I-5/LA CENTER ROAD INTERCHANGE IMPROVEMENTS ENVIRONMENTAL REEVALUATION REPORT

FEBRUARY 2016

PREPARED FOR:

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Washington State Department of Transportation
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Olympia, WA 98504-7300

City of La Center
214 East 4th Street
La Center, WA 98629

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1.0 INTRODUCTION

The Federal Highway Administration (FHWA), Washington Department of Transportation (WSDOT), City of La Center, and the Cowlitz Indian Tribe (Tribe) are collectively pursuing improvements to the Interstate 5 (I-5) Interchange with NW 319th Street/La Center Road (La Center Interchange Improvements). The La Center Interchange Improvements are needed to implement measures required to address traffic impacts caused, in part, by the Tribe's proposed casino project to be located on 156.4 acres of land that are held in trust by the U.S. Department of the Interior for the Cowlitz Indian Tribe along the west side of I-5. This property spans the north and south sides of NW 319th Street and has been approved by the Department of the Interior to be developed as a casino and entertainment center by the Tribe (herein referred to as the Cowlitz Reservation Development). The Cowlitz Reservation Development and associated off-site transportation improvements were analyzed in detail within an Environmental Impact Statement (EIS) prepared by the Bureau of Indian Affairs (BIA) in accordance with the National Environmental Policy Act (NEPA). FHWA and WSDOT served as Cooperating Agencies throughout the EIS process. Through consultation with FHWA and WSDOT, improvements to the La Center Interchange were identified as traffic mitigation measures and the environmental consequences of constructing the improvements were thoroughly analyzed within the 2008 Final EIS (2008 FEIS). The BIA issued a Record of Decision (ROD), which approved the Cowlitz Reservation Development and adopted mitigation measures recommended within the 2008 FEIS, including the La Center Interchange Improvements.

Implementation of the La Center Interchange Improvements is subject to discretionary approvals from FHWA, WSDOT, and the City of La Center. To assist FHWA with NEPA compliance and WSDOT with State Environmental Policy Act (SEPA) compliance, an Environmental Reevaluation Report was prepared in May 2015 (May 2015 Reevaluation) to identify and document changed environmental conditions and effects associated with the La Center Interchange Improvements (*See* 23 C.F.R. §771.129). FHWA issued a ROD which approved the La Center Interchange Improvements and adopted mitigation measures recommended within the 2008 FEIS and May 2015 Reevaluation on July 29, 2015. WSDOT and the City of La Center each published a SEPA Determination of Significance and Adoption of Existing Environmental Document (SEPA Adoptions) on August 18, 2015 and August 19, 2015, respectively.

Since issuance of the FHWA ROD, WSDOT's SEPA Adoption, and the City of La Center's SEPA Adoption, the design of stormwater facilities has been modified, consistent with applicable management guidelines, and the previously proposed realignment of NW Paradise Park Road has been refined. To assist FHWA with NEPA compliance and WSDOT with SEPA compliance, this Environmental Reevaluation Report (Reevaluation) has been prepared to identify and document potential effects associated with changes to the La Center Interchange Improvements.

This document has been completed in accordance with NEPA; the Council on Environmental Quality's regulations implementing NEPA (40 C.F.R. Parts 1500-1508); the FHWA's regulations for Environmental Impact and Related Procedures (23 C.F.R. Part 771); Section 4(f) of the Department of Transportation Act (49 U.S.C. §303); the FHWA's regulations implementing Section 4(f) (23 C.F.R. Part 774); the FHWA's *NEPA and Transportation Decisionmaking* (FHWA, 1992)*;* and Chapter 400.06 (1) *Reevaluations* of the WSDOT Environmental Manual M 31-11.13 (WSDOT, 2014).

1.1 PREVIOUS ENVIRONMENTAL REVIEW

1.1.1 SUMMARY OF 2008 FEIS NEPA PROCESS

The BIA published a Notice of Intent (NOI) in the *Federal Register* on November 12, 2004, announcing the BIA's intent to prepare an EIS to address the environmental impacts of the "Cowlitz Indian Tribe Trust Acquisition and Casino Project"[1]. During the NOI comment period (November 12 to December 13, 2004), the BIA identified 14 Cooperating Agencies: (1) FHWA (2) WSDOT (3) U.S. Army Corps of Engineers (USACE), (4) National Indian Gaming Commission, (5) the Tribe, (6) Clark County, (7) the Clark County Sheriff's Office, (8) Cowlitz County, (9) the City of Vancouver, (10) the City of La Center, (11) the City of Ridgefield, (12) the Port of Ridgefield, (13) the City of Woodland, and (14) the City of Battle Ground. A Scoping Report was published by the BIA in February 2005.

An administrative version of the Draft EIS was circulated to Cooperating Agencies, including FHWA and WSDOT, in October 2005 for review and comment. Comments were taken into consideration and revisions were completed as appropriate prior to public release. The Draft EIS (EIS No. 200600122) was made available to federal, Tribal, state, and local agencies and other interested parties in April 2006 initiating a 90-day public review period[2]. Public hearings were held at the Skyview High School Auditorium in Vancouver City, Washington on June 14 and June 15, 2006. This comment period was subsequently reopened on August 4, 2006 and closed again on August 25, 2006[3]. The total comment period for the Draft EIS was 136 days.

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1 69 FR 65447

2 The Environmental Protection Agency (EPA) published the Notice of Availability (NOA) for the Draft EIS for the Cowlitz Indian Tribe Trust Acquisition and Casino Project in the Federal Register on April 14, 2006 (71 FR 19505).

3 The EPA published an amendment to the NOA for the Draft EIS on August 4, 2006 (71 FR 44280).

Substantive comments on the Draft EIS received during the comment period, including those submitted or recorded at the public hearing, were considered in the preparation of the Final EIS. Responses to the comments received were provided in Appendices B and C of the Final EIS and relevant information was revised in the Final EIS as appropriate to address those comments. An administrative version of the Final EIS was circulated to cooperating agencies in March of 2007 for review. All comments received as a result of cooperating agency review were considered, and changes to the Final EIS were made as appropriate. The Final EIS (EIS No. 20080212) was issued on May 30, 2008[4].

In April 2013, the BIA conducted a thorough reevaluation of the 2008 FEIS to ensure that the document remained adequate to meet NEPA compliance requirements (2013 Adequacy Review). The reevaluation concluded that the current conditions of the project site remained largely unchanged from the time of the preparation of the 2008 FEIS. The few changes that had occurred were either anticipated within the 2008 FEIS or were insignificant to the analysis. Therefore, the analysis, conclusions and mitigation measures set forth in the 2008 FEIS were determined to remain applicable to the Proposed Action. The reevaluation confirmed that the 2008 FEIS continued to be adequate to meet NEPA compliance requirements for the Proposed Action.

On April 22, 2013, the Assistant Secretary - Indian Affairs (Assistant Secretary) made a final agency determination to implement the Preferred Alternative (Alternative A) identified within the 2008 FEIS. The Preferred Alternative includes acquisition in trust of the 156.4-acre Cowlitz Parcel, located adjacent to the La Center Interchange and west of I-5; proclamation of the parcel as the Tribe's reservation; and construction of a casino-resort complex and associated facilities, a recreational vehicle park, and Tribal Government facilities, including Tribal offices, a cultural center, and elder housing[5]. Practicable means to avoid or minimize environmental harm from the Preferred Alternative were identified and adopted as part of the ROD. The adopted measures included improvements to the La Center Interchange that would reduce project-related traffic impacts from development of the Preferred Alternative.

WSDOT and FHWA accepted the BIA's invitation to be a Cooperating Agency on the NEPA document for the Cowlitz Reservation Development on January 12, 2005 and June 21, 2005, respectively. As described above, an administrative version of the Draft EIS and Final EIS was circulated to cooperating agencies for review and comment. Comments were taken into consideration and revisions were completed as appropriate prior to approval. Additionally, FHWA and WSDOT actively participated in

4 The EPA published the NOA for the 2008 FEIS for the Cowlitz Indian Tribe Trust Acquisition and Casino Project in the Federal Register on May 30, 2008 (73 FR 31115).

5 Since the 2008 FEIS was published, the Preferred Alternative has been slightly modified to include a smaller footprint. It is anticipated that the Cowlitz Reservation Development would include the following uses: 2,440 gaming uses; 4 interior restaurants; 5,000 to 6,000 square feet of interior retail space; Casino bars; an event center with seating for up to 1,500 guests; valet parking services; a 250-room hotel with restaurant and retail space; and up to 3,450 parking spaces

the preparation of the Traffic Impact Study[6], Supplemental Traffic Impact Study[7], and the Draft Interchange Justification Report (IJR)[8] including attending conference calls and meetings.

1.1.2 SUMMARY OF MAY 2015 REEVALUATION NEPA PROCESS

In May 2015, an Environmental Reevaluation Report was prepared to address interchange design refinements, identifying and documenting changed environmental conditions and effects associated with the La Center Interchange Improvements. The May 2015 Reevaluation determined that the conclusions and mitigation measures set forth in the 2008 FEIS remained applicable to the La Center Interchange improvements and that there was no significant new information or new impacts. Therefore, the May 2015 Reevaluation concluded that the 2008 FEIS was adequate to meet NEPA compliance requirements for the La Center Interchange Improvements and preparation of a supplemental EIS was not required. FHWA and WSDOT served as lead agencies for the May 2015 Reevaluation. FHWA adopted a ROD approving the portions of the La Center Interchange Improvements that affect the Interstate right-of-way (ROW) on July 29, 2015. WSDOT and the City of La Center each published a SEPA Adoption on August 18, 2015 and August 19, 2015, respectively, which approved the La Center Interchange Improvements and adopted the May 2015 Reevaluation as well as the previous environmental documents discussed in **Section 1.2.1**, determining that these documents were sufficient for SEPA compliance.

1.2 SUMMARY OF CHANGES TO THE LA CENTER INTERCHANGE IMPROVEMENTS

The La Center Interchange Improvements site is located in Clark County, Washington, approximately 1.5 miles west of La Center, and 3 miles northeast of Ridgefield (**Figure 1** and **Figure 2**). The project site is located east of the Cowlitz Reservation Development site, on and around the La Center Interchange and its functional area along the NW 319th Street/NW La Center Road corridors, including the two adjacent frontage roads on either side of the interchange. The proposed project site/area of potential effects (APE) is shown in **Figure 3**. **Figure 4** provides a comparison of the APE analyzed in the May 2015 Reevaluation to the current APE.

The currently proposed La Center Interchange Improvements incorporate the design elements that were analyzed in the May 2015 Reevaluation and are summarized in **Section 2.1**. At this time, design refinements are proposed that are evaluated further in this report, including: alternate alignment of NW Paradise Park Road north of NW La Center Road, elimination of compost-amended vegetation filter strips (CAVFS) in WSDOT ROW, addition of two newly proposed stormwater detention ponds in WSDOT ROW, and expansion of the previously proposed City of La Center detention pond. As refined, none of the La Center Interchange Improvements would occur within Clark County jurisdiction.

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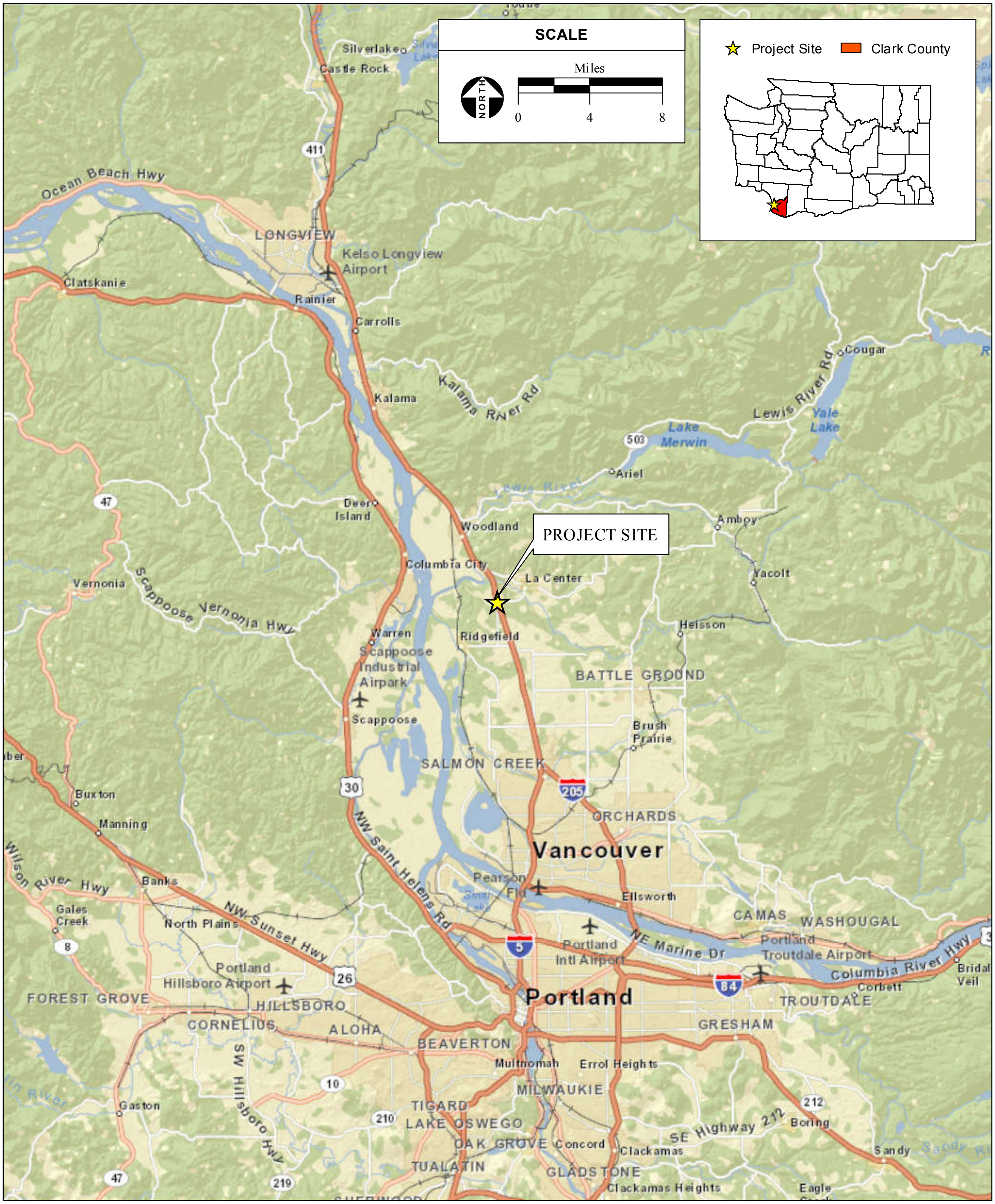
6 Appendix T of Volume I of the 2008 FEIS

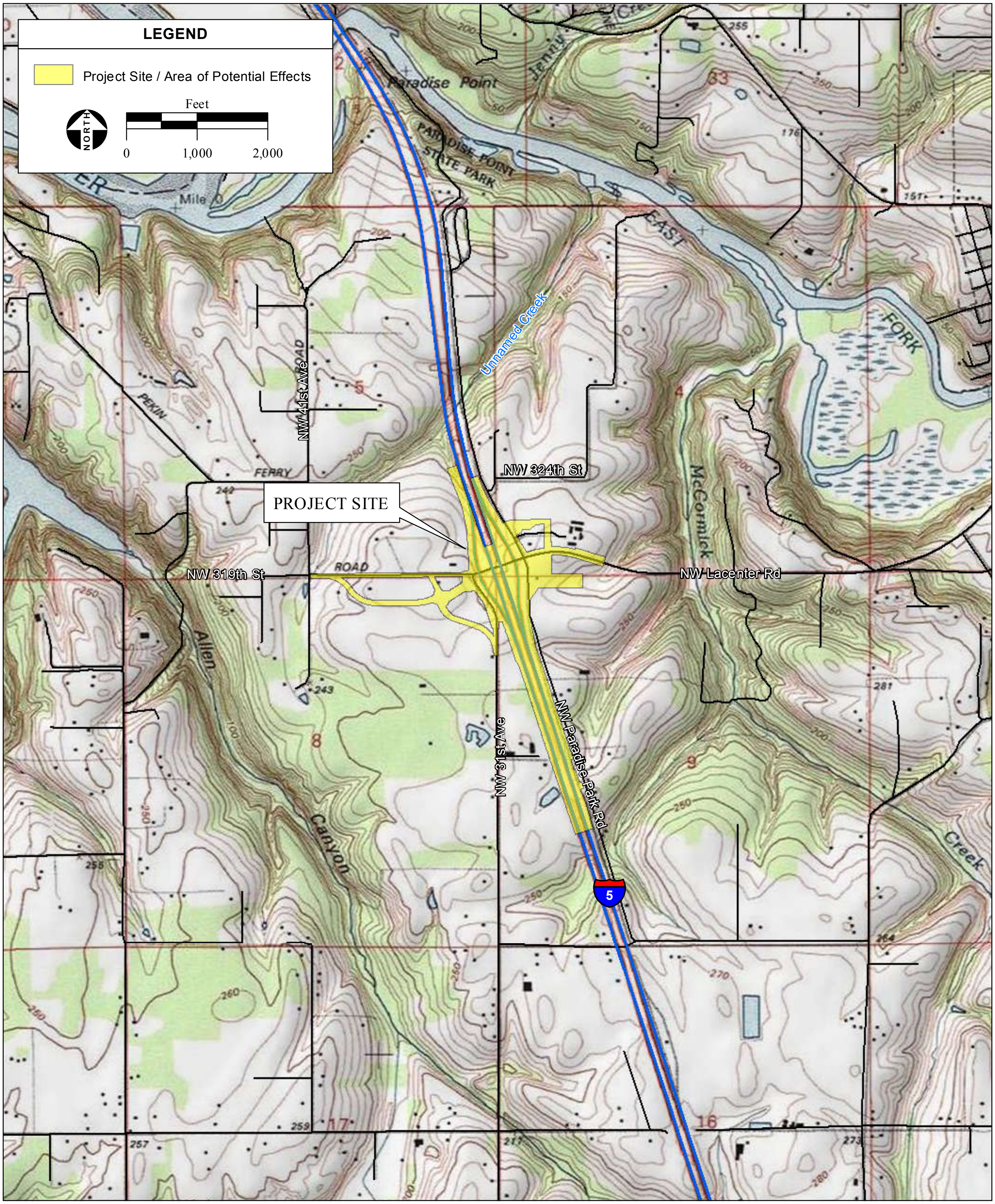
7 Appendix O of Volume VII of the 2008 FEIS

8 Appendix P of Volume VII of the 2008 FEIS



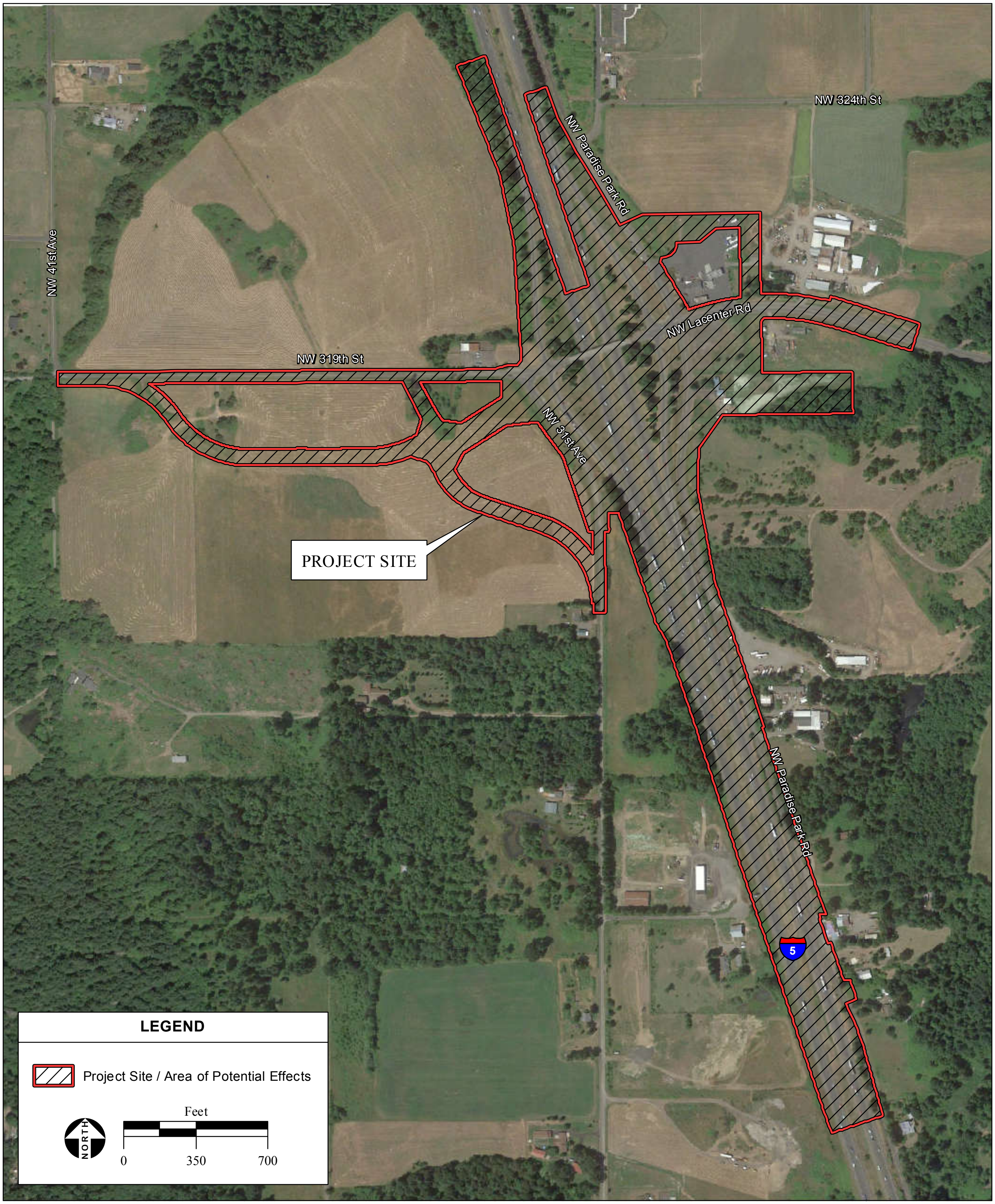
SOURCE: ESRI Data, 2015; AES, 11/19/2015

Figure 1
Regional Location



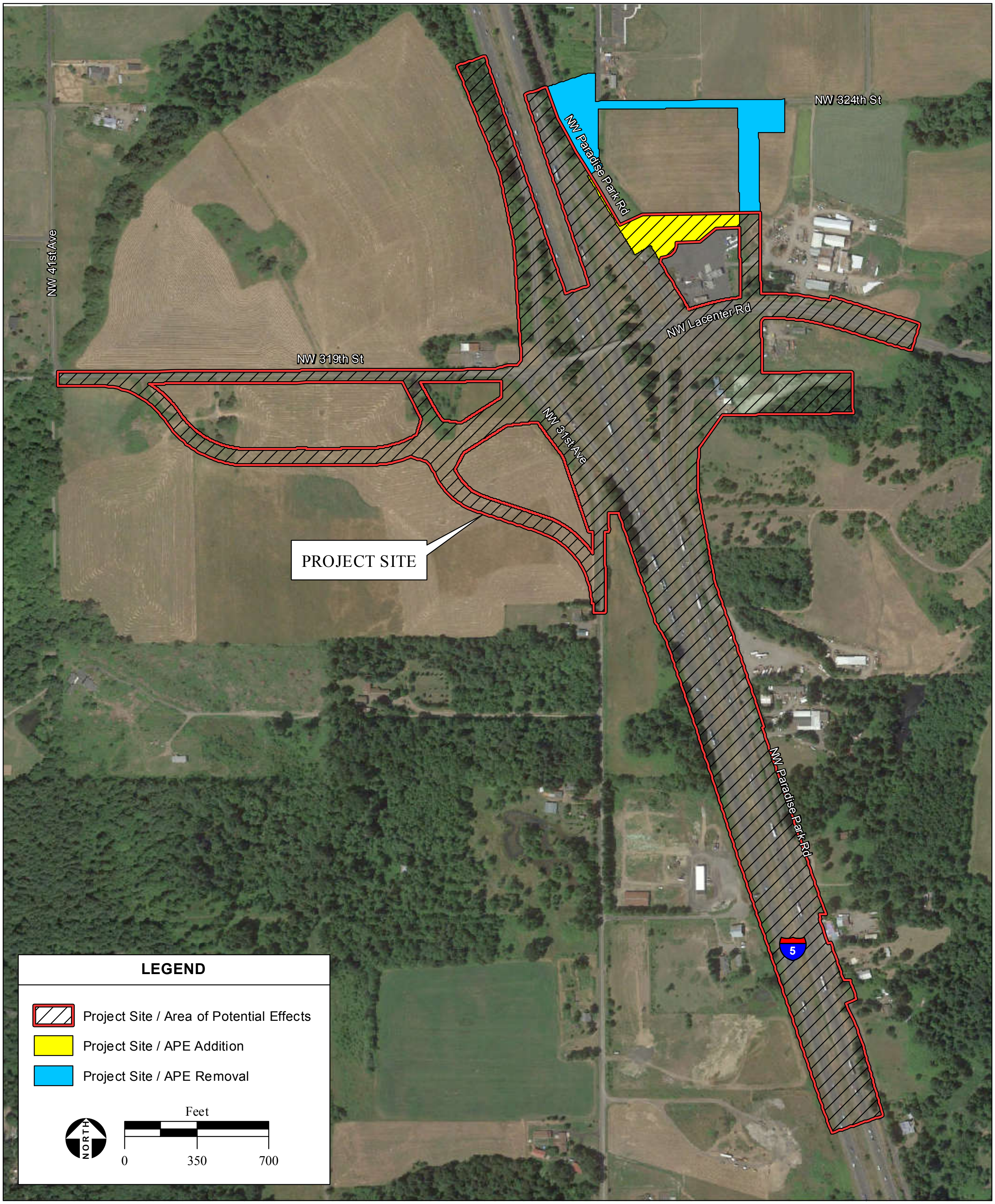
SOURCE: "Ridgefield, WA" USGS 7.5 Minute Topographic Quadrangle, Sections 5, 8, and 9, T4N, R1E, Willamette Baseline & Meridian; Kittelson & Associates, Inc., 3/13/2014; AES, 10/29/2015

Figure 2
Project Site and Vicinity



SOURCE: Kittelson & Associates, Inc., 3/14/2014;
DigitalGlobe aerial photograph, 7/14/2014; AES, 11/19/2015

Figure 3
Aerial Site Map



SOURCE: Kittelson & Associates, Inc., 3/14/2014;
DigitalGlobe aerial photograph, 7/14/2014; AES, 11/19/2015

Figure 4
Project Footprint Comparison

1.3 OVERVIEW OF THE REEVALUATION PROCESS

NEPA regulations and SEPA rules encourage the use of existing documents to reduce duplication and unnecessary paperwork. NEPA encourages agencies to avoid duplication of environmental documents by providing that an agency may adopt appropriate environmental documents prepared by another agency (40 CFR §1500.4(n)). Regulations regarding adoption of a prior EIS outlined in 40 CFR §1506.3 indicate that a cooperating agency may adopt without recirculating the EIS of a lead agency when, after an independent review of the statement, the cooperating agency concludes that its comments and suggestions have been satisfied. FHWA's NEPA regulations further authorize re-evaluation of and reliance on existing NEPA documents (23 C.F.R. §771.129). Likewise, Chapter 400.06 of the WSDOT Environmental Manual authorizes WSDOT to reevaluate to determine whether a supplemental document is required or when major steps to advance the project have not occurred within three years of a ROD (WSDOT, 2014). This NEPA reevaluation will determine whether previously prepared analyses (including those prepared in connection with the 2008 FEIS, those prepared in connection with BIA's 2013 reevaluation, and those prepared in connection with the May 2015 Reevaluation) remain adequate to fully and properly evaluate the environmental consequences of the Interchange Improvements.

2.0 UPDATED PROJECT DESCRIPTION

2.1 PROJECT DESCRIPTION IN THE MAY 2015 REEVALUATION

A detailed description of the proposed La Center Interchange Improvements was provided in Section 2.2 of the May 2015 Reevaluation. Below is a brief summary of the approved La Center Interchange Improvements, including stormwater facilities:

- **Overpass Bridge:** Construction of a new overpass structure located immediately south of the existing structure which will accommodate four travel lanes and pedestrian and bicycle facilities;
- **I-5 Ramps**:
  - Modification of the existing northbound and southbound interchange ramp terminals to include multilane modern roundabouts;
  - A modified northbound off-ramp that is lengthened and includes a second exit lane;
  - A modified southbound on-ramp that includes two receiving lanes off of the ramp terminal that transition to a single lane prior to merging with I-5 mainline traffic.
- **NW Paradise Park Road**: A partial relocation of NW Paradise Park Road and the development of a new intersection with NW La Center Road. This new intersection would be located approximately 450 feet (centerline-to-centerline) east of the northbound roundabout terminal to meet WSDOT guidelines for intersection spacing of 350 or more feet. The new intersection will operate as a two-way stop-control intersection in the near-term (Phase I) and eventually will need to be converted to a traffic signal with future development. The existing NW Paradise Park Road intersection would be eliminated by forming cul-de-sacs or potentially vacating the roadways north and south of NW La Center Road. The new realignment would rely on NW 324th Street to connect to the northerly portion of the NW Paradise Park Road.
- **NW 319th Street**: Relocation of NW 319th Street approximately 350 feet south of the current alignment to accommodate the new overpass and provide an enhanced east-west circulation network that is more compatible with the Cowlitz Reservation Development; and
- **NW 31st Avenue**: A partial relocation of NW 31st Avenue and the development of a new intersection with NW 319th Street. This new intersection would be located approximately 600 feet (centerline-to-centerline) west of the southbound roundabout terminal to meet WSDOT intersection spacing guidelines. The new intersection will operate as a roundabout to accommodate near-term and future development.

Note that the Cowlitz Tribe has authority to relocate the rights of way for both NW 319th Street and NW 31st Avenue pursuant to Tribal law. Clark County holds the rights of way for these two existing roads, but the underlying fee is held by the United States in trust for the Cowlitz Tribe. The County has no jurisdiction over tribal trust lands, and therefore, no County ordinances apply. Tribal Ordinance No. 15-02 provides that, where the location and dimension of rights of way are not specified in a recorded instrument, the Tribe is entitled to make reasonable changes in their location or dimension, at its expense, to permit normal use and development of the Tribe's trust lands, so long as the changes do not lessen the utility of the rights of way or increase the burden on the holder, or frustrate the purpose for which the rights of way were created. Because the relocation of NW 319th Street and NW 31st Avenue will enhance the utility of the roads, lessen the burdens on the County (because the Tribe will pay for relocation and maintenance), and further the purpose for which the roads were created -- providing access for individuals living in the nearby area -- the Tribe has enacted a Tribal resolution authorizing the relocation of NW 319th Street and NW 31st Avenue, consistent with the underlying BIA FEIS (which contemplated relocation), the FHWA ROD and the IJR.

The La Center Interchange Improvements would be constructed in two phases. Phase I is expected to be operational by 2017 and Phase II is expected to be operational by 2037. Anticipated staging areas are included within the project site/APE shown in **Figure 3**, and may include the areas directly east and west of NW Paradise Park Road (existing) on the south side of NW La Center Road.

The existing overpass bridge would remain open to traffic until the new overpass bridge is operational. Demolition of the existing overpass would take place at night, when traffic volumes are low, and staged so that traffic is detoured a safe distance away from the stretch demolished. Demolition would be staged so that traffic is detoured a safe distance away from the stretch demolished. This would be accomplished by establishing a detour that diverts traffic onto the diamond interchange ramps during demolition activities. Because one direction of the overpass can be accomplished in one night shift, demolition of the existing overpass is anticipated to take no more than two to three days. Construction impacts associated with the La Center Interchange Improvements were discussed within Section 3.8 of the May 2015 Reevaluation. As discussed within the May 2015 Reevaluation, construction activities would be limited in scale and duration, resulting only in short-term disturbances to traffic flows.

STORMWATER FACILITIES

Stormwater treatment and detention facilities will be constructed to accommodate increased runoff generated by the impervious surface areas of the La Center Interchange Improvements. These new hydraulic features will be designed to comply with federal and State water quality regulations, using appropriate guidance documents, as described below, to meet applicable jurisdictional requirements and protect water quality to the maximum extent practicable. The facilities for the La Center Interchange Improvements previously spanned over several jurisdictional boundaries, including: WSDOT, Clark County[9], the City of La Center, and the Cowlitz Reservation, which is under the jurisdiction of the U.S. Environmental Protection Agency (EPA) as the land is held in trust.

Flow control and treatment facilities will be operated and maintained to preserve full effectiveness. After flow control and treatment, the stormwater will be released at outfall points to the nearby waterways or upstream of the waterways to existing stormwater conveyance structures. In the northern and western portions of the project site, treated project run-off will mix with additional on- and off-site runoff before

[9] No stormwater facilities are currently proposed within Clark County jurisdiction (see **Section 2.2**).

being discharged to the unnamed stream, and in the southern and eastern portions of the project site, treated project run-off will mix with additional on- and off-site runoff before being discharged to McCormick Creek. See Section 2.2 and Appendix B of the May 2015 Reevaluation for a detailed discussion of previously proposed stormwater facilities.

2.2 CHANGES TO THE PROJECT DESCRIPTION

Since preparation of the May 2015 Reevaluation Report, several minor adjustments have been proposed to the La Center Interchange Improvements. These include modifications to alignment of NW Paradise Park Road and the proposed stormwater facilities based primarily on additional input from WSDOT and the City of La Center. Detailed descriptions of the proposed changes are provided below. **Figure 4** presents the new APE, showing areas that have been added to and removed from the previous APE evaluated in the May 2015 Reevaluation.

NW PARADISE PARK ROAD ALIGNMENT

NW Paradise Park Road was previously designed to extend north from NW La Center Road to NW 324th Street. The current proposed alignment of NW Paradise Park Road extends north from its intersection with NW La Center Road for approximately 400 feet, then turns west and extends approximately 600 feet to reconnect with the existing alignment of NW Paradise Park Road. With the new alignment of NW Paradise Park Road, improvements along NW 324th Street would no longer be necessary and are eliminated from the La Center Interchange Improvements design (**Figure 4**). Thus, no improvements would take place within Clark County jurisdiction. **Figures 5** and **6** show the La Center Interchange Improvements for 2017 and 2037, including the proposed alignment of NW Paradise Park Road.

STORMWATER FACILITIES

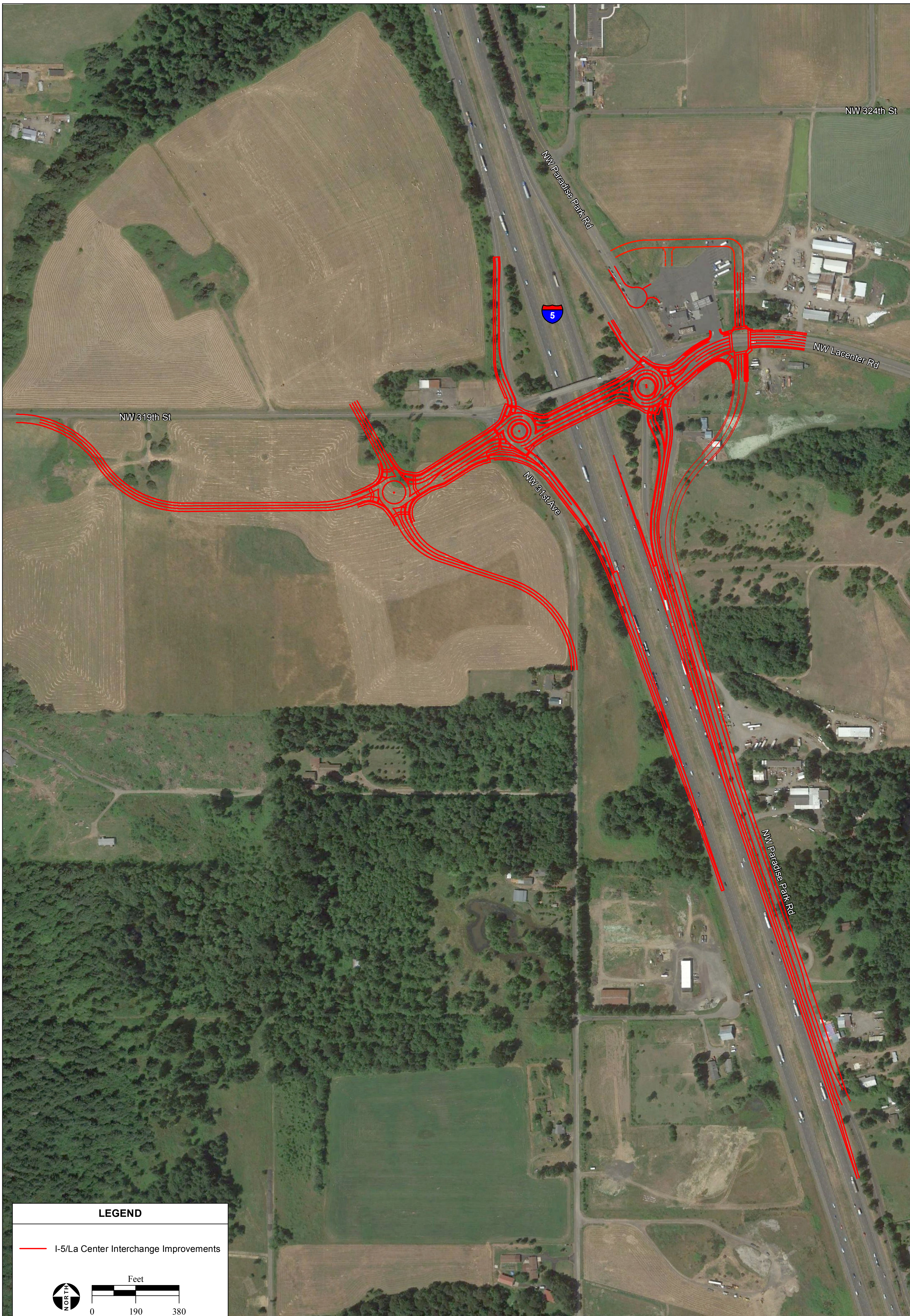
A detailed description of the proposed stormwater facilities for improvements under WSDOT and City of La Center jurisdiction is included in the Stormwater Technical Memoranda (**Appendix A**). Refinements from the design previously considered in the May 2015 Reevaluation include: elimination of CAVFS in WSDOT ROW, addition of two newly proposed stormwater detention ponds to accommodate run-off from WSDOT ROW, and expansion of the previously proposed City of La Center detention pond. All proposed changes are located within the APE analyzed within the May 2015 Reevaluation. **Figure 7** depicts the proposed changes to the stormwater facilities under WSDOT and City of La Center jurisdiction. Stormwater design refinements are described in detail below.

WSDOT Stormwater Facilities

A detailed description of the WSDOT stormwater facilities is provided within the WSDOT Preliminary Hydraulic Report prepared for the La Center Interchange Improvements, included in **Appendix A** (CH2M Hill, 2015a). As described and analyzed in the May 2015 Reevaluation, proposed WSDOT stormwater facilities would be constructed in accordance with the 2010 Hydraulics Manual and the 2014 Highway Runoff Manual (HRM). In addition, the following guiding documents were used to develop the design

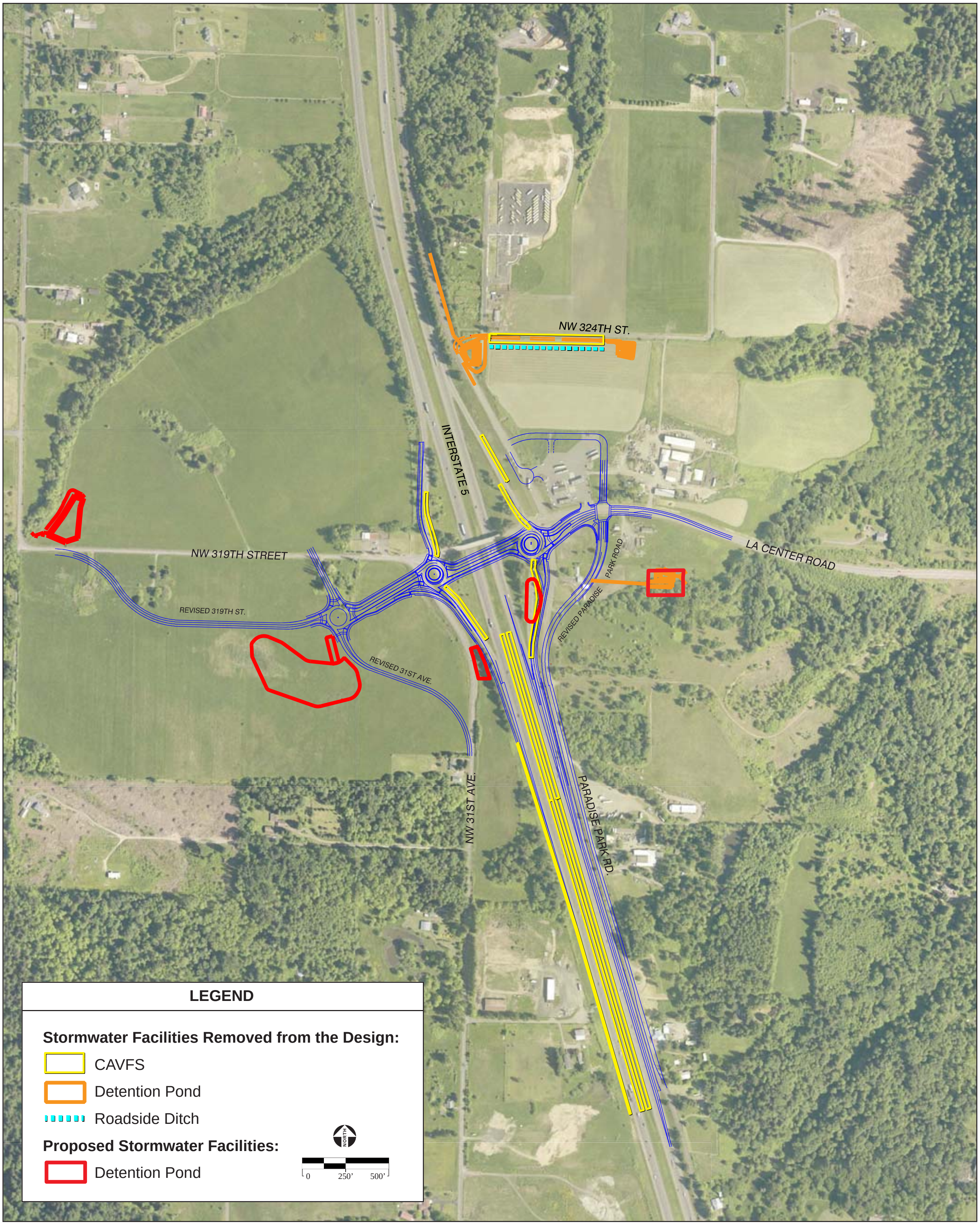
SOURCE: Kittelson & Associates, Inc., 2015; DigitalGlobe aerial photograph, 7/14/2014; AES, 12/24/2015

Figure 5
Interchange Improvements for Year 2017



SOURCE: Kittelson & Associates, Inc., 2015; DigitalGlobe aerial photograph, 7/14/2014; AES, 12/24/2015

Figure 6
Interchange Improvements for Year 2037



SOURCE: CH2M Hill and Olson Engineering Inc., 2015/2016; AES, 11/19/2015

Figure 7
Proposed Changes to Stormwater Treatment Facilities

standards for the currently proposed stormwater collection and treatment facilities within WSDOT jurisdiction: WSDOT's Design Manual, Roadside Manual, 2008 Environmental Manual, Standard Plans and Specifications, and 2013 Maintenance Manual, and the Washington State Department of Ecology (Ecology) 2005 Stormwater Management Manual for Western Washington (SMMWW). Within the May 2015 Reevaluation, enhanced stormwater treatment and flow control requirements for improvements within WSDOT jurisdiction were assumed to be met through the use of CAVFS. Under the current proposed stormwater design, CAVFS would be eliminated and enhanced treatment of stormwater runoff would instead be provided by Media Filter Drains (MFDs) located along the roadway shoulder in areas that meet the slope and size requirements described in the HRM. Additionally, two new detention ponds are proposed to meet flow control requirements for stormwater generated by improvements within WSDOT jurisdiction. The western pond would be located on the west side of the southbound on-ramp and the eastern pond would be located on the west side of the northbound off-ramp (CH2M Hill, 2015a). The western pond has been sized to detain runoff from 0.9 acres of roadway impervious area and the eastern pond has been sized to detain runoff from 1.8 acres of roadway impervious area. Both ponds are designed to allow runoff from grass to pass through undetained such that they meet the "50 percent rule." The 50 percent rule states that the undetained area may pass through the detention facility, so long as 100-year flow from the pass-through area does not exceed 50 percent of the 100-year undetained flow from the area requiring flow control. The outlet flow from the western pond would be metered by a primary control structure containing an orifice and riser designed to match the required predeveloped storm durations. The outlet flow from the eastern pond would be metered by a primary control structure containing lower and upper orifice and a riser designed to match the required predeveloped storm durations. Emergency overflow structures (birdcages) would be placed and sized to accommodate the 100-year undetained storm even for both ponds. After being stored within the ponds, water would be conveyed to surface waters as described within the May 2015 Reevaluation. Implementation of these stormwater best management practices (BMPs) would, at a minimum, reduce peak flow rates to pre-project conditions and treat a total impervious area greater than that being installed (CH2M Hill, 2015a).

Clark County Stormwater Facilities

With the proposed realignment of NW Paradise Park Road, no roadway improvements are proposed within the jurisdiction of Clark County. Previously proposed stormwater treatment facilities within Clark County have been removed from the stormwater design.

City of La Center Stormwater Facilities

A detailed description of the City of La Center stormwater facilities is provided within the NW Paradise Park Road Improvements Final Stormwater Plan and November 2015 Technical Memorandum, included within **Appendix A** (Olson, 2015a; 2015b). The City of La Center stormwater collection and treatment facilities analyzed within the May 2015 Reevaluation were designed and sized in accordance with the La Center Municipal Code Chapter 18.320 and the 1992 Stormwater Management Manual for the Puget Sound Basin (Puget Sound Manual), and included biofiltration swales for stormwater treatment and a 120-foot long by 65-foot wide detention pond for flow control. Since preparation of the May 2015

Reevaluation Report the City's stormwater facilities have been refined to address Ecology's SMMWW. Design refinements, including expansion, are proposed to the City of La Center detention pond. The refined pond would consist of a constructed wetland that would meet both enhanced treatment and flow control requirements. The pond would be divided into two cells separated by a berm. The first cell would consist of a sedimentation forebay that would be 4 feet deep and occupy approximately 3,663 square feet of the wetted area, while the remainder of the pond would be of varying depths from 1 to 2.5 feet. The Western Washington Hydrology Model (WWHM) was used to determine the minimum pond base area necessary to satisfy the SMMWW flow control requirements. The City of La Center detention pond was designed with a total base area of approximately 9,793 square feet, including the berm that separates the forebay and the second wetland. The outlet structure was designed based on the minimum base area, so the pond is expected to exceed the detention standard (Olson Engineering, 2015a). The expanded pond was sized to accommodate runoff from the proposed alignment of NW Paradise Park Road. An existing stormwater facility is partially located within the proposed ROW for the realigned NW Paradise Park Road, which serves the Mini Mart on the corner of the existing NW La Center Road/NW Paradise Park Road intersection. This stormwater facility would be reconstructed outside of the proposed ROW in accordance with City of La Center standards (Olson Engineering, 2015b).

3.0 ENVIRONMENTAL ANALYSIS

3.1 INTRODUCTION

This section discusses how the proposed refinements to the La Center Interchange Improvements (**Section 2.2**) would affect the natural and built environment in the project area, and whether those effects differ from the effects of the La Center Interchange Improvements described in the May 2015 Reevaluation and 2008 FEIS. The analysis was conducted using current information and compares the changes and effects between the project footprint and stormwater design described in the May 2015 Reevaluation to the current footprint (**Figure 4**). Resource areas or issues that are described and analyzed in this section include:

Section	Resource Area/Issue
3.2	Geology and Soils
3.3	Water Resources
3.4	Air Quality
3.5	Biological Resources
3.6	Cultural and Paleontological Resources
3.7	Socioeconomic Conditions
3.8	Transportation/Circulation
3.9	Land Use
3.10	Public Services
3.11	Noise
3.12	Hazardous Materials
3.13	Aesthetics
3.14	Indirect Effects
3.15	Cumulative Effects
3.16	Section 4(f) Resources

3.2 GEOLOGY AND SOILS

The existing setting and potential impacts to geology and soils as a result of the La Center Interchange Improvements were discussed in Sections 3.2 and 4.14.2 of the 2008 FEIS and Section 3.2 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not impact geology and soils. Therefore, proposed refinements would not change the conclusions within Section 3.2 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to geology and soils would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.3 WATER RESOURCES

3.3.1 CHANGES TO THE AFFECTED ENVIRONMENT

The water resources environmental setting of the project area was described in Section 3.3 of the 2008 FEIS, Section 3.1 of the 2013 Adequacy Review, and Section 3.3.1 of the May 2015 Reevaluation. The affected environment with respect to water resources is the same as was discussed within the May 2015 Reevaluation.

3.3.2 NEW OR SUBSTANTIALLY MORE SEVERE IMPACTS

Impacts to water resources as a result of the La Center Interchange Improvements were analyzed in Section 4.14.2 of the 2008 FEIS and Section 3.3.2 of the May 2015 Reevaluation. A Water Resources Technical Memorandum Update was prepared to identify changes to the stormwater management guidelines and design standards, and to evaluate potential impacts to water resources that could occur as a result of the refinements to the La Center Interchange Improvements (**Appendix B**). Potential effects to water resources as a result of the proposed refinements to the La Center Interchange Improvements would be similar to those identified in the 2008 FEIS and the May 2015 Reevaluation. Water resources in the vicinity of the proposed road improvements may be affected by grading, construction, and an increase in impervious surfaces, as detailed in Section 4.14.2 of the 2008 FEIS.

Construction

Impacts as a result of construction activities would be the same as was analyzed within the May 2015 Reevaluation. The La Center Interchange Improvements would still be required to comply with the National Pollutant Discharge Elimination System (NPDES) General Construction Permit Program, and construction on WSDOT roadways would be required to comply with the Construction Stormwater General Permit (CSWGP) issued by the Washington State Department of Ecology. The La Center Interchange Improvements would require the installation of temporary northbound off-ramps and southbound on-ramps for traffic control and staging during construction. Both temporary loop ramps would occur within the current APE in WSDOT jurisdiction. As these would be temporary, stormwater runoff from the temporary loop ramps during construction would be under the jurisdiction of the CSWGP, and all requirements of the CSWGP would be met for the temporary facilities. Implementation of Temporary Erosion and Sediment Control (TESC) plans and a Stormwater Pollution Prevention Plan (SWPPP) would be required for construction activities. These plans would include soil erosion and sediment control practices to reduce the amount of exposed soil, prevent runoff from flowing across disturbed areas, slow runoff from the site, and remove sediment from the runoff, as well as a water quality monitoring program during construction. The construction contractor would be required to maintain a spill control kit to be used in case of a material spill and Spill Prevention Control and Countermeasures (SPCC) plans (CH2M Hill, 2015b). Therefore, proposed refinements would not change the conclusions within Section 3.3 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to water resources would occur during construction as a result of the La Center

Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

Operation

As described in Section 4.14.2 of the 2008 FEIS and Section 3.3.2 of the May 2015 Reevaluation Report, the increase in impervious surfaces and change in drainage patterns as a result of the La Center Interchange Improvements could result in increased storm water runoff rates and increased erosion, which could lead to an effect on surface water quality due to increases in sediment and roadway pollutants such as grease and oil. Operational impacts to water resources would be similar to those analyzed within the May 2015 Reevaluation. Construction of the La Center Interchange Improvements would still result in an increase in impervious surfaces, but effects to existing runoff volumes are expected to be minimal due to the limited extent of the improvements in comparison to the existing roadways in the watershed.

Proposed changes to the stormwater design are discussed within **Section 2.2** of this Reevaluation. All proposed stormwater facilities would provide enhanced treatment and flow control for onsite stormwater, consistent with the applicable stormwater management manuals and guidelines described in **Section 2.2**. Proposed stormwater treatment facilities within the City of La Center were designed to accommodate runoff from the proposed realignment of NW Paradise Park Road (Olson, 2015b; **Appendix A**).

To prevent and minimize long-term pollution impacts, appropriate stormwater BMPs would be implemented, in accordance with State and federal water quality runoff treatment and flow control requirements (CH2M Hill, 2015b). Stormwater BMPs would include detention ponds, MFDs, and a constructed wetland with a sedimentation forebay, as described in **Section 2.2**. The La Center Interchange Improvements would still benefit water quality by treating and controlling stormwater runoff from the proposed La Center Interchange Improvements to a level that would meet or exceed existing conditions and the current requirements of State and federal water quality regulations. Stormwater design refinements, including the elimination of CAVFS, addition of two detention ponds and MFDs, and expansion and redesign of one detention pond consistent with the SMMWW, would ensure that stormwater is adequately treated and flows controlled prior to discharge. The proposed refinements to the stormwater facilities within the City of La Center would provide a greater level of treatment and stormwater flow control than the previous facilities analyzed within the May 2015 Reevaluation Report, thus potential effects to water quality would be even further reduced. Additionally, the existing gas station stormwater facility would be redesigned to City of La Center standards with the proposed realignment of NW Paradise Park Road; the redesigned stormwater facility would consist of cartridge filters and underground detention pipe for water quality treatment and flow control. There are no known significant sources of bacteria within the new APE area that would contribute to pollution of stormwater and runoff would be treated at proposed City of La Center stormwater BMPs prior to discharge to receiving waters. Additionally, because rain events typically occur when atmospheric temperatures are cooler, and stormwater would not be stored for an extended period of time prior to discharge to receiving water bodies, the temperatures of stormwater runoff would not be expected to exceed ambient temperatures in McCormick Creek and East Fork Lewis River. Therefore, since stormwater would be treated by BMPs consistent with applicable stormwater management guidelines and would not be expected to increase in temperature before reaching receiving water bodies, the proposed refinements to the La Center Interchange Improvements would not change the conclusions within Section 3.3 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to water resources would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

Sole Source Aquifers

Under 40 CFR Part 149, sole source groundwater aquifers are given protection from federally-funded projects that would potentially impact the use of the aquifer as a potable water supply. The Sole Source Aquifer (SSA) program allows the EPA to perform environmental review of projects that are financed or are provided financial assistance from federal grants or federal loan guarantees. To become designated as an SSA an individual, corporation, association, or federal, state, or local agency may petition the EPA, provided the petition includes sufficient hydrogeologic information to confirm that the aquifer provides over 50 percent of a community's water supply. Currently, Region 10 of the EPA (Washington, Oregon, Idaho, and Alaska) has designated 15 SSAs, with 13 designated in Washington (EPA, 2015). The project site/APE is located within the Troutdale Aquifer System, a designated SSA (EPA, 2015). The Troutdale Aquifer System is discussed within Response to Comment 198-29, within Appendix C, Volume IV of the 2008 FEIS.

A Memorandum of Understanding (MOU) between the FHWA, EPA, and WSDOT was signed in October 2014. The stated goal of the MOU is to "assure that each highway project that receives FHWA financial assistance is designed and constructed in a manner that will prevent the introduction of contaminants into an Aquifer" (FHWA, 2014). Although located within a designated SSA, the La Center Interchange Improvements would not involve federal funding or FHWA assistance and would be funded entirely by the Cowlitz Tribe as part of traffic mitigation measures adopted within the 2008 FEIS. Therefore, EPA review under the SSA program is not warranted. Further, as described under ***Operation*** above, extensive stormwater BMPs would be implemented to address the increase in impervious surfaces and ensure that stormwater from the La Center Interchange Improvements is adequately treated prior to reaching receiving water bodies. Since the La Center Interchange Improvements would not impact water quality in the Troutdale Aquifer, there would be no new or substantially more severe significant impacts to SSA water quality as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.4 AIR QUALITY

The existing setting and potential impacts to air quality as a result of the La Center Interchange Improvements were discussed in Sections 3.4 and 4.14.2 of the 2008 FEIS, Section 3.2 of the 2013

Adequacy Review, and Section 3.2 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not impact air quality. Therefore, proposed refinements would not change the conclusions within Section 3.4 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to air quality would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.5 BIOLOGICAL RESOURCES

3.5.1 CHANGES TO THE AFFECTED ENVIRONMENT

A discussion of the project area setting with respect to biological resources was provided in Section 3.5.1 of the 2008 FEIS, Section 3.3 of the 2013 Adequacy Review, and Section 3.5.1 of the May 2015 Reevaluation. A detailed discussion of potential biological resources within the La Center Interchange Improvements refined APE is provided below and in the Biological Resources Technical Memorandum Addendum provided as **Appendix C**, and Biological Assessment Addendum (BA Addendum) provided in **Appendix D** (BergerABAM, 2016a; 2016b).

Habitat Types

Habitat types occurring in the current project site/APE are consistent with the habitat types described in the Biological Assessment (BA) developed for the May 2015 Reevaluation (2015 BA). The habitat types in the vicinity of the project site have not changed, and include ruderal/developed lands, pasture, deciduous woodland, palustrine emergent wetland, and roadside ditches. The 1.86-acre addition to the APE shown in **Figure 4** as a result of the proposed realignment of NW Paradise Park Road is located in an area of previous development for the existing gas station. The new APE area consists of impervious surfaces, weedy and non-native herbaceous cover, and the stormwater facility for the existing gas station. Proposed changes to the existing gas station stormwater facility are discussed above in **Section 3.3.2**. A summary of habitat types and new acreages and percent coverage within the current project site/APE is provided in **Table 1**. **Appendix C** includes a habitat map of the project site and detailed descriptions of each habitat type.

TABLE 1
SUMMARY OF HABITAT TYPES ON THE INTERCHANGE IMPROVEMENTS PROJECT SITE

Habitat Type	May 2015 Reevaluation APE		Current APE	
	Acres	Percent Area	Acres	Percent Area
Ruderal/Developed	64.91	83	64.12	86
Pasture	10.75	14	8.24	11
Deciduous Woodland	1.21	1.5	1.21	1.6
Palustrine Emergent Wetland	0.34	0.5	0.34	0.5
Roadside Ditch	0.65	1	0.65	0.9
Total	**77.86**	**100**	**74.56**	**100**
Source: BergerABAM, 2016a; **Appendix C**				

Waters of the U.S.

A formal delineation of jurisdictional wetlands and waterbodies that are subject to USACE regulations under Section 404 of the Clean Water Act was conducted within the project site/APE. The jurisdictional waters of the U.S. that were identified include 0.34 acre of palustrine emergent wetlands, which are categorized as Category IV wetlands as discussed within Section 3.5.1 of the May 2015 Reevaluation. Most of roadside ditches identified did not have an ordinary high water mark, were ephemeral, appear to be excavated wholly in uplands and drain only uplands, and were not described as waters of the U.S. A jurisdictional determination conducted by the USACE determined that the ditches are not subject to regulation under Section 404 of the Clean Water Act (BergerABAM, 2016a; **Appendix C**). Ecology accepted the USACE determination issued for the project and did not indicate they would regulate any additional waters that USACE determined to be non-jurisdictional. A letter was issued on September 29, 2015 by the USACE stating that the La Center Interchange Improvements are authorized under a nationwide permit (NWP-2005-0017) for the Cowlitz Reservation Development. No wetlands or waterbodies were identified within the modified APE addition for the proposed realignment of NW Paradise Park Road.

Federally Listed Special Status Species

A 2015 BA was prepared to address potential impacts of the La Center Interchange Improvements on federally listed species and designated and proposed critical habitats. The 2015 BA was used for consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) for review and concurrence. Letters of concurrence were issued by USFWS on July 8, 2015 and by NMFS on June 2, 2015. The letters concurred that the La Center Interchange Improvements "may affect, not likely to adversely affect" Endangered Species Act (ESA)-listed bull trout, Pacific salmon species, and Pacific eulachon, and would not adversely affect essential fish habitat. The USFWS also determined that the project would have "no effect" on several additional species and critical habitat known to occur in Clark County. The USFWS determinations were based on the findings that (1) the project does not include any in-water work; (2) BMPs will be implemented to minimize sediment and turbidity during construction; (3) stormwater treatment will be provided for all new pollution-generating impervious surface (PGIS) as well as 2.04 acres of existing PGIS; (4) elevated pollutant concentrations from stormwater runoff will be diluted to below biological thresholds before reaching waterbodies potentially containing bull trout; and (5) federal, state, and local regulations requiring stormwater treatment and mitigation for environmental impacts will minimize impacts to water quality, hydrology, and streams resulting from land use changes in the action area (BergerABAM, 2016a; USFWS, 2015).

NMFS concurred with the "may affect, not likely to adversely affect" determinations for ESA-listed salmonids because (1) enhanced stormwater treatment to biological thresholds will be provided for all new PGIS as well as 2.04 acres of existing PGIS; and (2) the proposed stormwater treatment system was expected to treat stormwater runoff to the extent that metal and suspended solids in treated stormwater would be expected to dilute to background levels prior to reaching ESA-listed fish-bearing waters (BergerABAM, 2016a; NMFS, 2015).

A 2015 Biological Assessment Addendum (2015 BA Addendum) has been prepared that addresses potential impacts of the refinements to the La Center Interchange Improvements on federally listed species and designated and proposed critical habitats. The 2015 BA Addendum will be used for subsequent consultation with USFWS and NMFS on the effects of the refinements to the La Center Interchange Improvements. WSDOT will submit the 2015 BA Addendum to USFWS and NMFS for review and concurrence. Based on the results of a stormwater pollutant loading and dilution analysis conducted as part of the 2015 BA Addendum, stormwater treatment proposed for new impervious areas has been designed to meet Ecology standards, and any elevated levels of pollutants or suspended solids would be below levels where adverse effects to any primary constituent elements of critical habitat in McCormick Creek or the East Fork Lewis River would be adversely affected. The proposed road realignment and stormwater redesign will not affect ESA-listed species or their designated critical habitat, and no impacts to federally listed special status species are anticipated from the proposed refinements to the La Center Interchange Improvements (BergerABAM, 2016a; **Appendix C**).

State Listed Species

The list of known occurrences of rare plants and plant communities within Clark County was consulted through the Washington Natural Heritage Program (WNHP). While 29 rare plant species are documented in Clark County, no occurrences of these species on the project site have been reported. Due to a lack of suitable habitat, the current project site/APE does not support rare plant communities identified by the WNHP.

3.5.2 NEW OR SUBSTANTIALLY MORE SEVERE IMPACTS

Impacts to biological resources as a result of the La Center Interchange Improvements were discussed in Section 4.14.2 of the 2008 FEIS and Section 3.5.2 of the May 2015 Reevaluation. Additionally, impacts to biological resources as a result of refinements to the La Center Interchange Improvements are analyzed in the Biological Resources Technical Memorandum Addendum, attached as **Appendix C**, and 2015 BA Addendum, attached as **Appendix D**. Potential effects to biological resources would be similar to those identified in the May 2015 Reevaluation. Refinements to the La Center Interchange Improvements would not result in any new or different impacts to or loss of habitats, waters of the U.S., wildlife, or federally listed species. Approximately 86 percent of habitat impacts would occur to 64.12 acres of ruderal/developed and pasture habitats. The approved La Center Interchange Improvements identified impacts to approximately 0.34 acres of waters of the U.S., including several roadside ditches. However, through avoidance and minimization measures, project impacts were reduced to 0.084 acres of wetlands and 0.039 acres of stream, and have been authorized under a nationwide permit (NWP-2005-0017) for the Cowlitz Reservation Development. Additionally, approximately 0.03 acre of wetlands and 0.30 acre of wetland buffers would be impacted by the temporary loop ramps developed for construction of the project. However, these wetlands and wetland buffers would be restored to the original contours and conditions upon completion of the project. Upon completion, the temporary ramps will be removed and all applicable BMPs for erosion and sediment control will be employed. The disturbed areas will be landscaped in accordance with landscape plans approved by WSDOT. On January 14, 2016, USACE confirmed that no additional compensatory mitigation would be required for the temporary wetland impacts, which are authorized under the existing NWP-2005-0017 for the Cowlitz Reservation Development (USACE, 2016).

Proposed refinements to the La Center Interchange Improvements would impact an additional 0.09 acres of wetland buffers, which would reduce the effectiveness of the wetland buffers in protecting wetland functions and could lead to minor water quality impacts. However, the proposed buffer impacts have been minimized to the greatest extent practicable such that the buffer will still protect wetland functions. Additionally, wetland buffer impacts will be mitigated in accordance with the City's critical areas ordinance through approved mitigation measures, as discussed within Section 3.5.2 of the May 2015 Reevaluation. The project will apply for all necessary permits with applicable jurisdictions and will comply with all terms and conditions of issued permits. No additional impacts to waters of the U.S. are anticipated from the proposed refinements to the La Center Interchange Improvements, which will comply with all the terms and conditions of the Section 404 permit from the USACE. Ecology accepted the USACE determination issued for the project and did not indicate they would regulate any additional waters that USACE determined to be non-jurisdictional. Therefore, proposed refinements would not result in additional impacts to significant habitat types.

Similar to the effects discussed in the May 2015 Reevaluation, refinements to the stormwater design could affect fisheries resources, including critical habitat for ESA-listed salmon and/or bull trout, through the discharge of treated stormwater associated with the project. However, it is likely that the refinements will result in lesser effects to fisheries resources than the previously-proposed design. Based on the results of a stormwater pollutant loading and dilution analysis conducted as part of the 2015 BA Addendum, stormwater treatment proposed for new impervious areas has been designed to meet Ecology standards, and any elevated levels of pollutants or suspended solids would be below levels where adverse effects to any primary constituent elements of critical habitat in McCormick Creek or the East Fork Lewis River would be adversely affected. It is anticipated that the effect determinations for listed species concurred with by USFWS and NMFS in their letters of concurrence would be unchanged by the proposed refinements. Therefore, proposed refinements would not change the conclusions within Section 3.6 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to biological resources would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.6 CULTURAL AND PALEONTOLOGICAL RESOURCES

3.6.1 CHANGES TO THE AFFECTED ENVIRONMENT

A discussion of the project area setting with respect to cultural resources was provided in Section 3.6.1 of the 2008 FEIS and Section 3.6.1 of the May 2015 Reevaluation. A supplemental survey of the La Center Interchange Improvements' APE for cultural resources was conducted in November 2014. The results of the survey are documented within the supplemental Cultural Resources Study provided as Appendix E to the May 2015 Reevaluation Report. The Cultural Resources Study found that there were no known cultural resources of any kind within the May 2015 APE, with the exception of two pieces of lithic debitage found on the surface and two square nails, each found during previous investigations. A letter was issued on May 19, 2015 by the Washington State Department of Archaeology and Historic Preservation (DAHP) on behalf of the State Historic Preservation Officer under provisions of Section 106 of the National Historic Preservation Act, concurring with WSDOT's determination that no historic properties would be affected by the La Center Interchange Improvements Project (DAHP, 2015). An additional cultural resources survey was conducted for the 1.86-acre addition to the APE shown in **Figure 4** as a result of the proposed realignment of NW Paradise Park Road. The results of the survey are included within the 2015 Cultural Resources Study Amendment provided as **Appendix E** to this Reevaluation. Six shovel test probes were excavated in the proposed realigned ROW of NW Paradise Park Road where native deposits may remain intact beneath fill. As a result of this additional effort, no cultural resources were discovered.

