				**$ 8,530**	

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	$ 10,300.00	$ 10,300.00	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	$ 200.00	$ -	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	$ 2,500.00	$ 2,500.00	For fence
Chain Link Fence Type 3	335	LF	$ 60.00	$ 20,100.00	Around the pond
Estimated Construction Cost				**$ 83,769**	

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	$115.00	$ 72,430.00	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				**$ 72,880.00**	

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.	239	LF	$ 85.00	$ 20,315.00	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 12 In. Diam. Concrete CL IV		LF	$ 100.00	$ -	UBA from SoQ Updated 9/18/19
Schedule A Storm Sewer Pipe 18 In. Diam.	140	LF	$ 135.00	$ 18,900.00	UBA from SoQ Updated 9/18/20
Drain Pipe 6 In Diam.	50	LF	$ 60.00	$ 3,000.00	
Catch Basin Type 1	7	Each	$ 2,500.00	$ 17,500.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam.	2	Each	$ 5,500.00	$ 11,000.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam. w/ solid lid	3	Each	$ 5,500.00	$ 16,500.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 54 In. Diam. w/ solid lid and FC	1	Each	$ 10,300.00	$ 10,300.00	UBA from SoQ Updated 9/18/20
Catch Basin Type 2 96 In. Diam. w/ Flow splitter	0	Each	$ 17,200.00	$ -	UBA from SoQ Updated 9/18/19
Excavation Class B Incl. Haul	450	CY	$ 60.00	$ 27,000.00	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	2790	SF	$ 3.00	$ 8,370.00	UBA from SoQ Updated 9/18/19
Testing Storm Sewer Pipe	50	LF	$ 4.00	$ 200.00	UBA from SoQ Updated 9/18/19
Quarry Spalls		Tons	$ 85.00	$ -	UBA from SoQ Updated 9/18/19
Estimated Construction Cost				**$ 147,185**	

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	$ 12.00	$ 95.29	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	$ 10,300.00	$ -	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	$ 200.00	$ -	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			$ 2,500.00		For fence
Chain Link Fence Type 3			$ 60.00	$ -	Around the pond
Estimated Construction Cost				**$ 10,871**	

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	$115.00	$ 68,446.00	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				**$ 68,596.00**	

WET BIOFILTRATION SWALE

Bid Item	Qty	Unit	Unit Price	Total	Notes
Roadway Excavation Incl. Haul - Area CAB5	45.00	CY	$60.00	$ 2,700.00	Exc qty from FG to EG
Topsoil Type A	0.06	Acres	$150,000.00	$ 9,000.00	0.67'
Estimated Wet Bioswale Construction Cost				**$ 11,700.00**	

Wetbioswale is a retrofit BMP

TDA 3 - CONVEYANCE (RETROFIT)

Pipe Conveyance

Bid Item	Qty	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 12 In. Diam. Concrete CL IV		LF	$ 100.00	$ -	UBA from SoQ Updated 9/18/19
Schedule A Storm Sewer Pipe 18 In. Diam.		LF	$ 135.00	$ -	UBA from SoQ Updated 9/18/20
Drain Pipe 6 In Diam.		LF	$ 60.00	$ -	
Catch Basin Type 1		Each	$ 2,500.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam.		Each	$ 5,500.00	$ -	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 48 In. Diam. w/ solid lid	2	Each	$ 5,500.00	$ 11,000.00	UBA from SoQ Updated 9/18/19
Catch Basin Type 2 54 In. Diam. w/ solid lid and FC	0	Each	$ 10,300.00	$ -	UBA from SoQ Updated 9/18/20
Catch Basin Type 2 96 In. Diam. w/ Flow splitter	1	Each	$ 17,200.00	$ 17,200.00	UBA from SoQ Updated 9/18/19
Excavation Class B Incl. Haul	290	CY	$ 60.00	$ 17,400.00	UBA from SoQ Updated 9/18/19
Shoring or Extra Excavation Class B	2040	SF	$ 3.00	$ 6,120.00	UBA from SoQ Updated 9/18/19
Testing Storm Sewer Pipe	32	LF	$ 4.00	$ 128.00	UBA from SoQ Updated 9/18/19
Quarry Spalls		Tons	$ 85.00	$ -	UBA from SoQ Updated 9/18/19
Estimated Construction Cost				**$ 82,363**	

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

TDA 5 -RUNOFF TREATMENT COST (PER HRM)					
MEDIA FILTER DRAIN (MFD)					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
MEDIA FILTER DRAIN	0	LF	$115.00	$ -	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)		201	201	MFDs DR4-1 (RT4-1) is retrofit

TDA 5 -RUNOFF TREATMENT COST (RETROFIT)					
MEDIA FILTER DRAIN (MFD)					
Bid Item	**Qty**	**Unit**	**Unit Price**	**Total**	**Notes**
MEDIA FILTER DRAIN	201	LF	$115.00	$ 23,115.00	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				**$ 23,265.00**	

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 YES/NO	TDA1 Response	TDA2 YES/NO	TDA2 Response	TDA3 YES/NO	TDA3 Response	TDA4 YES/NO	TDA4 Response	TDA5 YES/NO	TDA5 Response	TDA6 YES/NO	TDA6 Response	TDA7 YES/NO	TDA7 Response	TDA8 YES/NO	TDA8 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 YES/NO	TDA1 Response	TDA2 YES/NO	TDA2 Response	TDA3 YES/NO	TDA3 Response	TDA4 YES/NO	TDA4 Response	TDA5 YES/NO	TDA5 Response	TDA6 YES/NO	TDA6 Response	TDA7 YES/NO	TDA7 Response	TDA8 YES/NO	TDA8 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 YES/NO	TDA1 Response	TDA2 YES/NO	TDA2 Response	TDA3 YES/NO	TDA3 Response	TDA4 YES/NO	TDA4 Response	TDA5 YES/NO	TDA5 Response	TDA6 YES/NO	TDA6 Response	TDA7 YES/NO	TDA7 Response	TDA8 YES/NO	TDA8 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

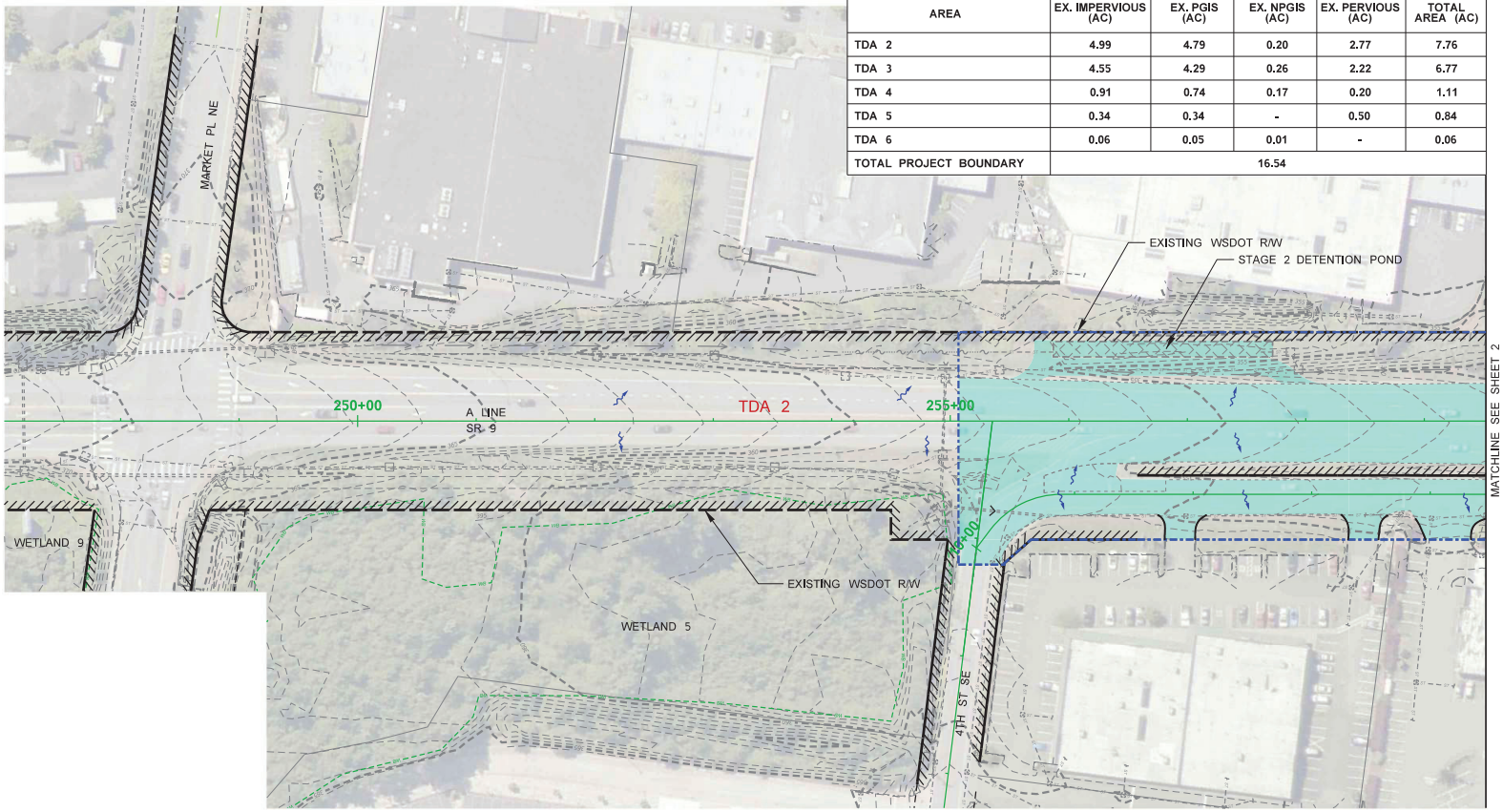
Feasiblity Criteria	TDA1 YES/NO	TDA1 Response	TDA2 YES/NO	TDA2 Response	TDA3 YES/NO	TDA3 Response	TDA4 YES/NO	TDA4 Response	TDA5 YES/NO	TDA5 Response	TDA6 YES/NO	TDA6 Response	TDA7 YES/NO	TDA7 Response	TDA8 YES/NO	TDA8 Response
Is there insufficient space for a MFD within the existing public right-of-way 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										

BIORETENTION AREA																
Yes = LID not feasible		TDA1		TDA2		TDA3		TDA4		TDA5		TDA6		TDA7		TDA8	
No = LID is feasible	**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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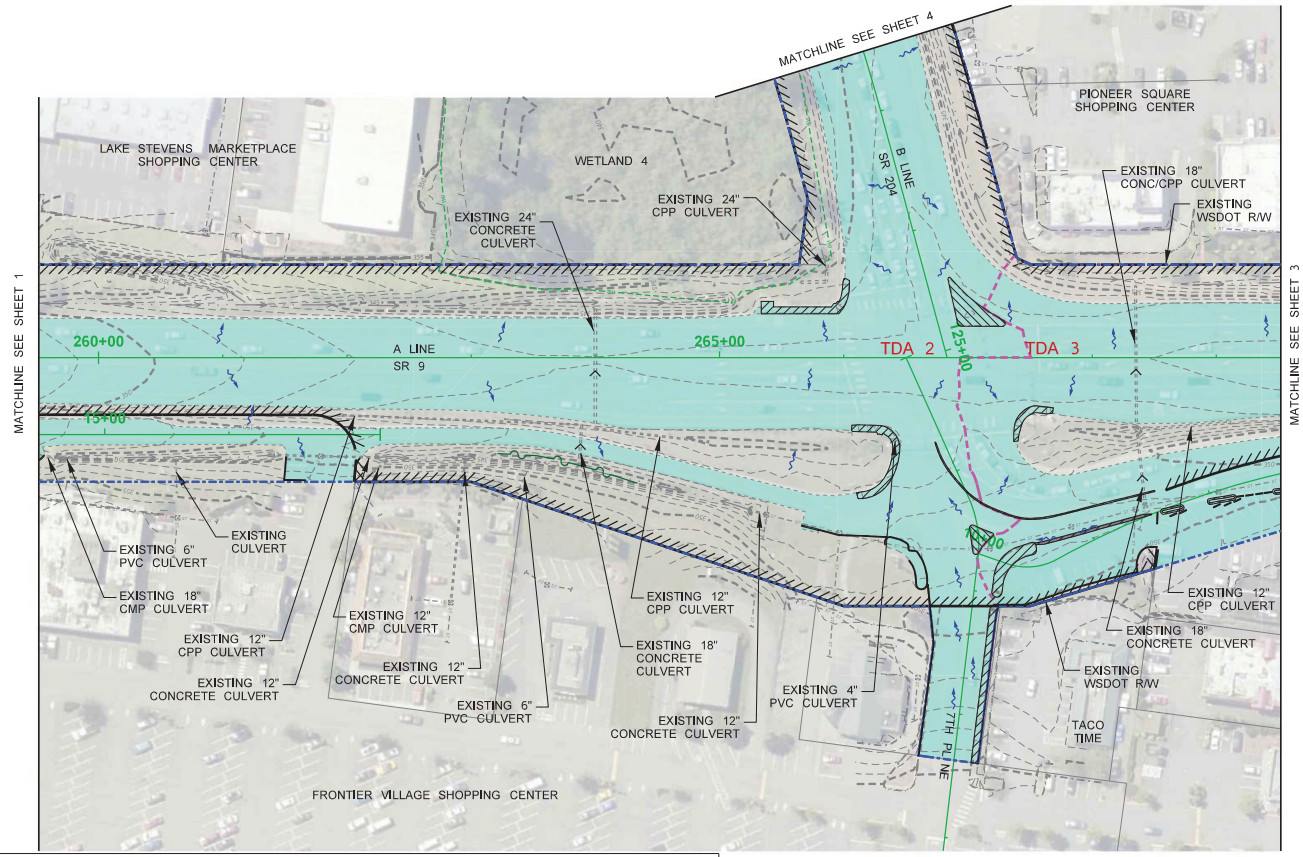
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 1

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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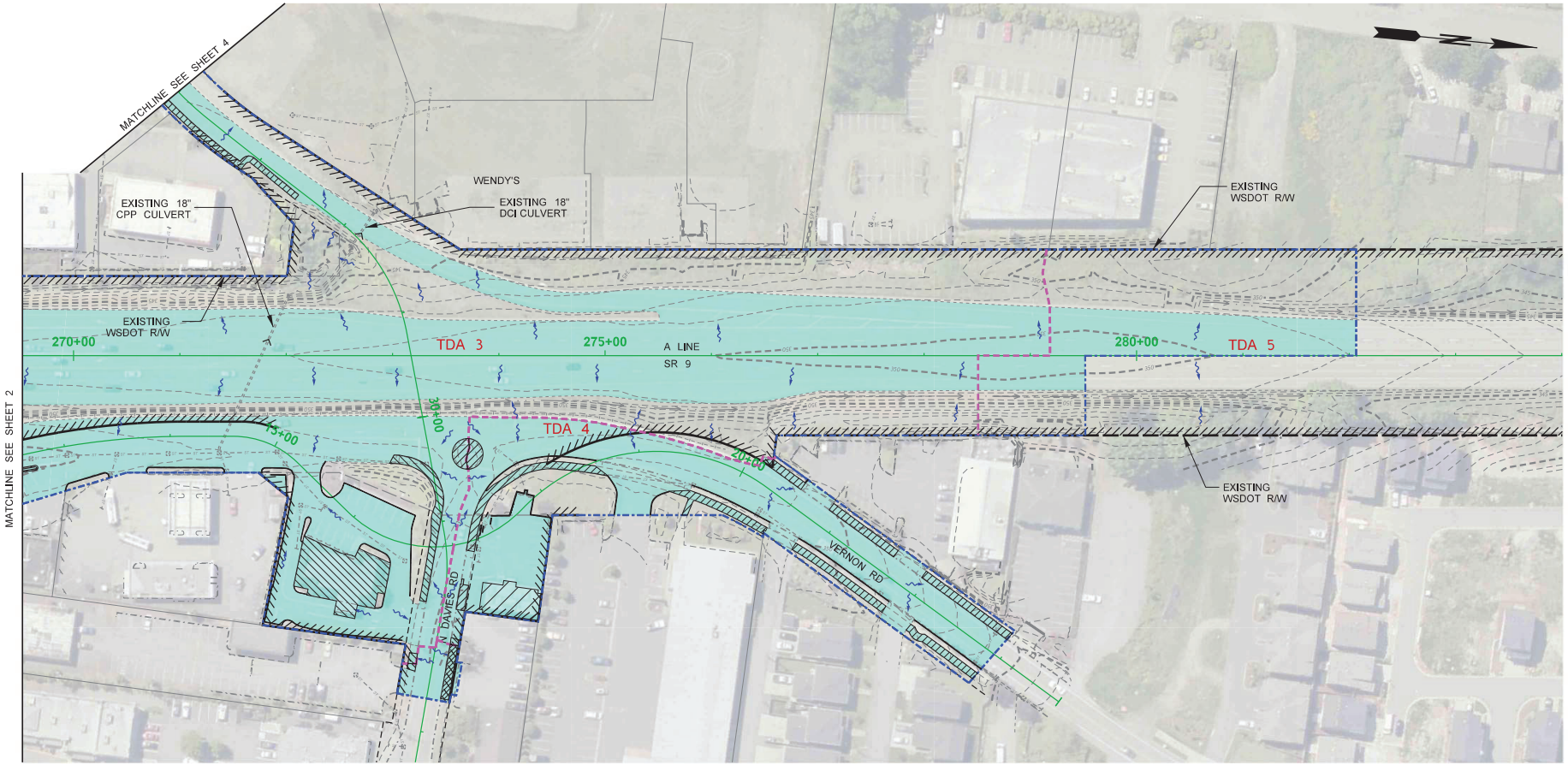
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 2

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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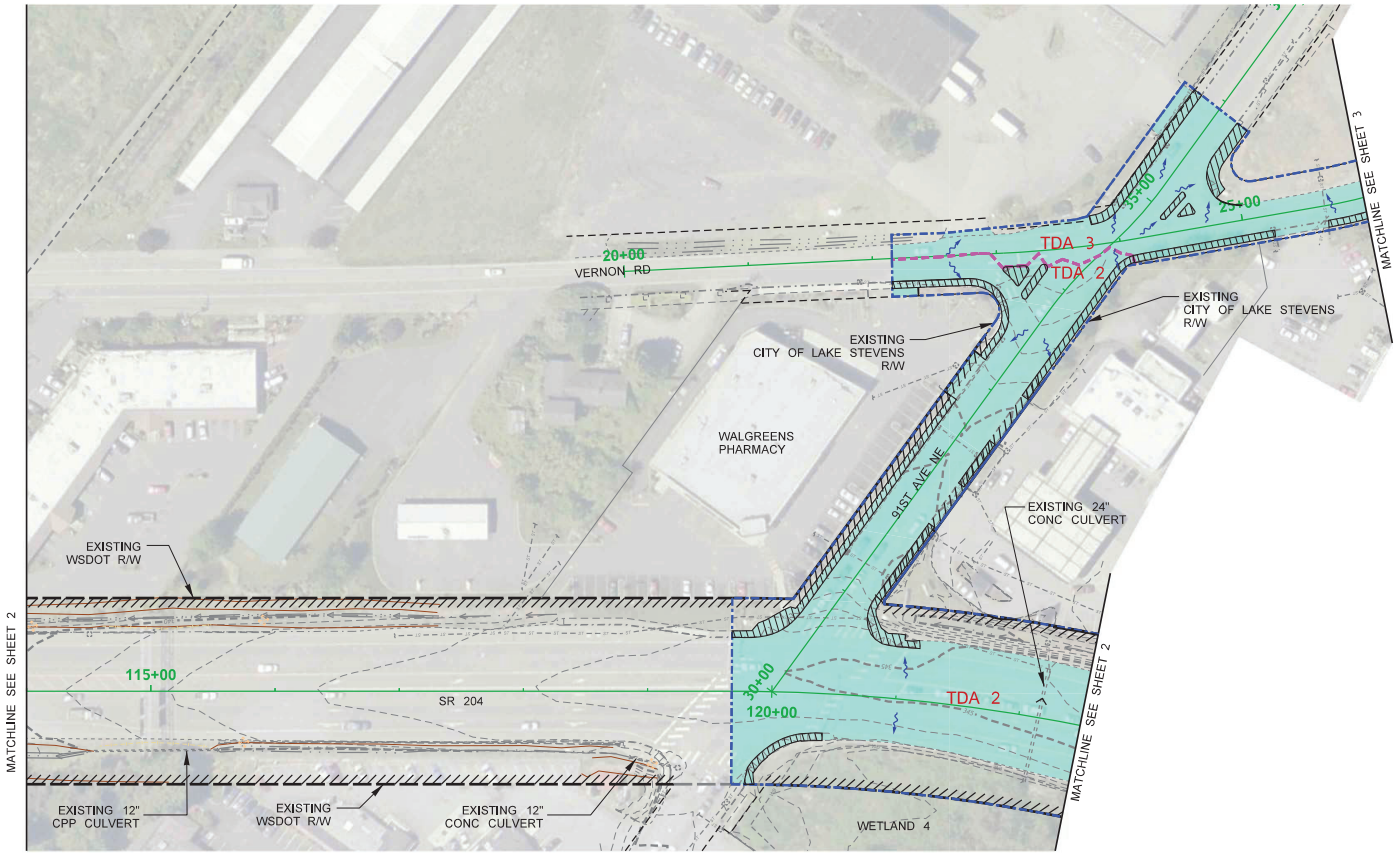
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 3

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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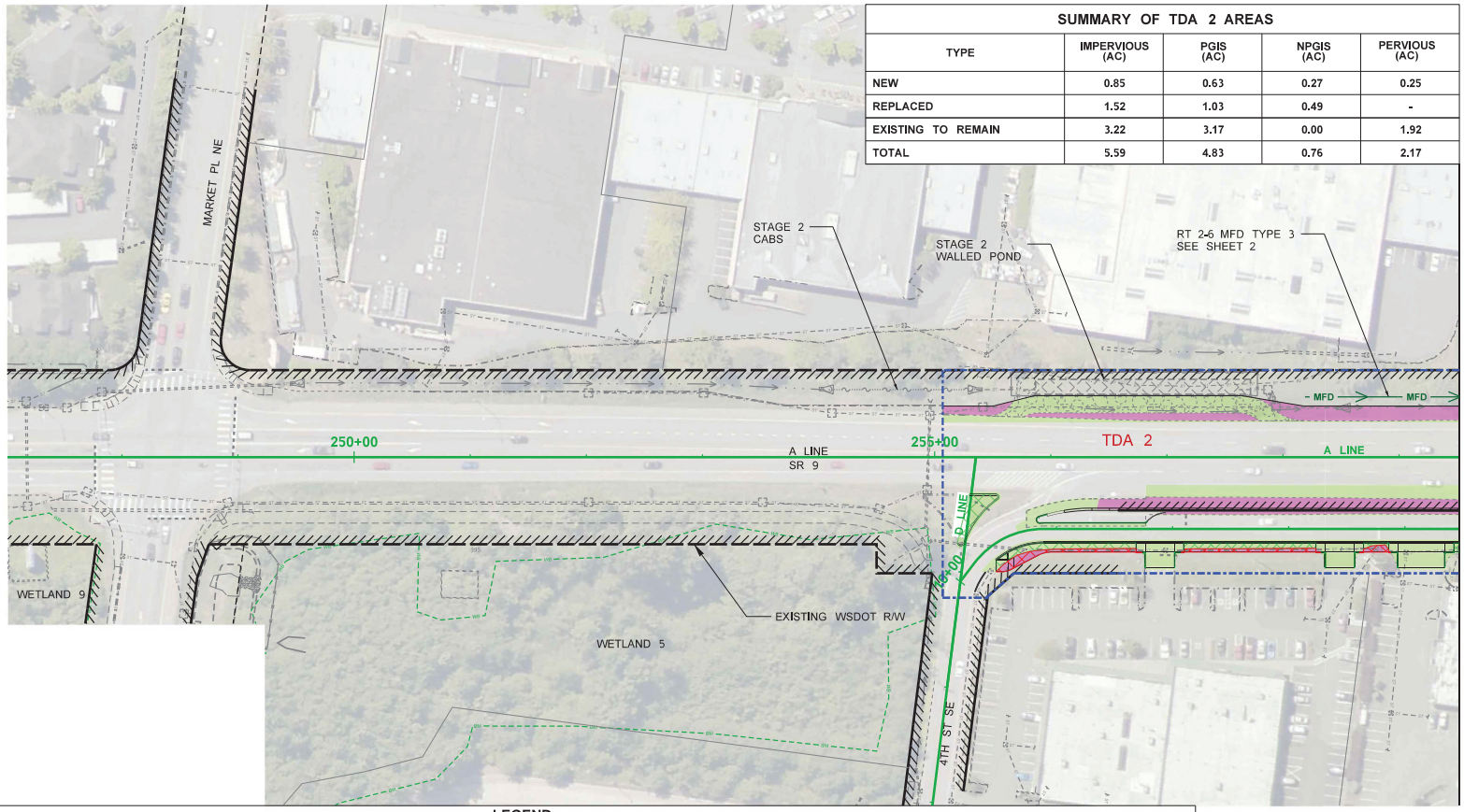
FIGURE A-2.1 : EXISTING CONDITIONS SHEET 4

0 50 100
SCALE IN FEET



SUMMARY OF TDA 2 AREAS

TYPE	IMPERVIOUS (AC)	PGIS (AC)	NPGIS (AC)	PERVIOUS (AC)
NEW	0.85	0.63	0.27	0.25
REPLACED	1.52	1.03	0.49	-
EXISTING TO REMAIN	3.22	3.17	0.00	1.92
TOTAL	5.59	4.83	0.76	2.17

LEGEND

- NEW IMPERVIOUS AREA
- NEW NPGIS AREA
- REPLACED IMPERVIOUS AREA
- MAINTENANCE ACCESS ROAD
- REPLACED NPGIS AREA
- EXISTING R/W
- LIMITED ACCESS
- 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 WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. NEW IMPERVIOUS AREAS NOT INCLUDED IN THE NEW NPGIS AREA CROSSHATCH IS CONSIDERED PGIS.
3. SEE FIGURE A-2.1 FOR EXISTING AREAS.
4. SEE DRAFT DEVIATION MEMO FOR FLOW SHIFT AREAS BETWEEN TDAs 2, 3, 4 AND 6.

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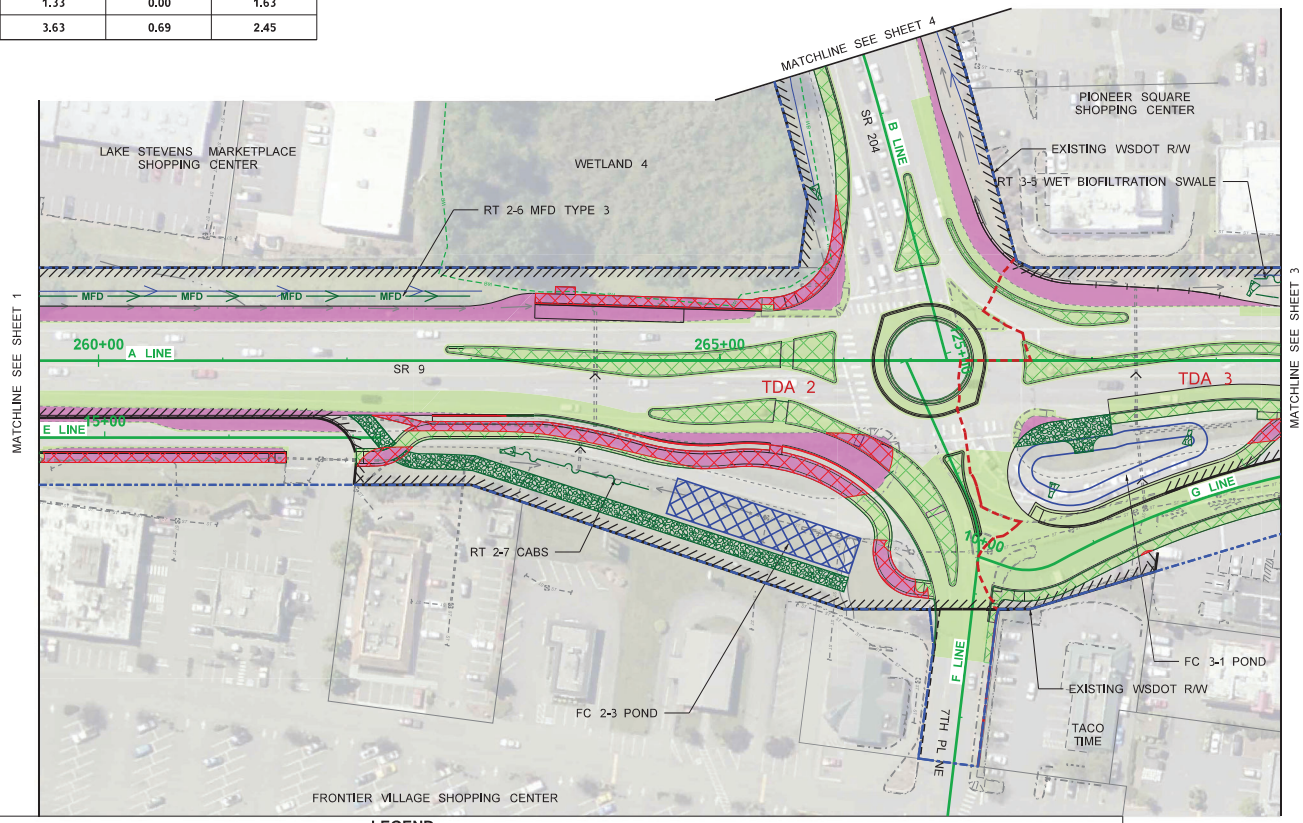
FIGURE A-2.2 : DEVELOPED CONDITIONS SHEET 1

0 50 100
SCALE IN FEET

SUMMARY OF TDA 3 AREAS				
TYPE	IMPERVIOUS (AC)	PGIS (AC)	NPGIS (AC)	PERVIOUS (AC)
NEW	0.59	0.58	0.09	0.82
REPLACED	2.32	1.72	0.60	-
EXISTING TO REMAIN	1.41	1.33	0.00	1.63
TOTAL	4.32	3.63	0.69	2.45



LEGEND

- NEW IMPERVIOUS AREA
- NEW NPGIS AREA
- REPLACED IMPERVIOUS AREA
- MAINTENANCE ACCESS ROAD
- REPLACED NPGIS AREA
- EXISTING R/W
- LIMITED ACCESS
- 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 WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. NEW IMPERVIOUS AREAS NOT INCLUDED IN THE NEW NPGIS AREA CROSSHATCH IS CONSIDERED PGIS.
3. SEE FIGURE A-2.1 FOR EXISTING AREAS.
4. SEE DRAFT DEVIATION MEMO FOR FLOW SHIFT AREAS BETWEEN TDAs 2, 3, 4 AND 6.

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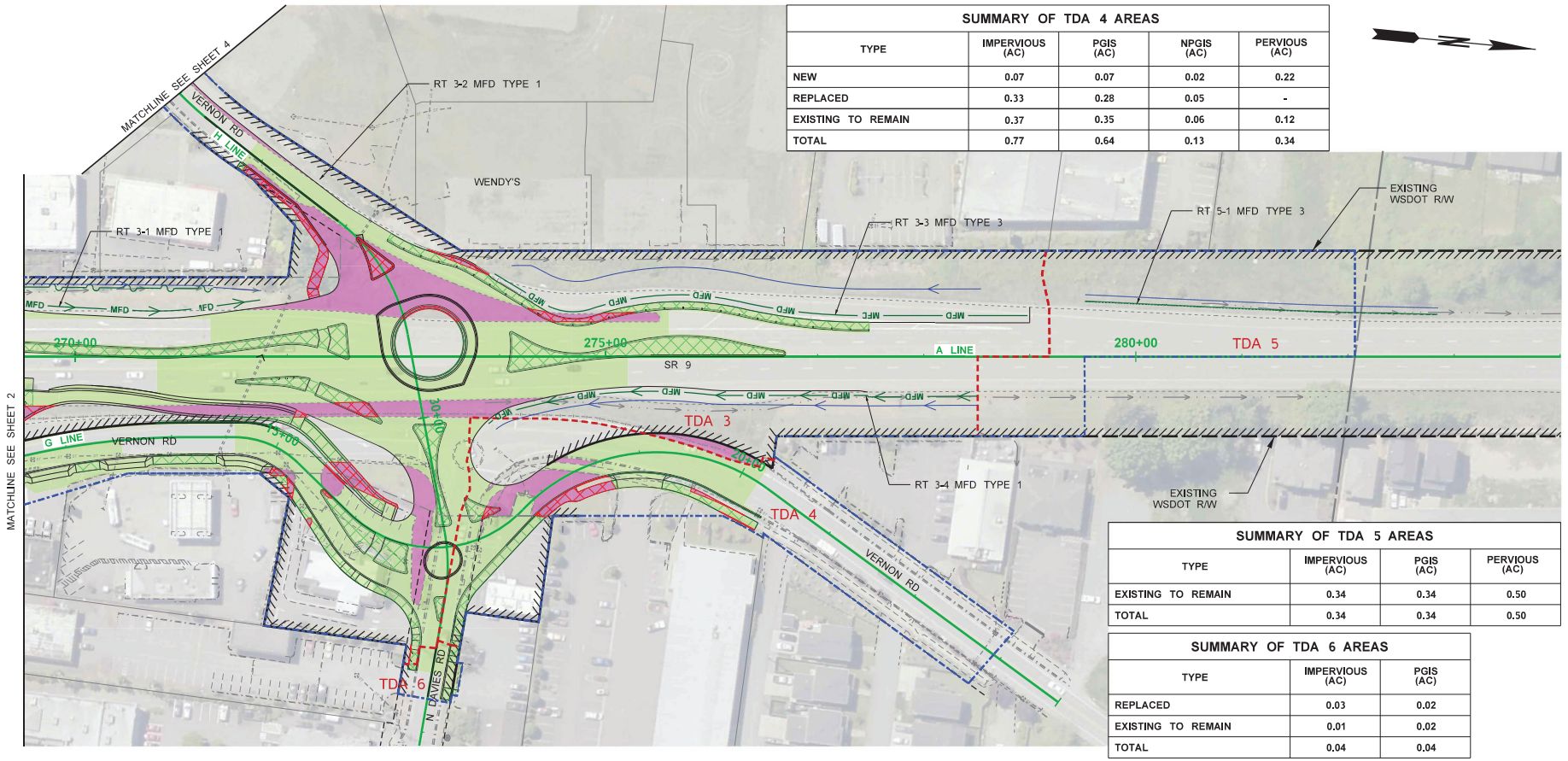
FIGURE A-2.2 : DEVELOPED CONDITIONS SHEET 2

0 50 100
SCALE IN FEET



SUMMARY OF TDA 4 AREAS				
TYPE	IMPERVIOUS (AC)	PGIS (AC)	NPGIS (AC)	PERVIOUS (AC)
NEW	0.07	0.07	0.02	0.22
REPLACED	0.33	0.28	0.05	-
EXISTING TO REMAIN	0.37	0.35	0.06	0.12
TOTAL	0.77	0.64	0.13	0.34

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	0.03	0.02
EXISTING TO REMAIN	0.01	0.02
TOTAL	0.04	0.04

NEW IMPERVIOUS AREA
NEW NPGIS AREA
REPLACED IMPERVIOUS AREA
MAINTENANCE ACCESS ROAD
REPLACED NPGIS AREA
EXISTING R/W
LIMITED ACCESS
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 WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. NEW IMPERVIOUS AREAS NOT INCLUDED IN THE NEW NPGIS AREA CROSSHATCH IS CONSIDERED PGIS.
3. SEE FIGURE A-2.1 FOR EXISTING AREAS.
4. SEE DRAFT DEVIATION MEMO FOR FLOW SHIFT AREAS BETWEEN TDAs 2, 3, 4 AND 6.
5. NO ROADWAY IMPROVEMENTS ARE PROPOSED WITHIN TDA 5.
6. NO NEW IMPERVIOUS/NEW PGIS SURFACES ARE PROPOSED WITHIN TDA 6.

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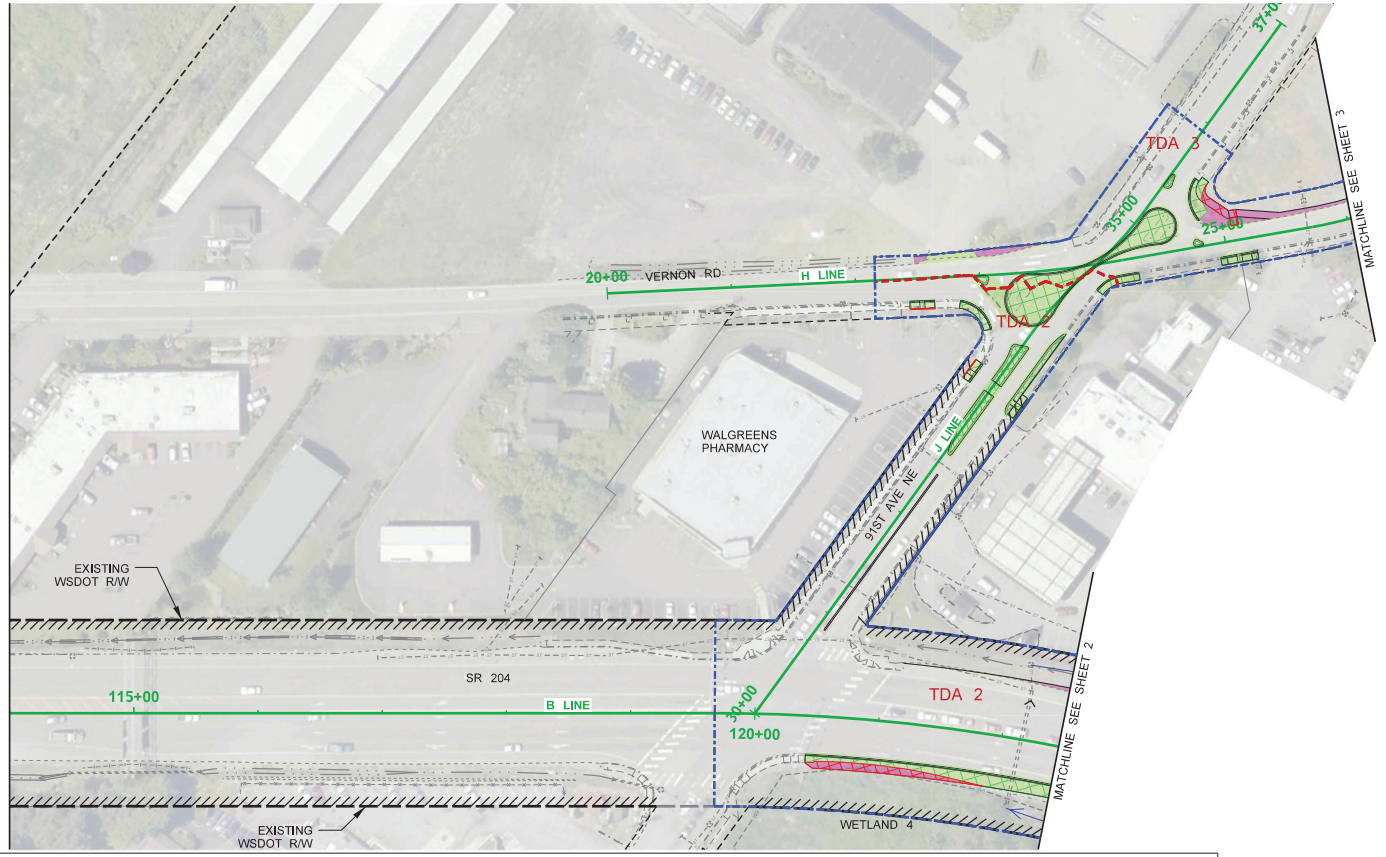
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

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
- 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 WITHIN THE PROJECT BOUNDARY IS CONSIDERED DEVELOPED PERVIOUS AREA.
2. NEW IMPERVIOUS AREAS NOT INCLUDED IN THE NEW NPGIS AREA CROSSHATCH IS CONSIDERED PGIS.
3. SEE FIGURE A-2.1 FOR EXISTING AREAS.
4. SEE DRAFT DEVIATION MEMO FOR FLOW SHIFT AREAS BETWEEN TDAs 2, 3, 4 AND 6.

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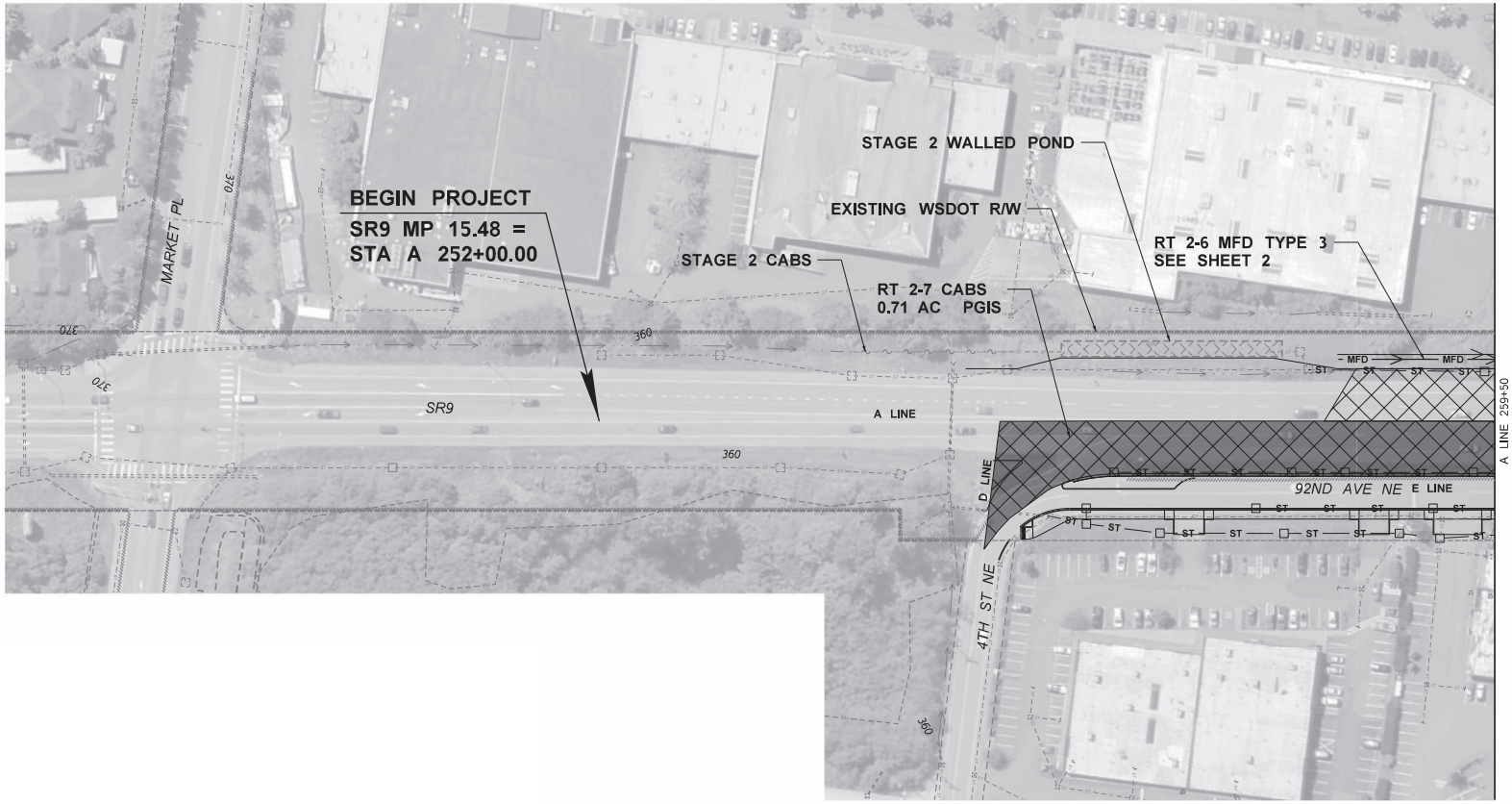
Washington State Department of Transportation

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	MEDIA FILTER DRAIN (MFD)	BASIC TREATMENT AREA
WETLAND BOUNDARY	EXISTING DITCH	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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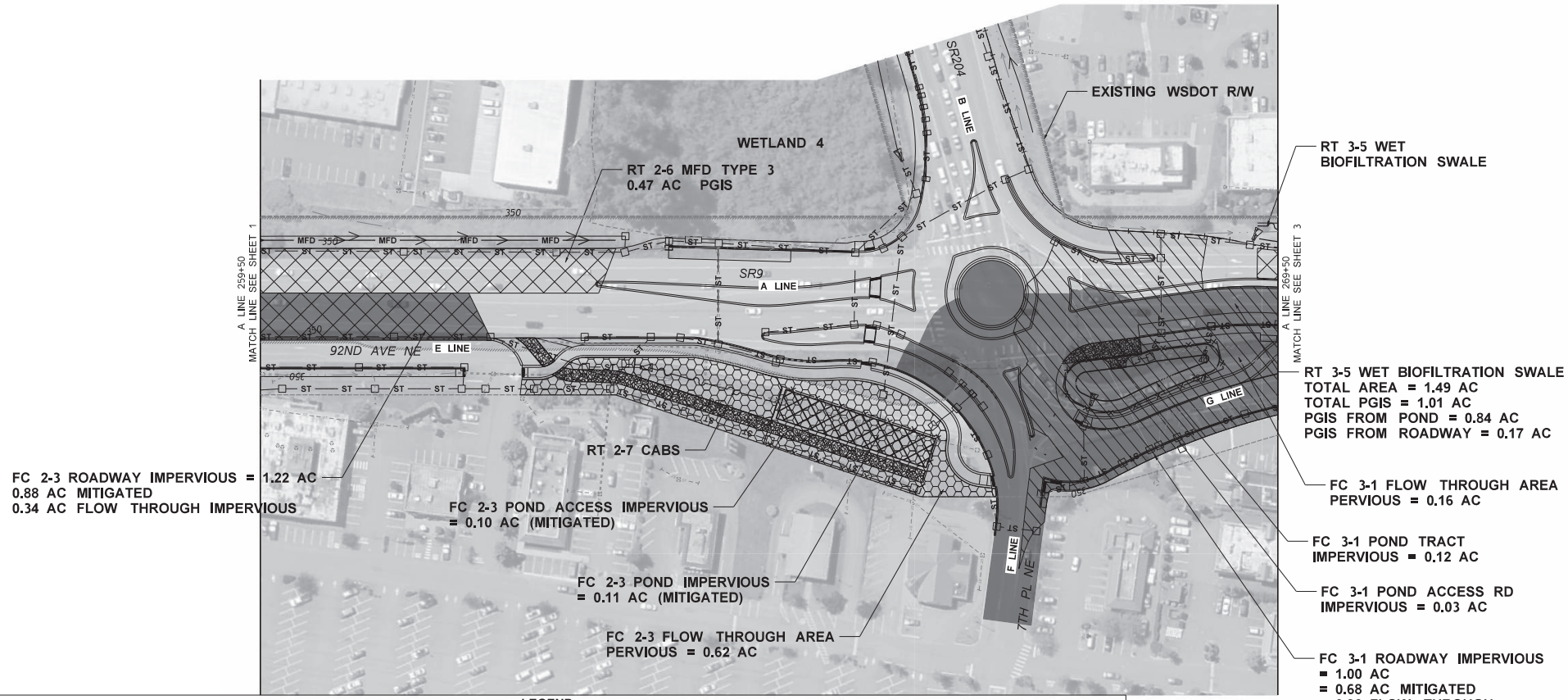
Washington State Department of Transportation

SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-2.3 : BMP CATCHMENT AREA SHEET 1

0 50 100
SCALE IN FEET



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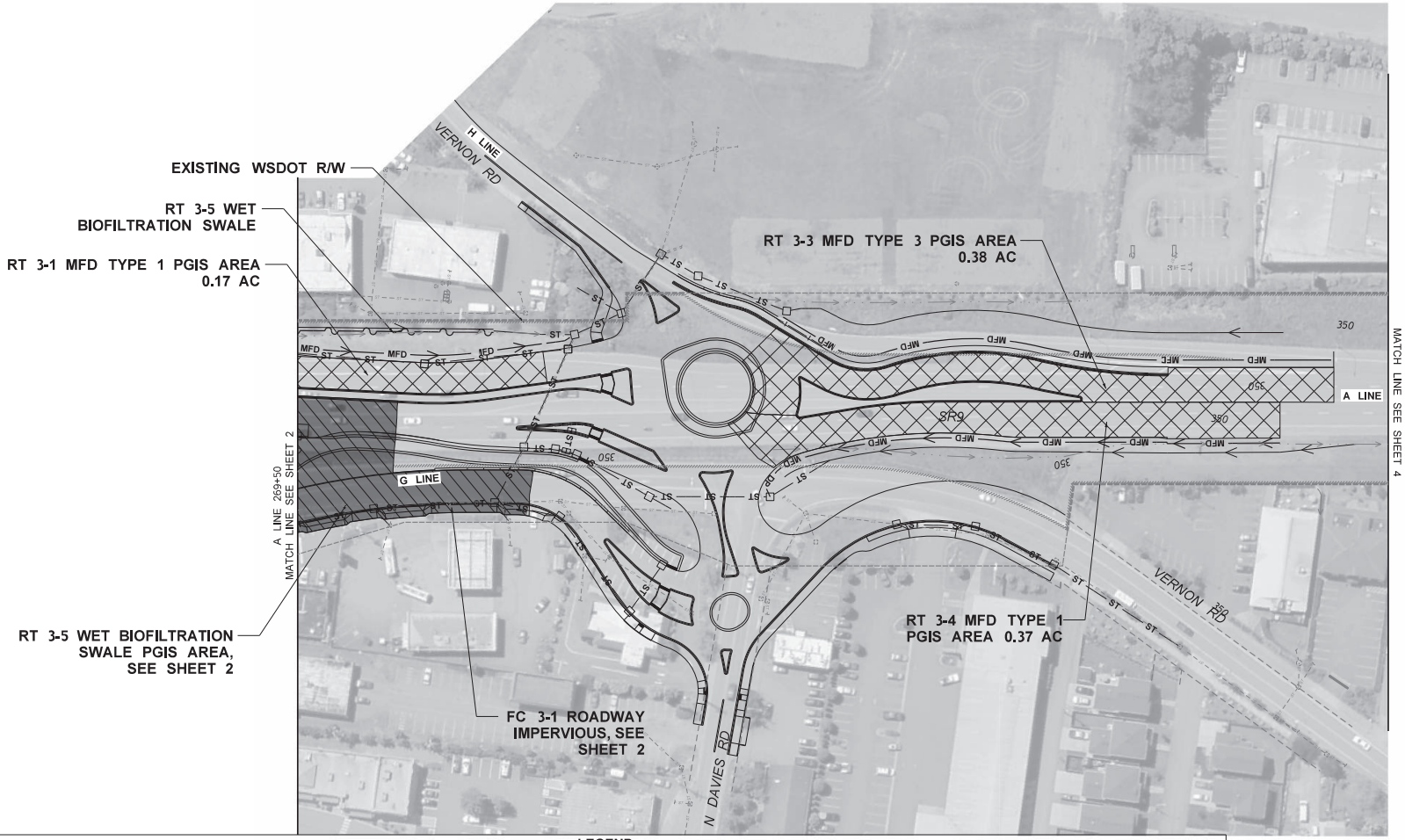
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

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		

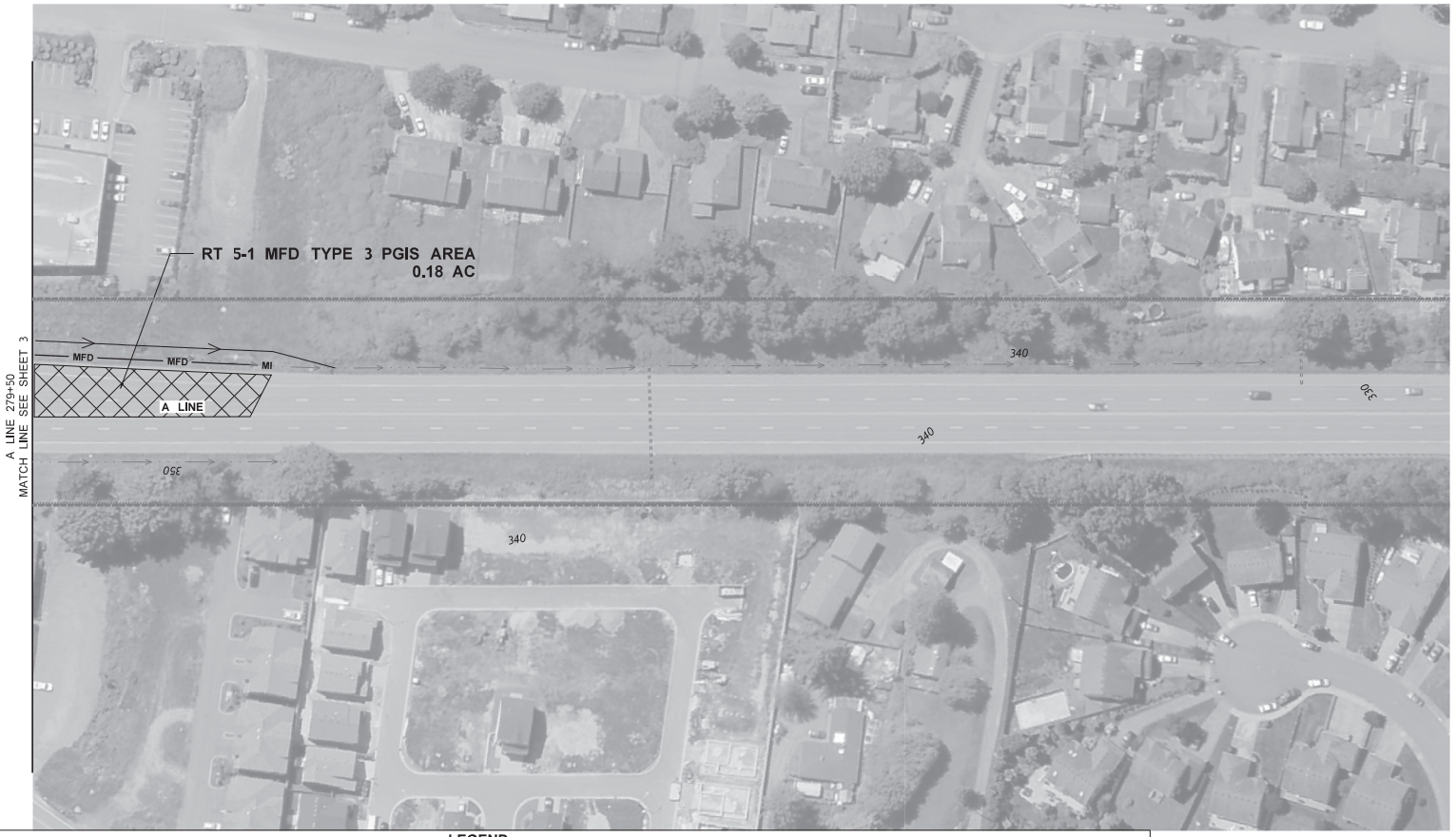
OSBORN CONSULTING INCORPORATED

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		

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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

OSBORN CONSULTING INCORPORATED

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

Step 7 - Step 9

Modeled (Input for MGSFlood)

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

		Brief Description of Land Cover Conversion
0.880 Acres	Forest to Impervious	Proposed roadway widening
0.100 Acres	Forest to Impervious	Pond Tract
0.110 Acres	Forest to Impervious	Access Road

1.09 Acres

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 - Step 9

Modeled (Input for MGSFlood)

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)

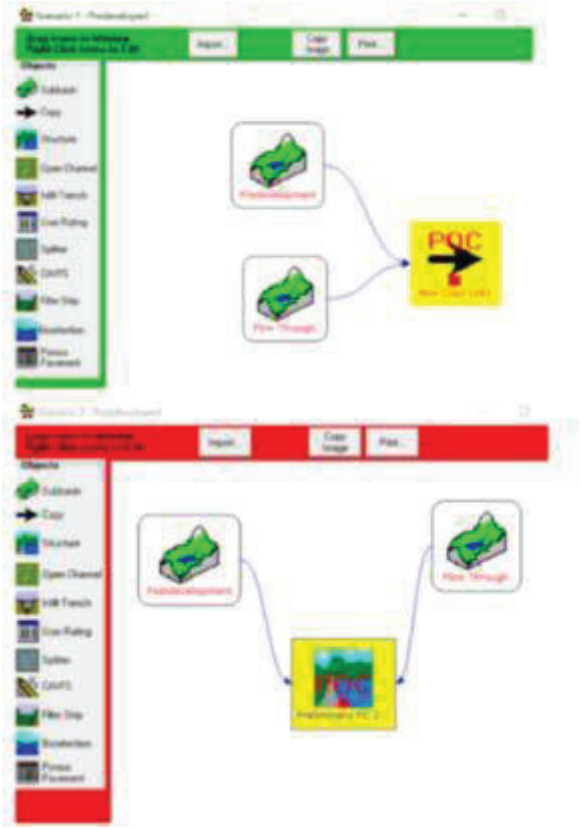
2-Year	0.163	2-Year	7.495E-02
5-Year	0.217	5-Year	0.104
10-Year	0.282	10-Year	0.131
25-Year	0.402	25-Year	0.187
50-Year	0.547	50-Year	0.204
100-Year	0.650	100-Year	0.223
200-Year	0.652	200-Year	0.450
500-Year	0.652	500-Year	0.757

** 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

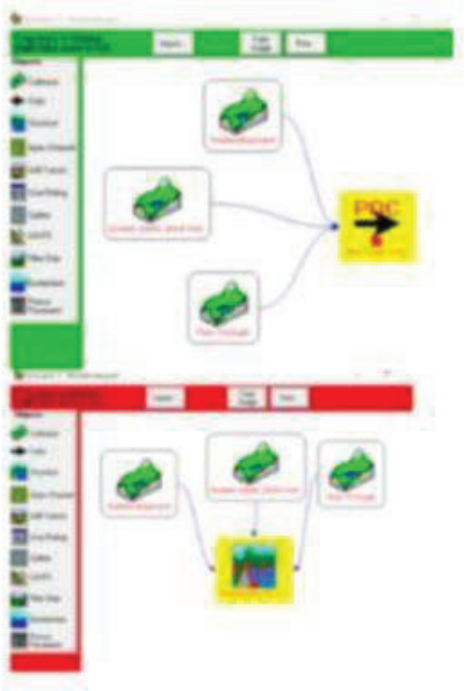
Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.160	2-Year	6.176E-02
5-Year	0.209	5-Year	9.652E-02
10-Year	0.269	10-Year	0.127
25-Year	0.382	25-Year	0.222
50-Year	0.499	50-Year	0.292
100-Year	0.577	100-Year	0.336
200-Year	0.601	200-Year	0.478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

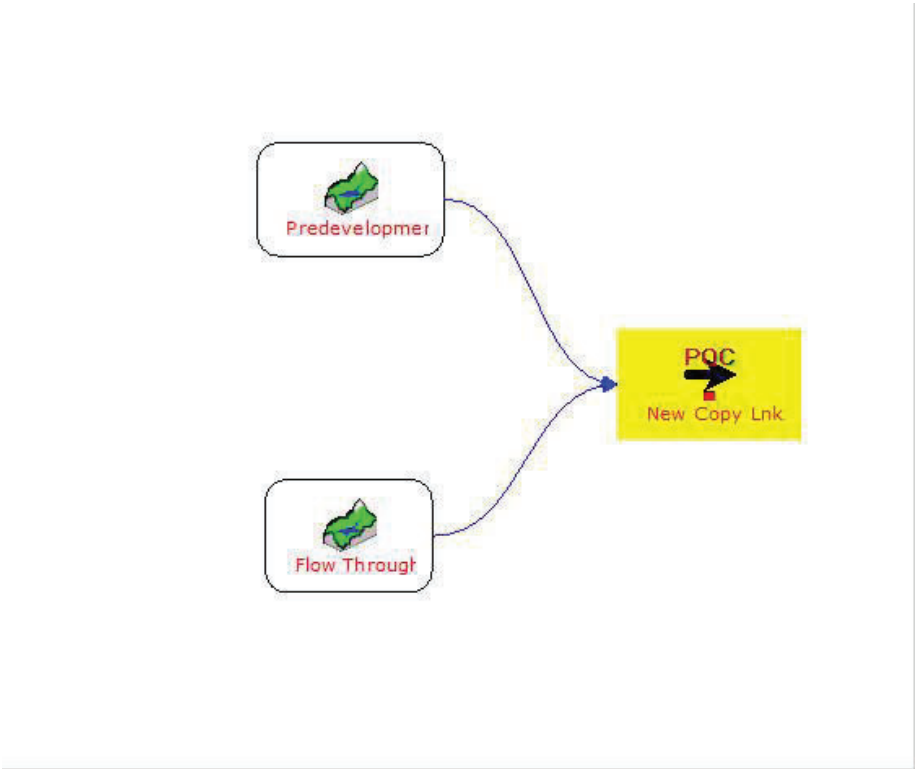
Choose N/A ----------> N/A

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

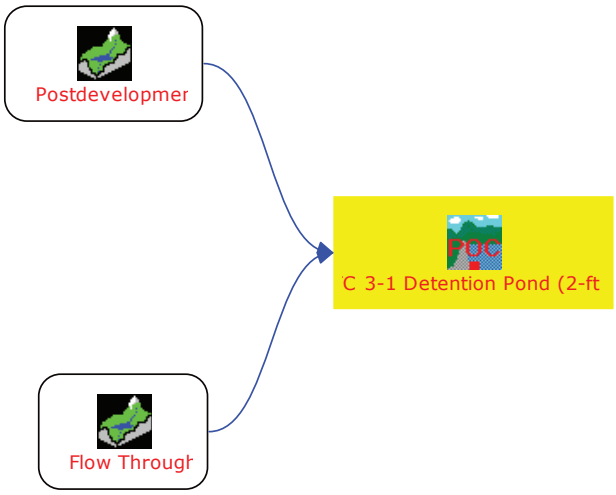
The designer should produce at least two iterations of this spreadsheet. The intent of the first iteration is to estimate the size of the detention BMP footprint and determine if the design meets flow control standards. The second iteration would create a separate subbasin to account for the BMP footprint 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

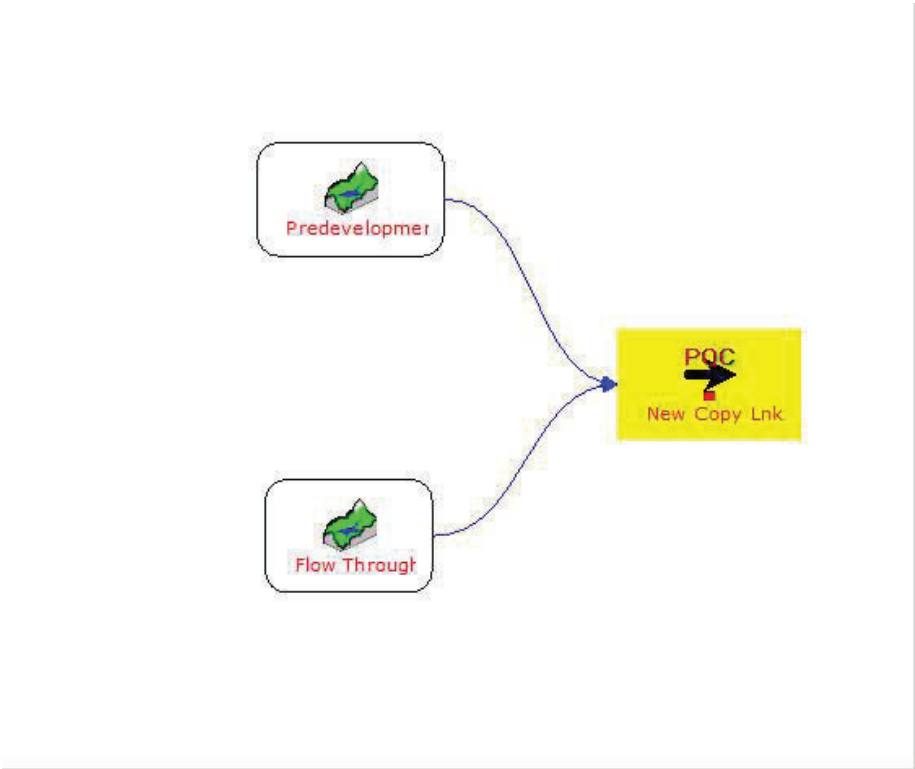
50% Rule Check

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

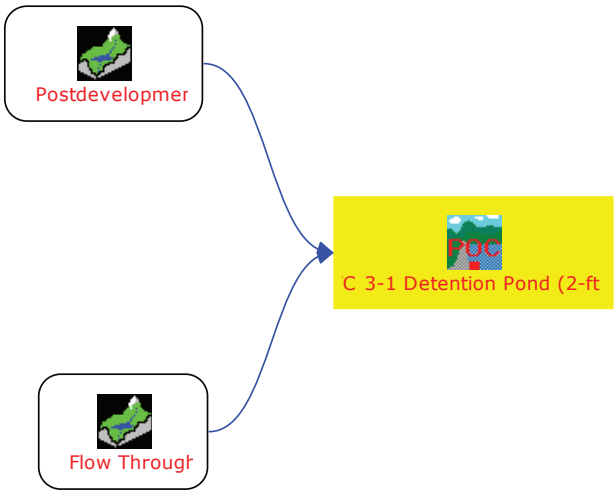
The flow through area meets the 50% rule.

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

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

********** **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

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

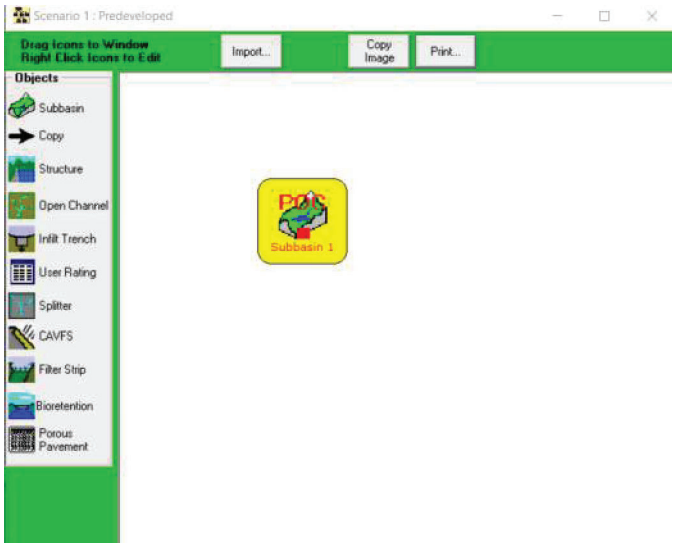
HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

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

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

Predevelopment/Post Development Tributary Area Summary

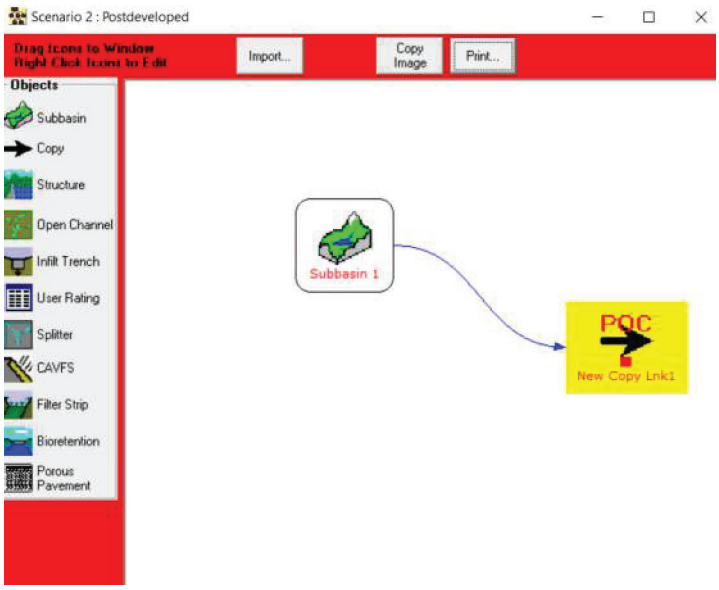
	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.110	0.740
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.110	0.740



----------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

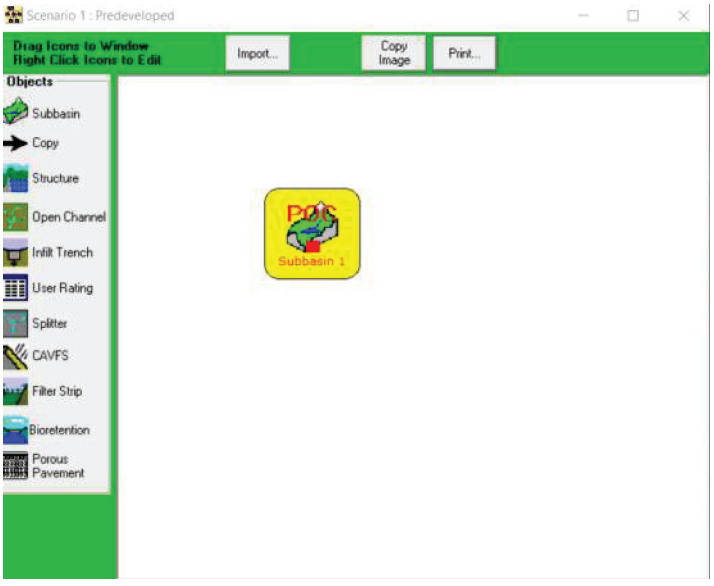
HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

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

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

Predevelopment/Post Development Tributary Area Summary

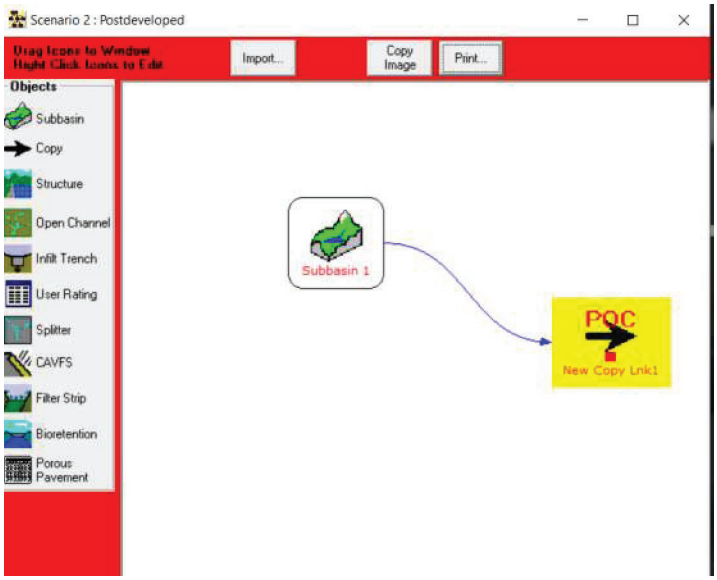
	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.840	0.840
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.840	0.840



----------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

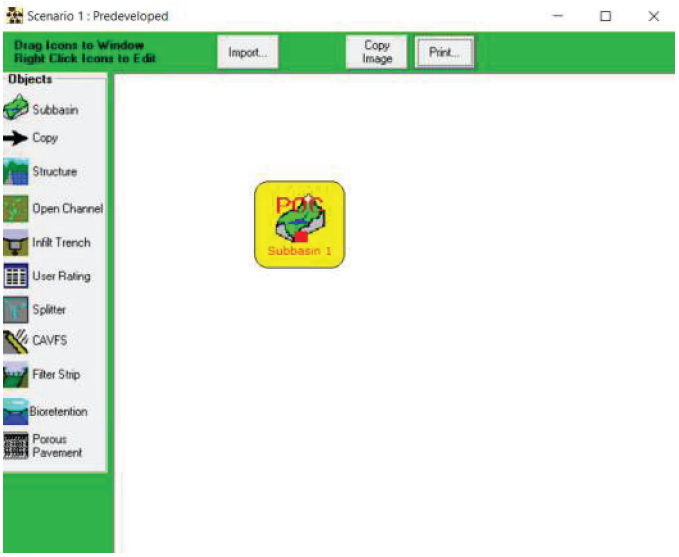
HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

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

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

Predevelopment/Post Development Tributary Area Summary

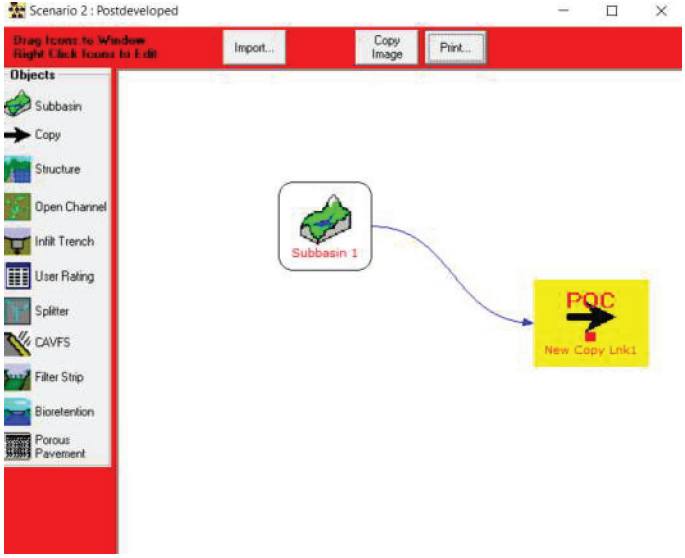
	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.060	0.040
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.060	0.040



----------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:

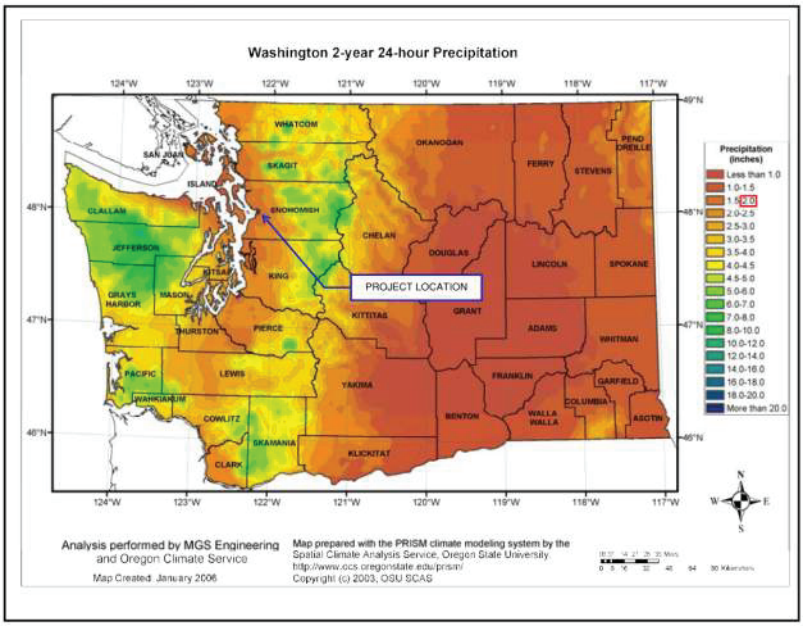
1. CABS facilities will be online.
2. Design water depth in CABS facility is 4 inches maximum. Assumed CABS will be mowed infrequently or inconsistently. Refer to HRM Table 5-4 for Biofiltration Swale Sizing Criteria.
3. The soil sand vegetation cover will be a grass-legume mix on lightly compacted topsoil 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

OSBORN CONSULTING INCORPORATED

CALCULATIONS COVER PAGE

(DATE: 11/9/2021)

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: 11/9/2021

MFD SUMMARY TABLE											
MFD ID	MFD TYPE	TDA	STRUCTURE ID	TREATMENT AREA (AC)	LENGTH OF MFD/ PAVEMENT TREATED (FT)	WIDTH OF MFD (FT)	PAVEMENT WIDTH (FT)	UNDER-DRAIN DIAM (IN)	CSBC (FT)	GRASS STRIP (FT)	MFD SIDE SLOPE (H:V)
RT 2-6	3	2	DR02-14	0.47	480	8	45	N/A	1	3	4:1
RT 3-1	1	3	DR03-34	0.17	244	8	30	6	1	3	4:1
RT 3-3	3	3	DR03-32	0.38	515	8	50	N/A	2	4	4.5:1
RT 3-4	1	3	DR03-31	0.37	466	8	45	8	1	3	4:1
RT5-1	3	5	DR04-1	0.18	201	8	45	N/A	1	3	10:1

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.

$$\frac{Q_{UD}}{ft} = smaller\left\{\frac{Q_{highway}}{ft} \; or \; \frac{Q_{MFD}}{ft}\right\} \quad \text{(E-23)}$$

where: $\frac{Q_{UD}}{ft}$ = 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.

$$Q_{UD} = 1.2 \times \frac{Q_{UD}}{ft} \times W \times L_{MFD} \quad \text{(E-24)}$$

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.

$$D = 16\left(\frac{\frac{Q_{UD}}{ft} \times n}{s^{0.5}}\right)^{\frac{3}{8}} \quad \text{(E-25)}$$

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 3-4

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

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 3-3	1.68%	1.57%	2.30%
RT 3-4	1.88%	2.19%	2.88%
RT 5-1	0.02%	0.78%	0.78%

** 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
beginning of
S.R.: barrier on
Designed By: S. Sridharan
Date: 4/2/2021

TDA 2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	ΔQ 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_{to} (cfs)	Z_d Check	Q_{to} 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	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 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 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 Informatio n		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 Intercept ed 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 (U/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 8-30.30-03 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 8-30.30-03 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)	ΔQ 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} (c/fs)	Z_d Check	Q_{bp} Check	Comments (UR)
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 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.
DR02-30	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	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	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)	ΔQ 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} (c/fs)	Z_d Check	Q_{bp} Check	Comments (UR)
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

TDA2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	ΔQ 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	0.000	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)	ΔQ cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-1 1	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 Intercept ed 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 (LJR)
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 8-40.40-02 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)	ΔQ cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-1.1	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 to 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 Intercept ed 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 (LR)
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 8-30.30-03 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 8-40.40-02 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)	ΔQ cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-1.1	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 Intercept ed 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 (LR)
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 8-30.30-08 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 8-30.30-08 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)	ΔQ cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-1.1	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 Intercept ed 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 (LR)
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 8-30.30-08 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 8-30.30-08 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)	ΔQ cfs (cfs)	Σ Q (cfs)	Slope L (ft/ft)	Super T (ft/ft)	Grate Type HM Figure 5-1.1	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 Intercept ed 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 (LR)
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 8-30.30-08 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_x	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																															
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	0.020	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

TDA2

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_i (cfs)	Q_{by} (cfs)	Z_d Check	Q_{by} 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)	ΔQ 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 Intercept ed 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 (LR)
Begin curb	120+45.00																															
DR05-6	120+76.00	31.00		1.581	0.08	0.08	0.005	0.043	Standard Plan 8-40.40-02 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. Siddharan
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 to 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_a (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
204 WB - north of RBT median curb, in S.R. 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)	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+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.

:HEET (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)	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 to 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_{sp} (cfs)	Z_d Check	Q_{sp} 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_{to} (cfs)	Z_d Check	Q_{to} 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)	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 to 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		6.50	0.05	0.05	0.006	0.014	Standard Plan 8-30.3-03 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)	ΔQ 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} (c/fs)	Z_d Check	Q_{bp} Check	Comments (UR)
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 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.
DR02-30	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	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 =	3.40 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 to 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 (LR)
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 8-30.30-03 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 ctrn.																																
Note: Longitudinal and Transverse slopes are based on surface provided on 4/22/2021. 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 =	3.40 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 to 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 (LJR)
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 8-30.30-03 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 =	3.40 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 to 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 (LR)
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 8-30.30-03 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

TDA2

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	ΔQ 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)	ΔQ cfs (c/s)	ΣQ (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 to 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	Efficiency of Grate E	Q_i (cfs)	Q_{bp} (c/s)	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)	ΔQ cfs (c/s)	ΣQ (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 to 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	Efficiency of Grate E	Q_i (cfs)	Q_{bp} (c/s)	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 8-40.40-02 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 dim.																															
	[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.
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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_a (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.

PLEASE REPORT ANY PROBLEMS TO WSDOT HQ HYDRAULICS SECTION. SPREADSHEET IS PROTECTED BUT DOES NOT REQUIRE A PASSWORD TO UNPROTECT.
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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 (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 =	3.48
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)	ΔQ cfs (cfs)	ΣQ (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_{to} (cfs)	Z_d Check	Q_{to} 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 Qto	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)	Shoulde r Width (ft)	Allowable Zd (ft)	Calculate d 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 Intercept ed to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_x	Effiency of Grate E	Q_t (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

7TH PL 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)	ΔQ cfs (cfs)	ΣQ (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)
	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 =	3.48
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)	Shoulde r Width (ft)	Allowable Zd (ft)	Calculate d 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 Intercept ed to Full Frontal Flow R_f	Ratio of Side Flow Intercepted to Total Side Flow R_x	Effiency of Grate E	Q (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	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 (cfs)	Q_{to} (cfs)	Z_d Check	Q_{to} 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 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 to 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.

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Version 6.2, Revised 9/13/2019

NB SR9 RT_archive

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
x =	2.50
m=	6.31
n=	0.58

10-YR

Project Name: SR9-204 Interchange Improvements - Stage 3
Project #: XL11834, PIN 100901K
S.R.: 9
Designed By: T. Hew
Date: 4/12/2021

TDA 3

Structure ID	Station	Distance (ft)	Width (ft)	Area (ft2)	ΔQ cfs (cfs)	ΣQ (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 to 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 (Dw 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

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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

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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:

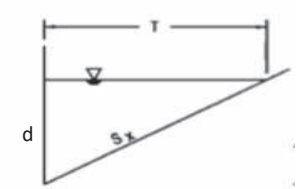
E = Efficiency
L = curb-opening length, ft
L_T = curb opening length required to intercept 100% of the gutter flow, ft

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_{CA}) = 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	1.6218	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

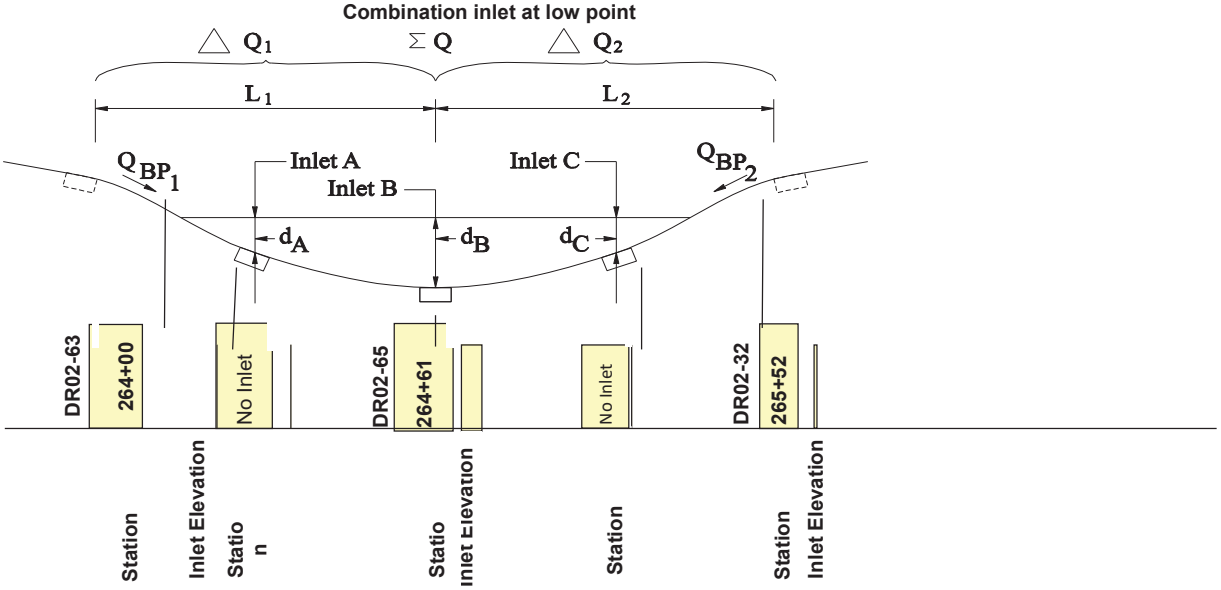
Total Curb Length (ft) 480

APPENDIX C-4

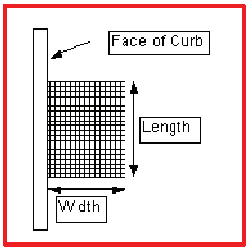
SAG DESIGN

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.

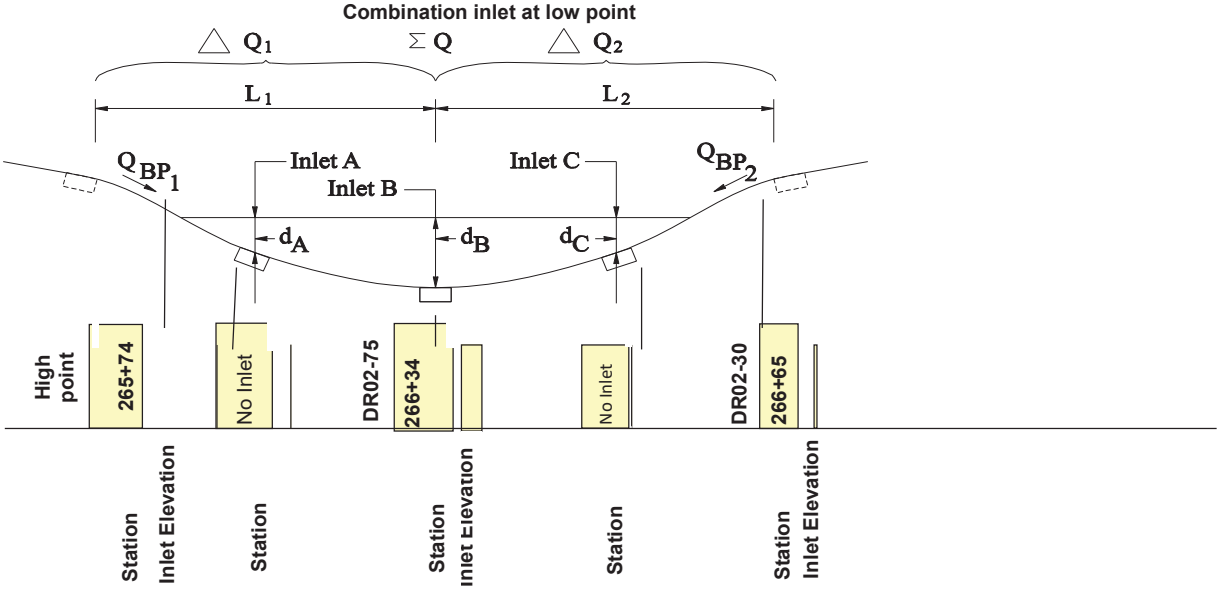
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

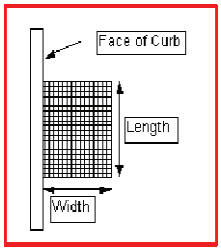
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

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.

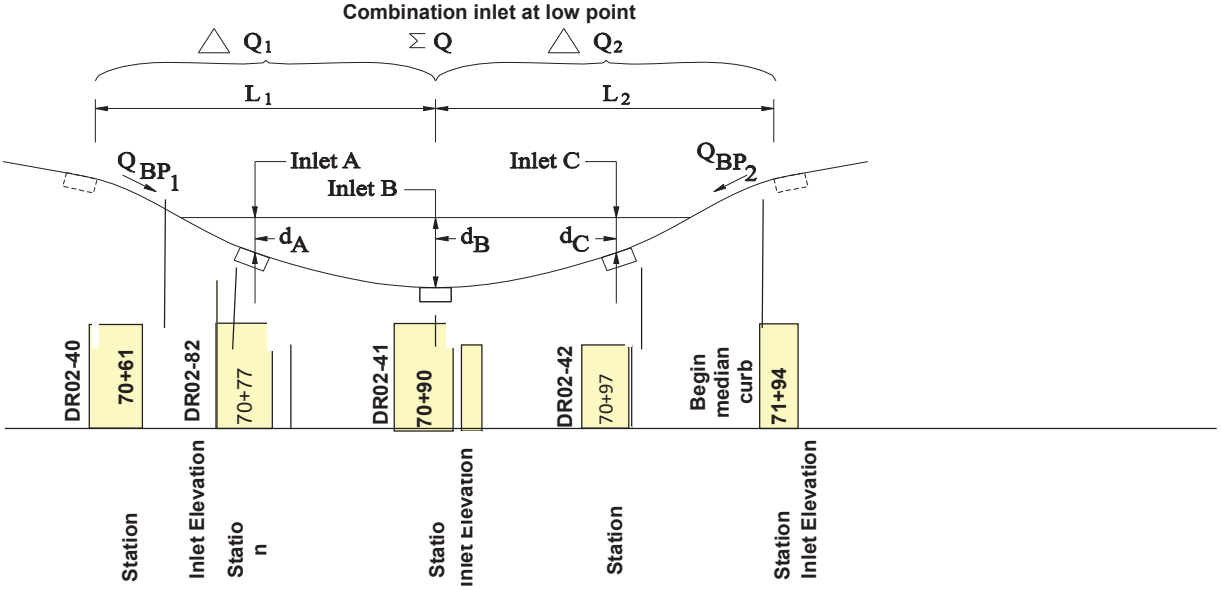
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

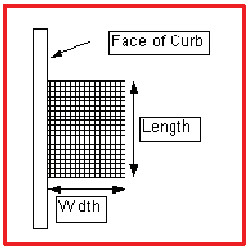
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

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.

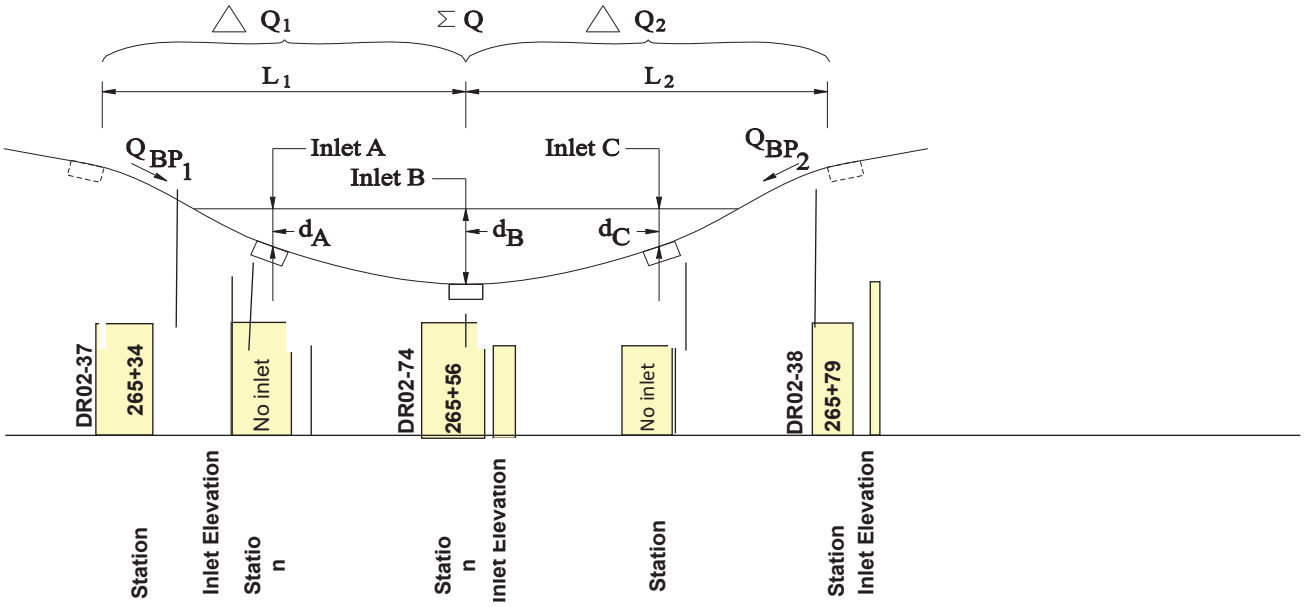
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

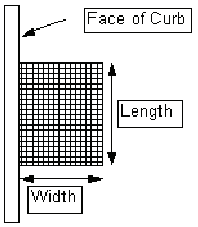
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

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)				Width		Length	
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.

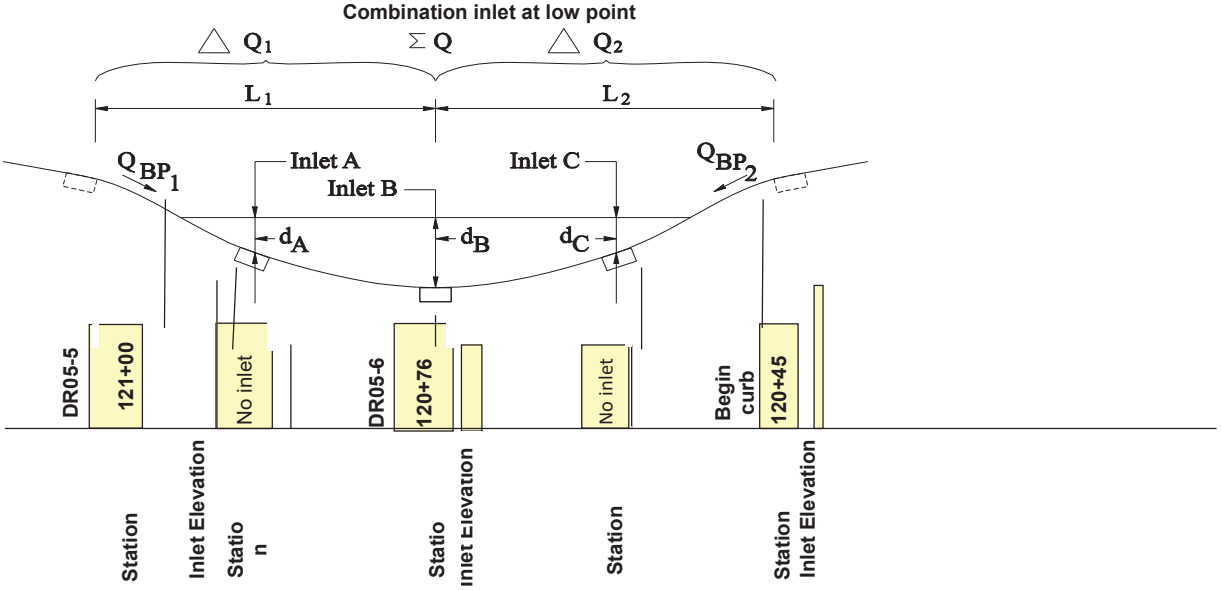
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

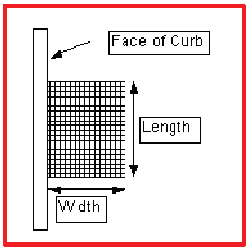
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

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).

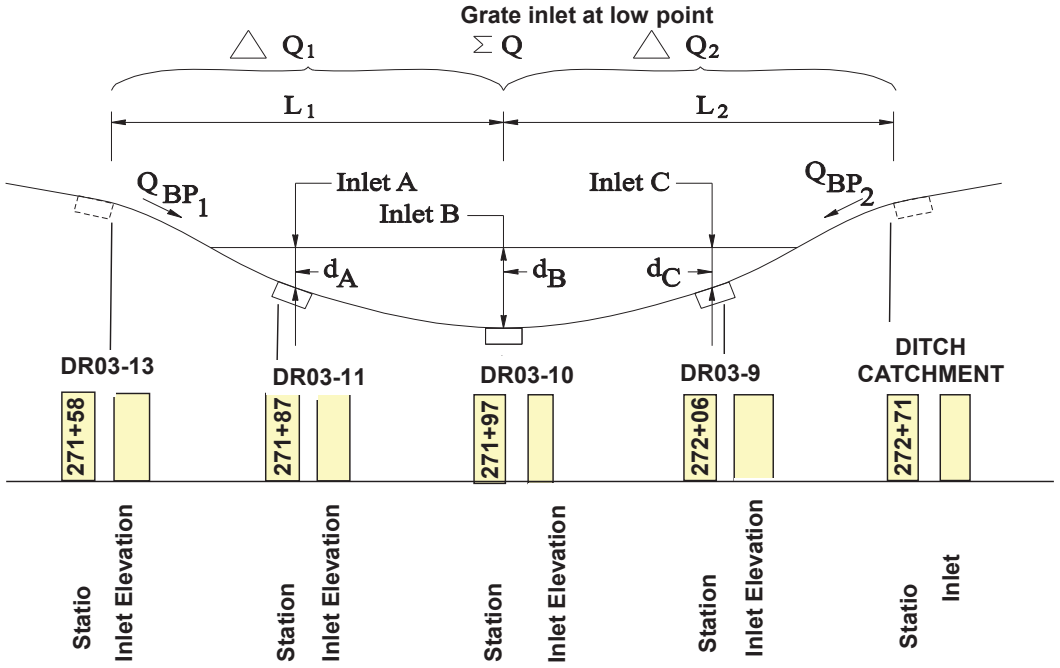
[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

[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.

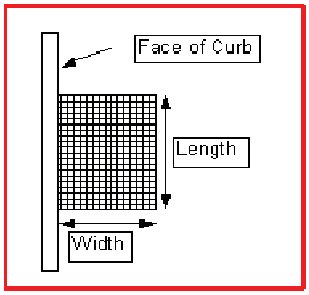
[4] Q_{bp1} and Q_{bp2}come from the 50-yr inlet spreadsheet.

[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).

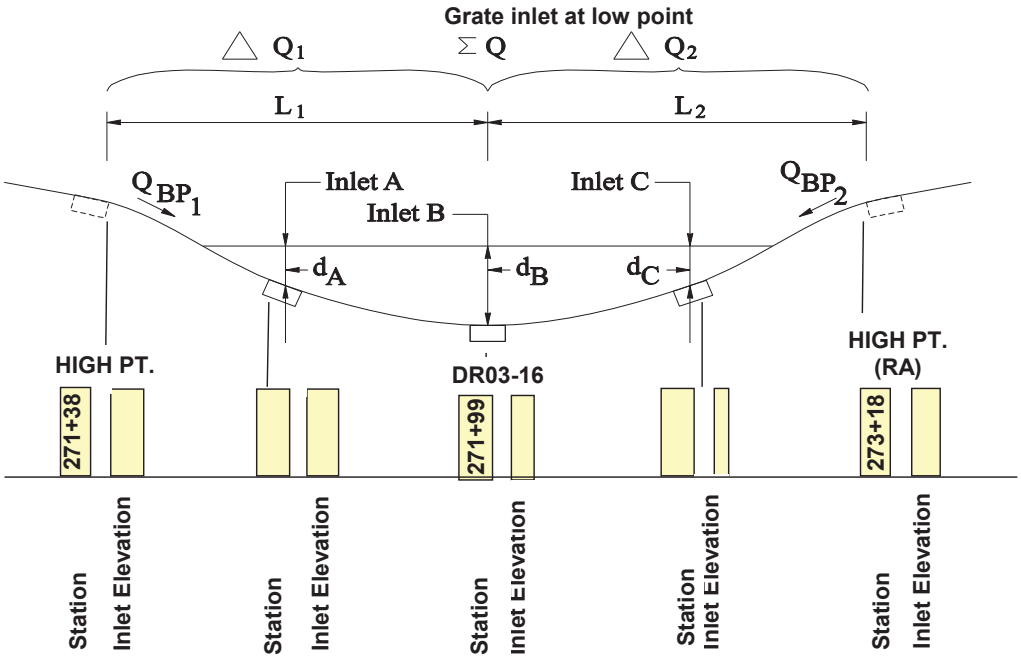
[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

[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.

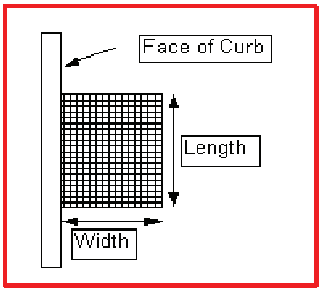
[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET



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)							
P_A	Flank	0.00	ft	Width	0	Length	0
P_B		4.14	ft	Width	1.29	Length	2.85
P_C	Flank	0	ft	Width	0	Length	0

⇨

$\Sigma Q = Q_A + Q_B + Q_C$

$\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ = 0.45 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A 0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C 0.3536} \right)^{2/3} = 0.11 \text{ ft}$$

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.

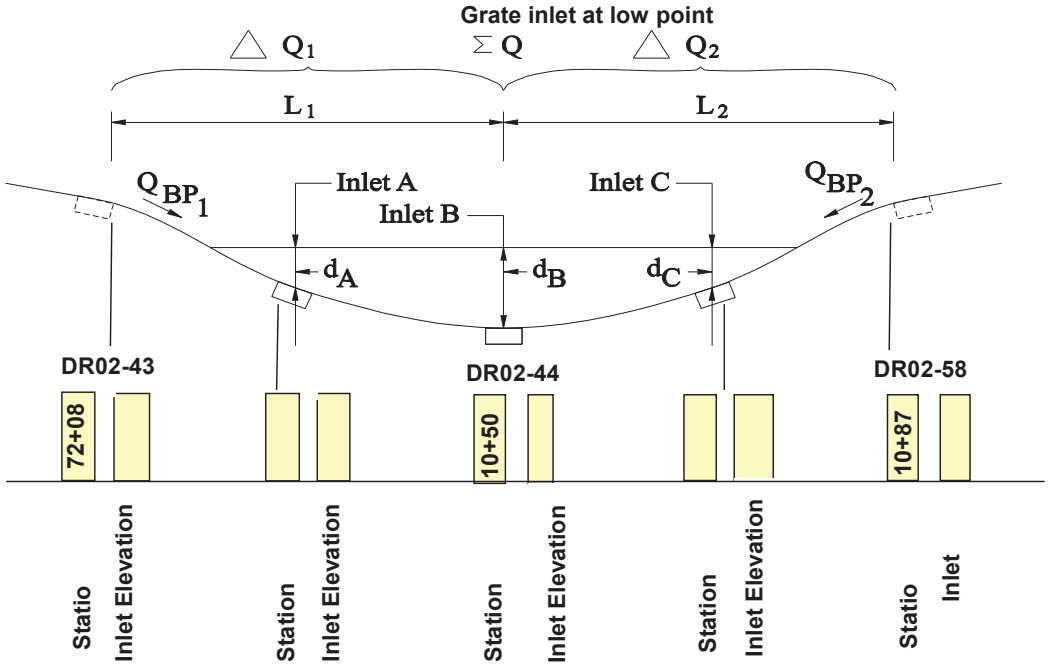
[3] To add more than one inlet in the sag or flanks just increase the width and length values to the sum of all values. Inlets can be different sizes. See Figure 5-11 in Hydraulics Manual for grate dimensions.

[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

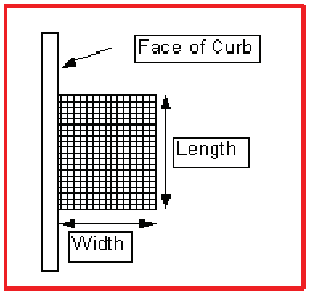
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

[6] Allowable Zd includes an additional 5' (min.) measured from shoulder line to recessed CB in traffic island.

SAG INLET DESIGN WORKSHEET



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	



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 + 0.12 + 0.08 = 0.31 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		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.

If d_B > allowable d_B, additional inlets must be added[3] and the process repeated.

Depth at fog line = 0.12'

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).

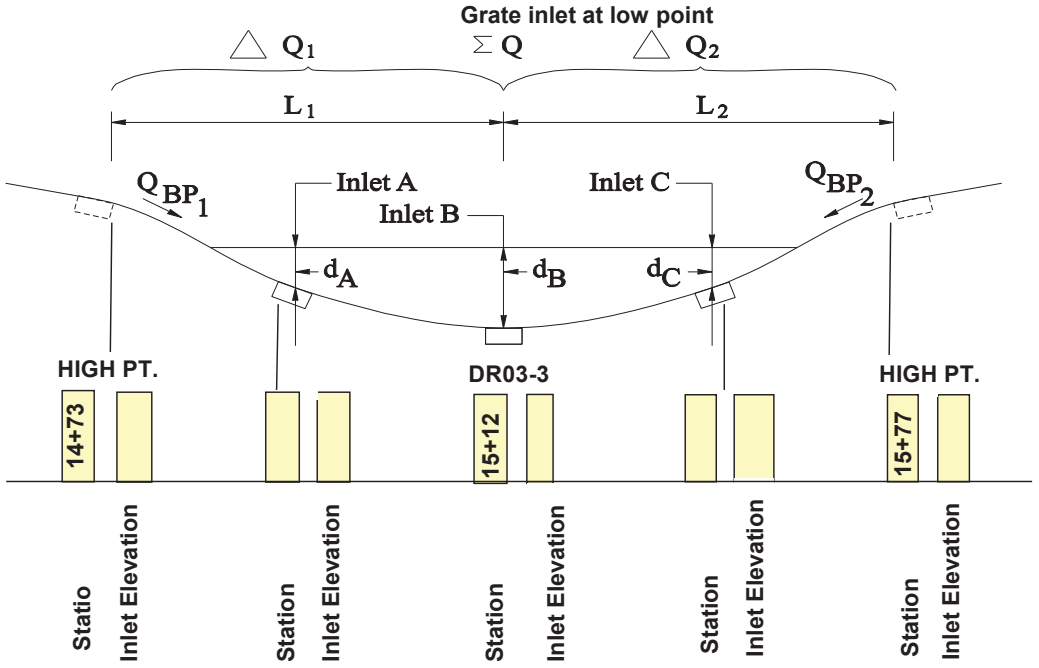
[2] Formulas based on weir flow. See Hydraulic Manual 5-4.2.

[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.

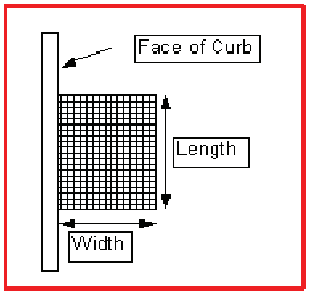
[4] Q_{bp1} and Q_{bp2} come from the inlet spreadsheet.

[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

SAG INLET DESIGN WORKSHEET



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)			
Distance between last	A_1	1422	ft^2	A_2	3017	ft^2	
	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.

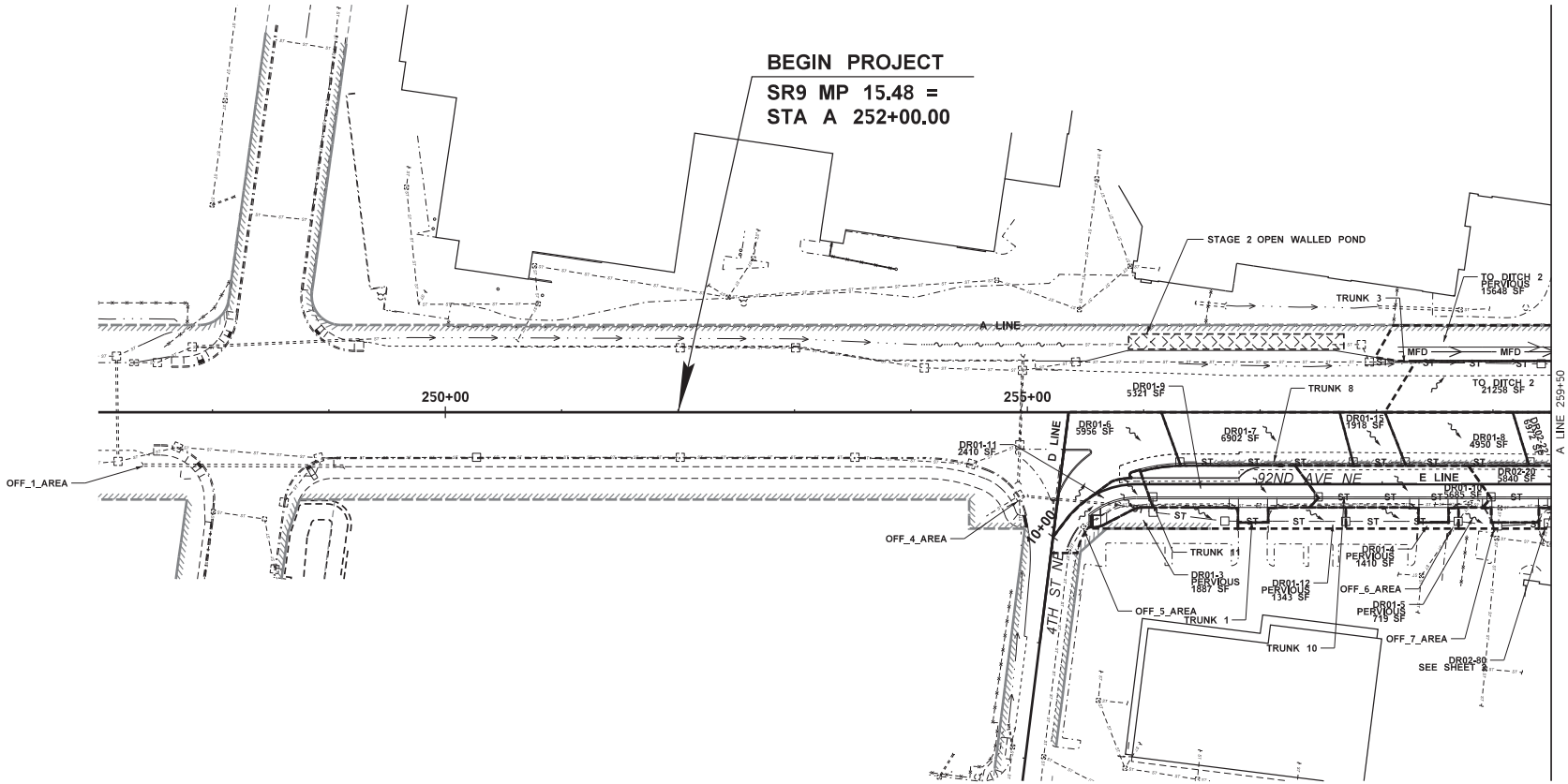
[5] Values for L and W are calculated based on irregular catchment areas around the roundabouts.

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

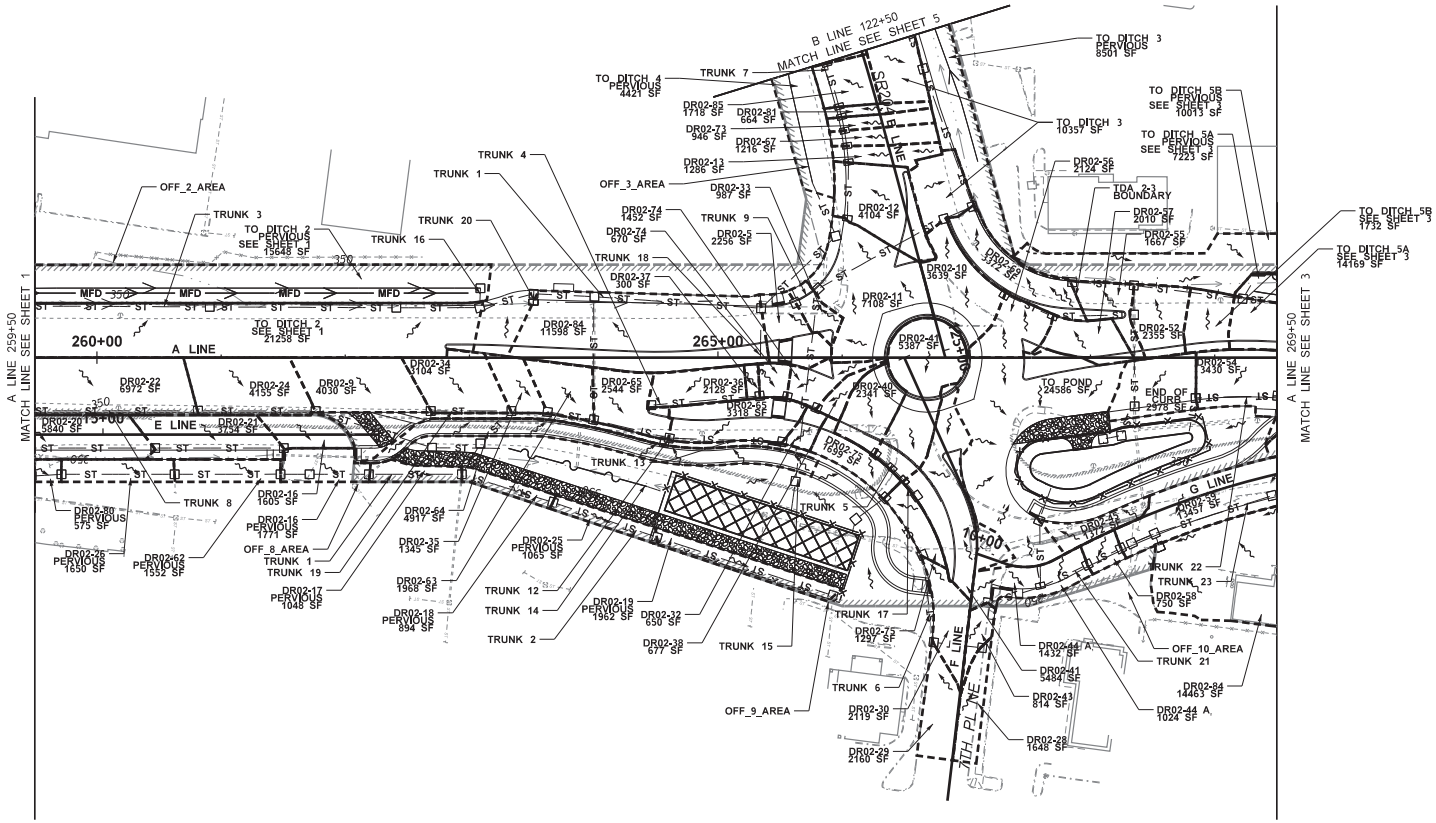
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

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

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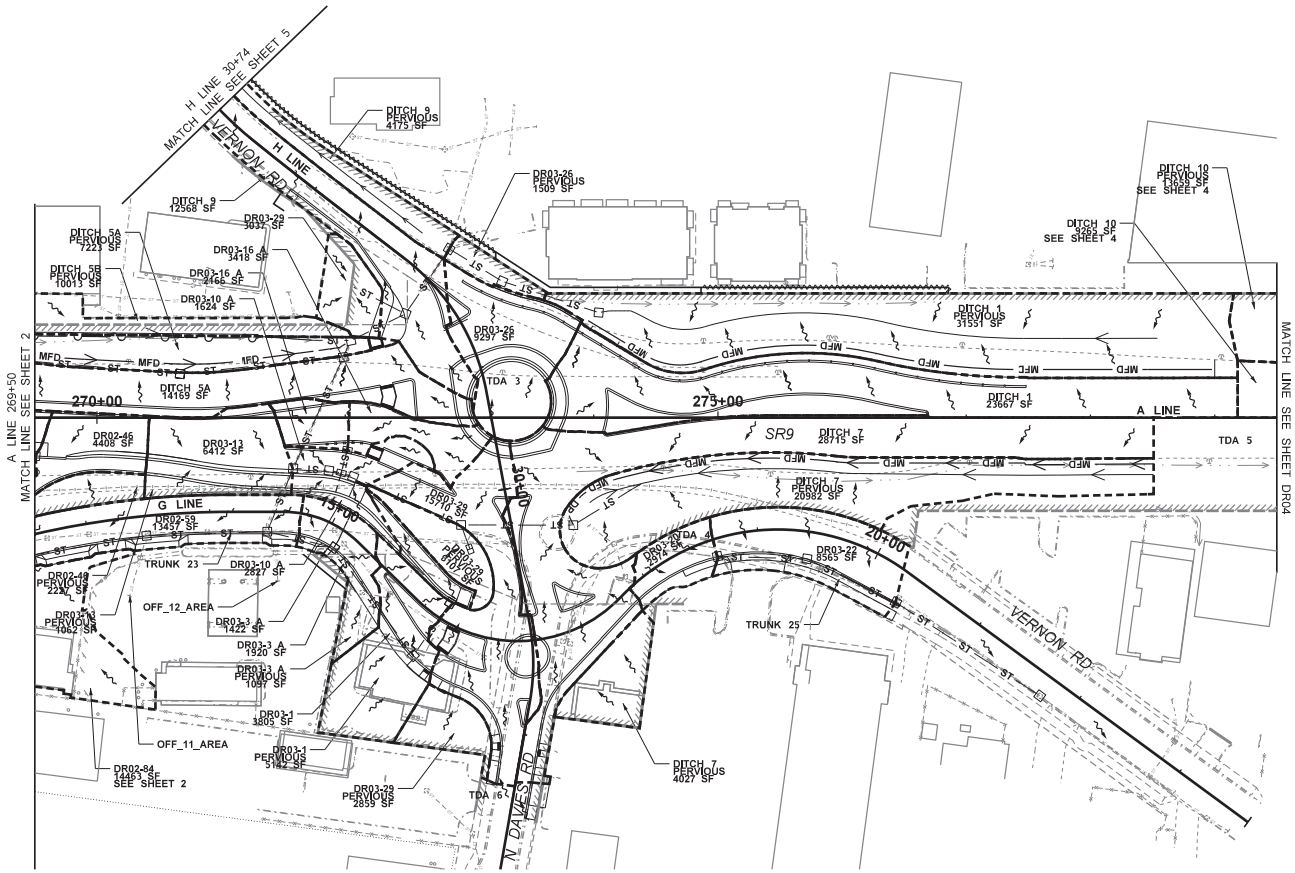
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

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

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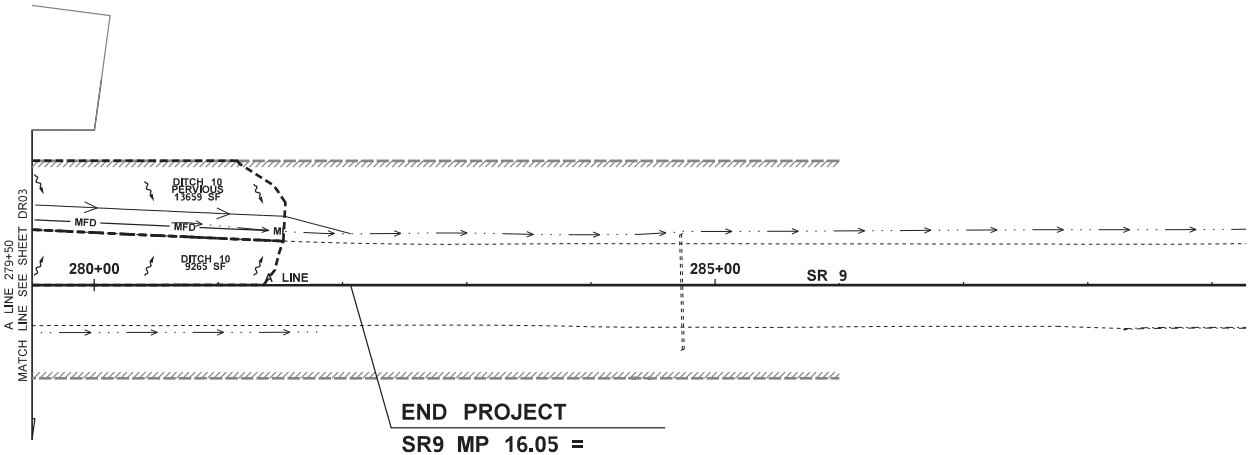
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

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

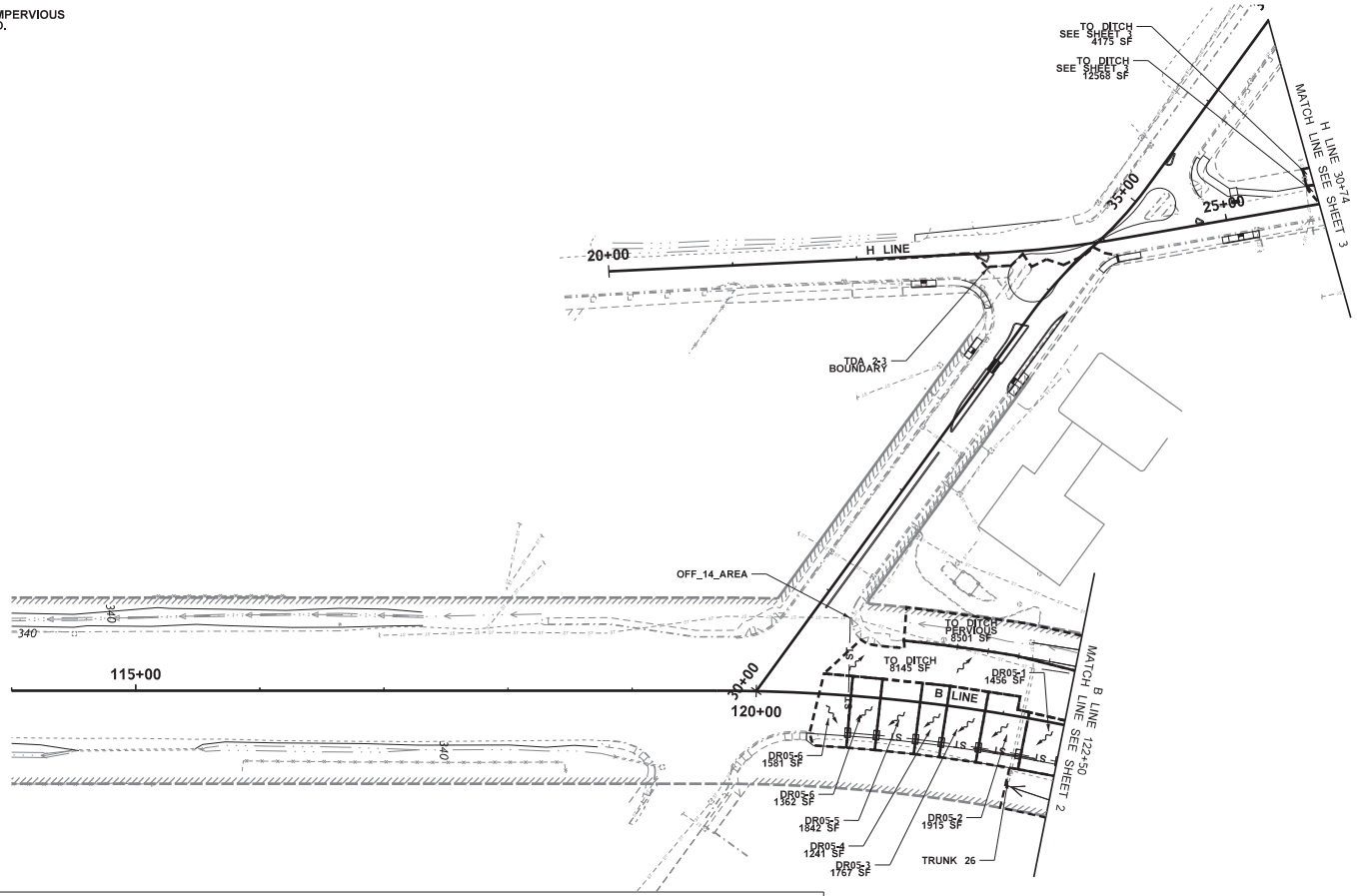
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

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

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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 storm sewer 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) =** 0.95 | **Pipe Thickness (inches) =** 2

Note: pavement depth is 0.65' on 7th Pl, and 0.95' for SR9 Slip lane

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 (acres)	Runoff Coeff C	CA (acres)	Sum CA (acres)	T, Across Area (minutes)	Total Tc = Col. 6a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Run off (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)	
													Fm							Fm																	
																								/ fs	/ fs											
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	1.91	1.90	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Pavement depth on 7th Pl is 0.65'. Sufficient cover on 7th place
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	0.0300	7.86	6.16	VELOCITY OK	ADEQUATE PIPE CAPACITY	71.0	2.13	345.63	343.50	349.65	348.02	4.02	1.90	2.40	Low Cover - See Notes at Bottom	More than 2 ft of cover	Pavement depth on 7th Pl is 0.65'. Sufficient cover on 7th place
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	3.02	0.39	0.00	0.39	12	0.013	0.0385	8.90	6.99	VELOCITY OK	ADEQUATE PIPE CAPACITY	55.0	2.12	343.50	341.38	348.02	345.90	4.52	2.40	2.40	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	2.98	0.58	0.88	1.46	12	0.013	0.0062	3.57	2.80	VELOCITY OK	ADEQUATE PIPE CAPACITY	29.0	0.18	341.38	341.20	345.90	346.79	4.52	2.40	3.47	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	141.3 RT		-	0.000	0.95	0.00	0.19	5.0	5.4	2.94	0.58	0.00	1.46	12	0.013	0.0067	3.70	2.91	VELOCITY OK	ADEQUATE PIPE CAPACITY	12.0	0.08	341.20	341.12	346.79	347.00	5.59	3.47	3.76	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) = 0.33 | Pipe Thickness (inches) = 2

Note: Location is the splitter island

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)	Tc 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 (fps)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 ft/sec; Desirable Maximum 10 ft/sec for Column 16)	Pipe Capacity Check (Column 15 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)	
													Ac							Mnv				FPS	CFS																				
FLINE	DR02-40	CATCH BASIN TYPE 1	70+61.0	53.1 RT	70+77.0	46.4 RT	Roadway	2,340	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	4.87	3.86	VELOCITY OK	ADEQUATE PIPE CAPACITY	17.0	0.18	342.68	342.50	346.54	346.42	3.86	2.36	2.42	More than 2 ft of cover	More than 2 ft of cover	
FLINE	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	346.42	346.24	3.92	2.42	2.31	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
FLINE	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	0.89	12	0.013	0.0477	9.91	7.78	VELOCITY OK	ADEQUATE PIPE CAPACITY	22.0	1.05	342.43	341.38	346.24	345.90	3.81	2.31	3.02	More than 2 ft of cover	More than 2 ft of cover	Inflows from Trunk 17, Connects to DR02-75
									1.154																																			

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 17 | m = 7.83 | n = 0.582 | Design Storm Event = 25 | Pavement thickness (ft) = 0.33 | Pipe Thickness (inches) = 2

Note: Location is the splitter island

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, 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)	
													4a							Inv				7.5<	1.9<											
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	346.60	346.24	3.95	2.45	2.31	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 9-11.2
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) =** 0.00 | **Pipe Thickness (inches) =** 2

Note: Pipe(s) along this trunk line are located outside the pavement

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, 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 15 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)	
													ac							n/a				f/s	f/s													
A LINE	DR02-78	PIPE FROM CABS	264+43.0	103.8 RT	264+62.0	109.8 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	-1.17	4.97	Not Enough Cover - Need to Revise Pipe Elevations	More than 2 ft of cover	25-yr inflow from RT 2-7 MGS Flood 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 8-1 1.2
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) =** 0.95 | **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, Across Area (minutes)	Total Tc = Col. 6a + 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)	
													6a							14a				17a	17b												
A LINE	DR01-6	CATCH BASIN TYPE 1	256+31.0	42.7 RT	257+80.0	42.8 RT	Roadway	5,966	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	351.68	348.88	355.80	353.36	4.12	2.00	2.36	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR01-7	CATCH BASIN TYPE 1	257+80.0	42.8 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	348.88	348.41	353.36	352.67	4.48	2.36	2.14	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	348.41	346.86	352.67	351.10	4.26	2.14	2.12	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	0.0119	4.96	3.89	VELOCITY OK	ADEQUATE PIPE CAPACITY	149.0	1.78	346.86	345.08	351.10	348.70	4.24	2.12	1.50	More than 2 ft of cover	Low Cover - See Notes at Bottom	CONC CL III
A LINE	DR02-22	CATCH BASIN TYPE 1	260+81.0	42.8 RT	261+76.0	43.0 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	0.0082	4.11	3.22	VELOCITY OK	ADEQUATE PIPE CAPACITY	95.0	0.78	345.08	344.30	348.70	347.48	3.62	1.50	1.06	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC CL IV
A LINE	DR02-24	CATCH BASIN TYPE 1	261+76.0	43.0 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	0.0105	4.65	3.65	VELOCITY OK	ADEQUATE PIPE CAPACITY	98.0	1.03	344.30	343.27	347.48	348.53	3.18	1.06	3.14	Low Cover - See Notes at Bottom	More than 2 ft of cover	CONC CL IV
A LINE	DR02-86	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	342.80	5.26	3.14	-2.12	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 storm sewer 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) = 0.95 | 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 (acres)	Runoff Coeff C	CA (acres)	Bare CA (acres)	Σ Acres Area (minutes)	Total Tc = Col. 6a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Run off (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)	
													Σ=																							
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	4.21	5.12	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 MGS flood 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	5.12	5.95	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	52.7 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	5.95	5.68	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	52.7 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	5.68	6.01	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	6.01	5.63	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	2.00	8.17	INCREASE VE	ADEQUATE PIPE CAPACITY	153.0	0.20	337.80	337.60	345.55	342.76	7.75	4.63	2.04	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.
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 9 | m = 7.83 | n = 0.582 | Design Storm Event = 25 | Pavement thickness (ft) = 0.95 | 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, 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)	
													4a							16a				17a	17b											
A LINE	DR02-33	GRATE INLET TYPE 2	265+62.0	44.1 LT	265+81.0	55.6 LT	Roadway	967	0.023	0.95	0.02	0.02	5.0	5.0	3.07	0.07	0.00	0.07	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	22.0	0.11	342.47	342.36	346.64	346.59	4.17	2.05	2.11	More than 2 ft of cover	More than 2 ft of cover	Adequate cover for 12" pipe. Connects to DR02-6B (Trunk 15)

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 16 | m = 7.83 | n = 0.582 | Design Storm Event = 25 | Pavement thickness (ft) = 0.00 | Pipe Thickness (inches) = 2.5

Note: Pipe(s) along this trunkline are located outside the pavement

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, Across Area (minutes)	Total Tc = Col. 9a + 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 15 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)	
													4a							14a				7.7c	7.9											
A LINE	DRG2-7	CATCH BASIN TYPE 2 48IN. DIAM. W/ BEEHIVE GRATE	263+09.0	96.0 LT	263+08.0	40.3 LT	Pervious ditch		0.000	0.30	0.00	0.00	6.0	0.0	3.07	0.00	10.82	10.82	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:

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 3 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.95 | **Pipe Thickness (inches) =** 3.5

Note: Pipe thickness varies based on pipe dia for this trunkline

Location																	Discharge Desinage 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)	
													8e							11e					17b																
A LINE	DR01-14	EX CB	257+94.0	43.2 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	0.0173	9.48	29.75	VELOCITY OK	ADEQUATE PIPE CAPACITY	150.0	2.60	347.00	344.40	352.29	349.60	5.29	2.05	1.96	More than 2 ft of cover	Low Cover - See Notes at Bottom	U/S pipe elevations for SR 9 Stage 2 pipe DR3-6. See Stage 2 hydraulic report Appendix C-5.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	3.85	1.40	More than 2 ft of cover	Low Cover - See Notes at Bottom	Concrete pipe CL IV
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	1.40	1.96	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL IV
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	1.96	1.47	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL IV
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	1.47	1.78	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL IV; 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	1.78	1.96	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	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) = 0.95 | 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, 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)	
													ac																						
																				Mn				FV	FB										
A LINE	DR02-84	GRATE INLET TYPE 2	263+51.0	44.7 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	346.37	3.50	1.38	1.90	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL IV. Connects to DR03-71 (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 9-11.2
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) = 0.00 | Pipe Thickness (inches) = 2

Note: Pipe(s) along this trunkline are located outside the pavement

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 (acres)	Runoff Coeff C	CA (acres)	Sum CA (acres)	I, Across Area (minutes)	Total Tc = Col. 6a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Run off (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)	
													Fe							I-Fe				I/fe	I*fe											
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	0.90	0.11	0.11	5.0	5.0	3.07	0.33	0.00	0.33	12	0.013	0.0140	5.37	4.21	VELOCITY OK	ADEQUATE PIPE CAPACITY	5.0	0.07	341.70	341.63	345.36	345.84	3.86	2.49	3.04	More than 2 ft of cover	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 ass4917 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 storm sewer 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) =** 0.95 | **Pipe Thickness (inches) =** 2

Location							Discharge Drainage Design																				Drain Profile								Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset	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, Across Area (minutes)	Total Tc = Col. 8a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Run off (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)	
													Ave																							
A LINE	DR02-32	CATCH BASIN TYPE 1	285+52.0	67.7 RT	284+61.0	64.6 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	0.0044	3.01	2.36	VELOCITY OK	ADEQUATE PIPE CAPACITY	91.0	0.40	342.03	341.63	346.17	345.84	4.14	2.02	2.09	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR02-65	CATCH BASIN TYPE 1	284+61.0	64.8 RT	284+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	0.0045	3.05	2.39	VELOCITY OK	ADEQUATE PIPE CAPACITY	62.0	0.28	341.63	341.35	345.84	346.10	4.21	2.09	2.83	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 8-1.1.2
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) = 0.95 | 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, 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 (fps)	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)	
													ac							Inv				ft/s												
A LINE	DR02-9	CATCH BASIN TYPE 1	262+89.0	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	2.15	2.52	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 9-11.2
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) =** 0.15 | **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 (acres)	Runoff Coef C	CA (acre)	Sum CA (acre)	T, Across Area (minutes)	Total Tc = Col. 6a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Run off (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.	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													Ave							I ave				I V	I*A											
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	2.70	3.32	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	2.70	2.73	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	2.73	3.32	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	3.32	3.35	More than 2 ft of cover	More than 2 ft of cover	Inflow from Trunk 4; Connects to DR02-5 (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 storm sewer 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) = 0.15 | 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 (acres)	Runoff Coeff C	CA (acres)	Sum CA (acres)	T, Across Area (minutes)	Total Tc = Col.6a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Run off (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	Pipe Dia. (in)	Manning roughness coefficient "n"	Pipe Slope (ft/ft)	Velocity Of Flow (f/s)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 f/sec; Desirable Maximum 10 f/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													Fe							Tfe					Tfe	Tfe										
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	0.0076	4.00	3.14	VELOCITY OK	ADEQUATE PIPE CAPACITY	148.0	1.15	350.43	349.28	354.40	352.63	3.97	2.65	2.03	More than 2 ft of cover	More than 2 ft of cover	
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	0.0131	5.19	4.07	VELOCITY OK	ADEQUATE PIPE CAPACITY	149.0	1.95	349.28	347.33	352.63	350.67	3.35	2.03	2.02	More than 2 ft of cover	More than 2 ft of cover	
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	2.91	1.07	0.00	1.07	12	0.013	0.0073	3.87	3.04	VELOCITY OK	ADEQUATE PIPE CAPACITY	103.0	0.75	347.33	346.58	350.67	349.58	3.34	2.02	1.68	More than 2 ft of cover	Low Cover - See Notes at Bottom	Concrete pipe CL III
E LINE	DR02-21	CATCH BASIN TYPE 1	16+46.0	10.9 RT	261+48.0	93.9 RT	Roadway	3,754	0.086	0.95	0.08	0.45	5.0	5.9	2.78	1.25	0.00	1.25	12	0.013	0.0035	3.35	2.63	VELOCITY OK	ADEQUATE PIPE CAPACITY	22.0	0.12	346.58	346.46	349.58	351.55	3.00	1.68	3.77	Low Cover - See Notes at Bottom	More than 2 ft of cover	Concrete pipe CL III , 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	352.70	352.64	356.20	356.60	3.50	2.18	2.64	More than 2 ft of cover	More than 2 ft of cover	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:

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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.

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

Note: Pipe(s) along this trunk line are located outside the pavement

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, 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 15 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)	
													ac											FV	FP											
A LINE	DR02-19	CATCH BASIN TYPE 1	295+92.0	191.5 RT	294+61.0	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.	294+91.0	144.5 RT	293+67.0	116.5 RT	Pervious	1,093	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.	293+67.0	116.5 RT	292+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:

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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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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) = 0.95 | Pipe Thickness (inches) = 3.5

Note: pavement thickness only applicable to pipes within the roadway prism

Note: pipe thickness varies throughout this run based on pipe dia per HM Chapt 8

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. 8k + 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 15 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)	
													Fig							I/Fig				I/fs	I/fs											
A LINE	DR01-1	EXISTING CATCH BASIN	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	0.0283	9.99	17.65	VELOCITY OK	ADEQUATE PIPE CAPACITY	35.0	0.99	353.13	352.14	356.16	356.60	3.03	0.29	1.72	Not Enough Cover - Need to Revise Pipe Elevations	Low Cover - See Notes at Bottom	U/S structure is existing DIs cover not achieved to meet velocity requirements. Use Concrete pipe CL IV. Inflows from OFF_1 OFF_4 and OFF_5
A LINE	DR01-2	CATCH BASIN TYPE 24IN. DIAM. W/ SOLID LID	256+08.0	85.9 RT	258+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	0.0035	4.25	13.35	VELOCITY OK	ADEQUATE PIPE CAPACITY	63.0	0.22	351.64	351.42	356.60	356.52	4.96	1.72	1.86	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 24IN. 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	1.86	1.83	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 24IN. 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	1.83	1.89	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 27IN. 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	1.89	1.26	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 24IN. DIAM.	259+04.0	97.9 RT	259+48.0	95.2 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	0.0068	5.94	18.66	VELOCITY OK	ADEQUATE PIPE CAPACITY	44.0	0.30	349.40	349.10	353.90	354.26	4.50	1.26	1.92	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	OFF_7 inflows.Adequate pipe cover. Structure in pervious area, pavement thickness is not included in cover calcs
A LINE	DR01-16	CATCH BASIN TYPE 24IN. DIAM.	259+48.0	95.2 RT	259+71.0	93.9 RT	Offsite		0.000	0.30	0.00	0.04	5.0	5.8	2.82	0.11		18.17	24	0.013	0.0083	6.57	20.63	VELOCITY OK	ADEQUATE PIPE CAPACITY	24.0	0.20	349.10	348.90	354.26	354.46	5.16	1.92	2.31	Low Cover - See Notes at Bottom	More than 2 ft of cover	
A LINE	DR02-80	CATCH BASIN TYPE 24IN. DIAM.	259+71.0	93.9 RT	260+63.0	93.8 RT	Pervious	979	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	2.31	1.87	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 24IN. DIAM.	260+63.0	93.8 RT	261+48.0	93.9 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	1.87	1.85	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 24IN. DIAM.	261+48.0	93.9 RT	261+71.0	93.9 RT	Pervious	1,052	0.036	0.30	0.01	0.06	5.0	6.0	2.76	0.16	1.25	19.47	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	1.85	1.89	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 24IN. DIAM. W/ SOLID LID	261+71.0	93.9 RT	262+19.0	93.8 RT	Roadway		0.000	0.95	0.00	0.06	5.0	6.0	2.75	0.16		19.47	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	1.89	2.15	Low Cover - See Notes at Bottom	More than 2 ft of cover	
A LINE	DR02-16	CATCH BASIN TYPE 26IN. 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	2.15	2.22	More than 2 ft of cover	More than 2 ft of cover	OFF_8 inflows
A LINE	DR02-17	CATCH BASIN TYPE 24IN. 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	23.99	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	2.22	0.66	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, but pipe under access road
A LINE	DR02-27	CATCH BASIN TYPE 24IN. 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		23.98	30	0.013	0.0067	6.82	33.45	VELOCITY OK	ADEQUATE PIPE CAPACITY	36.0	0.24	341.90	341.66	348.70	346.40	6.80	3.06	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 26IN. 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	2.66	0.46	0.27	24.42	30	0.013	0.0048	5.80	28.47	VELOCITY OK	ADEQUATE PIPE CAPACITY	29.0	0.14	341.66	341.52	346.40	346.27	4.74	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 24IN. 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	2.64	0.53		24.50	30	0.013	0.0045	5.59	27.41	VELOCITY OK	ADEQUATE PIPE CAPACITY	38.0	0.17	341.52	341.35	346.27	346.10	4.75	1.01	1.01	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Concrete pipe CL IV
A LINE	DR02-63	CATCH BASIN TYPE 24IN. DIAM.	264+00.0	50.0 RT	264+01.0	49.1 LT	Roadway	1,368	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	0.25	341.35	341.10	346.10	346.30	4.75	1.01	1.46	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 27IN. DIAM. W/ SOLID LID	264+01.0	49.1 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	52.73	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	1.46	2.04	Low Cover - See Notes at Bottom	More than 2 ft of cover	Concrete pipe CL IV; Trunk 3 inflows
A LINE	DR02-5	CATCH BASIN TYPE 27IN. 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	2.04	2.47	More than 2 ft of cover	More than 2 ft of cover	Trunk 18 inflows, pipe not within roadway prism
A LINE	DR02-6	CATCH BASIN TYPE 27IN. DIAM. W/ SOLID LID	265+95.0	97.9 LT	265+76.0	140.8 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	2.47	-4.74	More than 2 ft of cover	Not Enough Cover - Need to Revise Pipe Elevations	Beveled end into ditch, pavement thickness not included for pipe cover calcs since structure on sidewalk and pipe in pervious area

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= 3771 sf and roadway area =1605 sf draining to DR02-16.

C_{PVC}	0.95	C_{Turf}	0.30	$C_{Weighted}$ (DR02-16)=	0.61
A_{Pvmt} (SF)	1605	A_{Turf} (SF)	3771		

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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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 7 | **m =** 7.83 | **n =** 0.582 | **Design Storm Event =** 25 | **Pavement thickness (ft) =** 0.15 | **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, Across Area (minutes)	Total Tc = Col. 9a + Tc across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Contrib. Inflow (cfs)	Total Flow (cfs)	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 15 vs. Column 17)	Drain Profile: 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)	Remarks
Drain Located On	Structure ID	Structure Type	From Sta.	Offset 1	To Sta.								9a							16				16	17											
B LINE	DR03-11	GRATE INLET TYPE 2 (ROTATED)	123+77.0	47.0 RT	123+34.0	34.4 RT	Roadway	7,908	0.183	0.95	0.16	0.16	5.0	5.0	3.07	0.46	0.00	0.48	12	0.013	0.0049	3.17	2.49	VELOCITY OK	ADEQUATE PIPE CAPACITY	46.0	0.22	342.42	342.20	345.90	345.04	3.48	2.16	1.52	More than 2 ft of cover	Low Cover - See Notes at Bottom	CONC PIPE CL III
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	0.0131	5.19	4.07	VELOCITY OK	ADEQUATE PIPE CAPACITY	13.0	0.17	342.20	342.03	345.04	344.87	2.84	1.52	1.52	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL III
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	0.0067	3.70	2.91	VELOCITY OK	ADEQUATE PIPE CAPACITY	12.0	0.08	342.03	341.95	344.87	344.77	2.84	1.92	1.90	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL III
B LINE	DR02-07	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	341.95	341.90	344.77	344.74	2.82	1.92	1.52	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL III
B LINE	DR02-8	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	341.90	341.86	344.74	344.72	2.84	1.52	1.54	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL III
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	341.86	341.69	344.72	344.48	2.86	1.54	1.47	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL IV
B LINE	DR02-85	GRATE INLET TYPE 2 (ROTATED)	122+51.0	30.0 RT	122+18.0	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	341.69	341.55	344.48	344.22	2.79	1.47	1.35	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CONC PIPE CL IV
B LINE	DR05-1	GRATE INLET TYPE 2 (ROTATED)	122+18.0	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	0.0456	9.68	7.60	VELOCITY OK	ADEQUATE PIPE CAPACITY	34.0	1.55	341.55	340.00	344.22	343.91	2.67	1.35	2.59	Low Cover - See Notes at Bottom	More than 2 ft of cover	CONC PIPE CL IV
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	2.59	3.05	More than 2 ft of cover	More than 2 ft of cover	
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	3.05	3.10	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+02.0	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	3.10	3.03	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	3.03	3.03	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	0.0096	3.39	2.66	VELOCITY OK	ADEQUATE PIPE CAPACITY	95.0	0.53	338.90	338.37	343.25	342.55	4.35	3.03	2.86	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	2.86	4.40	More than 2 ft of cover	More than 2 ft of cover	Checked capacity of ex 24" pipe downstream; capacity available; inflow from OFF_L4; 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.