3.6.2 New or Substantially More Severe Impacts

Impacts to cultural resources as a result of the La Center Interchange Improvements were discussed in Section 4.14.2 of the 2008 FEIS and Section 3.6.2 of the May 2015 Reevaluation. A Cultural Resources Study Addendum (**Appendix E**) found that there are no known cultural resources of any kind within the added portion of the refined APE for the La Center Interchange Improvements. The Cultural Resources Study Addendum determined that implementation of the La Center Interchange Improvements would have no effect on historic properties and that no further archaeological work is recommended (CH2M Hill, 2015c; **Appendix E**). Therefore, proposed refinements would not change the conclusions within Section 3.6 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to cultural resources would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or revised mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.7 Socioeconomic Conditions

The existing setting and potential impacts as a result of the La Center Interchange Improvements with respect to socioeconomic conditions were discussed in Sections 3.7 and 4.14.2 of the 2008 FEIS, Section 3.4 of the 2013 Adequacy Review, and Section 3.7 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not impact socioeconomic conditions. Therefore, proposed refinements would not change the conclusions within Section 3.7 of the May 2015 Reevaluation, which are that no new or substantially more severe significant socioeconomic impacts would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.8 TRANSPORTATION AND CIRCULATION

The existing setting and potential impacts to transportation and circulation as a result of the La Center Interchange Improvements were discussed in Sections 3.8, 4.8.2 and 4.14.2 of the 2008 FEIS, Section 3.5 of the 2013 Adequacy Review, and Section 3.8 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not impact transportation and circulation. The existing overpass bridge would remain open to traffic until the new overpass bridge is operational. Demolition of the overpass bridge would take place at night when traffic volumes are low and traffic would be diverted to the diamond interchange ramps during demolition activities. Clark County Roads would not be used to divert traffic off the interchange. Therefore, proposed refinements would not change the conclusions within Section 3.8 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to transportation and circulation would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.9 LAND USE

The existing setting and potential impacts to air quality as a result of the La Center Interchange Improvements were discussed in Sections 3.9 and 4.14.2 of the 2008 FEIS, Section 3.6 of the 2013 Adequacy Review, and Section 3.9 of the May 2015 Reevaluation. The proposed realignment of NW Paradise Park Road would eliminate improvements within Clark County ROW. Additionally, the proposed realignment of NW Paradise Park Road would result in relocation of existing utilities and a stormwater facility located in the proposed ROW. Relocation of utility lines were discussed within Section 3.10 of the May 2015 Reevaluation and stormwater impacts are discussed within Section 3.3 of this Reevaluation. The proposed refinements to the La Center Interchange Improvements would not result in any conflicts with existing land uses. Therefore, proposed refinements would not change the conclusions within Section 3.9 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to land use would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.10 PUBLIC SERVICES

The existing setting and potential impacts to public services as a result of the La Center Interchange Improvements were discussed in Sections 3.10 and 4.14.2 of the 2008 FEIS, Section 3.7 of the 2013 Adequacy Review, and Section 3.10 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not impact public services. Therefore, proposed refinements would not change the conclusions within Section 3.10 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to public services would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.11 NOISE

The existing setting and potential impacts with respect to noise were described in Section 3.11 and 4.14.2 of the 2008 FEIS and Section 3.11 of the May 2015 Reevaluation. A Noise Technical Report (2015 Noise Report) was prepared for the La Center Interchange Improvements and included as Appendix F to the May 2015 Reevaluation, in order to identify any changes in the noise environment, analyze potential noise impacts on sensitive receptors, and evaluate the feasibility and reasonability of noise mitigation at impacted sensitive receptors (CH2M Hill, 2015d). Construction noise impacts would be the same as those analyzed within the May 2015 Reevaluation. Additionally, proposed stormwater refinements would not have an impact on noise levels at sensitive receptors in the project area; therefore, stormwater refinements would not change the conclusions within Section 3.11 of the May 2015 Reevaluation with respect to noise

The study area that was analyzed within the 2015 Noise Report encompasses the new project site/APE (see Figure 5-1 within Appendix F of the May 2015 Reevaluation). The proposed realignment of NW Paradise Park Road would place traffic approximately 500 feet farther away from the nearest receptors than the previous alignment. Therefore, noise impacts at the nearest sensitive receptor to the proposed realignment of NW Paradise Park Road would be reduced. NW Paradise Park Road would place traffic approximately 500 feet closer to the next closest sensitive receptor. However, this sensitive receptor is located over 1,800 feet southwest of the proposed realignment and traffic along the roadway would not increase, so changes to ambient noise levels at this sensitive receptor as a result of the proposed realignment would be negligent. Therefore, proposed refinements would not change the conclusions within Section 3.11 of the May 2015 Reevaluation, which are that no new or substantially more severe significant noise impacts would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.12 HAZARDOUS MATERIALS

The existing hazardous materials setting and associated potential impacts as a result of the La Center Interchange Improvements were discussed in Sections 3.12 and 4.14.2 of the 2008 FEIS, Section 3.8 of the 2013 Adequacy Review, and Section 3.12 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not result in additional hazardous materials impacts. The closest hazardous materials site to the proposed alignment of NW Paradise Park Road is the Paradise Quick Stop (Shell Station) site located at the northeastern corner of the current NW La Center Road/NW Paradise Park Road intersection. As described in Section 3.12.1 of the May 2015 Reevaluation, the Shell Station site was listed in the Facility Index system (FINDS) and Leaking Underground Storage Tank (LUST) database, but remediation activities were completed and Ecology issued a No Further Action letter for the site in 2004. The 2015 Hazardous Material Survey Technical Memorandum included as Appendix G to the May 2015 Reevaluation determined that the Shell Station site was considered a low risk to the La Center Interchange Improvements, and would continue to be a low risk for to the proposed refinements. The possibility for encountering contaminated soil and/or groundwater during construction would be the same for the proposed refinements as was analyzed within Section 3.13.2 of the May 2015 Reevaluation. Compliance with WSDOT policies and procedures pertaining to hazardous materials identified in the May 2015 Reevaluation would reduce potential impacts associated with contaminated soil and/or groundwater that may be encountered during construction activities. Therefore, proposed refinements would not change the conclusions within Section 3.12 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts associated with hazardous materials would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.13 AESTHETICS

The existing setting and potential impacts to aesthetics as a result of the La Center Interchange Improvements were discussed in Sections 3.13 and 4.14.2 of the 2008 FEIS and Section 3.13 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not impact aesthetics as the refinements would not result in significantly more development than what was previously proposed, and the proposed realignment of NW Paradise Park Road represents only a small portion of the overall improvements. Therefore, proposed refinements would not change the conclusions within Section 3.13 of the May 2015 Reevaluation, which are that no new or substantially more severe significant impacts to aesthetics would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.14 INDIRECT EFFECTS

Indirect effects as a result of development of the La Center Interchange Improvements were discussed in Section 3.14 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not result in additional indirect effects as refinements would not lead to additional growth over what was analyzed in the May 2015 Reevaluation. Therefore, proposed refinements would not change the conclusions within Section 3.14 of the May 2015 Reevaluation, which are that no new or substantially more severe significant indirect effects would occur as a result of the La Center Interchange Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.15 CUMULATIVE EFFECTS

Cumulative effects as a result of the La Center Interchange Improvements were discussed in Section 3.15 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not result in additional cumulative effects. Therefore, proposed refinements would not change the conclusions within Section 3.15 of the May 2015 Reevaluation, which are that no new or substantially more severe significant cumulative impacts would occur as a result of the La Center Interchange

Improvements that were not previously identified in the 2008 FEIS and no new or modified mitigation measures are required. No changes or new impacts from previous environmental evaluations.

3.16 SECTION 4(F) RESOURCES

Impacts to Section 4(f) resources as a result of the La Center Interchange Improvements were discussed in Section 4.0 of the May 2015 Reevaluation. The proposed refinements to the La Center Interchange Improvements would not impact Section 4(f) resources as there are no public parks, recreation areas, or wildlife or waterfowl refuges within the new APE. Additionally, the Cultural Resources Report Addendum, included as **Appendix E** to this Reevaluation, shows that there are no historic sites listed or eligible for listing on the National Register of Historic Places within the new APE. Therefore, proposed refinements would not change the conclusions within Section 4.0 of the May 2015 Reevaluation, which are that construction and operation of the La Center Interchange Improvements would not use any Section 4(f) property. No changes or new impacts from previous environmental evaluations.

4.0 CONCLUSION

As described in **Section 2** of this Reevaluation and shown in **Figure 4**, the proposed refinements to the La Center Interchange Improvements would result in only minor changes to the APE analyzed in the May 2015 Reevaluation. The proposed changes to stormwater facilities would take place entirely within the APE evaluated in the May 2015 Reevaluation Report, and would result in a higher level of stormwater treatment and flow control. Additionally, the new 1.86-acre area of the APE as a result of the new proposed adjusted alignment of NW Paradise Park Road does not contain any known sensitive environmental resources. As discussed in **Section 3.0** of this Reevaluation, the conclusions and mitigation measures set forth in the May 2015 Reevaluation remain applicable to the La Center Interchange Improvements. There are no changes to the Proposed Action or new information or circumstances that result in any new significant environmental impacts. Therefore, the May 2015 Reevaluation and the 2008 FEIS are adequate to meet NEPA compliance requirements for the La Center Interchange Improvements and preparation of a supplemental EIS is not required.

5.0 REFERENCES

BergerABAM, 2016a. Biological Resources Technical Memorandum Addendum – NW La Center Road/Interstate-5 Interchange Improvement Project. Dated November 19, 2015.

BergerABAM, 2016b. Biological Assessment Addendum – NW La Center Road/Interstate-5 Interchange Improvement Project. Dated November 25, 2015.

CH2M Hill, 2015a. Type A Preliminary Hydraulic Report for the I-5/NW La Center Road Interchange Improvement Project. Dated November 2015.

CH2M Hill, 2015b. Water Resources Technical Memorandum Update for the NW La Center Road/I-5 Interchange Improvement Project. Dated November 25, 2015.

CH2M Hill, 2015c. Amendment to La Center Interchange Archaeological Resources Discipline Report. Dated November 6, 2015.

CH2M Hill, 2015d. NW La Center Road/I-5 Interchange Improvement Project (MP 16.80) Noise Technical Report Addendum. Dated April 2015.

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APPENDICES

APPENDIX A

STORMWATER TECHNICAL MEMORANDA

Type A
Preliminary Hydraulic Report

I-5 / NW La Center Road Interchange Improvement Project

Clark County, Washington

MP 16.80 to MP 17.05

Washington Department of Transportation
Southwest Region

Vancouver, Washington

Prepared by:

ch2m

2020 SW Fourth Avenue
Portland, OR 97201

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This report was prepared under my direct supervision as defined in WAC 196-23-030.

Deva Alves, P.E.
Project Hydraulic Engineer

,P.E.
Region Administrator

December 2015

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FIGURES

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Section 1 Project Overview

1.1 Project Introduction

In 2004, the Cowlitz Indian Tribe applied to the Department of the Interior to have approximately 152 acres of land to the west of Interstate 5 (I-5) at Exit 16 near La Center, Washington taken into trust as the Initial Reservation of the Cowlitz Tribe. In December 2010 the federal government initially approved the Tribe's application. The decision was appealed and has since been approved. The Tribe proposes to develop this land for several uses: a gaming and entertainment casino, Tribal government center and Tribal housing. An environmental impact statement (EIS) process was completed for the Cowlitz Indian Tribe Trust Acquisition and Casino Project (referred to as the Cowlitz Reservation Project) with the final EIS dated 30 May 2008. The Record of Decision was issued on 22 April 2013 (2013 ROD). The EIS addressed the I-5 / NW La Center Road interchange and frontage road realignments that would be required as a result of the development of tribal center and casino. Consultation under Section 7 of the Endangered Species Act (ESA) was conducted in 2007 for the tribal development and casino west of I-5, which considered the interchange improvements an interdependent effect and acknowledged that impacts associated with the interchange improvements would be addressed under a separate ESA consultation under the authority of the Federal Highways Administration (FHWA) and the Washington State Department of Transportation (WSDOT) (Analytical Environmental Services [AES] 2007a).

The Tribe is proposing improvements to the existing interchange (Exit 16) of I-5 at NW La Center Road as traffic mitigation for the Cowlitz Reservation Project. The proposed reconstruction and modification of the existing interchange required the review and approval of an interchange justification report (IJR) by WSDOT and FHWA. The approval of the IJR is considered a federal action consistent with Title 23 Section 771.109(a)(1) of the Code of Federal Regulations (CFR) and therefore requires separate review under the ESA. The IJR was accepted as final.

This hydraulic report encompasses the proposed interchange improvements within WSDOT right-of-way. Separate reports discuss stormwater management within City of La Center right-of-way and on Tribal Lands. The total proposed interchange improvements project are currently at the 90-percent level of design for the improvement elements.

1.2 Site Location

The interchange improvements project is located within both unincorporated Clark County, the City of La Center and Tribal Lands, at the existing interchange of I-5 and NW La Center Road (NW 319th Street). The location is approximately 3 miles north of the City of Ridgefield interchange and 4 miles south of the City of Woodland interchange. The approximately 78-acre site of the project consists of WSDOT right-of-way, NW La Center Road right-of-way, portions of three tax lots adjacent to Paradise Park Road south of NW La Center Road, and four tax lots north of NW La Center Road up to NW 324th Street, all located east of I-5.

The I-5/NW La Center Road Interchange Improvement project encompasses several transportation improvement projects along I-5, NW La Center Road, NW 319th Street, NW 31st Avenue and NW Paradise Park Road. The project is driven by the need to augment vehicle capacity though the interchange in anticipation of increased traffic in the future due to the Cowlitz Tribe Casino. These improvements occur between mileposts (MP) 16.80 and 17.05.

The vicinity map in Figure 1-1 shows the extent of the project WSDOT improvements.

1.3 Scope of Work

The primary purpose of the proposed action is to provide traffic mitigation for the tribal casino. The project area covers approximately 78 acres including WSDOT right-of-way, NW La Center Road right-of-way, portions of three tax lots adjacent to NW Paradise Park Road south of NW La Center Road, and four tax lots north of NW La Center Road up to NW 324th Street, east of I-5. The general location includes portions of Sections 4 and 9, Township 04 North, Range 01 East of the Willamette Meridian (WM). All project activities occur within the Lewis River watershed.

The interchange improvements will include the following general elements.

- Site preparation
- Grading and earthwork
- Bridge construction
- Road construction
- Drainage construction
- Traffic control
- Demolition

Specific WSDOT project elements includes the interchange ramps and related I-5 mainline improvements.

Modifications to the northbound off-ramp include increasing its length to approximately 3,600 feet and constructing a second exit lane. In total, approximately 121,000 square feet of new impervious surface will be constructed. Approximately 1,300 feet (31,800 square feet of impervious surface) of the existing ramp will be re-aligned. The northbound on-ramp will be realigned to tie into the proposed roundabout on the east side of I-5. Approximately 270 feet of new ramp (7,100 square feet of impervious surface) will be constructed.

Modifications to the southbound off-ramp will realign the existing lane to tie into the proposed roundabout west of I-5. Approximately 640 feet (1,800 square feet of impervious surface) of the existing ramp will be removed. Approximately 720 feet of new ramp (2,100 square feet of impervious surface) will be constructed. A modified southbound on-ramp will be constructed for two lanes that transition to a single lane prior to merging with I-5 mainline traffic. Approximately 2,000 feet (38,000 square feet of impervious surface) of the existing ramp will be removed. Approximately 2,200 feet of new ramp (65,000 square feet of impervious surface) will be constructed.

Typical road construction techniques will be used to remove/construct the existing/new ramps. Demolition of existing ramps will require the use of jackhammers, excavators, loaders, and dump trucks. Construction debris will be temporarily stockpiled within the project before being hauled off site to an approved disposal location.

Ramp construction will involve bulldozers and graders to establish grades and construct base courses. The finish course will be constructed of asphalt.

Following completion of the new roundabouts and interchange, traffic will be shifted to the new alignment and the old interchange will be removed. Demolition will involve jackhammers, excavators, loaders, and dump trucks to remove materials. Cranes may be used to remove old girders. Following demolition, disturbed areas will be stabilized according to WSDOT specifications.

1.5 Areas Affected

Table 1-1 presents a summary of replaced and new surface area for the project. The breakdown of these areas by Threshold Discharge Area (TDA) is presented in Section 3 of this report. Replaced impervious surface area is existing impervious surface removed to below subgrade or filled areas with new impervious surface reconstructed upon it, by the project improvements. Added new impervious surface area is existing pervious surface, typically grass vegetation, converted to impervious surface by project improvements. Net new impervious surface area represents the total area for which for stormwater management is required. These areas are explained further in Section 3.1.

TABLE 1-1
Summary of Affected Areas within WSDOT right of way

	Area
Replaced Impervious Surface Area	215,000 sf (4.94 acres)
Added Impervious Surface Area	88,000 sf (1.74 acres)
Net New Impervious Surface Area	88,000 sf (1.74 acres)

FIGURE 1.1
VICINITY MAP SHOWING PROJECT LIMITS WITHIN WSDOT RIGHT-OF-WAY
I-5 / NW La Center Road Interchange Improvement Project

Section 2 Site Conditions

2.1 Existing Conditions

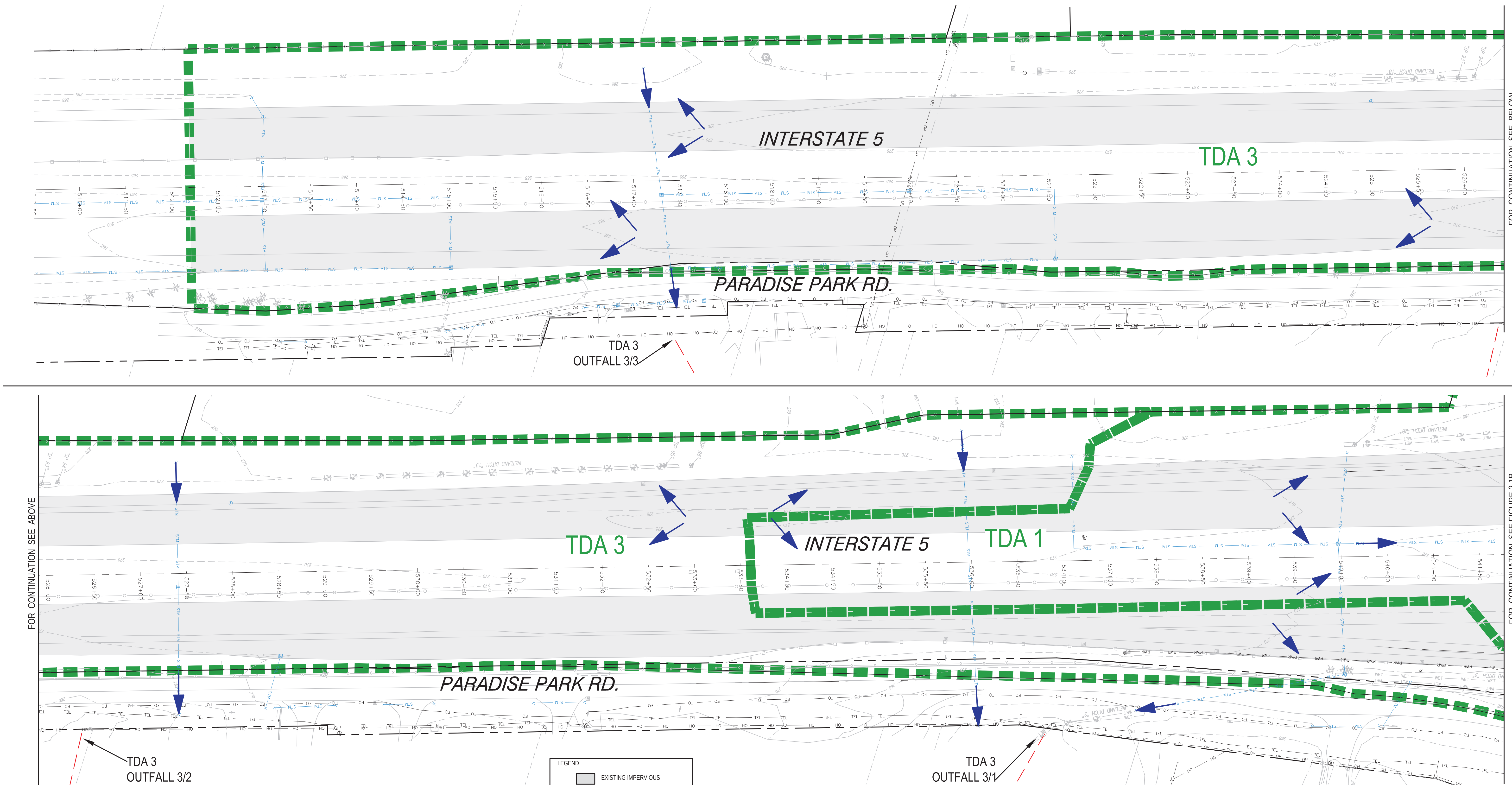
I-5 is one of the most heavily traveled interstates in WSDOT's jurisdiction. Farmland borders the right-of-way for most of the project length. The roadside area outside the shoulders and interior areas of the interchange within the project limits are currently vegetated. The I-5 mainline median is also vegetated. The vegetation is dominated by grasses and sedges; however, some trees are located along the interchange ramps and outside shoulders. The highway lanes in the project area are generally crowned along straight segments and super elevated when curved (and along ramps) to shed to the median or outside shoulders depending on the alignment.

The downstream receiving waters for the project are McCormick Creek and an unnamed stream, both of which flow to the East Fork Lewis River. The location of these waterways are shown in Figure 2-1.

A key consideration in the hydraulic design is the extent to which mainline interstate and ramp runoff can be segregated from Tribal Lands and City of La Center roadway improvement runoff, and offsite runoff, to reduce inter-jurisdictional complexity of the drainage systems in the future and clarify each jurisdiction's responsibilities for drainage system maintenance. Options for a combined drainage system and potential joining on stormwater management facilities were considered early in the concept development phase of this project, and discussed with City of La Center and WSDOT representatives. After further consideration, the city stated that the interstate right-of-way portion of the project must address its runoff treatment and flow control needs within WSDOT right-of-way, as there are no opportunities for partnering with the City on downstream improvements in lieu of onsite stormwater management.

2.2 Existing Hydraulic Features

Existing hydraulic features within WSDOT project limits consist primarily of roadside shoulder ditches. At low sag points along the roadway, culverts convey stormwater runoff from these ditches under the interstate roadway to downstream drainage channels leading to the receiving waters, see Figure 2-1 for existing culvert locations Currently, there are no engineered facilities within WSDOT project limits that provide for flow control or water quality treatment.



LEGEND

- EXISTING IMPERVIOUS
- EXISTING WSDOT RIGHT OF WAY
- EXISTING FIBER OPTIC
- EXISTING OVERHEAD LINES
- EXISTING POWER
- EXISTING TELEPHONE
- STORM DRAIN SYSTEM
- FLOW DIRECTION
- TDA BOUNDARY

I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 2-1A
EXISTING CONDITIONS

SCALE IN FEET
0 50 100
1" = 100 FOOT

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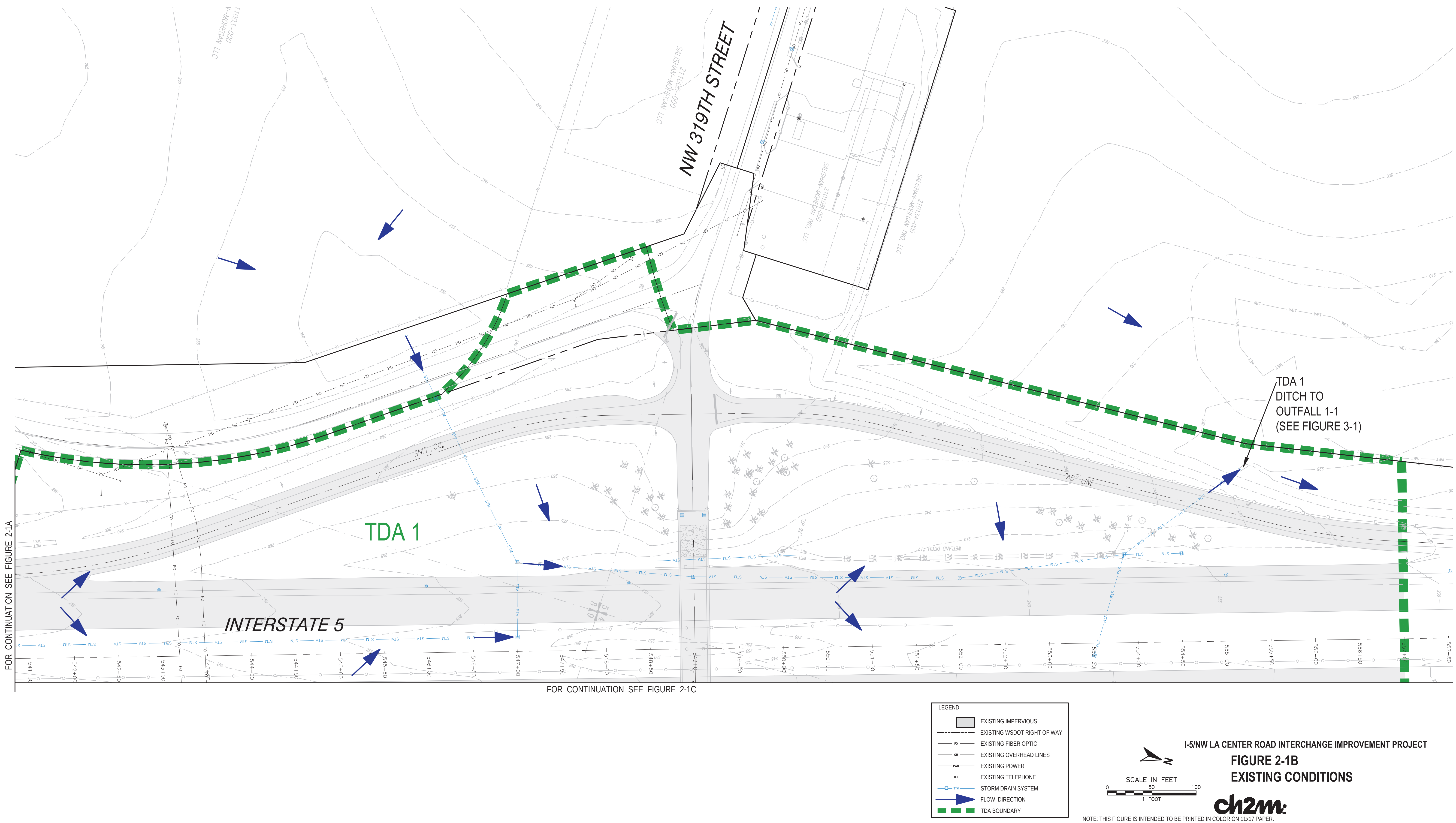

I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 2-1B
EXISTING CONDITIONS

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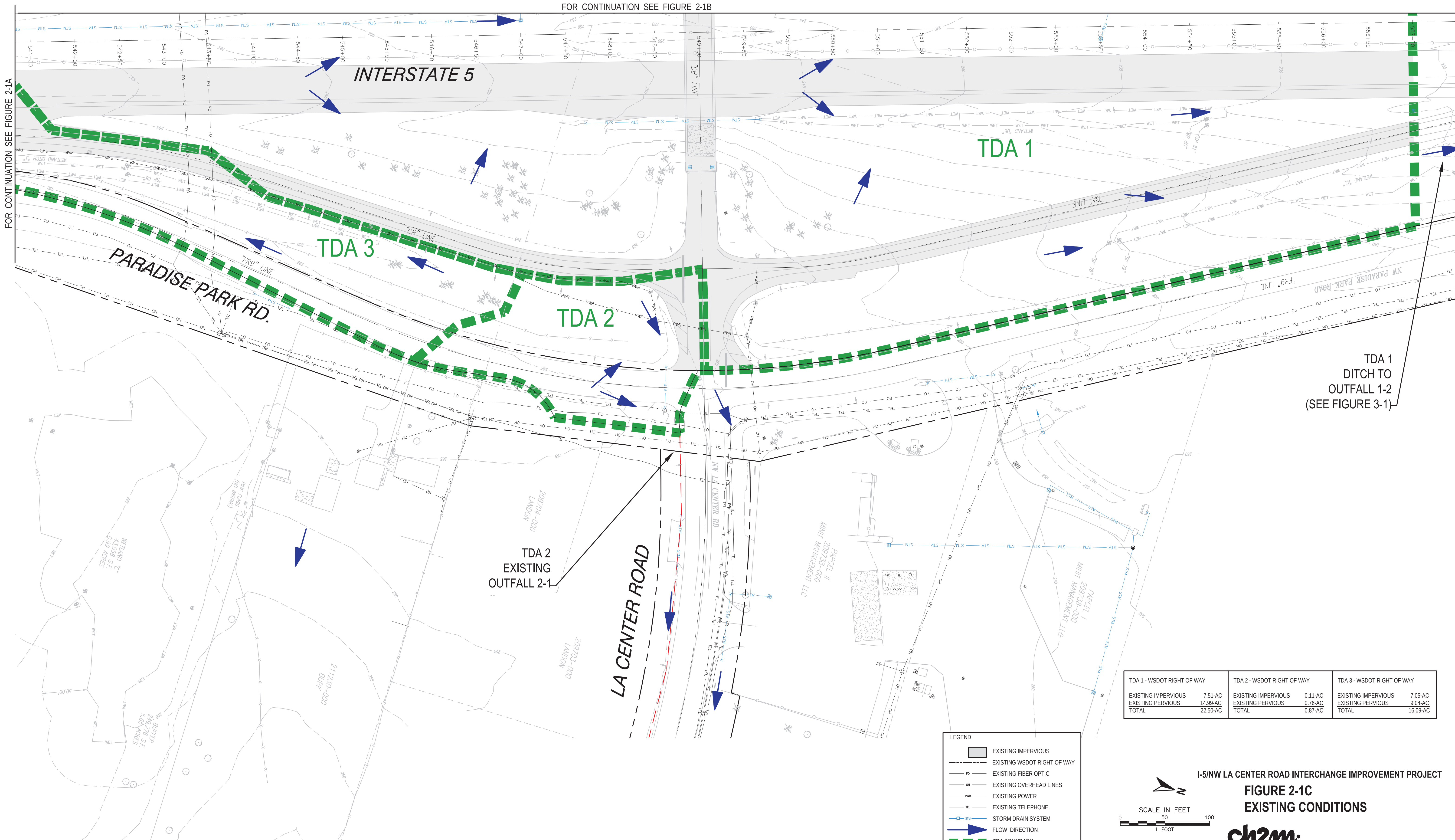

TDA 1 - WSDOT RIGHT OF WAY	
EXISTING IMPERVIOUS	7.51-AC
EXISTING PERVIOUS	14.99-AC
TOTAL	22.50-AC

TDA 2 - WSDOT RIGHT OF WAY	
EXISTING IMPERVIOUS	0.11-AC
EXISTING PERVIOUS	0.76-AC
TOTAL	0.87-AC

TDA 3 - WSDOT RIGHT OF WAY	
EXISTING IMPERVIOUS	7.05-AC
EXISTING PERVIOUS	9.04-AC
TOTAL	16.09-AC

I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 2-1C
EXISTING CONDITIONS

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2.3 TDAs Delineation and Existing Outfalls

This section documents the threshold discharge areas (TDAs) for project limits within WSDOT right of way located in the existing drainage basins. There are a total of three applicable existing basins within the project limits based on preproject conditions. These basins are applicable to the proposed project and are discussed as TDAs in the Developed Conditions section of this report. The basin delineation was based on the following sources of data:

- WSDOT roadway as-builts
- Survey base maps showing existing 1-foot topographic contours, highway lanes and shoulders, stormwater conveyance features, streams, and roadway stationing along the existing median
- Site visit field conditions
- USGS 7.5 minute topographic maps
- GIS delineation/mapping of watershed basins
- ¼ mile downstream flowpath location

Existing roadway cross sections aided in determining the direction of sheet flow runoff resulting from crowned and super elevated road surfaces. The existing road surface profiles were used to note high and low elevations along the longitudinal axis of the roadway. Information from the roadway cross sections and roadway profiles was used in combination with the resources listed above to provide a continuous layout of stormwater drainage paths within the project corridor.

The TDAs for the project are described in detail below. Figure 2-1 shows the basin boundaries within the project limits and the receiving waterways to which they flow. There are no existing water quality or flow control facilities currently treating the runoff within the TDAs.

The existing project outfall locations are identified in Figure 2-1 and are not anticipated to be impacted by the proposed project developments, i.e. the developed outfalls will remain the same as the existing outfalls.

2.3.1 TDA 1 – Northern Project Area

TDA 1 encompasses the northbound on-ramp, the southbound off-ramp, the majority of the southbound on-ramp, and the I-5 mainline from approximately 1,600 feet south of the overpass to the north. In general, stormwater runoff from this area drains into existing roadside ditches alongside the interstate shoulders and median that flow north to the unnamed stream. An existing culvert transports the unnamed stream under the interstate discharging it to the eastside of the interstate.

2.3.2 TDA 2 – Northbound Off Ramp

TDA 2 consists of a small portion of area within WSDOT right of way located at the end of the northbound off-ramp. This area drains into the NW La Center Road conveyance system.

2.3.3 TDA 3 – Southern Project Area

TDA 3 encompasses the southern extensions of the northbound off-ramp and the southbound on-ramp and I-5 mainline from approximately 1,600 feet south of the overpass to the south. Stormwater is conveyed under the interstate through three separate culverts discharging to the east of the interstate. The discharge flowpath from these culverts merge with one quarter mile from the WSDOT right of way. The stormwater flows through a number of existing drainage channels until it reaches the receiving waterway of McCormick Creek.

2.3 Soils

The project site soils consist primarily of silt loams that have slow runoff and moderate permeability. The hydrologic soils group categorization of C and D suggests slow to very slow infiltration rate when the soils are wetted. Two geotechnical investigation programs were performed at the project site and can be described as follows:

January and February 2015

A geotechnical investigation program was performed in late January and early February of 2015 during a typical wet season in Washington. A total of 13 soil borings and 8 test pits were advanced as part of the geotechnical investigation, attached in Appendix B. Monitoring wells were installed at two of the soil boring locations: soil boring B-4 at the west bridge abutment and soil boring B-6 at the east bridge abutment. The groundwater elevation at the west and east abutments, measured from the borings on March 9, 2015, were 12.6 feet below ground surface (bgs) and 26.5 feet bgs, respectively. Water seepage was noted between a depth of 3 and 6 feet in 6 of the 8 test pits that were excavated: TP-2, TP-3, TP-7, TP-8, TP-9, and TP-10. The water seepage encountered was observed to be likely from surface runoff. No groundwater or water table was encountered in the test pits at the time of the geotechnical investigation. Gradation testing was performed on soil samples collected from four of the test pits.

June 2015

A second geotechnical investigation program was performed during the first week and last week of June, 2015. This investigation included eight additional test pits and 9 additional soil borings in which groundwater monitoring tubes were installed. Gradation testing was conducted for all of the test pits with two samples tested in three of the test pits where there was the possibility of a soil horizon.

Water seepage was noted in two of the test pits excavated in June 2015: TP-14 and TP-19 at depths of 6 and 7.5 feet, respectively. The geotechnical engineers on-site observed that seepage encountered was likely due to the presence of nearby culverts as well as surface runoff. No groundwater or water table was encountered in the test pits at the time of the geotechnical investigation.

The hydrometer sieve graphs and infiltration rate calculations are included in Appendix B. An infiltration analysis was performed with this information using the process described in the WSDOT Highway Runoff Manual M 31-16.04, Appendix 4D. The analysis indicates that infiltration rates vary from 0.26 to 0.23 in/hr. with the exception of the Northbound On-Ramp at 0.15 in/hr.

2.4 Outfalls

Within the project area, the locations where stormwater runoff from WSDOT facilities leaves WSDOT right-of-way were considered to be the project outfalls. These existing locations are identified in Figure 2-1 and are not anticipated to be impacted by the proposed project developments, i.e. the developed outfalls will remain the same as the existing outfalls.

2.5 Existing Utilities

Active utilities within the project area have the potential to impact the project drainage plans. Existing records and survey were reviewed to determine any potential conflicts. Active storm sewers, electric and telecom are the utilities in the vicinity of this project. They will be relocated where in conflict with proposed stormwater ponds and further detailed in the drainage plan and profile sheets. Figure 2-1 shows the approximate locations of this infrastructure and other utilities in proximity.

Section 3 Design Standards

The modification and augmentation of the existing ramps and I-5 mainline throughout the project area adds impervious area within the project limits. Enhanced water quality treatment and flow control facilities will be installed to compensate for the increased runoff generated by the additional impervious area.

Design standards for the stormwater management facilities and stormwater conveyance system were taken from the following:

WSDOT Design Manual, Section 800
WSDOT Highway Hydraulic Manual M 23-03.03 (HM) (WSDOT 2015)
WSDOT Highway Runoff Manual M 31-16.04 (HRM) (WSDOT, 2014).
WSDOT Roadside Manual (M 25-30)
WSDOT Environmental Manual M31-11 (June 2015)
WSDOT Standard Plans and Specifications
WSDOT Maintenance Manual, M-51-01.05 (August 2013)
Washington State Department of Ecology, 2012 *Stormwater Management Manual for Western Washington*

3.1 Stormwater Management Guidelines

An analysis of the project was completed following the WSDOT HRM guidance to determine how the Minimum Requirements (MR) apply to the project. For the following discussion, see WSDOT Stormwater Spreadsheets in Appendix A. HRM Figure 3-1, Steps 1 through 4, require that any project with at least 2,000 sf of new and replaced impervious surface or that has land-disturbing activities greater than 7,000 sf conform to MR 1, 2, 3 and 4. As this project exceeds both of these thresholds (creating or replacing 303,000 sf of impervious surface and land-disturbing activities affecting approximately 0.6 million sf), these requirements are applied.

HRM Figure 3-1, Steps 3 through 6, require that projects adding at least 5,000 sf of new impervious surface delineate TDAs (see section 4.2) and apply MR 6, 7, 8, and 9 to the new impervious surface and apply MR 5 to the new pollution-generating impervious surface (PGIS). If a project is defined as "road-related" and the added new impervious surface equals 50% or more of the existing impervious surface, these MR also apply to replaced impervious surface and PGIS.

NOTE: This existing impervious surface used in this calculation is that which exists within the existing WSDOT right of way and not the proposed expanded right of way, see Figure 4-1. Two versions of the new impervious surface were used in this calculation. Version one, contains the new the impervious within the WSDOT right of way plus the new bridge overpass area tributary to City of La Center's drainage system. Version two contains only the new impervious surface within the WSDOT right of way and determined to be WSDOT jurisdiction.

For Version one, the proposed project adds 164,000 sf of impervious surface (26% of the existing impervious), thus necessitating implementation of minimum requirements 6-9 to new impervious surface but not to replaced impervious surface.

For Version two, the proposed project adds 88,000 sf of impervious surface (14% of the existing impervious), thus necessitating implementation of minimum requirements 6-9 to new impervious surface but not to replaced impervious surface

It is worth noting that the new La Center bridge overpass is not included in the calculations, except as noted above. For Tribal Land improvements on the westside of I-5, see separate report prepared by

BergerABAM. For City of La Center improvements on the eastside of I-5, see separate report prepared by Olson Engineering.

Minimum Requirement 1 – Stormwater Planning

To meet the objectives of the permanent stormwater control planning requirements, this report has been prepared to provide a complete record of the engineering justification for all drainage based on guidelines in the HRM, HM and the Maintenance Manual. As noted in the Hydraulic Manual, this report contains detailed descriptions of the following items:

* Existing and developed site hydrology
* Flow control and runoff treatment systems
* Conveyance system analysis and design
* Wetland hydrology analysis, if applicable
* Downstream analysis

This project does not meet any of the exemptions from section 3-2.2 of the HRM. However, it does meet the exemption for treating the replaced impervious area, as explained above.

Construction Stormwater Pollution Prevention Planning consists of the preparation of a Temporary Erosion and Sediment Control Plan (TESC) which are included in the Volume 1 design plans and have been submitted to the Southwest Region Compliance and TESC Group. A Spill Prevention, Control and Counter Measures Plan (SPCC) will be required.

Minimum Requirement 2 – Construction Stormwater Pollution Prevention

All projects that disturb 7,000 square feet or more of land or add 2,000 square feet or more of new, replaced or new plus replaced impervious surface must prepare a TESC plan in addition to an SPCC plan. (Also see Section 3-3.1.2 Applicability in the HRM)

Construction stormwater prevention is documented in the TESC Plan that has been prepared for this project. Construction stormwater pollution prevention is also specified in Standard Specification 1.07.15(1).

Minimum Requirement 3 – Source Control of Pollutants

Selected BMPs for construction source control are documented in a TESC Plan.

Post construction source control of the highway system will be managed through operational and structural BMPs discussed in this report and WSDOT's Maintenance Manual.

Minimum Requirement 4 – Maintain the Natural Drainage System

The design maintains hydrologic function and drainage patterns based on site geology, hydrology, and topography.

All natural drainage system will be maintained.

Minimum Requirement 5 and 6 – Runoff Treatment and Flow Control

Runoff Treatment (Minimum Requirement 5)

Based on the ADT of the roadway, enhanced water quality treatment is required within the WSDOT right of way. Enhanced treatment provides removal of dissolved metals in addition to suspended solids.

Enhanced treatment is applicable only for TDA 1 and 3. Media filter Drains (MFDs) will be installed as the enhanced water quality treatment measure and will treat an equivalent amount of roadway pavement to mitigate for the new Pollution Generating Impervious Surface (PGIS) created within the TDAs.

Flow Control (Minimum Requirement 6)

Flow control is applicable only for TDA 1 and 3. Detention ponds will be installed as the flow control method and will provide mitigation for an equivalent amount of impervious area to mitigate for the new impervious area created within the TDA.

The flow control criteria for Western Washington states that the storage volume must be provided for stormwater discharge to match the duration of predeveloped flows from 50 percent of the 2-year peak storm flow to the full 50-year peak storm flow. An emergency overflow drain shall be sized to pass the 100 year post-developed peak flow. The predeveloped condition to be matched shall be defined as forested land cover for the new impervious area created by the project within each TDA. The 100-year peak flow must also be checked for potential downstream property impacts.

Minimum Requirement 7 – Wetlands Protection

The project will maintain the existing discharge points and a provided flow mitigation.

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

There are no formally adopted watershed or basin plans, nor local ordinances or regulations which are more stringent than those contained in the 2014 *Highway Runoff Manual* applicable to the proposed project.

Minimum Requirement 9 – Operation and Maintenance

See Section 5-5 of the 2008 *Highway Runoff Manual*, WSDOT's *Maintenance Manual* and Section 7.0 of this report for procedures to be followed in operations and maintenance of the permanent features of this project site.

3.2 Stormwater Retrofit Analysis

This section will describe the changes to the existing storm conveyance system.

3.3 Other Requirements

No additional requirements apply to this project.

3.4 Pipe Alternatives

The WSDOT HM and Standard Specifications were used to determine the acceptable material allowed for new drainage piping and culverts proposed by the roadway improvements.

3.5 Downstream Analysis

A downstream analysis identifies and evaluates potential impacts, if any, a project will have on downstream receiving resources, most importantly waterways. Projects that contribute greater than 5,000 square feet of impervious surface area, as this one does, are required to complete a downstream analysis as part of the submittal.

The WSDOT interchange improvements portion of the project proposes measures that detain and treat to the greatest range stipulated in the guidance manual. The implemented Best Management Practices (BMPs) will, at a minimum, reduce peak flow rates to preproject conditions and treat a total impervious area greater than that being created by this project. Nutrient loading is likely to decrease due the extent of the filtration BMPs installed. Therefore, with the mitigation measures, the project will likely experience improved water quality.

3.5.1 Review of Resources

A review of water resources, carried out up to a quarter mile downstream of the project outfalls, takes into account potential wetlands, floodplain, aquatic habitat, land use and development, and sensitive waterbodies. With no mitigation, these resources will be negatively impacted by the project improvements. However, with the mitigation practices for both quantity and quality described in this report, the developed conditions will be an improvement upon the existing conditions.

3.5.2 Inspection of Drainage Conveyance Systems in the Site Area

The downstream site inspection field walk was performed on November 19, 2015. The purpose of this field walk is to document the existing conditions of the downstream flowpaths for a quarter mile from the project outfalls.

On August 13th, 2015, Heidi Holstrum of WSDOT maintenance was contacted and reported no existing drainage issues in the area, with the exception of a clogged northbound on-ramp culvert.

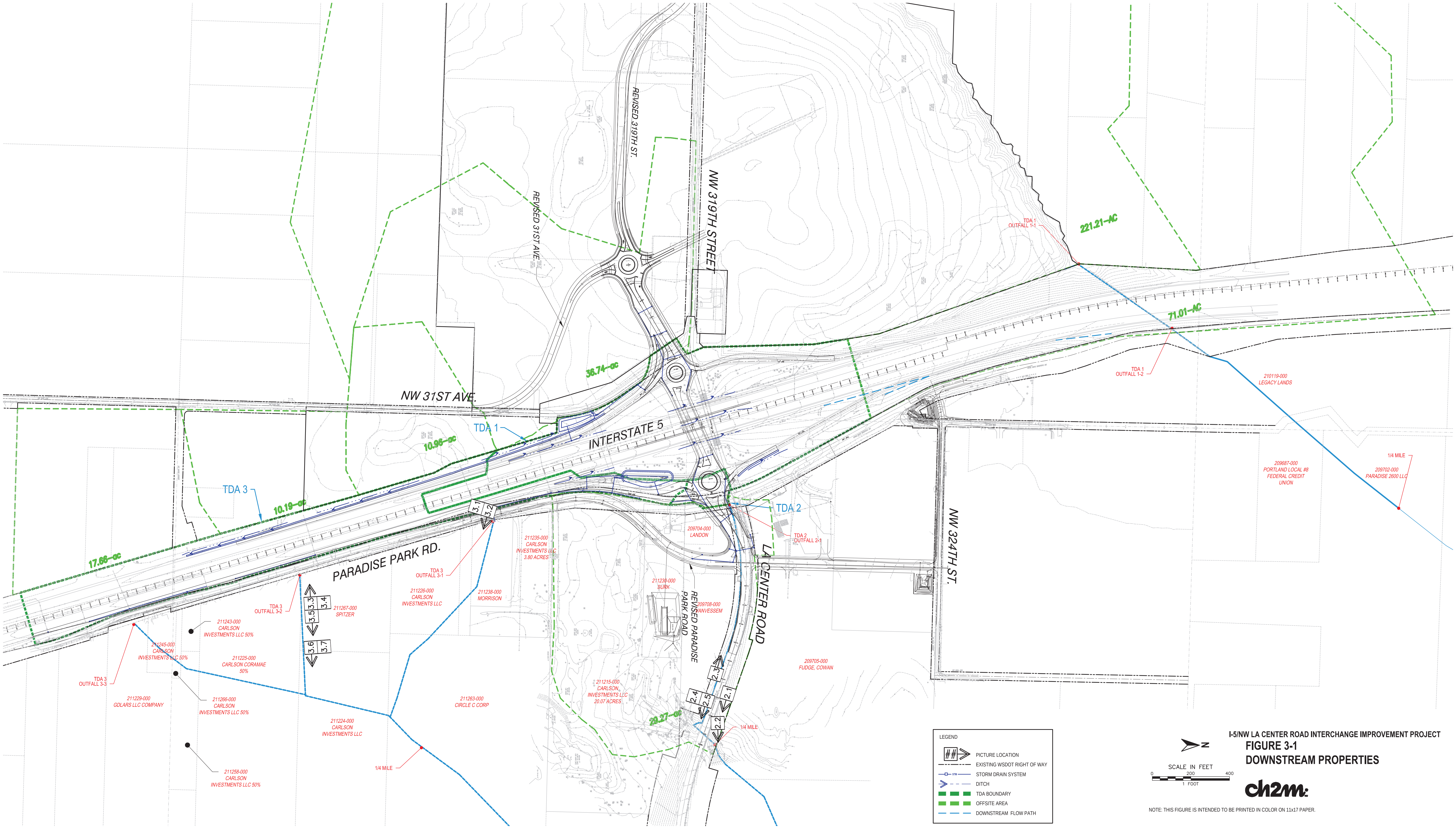
TDA 1:

Outfall 1-1 Downstream Flowpath

This outfall is a 30-inch culvert discharging on the northside of the southbound offramp into an existing roadside drainage ditch. This ditch flows north along the westside of the southbound lanes to approximately Station 570+00. Here the roadway runoff combines with an Unnamed stream and enters a 48-inch culvert that transports the flow to the eastside of the highway, where the stream exits the WSDOT right of way, as shown on Figure 3-1.

Outfall 1-2 Downstream Flowpath

This outfall is an 18-inch culvert discharging on the northside of the northbound onramp into an existing closed conveyance system. This system flows north along the eastside of the northbound lanes to approximately Station 570+00, where it discharges into a roadside ditch. This ditch is collected by an existing drainage structure that is connected to the existing 48-inch culvert, crossing the highway, thus combining with the flow from Outfall 1-1 and the Unnamed Stream. This stream continues to flow in a northeasterly direction. The quarter mile point of convergence for this TDA is located on the Paradise 2600 LLC property, as shown on Figure 3-1. Property owner permission had not yet been granted, at the time of the field visit, in order to document the length of the quarter mile downstream flowpath.



I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 3-1
DOWNSTREAM PROPERTIES

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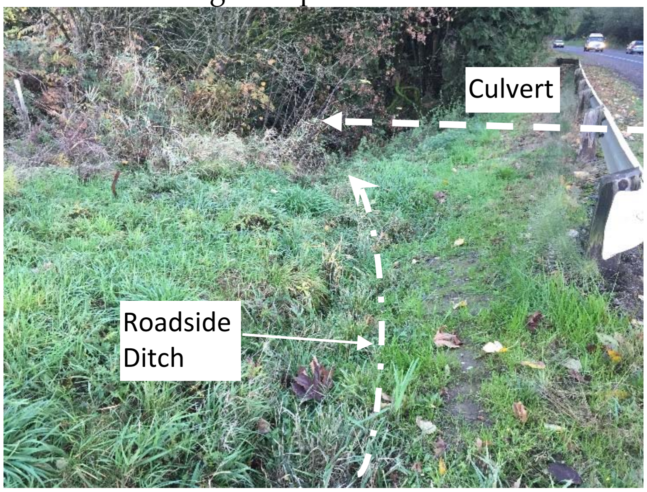
TDA 2:

Outfall 2-1 Downstream Flowpath

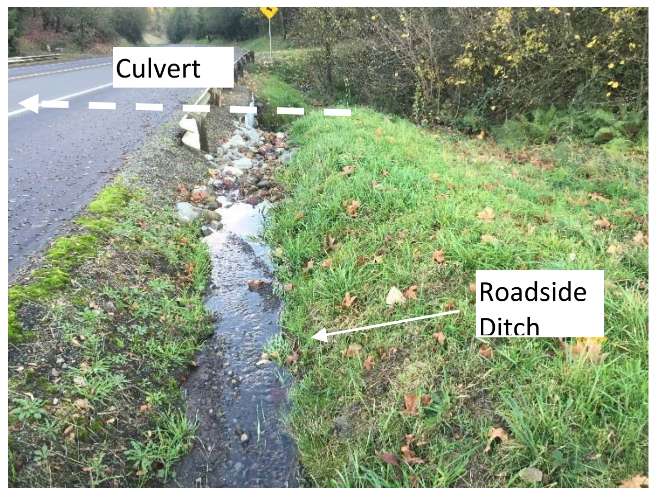
This outfall is a 12-inch culvert discharging on the southside of La Center Rd into a roadside ditch flowing east down La Center Rd. These ditches drain down the riprap lined roadway embankment into a stream flowing north under La Center Road via a 24-inch cuvert. flowpath for this outfall. As shown in the following field pictures.



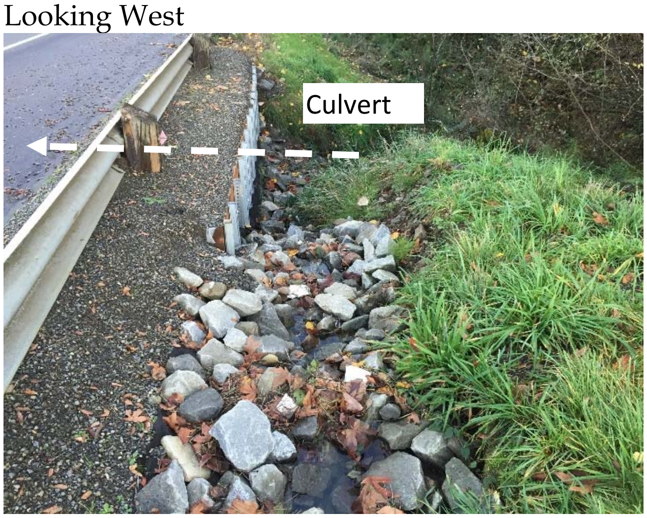
Picture 2.1: Northside of La Center Rd

Picture 2.2: Northside of La Center Rd

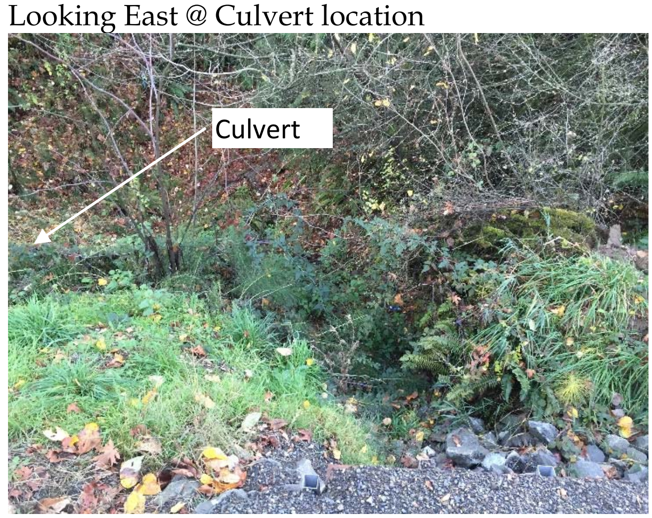
Picture 2.3: Southside of La Center Rd
Looking West



Picture 2.4: Southside of La Center Rd
Looking East @ Culvert location



Picture 2.5a: Southside of La Center Rd
Looking East above culvert location



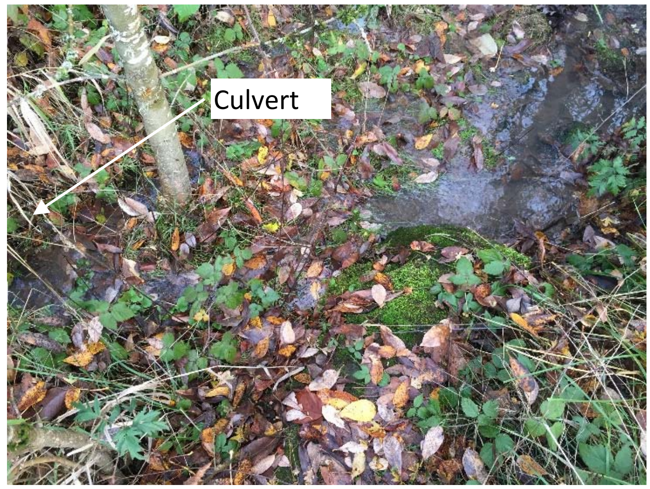
Picture 2.5b: Southside of La Center Rd
Looking @ embankment above culvert location

TDA 3:

Outfall 3-1 Downstream Flowpath

This outfall consists of two 18-inch culverts discharging on the eastside of Paradise Park Rd into a drainage channel flowing southeasterly across the Morrison, Carlson Investments LLC and Circle C Corp properties. For what could be seen from the edge of Paradise Park, the channel flows through bushes and overgrowth. As shown in the following field pictures. However, property owner permission had not yet been granted, at the time of the field visit, in order to document the length of the channel.

Picture 3.1: Eastside of Paradise Park Road
Looking east downstream of outlet

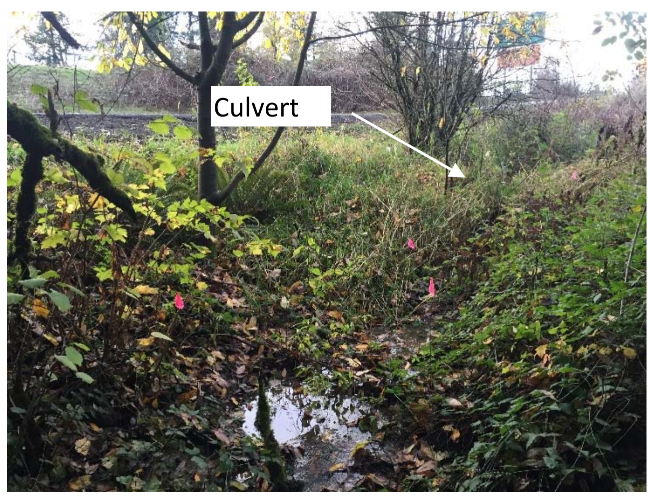


Picture 3.2: Eastside of Paradise Park Road
Looking east downstream of outlet

Outfall 3-2 Downstream Flowpath

This outfall consists of an 18-inch culvert discharging on the eastside of Paradise Park Rd into a drainage channel flowing easterly across the Spitzer and Carlson Investments LLC properties. The channel flows through bushes and wooded overgrowth. The channel becomes wide and shallow as it exists the Spitzer property. As shown in the following field pictures. However, property owner permission had not yet been granted, at the time of the field visit, in order to document the length of the channel beyond the Spitzer property.

Picture 3.3: Eastside of Paradise Park Road
Looking west downstream of outlet



Picture 3.4: Eastside of Paradise Park Road
Looking west downstream of outlet

Picture 3.5: Eastside of Paradise Park Road
Looking east downstream of outlet

Picture 3.6: Southeast corner of Spitzer property
Looking east downstream

Picture 3.7: Southeast corner of Spitzer property
Looking at the channel bed material

Outfall 3-3 Downstream Flowpath
This outfall consists of an 18-inch culvert discharging to the east. However, the end of this existing culvert was not found by the surveyors.

Based on the USGS topographic map, the culvert discharges on the eastside of Paradise Park Rd into a channel. As this channel flows northeast and ultimately into McCormick Creek, it collects the runoff from the downstream channels of Outfalls 3-1 and 3-3.

The quarter mile point of convergence for this TDA is located on the Circle C Corp property, as shown on Figure 3-1. . Property owner permission had not yet been granted, at the time of the field visit, in order to document the length of the quarter mile downstream flowpath.

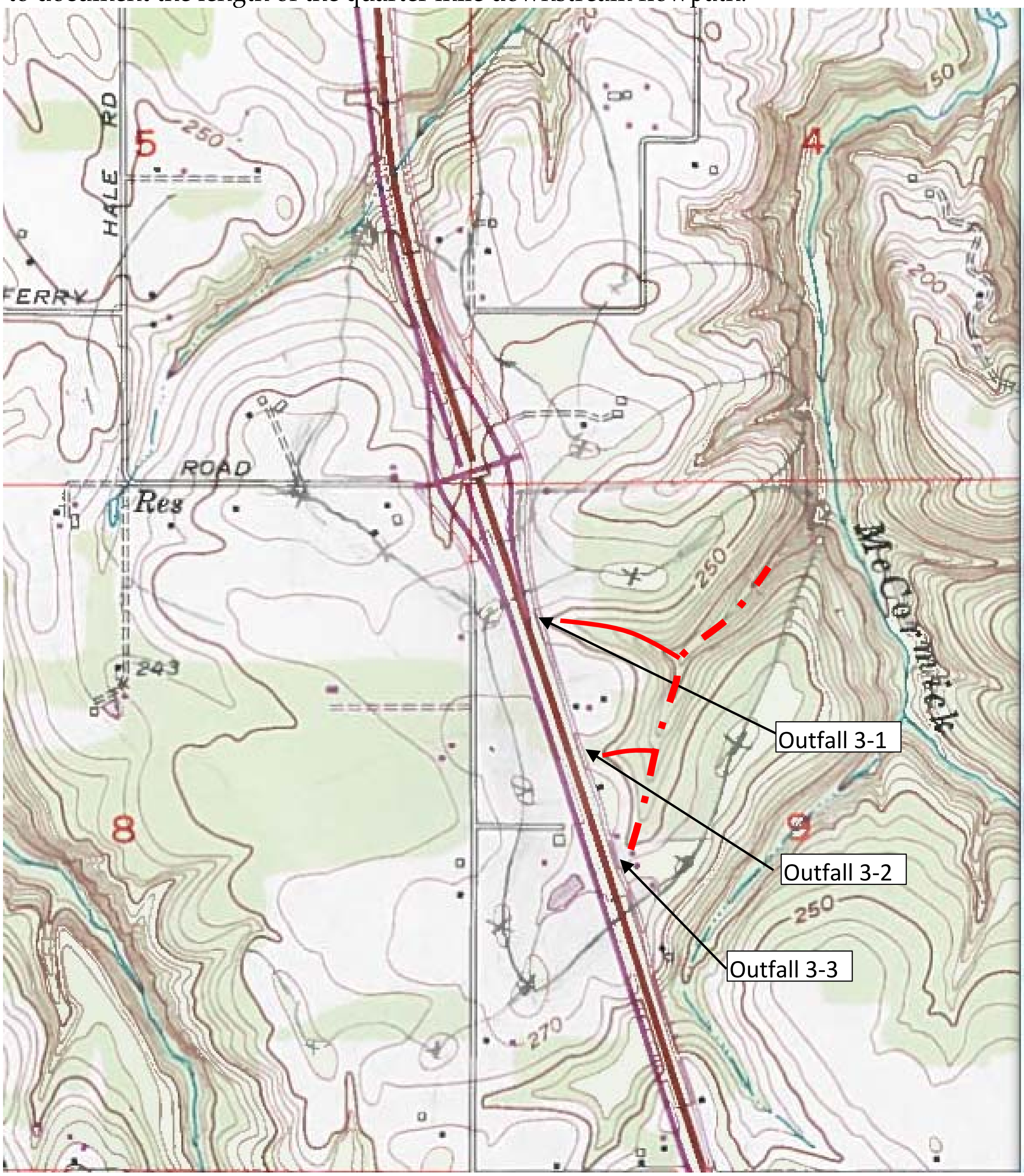


Figure 3-2: USGS Topographic map, Ridgefield Quad

3.5.3 Analysis of Offsite Effects

It is anticipated that the project will not create additional problems downstream, nor exacerbate existing problem, and no further corrective or preventative actions will be necessary aside from those described in this report. By collecting and mitigating for more impervious area that required, stormwater runoff will be treated to a greater level of flow control than stipulated by the minimum requirements in the HRM. No downstream resources are likely to be affected by the minor changes in runoff at some of the outfalls.

TABLE 3-1
Downstream flows

TDA-Outfall	Pre-developed 100-year Flow (cfs)	Post-developed 100-year Flow (cfs)	Percent Increase
1-1 (Pond 1-1)	163.06	161.81	-0.77%
1-2	48.46	48.48	0.04%
TDA 1 Total @ Convergance	211.52	210.29	-0.58%
2-1	17.33	17.37	0.23%
3-1 (Pond 3-1)	9.73	7.65	-27.19%
3-2	9.15	9.22	0.76%
3-3	16.46	16.50	0.24%
TDA 3 Total @ Convergance	35.34	33.37	-5.90%

3.5.4 Property Owner Notification

For properties within the quarter mile downstream flow path, as shown in Figure 3-1, the property owners have been notified about the project and desire to perform the field walk and meet with them to dicuss the project impacts.

The following property onwers have responded to the notification and meeting was held either in-person or via a phone conversation, see Appendix C for meeting minutes.

A meeting with the Spitzer residence was held in-person on November 19, 2015, along with a field walk.
A meeting with the Fudge residence was held in-person on November 20, 2015.
A phone conversation the Morrison residence was completed on December 7, 2015.

3.6 New Stormwater Outfalls

There are no new stormwater outfalls proposed with this project.

Section 4 Developed Conditions

4.1 Calculations

All Excel spreadsheets used for design were developed and provided by WSDOT. The combination flow control and water quality treatment BMPs were sized according to standards in the HRM and modeled in MGS Flood (version 4.34). The sizing and compliance analysis are provided in Appendix A of this report.

TABLE 4-1: Media Filter Drain Locations

MEDIA FILTER DRAIN TYPE 3			
LOCATION	START STA. RT/LT	END STA. LT/RT	SLOPE (FT/FT)
I-5 SB ON-RAMP	L 521+00 LT	L 535+00 LT	10:1
I-5 SB ON-RAMP	L 535+00 LT	L 535+50 LT	10:1 - 4:1
I-5 SB ON-RAMP	L 535+50 LT	L 536+28 LT	4:1
I-5 SB ON-RAMP	DC 97+62 LT	DC 97+80 LT	4:1
I-5 SB ON-RAMP	DC 97+80 LT	DC 98+30 LT	4:1 - 10:1
I-5 SB ON-RAMP	DC 98+30 LT	DC 105+00 LT	10:1
I-5 SB ON-RAMP	DC 105+00 LT	DC 105+29 LT	10:1 - 6:1
I-5 NB ON-RAMP	BA 100+61 RT	BA 103+16 RT	10:1

4.2 Threshold Discharge Areas

The threshold discharge areas will release to their respective waterways after receiving flow control and enhanced water quality treatment. This section includes a description of each TDA, and the proposed stormwater drainage plan for each. Figure 4-1 shows the proposed improvements by TDA.

4.2.1 TDA 1 – Northern Project Area

TDA 1 contains upgrades to the I-5 mainline, the northbound on-ramp, the southbound off-ramp, and the majority of the southbound on-ramp, resulting in the addition of 29,000 sf (0.67 ac) of new impervious surface. As such, the thresholds for requirements 5 and 6 are exceeded, thus requiring both enhanced runoff treatment (RT) and flow control (FC).

Enhanced RT will be provided by Media Filter Drains (MFDs) located along the roadway shoulder in areas that meet the slope and size requirements described in the HRM. Table 4-1 and Figure 4-3 show the location of the MFD and the corresponding PGIS being treated.

Flow control in TDA 1 will be provided by a detention pond, placed on the west side of the southbound on-ramp, see Figure 4-2. It is sized to detain the runoff from 39,000 sf (0.9 ac) of roadway impervious area. It is also designed to allow runoff from grass to pass through undetained such that it meets the "50 percent rule." (This rule states that the undetained area may pass through the detention facility, so long as 100 yr flow from the pass through area does not exceed 50% of the 100 yr undetained flow from the area requiring flow control.)

The outlet flow from this pond is metered by a primary control structure containing an orifice and riser designed to match the required predeveloped storm durations. An emergency overflow structure (birdcage) is placed and sized to accommodate the 100-year undetained storm event. For MGSFlood calculations see Appendix A.

4.2.2 TDA 2 – Northbound Off Ramp

TDA 2 contains a small portion of the WSDOT proposed right of way on the northbound off-ramp, resulting in the addition of 4,000 sf (0.09 ac) of new impervious surface area. This new impervious area is lower than the thresholds for RT and FC, thus this TDA is not subject to RT or FC.

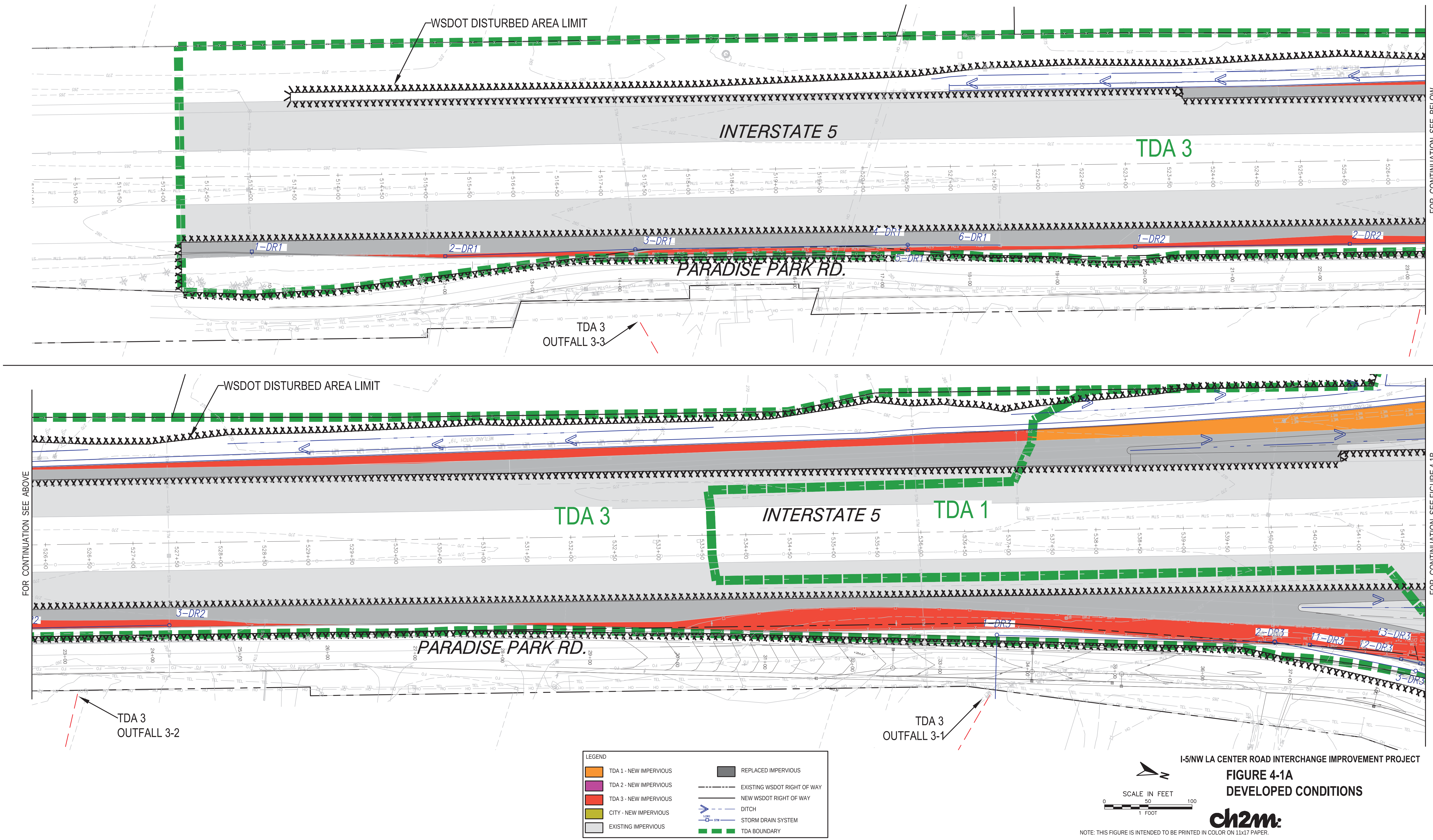
4.2.3 TDA 3 –Southern Project Area

The TDA 3 (Basin 3) I-5 mainline and ramp improvements comprise upgrades to the I-5 mainline, the northbound off-ramp, and the extension of the southbound on-ramp. This TDA will include 55,000 sf (1.26 ac) of new impervious surface and 165,000 sf (3.78 ac) of replaced impervious surface. The thresholds for requirements 5 and 6 are exceeded thus requiring both enhanced runoff treatment (RT) and flow control (FC).