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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 26 | m = 7.83 | n = 0.582 | Design Storm Event = 25 | Pavement thickness (ft) = 0.00 | Pipe Thickness (inches) = 3

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, 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)	
													4a							Inv				J7a	J7b											
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	53.13	24	0.013	0.0100	7.20	22.60	VELOCITY OK	NEED MORE CAPACITY	4.0	0.04	338.88	338.84	338.88	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 ds
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		53.13	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:

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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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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 storm sewer 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) = 0.60 (Pavement thickness is 0.60' on Frontage Rd.) | 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. 6e + 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 15 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)	
													6e							6e				15	17															
G LINE	DR02-59	Catch Basin Type 1	11+18	15.9 RT	10+87	15.9 RT	ROADWAY	13,487	0.309	0.95	0.29	0.29	5.0	5.0	3.07	0.90	0.00	0.90	12	0.013	0.0070	3.79	2.98	VELOCITY OK	ADEQUATE PIPE CAPACITY	30.0	0.21	344.63	344.42	348.63	348.58	4.00	2.23	2.39	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	15.6 RT	ROADWAY	750	0.017	0.95	0.02	0.31	5.0	5.1	3.02	0.94	0.00	0.94	12	0.013	0.0071	3.81	2.99	VELOCITY OK	ADEQUATE PIPE CAPACITY	41.0	0.29	344.42	344.13	348.58	348.52	4.16	2.39	2.62	More than 2 ft of cover	More than 2 ft of cover	
G LINE	DR02-44	Grate Inlet Type 2	10+50	15.6 RT	10+70	33.6 LT	ROADWAY	2,498	0.056	0.95	0.05	0.36	5.0	5.3	2.96	1.08	0.05	1.13	12	0.013	0.0069	3.77	2.96	VELOCITY OK	ADEQUATE PIPE CAPACITY	52.0	0.36	344.13	343.77	348.52	348.47	4.39	2.62	2.93	More than 2 ft of cover	More than 2 ft of cover	
G LINE - A LINE	DR02-45	Catch Basin Type 1	10+70	33.6 LT	267+67	106.2 RT	ROADWAY	1,372	0.031	0.95	0.03	0.39	5.0	5.5	2.89	1.14	0.00	1.19	12	0.013	0.0068	3.74	2.93	VELOCITY OK	ADEQUATE PIPE CAPACITY	28.0	0.19	343.77	343.58	348.47	343.58	4.70	2.93	-1.77	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 storm sewer 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 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 (Pavement thickness is 0.65' on 7th Pl.) | 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 18)	Pipe Capacity Check (Column 15 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)	
													Ave							Inv				ft/s	f ts													
7th Pl NE - Vernon Rd	DR02-43	Catch Basin Type 1	72+08	13.5 LT	10+90	15.6 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	0.0116	4.92	3.86	VELOCITY OK	ADEQUATE PIPE CAPACITY	45.0	0.53	344.66	344.13	349.04	348.52	4.38	2.56	2.57	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.
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 24

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) =** 1.65 **Pipe Thickness (inches) =** 2

Pavement thickness is 1' at bus pad and 1.05' at western edge of SB SR 9

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. 8b + 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															
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	12	0.013	0.0073	3.88	3.05	VELOCITY OK	ADEQUATE PIPE CAPACITY	15.0	0.11	343.58	343.47	347.63	346.69	4.05	1.83	0.00	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 elevation, Pipe is outside of the pavement limits.
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	12	0.013	0.0068	3.74	2.93	VELOCITY OK	ADEQUATE PIPE CAPACITY	28.0	0.19	343.47	343.28	345.69	347.57	2.22	0.00	2.07	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, Pipe is outside of the pavement limits.
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	12	0.013	0.0062	3.58	2.81	VELOCITY OK	ADEQUATE PIPE CAPACITY	74.0	0.46	343.28	342.82	347.57	347.51	4.29	2.07	2.47	More than 2 ft of cover	More than 2 ft of cover	
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	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	24.0	0.12	342.82	342.70	347.51	347.19	4.69	2.47	2.27	More than 2 ft of cover	More than 2 ft of cover	Inflow from DR02-57
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	12	0.013	0.0050	3.21	2.52	VELOCITY OK	ADEQUATE PIPE CAPACITY	88.0	0.44	342.70	342.26	347.19	347.15	4.49	2.27	2.67	More than 2 ft of cover	More than 2 ft of cover	
SR 9	DR02-53	Catch Basin Type 2 96 In. Diam w/ Flow Splitter	269+23	47.4 LT	269+29	58.2 LT	-	-	0.000	0.95	0.00	0.00	5.0	1.1	3.07	0.00	0.00	0.46	12	0.013	0.0072	3.85	3.02	VELOCITY OK	ADEQUATE PIPE CAPACITY	18.0	0.13	342.26	342.13	347.15	342.13	4.89	2.67	-2.22	More than 2 ft of cover	Not Enough Cover - Need to Revise Pipe Elevations	Flow Splitter, Pipe outfalls to proposed Wet Biofiltration Swale, Pipe is outside of the pavement limits.

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 24

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) = 0.92 | Pipe Thickness (inches) = 2

Pavement thickness within sawcut line within Circulating lane taken to be 0.95'

Location						Inflow										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)	Tc 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)	
													Av							Hv																
A Line	DR03-S6	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	347.07	347.28	3.68	1.56	1.99	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL III Conc Pipe
A Line	DR02-S7	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	1.99	2.57	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) =** 0.92 **Pipe Thickness (inches) =** 2

Pavement thickness at shoulder of SR 9 SR 9 slip lane to SR 204 is 0.95'

| Location | | |

TRUNK 22

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 (Pavement at bus stop pad is 1.0') | 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 + To 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)	
													4a							14a				15	17											
A LINE	DR02-46	Catch Basin Type 1	269+51	30.7 RT	268+85	32.5 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	32.5 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 on Frontage Rd is 0.6' and SR 9 south of SR9/204 RA is 0.95'
Pavement thickness (ft) = 0.95 **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)	
													Ac							I dir				I Vs	I Vs												
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	0.60	0.74	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL V Conc Pipe, Offsite flows
G LINE	DR02-87	Catch Basin Type 1 w Solid Lid	11+48	15.9 RT	12+50	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	0.0051	3.22	2.53	VELOCITY OK	ADEQUATE PIPE CAPACITY	99.0	0.50	345.78	345.28	348.68	349.37	2.90	0.74	1.93	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+50	15.9 RT	13+47	15.9 RT	-	-	0.000	0.95	0.00	0.00	5.0	0.6	3.07	0.00	0.00	1.27	12	0.013	0.0051	3.22	2.53	VELOCITY OK	ADEQUATE PIPE CAPACITY	95.0	0.48	345.28	344.80	349.37	350.45	4.09	1.93	3.49	Low Cover - See Notes at Bottom	More than 2 ft of cover	CL III Conc Pipe,
G LINE	DR03-28	Catch Basin Type 248 In. Diam. w/ Solid Lid	13+47	15.9 RT	14+46	15.9 RT	OFF-SITE AREA 11	-	0.000	0.95	0.00	0.00	5.0	1.1	3.07	0.00	0.37	1.64	12	0.013	0.0051	3.22	2.53	VELOCITY OK	ADEQUATE PIPE CAPACITY	97.0	0.49	344.80	344.31	350.45	351.12	5.65	3.49	4.65	More than 2 ft of cover	More than 2 ft of cover	Offsite flows
G LINE - A LINE	DR03-4	Catch Basin Type 248 In. Diam. w/ Solid Lid	14+46	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	0.0342	8.38	6.58	VELOCITY OK	ADEQUATE PIPE CAPACITY	55.0	1.86	344.31	342.43	351.12	347.43	6.81	4.65	2.84	More than 2 ft of cover	More than 2 ft of cover	Offsite flows fr om DR03-5 + flows from DR03-3
A LINE	DR03-13	Catch Basin Type 248 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	2.84	4.31	More than 2 ft of cover	More than 2 ft of cover	Composite C value equal to the weighted average c 8412 SF impervious (0.95) and 1062 SF pervious (0.33) area draining to structure
A LINE	DR03-19	Catch Basin Type 254 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	7.19	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	4.31	2.40	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-14	Catch Basin Type 260 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	0.0096	5.82	10.28	VELOCITY OK	ADEQUATE PIPE CAPACITY	49.0	0.47	340.45	339.98	345.51	346.89	5.06	2.40	4.25	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-15	Catch Basin Type 260 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	0.0100	5.94	10.49	VELOCITY OK	ADEQUATE PIPE CAPACITY	63.0	0.63	339.98	339.35	346.89	343.38	6.91	4.25	1.37	More than 2 ft of cover	Low Cover - See Notes at Bottom	DS end of pipe is outside of the roadway
A LINE	DR03-26	Catch Basin Type 248 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	2.02	4.64	More than 2 ft of cover	More than 2 ft of cover	New structure connecting to existing pipe, Existing pipe velocity is high in the existing condition

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.

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 = 0.552 | Design Storm Event = 25 | Pavement thickness (ft) = 0.60 | Pipe Thickness (inches) = 2

Pavement for offsite area assumed to match Frontage Rd at 0.60'

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 + To 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)	
													4a							14a				15	17											
G.LINE	DR03-27	EXISTING PIPE	13+40	33.1 RT	13+47	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	8	0.013	0.0142	4.13	1.44	VELOCITY OK	ADEQUATE PIPE CAPACITY	19.0	0.27	348.70	348.43	351.05	350.45	2.35	0.92	0.59	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Maintain existing off-site connection pipe Off-Site Area 11, connect to new structure. Contributing Inflow measured using MGSFlood, see Off-site Area figure for details.

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 = 0.552 | Design Storm Event = 25 | Pavement thickness (ft) = 0.60 | Pipe Thickness (inches) = 2

Pavement for offsite area assumed to match Frontage Rd at 0.60'

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 + To 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 15 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)	
													4a							14a				15	17													
G LINE	DR02-66	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	2.53	1.13	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 CB

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 = 0.552 | Design Storm Event = 25 | Pavement thickness (ft) = 0.60 | Pipe Thickness (inches) = 2

Pavement for offsite area assumed to match Frontage Rd at 0.60'

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 + To 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 15 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)	
													4a							14a				15	17											
G LINE	DRG3-5	EXISTING PIPE	14+63	32.7 RT	14+46	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	0.0000	0.00	0.00	TRY TO INCREASE VELOCITY	NEED MORE CAPACITY	18.0	0.00	348.90	348.50	351.41	351.12	2.91	1.14	0.85	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Maintain existing off-site connection pipe Off-Site Area 12, connect to new structure. Existing pipe slope is flat. Contributing inflow measured using MGS Flood, see Off-site Area figure for details.

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) =** 0.60 **Pipe Thickness (inches) =** 2

Pavement thickness on Frontage Rd is 0.60

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, Across Area (minutes)	Total Tc = Col. 8a + To 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							13a			17a	17b												
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	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	2.98	5.12	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.
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	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	5.12	4.42	More than 2 ft of cover	More than 2 ft of cover	
G LINE	DR03-3	Catch Basin Type 2 48 In. Diam	15+12	15.9 RT	14+46	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	12	0.013	0.0111	4.78	3.75	VELOCITY OK	ADEQUATE PIPE CAPACITY	55.0	0.61	344.92	344.31	351.11	351.12	6.19	4.42	5.04	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.

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) = 0.95 | Pipe Thickness (inches) = 2.5

Pavement thickness on Vernon Rd is 0.6' and NB SR 9 south of SR9/204 RA along sliplane is 0.95'

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 + To 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)	
													4a							14a				15	17a											
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	-2.16	1.77	Not Enough Cover - Need to Revise Pipe Elevations	Low Cover - See Notes at Bottom	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 21745 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	1.77	0.84	Low Cover - See Notes at Bottom	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	2.97	2.37	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-9	Catch Basin Type 2 48 In. Diam	272+06	47.6 RT	271+97	44.4 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	90.0	0.05	342.18	342.13	347.21	347.17	5.03	2.37	2.38	More than 2 ft of cover	More than 2 ft of cover	
A LINE	DR03-10	Grate Inlet Type 2	271+97	44.4 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	2.38	2.47	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+46	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	351.12	5.13	2.47	6.53	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

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 (Pavement thickness taken within splitter island abutting rolled curb, assumed to be 1') | 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 + To 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 15 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)	
													4a							14a				15	17											
A LINE	DR03-16	Grate Inlet Type 2	272+02	25.9 RT	271+97	44.4 RT	ROADWAY	5,384	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

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) = 0.00 | 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 T_c = Col. 6a + T_c 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 15 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)	
													Hr.							Hr.				ft/s	ft/s											
A LINE	DR03-38	Grate Inlet Type 2	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	0.0157	5.69	4.46	VELOCITY OK	ADEQUATE PIPE CAPACITY	21.0	0.33	343.50	343.17	345.55	348.30	2.05	0.88	3.96	Low Cover - See Notes at Bottom	More than 2 ft of cover	Composite C value equal to the weighted average o 15709 SF impervious (0.95) and 5965 SF pervious (0.33) area draining to pipe end. Pipe is located outside of the pavement limits.

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 storm sewer 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 a

m = 7.83 **n =** 0.582 **Design Storm Event =** 25 **Pavement thickness (ft) =** 0.95 (Pavement thickness of 0.95' from SB SR9 shoulder between Vernon and SR 204 RA) **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 (fps)	Pipe Capacity (cfs)	Pipe Velocity Check (Desirable Minimum 3 fpsec, 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)	
													Ac							Inc				ft/s	ft/s											
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	2.72	4.14	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	4.14	4.62	More than 2 ft of cover	More than 2 ft of cover	Connects to DR03-19

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.

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 + To across pipe length (minutes)	Rainfall Intensity (in/hr)	Runoff (cfs)	Cumltv. 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 15 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)	
													4a							14a				15	17											
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 SB/SB. Composite C value equal to the weighted average of 22,209 SF impervious (0.95) and 12,524 SF pervious (0.33) area draining to structure. Pipe is outside of the pavement limits.

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.

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						Drainage Design											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 + To 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)	
													4a							14a				15	17												
G-LINE	DR03-29	Schedule A Storm Sewer Pipe	272+07	105.0 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. Pipe is outside of the pavement limits.

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.

m = 7.83 | n = 0.582 | Design Storm Event = 2.5 | Pavement thickness (ft) = 0.00 (Pipe run outside of the roadway, pavement thickness is 0') | 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 + To 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)	
													4a							14a				15	17												
A LINE	DR03-17	Schedule A Storm Sewer Pipe	274+12	86.0 LT	274+12	84.7 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	0.0062	4.70	8.30	VELOCITY OK	ADEQUATE PIPE CAPACITY	8.0	0.05	340.96	340.91	343.93	343.90	2.97	1.26	1.28	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	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 (0.35) area draining to structure.
A LINE	DR03-24	Catch Basin Type 2 48 in. Diam. w/ Solid Lid	274+12	84.7 LT	273+26	109.8 LT	-	-	-	0.000	0.95	0.00	0.86	5.0	5.0	3.06	2.62	0.00	2.62	18	0.013	0.0050	4.20	7.42	VELOCITY OK	ADEQUATE PIPE CAPACITY	82.0	0.41	340.91	340.50	343.90	344.06	2.99	1.26	1.85	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	Structure and pipe outside of roadway, rim set 0.3' above FG slope
A LINE	DR03-25	Catch Basin Type 2 48 in. Diam. w/ Solid Lid	273+26	109.8 LT	272+48	83.7 LT	-	-	-	0.000	0.95	0.00	0.86	5.0	5.4	2.95	2.62	0.00	2.62	18	0.013	0.0353	11.16	19.71	TRY TO REDUCE VELOCITY	ADEQUATE PIPE CAPACITY	61.0	1.80	340.50	338.70	344.06	346.89	3.96	1.85	6.48	Low Cover - See Notes at Bottom	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

See WSDOT Hydraulic Manual 6-5 for explanation of columns. http://www.wsdot.wa.gov/eesc/design/hydraulics/

2

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 25

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) = 0.60 | Pipe Thickness (inches) = 2

Pavement thickness at Vernon Rd north of Vernon/Davies RA is 0.60'

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 + To 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	Downstr. Pipe Cover (ft)	Upstr. Pipe Cover Check (ft)	Downstr. Pipe Cover Check (ft)	
													4a					13	14a					15	17													
GLINE	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	1.12	1.05	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL IV Conc Pipe.
GLINE	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	1.05	1.14	Low Cover - See Notes at Bottom	Low Cover - See Notes at Bottom	CL IV Conc Pipe.
GLINE	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	1.14	0.34	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/

Notes:

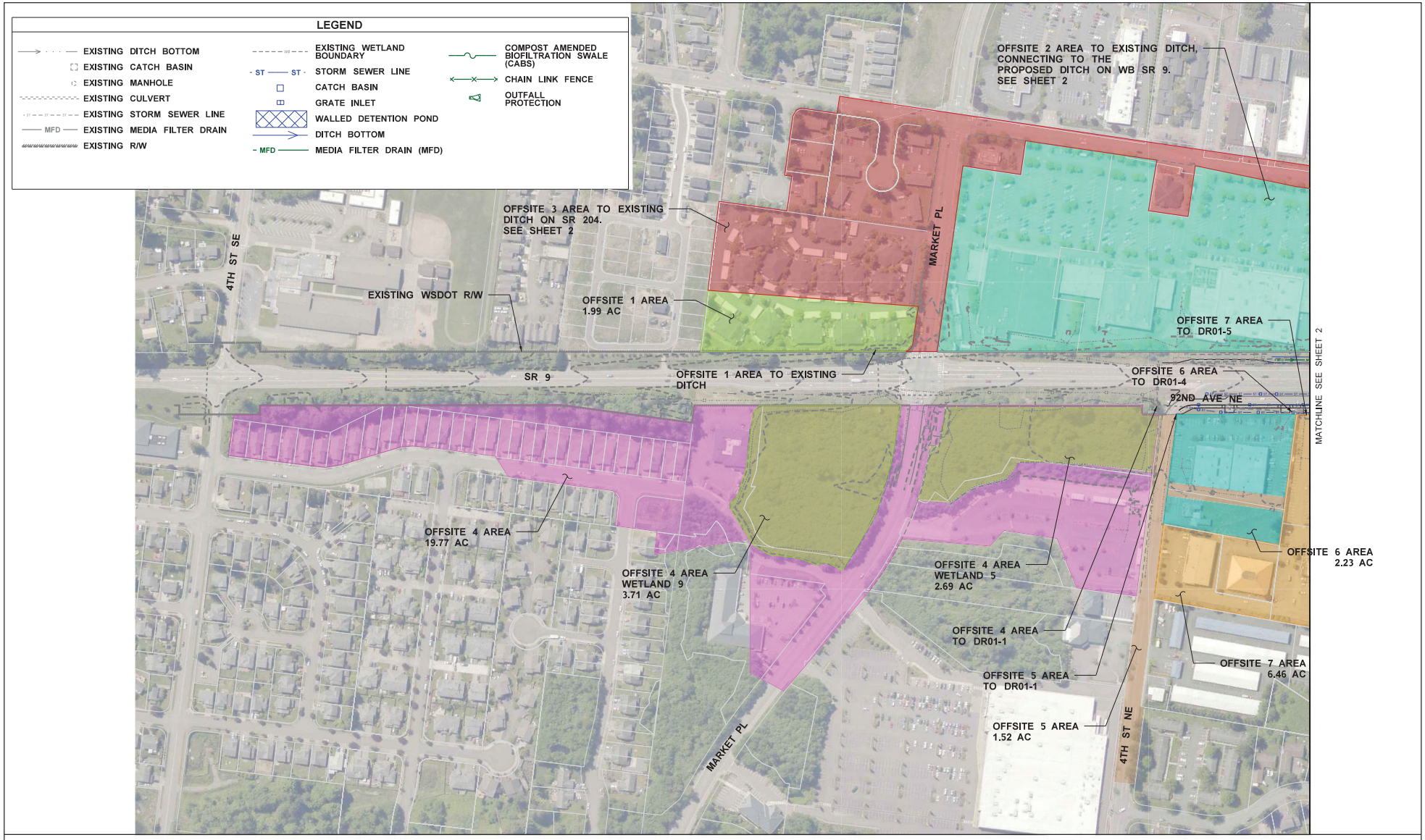
Column 12 represents inflow from a storm sewer line, branch, an offsite source that flows into the trunk line being analyzed.
The conservative assumption is that the flow enters the storm sewer run at the upstream end of the run being analyzed.

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.



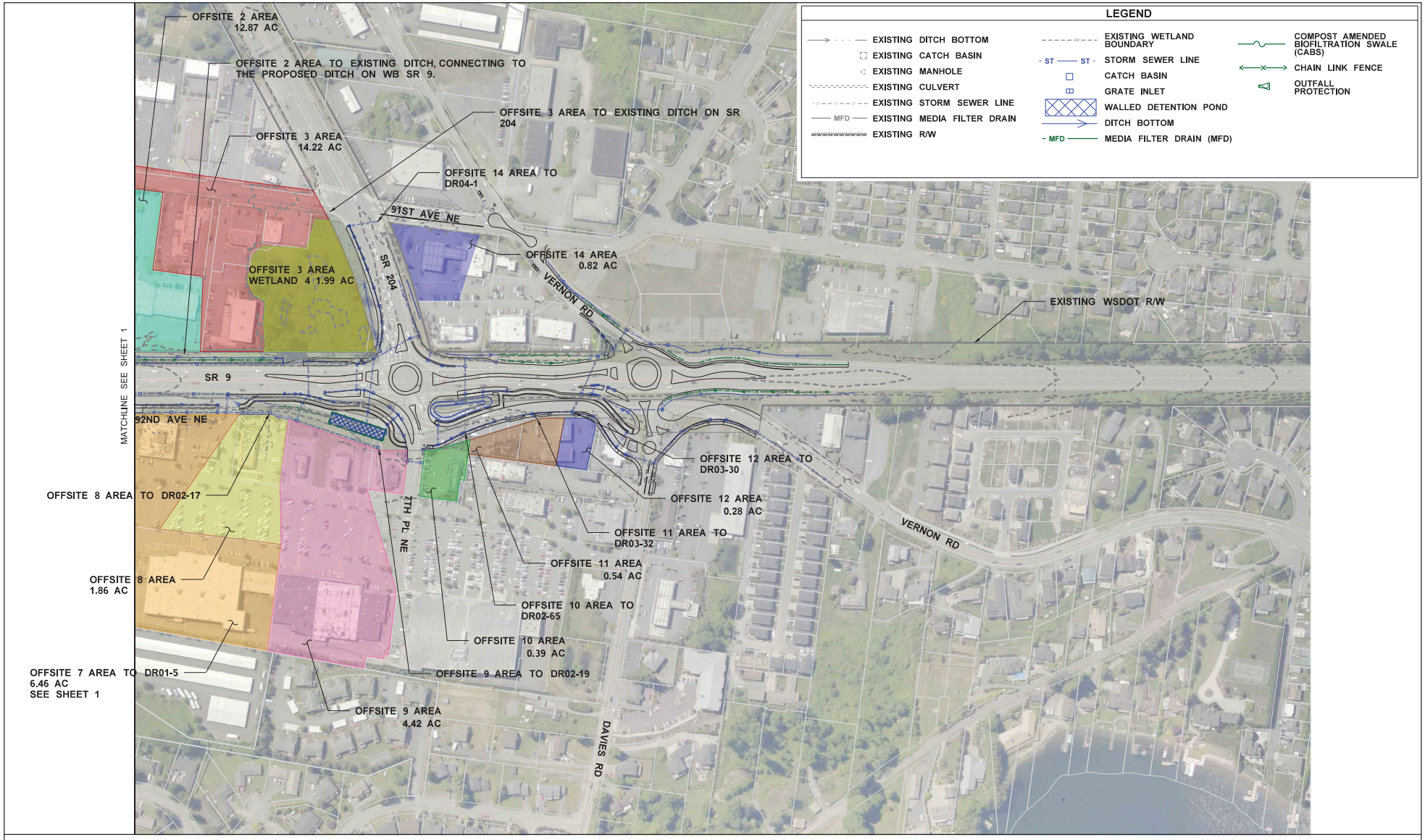
OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE A-3.6 : OFFSITE AREAS
SHEET 1

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	900
Open Channel Flow Narrow Channel (w/d = 1)	1 foot deep	1100
	2 foot deep	1800
	4 foot deep	2800

*typical case for this project

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	
n	0. 582	
50-year		
m	8.96	
n	0. 585	

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)		201.00	0.0048	2.63	2.63	5.00	0.21	0.31	2.50	0.72	3.07	0.94	3.49	1.10	3.92	1.26	Ditch downslope of the MFD Type 3 at north end of the project (TDA 5) 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	10:1	3:1	0.0	0.0048	0.72	1.26	0.52	0.26	6.73	0.41	0.57	0.28	7.44	0.44	0.61	0.30	7.89	0.46	0.64	0.32	8.30	0.48	1.9	2.00	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	0.72
	s = Ditch Slope (ft/ft) =	0.005	0.0106	0.007	0.0027	0.004	0.004	0.003	0.013	0.005
	d = Depth of Flow (ft) =	0.87	1.78	0.64	2.78	0.39	0.43	0.96	0.63	0.52
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**	**0.16**

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

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

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 10 - 10

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 10.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0048 ft/ft

Manning's n: 0.1000

Flow: 0.7200 cfs

Result Parameters

Depth: 0.5175 ft

Area of Flow: 1.7409 ft^2

Wetted Perimeter: 6.8376 ft

Hydraulic Radius: 0.2546 ft

Average Velocity: 0.4136 ft/s

Top Width: 6.7278 ft

Froude Number: 0.1433

Critical Depth: 0.2548 ft

Critical Velocity: 1.7066 ft/s

Critical Slope: 0.2103 ft/ft

Critical Top Width: 4.66 ft

Calculated Max Shear Stress: 0.1550 lb/ft^2

Calculated Avg Shear Stress: 0.0763 lb/ft^2

Channel Analysis: DITCH 10 - 25

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 10.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0048 ft/ft

Manning's n: 0.1000

Flow: 0.9400 cfs

Result Parameters

Depth: 0.5719 ft

Area of Flow: 2.1263 ft^2

Wetted Perimeter: 7.5567 ft

Hydraulic Radius: 0.2814 ft

Average Velocity: 0.4421 ft/s

Top Width: 7.4353 ft

Froude Number: 0.1457

Critical Depth: 0.2834 ft

Critical Velocity: 1.8001 ft/s

Critical Slope: 0.2029 ft/ft

Critical Top Width: 5.19 ft

Calculated Max Shear Stress: 0.1713 lb/ft^2

Calculated Avg Shear Stress: 0.0843 lb/ft^2

Channel Analysis: DITCH 10 - 50

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 10.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0048 ft/ft

Manning's n: 0.1000

Flow: 1.1000 cfs

Result Parameters

Depth: 0.6067 ft

Area of Flow: 2.3923 ft^2

Wetted Perimeter: 8.0155 ft

Hydraulic Radius: 0.2985 ft

Average Velocity: 0.4598 ft/s

Top Width: 7.8868 ft

Froude Number: 0.1471

Critical Depth: 0.3018 ft

Critical Velocity: 1.8576 ft/s

Critical Slope: 0.1987 ft/ft

Critical Top Width: 5.53 ft

Calculated Max Shear Stress: 0.1817 lb/ft^2

Calculated Avg Shear Stress: 0.0894 lb/ft^2

Channel Analysis: DITCH 10 - 100

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 10.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Longitudinal Slope: 0.0048 ft/ft

Manning's n: 0.1000

Flow: 1.2600 cfs

Result Parameters

Depth: 0.6384 ft

Area of Flow: 2.6488 ft^2

Wetted Perimeter: 8.4342 ft

Hydraulic Radius: 0.3141 ft

Average Velocity: 0.4757 ft/s

Top Width: 8.2988 ft

Froude Number: 0.1484

Critical Depth: 0.3187 ft

Critical Velocity: 1.9087 ft/s

Critical Slope: 0.1952 ft/ft

Critical Top Width: 5.83 ft

Calculated Max Shear Stress: 0.1912 lb/ft^2

Calculated Avg Shear Stress: 0.0941 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

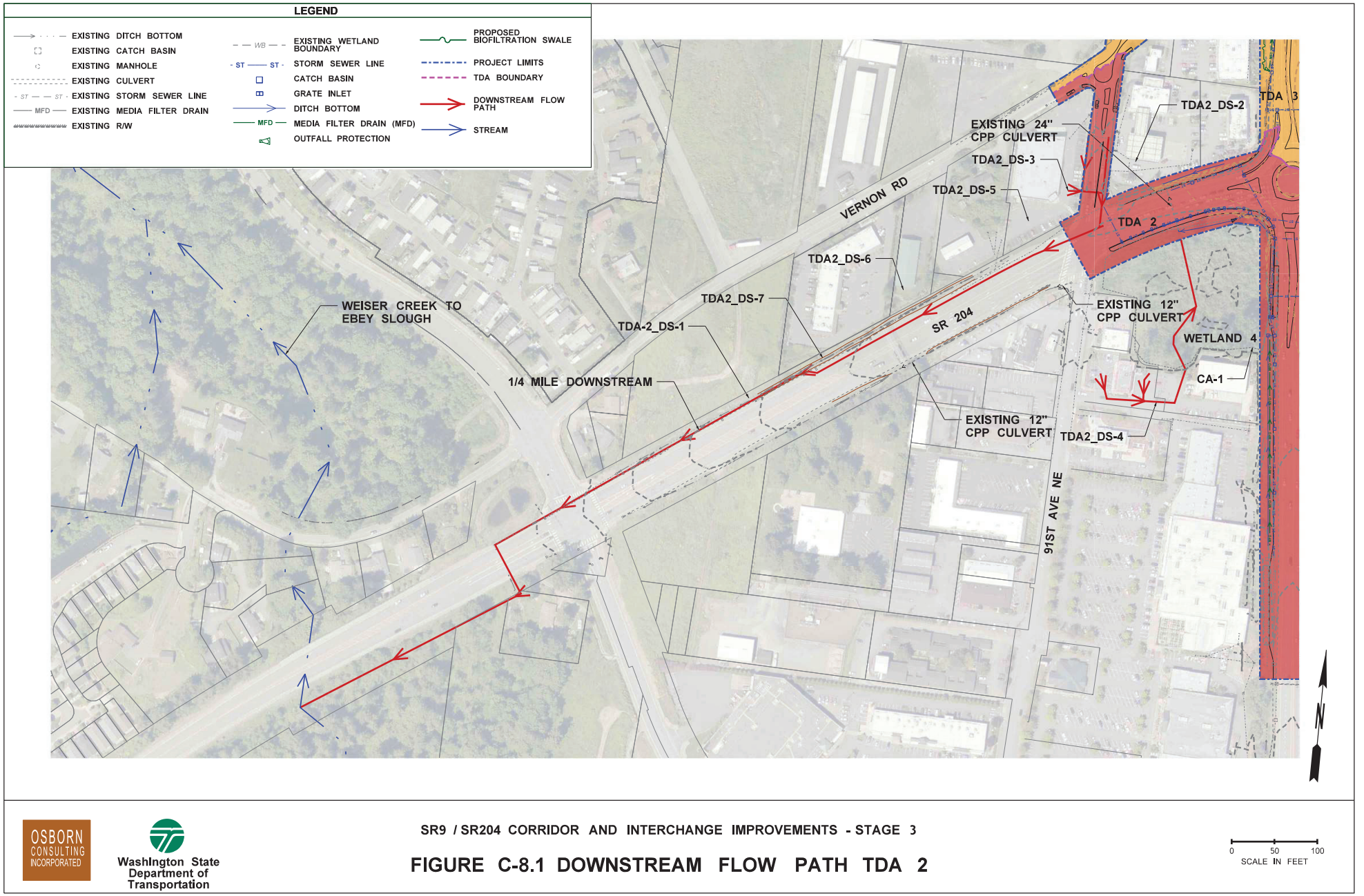
		drains to 8" PVC SD.						
TDA-2_DS-7	Vegetated ditch along north side of SR 204	Vegetated ditch runs parallel to SR 204 on the north side of the roadway.	Vegetated ditch	Unknown	725 – 1500 ft	No problems noted.	No problems anticipated.	N/A
TDA-3_DS-1	Frontier Circle mainline	Sheet flow along Frontier 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.



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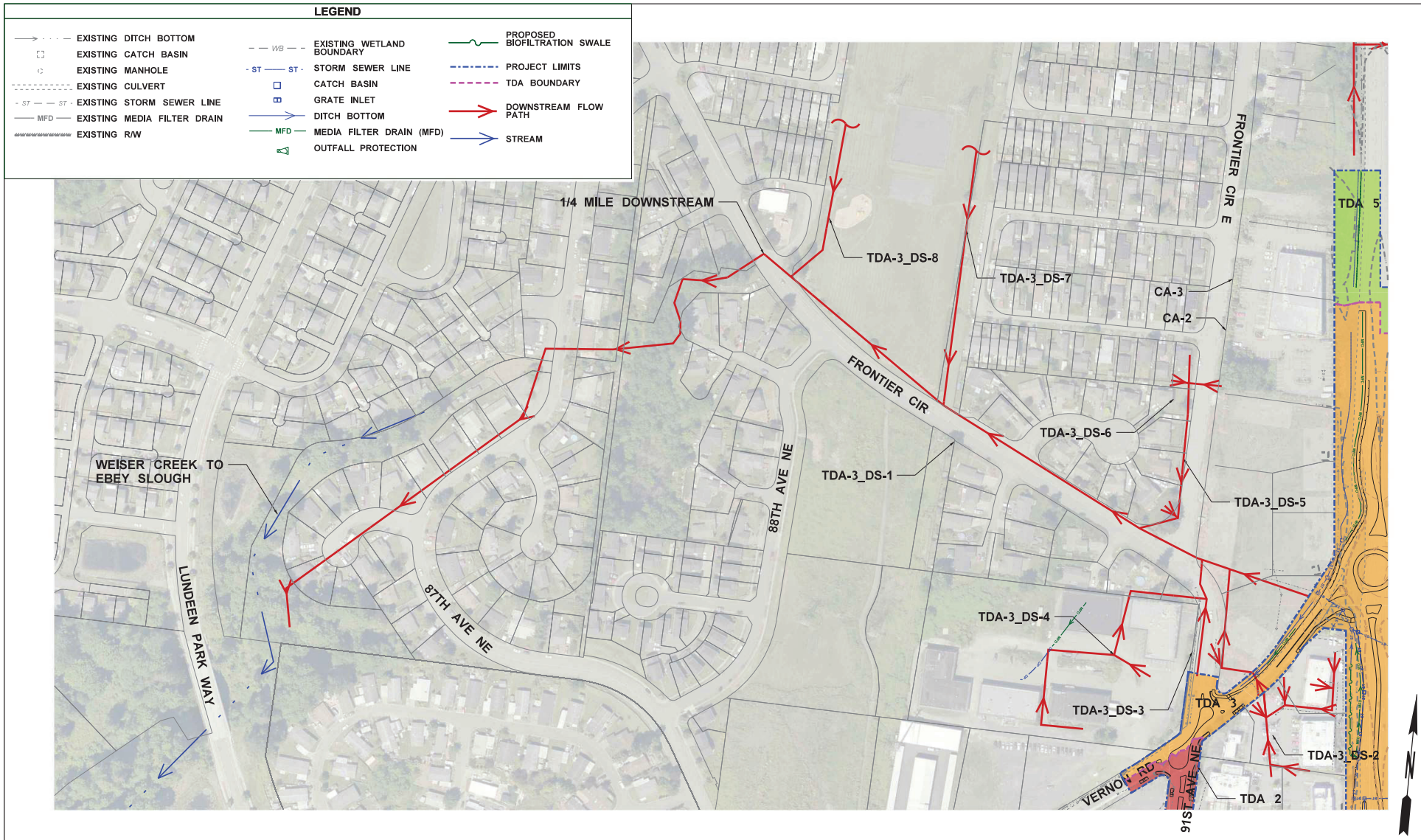
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE C-8.1 DOWNSTREAM FLOW PATH TDA 2

0 50 100
SCALE IN FEET



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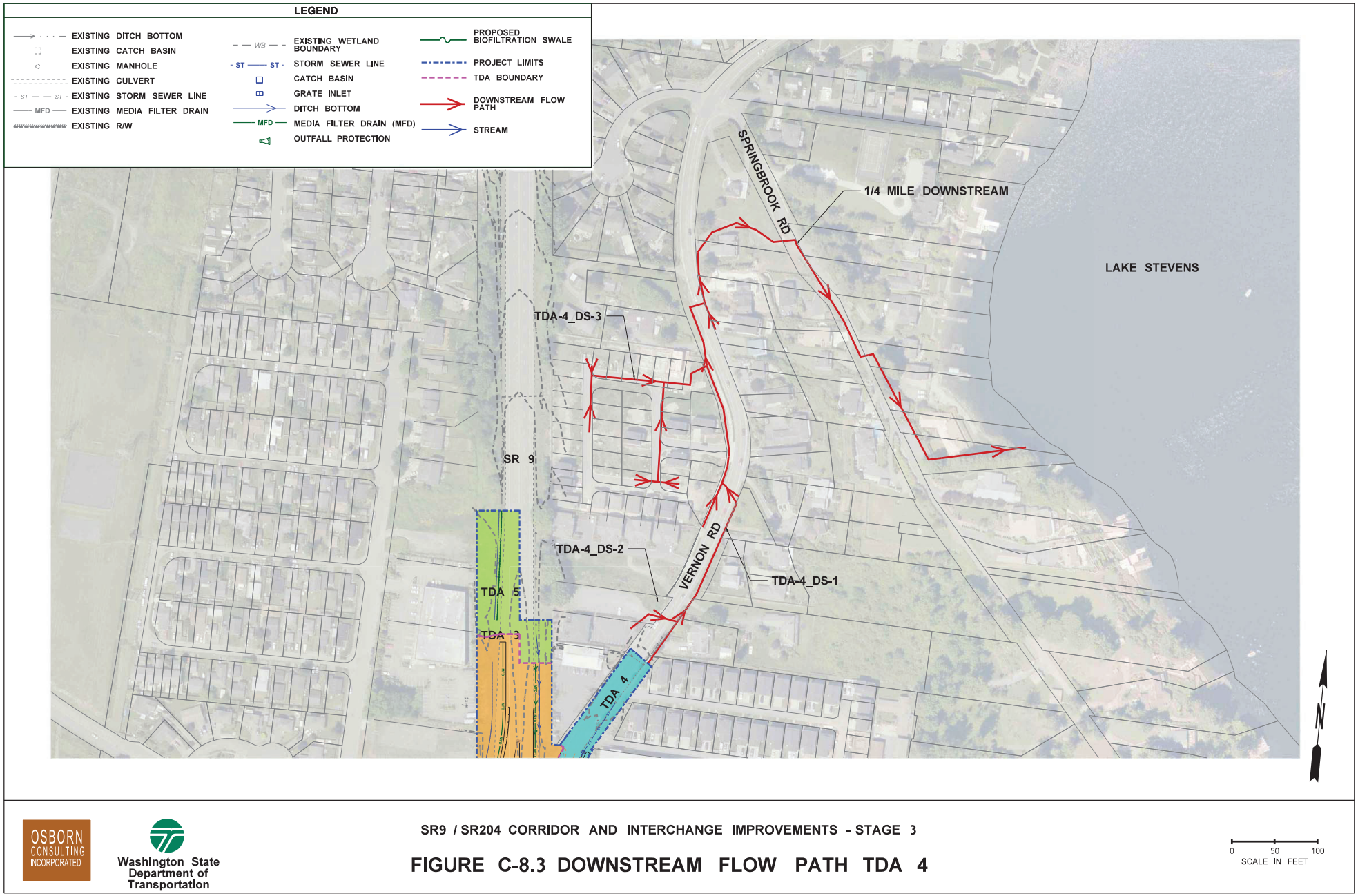
SR9 / SR204 CORRIDOR AND INTERCHANGE IMPROVEMENTS - STAGE 3

FIGURE C-8.2 DOWNSTREAM FLOW PATH TDA 3

0 50 100
SCALE IN FEET



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Washington State Department of Transportation

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

OSBORN CONSULTING INCORPORATED

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%

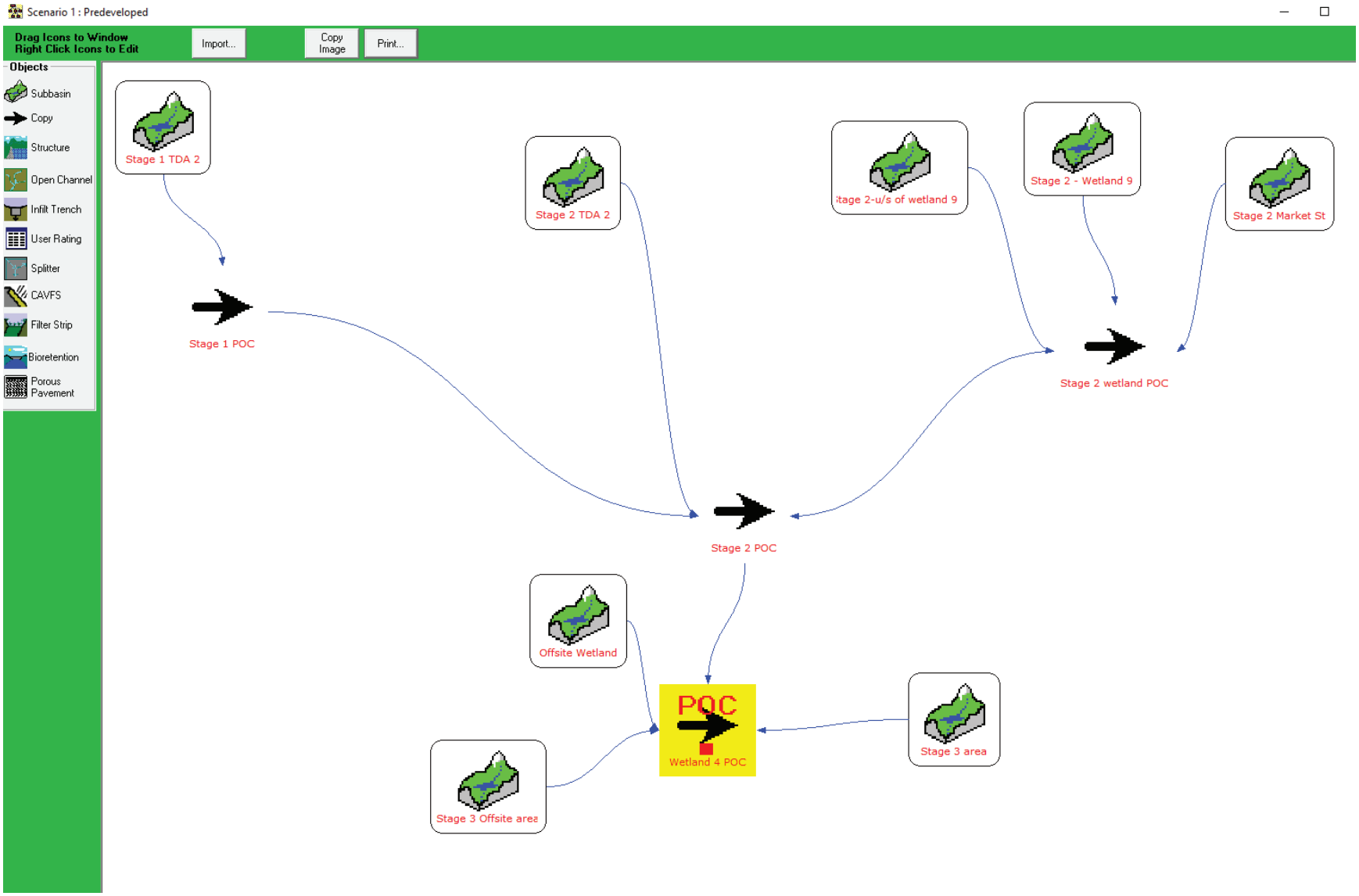
Jun-24	2.485E-01	2.441E-01	-1.76%
Jun-25	1.234E-01	1.229E-01	-0.38%
Jun-26	1.268E-01	1.254E-01	-1.07%
Jun-27	1.062E-01	1.056E-01	-0.62%
Jun-28	1.700E-01	1.678E-01	-1.32%
Jun-29	2.421E-01	2.381E-01	-1.65%
Jun-30	8.562E-02	8.572E-02	0.12%
Jul-01	1.460E-01	1.442E-01	-1.19%
Jul-02	8.584E-02	8.557E-02	-0.32%
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%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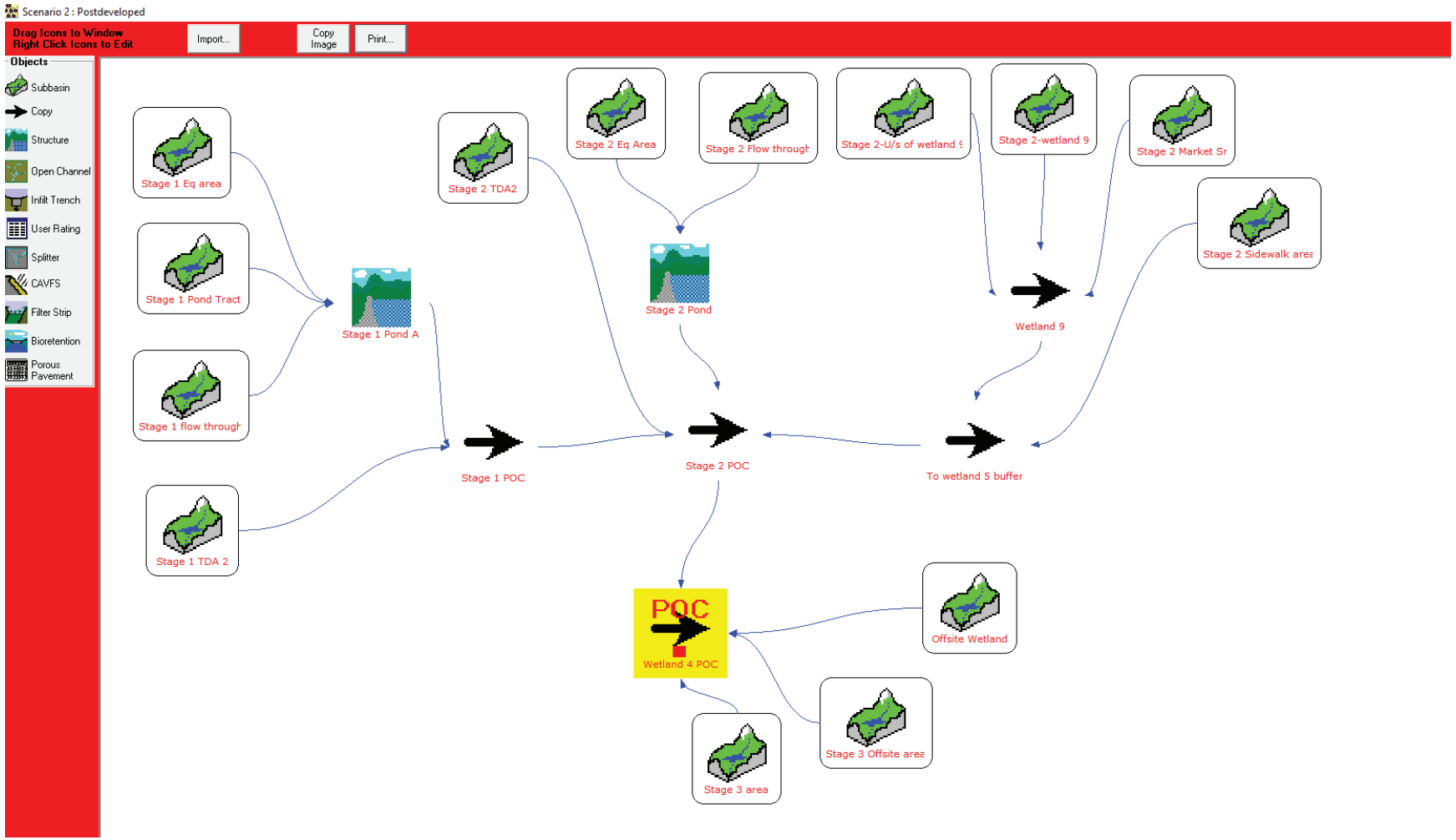
CAVFS
Filter Strip
Bioretention
Porous Pavement
Stage 1 TDA 2
Stage 2 TDA 2
itage 2-u/s of wetland 9
Stage 2 - Wetland 9
Stage 2 Market St
Stage 1 POC
Stage 2 wetland POC
Stage 2 POC
Offsite Wetland
POC
Wetland 4 POC
Stage 3 area
Stage 3 Offsite area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CAVFS
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

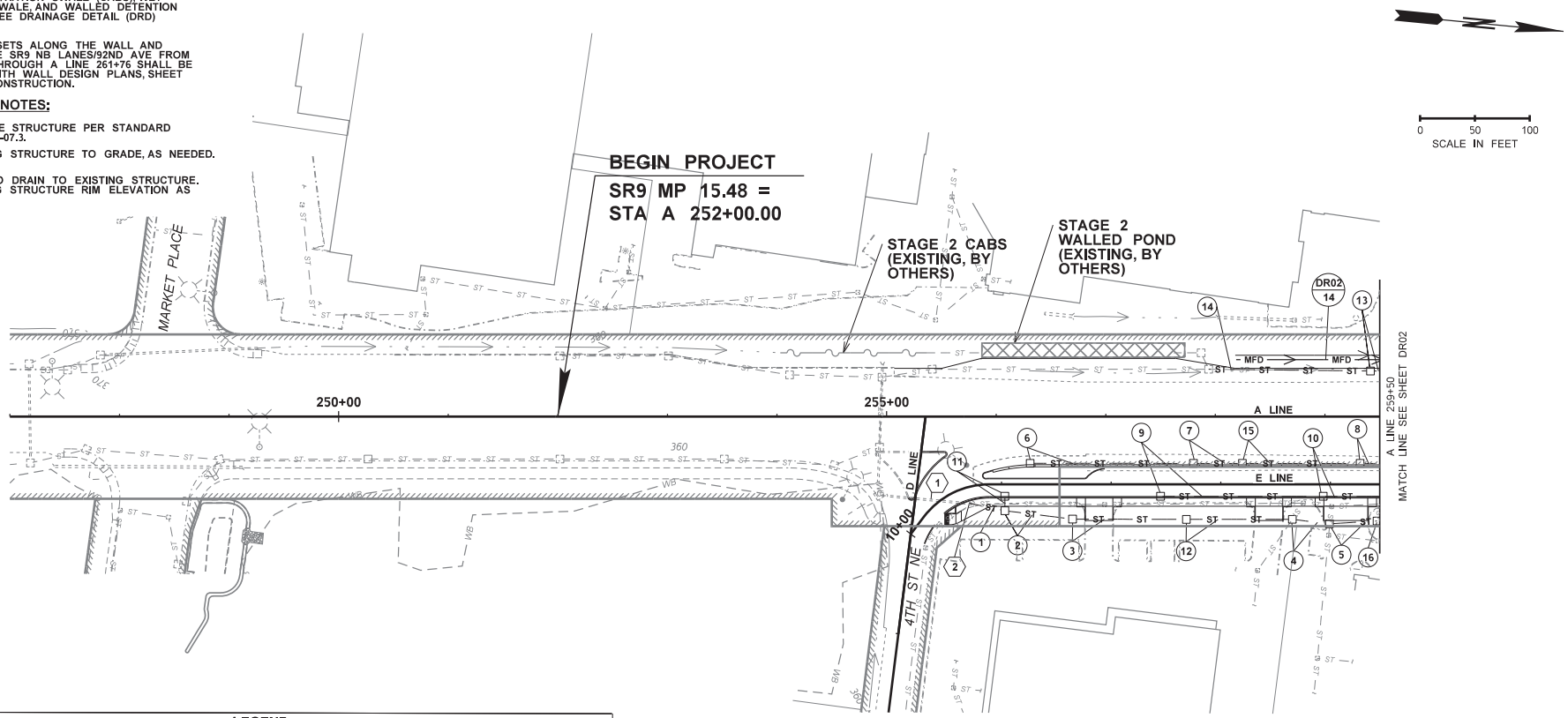
T. 29N. R. 5E. W.M. SEC. 13

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 A LINE 256+31 THROUGH A LINE 261+76 SHALL BE COORDINATED WITH WALL DESIGN PLANS, SHEET WA08, DURING CONSTRUCTION.

CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.
3. GRADE DITCH TO DRAIN TO EXISTING STRUCTURE. ADJUST EXISTING STRUCTURE RIM ELEVATION AS NEEDED.



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- (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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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 21A008
CONTRACT NO. | LOCATION NO.
SEE SHEET CT1
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 DR01
SHEET 80 OF 366 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.
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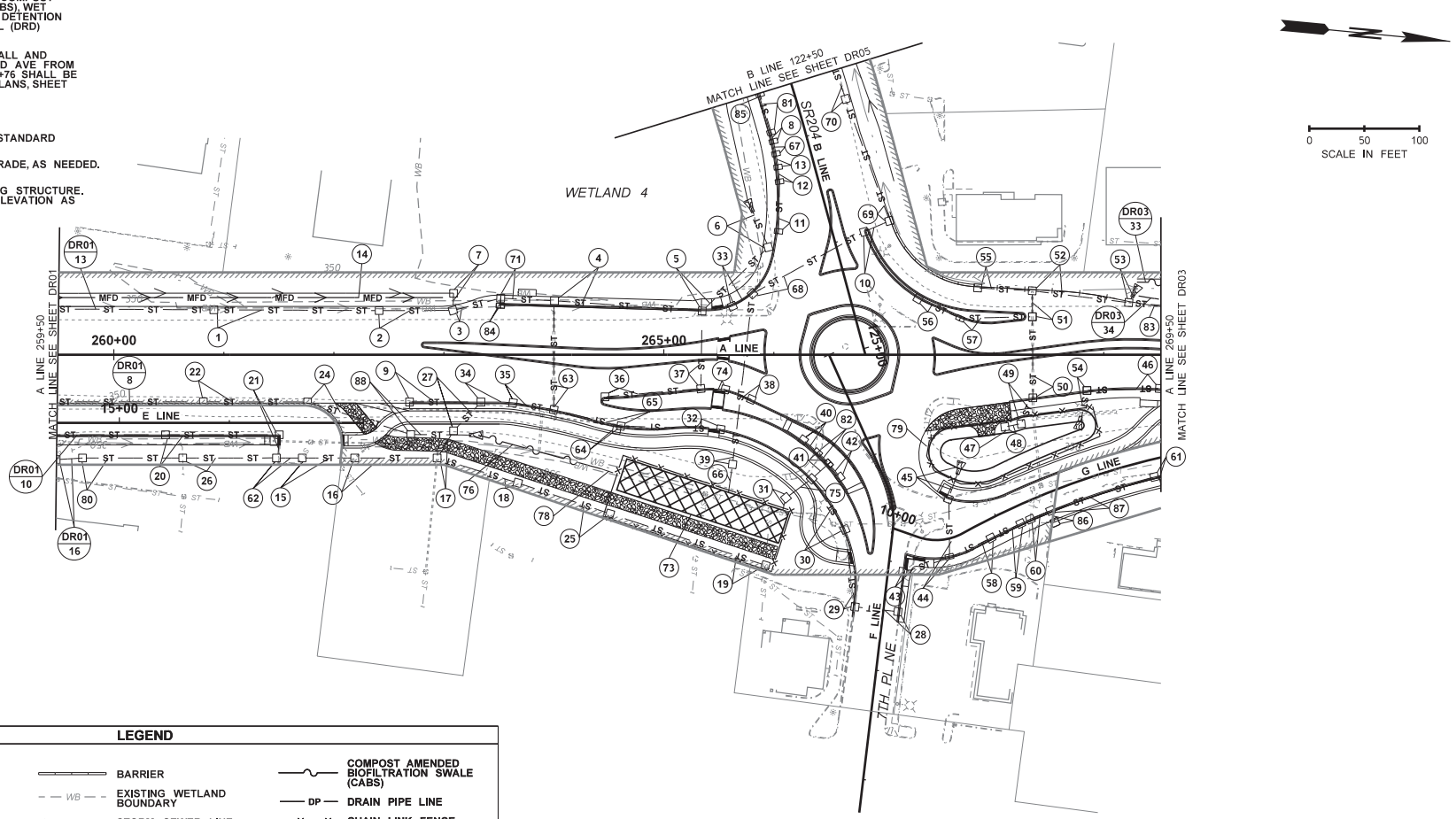
CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.
3. GRADE DITCH TO DRAIN TO EXISTING STRUCTURE. ADJUST EXISTING STRUCTURE RIM ELEVATION AS NEEDED.



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- STRUCTURE NOTE CODE
- EXISTING DITCH BOTTOM
- EXISTING CATCH BASIN
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- 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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CHECKED BY	L. THOMSEN				
PROJ. ENGR.	K. NDILE				
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO.	STATE
10	WASH
JOB NUMBER	21A008
CONTRACT NO.	

FED.AID PROJ.NO.

LOCATION NO.

SEE SHEET CT1
DATE
P.E. STAMP BOX

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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
DR02

SHEET 81 OF 366 SHEETS

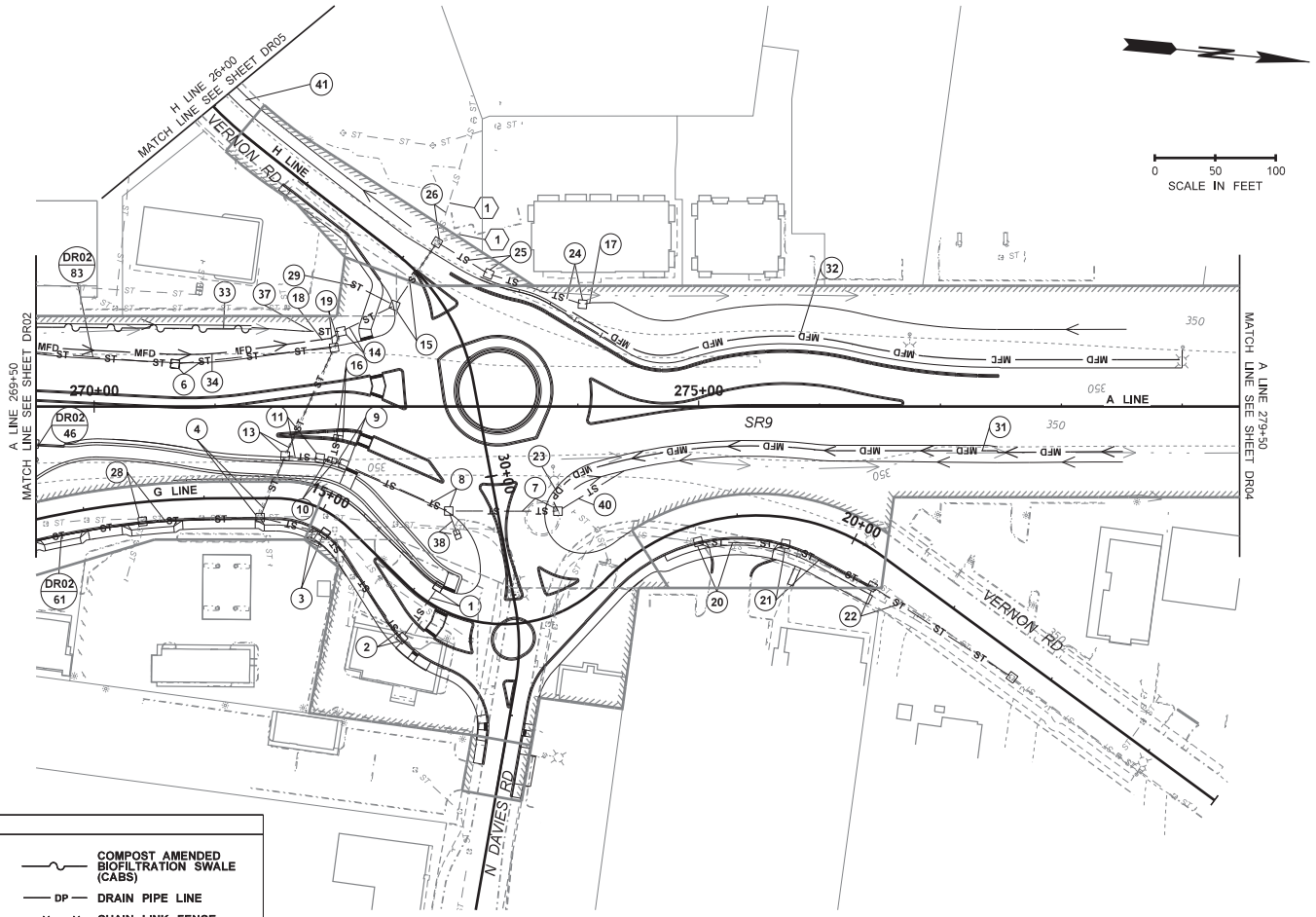
NOTES:

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 A LINE 256+31 THROUGH A LINE 261+76 SHALL BE COORDINATED WITH WALL DESIGN PLANS, SHEET WA08, DURING CONSTRUCTION.

CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.
3. GRADE DITCH TO DRAIN TO EXISTING STRUCTURE. ADJUST EXISTING STRUCTURE RIM ELEVATION AS NEEDED.

T. 29N. R. 5E. W.M. SEC. 13



LEGEND

- STRUCTURE NOTE CODE
- EXISTING DITCH BOTTOM
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- 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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PROJ. ENGR.	K. NDILE				
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO.	STATE
10	WASH
JOB NUMBER	
21A008	
CONTRACT NO.	

FED.AID PROJ.NO.

LOCATION NO.

SEE SHEET CT1
DATE
P.E. STAMP BOX

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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
DR03

SHEET 82 OF 366 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.
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CONSTRUCTION NOTES:

1. CLEAN DRAINAGE STRUCTURE PER STANDARD SPECIFICATION 7-07.3.
2. ADJUST EXISTING STRUCTURE TO GRADE, AS NEEDED.
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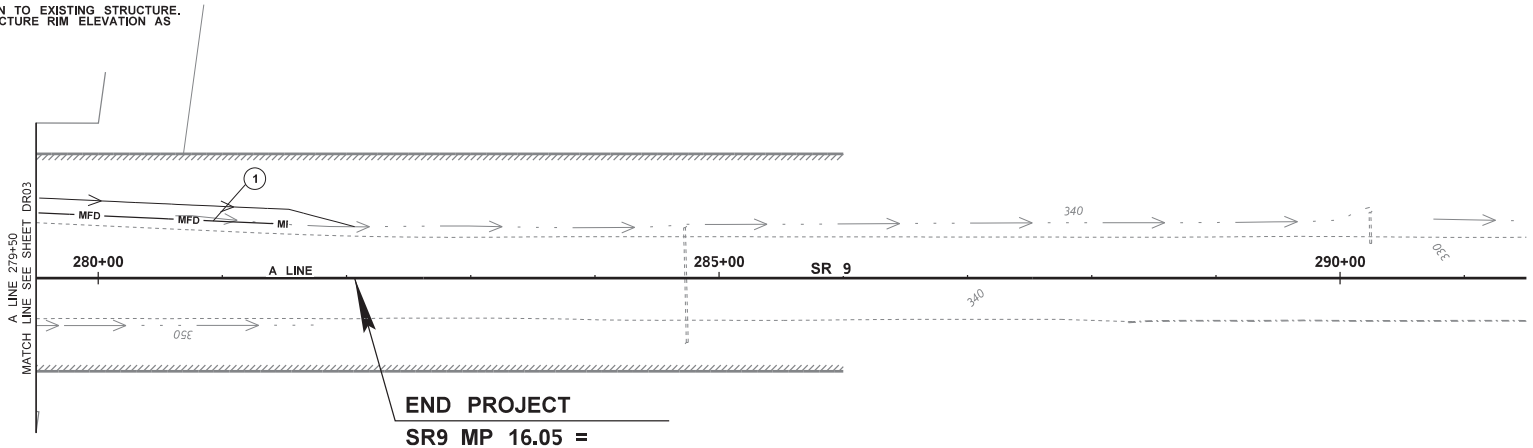

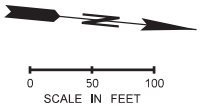

LEGEND

- 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
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- OUTFALL PROTECTION
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REGION NO.	STATE
10	WASH
JOB NUMBER	
21A008	
CONTRACT NO.	

FED.AID PROJ.NO.

LOCATION NO.

SEE SHEET CT1
DATE
P.E. STAMP BOX

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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
83
OF
366
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.
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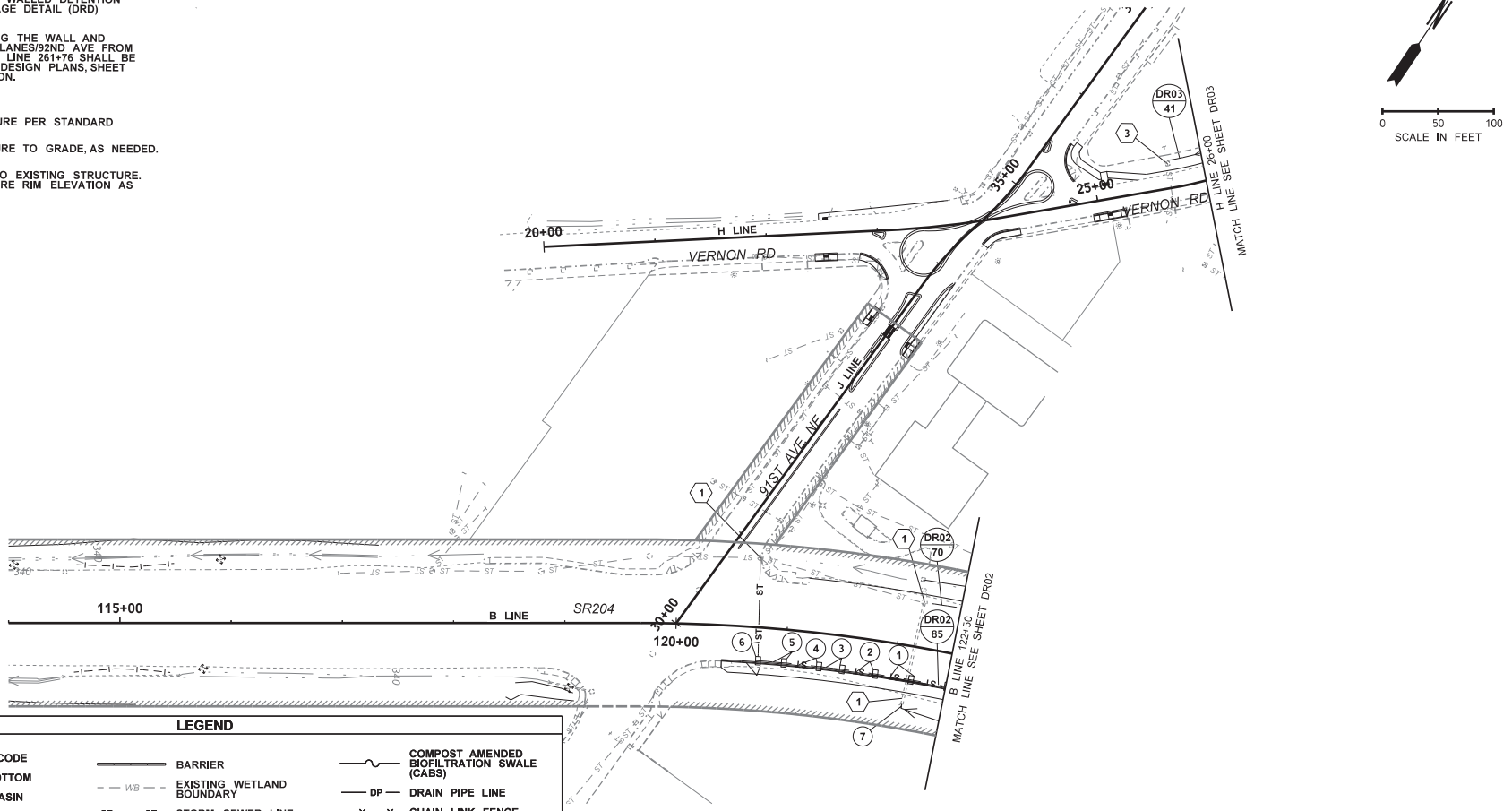

LEGEND

(X) STRUCTURE NOTE CODE	BARRIER
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EXISTING CATCH BASIN	STORM SEWER LINE
EXISTING MANHOLE	CATCH BASIN
EXISTING CULVERT	GRATE INLET
EXISTING STORM SEWER LINE	WALLED DETENTION POND
EXISTING MEDIA FILTER DRAIN	DITCH BOTTOM
EXISTING R/W	MEDIA FILTER DRAIN (MFD)
EXISTING COMPOST AMENDED BIOFILTRTION SWALE (CABS)	COMPOST AMENDED BIOFILTRATION SWALE (CABS)
	DRAIN PIPE LINE
	CHAIN LINK FENCE
	NOISE WALL
	OUTFALL PROTECTION
	MAINTENANCE ACCESS ROAD

PROOF COPY
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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. 10 | STATE WASH | FED.AID PROJ.NO.
JOB NUMBER 21A008
CONTRACT NO. | LOCATION NO.

SEE SHEET CT1
DATE
P.E. STAMP BOX

PARSONS
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Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PLAN

PLAN REF NO DR05

SHEET 84 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	ROADWAY EXCAVATION INCL. HAUL - AREA SWALE C.Y.	GRATE INLET TYPE 2 EACH	QUARRY SPALLS TON	DRAIN PIPE 6 IN. DIAM. L.F.	DRAIN PIPE 8 IN. DIAM. L.F.		CATCH BASIN TYPE 2 48 IN. DIAM. W/ CAGE EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR & CAGE EACH	CATCH BASIN TYPE 2 96 IN. DIAM. W/FLOW SPLITTER EACH	CATCH BASIN TYPE 1 EACH		CATCH BASIN TYPE 2 48 IN. DIAM. EACH	CATCH BASIN TYPE 2 54 IN. DIAM. EACH	CATCH BASIN TYPE 2 60 IN. DIAM. EACH	SEE GENERAL NOTES
DR01-1	A LINE 255+78.0 (79.6 RT) TO A LINE 256+08.0 (85.9 RT)																
DR01-2	A LINE 256+08.0 (85.9 RT) TO A LINE 256+70.0 (93.6 RT)													1			2, 6
DR01-3	A LINE 256+70.0 (93.6 RT) TO A LINE 257+74.0 (93.9 RT)													1			2, 5
DR01-4	A LINE 258+70.0 (93.8 RT) TO A LINE 259+04.0 (97.9 RT)																2, 5, 14
DR01-5	A LINE 259+04.0 (97.9 RT) TO A LINE 259+48.0 (95.2 RT)													1			2, 5, 14
DR01-6	A LINE 256+31.0 (42.7 RT) TO A LINE 257+80.0 (42.8 RT)											1					1, 5
DR01-7	A LINE 257+80.0 (42.8 RT) TO A LINE 258+25.0 (42.8 RT)											1					1, 5
DR01-8	A LINE 259+32.0 (42.8 RT) TO A LINE 260+81.0 (42.8 RT)											1					1, 5
DR01-9	E LINE 12+45.0 (10.9 RT) TO E LINE 13+93.0 (10.9 RT)											1					1, 5
DR01-10	E LINE 13+93.0 (10.9 RT) TO E LINE 15+42.0 (10.9 RT)											1					1, 5
DR01-11	E LINE 11+03.0 (10.9 RT) TO E LINE 256+08.0 (85.9 RT)											1					1, 5
DR01-12	A LINE 257+74.0 (93.9 RT) TO A LINE 258+70.0 (93.8 RT)													1			2, 5
DR01-13	A LINE 259+42.0 (41.6 LT) TO A LINE 260+91.0 (40.9 LT)														1		2, 6
DR01-14	A LINE 257+94.0 (43.2 LT) TO A LINE 259+42.0 (41.6 LT)																
DR01-15	A LINE 258+25.0 (42.8 RT) TO A LINE 259+32.0 (42.8 RT)											1					1, 5
DR01-16	A LINE 259+48.0 (95.2 RT) TO A LINE 259+71.0 (93.9 RT)													1			1, 5
DR02-1	A LINE 260+91.0 (40.9 LT) TO A LINE 262+41.0 (40.2 LT)														1		2, 6
DR02-2	A LINE 262+41.0 (40.2 LT) TO A LINE 263+08.0 (40.3 LT)														1		2, 6
DR02-3	A LINE 263+08.0 (40.3 LT) TO A LINE 263+52.0 (51.5 LT)														1		2, 6
DR02-4	A LINE 264+01.0 (49.1 LT) TO A LINE 265+35.0 (39.8 LT)																2, 6
DR02-5	A LINE 265+35.0 (39.8 LT) TO A LINE 265+95.0 (97.9 LT)																2, 5
DR02-6	A LINE 265+95.0 (97.9 LT) TO A LINE 265+76.0 (140.8 LT)			38													2, 6, 8
DR02-7	A LINE 263+09.0 (56.0 LT) TO A LINE 263+08.0 (40.3 LT)							1						1			2, 5
DR02-8	B LINE 122+97.0 (30.2 RT) TO B LINE 122+88.0 (30.0 RT)		1														3, 7
DR02-9	A LINE 262+69.0 (42.9 RT) TO A LINE 263+34.0 (42.9 RT)											1					1, 5
DR02-10	B LINE 123+98.0 (28.1 LT) TO B LINE 123+94.0 (52.7 LT)													1			2, 5
DR02-11	B LINE 123+77.0 (47.0 RT) TO B LINE 123+34.0 (34.4 RT)		1														3, 7
DR02-12	B LINE 123+34.0 (34.4 RT) TO B LINE 123+20.0 (32.3 RT)		1														3, 7
DR02-13	B LINE 123+20.0 (32.3 RT) TO B LINE 123+08.0 (30.9 RT)		1														3, 7
DR02-14	A LINE 258+19.0 (52.0 RT) TO A LINE 262+99.0 (52.0 LT)																10
DR02-15	A LINE 261+71.0 (93.9 RT) TO A LINE 262+19.0 (93.8 RT)													1			2, 6
DR02-16	A LINE 262+19.0 (93.8 RT) TO A LINE 262+94.0 (93.9 RT)															1	2, 5
DR02-17	A LINE 262+94.0 (93.9 RT) TO A LINE 263+09.0 (69.1 RT)														1		2, 5, 14
DR02-18	A LINE 263+67.0 (116.5 RT) TO A LINE 262+94.0 (93.9 RT)													1			2, 5
DR02-19	A LINE 265+92.0 (191.5 RT) TO A LINE 264+51.0 (144.5 RT)											1					1, 5
	SHEET TOTAL		4	38				1				9		9	5	1	

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

1. SEE CATCH BASIN TYPE 1 – STD PLAN B-5.20-03.
2. SEE CATCH BASIN TYPE 2 - STD PLAN B-10.20-02.
3. SEE GRATE INLET TYPE 2 - STD PLAN B-35.40-00.
4. SEE CATCH BASIN TYPE 2 54 IN. W/FLOW RESTRICTOR (FC) DETAIL, SHT. DRD05.
5. SEE RECTANGULAR VANED GRATE - STD PLAN B-30.30-03 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
6. SEE RECTANGULAR SOLID METAL COVER – STD PLAN B-30.20-04 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
7. SEE WELDED GRATES FOR GRATE INLET (GRATE A) – STD PLAN B-40.20-00.
8. SEE OUTFALL PROTECTION DETAIL, SHT. DRD02.
9. SEE WALLED DETENTION POND DETAIL, SHT. DRD05 AND SHT. DRD06.
10. SEE SPECIAL PROVISION 7-01 "MEDIA FILTER DRAIN". SEE DIMENSION AND DETAILS ON SHT. DRD01.
11. SEE COMPOST AMENDED BIOFILTRATION SWALE DETAIL ON SHT. DRD03 AND SHT. DRD04.
12. SEE WET BIOFILTRATION SWALE DETAIL ON SHT. DRD08.