Enhanced RT will be provided by Media Filter Drains (MFDs) located along the roadway shoulder in areas that meet the slope and size requirements described in the HRM. Table 4-1 and Figure 4-3 show the location of the MFD and the corresponding PGIS being treated.

Flow control in TDA 3 will be provided by a detention pond on the westside of the northbound off-ramp, see Figure 4-2. It is sized to detain the runoff from 78,400 sf (1.8 ac) of impervious area. It is also designed to allow runoff from grass to pass through undetained such that it meets the “50 percent rule.”

The outlet flow from this pond is metered by a primary control structure containing lower and upper orifice and a riser designed to match the required predeveloped storm durations. An emergency overflow structure (birdcage) is placed and sized to accommodate the 100-year undetained storm event. For MGSFlood calculations see Appendix A.



I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 4-1A
DEVELOPED CONDITIONS

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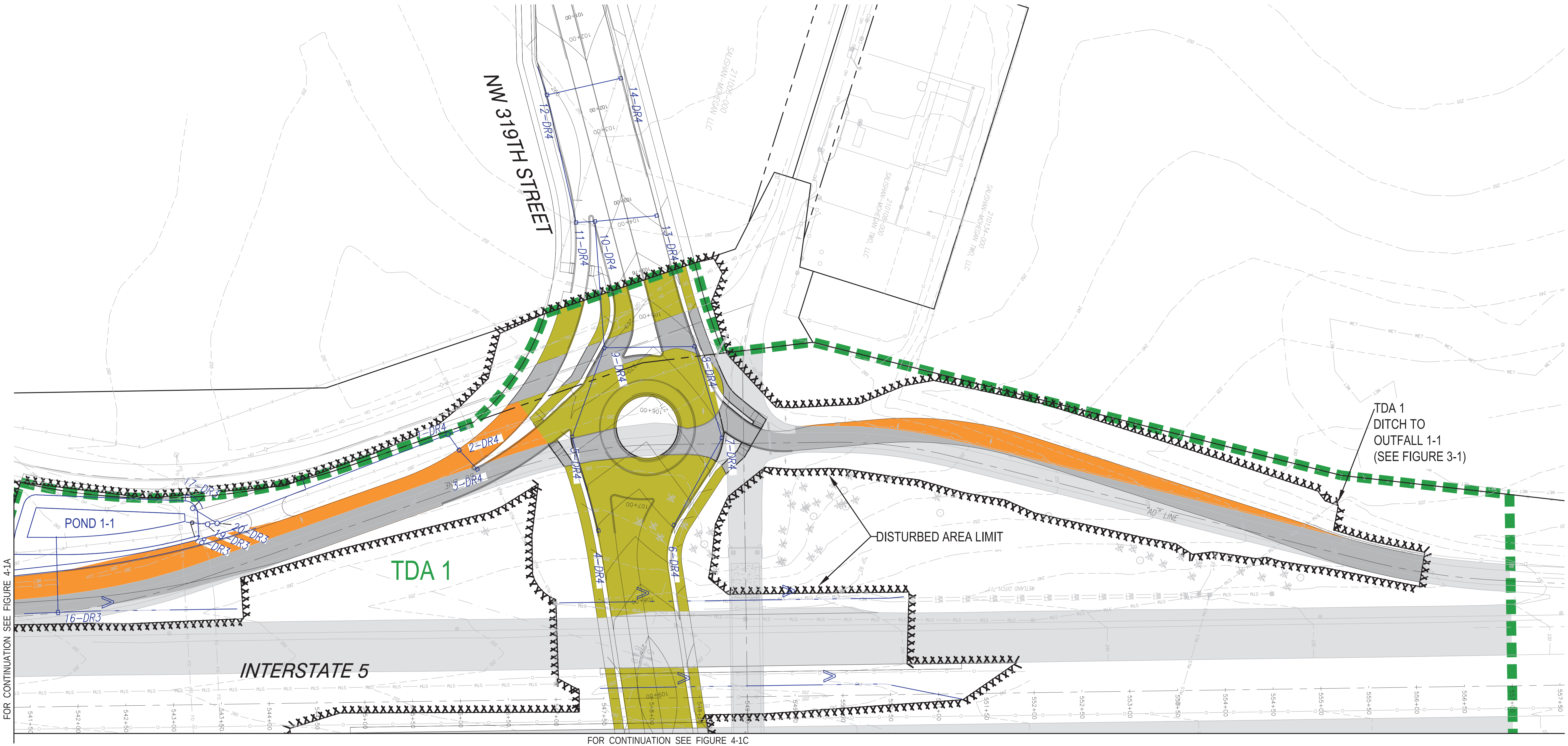

LEGEND

TDA 1 - NEW IMPERVIOUS	REPLACED IMPERVIOUS
TDA 2 - NEW IMPERVIOUS	EXISTING WSDOT RIGHT OF WAY
TDA 3 - NEW IMPERVIOUS	NEW WSDOT RIGHT OF WAY
CITY - NEW IMPERVIOUS	DITCH
EXISTING IMPERVIOUS	STORM DRAIN SYSTEM
	TDA BOUNDARY

SCALE IN FEET
0 50 100
1 FOOT

I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 4-1B
DEVELOPED CONDITIONS

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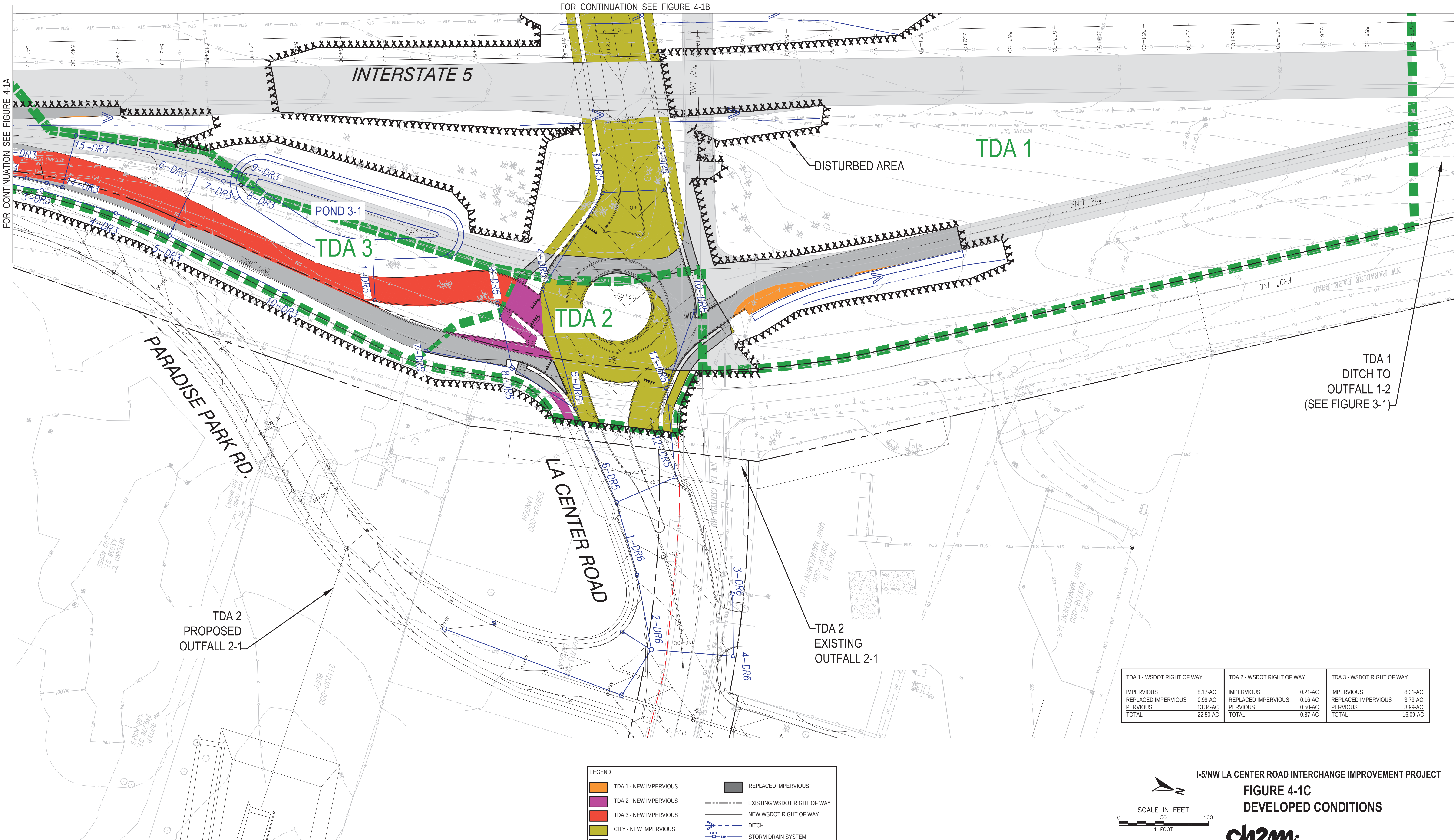
NOTE: THIS FIGURE IS INTENDED TO BE PRINTED IN COLOR ON 11x17 PAPER.



LEGEND

TDA 1 - NEW IMPERVIOUS	REPLACED IMPERVIOUS
TDA 2 - NEW IMPERVIOUS	EXISTING WSDOT RIGHT OF WAY
TDA 3 - NEW IMPERVIOUS	NEW WSDOT RIGHT OF WAY
CITY - NEW IMPERVIOUS	DITCH
EXISTING IMPERVIOUS	1-DR1 STM STORM DRAIN SYSTEM
	TDA BOUNDARY

TDA 1 - WSDOT RIGHT OF WAY		TDA 2 - WSDOT RIGHT OF WAY		TDA 3 - WSDOT RIGHT OF WAY	
IMPERVIOUS	8.17-AC	IMPERVIOUS	0.21-AC	IMPERVIOUS	8.31-AC
REPLACED IMPERVIOUS	0.99-AC	REPLACED IMPERVIOUS	0.16-AC	REPLACED IMPERVIOUS	3.79-AC
PERVIOUS	13.34-AC	PERVIOUS	0.50-AC	PERVIOUS	3.99-AC
TOTAL	22.50-AC	TOTAL	0.87-AC	TOTAL	16.09-AC

SCALE IN FEET
0 50 100
1 FOOT

I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 4-1C
DEVELOPED CONDITIONS

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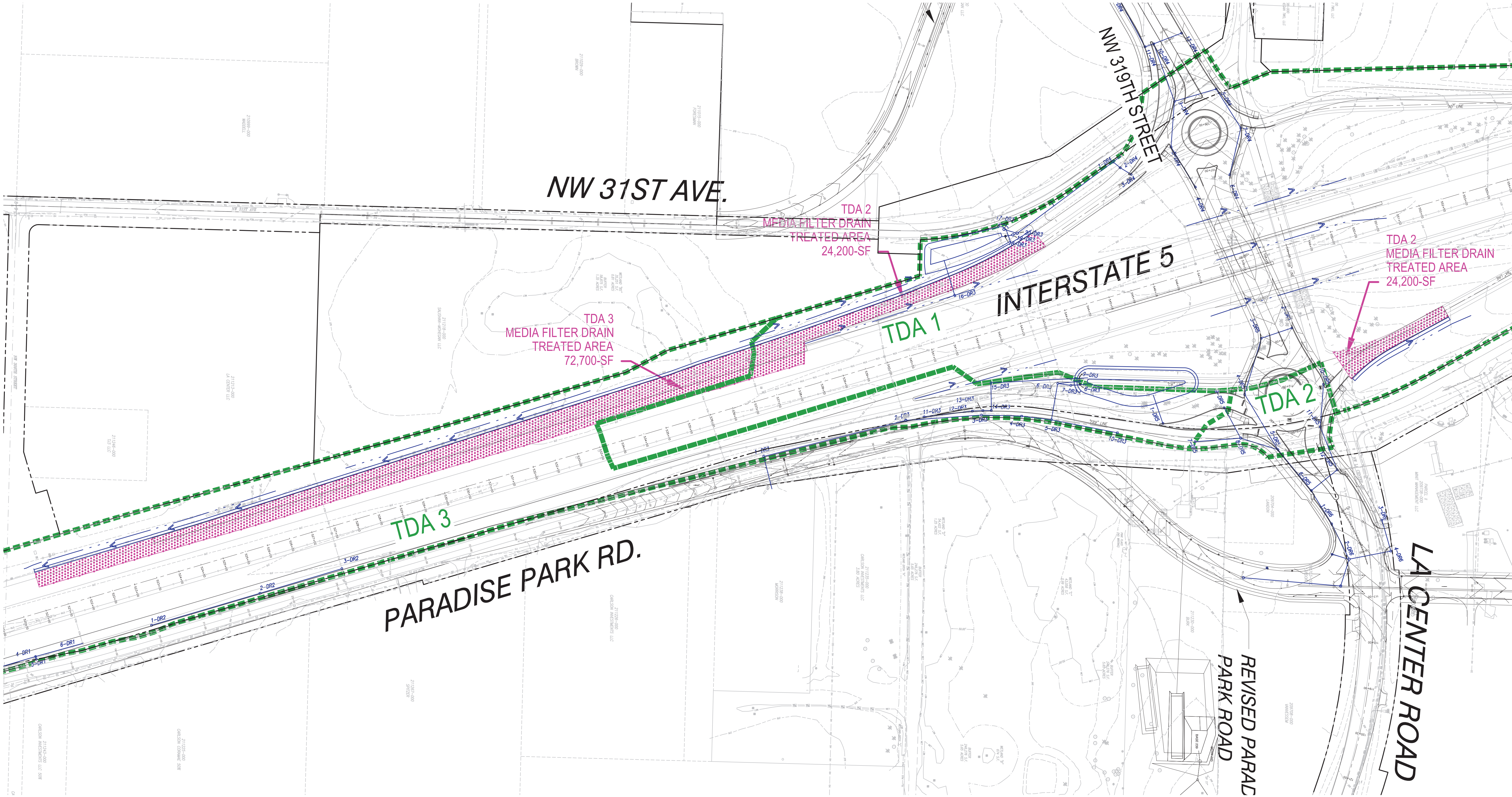
NOTE: THIS FIGURE IS INTENDED TO BE PRINTED IN COLOR ON 11x17 PAPER.



N

SCALE IN FEET

0 100 200

1 FOOT

I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 4-3

MEDIA FILTER DRAIN AREAS

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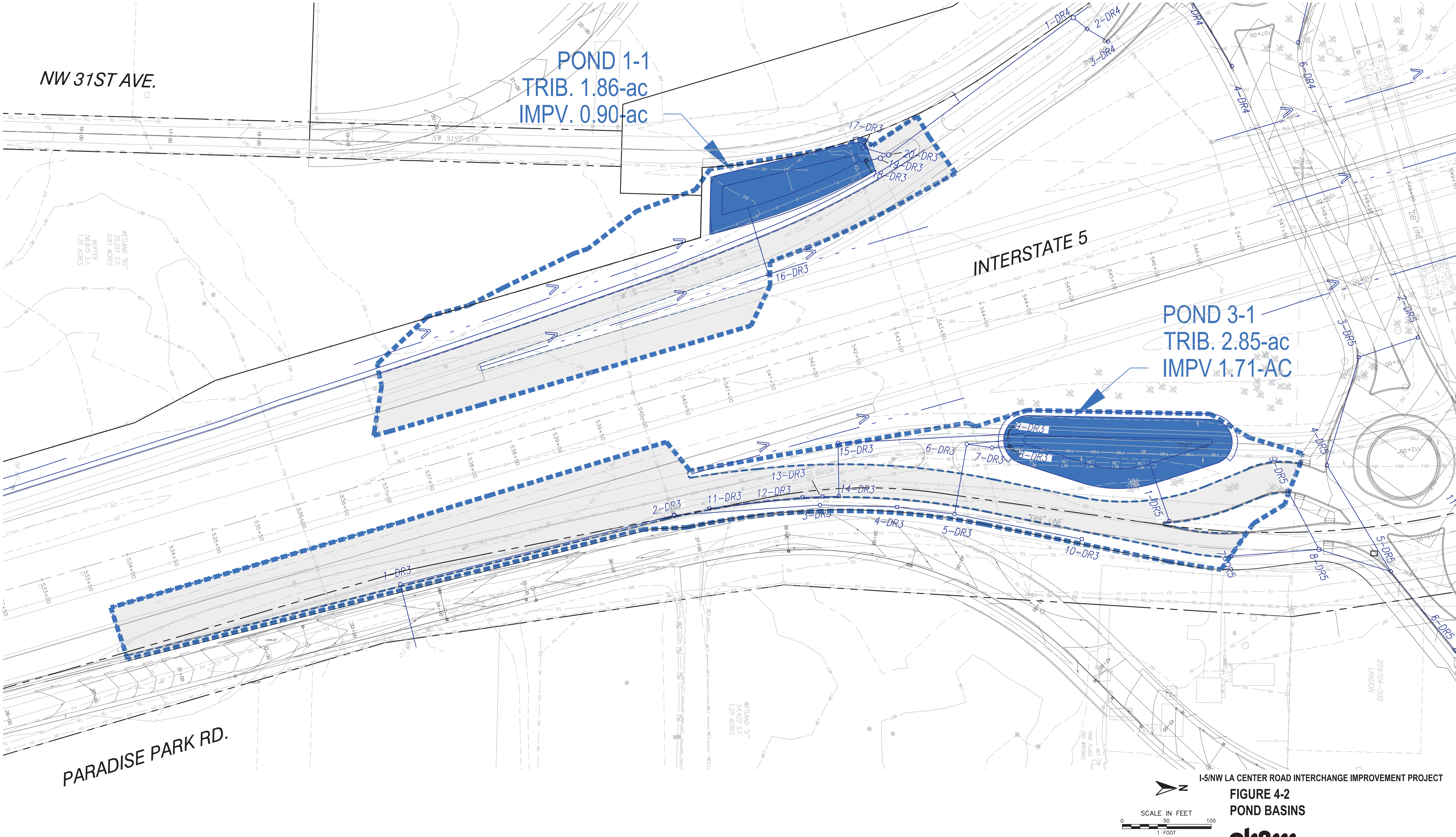
NOTE: THIS FIGURE IS INTENDED TO BE PRINTED IN COLOR ON 11x17 PAPER.



I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 4-2
POND BASINS

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Section 5 Hydraulic Design

5.1 Calculations

Components of the proposed storm drainage system are designed using different storm recurrence intervals. Design storm return periods used for the various storm system components of the project are listed in Table 3-2.

TABLE 5-1
Mean Recurrence Interval for System Components

Design Element	Mean Recurrence Interval
Gutters	10 year
Inlets	10 year
Sags	50 year
Ditches	10 year
Culverts	25 year
Laterals	25 year
Trunks	25 year

5.2 Enclosed Drainage Design

Enclosed drainage is used to convey stormwater runoff from roadway impervious surfaces where roadside ditches are not constructible due to space constraints. For this project, this is primarily on the northbound I-5 roadway, south of the overpass, where the County NW Paradise Park Road aligns close to the highway. The enclosed conveyance system was designed in accordance with guidance in the WSDOT HM. However, the 100-yr event was used in lieu of the required 25-yr event. This was done in order to analyze the conveyance systems downstream of the ponds. Bentley StormCAD software was used to calculate the HGL and pipe capacity. Details can be found on Figure 5-1 and calculations provided in Appendix C.

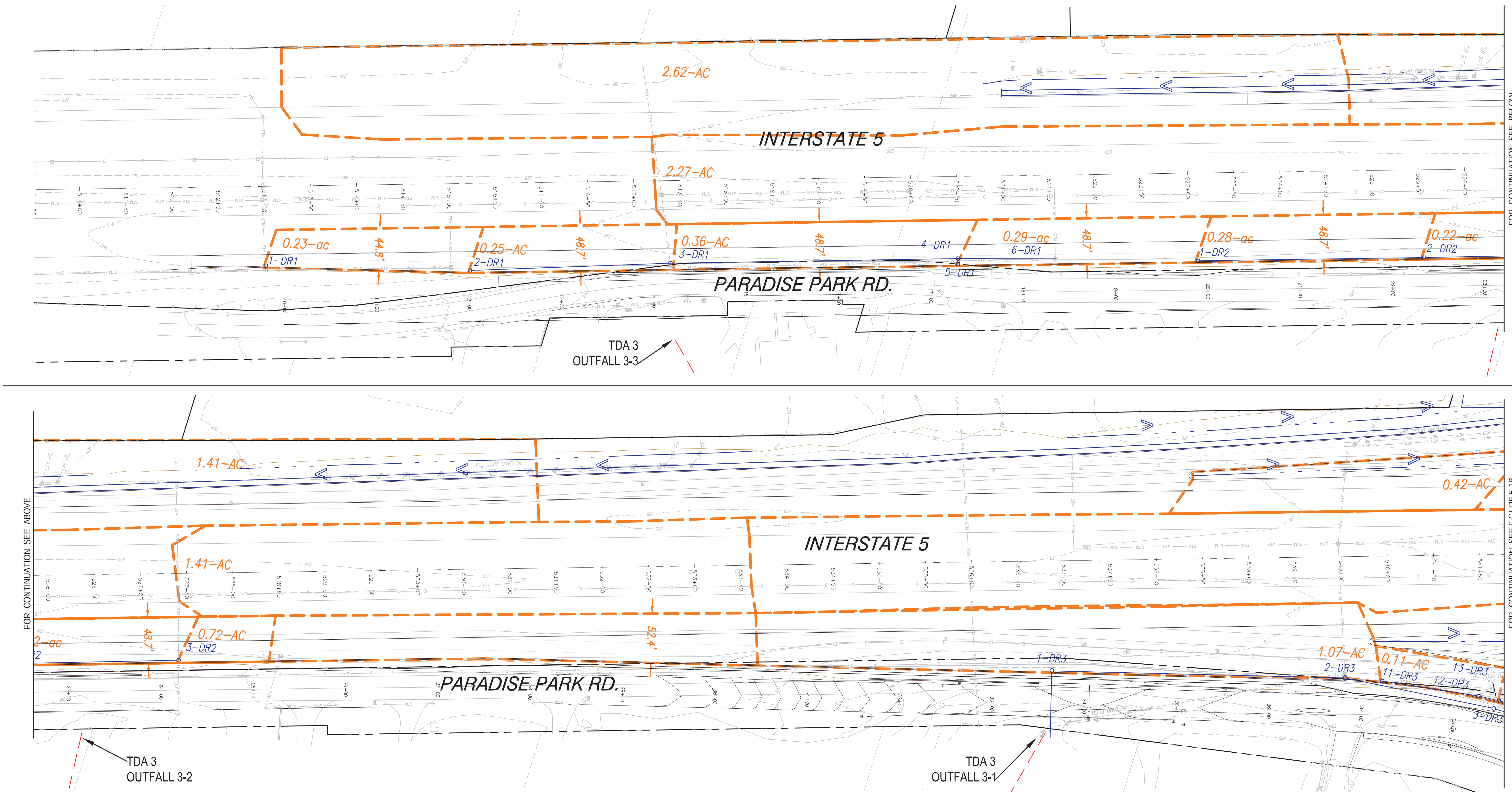
5.3 Ditch Design

Existing ditches will be altered by the proposed improvements. In this project area, ditches are used along uncurbed roadways as a conveyance and runoff control mechanism. Criteria from the WSDOT Hydraulic Manual (HM), including 10-year design recurrence interval with 0.5 feet of freeboard and maximum side slope of 2:1, will be used in the design process. It is not anticipated that ditch modifications will significantly change the existing ditch lines. Details can be found in the drainage plan and profile sheets.

5.4 Inlet Design

Inlets are used to collect stormwater runoff from roadway impervious surfaces where roadside ditches are not constructible due to space constraints. On this project, this is primarily on the northbound I-5 roadway, south of the overpass, where the County NW Paradise Park Road aligns close to the highway. The inlet placement was designed in accordance with guidance in the WSDOT HM. Details can be found on the drainage plan and profile sheets, and calculations are provided in Appendix C.

For the Sag inlet, locate on the NB off ramp, calculations show that the flanking inlets are not necessary. However, the flanking inlets were still included in the design because there is not a safe overflow outlet for at the sag on the backside of the curb. There is a grade break between the higher off ramp and Paradise Park Rd, and potential for erosion existing down the roadway embankment.



LEGEND

EXISTING WSDOT RIGHT OF WAY
NEW WSDOT RIGHT OF WAY
DITCH
STORM DRAIN SYSTEM
AREA BOUNDARY

SCALE IN FEET
0 50 100
1 FOOT

I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 5-1A
CONVEYANCE SYSTEM

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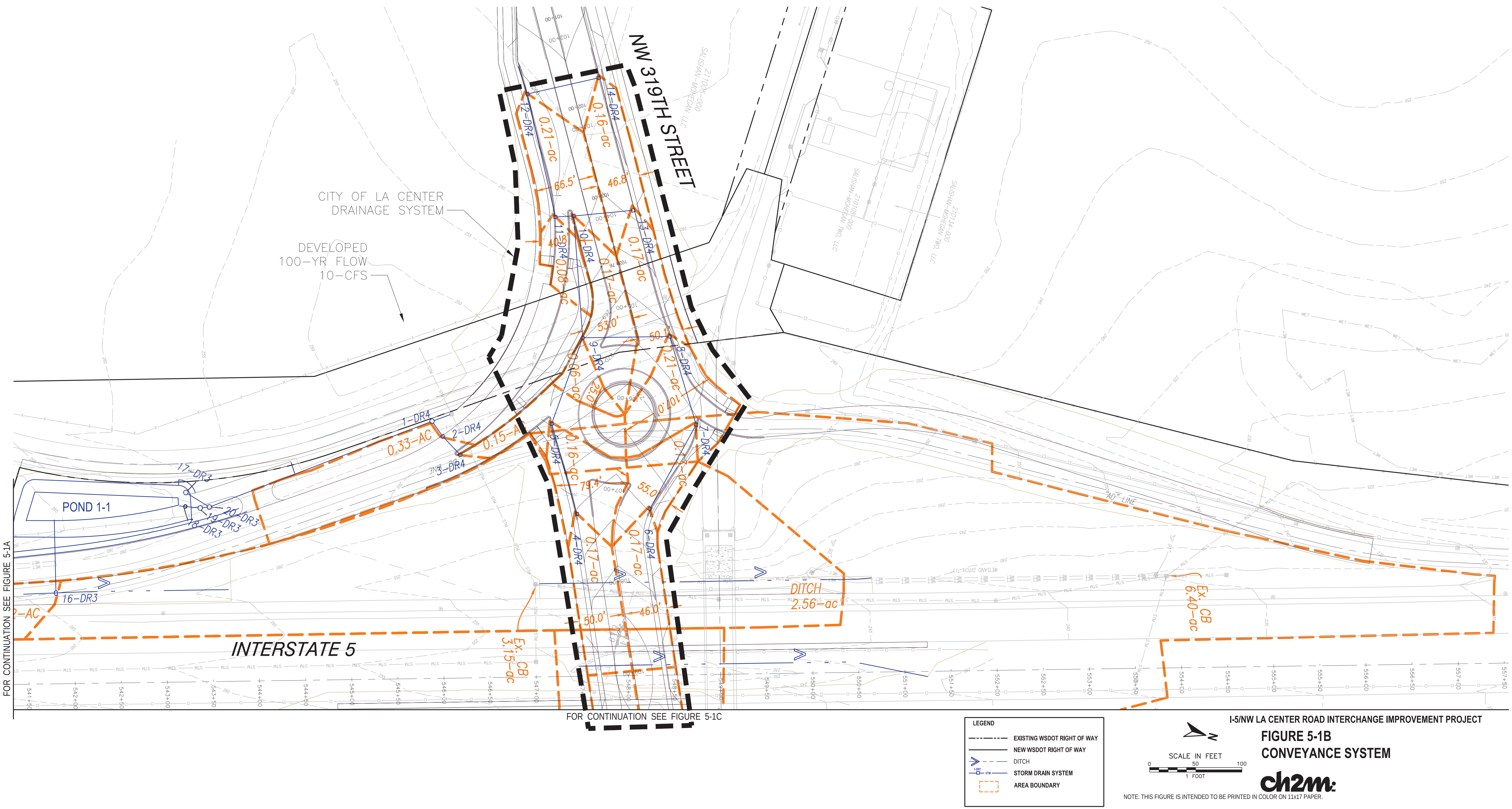
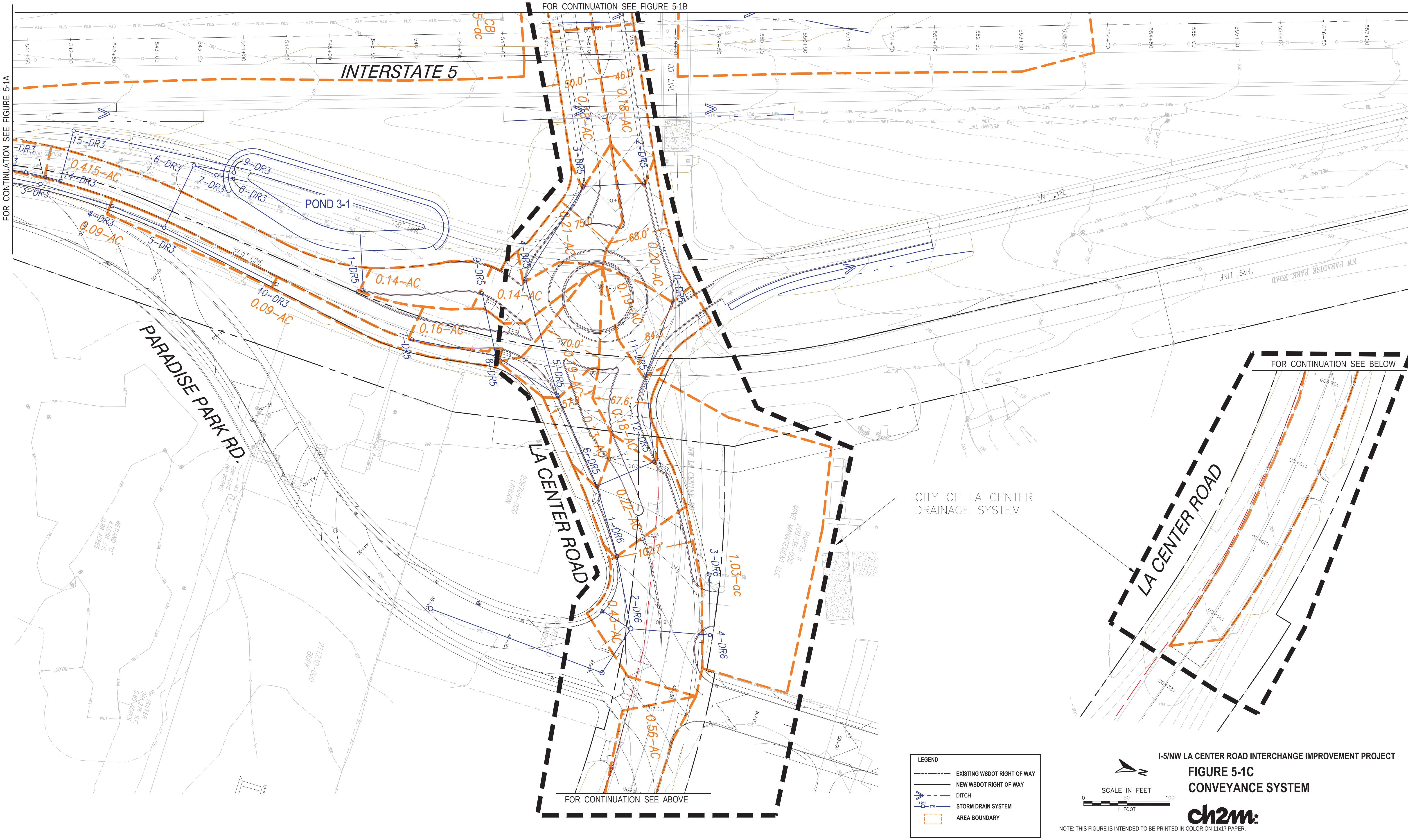


I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 5-1B
CONVEYANCE SYSTEM



I-5/NW LA CENTER ROAD INTERCHANGE IMPROVEMENT PROJECT

FIGURE 5-1C
CONVEYANCE SYSTEM

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5.5 Traffic Analysis Data (Design Year ADT)

Table 5-2 shows the existing and anticipated average daily traffic (ADT) volumes and peak hour (pm) volumes for the ramp improvements for 2017 and 2037, respectively. Using the design years 2017 and 2037, the roadway improvements were designed to accommodate these traffic flows in construction as well as in the completed design.

TABLE 5-2
Average Daily and Peak Hour Traffic Volumes

	Traffic Volume			
	Average Daily Traffic		PM Peak Hour	
Design Year	2017	2037	2017	2037
SB Off-ramp	1,703	4,968	208	552
SB On-ramp	4,768	10,944	364	1,216
NB On-ramp	1,881	5,292	133	558
NB Off-ramp	4,983	15,426	579	1,714

Section 6 Permits and Associated Reports

6.1 Environmental Issues, Fish and Other Endangered Habitat

The information in the following section can be located in the Biological Assessment for the NW La Center Road/Interstate 5 Interchange Improvements (BergerABAM 2015). This report discusses in depth the potential effects of the proposed project on the following species. The effect determinations are provisional and will be further analyzed in accordance with WSDOT Stormwater Impact Assessment guidelines for biological assessment preparation.

Information from the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Washington State Department of Fish and Wildlife indicates that the proposed projects "may affect, but is not likely to adversely affect" the following threatened or endangered species: Lower Columbia River (LCR) Evolutionarily Significant Unit (ESU) Chinook salmon, Columbia River (CR) ESU chum salmon, LCR ESU coho salmon, LCR Distinct Population Segment (DPS) steelhead, CR DPS bull trout, Southern DPS of Pacific eulachon, and all designated critical habitat. The proposed projects will have "no effect" on Streaked Horned Lark, Yellow-Billed Cuckoo, Water Howellia, and Columbian White-tailed Deer. The proposed projects "will not adversely affect" essential fish habitat for Pacific salmon and for groundfish.

6.2 Permits/Approvals

The following permit and approvals are expected:

- Construction Stormwater General Permit (CSWGP)
- NEPA & SEPA Approval
- ESA Consultation
- Section 404 and 401 Clean Water Act authorizations
- Local critical area ordinance permits

6.3 Easements

No easements are anticipated to be required by local jurisdictions or resource agencies to complete the WSDOT portion of the interchange improvements project.

6.4 Additional Reports or Studies

No additional reports or studies are anticipated for this project, with exception of completion of the Geotechnical Data Reports for the project.

Section 7 Inspection and Maintenance Summary

7.1 Media Filter Drain

Media filter drains are relatively low maintenance BMPs. General Maintenance requirements are as follows:

- Ensure sediment accumulation over grassy areas does not exceed 2 inches and that flow can pass evenly through a level strip. Remove any thrash or debris in the filter.
- Mow grass and control nuisance vegetation so that flow is not impeded; grass height should not exceed 10 inches.
- Level and clean the gravel flow spreader to ensure stormwater runoff flows are spread evenly over the entire filter strip width.
- Repair any eroded or scoured areas by channelization or high flows

7.2 Detention Pond

General Maintenance requirements are as follows:

- To facilitate mowing, ensure side slopes for earthen/grass embankments do not exceed 3H:1V. If side slopes are greater than 3H:1V, consult with local area maintenance personnel to ensure tall grass does not restrict site access or pose other issues.
- Remove sediment store in the bottom of the pond, once sediment marker measures sediment deposition of 6 inches or more.
- Repair any eroded or scoured areas by channelization or high flows.
- Inspect pond berm for any rilling or seepage.
- Ensure orifice, riser and birdage are clear and free of debris. Remove any thrash or debris.
- Ensure outlet pipes are free flowing and not plugged.

7.3 Conveyance System

For maintenance of conveyance system see WSDOT's Maintenance Manual.

Section 8 References

Analytical Environmental Services (AES). 2007a. Biological Assessment Cowlitz Indian Tribe Trust Acquisition and Casino Project.

BergerABAM. 2014. Supplemental Draft Biological Assessment: NW La Center Road/Interstate 5 Interchange Improvements.

Bureau of Indian Affairs (BIA). 2008. Final Environmental Impact Statement: Cowlitz Indian Tribe Trust Acquisition and Casino Project. Available online at http://cowlitzeis.com/documents/final_eis/report.htm/. Accessed 12/22/2014.

U.S. Geological Survey (USGS). 2014. Ridgefield quadrangle, Washington. 1:24,000. 7.5 Minute Series. Ridgefield, WA.

Washington State Department of Transportation (WSDOT). 2014. Highway Runoff Manual. Publication Number M 31-16.04.

Washington State Department of Transportation (WSDOT). 2015. Hydraulic Manual. Publication Number M 23-03.03.

Washington State Department of Transportation (WSDOT). MGS Flood Users Manual.

APPENDIX A
Stormwater Modeling Report

Project Title: La Center I-5 Exit 16
WSDOT Region: Southwest
WIN:
PIN(s):
Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2014
Job Number:

Spreadsheet Version 5.1

Is this project in western Washington? YES

Existing Impervious Surface
Total Project Area (ft^2): 639,000

New Impervious Surface
Total Project Area (ft^2): 164,000

Version 1: LaCenter Overpass plus WSDOT new impervious

Conversion of Native Vegetation to Lawn or Landscaped
Total Project Area (ft^2): 0

Conversion of Native Vegetation to Pasture
Total Project Area (ft^2): 0

Replaced Impervious Surface
Total Project Area (ft^2): 236,000

Land Disturbing Activity
Total Project Area (ft^2): 1,719,000

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? NO

Description	Project Area	Threshold Area Triggers	HRM Figure 3-1 Step #	Decision Response	HRM Minimum Requirements
New and replace impervious surfaces added to Project	400,000	≥ 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	1,719,000	≥ 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	164,000	≥ 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	26%	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
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	7	Wetland Protection
3	Source Control of Pollutants	8	Incorporating Watershed-Based/Basin
4	Maintaining the Natural Drainage	9	Operations and Maintenance
5	Runoff Treatment (quality)		

Project Title:	La Center I-5 Exit 16
WSDOT Region:	Southwest
WIN:	
PIN(s):	
Design Manual Used:	Highway Runoff Manual
Manual Publication Year:	2014
Job Number:	

Spreadsheet Version 5.1

Is this project in western Washington? YES

Existing Impervious Surface	
Total Project Area (ft^2)	639,000

New Impervious Surface	
Total Project Area (ft^2)	88,000

Version 2: WSDOT new impervious only

Conversion of Native Vegetation to Lawn or Landscaped	
Total Project Area (ft^2)	0

Conversion of Native Vegetation to Pasture	
Total Project Area (ft^2)	0

Replaced Impervious Surface	
Total Project Area (ft^2)	215,000

Land Disturbing Activity	
Total Project Area (ft^2)	1,719,000

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? NO

Description	Project Area	Threshold Area Triggers	HRM Figure 3-1 Step #	Decision Response	HRM Minimum Requirements
New and replace impervious surfaces added to Project	303,000	≥ 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	1,719,000	≥ 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	88,000	≥ 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
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	7	Wetland Protection
3	Source Control of Pollutants	8	Incorporating Watershed-Based/Basin
4	Maintaining the Natural Drainage	9	Operations and Maintenance
5	Runoff Treatment (quality)		

Project Title: La Center I-5 Exit 16
WSDOT Region: Southwest
WIN:
PIN(s):
Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2014
Job Number:

Is this project in western Washington? YES

Existing PGIS

Total Project Area (ft^2)	639,000

New PGIS

Total Project Area (ft^2)	88,000

Conversion of Native Vegetation to PGPS

Total Project Area (ft^2)	0

Replaced PGIS

Total Project Area (ft^2)	215,000

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	88,000	≥ 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	14%	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
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	7	Wetland Protection
3	Source Control of Pollutants	8	Incorporating Watershed-Based /Basin
4	Maintaining the Natural Drainage	9	Operations and Maintenance
5	Runoff Treatment (quality)		

Project Title: **La Center I-5 Exit 16**
WSDOT Region: Southwest
WIN:
PIN(s):
Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2014
Job Number:

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? NO
Is this project in western Washington? YES
Does the project have retrofit requirements for discharges to Puget Sound? NO

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)	Enhanced RT or Basic RT? (Enhanced/Basic)	Oil Control (Yes/No)	Phosphorus Control? (Yes/No)	Comments
1	Northern Project Area	29,000	43,000	0	29,000	0	YES	NO	29,000	0	15,001	NO	Enhanced RT			RT=Runoff Treatment
2	NB off Ramp - Project Area (WSDOT ROW Only)	4,000	7,000	0	4,000	0	NO	NO	0	0	4,983	NO	N/A			
3	Southern Project Area	55,000	165,000	0	55,000	0	YES	NO	55,000	0	15,001	NO	Enhanced RT			
	Area Totals for Project	**88,000**	**215,000**	**0**	**88,000**	**0**			**84,000**	**0**						

Project Title: La Center I-5 Exit 16
WSDOT Region: Southwest
WIN:
PIN(s):
Design Manual Used: Highway Runoff Manual
Manual Publication Year: 2014
Job Number:

Refer to HRM Figure 3-3 Step 8

Are the replaced Impervious surfaces applicable to the project per HRM Figure 3-2 Step 5? NO
Are there any existing flow control stormwater BMPs within the project limits? **NO**

Is this project in western Washington? YES

Does the project have retrofit requirements for discharges to Puget Sound? NO

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 0.1 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 0.1 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
1	Northern Project Area	29,000	0	29,000	43,000	0	29,000	0	YES	YES	NO	YES	29,000	0	0.7acres
2	NB off Ramp - Project Area (WSDOT ROW Only)	4,000	0	4,000	7,000	0	4,000	0	NO	NO	NO	NO	0	0	
3	Southern Project Area	55,000	0	55,000	165,000	0	55,000	0	YES	YES	NO	YES	55,000	0	1.5acres
	Area Totals for Project	**88,000**	**0**	**88,000**	**215,000**	**0**	**88,000**	**0**					**84,000**	**0**	

**** Input zero into this column if the reverted impervious surface does not meet the reversion requirements per HRM 4-3.5.1.**

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

TDA 1

MGSFlood Inputs Worksheet

MGSFlood Input Sheet for TDA **TDA 1**
Project: LaCenter, i5, Exit 16
Description: Northern Project Area

Version 5.0
Designed By: D. Alves
Checked By:

What kind of flow control facility is this? | Detention Pond

What type of flow control modeling scenario does this follow? | Equivalent Area + Point of Compliance

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

Are there any partial reversion or full reversion areas in the TDA? | Yes Partial Reversion

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

Step 1

Existing	Ac.	Postdeveloped	Ac.
Forest	0.00	Forest	0.000
Pasture	0.00	Pasture	0.000
Grass	14.99	Grass	14.330
Sat. Soils	0.00	Sat. Soils	0.000
Impervious	7.51	Impervious	8.170
	22.50		22.50

The Existing condition refers to the existing land cover observed prior to the start of the project.
Sat. Soil = Saturated Soils

Land Cover Conversions and Mitigated Areas for Flow Control

Step 2

		Brief Description of Land Cover Conversion
0.900 Acres	Forest to Impervious	New PGIS
0.200 Acres	Forest to Impervious	Pond area

1.10 Acres

Step 3 — **Mitigated (difference)**

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	1.100	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	1.100
	1.100	=	1.100

Step 4 — **Non-Mitigated (unchanged area)**

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.000	Forest	0.000
Pasture	0.000	Pasture	0.000
Grass	14.330	Grass	14.330
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	7.070	Impervious	7.070
	21.400	=	21.400

Step 5 — **Area Physically Transported to Detention Facility**

Postdeveloped	Ac.
Forest	
Pasture	
Grass	0.770
Sat. Soils	
Impervious	1.100

Step 6

Bypass Area Ac.		**Flow-Through Area** Ac.	
		0.770	Grass Flow-through Area

Step 7 - Step 9 — **Modeled (Input for MGSFlood)**

Predeveloped	Ac.	Flow-Through	Ac.	Postdeveloped	Ac.	Bypass	Ac.	Flow-Through	Ac.
Forest	**1.100**	Forest		Forest	**0.000**	Forest		Forest	
Pasture	**0.000**	Pasture		Pasture	**0.000**	Pasture		Pasture	
Grass	**0.000**	Grass	**0.770**	Grass	**0.000**	Grass		Grass	**0.770**
Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	
Impervious	**0.000**	Impervious		Impervious	**1.100**	Impervious		Impervious	
	1.100	+	0.770	=	1.100			+	0.770

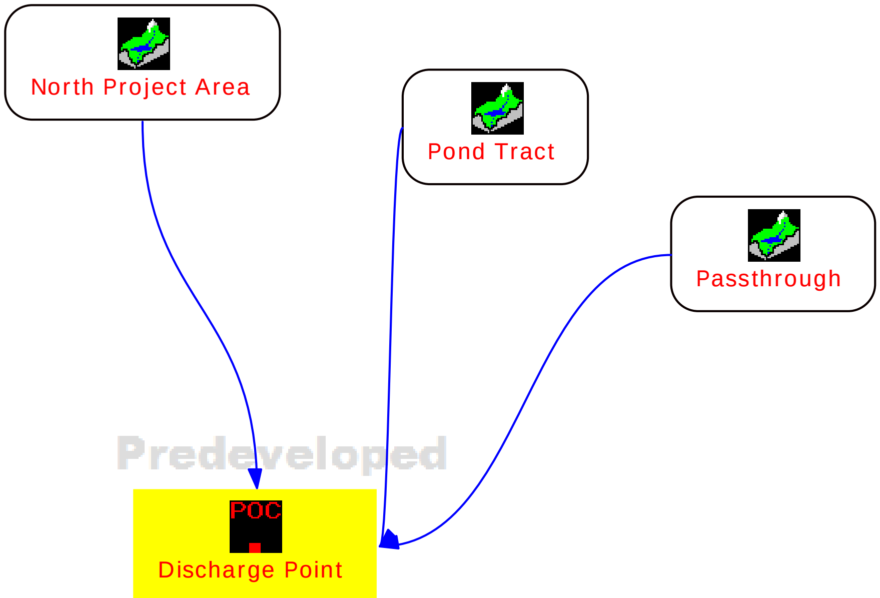
Was the pond footprint represented in the above MGSFlood inputs? | YES

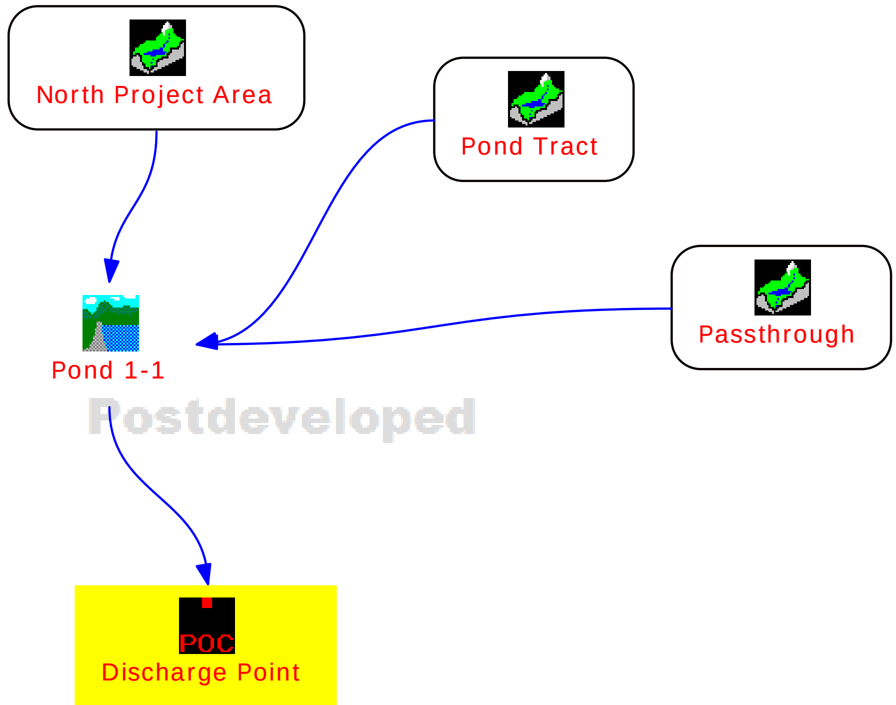
Choose N/A --->

50% Rule Check

100year undetained flow rate (cfs) from area receiving flow control = 0.97
100year undetained flow rate (cfs) from flow through area = 0.46

The flow through area meets the 50% rule.


North Project Area
Pond Tract
Passthrough
Predeveloped
POC
Discharge Point



North Project Area
Pond Tract
Passthrough
Pond 1-1
Postdeveloped
POC
Discharge Point

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 12/02/2015 5:44 PM
Report Generation Date: 12/21/2015 11:29 AM

Input File Name:	TDA1-pond_1-1.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 1
Comments:	Flow Control.

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	1.870	1.870
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.870	1.870

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

---------- Subbasin : North Project Area ----------

	-------Area(Acres) --------
Till Forest	0.900
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total 0.900

---------- Subbasin : Pond Tract ----------

	-------Area(Acres) --------
Till Forest	0.200
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total 0.200

---------- Subbasin : Passthrough ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.770
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total 0.770

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

Number of Subbasins: 3

---------- Subbasin : North Project Area ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious	0.900

Subbasin Total	0.900

---------- Subbasin : Pond Tract ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.200

Subbasin Total	0.200

---------- Subbasin : Passthrough ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.770
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	0.770

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

--
Link Name: Pond 1-1
Link Type: Structure
Downstream Link Name: Discharge Point

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
256.00	0.
257.00	5002.
258.00	17158.
259.00	25057.
260.00	34503.

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

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 15.00
Common Length (ft) : 0.000
Riser Crest Elevation : 258.50 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 256.00
Diameter (in) : 1.30
Orientation : Horizontal
Elbow : Yes

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

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

*********** Subbasin: North Project Area *************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.889E-02

5-Year	4.384E-02
10-Year	5.985E-02
25-Year	8.259E-02
50-Year	0.114
100-Year	0.146
200-Year	0.176

************ Subbasin: Pond Tract ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	6.420E-03
5-Year	9.741E-03
10-Year	1.330E-02
25-Year	1.835E-02
50-Year	2.528E-02
100-Year	3.240E-02
200-Year	3.907E-02

************ Subbasin: Passthrough ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	8.903E-02
5-Year	0.166
10-Year	0.237
25-Year	0.303
50-Year	0.384
100-Year	0.457
200-Year	0.476

********** Link: Discharge Point ********** Link Inflow Frequency Stats

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.115
5-Year	0.213
10-Year	0.283
25-Year	0.405
50-Year	0.469
100-Year	0.579
200-Year	0.686

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

Number of Subbasins: 3
Number of Links: 2

*********** Subbasin: North Project Area ***********

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

(0.457/0.967)x100
=47%

Tr (yrs)	Flood Peak (cfs)
2-Year	0.371
5-Year	0.491
10-Year	0.562
25-Year	0.709
50-Year	0.793
100-Year	0.967
200-Year	1.066

*********** Subbasin: Pond Tract ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	8.240E-02
5-Year	0.109
10-Year	0.125
25-Year	0.158
50-Year	0.176
100-Year	0.215
200-Year	0.237

*********** Subbasin: Passthrough ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	8.903E-02
5-Year	0.166
10-Year	0.237
25-Year	0.303
50-Year	0.384
100-Year	0.457
200-Year	0.476

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.123E-02

5-Year	5.694E-02
10-Year	6.175E-02
25-Year	7.694E-02
50-Year	0.254
100-Year	0.352
200-Year	0.410

********** Link: Pond 1-1 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.568
5-Year	0.725
10-Year	0.893
25-Year	1.110
50-Year	1.386
100-Year	1.488
200-Year	1.578

********** Link: Pond 1-1 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.123E-02
5-Year	5.694E-02
10-Year	6.175E-02
25-Year	7.694E-02
50-Year	0.254
100-Year	0.352
200-Year	0.410

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

Tr (yrs)	WSEL Peak (ft)
1.05-Year	256.943
1.11-Year	257.048
1.25-Year	257.150
2.00-Year	257.430
3.33-Year	257.560
5-Year	257.768
10-Year	258.070
25-Year	258.488
50-Year	258.558

100-Year 258.577

*************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: North Project Area	141.401
Subbasin: Pond Tract	31.422
Subbasin: Passthrough	78.168
Link: Discharge Point	0.000
Total:	250.991

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: North Project Area	0.000
Subbasin: Pond Tract	0.000
Subbasin: Passthrough	78.168
Link: Discharge Point	0.000
Link: Pond 1-1	0.000
Total:	78.168

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 2.074 ac-ft/year, Post Developed: 0.646 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 311.44
Inflow Volume Including PPT-Evap (ac-ft): 311.44
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): 311.44
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 2

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 644.11
Inflow Volume Including PPT-Evap (ac-ft): 644.11
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): 644.11
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: Pond 1-1 **********

Basic Wet Pond Volume (91% Exceedance): 6927. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 10391. cu-ft

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 644.12
Inflow Volume Including PPT-Evap (ac-ft): 644.12
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): 644.11
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	0.115	2-Year	5.123E-02
5-Year	0.213	5-Year	5.694E-02
10-Year	0.283	10-Year	6.175E-02
25-Year	0.405	25-Year	7.694E-02
50-Year	0.469	50-Year	0.254
100-Year	0.579	100-Year	0.352
200-Year	0.686	200-Year	0.410

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

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

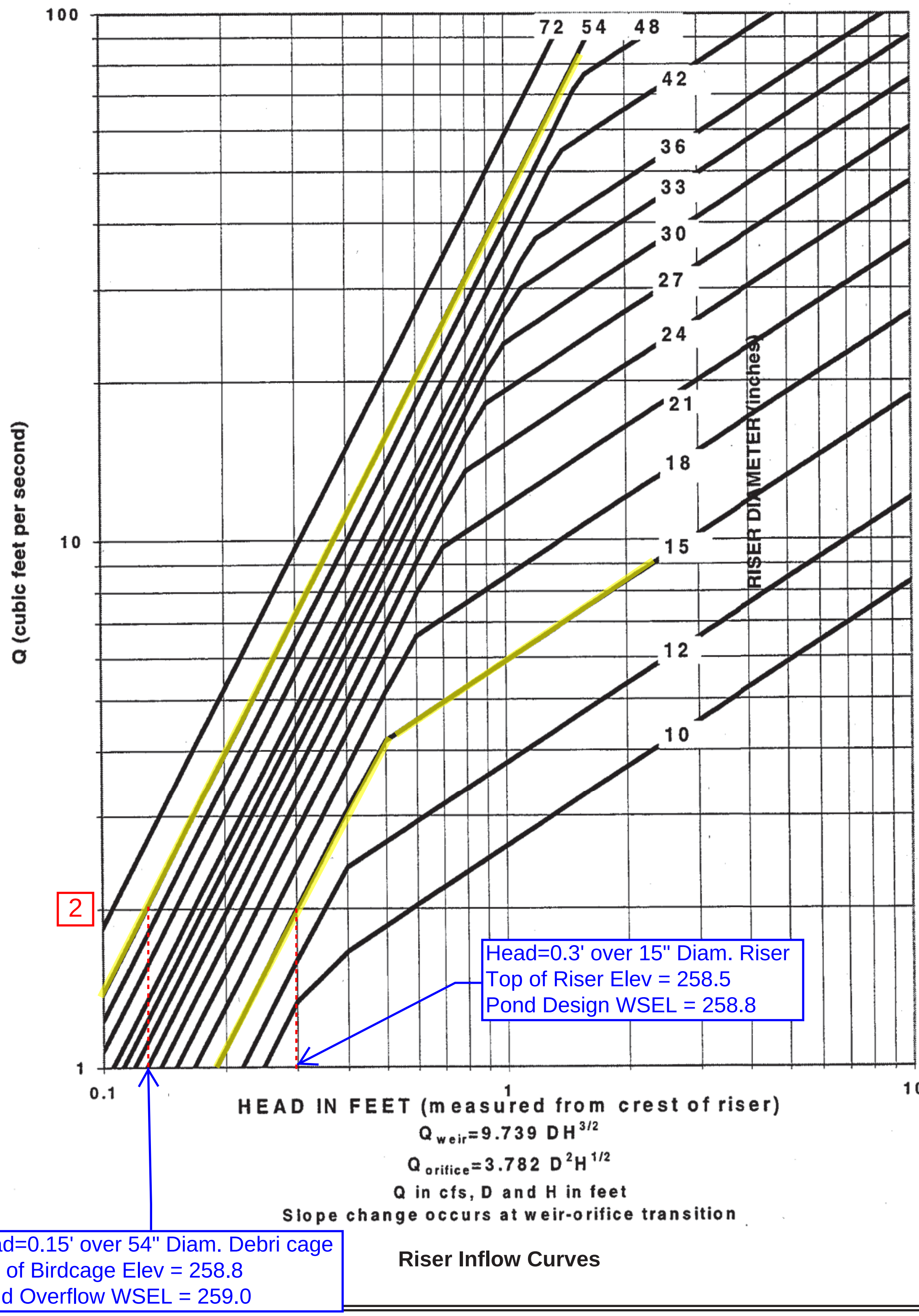
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-47.8%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-47.8%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-6.2%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	127.7%	FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	280.8%	FAIL

LID DURATION DESIGN CRITERIA: FAIL



$Q_{weir} = 9.739\ DH^{3/2}$

$Q_{orifice} = 3.782\ D^2H^{1/2}$

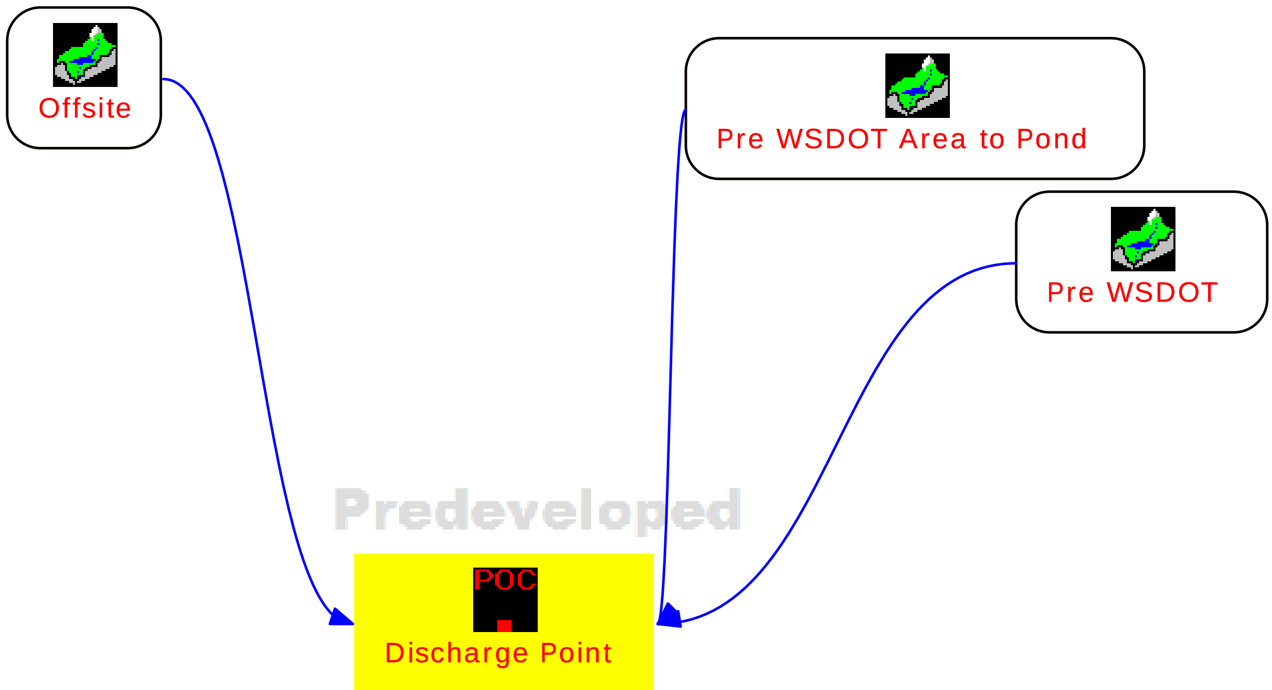
Q in cfs, D and H in feet

Slope change occurs at weir-orifice transition

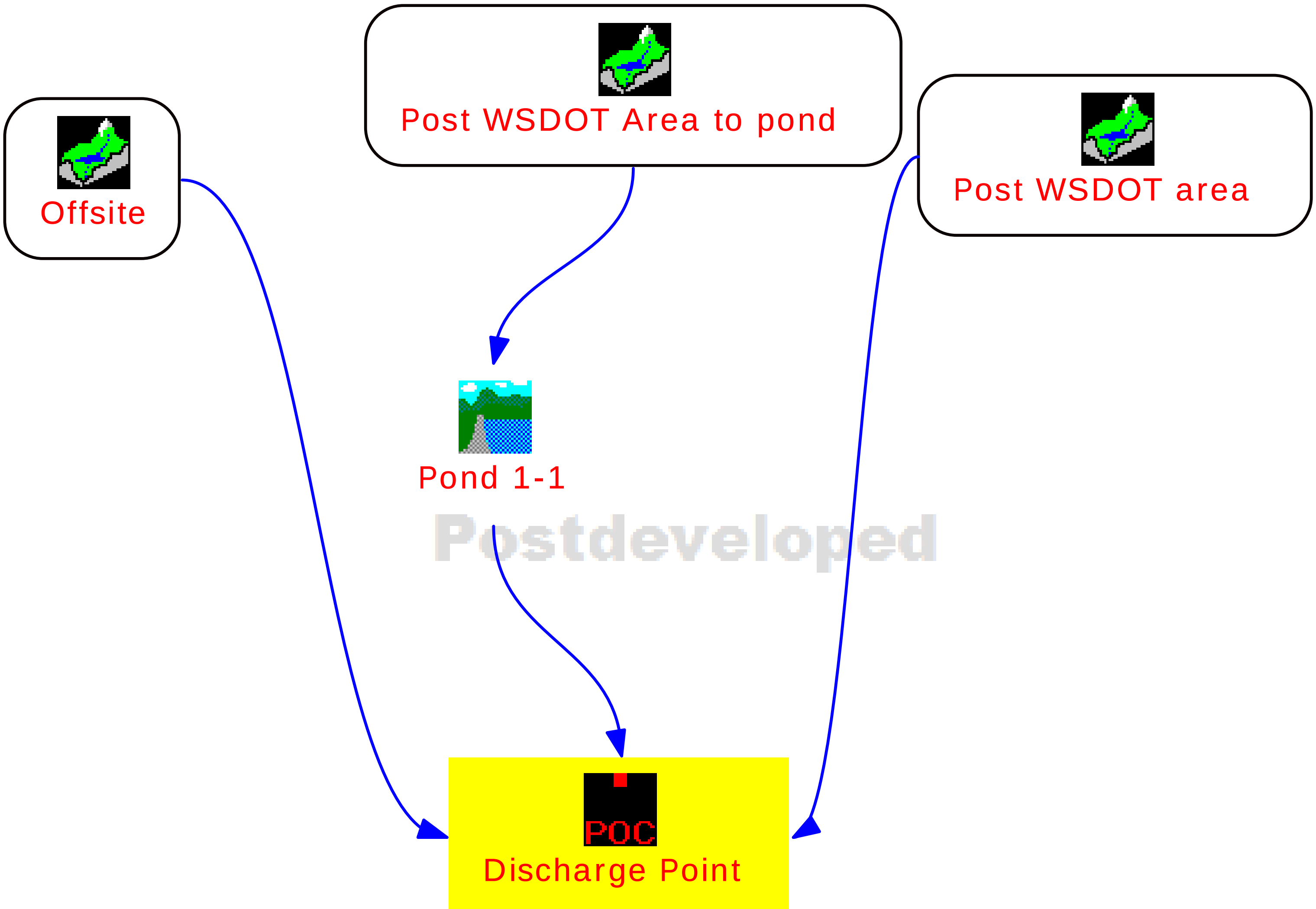
Riser Inflow Curves

Figure 5-56 Overflow structure sizing.

Pond 1-1 Post Developed
100-yr Undetained flow = 1.639cfs



TDA1-Outfall1-1_100flowIncrease



TDA1-Outfall1-1_100flowIncrease

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 12/21/2015 11:48 AM
Report Generation Date: 12/21/2015 11:48 AM

Input File Name:	TDA1-Outfall1-1_100flowIncrease.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 1
Comments:	POC 100-yr flow

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	272.020	272.020
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	272.020	272.020

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

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	257.950
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total 257.950

---------- Subbasin : Pre WSDOT Area to Pond ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	1.610
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.240

Subbasin Total 1.850

---------- Subbasin : Pre WSDOT ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	8.300
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	3.920

Subbasin Total 12.220

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

---------- Subbasin : Post WSDOT Area to pond ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.760
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious	1.100
--	
Subbasin Total	1.860

---------- Subbasin : Post WSDOT area ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	8.510
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	3.700
--	
Subbasin Total	12.210

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	257.950
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
--	
Subbasin Total	257.950

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

Link Name: Pond 1-1
Link Type: Structure
Downstream Link Name: Discharge Point

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
256.00	0.
257.00	5002.
258.00	17161.
259.00	25062.
260.00	34491.