DESIGNED BY	T. HEW	10/01/21	
ENTERED BY	T. HEW	10/01/21	
CHECKED BY	C. COVINGTON	10/01/21	
PROJ. ENGR.	K. NDILE	10/01/21	
REGION ADM.	M. COTTEN	10/01/21	
		DATE	DATE

REVISION | BY

REGION NO.	STATE	FED. AID PROJ. NO.
10	WASH	
JOB NUMBER		
21A008		
CONTRACT NO.		LOCATION No.

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN01

SHEET 65 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ➢ / \ UNIT OF MEASURE ➢	CATCH BASIN TYPE 2 72 IN. DIAM.	TESTING STORM SEWER PIPE		CL. III REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 24 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 18 IN. DIAM.		CL. IV REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 42 IN. DIAM.	CL. V REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 18 IN. DIAM.		SEE GENERAL NOTES
		EACH	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		
DR01-1	A LINE 255+78.0 (79.6 RT) TO A LINE 256+08.0 (85.9 RT)		35						35								
DR01-2	A LINE 256+08.0 (85.9 RT) TO A LINE 256+70.0 (93.6 RT)		63														2, 6
DR01-3	A LINE 256+70.0 (93.6 RT) TO A LINE 257+74.0 (93.9 RT)		104														2, 5
DR01-4	A LINE 258+70.0 (93.8 RT) TO A LINE 259+04.0 (97.9 RT)	1	34														2, 5, 14
DR01-5	A LINE 259+04.0 (97.9 RT) TO A LINE 259+48.0 (95.2 RT)		44														2, 5, 14
DR01-6	A LINE 256+31.0 (42.7 RT) TO A LINE 257+80.0 (42.8 RT)		149											149			1, 5
DR01-7	A LINE 257+80.0 (42.8 RT) TO A LINE 258+25.0 (42.8 RT)		45											45			1, 5
DR01-8	A LINE 259+32.0 (42.8 RT) TO A LINE 260+81.0 (42.8 RT)		149		149												1, 5
DR01-9	E LINE 12+45.0 (10.9 RT) TO E LINE 13+93.0 (10.9 RT)		148											148			1, 5
DR01-10	E LINE 13+93.0 (10.9 RT) TO E LINE 15+42.0 (10.9 RT)		149											149			1, 5
DR01-11	E LINE 11+03.0 (10.9 RT) TO E LINE 256+08.0 (85.9 RT)		13											13			1, 5
DR01-12	A LINE 257+74.0 (93.9 RT) TO A LINE 258+70.0 (93.8 RT)		96														2, 5
DR01-13	A LINE 259+42.0 (41.6 LT) TO A LINE 260+91.0 (40.9 LT)		150								150						2, 6
DR01-14	A LINE 257+94.0 (43.2 LT) TO A LINE 259+42.0 (41.6 LT)		150														
DR01-15	A LINE 258+25.0 (42.8 RT) TO A LINE 259+32.0 (42.8 RT)		107											107			1, 5
DR01-16	A LINE 259+48.0 (95.2 RT) TO A LINE 259+71.0 (93.9 RT)		24														1, 5
DR02-1	A LINE 260+91.0 (40.9 LT) TO A LINE 262+41.0 (40.2 LT)		150								150						2, 6
DR02-2	A LINE 262+41.0 (40.2 LT) TO A LINE 263+08.0 (40.3 LT)		67								67						2, 6
DR02-3	A LINE 263+08.0 (40.3 LT) TO A LINE 263+52.0 (51.5 LT)		45								45						2, 6
DR02-4	A LINE 264+01.0 (49.1 LT) TO A LINE 265+35.0 (39.8 LT)	1	135									135					2, 6
DR02-5	A LINE 265+35.0 (39.8 LT) TO A LINE 265+95.0 (97.9 LT)	1	84														2, 5
DR02-6	A LINE 265+95.0 (97.9 LT) TO A LINE 265+76.0 (140.8 LT)	1	49														2, 6, 8
DR02-7	A LINE 263+09.0 (56.0 LT) TO A LINE 263+08.0 (40.3 LT)		18														2, 5
DR02-8	B LINE 122+97.0 (30.2 RT) TO B LINE 122+88.0 (30.0 RT)		8		8												3, 7
DR02-9	A LINE 262+69.0 (42.9 RT) TO A LINE 263+34.0 (42.9 RT)		65											65			1, 5
DR02-10	B LINE 123+98.0 (28.1 LT) TO B LINE 123+94.0 (52.7 LT)		24											24			2, 5
DR02-11	B LINE 123+77.0 (47.0 RT) TO B LINE 123+34.0 (34.4 RT)		45		45												3, 7
DR02-12	B LINE 123+34.0 (34.4 RT) TO B LINE 123+20.0 (32.3 RT)		13		13												3, 7
DR02-13	B LINE 123+20.0 (32.3 RT) TO B LINE 123+08.0 (30.9 RT)		12		12												3, 7
DR02-14	A LINE 258+19.0 (52.0 RT) TO A LINE 262+99.0 (52.0 LT)																10
DR02-15	A LINE 261+71.0 (93.9 RT) TO A LINE 262+19.0 (93.8 RT)		48														2, 6
DR02-16	A LINE 262+19.0 (93.8 RT) TO A LINE 262+94.0 (93.9 RT)		75														2, 5
DR02-17	A LINE 262+94.0 (93.9 RT) TO A LINE 263+09.0 (69.1 RT)		29				29										2, 5, 14
DR02-18	A LINE 263+67.0 (116.5 RT) TO A LINE 262+94.0 (93.9 RT)		77												77		2, 5
DR02-19	A LINE 265+92.0 (191.5 RT) TO A LINE 264+51.0 (144.5 RT)		149						149								1, 5
	SHEET TOTAL	4	2553		227		29		184		412	135		700	77		

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

13. SEE DETENTION POND MAINTENANCE ACCESS ON SHT. DRD02 AND SHT. DRD07.
14. CONNECT EXISTING STORM DRAIN PIPE TO NEW DRAINAGE STRUCTURE. REFER TO SPECIAL PROVISION 7-05.
15. SEE CULVERT EXTENSION PIPE DETAIL ON SHT. DRD03.
16. SEE FLOW SPLITTER DETAIL ON SHT. DRD08.

DESIGNED BY	T. HEW	10/01/21		REGION NO.	STATE
ENTERED BY	T. HEW	10/01/21		10	WASH
CHECKED BY	C. COVINGTON	10/01/21		JOB NUMBER	
PROJ. ENGR.	K. NDILE	10/01/21		21A008	
REGION ADM.	M. COTTEN	10/01/21		CONTRACT NO.	
		DATE	DATE	REVISION	BY

FED. AID PROJ. NO.

LOCATION No.

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN02

SHEET 66 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	SCHEDULE A STORM SEWER PIPE 24 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 30 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 42 IN. DIAM. L.F.	STRUCTURE EXCAVATION CLASS B INCL. HAUL L.F.	SHORING OR EXTRA EXCAVATION CLASS B C.Y.		CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION S.F.	MEDIA FILTER DRAIN S.Y.	BIOFILTRATION SWALE LEVEL SPREADER AND DIVIDER L.F.	CONNECTION TO DRAINAGE STRUCTURE L.F.						SEE GENERAL NOTES
DR01-1	A LINE 255+78.0 (79.6 RT) TO A LINE 256+08.0 (85.9 RT)				20	150					1						
DR01-2	A LINE 256+08.0 (85.9 RT) TO A LINE 256+70.0 (93.6 RT)	63			70	380											2, 6
DR01-3	A LINE 256+70.0 (93.6 RT) TO A LINE 257+74.0 (93.9 RT)	104			110	620											2, 5
DR01-4	A LINE 258+70.0 (93.8 RT) TO A LINE 259+04.0 (97.9 RT)	34			50	230											2, 5, 14
DR01-5	A LINE 259+04.0 (97.9 RT) TO A LINE 259+48.0 (95.2 RT)	44			50	270											2, 5, 14
DR01-6	A LINE 256+31.0 (42.7 RT) TO A LINE 257+80.0 (42.8 RT)				100	750											1, 5
DR01-7	A LINE 257+80.0 (42.8 RT) TO A LINE 258+25.0 (42.8 RT)				40	240											1, 5
DR01-8	A LINE 259+32.0 (42.8 RT) TO A LINE 260+81.0 (42.8 RT)				100	700											1, 5
DR01-9	E LINE 12+45.0 (10.9 RT) TO E LINE 13+93.0 (10.9 RT)				90	660											1, 5
DR01-10	E LINE 13+93.0 (10.9 RT) TO E LINE 15+42.0 (10.9 RT)				80	610											1, 5
DR01-11	E LINE 11+03.0 (10.9 RT) TO E LINE 256+08.0 (85.9 RT)				10	60											1, 5
DR01-12	A LINE 257+74.0 (93.9 RT) TO A LINE 258+70.0 (93.8 RT)	96			100	580											2, 5
DR01-13	A LINE 259+42.0 (41.6 LT) TO A LINE 260+91.0 (40.9 LT)				230	1130											2, 6
DR01-14	A LINE 257+94.0 (43.2 LT) TO A LINE 259+42.0 (41.6 LT)	150			150	880					1						
DR01-15	A LINE 258+25.0 (42.8 RT) TO A LINE 259+32.0 (42.8 RT)				70	530											1, 5
DR01-16	A LINE 259+48.0 (95.2 RT) TO A LINE 259+71.0 (93.9 RT)	24			30	170											1, 5
DR02-1	A LINE 260+91.0 (40.9 LT) TO A LINE 262+41.0 (40.2 LT)				190	950											2, 6
DR02-2	A LINE 262+41.0 (40.2 LT) TO A LINE 263+08.0 (40.3 LT)				90	440											2, 6
DR02-3	A LINE 263+08.0 (40.3 LT) TO A LINE 263+52.0 (51.5 LT)				60	290											2, 6
DR02-4	A LINE 264+01.0 (49.1 LT) TO A LINE 265+35.0 (39.8 LT)				260	1020											2, 6
DR02-5	A LINE 265+35.0 (39.8 LT) TO A LINE 265+95.0 (97.9 LT)			84	180	680											2, 5
DR02-6	A LINE 265+95.0 (97.9 LT) TO A LINE 265+76.0 (140.8 LT)			49	80	280											2, 6, 8
DR02-7	A LINE 263+09.0 (56.0 LT) TO A LINE 263+08.0 (40.3 LT)	18			20	100											2, 5
DR02-8	B LINE 122+97.0 (30.2 RT) TO B LINE 122+88.0 (30.0 RT)				10	50											3, 7
DR02-9	A LINE 262+69.0 (42.9 RT) TO A LINE 263+34.0 (42.9 RT)				50	340											1, 5
DR02-10	B LINE 123+98.0 (28.1 LT) TO B LINE 123+94.0 (52.7 LT)				40	230											2, 5
DR02-11	B LINE 123+77.0 (47.0 RT) TO B LINE 123+34.0 (34.4 RT)				30	190											3, 7
DR02-12	B LINE 123+34.0 (34.4 RT) TO B LINE 123+20.0 (32.3 RT)				20	70											3, 7
DR02-13	B LINE 123+20.0 (32.3 RT) TO B LINE 123+08.0 (30.9 RT)				10	60											3, 7
DR02-14	A LINE 258+19.0 (52.0 RT) TO A LINE 262+99.0 (52.0 LT)								480								10
DR02-15	A LINE 261+71.0 (93.9 RT) TO A LINE 262+19.0 (93.8 RT)	48			60	300											2, 6
DR02-16	A LINE 262+19.0 (93.8 RT) TO A LINE 262+94.0 (93.9 RT)		75		110	530											2, 5
DR02-17	A LINE 262+94.0 (93.9 RT) TO A LINE 263+09.0 (69.1 RT)				40	200											2, 5, 14
DR02-18	A LINE 263+67.0 (116.5 RT) TO A LINE 262+94.0 (93.9 RT)				80	560											2, 5
DR02-19	A LINE 265+92.0 (191.5 RT) TO A LINE 264+51.0 (144.5 RT)				110	780											1, 5
	SHEET TOTAL	581	75	133	2740	15030			480		2						

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

DESIGNED BY	T. HEW	10/01/21		
ENTERED BY	T. HEW	10/01/21		
CHECKED BY	C. COVINGTON	10/01/21		
PROJ. ENGR.	K. NDILE	10/01/21		
REGION ADM.	M. COTTEN	10/01/21		
		DATE	**DATE**	**REVISION**

BY	**REGION NO.**	**STATE**	**FED. AID PROJ. NO.**
	10	WASH	
	JOB NUMBER		
	21A008		
	CONTRACT NO.		**LOCATION No.**

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN03

SHEET 67 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	ROADWAY EXCAVATION INCL. HAUL - AREA SWALE C.Y.	GRATE INLET TYPE 2 EACH	QUARRY SPALLS TON	DRAIN PIPE 6 IN. DIAM. L.F.	DRAIN PIPE 8 IN. DIAM. L.F.		CATCH BASIN TYPE 2 48 IN. DIAM. W/ CAGE EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR & CAGE EACH	CATCH BASIN TYPE 2 96 IN. DIAM. W/FLOW SPLITTER EACH	CATCH BASIN TYPE 1 EACH		CATCH BASIN TYPE 2 48 IN. DIAM. EACH	CATCH BASIN TYPE 2 54 IN. DIAM. EACH	CATCH BASIN TYPE 2 60 IN. DIAM. EACH	SEE GENERAL NOTES
DR02-20	E LINE 15+42.0 (10.9 RT) TO E LINE 16+46.0 (10.9 RT)											1					1, 5
DR02-21	E LINE 16+46.0 (10.9 RT) TO E LINE 261+48.0 (93.9 RT)											1					1, 5
DR02-22	A LINE 260+81.0 (42.8 RT) TO A LINE 261+76.0 (43.0 RT)											1					1, 5
DR02-23	NOT USED																
DR02-24	A LINE 261+76.0 (43.0 RT) TO A LINE 262+70.0 (72.5 RT)											1					1, 5, 14
DR02-25	A LINE 264+51.0 (144.5 RT) TO A LINE 263+67.0 (116.5 RT)													1			2, 5, 14
DR02-26	A LINE 260+63.0 (93.8 RT) TO A LINE 261+48.0 (93.9 RT)													1			2, 5
DR02-27	A LINE 263+09.0 (69.1 RT) TO A LINE 263+34.0 (42.9 RT)														1		2, 6
DR02-28	F LINE 72+45.0 (13.4 RT) TO F LINE 72+45.0 (25.9 RT)											1					1, 5
DR02-29	F LINE 72+45.0 (25.9 RT) TO F LINE 266+65.0 (158.8 RT)											1					1, 5
DR02-30	A LINE 266+65.0 (158.8 RT) TO A LINE 266+34.0 (112.8 RT)											1					1, 5
DR02-31	A LINE 266+11.0 (130.1 RT) TO A LINE 266+08.0 (141.3 RT)													1			2, 6
DR02-32	A LINE 265+52.0 (67.7 RT) TO A LINE 264+61.0 (64.8 RT)											1					1, 5
DR02-33	A LINE 265+62.0 (44.1 LT) TO A LINE 265+81.0 (55.6 LT)		1														3, 7
DR02-34	A LINE 263+34.0 (42.9 RT) TO A LINE 263+63.0 (43.6 RT)															1	2, 5
DR02-35	A LINE 263+63.0 (43.6 RT) TO A LINE 264+00.0 (50.0 RT)														1		2, 5
DR02-36	A LINE 264+46.0 (38.2 RT) TO A LINE 265+34.0 (30.8 RT)											1					1, 5
DR02-37	A LINE 265+34.0 (30.8 RT) TO A LINE 265+35.0 (39.8 LT)													1			2, 5
DR02-38	A LINE 265+79.0 (40.6 RT) TO A LINE 265+56.0 (31.4 RT)											1					1, 5
DR02-39	A LINE 265+62.0 (99.6 RT) TO A LINE 265+81.0 (55.6 LT)									1							2, 4, 5
DR02-40	F LINE 70+61.0 (53.1 RT) TO F LINE 70+77.0 (45.4 RT)											1					1, 5
DR02-41	F LINE 70+90.0 (40.5 RT) TO F LINE 266+34.0 (112.8 RT)		1														3, 7
DR02-42	F LINE 71+06.0 (36.5 RT) TO F LINE 70+90.0 (40.5 RT)											1					1, 5
DR02-43	F LINE 72+08.0 (13.5 LT) TO G LINE 10+50.0 (15.6 RT)											1					1, 5
DR02-44	G LINE 10+50.0 (15.6 RT) TO G LINE 10+70.0 (33.6 LT)		1														3, 7
DR02-45	G LINE 10+70.0 (33.6 LT) TO G LINE 10+89.0 (52.4 LT)			8								1					1, 5, 8
DR02-46	A LINE 269+51.0 (30.7 RT) TO A LINE 268+85.0 (32.5 RT)											1					1, 5
DR02-47	A LINE 268+10.6 (69.6 RT)A LINE 268+10.0 (65.5 RT)																
DR02-48	A LINE 268+10.0 (65.5 RT) TO A LINE 268+25.0 (62.7 RT)								1						1		2, 4, 5, 8
DR02-49	A LINE 268+25.0 (62.7 RT) TO A LINE 268+35.5 (39.1 RT)							1									2, 5
DR02-50	A LINE 268+35.5 (39.1 RT) TO A LINE 268+35.0 (34.6 LT)													1			2, 6
DR02-51	A LINE 268+35.0 (34.6 LT) TO A LINE 268+35.0 (58.2 LT)													1			12
DR02-52	A LINE 268+35.0 (58.2 LT) TO A LINE 269+22.6 (47.4 LT)													1			2, 5, 14
DR02-53	A LINE 269+23.0 (47.4 LT) TO A LINE 269+29.0 (58.2 LT)			8							1						2, 5, 8, 16
DR02-54	A LINE 268+85.0 (32.5 RT) TO A LINE 268+79.0 (59.2 RT)			8								1					1, 5, 8
	SHEET TOTAL		3	24				1	1	1	1	16		7	3	1	

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

1. SEE CATCH BASIN TYPE 1 – STD PLAN B-5.20-03.
2. SEE CATCH BASIN TYPE 2 - STD PLAN B-10.20-02.
3. SEE GRATE INLET TYPE 2 - STD PLAN B-35.40-00.
4. SEE CATCH BASIN TYPE 2 54 IN. W/FLOW RESTRICTOR (FC) DETAIL, SHT. DRD05.
5. SEE RECTANGULAR VANED GRATE - STD PLAN B-30.30-03 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
6. SEE RECTANGULAR SOLID METAL COVER – STD PLAN B-30.20-04 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
7. SEE WELDED GRATES FOR GRATE INLET (GRATE A) – STD PLAN B-40.20-00.
8. SEE OUTFALL PROTECTION DETAIL, SHT. DRD02.
9. SEE WALLED DETENTION POND DETAIL, SHT. DRD05 AND SHT. DRD06.
10. SEE SPECIAL PROVISION 7-01 "MEDIA FILTER DRAIN". SEE DIMENSION AND DETAILS ON SHT. DRD01.
11. SEE COMPOST AMENDED BIOFILTRATION SWALE DETAIL ON SHT. DRD03 AND SHT. DRD04.
12. SEE WET BIOFILTRATION SWALE DETAIL ON SHT. DRD08.

DESIGNED BY	T. HEW	10/01/21	
ENTERED BY	T. HEW	10/01/21	
CHECKED BY	C. COVINGTON	10/01/21	
PROJ. ENGR.	K. NDILE	10/01/21	
REGION ADM.	M. COTTEN	10/01/21	
		DATE	DATE

REVISION | BY

REGION NO.	STATE
10	WASH

JOB NUMBER 21A008

CONTRACT NO.

FED. AID PROJ. NO.

LOCATION No.

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN04

SHEET 68 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	CATCH BASIN TYPE 2 72 IN. DIAM.	TESTING STORM SEWER PIPE		CL. III REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 24 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 18 IN. DIAM.		CL. IV REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 42 IN. DIAM.	CL. V REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 18 IN. DIAM.		SEE GENERAL NOTES
		EACH	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		
DR02-20	E LINE 15+42.0 (10.9 RT) TO E LINE 16+46.0 (10.9 RT)		103		103												1, 5
DR02-21	E LINE 16+46.0 (10.9 RT) TO E LINE 261+48.0 (93.9 RT)		22		22												1, 5
DR02-22	A LINE 260+81.0 (42.8 RT) TO A LINE 261+76.0 (43.0 RT)		95					95									1, 5
DR02-23	NOT USED																
DR02-24	A LINE 261+76.0 (43.0 RT) TO A LINE 262+70.0 (72.5 RT)		98					98									1, 5, 14
DR02-25	A LINE 264+51.0 (144.5 RT) TO A LINE 263+67.0 (116.5 RT)		89												89		2, 5, 14
DR02-26	A LINE 260+63.0 (93.8 RT) TO A LINE 261+48.0 (93.9 RT)		85														2, 5
DR02-27	A LINE 263+09.0 (69.1 RT) TO A LINE 263+34.0 (42.9 RT)		36				36										2, 6
DR02-28	F LINE 72+45.0 (13.4 RT) TO F LINE 72+45.0 (25.9 RT)		40											40			1, 5
DR02-29	F LINE 72+45.0 (25.9 RT) TO F LINE 266+65.0 (158.8 RT)		71											71			1, 5
DR02-30	A LINE 266+65.0 (158.8 RT) TO A LINE 266+34.0 (112.8 RT)		55											55			1, 5
DR02-31	A LINE 266+11.0 (130.1 RT) TO A LINE 266+08.0 (141.3 RT)		13											13			2, 6
DR02-32	A LINE 265+52.0 (67.7 RT) TO A LINE 264+61.0 (64.8 RT)		91											91			1, 5
DR02-33	A LINE 265+62.0 (44.1 LT) TO A LINE 265+81.0 (55.6 LT)		22											22			3, 7
DR02-34	A LINE 263+34.0 (42.9 RT) TO A LINE 263+63.0 (43.6 RT)		29								29						2, 5
DR02-35	A LINE 263+63.0 (43.6 RT) TO A LINE 264+00.0 (50.0 RT)		38								38						2, 5
DR02-36	A LINE 264+46.0 (38.2 RT) TO A LINE 265+34.0 (30.8 RT)		88											88			1, 5
DR02-37	A LINE 265+34.0 (30.8 RT) TO A LINE 265+35.0 (39.8 LT)		71											71			2, 5
DR02-38	A LINE 265+79.0 (40.6 RT) TO A LINE 265+56.0 (31.4 RT)		25											25			1, 5
DR02-39	A LINE 265+62.0 (99.6 RT) TO A LINE 265+81.0 (55.6 LT)		156											156			2, 4, 5
DR02-40	F LINE 70+61.0 (53.1 RT) TO F LINE 70+77.0 (45.4 RT)		17											17			1, 5
DR02-41	F LINE 70+90.0 (40.5 RT) TO F LINE 266+34.0 (112.8 RT)		22											22			3, 7
DR02-42	F LINE 71+06.0 (36.5 RT) TO F LINE 70+90.0 (40.5 RT)		16											16			1, 5
DR02-43	F LINE 72+08.0 (13.5 LT) TO G LINE 10+50.0 (15.6 RT)		45											45			1, 5
DR02-44	G LINE 10+50.0 (15.6 RT) TO G LINE 10+70.0 (33.6 LT)		52											52			3, 7
DR02-45	G LINE 10+70.0 (33.6 LT) TO G LINE 10+89.0 (52.4 LT)		28											28			1, 5, 8
DR02-46	A LINE 269+51.0 (30.7 RT) TO A LINE 268+85.0 (32.5 RT)		66		66												1, 5
DR02-47	A LINE 268+10.6 (69.6 RT)A LINE 268+10.0 (65.5 RT)		5											5			
DR02-48	A LINE 268+10.0 (65.5 RT) TO A LINE 268+25.0 (62.7 RT)		15											15			2, 4, 5, 8
DR02-49	A LINE 268+25.0 (62.7 RT) TO A LINE 268+35.5 (39.1 RT)		28											28			2, 5
DR02-50	A LINE 268+35.5 (39.1 RT) TO A LINE 268+35.0 (34.6 LT)		74											74			2, 6
DR02-51	A LINE 268+35.0 (34.6 LT) TO A LINE 268+35.0 (58.2 LT)		24											24			12
DR02-52	A LINE 268+35.0 (58.2 LT) TO A LINE 269+22.6 (47.4 LT)		88											88			2, 5, 14
DR02-53	A LINE 269+23.0 (47.4 LT) TO A LINE 269+29.0 (58.2 LT)		18											18			2, 5, 8, 16
DR02-54	A LINE 268+85.0 (32.5 RT) TO A LINE 268+79.0 (59.2 RT)		28		28												1, 5, 8
	SHEET TOTAL		1753		219		36	193			67			1064	89		

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

13. SEE DETENTION POND MAINTENANCE ACCESS ON SHT. DRD02 AND SHT. DRD07.
14. CONNECT EXISTING STORM DRAIN PIPE TO NEW DRAINAGE STRUCTURE. REFER TO SPECIAL PROVISION 7-05.
15. SEE CULVERT EXTENSION PIPE DETAIL ON SHT. DRD03.
16. SEE FLOW SPLITTER DETAIL ON SHT. DRD08.

					REGION NO.	STATE	FED. AID PROJ. NO.
					10	WASH	
DESIGNED BY	T. HEW	10/01/21			JOB NUMBER		
ENTERED BY	T. HEW	10/01/21			21A008		
CHECKED BY	C. COVINGTON	10/01/21			CONTRACT NO.		LOCATION No.
PROJ. ENGR.	K. NDILE	10/01/21					
REGION ADM.	M. COTTEN	10/01/21					
		DATE	DATE	REVISION	BY		

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN05

SHEET 69 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	SCHEDULE A STORM SEWER PIPE 24 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 30 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 42 IN. DIAM. L.F.	STRUCTURE EXCAVATION CLASS B INCL. HAUL L.F.	SHORING OR EXTRA EXCAVATION CLASS B C.Y.		CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION S.F.	MEDIA FILTER DRAIN S.Y.	BIOFILTRATION SWALE LEVEL SPREADER AND DIVIDER L.F.	CONNECTION TO DRAINAGE STRUCTURE L.F.						SEE GENERAL NOTES
DR02-20	E LINE 15+42.0 (10.9 RT) TO E LINE 16+46.0 (10.9 RT)				60	410											1, 5
DR02-21	E LINE 16+46.0 (10.9 RT) TO E LINE 261+48.0 (93.9 RT)				20	110											1, 5
DR02-22	A LINE 260+81.0 (42.8 RT) TO A LINE 261+76.0 (43.0 RT)				60	400											1, 5
DR02-23	NOT USED																
DR02-24	A LINE 261+76.0 (43.0 RT) TO A LINE 262+70.0 (72.5 RT)				70	480											1, 5, 14
DR02-25	A LINE 264+51.0 (144.5 RT) TO A LINE 263+67.0 (116.5 RT)				100	640											2, 5, 14
DR02-26	A LINE 260+63.0 (93.8 RT) TO A LINE 261+48.0 (93.9 RT)	85			90	520											2, 5
DR02-27	A LINE 263+09.0 (69.1 RT) TO A LINE 263+34.0 (42.9 RT)				60	270											2, 6
DR02-28	F LINE 72+45.0 (13.4 RT) TO F LINE 72+45.0 (25.9 RT)				30	200											1, 5
DR02-29	F LINE 72+45.0 (25.9 RT) TO F LINE 266+65.0 (158.8 RT)				50	360											1, 5
DR02-30	A LINE 266+65.0 (158.8 RT) TO A LINE 266+34.0 (112.8 RT)				40	290											1, 5
DR02-31	A LINE 266+11.0 (130.1 RT) TO A LINE 266+08.0 (141.3 RT)				20	110											2, 6
DR02-32	A LINE 265+52.0 (67.7 RT) TO A LINE 264+61.0 (64.8 RT)				60	450											1, 5
DR02-33	A LINE 265+62.0 (44.1 LT) TO A LINE 265+81.0 (55.6 LT)				20	120											3, 7
DR02-34	A LINE 263+34.0 (42.9 RT) TO A LINE 263+63.0 (43.6 RT)				40	190											2, 5
DR02-35	A LINE 263+63.0 (43.6 RT) TO A LINE 264+00.0 (50.0 RT)				50	240											2, 5
DR02-36	A LINE 264+46.0 (38.2 RT) TO A LINE 265+34.0 (30.8 RT)				60	450											1, 5
DR02-37	A LINE 265+34.0 (30.8 RT) TO A LINE 265+35.0 (39.8 LT)				60	400											2, 5
DR02-38	A LINE 265+79.0 (40.6 RT) TO A LINE 265+56.0 (31.4 RT)				20	120											1, 5
DR02-39	A LINE 265+62.0 (99.6 RT) TO A LINE 265+81.0 (55.6 LT)				160	1190											2, 4, 5
DR02-40	F LINE 70+61.0 (53.1 RT) TO F LINE 70+77.0 (45.4 RT)				20	90											1, 5
DR02-41	F LINE 70+90.0 (40.5 RT) TO F LINE 266+34.0 (112.8 RT)				20	130											3, 7
DR02-42	F LINE 71+06.0 (36.5 RT) TO F LINE 70+90.0 (40.5 RT)				20	90											1, 5
DR02-43	F LINE 72+08.0 (13.5 LT) TO G LINE 10+50.0 (15.6 RT)				40	240											1, 5
DR02-44	G LINE 10+50.0 (15.6 RT) TO G LINE 10+70.0 (33.6 LT)				50	300											3, 7
DR02-45	G LINE 10+70.0 (33.6 LT) TO G LINE 10+89.0 (52.4 LT)				20	110											1, 5, 8
DR02-46	A LINE 269+51.0 (30.7 RT) TO A LINE 268+85.0 (32.5 RT)				40	300											1, 5
DR02-47	A LINE 268+10.6 (69.6 RT)A LINE 268+10.0 (65.5 RT)																
DR02-48	A LINE 268+10.0 (65.5 RT) TO A LINE 268+25.0 (62.7 RT)				20	90											2, 4, 5, 8
DR02-49	A LINE 268+25.0 (62.7 RT) TO A LINE 268+35.5 (39.1 RT)				20	120											2, 5
DR02-50	A LINE 268+35.5 (39.1 RT) TO A LINE 268+35.0 (34.6 LT)				60	400											2, 6
DR02-51	A LINE 268+35.0 (34.6 LT) TO A LINE 268+35.0 (58.2 LT)				30	150											12
DR02-52	A LINE 268+35.0 (58.2 LT) TO A LINE 269+22.6 (47.4 LT)				70	510											2, 5, 14
DR02-53	A LINE 269+23.0 (47.4 LT) TO A LINE 269+29.0 (58.2 LT)				10	50											2, 5, 8, 16
DR02-54	A LINE 268+85.0 (32.5 RT) TO A LINE 268+79.0 (59.2 RT)				20	100											1, 5, 8
	SHEET TOTAL	85			1510	9630											

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

					REGION NO.	STATE	FED. AID PROJ. NO.
DESIGNED BY	T. HEW	10/01/21			10	WASH	
ENTERED BY	T. HEW	10/01/21			JOB NUMBER		
CHECKED BY	C. COVINGTON	10/01/21			21A008		
PROJ. ENGR.	K. NDILE	10/01/21			CONTRACT NO.		LOCATION No.
REGION ADM.	M. COTTEN	10/01/21					
		DATE	DATE	REVISION	BY		

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN06

SHEET 70 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	ROADWAY EXCAVATION INCL. HAUL - AREA SWALE C.Y.	GRATE INLET TYPE 2 EACH	QUARRY SPALLS TON	DRAIN PIPE 6 IN. DIAM. L.F.	DRAIN PIPE 8 IN. DIAM. L.F.		CATCH BASIN TYPE 2 48 IN. DIAM. W/ CAGE EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR & CAGE EACH	CATCH BASIN TYPE 2 96 IN. DIAM. W/FLOW SPLITTER EACH	CATCH BASIN TYPE 1 EACH		CATCH BASIN TYPE 2 48 IN. DIAM. EACH	CATCH BASIN TYPE 2 54 IN. DIAM. EACH	CATCH BASIN TYPE 2 60 IN. DIAM. EACH	SEE GENERAL NOTES
DR02-55	A LINE 267+85.0 (60.8 RT) TO A LINE 268+35.0 (58.2 LT)											1					1, 5
DR02-56	A LINE 267+31.0 (51.0 LT) TO A LINE 267+69.0 (33.2 LT)											1					1, 5
DR02-57	A LINE 267+69.0 (33.2 LT) TO A LINE 268+35.0 (34.6 LT)		1														3, 7
DR02-58	G LINE 10+87.1 (15.9 RT) TO G LINE 10+50.0 (15.6 RT)											1					1, 5
DR02-59	G LINE 11+17.8 (15.9 RT) TO G LINE 10+87.0 (15.9 RT)											1					1, 5
DR02-60	G LINE 11+27.7 (15.9 RT) TO G LINE 11+48.0 (15.9 RT)											1					1, 6
DR02-61	G LINE 12+50.0 (15.9 RT) TO G LINE 13+47.0 (15.9 RT)											1					1, 6
DR02-62	A LINE 261+48.0 (93.9 RT) TO A LINE 261+71.0 (93.9 RT)													1			2, 5
DR02-63	A LINE 264+00.0 (50.0 RT) TO A LINE 264+01.0 (49.1 LT)														1		2, 5
DR02-64	A LINE 264+57.0 (68.4 RT) TO A LINE 264+61.0 (64.8 RT)							1									2, 5
DR02-65	A LINE 264+61.0 (64.8 RT) TO A LINE 264+00.0 (50.0 RT)											1					1, 5
DR02-66	A LINE 265+59.0 (125.1 RT) TO A LINE 265+62.0 (99.6 RT)																
DR02-67	B LINE 123+08.0 (30.9 RT) TO B LINE 122+97.0 (30.2 RT)		1														3, 7
DR02-68	A LINE 265+81.0 (55.6 LT) TO A LINE 123+98.0 (28.1 LT)													1			2, 6
DR02-69	B LINE 123+94.0 (52.7 LT) TO B LINE 122+77.0 (43.5 LT)													1			2, 5
DR02-70	B LINE 122+77.0 (43.5 LT) TO B LINE 122+18.0 (40.6 LT)													1			2, 6
DR02-71	A LINE 263+52.0 (51.5 LT) TO A LINE 264+01.0 (49.1 LT)														1		2, 6
DR02-72	NOT USED																
DR02-73	A LINE 265+35.0 (133.5 RT)																9, 13
DR02-74	A LINE 265+56.0 (31.4 RT) TO A LINE 265+34.0 (30.8 RT)											1					1, 5
DR02-75	A LINE 266+34.0 (112.8 RT) TO A LINE 266+11.0 (130.1 RT)											1					1, 5
DR02-76	A LINE 263+31.0 (73.1 RT) TO A LINE 264+43.0 (103.8 RT)	90		16													11
DR02-77	NOT USED																
DR02-78	A LINE 264+43.0 (103.8 RT) TO A LINE 264+62.0 (109.8 RT)																
DR02-79	A LINE 268+04.0 (83.5 RT)																13
DR02-80	A LINE 259+71.0 (93.9 RT) TO A LINE 260+63.0 (93.8 RT)														1		2, 5
DR02-81	B LINE 122+88.0 (30.0 RT) TO B LINE 122+51.0 (30.0 RT)		1														3, 7
DR02-82	F LINE 70+77.0 (45.4 RT) TO F LINE 70+90.0 (40.5 RT)		1														3, 7
DR02-83	A LINE 269+22.6 (47.4 LT) TO A LINE 270+66.9 (35.3 LT)																
DR02-84	A LINE 263+51.0 (44.6 LT) TO A LINE 263+52.0 (51.5 LT)		1														3, 7
DR02-85	B LINE 122+51.0 (30.0 RT) TO B LINE 122+18.0 (30.0 RT)		1														3, 7
DR02-86	G LINE 11+48.0 (27.4 RT) TO G LINE 11+48.0 (15.9 RT)											1					1, 5
DR02-87	G LINE 11+48.0 (15.9 RT) TO G LINE 12+50.0 (15.9 RT)											1					1, 6
DR02-88	A LINE 262+70.0 (72.5 RT) TO A LINE 263+31.0 (73.1 RT)																
DR03-1	G LINE 16+16.3 (15.0 LT) TO G LINE 16+14.6 (36.9 RT)											1					1, 5
	SHEET TOTAL	90	6	16				1				12		4	3		

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

1. SEE CATCH BASIN TYPE 1 – STD PLAN B-5.20-03.
2. SEE CATCH BASIN TYPE 2 - STD PLAN B-10.20-02.
3. SEE GRATE INLET TYPE 2 - STD PLAN B-35.40-00.
4. SEE CATCH BASIN TYPE 2 54 IN. W/FLOW RESTRICTOR (FC) DETAIL, SHT. DRD05.
5. SEE RECTANGULAR VANED GRATE - STD PLAN B-30.30-03 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
6. SEE RECTANGULAR SOLID METAL COVER – STD PLAN B-30.20-04 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
7. SEE WELDED GRATES FOR GRATE INLET (GRATE A) – STD PLAN B-40.20-00.
8. SEE OUTFALL PROTECTION DETAIL, SHT. DRD02.
9. SEE WALLED DETENTION POND DETAIL, SHT. DRD05 AND SHT. DRD06.
10. SEE SPECIAL PROVISION 7-01 "MEDIA FILTER DRAIN". SEE DIMENSION AND DETAILS ON SHT. DRD01.
11. SEE COMPOST AMENDED BIOFILTRATION SWALE DETAIL ON SHT. DRD03 AND SHT. DRD04.
12. SEE WET BIOFILTRATION SWALE DETAIL ON SHT. DRD08.

DESIGNED BY	T. HEW	10/01/21	
ENTERED BY	T. HEW	10/01/21	
CHECKED BY	C. COVINGTON	10/01/21	
PROJ. ENGR.	K. NDILE	10/01/21	
REGION ADM.	M. COTTEN	10/01/21	
		DATE	DATE

REVISION | BY

REGION NO.	STATE
10	WASH

JOB NUMBER 21A008

CONTRACT NO.

FED. AID PROJ. NO.

LOCATION No.

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN07

SHEET 71 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	CATCH BASIN TYPE 2 72 IN. DIAM.	TESTING STORM SEWER PIPE		CL. III REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 24 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 18 IN. DIAM.		CL. IV REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 42 IN. DIAM.	CL. V REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 18 IN. DIAM.		SEE GENERAL NOTES
		EACH	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		
DR02-55	A LINE 267+85.0 (60.8 RT) TO A LINE 268+35.0 (58.2 LT)		50		50												1, 5
DR02-56	A LINE 267+31.0 (51.0 LT) TO A LINE 267+69.0 (33.2 LT)		42		42												1, 5
DR02-57	A LINE 267+69.0 (33.2 LT) TO A LINE 268+35.0 (34.6 LT)		66		66												3, 7
DR02-58	G LINE 10+87.1 (15.9 RT) TO G LINE 10+50.0 (15.6 RT)		41											41			1, 5
DR02-59	G LINE 11+17.8 (15.9 RT) TO G LINE 10+87.0 (15.9 RT)		30											30			1, 5
DR02-60	G LINE 11+27.7 (15.9 RT) TO G LINE 11+48.0 (15.9 RT)		20										20				1, 6
DR02-61	G LINE 12+50.0 (15.9 RT) TO G LINE 13+47.0 (15.9 RT)		95		95												1, 6
DR02-62	A LINE 261+48.0 (93.9 RT) TO A LINE 261+71.0 (93.9 RT)		23														2, 5
DR02-63	A LINE 264+00.0 (50.0 RT) TO A LINE 264+01.0 (49.1 LT)		98								98						2, 5
DR02-64	A LINE 264+57.0 (68.4 RT) TO A LINE 264+61.0 (64.8 RT)		5											5			2, 5
DR02-65	A LINE 264+61.0 (64.8 RT) TO A LINE 264+00.0 (50.0 RT)		62											62			1, 5
DR02-66	A LINE 265+59.0 (125.1 RT) TO A LINE 265+62.0 (99.6 RT)		26											26			
DR02-67	B LINE 123+08.0 (30.9 RT) TO B LINE 122+97.0 (30.2 RT)		11		11												3, 7
DR02-68	A LINE 265+81.0 (55.6 LT) TO A LINE 123+98.0 (28.1 LT)		117											117			2, 6
DR02-69	B LINE 123+94.0 (52.7 LT) TO B LINE 122+77.0 (43.5 LT)		118											118			2, 5
DR02-70	B LINE 122+77.0 (43.5 LT) TO B LINE 122+18.0 (40.6 LT)		62											62			2, 6
DR02-71	A LINE 263+52.0 (51.5 LT) TO A LINE 264+01.0 (49.1 LT)		49				49										2, 6
DR02-72	NOT USED																
DR02-73	A LINE 265+35.0 (133.5 RT)																9, 13
DR02-74	A LINE 265+56.0 (31.4 RT) TO A LINE 265+34.0 (30.8 RT)		22											22			1, 5
DR02-75	A LINE 266+34.0 (112.8 RT) TO A LINE 266+11.0 (130.1 RT)		25											25			1, 5
DR02-76	A LINE 263+31.0 (73.1 RT) TO A LINE 264+43.0 (103.8 RT)																11
DR02-77	NOT USED																
DR02-78	A LINE 264+43.0 (103.8 RT) TO A LINE 264+62.0 (109.8 RT)		19											19			
DR02-79	A LINE 268+04.0 (83.5 RT)																13
DR02-80	A LINE 259+71.0 (93.9 RT) TO A LINE 260+63.0 (93.8 RT)		91														2, 5
DR02-81	B LINE 122+88.0 (30.0 RT) TO B LINE 122+51.0 (30.0 RT)		37					37									3, 7
DR02-82	F LINE 70+77.0 (45.4 RT) TO F LINE 70+90.0 (40.5 RT)		14											14			3, 7
DR02-83	A LINE 269+22.6 (47.4 LT) TO A LINE 270+66.9 (35.3 LT)		145											145			
DR02-84	A LINE 263+51.0 (44.6 LT) TO A LINE 263+52.0 (51.5 LT)		7					7									3, 7
DR02-85	B LINE 122+51.0 (30.0 RT) TO B LINE 122+18.0 (30.0 RT)		31					31									3, 7
DR02-86	G LINE 11+48.0 (27.4 RT) TO G LINE 11+48.0 (15.9 RT)		11					11									1, 5
DR02-87	G LINE 11+48.0 (15.9 RT) TO G LINE 12+50.0 (15.9 RT)		99										99				1, 6
DR02-88	A LINE 262+70.0 (72.5 RT) TO A LINE 263+31.0 (73.1 RT)																
DR03-1	G LINE 16+16.3 (15.0 LT) TO G LINE 16+14.6 (36.9 RT)		52											52			1, 5
	SHEET TOTAL		1468		264		49	86			98		119	738			

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

13. SEE DETENTION POND MAINTENANCE ACCESS ON SHT. DRD02 AND SHT. DRD07.
14. CONNECT EXISTING STORM DRAIN PIPE TO NEW DRAINAGE STRUCTURE. REFER TO SPECIAL PROVISION 7-05.
15. SEE CULVERT EXTENSION PIPE DETAIL ON SHT. DRD03.
16. SEE FLOW SPLITTER DETAIL ON SHT. DRD08.

					REGION NO.	STATE	FED. AID PROJ. NO.
DESIGNED BY	T. HEW	10/01/21			10	WASH	
ENTERED BY	T. HEW	10/01/21			JOB NUMBER		
CHECKED BY	C. COVINGTON	10/01/21			21A008		
PROJ. ENGR.	K. NDILE	10/01/21			CONTRACT NO.		LOCATION No.
REGION ADM.	M. COTTEN	10/01/21					
		DATE	DATE	REVISION	BY		

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN08

SHEET 72 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	SCHEDULE A STORM SEWER PIPE 24 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 30 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 42 IN. DIAM. L.F.	STRUCTURE EXCAVATION CLASS B INCL. HAUL L.F.	SHORING OR EXTRA EXCAVATION CLASS B C.Y.		CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION S.F.	MEDIA FILTER DRAIN S.Y.	BIOFILTRATION SWALE LEVEL SPREADER AND DIVIDER L.F.	CONNECTION TO DRAINAGE STRUCTURE L.F.						SEE GENERAL NOTES
DR02-55	A LINE 267+85.0 (60.8 RT) TO A LINE 268+35.0 (58.2 LT)				40	250											1, 5
DR02-56	A LINE 267+31.0 (51.0 LT) TO A LINE 267+69.0 (33.2 LT)				30	200											1, 5
DR02-57	A LINE 267+69.0 (33.2 LT) TO A LINE 268+35.0 (34.6 LT)				50	360											3, 7
DR02-58	G LINE 10+87.1 (15.9 RT) TO G LINE 10+50.0 (15.6 RT)				30	220											1, 5
DR02-59	G LINE 11+17.8 (15.9 RT) TO G LINE 10+87.0 (15.9 RT)				30	160											1, 5
DR02-60	G LINE 11+27.7 (15.9 RT) TO G LINE 11+48.0 (15.9 RT)				20	80											1, 6
DR02-61	G LINE 12+50.0 (15.9 RT) TO G LINE 13+47.0 (15.9 RT)				70	530											1, 6
DR02-62	A LINE 261+48.0 (93.9 RT) TO A LINE 261+71.0 (93.9 RT)	23			30	150											2, 5
DR02-63	A LINE 264+00.0 (50.0 RT) TO A LINE 264+01.0 (49.1 LT)				120	590											2, 5
DR02-64	A LINE 264+57.0 (68.4 RT) TO A LINE 264+61.0 (64.8 RT)				10	50											2, 5
DR02-65	A LINE 264+61.0 (64.8 RT) TO A LINE 264+00.0 (50.0 RT)				50	330											1, 5
DR02-66	A LINE 265+59.0 (125.1 RT) TO A LINE 265+62.0 (99.6 RT)				30	170											
DR02-67	B LINE 123+08.0 (30.9 RT) TO B LINE 122+97.0 (30.2 RT)				10	60											3, 7
DR02-68	A LINE 265+81.0 (55.6 LT) TO A LINE 123+98.0 (28.1 LT)				140	990											2, 6
DR02-69	B LINE 123+94.0 (52.7 LT) TO B LINE 122+77.0 (43.5 LT)				140	1040											2, 5
DR02-70	B LINE 122+77.0 (43.5 LT) TO B LINE 122+18.0 (40.6 LT)				80	550					1						2, 6
DR02-71	A LINE 263+52.0 (51.5 LT) TO A LINE 264+01.0 (49.1 LT)				70	340											2, 6
DR02-72	NOT USED																
DR02-73	A LINE 265+35.0 (133.5 RT)							550									9, 13
DR02-74	A LINE 265+56.0 (31.4 RT) TO A LINE 265+34.0 (30.8 RT)				20	120											1, 5
DR02-75	A LINE 266+34.0 (112.8 RT) TO A LINE 266+11.0 (130.1 RT)				30	170											1, 5
DR02-76	A LINE 263+31.0 (73.1 RT) TO A LINE 264+43.0 (103.8 RT)							30		16							11
DR02-77	NOT USED																
DR02-78	A LINE 264+43.0 (103.8 RT) TO A LINE 264+62.0 (109.8 RT)				10	60											
DR02-79	A LINE 268+04.0 (83.5 RT)							160									13
DR02-80	A LINE 259+71.0 (93.9 RT) TO A LINE 260+63.0 (93.8 RT)	91			110	630											2, 5
DR02-81	B LINE 122+88.0 (30.0 RT) TO B LINE 122+51.0 (30.0 RT)				30	150											3, 7
DR02-82	F LINE 70+77.0 (45.4 RT) TO F LINE 70+90.0 (40.5 RT)				20	100											3, 7
DR02-83	A LINE 269+22.6 (47.4 LT) TO A LINE 270+66.9 (35.3 LT)				120	890											
DR02-84	A LINE 263+51.0 (44.6 LT) TO A LINE 263+52.0 (51.5 LT)				10	50											3, 7
DR02-85	B LINE 122+51.0 (30.0 RT) TO B LINE 122+18.0 (30.0 RT)				20	130											3, 7
DR02-86	G LINE 11+48.0 (27.4 RT) TO G LINE 11+48.0 (15.9 RT)				10	60											1, 5
DR02-87	G LINE 11+48.0 (15.9 RT) TO G LINE 12+50.0 (15.9 RT)				50	360											1, 6
DR02-88	A LINE 262+70.0 (72.5 RT) TO A LINE 263+31.0 (73.1 RT)																
DR03-1	G LINE 16+16.3 (15.0 LT) TO G LINE 16+14.6 (36.9 RT)				50	330											1, 5
	SHEET TOTAL	114			1430	9120		740		16	1						

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

					REGION NO.	STATE	FED. AID PROJ. NO.
DESIGNED BY	T. HEW	10/01/21			10	WASH	
ENTERED BY	T. HEW	10/01/21					
CHECKED BY	C. COVINGTON	10/01/21			JOB NUMBER		
PROJ. ENGR.	K. NDILE	10/01/21			21A008		
REGION ADM.	M. COTTEN	10/01/21			CONTRACT NO.		LOCATION No.
		DATE	DATE	REVISION		BY	

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN09

SHEET 73 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	ROADWAY EXCAVATION INCL. HAUL - AREA SWALE C.Y.	GRATE INLET TYPE 2 EACH	QUARRY SPALLS TON	DRAIN PIPE 6 IN. DIAM. L.F.	DRAIN PIPE 8 IN. DIAM. L.F.		CATCH BASIN TYPE 2 48 IN. DIAM. W/ CAGE EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR & CAGE EACH	CATCH BASIN TYPE 2 96 IN. DIAM. W/FLOW SPLITTER EACH	CATCH BASIN TYPE 1 EACH		CATCH BASIN TYPE 2 48 IN. DIAM. EACH	CATCH BASIN TYPE 2 54 IN. DIAM. EACH	CATCH BASIN TYPE 2 60 IN. DIAM. EACH	SEE GENERAL NOTES
DR03-2	G LINE 16+14.6 (36.9 RT) TO G LINE 15+12.4 (15.9 RT)													1			2, 6
DR03-3	G LINE 15+12.4 (15.9 RT) TO G LINE 14+46.3 (15.9 RT)													1			2, 5
DR03-4	G LINE 14+46.3 (15.9 RT) TO A LINE 271+58.0 (40.7 RT)													1			2, 6
DR03-5	NOT USED																
DR03-6	A LINE 270+66.9 (35.3 LT) TO A LINE 271+98.4 (48.8 LT)													1			2, 5
DR03-7	A LINE 273+83.6 (86.5 RT) TO A LINE 272+93.0 (86.4 RT)													1			2, 6
DR03-8	A LINE 272+93.0 (86.4 RT) TO A LINE 272+06.3 (47.6 RT)													1			2, 6
DR03-9	A LINE 272+06.3 (47.6 RT) TO A LINE 271+96.7 (44.4 RT)													1			2, 5
DR03-10	A LINE 271+96.7 (44.4 RT) TO A LINE 271+86.8 (42.5 RT)		1														3, 7
DR03-11	A LINE 271+86.8 (42.5 RT) TO A LINE 271+58.0 (40.8 RT)													1			2, 5
DR03-12	NOT USED																
DR03-13	A LINE 271+58.0 (40.7 RT) TO A LINE 271+98.4 (48.8 LT)													1			2, 5
DR03-14	A LINE 272+04.0 (62.2 LT) TO A LINE 272+48.0 (83.7 LT)															1	2, 6
DR03-15	A LINE 272+48.0 (83.7 LT) TO A LINE 272+83.6 (135.9 LT)															1	2, 6
DR03-16	A LINE 272+02.0 (25.9 RT) TO A LINE 271+96.7 (44.5 RT)		1														3, 7
DR03-17	A LINE 274+12.0 (86.0 LT) TO A LINE 274+04.0 (84.7 LT)																
DR03-18	A LINE 271+47.0 (53.6 LT) TO A LINE 272+04.0 (62.2 LT)				35												10
DR03-19	A LINE 271+98.4 (48.8 LT) TO A LINE 272+04.0 (62.2 LT)														1		2, 6
DR03-20	G LINE 18+63.0 (14.1 RT) TO G LINE 19+43.0 (21.8 RT)											1					1, 5
DR03-21	G LINE 19+43.0 (21.8 RT) TO G LINE 20+35.1 (25.2 RT)											1					1, 6
DR03-22	G LINE 20+35.1 (25.2 RT) TO G LINE 21+72.9 (17.2 RT)											1					1, 5
DR03-23	A LINE 278+51.0 (37.2 RT) TO A LINE 273+84.0 (86.5 RT)					30											10
DR03-24	A LINE 274+04.0 (84.7 LT) TO A LINE 273+26.0 (109.8 LT)													1			2, 6
DR03-25	A LINE 273+26.0 (109.8 LT) TO A LINE 272+84.0 (135.9 LT)													1			2, 6
DR03-26	A LINE 272+84.0 (135.9 LT) TO A LINE 273+14.1 (237 LT)													1			2, 5
DR03-27	NOT USED																
DR03-28	G LINE 13+47.0 (15.9 RT) TO G LINE 14+46.0 (15.9 RT)													1			2, 6, 14
DR03-29	G LINE 272+07.0 (105.0 LT) TO G LINE 272+48.0 (83.7 LT)																
DR03-30	NOT USED																
DR03-31	A LINE 273+89.8 (63.2 RT) TO A LINE 278+50.9 (37.2 RT)																10
DR03-32	A LINE 273+95.5 (78.1 LT) TO A LINE 278+98.1 (38.8 LT)																10
DR03-33	A LINE 269+30.0 (66.3 LT) TO A LINE 271+30.0 (64.3 LT)	50															12
DR03-34	A LINE 269+32.0 (53.5 LT) TO A LINE 271+74 (53.6 LT)																10
DR03-35	NOT USED																
DR03-36	NOT USED																
	SHEET TOTAL	50	2		35	30						3		13	1	2	

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

1. SEE CATCH BASIN TYPE 1 – STD PLAN B-5.20-03.
2. SEE CATCH BASIN TYPE 2 - STD PLAN B-10.20-02.
3. SEE GRATE INLET TYPE 2 - STD PLAN B-35.40-00.
4. SEE CATCH BASIN TYPE 2 54 IN. W/FLOW RESTRICTOR (FC) DETAIL, SHT. DRD05.
5. SEE RECTANGULAR VANED GRATE - STD PLAN B-30.30-03 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
6. SEE RECTANGULAR SOLID METAL COVER – STD PLAN B-30.20-04 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
7. SEE WELDED GRATES FOR GRATE INLET (GRATE A) – STD PLAN B-40.20-00.
8. SEE OUTFALL PROTECTION DETAIL, SHT. DRD02.
9. SEE WALLED DETENTION POND DETAIL, SHT. DRD05 AND SHT. DRD06.
10. SEE SPECIAL PROVISION 7-01 "MEDIA FILTER DRAIN". SEE DIMENSION AND DETAILS ON SHT. DRD01.
11. SEE COMPOST AMENDED BIOFILTRATION SWALE DETAIL ON SHT. DRD03 AND SHT. DRD04.
12. SEE WET BIOFILTRATION SWALE DETAIL ON SHT. DRD08.

DESIGNED BY	T. HEW	10/01/21	
ENTERED BY	T. HEW	10/01/21	
CHECKED BY	C. COVINGTON	10/01/21	
PROJ. ENGR.	K. NDILE	10/01/21	
REGION ADM.	M. COTTEN	10/01/21	
		DATE	DATE

REVISION | BY

REGION NO.	STATE	FED. AID PROJ. NO.
10	WASH	
JOB NUMBER 21A008		
CONTRACT NO.		LOCATION No.

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN10

SHEET 74 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	CATCH BASIN TYPE 2 72 IN. DIAM.	TESTING STORM SEWER PIPE		CL. III REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 24 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 18 IN. DIAM.		CL. IV REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 42 IN. DIAM.	CL. V REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 18 IN. DIAM.		SEE GENERAL NOTES
		EACH	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		
DR03-2	G LINE 16+14.6 (36.9 RT) TO G LINE 15+12.4 (15.9 RT)		108											108			2, 6
DR03-3	G LINE 15+12.4 (15.9 RT) TO G LINE 14+46.3 (15.9 RT)		55											55			2, 5
DR03-4	G LINE 14+46.3 (15.9 RT) TO A LINE 271+58.0 (40.7 RT)		55											55			2, 6
DR03-5	NOT USED																
DR03-6	A LINE 270+66.9 (35.3 LT) TO A LINE 271+98.4 (48.8 LT)		132											132			2, 5
DR03-7	A LINE 273+83.6 (86.5 RT) TO A LINE 272+93.0 (86.4 RT)		90						90								2, 6
DR03-8	A LINE 272+93.0 (86.4 RT) TO A LINE 272+06.3 (47.6 RT)		95												95		2, 6
DR03-9	A LINE 272+06.3 (47.6 RT) TO A LINE 271+96.7 (44.4 RT)		10												10		2, 5
DR03-10	A LINE 271+96.7 (44.4 RT) TO A LINE 271+86.8 (42.5 RT)		10												10		3, 7
DR03-11	A LINE 271+86.8 (42.5 RT) TO A LINE 271+58.0 (40.8 RT)		29												29		2, 5
DR03-12	NOT USED																
DR03-13	A LINE 271+58.0 (40.7 RT) TO A LINE 271+98.4 (48.8 LT)		98												98		2, 5
DR03-14	A LINE 272+04.0 (62.2 LT) TO A LINE 272+48.0 (83.7 LT)		49												49		2, 6
DR03-15	A LINE 272+48.0 (83.7 LT) TO A LINE 272+83.6 (135.9 LT)		63												63		2, 6
DR03-16	A LINE 272+02.0 (25.9 RT) TO A LINE 271+96.7 (44.5 RT)		19											19			3, 7
DR03-17	A LINE 274+12.0 (86.0 LT) TO A LINE 274+04.0 (84.7 LT)		8												8		
DR03-18	A LINE 271+47.0 (53.6 LT) TO A LINE 272+04.0 (62.2 LT)																10
DR03-19	A LINE 271+98.4 (48.8 LT) TO A LINE 272+04.0 (62.2 LT)		15												15		2, 6
DR03-20	G LINE 18+63.0 (14.1 RT) TO G LINE 19+43.0 (21.8 RT)		72					72									1, 5
DR03-21	G LINE 19+43.0 (21.8 RT) TO G LINE 20+35.1 (25.2 RT)		80					80									1, 6
DR03-22	G LINE 20+35.1 (25.2 RT) TO G LINE 21+72.9 (17.2 RT)		138					138									1, 5
DR03-23	A LINE 278+51.0 (37.2 RT) TO A LINE 273+84.0 (86.5 RT)																10
DR03-24	A LINE 274+04.0 (84.7 LT) TO A LINE 273+26.0 (109.8 LT)		82												82		2, 6
DR03-25	A LINE 273+26.0 (109.8 LT) TO A LINE 272+84.0 (135.9 LT)		51												51		2, 6
DR03-26	A LINE 272+84.0 (135.9 LT) TO A LINE 273+14.1 (237 LT)																2, 5
DR03-27	NOT USED																
DR03-28	G LINE 13+47.0 (15.9 RT) TO G LINE 14+46.0 (15.9 RT)		97											97			2, 6, 14
DR03-29	G LINE 272+07.0 (105.0 LT) TO G LINE 272+48.0 (83.7 LT)		47												47		
DR03-30	NOT USED																
DR03-31	A LINE 273+89.8 (63.2 RT) TO A LINE 278+50.9 (37.2 RT)																10
DR03-32	A LINE 273+95.5 (78.1 LT) TO A LINE 278+98.1 (38.8 LT)																10
DR03-33	A LINE 269+30.0 (66.3 LT) TO A LINE 271+30.0 (64.3 LT)																12
DR03-34	A LINE 269+32.0 (53.5 LT) TO A LINE 271+74 (53.6 LT)																10
DR03-35	NOT USED																
DR03-36	NOT USED																
	SHEET TOTAL		1403					290	90					466	557		

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

13. SEE DETENTION POND MAINTENANCE ACCESS ON SHT. DRD02 AND SHT. DRD07.
14. CONNECT EXISTING STORM DRAIN PIPE TO NEW DRAINAGE STRUCTURE. REFER TO SPECIAL PROVISION 7-05.
15. SEE CULVERT EXTENSION PIPE DETAIL ON SHT. DRD03.
16. SEE FLOW SPLITTER DETAIL ON SHT. DRD08.

					REGION NO.	STATE	FED. AID PROJ. NO.
DESIGNED BY	T. HEW	10/01/21			10	WASH	
ENTERED BY	T. HEW	10/01/21			JOB NUMBER		
CHECKED BY	C. COVINGTON	10/01/21			21A008		
PROJ. ENGR.	K. NDILE	10/01/21			CONTRACT NO.		LOCATION No.
REGION ADM.	M. COTTEN	10/01/21					
		DATE	DATE	REVISION	BY		

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN11

SHEET 75 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↘ \ UNIT OF MEASURE ➢	SCHEDULE A STORM SEWER PIPE 24 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 30 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 42 IN. DIAM. L.F.	STRUCTURE EXCAVATION CLASS B INCL. HAUL L.F.	SHORING OR EXTRA EXCAVATION CLASS B C.Y.		CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION S.F.	MEDIA FILTER DRAIN S.Y.	BIOFILTRATION SWALE LEVEL SPREADER AND DIVIDER L.F.	CONNECTION TO DRAINAGE STRUCTURE L.F.						SEE GENERAL NOTES
DR03-2	G LINE 16+14.6 (36.9 RT) TO G LINE 15+12.4 (15.9 RT)				110	800											2, 6
DR03-3	G LINE 15+12.4 (15.9 RT) TO G LINE 14+46.3 (15.9 RT)				60	410											2, 5
DR03-4	G LINE 14+46.3 (15.9 RT) TO A LINE 271+58.0 (40.7 RT)				60	410											2, 6
DR03-5	NOT USED																
DR03-6	A LINE 270+66.9 (35.3 LT) TO A LINE 271+98.4 (48.8 LT)				130	960											2, 5
DR03-7	A LINE 273+83.6 (86.5 RT) TO A LINE 272+93.0 (86.4 RT)				70	440											2, 6
DR03-8	A LINE 272+93.0 (86.4 RT) TO A LINE 272+06.3 (47.6 RT)				90	600											2, 6
DR03-9	A LINE 272+06.3 (47.6 RT) TO A LINE 271+96.7 (44.4 RT)				20	80											2, 5
DR03-10	A LINE 271+96.7 (44.4 RT) TO A LINE 271+86.8 (42.5 RT)				20	80											3, 7
DR03-11	A LINE 271+86.8 (42.5 RT) TO A LINE 271+58.0 (40.8 RT)				40	230											2, 5
DR03-12	NOT USED																
DR03-13	A LINE 271+58.0 (40.7 RT) TO A LINE 271+98.4 (48.8 LT)				100	690											2, 5
DR03-14	A LINE 272+04.0 (62.2 LT) TO A LINE 272+48.0 (83.7 LT)				60	350											2, 6
DR03-15	A LINE 272+48.0 (83.7 LT) TO A LINE 272+83.6 (135.9 LT)				70	430											2, 6
DR03-16	A LINE 272+02.0 (25.9 RT) TO A LINE 271+96.7 (44.5 RT)				20	140											3, 7
DR03-17	A LINE 274+12.0 (86.0 LT) TO A LINE 274+04.0 (84.7 LT)				10	20											
DR03-18	A LINE 271+47.0 (53.6 LT) TO A LINE 272+04.0 (62.2 LT)				20	160											10
DR03-19	A LINE 271+98.4 (48.8 LT) TO A LINE 272+04.0 (62.2 LT)				30	140											2, 6
DR03-20	G LINE 18+63.0 (14.1 RT) TO G LINE 19+43.0 (21.8 RT)				40	270											1, 5
DR03-21	G LINE 19+43.0 (21.8 RT) TO G LINE 20+35.1 (25.2 RT)				40	300											1, 6
DR03-22	G LINE 20+35.1 (25.2 RT) TO G LINE 21+72.9 (17.2 RT)				60	450						1					1, 5
DR03-23	A LINE 278+51.0 (37.2 RT) TO A LINE 273+84.0 (86.5 RT)				20	100											10
DR03-24	A LINE 274+04.0 (84.7 LT) TO A LINE 273+26.0 (109.8 LT)				50	350											2, 6
DR03-25	A LINE 273+26.0 (109.8 LT) TO A LINE 272+84.0 (135.9 LT)				50	340											2, 6
DR03-26	A LINE 272+84.0 (135.9 LT) TO A LINE 273+14.1 (237 LT)				10	30											2, 5
DR03-27	NOT USED																
DR03-28	G LINE 13+47.0 (15.9 RT) TO G LINE 14+46.0 (15.9 RT)				100	710											2, 6, 14
DR03-29	G LINE 272+07.0 (105.0 LT) TO G LINE 272+48.0 (83.7 LT)				30	150											
DR03-30	NOT USED																
DR03-31	A LINE 273+89.8 (63.2 RT) TO A LINE 278+50.9 (37.2 RT)									466							10
DR03-32	A LINE 273+95.5 (78.1 LT) TO A LINE 278+98.1 (38.8 LT)									515							10
DR03-33	A LINE 269+30.0 (66.3 LT) TO A LINE 271+30.0 (64.3 LT)										220						12
DR03-34	A LINE 269+32.0 (53.5 LT) TO A LINE 271+74 (53.6 LT)									244							10
DR03-35	NOT USED																
DR03-36	NOT USED																
	SHEET TOTAL				1310	8640				1225	220	1					

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

					REGION NO.	STATE	FED. AID PROJ. NO.
					10	WASH	
DESIGNED BY	T. HEW	10/01/21			JOB NUMBER		
ENTERED BY	T. HEW	10/01/21			21A008		
CHECKED BY	C. COVINGTON	10/01/21			CONTRACT NO.		LOCATION No.
PROJ. ENGR.	K. NDILE	10/01/21					
REGION ADM.	M. COTTEN	10/01/21					
		DATE	DATE	REVISION	BY		

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN12

SHEET 76 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	ROADWAY EXCAVATION INCL. HAUL - AREA SWALE C.Y.	GRATE INLET TYPE 2 EACH	QUARRY SPALLS TON	DRAIN PIPE 6 IN. DIAM. L.F.	DRAIN PIPE 8 IN. DIAM. L.F.		CATCH BASIN TYPE 2 48 IN. DIAM. W/ CAGE EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR EACH	CATCH BASIN TYPE 2 54 IN. DIAM. W/FR & CAGE EACH	CATCH BASIN TYPE 2 96 IN. DIAM. W/FLOW SPLITTER EACH	CATCH BASIN TYPE 1 EACH		CATCH BASIN TYPE 2 48 IN. DIAM. EACH	CATCH BASIN TYPE 2 54 IN. DIAM. EACH	CATCH BASIN TYPE 2 60 IN. DIAM. EACH	SEE GENERAL NOTES
DR03-37	A LINE 271+75.4 (62.3 LT) TO A LINE 272+04.0 (62.2 LT)																
DR03-38	A LINE 273+00.0 (105.8 RT) TO A LINE 272+93.0 (86.4 RT)		1														3, 7
DR03-39	NOT USED																
DR03-40	A LINE 274+38.0 (53.1 RT) TO A LINE 273+83.6 (86.5 RT)																
DR03-41	NOT USED																
DR04-1	A LINE 279+52.0 (52.2 LT) TO A LINE 282+84.0 (40.0 LT)																10
DR05-1	B LINE 122+18.0 (30.0 RT) TO B LINE 121+84.0 (30.0 RT)		1														3, 7
DR05-2	B LINE 121+84.0 (30.0 RT) TO B LINE 121+54.0 (30.0 RT)		1														3, 7
DR05-3	B LINE 121+54.0 (30.0 RT) TO B LINE 121+32.0 (30.0 RT)		1														3, 7
DR05-4	B LINE 121+32.0 (30.0 RT) TO B LINE 121+00.0 (30.0 RT)		1														3, 7
DR05-5	B LINE 121+00.0 (30.0 RT) TO B LINE 120+76.0 (30.0 RT)		1														3, 7
DR05-6	B LINE 120+76.0 (30.0 RT) TO B LINE 120+71.0 (62.5 LT)		1														3, 7
DR05-7	A LINE 122+13.0 (56.6 RT) TO A LINE 122+13.0 (53.0 RT)																15
	SHEET TOTAL		7														
	PROJECT TOTAL	140	22	78	35	30		3	1	1	1	40		33	12	4	

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

1. SEE CATCH BASIN TYPE 1 – STD PLAN B-5.20-03.
2. SEE CATCH BASIN TYPE 2 - STD PLAN B-10.20-02.
3. SEE GRATE INLET TYPE 2 - STD PLAN B-35.40-00.
4. SEE CATCH BASIN TYPE 2 54 IN. W/FLOW RESTRICTOR (FC) DETAIL, SHT. DRD05.
5. SEE RECTANGULAR VANED GRATE - STD PLAN B-30.30-03 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
6. SEE RECTANGULAR SOLID METAL COVER – STD PLAN B-30.20-04 AND RECTANGULAR FRAME (REVERSIBLE) - STD PLAN B-30.10-03.
7. SEE WELDED GRATES FOR GRATE INLET (GRATE A) – STD PLAN B-40.20-00.
8. SEE OUTFALL PROTECTION DETAIL, SHT. DRD02.
9. SEE WALLED DETENTION POND DETAIL, SHT. DRD05 AND SHT. DRD06.
10. SEE SPECIAL PROVISION 7-01 "MEDIA FILTER DRAIN". SEE DIMENSION AND DETAILS ON SHT. DRD01.
11. SEE COMPOST AMENDED BIOFILTRATION SWALE DETAIL ON SHT. DRD03 AND SHT. DRD04.
12. SEE WET BIOFILTRATION SWALE DETAIL ON SHT. DRD08.

DESIGNED BY	T. HEW	10/01/21	
ENTERED BY	C. COVINGTON	10/01/21	
CHECKED BY	K. NDILE	10/01/21	
PROJ. ENGR.	M. COTTEN	10/01/21	
REGION ADM.	M. COTTEN	10/01/21	
		DATE	DATE

REVISION | BY

1. SEE CATCH BASIN TYPE 1 – STD PLAN B-

REGION NO.	STATE	FED. AID PROJ. NO.
10	WASH	

JOB NUMBER 21A008

CONTRACT NO. | LOCATION No.