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

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 15.00
Common Length (ft) : 0.000
Riser Crest Elevation : 258.80 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 256.00
Diameter (in) : 1.25
Orientation : Horizontal
Elbow : Yes

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

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

---------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 2

**************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: Offsite	26186.240
Subbasin: Pre WSDOT Area to Po	163.442
Subbasin: Pre WSDOT	842.589
Link: Discharge Point	0.000
Total:	27192.270

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Post WSDOT Area to p	77.153
Subbasin: Post WSDOT area	863.907
Subbasin: Offsite	26186.240
Link: Discharge Point	0.000
Link: Pond 1-1	0.000
Total:	27127.300

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 224.730 ac-ft/year, Post Developed: 224.193 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 62642.96
Inflow Volume Including PPT-Evap (ac-ft): 62642.96
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): 62642.96
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 2

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 62770.47
Inflow Volume Including PPT-Evap (ac-ft): 62770.47
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): 62770.47
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: Pond 1-1 **********

Basic Wet Pond Volume (91% Exceedance): 6906. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 10359. cu-ft

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 641.85
Inflow Volume Including PPT-Evap (ac-ft): 641.85
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): 641.83
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	32.414	2-Year	32.113
5-Year	59.542	5-Year	59.065
10-Year	85.103	10-Year	84.418
25-Year	107.985	25-Year	107.193
50-Year	136.670	50-Year	135.644
100-Year	163.062	100-Year	161.809
200-Year	169.219	200-Year	168.017

=(161.81/163.06x100= -0.77%

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

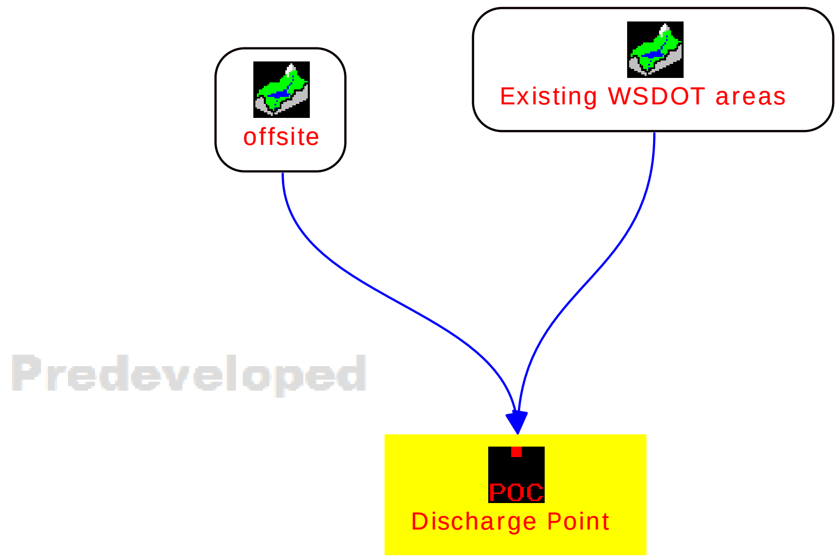
****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): -2.0% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 0.0% PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 0.1% PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%): 0.8% PASS

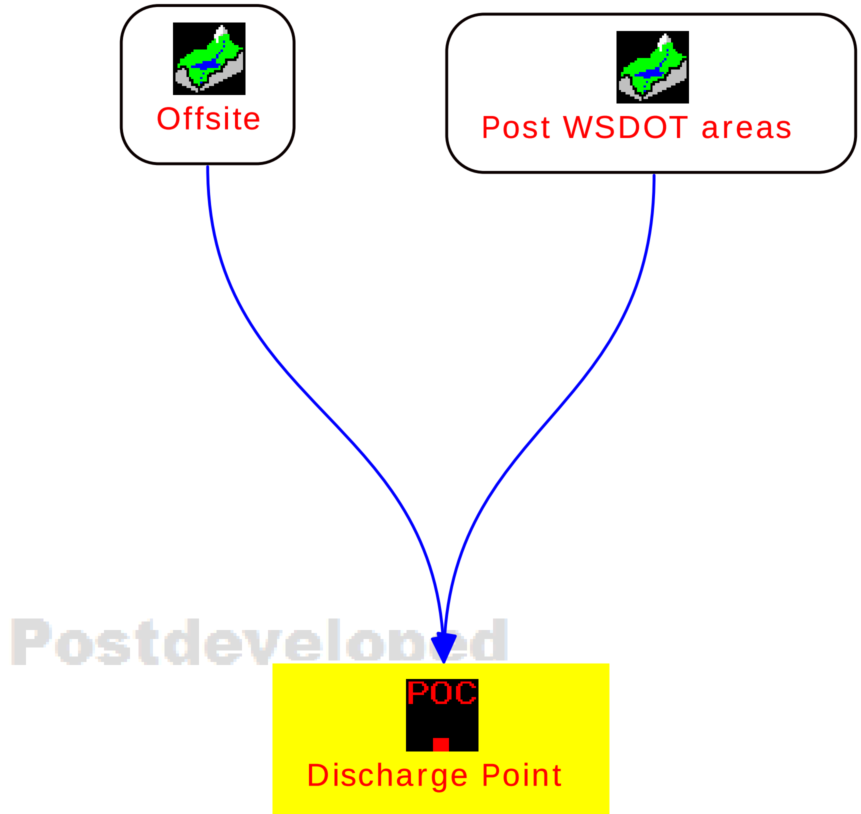
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 0.4% FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 0.2% FAIL



TDA1-Outfall1-2_100flowIncrease



TDA1-Outfall1-2_100flowIncrease

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 12/21/2015 11:42 AM
Report Generation Date: 12/21/2015 11:42 AM

Input File Name:	TDA1-Outfall1-2_100flowIncrease.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 1
Comments:	Flow Control.

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	79.460	79.460
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	79.460	79.460

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

---------- Subbasin : Existing WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	5.100
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	3.350
Subbasin Total	8.450

---------- Subbasin : offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	71.010
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
Subbasin Total	71.010

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

Number of Subbasins: 2

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	71.010
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
Subbasin Total	71.010

---------- Subbasin : Post WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	5.050
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious 3.400

Subbasin Total 8.450

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

*********** Subbasin: Existing WSDOT areas **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.038
5-Year	2.742
10-Year	3.710
25-Year	4.284
50-Year	5.039
100-Year	6.041
200-Year	6.404

********** Subbasin: offsite **********

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

2-Year	8.210
5-Year	15.271
10-Year	21.851
25-Year	27.966
50-Year	35.398
100-Year	42.146
200-Year	43.941

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	9.963
5-Year	17.906
10-Year	25.576
25-Year	31.983
50-Year	40.471
100-Year	48.459
200-Year	49.890

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

*********** Subbasin: Offsite *************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	8.210
5-Year	15.271
10-Year	21.851
25-Year	27.966
50-Year	35.398
100-Year	42.146
200-Year	43.941

*********** Subbasin: Post WSDOT areas *************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.050
5-Year	2.753
10-Year	3.718
25-Year	4.297

50-Year	5.085
100-Year	6.054
200-Year	6.425

********** Link: Discharge Point ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	9.974
5-Year	17.917
10-Year	25.593
25-Year	31.993
50-Year	40.484
100-Year	48.478
200-Year	49.900

*************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: Existing WSDOT areas	517.735
Subbasin: offsite	7208.702
Link: Discharge Point	0.000
Total:	7726.438

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Offsite	7208.702
Subbasin: Post WSDOT areas	512.659
Link: Discharge Point	0.000
Total:	7721.361

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 63.855 ac-ft/year, Post Developed: 63.813 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 18724.07
Inflow Volume Including PPT-Evap (ac-ft): 18724.07
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): 18724.07
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 18734.03
Inflow Volume Including PPT-Evap (ac-ft): 18734.03
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): 18734.03
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	9.963	2-Year	9.974
5-Year	17.906	5-Year	17.917
10-Year	25.576	10-Year	25.593
25-Year	31.983	25-Year	31.993
50-Year	40.471	50-Year	40.484
100-Year	48.459	100-Year	48.478
200-Year	49.890	200-Year	49.900

=(48.48/48.46)x100= 0.04%

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

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

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	0.3%	FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	0.8%	FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	11.4%	PASS

FLOW DURATION DESIGN CRITERIA: FAIL

TDA 2

MGSFlood Inputs Worksheet

MGSFlood Input Sheet for TDA **TDA 2**
Project: LaCenter, i5, Exit 16
Description: East Project Area

Version 5.0
Designed By: D. Alves
Checked By:

What kind of flow control facility is this? | Detention Pond

What type of flow control modeling scenario does this follow? | Equivalent Area + Point of Compliance

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

Are there any partial reversion or full reversion areas in the TDA? | Yes Partial Reversion

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

Step 1

Existing	Ac.	Postdeveloped	Ac.
Forest	0.00	Forest	0.000
Pasture	0.00	Pasture	0.000
Grass	0.76	Grass	0.660
Sat. Soils	0.00	Sat. Soils	0.000
Impervious	0.11	Impervious	0.210
	0.87		0.87

The Existing condition refers to the existing land cover observed prior to the start of the project.
Sat. Soil = Saturated Soils

Land Cover Conversions and Mitigated Areas for Flow Control

Step 2

		Brief Description of Land Cover Conversion
0.090 Acres	Forest to Impervious	New Impervious within WSDOT ROW

0.09 Acres

Mitigated (difference)

Step 3

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.090	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	0.090
	0.090	=	0.090

Non-Mitigated (unchanged area)

Step 4

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.000	Forest	0.000
Pasture	0.000	Pasture	0.000
Grass	0.660	Grass	0.660
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	0.120	Impervious	0.120
	0.780	=	0.780

Step 5

Area Physically Transported to Detention Facility

Postdeveloped	Ac.
Forest	
Pasture	
Grass	0.000
Sat. Soils	
Impervious	0.090

Step 6

Bypass Area		**Flow-Through Area**	
Ac.		Ac.	

Modeled (Input for MGSFlood)

Step 7 -
Step 9

Predeveloped	Ac.	Flow-Through	Ac.	Postdeveloped	Ac.	Bypass	Ac.	Flow-Through	Ac.
Forest	**0.090**	Forest		Forest	**0.000**	Forest		Forest	
Pasture	**0.000**	Pasture		Pasture	**0.000**	Pasture		Pasture	
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		Impervious	**0.090**	Impervious		Impervious	
	0.090		=		0.090				

Was the pond footprint represented in the above MGSFlood inputs? | YES

Choo ------------------------------------->

NOTE: Flow Control not re qured. This sheet was used to show MGSFlood Input to check the 100-yr increase does not exceed 0.1cfs. See calc MSGFlood output file for flows.

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

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 12/21/2015 12:14 PM
Report Generation Date: 12/21/2015 12:14 PM

Input File Name:	TDA2-100yrIncrease-.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 2
Comments:	100yr Increase from New impervious

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	0.090	0.090
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.090	0.090

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

---------- Subbasin : North Project Area ----------

	-------Area(Acres) --------
Till Forest	0.090
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
--	
Subbasin Total	0.090

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

---------- Subbasin : North Project Area ----------

-------Area(Acres) --------	
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.090
--	
Subbasin Total	0.090

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

************ Subbasin: North Project Area ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.889E-03
5-Year	4.384E-03
10-Year	5.985E-03
25-Year	8.259E-03
50-Year	1.138E-02
100-Year	1.458E-02
200-Year	1.758E-02

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.889E-03
5-Year	4.384E-03
10-Year	5.985E-03
25-Year	8.259E-03
50-Year	1.138E-02
100-Year	1.458E-02
200-Year	1.758E-02

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

************ Subbasin: North Project Area ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.708E-02
5-Year	4.912E-02
10-Year	5.616E-02
25-Year	7.089E-02
50-Year	7.932E-02
100-Year	9.669E-02
200-Year	0.107

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.708E-02
5-Year	4.912E-02
10-Year	5.616E-02
25-Year	7.089E-02
50-Year	7.932E-02
100-Year	9.669E-02
200-Year	0.107

*************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: North Project Area	14.140
Link: Discharge Point	0.000
Total:	14.140

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: North Project Area	0.000
Link: Discharge Point	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 0.117 ac-ft/year, Post Developed: 0.000 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 11.17
Inflow Volume Including PPT-Evap (ac-ft): 11.17
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): 11.17
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 38.38
Inflow Volume Including PPT-Evap (ac-ft): 38.38
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): 38.38
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

0.0097-0.0015=0.0082cfs increase
(1.5/9.7)x100=15% Increase

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	2.889E-03	2-Year	3.708E-02
5-Year	4.384E-03	5-Year	4.912E-02
10-Year	5.985E-03	10-Year	5.616E-02
25-Year	8.259E-03	25-Year	7.089E-02
50-Year	1.138E-02	50-Year	7.932E-02
100-Year	1.458E-02	100-Year	9.669E-02
200-Year	1.758E-02	200-Year	0.107

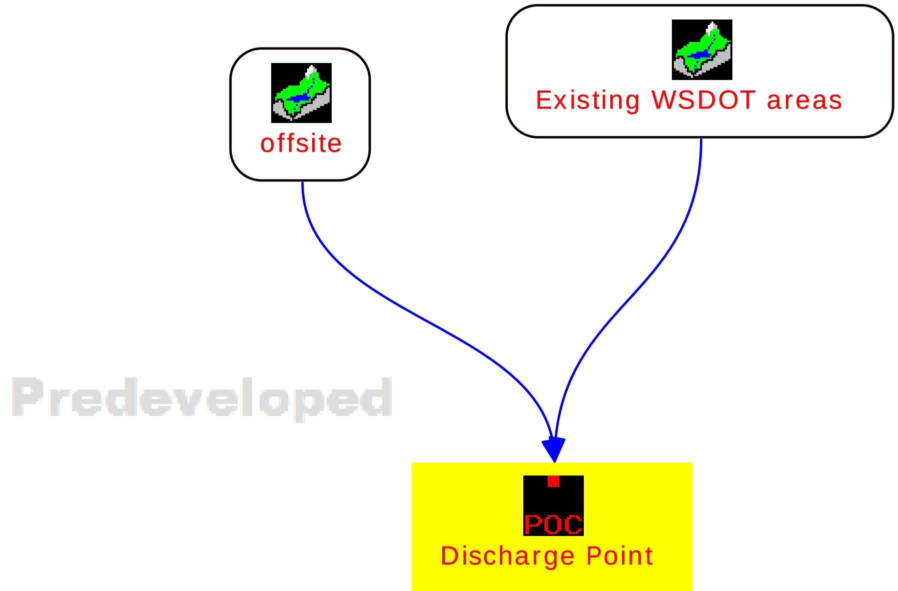
** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 539.5% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 2977.7% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 100.0% FAIL

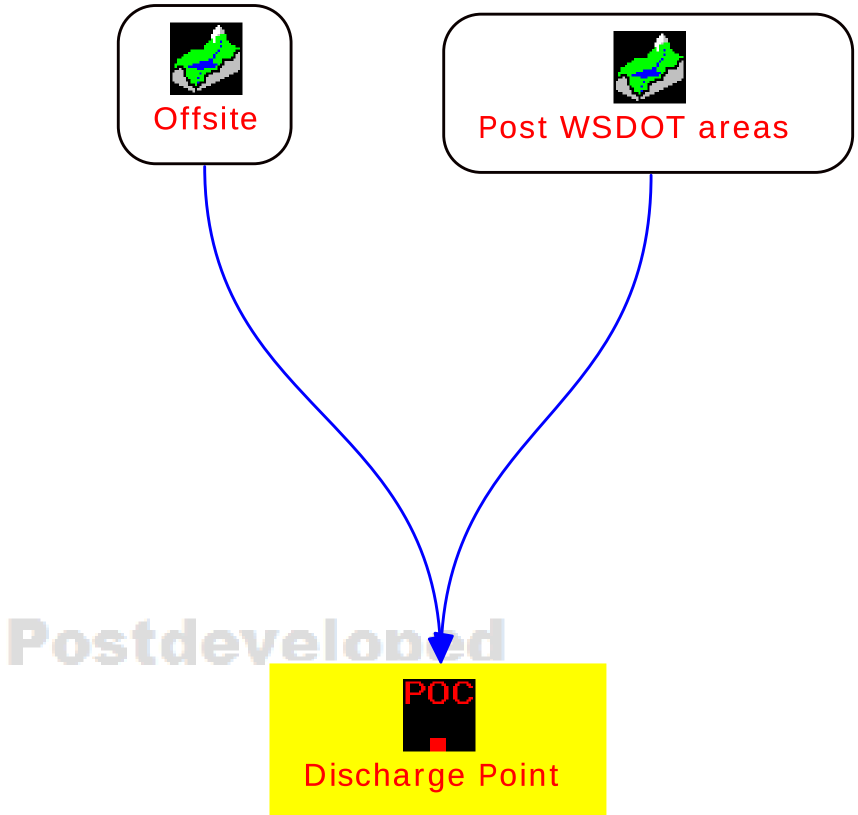
FLOW DURATION DESIGN CRITERIA: FAIL

****** LID Duration Performance ******
Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 12.2% FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 539.5% FAIL

LID DURATION DESIGN CRITERIA: FAIL



TDA2-Outfall2-1_100flowIncrease



TDA2-Outfall2-1_100flowIncrease

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 12/21/2015 12:20 PM
Report Generation Date: 12/21/2015 12:20 PM

Input File Name:	TDA2-Outfall2-1_100flowIncrease.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 2
Comments:	POC 100yr Flow Increase

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	29.130	29.130
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	29.130	29.130

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

---------- Subbasin : Existing WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.760
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.110

Subbasin Total	0.870

---------- Subbasin : offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	28.260
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	28.260

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

Number of Subbasins: 2

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	28.260
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	28.260

---------- Subbasin : Post WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.660
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious 0.210

Subbasin Total 0.870

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

************ Subbasin: Existing WSDOT areas ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.126
5-Year	0.215
10-Year	0.305
25-Year	0.365
50-Year	0.462
100-Year	0.559
200-Year	0.562

************ Subbasin: offsite ************

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

==

2-Year	3.267
5-Year	6.077
10-Year	8.696
25-Year	11.130
50-Year	14.088
100-Year	16.773
200-Year	17.487

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.393
5-Year	6.290
10-Year	9.001
25-Year	11.495
50-Year	14.549
100-Year	17.332
200-Year	18.049

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

*********** Subbasin: Offsite ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.267
5-Year	6.077
10-Year	8.696
25-Year	11.130
50-Year	14.088
100-Year	16.773
200-Year	17.487

*********** Subbasin: Post WSDOT areas ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.161
5-Year	0.246
10-Year	0.349
25-Year	0.393

50-Year	0.485
100-Year	0.587
200-Year	0.601

********** Link: Discharge Point ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.417
5-Year	6.314
10-Year	9.034
25-Year	11.515
50-Year	14.575
100-Year	17.371
200-Year	18.071

*************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: Existing WSDOT areas	77.153
Subbasin: offsite	2868.862
Link: Discharge Point	0.000
Total:	2946.015

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Offsite	2868.862
Subbasin: Post WSDOT areas	67.001
Link: Discharge Point	0.000
Total:	2935.863

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 24.347 ac-ft/year, Post Developed: 24.263 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 6641.44
Inflow Volume Including PPT-Evap (ac-ft): 6641.44
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): 6641.44
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 6661.37
Inflow Volume Including PPT-Evap (ac-ft): 6661.37
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): 6661.37
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	3.393	2-Year	3.417
5-Year	6.290	5-Year	6.314
10-Year	9.001	10-Year	9.034
25-Year	11.495	25-Year	11.515
50-Year	14.549	50-Year	14.575
100-Year	17.332	100-Year	17.371
200-Year	18.049	200-Year	18.071

=(7.65/9.73)x100= -27.19%

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

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 1.3% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 2.5% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 30.4% PASS

FLOW DURATION DESIGN CRITERIA: FAIL

TDA 3

MGSFlood Inputs Worksheet

MGSFlood Input Sheet for TDA **TDA 3**
Project: LaCenter, i5, Exit 16
Description: Southern Project Area

Version 5.0
Designed By: D. Alves
Checked By:

What kind of flow control facility is this? Detention Pond

What type of flow control modeling scenario does this follow? Equivalent Area + Point of Compliance

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

Are there any partial reversion or full reversion areas in the TDA? Yes Partial Reversion

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

Step 1

Existing	Ac.	Postdeveloped	Ac.
Forest	0.00	Forest	0.000
Pasture	0.00	Pasture	0.000
Grass	9.04	Grass	7.780
Sat. Soils	0.00	Sat. Soils	0.000
Impervious	7.05	Impervious	8.310
	16.09		16.09

The Existing condition refers to the existing land cover observed prior to the start of the project.
Sat. Soil = Saturated Soils

Land Cover Conversions and Mitigated Areas for Flow Control

Step 2

		Brief Description of Land Cover Conversion
1.710 Acres	Forest to Impervious	New PGIS
0.320 Acres	Forest to Impervious	Pond Area

2.03 Acres

Mitigated (difference)

Step 3

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	2.030	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	2.030
	2.030	=	2.030

Non-Mitigated (unchanged area)

Step 4

Predeveloped	Ac.	Postdeveloped	Ac.
Forest	0.000	Forest	0.000
Pasture	0.000	Pasture	0.000
Grass	7.780	Grass	7.780
Sat. Soils	0.000	Sat. Soils	0.000
Impervious	6.280	Impervious	6.280
	14.060	=	14.060

Step 5

Area Physically Transported to Detention Facility

Postdeveloped	Ac.
Forest	
Pasture	
Grass	0.810
Sat. Soils	
Impervious	2.030

Step 6

Bypass Area		**Flow-Through Area**	
Ac.		Ac.	
		0.810	Grass Flow-through Area

Step 7 - Step 9

Modeled (Input for MGSFlood)

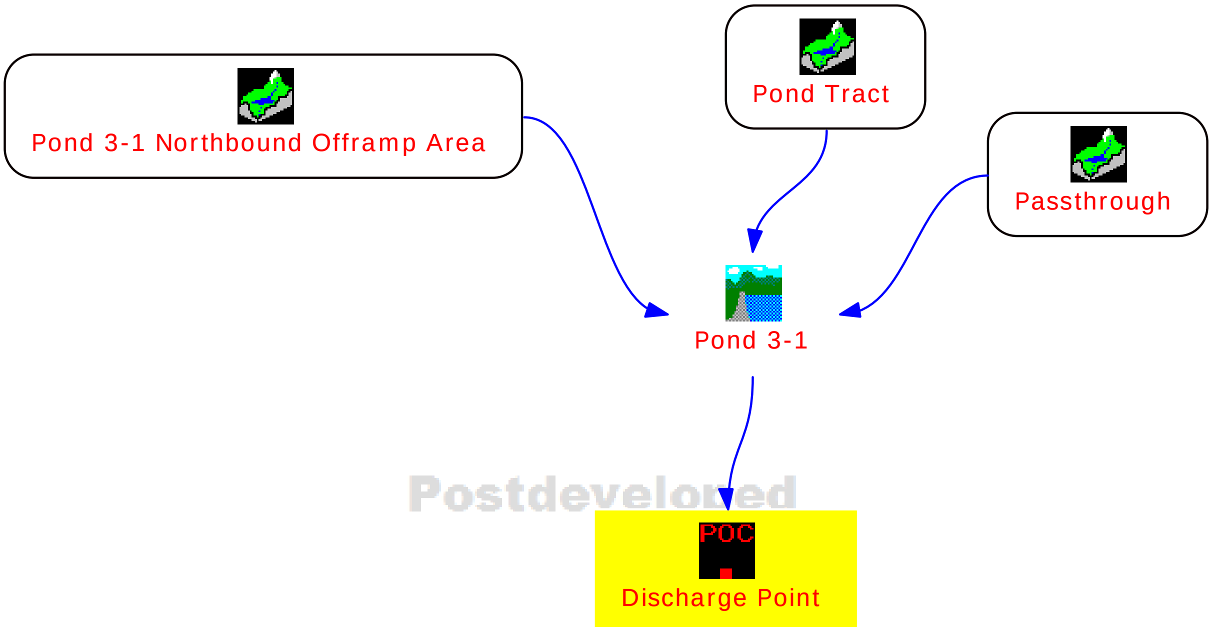
Predeveloped	Ac.	Flow-Through	Ac.	Postdeveloped	Ac.	Bypass	Ac.	Flow-Through	Ac.
Forest	**2.030**	Forest		Forest	**0.000**	Forest		Forest	
Pasture	**0.000**	Pasture		Pasture	**0.000**	Pasture		Pasture	
Grass	**0.000**	Grass	**0.810**	Grass	**0.000**	Grass		Grass	**0.810**
Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	**0.000**	Sat. Soils		Sat. Soils	
Impervious	**0.000**	Impervious		Impervious	**2.030**	Impervious		Impervious	
	2.030	+	0.810	=	2.030			+	0.810

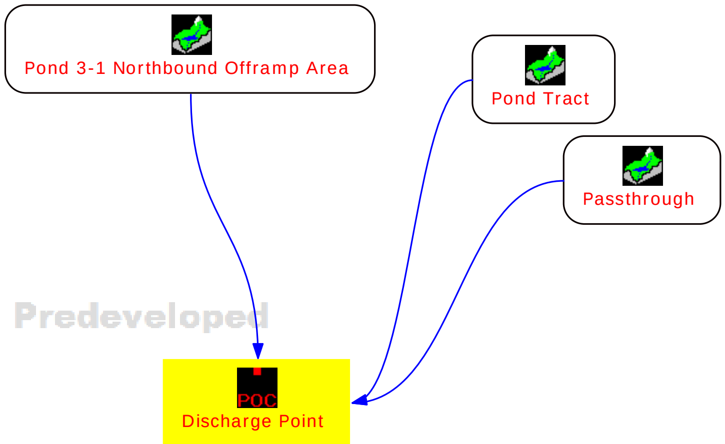
Was the pond footprint represented in the above MGSFlood inputs? YES

Choose N/A -->

50% Rule Check

100year undetained flow rate (cfs) from area receiving flow control = 1.84
100year undetained flow rate (cfs) from flow through area = 0.48
The flow through area meets the 50% rule.


Pond 3-1 Northbound Offramp Area
Pond Tract
Passthrough
Pond 3-1
Postdeveloped
POC
Discharge Point


Pond 3-1 Northbound Offramp Area
Pond Tract
Passthrough
Predeveloped
POC
Discharge Point

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 12/02/2015 5:28 PM
Report Generation Date: 12/21/2015 12:35 PM

Input File Name:	TDA3-pond_3-1_StageStorage.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 3
Comments:	Flow Control.

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	2.850	2.850
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	2.850	2.850

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

---------- Subbasin : Pond 3-1 Northbound Offramp Area ----------

	-------Area(Acres) --------
Till Forest	1.710
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	1.710

---------- Subbasin : Passthrough ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.810
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	0.810

---------- Subbasin : Pond Tract ----------

	-------Area(Acres) --------
Till Forest	0.330
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	0.330

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

Number of Subbasins: 3

---------- Subbasin : Pond 3-1 Northbound Offramp Area ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious	1.710
--	
Subbasin Total	1.710

---------- Subbasin : Passthrough ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.810
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
--	
Subbasin Total	0.810

---------- Subbasin : Pond Tract ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.330
--	
Subbasin Total	0.330

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--

Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

--

Link Name: Pond 3-1
Link Type: Structure
Downstream Link Name: Discharge Point

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
259.00	0.
260.00	6232.
261.00	13864.
262.00	22952.
263.00	33549.
264.00	45711.
265.00	59493.
266.00	74948.

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

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 15.00
Common Length (ft) : 0.000
Riser Crest Elevation : 263.30 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 259.00
Diameter (in) : 1.28
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 262.20
Diameter (in) : 1.75
Orientation : Horizontal
Elbow : Yes

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

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

Number of Subbasins: 3
Number of Links: 1

************ Subbasin: Pond 3-1 Northbound Offramp Area ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	5.489E-02
5-Year	8.329E-02
10-Year	0.114
25-Year	0.157
50-Year	0.216
100-Year	0.277
200-Year	0.334

************ Subbasin: Passthrough ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	9.365E-02
5-Year	0.174
10-Year	0.249
25-Year	0.319
50-Year	0.404
100-Year	0.481
200-Year	0.501

************ Subbasin: Pond Tract ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.059E-02
5-Year	1.607E-02
10-Year	2.194E-02
25-Year	3.028E-02
50-Year	4.171E-02
100-Year	5.346E-02
200-Year	6.447E-02

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.148

5-Year	0.262
10-Year	0.352
25-Year	0.503
50-Year	0.588
100-Year	0.752
200-Year	0.894

----------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 2

************ Subbasin: Pond 3-1 Northbound Offramp Area ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.705
5-Year	0.933
10-Year	1.067
25-Year	1.347
50-Year	1.507
100-Year	1.837
200-Year	2.025

(0.481/1.837)x100
=26%

************ Subbasin: Passthrough ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	9.365E-02
5-Year	0.174
10-Year	0.249
25-Year	0.319
50-Year	0.404
100-Year	0.481
200-Year	0.501

************ Subbasin: Pond Tract ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.136
5-Year	0.180
10-Year	0.206
25-Year	0.260
50-Year	0.291
100-Year	0.355
200-Year	0.391

********** Link: Discharge Point ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	7.178E-02
5-Year	0.116
10-Year	0.150
25-Year	0.166
50-Year	0.322
100-Year	0.488
200-Year	0.518

********** Link: Pond 3-1 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.961
5-Year	1.233
10-Year	1.502
25-Year	1.900
50-Year	2.217
100-Year	2.584
200-Year	2.587

********** Link: Pond 3-1 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	7.178E-02
5-Year	0.116
10-Year	0.150
25-Year	0.166
50-Year	0.322
100-Year	0.488
200-Year	0.518

********** Link: Pond 3-1 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) WSEL Peak (ft)

=======================================

1.05-Year	260.551
1.11-Year	260.789
1.25-Year	261.022
2.00-Year	261.696
3.33-Year	262.167
5-Year	262.410
10-Year	262.881
25-Year	263.171
50-Year	263.349
100-Year	263.382

*************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: Pond 3-1 Northbound		268.662
Subbasin: Passthrough	82.229	
Subbasin: Pond Tract	51.847	
Link: Discharge Point	0.000	
Total:		402.737

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Pond 3-1 Northbound		0.000
Subbasin: Passthrough	82.229	
Subbasin: Pond Tract	0.000	
Link: Discharge Point	0.000	
Link: Pond 3-1	0.000	
Total:		82.229

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 3.328 ac-ft/year, Post Developed: 0.680 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 437.15
Inflow Volume Including PPT-Evap (ac-ft): 437.15
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): 437.15
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 2

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 1054.08
Inflow Volume Including PPT-Evap (ac-ft): 1054.08
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): 1054.08
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: Pond 3-1 **********

Basic Wet Pond Volume (91% Exceedance): 11871. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 17807. cu-ft

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 1054.12
Inflow Volume Including PPT-Evap (ac-ft): 1054.12
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): 1054.08
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	0.148	2-Year	7.178E-02
5-Year	0.262	5-Year	0.116
10-Year	0.352	10-Year	0.150
25-Year	0.503	25-Year	0.166
50-Year	0.588	50-Year	0.322
100-Year	0.752	100-Year	0.488
200-Year	0.894	200-Year	0.518

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

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

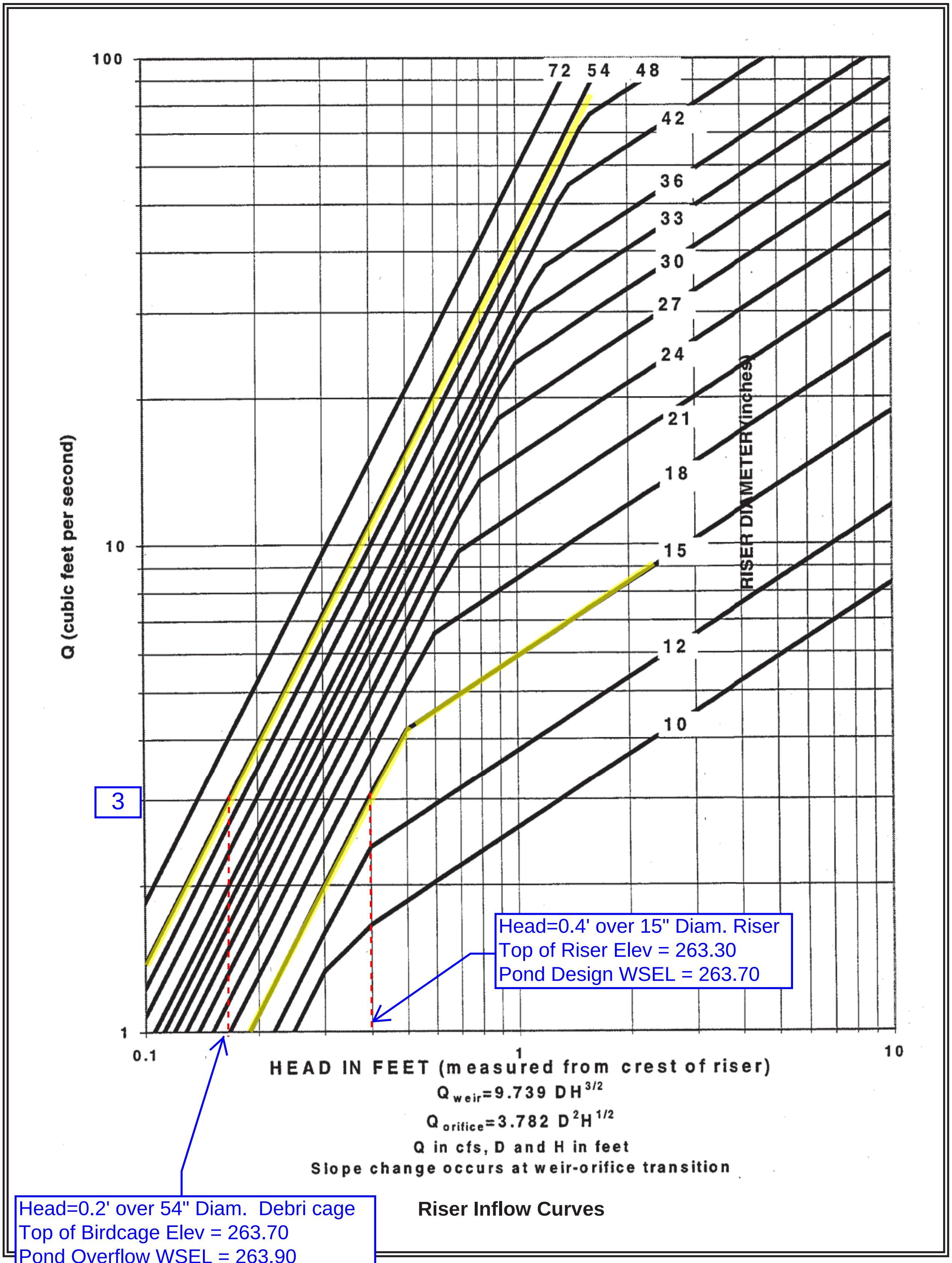
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-7.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-7.2%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	7.7%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	7.1%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	164.6%	FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	325.2%	FAIL

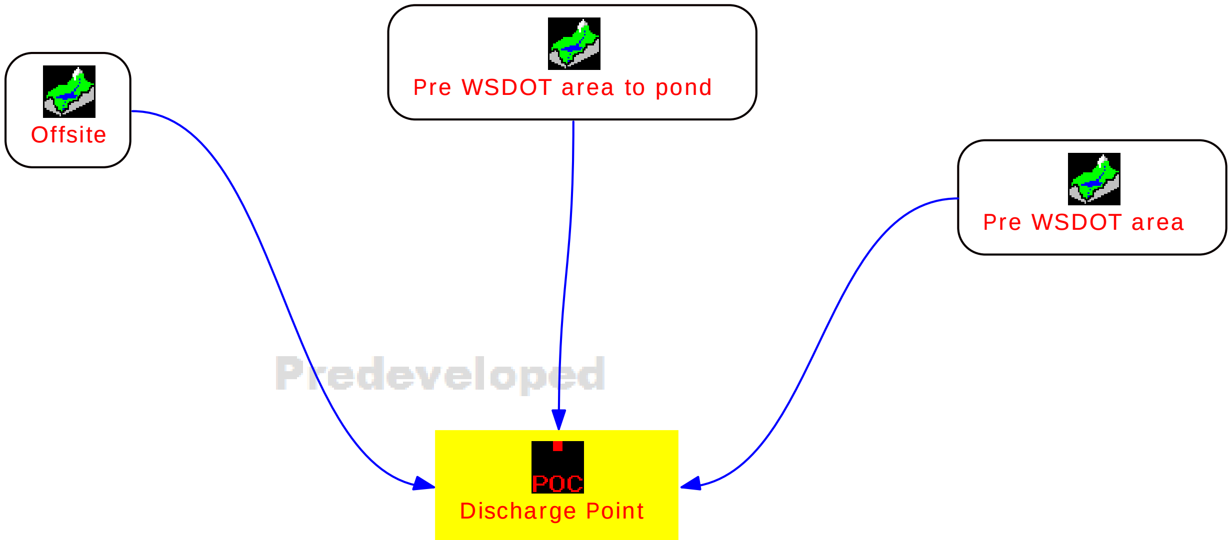
LID DURATION DESIGN CRITERIA: FAIL



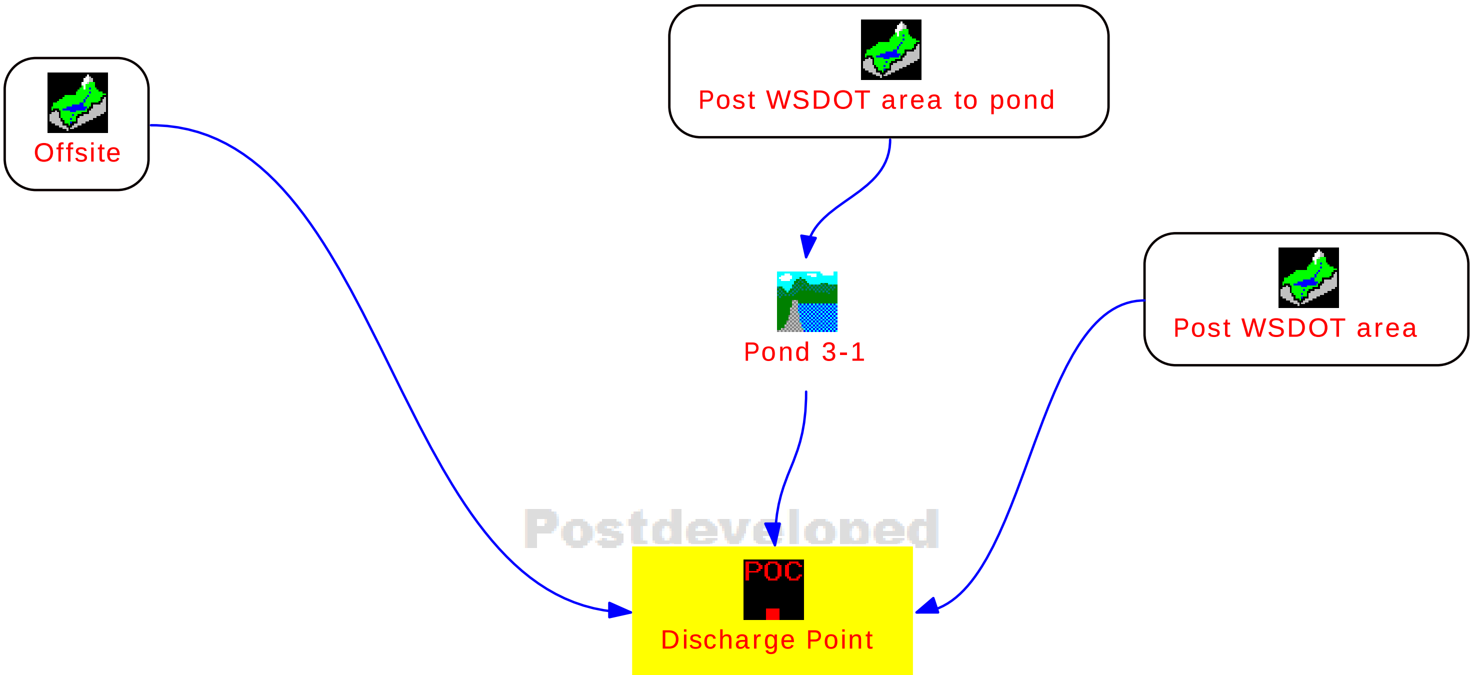
Riser Inflow Curves

Figure 5-56 Overflow structure sizing.

Pond 3-1 Post Developed
100-yr Undetained flow = 2.673 cfs



TDA3-Outfall3-1_100flowIncrease



TDA3-Outfall3-1_100flowIncrease

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 11/18/2015 4:59 PM
Report Generation Date: 12/21/2015 1:21 PM

Input File Name:	TDA3-Outfall3-1_100flowIncrease.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 3
Comments:	POC 100yr flow increase

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	15.230	15.230
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	15.230	15.230

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

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	10.960
Outwash Forest	0.000

Outwash Pasture 0.000
Outwash Grass 0.000
Wetland 0.000
Green Roof 0.000
User 2 0.000
Impervious 0.000

Subbasin Total 10.960

---------- Subbasin : Pre WSDOT area ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.100
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	1.320
Subbasin Total	1.420

---------- Subbasin : Pre WSDOT area to pond ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	2.400
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.450
Subbasin Total	2.850

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

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	10.960
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious 0.000

Subbasin Total 10.960

---------- Subbasin : Post WSDOT area ----------

-------Area(Acres) --------	
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.730
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.690
Subbasin Total	1.420

---------- Subbasin : Post WSDOT area to pond ----------

-------Area(Acres) --------	
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.810
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	2.040
Subbasin Total	2.850

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--

Link Name: Discharge Point

Link Type: Copy

Downstream Link: None

--

Link Name: Pond 3-1

Link Type: Structure

Downstream Link Name: Discharge Point

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
259.00	0.
260.00	6157.
260.50	14862.
261.00	18773.
262.00	27638.
263.00	37975.
264.00	49842.
265.00	63296.
265.50	70634.

Massmann Infiltration Option Used

Hydraulic Conductivity (in/hr) : 0.00

Depth to Water Table (ft) : 100.00

Bio-Fouling Potential : Low

Maintenance : Average or Better

Riser Geometry

Riser Structure Type : Circular

Riser Diameter (in) : 15.00

Common Length (ft) : 0.000

Riser Crest Elevation : 263.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---

Device Type : Circular Orifice

Control Elevation (ft) : 259.00

Diameter (in) : 1.25

Orientation : Horizontal

Elbow : Yes

---Device Number 2 ---

Device Type : Circular Orifice

Control Elevation (ft) : 262.50

Diameter (in) : 1.85

Orientation : Horizontal

Elbow : Yes

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

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

---------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 2

*************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: Offsite	1112.623	
Subbasin: Pre WSDOT area		10.152
Subbasin: Pre WSDOT area to po		243.640
Link: Discharge Point	0.000	
Total:		1366.415

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)	
Subbasin: Offsite	1112.623		
Subbasin: Post WSDOT area		74.107	
Subbasin: Post WSDOT area to p		82.229	
Link: Discharge Point	0.000		
Link: Pond 3-1	0.000		
Total:			1268.959

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 11.293 ac-ft/year, Post Developed: 10.487 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 3813.56
Inflow Volume Including PPT-Evap (ac-ft): 3813.56
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): 3813.56
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 2

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 4004.81
Inflow Volume Including PPT-Evap (ac-ft): 4004.81
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): 4004.81
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: Pond 3-1 **********

Basic Wet Pond Volume (91% Exceedance): 11871. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 17807. cu-ft

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 1054.12
Inflow Volume Including PPT-Evap (ac-ft): 1054.12
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): 1054.08
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

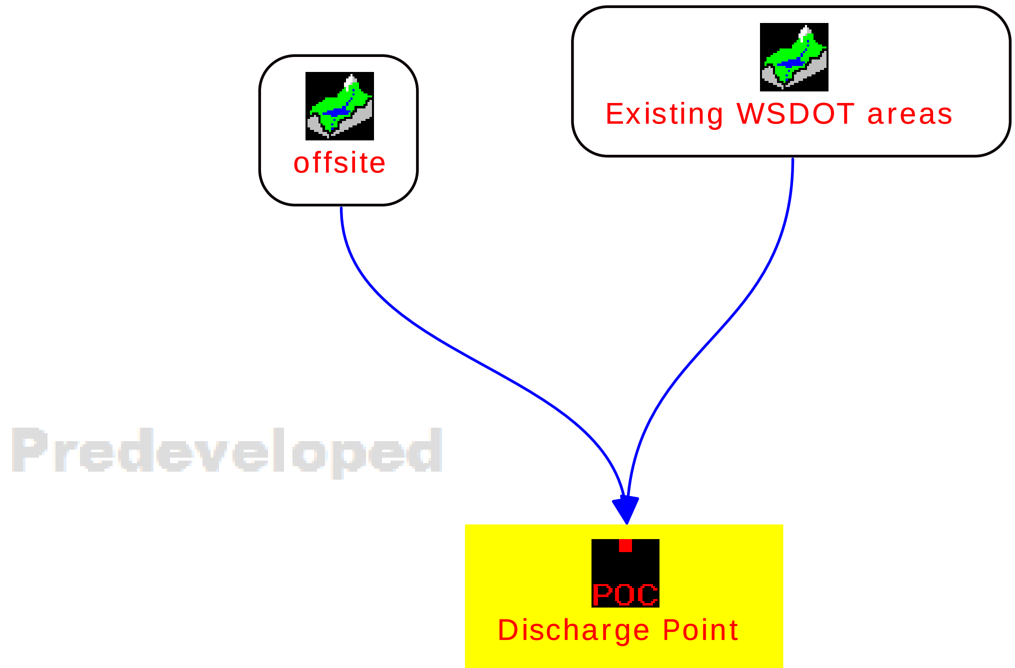
***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	2.171	2-Year	1.618
5-Year	3.729	5-Year	2.898
10-Year	5.281	10-Year	4.097
25-Year	6.362	25-Year	5.059
50-Year	8.047	50-Year	6.374
100-Year	9.725	100-Year	7.654
200-Year	9.805	200-Year	7.878

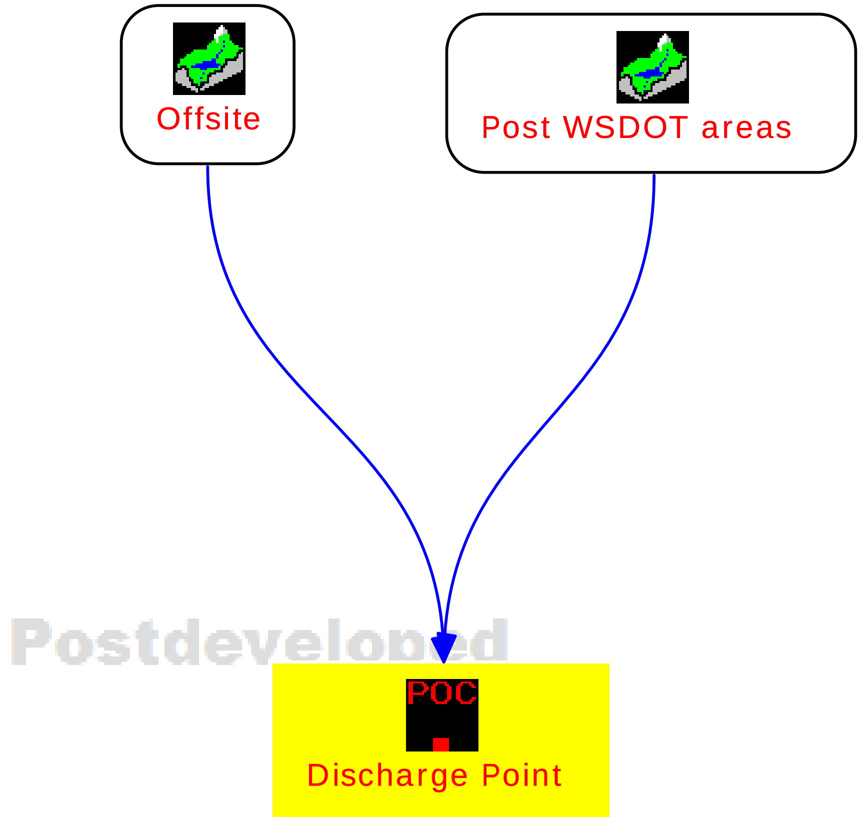
=(17.37/17.33)x100= 0.23%

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

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): -49.2% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): -42.2% PASS



TDA3-Outfall3-2_100flowIncrease



TDA3-Outfall3-2_100flowIncrease

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 11/18/2015 3:20 PM
Report Generation Date: 12/21/2015 1:32 PM

Input File Name:	TDA3-Outfall3-2_100flowIncrease.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 3
Comments:	POC 100yr flow increase

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	14.160	14.160
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	14.160	14.160

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

---------- Subbasin : Existing WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	2.040
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	1.930

Subbasin Total	3.970

---------- Subbasin : offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	10.190
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	10.190

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

Number of Subbasins: 2

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	10.190
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	10.190

---------- Subbasin : Post WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	1.840
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious	2.130
Subbasin Total	3.970

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

********** Subbasin: Existing WSDOT areas **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.091
5-Year	1.368
10-Year	1.806
25-Year	2.123
50-Year	2.696
100-Year	2.930
200-Year	3.162

********** Subbasin: offsite **********

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

======================================

2-Year	1.178
5-Year	2.191
10-Year	3.136
25-Year	4.013
50-Year	5.080
100-Year	6.048
200-Year	6.306

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.119
5-Year	3.556
10-Year	5.003
25-Year	5.974
50-Year	7.555
100-Year	9.152
200-Year	9.177

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

Number of Subbasins: 2
Number of Links: 1

*********** Subbasin: Offsite **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.178
5-Year	2.191
10-Year	3.136
25-Year	4.013
50-Year	5.080
100-Year	6.048
200-Year	6.306

*********** Subbasin: Post WSDOT areas **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.140
5-Year	1.465
10-Year	1.841
25-Year	2.229

50-Year	2.881
100-Year	2.982
200-Year	3.248

********** Link: Discharge Point ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.218
5-Year	3.629
10-Year	5.051
25-Year	6.020
50-Year	7.604
100-Year	9.222
200-Year	9.231

*************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: Existing WSDOT areas	207.094
Subbasin: offsite	1034.455
Link: Discharge Point	0.000
Total:	1241.549

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Offsite	1034.455
Subbasin: Post WSDOT areas	186.791
Link: Discharge Point	0.000
Total:	1221.246

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 10.261 ac-ft/year, Post Developed: 10.093 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 3602.30
Inflow Volume Including PPT-Evap (ac-ft): 3602.30
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): 3602.30
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 3642.15
Inflow Volume Including PPT-Evap (ac-ft): 3642.15
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): 3642.15
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	2.119	2-Year	2.218
5-Year	3.556	5-Year	3.629
10-Year	5.003	10-Year	5.051
25-Year	5.974	25-Year	6.020
50-Year	7.555	50-Year	7.604
100-Year	9.152	100-Year	9.222
200-Year	9.177	200-Year	9.231

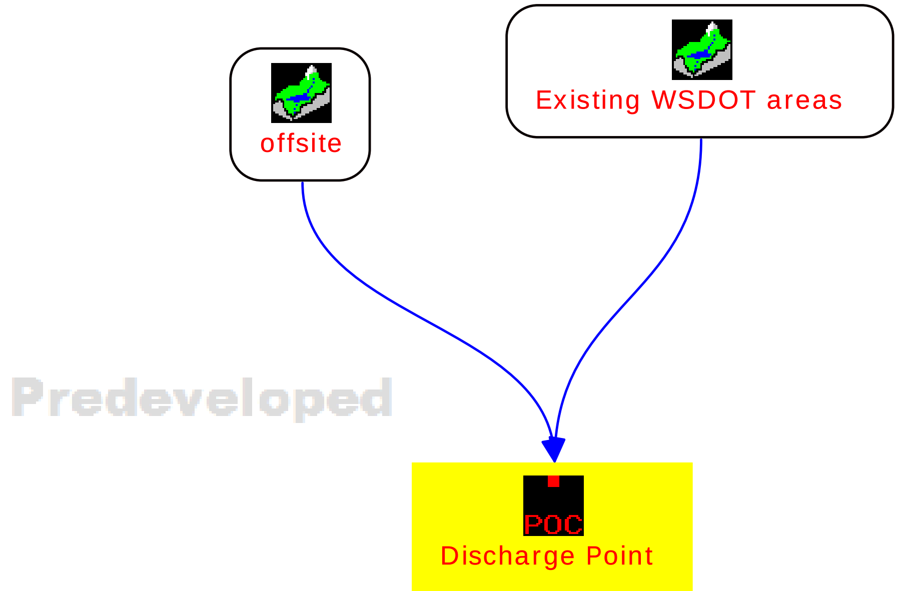
=(9.22/9.15)x100= 0.76%

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

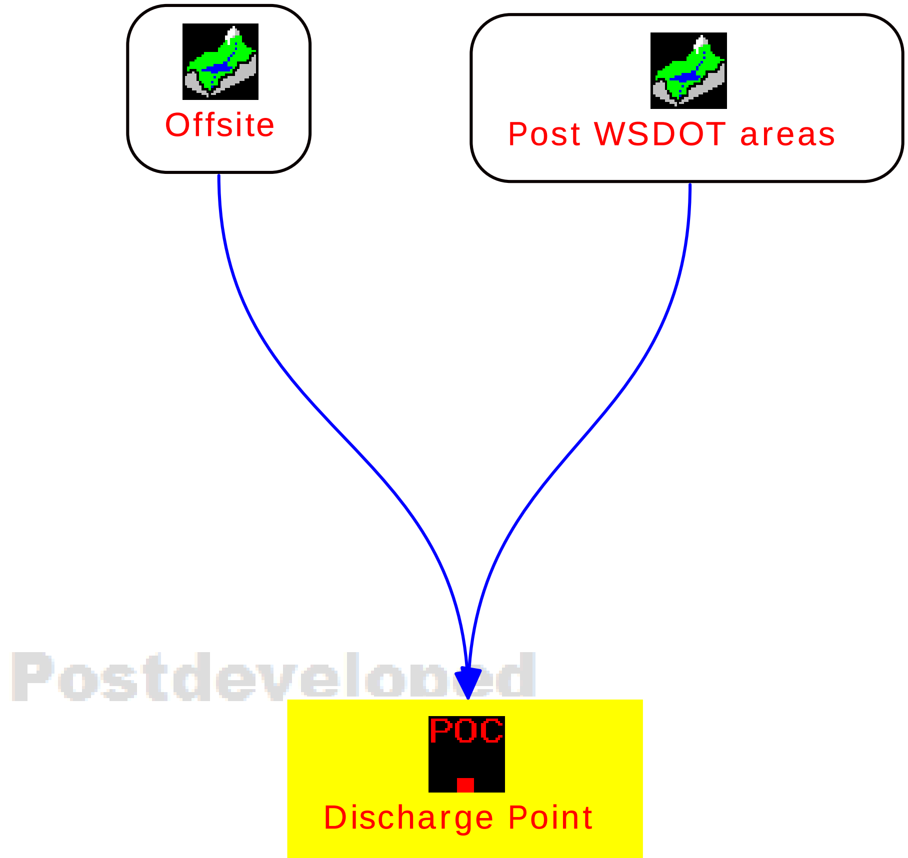
****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 11.1% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 11.1% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 57.5% FAIL

FLOW DURATION DESIGN CRITERIA: FAIL



TDA3-Outfall3-3_100flowIncrease



TDA3-Outfall3-3_100flowIncrease

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200410003
Project Simulation Performed on: 12/21/2015 1:45 PM
Report Generation Date: 12/21/2015 1:45 PM

Input File Name:	TDA3-Outfall3-3_100flowIncrease.fld
Project Name:	La Center Intersection
Analysis Title:	TDA 3
Comments:	POC 100-yr Flow Increase

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 21

Full Period of Record Available used for Routing
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 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)	25.530	25.530
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	25.530	25.530

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

---------- Subbasin : Existing WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	4.500
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	3.370

Subbasin Total	7.870

---------- Subbasin : offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	17.660
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	17.660

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

Number of Subbasins: 2

---------- Subbasin : Offsite ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	17.660
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total	17.660

---------- Subbasin : Post WSDOT areas ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	4.380
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000

Impervious	3.490
Subbasin Total	7.870

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

--
Link Name: Discharge Point
Link Type: Copy
Downstream Link: None

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

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

*********** Subbasin: Existing WSDOT areas ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.982
5-Year	2.608
10-Year	3.499
25-Year	4.060
50-Year	4.924
100-Year	5.691
200-Year	6.072

*********** Subbasin: offsite ***********

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

Tr (yrs)	Flood Peak (cfs)

==

2-Year	2.042
5-Year	3.798
10-Year	5.434
25-Year	6.955
50-Year	8.803
100-Year	10.482
200-Year	10.928

********** Link: Discharge Point ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.760
5-Year	6.372
10-Year	8.987
25-Year	10.748
50-Year	13.592
100-Year	16.457
200-Year	16.522

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

*********** Subbasin: Offsite *************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.042
5-Year	3.798
10-Year	5.434
25-Year	6.955
50-Year	8.803
100-Year	10.482
200-Year	10.928

*********** Subbasin: Post WSDOT areas *************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.029
5-Year	2.634
10-Year	3.520
25-Year	4.098

50-Year	5.035
100-Year	5.722
200-Year	6.124

********** Link: Discharge Point ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.826
5-Year	6.416
10-Year	9.022
25-Year	10.773
50-Year	13.623
100-Year	16.504
200-Year	16.548

*************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: Existing WSDOT areas	456.825
Subbasin: offsite	1792.785
Link: Discharge Point	0.000
Total:	2249.610

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Offsite	1792.785
Subbasin: Post WSDOT areas	444.643
Link: Discharge Point	0.000
Total:	2237.428

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 18.592 ac-ft/year, Post Developed: 18.491 ac-ft/year

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

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 6472.95
Inflow Volume Including PPT-Evap (ac-ft): 6472.95
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): 6472.95
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Number of Links: 1

********** Link: Discharge Point **********

Infiltration/Filtration Statistics--------------------
Inflow Volume (ac-ft): 6496.86
Inflow Volume Including PPT-Evap (ac-ft): 6496.86
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): 6496.86
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Link: Discharge Point
Scenario Postdeveloped Compliance Link: Discharge Point

***** 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	3.760	2-Year	3.826
5-Year	6.372	5-Year	6.416
10-Year	8.987	10-Year	9.022
25-Year	10.748	25-Year	10.773
50-Year	13.592	50-Year	13.623
100-Year	16.457	100-Year	16.504
200-Year	16.522	200-Year	16.548

=(16.50/16.46)x100= 0.24%

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

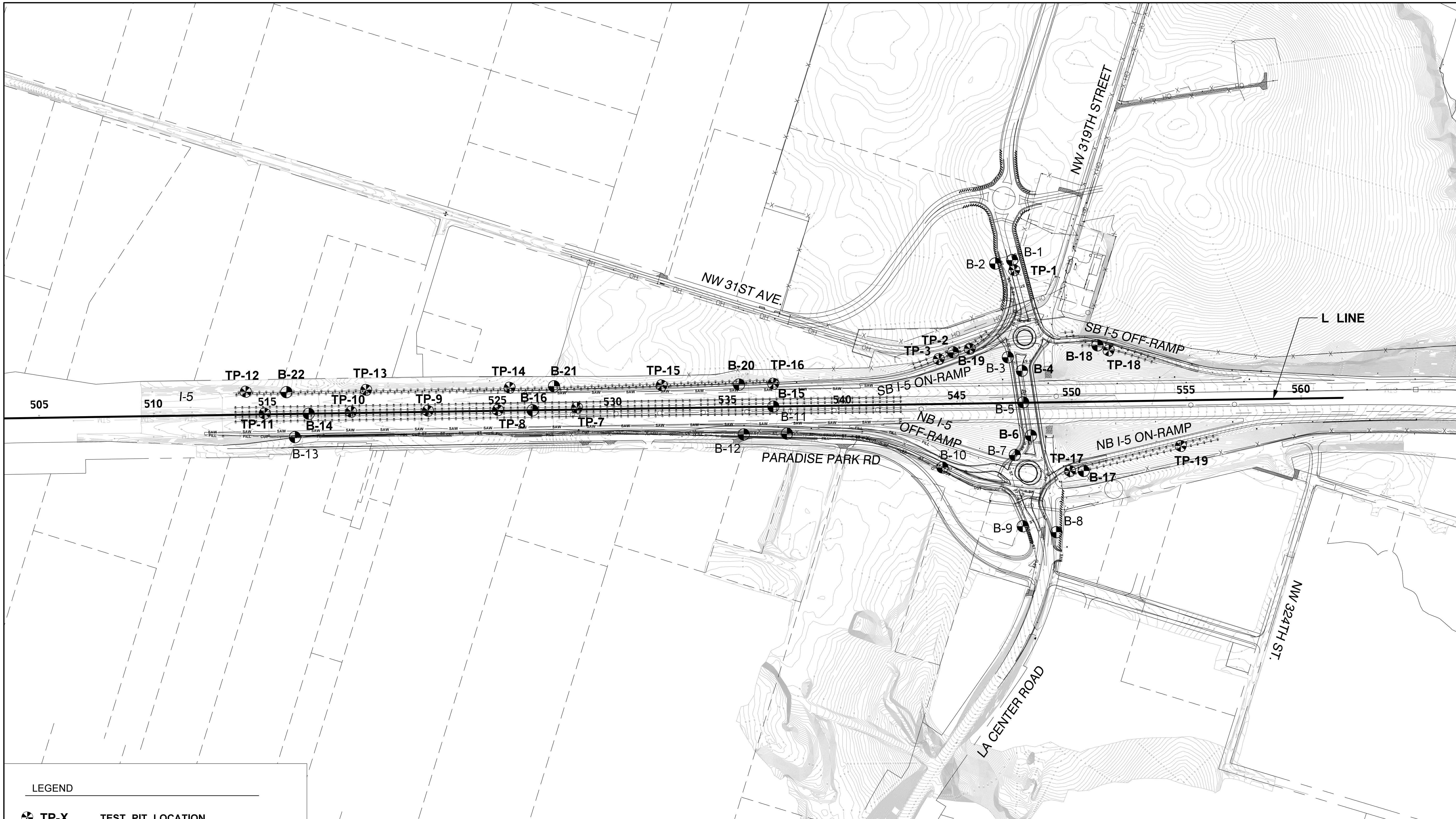
****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 3.3% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 3.6% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 40.0% PASS

FLOW DURATION DESIGN CRITERIA: FAIL

APPENDIX B

Geotechnical Investigation Results



LEGEND

TP-X	TEST PIT LOCATION
B-X	BORING/GROUNDWATER MONITORING TUBE LOCATION
B-1	BORING (ONLY) LOCATION
	P-CAVFS

0 200 400
SCALE IN FEET

GEOTECHNICAL TESTING LOCATIONS

I-5 LA CENTER INTERCHANGE PROJECT
CLARK COUNTY, WASHINGTON

458952

CH2MHILL

Project: I5 / La Center Interchange
Project No. CH2M-2015-003 T001
Date: 19-Jun-15

Sieve / Hydrometer Analysis (ASTM D 422)

B14 at 5.0 - 6.5 feet		B16 at 5.0 - 6.5 feet		B17 5 - 6.5 feet		B19 at 5.0-6.5 feet		B20 at 5.0-6.5 feet		B21 at 5.0-6.5 feet		B22 at 5.0-6.5 feet		TP12 at 6 feet		TP13 at 5 feet	
Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing
4.75	100	4.75	100	4.75	100	4.75	100	4.75	100	4.75	100	4.75	100	4.75	100	4.75	100
2.38	100	2.38	100	2.38	100	2.38	100	2.38	100	2.38	100	2.38	100	2.38	100	2.38	100
2	100	2	100	2	100	2	100	2	100	2	100	2	100	2	100	2	100
1.19	99	1.19	99	1.19	99	1.19	100	1.19	99	1.19	100	1.19	100	1.19	100	1.19	98
0.595	99	0.595	99	0.595	97	0.595	99	0.595	99	0.595	99	0.595	99	0.595	99	0.595	97
0.42	99	0.42	99	0.42	96	0.42	99	0.42	99	0.42	98	0.42	99	0.42	99	0.42	96
0.3	99	0.3	98	0.3	95	0.3	98	0.3	98	0.3	98	0.3	98	0.3	99	0.3	95
0.15	97	0.15	96	0.15	91	0.15	94	0.15	96	0.15	95	0.15	97	0.15	98	0.15	93
0.075	89	0.075	88	0.075	81	0.075	81	0.075	88	0.075	85	0.075	84	0.075	97	0.075	92
0.0614	55.1	0.0617	53.2	0.0627	53.2	0.0614	56.9	0.064	43.2	0.0572	58	0.0582	58.8	0.0565	62.9	0.0547	65.2
0.0448	51.7	0.0454	48.5	0.0462	48.8	0.0454	52.5	0.046	40.9	0.0431	51	0.0439	52	0.0399	62.9	0.0407	60.7
0.0308	41.6	0.0302	41.4	0.0309	42.1	0.0302	47	0.0298	37.4	0.0291	42.9	0.0294	45.2	0.0274	54.9	0.0282	51.7
0.0187	34.9	0.0185	33.1	0.0188	35.5	0.0189	37.2	0.018	30.4	0.0178	34.8	0.0182	36.2	0.0169	46.9	0.0174	43.9
0.0136	30.4	0.0133	29.6	0.0139	28.9	0.0137	33.9	0.0131	25.7	0.0129	30.2	0.0133	31.7	0.0124	42.3	0.0127	39.4
0.0098	27	0.0097	24.9	0.0102	23.3	0.01	29.6	0.0095	21.1	0.0095	23.2	0.0097	27.2	0.0091	37.8	0.0092	36
0.005	21.4	0.0049	20.1	0.0052	16.7	0.0051	21.9	0.0048	16.4	0.0048	17.5	0.0049	20.4	0.0046	34.3	0.0046	32.6
0.0021	15.8	0.0021	13.1	0.0022	13.4	0.0022	16.5	0.002	12.9	0.002	15.1	0.0021	17	0.002	28.6	0.002	28.1

TP14 at 6 feet		TP15 at 3 feet		TP16 at 3.5 feet		TP16 at 8 feet		TP17 at 3 feet		TP17 at 8 feet		TP18 at 1 feet		TP18 at 4 feet		TP19 at 3 feet	
Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing
4.75	100	4.75	100	31.25	100	4.75	100	4.75	100	4.75	100	50	74	4.75	100	4.75	100
2.38	100	2.38	100	25	92	2.38	100	2.38	100	2.38	100	37.5	64	2.38	100	2.38	100
2	100	2	100	18.75	87	2	100	2	100	2	99	31.25	64	2	100	2	100
1.19	100	1.19	100	12.5	82	1.19	99	1.19	99	1.19	98	25	60	1.19	100	1.19	100
0.595	100	0.595	100	9.375	81	0.595	98	0.595	98	0.595	97	18.75	54	0.595	99	0.595	99
0.42	99	0.42	99	6.25	79	0.42	98	0.42	98	0.42	96	12.5	48	0.42	99	0.42	99
0.3	99	0.3	98	4.75	77	0.3	97	0.3	97	0.3	95	9.375	46	0.3	99	0.3	98
0.15	98	0.15	97	2.38	96	0.15	95	0.15	93	0.15	92	6.25	45	0.15	92	0.15	96
0.075	93	0.075	94	2	75	0.075	82	0.075	84	0.075	83	4.75	44	0.075	76	0.075	90
0.0553	64.1	0.0559	64	1.19	74	0.0658	46.4	0.0588	58.6	0.0564	62.2	2.38	44	0.0582	58.5	0.0584	59.3
0.0429	55	0.0421	58.4	0.595	72	0.0482	41.9	0.0444	51.8	0.0413	58.8	2	43	0.043	53.9	0.0441	52.5
0.0296	44.7	0.0281	52.8	0.42	70	0.032	35.1	0.0303	42.8	0.0282	50.9	1.19	43	0.0283	49.3	0.0295	45.7
0.0186	33.2	0.0174	44.9	0.3	68	0.0195	27.2	0.0184	36.1	0.0175	41.8	0.595	42	0.0172	42.5	0.0182	36.5
0.0134	29.8	0.0128	39.3	0.15	61	0.0141	23.8	0.0134	31.6	0.0128	37.3	0.42	42	0.0125	39	0.0134	30.8
0.0097	26.4	0.0094	34.8	0.075	53	0.0101	20.4	0.0098	27.1	0.0092	35.1	0.3	41	0.0091	34.4	0.0097	27.4
0.0049	20.7	0.0047	30.3	0.0652	37.1	0.0051	15.9	0.0049	21.4	0.0047	28.3	0.15	38	0.0046	28.7	0.0048	24
0.0021	13.8	0.0021	23.6	0.047	35.4	0.0022	12.5	0.0021	16.9	0.002	23.8	0.075	34	0.002	20.7	0.0021	19.4
				0.0314	30.4							0.0623	23.6				
				0.0193	23.6							0.045	22.6				
				0.0139	22							0.0296	20.7				
				0.0099	20.3							0.0182	17.2				
				0.005	16.1							0.0133	15.3				
				0.0022	12.7							0.0097	13.3				
												0.0049	10.8				
												0.0021	8.4				

Boring B-14 (WADOE Start Card 10881, Tag# BJC614)

Ground Surface Elev. = 268
Monument Elev. = 268
Standpipe Elev. = 267.4

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	38	229.4

Boring B-15 (WADOE Start Card 10881, Tag# BJC616)

Ground Surface Elev. = 274
Monument Elev. = 274
Standpipe Elev. = 273.8

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	38.8	235

Boring B-16 (WADOE Start Card 10881, Tag# BJC615)

Ground Surface Elev. = 271
Monument Elev. = 271
Standpipe Elev. = 270.5

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	38.3	232.2

Boring B-17 (WADOE Start Card 10881, Tag# BJC617)

Ground Surface Elev. = 258
Monument Elev. = 258
Standpipe Elev. = 257.5

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	16.8	240.7

Boring B-18 (WADOE Start Card 10881, Tag# BJC618)

Ground Surface Elev. = 242
Monument Elev. = 242
Standpipe Elev. = 241.7

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	15.5	226.2

Boring B-19 (WADOE Start Card 10881, Tag# BJC621)

Ground Surface Elev. = 254
Monument Elev. = 254
Standpipe Elev. = 253.5

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	28.2	225.3

Boring B-20 (WADOE Start Card 10881, Tag# BJC619)

Ground Surface Elev. = 271
Monument Elev. = 271
Standpipe Elev. = 270.6

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	17.7	252.9

Boring B-21 (WADOE Start Card 10881, Tag# BJC620)

Ground Surface Elev. = 274
Monument Elev. = 274
Standpipe Elev. = 273.5

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	38.1	235.4

Boring B-22 (WADOE Start Card 10881, Tag# BJC622)

Ground Surface Elev. = 270
Monument Elev. = 270
Standpipe Elev. = 269.7

Date	Measurement Below Top of Standpipe (feet)	Elevation (feet)
6/24/2015	35.5	234.2

Boring B-4 (WADOE Start Card 10881, Tag# BJC602)

Ground Surface Elev. = 255.3
Monument Elev. = 255.3
Standpipe Elev. = 255

Date	Measurement Below Top of	Elevation (feet)
3/9/2015	12.6	254.8
4/9/2015	18.3	249.1
5/28/2015	22.8	244.6
6/23/2015	25.3	242.1

Boring B-6 (WADOE Start Card 10881, Tag# BJC601)

Ground Surface Elev. = 257.1
Monument Elev. = 257.1
Standpipe Elev. = 256.8

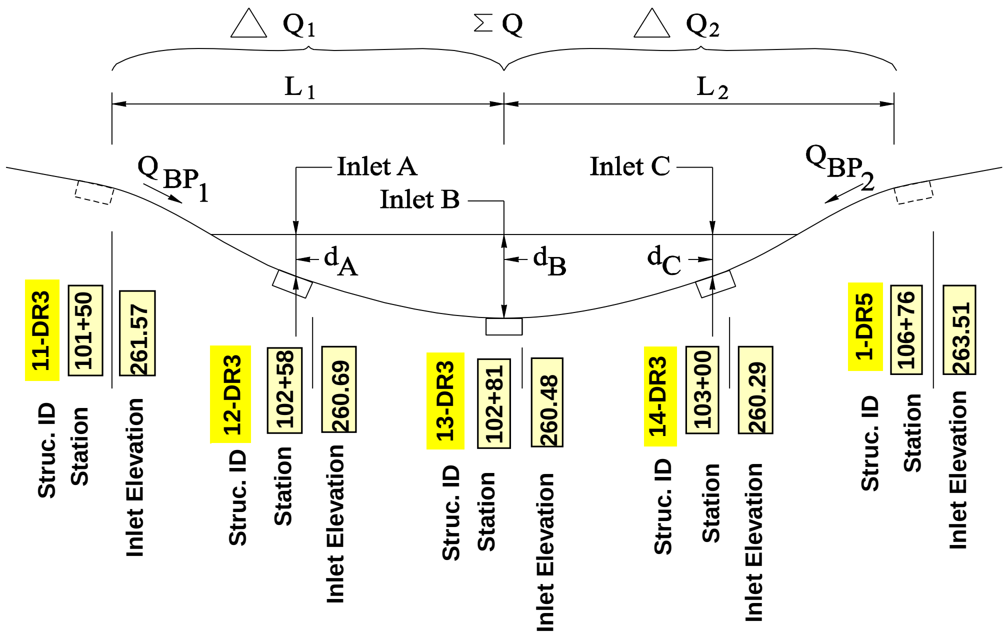
Date	Measurement Below Top of	Elevation (feet)
3/9/2015	26.5	247.3
4/9/2015	30.4	243.4
5/28/2015	32.5	241.3
6/23/2015	33.4	240.4

APPENDIX C

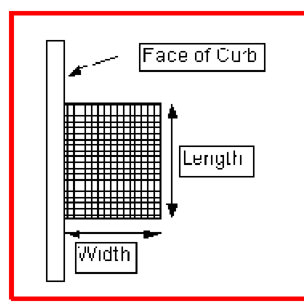
Pipe Conveyance and Inlet Spacing Calculations

SAG INLET DESIGN WORKSHEET

Combination inlet at low point



Transverse Slope	S_T	0.080	ft/ft	Shoulder Width		8.00	ft
Allowable	Z_d	10.00	ft	Lane Width		12.00	ft
Allowable	d_B	0.8	ft	($d_A = d_C =$ 0.4 ft allowable)			
Time of Concentration	T_c	5.0	min				
50 yr. rainfall coefficients	m	6.95					
	n	0.520					
Rainfall Intensity	$I_{50\text{-}yr}$	3.01	in/hr	(for 5 minute duration)			
Distance between last inlet and low point	L_1	131.20	ft	L_2		376.00	ft
Width of catchment area	W_1	38.00	ft	W_2		38.00	ft
Bypass from last inlet	Q_{BP1}[4]	0.08	cfs	Q_{BP2}[4]		0.05	cfs
Discharge of catchment area	Q_1	0.33	cfs	Q_2		0.94	cfs



$Q_{Total} = Q_{BP1} + Q_1 + Q_{BP2} + Q_2$

$Q_{Total} =$ 0.08 + 0.33 + 0.05 + 0.94 = 1.40 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	2.67	ft	Width	1.67	Length	2
	P_B		1.34	ft	Width	0.84	Length	1.00
	P_C	Flank	2.67	ft	Width	1.67	Length	2

$\Sigma Q = Q_A + Q_B + Q_C$

[2] $\Sigma Q = C_{WA}P_A(0.5d_B)^{1.5} + C_{WB}P_Bd_B^{1.5} + C_{WC}P_C(0.5d_B)^{1.5}$ 6.93 cfs

Capacity is adequate, design is complete.

$$d_B = \left(\frac{\Sigma Q}{C_{WA}P_A0.3536 + C_{WB}P_B + C_{WB} + C_{WC}P_C0.3536}\right)^{2/3} = 0.28 \text{ ft}$$

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 5-5.2.

[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 5-5 in Hydraulics Manual for grate dimensions.

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

INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

CONTINUOUS GRADE INLET SPACING

Tc =	5.00	
C =	0.90	
I =	2.18	10yr - Required WSDOT
m=	4.92	
n=	0.506	
Allowable Zd=	10.00	8 ft shoulder, 12 ft lane with 10 ft wide clear travelled way, Sect 5.5 WSDOT Hyd. Manual

Project Name:	I-5/NW LaCenter Road Interchange Improvements
Project #:	458952
S.R.:	DA
Designed By:	TR
Date:	10/26/2015
Updated:	12/18/2015

Struc ID	Station	Distance	Width	Δ Q	Σ Q	Slope L	Super T	G.W.	G.L.	d	Z_d	Q_{bp**}	Vcontinuous**	Vside**	E_o	R_s	E	Q_i	Q_{bp**}	Z_d Check	Velocity Check	Q_{bp} Check	Comments (L/R)
	"L" NB Mainline																						
	533+50.00																						
3-DR2	527+40.12	609.88	52.40	1.44	1.44	0.0050	0.0300	1.67	2.00	0.21	7.00	0.70	2.41	1.84	0.52	0.25	0.64	0.92	0.52	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
2-DR2	525+55.08	185.04	48.70	0.41	0.93	0.0050	0.0300	1.67	2.00	0.18	6.00	0.39	2.10	1.66	0.58	0.28	0.70	0.65	0.28	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
1-DR2	523+10.08	245	48.70	0.54	0.82	0.0050	0.0300	1.67	2.00	0.17	5.67	0.32	2.05	1.60	0.61	0.30	0.72	0.59	0.23	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
5-DR1	520+50.00	260.08	48.70	0.57	0.80	0.0050	0.0300	1.67	2.00	0.17	5.67	0.31	1.99	1.60	0.61	0.30	0.72	0.58	0.22	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
3-DR1	517+38.43	311.57	48.70	0.68	0.90	0.0050	0.0260	1.67	2.00	0.17	6.54	0.41	1.98	1.60	0.54	0.27	0.67	0.60	0.30	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
2-DR1	514+80.00	258.43	48.70	0.57	0.87	0.0066	0.0270	1.67	2.00	0.16	5.93	0.36	2.22	1.76	0.59	0.24	0.69	0.60	0.27	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC	NEED TO REDUCE Qbp	
1-DR1	513+00.06	179.94	44.80	0.36	0.63	0.0900	0.0280	1.67	2.00	0.09	3.21	0.09	4.88							Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC	Qbp < 0.1 CFS	

****FOR LAST GRATE ON RUN OF GUTTER, IF SPREADSHEET SHOWS A VALUE FOR Vside, CHECK Vside AND Qbp (COLUMN S) FOR COMPLIANCE. OTHERWISE, CHECK Vcontinuous AND Qbp (COLUMN L) FOR COMPLIANCE.**

PLEASE REPORT ANY PROBLEMS TO WSDOT HQ HYDRAULICS OFFICE. SPREADSHEET IS PROTECTED BUT DOES NOT REQUIRE A PASSWORD TO UNPROTECT.

INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

CONTINUOUS GRADE INLET SPACING

Tc =	5.00	
C =	0.90	
I =	2.18	
m=	4.92	10yr
n=	0.506	10yr
Allowable Zd=	10.00	8 ft shoulder, 12 ft lane with 10 ft wide clear travelled way, Sect 5.5 WSDOT Hyd. Manual

Project Name: I-5/NW LaCenter Road Interchange Improvements
Project #: 458952
S.R.: DA
Designed By: TR
Date: 10/26/2015
Updated: 12/18/2015

Struc ID	Station	Distance	Width	Δ Q	Σ Q	Slope L	Super T	G.W.	G.L.	d	Z_d	Q_{bp**}	Vcontinuous**	Vside**	E_o	R_s	E	Q_i	Q_{bp**}	Z_d Check	Velocity Check	Q_{bp} Check	Comments (L/R)
	"L" NB Mainline transition to 'CB' Line																						
	533+40.00	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	
11-DR3	540+44.33	704.33																					Distance Added to 11-DR3 (Full)
	"CB" Line																						
	100+99.63	= "L" 540 + 44.33																					
11-DR3 (Full)	101+50.00	862.7	47.50	1.84	1.84	0.0090	0.0800	1.67	2.00	0.30	3.75	0.38	3.74							Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
12-DR2	102+58.00	131.2	48.50	0.29	0.29	0.0070	0.0800	1.67	2.00	0.16	2.00	0.00	1.85	1.81	0.99	0.47	1.00	0.29	0.00	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		See Sag Calculations.
13-DR3	102+81.20	23.2	49.50	0.05	0.05	0.0070	0.0800	1.67	2.00	0.08	1.00	0.00	2.27	1.14	1.00	0.67	1.00	0.05	0.00	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC	Qbp < 0.1 CFS	See Sag Calculations.
	"CB-R" Line																						
	208+98.23																						
7-DR5	207+50.00	148.23	24.00	0.16	0.16	0.0039	0.0200	1.67	2.00	0.08	4.00	0.04	1.16	0.85	0.76	0.47	0.87	0.14	0.02	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
	"CB" Line																						
	108+77.50																						
9-DR5	108+14.00	63.5	37.00	0.11	0.11	0.0064	0.0200	1.67	2.00	0.07	3.50	0.02	1.02	1.00	0.82	0.40	0.89	0.10	0.01	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
1-DR5	106+76.00	138	38.00	0.24	0.25	0.0064	0.0200	1.67	2.00	0.09	4.50	0.07	1.46	1.18	0.71	0.33	0.80	0.20	0.05	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		
14-DR3	103+00.00	376	39.00	0.66	0.71	0.0070	0.0800	1.67	2.00	0.22	2.75	0.10	2.39	2.24	0.92	0.38	0.95	0.67	0.06	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC		Qpb From 7-DR5 added to this line
13-DR3	102+81.20	18.8	49.50	0.04	0.05	0.0070	0.0800	1.67	2.00	0.08	1.00	0.00	2.35	1.14	1.00	0.67	1.00	0.05	0.00	Zd ALLOWABLE > Zd DESIGN	VELOCITY < 5 FT/SEC	Qbp < 0.1 CFS	SAG. See Sag Calculations.

****FOR LAST GRATE ON RUN OF GUTTER, IF SPREADSHEET SHOWS A VALUE FOR Vside, CHECK Vside AND Qbp (COLUMN S) FOR COMPLIANCE. OTHERWISE, CHECK Vcontinuous AND Qbp (COLUMN L) FOR COMPLIANCE.**

PLEASE REPORT ANY PROBLEMS TO WSDOT HQ HYDRAULICS OFFICE. SPREADSHEET IS PROTECTED BUT DOES NOT REQUIRE A PASSWORD TO UNPROTECT.

Pipe Conveyance Calculations

Location	Return	10 yr	25 yr	100 yr
Vancouver	m	4.92	6.06	7.82
From WSDOT Hydraulic Manual	n	0.506	0.515	0.525

	Intensity (in/hr)		
Tc (mins)	10 yr	25 yr	100 yr
1	4.920	6.060	7.820
5	2.179	2.645	3.359
10	1.534	1.851	2.335
15	1.250	1.502	1.887
30	0.880	1.051	1.311
45	0.717	0.853	1.060
60	0.620	0.736	0.911

From WSDOT Hydraulic Manual

It should be noted that the rainfall intensity at any given time is the average of the most intense period enveloped by the time of concentration and is not the instantaneous rainfall. Equation 2-4 is the equation for calculating rainfall intensity.

$$I = \frac{m}{(T_c)^n} \qquad (2\text{-}4)$$

Where:

I = rainfall intensity in inches per hour (millimeters per hour)

T_c = time of concentration in minutes

m & n = coefficients in dimensionless units (Figures 2-5.4A and 2-5.4B)

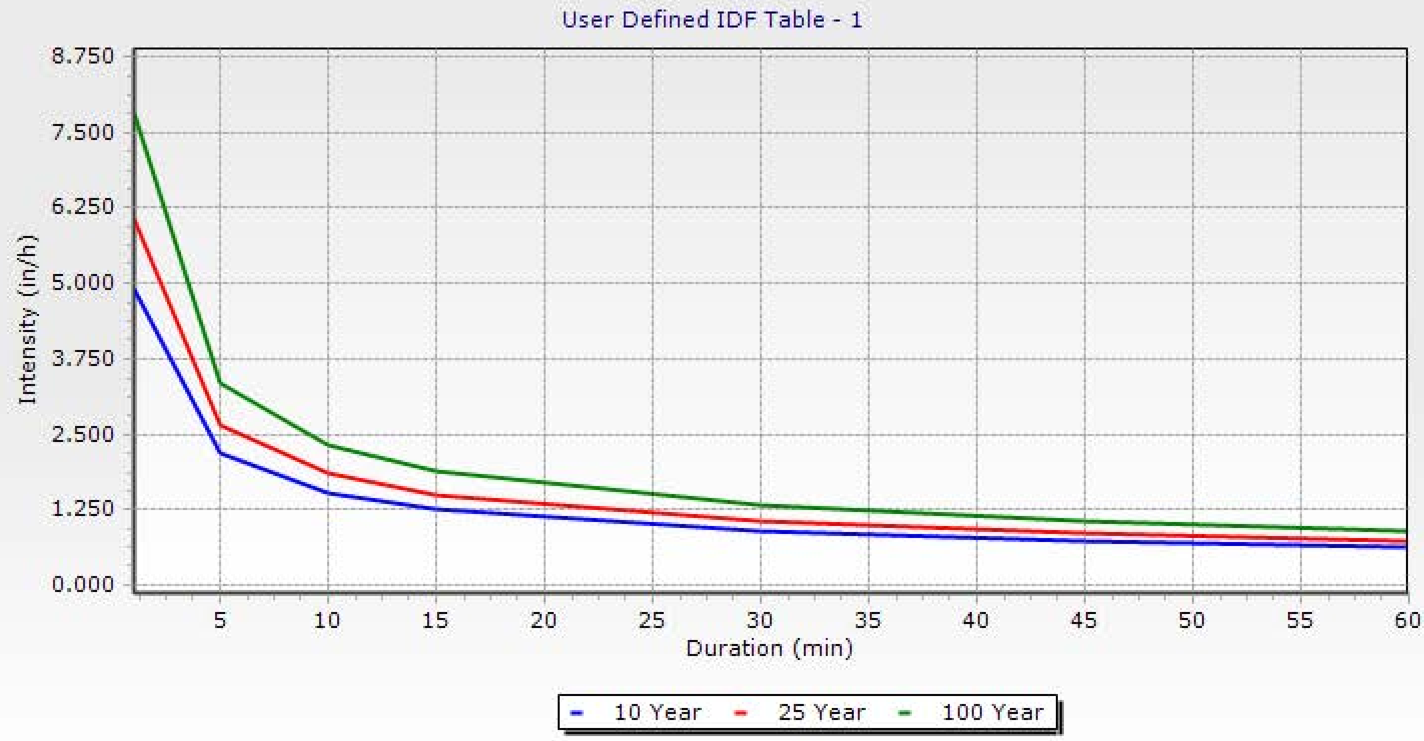
The coefficients (m and n) have been determined for all major cities for the 2-, 5-, 10-, 25-, 50-, and 100-year mean recurrence intervals (MRI). The coefficients listed are accurate from 5-minute durations to 1,440-minute durations (24 hours). These equations were developed from the *1973 National Oceanic and Atmospheric Administration Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume IX-Washington.*

Storm Data

- User Defined IDF Table
  - User Defined IDF Table - 1
- Hydro-35
- IDF Table Equation
- IDF Curve Equation
- IDF Polynomial Log Equation

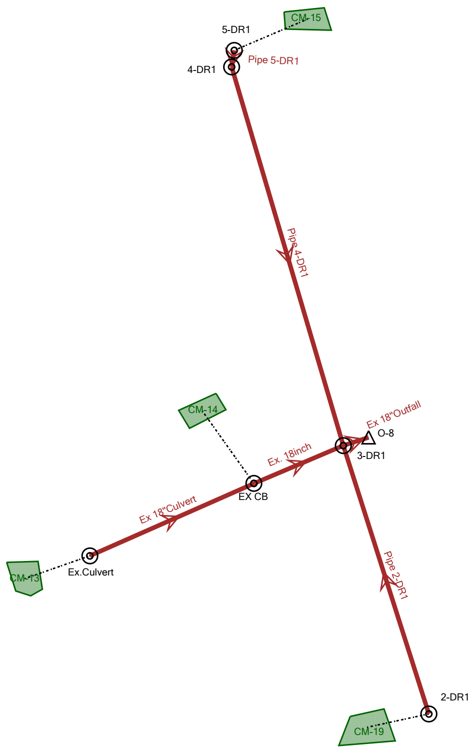
Storm Event Input | Library | Notes

	Duration (min)	10 Year (in/h)	25 Year (in/h)	100 Year (in/h)
1	1	4.920	6.060	7.820
2	5	2.179	2.645	3.359
3	10	1.534	1.851	2.335
4	15	1.250	1.502	1.887
5	30	0.880	1.051	1.311
6	45	0.717	0.853	1.060
7	60	0.620	0.736	0.911



Close | Help

Scenario: Base



Calculation Detailed Summary

Element Details

ID	26	Notes	
Label	Base Calculation Options		

Hydraulic Summary

Flow Profile Method	Backwater Analysis	Average Velocity Method	Actual Uniform Flow Velocity
Number of Flow Profile Steps	5	Minimum Structure Headloss	0.00 ft
Hydraulic Grade Convergence Test	0.00 ft	Minimum Time of Concentration	5 min

Inlets

Neglect Side Flow?	False	Active Components for Combination Inlets In Sag	Grate and Curb
Neglect Gutter Cross Slope For Side Flow?	False	Active Components for Combination Inlets on Grade	Grate and Curb

HEC-22 Energy Losses

Elevations Considered Equal Within	0.50 ft	Depressed Unsubmerged Factor	1.000
Consider Non-Piped Plunging Flow?	False	Half Bench Submerged Factor	0.950
Flat Submerged Factor	1.000	Half Bench Unsubmerged Factor	0.150
Flat Unsubmerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Submerged Factor	1.000	Full Bench Unsubmerged Factor	0.070

Headloss (AASHTO)

Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Bend Angle vs. Bend Loss Curve

Calculation Detailed Summary

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

Gravity Hydraulics

Governing Upstream Pipe Selection Method	Pipe with Maximum QV

Catchment Summary

Label	Area (User Defined) (acres)	Time of Concentration (min)	Rational C	Catchment CA (acres)	Catchment Intensity (in/h)	Catchment Rational Flow (cfs)
CM-13	20.280	20	0.563	11.417	1.695	19.51
CM-14	2.270	5	0.650	1.475	3.359	5.00
CM-15	0.290	5	0.900	0.261	3.359	0.88
CM-19	0.610	5	0.900	0.549	3.359	1.86

Conduit Summary

Label	Section Type	Branch ID	Subnetwork Outfall	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)
Ex 18"Outfall	Circle	1	O-8	23.25	13.16	258.20
Pipe 4-DR1	Circle	1	O-8	0.88	4.01	260.67
Pipe 5-DR1	Circle	1	O-8	0.88	4.15	261.04
Ex. 18inch	Circle	2	O-8	21.92	12.41	261.46
Pipe 2-DR1	Circle	3	O-8	1.86	4.54	260.00
Ex 18"Culvert	Circle	2	O-8	19.51	11.04	266.23

Calculation Detailed Summary

Conduit Summary

Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
257.91	1.67	1.48
258.20	0.39	1.55
260.80	0.39	0.32
258.20	3.20	1.55
258.20	0.58	0.90
261.46	4.60	3.20

Node Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)
4-DR1	Manhole	O-8	0.88	0.88	264.65	258.22
5-DR1	Manhole	O-8	0.88	0.88	264.65	258.65
EX CB	Manhole	O-8	24.50	21.92	263.00	256.26
3-DR1	Manhole	O-8	24.66	23.25	261.34	254.65
O-8	Outfall	(N/A)	(N/A)	23.24	261.00	256.00
2-DR1	Manhole	O-8	1.86	1.86	263.08	259.00
Ex.Culvert	Manhole	O-8	19.51	19.51	269.00	260.00

Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
260.93	260.82
261.19	261.19
263.36	263.85
258.22	260.89
(N/A)	(N/A)
260.24	260.24
268.12	268.12

Inlet Summary

Label	Inlet Type	Catalog Inlet Type	Catalog Inlet	Flow (Captured) (cfs)	Flow (Total Bypassed) (cfs)	Bypass Target

Capture Efficiency (Calculated) (%)	Depth (Gutter) (in)	Spread / Top Width (ft)

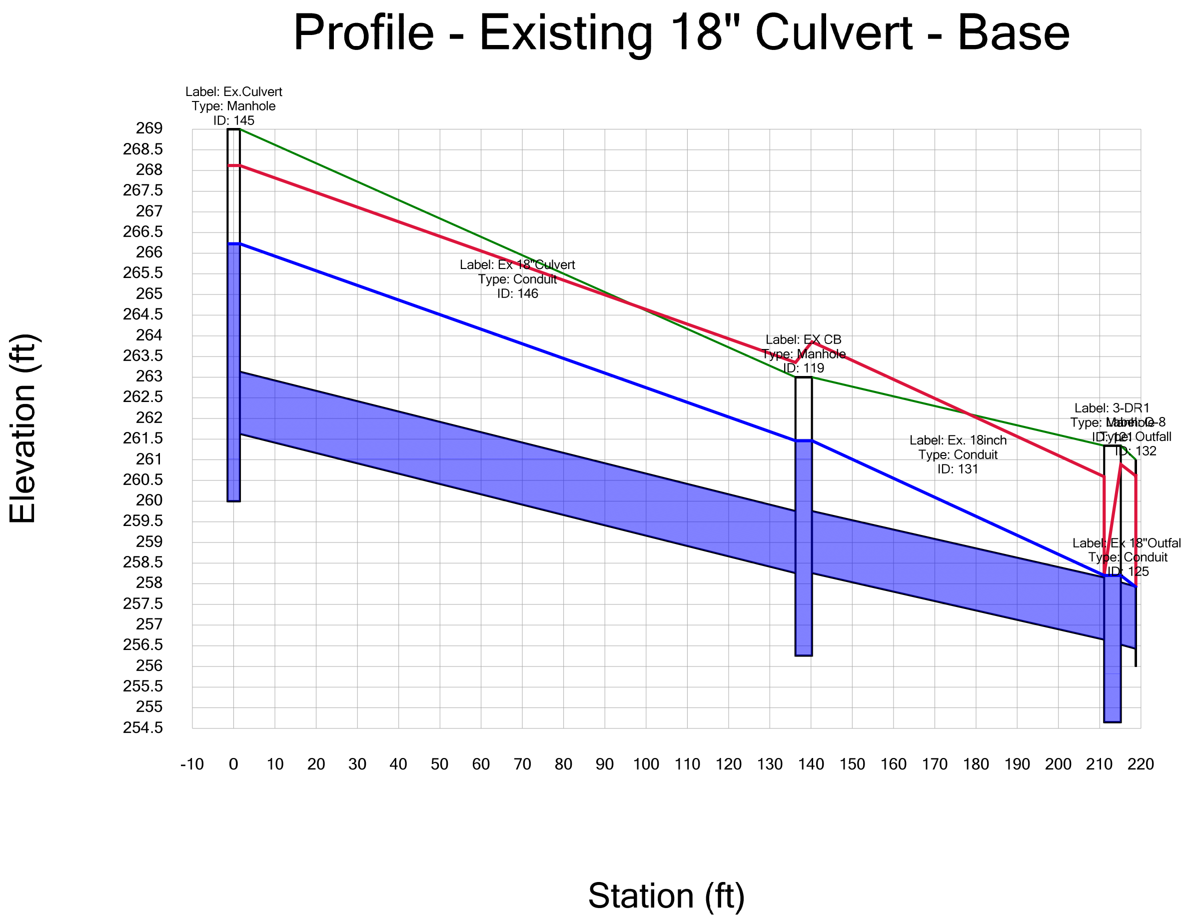
Calculation Detailed Summary

Pond Summary

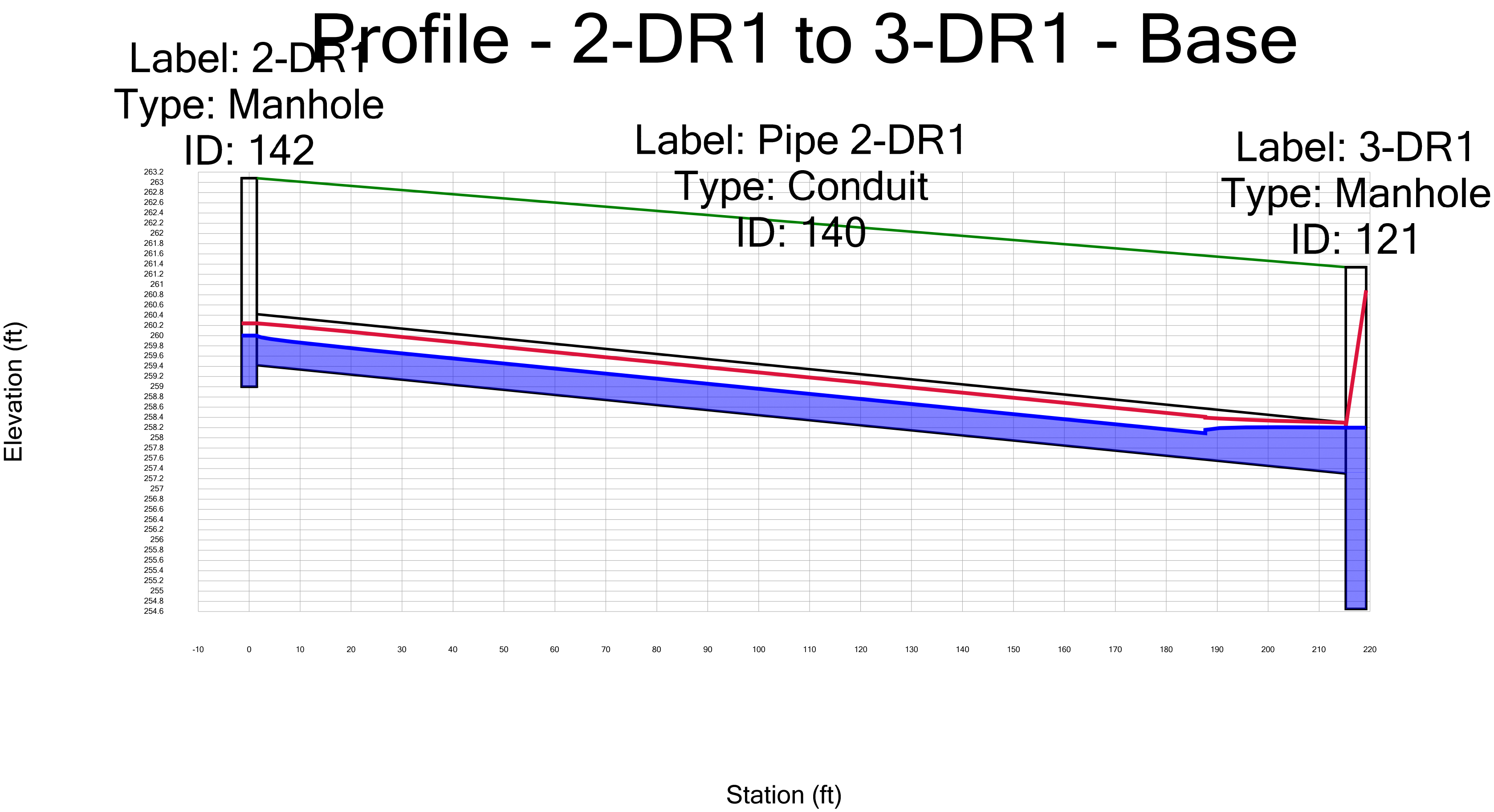
Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade (ft)	Volume (gal)

Profile Report

Profile: Profile - Existing 18" Culvert



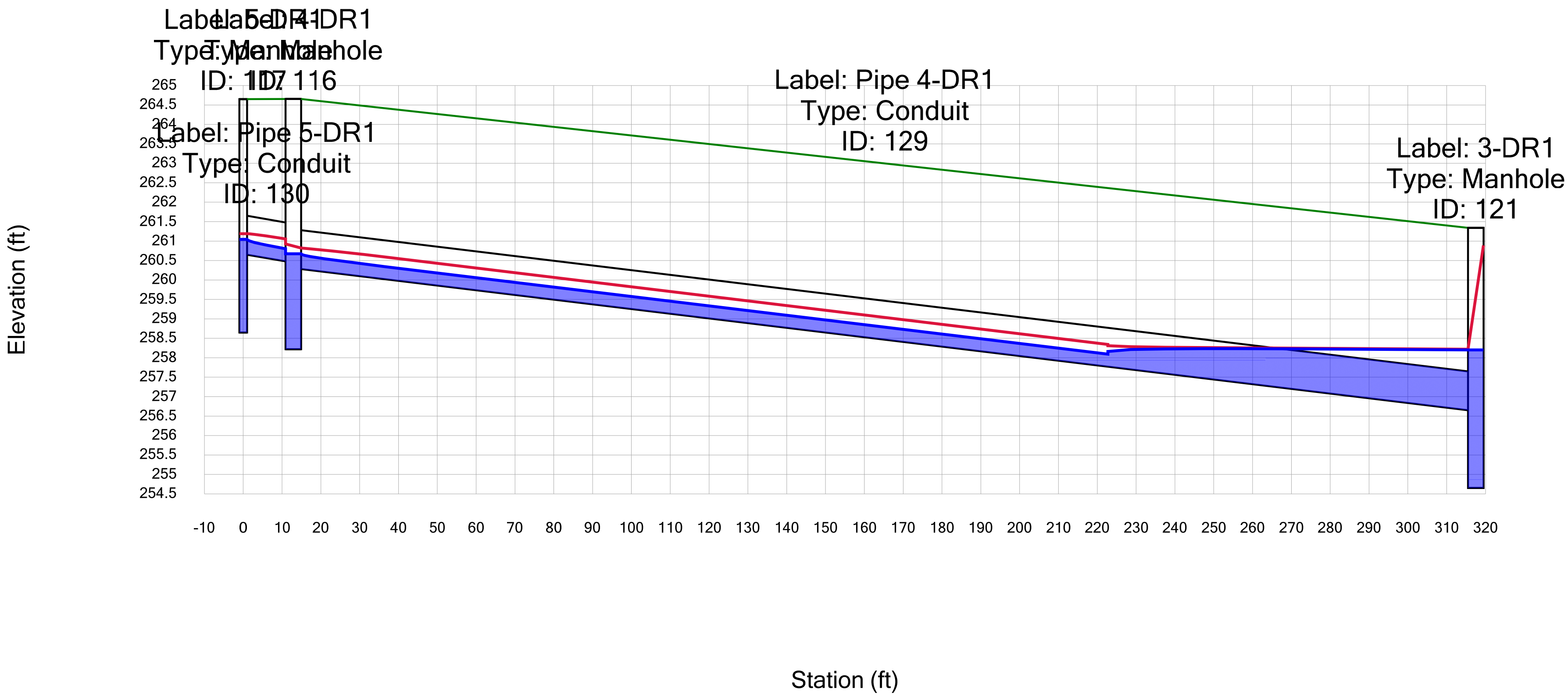
Profile Report
Profile: Profile - 2-DR1 to 3-DR1



Profile Report

Profile: Profile - 5-DR1 to 3-DR1

Profile - 5-DR1 to 3-DR1 - Base



NB South 1.stsw
12/17/2015

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA +1-203 -755-1666

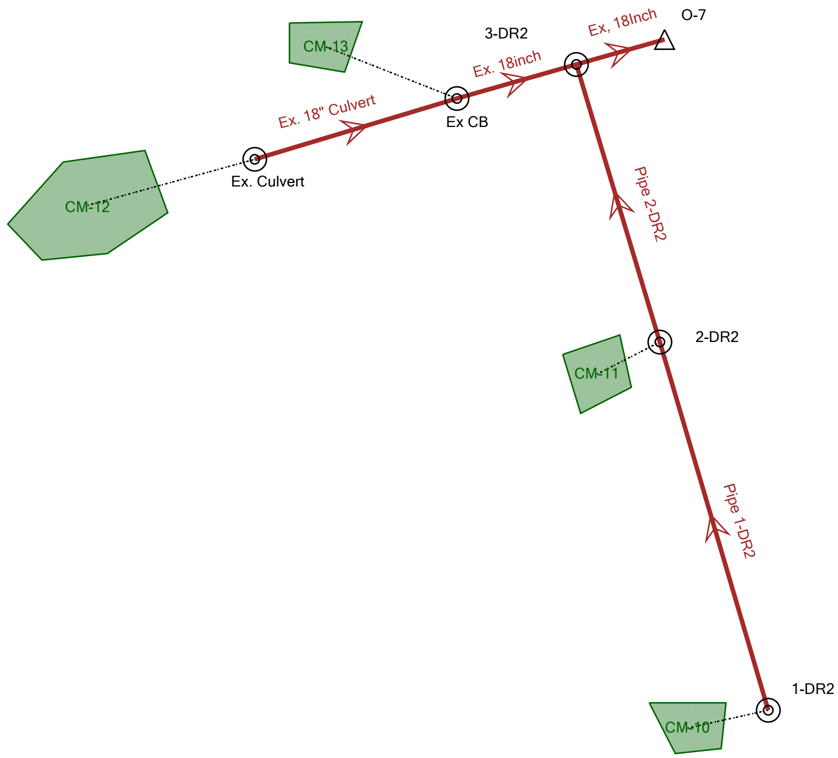
Bentley StormCAD V8i (SELECTseries 3)
[08.11.03.84]

FlexTable: Conduit Table (NB South 1.stsw)

	ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node	Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes
146: Ex 18"Culvert	146	Ex 18"Culvert	Ex.C...	☐	261.63	EX CB	☐	258.26	☐		138.2	0.024	Circle	18.0	0.013	19.51	11.04	3.20	16.40	118.9	(N/A)	
131: Ex. 18inch	131	Ex. 18inch	EX CB	☐	258.26	3-DR1	☐	256.65	☑	74.9	74.9	0.021	Circle	18.0	0.013	21.92	12.41	1.55	15.40	142.4	(N/A)	18 inch...
130: Pipe 5-DR1	130	Pipe 5-DR1	5-DR1	☐	260.65	4-DR1	☐	260.48	☑	12.9	12.9	0.013	Circle	12.0	0.013	0.88	4.15	0.32	4.09	21.6	31.6	12 inch...
129: Pipe 4-DR1	129	Pipe 4-DR1	4-DR1	☐	260.28	3-DR1	☐	256.65	☑	304.6	304.6	0.012	Circle	12.0	0.013	0.88	4.01	1.55	3.89	22.6	32.3	12 inch...
140: Pipe 2-DR1	140	Pipe 2-DR1	2-DR1	☐	259.42	3-DR1	☐	257.30	☐		217.2	0.010	Circle	12.0	0.013	1.86	4.54	0.90	3.52	52.8	51.7	
125: Ex 18"Outfall	125	Ex 18"Outfall	3-DR1	☐	256.53	O-8	☐	256.43	☑	5.7	20.5	0.018	Circle	18.0	0.013	23.25	13.16	1.48	13.97	166.4	(N/A)	18 inch...

6 of 6 elements displayed

Scenario: Base



Calculation Detailed Summary

Element Details

ID	26	Notes	
Label	Base Calculation Options		

Hydraulic Summary

Flow Profile Method	Backwater Analysis	Average Velocity Method	Actual Uniform Flow Velocity
Number of Flow Profile Steps	5	Minimum Structure Headloss	0.00 ft
Hydraulic Grade Convergence Test	0.00 ft	Minimum Time of Concentration	5 min

Inlets

Neglect Side Flow?	False	Active Components for Combination Inlets In Sag	Grate and Curb
Neglect Gutter Cross Slope For Side Flow?	False	Active Components for Combination Inlets on Grade	Grate and Curb

HEC-22 Energy Losses

Elevations Considered Equal Within	0.50 ft	Depressed Unsubmerged Factor	1.000
Consider Non-Piped Plunging Flow?	False	Half Bench Submerged Factor	0.950
Flat Submerged Factor	1.000	Half Bench Unsubmerged Factor	0.150
Flat Unsubmerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Submerged Factor	1.000	Full Bench Unsubmerged Factor	0.070

Headloss (AASHTO)

Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Bend Angle vs. Bend Loss Curve

Calculation Detailed Summary

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

Gravity Hydraulics

Governing Upstream Pipe Selection Method	Pipe with Maximum QV

Catchment Summary

Label	Area (User Defined) (acres)	Time of Concentration (min)	Rational C	Catchment CA (acres)	Catchment Intensity (in/h)	Catchment Rational Flow (cfs)
CM-10	0.278	5	0.900	0.250	3.359	0.85
CM-11	0.930	5	0.900	0.837	3.359	2.83
CM-12	11.600	10	0.562	6.523	2.335	15.35
CM-13	1.410	5	0.650	0.916	3.359	3.10

Conduit Summary

Label	Section Type	Branch ID	Subnetwork Outfall	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)
Ex, 18Inch	Circle	1	O-7	19.77	11.18	263.27
Pipe 1-DR2	Circle	1	O-7	0.85	1.08	264.58
Pipe 2-DR2	Circle	1	O-7	2.83	3.61	264.44
Ex. 18" Culvert	Circle	2	O-7	15.35	8.69	268.31
Ex. 18inch	Circle	2	O-7	17.34	9.81	265.43

Calculation Detailed Summary

Conduit Summary

Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
261.18	3.12	1.47
264.44	1.08	2.17
263.27	2.27	2.62
265.43	2.58	4.68
263.27	4.69	3.12

Node Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
2-DR2	Manhole	O-7	3.68	2.83	269.00	260.17	264.46	264.64
3-DR2	Manhole	O-7	20.17	19.77	269.98	258.15	263.47	265.22
1-DR2	Manhole	O-7	0.85	0.85	267.75	261.50	264.60	264.60
O-7	Outfall	(N/A)	(N/A)	19.70	261.00	259.00	(N/A)	(N/A)
Ex. Culvert	Manhole	O-7	15.35	15.35	270.00	265.00	269.49	269.49
Ex CB	Manhole	O-7	18.46	17.34	267.38	260.00	266.61	266.93

Inlet Summary

Label	Inlet Type	Catalog Inlet Type	Catalog Inlet	Flow (Captured) (cfs)	Flow (Total Bypassed) (cfs)	Bypass Target	Capture Efficiency (Calculated) (%)	Depth (Gutter) (in)	Spread / Top Width (ft)

Pond Summary

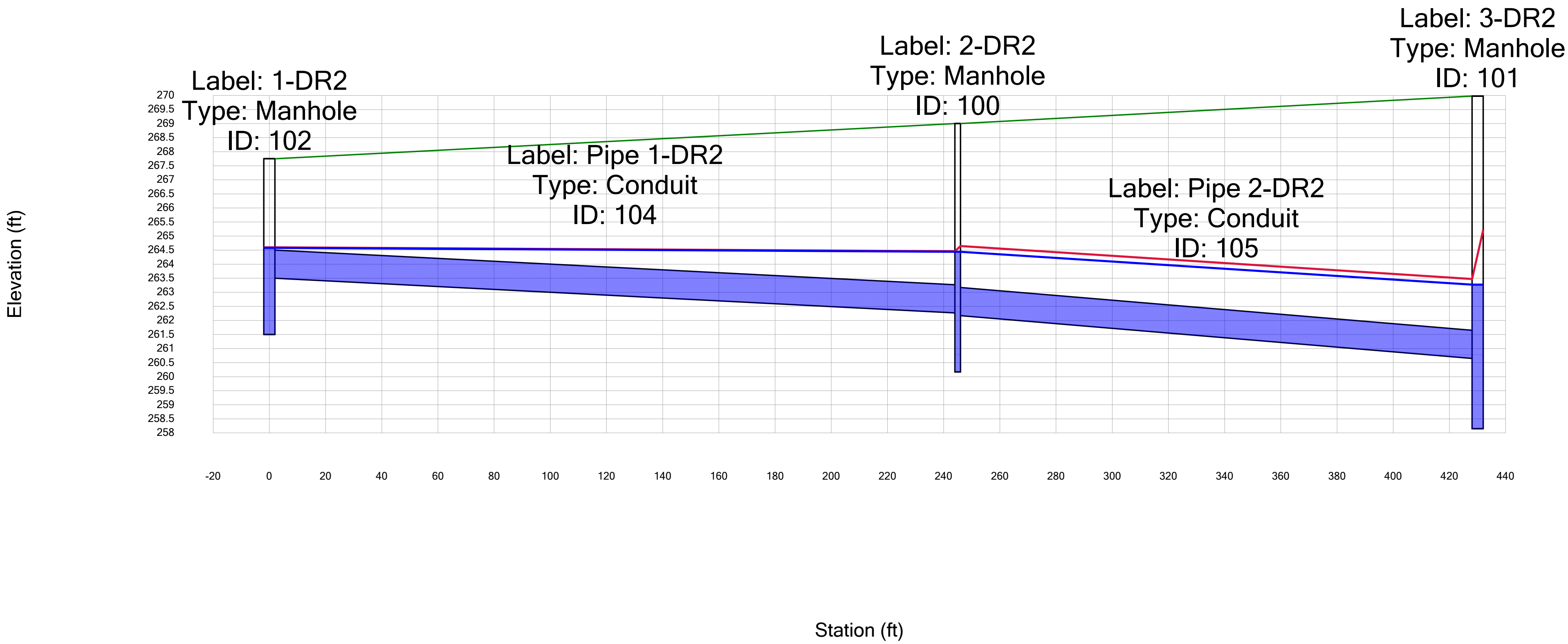
Calculation Detailed Summary

Pond Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade (ft)	Volume (gal)

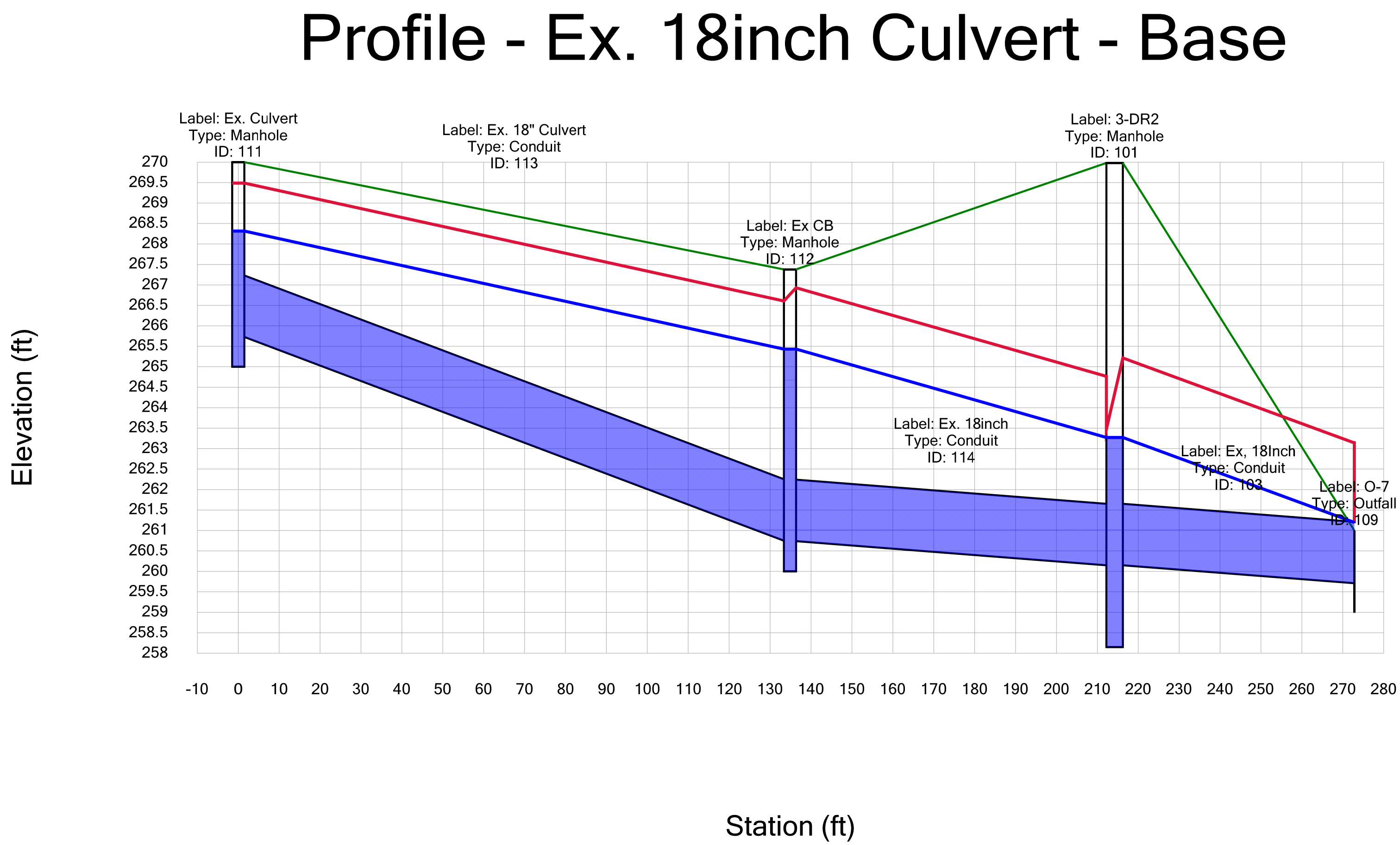
Profile Report
Profile: Profile - 1-DR2 to 3-DR2

Profile - 1-DR2 to 3-DR2 - Base



Profile Report

Profile: Profile - Ex. 18inch Culvert

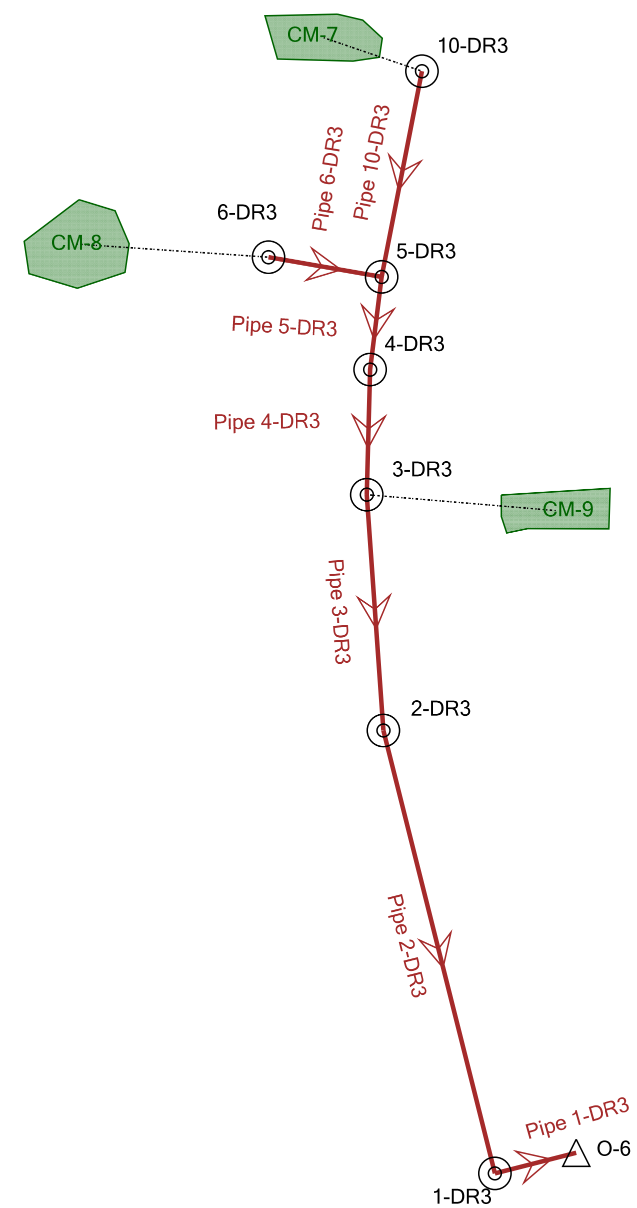


FlexTable: Conduit Table (NB South 2.stsw)

	ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node	Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes
113: Ex. 18" Culv...	113	Ex. 18" Culv...	Ex. C...	☐	265.73	Ex CB	☐	260.75	☐		134.9	0.037	Circle	18.0	0.013	15.35	8.69	4.68	20.18	76.1	65.3	
114: Ex. 18inch	114	Ex. 18inch	Ex CB	☐	260.74	3-DR2	☐	260.15	☐		79.4	0.007	Circle	18.0	0.013	17.34	9.81	3.12	9.06	191.4	(N/A)	
104: Pipe 1-DR2	104	Pipe 1-DR2	1-DR2	☐	263.50	2-DR2	☐	262.27	☑	245.0	245.0	0.005	Circle	12.0	0.013	0.85	1.08	2.17	2.53	33.6	39.9	12 inch...
105: Pipe 2-DR2	105	Pipe 2-DR2	2-DR2	☐	262.17	3-DR2	☐	260.65	☑	185.0	185.0	0.008	Circle	12.0	0.013	2.83	3.61	2.62	3.23	87.7	72.6	12 inch...
103: Ex, 18Inch	103	Ex, 18Inch	3-DR2	☐	260.15	O-7	☐	259.71	☑	58.6	58.6	0.007	Circle	18.0	0.013	19.77	11.18	1.47	9.10	217.3	(N/A)	18 inch...

5 of 5 elements displayed

Scenario: Base



Calculation Detailed Summary

Element Details

ID	26	Notes	
Label	Base Calculation Options		

Hydraulic Summary

Flow Profile Method	Backwater Analysis	Average Velocity Method	Actual Uniform Flow Velocity
Number of Flow Profile Steps	5	Minimum Structure Headloss	0.00 ft
Hydraulic Grade Convergence Test	0.00 ft	Minimum Time of Concentration	5 min

Inlets

Neglect Side Flow?	False	Active Components for Combination Inlets In Sag	Grate and Curb
Neglect Gutter Cross Slope For Side Flow?	False	Active Components for Combination Inlets on Grade	Grate and Curb

HEC-22 Energy Losses

Elevations Considered Equal Within	0.50 ft	Depressed Unsubmerged Factor	1.000
Consider Non-Piped Plunging Flow?	False	Half Bench Submerged Factor	0.950
Flat Submerged Factor	1.000	Half Bench Unsubmerged Factor	0.150
Flat Unsubmerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Submerged Factor	1.000	Full Bench Unsubmerged Factor	0.070

Headloss (AASHTO)

Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Bend Angle vs. Bend Loss Curve

Calculation Detailed Summary

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

Gravity Hydraulics	
Governing Upstream Pipe Selection Method	Pipe with Maximum QV

Catchment Summary

Label	Area (User Defined) (acres)	Time of Concentration (min)	Rational C	Catchment CA (acres)	Catchment Intensity (in/h)	Catchment Rational Flow (cfs)
CM-7	0.090	5	0.300	0.027	3.359	0.09
CM-8	2.850	10	0.729	2.079	2.335	4.89
CM-9	0.090	5	0.300	0.027	3.359	0.09

Conduit Summary

Label	Section Type	Branch ID	Subnetwork Outfall	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)
Pipe 2-DR3	Circle	1	O-6	4.70	4.79	257.12
Pipe 3-DR3	Circle	1	O-6	4.83	4.06	257.99
Pipe 10-DR3	Circle	2	O-6	0.09	2.29	261.25
Pipe 6-DR3	Circle	1	O-6	4.89	4.01	259.17
Pipe 5-DR3	Circle	1	O-6	4.89	3.98	258.77
Pipe 4-DR3	Circle	1	O-6	4.84	4.01	258.43
Pipe 1-DR3	Circle	1	O-6	4.54	4.02	255.14

Calculation Detailed Summary

Conduit Summary

Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
255.65	0.83	0.82
257.24	0.96	0.85
258.87	0.12	0.10
258.77	0.97	0.87
258.43	0.97	0.87
257.99	0.97	0.86
254.82	0.91	0.82

Node Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)
2-DR3	Manhole	O-6	4.83	4.70	266.91	255.82
10-DR3	Manhole	O-6	0.09	0.09	265.71	259.13
6-DR3	Manhole	O-6	4.89	4.89	266.22	256.91
5-DR3	Manhole	O-6	4.98	4.89	263.54	257.40
3-DR3	Manhole	O-6	4.93	4.83	263.13	256.65
4-DR3	Manhole	O-6	4.89	4.84	263.54	257.08
1-DR3	Manhole	O-6	4.70	4.54	271.25	253.00
O-6	Outfall	(N/A)	(N/A)	4.50	260.00	251.00

Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
257.47	257.46
261.29	261.29
259.43	259.43
259.10	259.03
258.32	258.24
258.76	258.68
255.50	255.40
(N/A)	(N/A)

Inlet Summary

Label	Inlet Type	Catalog Inlet Type	Catalog Inlet	Flow (Captured) (cfs)	Flow (Total Bypassed) (cfs)	Bypass Target

Calculation Detailed Summary

Inlet Summary

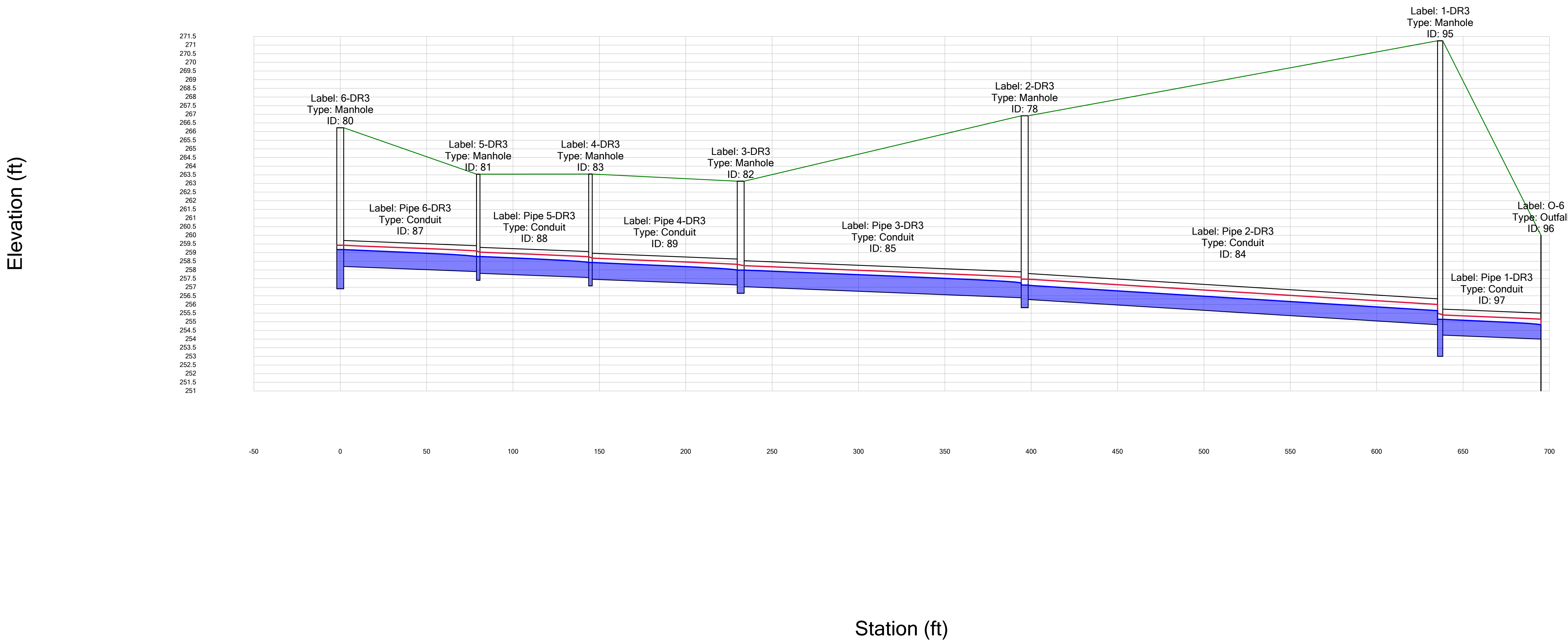
Capture Efficiency (Calculated) (%)	Depth (Gutter) (in)	Spread / Top Width (ft)

Pond Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade (ft)	Volume (gal)

Profile Report
Profile: Profile - 6-DR3 to Outfall

Profile - 6-DR3 to Outfall - Base

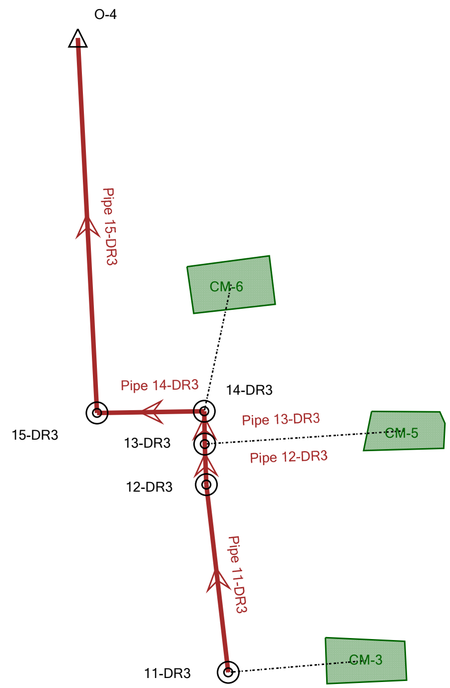


FlexTable: Conduit Table (Pond3-1_OutflowSouth.stsw)

	ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node	Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes
87: Pipe 6-DR3	87	Pipe 6-DR3	6-DR3	☐	258.20	5-DR3	☐	257.90	☑	79.9	79.9	0.004	Circle	18.0	0.013	4.89	4.01	0.87	6.44	76.0	65.2	
86: Pipe 10-DR3	86	Pipe 10-DR3	10-DR3	☐	261.13	5-DR3	☐	258.77	☑	145.7	145.7	0.016	Circle	12.0	0.013	0.09	2.29	0.10	4.53	2.0	9.8	
88: Pipe 5-DR3	88	Pipe 5-DR3	5-DR3	☐	257.80	4-DR3	☐	257.56	☑	65.0	65.0	0.004	Circle	18.0	0.013	4.89	3.98	0.87	6.38	76.6	65.6	
89: Pipe 4-DR3	89	Pipe 4-DR3	4-DR3	☐	257.46	3-DR3	☐	257.13	☑	87.0	87.0	0.004	Circle	18.0	0.013	4.84	4.01	0.86	6.47	74.8	64.5	
85: Pipe 3-DR3	85	Pipe 3-DR3	3-DR3	☐	257.03	2-DR3	☐	256.39	☑	164.4	164.4	0.004	Circle	18.0	0.013	4.83	4.06	0.85	6.55	73.8	63.9	
84: Pipe 2-DR3	84	Pipe 2-DR3	2-DR3	☐	256.29	1-DR3	☐	254.83	☑	240.5	317.6	0.006	Circle	18.0	0.013	4.70	4.79	0.82	8.18	57.5	54.4	
97: Pipe 1-DR3	97	Pipe 1-DR3	1-DR3	☐	254.23	O-6	☐	254.00	☐		58.4	0.004	Circle	18.0	0.013	4.54	4.02	0.82	6.59	68.9	61.0	

7 of 7 elements displayed

Scenario: Base



Calculation Detailed Summary

Element Details

ID	26	Notes	
Label	Base Calculation Options		

Hydraulic Summary

Flow Profile Method	Backwater Analysis	Average Velocity Method	Actual Uniform Flow Velocity
Number of Flow Profile Steps	5	Minimum Structure Headloss	0.00 ft
Hydraulic Grade Convergence Test	0.00 ft	Minimum Time of Concentration	5 min

Inlets

Neglect Side Flow?	False	Active Components for Combination Inlets In Sag	Grate and Curb
Neglect Gutter Cross Slope For Side Flow?	False	Active Components for Combination Inlets on Grade	Grate and Curb

HEC-22 Energy Losses

Elevations Considered Equal Within	0.50 ft	Depressed Unsubmerged Factor	1.000
Consider Non-Piped Plunging Flow?	False	Half Bench Submerged Factor	0.950
Flat Submerged Factor	1.000	Half Bench Unsubmerged Factor	0.150
Flat Unsubmerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Submerged Factor	1.000	Full Bench Unsubmerged Factor	0.070

Headloss (AASHTO)

Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Bend Angle vs. Bend Loss Curve

Calculation Detailed Summary

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

Gravity Hydraulics	
Governing Upstream Pipe Selection Method	Pipe with Maximum QV

Catchment Summary

Label	Area (User Defined) (acres)	Time of Concentration (min)	Rational C	Catchment CA (acres)	Catchment Intensity (in/h)	Catchment Rational Flow (cfs)
CM-3	1.074	5	0.900	0.966	3.359	3.27
CM-5	0.113	5	0.900	0.102	3.359	0.34
CM-6	0.415	5	0.900	0.373	3.359	1.26

Conduit Summary

Label	Section Type	Branch ID	Subnetwork Outfall	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)
Pipe 15-DR3	Circle	1	O-4	4.49	2.54	263.70
Pipe 11-DR3	Circle	1	O-4	3.27	2.67	264.41
Pipe 14-DR3	Circle	1	O-4	4.61	2.61	263.87
Pipe 12-DR3	Circle	1	O-4	3.14	2.56	264.09
Pipe 13-DR3	Circle	1	O-4	3.44	2.80	263.97

Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)

Calculation Detailed Summary

Conduit Summary

Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
263.32	3.91	4.32
264.14	2.84	3.45
263.75	3.68	3.86
264.04	3.50	3.56
263.92	3.59	3.63

Node Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)
11-DR3	Manhole	O-4	3.27	3.27	265.82	259.57
15-DR3	Manhole	O-4	4.61	4.49	266.37	258.54
12-DR3	Manhole	O-4	3.27	3.14	264.45	259.05
14-DR3	Manhole	O-4	4.70	4.61	264.43	258.84
13-DR3	Manhole	O-4	3.48	3.44	264.41	258.93
O-4	Outfall	(N/A)	(N/A)	4.08	259.50	258.00

Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
264.58	264.52
263.86	263.80
264.25	264.19
264.04	263.98
264.14	264.10
(N/A)	(N/A)

Inlet Summary

Label	Inlet Type	Catalog Inlet Type	Catalog Inlet	Flow (Captured) (cfs)	Flow (Total Bypassed) (cfs)	Bypass Target

Capture Efficiency (Calculated) (%)	Depth (Gutter) (in)	Spread / Top Width (ft)

Pond Summary

Calculation Detailed Summary

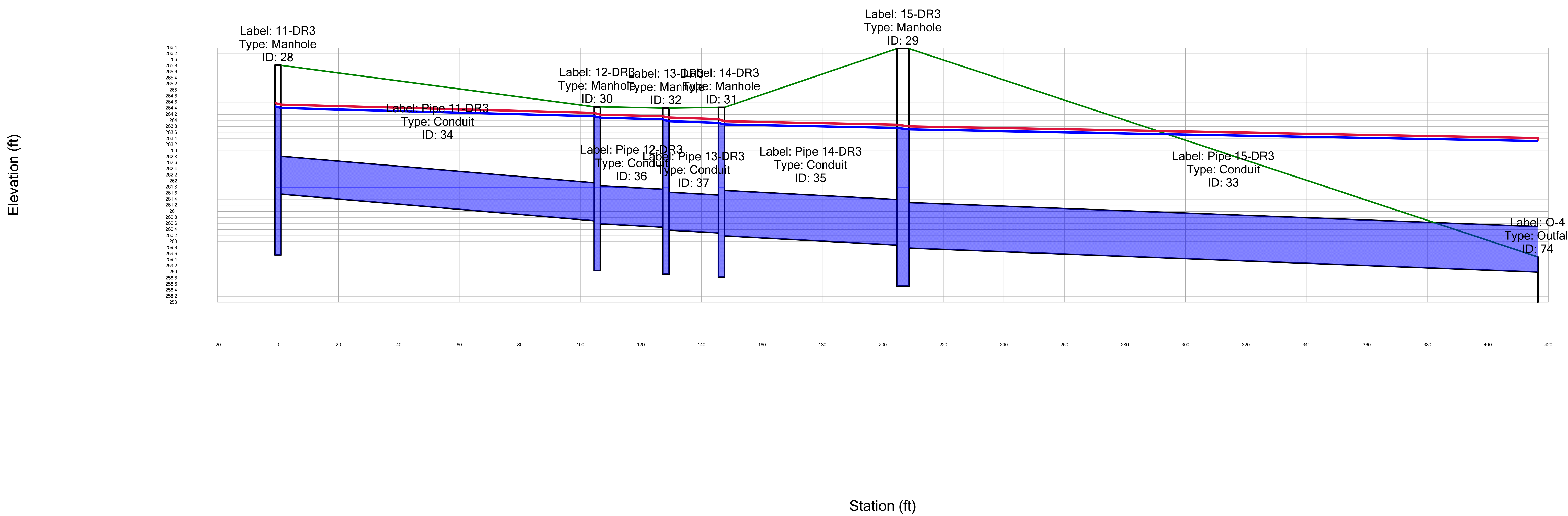
Pond Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade (ft)	Volume (gal)

Profile Report

Profile: Profile - 11-DR3 to Pond3-1

Profile - 11-DR3 to Pond3-1 - Base

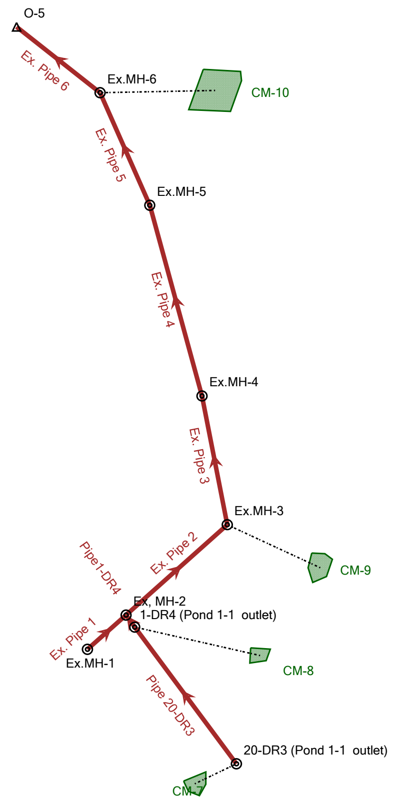


FlexTable: Conduit Table (Pond3-1_InflowSouth.stsw)

	ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node	Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes
34: Pipe 11-DR3	34	Pipe 11-DR3	11-DR3	☐	261.57	12-DR3	☐	260.69	☑	105.6	105.6	0.008	Circle	15.0	0.013	3.27	2.67	3.45	5.90	55.5	53.2	
36: Pipe 12-DR3	36	Pipe 12-DR3	12-DR3	☐	260.59	13-DR3	☐	260.48	☑	22.7	22.7	0.005	Circle	15.0	0.013	3.14	2.56	3.56	4.50	69.8	61.5	
37: Pipe 13-DR3	37	Pipe 13-DR3	13-DR3	☐	260.38	14-DR3	☐	260.29	☑	18.4	18.4	0.005	Circle	15.0	0.013	3.44	2.80	3.63	4.52	76.1	65.3	
35: Pipe 14-DR3	35	Pipe 14-DR3	14-DR3	☐	260.19	15-DR3	☐	259.89	☑	60.0	60.0	0.005	Circle	18.0	0.013	4.61	2.61	3.86	7.43	62.0	57.0	
33: Pipe 15-DR3	33	Pipe 15-DR3	15-DR3	☐	259.79	O-4	☐	259.00	☑	209.8	209.8	0.004	Circle	18.0	0.013	4.49	2.54	4.32	6.44	69.7	61.5	

5 of 5 elements displayed

Scenario: Base



Calculation Detailed Summary

Element Details

ID	26	Notes	
Label	Base Calculation Options		

Hydraulic Summary

Flow Profile Method	Backwater Analysis	Average Velocity Method	Actual Uniform Flow Velocity
Number of Flow Profile Steps	5	Minimum Structure Headloss	0.00 ft
Hydraulic Grade Convergence Test	0.00 ft	Minimum Time of Concentration	5 min

Inlets

Neglect Side Flow?	False	Active Components for Combination Inlets In Sag	Grate and Curb
Neglect Gutter Cross Slope For Side Flow?	False	Active Components for Combination Inlets on Grade	Grate and Curb