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN13

SHEET 77 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	CATCH BASIN TYPE 2 72 IN. DIAM.	TESTING STORM SEWER PIPE		CL. III REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 24 IN. DIAM.	CL. III REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 18 IN. DIAM.		CL. IV REINF. CONC. STORM SEWER PIPE 30 IN. DIAM.	CL. IV REINF. CONC. STORM SEWER PIPE 42 IN. DIAM.	CL. V REINF. CONC. STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 12 IN. DIAM.	SCHEDULE A STORM SEWER PIPE 18 IN. DIAM.		SEE GENERAL NOTES
		EACH	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		L.F.	L.F.	L.F.	L.F.	L.F.		
DR03-37	A LINE 271+75.4 (62.3 LT) TO A LINE 272+04.0 (62.2 LT)		29												29		
DR03-38	A LINE 273+00.0 (105.8 RT) TO A LINE 272+93.0 (86.4 RT)		21											21			3, 7
DR03-39	NOT USED																
DR03-40	A LINE 274+38.0 (53.1 RT) TO A LINE 273+83.6 (86.5 RT)		64											64			
DR03-41	NOT USED																
DR04-1	A LINE 279+52.0 (52.2 LT) TO A LINE 282+84.0 (40.0 LT)																10
DR05-1	B LINE 122+18.0 (30.0 RT) TO B LINE 121+84.0 (30.0 RT)		34					34									3, 7
DR05-2	B LINE 121+84.0 (30.0 RT) TO B LINE 121+54.0 (30.0 RT)		31											31			3, 7
DR05-3	B LINE 121+54.0 (30.0 RT) TO B LINE 121+32.0 (30.0 RT)		21											21			3, 7
DR05-4	B LINE 121+32.0 (30.0 RT) TO B LINE 121+00.0 (30.0 RT)		32											32			3, 7
DR05-5	B LINE 121+00.0 (30.0 RT) TO B LINE 120+76.0 (30.0 RT)		23											23			3, 7
DR05-6	B LINE 120+76.0 (30.0 RT) TO B LINE 120+71.0 (62.5 LT)		95											95			3, 7
DR05-7	A LINE 122+13.0 (56.6 RT) TO A LINE 122+13.0 (53.0 RT)		4			4											15
	SHEET TOTAL		354			4		34						287	29		
	PROJECT TOTAL	4	7531		710	4	114	603	274		577	135	119	3255	752		

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

13. SEE DETENTION POND MAINTENANCE ACCESS ON SHT. DRD02 AND SHT. DRD07.
14. CONNECT EXISTING STORM DRAIN PIPE TO NEW DRAINAGE STRUCTURE. REFER TO SPECIAL PROVISION 7-05.
15. SEE CULVERT EXTENSION PIPE DETAIL ON SHT. DRD03.
16. SEE FLOW SPLITTER DETAIL ON SHT. DRD08.

DESIGNED BY	T. HEW	10/01/21	
ENTERED BY	C. COVINGTON	10/01/21	
CHECKED BY	K. NDILE	10/01/21	
PROJ. ENGR.	M. COTTEN	10/01/21	
REGION ADM.	M. COTTEN	10/01/21	
		DATE	DATE

REVISION | BY

REGION NO.	STATE	FED. AID PROJ. NO.
10	WASH	

JOB NUMBER 21A008

CONTRACT NO. | LOCATION No.

OSBORN CONSULTING INCORPORATED

Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

DSN14

SHEET 78 OF 366 SHEETS

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF THE "CODE DESIGNATION" BELOW REFERS TO THE SHEET NO. OR THE SHEET REFERENCE NO. SHOWING THE DRAINAGE FEATURE.

THE SECOND NUMBER REFERS TO THE DRAINAGE FEATURE FOUND ON THAT SHEET.

CODE	LOCATION ↓ \ UNIT OF MEASURE →	SCHEDULE A STORM SEWER PIPE 24 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 30 IN. DIAM. L.F.	SCHEDULE A STORM SEWER PIPE 42 IN. DIAM. L.F.	STRUCTURE EXCAVATION CLASS B INCL. HAUL L.F.	SHORING OR EXTRA EXCAVATION CLASS B C.Y.		CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION S.F.	MEDIA FILTER DRAIN S.Y.	BIOFILTRATION SWALE LEVEL SPREADER AND DIVIDER L.F.	CONNECTION TO DRAINAGE STRUCTURE L.F.						SEE GENERAL NOTES
DR03-37	A LINE 271+75.4 (62.3 LT) TO A LINE 272+04.0 (62.2 LT)				20	90											
DR03-38	A LINE 273+00.0 (105.8 RT) TO A LINE 272+93.0 (86.4 RT)				20	110											3, 7
DR03-39	NOT USED																
DR03-40	A LINE 274+38.0 (53.1 RT) TO A LINE 273+83.6 (86.5 RT)				30	160											
DR03-41	NOT USED																
DR04-1	A LINE 279+52.0 (52.2 LT) TO A LINE 282+84.0 (40.0 LT)								333								10
DR05-1	B LINE 122+18.0 (30.0 RT) TO B LINE 121+84.0 (30.0 RT)				30	150											3, 7
DR05-2	B LINE 121+84.0 (30.0 RT) TO B LINE 121+54.0 (30.0 RT)				30	170											3, 7
DR05-3	B LINE 121+54.0 (30.0 RT) TO B LINE 121+32.0 (30.0 RT)				20	130											3, 7
DR05-4	B LINE 121+32.0 (30.0 RT) TO B LINE 121+00.0 (30.0 RT)				30	180											3, 7
DR05-5	B LINE 121+00.0 (30.0 RT) TO B LINE 120+76.0 (30.0 RT)				20	140											3, 7
DR05-6	B LINE 120+76.0 (30.0 RT) TO B LINE 120+71.0 (62.5 LT)				70	510						1					3, 7
DR05-7	A LINE 122+13.0 (56.6 RT) TO A LINE 122+13.0 (53.0 RT)				10	20											15
	SHEET TOTAL				280	1660			333			1					
	PROJECT TOTAL	780	75	133	7270	44080		740	2038	236	5						

GENERAL NOTES:

A. DRAINAGE STRUCTURE STATIONING AND OFFSET IS TO THE CENTER OF THE GRATE REGARDLESS OF STRUCTURE TYPE AND SIZE.

B. PIPE ZONE BEDDING AND BACKFILL PER STD. PLAN B-55.20.

DESIGNED BY	T. HEW	10/01/21	
ENTERED BY	C. COVINGTON	10/01/21	
CHECKED BY	K. NDILE	10/01/21	
PROJ. ENGR.	M. COTTEN	10/01/21	
REGION ADM.	M. COTTEN	10/01/21	
		DATE	DATE

REVISION | BY

REGION NO.	STATE	FED. AID PROJ. NO.
10	WASH	

JOB NUMBER 21A008

CONTRACT NO. | LOCATION No.

OSBORN CONSULTING INCORPORATED

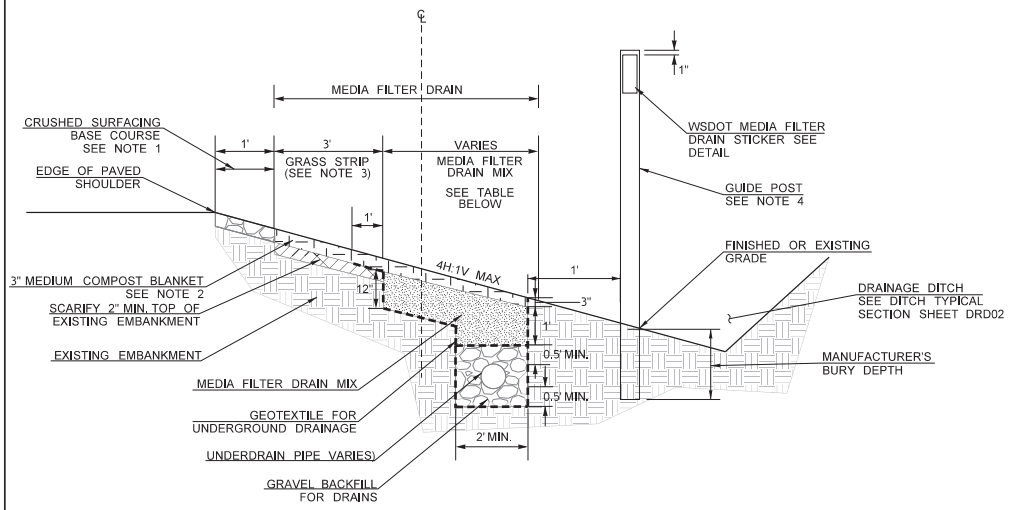
Washington State Department of Transportation

SR9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

STRUCTURE NOTES
DRAINAGE

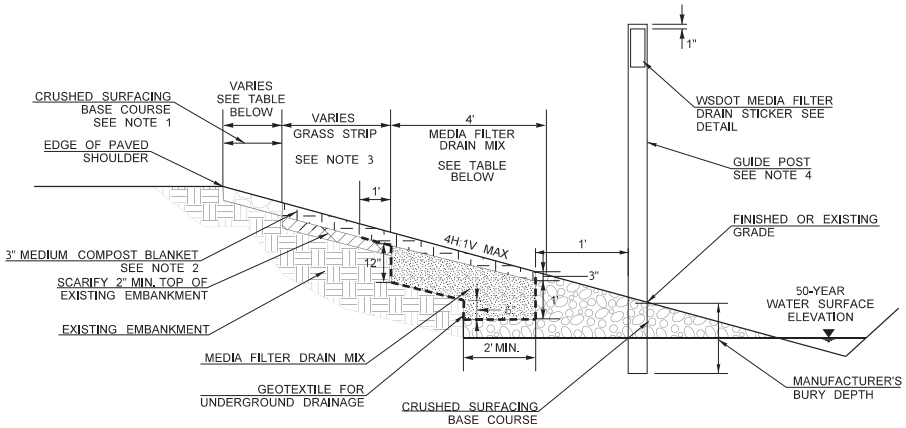
DSN15

SHEET 78 OF 366 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

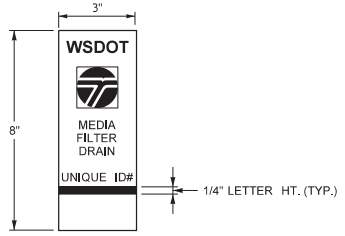
STRUCTURE CODE	MFD TYPE	LOCATION	LENGTH	WIDTH	UNDER-DRAIN DIAM.	CSBC	GRASS STRIP
			FEET	FEET	INCHES	FEET	FEET
DR02-14	3	A LINE STA 258+19 (52.0' LT) TO A LINE STA 262+99 (52.0' LT)	480	4	N/A	1	3
DR03-34	1	A LINE STA 269+32 (53.5' LT) TO A LINE STA 271+74 (53.6' LT)	244	4	6	1	3
DR03-32	3	A LINE STA 273+96 (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 281+53 (43.5' LT)	201	4	N/A	1	3

MEDIA FILTER DRAIN

NOT TO SCALE

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 LIMITTED 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.



WHITE TEXT ON GREEN BACKGROUND
SEE NOTE 5

WSDOT MEDIA FILTER DRAIN STICKER

NOT TO SCALE

PROOF COPY
DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

FILE NAME	c:\pw_workIng\wastate\parsons_epw16979\dms08810\Stage 3_Y-11834_PS_DRD_01.dgn
TIME	1:03:06 PM
DATE	11/10/2021
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. 10 | STATE WASH
JOB NUMBER 21A008
CONTRACT NO.
FED.AID PROJ.NO.
LOCATION NO.

SEE SHEET CT1
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

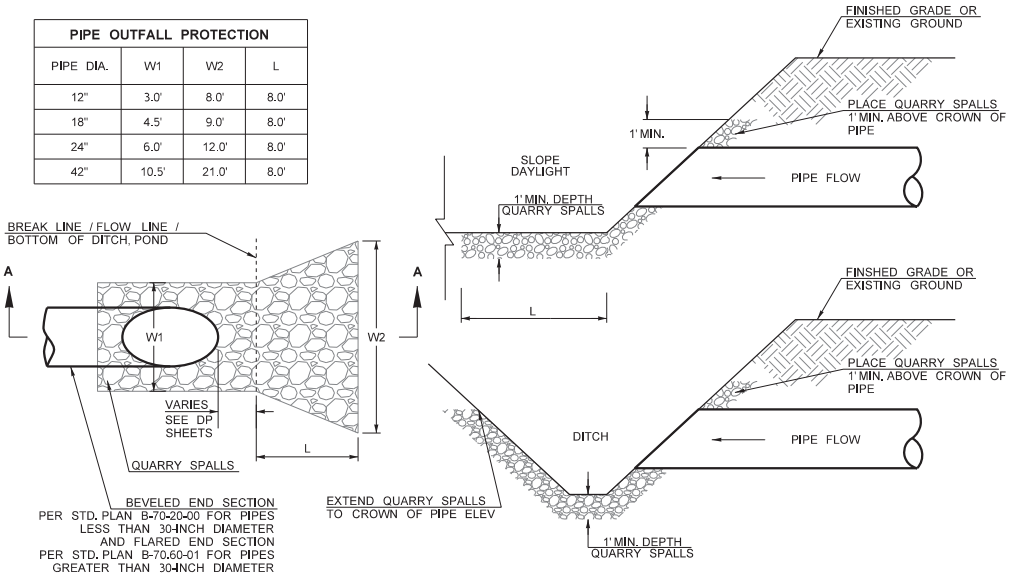
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO DRD01
SHEET
OF 366 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:

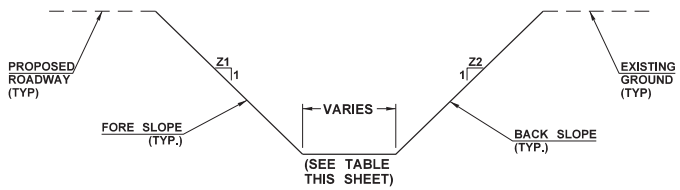
1. QUARRY SPALLS SHALL BE IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION SECTION 9-13.1(5).

SECTION A-A

NOT TO SCALE

OUTFALL PROTECTION

NOT TO SCALE



NOTES:

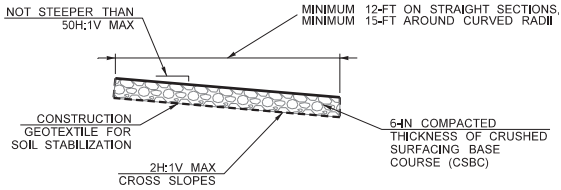
1. DITCH EXCAVATION IS INCLUDED IN ROADWAY EXCAVATION INCLUDING HAUL.
2. FOR DITCH GRADING DETAILS, SEE ROADWAY TYPICAL SECTIONS (RS) SHEETS.
3. SEE DITCH TABLE, THIS SHEET, FOR DITCH LOCATIONS.
4. MAXIMUM DITCH SIDE SLOPE IS 2H:1V. DITCH SIDE SLOPES MAY VARY FROM TYPICAL 3H:1V TO MATCH INTO EXISTING 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 (64.5' LT) TO STA 281+53 (55.4' LT)	0	201	10	3	0.48	1.90

* 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
TONS	CU YD	CU YD
165	69	400

MAINTENANCE ACCESS ROAD TYPICAL SECTION

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PLOTTED BY	terrenceh					21A008		
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 42603 REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
DATE
P.E. STAMP BOX

PARSONS
OSBORN CONSULTING INCORPORATED

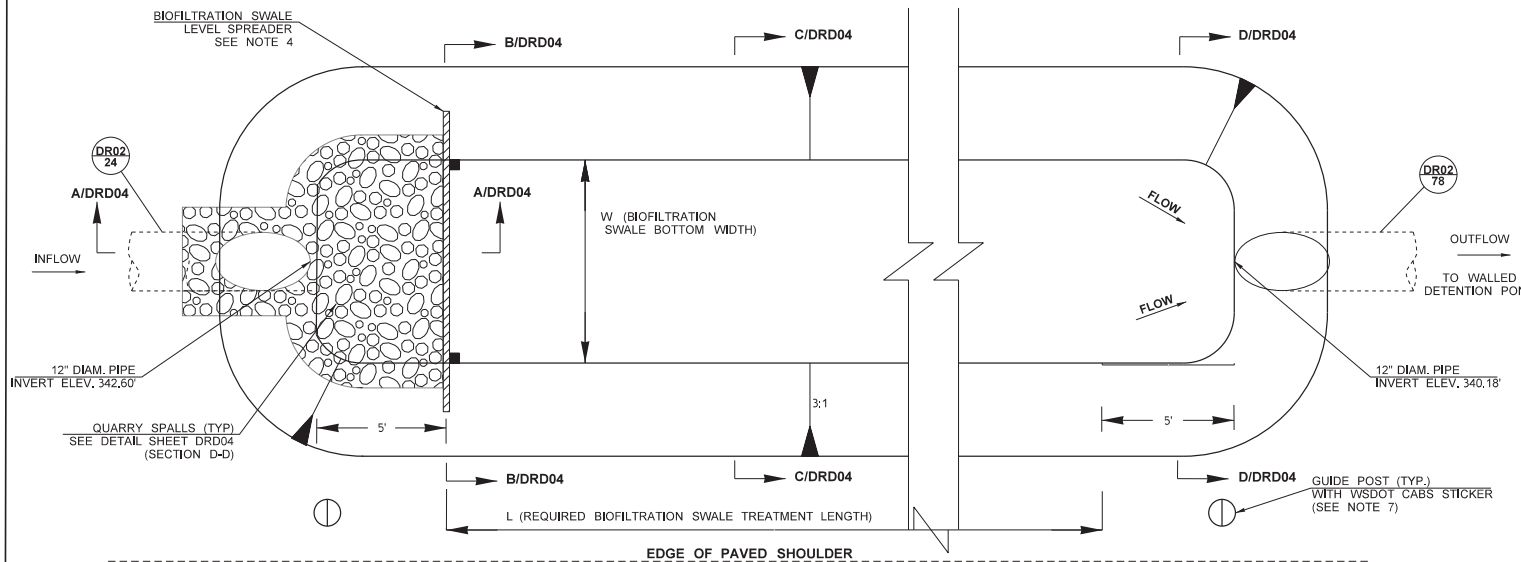
Washington State Department of Transportation

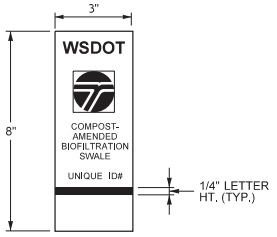
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO
DRD02

SHEET
OF
366
SHEETS





WSDOT CABS STICKER

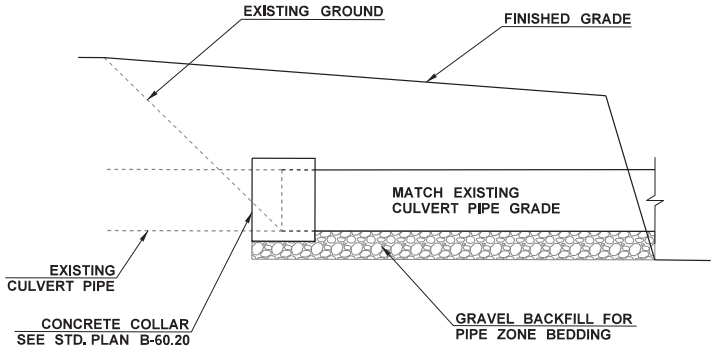
NOT TO SCALE

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



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COMPOST AMENDED BIOFILTRATION SWALE (CABS) PLAN VIEW DR02 76

NOT TO SCALE

CULVERT EXTENSION PIPE DETAIL DR05 7

NOT TO SCALE

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DATE	11/10/2021				JOB NUMBER 21A008	
PLOTTED BY	terrenceh					
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	

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DATE
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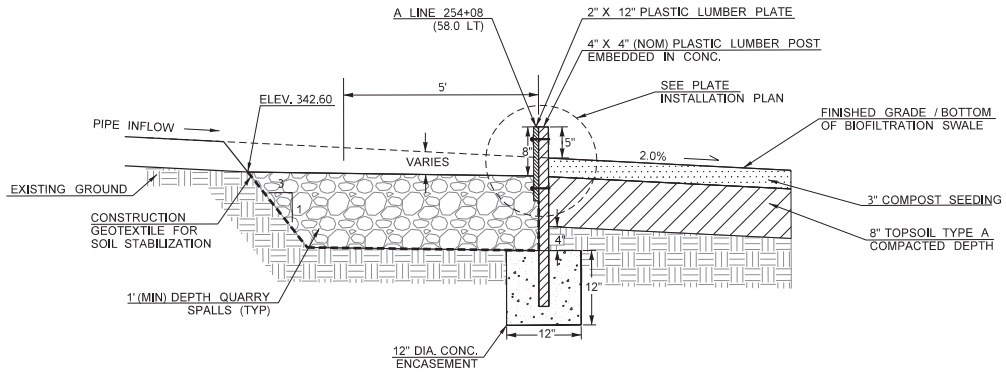
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO DRD03

SHEET 104 OF 366 SHEETS

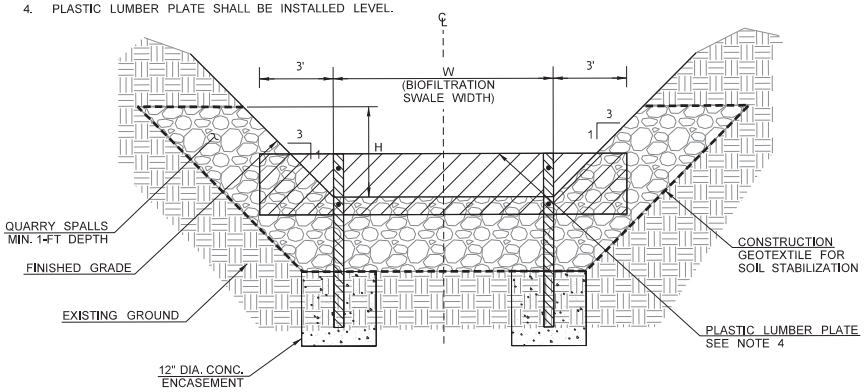


SECTION A-A SHEET DRD03

NOT TO SCALE

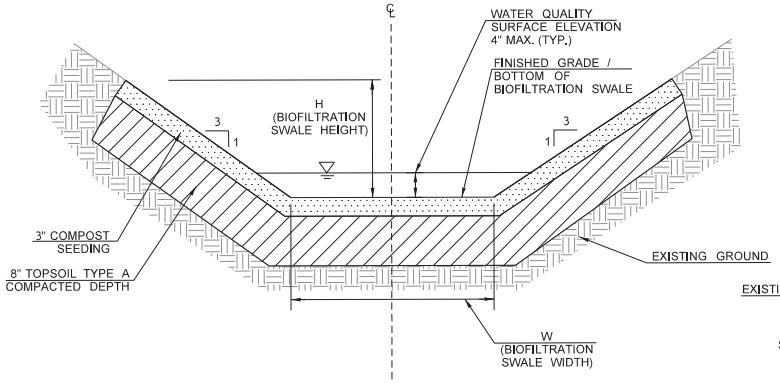
NOTES:

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

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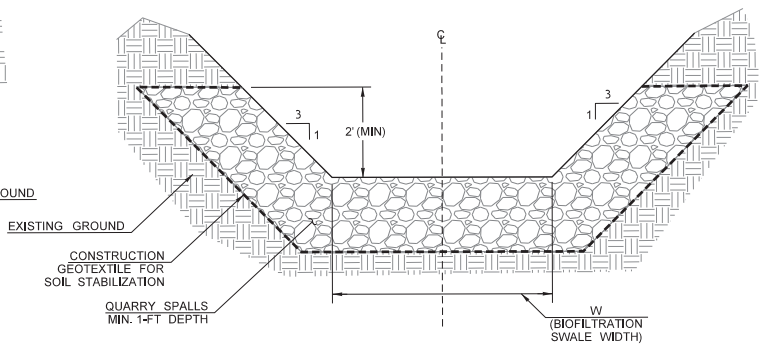

SECTION D-D SHEET DRD03

NOT TO SCALE

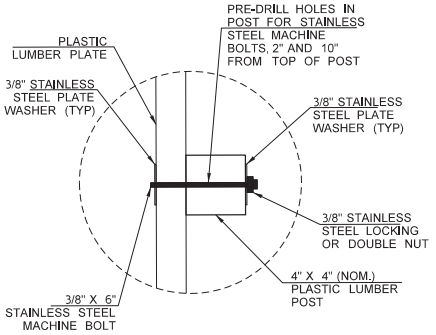

PLATE INSTALLATION PLAN

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COMPOST AMENDED BIOFILTRATION SWALE (CABS) SECTION VIEW

DR02
76

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PLOTTED BY	terrenceh					21A008			
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				

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SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

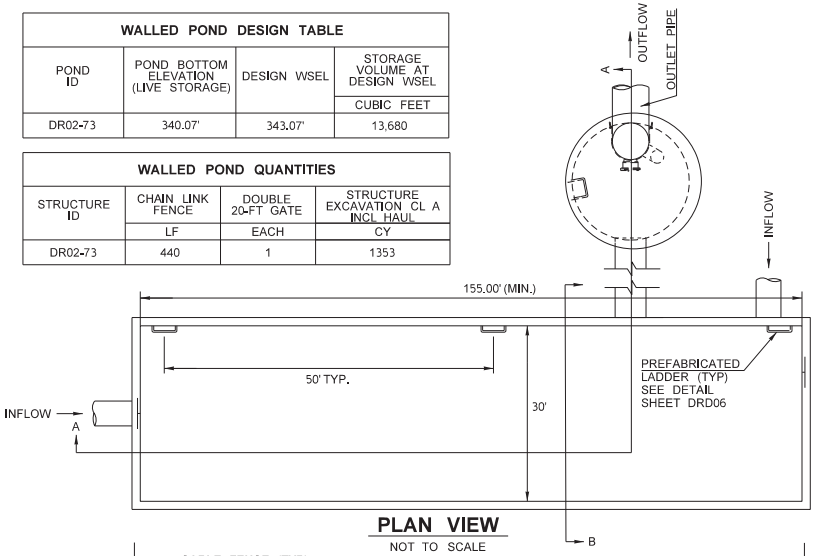
DRAINAGE DETAILS

PLAN REF NO
DRD04

SHEET
OF
366
SHEETS

WALLED 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

WALLED POND QUANTITIES			
STRUCTURE ID	CHAIN LINK FENCE	DOUBLE 20-FT GATE	STRUCTURE EXCAVATION CL A INCL HAUL
	LF	EACH	CY
DR02-73	440	1	1353



PLAN VIEW
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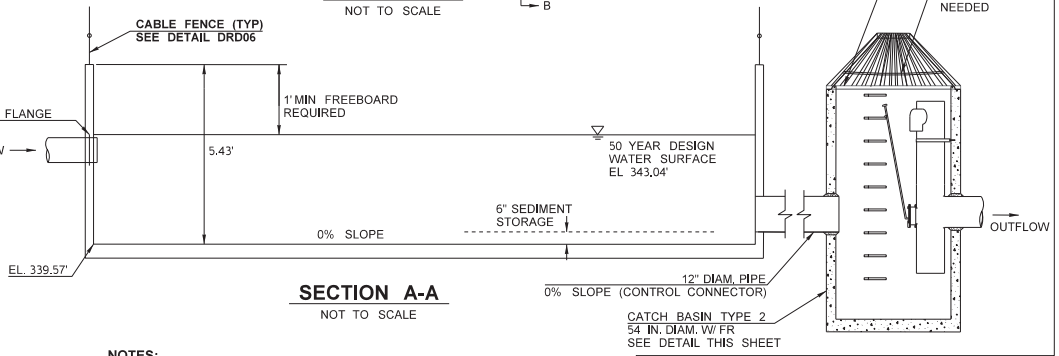
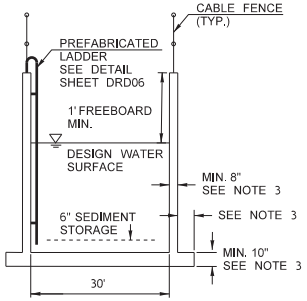
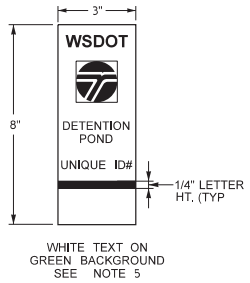


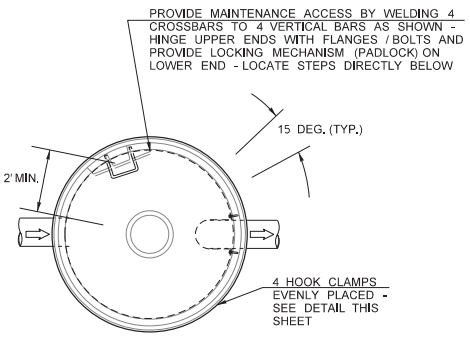
SECTION A-A
NOT TO SCALE

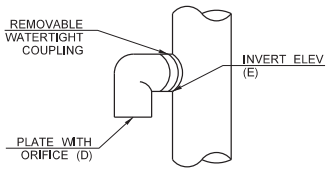


SECTION B-B
NOT TO SCALE



WSDOT
DETENTION POND STICKER
NOT TO SCALE





ELBOW DETAIL
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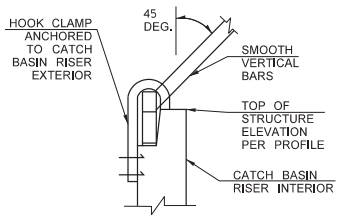
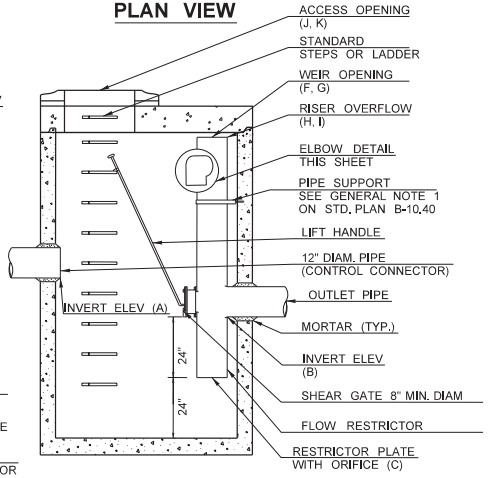


DETAIL HOOK CLAMP

PLAN VIEW



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

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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

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ENTERED BY	N. CHEN						
CHECKED BY	L. THOMSEN						
PROJ. ENGR.	K. NDILE						
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY		

FED.AID PROJ.NO.

LOCATION NO.

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DATE
P.E. STAMP BOX

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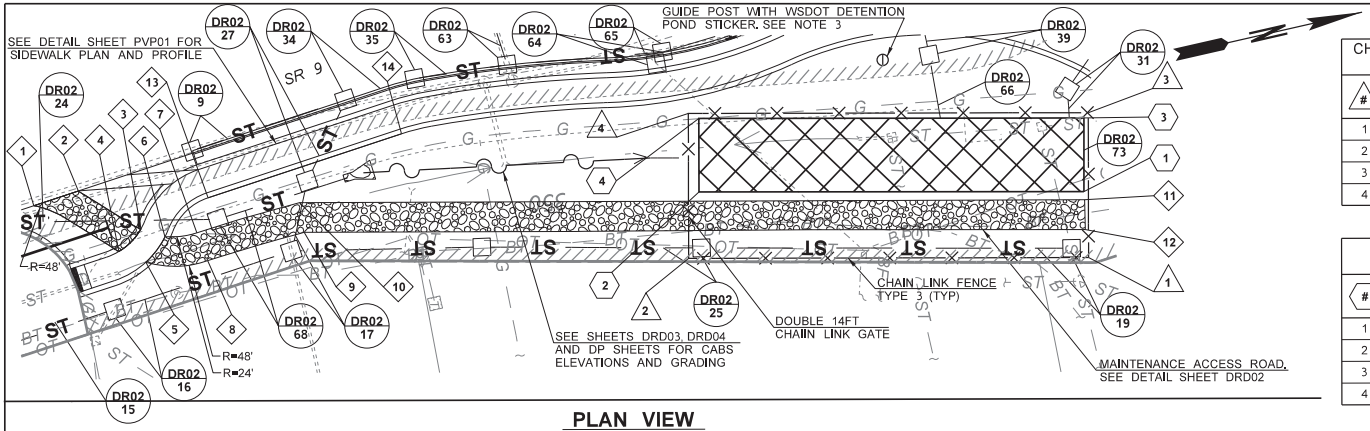
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO
DRD05

SHEET
OF
366
SHEETS



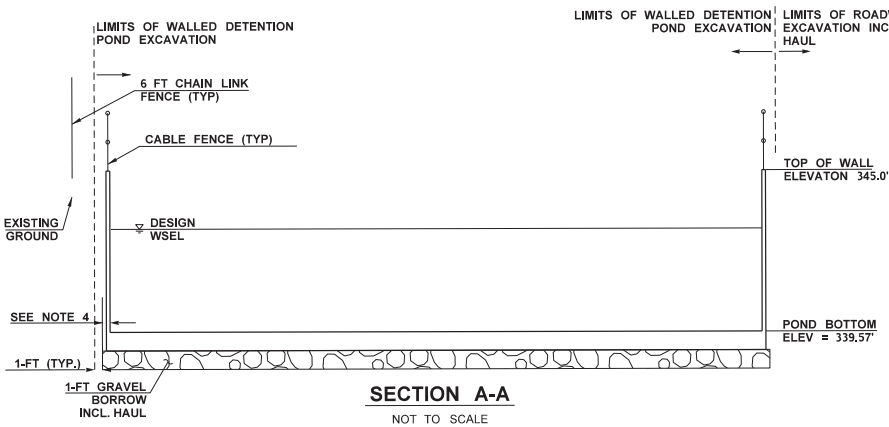
PLAN VIEW

NOT TO SCALE

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)

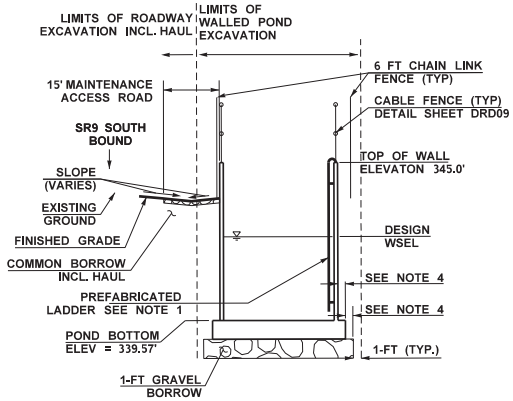
WALLED POND POINT TABLE	
#	LOCATION
1	A LINE 266+04 (171.3' RT)
2	A LINE 264+57 (122.8' RT)
3	A LINE 266+14 (143.2' RT)
4	A LINE 264+66 (94.7' RT)

ACCESS ROAD AND SIDEWALK POINT TABLE		
#	LOCATION	ELEVATION
1	A LINE 262+01 (44.0' RT)	347.17
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+62 (87.0' RT)	348.61
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 (174.6' RT)	348.09
12	A LINE 266+00 (186.0' RT)	348.40
13	A LINE 262+69 (63.0' RT)	347.55
14	A LINE 263+51 (63.0' RT)	345.75



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 INSIDE OF WALLED POND 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.

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WALLED DETENTION POND DETAIL PLAN & SECTION

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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 — SEE SHEET CT1 — DATE

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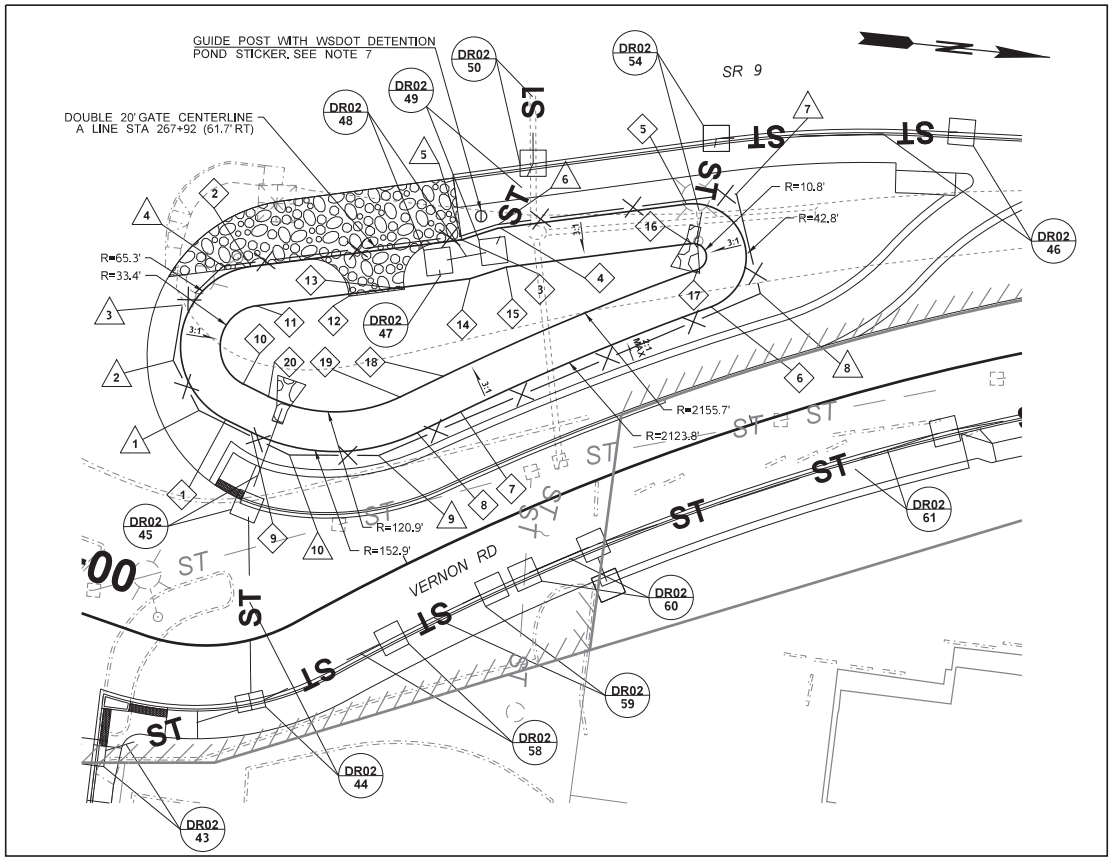
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO DRD06

SHEET OF 366 SHEETS



POND PLAN VIEW DR02 79

NOT TO SCALE

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.
7. 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

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
TONS	CU YD	CU YD
50	45	0

POND QUANTITIES

CHAIN LINK FENCE TYPE 3	DOUBLE 20-FT GATE	ROADWAY EXCAVATION INCL. HAUL - POND
LF	EACH	CY
335	1	935

PROOF COPY
DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

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DATE	11/10/2021					JOB NUMBER		
PLOTTED BY	terrenceh					21A008		
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			

SEE SHEET CT1
DATE
P.E. STAMP BOX

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OSBORN CONSULTING INCORPORATED

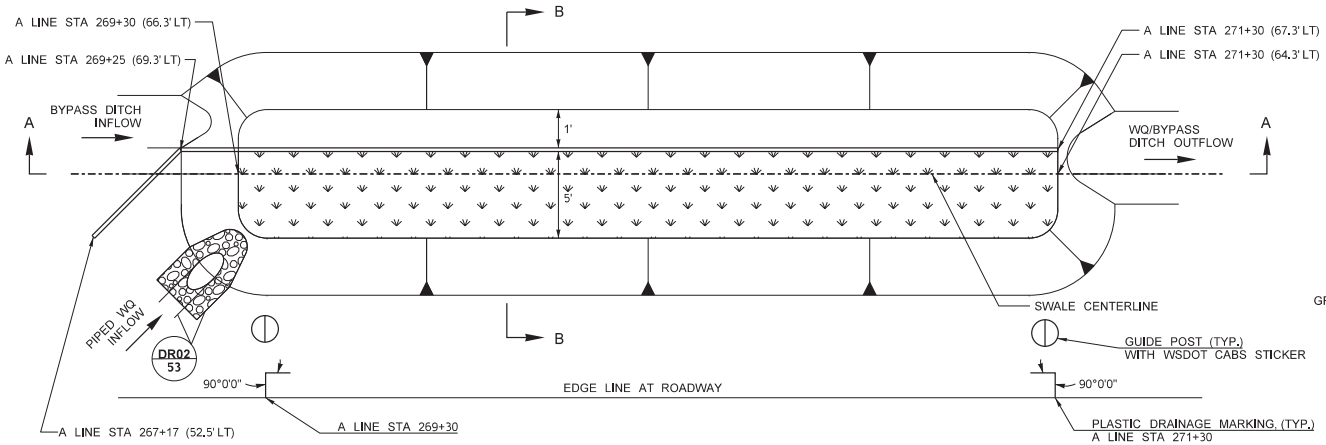
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE DETAILS

PLAN REF NO DRD07

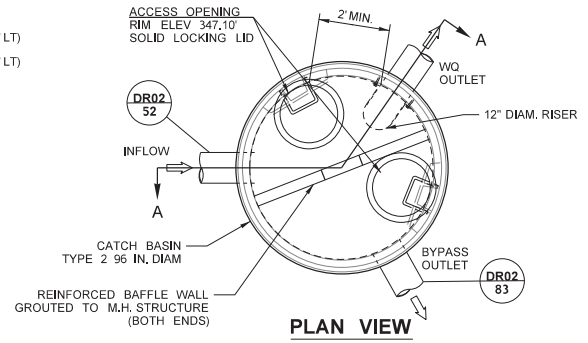
SHEET OF 366 SHEETS



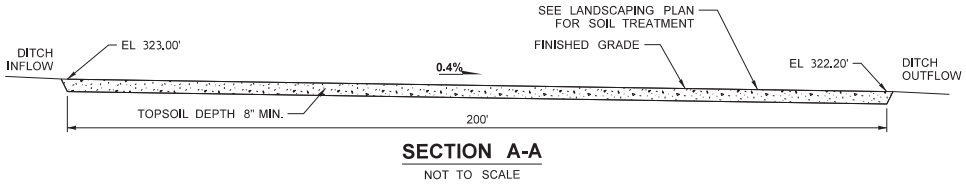
WET BIOFILTRATION SWALE

NOT TO SCALE

DR03 33

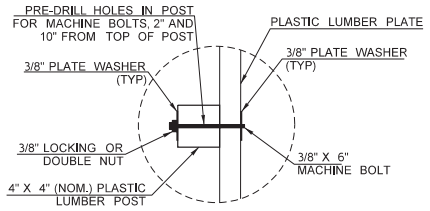


PLAN VIEW



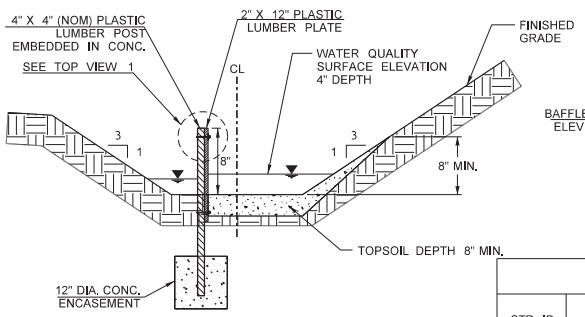
SECTION A-A

NOT TO SCALE



TOP VIEW 1
PLATE INSTALLATION PLAN

NOT TO SCALE



SECTION B-B

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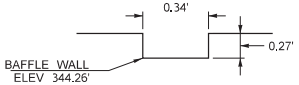
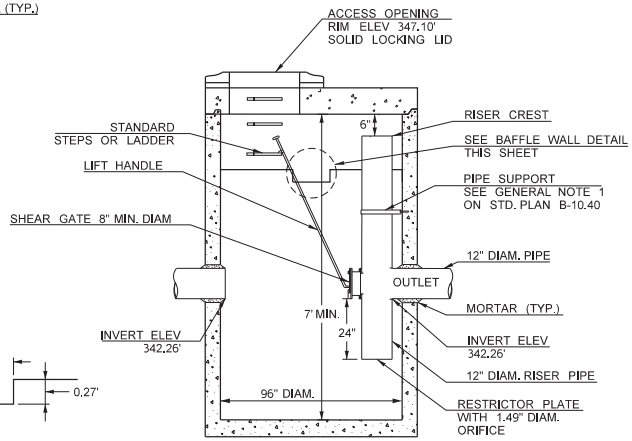


BAFFLE WALL DETAIL

NOT TO SCALE



SECTION A-A

NOT TO SCALE

FLOW SPLITTER

NOT TO SCALE

DR02 53

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

PROOF COPY
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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			

STATE OF WASHINGTON — 42603 — REGISTERED PROFESSIONAL ENGINEER
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DATE
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SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

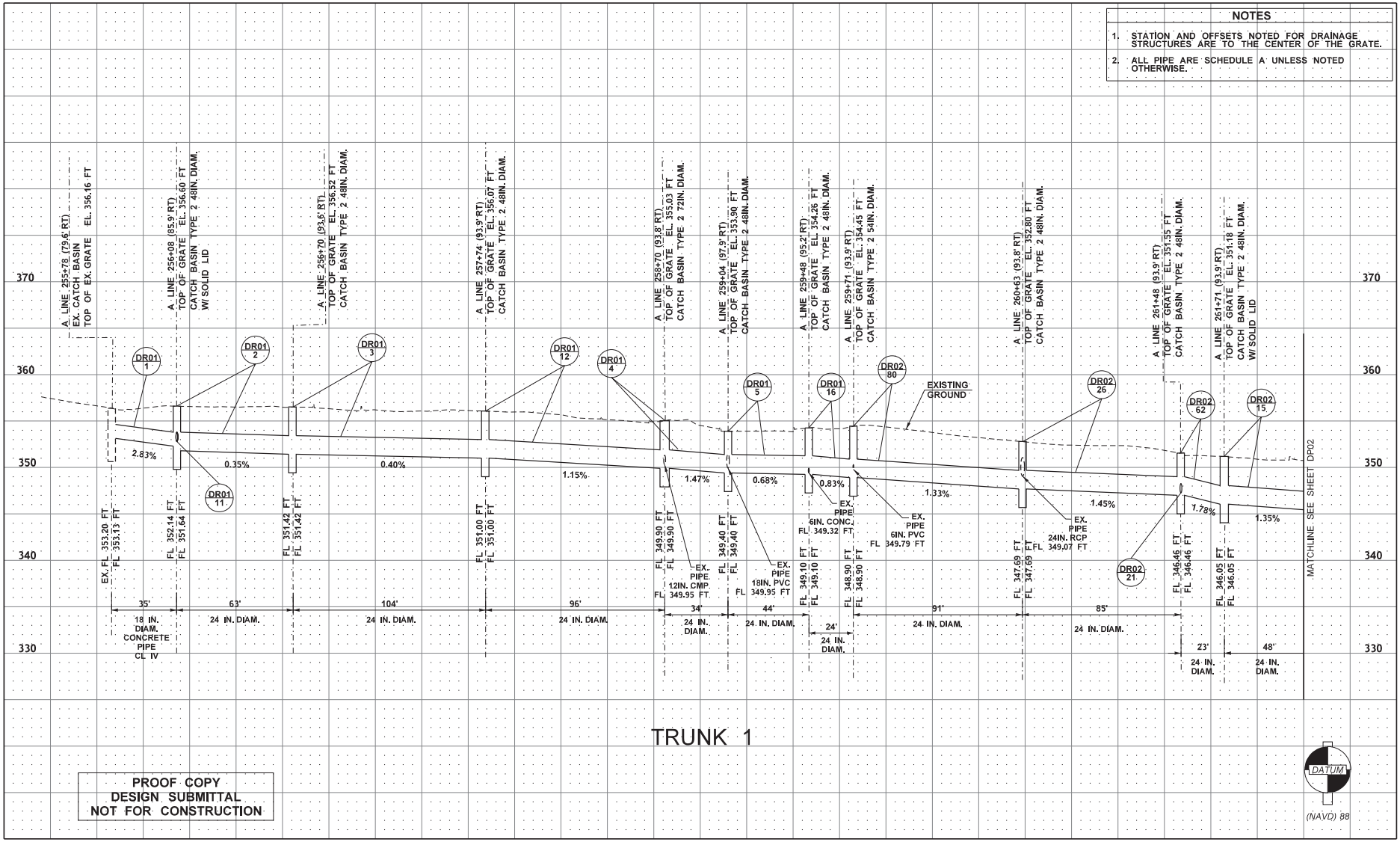
DRAINAGE DETAILS

PLAN REF NO
DRD08

SHEET
OF
366
SHEETS

APPENDIX E

DRAINAGE PROFILE SHEETS



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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
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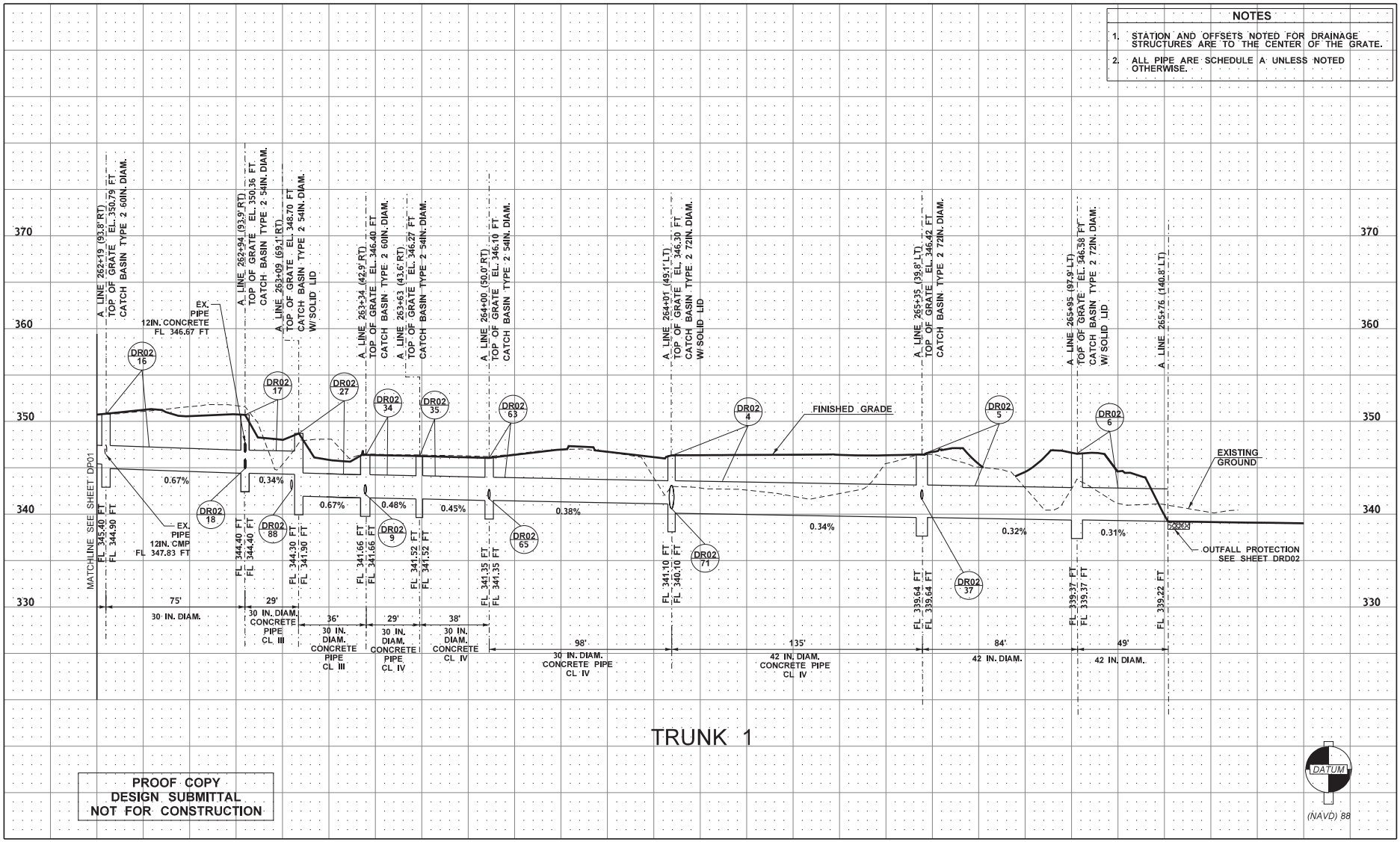
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP01

SHEET 85 OF 366 SHEETS



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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 — SEE SHEET CT1 — DATE

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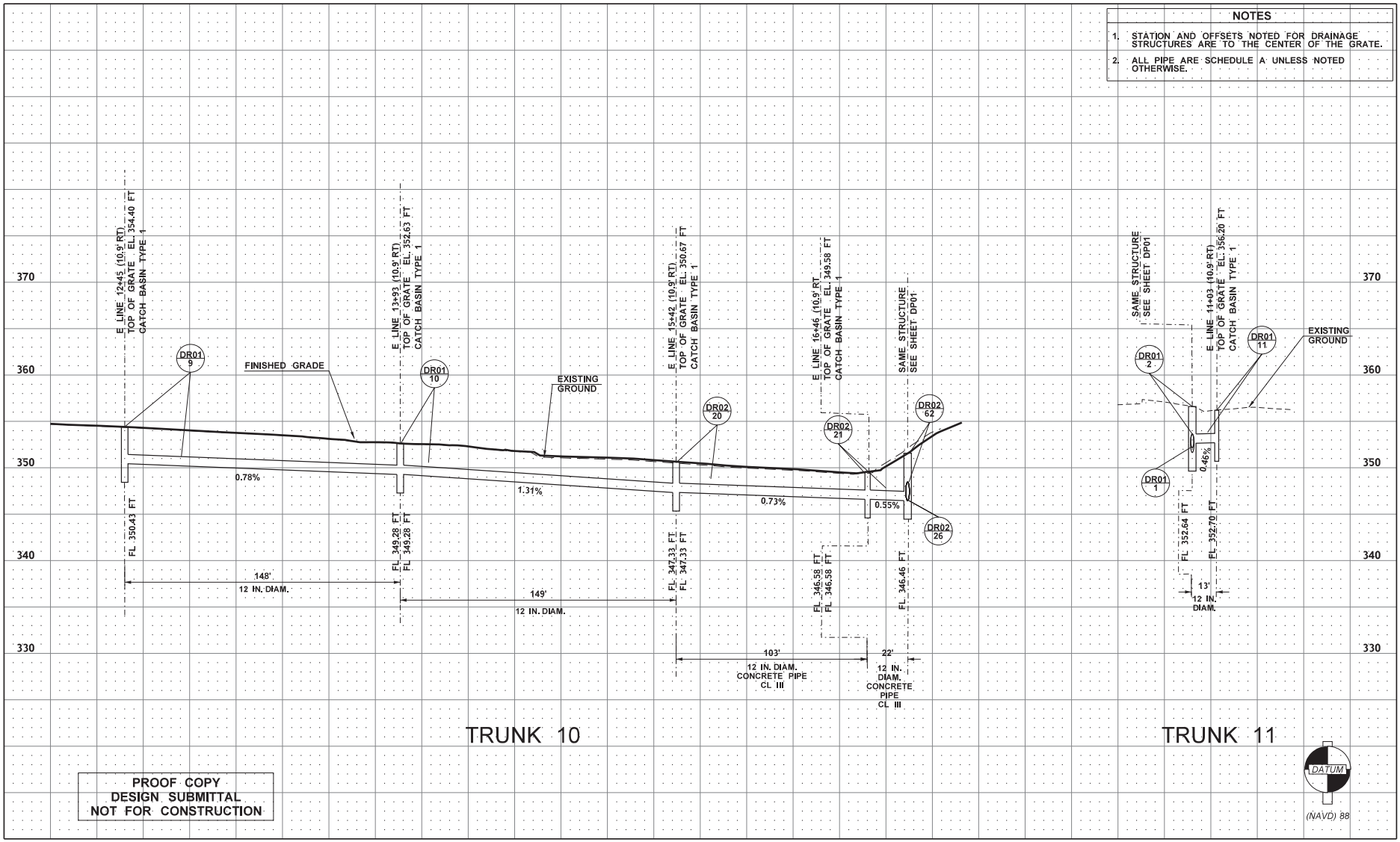
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO DP02

SHEET 86 OF 366 SHEETS



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ENTERED BY	N. CHEN								
CHECKED BY	L. THOMSEN								
PROJ. ENGR.	K. NDILE								
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY				

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SR 9
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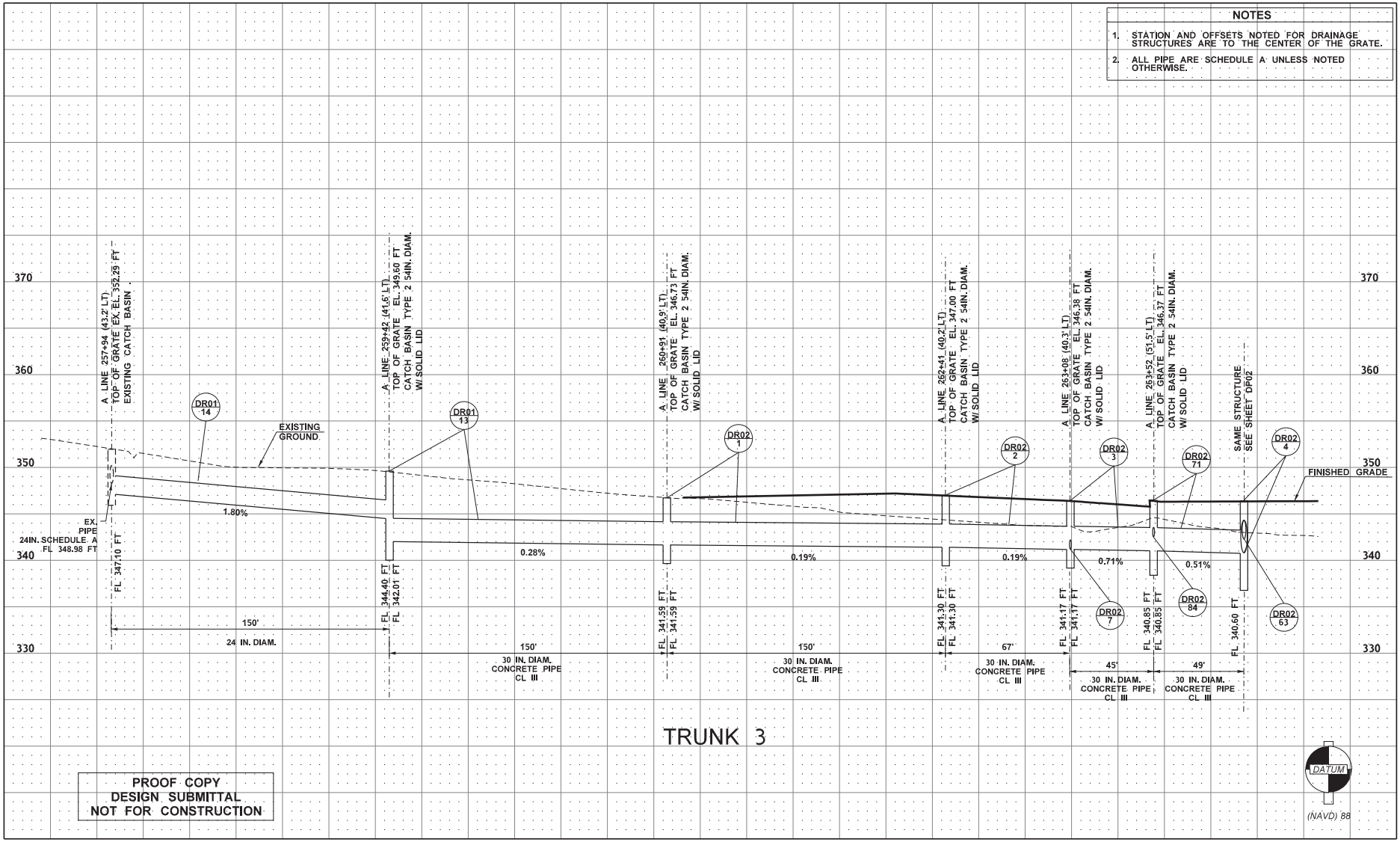
DRAINAGE PROFILES

PLAN REF NO
DP03

SHEET 87 OF 366 SHEETS



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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			

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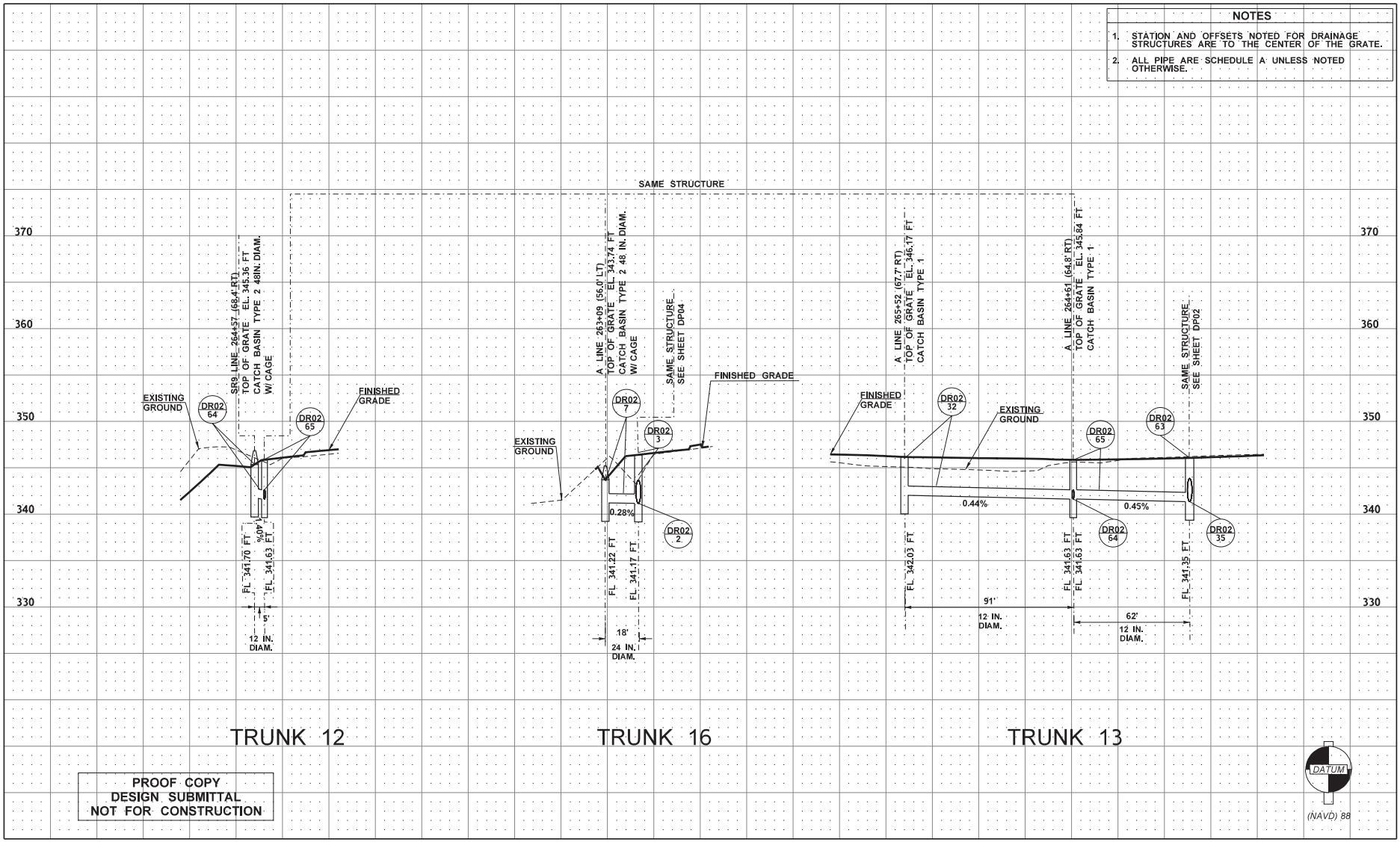
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP04

SHEET 88 OF 366 SHEETS



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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			

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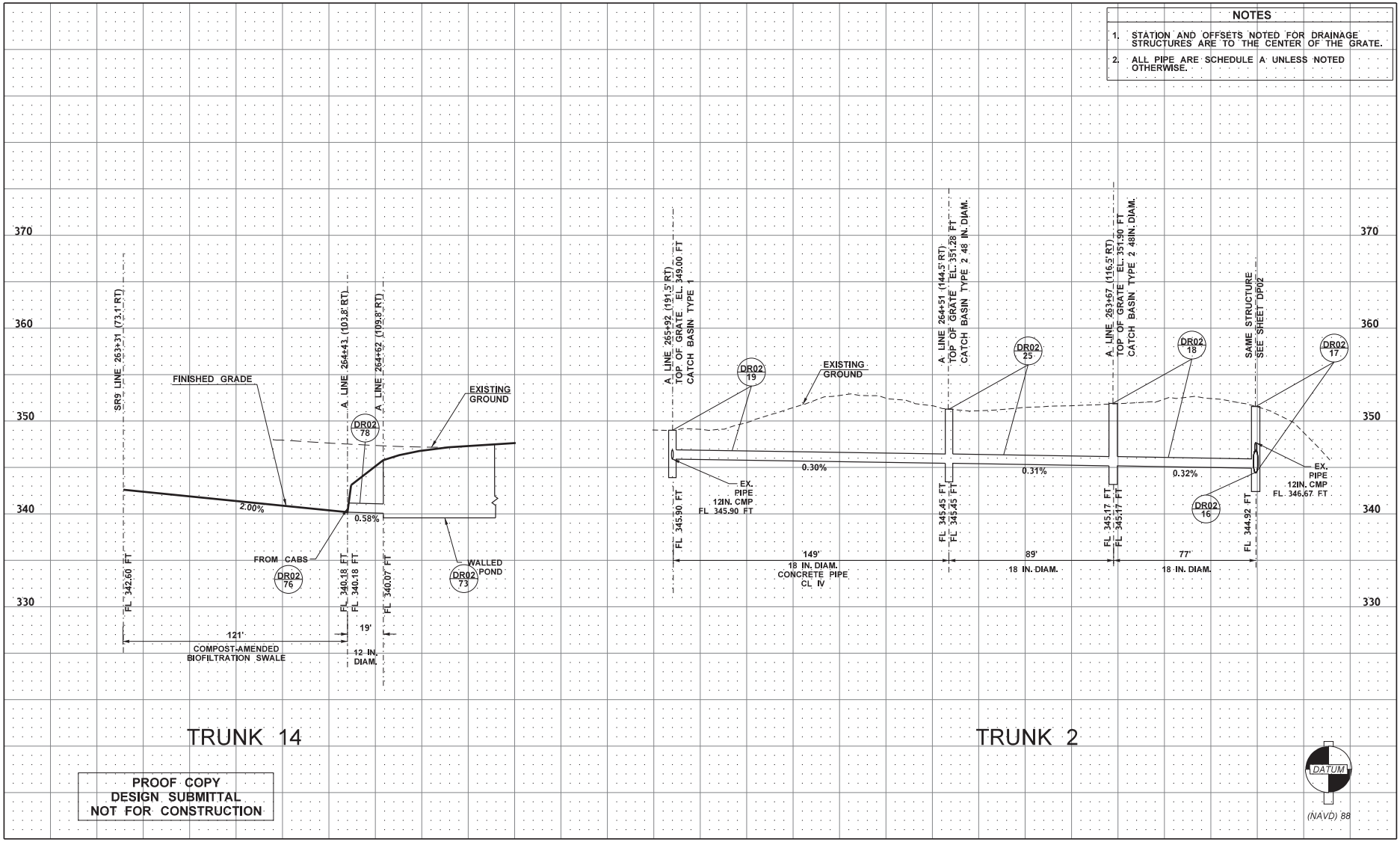
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP05

SHEET 89 OF 366 SHEETS



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DESIGNED BY	S. SRIDHARAN/T.HEW					CONTRACT 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.

LOCATION NO.

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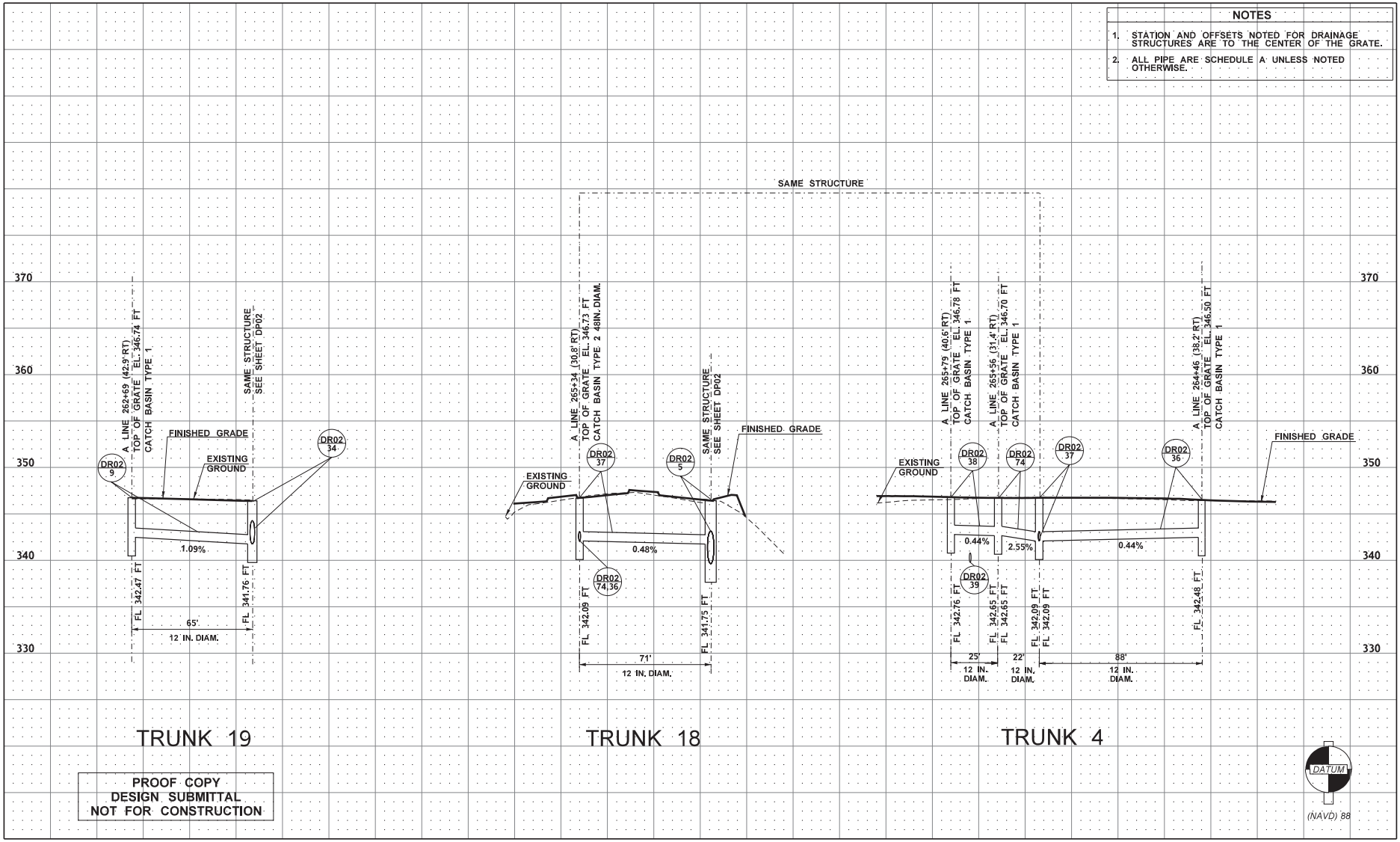
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP06

SHEET 90 OF 366 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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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.	STATE	FED.AID PROJ.NO.
10	WASH	
JOB NUMBER		
21A008		
CONTRACT NO.		LOCATION NO.

SEE SHEET CT1
DATE
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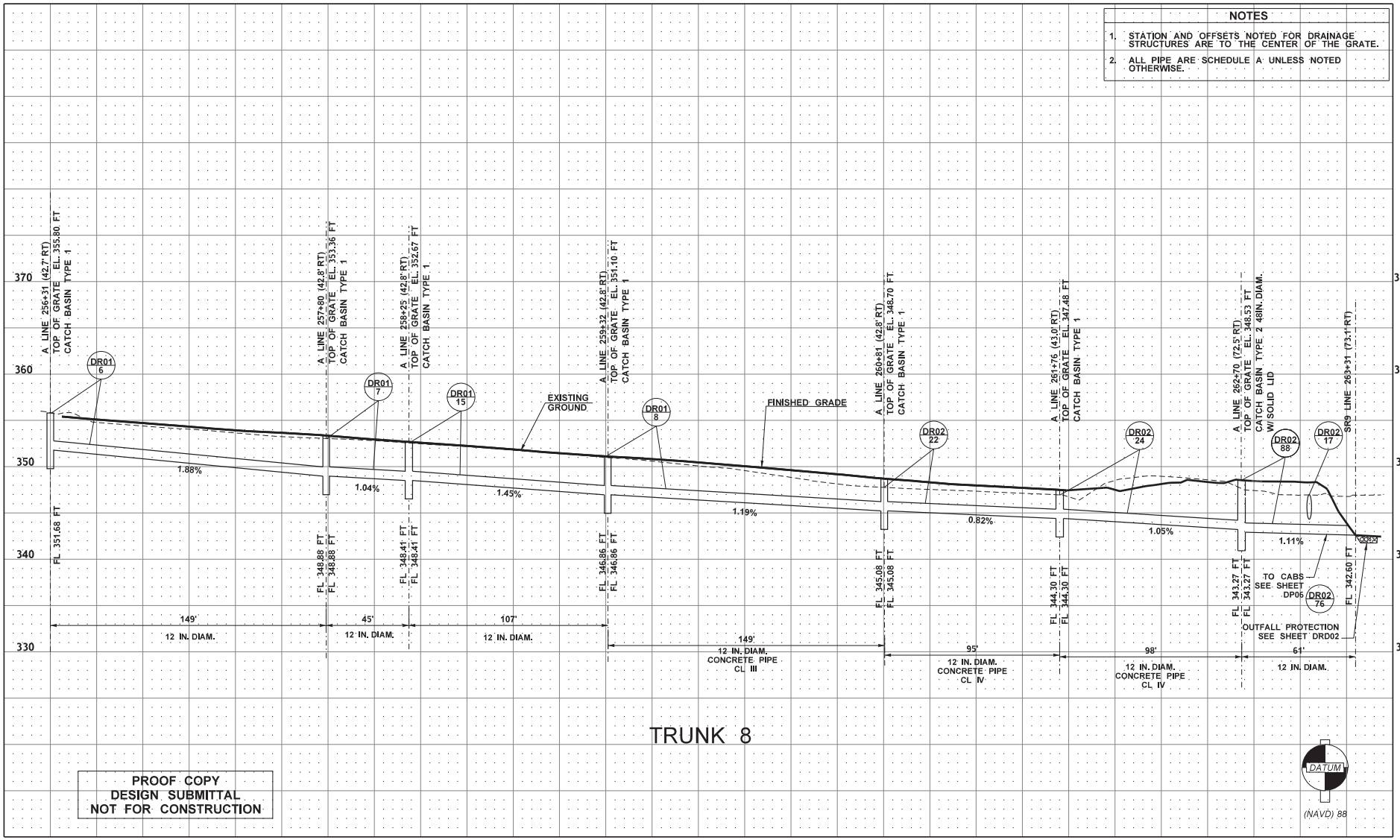
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP07

SHEET
91
OF
366
SHEETS



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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
10	WASH
JOB NUMBER	
21A008	
CONTRACT NO.	

FED.AID PROJ.NO.

LOCATION NO.

SEE SHEET CT1

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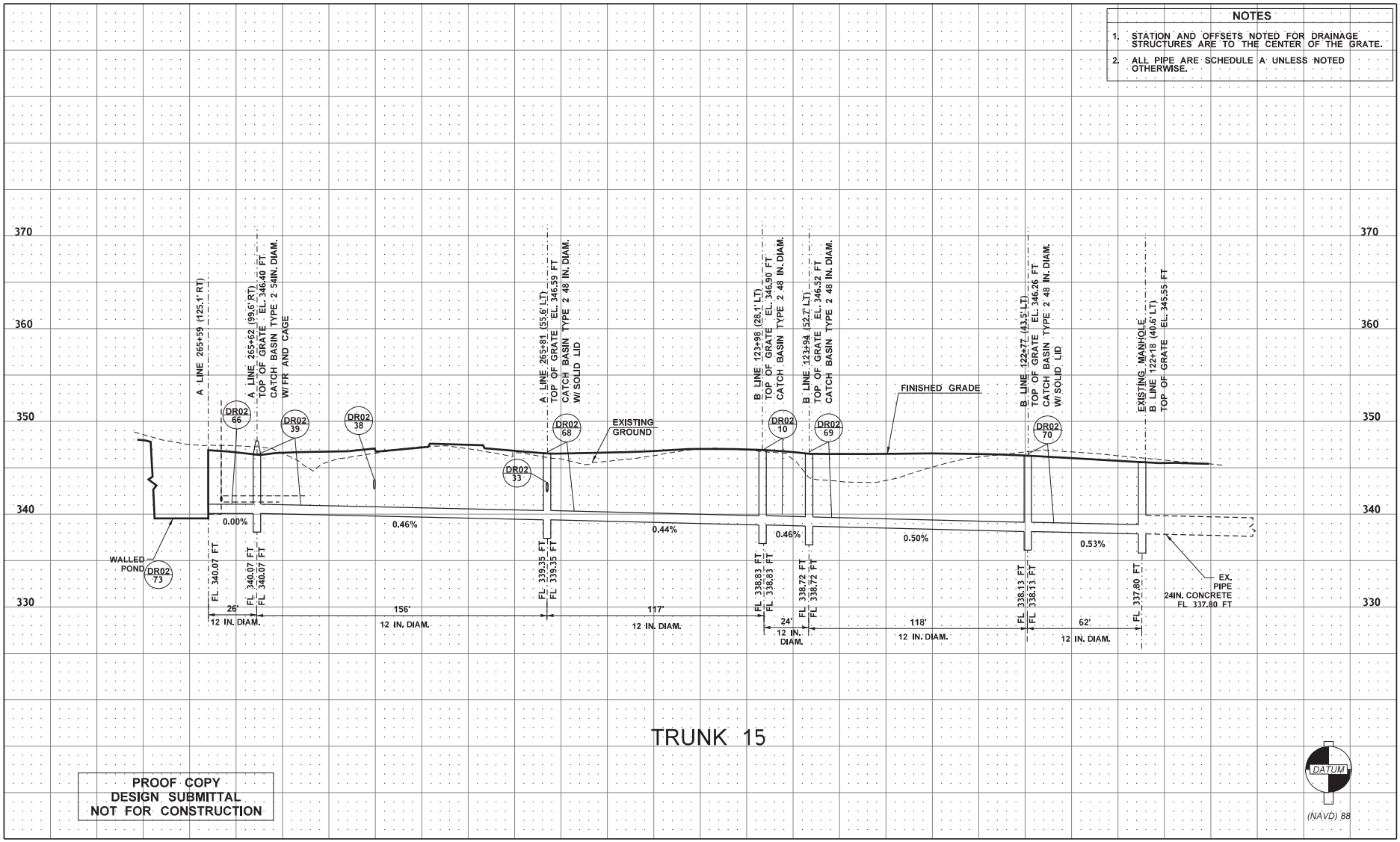
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP08

SHEET 92 OF 366 SHEETS



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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
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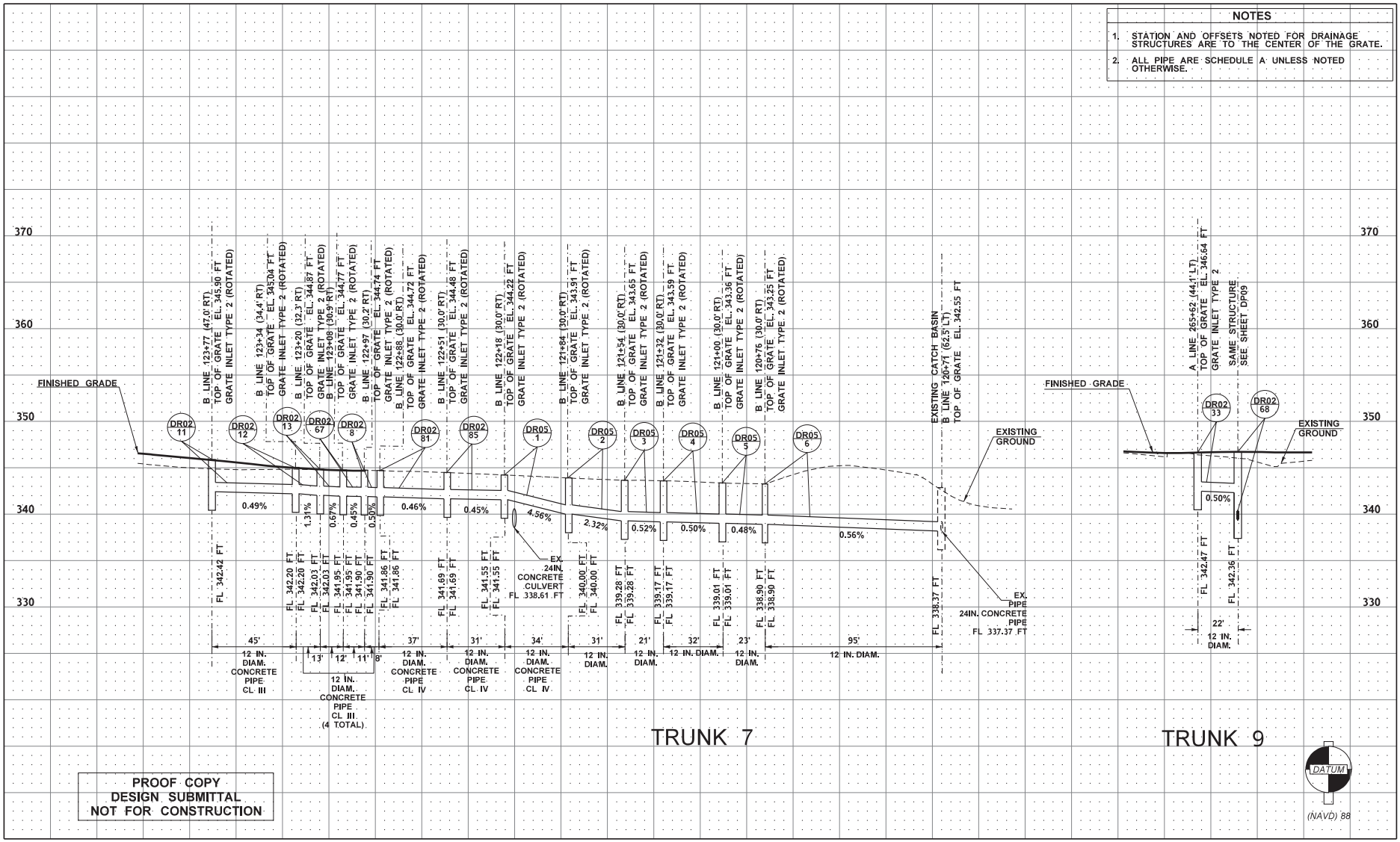
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP09

SHEET 93 OF 366 SHEETS



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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				

STATE OF WASHINGTON — 40803 — REGISTERED PROFESSIONAL ENGINEER
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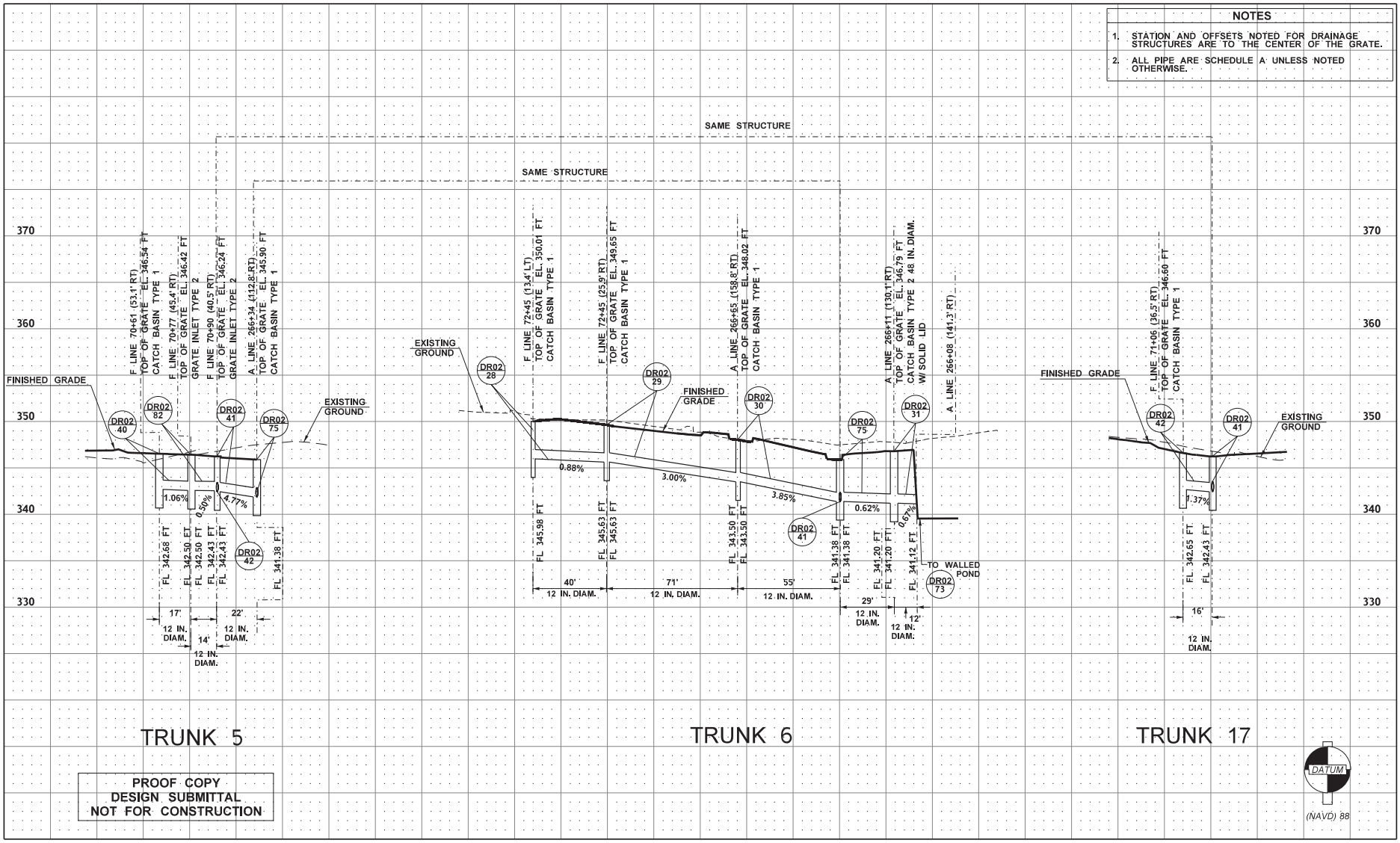
Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP10

SHEET
94
OF
366
SHEETS



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ENTERED BY	N. CHEN							
CHECKED BY	L. THOMSEN							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

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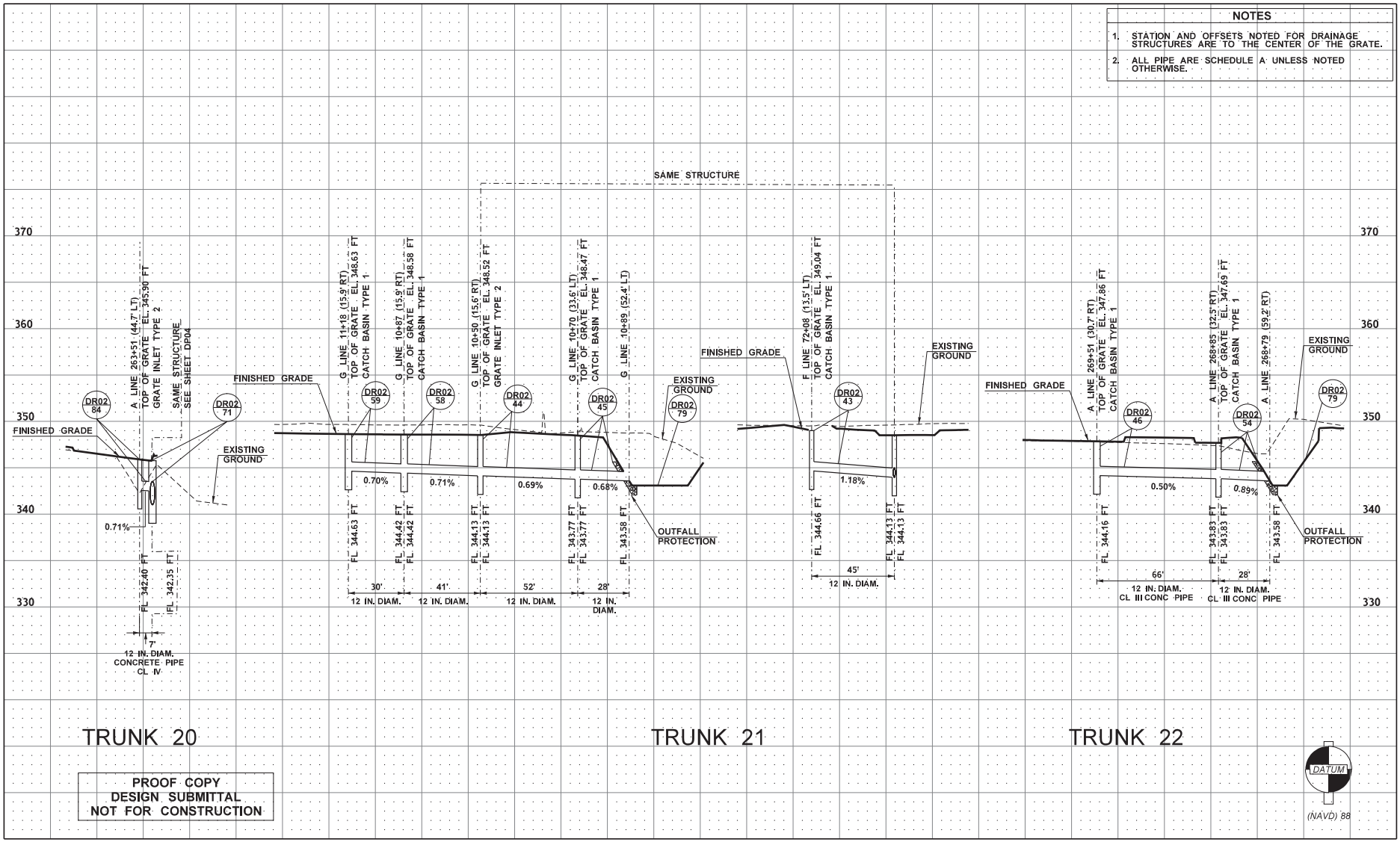
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP11

SHEET 95 OF 366 SHEETS



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REGION NO.	STATE
10	WASH
JOB NUMBER	
21A008	
CONTRACT NO.	

FED.AID PROJ.NO.

LOCATION NO.

STATE OF WASHINGTON 40803 REGISTERED PROFESSIONAL ENGINEER

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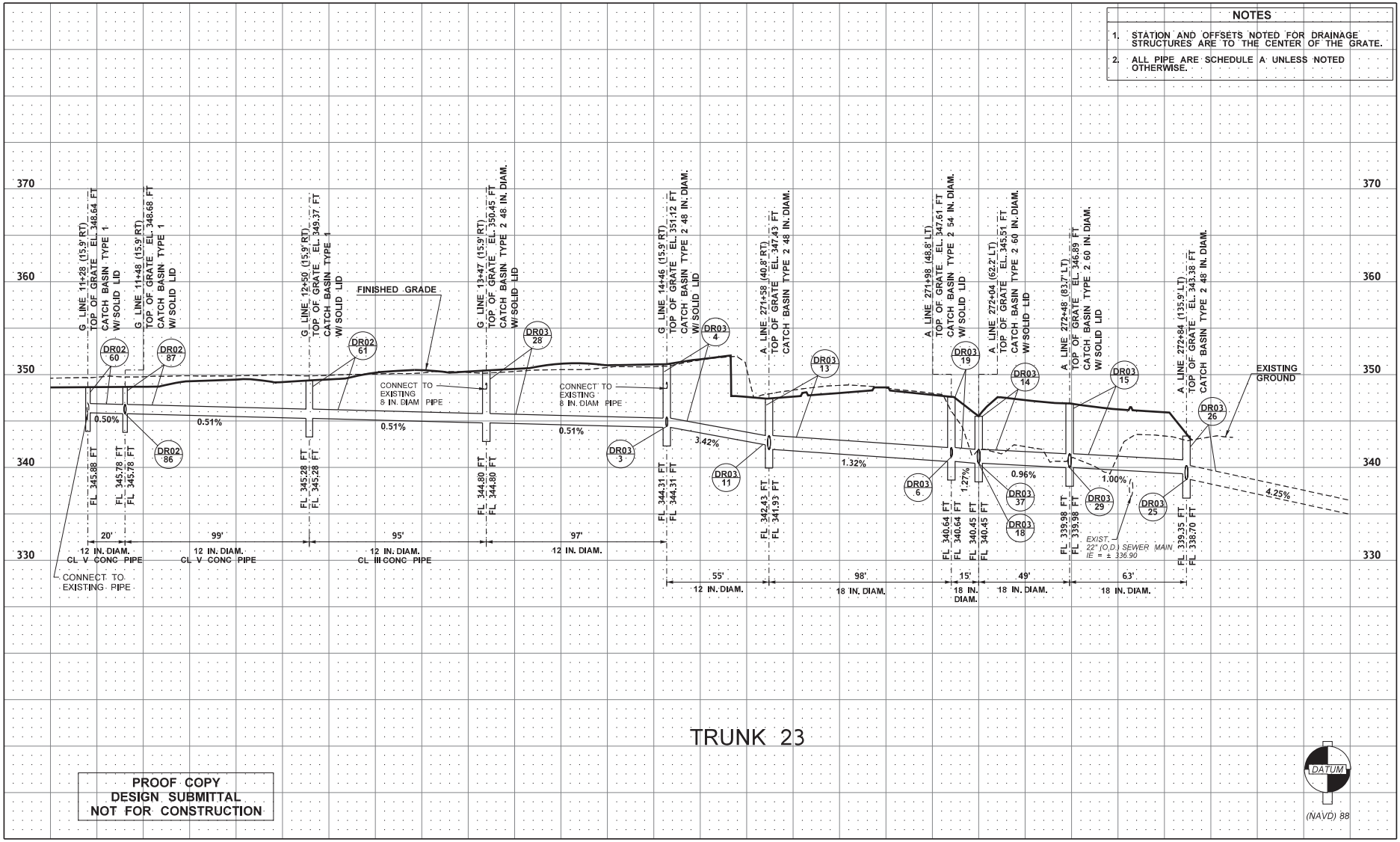
SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
DP12

SHEET
96
OF
366
SHEETS



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PROJ. ENGR.	K. NDILE								
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY				

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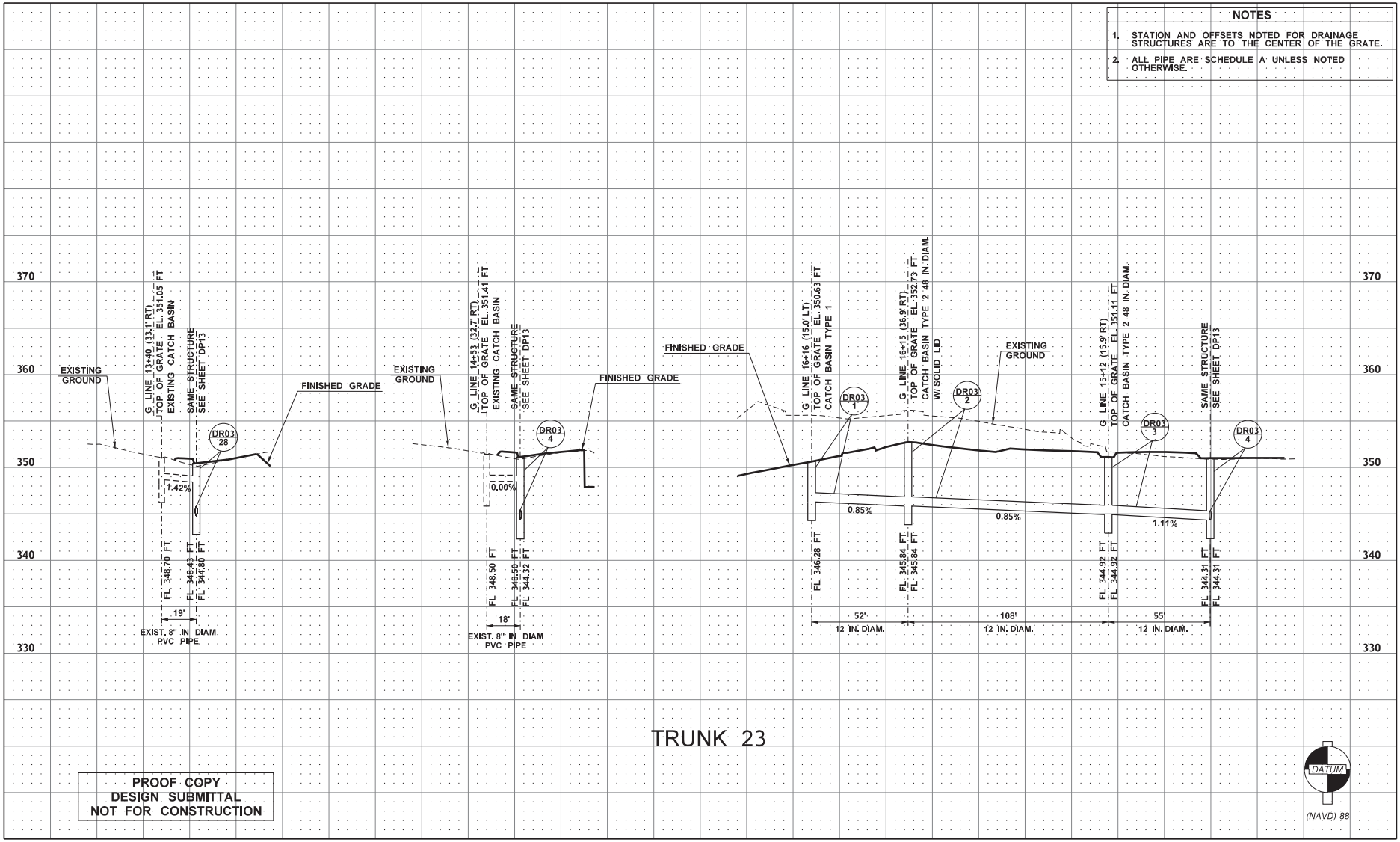
DRAINAGE PROFILES

PLAN REF NO DP13

SHEET 97 OF 366 SHEETS



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REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO. 10 | STATE WASH | FED.AID PROJ.NO.
JOB NUMBER 21A008
CONTRACT NO. | LOCATION NO.

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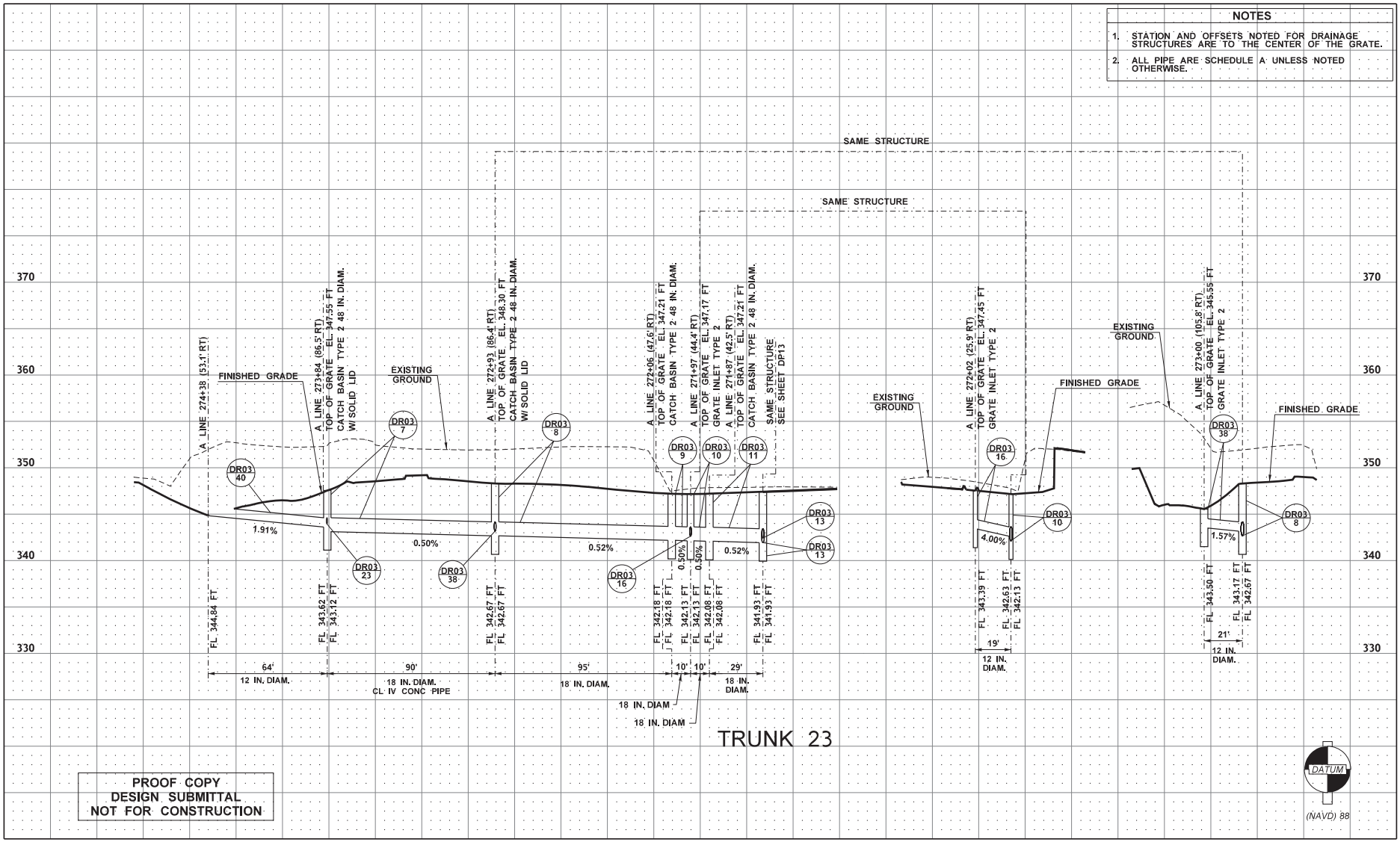
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO DP14

SHEET 98 OF 366 SHEETS



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REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

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SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO DP15

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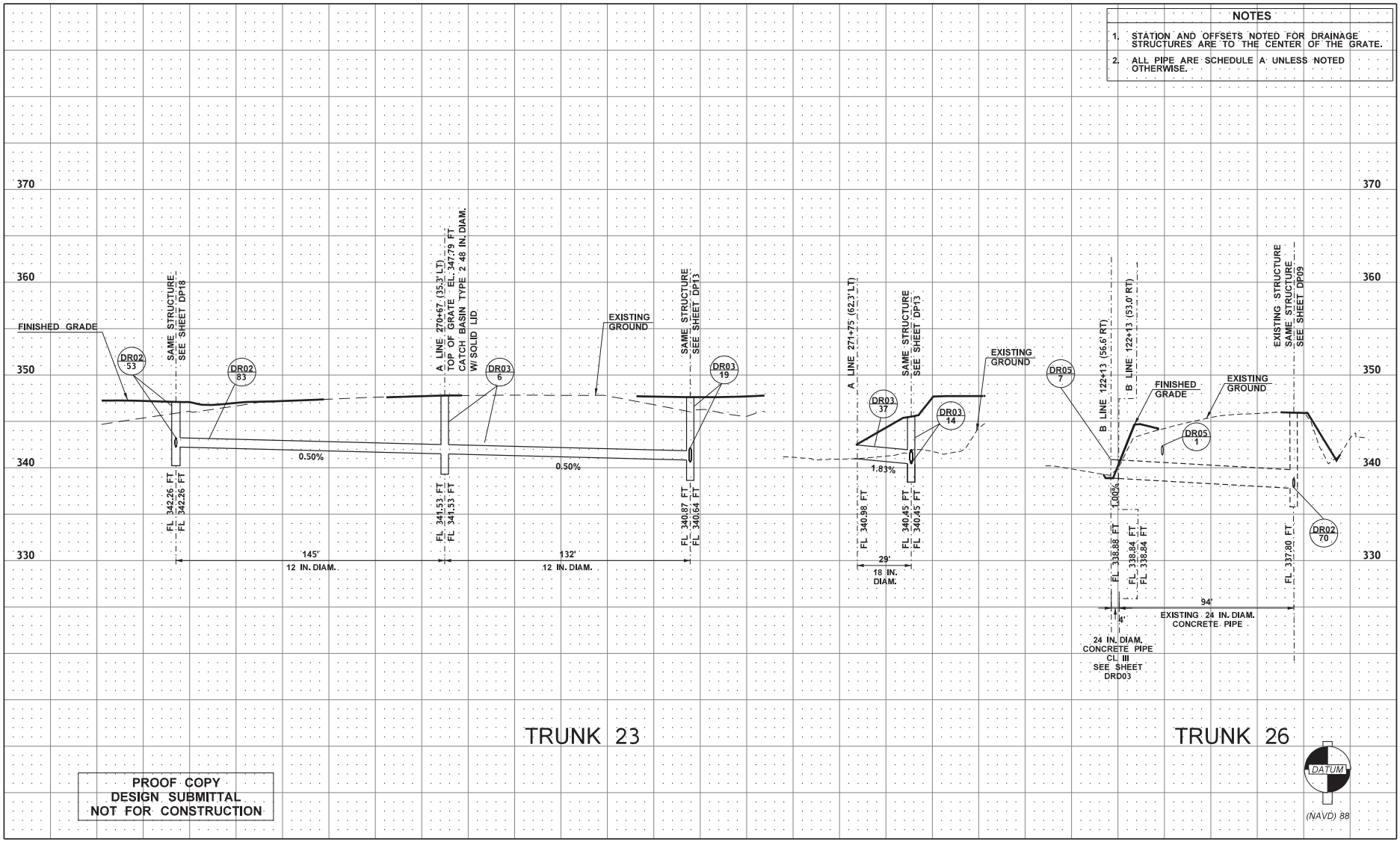

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PROJ. ENGR.	K. NDILE				
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

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JOB NUMBER 21A008
CONTRACT NO.
FED.AID PROJ.NO.
LOCATION NO.

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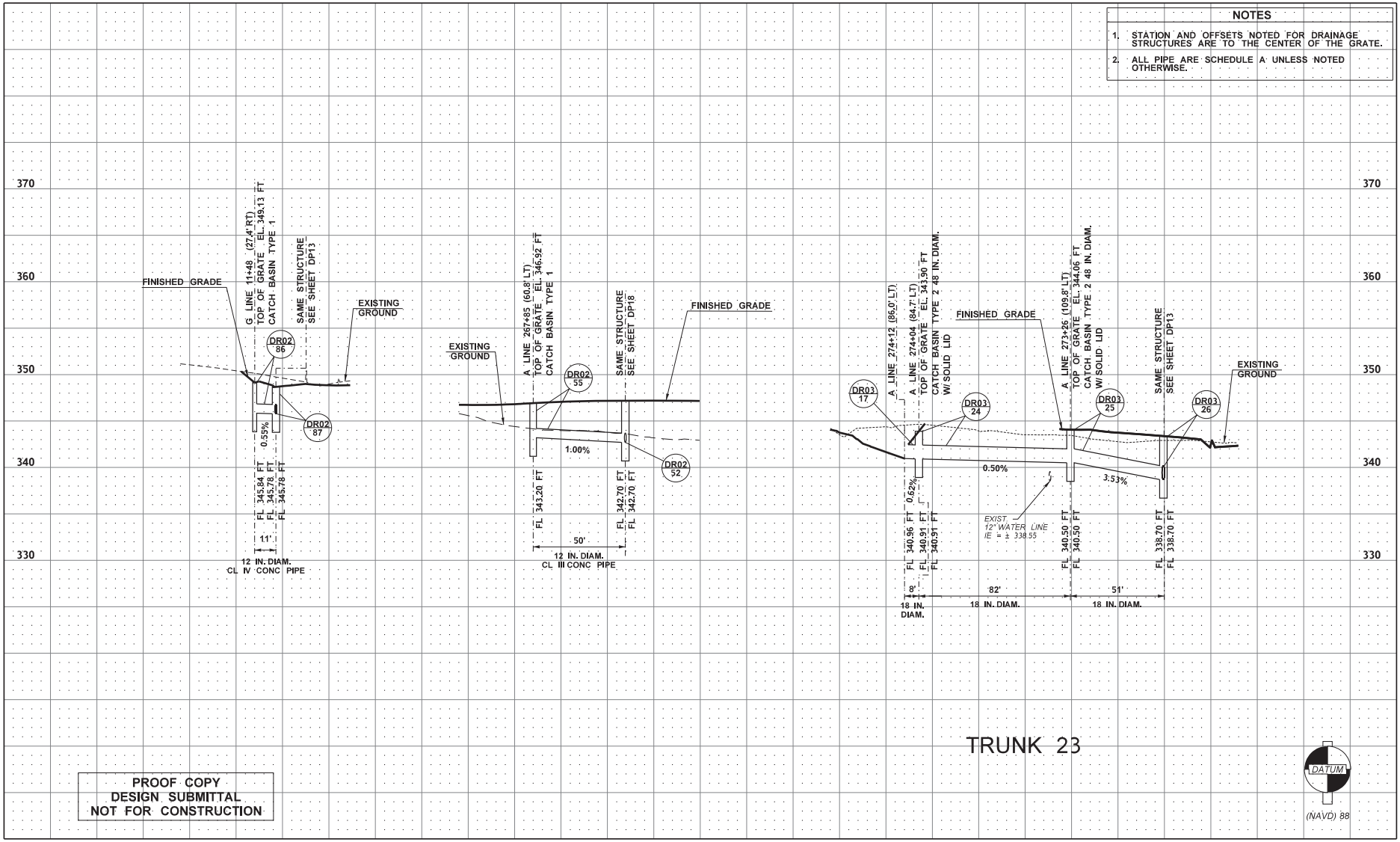
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO DP16

SHEET 100 OF 366 SHEETS



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REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY

REGION NO.	STATE
10	WASH
JOB NUMBER	
21A008	
CONTRACT NO.	

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SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

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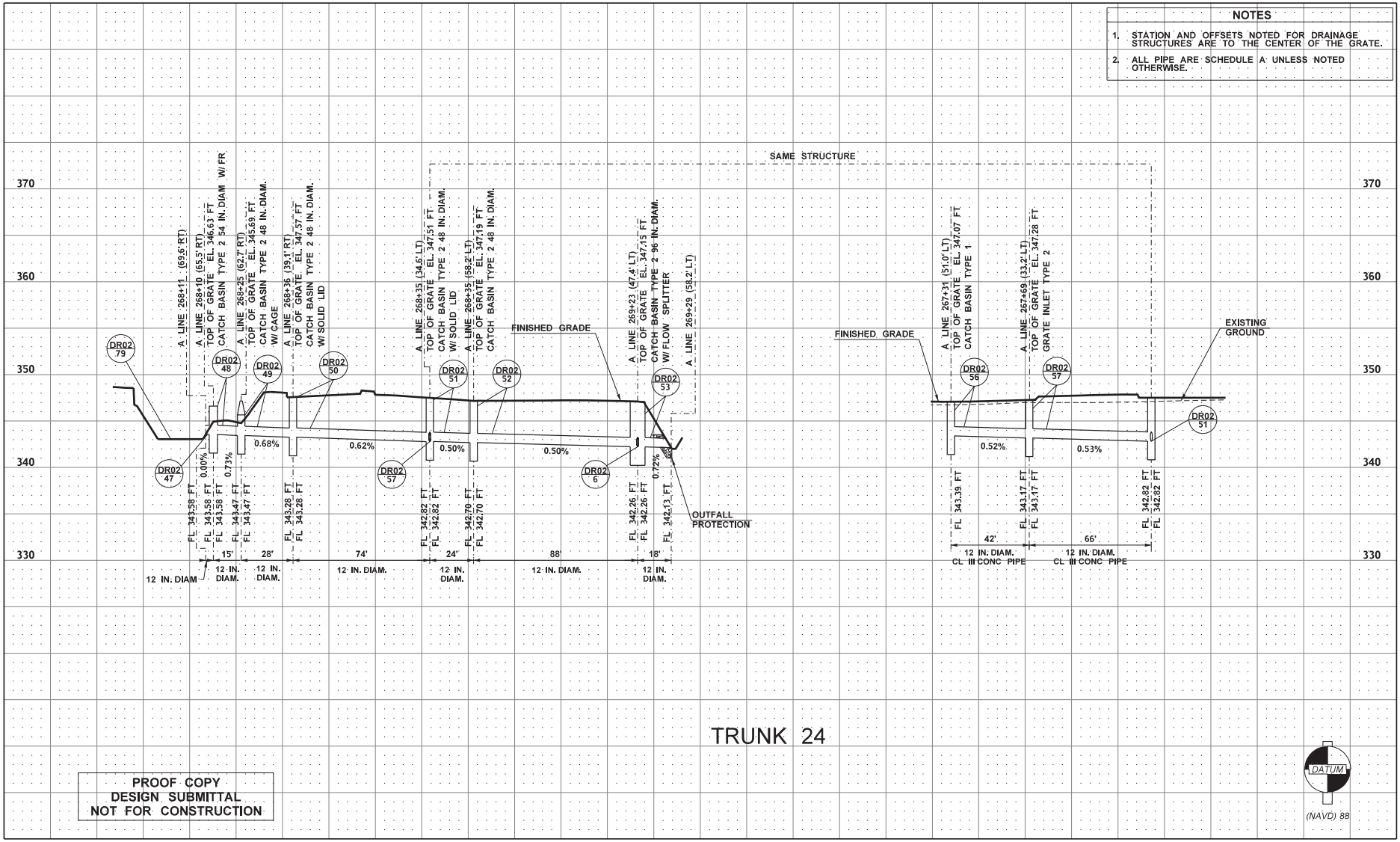

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PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

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SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO
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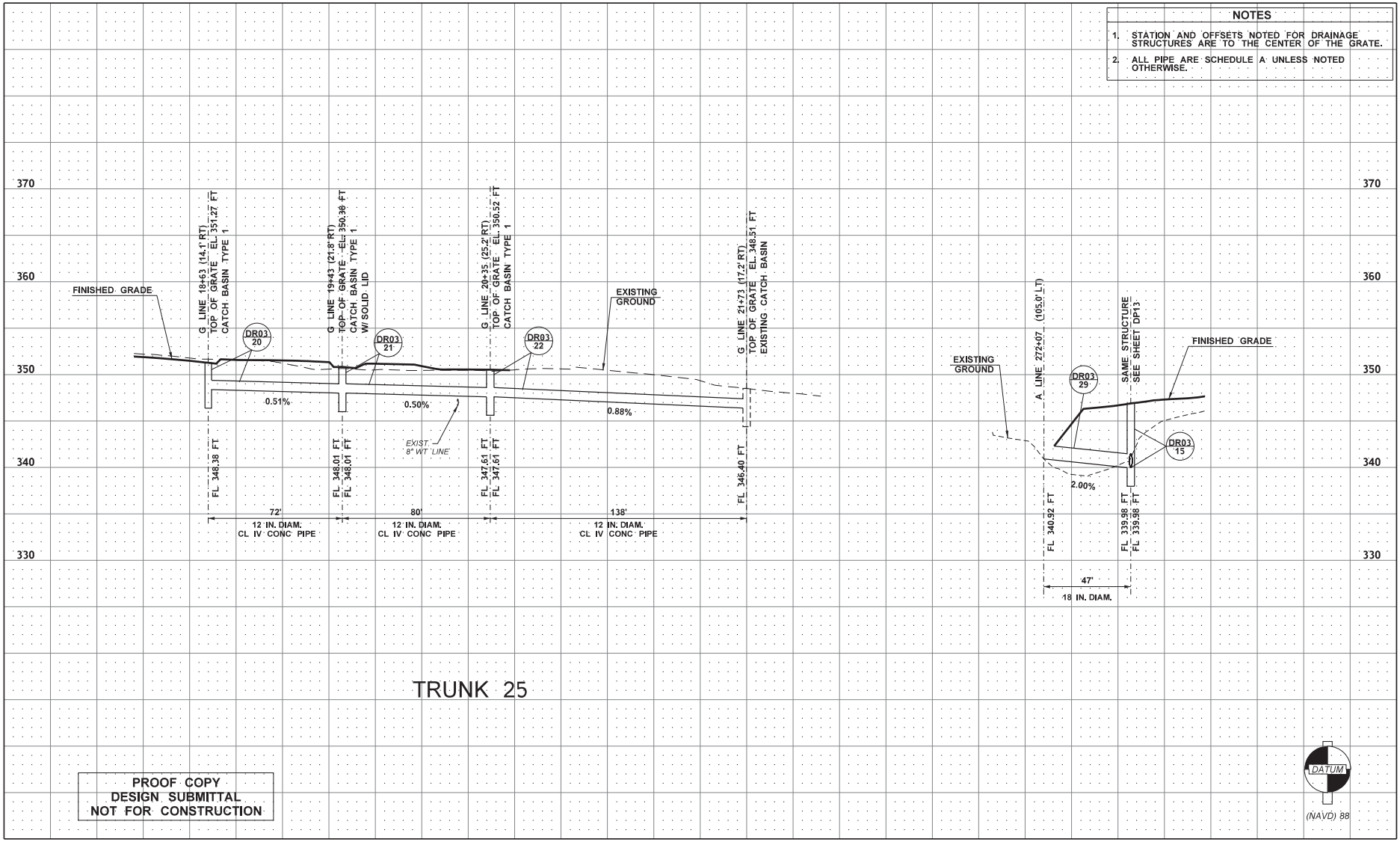
SHEET 102 OF 366 SHEETS



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REGIONAL ADM.	M. COTTEN

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REGION NO.	STATE
10	WASH
JOB NUMBER	21A008
CONTRACT NO.	

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SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

DRAINAGE PROFILES

PLAN REF NO DP19

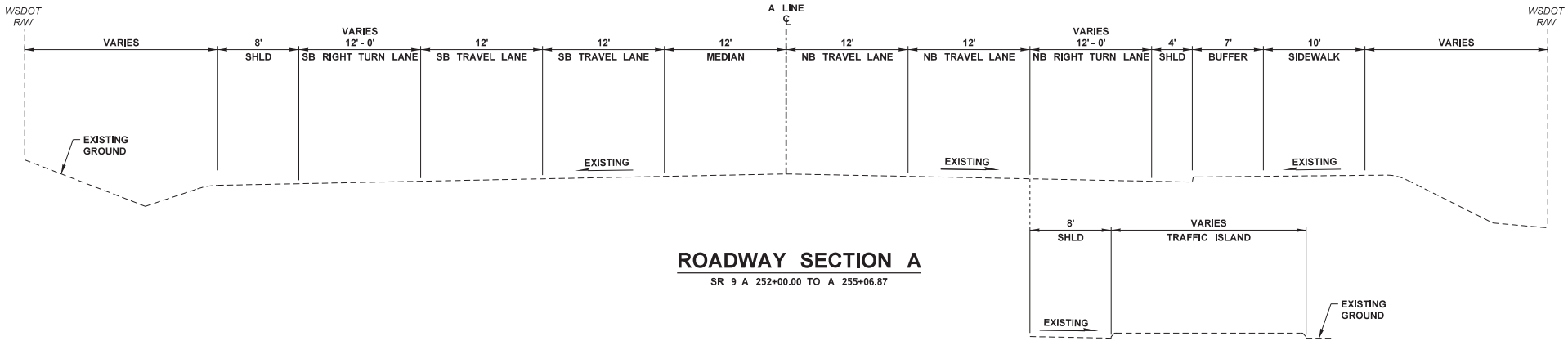
SHEET 103 OF 366 SHEETS

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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



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) SEE PAVING DETAILS
14. ROADWAY EXCAVATION INCL. HAUL
15. HMA FOR PRELEVELING CL, 1/2 IN. PG
16. BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17. STRUCTURE EXCAVATION, CLASS A INCL. HAUL

ABBREVIATION KEY

℄ - CENTERLINE
NB - NORTHBOUND
SB - SOUTHBOUND
EB - EASTBOUND
WB - WESTBOUND
NST - NOT STEEPER THAN
R/W - RIGHT OF WAY
SH - SHOULDER
SHLD - SHOULDER
SWLK - SIDEWALK

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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		

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SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

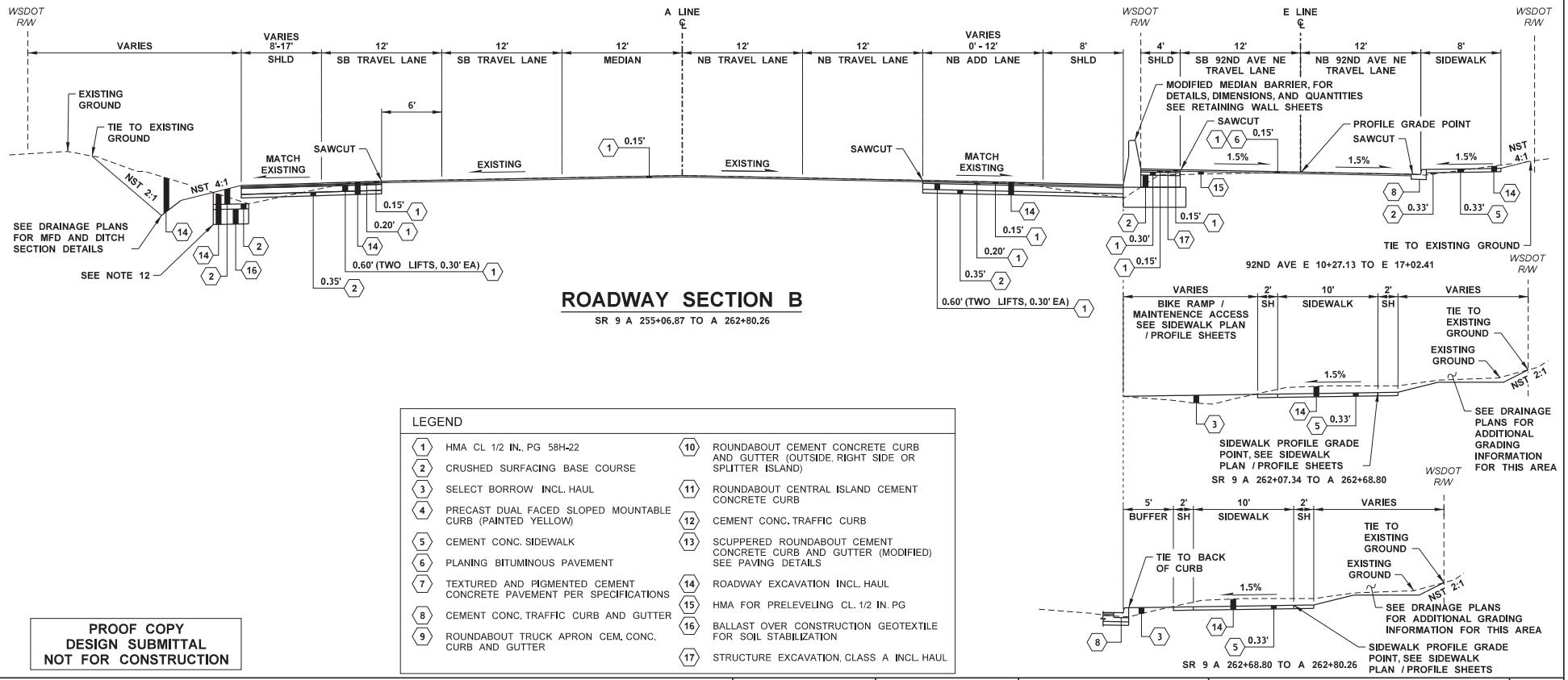
ROADWAY SECTIONS

PLAN REF NO RS01

SHEET 10 OF 366 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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



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) SEE PAVING DETAILS
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	HMA FOR PRELEVELING CL. 1/2 IN. PG
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

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REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY				

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SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

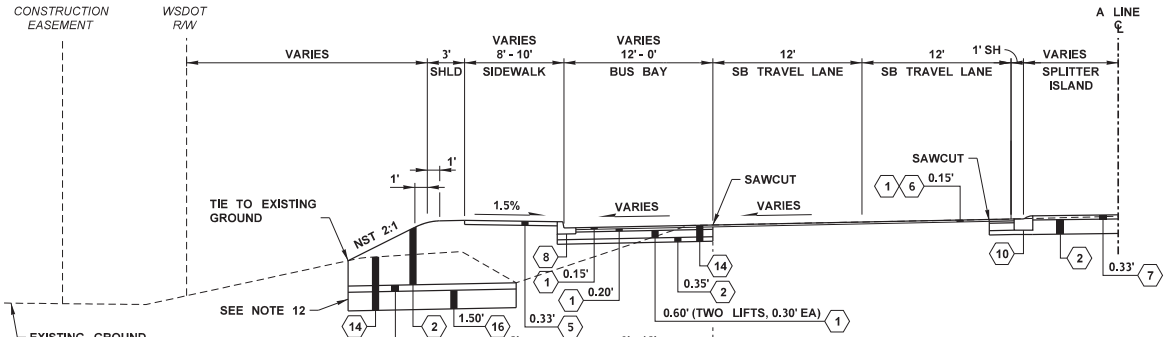
ROADWAY SECTIONS

PLAN REF NO RS02

SHEET 11 OF 366 SHEETS

GENERAL NOTES:

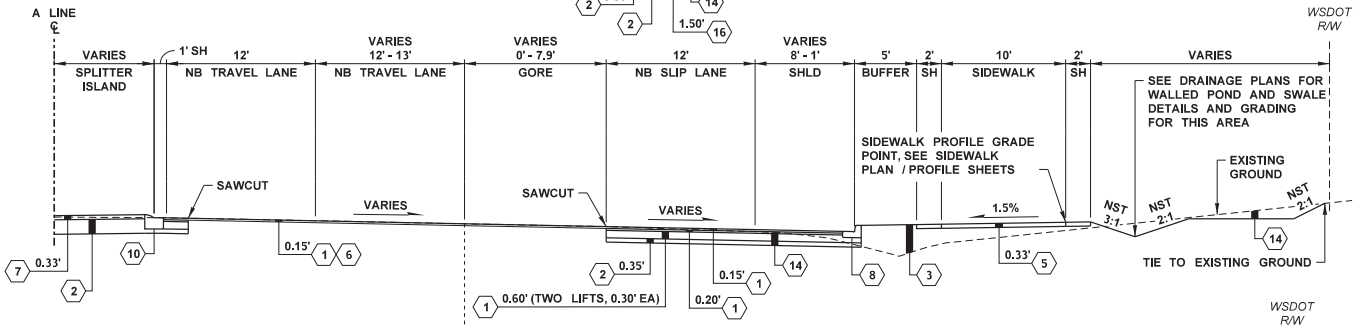
1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING 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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



SR 9 A 262+80.06 TO A 263+51.46

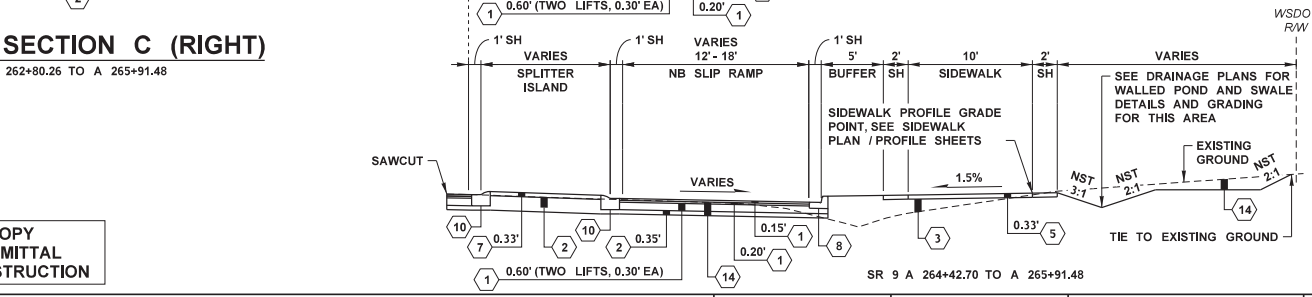
ROADWAY SECTION C (LEFT)

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



SR 9 A 264+42.70 TO A 265+91.48

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) SEE PAVING DETAILS
14	ROADWAY EXCAVATION INCL. HAUL
15	HMA FOR PRELEVELING CL. 1/2 IN. PG
16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL

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ENTERED BY	K. MCWILLIAMS							
CHECKED BY	R. HOWARD							
PROJ. ENGR.	K. NDILE							
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

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SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO RS03

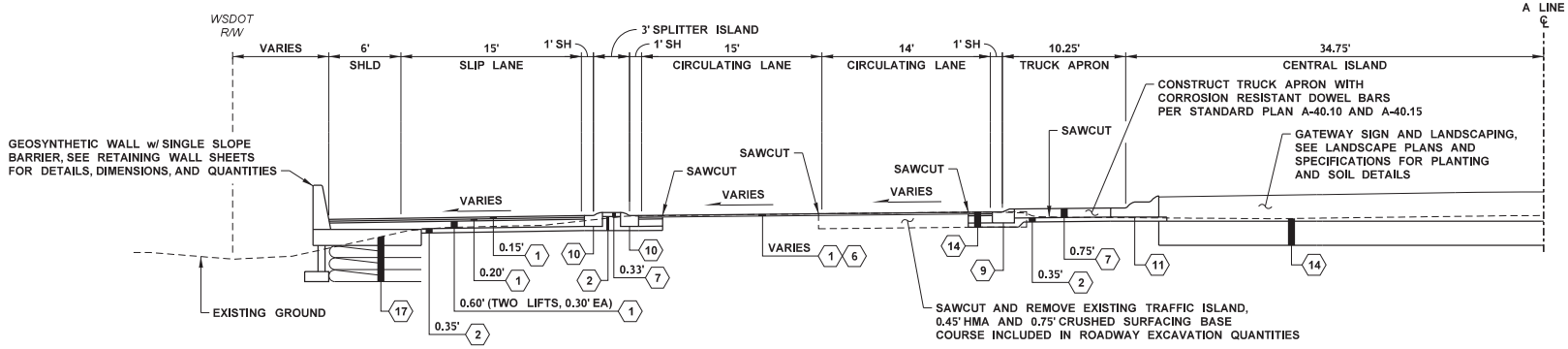
SHEET 12 OF 366 SHEETS

GENERAL NOTES:

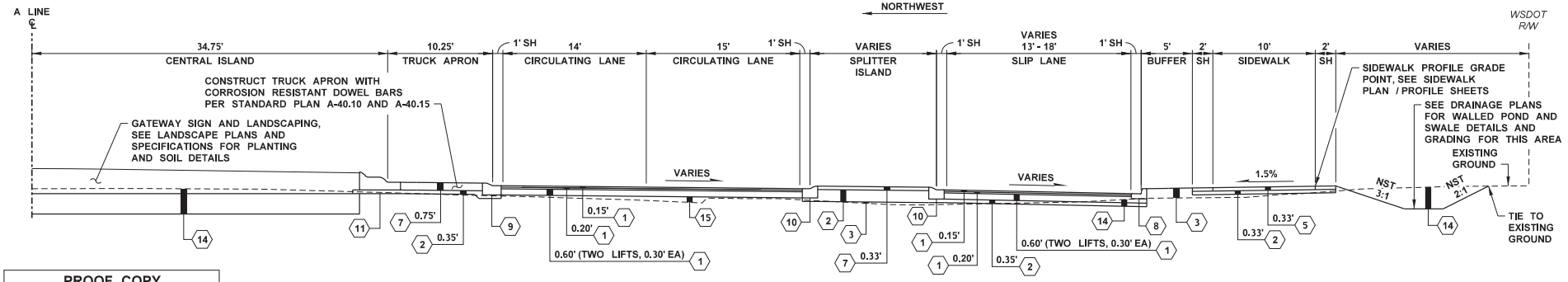
1. SHOULDERS TO BE FULL DEPTH TO MATCH TRAVEL LANE.
2. ALL PAVING AND SURFACING DEPTHS SHOWN ARE COMPACTED DEPTHS.
3. SEE PAVING PLAN FOR VARIABLE WIDTHS.
4. PAVE THE ENTIRE ROADWAY, INCLUDING WIDENING AREAS, TURN POCKETS AND SHOULDERS.
5. ALL SLOPE TRANSITIONS BEYOND ROADWAY SHOULDER REQUIRE SLOPE ROUNDING 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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.

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) SEE PAVING DETAILS
14. ROADWAY EXCAVATION INCL. HAUL
15. HMA FOR PRELEVELING CL. 1/2 IN. PG
16. BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17. STRUCTURE EXCAVATION, CLASS A INCL. HAUL



ROUNDABOUT SECTION - SR9/SR204



ROUNDABOUT SECTION - SR9/SR204

SOUTHEAST

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NOT FOR CONSTRUCTION

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PLOTTED BY	p0024020					21A008		
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 — 21826 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

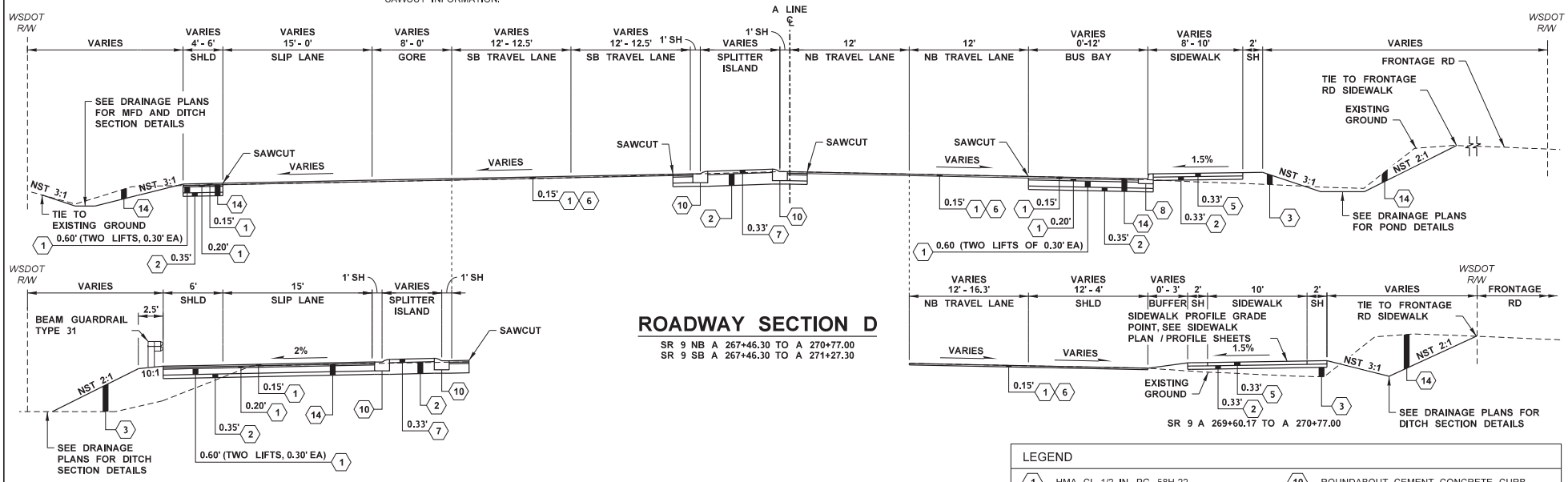
ROADWAY SECTIONS

PLAN REF NO
RS04

SHEET 13 OF 366 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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



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) SEE PAVING DETAILS
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	HMA FOR PRELEVELING CL. 1/2 IN. PG
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

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NOT FOR CONSTRUCTION

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TIME	1:02:37 PM					10	WASH	
DATE	11/8/2021					JOB NUMBER		
PLOTTED BY	p0024020					21A008		
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 — 21824 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

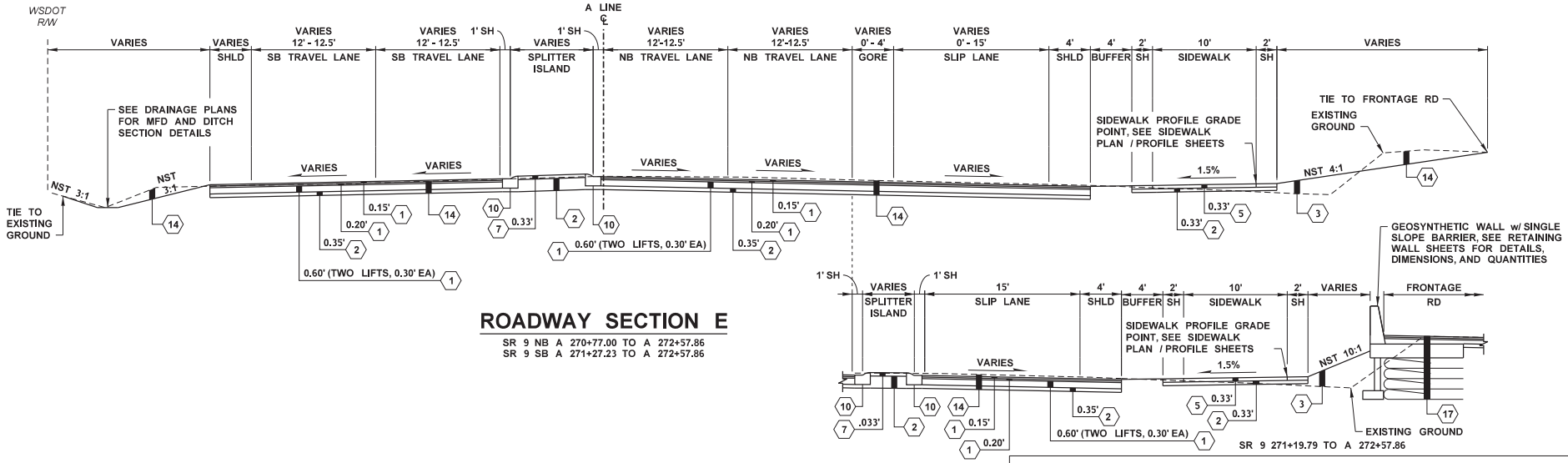
ROADWAY SECTIONS

PLAN REF NO
RS05

SHEET 14 OF 366 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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



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) SEE PAVING DETAILS
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	HMA FOR PRELEVELING CL. 1/2 IN. PG
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		

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TIME	1:02:50 PM					10	WASH	
DATE	11/8/2021					JOB NUMBER		
PLOTTED BY	p0024020					21A008		
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 — 21824 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
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 15 OF 366 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.
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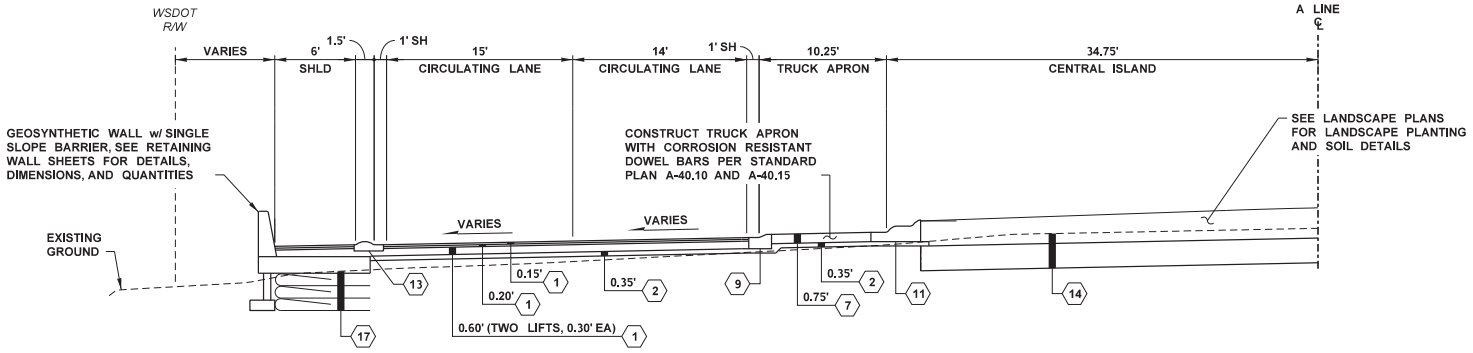
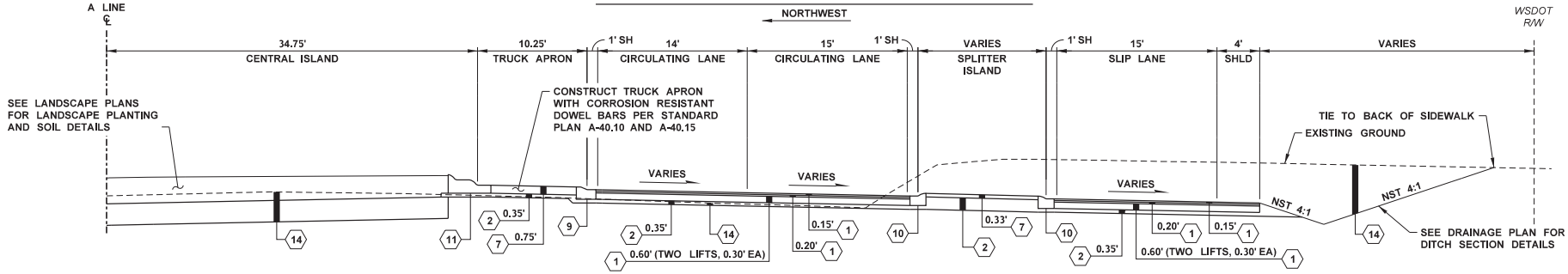
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.

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) SEE PAVING DETAILS
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	HMA FOR PRELEVELING CL. 1/2 IN. PG
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		



ROUNDABOUT SECTION - SR9/VERNON



ROUNDABOUT SECTION - SR9/VERNON

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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 — 17826 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
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

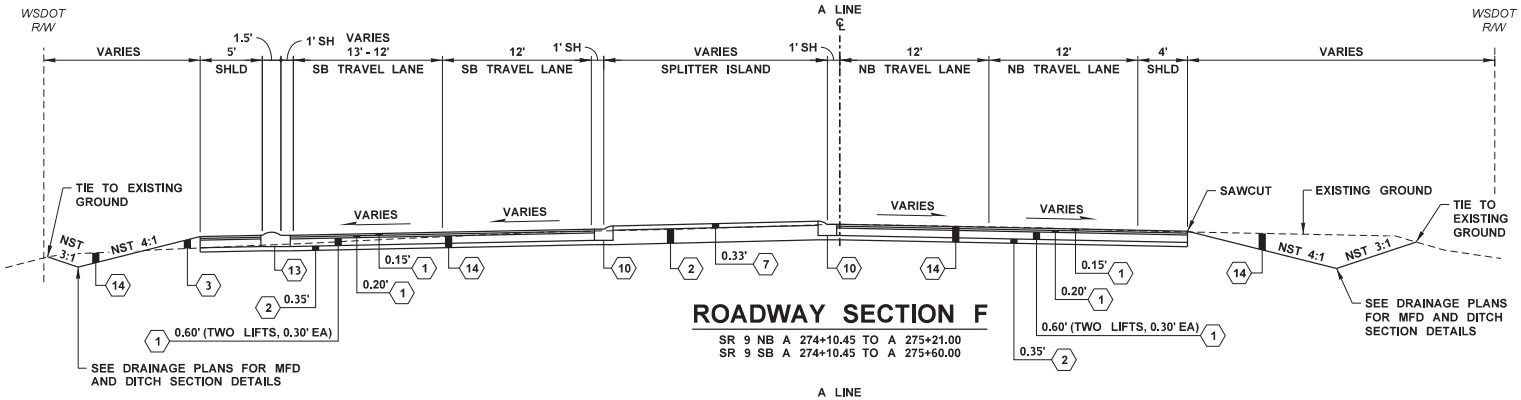
SHEET 16 OF 366 SHEETS

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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.