HEC-22 Energy Losses

Elevations Considered Equal Within	0.50 ft	Depressed Unsubmerged Factor	1.000
Consider Non-Piped Plunging Flow?	False	Half Bench Submerged Factor	0.950
Flat Submerged Factor	1.000	Half Bench Unsubmerged Factor	0.150
Flat Unsubmerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Submerged Factor	1.000	Full Bench Unsubmerged Factor	0.070

Headloss (AASHTO)

Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

Gravity Hydraulics

Governing Upstream Pipe Selection Method	Pipe with Maximum QV

Catchment Summary

Calculation Detailed Summary

Catchment Summary

Label	Area (User Defined) (acres)	Time of Concentration (min)	Rational C	Catchment CA (acres)	Catchment Intensity (in/h)	Catchment Rational Flow (cfs)
CM-7	1.870	5	0.694	1.298	3.359	4.39
CM-8	0.335	5	0.900	0.301	3.359	1.02
CM-9	4.437	5	0.800	3.550	3.359	12.02
CM-10	5.170	5	0.800	4.136	3.359	14.00

Conduit Summary

Label	Section Type	Branch ID	Subnetwork Outfall	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
Ex. Pipe 1	Circle	2	O-5	10.00	9.83	247.42	245.09	1.22	0.85
Ex. Pipe 6	Circle	1	O-5	37.64	12.34	231.32	227.66	2.08	1.50
Pipe 20-DR3	Circle	1	O-5	4.39	9.30	256.04	245.98	0.85	0.51
Pipe1-DR4	Circle	1	O-5	5.26	10.44	246.30	244.93	0.93	0.59
Ex. Pipe 2	Circle	1	O-5	15.25	8.46	245.22	242.32	1.41	1.12
Ex. Pipe 3	Circle	1	O-5	26.47	10.91	242.20	238.79	1.75	1.77
Ex. Pipe 4	Circle	1	O-5	26.15	10.60	238.79	233.48	1.74	1.25
Ex. Pipe 5	Circle	1	O-5	25.64	10.46	233.95	231.32	1.73	2.03

Node Summary

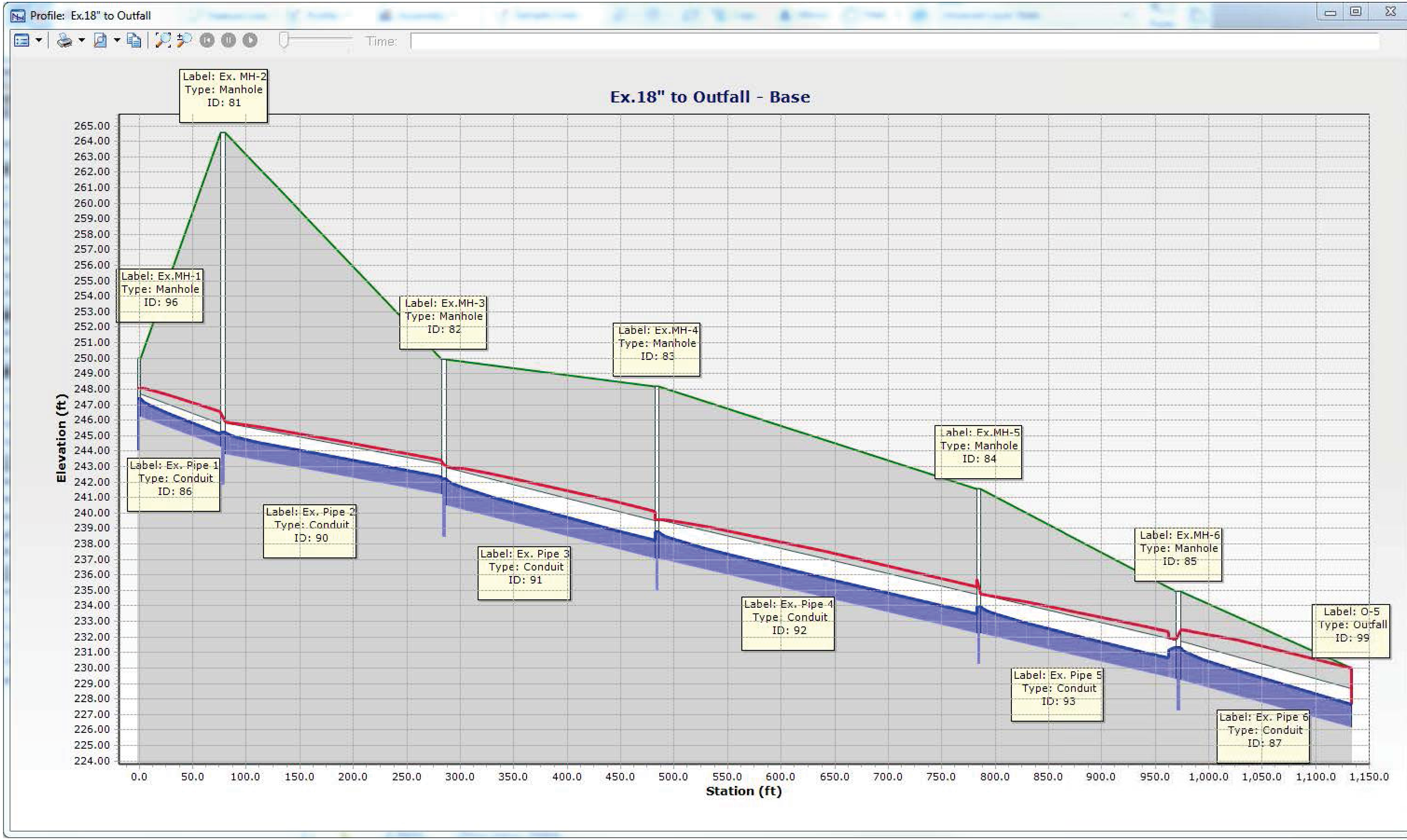
Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
20-DR3	Manhole	O-5	4.39	4.39	260.55	254.00	256.42	256.42
1-DR4	Manhole	O-5	5.41	5.26	262.25	248.20	247.64	246.75
Ex. MH-2	Manhole	O-5	15.26	15.25	264.55	241.81	246.52	245.86
Ex.MH-3	Manhole	O-5	27.27	26.47	249.90	238.45	243.32	243.01
Ex.MH-4	Manhole	O-5	26.47	26.15	248.15	235.02	239.58	239.59
Ex.MH-5	Manhole	O-5	26.15	25.64	241.56	230.22	235.70	234.73
Ex.MH-6	Manhole	O-5	39.65	37.64	234.92	227.24	231.88	232.48
Ex.MH-1	Manhole	O-5	10.00	10.00	250.00	244.00	248.08	248.08
O-5	Outfall	(N/A)	(N/A)	37.22	230.00	225.00	(N/A)	(N/A)

Inlet Summary

Label	Inlet Type	Catalog Inlet Type	Catalog Inlet	Flow (Captured) (cfs)	Flow (Total Bypassed) (cfs)	Bypass Target	Capture Efficiency (Calculated) (%)	Depth (Gutter) (in)	Spread / Top Width (ft)

Pond Summary

Label	Element Type	Subnetwork Outfall	Flow (Total In) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade (ft)	Volume (gal)


Profile: Ex.18" to Outfall
Time:
Ex.18" to Outfall - Base
Label: Ex. MH-2
Type: Manhole
ID: 81
Label: Ex.MH-1
Type: Manhole
ID: 96
Label: Ex.MH-3
Type: Manhole
ID: 82
Label: Ex.MH-4
Type: Manhole
ID: 83
Label: Ex.MH-5
Type: Manhole
ID: 84
Label: Ex.MH-6
Type: Manhole
ID: 85
Label: O-5
Type: Outfall
ID: 99
Label: Ex. Pipe 1
Type: Conduit
ID: 86
Label: Ex. Pipe 2
Type: Conduit
ID: 90
Label: Ex. Pipe 3
Type: Conduit
ID: 91
Label: Ex. Pipe 4
Type: Conduit
ID: 92
Label: Ex. Pipe 5
Type: Conduit
ID: 93
Label: Ex. Pipe 6
Type: Conduit
ID: 87
Elevation (ft)
265.00
264.00
263.00
262.00
261.00
260.00
259.00
258.00
257.00
256.00
255.00
254.00
253.00
252.00
251.00
250.00
249.00
248.00
247.00
246.00
245.00
244.00
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700.0
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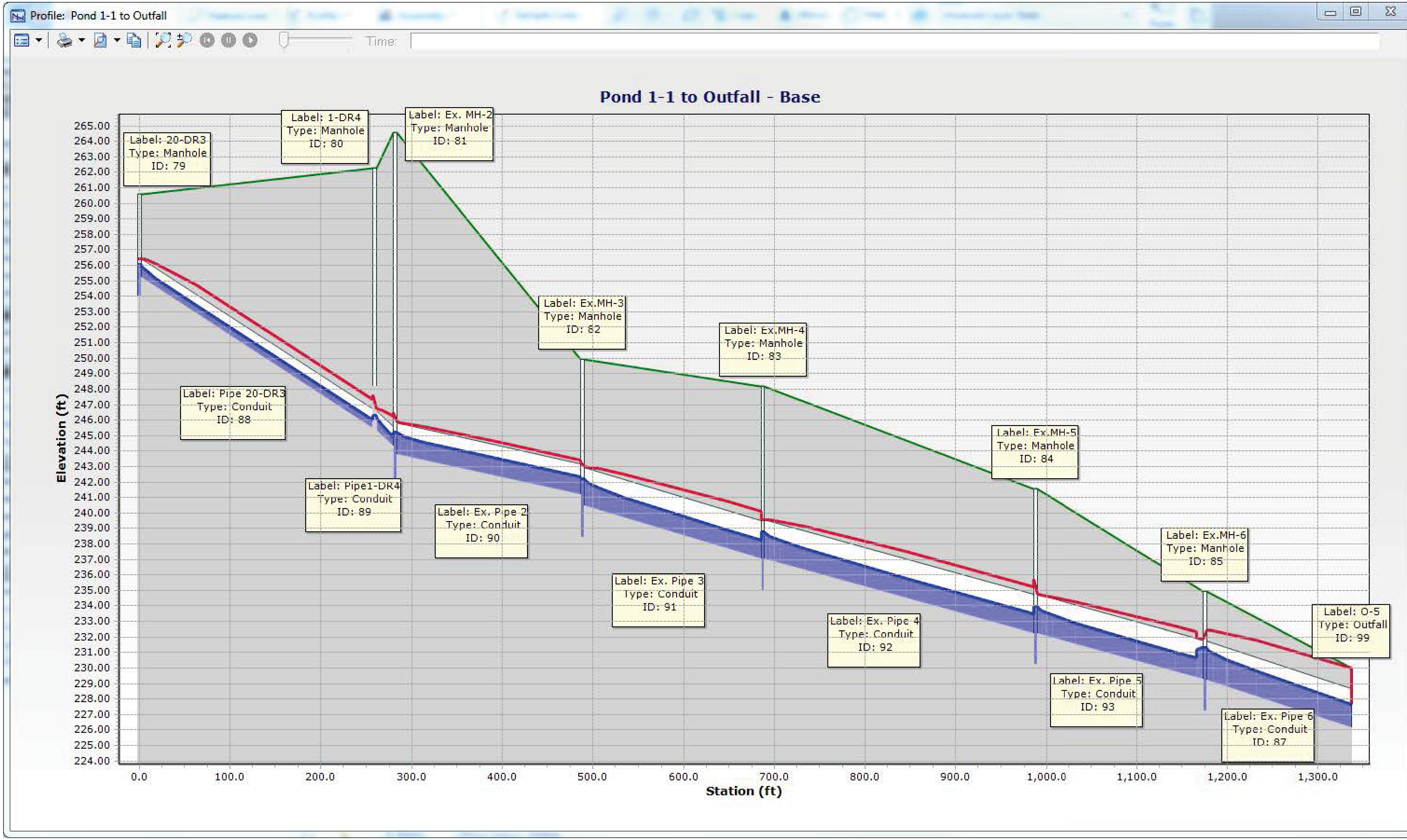
Station (ft)



Profile: Pond 1-1 to Outfall
Time:
Pond 1-1 to Outfall - Base
Label: 20-DR3
Type: Manhole
ID: 79
Label: 1-DR4
Type: Manhole
ID: 80
Label: Ex. MH-2
Type: Manhole
ID: 81
Label: Ex.MH-3
Type: Manhole
ID: 82
Label: Ex.MH-4
Type: Manhole
ID: 83
Label: Ex.MH-5
Type: Manhole
ID: 84
Label: Ex.MH-6
Type: Manhole
ID: 85
Label: O-5
Type: Outfall
ID: 99
Label: Pipe 20-DR3
Type: Conduit
ID: 88
Label: Pipe1-DR4
Type: Conduit
ID: 89
Label: Ex. Pipe 2
Type: Conduit
ID: 90
Label: Ex. Pipe 3
Type: Conduit
ID: 91
Label: Ex. Pipe 4
Type: Conduit
ID: 92
Label: Ex. Pipe 5
Type: Conduit
ID: 93
Label: Ex. Pipe 6
Type: Conduit
ID: 87
Elevation (ft)
265.00
264.00
263.00
262.00
261.00
260.00
259.00
258.00
257.00
256.00
255.00
254.00
253.00
252.00
251.00
250.00
249.00
248.00
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225.00
224.00
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1,000.0
1,100.0
1,200.0
1,300.0
Station (ft)

FlexTable: Conduit Table (Pond1-1_Outflow2.stsw)

	ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node	Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes
88: Pipe 20-...	88	Pipe 20-DR3	20-DR3 (Pon...	☐	256.00	1-DR4 (Pond...	☐	250.20	☑	258.9	258.8	0.022	Circle	15.0	0.013	4.39	7.69	0.98	9.67	45.5	47.3	15 inch...
89: Pipe1-DR4	89	Pipe1-DR4	1-DR4 (Pond...	☐	250.20	Ex, MH-2	☐	247.00	☑	22.8	22.6	0.140	Circle	15.0	0.013	5.92	16.28	0.48	24.18	24.5	33.7	15 inch...
86: Ex. Pipe 1	86	Ex. Pipe 1	Ex.MH-1	☐	246.20	Ex, MH-2	☐	244.24	☑	78.4	78.4	0.025	Circle	18.0	0.013	10.00	9.83	0.85	16.61	60.2	56.0	18 inch...
90: Ex. Pipe 2	90	Ex. Pipe 2	Ex, MH-2	☐	243.81	Ex.MH-3	☐	241.20	☑	206.2	206.2	0.013	Circle	24.0	0.013	15.91	8.55	1.15	25.45	62.5	57.3	24 inch...
91: Ex. Pipe 3	91	Ex. Pipe 3	Ex.MH-3	☐	240.45	Ex.MH-4	☐	237.02	☑	199.4	199.3	0.017	Circle	30.0	0.013	27.06	10.97	1.79	53.80	50.3	50.2	30 inch...
92: Ex. Pipe 4	92	Ex. Pipe 4	Ex.MH-4	☐	237.05	Ex.MH-5	☐	232.22	☑	300.6	300.5	0.016	Circle	30.0	0.013	26.73	10.66	1.27	51.97	51.4	50.8	30 inch...
93: Ex. Pipe 5	93	Ex. Pipe 5	Ex.MH-5	☐	232.22	Ex.MH-6	☐	229.29	☑	187.0	187.0	0.016	Circle	30.0	0.013	26.21	10.52	2.04	51.37	51.0	50.6	30 inch...
87: Ex. Pipe 6	87	Ex. Pipe 6	Ex.MH-6	☐	229.24	O-5	☐	226.16	☑	161.6	161.6	0.019	Circle	30.0	0.013	38.12	12.37	1.52	56.62	67.3	60.1	30 inch...

8 of 8 elements displayed

Property Owner Meeting Minutes

MEETING SUMMARY

I-5/NW La Center Road Interchange

Stormwater Meeting

ATTENDEES: Dave Bellinger, WSDOT
Bill Spitzer, Owner
Deva Alves, CH2M
Darren Hippenstiel, CH2M

PREPARED BY: Darren Hippenstiel

DATE: 11/19/2015

PROJECT: 458952

Objectives

A meeting was held with Bill Spitzer, owner of a property located at 31435 NW Paradise Park Road, Ridgefield, WA 98642 to discuss the proposed improvements to the NW La Center Road interchange at Interstate 5 project and existing drainage/stormwater across the subject property.

Summary

- Described the general overview of the project and improvements that will be made including a new overcrossing roadway and structure, ramp improvements, and realignment of segments of Paradise Park Road away from the subject property.
- Described the existing condition of roadways stormwater runoff and receiving water bodies including an unnamed stream across the subject property.
- Discussed calculated runoff and flows across the subject property and new runoff and flows expected following the completion of the project. No significant increase in runoff is anticipated.
- Property owner noted no apparent existing problems with the drainage and or stream across property. He noted that he has never seen flooding across the property.
- Property owner was notified of open house scheduled by project team in December 2015.
- Walked the project site and took photos of subject water body.

MEETING SUMMARY

I-5/NW La Center Road
Interchange

Stormwater Meeting

ATTENDEES: Dave Bellinger, WSDOT
Linda Fudge, Owner
Deva Alves, CH2M
Darren Hippenstiel, CH2M

PREPARED BY: Darren Hippenstiel

DATE: 11/20/2015

PROJECT: 458952

Objectives

A meeting was held with Linda Fudge, owner of a property located at 2706 NW La Center Road, Ridgefield WA, 98642 to discuss the proposed improvements to the NW La Center Road interchange at Interstate 5 project and existing drainage/stormwater across the subject property. Mrs. Fudge's son also attended the meeting.

Summary

- Described the general overview of the project and improvements that will be made including a new overcrossing roadway and structure, ramp improvements, and realignment of segments of Paradise Park Road.
- Described the existing condition of roadways stormwater runoff and receiving water bodies including McCormick Creek which runs partly across the subject property.
- Discussed calculated runoff and flows across the subject property and new runoff and flows expected following the completion of the project. No significant increase in runoff is anticipated.
- Property owner noted no apparent existing problems with the drainage and or stream across property. He noted that he has never seen flooding across the property.
- Property owner recalled watching La Center Road being constructed, 15+ years ago and the fill placed across McCormick Creek.
- Property owner was notified of open house scheduled by project team in December 2015.
- Walked the project site and took photos of subject water body.

TELEPHONE CONVERSATION RECORD

CALL TO:	Nora Morrison
PHONE NO.:	928-565-3111
DATE:	December 7, 2015
CALL FROM:	Darren Hippenstiel
SUBJECT:	Stormwater Meeting
PROJECT NO.:	458952

A phone call was made to Nora Morrison, owner of a property located along NW Paradise Park Road in Ridgefield, Washington, taxlot 211238000 to discuss the proposed improvements to the NW La Center Road interchange at Interstate 5 project and existing drainage/stormwater across the subject property.

Ms. Morrison confirmed she was the property owner.

The general overview of the project and improvements that will be made including a new overcrossing roadway and structure, ramp improvements, and realignment of segments of Paradise Park Road away from the subject property, as described to her.

Also, described the existing condition of roadways stormwater runoff and receiving water bodies including an unnamed stream across the subject property. Ms. Morrison noted the water body as having the name “Johnson Creek”.

Ms. Morrison reiterated several times her support for the project so long as the following conditions are met:

- Johnson Creek across the subject property is maintained.
- There are no impacts to the subject property, environment or creek.

Discussed with her the calculated runoff and flows across the subject property and new runoff and flows expected following the completion of the project, and how no significant increase in runoff is anticipated.

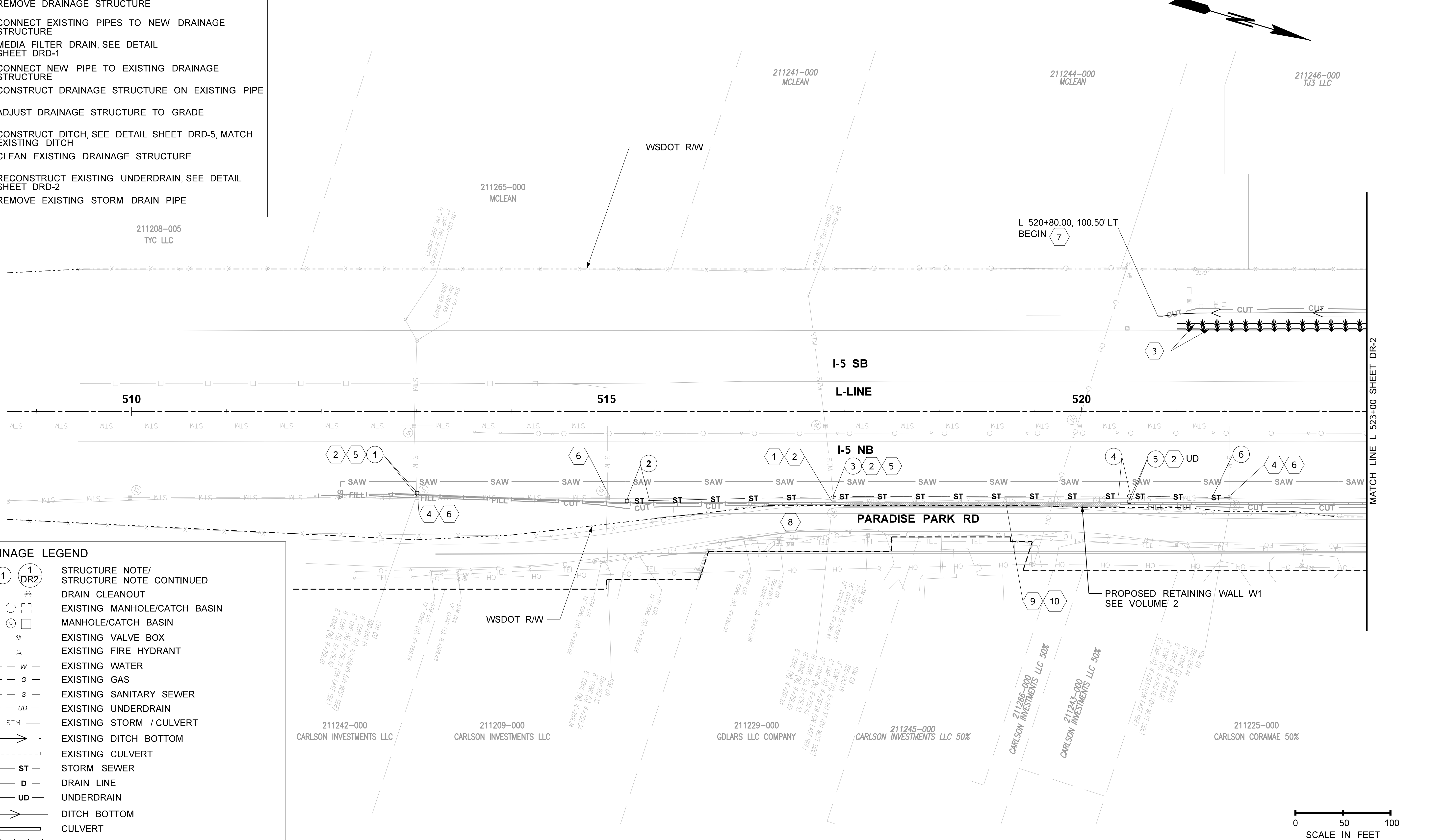
APPENDIX D

Drainage Plans and Profiles

DRAINAGE CONSTRUCTION NOTES

1. REMOVE DRAINAGE STRUCTURE
2. CONNECT EXISTING PIPES TO NEW DRAINAGE STRUCTURE
3. MEDIA FILTER DRAIN, SEE DETAIL SHEET DRD-1
4. CONNECT NEW PIPE TO EXISTING DRAINAGE STRUCTURE
5. CONSTRUCT DRAINAGE STRUCTURE ON EXISTING PIPE
6. ADJUST DRAINAGE STRUCTURE TO GRADE
7. CONSTRUCT DITCH, SEE DETAIL SHEET DRD-5, MATCH EXISTING DITCH
8. CLEAN EXISTING DRAINAGE STRUCTURE
9. RECONSTRUCT EXISTING UNDERDRAIN, SEE DETAIL SHEET DRD-2
10. REMOVE EXISTING STORM DRAIN PIPE

T.4N.R.1E. W.M.



100% SUBMITTAL - NOT FOR CONSTRUCTION

DRAINAGE LEGEND

1 / 1 DR2	STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
	DRAIN CLEANOUT
	EXISTING MANHOLE/CATCH BASIN
	MANHOLE/CATCH BASIN
	EXISTING VALVE BOX
	EXISTING FIRE HYDRANT
W — W	EXISTING WATER
G — G	EXISTING GAS
S — S	EXISTING SANITARY SEWER
UD — UD	EXISTING UNDERDRAIN
STM	EXISTING STORM / CULVERT
	EXISTING DITCH BOTTOM
	EXISTING CULVERT
ST — ST	STORM SEWER
D — D	DRAIN LINE
UD — UD	UNDERDRAIN
	DITCH BOTTOM
	CULVERT
	MEDIA FILTER DRAIN

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DATE	12/10/2015
PLOTTED BY	DENPWP01$
DESIGNED BY	D. ALVES
ENTERED BY	S. TAYLOR
CHECKED BY	R. ATTANASIO
PROJ. ENGR.	
REGIONAL ADM.	

REVISION | DATE | BY

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

DEVA ALVES, STATE OF WASHINGTON, 46329, REGISTERED PROFESSIONAL ENGINEER — PRE-FINAL — 12/3/15
DATE
P.E. STAMP BOX

DATE
P.E. STAMP BOX

COWLITZ INDIAN RESERVATION
ch2m.

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE IMPROVEMENT PROJECT

DRAINAGE PLAN

PLAN REF NO V1 DR-1
SHEET 80 OF 236 SHEETS

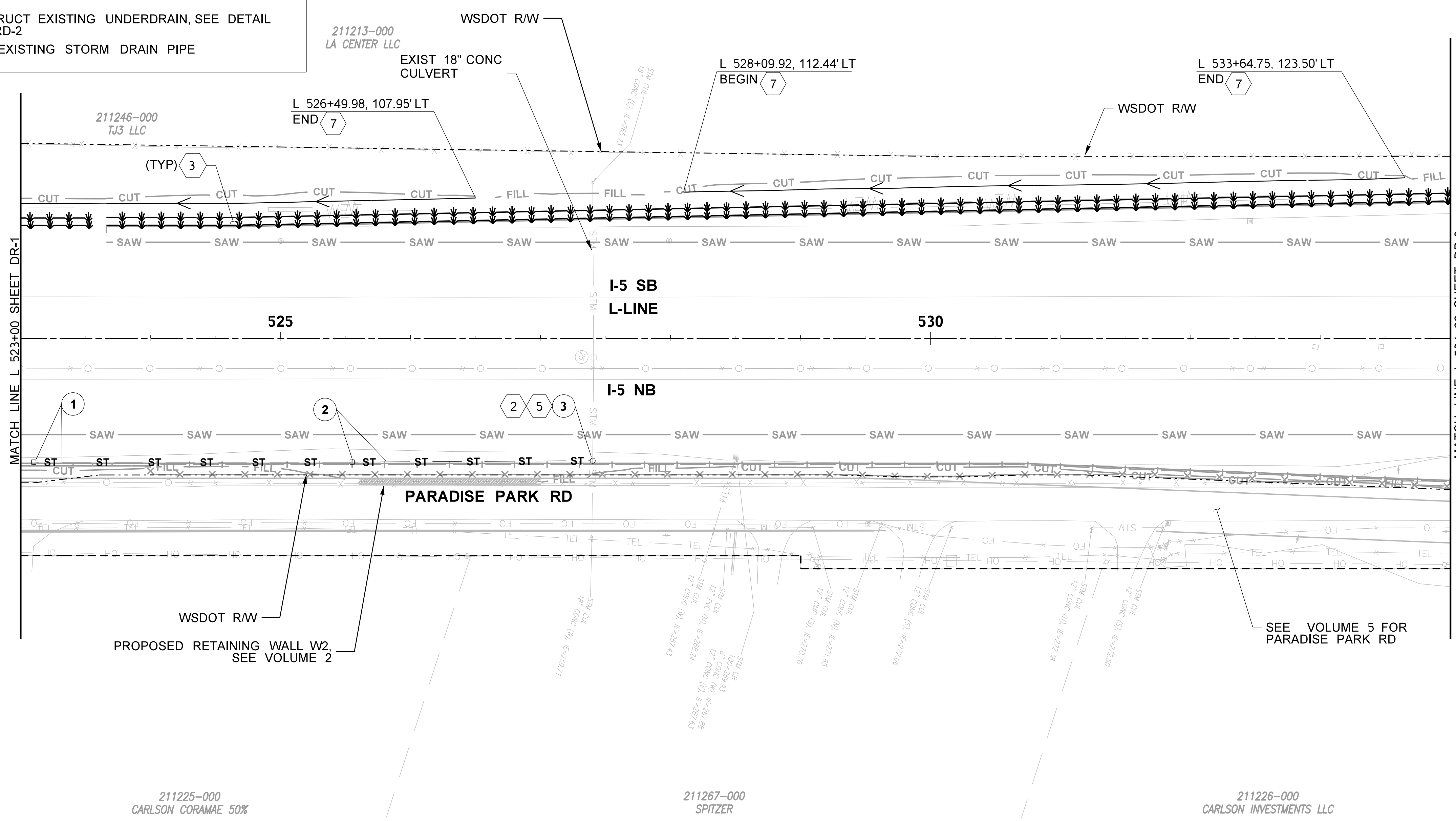
T.4N.R.1E. W.M.

DRAINAGE CONSTRUCTION NOTES

1. REMOVE DRAINAGE STRUCTURE
2. CONNECT EXISTING PIPES TO NEW DRAINAGE STRUCTURE
3. MEDIA FILTER DRAIN, SEE DETAIL SHEET DRD-1
4. CONNECT NEW PIPE TO EXISTING DRAINAGE STRUCTURE
5. CONSTRUCT DRAINAGE STRUCTURE ON EXISTING PIPE
6. ADJUST DRAINAGE STRUCTURE TO GRADE
7. CONSTRUCT DITCH, SEE DETAIL SHEET DRD-5, MATCH EXISTING DITCH
8. CLEAN EXISTING DRAINAGE STRUCTURE
9. RECONSTRUCT EXISTING UNDERDRAIN, SEE DETAIL SHEET DRD-2
10. REMOVE EXISTING STORM DRAIN PIPE

DRAINAGE LEGEND

1 / 1 DR2	STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
	DRAIN CLEANOUT
	EXISTING MANHOLE/CATCH BASIN
	MANHOLE/CATCH BASIN
	EXISTING VALVE BOX
	EXISTING FIRE HYDRANT
W — W	EXISTING WATER
G — G	EXISTING GAS
S — S	EXISTING SANITARY SEWER
UD — UD	EXISTING UNDERDRAIN
STM	EXISTING STORM / CULVERT
	EXISTING DITCH BOTTOM
	EXISTING CULVERT
ST — ST	STORM SEWER
D — D	DRAIN LINE
UD — UD	UNDERDRAIN
	DITCH BOTTOM
	CULVERT
	MEDIA FILTER DRAIN



100% SUBMITTAL - NOT FOR CONSTRUCTION

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ENTERED BY	S. TAYLOR			
CHECKED BY	R. ATTANASIO			
PROJ. ENGR.				
REGIONAL ADM.		REVISION	DATE	BY

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

DEVA ALVES — STATE OF WASHINGTON — 46329 — REGISTERED PROFESSIONAL ENGINEER — PRE-FINAL — 12/3/15

DATE — P.E. STAMP BOX

DATE — P.E. STAMP BOX

COWLITZ INDIAN RESERVATION

ch2m

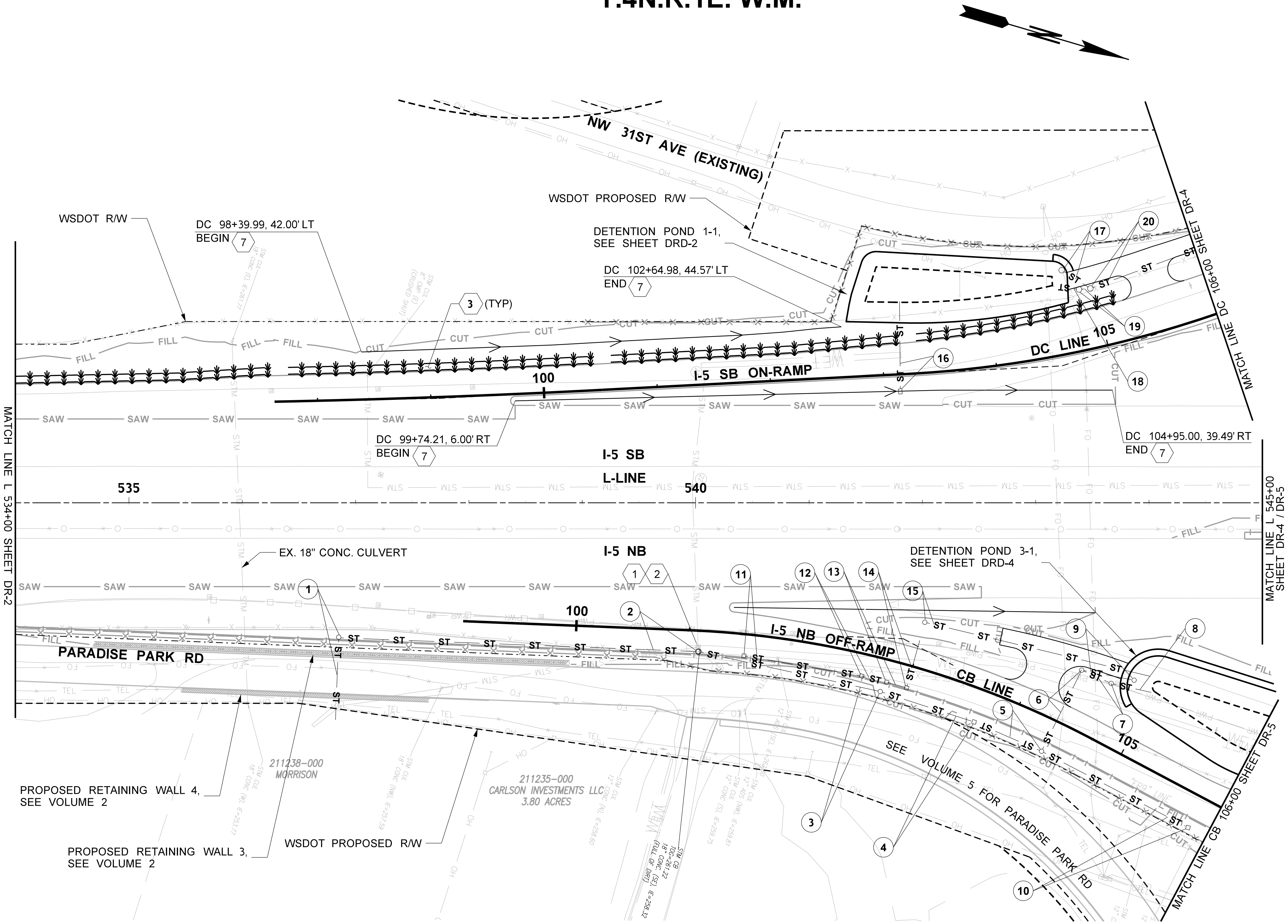
COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PLAN

PLAN REF NO V1 DR-2

SHEET 81 OF 236 SHEETS

T.4N.R.1E. W.M.



DRAINAGE LEGEND

1 / 1 DR2	STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
	DRAIN CLEANOUT
	EXISTING MANHOLE/CATCH BASIN
	MANHOLE/CATCH BASIN
	EXISTING VALVE BOX
	EXISTING FIRE HYDRANT
W — W	EXISTING WATER
G — G	EXISTING GAS
S — S	EXISTING SANITARY SEWER
UD — UD	EXISTING UNDERDRAIN
STM	EXISTING STORM / CULVERT
	EXISTING DITCH BOTTOM
	EXISTING CULVERT
ST — ST	STORM SEWER
D — D	DRAIN LINE
UD — UD	UNDERDRAIN
	DITCH BOTTOM
	CULVERT
	MEDIA FILTER DRAIN

DRAINAGE CONSTRUCTION NOTES

1. REMOVE DRAINAGE STRUCTURE
2. CONNECT EXISTING PIPES TO NEW DRAINAGE STRUCTURE
3. MEDIA FILTER DRAIN, SEE DETAIL SHEET DRD-1
4. CONNECT NEW PIPE TO EXISTING DRAINAGE STRUCTURE
5. CONSTRUCT DRAINAGE STRUCTURE ON EXISTING PIPE
6. ADJUST DRAINAGE STRUCTURE TO GRADE
7. CONSTRUCT DITCH, SEE DETAIL SHEET DRD-5, MATCH EXISTING DITCH
8. CLEAN EXISTING DRAINAGE STRUCTURE
9. RECONSTRUCT EXISTING UNDERDRAIN, SEE DETAIL SHEET DRD-2
10. REMOVE EXISTING STORM DRAIN PIPE

0 50 100
SCALE IN FEET

100% SUBMITTAL - NOT FOR CONSTRUCTION

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DESIGNED BY	D. ALVES			
ENTERED BY	S. TAYLOR			
CHECKED BY	R. ATTANASIO			
PROJ. ENGR.				
REGIONAL ADM.		REVISION	DATE	BY

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

DEVA ALVES — STATE OF WASHINGTON — 46329 — REGISTERED PROFESSIONAL ENGINEER
PRE-FINAL
12/3/15
DATE
P.E. STAMP BOX

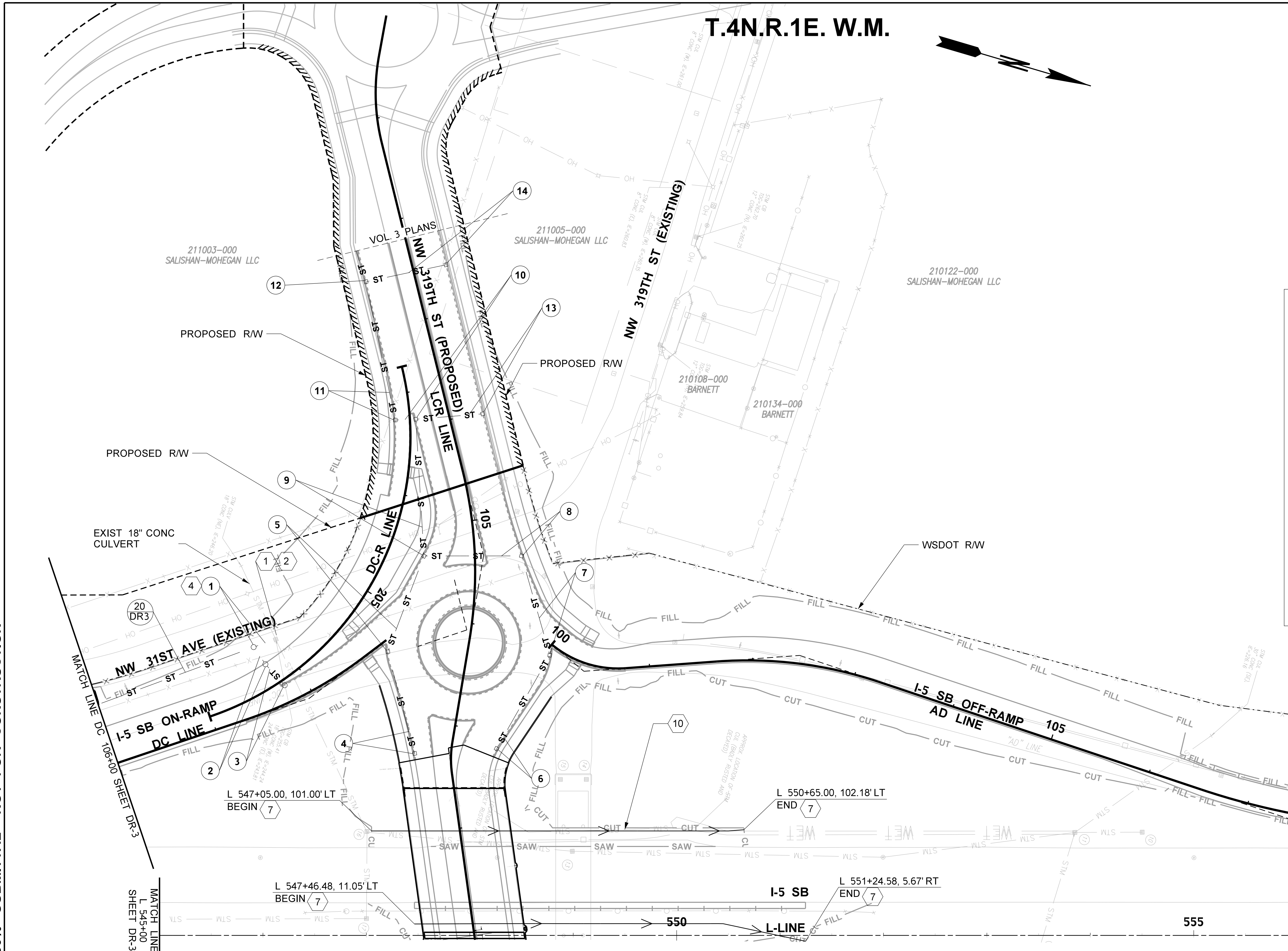
DATE
P.E. STAMP BOX

COWLITZ INDIAN RESERVATION
ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PLAN

PLAN REF NO V1 DR-3
SHEET 82 OF 236 SHEETS



DRAINAGE CONSTRUCTION NOTES

1. REMOVE DRAINAGE STRUCTURE
2. CONNECT EXISTING PIPES TO NEW DRAINAGE STRUCTURE
3. MEDIA FILTER DRAIN, SEE DETAIL SHEET DRD-1
4. CONNECT NEW PIPE TO EXISTING DRAINAGE STRUCTURE
5. CONSTRUCT DRAINAGE STRUCTURE ON EXISTING PIPE
6. ADJUST DRAINAGE STRUCTURE TO GRADE
7. CONSTRUCT DITCH, SEE DETAIL SHEET DRD-5, MATCH EXISTING DITCH
8. CLEAN EXISTING DRAINAGE STRUCTURE
9. RECONSTRUCT EXISTING UNDERDRAIN, SEE DETAIL SHEET DRD-2
10. REMOVE EXISTING STORM DRAIN PIPE

DRAINAGE LEGEND

1 / 1 DR2	STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
	DRAIN CLEANOUT
	EXISTING MANHOLE/CATCH BASIN
	MANHOLE/CATCH BASIN
	EXISTING VALVE BOX
	EXISTING FIRE HYDRANT
W — W	EXISTING WATER
G — G	EXISTING GAS
S — S	EXISTING SANITARY SEWER
UD — UD	EXISTING UNDERDRAIN
STM	EXISTING STORM / CULVERT
	EXISTING DITCH BOTTOM
	EXISTING CULVERT
ST — ST	STORM SEWER
D — D	DRAIN LINE
UD — UD	UNDERDRAIN
	DITCH BOTTOM
	CULVERT
	MEDIA FILTER DRAIN

100% SUBMITTAL - NOT FOR CONSTRUCTION

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DATE	12/10/2015
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DESIGNED BY	D. ALVES
ENTERED BY	S. TAYLOR
CHECKED BY	R. ATTANASIO
PROJ. ENGR.	
REGIONAL ADM.	

REVISION | DATE | BY

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PRE-FINAL

12/3/15

DATE

P.E. STAMP BOX

DATE

P.E. STAMP BOX

COWLITZ INDIAN RESERVATION

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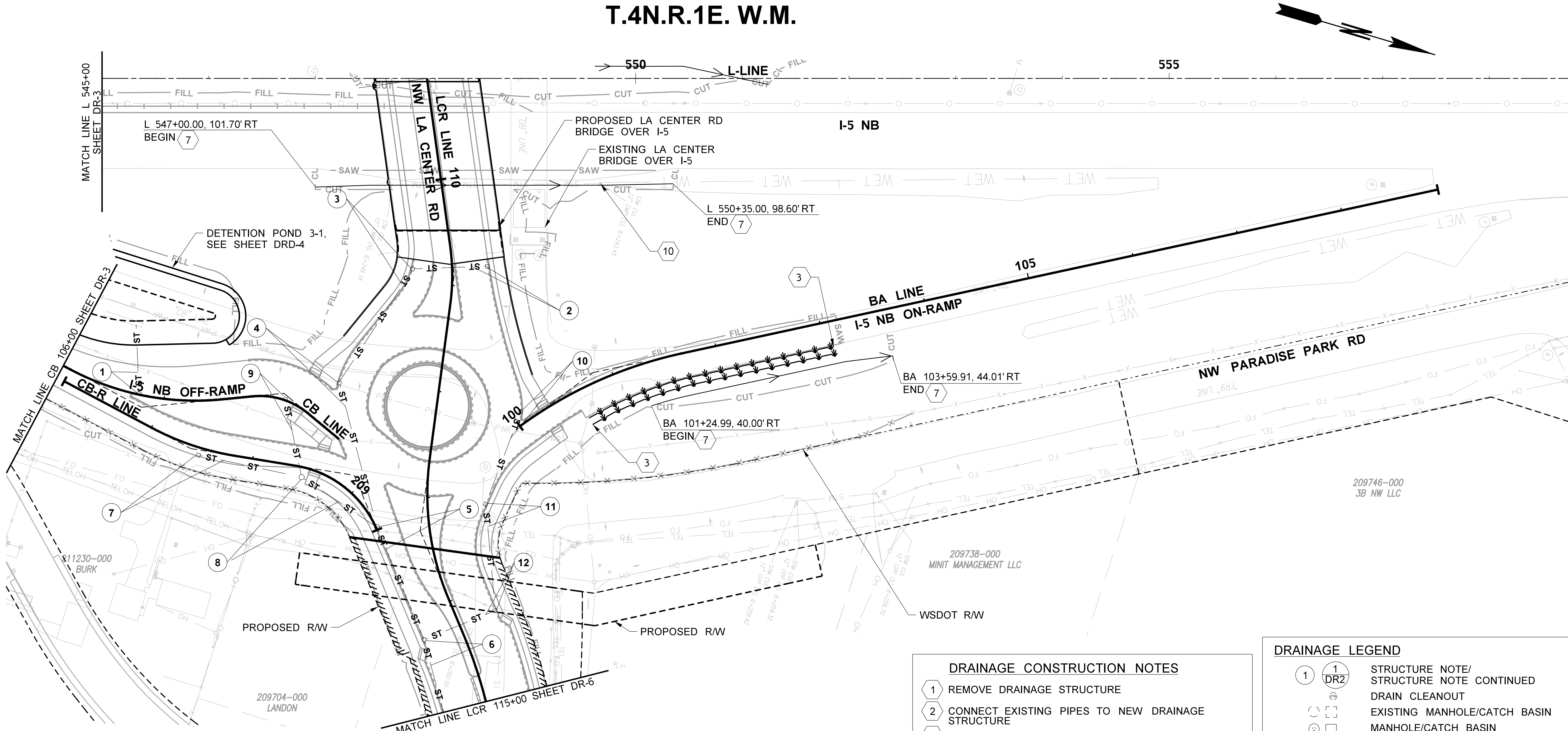
COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PLAN

PLAN REF NO V1 DR-4

SHEET 83 OF 236 SHEETS



DRAINAGE CONSTRUCTION NOTES

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DRAINAGE LEGEND

1 / 1 DR2	STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
	DRAIN CLEANOUT
	EXISTING MANHOLE/CATCH BASIN
	MANHOLE/CATCH BASIN
	EXISTING VALVE BOX
	EXISTING FIRE HYDRANT
W — W	EXISTING WATER
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UD — UD	EXISTING UNDERDRAIN
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	EXISTING DITCH BOTTOM
	EXISTING CULVERT
ST — ST	STORM SEWER
D — D	DRAIN LINE
UD — UD	UNDERDRAIN
	DITCH BOTTOM
	CULVERT
	MEDIA FILTER DRAIN

0 50 100
SCALE IN FEET

100% SUBMITTAL - NOT FOR CONSTRUCTION

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CHECKED BY	R. ATTANASIO				
PROJ. ENGR.					
REGIONAL ADM.		REVISION	DATE	BY	

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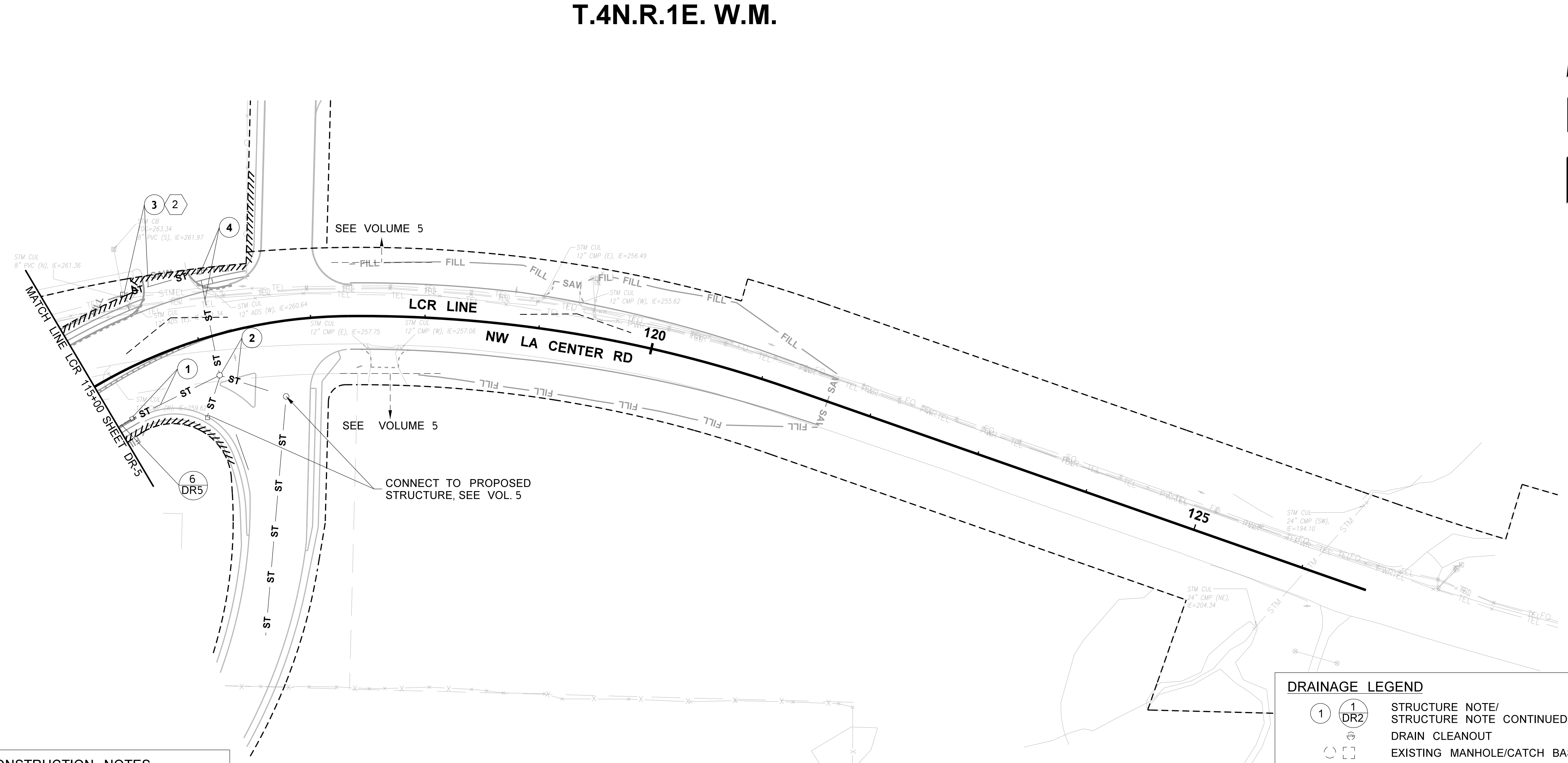
ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE IMPROVEMENT PROJECT

DRAINAGE PLAN

PLAN REF NO
V1
DR-5

SHEET
84
OF
236
SHEETS



100% SUBMITTAL - NOT FOR CONSTRUCTION

DRAINAGE CONSTRUCTION NOTES

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2. CONNECT EXISTING PIPES TO NEW DRAINAGE STRUCTURE
3. MEDIA FILTER DRAIN, SEE DETAIL SHEET DRD-1
4. CONNECT NEW PIPE TO EXISTING DRAINAGE STRUCTURE
5. CONSTRUCT DRAINAGE STRUCTURE ON EXISTING PIPE
6. ADJUST DRAINAGE STRUCTURE TO GRADE
7. CONSTRUCT DITCH, SEE DETAIL SHEET DRD-5, MATCH EXISTING DITCH
8. CLEAN EXISTING DRAINAGE STRUCTURE
9. RECONSTRUCT EXISTING UNDERDRAIN, SEE DETAIL SHEET DRD-2
10. REMOVE EXISTING STORM DRAIN PIPE

DRAINAGE LEGEND

1 (1 DR2)	STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
	DRAIN CLEANOUT
	EXISTING MANHOLE/CATCH BASIN
	MANHOLE/CATCH BASIN
	EXISTING VALVE BOX
	EXISTING FIRE HYDRANT
- W — — W —	EXISTING WATER
- G — — G —	EXISTING GAS
- S — — S —	EXISTING SANITARY SEWER
- UD — — UD —	EXISTING UNDERDRAIN
—— STM ——	EXISTING STORM / CULVERT
	EXISTING DITCH BOTTOM
	EXISTING CULVERT
- ST —— ST —	STORM SEWER
- D —— D —	DRAIN LINE
- UD —— UD —	UNDERDRAIN
	DITCH BOTTOM
	CULVERT
	MEDIA FILTER DRAIN

FILE NAME	458952-DR-6.dgn
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DESIGNED BY	D. ALVES
ENTERED BY	S. TAYLOR
CHECKED BY	R. ATTANASIO
PROJ. ENGR.	
REGIONAL ADM.	

REVISION | DATE | BY

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

JOB NUMBER

CONTRACT NO. | LOCATION NO.

DEVA ALVES
STATE OF WASHINGTON
46329
REGISTERED PROFESSIONAL ENGINEER
PRE-FINAL
12/3/15
DATE
P.E. STAMP BOX

DATE
P.E. STAMP BOX

COWLITZ INDIAN RESERVATION

ch2m.

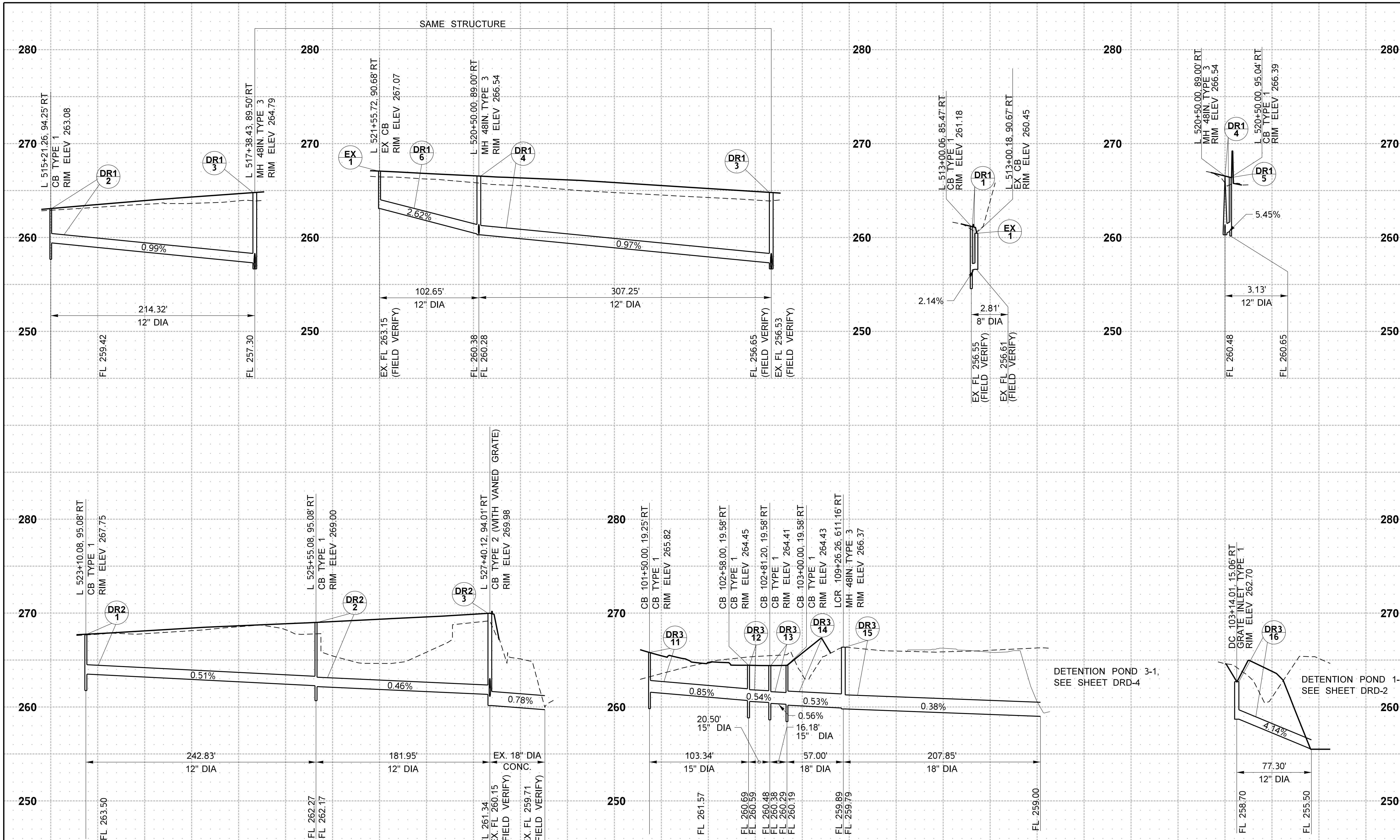
COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PLAN

PLAN REF NO
V1
DR-6

SHEET
85
OF
236
SHEETS

100% SUBMITTAL - NOT FOR CONSTRUCTION



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PLOTTED BY	DENPWP01$			
DESIGNED BY	D. ALVES			
ENTERED BY	S. TAYLOR			
CHECKED BY	R. ATTANASIO			
PROJ. ENGR.				
REGIONAL ADM.		REVISION	DATE	BY

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

DEVA ALVES
STATE OF WASHINGTON
46329
REGISTERED PROFESSIONAL ENGINEER
PRE-FINAL
12/3/15
DATE
P.E. STAMP BOX

DATE
P.E. STAMP BOX

COWLITZ INDIAN RESERVATION

ch2m

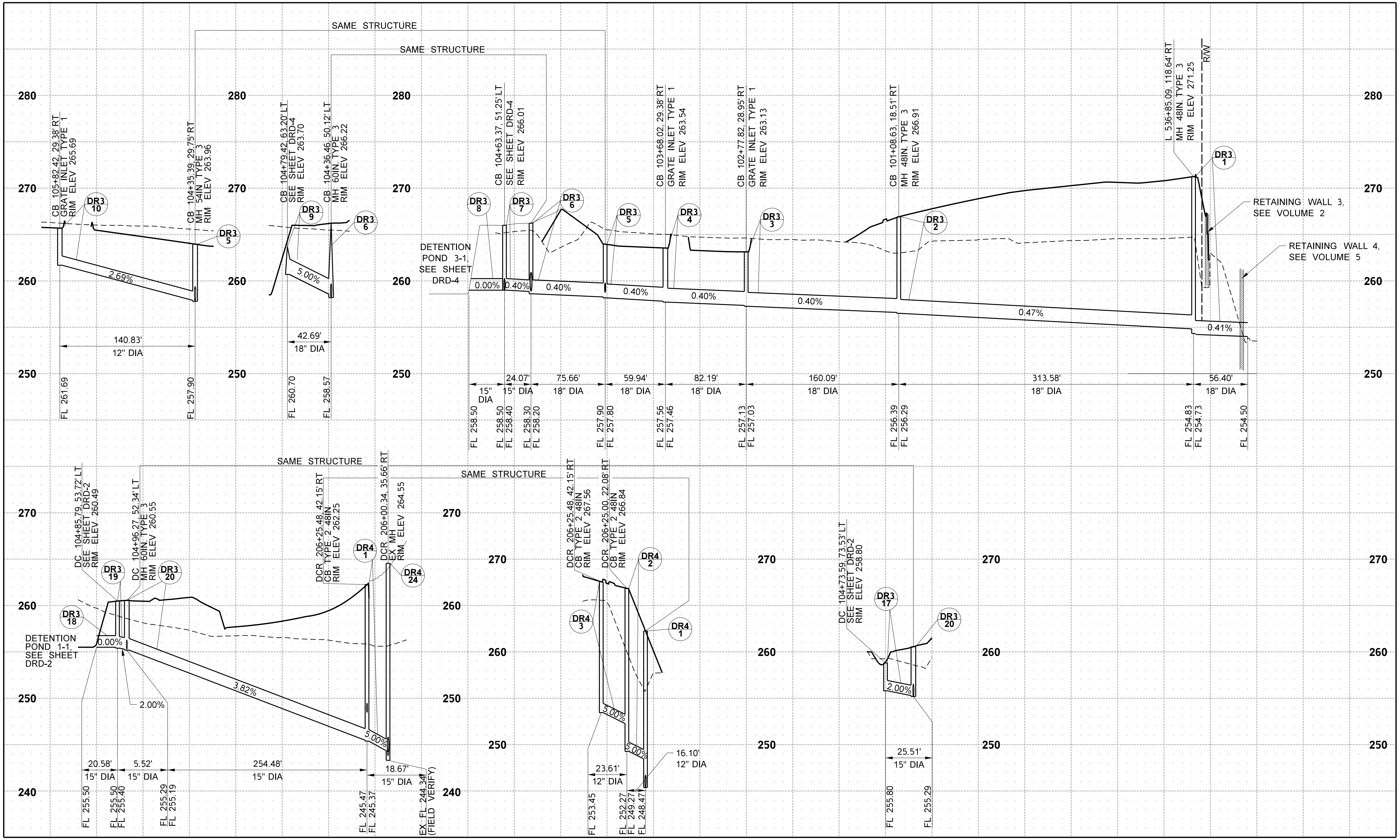
COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PROFILES

PLAN REF. NO.
V1
DP-1

SHEET
86
OF
236
SHEETS

100% SUBMITTAL - NOT FOR CONSTRUCTION



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CHECKED BY	R. ATTANASIO				
PROJ. ENGR.					
REGIONAL ADM.		REVISION	DATE	BY	

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

DEVA ALVES
STATE OF WASHINGTON
46329
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COWLITZ INDIAN RESERVATION

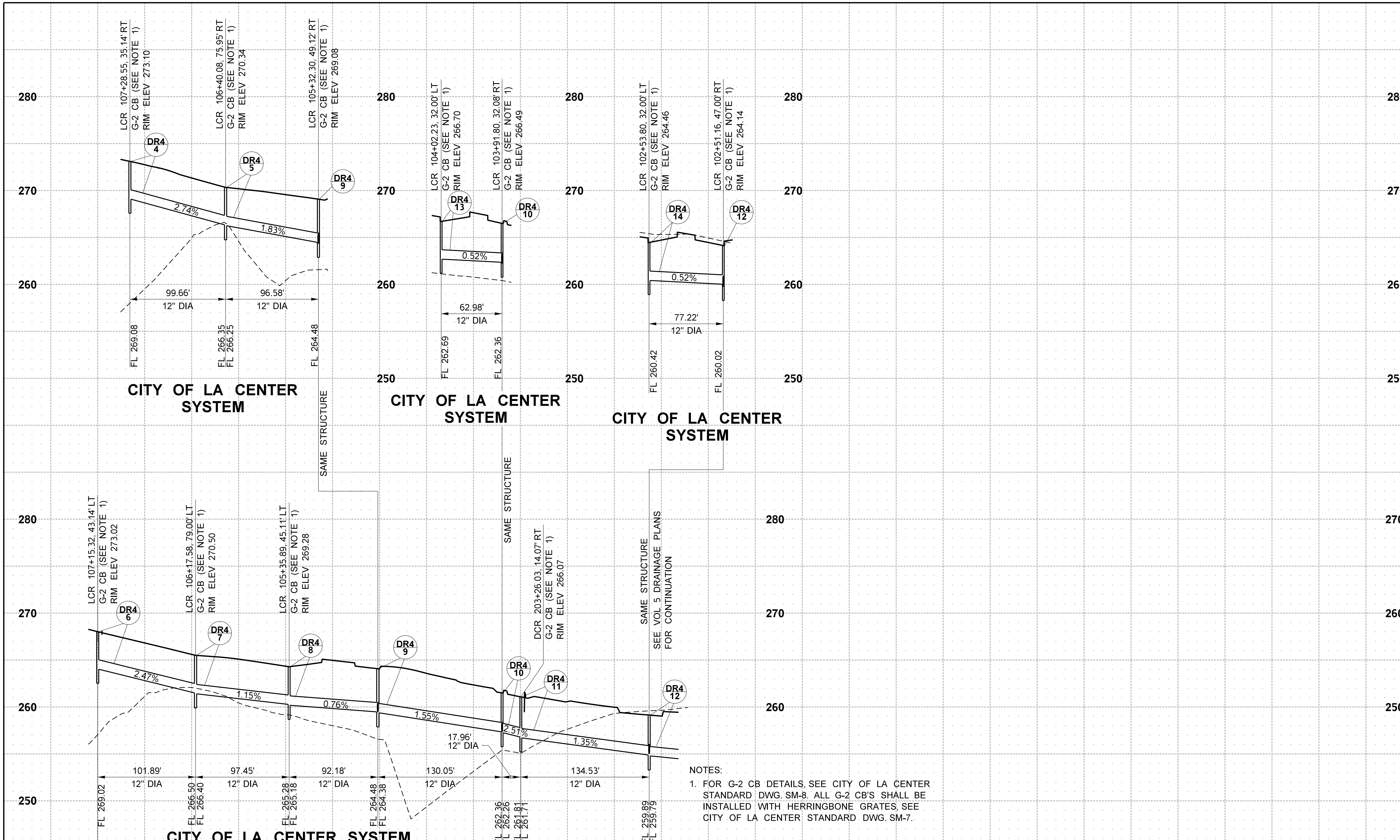
ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PROFILES

PLAN REF. NO. V1 DP-2

SHEET 87 OF 236 SHEETS



NOTES:

1. FOR G-2 CB DETAILS, SEE CITY OF LA CENTER STANDARD DWG. SM-8. ALL G-2 CB'S SHALL BE INSTALLED WITH HERRINGBONE GRATES, SEE CITY OF LA CENTER STANDARD DWG. SM-7.

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DEVA ALVES STATE OF WASHINGTON 46329 REGISTERED PROFESSIONAL ENGINEER

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COWLITZ INDIAN RESERVATION

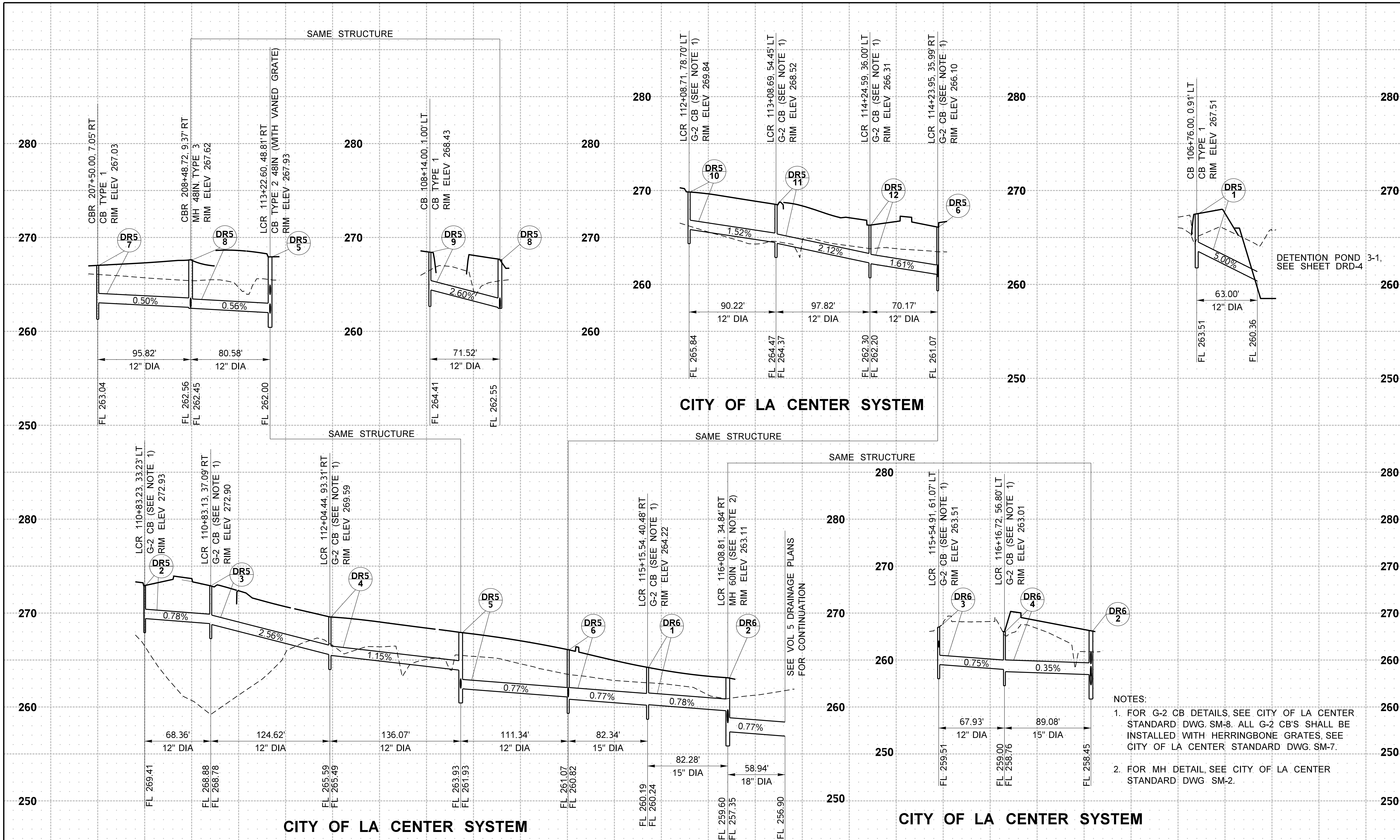
ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PROFILES

PLAN REF. NO. V1 DP-3

SHEET 88 OF 236 SHEETS



NOTES:

1. FOR G-2 CB DETAILS, SEE CITY OF LA CENTER STANDARD DWG. SM-8. ALL G-2 CB'S SHALL BE INSTALLED WITH HERRINGBONE GRATES, SEE CITY OF LA CENTER STANDARD DWG. SM-7.
2. FOR MH DETAIL, SEE CITY OF LA CENTER STANDARD DWG SM-2.

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JOB NUMBER

CONTRACT NO. | LOCATION NO.

DEVA ALVES — STATE OF WASHINGTON — 46329 — REGISTERED PROFESSIONAL ENGINEER — PRE-FINAL

12/3/15

DATE

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DATE

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COWLITZ INDIAN RESERVATION

ch2m

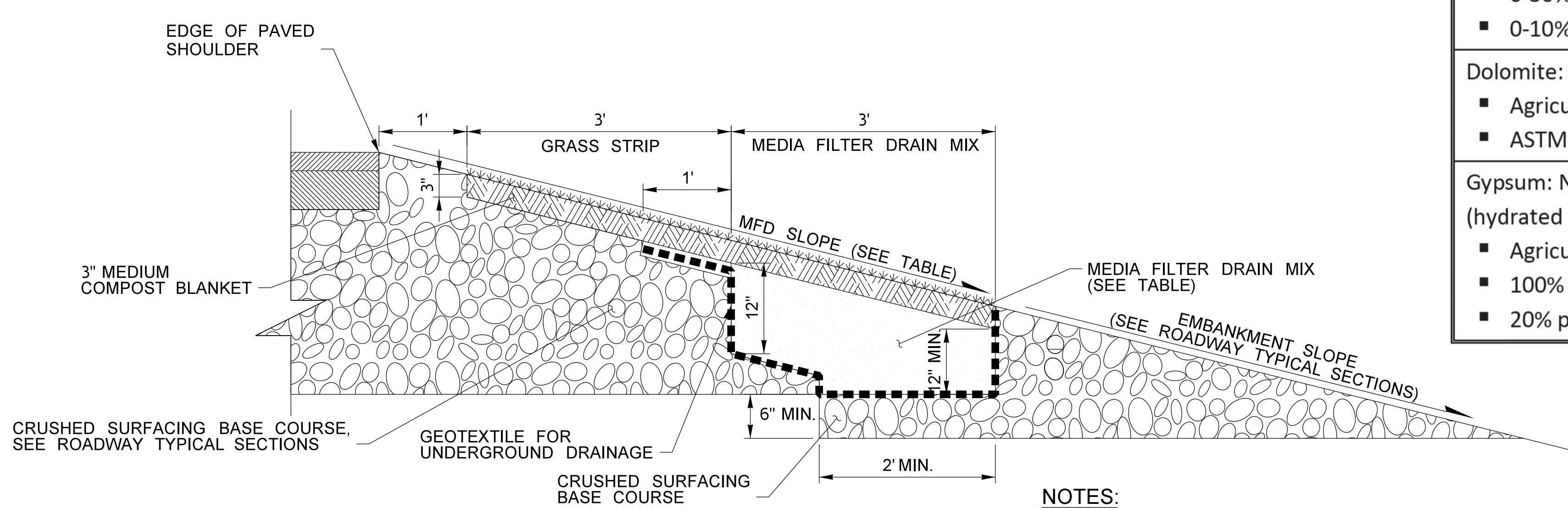
COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

DRAINAGE PROFILES

PLAN REF. NO. V1 DP-4

SHEET 89 OF 236 SHEETS

MEDIA FILTER DRAIN TYPE 3			
LOCATION	START STA. RT/LT	END STA. LT/RT	SLOPE (FT/FT)
I-5 SB ON-RAMP	L 521+00 LT	L 535+00 LT	10:1
I-5 SB ON-RAMP	L 535+00 LT	L 535+50 LT	10:1 - 4:1
I-5 SB ON-RAMP	L 535+50 LT	L 536+28 LT	4:1
I-5 SB ON-RAMP	DC 97+62 LT	DC 97+80 LT	4:1
I-5 SB ON-RAMP	DC 97+80 LT	DC 98+30 LT	4:1 - 10:1
I-5 SB ON-RAMP	DC 98+30 LT	DC 105+00 LT	10:1
I-5 SB ON-RAMP	DC 105+00 LT	DC 105+29 LT	10:1 - 6:1
I-5 NB ON-RAMP	BA 100+61 RT	BA 103+16 RT	10:1



SECTION

NOTES:

1. SEE TABLE FOR DIMENSIONS AND ADDITIONAL INFORMATION.
2. SEE ROADWAY TYPICAL SECTIONS FOR FURTHER DETAILS.

MEDIA FILTER DRAIN DETAILS

SCALE: NTS

Amendment	Quantity
Mineral aggregate: Crushed screenings 3/8-inch to #10 sieve **Aggregate for Media Filter Drain Mix** Aggregate for Media Filter Drain Mix shall be manufactured from ledge rock, talus, or gravel, in accordance with Section 3-01 of the *Standard Specifications for Road, Bridge, and Municipal Construction*, and shall meet the following test requirements for quality. The use of recycled material is not permitted. Los Angeles Wear, 500 Revolutions — 35% max. Degradation Factor — 30 min. Aggregate for the Media Filter Drain Mix shall conform to the following requirements for grading and quality: **Sieve Size** — **Percent Passing (by weight)** 1/2" square — 100 3/8" square — 90-100 U.S. No. 4 — 30-56 U.S. No. 10 — 0-10 U.S. No. 200 — 0-1.5 % fracture, by weight, min. — 75 The fracture requirement shall be at least two fractured faces and will apply to material retained on the U.S. No. 4. Aggregate for the Media Filter Drain shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50% of the surface area of any size between successive laboratory sieves.	3 cubic yards
Perlite: ▪ Horticultural grade, free of any toxic materials) ▪ 100% passing U.S. No. 4 Sieve ▪ 0-30% passing U.S. No. 18 Sieve ▪ 0-10% passing U.S. No. 30 Sieve	1 cubic yard per 3 cubic yards of mineral aggregate
Dolomite: CaMg(CO3)2 (calcium magnesium carbonate) ▪ Agricultural grade, free of any toxic materials ▪ ASTM C 602 Class Designation E	40 pounds per cubic yard of perlite
Gypsum: Noncalcined, agricultural gypsum CaSO4•2H2O (hydrated calcium sulfate) ▪ Agricultural grade, free of any toxic materials ▪ 100% passing ¼ -inch Sieve ▪ 20% passing U.S. No. 20 Sieve	12 pounds per cubic yard of perlite

MEDIA FILTER DRAIN MIX

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DATE	12/10/2015			
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PROJ. ENGR.				
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JOB NUMBER

CONTRACT NO. | LOCATION NO.

DEVA ALVES — STATE OF WASHINGTON — 46329 — REGISTERED PROFESSIONAL ENGINEER — PRE-FINAL

12/3/15 DATE — P.E. STAMP BOX

DATE — P.E. STAMP BOX

COWLITZ INDIAN RESERVATION

ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

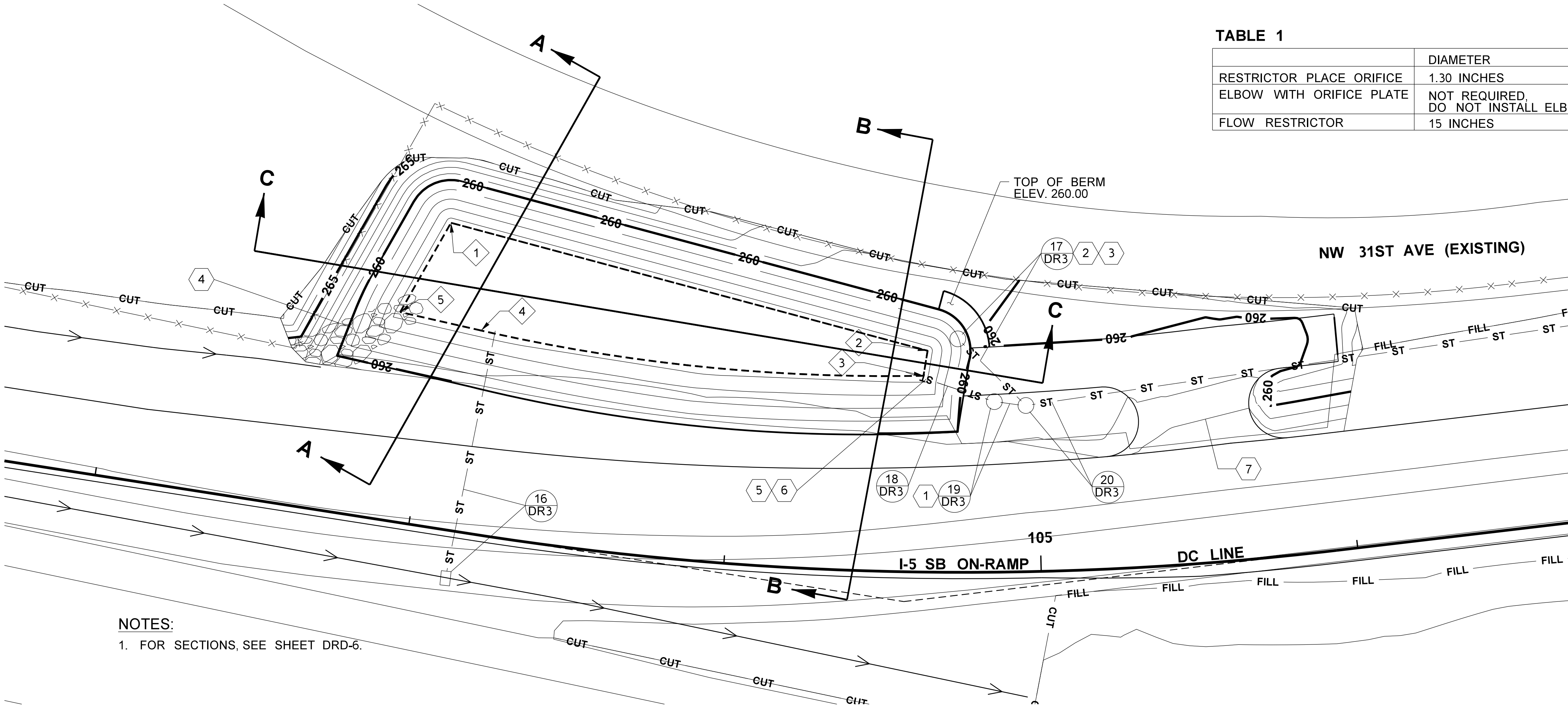
DRAINAGE DETAILS

PLAN REF NO V1 DRD-1

SHEET 90 OF 236 SHEETS

TABLE 1

	DIAMETER	ELEVATION
RESTRICTOR PLACE ORIFICE	1.30 INCHES	256.00
ELBOW WITH ORIFICE PLATE	NOT REQUIRED, DO NOT INSTALL ELBOW	N/A
FLOW RESTRICTOR	15 INCHES	258.50



NOTES:

1. FOR SECTIONS, SEE SHEET DRD-6.

DETENTION POND 1-1 PLAN

SCALE: 1" = 40'

100% SUBMITTAL - NOT FOR CONSTRUCTION

CONTROL POINT TABLE

POINT	STATION	OFFSET	ELEVATION	DESCRIPTION
1	DC 102+98.44	95.81' LT	255.50	BOTTOM OF POND
2	DC 104+63.38	69.72' LT	255.50	BOTTOM OF POND
3	DC 104+62.10	61.83' LT	255.50	BOTTOM OF POND
4	DC 103+13.07	63.77' LT	255.50	BOTTOM OF POND
5	DC 102+86.98	65.56' LT	255.50	BOTTOM OF POND

STORM POND LEGEND

- 1 / 1 DR2 — STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
- ST — ST — EXISTING STORM SEWER
- STM — EXISTING STORM / CULVERT
- EXISTING DITCH BOTTOM
- EXISTING CULVERT
- ST — ST — STORM SEWER
- D — D — DRAIN LINE
- UD — UD — UNDERDRAIN
- DITCH BOTTOM
- CULVERT
- MEDIA FILTER DRAIN

STORM POND NOTES

1. INSTALL 54" DIAM. CATCH BASIN TYPE 2 WITH FLOW RESTRICTOR. SEE WSDOT STD PLAN B-10.40-00 AND TABLE 1 ABOVE FOR RISER AND ORIFICE SIZE AND ELEVATION.
2. INSTALL 54" DIAM. MANHOLE TYPE 1.
3. INSTALL DEBRI CAGE, SEE DETAIL ON SHEET DRD-3.
4. PLACE QUARRY SPALLS 12 INCH THICK AND 10 FT WIDE ALONG SLOPE AND EXTEND 10' INTO BOTTOM OF POND.
5. INSTALL BEVELED END SECTION, SEE WSDOT STD PLAN B-70.20-00.
6. INSTALL INLET/OUTLET PROTECTION, SEE DETAIL SHEET DRD-5.
7. CONSTRUCT ACCESS ROAD WITH 4 INCH THICK CRUSHED SURFACING BASE COURSE.

0 20 40
SCALE IN FEET

FILE NAME	458952-DRD-2.dgn
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DATE	12/10/2015
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JOB NUMBER

CONTRACT NO. | LOCATION NO.

DEVA ALVES — STATE OF WASHINGTON — 46329 — REGISTERED PROFESSIONAL ENGINEER — PRE-FINAL — 12/3/15

DATE — P.E. STAMP BOX

DATE — P.E. STAMP BOX

COWLITZ INDIAN RESERVATION

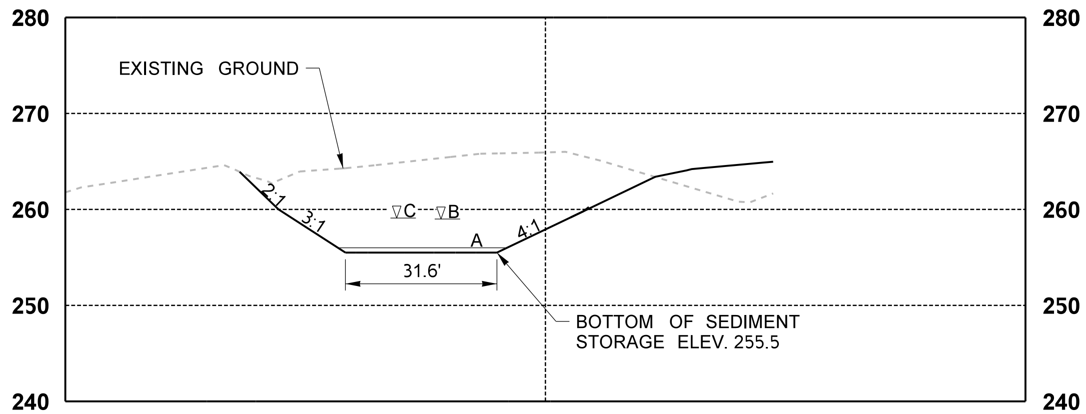
ch2m:

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

STORMWATER POND DETAILS

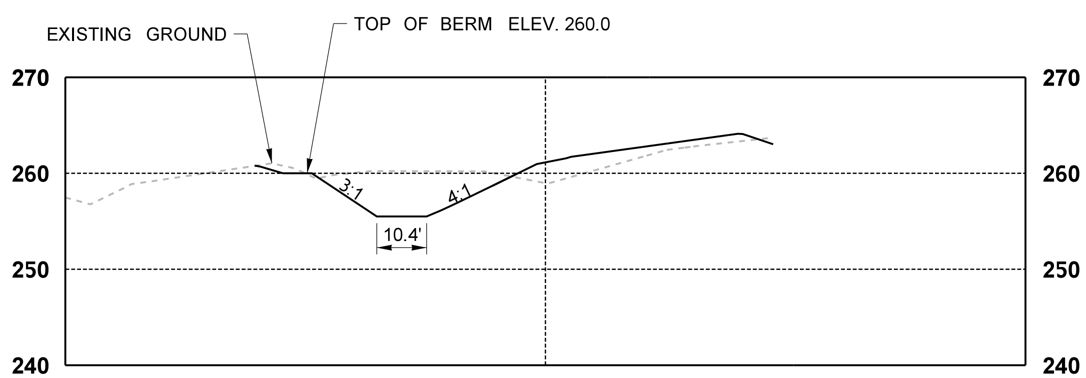
PLAN REF NO V1 DRD-2

SHEET 91 OF 236 SHEETS

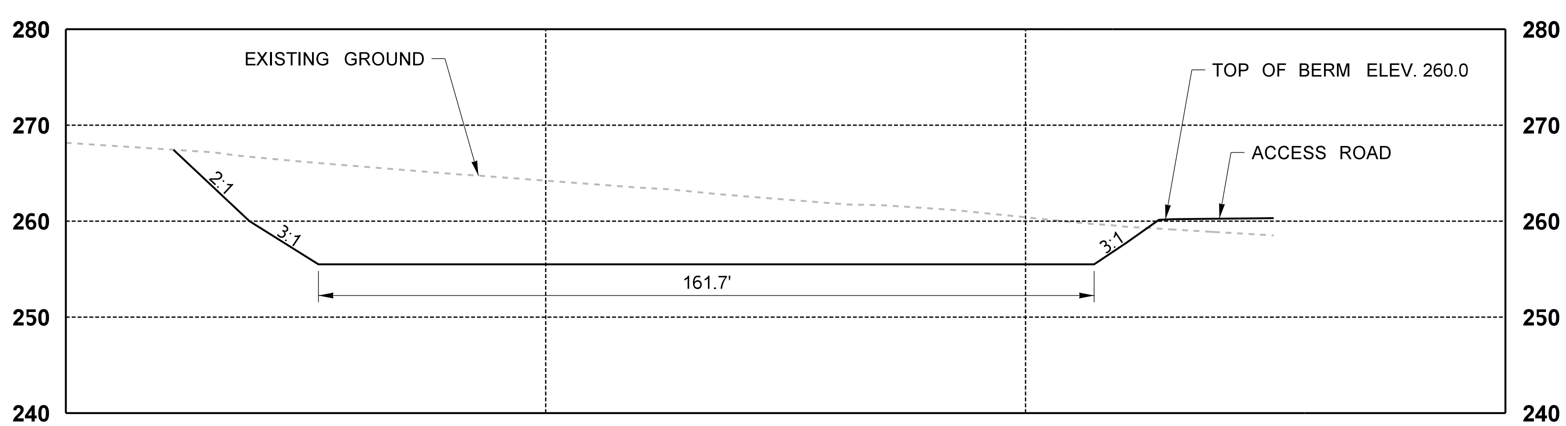


A BOTTOM OF POND STORAGE ELEV. 256.0
B 100-YR WSEL 258.8
C OVERFLOW WSEL 259.0

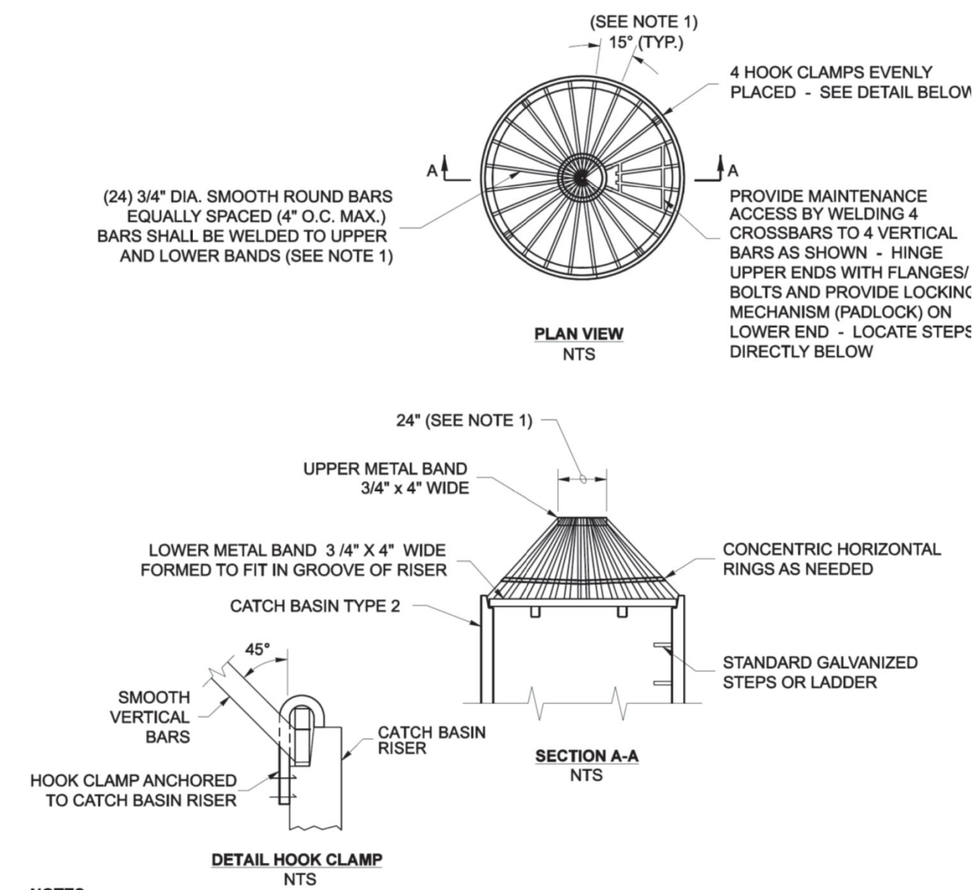
POND 1-1 SECTION A-A



POND 1-1 SECTION B-B



POND 1-1 SECTION C-C



NOTES:

1. DIMENSIONS ARE FOR INSTALLATION ON 54" DIAMETER CB. FOR DIFFERENT DIAMETERS, CB'S ADJUST TO MAINTAIN 45 DEGREE ANGLE ON "VERTICAL BARS" AND 7" O.C. MAXIMUM SPACING OF BARS AROUND LOWER METAL BAND.

   NOTE: WHERE THE MAXIMUM OPENING BETWEEN VERTICAL BARS EXCEED 4", ADD CONCENTRIC HORIZONTAL RINGS AS NEEDED SO THAT OPENINGS DO NOT EXCEED 4" IN ONE DIRECTION.

2. METAL PARTS MUST BE CORROSION RESISTANT; STEEL BARS MUST BE GALVANIZED.

OVERFLOW STRUCTURE WITH DEBRIS CAGE

NTS

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ENTERED BY	S. TAYLOR
CHECKED BY	R. ATTANASIO
PROJ. ENGR.	
REGIONAL ADM.	

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

JOB NUMBER

CONTRACT NO. | LOCATION NO.

DEVA ALVES STATE OF WASHINGTON 46329 REGISTERED PROFESSIONAL ENGINEER

PRE-FINAL

12/3/15

DATE

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COWLITZ INDIAN RESERVATION

ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

STORMWATER POND DETAILS

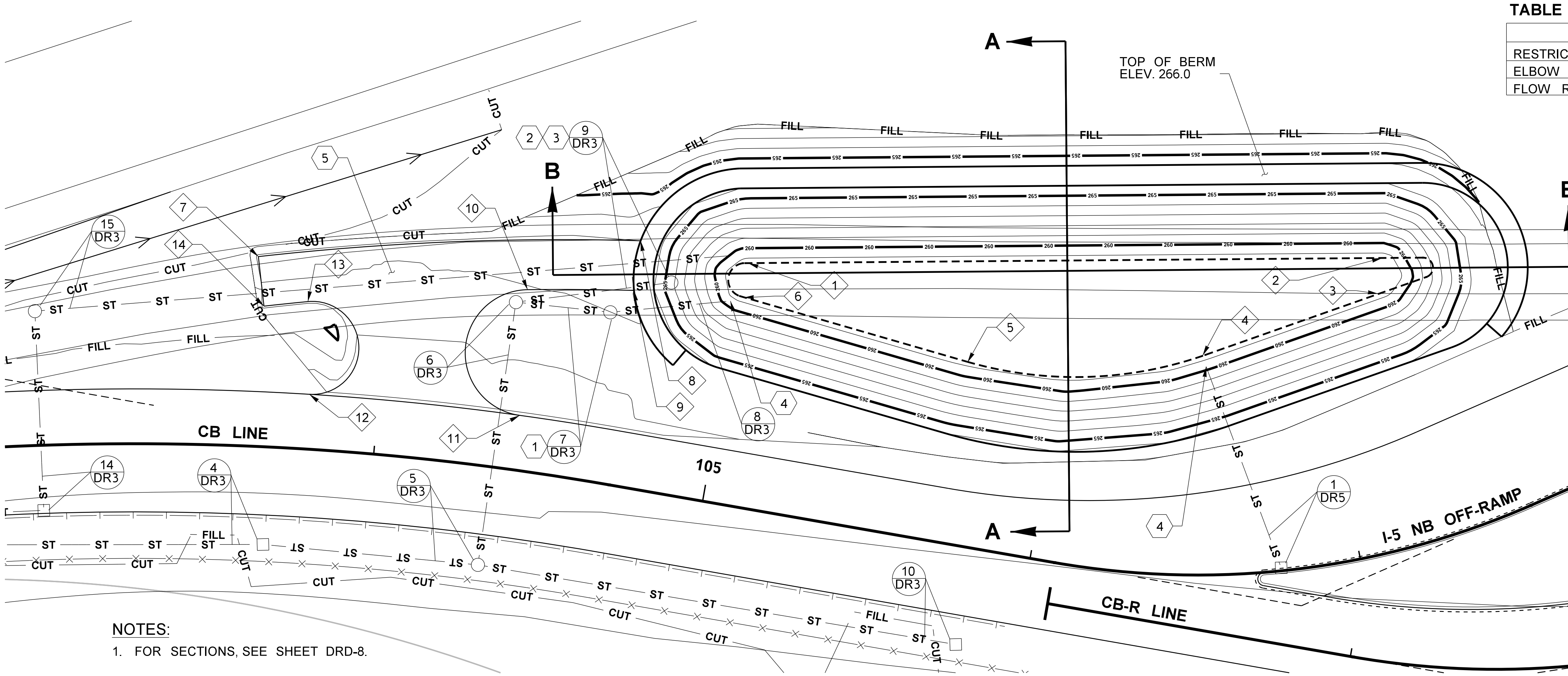
PLAN REF NO V1 DRD-3

SHEET 92 OF 236 SHEETS

100% SUBMITTAL - NOT FOR CONSTRUCTION

TABLE 1

	DIAMETER	ELEVATION
RESTRICTOR PLACE ORIFICE	1.28 INCHES	259.00
ELBOW WITH ORIFICE PLATE	1.75 INCHES	262.20
FLOW RESTRICTOR	15 INCHES	263.30



NOTES:

1. FOR SECTIONS, SEE SHEET DRD-8.

DETENTION POND 3-1 PLAN

SCALE: 1" = 40'

CONTROL POINT TABLE

POINT	STATION	OFFSET	ELEVATION	DESCRIPTION
1	CB 105+01.18	72.91 LT	258.50	BOTTOM OF POND
2	CB 107+36.95	85.74 LT	258.50	BOTTOM OF POND
3	CB 107+30.06	75.95 LT	258.50	BOTTOM OF POND
4	CB 106+52.78	66.02 LT	258.50	BOTTOM OF POND
5	CB 105+71.31	54.85 LT	258.50	BOTTOM OF POND
6	CB 105+01.56	62.43 LT	258.50	BOTTOM OF POND
7	CB 103+62.83	57.08 LT	265.80	POND ACCESS ROAD
8	CB 104+68.42	73.98 LT	266.00	POND ACCESS ROAD
9	CB 104+68.93	58.91 LT	266.00	POND ACCESS ROAD
10	CB 104+39.26	54.29 LT	266.03	POND ACCESS ROAD
11	CB 104+41.93	16.50 LT	263.75	POND ACCESS ROAD
12	CB 103+79.58	16.50 LT	263.35	POND ACCESS ROAD
13	CB 103+77.50	44.33 LT	266.18	POND ACCESS ROAD
14	CB 103+65.02	42.26 LT	266.20	POND ACCESS ROAD

STORM POND LEGEND

- (1) (1/DR2) STRUCTURE NOTE/ STRUCTURE NOTE CONTINUED
- ST — ST — EXISTING STORM SEWER
- STM — EXISTING STORM / CULVERT
- EXISTING DITCH BOTTOM
- EXISTING CULVERT
- ST — ST — STORM SEWER
- D — D — DRAIN LINE
- UD — UD — UNDERDRAIN
- DITCH BOTTOM
- CULVERT
- MEDIA FILTER DRAIN

STORM POND NOTES

1. INSTALL 54" DIAM. CATCH BASIN TYPE 2 WITH FLOW RESTRICTOR. SEE WSDOT STD PLAN B-10.40-00 AND TABLE 1 ABOVE FOR RISER AND ORIFICE SIZE AND ELEVATION.
2. INSTALL 54" DIAM. MANHOLE TYPE 1.
3. INSTALL DEBRI CAGE, SEE DETAIL ON SHEET DRD-3.
4. INSTALL INLET/OUTLET PROTECTION, SEE DETAIL ON SHEET DRD-5.
5. CONSTRUCT ACCESS ROAD WITH 4 INCH THICK CRUSHED SURFACING BASE COURSE.

0 20 40
SCALE IN FEET

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COWLITZ INDIAN RESERVATION

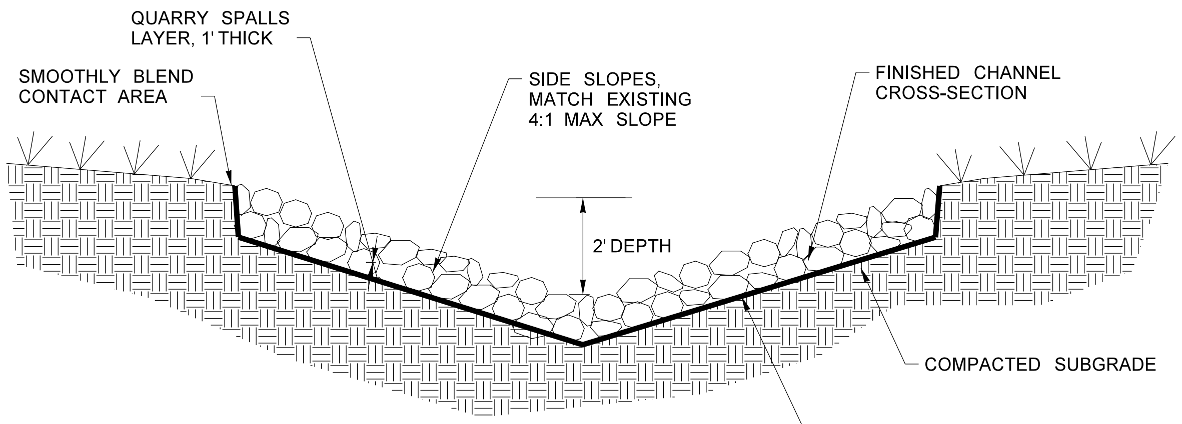
ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

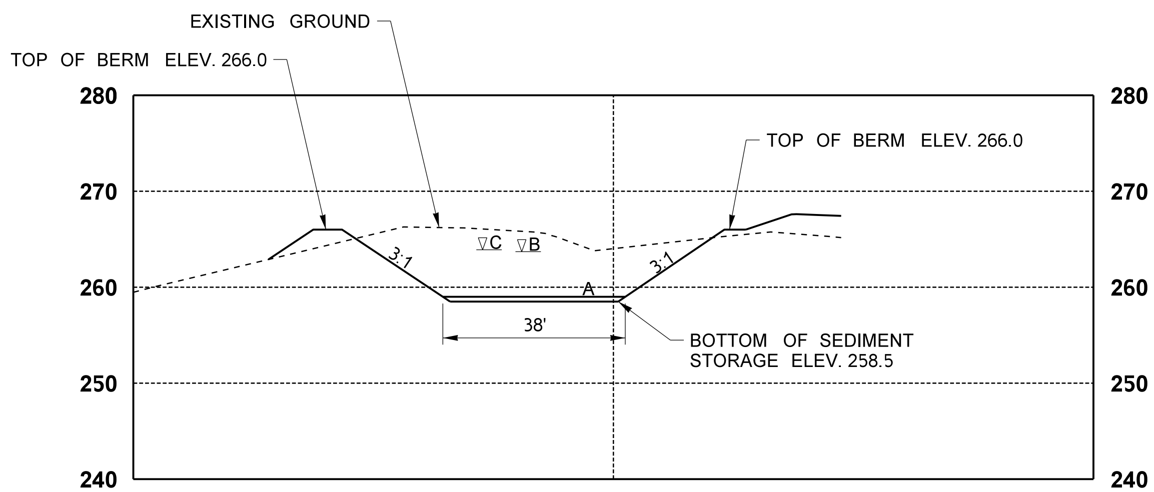
STORMWATER POND DETAILS

PLAN REF NO V1 DRD-4

SHEET 93 OF 236 SHEETS

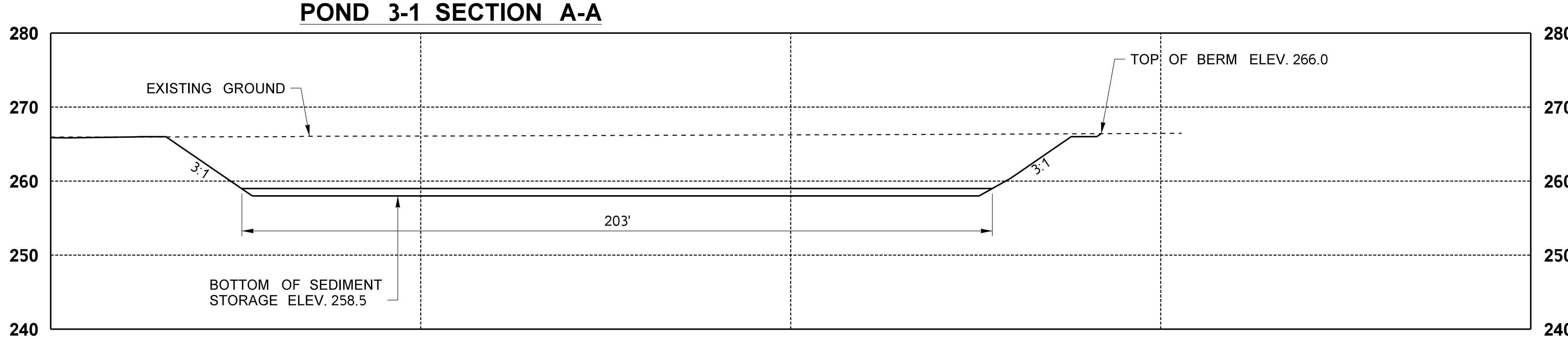


V-SHAPED ROADSIDE DITCH DETAIL
NTS

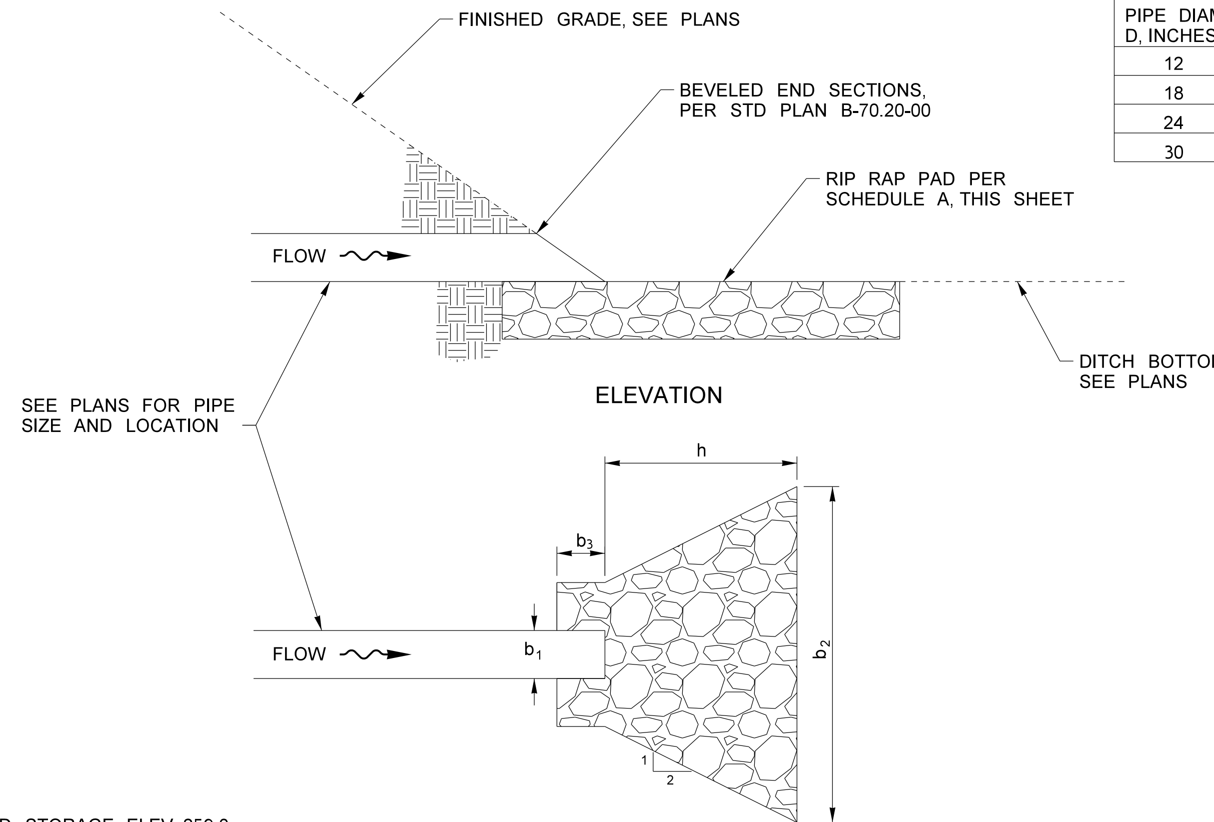


A BOTTOM OF POND STORAGE ELEV. 259.0
B 100-YR WSEL 263.70
C OVERFLOW WSEL 263.90

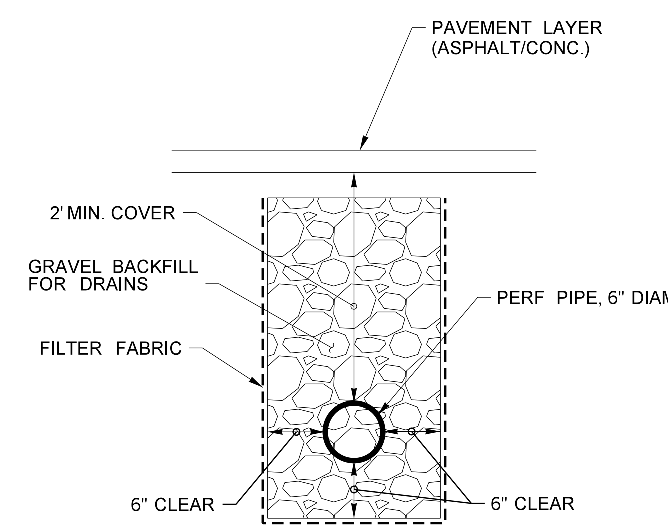
POND 3-1 SECTION A-A



POND 3-1 SECTION B-B



SCHEDULE A - RIP RAP PAD DIMENSIONS				
PIPE DIAMETER D, INCHES	b_1 (ft)	b_2 (ft)	b_3 (ft)	h(ft)
12	2	6	1	4
18	3	9	1	6
24	4	12	1	8
30	5	15	1	10



UNDERDRAIN DETAIL
NTS

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DEVA ALVES · STATE OF WASHINGTON · 46329 · REGISTERED PROFESSIONAL ENGINEER
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COWLITZ INDIAN RESERVATION
ch2m

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

STORMWATER POND DETAILS

PLAN REF NO
V1
DRD-5

SHEET
94
OF
236
SHEETS

FINAL STORMWATER PLAN

TECHNICAL INFORMATION REPORT

Paradise Park Road Improvements

Kittelson & Associates, Inc

PROJECT NO. 7714.02.03

PETER A. TUCK
STATE OF WASHINGTON
31817
REGISTERED
PROFESSIONAL ENGINEER

10/21/15

February 5, 2015
Revised October 21, 2015

Designed by: Peter A. Tuck, P.E.

Reviewed by: Peter A. Tuck, P.E.

Olson Engineering, Inc.
222 E. Evergreen Blvd.
Vancouver, WA 98660
(360) 695-1385

REVISION	BY	DATE	COMMENTS
3	CEM	10/21/15	Change to SMMWW Design

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- Vicinity Map
- Soil Map USSCS
- Water, Sewer & Storm System
- Environmental Constraints I and II
- Shoreline Map

Technical Information Report

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MAPS

Paradise Park Rd. Realignment

Legend

- Building Footprints
- Taxlots
- County Outline
- Roads
- ImageOrtho
  - Red: Band_1
  - Green: Band_2
  - Blue: Band_3
- World Street Map

Notes:

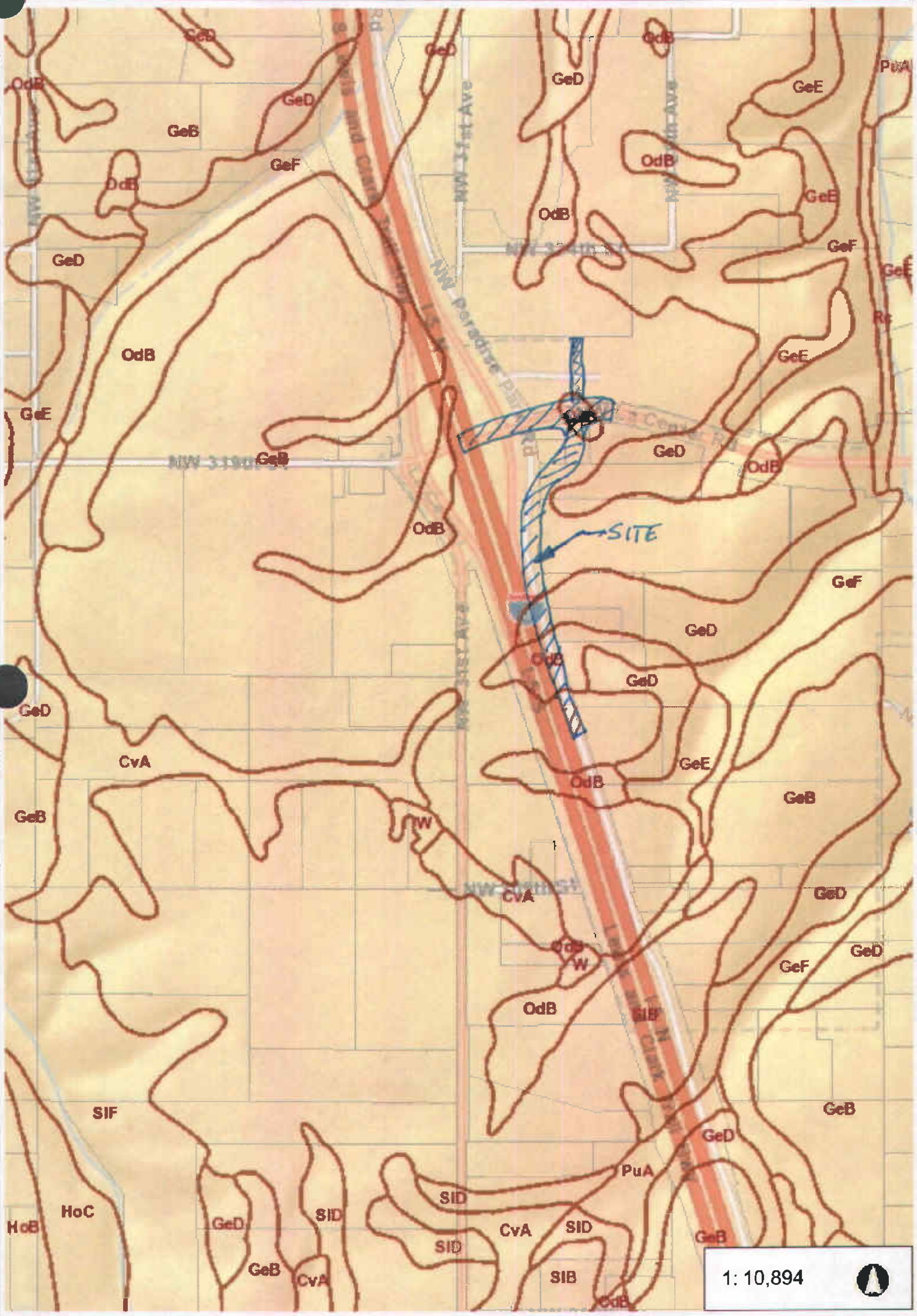
Vicinity Map w/ Photo

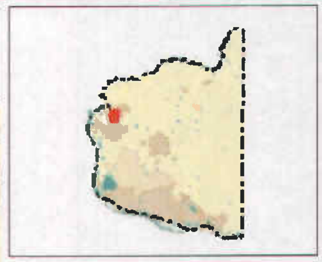
1: 10,894

1,815.7 | 0 | 907.86 | 1,815.7Feet

GS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

Paradise Park Rd. Realignment





Legend

- Soil Type
- Building Footprints
- Taxlots
- County Outline
- World Street Map

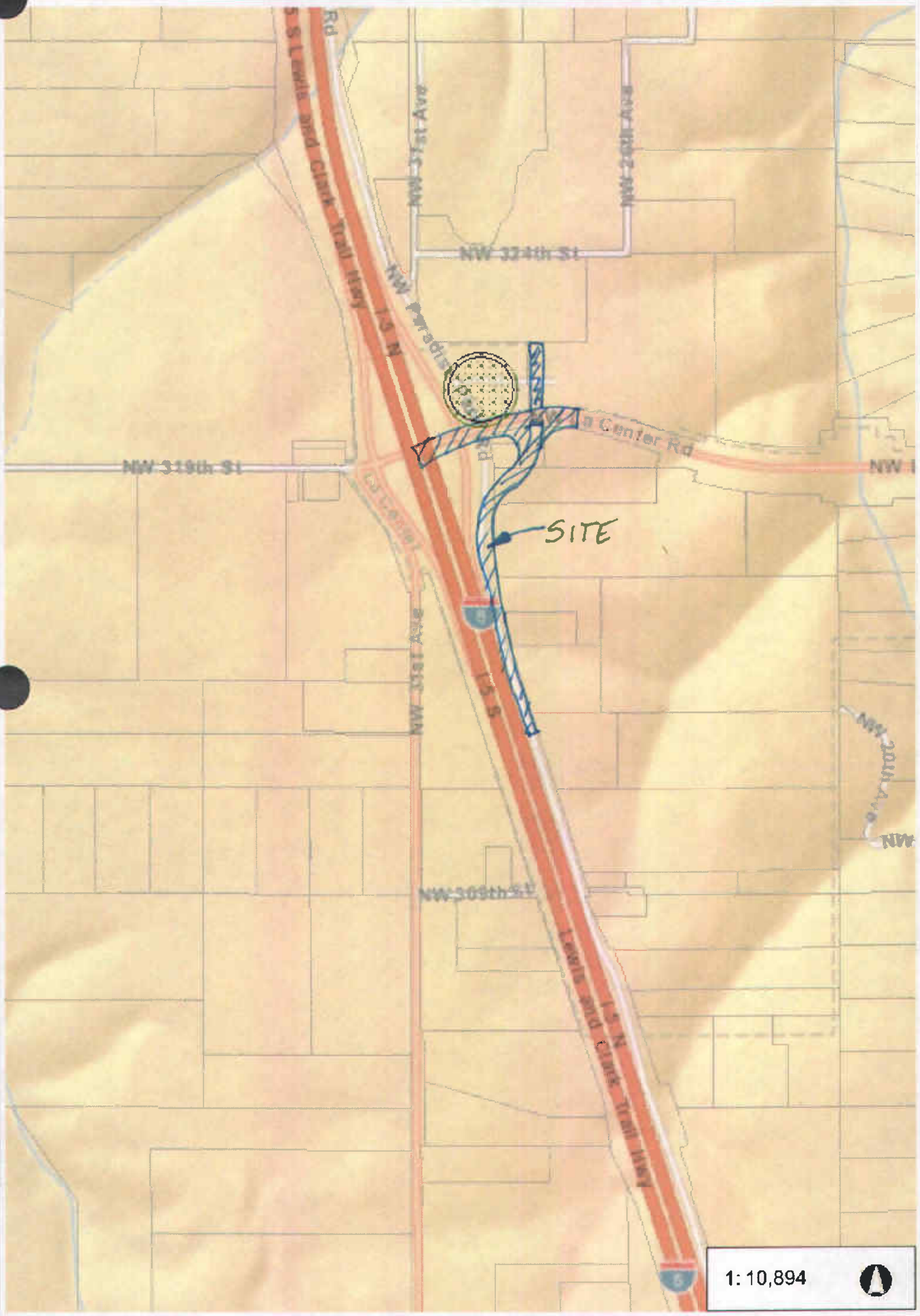
Notes:

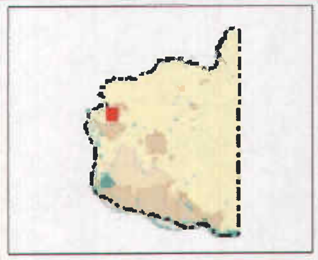
Soils Map

1,815.7 0 907.86 1,815.7 Feet

GS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

Paradise Park Rd. Realignment





Legend

- Sanitary Sewer
- Water Line
- Wellhead Protection Areas
  - 0
  - 1 Year
  - 5 Years
  - 10 Years
- Building Footprints
- Taxlots
- County Outline
- World Street Map

Notes:

Wellhead Protection, Sanitary Sewer, and Water Mains

1,815.7 | 0 | 907.86 | 1,815.7 Feet

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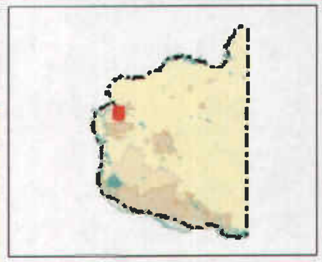
Clark County, WA. GIS - http://gis.clark.wa.gov

Paradise Park Rd. Realignment



Legend

- Gravity Main - City
- Channels - City
- Storm Treatment - City
- Plug - City
- Manhole - City
- Flow Control - City
- Discharge - City
- Catch Basin - City
- Unknown - City
- Building Footprints
- Taxlots
- County Outline
- World Street Map

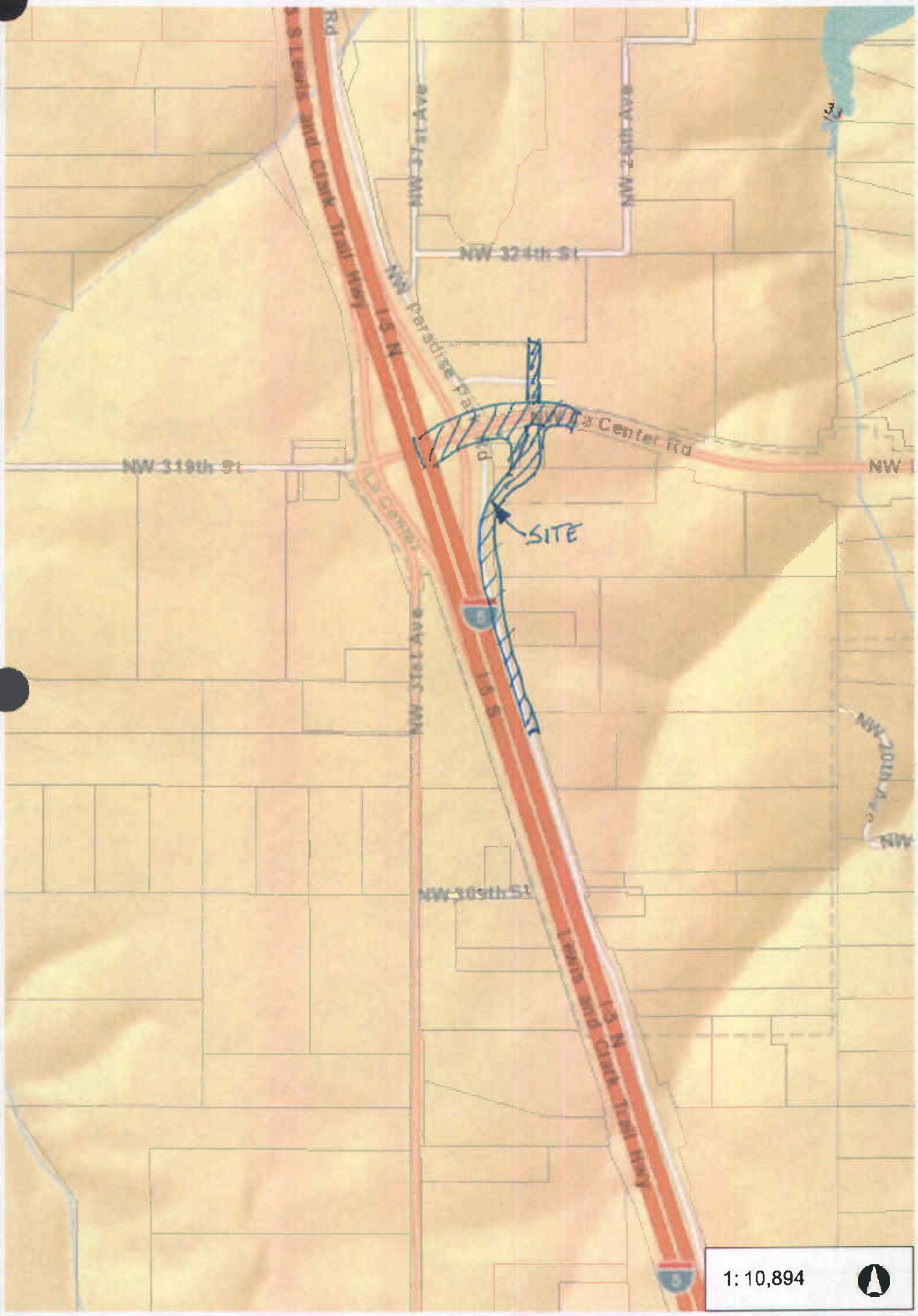
Notes:

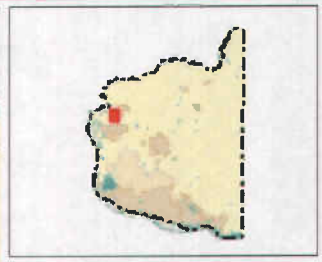
Stormwater Systems

1,815.7 0 907.86 1,815.7Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

Paradise Park Rd. Realignment





Legend

- Base Flood Elevation
- Flood Zone Designation
  - Floodway
  - Floodway Fringe
  - 500 Year Flood Area
  - Area Not Studied
- Building Footprints
- Taxlots
- County Outline
- World Street Map

1: 10,894

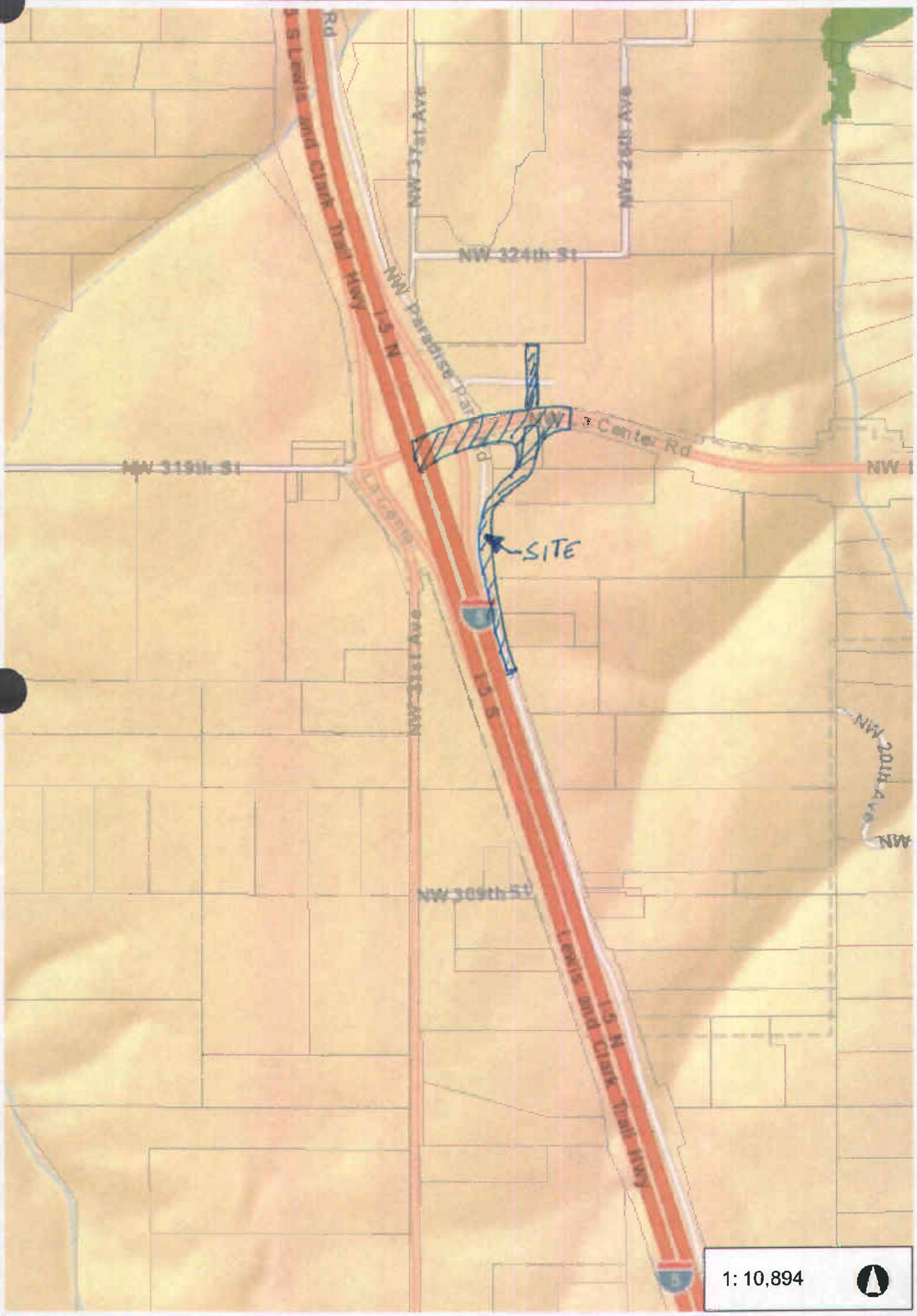
Notes:

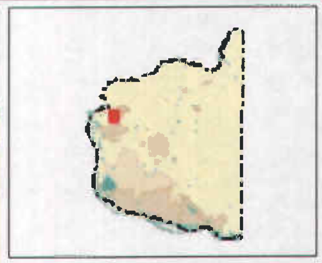
Flood Plain Mapping
(None Present)

1,815.7 0 907.86 1,815.7 Feet

GCS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

Paradise Park Rd. Realignment





Legend

Shoreline Designations
- Aquatic
- Natural
- Urban Conservancy
- Medium Intensity
- High Intensity
- Rural Conservancy Residential
- Rural Conservancy Resource Land

Building Footprints
Taxlots
County Outline
World Street Map

Notes:

Shoreline Designations
(None Present)

1,815.7 0 907.86 1,815.7Feet

GS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

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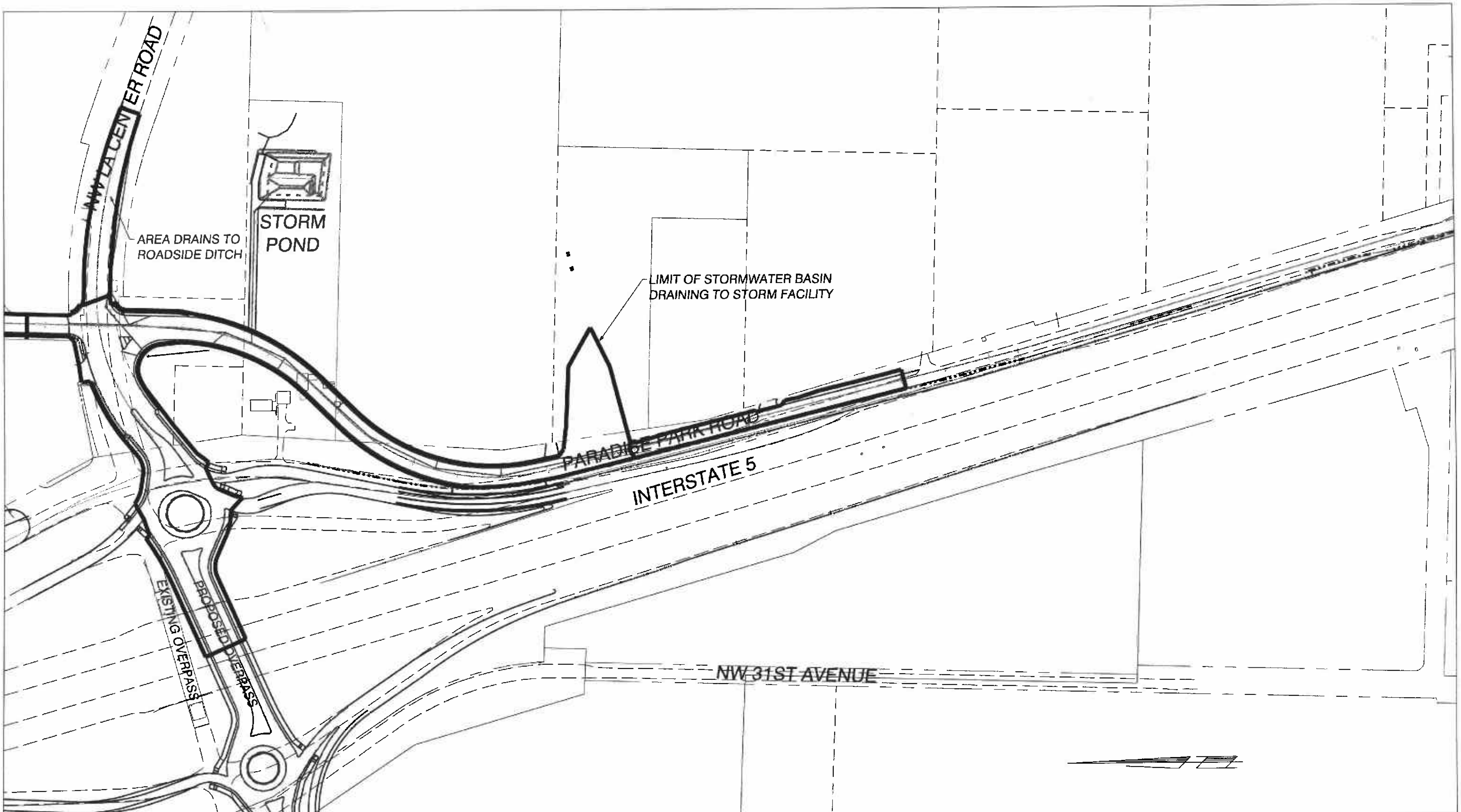

DEVELOPED CATCHMENT PLAN

OLSON ENGINEERING INC. LAND SURVEYORS ENGINEERS 1111 BROADWAY, VANCOUVER, WA 98660

PROJECT: LA CENTER JUNCTION IMPROVEMENTS

SCALE: 1"=200'
DATE: REV. 10/20/15
ISSUED BY: PAT
JOB NO. 7714.03.02
DWG. NO. 1 OF 1

R
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1.1 Project Introduction

In 2004, the Cowlitz Indian Tribe applied to the Department of the Interior to have approximately 152 acres of land to the west of I-5 at exit 16 near La Center, Washington taken into trust as the Initial Reservation of the Cowlitz Tribe. In December 2010 the federal government approved the Tribe's application, a decision that was appealed and has since been upheld. The Tribe proposes to develop this land for several uses: a gaming and entertainment casino, Tribal government center and Tribal housing. An environmental impact statement (EIS) process was completed for the Cowlitz Indian Tribe Trust Acquisition and Casino Project (referred to as the Cowlitz Reservation Project) with the final EIS dated 30 May 2008. The Record of Decision was issued on 22 April 2013 (2013 ROD). The EIS addressed the NW La Center Road/I-5 interchange and frontage road realignments that would be required as a result of the development of tribal center and casino.

The Cowlitz Tribe is proposing improvements to the existing interchange (Exit 16) of I-5 at NW La Center Road as traffic mitigation for the Cowlitz Reservation Project. The proposed reconstruction and modification of the existing interchange requires construction of a new overpass with associated improvements to off ramps, relocation of Paradise Park Road on the east of I-5, and relocation of NW 31st avenue and NW 319th Street to the west of I-5. Since the road improvements fall within different jurisdictions there are different stormwater mitigation different requirements for each. A summary of the different jurisdictions, the road improvements and the required stormwater mitigation is as follows:

- Overpass and off ramps: Within WSDOT right of way and required to meet requirements of the 2010 WSDOT Hydraulics Manual and the 2014 Highway Runoff Manual.
- Relocation of Paradise Park Road south of La Center Road – Within City of La Center. Due to permitting requirements, this design will be based on the 2014 revisions to the 2012 Stormwater Management Manual for Western Washington.
- Relocation of Paradise Park Road north of La Center Road – Partially within City of La Center but mostly within Clark County. Required to meet the Clark County Stormwater Ordinance based on the 2005 Western Washington Stormwater Manual.
- Relocation of NW 31st Avenue and NW 319th Street to the west of I-5 is within the Proposed Cowlitz Reservation boundaries. These improvements were part of the EIS process and were designed to meet the requirements of the Clark County Drainage Ordinance in effect at the time. The stormwater facilities submitted with the EIS was designed according to the 1992 Puget Sound Manual with some minor modifications as defined by Clark County Code.

A hydraulic report has been prepared by CH2M Hill to address the proposed interchange improvements within WSDOT right-of-way. Berger/ABAM has prepared reports detailing stormwater management for the areas west of the I-5 centerline. Olson Engineering prepared a separate report demonstrating compliance with the Clark County Stormwater Manual for work within the Clark County right-of-way and for that portion of Paradise Park Road within the City of La Center but draining to a Clark County stormwater facility. This report has been prepared to address the proposed stormwater management within City of La Center right-of-way draining to facilities which will be owned and maintained by the City of La Center.

1.2 Site Location

The Tribal property is approximately 20 miles north of Portland with frontage to Interstate 5. The site encompasses 9 contiguous lots in Clark County, near Ridgefield and La Center, Washington, and is located on NW 319th Street between NW 41st Avenue and NW 31st Avenue and adjacent to Interstate 5 at the NW 319th Street interchange.

The I-5/La Center Interchange Improvements project encompasses several transportation improvement projects along I-5, NW La Center Road, NW 319th Street, NW 31st Avenue and NW Paradise Park Road. The project is driven by the need to augment vehicle capacity though the interchange in anticipation of increased traffic in the future due to the Cowlitz Tribe Casino and growth in and around La Center. These improvements occur between mileposts (MP) 16.09 and 17.05.

1.3 Scope of Work

The primary purpose of the proposed action is to provide traffic mitigation for the tribal casino. The project area covers approximately 68 acres including WSDOT right of way, NW La Center Road right of way, portions of four tax lots adjacent to Paradise Park Road south of NW La Center Road, and four tax lots north of NW La Center Road up to NW 324th Street, east of I-5. The general location includes portions of sections 4 and 9, Township 04 North, Range 01 East of the Willamette Meridian (WM). All project activities occur within the Lewis River watershed.

The roadway improvements will include the following general elements.