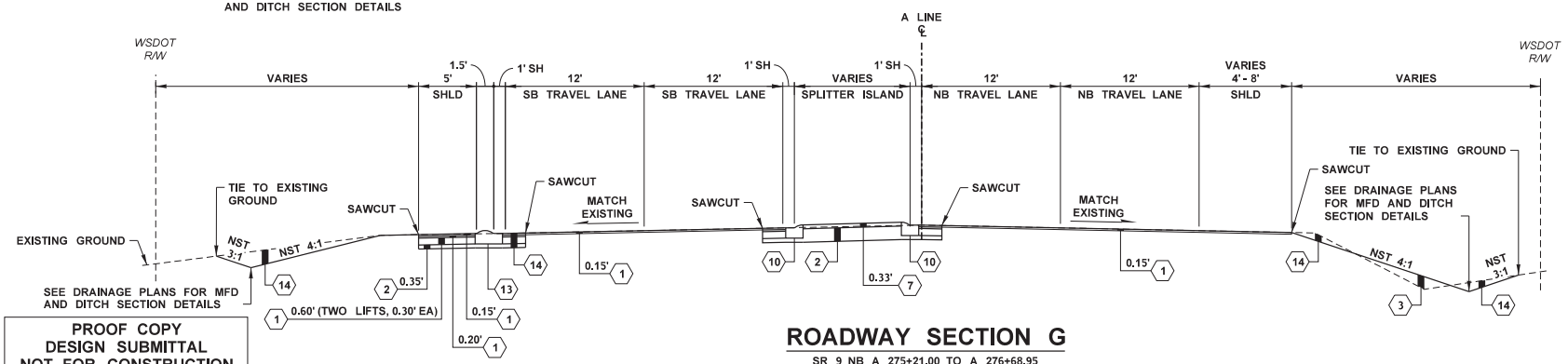
LEGEND

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) SEE PAVING DETAILS
14. ROADWAY EXCAVATION INCL. HAUL
15. HMA FOR PRELEVELING CL. 1/2 IN. PG
16. BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17. STRUCTURE EXCAVATION, CLASS A INCL. HAUL



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

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NOT FOR CONSTRUCTION

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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 — 21826 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
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

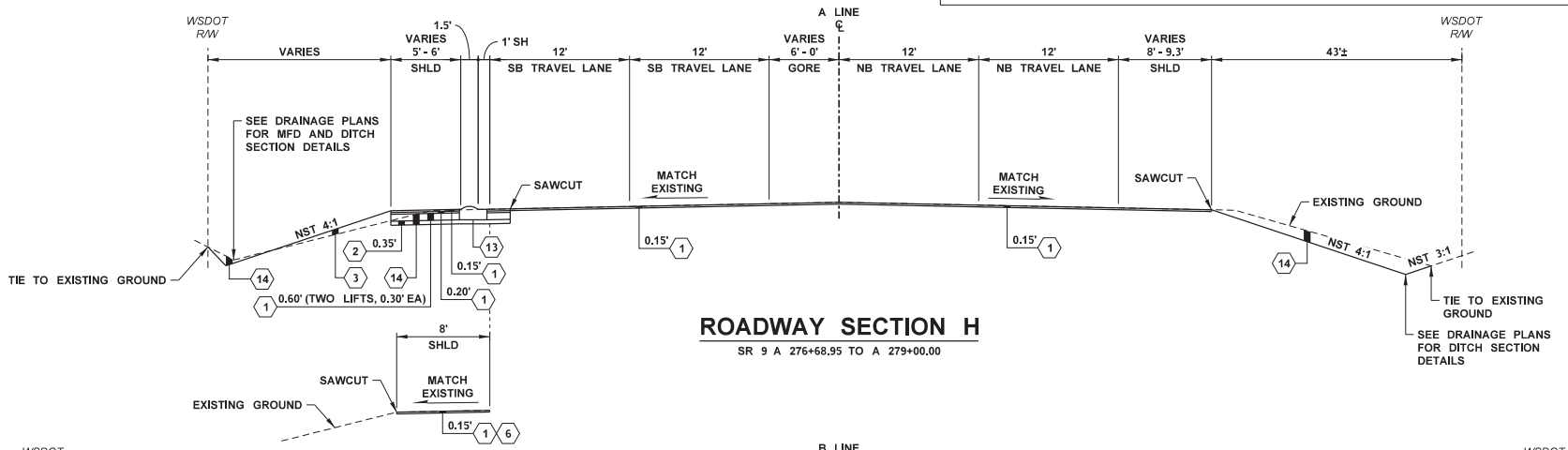
SHEET 17 OF 366 SHEETS

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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.

LEGEND

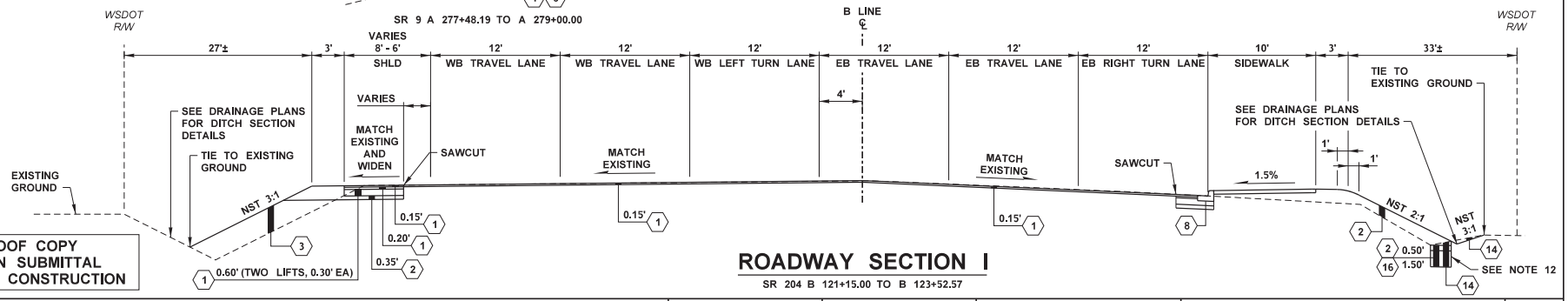
1	HMA CL 1/2 IN., PG 58H-22	10	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (OUTSIDE, RIGHT SIDE OR SPLITTER ISLAND)
2	CRUSHED SURFACING BASE COURSE	11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
3	SELECT BORROW INCL. HAUL	12	CEMENT CONC. TRAFFIC CURB
4	PRECAST DUAL FACED SLOPED MOUNTABLE CURB (PAINTED YELLOW)	13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED) SEE PAVING DETAILS
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	HMA FOR PRELEVELING CL. 1/2 IN. PG
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		



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

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FILE NAME	c:\pw_workIng\wastate\p0024020\dms08802\Stage 3_Y-11834_PS_RS_09.dgn					REGION NO.	STATE	FED.AID PROJ.NO.
TIME	1:03:29 PM					10	WASH	
DATE	11/8/2021					JOB NUMBER		
PLOTTED BY	p0024020					21A008		
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 — 21826 — REGISTERED PROFESSIONAL ENGINEER — SEE SHEET CT1 — DATE — P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

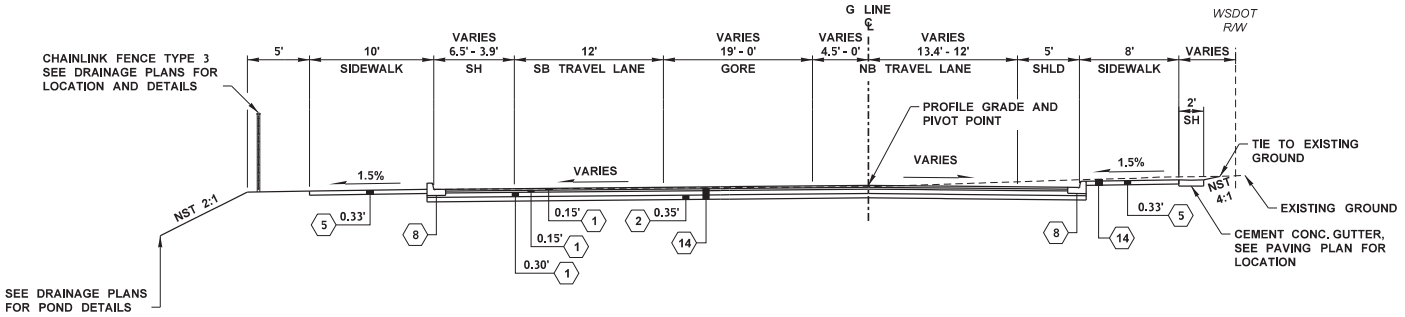
ROADWAY SECTIONS

PLAN REF NO RS09

SHEET 18 OF 366 SHEETS

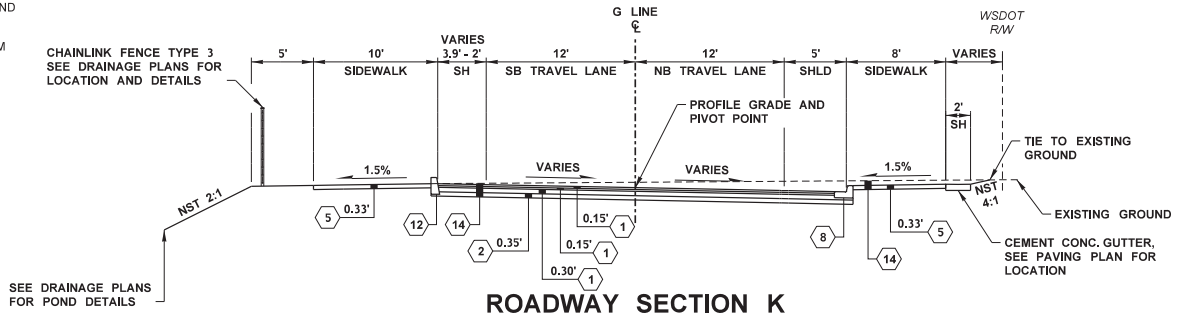
GENERAL NOTES:

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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



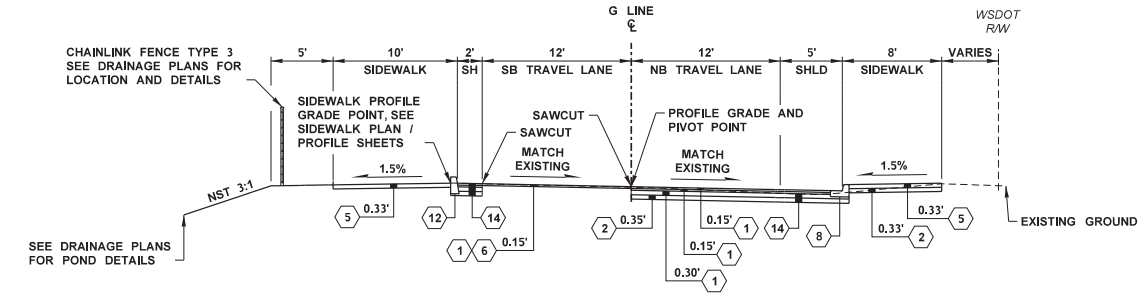
ROADWAY SECTION J

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) SEE PAVING DETAILS
14	ROADWAY EXCAVATION INCL. HAUL
15	HMA FOR PRELEVELING CL. 1/2 IN. PG
16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL

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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 — 21834 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

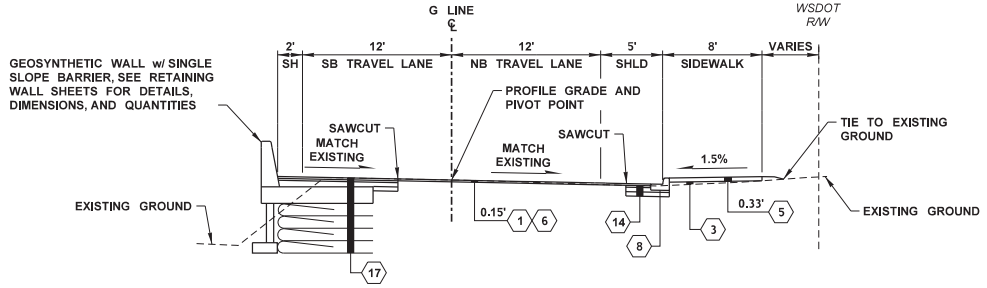
ROADWAY SECTIONS

PLAN REF NO RS10

SHEET 19 OF 366 SHEETS

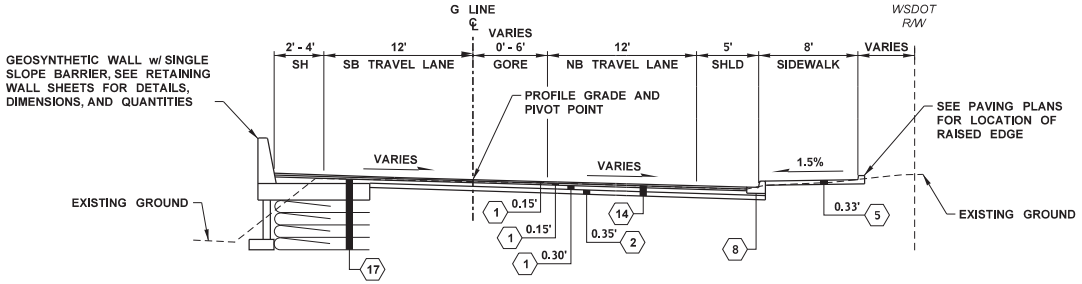
GENERAL NOTES:

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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



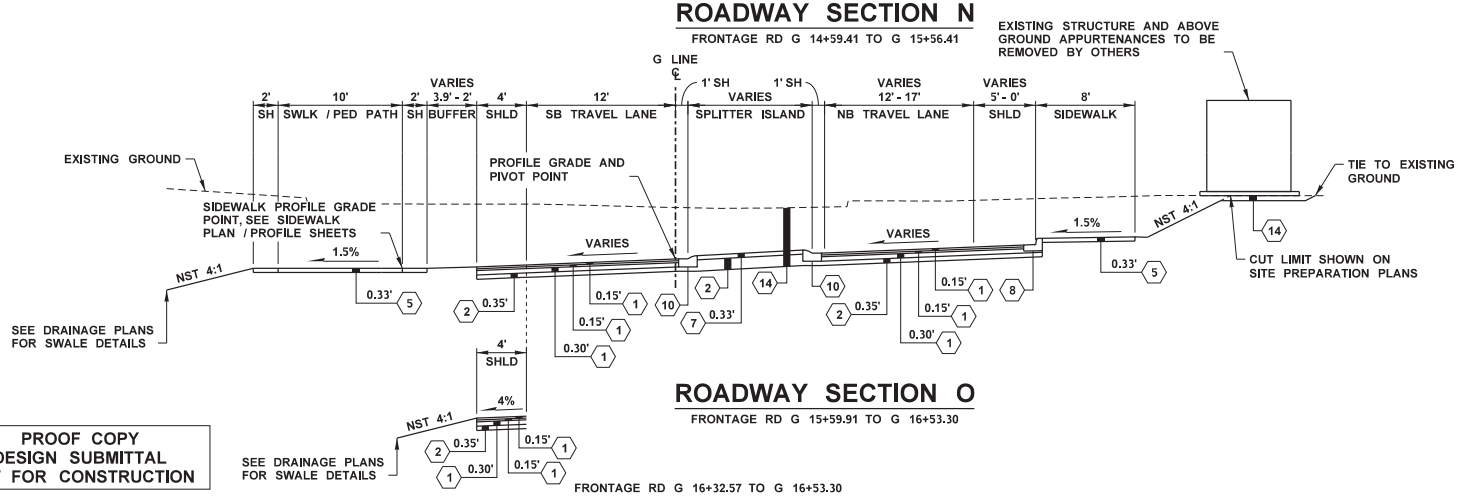
ROADWAY SECTION M

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



ROADWAY SECTION O

FRONTAGE RD G 15+59.91 TO G 16+53.30

FRONTAGE RD G 16+32.57 TO G 16+53.30

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DESIGN SUBMITTAL
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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) SEE PAVING DETAILS
14	ROADWAY EXCAVATION INCL. HAUL
15	HMA FOR PRELEVELING CL. 1/2 IN. PG
16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL

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DATE	11/8/2021					JOB NUMBER		
PLOTTED BY	p0024020					21A008		
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 — 21824 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
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 20 OF 366 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.
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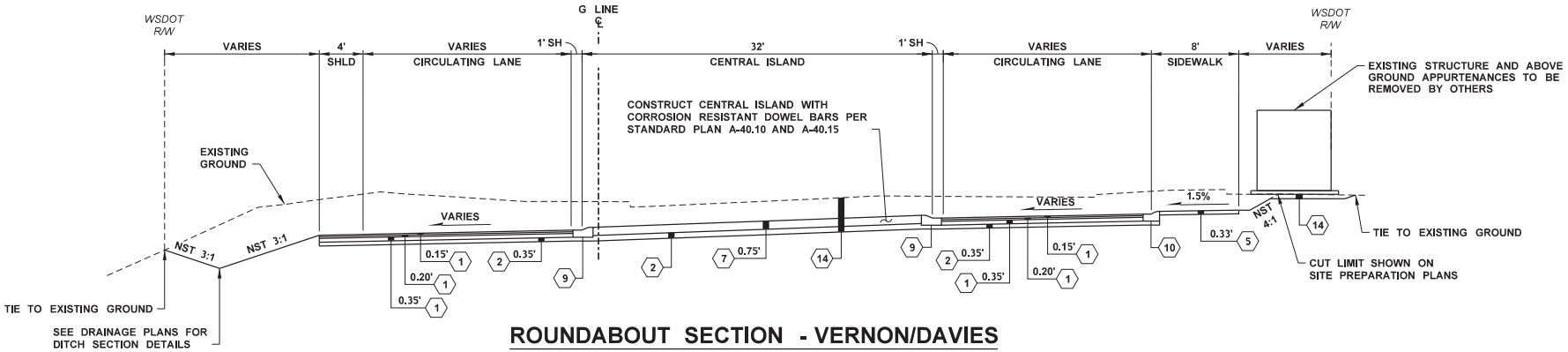
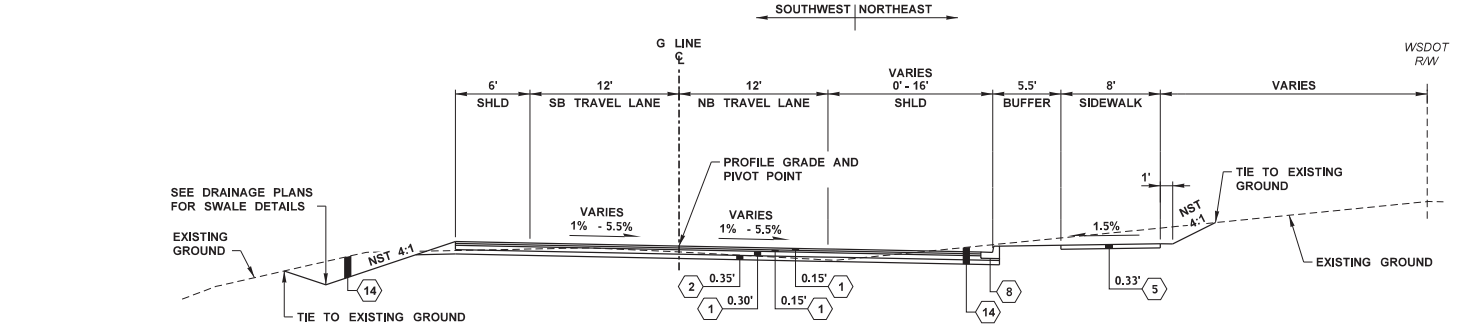
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.

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) SEE PAVING DETAILS
5	CEMENT CONC. SIDEWALK	14	ROADWAY EXCAVATION INCL. HAUL
6	PLANING BITUMINOUS PAVEMENT	15	HMA FOR PRELEVELING CL. 1/2 IN. PG
7	TEXTURED AND PIGMENTED CEMENT CONCRETE PAVEMENT PER SPECIFICATIONS	16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
8	CEMENT CONC. TRAFFIC CURB AND GUTTER	17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL
9	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER		



ROUNDABOUT SECTION - VERNON/DAVIES



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ROADWAY SECTION P

VERNON RD G 17+24.45 TO G 20+17.85

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PLOTTED BY	p0024020					21A008			
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 — 21826 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
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 21 OF 366 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.
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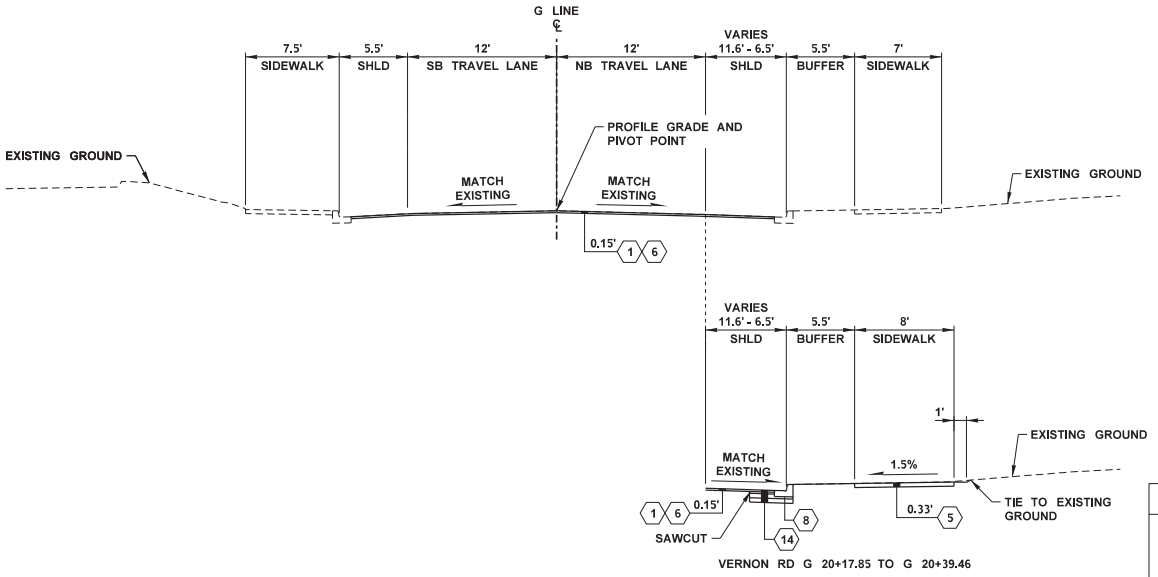
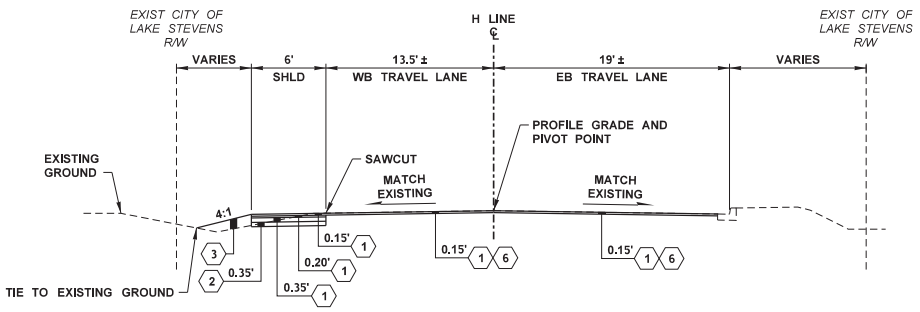
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



ROADWAY SECTION Q

VERNON RD G 20+17.85 TO G 21+16.77



ROADWAY SECTION R

VERNON RD H 22+47.77 TO H 22+80.06

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) SEE PAVING DETAILS
14	ROADWAY EXCAVATION INCL. HAUL
15	HMA FOR PRELEVELING CL. 1/2 IN. PG
16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL

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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 — 21826 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
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
22
OF
366
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.
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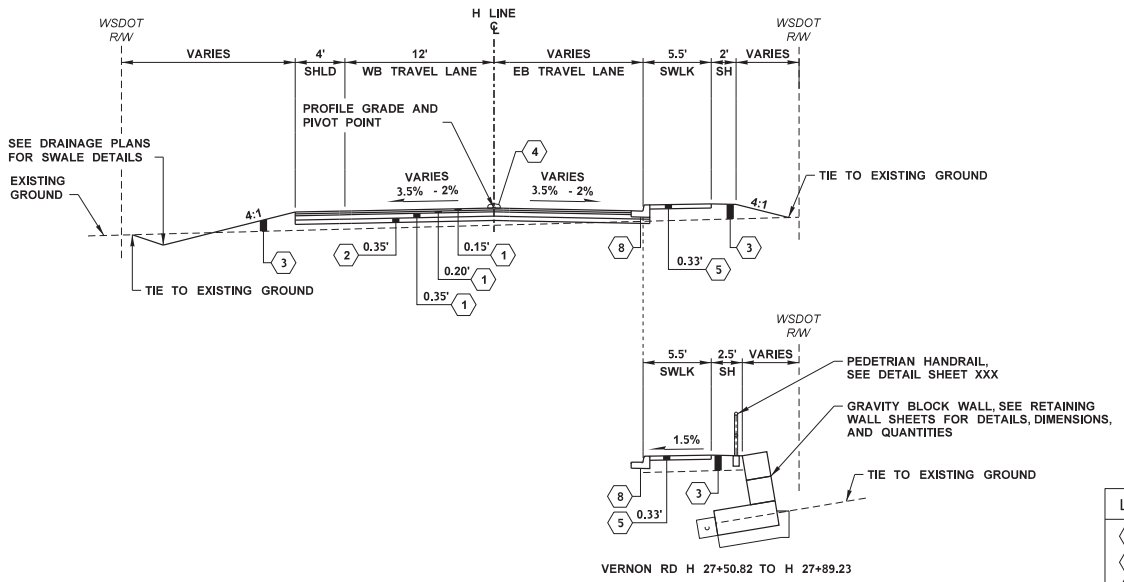
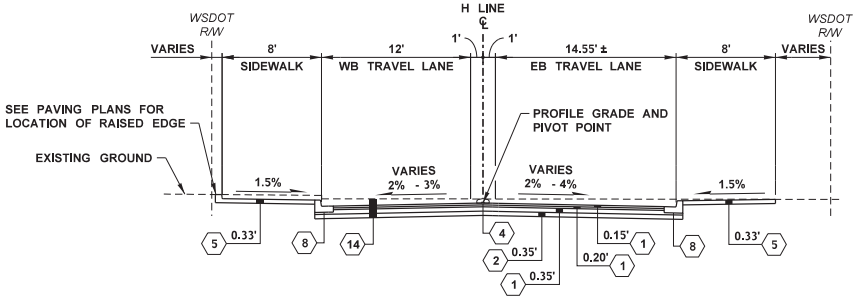
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



VERNON RD H 27+50.82 TO H 27+89.23

ROADWAY SECTION S

VERNON RD H 26+85.65 TO H 28+58.05
SEE SR9 / VERNON ROUNDABOUT SECTION, RS07 FOR ROUNDABOUT SECTION



ROADWAY SECTION T

N DAVIES RD H 32+07.50 TO H 32+43.98

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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11	ROUNDABOUT CENTRAL ISLAND CEMENT CONCRETE CURB
12	CEMENT CONC. TRAFFIC CURB
13	SCUPPERED ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER (MODIFIED) SEE PAVING DETAILS
14	ROADWAY EXCAVATION INCL. HAUL
15	HMA FOR PRELEVELING CL. 1/2 IN. PG
16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL

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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 — 21822 — REGISTERED PROFESSIONAL ENGINEER
SEE SHEET CT1
DATE
P.E. STAMP BOX

PARSONS

Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

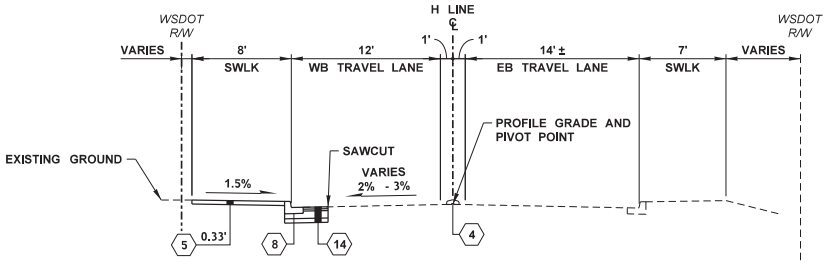
ROADWAY SECTIONS

PLAN REF NO
RS14

SHEET 23 OF 366 SHEETS

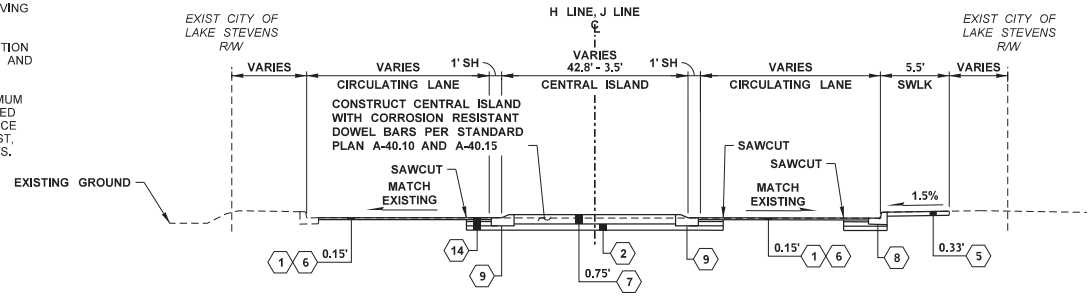
GENERAL NOTES:

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.
11. SEE NEW CURB TYPICAL SAWCUT PAVEMENT SECTION DETAIL ON SHEET PVD05 FOR ADDITIONAL PAVING AND SAWCUT INFORMATION.
12. FOR BALLAST LOCATIONS SHOWN, EXCAVATE MINIMUM 2.0' OF SOIL BENEATH FILL AREA NOT CONSTRUCTED ON EXISTING ROADWAY EMBANKMENT AND REPLACE WITH CRUSHED SURFACING BASE COURSE, BALLAST, AND SEE PAVING PLANS FOR APPROXIMATE LIMITS.



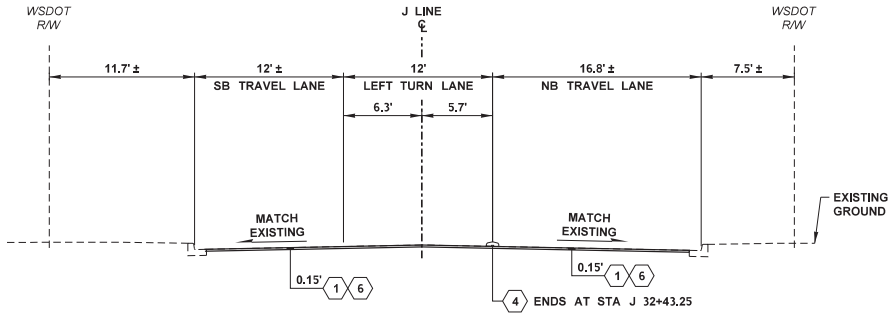
ROADWAY SECTION U

N DAVIES RD H 32+43.98 TO H 32+66.24



ROUNDABOUT SECTION - VERNON/91ST AVE NE

SOUTHWEST | NORTHEAST



ROADWAY SECTION V

91ST AVE J 30+73.79 TO J 32+61.25

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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) SEE PAVING DETAILS
14	ROADWAY EXCAVATION INCL. HAUL
15	HMA FOR PRELEVELING CL. 1/2 IN. PG
16	BALLAST OVER CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION
17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL

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ENTERED BY	K. MCWILLIAMS								
CHECKED BY	R. HOWARD								
PROJ. ENGR.	K. NDILE								
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY				

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Washington State Department of Transportation

SR 9
SR 204 INTERSECTION IMPROVEMENTS (STAGE 3)

ROADWAY SECTIONS

PLAN REF NO
RS15

SHEET
24
OF
366
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.
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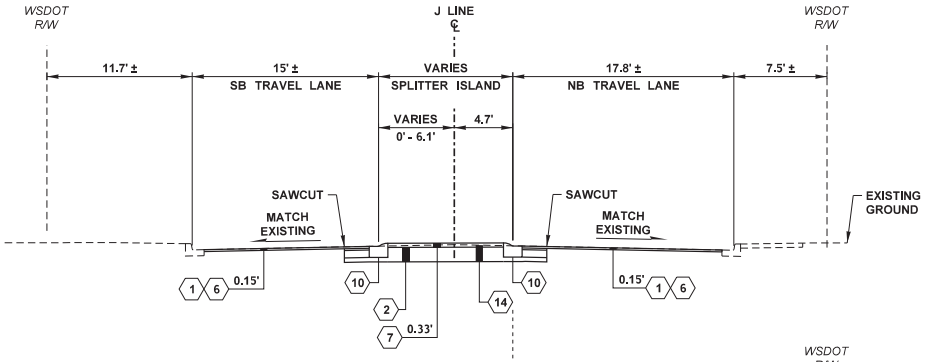
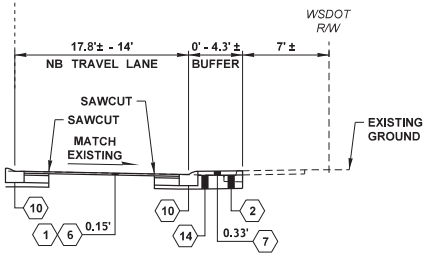
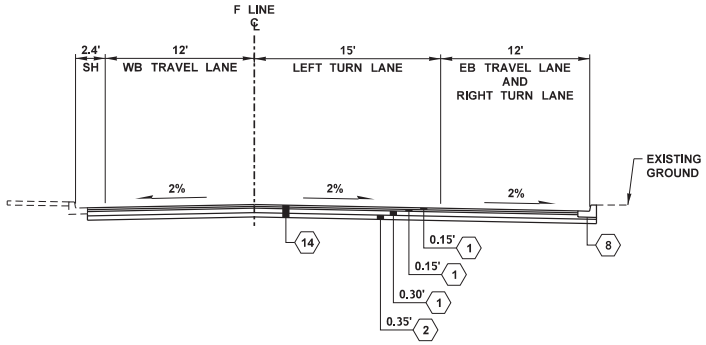




91ST AVE NE J 33+13.35 TO J 33+67.20

ROADWAY SECTION W

91ST AVE NE J 32+61.25 TO J 33+67.20



ROADWAY SECTION X

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
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17	STRUCTURE EXCAVATION, CLASS A INCL. HAUL

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REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY			

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ROADWAY SECTIONS

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RS16

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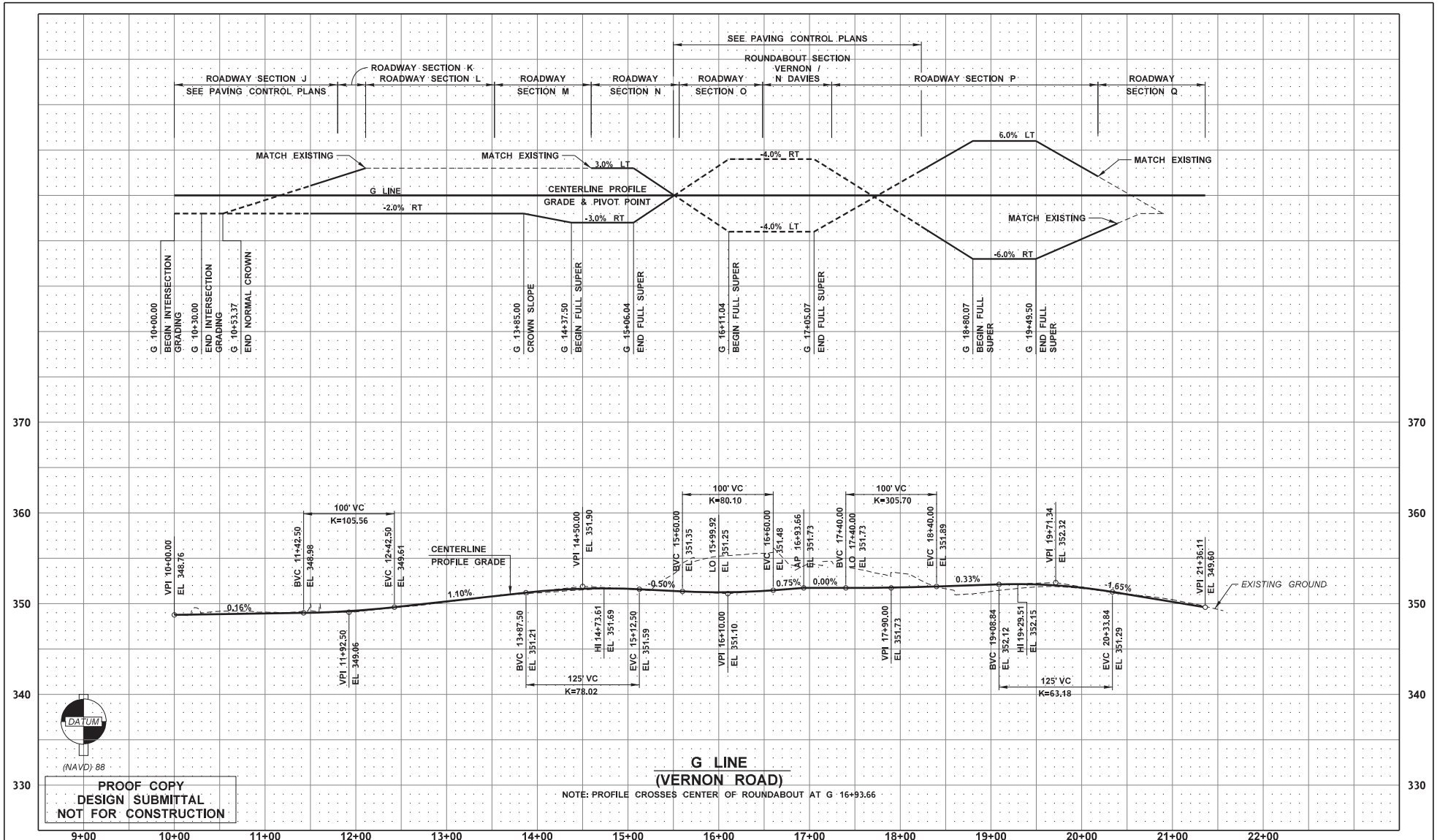

G LINE
(VERNON ROAD)

NOTE: PROFILE CROSSES CENTER OF ROUNDABOUT AT G 16+93.66

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REGION NO.	STATE
10	WASH

JOB NUMBER 21A008

CONTRACT NO.

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LOCATION NO.

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ROADWAY PROFILE

PLAN REF NO RP01

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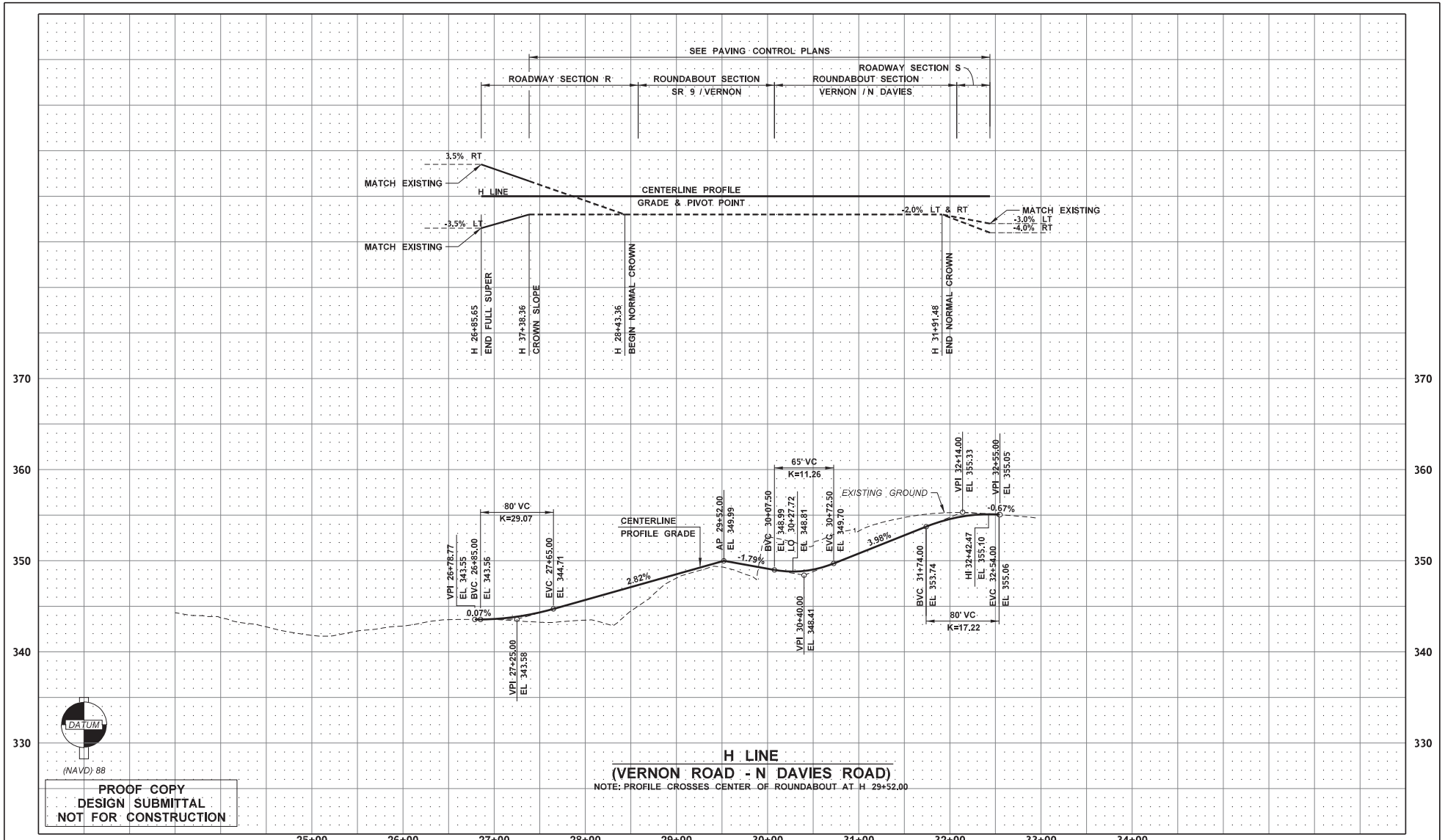

H LINE
(VERNON ROAD - N DAVIES ROAD)

NOTE: PROFILE CROSSES CENTER OF ROUNDABOUT AT H 29+52.00

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ENTERED BY	K. MCWILLIAMS								
CHECKED BY	S. EAGAN								
PROJ. ENGR.	K. NDILE								
REGIONAL ADM.	M. COTTEN	NO	REVISION	DATE	BY				

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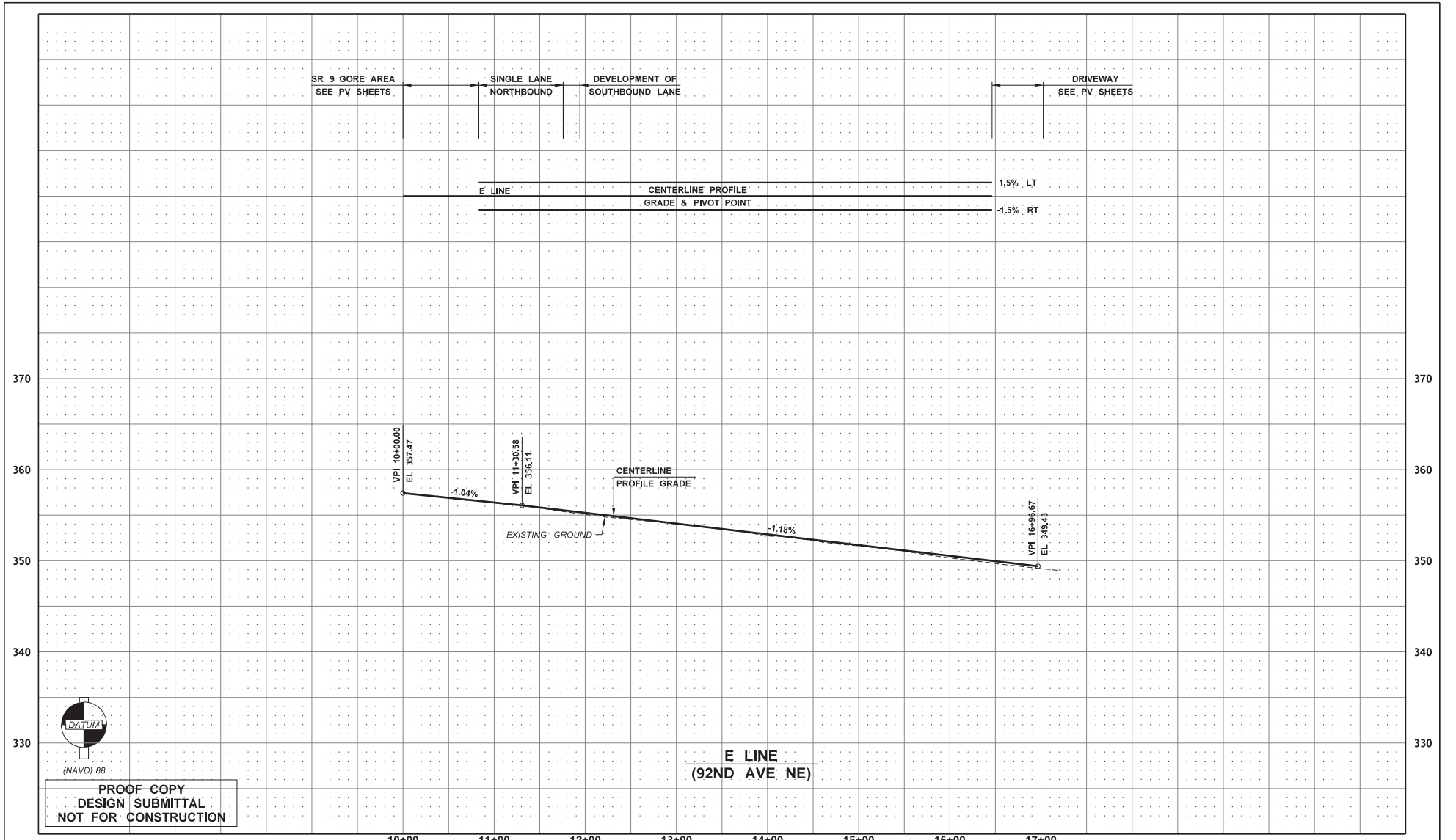
ROADWAY PROFILE

PLAN REF NO
RP02

SHEET 53 OF 366 SHEETS



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REGION NO. 10 | STATE WASH
JOB NUMBER 21A008
CONTRACT NO.
FED.AID PROJ.NO.
LOCATION NO.

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SR 9
SR 204 INTERSECTION
IMPROVEMENTS (STAGE 3)

ROADWAY PROFILE

PLAN REF NO RP03

SHEET 54 OF 366 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

TABLE OF CONTENTS

Title	Page No.
SECTION 1. Executive Summary	**1**
1.1 Introduction	1
1.1.1 Study Area	1
1.2 Existing Transportation Conditions	5
1.3 Baseline Conditions	5
1.4 Development of Alternatives and Selection of the Preferred Alternative	6
1.5 Potential Impacts and Benefits of the Preferred Alternative	10
SECTION 2. Introduction	**13**
2.1 Purpose of the Report	13
2.2 Purpose and Needs Statement	13
2.3 Project Description	14
2.3.1 Study Area	14
2.4 Project Alternatives	16
2.4.1 Preferred Alternative	16
2.4.2 No Build Alternative	17
2.4.3 Build Alternatives	17
SECTION 3. Methodology and Coordination	**21**
3.1 Analysis Years and Time Periods	21
3.2 Travel Demand Forecasting	21
3.2.1 Travel Demand Model Inputs	21
3.2.1.1 Land Use	22
3.2.1.2 Transportation Analysis Zones	22
3.2.1.3 Roadway Network and Transit Service Assumptions	22
3.2.1.4 Tolling/Congestion Pricing Assumptions	23
3.2.2 Travel Demand Model Validation	23
3.2.3 Travel Demand Model Forecast Development	23
3.3 Traffic Operations Analysis	23
3.3.1 Level of Service	23
3.3.2 Vissim Simulation Model	24
3.3.1 Travel Time	49
3.4 Collision Analysis	51
3.5 Non-Roadway Transportation Systems	51
3.6 Coordination	51
SECTION 4. Affected Environment	**53**
4.1 Study Area	53
4.1.1 Roadway Network	53
4.1.2 Freight	54
4.1.3 Parking	55
4.1.4 Pedestrian and Bicyclist Facilities	55

4.1.5 Transit Facilities and Service 57
4.1.6 Marine, Rail, and Air Transportation Systems 59
4.1.7 Emergency Services and Response Times 60
4.2 Existing Operating Conditions 60
4.2.1 Intersection Counts 60
4.2.2 Intersection Operations Results 63
4.3 Collision Analysis 65
4.3.1 Results – FHWA Method 65
4.3.2 Results – HSM Method 71

SECTION 5. Potential Effects 73
5.1 2040 Operations 73
5.1.1 No Build Alternative 73
5.1.1.1 Future Network 73
5.1.1.2 Level of Service and Delay 73
5.1.2 Build Alternatives 75
5.1.2.1 Alternative Concepts 75
5.1.2.2 Level of Service and Delay 75
5.1.2.3 Access Management 83
5.1.2.4 Emergency Services 84
5.2 2021 Operations 84
5.2.1 No Build Alternative 84
5.2.1.1 Future Network 84
5.2.1.2 Level of Service and Delay 84
5.2.2 Preferred Alternative 85
5.2.2.1 Alternative Configuration 85
5.2.2.2 Level of Service and Delay 86
5.3 Travel Time Analysis 89
5.4 Collision Analysis 93
5.4.1 Results 93
5.5 Walking and Biking Facilities 95
5.5.1 Future Network 95
5.5.2 Results 97
5.6 Transit 98
5.7 Transportation System Management Strategies 103
5.8 Temporary Construction Effects and Benefits 103

SECTION 6. References 105

SECTION 7. Appendix 107

SECTION 8. List of Preparers 108

APPENDICES

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

LIST OF TABLES

No.	Title	Page No.
Table 1-1.	Overview of Build Alternatives	8
Table 2-1.	Overview of Build Alternatives	18
Table 3-1.	Intersection Level of Service Thresholds	24
Table 4-1.	Access Control Designations For Study Area State Routes	54
Table 4-2.	Community Transit Bus Service through Study Area	57
Table 4-3.	Average Daily Boarding and Alighting by Transit Stop	59
Table 4-4.	Existing AM Peak Hour Intersection Level of Service Results (Approach and Overall)	63
Table 4-5.	Existing PM Peak Hour Intersection Level of Service Results (Approach and Overall)	64
Table 4-6.	Annual Average Intersection Collision Rates 2011-2015	67
Table 4-7.	Annual Average Roadway Segment Collision Rates 2011-2015	67
Table 4-8.	Collision Summary Statistics	69
Table 4-9.	Summary of Anticipated Performance By Segment and Intersection	71
Table 5-1.	Intersection Level of Service and Delay Results – 2040 No Build	75
Table 5-2.	Intersection Level of Service and Delay Results – 2040 PM Peak Hour	81
Table 5-3.	Intersection Level of Service and Delay Results – 2040 AM Peak Hour	83
Table 5-4.	Intersection Level of Service and Delay Results – 2021 No Build	85
Table 5-5.	Intersection Level of Service and Delay Results – 2021 Alternative E2B Variation 4	87
Table 5-6.	Auto Travel Time Results on Regional Facilities (in Minutes) – 2040 PM Peak Hour	91
Table 5-7.	Summary of Anticipated Performance for Each 2040 Alternative	94
Table 5-8.	Non-motorized Network Summary	98
Table 5-9.	Transit Travel Time Results on Regional Facilities (in Minutes) – 2040 PM Peak Hour	101

LIST OF FIGURES

No.	Title	Page No.
Figure 1-1.	Regional Map	3
Figure 1-2.	Study Area and Study Intersections	4
Figure 1-3.	Alternatives Screening Process	7
Figure 2-1.	Study Area and Study Intersections	15
Figure 2-2.	Preferred Alternative	17
Figure 3-1.	Existing PM Peak Hour	27
Figure 3-2.	Existing AM Peak Hour	28
Figure 3-3.	2040 No Build PM Peak Hour	29
Figure 3-4.	2040 Alternative B PM Peak Hour	30
Figure 3-5.	2040 Alternative C PM Peak Hour	31
Figure 3-6.	2040 Alternative E PM Peak Hour	32
Figure 3-7.	2040 Alternative E2A PM Peak Hour	33
Figure 3-8.	2040 Alternative E2B PM Peak Hour	34
Figure 3-9.	2040 Alternative E2B Variation 4 PM Peak Hour	35
Figure 3-10.	2040 Alternative E2C PM Peak Hour	36
Figure 3-11.	2040 Alternative E2D PM Peak Hour	37
Figure 3-12.	2040 Alternative G2B PM Peak Hour	38
Figure 3-13.	2040 Alternative H PM Peak Hour	39
Figure 3-14.	2040 Alternative SPUI PM Peak Hour	40
Figure 3-15.	2040 Preferred Alternative - Modified E2B Variation 4 PM Peak Hour	41
Figure 3-16.	2040 No Build AM Peak Hour	42
Figure 3-17.	2040 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative	43
Figure 3-18.	2021 No Build PM Peak Hour	44
Figure 3-19.	2021 Preferred Alternative - Modified E2B Variation 4 PM Peak Hour	45
Figure 3-20.	2021 No Build AM Peak Hour	46
Figure 3-21.	2021 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative	47
Figure 3-22.	Key Locations to Evaluate Travel Time	50
Figure 4-1.	Existing Dedicated Pedestrian and Bicyclist Facilities	56
Figure 4-2.	Existing Transit Routes and Stop Activity	58
Figure 4-3.	AM Existing Peak Hour Turning Movement Counts	61
Figure 4-4.	PM Existing Peak Hour Turning Movement Counts	62
Figure 4-5.	Existing Collision Rates	66
Figure 4-6.	Existing Collisions Resulting in a Fatality	70

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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**.

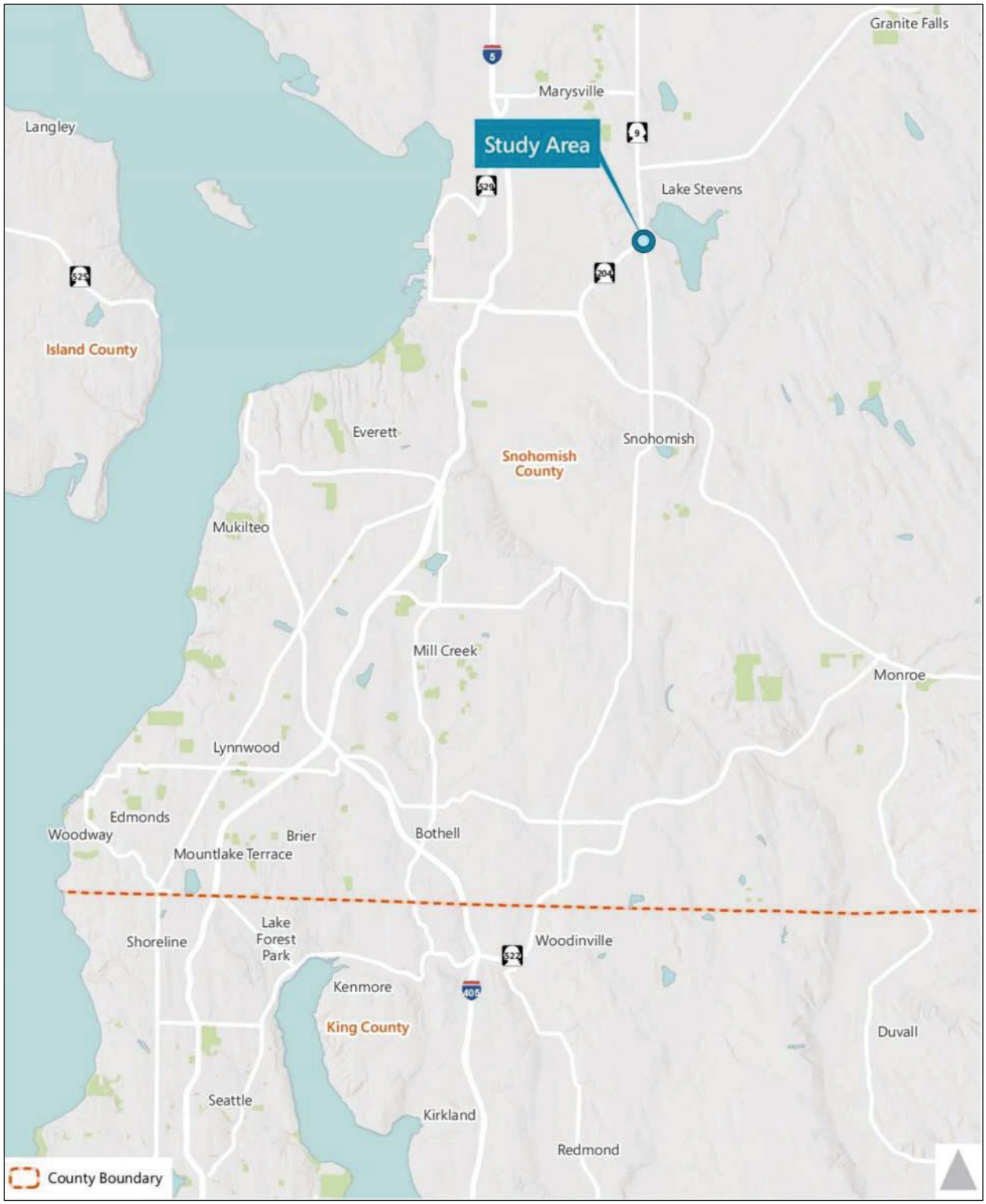

Figure 1-1. Regional Map

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**.

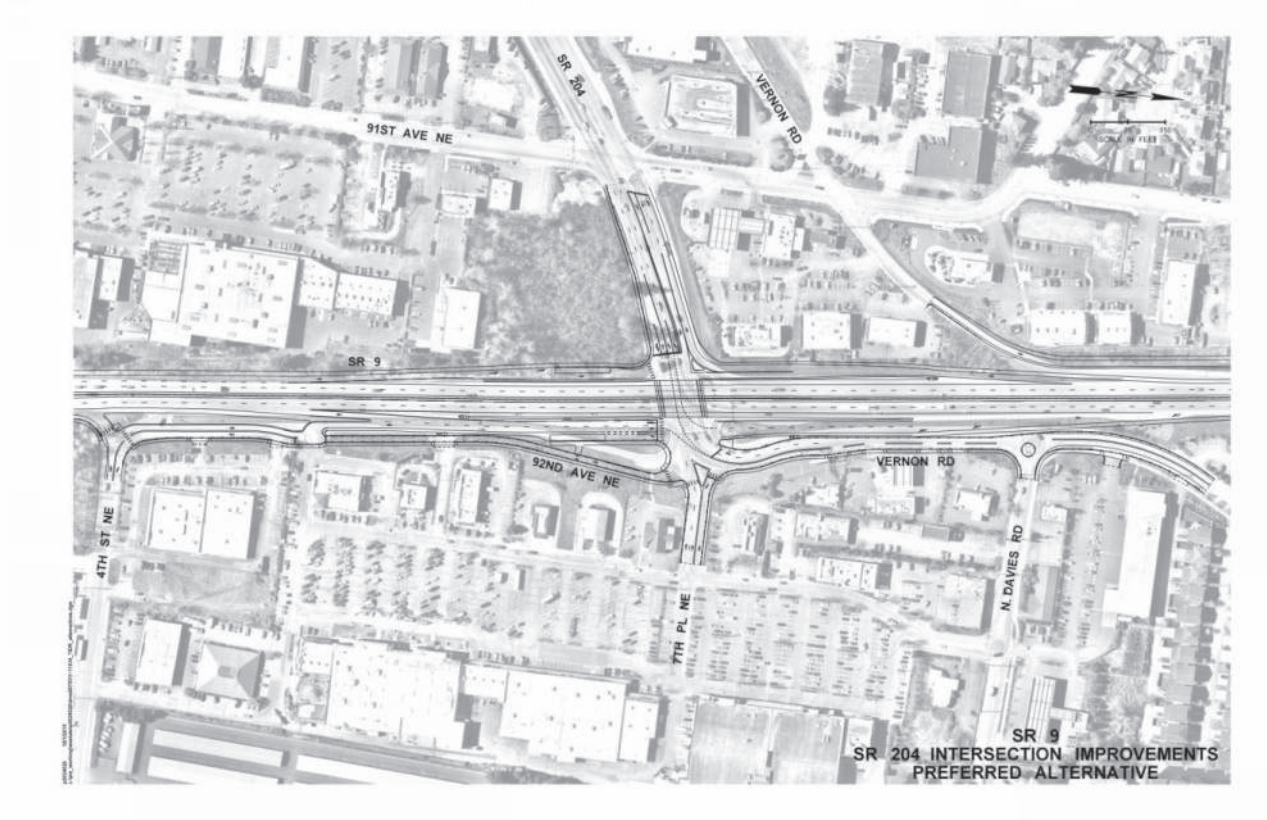

Figure 1-4: Preferred Alternative

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.**

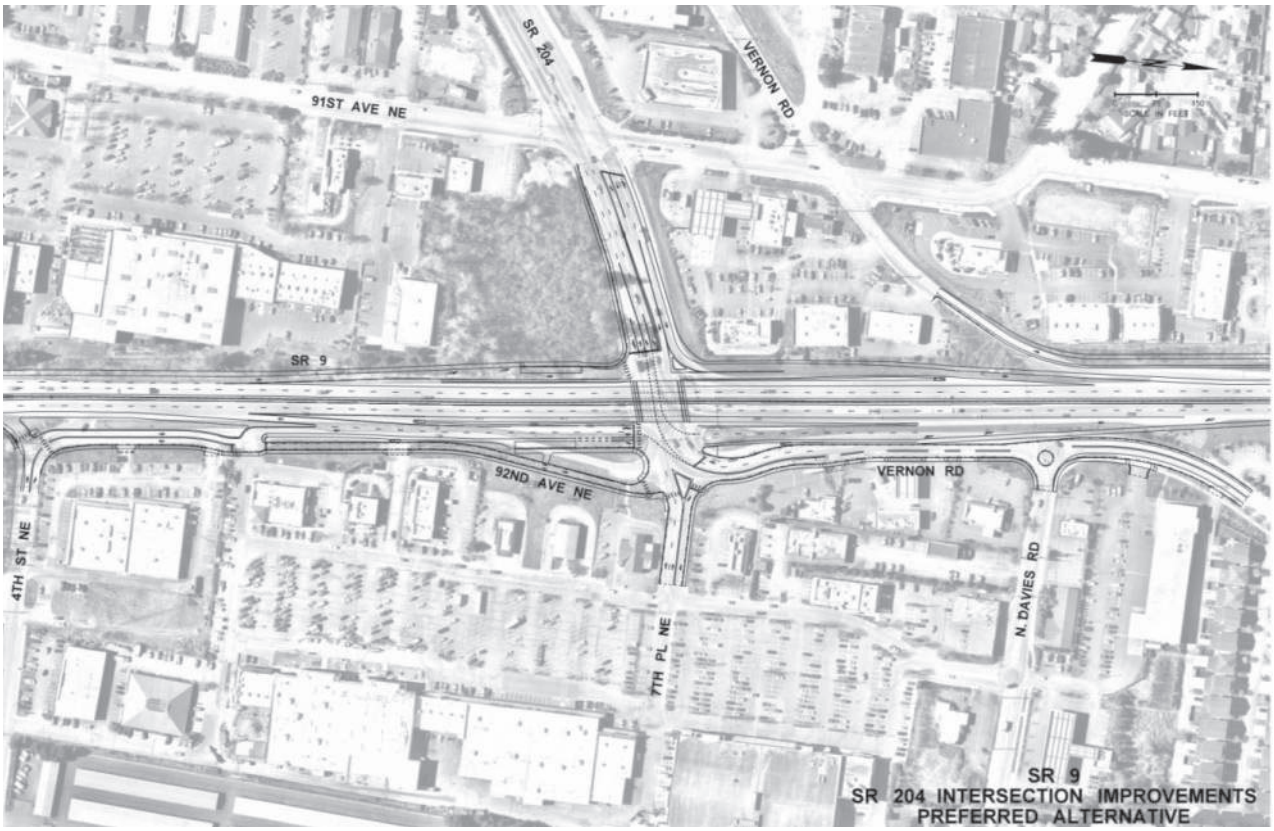

Figure 2-2. Preferred Alternative

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

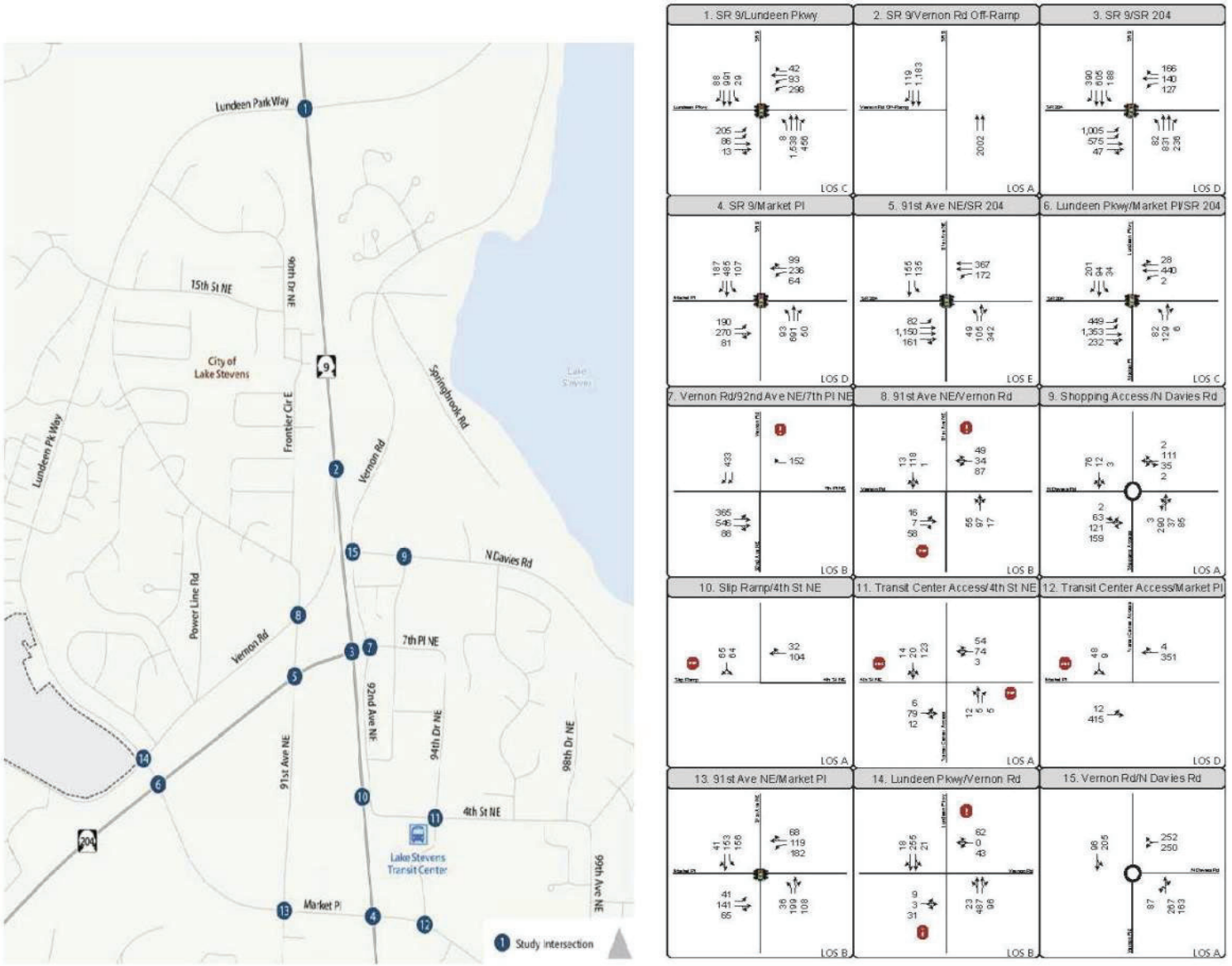

Figure 3-1. Existing PM Peak Hour

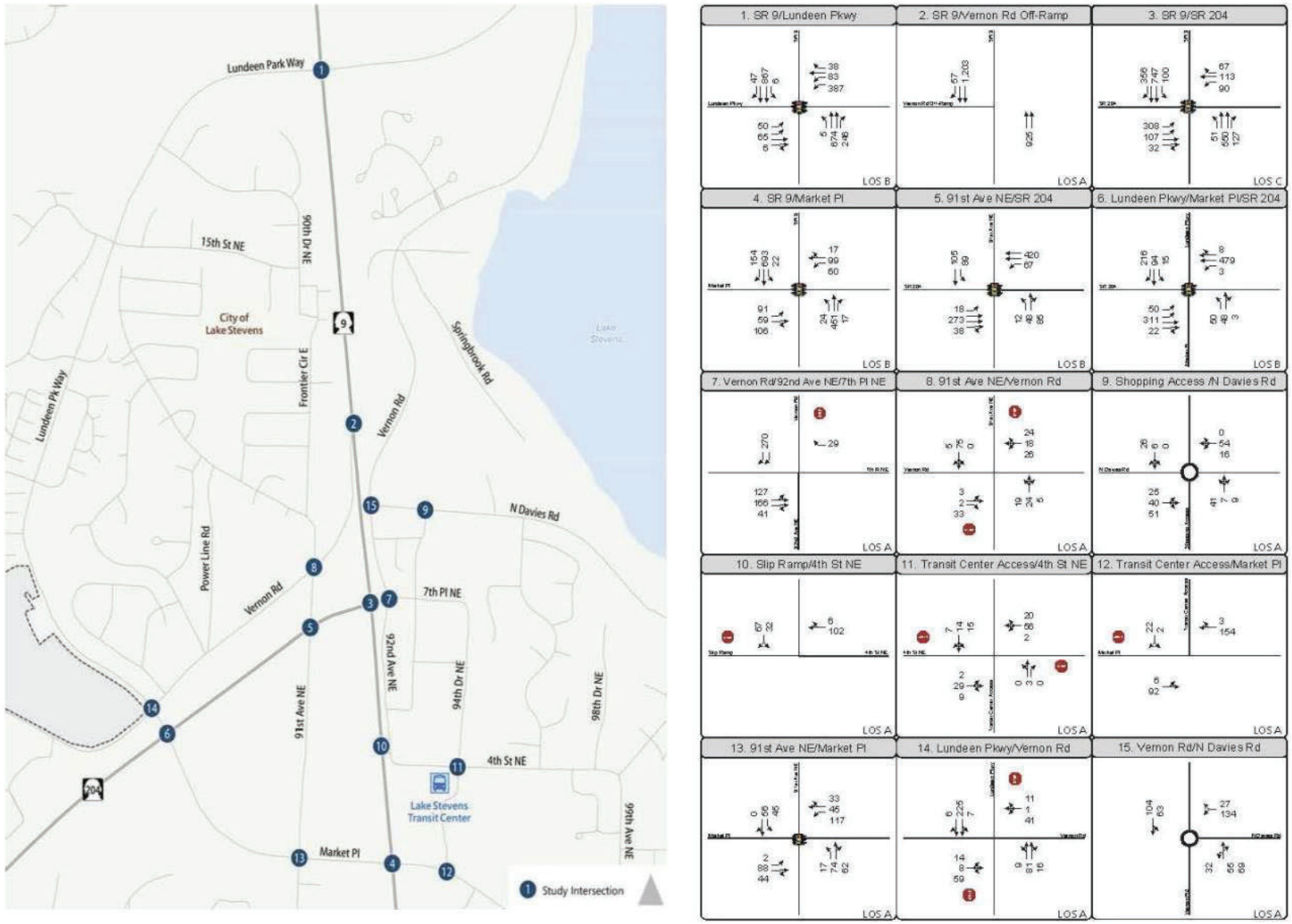

Figure 3-2. Existing AM Peak Hour

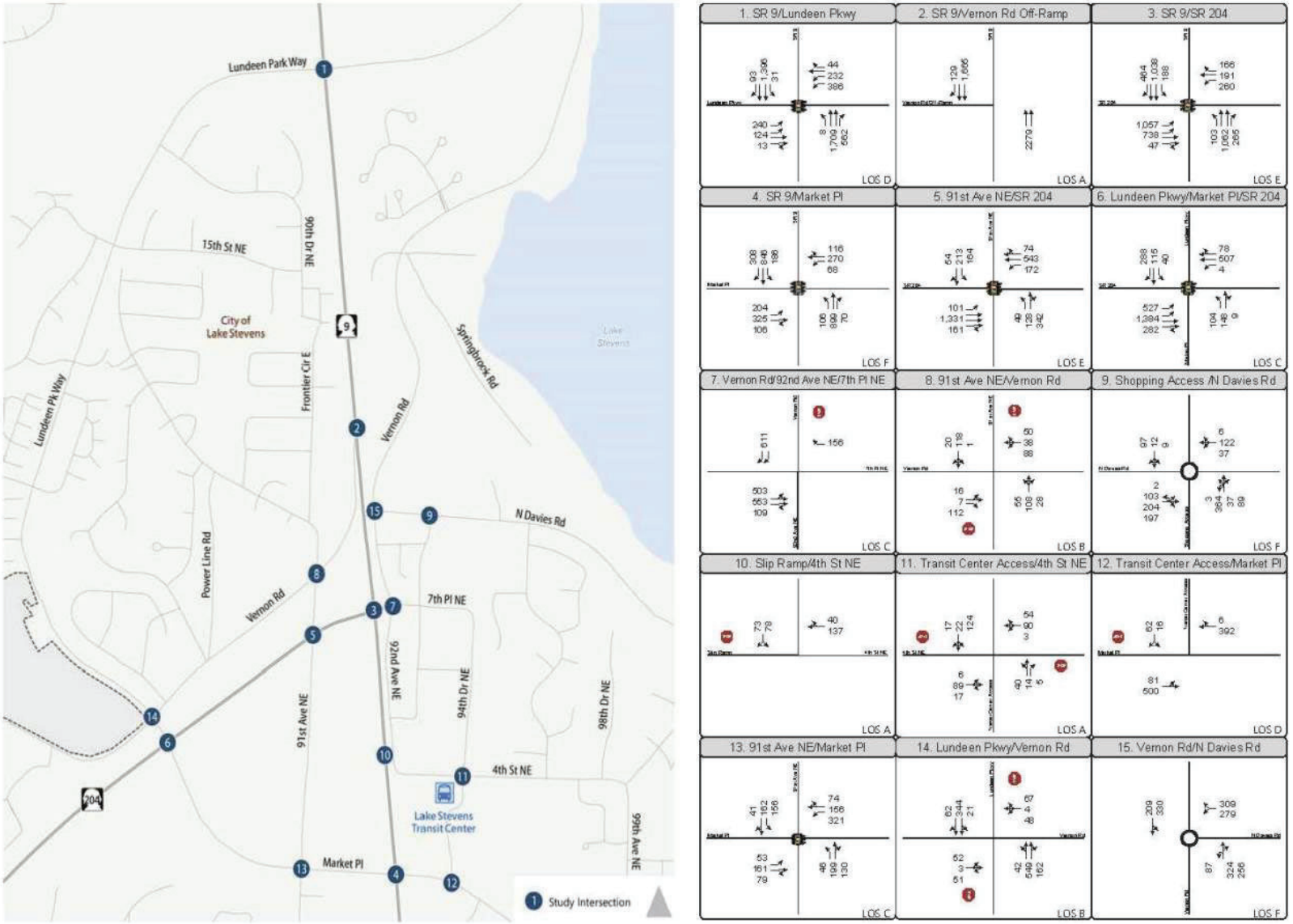

Figure 3-3. 2040 No Build PM Peak Hour

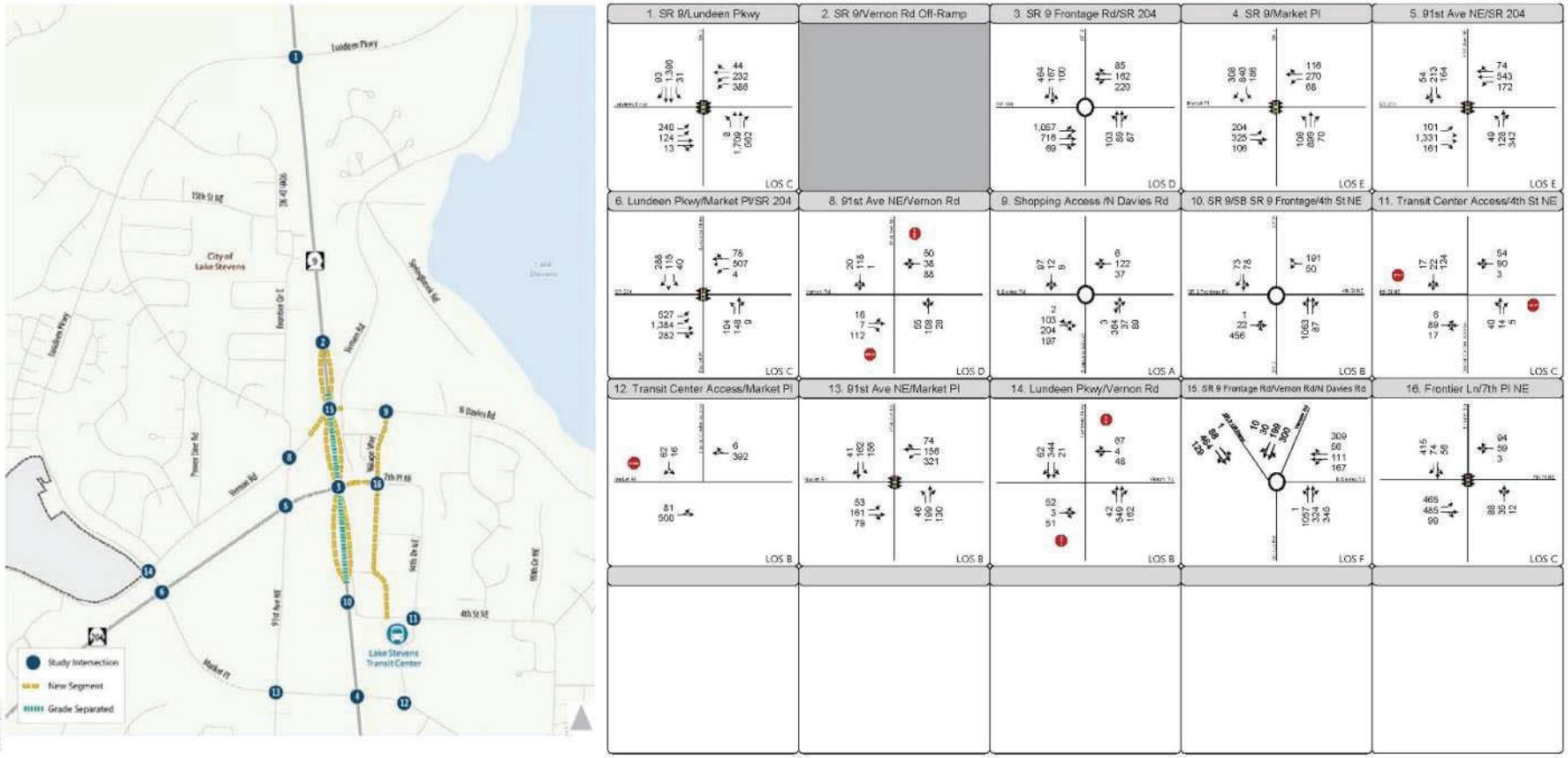

Figure 3-4. 2040 Alternative B PM Peak Hour

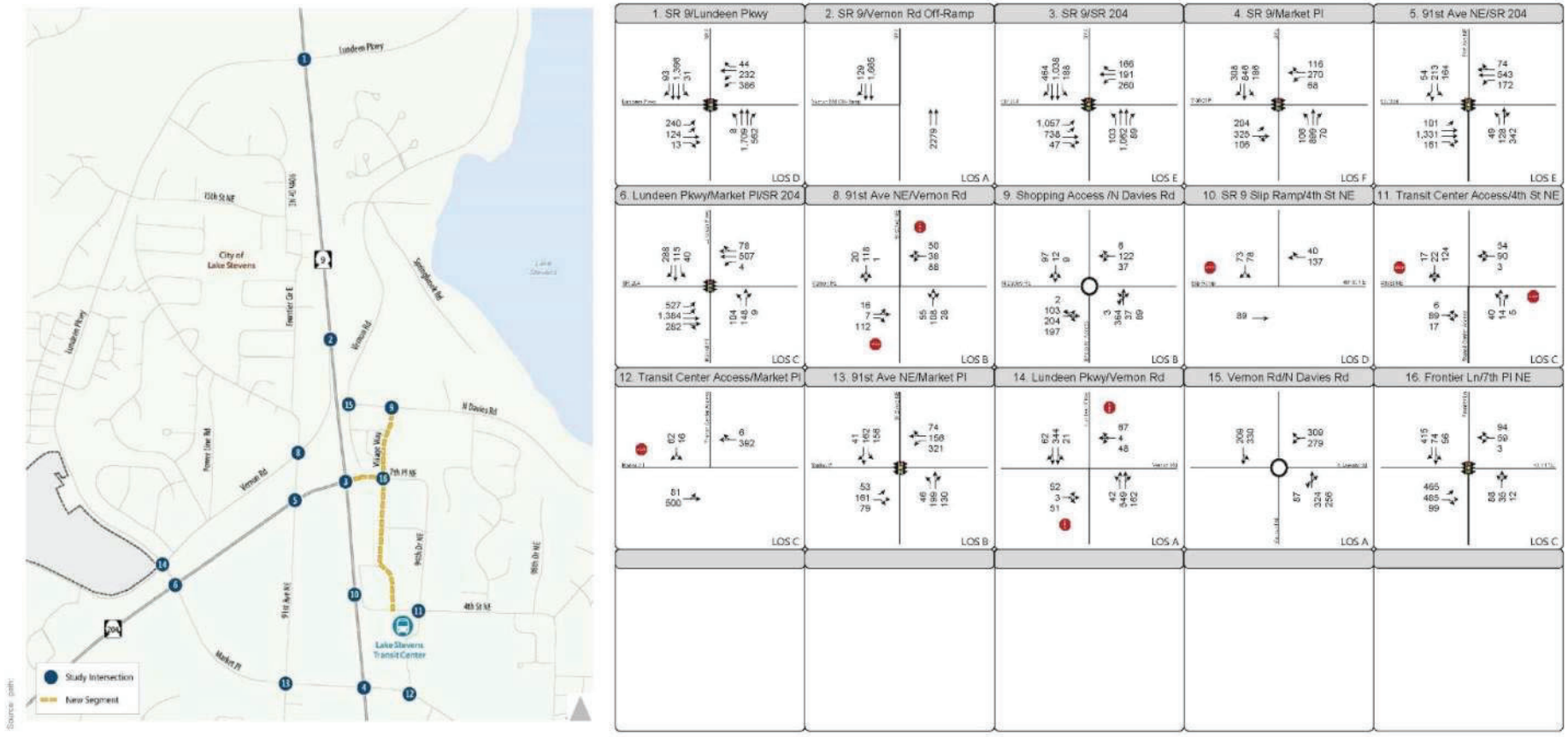

Figure 3-5. 2040 Alternative C PM Peak Hour

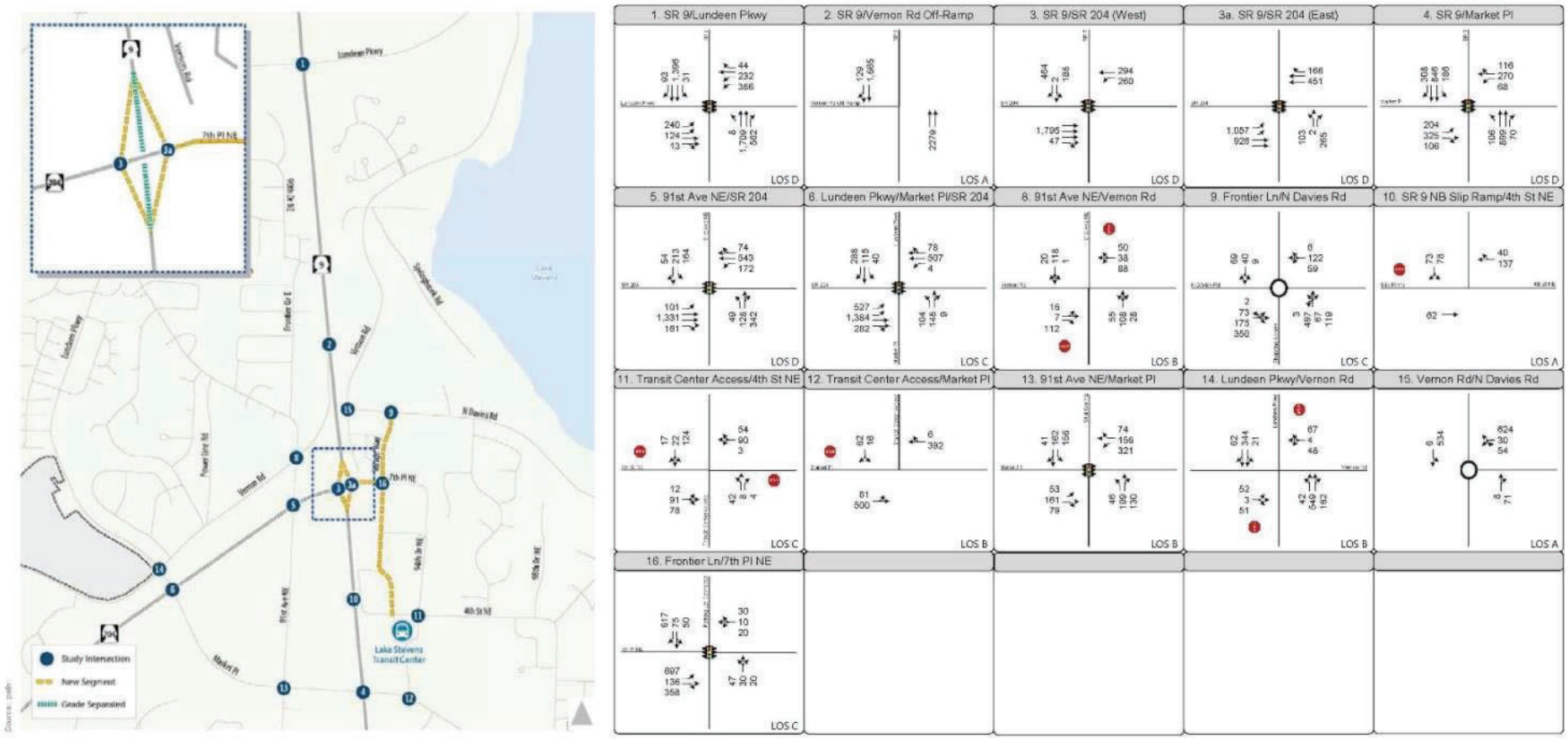

Figure 3-6. 2040 Alternative E PM Peak Hour

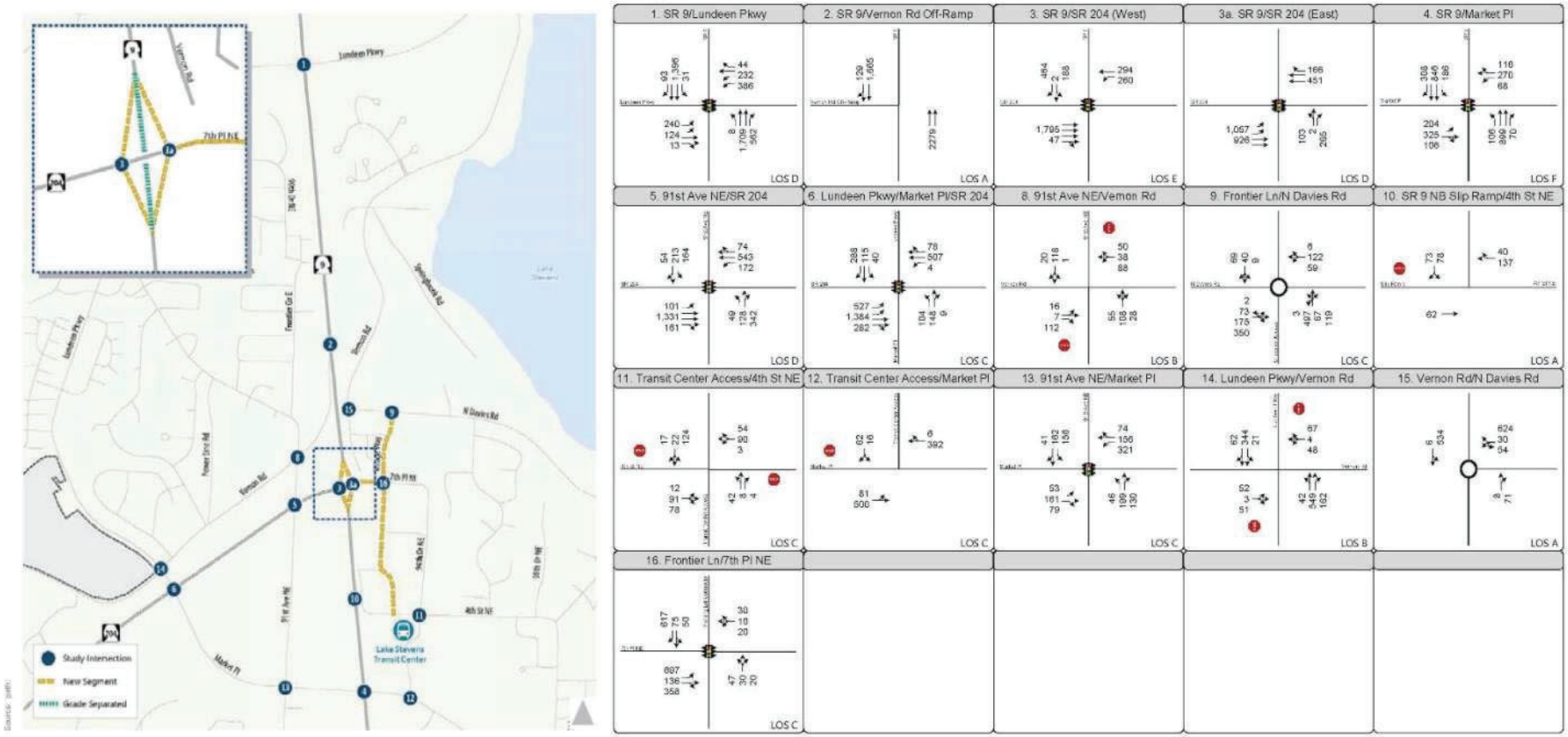

Figure 3-7. 2040 Alternative E2A PM Peak Hour

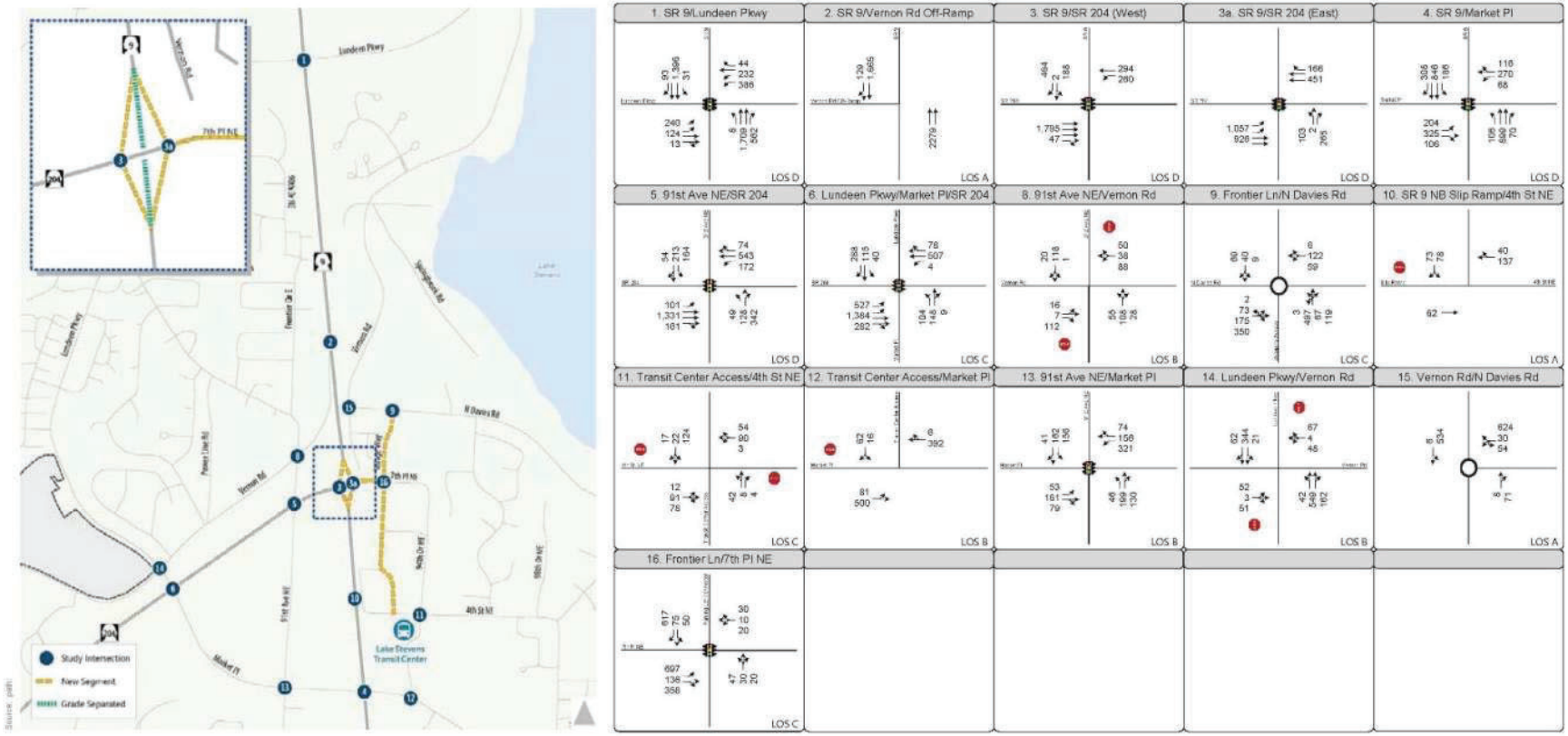

Figure 3-8. 2040 Alternative E2B PM Peak Hour

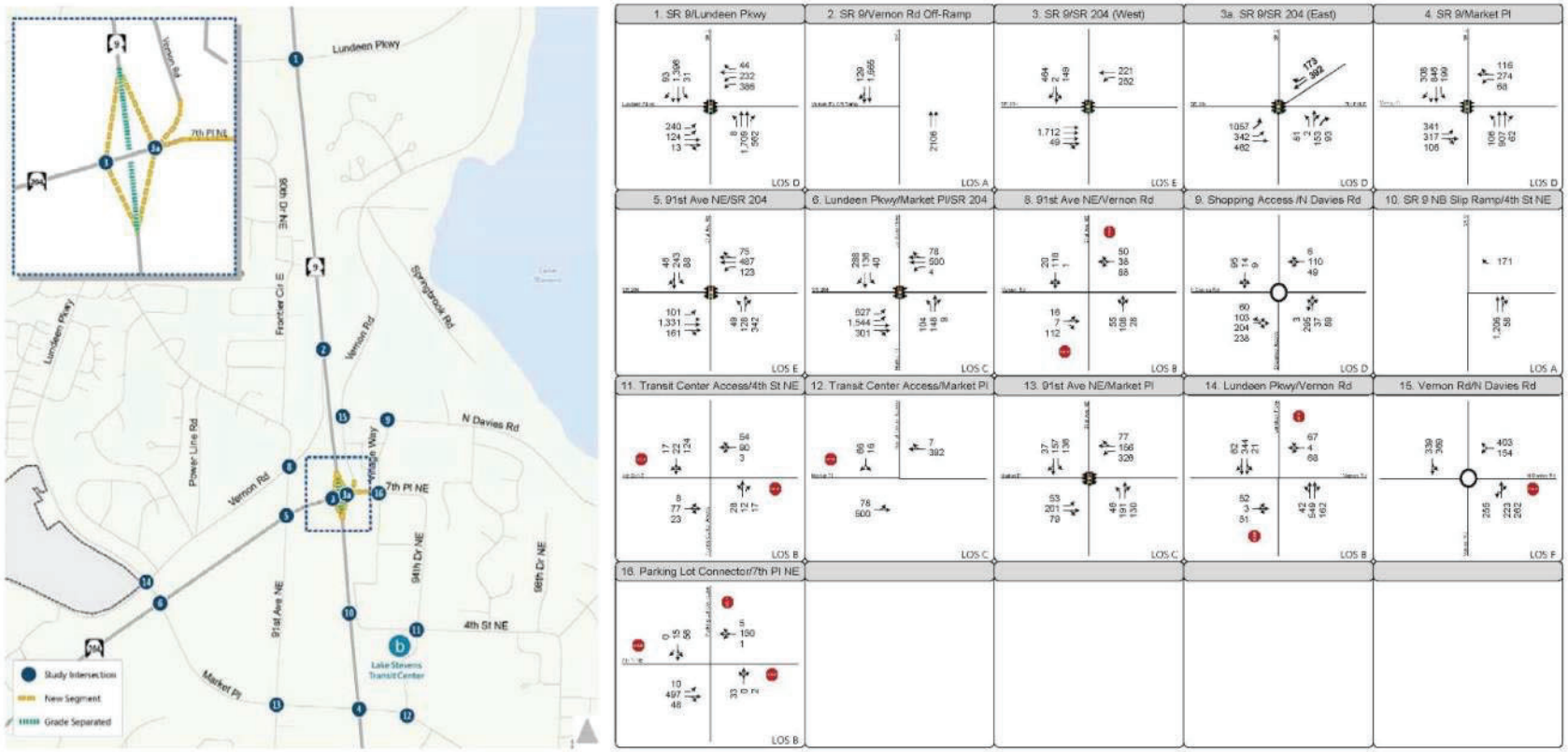

Figure 3-9. 2040 Alternative E2B Variation 4 PM Peak Hour

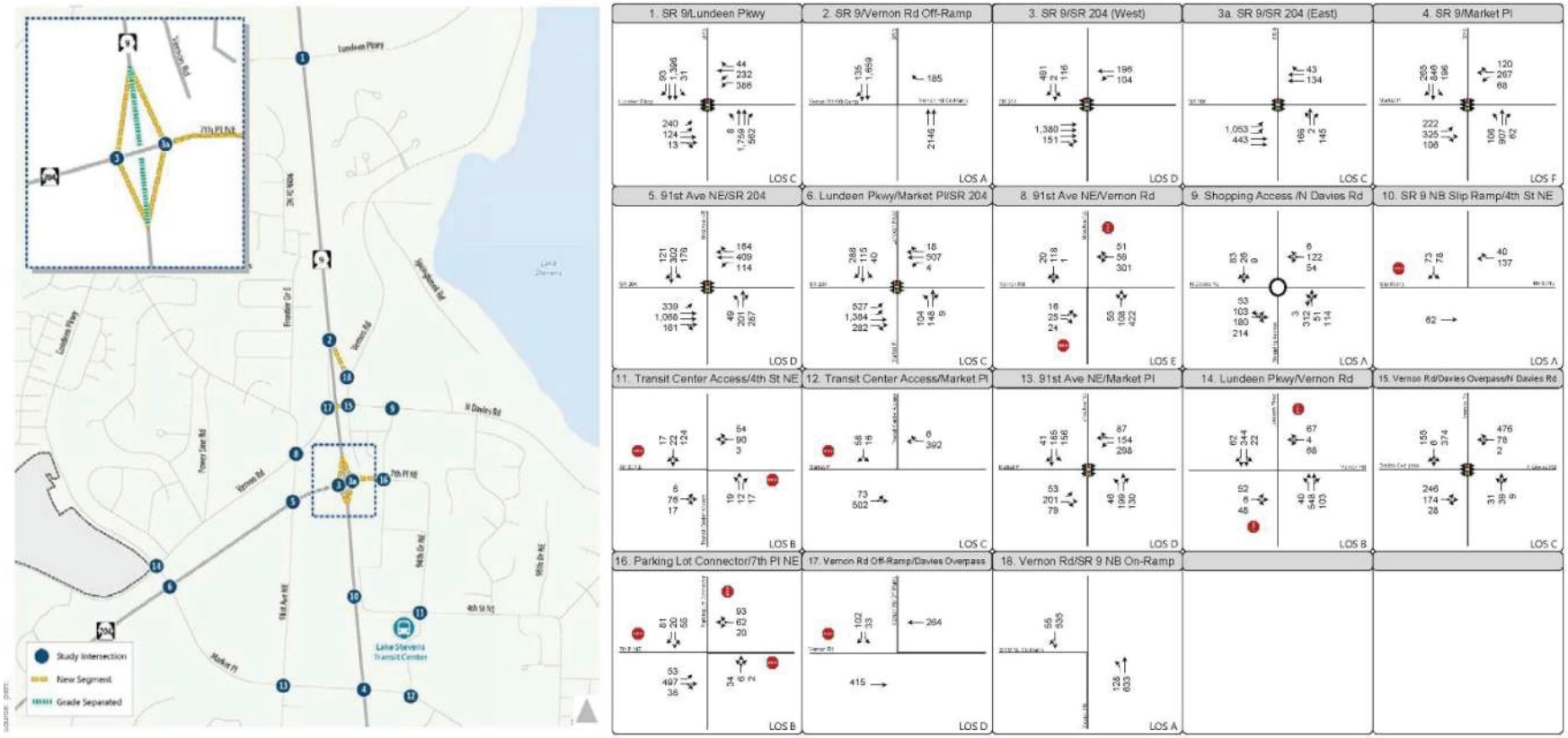

Figure 3-10. 2040 Alternative E2C PM Peak Hour

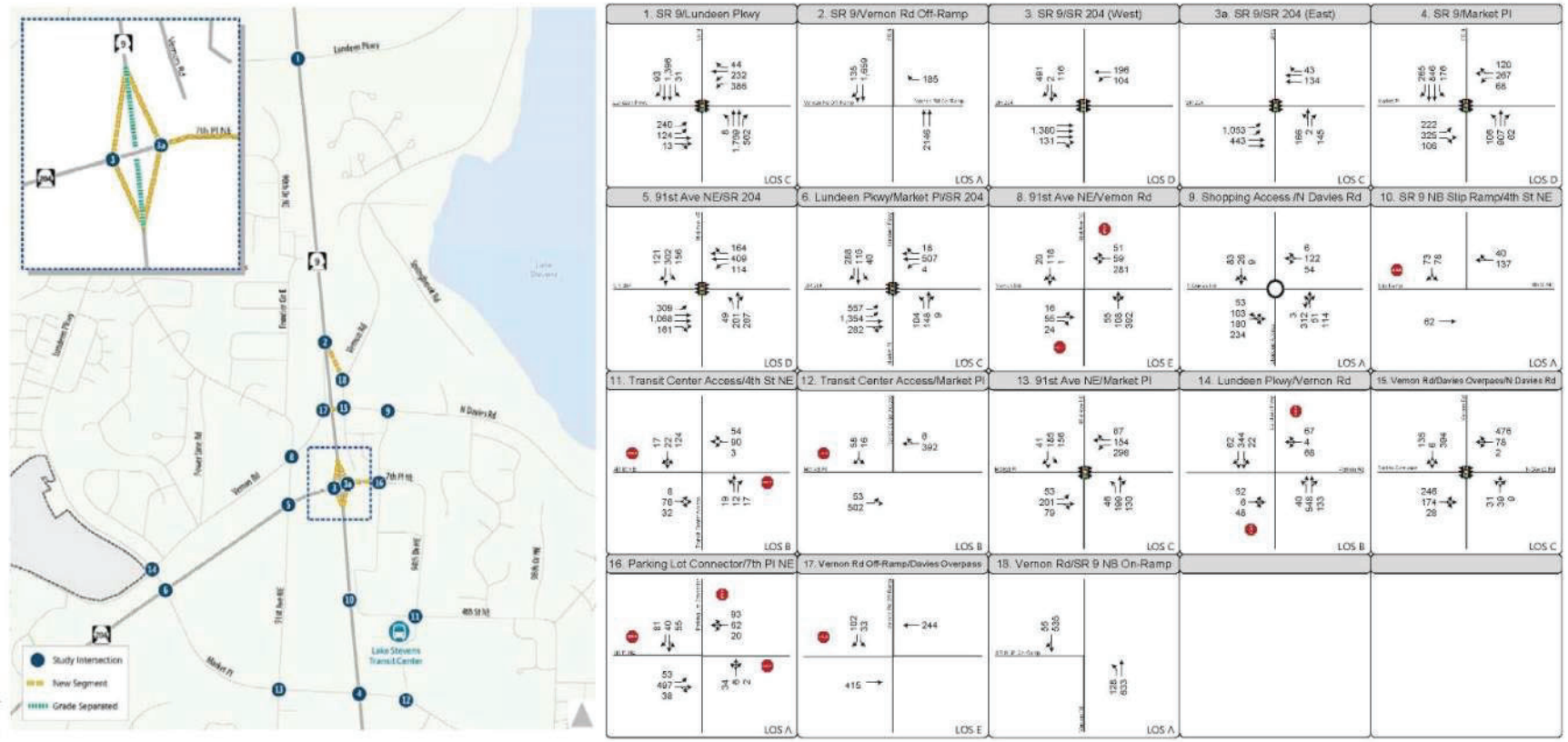

Figure 3-11. 2040 Alternative E2D PM Peak Hour

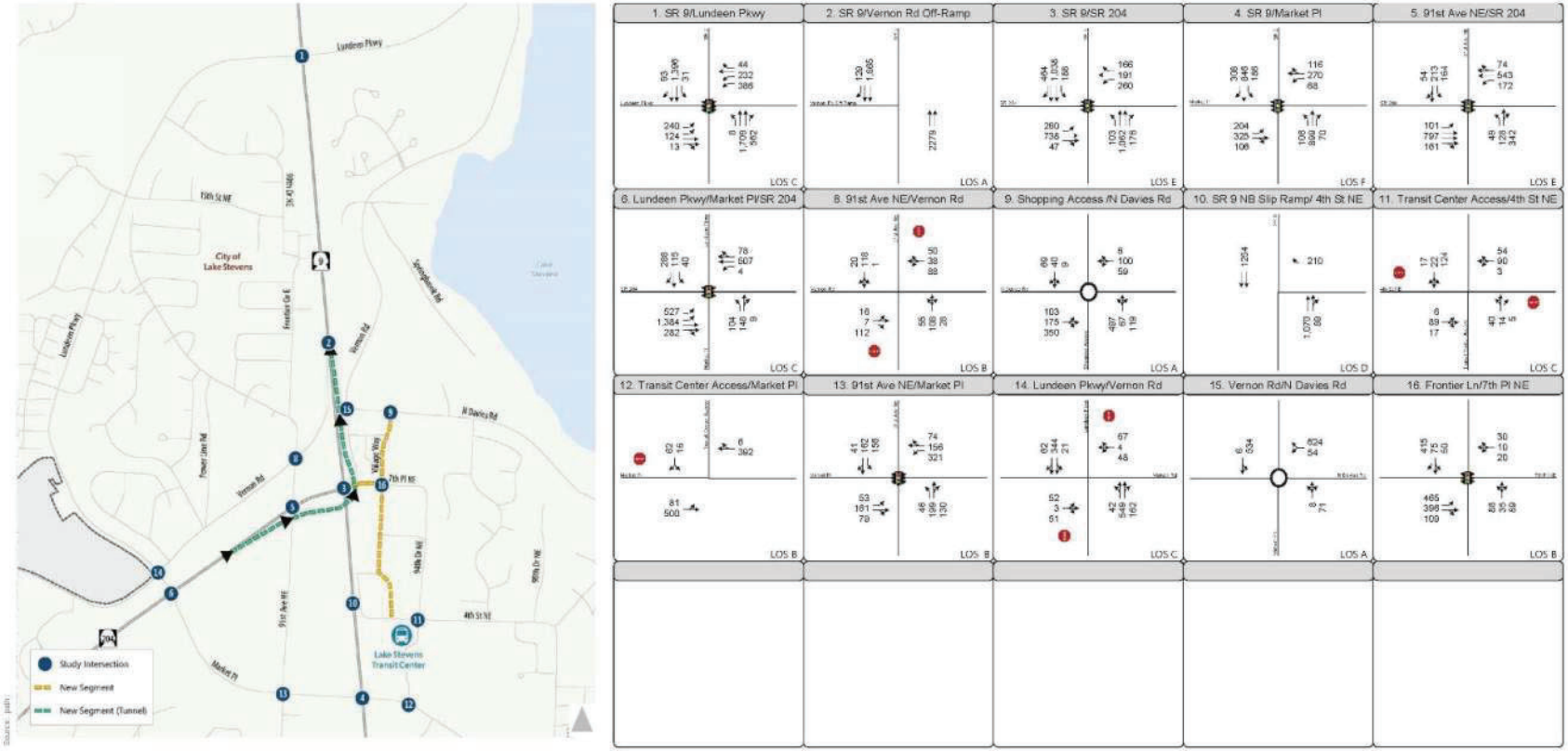

Figure 3-12. 2040 Alternative G2B PM Peak Hour

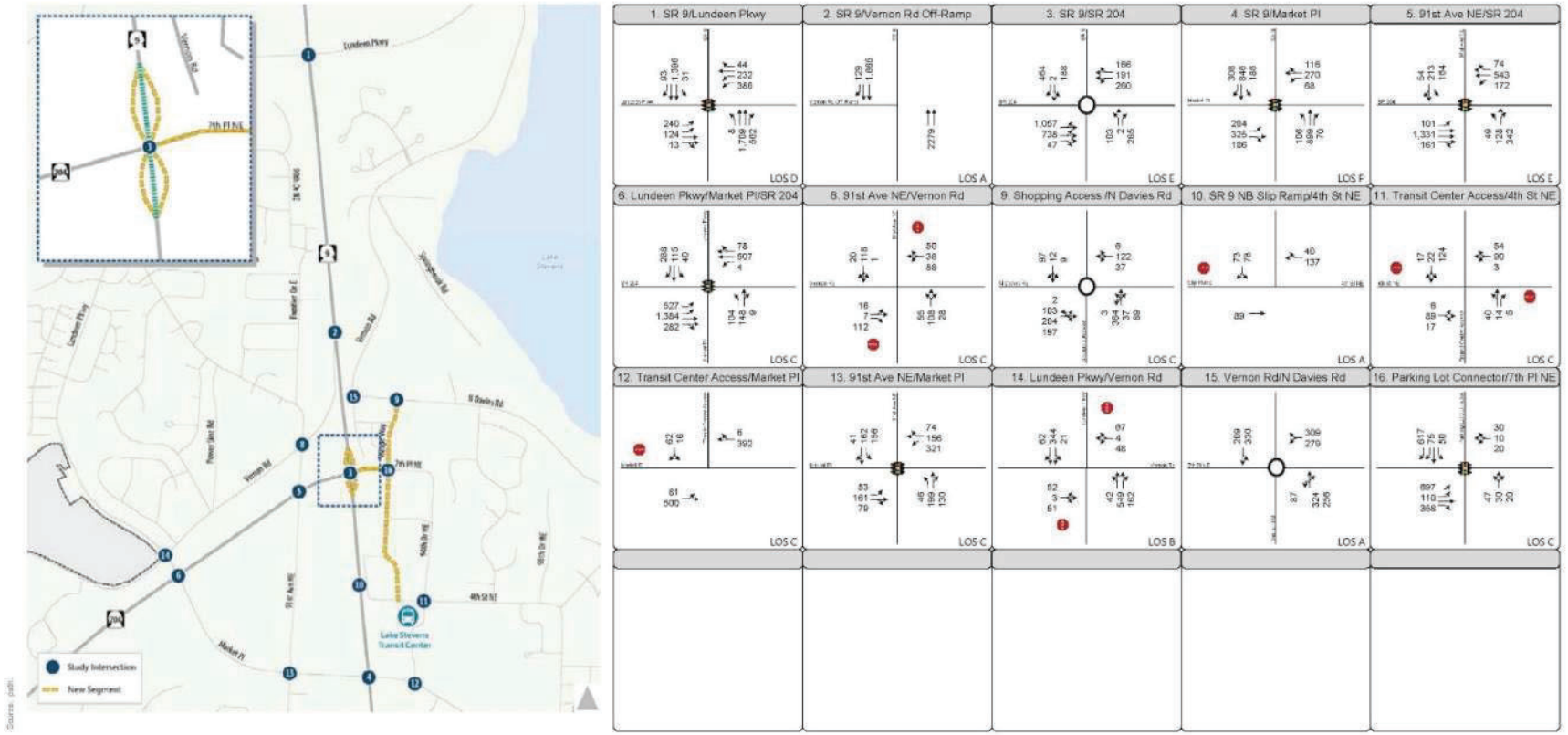

Figure 3-13. 2040 Alternative H PM Peak Hour

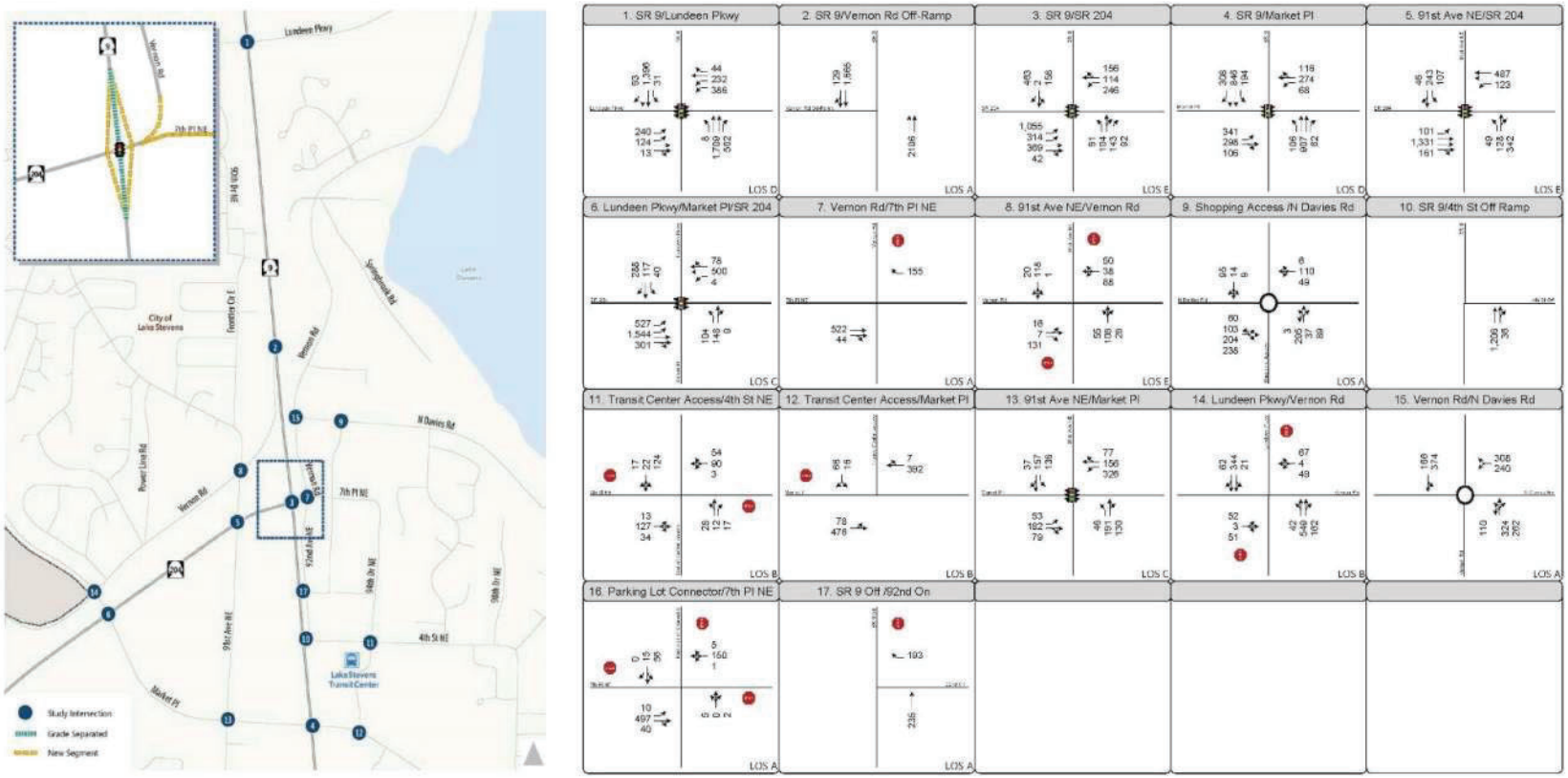

Figure 3-14. 2040 Alternative SPUI PM Peak Hour

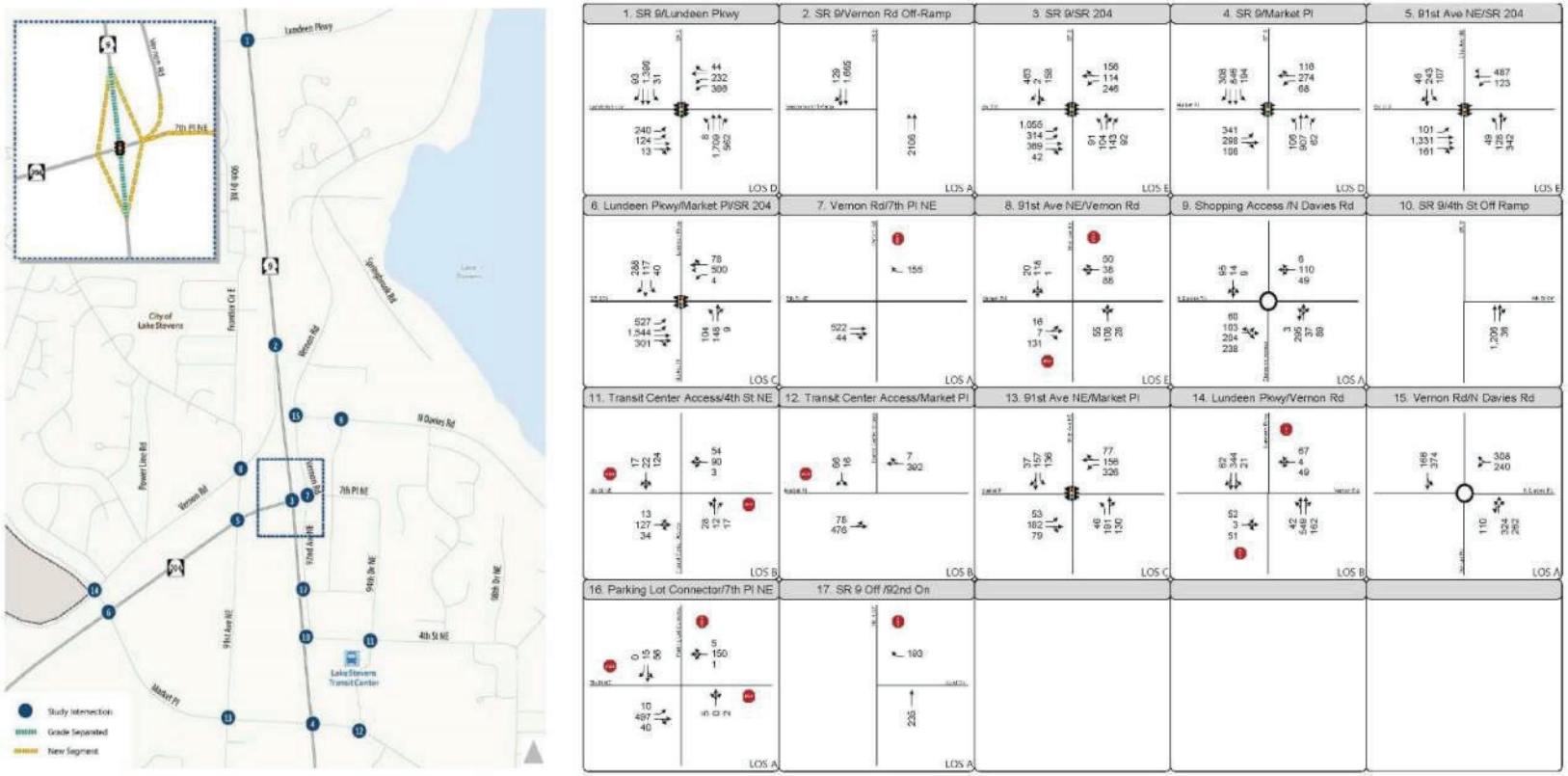

Figure 3-15. 2040 Preferred Alternative - Modified E2B Variation 4 PM Peak Hour

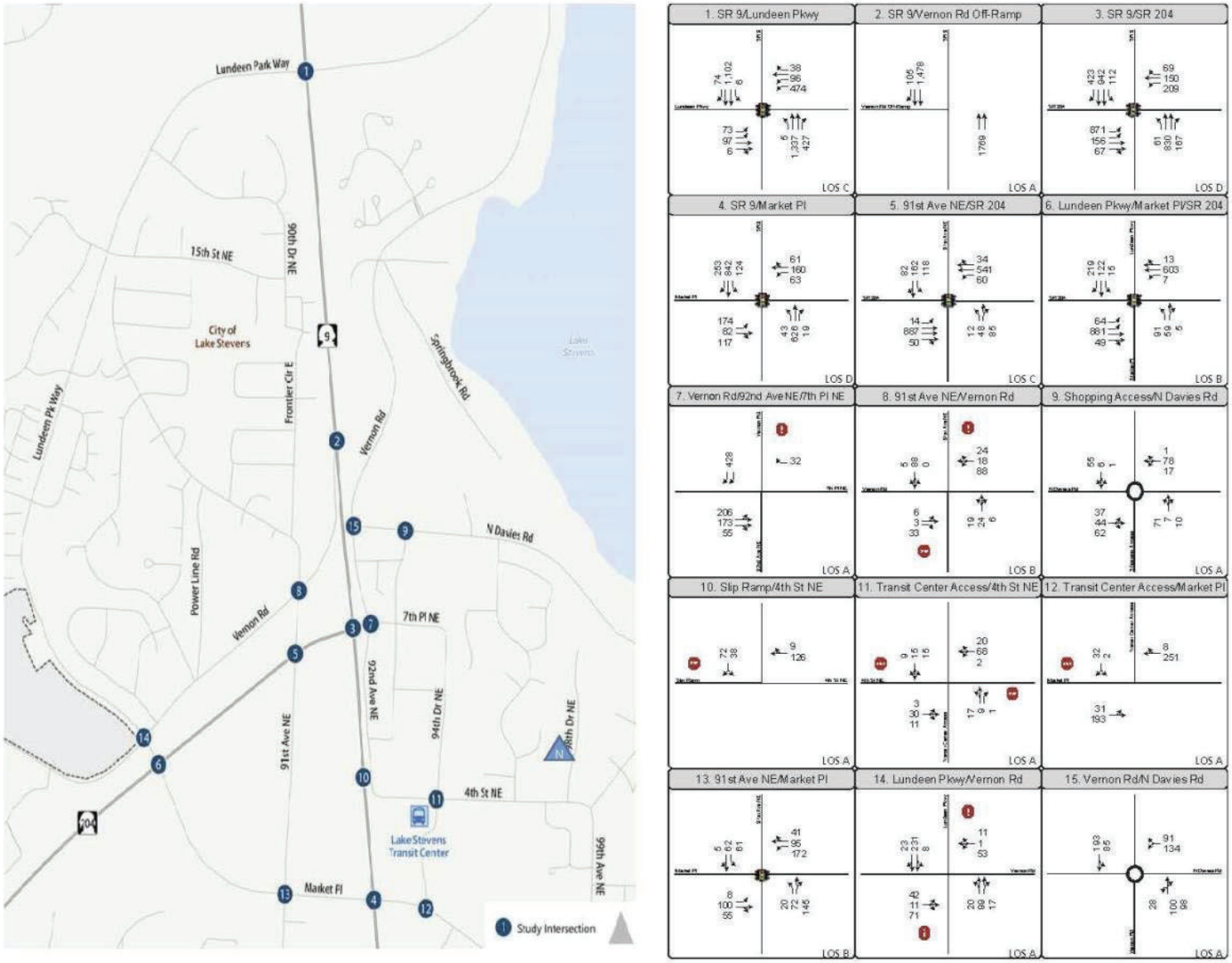

Figure 3-16. 2040 No Build AM Peak Hour

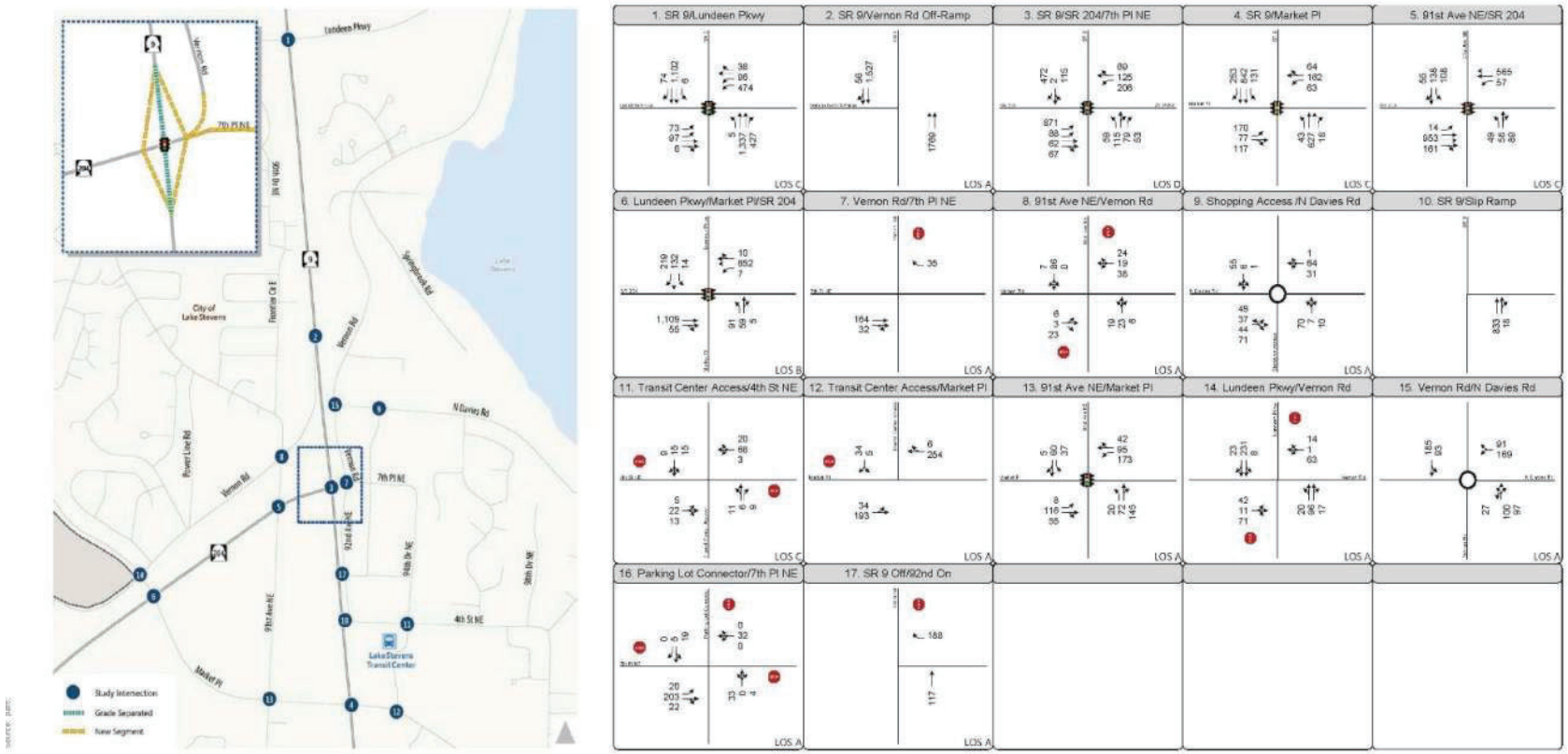

Figure 3-17. 2040 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative

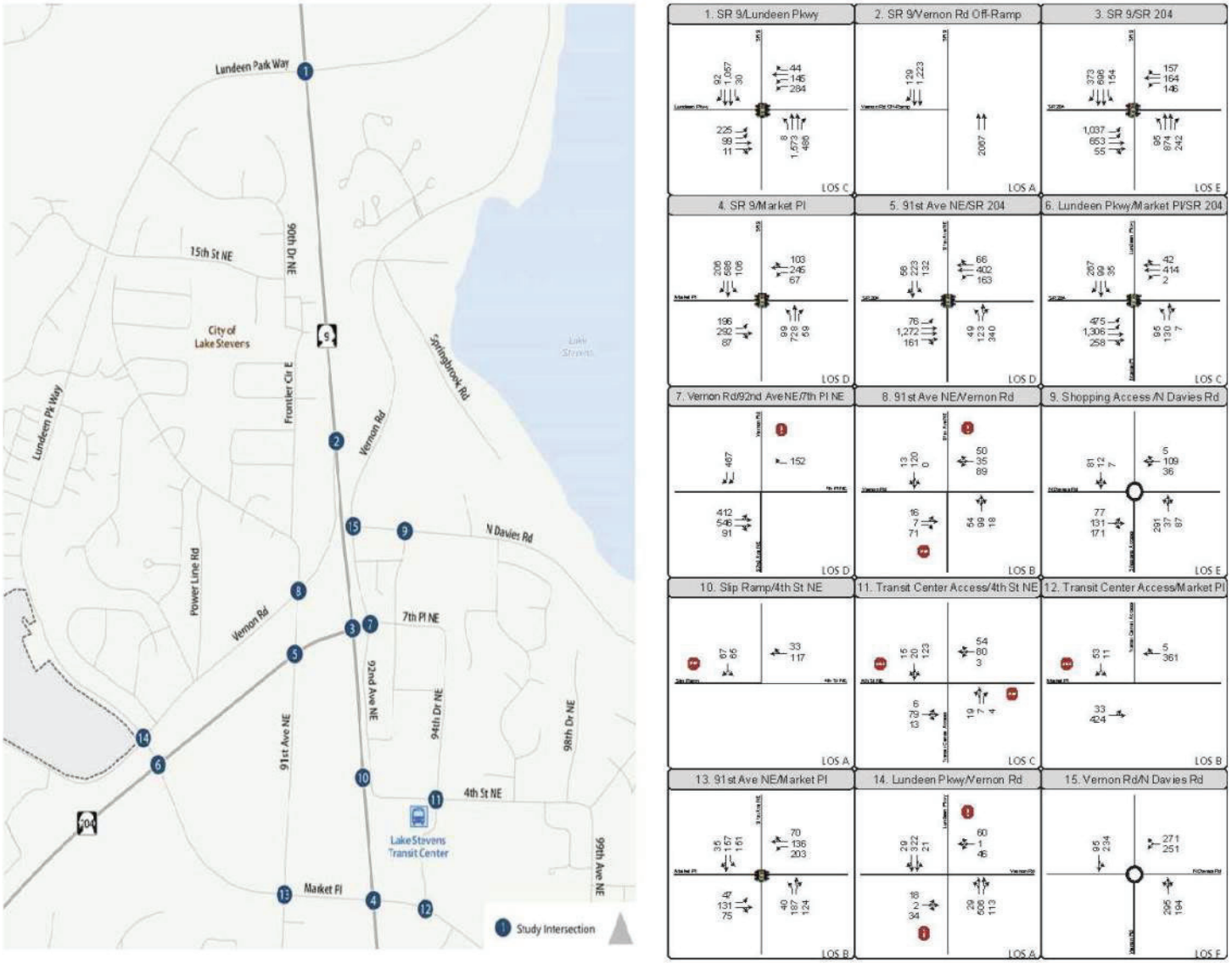

Figure 3-18. 2021 No Build PM Peak Hour

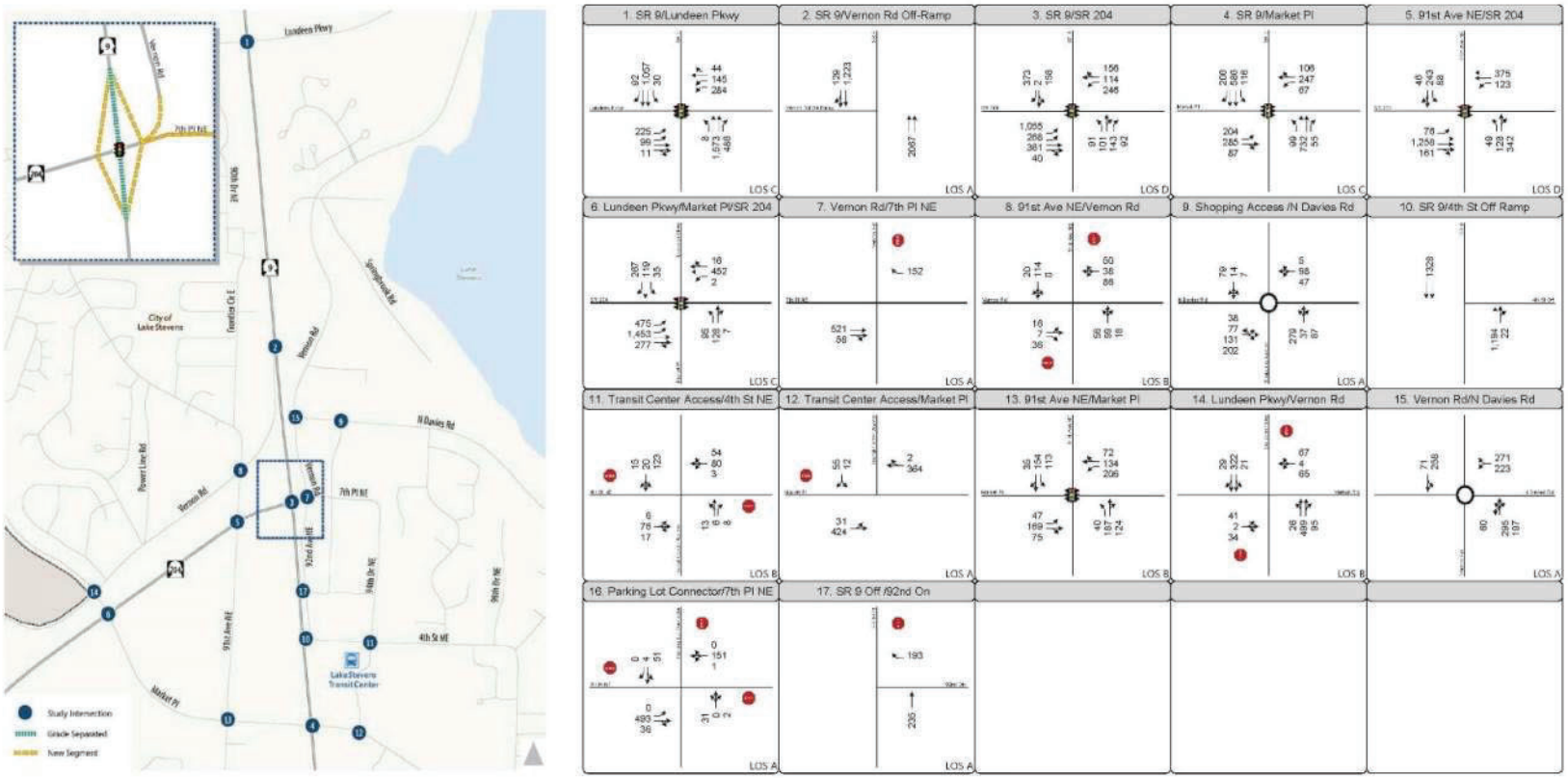

Figure 3-19. 2021 Preferred Alternative - Modified E2B Variation 4 PM Peak Hour

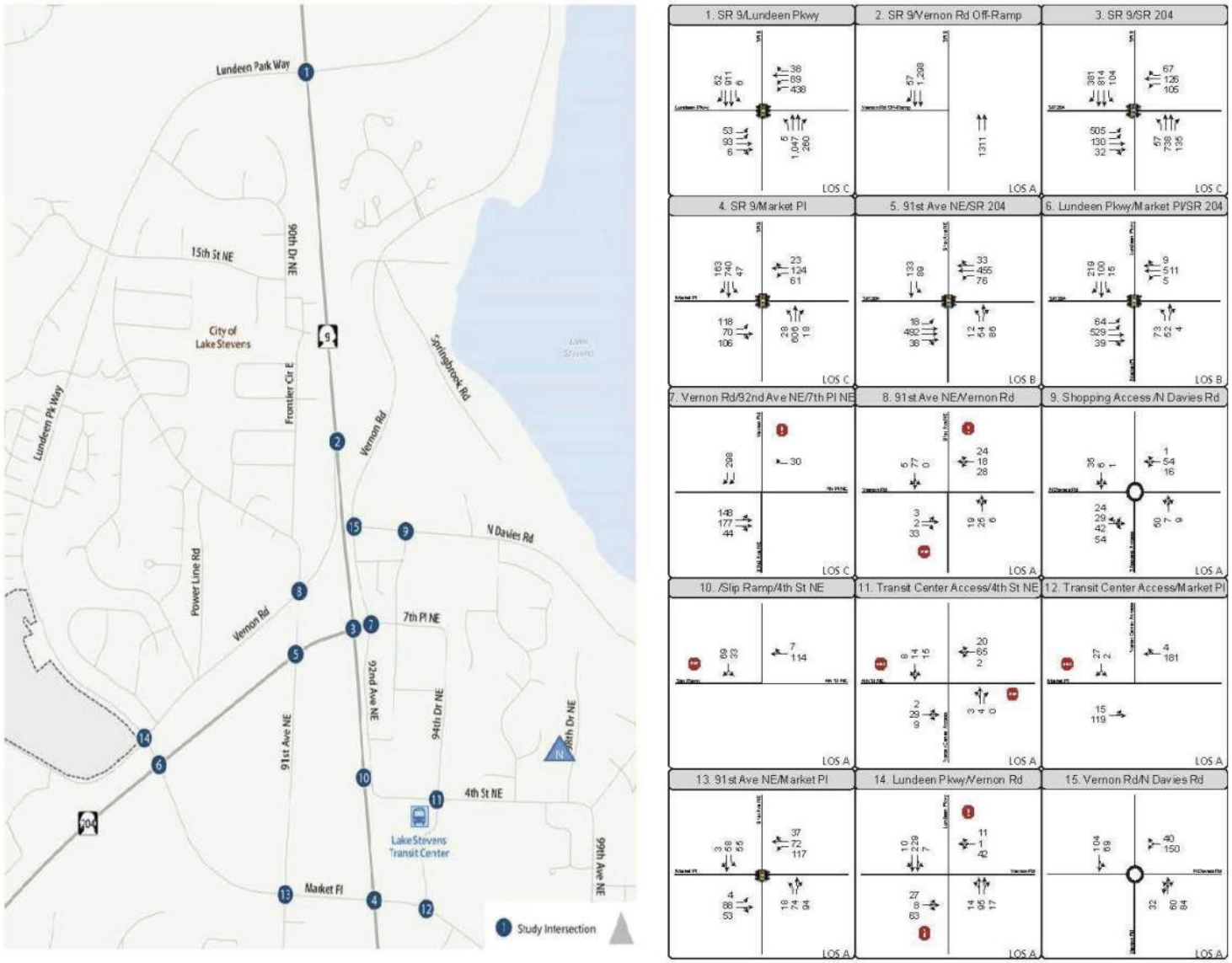

Figure 3-20. 2021 No Build AM Peak Hour

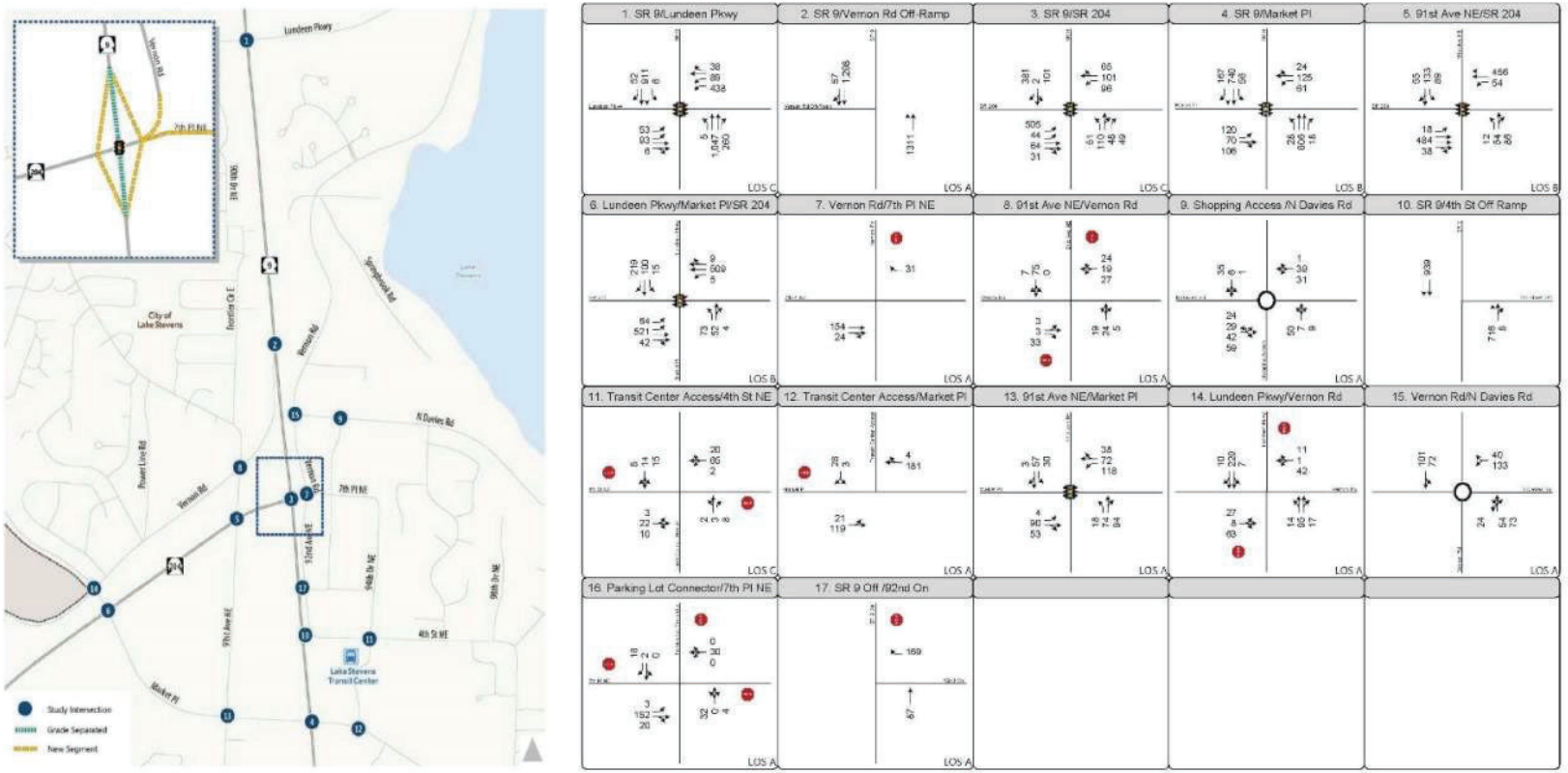

Figure 3-21. 2021 Modified E2B Variation 4 AM Peak Hour – Preferred Alternative

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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.

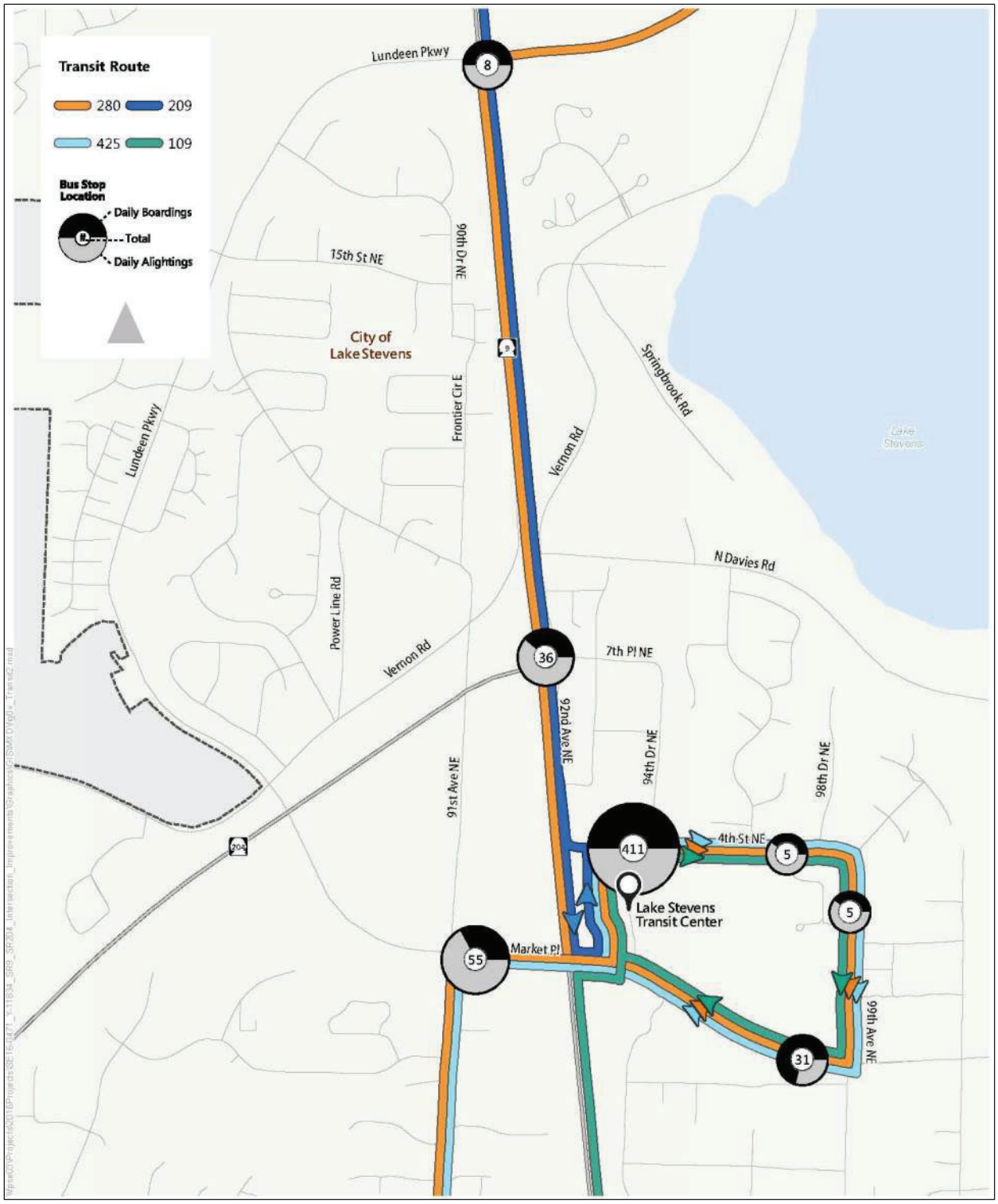

Figure 4-2. Existing Transit Routes and Stop Activity

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**.

APPENDIX I

ENVIRONMENTAL DOCUMENTATION

NOT USED

APPENDIX J

SPECIALTY DESIGN REPORTS

NOT USED

APPENDIX K

SUPPLEMENTS AND REVISIONS

NOT USED