- Site preparation
- Demolition
- Grading and earthwork
- Overpass construction
- Road construction
- Traffic control

Road Improvements within the City of La Center Limits

2.1 Existing Conditions

The area of the project within the City of La Center limits includes La Center Road from the west side of the overpass to the end of the new tapers on the east side of the overpass. It also includes approximately 400 ft of the newly relocated Paradise Road north of La Center Road and everything south of La Center Road. Currently Paradise Park Road south of La Center Road is located directly adjacent to I-5. The intersection of Paradise Park Road and La Center Road is only 100 ft east of the I-5 north bound off ramp. The right of way area is generally covered with grass, shrubs and small trees. The area to be impacted by the relocated road is currently pasture, lawn, shrubs, small trees and residential buildings.

There are some wetland areas on adjacent properties; no wetlands will be impacted with the road improvements. There are limited wetland buffer impacts as detailed in Berger/ABAM's mitigation plan.

All runoff from the portion of Paradise Park Road within the City limits drains to the east where it flows to several small tributaries of McCormick Creek. McCormick Creek then drains to the East Fork of the Lewis River.

2.2 Soils

Based on the Washington Division of Geology and Earth Resources Geologic Map of the Vancouver Quadrangle, both the Ridgefield and La Center sites are mapped as Quaternary periglacial deposits of sand silt and clay resulting from outburst from the Missoula floods. In addition, the near surface soils in both locations have been mapped by the USDA Soil Conservation Service as Gee Silt Loam with Odne Silt loam mapped along drainages.

A) Topsoil – approximately 5 inches of organic root mat with a tilled zone extending approximately 18 inches from the surface.
B) Silt – below the tilled zone, a deposit of silt with variable percentages of clay and sand extends to approximately 12.5 feet to 15 feet. In general, the silt zone is stiff in the upper 5 feet with an underlying softer layer.
C) Clay – Below the silt, a stiff to very stiff clay layer extends to a depth of between 23 and over 42 feet below the surface. In some locations, gravel is present within the clay layer.
D) Sandy Silt – Below the clay, a stiff deposit of sandy silt exists. Total depth of the sandy silt was not determined by the onsite testing.

As seen in the soil profile, the predominant soil types consist of silts and clays which generally have little to no infiltration capability.

2.3 Groundwater

For the geotechnical investigations completed on the proposed Tribal Property located to the west of I-5, groundwater was encountered at depths ranging from 5 feet to over 15 feet. Due to the tight nature of the soil, this could cause ground water seepage during excavation. Due to the high ground water and nature of the soil, in situ moisture contents were found to range from approximately 10% to 15% above optimum soil moisture content for compaction. Similar groundwater and soil moisture conditions are expected for the relocation of Paradise Park Road.

2.4 Existing Stormwater System

Currently there are shallow ditches that run along both sides of Paradise Park Road with occasional shallow culverts passing under to convey runoff from the west side to the east side of the road. There are also roadside ditches on both the north and south sides of La Center Road. All runoff from both Paradise Park Road and La Center Road discharge to tributaries of McCormick Creek, which eventually discharges to the East Fork of the Lewis River.

3.0 Drainage Analysis

Runoff quantities for this project were estimated using the Western Washington Hydrology Model (WWHM), a continuous runoff model based on the USGS's HSPF model. Soil conditions were selected based on Clark County's proposed soil characterizations for the Gee Silt Loam and Odne Silt Loam present, which both are classified as Soil Group 4 under Clark County's system.

3.1 Design Storms

Stormwater modeling under the SMMWW does not use a traditional design storm methodology (in which the 2-year, 10-year, and other assumed events are modeled) for detention and water quality treatment design. Instead, a continuous stormwater event extending more than fifty years is analyzed. Details of this analysis will be reported in the pertinent sections below.

A separate HydroCAD model is included with these calculations; this model was used to confirm pipe sizes for stormwater conveyance in the 100-year storm event using traditional SCS TR-20 methodology.

3.2 Historic and Developed Land Uses

Under the SMMWW, the historic condition for new development shall be assumed to be forested unless historic evidence can be provided demonstrating an alternative ground cover is appropriate. Forested conditions were assumed for this analysis.

The developed land uses were assumed to be paved.

3.3 Water Quality Treatment

The stormwater facility's discharge runs to a small tributary of a fish-bearing stream. Under SMMWW guidance, this requires enhanced treatment. A constructed wetland was selected to meet this standard; design criteria are as follows:

- *Wetted area is based on the Water Quality Volume estimated by WWHM, which is then divided by an assumed average depth of three feet. This is intended to replicate the wetted area of a traditional wet pond.* For this project, the Water Quality Volume is 0.6723 acre-feet, or 29,285 cubic feet. Dividing that result by 3.0 gives a minimum Constructed Wetland area of 9,762 square feet. As designed, the Constructed Wetland provides 9,793 square feet.
- *The first cell is a sedimentation forebay, which is intended to hold 25-35% of the Water Quality Volume, or 7,321 - 10,250 cubic feet. This cell shall be between 4 feet and 8 feet deep, excluding sediment storage.* As designed, the 4' deep forebay provides 8,600 cubic feet of storage (excluding 1' of sediment storage at the base of the forebay). This occupies approximately 3,663

square feet of the wetted area.

- The remainder of the facility is divided into areas of varying depths. The target depths are as follows:

Depth Range (feet)	Percent of Surface Area
1.0 to 1.5	40
1.5 to 2.0	40
2.0 to 2.5	20

As designed, the areas provided break down as follows:

Depth Range (feet)	Area (SF)	Percent of Surface Area*
1.0 to 1.5	2,208	36
1.5 to 2.0	2,643	43
2.0 to 2.5	1,334	22

*percentages do not total 100% due to rounding

- *The "berm" separating the forebay and the second wetland cell shall be shaped such that its downstream side gradually slopes to form the second shallow wetland cell or shall be graded "naturalistically" from the top of the dividing berm. This berm shall either be at the WQ design water surface or submerged one foot below the WQ design water surface.* Due to the city's concerns regarding the maintenance of the pond, this standard has not been met explicitly; it is the engineer's opinion, however, that the design provided will function in a manner consistent with the intent of the design. Instead, the pond has been designed as a series of benches of appropriate depth; this is intended to simplify the future removal of vegetation and sediment and the reconstruction of the facility following maintenance activities.
- *The upstream slope of the "berm" may be as steep as 2H:1V.* This is designed as 3:1 in the current design, flatter than the maximum allowed.
- Where soil conditions warrant, a low-permeability or treatment liner is required. In this design, soils are expected to be of very low infiltration capacity, so a liner should not be necessary.
- *The inlet shall be located at least two feet above the base of the forebay.* This criteria has been met.
- *The outlet shall be designed to draw water from at least 12 inches below the Water Quality Design Surface. If grade allows, a gravity drain shall be installed to facilitate drainage of the wetland*. In this design, grade does not allow a gravity drain, but the total volume of each cell and easy access to each will allow the use of a temporary pump to dewater the constructed wetland when necessary. The outlet for normal operation has been designed in accordance with this standard.
- Access to both cells has been provided in accordance with the standards.
- The wetland cell will be planted in accordance with the standards.

3.4 Water Quantity Control

The SMMWW requires design to the Flow-Duration standard. This standard attempts to replicate both the flow regime and the duration of flow at each step based on the historic land cover conditions. Based on the WWHM model, the pond provided exceeds this standard; the model indicates a minimum pond base area of approximately 65' x 130', or 8,450 square feet. The pond provided has a "base" area (at the wetted surface of the wetland) of approximately 9,793 square feet. The outlet structure has been designed based on the minimum base area, so this pond is expected to exceed the detention standard.

The following standards apply to the design of combined water quality and wetpool detention facilities:

- *A sump must be provided in the outlet structure of combined ponds.* This sump has been provided as required.
- *The detention flow restrictor and its outlet pipe shall be designed according to the requirements for detention ponds.* This requirement has been met.
- *The sizing procedure for combined detention and stormwater wetlands is identical to those outlined for stormwater wetlands and for detention facilities.* These standards have been met in this design.
- *The minimum sediment storage depth in the first cell is 1 foot. The 6 inches of sediment storage required for detention ponds does not need to be added to this, nor does the 6" of sediment storage in the second cell of detention ponds need to be added.* One foot of sediment storage has been provided as required in the standards.
- *The difference between the WQ design water surface and the maximum water surface associated with the 2-year runoff shall not be greater than 3 feet.* The WWHM model indicates a depth of 2.05 feet in the "2-year" storm. The pond meets the standard as designed.

A downstream analysis has been performed to verify the capacity of the downstream structure (the culvert at La Center Road) and the stream channel. This analysis, which is included as an appendix to this report, determined that the stream and culvert downstream from the site have sufficient capacity to convey the proposed runoff rates in accordance with the La Center Stormwater & Erosion Control Code.

The capacity of the pipe network needed to convey flows will be completed using the Rational Method and the 100-year storm event as required by LCMC.

4.0 Erosion Control

The road improvements are required to meet the latest requirements for Erosion and Sediment prevention as required by the City of La Center and WSDOE when obtaining an NPDES permit for the construction of the road improvements.

4.1 Stormwater Pollution Prevention Plan (SWPPP)

As part of the NPDES permit, a SWPPP has to be developed. The SWPPP must consist of and make provisions for:

- Erosion prevention and sediment control
- Control of other potential pollutants

The Construction SWPPP shall describe construction practices, stabilization techniques and structural BMPs that are to be implemented to prevent erosion and minimize sediment transport.

BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Reports summarizing the scope of these inspections, the personnel conducting the inspection, the dates of the inspections, major observations relating to the implementation of the SWPPP, and actions taken as a result of these inspections shall be prepared and retained as part of the SWPPP.

4.2 SWPPP Development and Implementation

The construction site contains soils with medium to high erosive potential, clays, high ground water, sensitive areas, and medium to steep slopes.

To minimize the potential for erosion to occur on the site, the following items will need to be address and implemented.

4.2.1 Mark Clearing Limits

Prior to land disturbing activities, the clearing and grading limits need to be marked clearly, both in the field and on the plans. This can be done using construction fences or by creating buffer zones.

4.2.2 Establish Construction Access and Staging Areas

Construction traffic should be limited in their access to the site to a single entrance. Once on the site, haul roads and staging areas should be developed to control impact to onsite soil. All access points, haul roads and staging areas should be stabilized with crushed rock. Any sediment should be removed daily and the road structure maintained.

4.2.3 Control Flow Rates and Install Sediment Control

Downstream waterways and properties shall be protected during construction from increase flow rates due to higher impervious nature of the site. During construction, proposed detention facilities can be utilized temporarily as sedimentation ponds as long as the detention volume is not impacted by a buildup of sediment.

Sediment control BMPs include installation of:

- Silt fence
- Gravel filter berms
- Straw wattles
- Sediment traps
- Mulching of disturbed soil
- Construction stormwater chemical treatment
- Construction stormwater filtration

It should be noted that, due to the clay on the site it is likely that settlement BMPs will not remove the fine clay particles. If this is the case, then the use of chemical treatment and stormwater filtration may be required.

The chemical treatment system that has been approved by WSDOE is Chitosan Enhanced Sand Filtration (CESF) under State BMP C250.

Prior to using stormwater chemical treatment, formal written permission from WSDOE is required and the intention to use the BMP shall be included in the notice of intent as required for coverage under an NPDES permit.

4.2.4 Soil Stabilization

Exposed and unworked soils shall be stabilized by the application of an effective BMP. These include:

- Temporary or permanent seeding
- Mulching
- Nets and blankets
- Plastic covering
- Sodding
- Gradient terraces

4.2.5 Protection of Slopes and Drains

Concentrated flows create high potential for erosion, therefore, any slopes should be protected from concentration of flow. This can be done by using gradient terraces, interceptor dikes and swales, installing pipe slope drains or level spreaders.

Inlets need to be protected to provide an initial filtering of stormwater runoff. However, any sediment buildup shall be removed so the inlet does not become blocked.

4.2.6 Control Pollutants

The SWPPP shall address maintenance and repair of heavy equipment onsite to remove the potential of pollution from oil, fuel, hydraulic fluid or any other potential pollutant.

4.2.7 Maintenance

The SWPPP shall address the maintenance of both temporary and permanent erosion and sediment control BMPs.

See Appendix for some proposed BMPs.

APPENDIX

APPENDICES

Appendix A	Soil Group Classifications for Soils in Clark County
Appendix B	WWHM Analysis – Water Quality Design
Appendix C	WWHM Analysis – Detention Design
Appendix D	HydroCAD Analysis – Conveyance System Design Rational Method assumptions for City of La Center
Appendix E	Stormwater Facility Detail
Appendix F	Downstream Analysis

A

Memorandum

otak

700 Washington Street
Suite 401.
Vancouver, WA 98660
Phone (360) 737-9613
Fax (360) 737-9651

To: Rod Swanson, Clark County Environmental Services

From: Tim Kraft

Copies: File

Date: December 21, 2010

Subject: Clark County WWHM Soil Groupings

The Clark County version of the Western Washington Hydrology Model (WWHM) includes five soils groups to represent the many soil types found within the county limits. Although there are over 110 different soil types throughout Clark County, similarities between the soils allows them to be grouped into categories for modeling purposes.

Clark County soils are grouped into five categories largely based on their permeability and runoff potential. These categories include:

- Soil Group (SG) 1 – Excessively drained soils (hydrologic soil groups A & B)
- Soil Group (SG) 2 – Well drained soils (mostly hydrologic soil group B)
- Soil Group (SG) 3 – Moderately drained soils (hydrologic soil groups B & C)
- Soil Group (SG) 4 – Poorly drained soils (slowly infiltrating C soils, as well as D soils)
- Soil Group (SG) 5 – Wetland soils (mucks).

Soil Groups 1 and 2 are those most suitable for traditional infiltration facilities such as trenches and drywells, while Soil Group 3 may only be suitable for slower infiltrating facilities such as rain gardens and other Low Impact Development (LID) measures. Soil Groups 4 and 5 are those which are typically not suitable for infiltration.

For additional information on the classification of soils for use in the Clark County WWHM model, please see the report titled "Development of the Clark County Version of the Western Washington Hydrology Model", which can be found on the county's community development web site.

The following table lists the WWHM soil group for each NCRS soil type in Clark County.

Map Symbol	Soil Name	HSG
	Soils Group (SG) 1	
LeB	LAUREN	B
LgB	LAUREN	B
LgD	LAUREN	B
LgF	LAUREN	B
LIB	LAUREN	B
Ro	ROUGH BROKEN LAND	A
SvA	SIFTON	B
WnB	WIND RIVER VARIANT	B
WnD	WIND RIVER VARIANT	B
WnG	WIND RIVER VARIANT	B
WrB	WIND RIVER VARIANT	B
WrF	WIND RIVER VARIANT	B
	PITS	A
	BONNEVILLE STONY SAND LOAM	A

Soils Group (SG) 2

BpB	BEAR PRARIE	B
BpC	BEAR PRARIE	B
CnB	CINEBAR	B
CnD	CINEBAR	B
CnE	CINEBAR	B
CnG	CINEBAR	B
CrE	CINEBAR	B
CrG	CINEBAR	B
CsF	CISPUS	B
CtA	CLOQUATO	B
HlA	HILLSBORO	B
HlB	HILLSBORO	B
HlC	HILLSBORO	B
HlD	HILLSBORO	B
HlE	HILLSBORO	B

Map Symbol	Soil Name	HSG
HlF	HILLSBORO	B
Soils Group (SG) 2 (continued)		
KeC	KINNEY	B
KeE	KINNEY	B
KeF	KINNEY	B
KnF	KINNEY	B
LaE	LARCHMOUNT	B
LaG	LARCHMOUNT	B
LcG	LARCHMOUNT	B
MsB	MOSSYROCK	B
NbA	NEWBERG	B
NbB	NEWBERG	B
PhB	PILCHUCK	C
PuA	PUYALLUP	B
SaC	SALKUM	B
VaB	VADER	B
VaC	VADER	B
WaA	WASHOUGAL	B
WgB	WASHOUGAL	B
WgE	WASHOUGAL	B
WhF	WASHOUGAL	B
YaA	YACOLT	B
YaC	YACOLT	B
YcB	YACOLT	B

Soils Group (SG) 3

DoB	DOLLAR	C
HcB	HESSON	C
HcD	HESSON	C
HcE	HESSON	C
HcF	HESSON	C
HgB	HESSON	C
HgD	HESSON	C
HhE	HESSON	C
HoA	HILLSBORO	B

Map Symbol	Soil Name	HSG
HoB	HILLSBORO	B
Soils Group (SG) 3 (continued)		
HoC	HILLSBORO	B
HoD	HILLSBORO	B
HoE	HILLSBORO	B
HoG	HILLSBORO	B
HsB	HILLSBORO	B
McB	McBEE	C
MeA	McBEE	C
MIA	McBEE	C
OeD	OLEQUA	B
OeE	OLEQUA	B
OeF	OLEQUA	B
OlB	OLYMPIC	B
OID	OLYMPIC	B
OlE	OLYMPIC	B
OIF	OLYMPIC	B
OmE	OLYMPIC	B
OmF	OLYMPIC	B
OpC	OLYMPIC VARIANT	C
OpE	OLYMPIC VARIANT	C
OpG	OLYMPIC VARIANT	C
OrC	OLYMPIC VARIANT	C
PoB	POWELL	C
PoD	POWELL	C
PoE	POWELL	C
SmA	SAUVIE	B
SmB	SAUVIE	B
SnA	SAUVIE	D
SpB	SAUVIE	B

Soils Group (SG) 4

CvA	COVE	D
CwA	COVE	D
GeB	GEE	C

Map Symbol	Soil Name	HSG
GeD	GEE	C
Soils Group (SG) 4 (continued)		
GeE	GEE	C
GeF	GEE	C
GuB	GUMBOOT	D
HtA	HOCKINSON	D
HuB	HOCKINSON	D
HvA	HOCKINSON	D
LrC	LAUREN	C
LrF	LAUREN	C
MnA	MINNIECE	D
MnD	MINNIECE	D
MoA	MINNIECE VARIANT	D
OdB	ODNE	D
OhD	OLEQUA VARIANT	C
OhF	OLEQUA VARIANT	C
SlB	SARA	D
SlD	SARA	D
SlF	SARA	D

Soils Group (SG) 5

Sr	SEMIAHMOO	C
Su	SEMIAHMOO VARIANT	D
ThA	TISCH	D

B

WATER QUALITY DESIGN

WWHM4

PROJECT REPORT

General Model Information

Project Name:	7714 Burk Pond without Landon Comm WQ
Site Name:	
Site Address:	
City:	
Report Date:	10/18/2015
Gage:	Ridgefield
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.11
Version:	2015/05/15

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
SG4, Forest, Mod	5.5
Pervious Total	5.5
Impervious Land Use	Acres
Impervious Total	0
Basin Total	5.5

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No	
GroundWater:	No	
Pervious Land Use	Acres	
Pervious Total	0	
Impervious Land Use	Acres	
ROADS FLAT	5.5	
Impervious Total	5.5	
Basin Total	5.5	

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	130.00 ft.
Bottom Width:	65.00 ft.
Depth:	3.5 ft.
Volume at riser head:	0.5806 acre-ft.
Side slope 1:	3 To 1
Side slope 2:	3 To 1
Side slope 3:	3 To 1
Side slope 4:	3 To 1
Discharge Structure	
Riser Height:	2.5 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	1.360 ft.
Notch Height:	0.050 ft.
Orifice 1 Diameter:	3.594 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

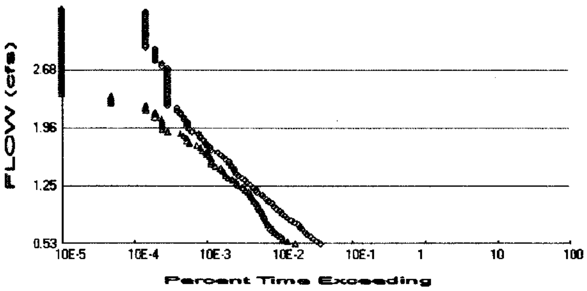
Hydraulic Table

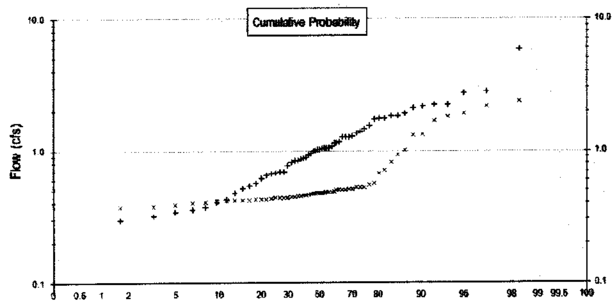
Stage(ft)	**Area(ac)**	**Volume(ac-ft)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.194	0.000	0.000	0.000
0.0389	0.195	0.007	0.066	0.000
0.0778	0.196	0.015	0.094	0.000
0.1167	0.197	0.022	0.115	0.000
0.1556	0.198	0.030	0.133	0.000
0.1944	0.199	0.038	0.149	0.000
0.2333	0.200	0.046	0.163	0.000
0.2722	0.201	0.053	0.177	0.000
0.3111	0.202	0.061	0.189	0.000
0.3500	0.203	0.069	0.200	0.000
0.3889	0.204	0.077	0.211	0.000
0.4278	0.205	0.085	0.221	0.000
0.4667	0.206	0.093	0.231	0.000
0.5056	0.207	0.101	0.241	0.000
0.5444	0.208	0.109	0.250	0.000
0.5833	0.209	0.117	0.259	0.000
0.6222	0.211	0.126	0.267	0.000
0.6611	0.212	0.134	0.275	0.000
0.7000	0.213	0.142	0.283	0.000
0.7389	0.214	0.150	0.291	0.000
0.7778	0.215	0.159	0.299	0.000
0.8167	0.216	0.167	0.306	0.000
0.8556	0.217	0.176	0.313	0.000
0.8944	0.218	0.184	0.320	0.000
0.9333	0.219	0.193	0.327	0.000
0.9722	0.220	0.201	0.334	0.000
1.0111	0.222	0.210	0.341	0.000
1.0500	0.223	0.218	0.347	0.000
1.0889	0.224	0.227	0.354	0.000
1.1278	0.225	0.236	0.360	0.000
1.1667	0.226	0.245	0.366	0.000
1.2056	0.227	0.253	0.372	0.000

1.2444	0.228	0.262	0.378	0.000
1.2833	0.229	0.271	0.384	0.000
1.3222	0.230	0.280	0.390	0.000
1.3611	0.232	0.289	0.395	0.000
1.4000	0.233	0.298	0.401	0.000
1.4389	0.234	0.307	0.406	0.000
1.4778	0.235	0.316	0.412	0.000
1.5167	0.236	0.326	0.417	0.000
1.5556	0.237	0.335	0.423	0.000
1.5944	0.238	0.344	0.428	0.000
1.6333	0.240	0.353	0.433	0.000
1.6722	0.241	0.363	0.438	0.000
1.7111	0.242	0.372	0.443	0.000
1.7500	0.243	0.382	0.448	0.000
1.7889	0.244	0.391	0.453	0.000
1.8278	0.245	0.401	0.458	0.000
1.8667	0.247	0.410	0.463	0.000
1.9056	0.248	0.420	0.468	0.000
1.9444	0.249	0.430	0.473	0.000
1.9833	0.250	0.439	0.477	0.000
2.0222	0.251	0.449	0.482	0.000
2.0611	0.252	0.459	0.487	0.000
2.1000	0.254	0.469	0.491	0.000
2.1389	0.255	0.479	0.496	0.000
2.1778	0.256	0.489	0.500	0.000
2.2167	0.257	0.499	0.505	0.000
2.2556	0.258	0.509	0.509	0.000
2.2944	0.260	0.519	0.513	0.000
2.3333	0.261	0.529	0.518	0.000
2.3722	0.262	0.539	0.522	0.000
2.4111	0.263	0.549	0.526	0.000
2.4500	0.264	0.559	0.531	0.000
2.4889	0.266	0.570	0.569	0.000
2.5278	0.267	0.580	0.657	0.000
2.5667	0.268	0.591	0.845	0.000
2.6056	0.269	0.601	1.099	0.000
2.6444	0.270	0.612	1.404	0.000
2.6833	0.272	0.622	1.753	0.000
2.7222	0.273	0.633	2.140	0.000
2.7611	0.274	0.643	2.563	0.000
2.8000	0.275	0.654	3.018	0.000
2.8389	0.276	0.665	3.504	0.000
2.8778	0.278	0.676	4.018	0.000
2.9167	0.279	0.686	4.559	0.000
2.9556	0.280	0.697	5.125	0.000
2.9944	0.281	0.708	5.716	0.000
3.0333	0.283	0.719	6.331	0.000
3.0722	0.284	0.730	6.968	0.000
3.1111	0.285	0.741	7.627	0.000
3.1500	0.286	0.752	8.308	0.000
3.1889	0.288	0.764	9.009	0.000
3.2278	0.289	0.775	9.730	0.000
3.2667	0.290	0.786	10.47	0.000
3.3056	0.291	0.797	11.22	0.000
3.3444	0.293	0.809	12.00	0.000
3.3833	0.294	0.820	12.80	0.000
3.4222	0.295	0.832	13.61	0.000
3.4611	0.296	0.843	14.44	0.000

3.5000	0.298	0.855	15.29	0.000
3.5389	0.299	0.866	16.15	0.000

Analysis Results
POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 5.5
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 5.5

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.059977
5 year	1.937425
10 year	2.468083
25 year	3.041585
50 year	3.397111
100 year	3.697154

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.525215
5 year	0.80401
10 year	1.042626
25 year	1.416807
50 year	1.756196
100 year	2.154796

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.887	0.567
1950	0.879	0.477
1951	1.754	0.504
1952	1.537	0.523
1953	1.022	0.416
1954	1.018	0.472
1955	0.683	0.419
1956	2.233	1.307
1957	0.921	0.443
1958	0.999	0.525

1959	0.688	0.373
1960	0.517	0.483
1961	1.460	0.816
1962	0.947	0.428
1963	1.350	0.472
1964	1.275	0.436
1965	1.256	0.503
1966	1.824	0.439
1967	0.773	0.455
1968	1.257	0.470
1969	1.050	2.179
1970	5.832	0.704
1971	0.814	0.418
1972	1.032	0.438
1973	0.988	0.473
1974	2.788	1.916
1975	0.837	0.449
1976	1.816	0.475
1977	0.007	0.421
1978	2.173	1.003
1979	0.563	0.486
1980	1.045	0.423
1981	2.107	0.931
1982	1.257	0.665
1983	2.705	0.507
1984	0.668	0.454
1985	0.356	0.503
1986	0.375	0.447
1987	1.085	0.509
1988	0.426	0.481
1989	0.319	0.403
1990	0.345	0.409
1991	0.832	0.426
1992	1.156	0.389
1993	0.861	0.505
1994	1.048	0.549
1995	0.673	1.688
1996	1.732	1.793
1997	1.897	2.354
1998	1.140	0.443
1999	1.388	0.523
2000	0.542	0.377
2001	0.296	0.339
2002	2.217	0.410
2003	1.744	0.482
2004	0.478	0.459
2005	0.406	0.471
2006	1.147	0.435
2007	0.651	1.321
2008	0.617	0.425

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	5.8322	2.3543
2	2.7876	2.1787
3	2.7047	1.9160
4	2.2325	1.7926

5	2.2171	1.6881
6	2.1733	1.3206
7	2.1072	1.3068
8	1.8966	1.0026
9	1.8240	0.9309
10	1.8163	0.8155
11	1.7537	0.7042
12	1.7437	0.6650
13	1.7318	0.5666
14	1.5367	0.5488
15	1.4605	0.5247
16	1.3877	0.5234
17	1.3505	0.5233
18	1.2745	0.5090
19	1.2575	0.5070
20	1.2574	0.5050
21	1.2562	0.5036
22	1.1562	0.5031
23	1.1472	0.5030
24	1.1397	0.4855
25	1.0852	0.4827
26	1.0501	0.4820
27	1.0482	0.4809
28	1.0445	0.4775
29	1.0323	0.4750
30	1.0218	0.4734
31	1.0181	0.4719
32	0.9985	0.4715
33	0.9876	0.4714
34	0.9466	0.4695
35	0.9214	0.4591
36	0.8870	0.4549
37	0.8786	0.4537
38	0.8613	0.4491
39	0.8365	0.4469
40	0.8318	0.4432
41	0.8138	0.4425
42	0.7729	0.4388
43	0.6885	0.4385
44	0.6833	0.4360
45	0.6732	0.4350
46	0.6683	0.4285
47	0.6510	0.4263
48	0.6166	0.4247
49	0.5627	0.4226
50	0.5419	0.4207
51	0.5172	0.4194
52	0.4778	0.4178
53	0.4259	0.4163
54	0.4062	0.4104
55	0.3753	0.4088
56	0.3555	0.4031
57	0.3452	0.3892
58	0.3187	0.3770
59	0.2958	0.3731
60	0.0068	0.3392

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.5300	748	340	45	Pass
0.5589	666	267	40	Pass
0.5879	604	233	38	Pass
0.6169	551	213	38	Pass
0.6458	496	195	39	Pass
0.6748	462	180	38	Pass
0.7038	429	166	38	Pass
0.7327	398	156	39	Pass
0.7617	374	146	39	Pass
0.7906	335	139	41	Pass
0.8196	301	134	44	Pass
0.8486	268	129	48	Pass
0.8775	247	127	51	Pass
0.9065	220	122	55	Pass
0.9354	209	116	55	Pass
0.9644	188	111	59	Pass
0.9934	173	106	61	Pass
1.0223	163	101	61	Pass
1.0513	145	93	64	Pass
1.0802	138	91	65	Pass
1.1092	126	86	68	Pass
1.1382	120	84	70	Pass
1.1671	102	77	75	Pass
1.1961	98	70	71	Pass
1.2250	90	64	71	Pass
1.2540	83	56	67	Pass
1.2830	75	52	69	Pass
1.3119	69	47	68	Pass
1.3409	63	41	65	Pass
1.3699	56	38	67	Pass
1.3988	52	37	71	Pass
1.4278	50	34	68	Pass
1.4567	48	32	66	Pass
1.4857	45	27	60	Pass
1.5147	43	24	55	Pass
1.5436	42	24	57	Pass
1.5726	37	24	64	Pass
1.6015	35	23	65	Pass
1.6305	32	21	65	Pass
1.6595	29	21	72	Pass
1.6884	24	18	75	Pass
1.7174	23	17	73	Pass
1.7463	21	15	71	Pass
1.7753	20	12	60	Pass
1.8043	19	11	57	Pass
1.8332	17	11	64	Pass
1.8622	17	10	58	Pass
1.8911	16	9	56	Pass
1.9201	13	6	46	Pass
1.9491	12	5	41	Pass
1.9780	11	5	45	Pass
2.0070	11	5	45	Pass
2.0360	11	5	45	Pass

2.0649	10	5	50	Pass
2.0939	10	4	40	Pass
2.1228	9	4	44	Pass
2.1518	9	4	44	Pass
2.1808	8	3	37	Pass
2.2097	8	3	37	Pass
2.2387	6	3	50	Pass
2.2676	6	1	16	Pass
2.2966	6	1	16	Pass
2.3256	6	1	16	Pass
2.3545	6	1	16	Pass
2.3835	6	0	0	Pass
2.4124	6	0	0	Pass
2.4414	6	0	0	Pass
2.4704	6	0	0	Pass
2.4993	6	0	0	Pass
2.5283	6	0	0	Pass
2.5572	6	0	0	Pass
2.5862	6	0	0	Pass
2.6152	6	0	0	Pass
2.6441	6	0	0	Pass
2.6731	6	0	0	Pass
2.7021	6	0	0	Pass
2.7310	5	0	0	Pass
2.7600	5	0	0	Pass
2.7889	4	0	0	Pass
2.8179	4	0	0	Pass
2.8469	4	0	0	Pass
2.8758	4	0	0	Pass
2.9048	4	0	0	Pass
2.9337	4	0	0	Pass
2.9627	3	0	0	Pass
2.9917	3	0	0	Pass
3.0206	3	0	0	Pass
3.0496	3	0	0	Pass
3.0785	3	0	0	Pass
3.1075	3	0	0	Pass
3.1365	3	0	0	Pass
3.1654	3	0	0	Pass
3.1944	3	0	0	Pass
3.2233	3	0	0	Pass
3.2523	3	0	0	Pass
3.2813	3	0	0	Pass
3.3102	3	0	0	Pass
3.3392	3	0	0	Pass
3.3682	3	0	0	Pass
3.3971	3	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.6723 acre-feet
On-line facility target flow:	0.9657 cfs.
Adjusted for 15 min:	0.9657 cfs.
Off-line facility target flow:	0.5472 cfs.
Adjusted for 15 min:	0.5472 cfs.

Model Default Modifications

Total of 0 changes have been made.

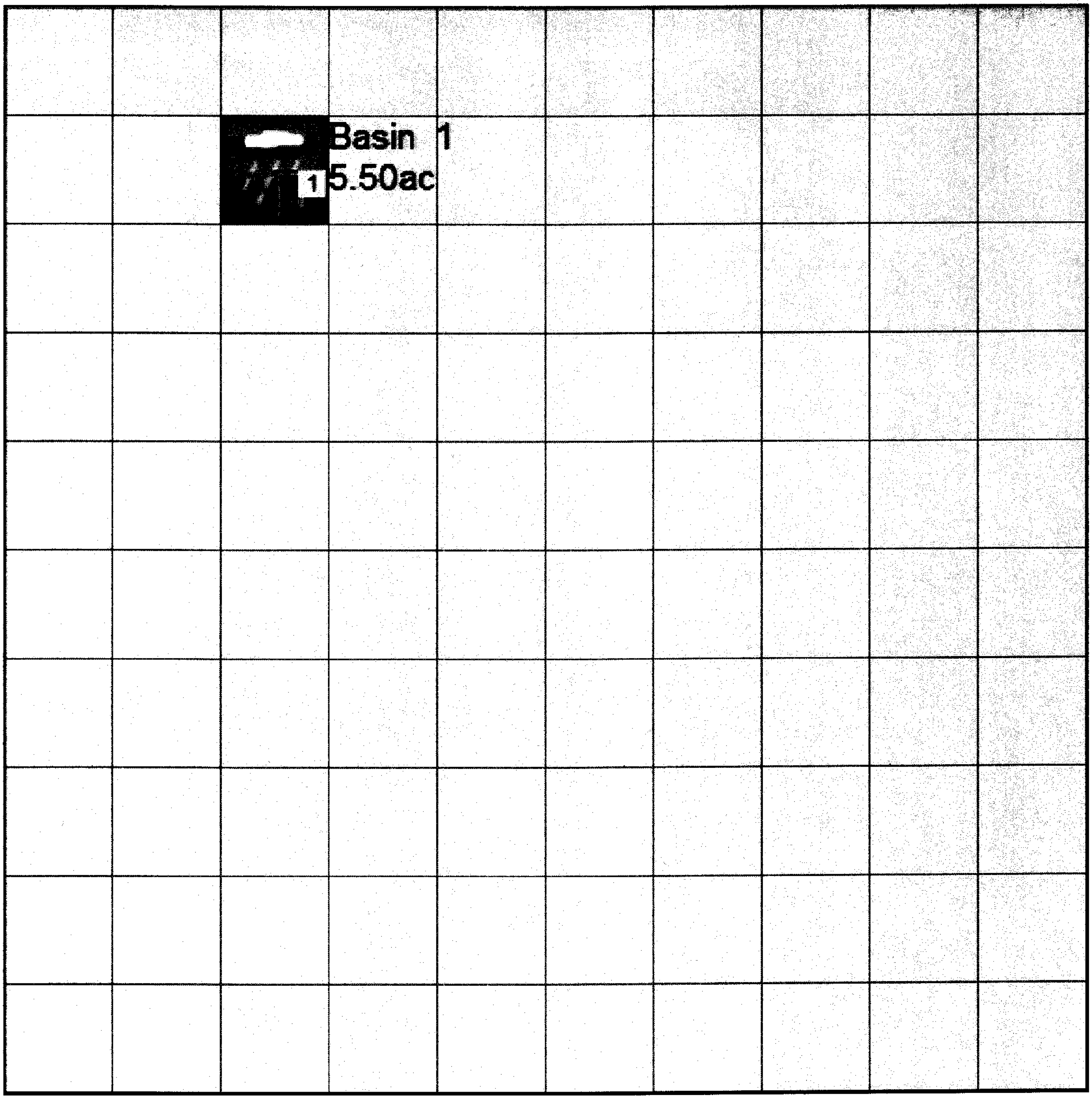
PERLND Changes

No PERLND changes have been made.

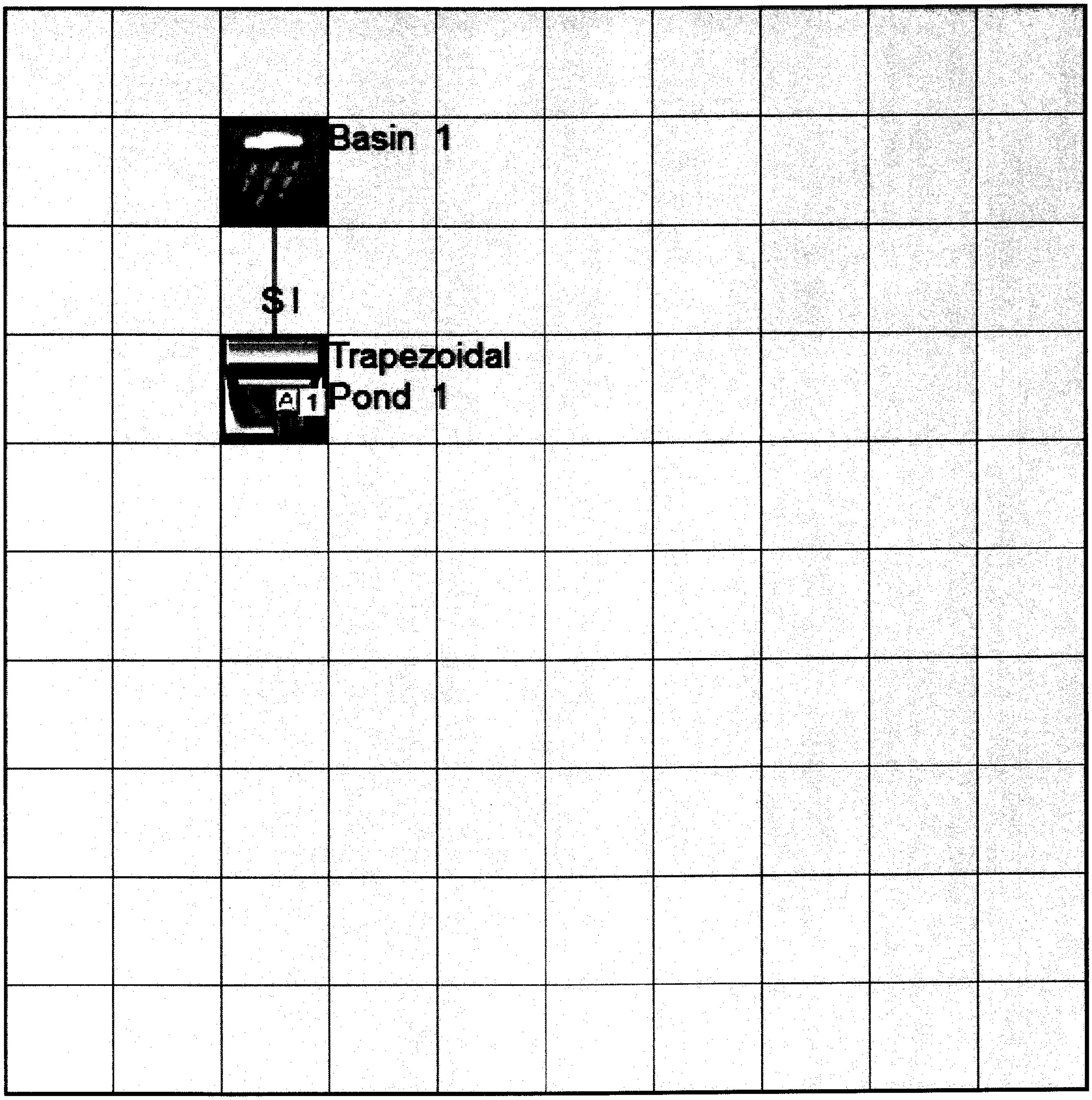
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

Mitigated HSPF Message File

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DETENTION DESIGN

WWHM4

PROJECT REPORT

General Model Information

Project Name:	7714 Burk Pond without Landon Comm
Site Name:	
Site Address:	
City:	
Report Date:	10/18/2015
Gage:	Ridgefield
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.11
Version:	2015/05/15

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
SG4, Forest, Mod	5.95
Pervious Total	5.95
Impervious Land Use	Acres
Impervious Total	0
Basin Total	5.95

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
Pervious Total	0
Impervious Land Use	Acres
ROADS FLAT	5.5
Impervious Total	5.5
Basin Total	5.5

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
Pervious Total	0
Impervious Land Use	Acres
ROADS MOD	0.45
Impervious Total	0.45
Basin Total	0.45

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	129.65 ft.
Bottom Width:	64.83 ft.
Depth:	3.5 ft.
Volume at riser head:	0.5778 acre-ft.
Side slope 1:	3 To 1
Side slope 2:	3 To 1
Side slope 3:	3 To 1
Side slope 4:	3 To 1
Discharge Structure	
Riser Height:	2.5 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	1.355 ft.
Notch Height:	0.050 ft.
Orifice 1 Diameter:	3.594 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.192	0.000	0.000	0.000
0.0389	0.194	0.007	0.066	0.000
0.0778	0.195	0.015	0.094	0.000
0.1167	0.196	0.022	0.115	0.000
0.1556	0.197	0.030	0.133	0.000
0.1944	0.198	0.038	0.149	0.000
0.2333	0.199	0.045	0.163	0.000
0.2722	0.200	0.053	0.177	0.000
0.3111	0.201	0.061	0.189	0.000
0.3500	0.202	0.069	0.200	0.000
0.3889	0.203	0.077	0.211	0.000
0.4278	0.204	0.085	0.221	0.000
0.4667	0.205	0.093	0.231	0.000
0.5056	0.206	0.101	0.241	0.000
0.5444	0.207	0.109	0.250	0.000
0.5833	0.208	0.117	0.259	0.000
0.6222	0.209	0.125	0.267	0.000
0.6611	0.211	0.133	0.275	0.000
0.7000	0.212	0.141	0.283	0.000
0.7389	0.213	0.150	0.291	0.000
0.7778	0.214	0.158	0.299	0.000
0.8167	0.215	0.166	0.306	0.000
0.8556	0.216	0.175	0.313	0.000
0.8944	0.217	0.183	0.320	0.000
0.9333	0.218	0.192	0.327	0.000
0.9722	0.219	0.200	0.334	0.000
1.0111	0.220	0.209	0.341	0.000
1.0500	0.222	0.217	0.347	0.000
1.0889	0.223	0.226	0.354	0.000
1.1278	0.224	0.235	0.360	0.000
1.1667	0.225	0.243	0.366	0.000
1.2056	0.226	0.252	0.372	0.000

1.2444	0.227	0.261	0.378	0.000
1.2833	0.228	0.270	0.384	0.000
1.3222	0.229	0.279	0.390	0.000
1.3611	0.230	0.288	0.395	0.000
1.4000	0.232	0.297	0.401	0.000
1.4389	0.233	0.306	0.406	0.000
1.4778	0.234	0.315	0.412	0.000
1.5167	0.235	0.324	0.417	0.000
1.5556	0.236	0.333	0.423	0.000
1.5944	0.237	0.342	0.428	0.000
1.6333	0.238	0.352	0.433	0.000
1.6722	0.240	0.361	0.438	0.000
1.7111	0.241	0.370	0.443	0.000
1.7500	0.242	0.380	0.448	0.000
1.7889	0.243	0.389	0.453	0.000
1.8278	0.244	0.399	0.458	0.000
1.8667	0.245	0.408	0.463	0.000
1.9056	0.247	0.418	0.468	0.000
1.9444	0.248	0.427	0.473	0.000
1.9833	0.249	0.437	0.477	0.000
2.0222	0.250	0.447	0.482	0.000
2.0611	0.251	0.457	0.487	0.000
2.1000	0.252	0.466	0.491	0.000
2.1389	0.254	0.476	0.496	0.000
2.1778	0.255	0.486	0.500	0.000
2.2167	0.256	0.496	0.505	0.000
2.2556	0.257	0.506	0.509	0.000
2.2944	0.258	0.516	0.513	0.000
2.3333	0.260	0.526	0.518	0.000
2.3722	0.261	0.536	0.522	0.000
2.4111	0.262	0.546	0.526	0.000
2.4500	0.263	0.557	0.531	0.000
2.4889	0.264	0.567	0.569	0.000
2.5278	0.265	0.577	0.657	0.000
2.5667	0.267	0.588	0.845	0.000
2.6056	0.268	0.598	1.098	0.000
2.6444	0.269	0.609	1.403	0.000
2.6833	0.270	0.619	1.752	0.000
2.7222	0.272	0.630	2.140	0.000
2.7611	0.273	0.640	2.562	0.000
2.8000	0.274	0.651	3.018	0.000
2.8389	0.275	0.662	3.503	0.000
2.8778	0.276	0.672	4.017	0.000
2.9167	0.278	0.683	4.558	0.000
2.9556	0.279	0.694	5.125	0.000
2.9944	0.280	0.705	5.716	0.000
3.0333	0.281	0.716	6.330	0.000
3.0722	0.283	0.727	6.968	0.000
3.1111	0.284	0.738	7.627	0.000
3.1500	0.285	0.749	8.307	0.000
3.1889	0.286	0.760	9.008	0.000
3.2278	0.288	0.771	9.729	0.000
3.2667	0.289	0.782	10.47	0.000
3.3056	0.290	0.794	11.22	0.000
3.3444	0.291	0.805	12.00	0.000
3.3833	0.293	0.816	12.80	0.000
3.4222	0.294	0.828	13.61	0.000
3.4611	0.295	0.839	14.44	0.000

3.5000	0.296	0.851	15.29	0.000
3.5389	0.298	0.862	16.15	0.000

Gravel Trench Bed 1

Bottom Length:	430.00 ft.
Bottom Width:	6.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	1.5
Pour Space of material for first layer:	0.2
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	0.1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft):	53.919
Total Volume Through Riser (ac-ft):	12.742
Total Volume Through Facility (ac-ft):	66.661
Percent Infiltrated:	80.89
Total Precip Applied to Facility:	0
Total Evap From Facility:	0

Discharge Structure
Riser Height: 1.5 ft.
Riser Diameter: 400 in.
Element Flows To:
Outlet 1 Outlet 2

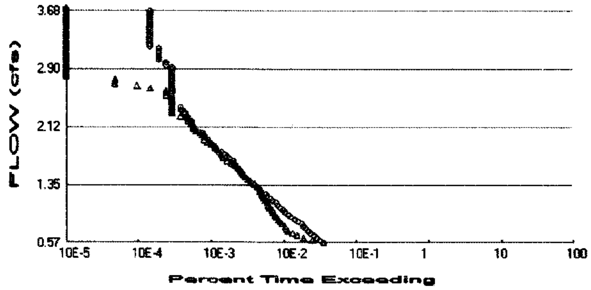
Gravel Trench Bed Hydraulic Table

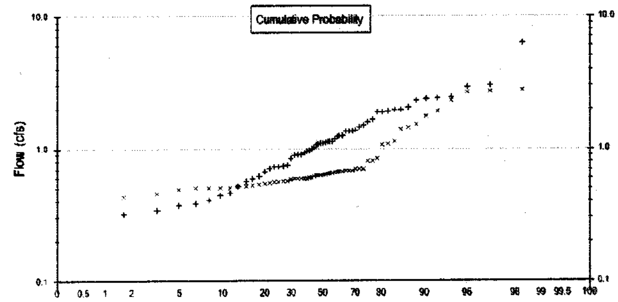
Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.059	0.000	0.000	0.000
0.0222	0.059	0.000	0.000	0.006
0.0444	0.059	0.000	0.000	0.006
0.0667	0.059	0.000	0.000	0.006
0.0889	0.059	0.001	0.000	0.006
0.1111	0.059	0.001	0.000	0.006
0.1333	0.059	0.001	0.000	0.006
0.1556	0.059	0.001	0.000	0.006
0.1778	0.059	0.002	0.000	0.006
0.2000	0.059	0.002	0.000	0.006
0.2222	0.059	0.002	0.000	0.006
0.2444	0.059	0.002	0.000	0.006
0.2667	0.059	0.003	0.000	0.006
0.2889	0.059	0.003	0.000	0.006
0.3111	0.059	0.003	0.000	0.006
0.3333	0.059	0.003	0.000	0.006
0.3556	0.059	0.004	0.000	0.006
0.3778	0.059	0.004	0.000	0.006
0.4000	0.059	0.004	0.000	0.006
0.4222	0.059	0.005	0.000	0.006
0.4444	0.059	0.005	0.000	0.006
0.4667	0.059	0.005	0.000	0.006
0.4889	0.059	0.005	0.000	0.006
0.5111	0.059	0.006	0.000	0.006
0.5333	0.059	0.006	0.000	0.006
0.5556	0.059	0.006	0.000	0.006

0.5778	0.059	0.006	0.000	0.006
0.6000	0.059	0.007	0.000	0.006
0.6222	0.059	0.007	0.000	0.006
0.6444	0.059	0.007	0.000	0.006
0.6667	0.059	0.007	0.000	0.006
0.6889	0.059	0.008	0.000	0.006
0.7111	0.059	0.008	0.000	0.006
0.7333	0.059	0.008	0.000	0.006
0.7556	0.059	0.009	0.000	0.006
0.7778	0.059	0.009	0.000	0.006
0.8000	0.059	0.009	0.000	0.006
0.8222	0.059	0.009	0.000	0.006
0.8444	0.059	0.010	0.000	0.006
0.8667	0.059	0.010	0.000	0.006
0.8889	0.059	0.010	0.000	0.006
0.9111	0.059	0.010	0.000	0.006
0.9333	0.059	0.011	0.000	0.006
0.9556	0.059	0.011	0.000	0.006
0.9778	0.059	0.011	0.000	0.006
1.0000	0.059	0.011	0.000	0.006
1.0222	0.059	0.012	0.000	0.006
1.0444	0.059	0.012	0.000	0.006
1.0667	0.059	0.012	0.000	0.006
1.0889	0.059	0.012	0.000	0.006
1.1111	0.059	0.013	0.000	0.006
1.1333	0.059	0.013	0.000	0.006
1.1556	0.059	0.013	0.000	0.006
1.1778	0.059	0.014	0.000	0.006
1.2000	0.059	0.014	0.000	0.006
1.2222	0.059	0.014	0.000	0.006
1.2444	0.059	0.014	0.000	0.006
1.2667	0.059	0.015	0.000	0.006
1.2889	0.059	0.015	0.000	0.006
1.3111	0.059	0.015	0.000	0.006
1.3333	0.059	0.015	0.000	0.006
1.3556	0.059	0.016	0.000	0.006
1.3778	0.059	0.016	0.000	0.006
1.4000	0.059	0.016	0.000	0.006
1.4222	0.059	0.016	0.000	0.006
1.4444	0.059	0.017	0.000	0.006
1.4667	0.059	0.017	0.000	0.006
1.4889	0.059	0.017	0.000	0.006
1.5111	0.059	0.019	0.380	0.006
1.5333	0.059	0.020	1.975	0.006
1.5556	0.059	0.021	4.250	0.006
1.5778	0.059	0.022	7.041	0.006
1.6000	0.059	0.024	10.26	0.006
1.6222	0.059	0.025	13.87	0.006
1.6444	0.059	0.026	17.82	0.006
1.6667	0.059	0.028	22.08	0.006
1.6889	0.059	0.029	26.65	0.006
1.7111	0.059	0.030	31.48	0.006
1.7333	0.059	0.032	36.59	0.006
1.7556	0.059	0.033	41.93	0.006
1.7778	0.059	0.034	47.52	0.006
1.8000	0.059	0.036	53.34	0.006
1.8222	0.059	0.037	59.37	0.006
1.8444	0.059	0.038	65.62	0.006

1.8667	0.059	0.040	72.07	0.006
1.8889	0.059	0.041	78.72	0.006
1.9111	0.059	0.042	85.57	0.006
1.9333	0.059	0.044	92.60	0.006
1.9556	0.059	0.045	99.81	0.006
1.9778	0.059	0.046	107.2	0.006
2.0000	0.059	0.047	114.7	0.006

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 5.95
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 5.95

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.146702
5 year	2.095941
10 year	2.670017
25 year	3.290442
50 year	3.675056
100 year	3.999648

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.688707
5 year	1.059475
10 year	1.37803
25 year	1.879211
50 year	2.33514
100 year	2.871905

Annual Peaks
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.960	0.798
1950	0.951	0.553
1951	1.897	0.593
1952	1.662	0.652
1953	1.105	0.547
1954	1.101	0.620
1955	0.739	0.516
1956	2.415	1.760
1957	0.997	0.562
1958	1.080	0.699

1959	0.745	0.456
1960	0.560	0.619
1961	1.580	1.134
1962	1.024	0.526
1963	1.461	0.587
1964	1.379	0.583
1965	1.359	0.654
1966	1.973	0.628
1967	0.836	0.587
1968	1.360	0.678
1969	1.136	2.769
1970	6.309	1.079
1971	0.880	0.564
1972	1.117	0.518
1973	1.068	0.660
1974	3.016	2.694
1975	0.905	0.554
1976	1.965	0.630
1977	0.007	0.500
1978	2.351	1.435
1979	0.609	0.642
1980	1.130	0.532
1981	2.280	1.388
1982	1.360	1.069
1983	2.926	0.680
1984	0.723	0.596
1985	0.385	0.701
1986	0.406	0.693
1987	1.174	0.618
1988	0.461	0.677
1989	0.345	0.506
1990	0.373	0.501
1991	0.900	0.491
1992	1.251	0.501
1993	0.932	0.666
1994	1.134	0.833
1995	0.728	1.911
1996	1.874	2.287
1997	2.052	2.651
1998	1.233	0.587
1999	1.501	0.672
2000	0.586	0.430
2001	0.320	0.413
2002	2.398	0.589
2003	1.886	0.649
2004	0.517	0.613
2005	0.439	0.591
2006	1.241	0.541
2007	0.704	1.521
2008	0.667	0.801

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	6.3094	2.7690
2	3.0157	2.6943
3	2.9260	2.6508
4	2.4152	2.2870

5	2.3985	1.9113
6	2.3512	1.7597
7	2.2796	1.5209
8	2.0518	1.4353
9	1.9733	1.3882
10	1.9649	1.1343
11	1.8972	1.0789
12	1.8863	1.0685
13	1.8735	0.8327
14	1.6624	0.8008
15	1.5800	0.7975
16	1.5012	0.7010
17	1.4609	0.6990
18	1.3788	0.6931
19	1.3604	0.6796
20	1.3602	0.6777
21	1.3590	0.6767
22	1.2507	0.6719
23	1.2411	0.6664
24	1.2329	0.6596
25	1.1740	0.6542
26	1.1360	0.6520
27	1.1339	0.6493
28	1.1300	0.6417
29	1.1168	0.6301
30	1.1054	0.6283
31	1.1014	0.6199
32	1.0802	0.6189
33	1.0684	0.6179
34	1.0241	0.6134
35	0.9968	0.5956
36	0.9596	0.5930
37	0.9505	0.5910
38	0.9318	0.5891
39	0.9050	0.5869
40	0.8998	0.5868
41	0.8804	0.5865
42	0.8361	0.5832
43	0.7448	0.5645
44	0.7392	0.5621
45	0.7282	0.5544
46	0.7230	0.5530
47	0.7042	0.5465
48	0.6670	0.5415
49	0.6088	0.5323
50	0.5863	0.5265
51	0.5595	0.5182
52	0.5169	0.5156
53	0.4607	0.5061
54	0.4394	0.5006
55	0.4060	0.5006
56	0.3846	0.5002
57	0.3734	0.4913
58	0.3448	0.4556
59	0.3200	0.4296
60	0.0073	0.4130

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.5734	748	748	100	Pass
0.6047	665	520	78	Pass
0.6360	602	402	66	Pass
0.6673	551	327	59	Pass
0.6987	496	282	56	Pass
0.7300	461	242	52	Pass
0.7613	428	231	53	Pass
0.7927	398	222	55	Pass
0.8240	374	200	53	Pass
0.8553	335	188	56	Pass
0.8867	301	179	59	Pass
0.9180	268	163	60	Pass
0.9493	247	157	63	Pass
0.9806	221	151	68	Pass
1.0120	210	145	69	Pass
1.0433	188	135	71	Pass
1.0746	173	131	75	Pass
1.1060	164	125	76	Pass
1.1373	145	117	80	Pass
1.1686	138	114	82	Pass
1.2000	126	110	87	Pass
1.2313	120	104	86	Pass
1.2626	102	100	98	Pass
1.2939	98	97	98	Pass
1.3253	90	91	101	Pass
1.3566	83	84	101	Pass
1.3879	75	74	98	Pass
1.4193	68	67	98	Pass
1.4506	63	62	98	Pass
1.4819	56	60	107	Pass
1.5133	52	57	109	Pass
1.5446	50	53	105	Pass
1.5759	48	49	102	Pass
1.6073	45	44	97	Pass
1.6386	43	40	93	Pass
1.6699	42	35	83	Pass
1.7012	37	31	83	Pass
1.7326	35	30	85	Pass
1.7639	32	29	90	Pass
1.7952	29	27	93	Pass
1.8266	24	26	108	Pass
1.8579	23	24	104	Pass
1.8892	21	21	100	Pass
1.9206	20	19	95	Pass
1.9519	19	17	89	Pass
1.9832	17	17	100	Pass
2.0145	17	16	94	Pass
2.0459	16	15	93	Pass
2.0772	13	13	100	Pass
2.1085	12	12	100	Pass
2.1399	11	12	109	Pass
2.1712	11	11	100	Pass
2.2025	11	10	90	Pass

2.2339	10	10	100	Pass
2.2652	10	8	80	Pass
2.2965	9	6	66	Pass
2.3279	9	6	66	Pass
2.3592	8	6	75	Pass
2.3905	8	6	75	Pass
2.4218	6	6	100	Pass
2.4532	6	6	100	Pass
2.4845	6	6	100	Pass
2.5158	6	6	100	Pass
2.5472	6	5	83	Pass
2.5785	6	5	83	Pass
2.6098	6	5	83	Pass
2.6412	6	3	50	Pass
2.6725	6	2	33	Pass
2.7038	6	1	16	Pass
2.7351	6	1	16	Pass
2.7665	6	1	16	Pass
2.7978	6	0	0	Pass
2.8291	6	0	0	Pass
2.8605	6	0	0	Pass
2.8918	6	0	0	Pass
2.9231	6	0	0	Pass
2.9545	5	0	0	Pass
2.9858	5	0	0	Pass
3.0171	4	0	0	Pass
3.0484	4	0	0	Pass
3.0798	4	0	0	Pass
3.1111	4	0	0	Pass
3.1424	4	0	0	Pass
3.1738	4	0	0	Pass
3.2051	3	0	0	Pass
3.2364	3	0	0	Pass
3.2678	3	0	0	Pass
3.2991	3	0	0	Pass
3.3304	3	0	0	Pass
3.3618	3	0	0	Pass
3.3931	3	0	0	Pass
3.4244	3	0	0	Pass
3.4557	3	0	0	Pass
3.4871	3	0	0	Pass
3.5184	3	0	0	Pass
3.5497	3	0	0	Pass
3.5811	3	0	0	Pass
3.6124	3	0	0	Pass
3.6437	3	0	0	Pass
3.6751	3	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.6721 acre-feet
On-line facility target flow:	0.9657 cfs.
Adjusted for 15 min:	0.9657 cfs.
Off-line facility target flow:	0.5472 cfs.
Adjusted for 15 min:	0.5472 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

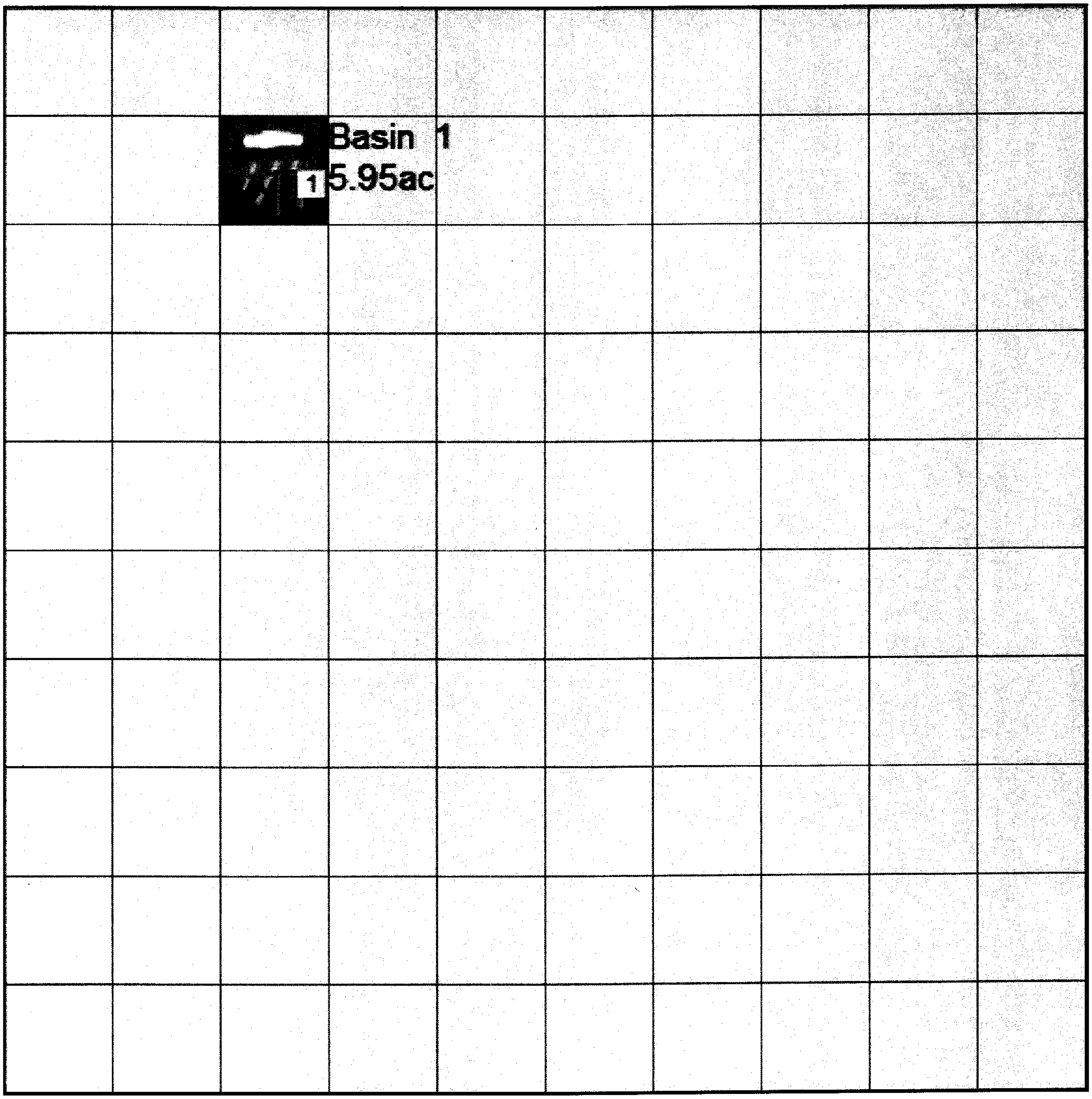
No PERLND changes have been made.

IMPLND Changes

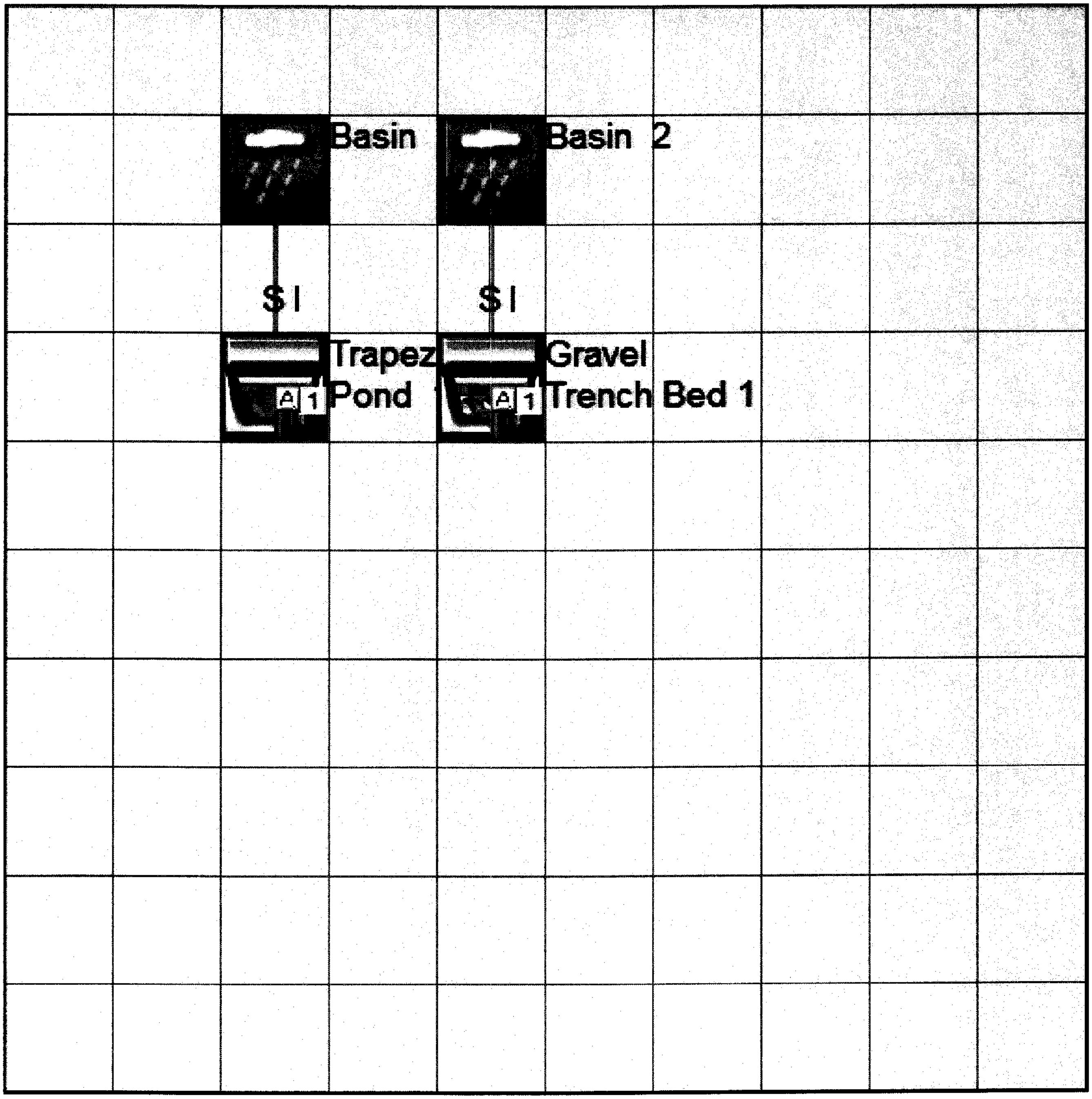
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                 UNIT SYSTEM     1
END GLOBAL

FILES
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WDM        26   7714 Burk Pond without Landon Comm.wdm
MESSU      25   Pre7714 Burk Pond without Landon Comm.MES
           27   Pre7714 Burk Pond without Landon Comm.L61
           28   Pre7714 Burk Pond without Landon Comm.L62
           30   POC7714 Burk Pond without Landon Comm1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      29
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      DISPLY       1
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END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
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  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
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  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   29         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags   ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   29        0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2          ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   29             0         6      0.04       400       0.1         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3          ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   29             0         0         3         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   29            0.2       0.4      0.35         2       0.4       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   29             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------> Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags   ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2          ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3          ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK    ***
<Name>   #                  <-factor->     <Name>   #   Tbl#    ***
Basin  1***
PERLND  29                        5.95     COPY   501     12
PERLND  29                        5.95     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name         Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
               *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO      LEN      DELTH      STCOR         KS       DB50        ***
  <------><--------><--------><--------><--------><--------><-------->           ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.11           PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.11           IMPLND   1 999 EXTNL  PREC
```

```
WDM       1 EVAP     ENGL     0.8               PERLND   1 999 EXTNL  PETINP
WDM       1 EVAP     ENGL     0.8               IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO        0.083333     COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO        0.083333     COPY           INPUT  MEAN
  END MASS-LINK   13

END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME      0 RUN     1                  UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   7714 Burk Pond without Landon Comm.wdm
MESSU      25   Mit7714 Burk Pond without Landon Comm.MES
           27   Mit7714 Burk Pond without Landon Comm.L61
           28   Mit7714 Burk Pond without Landon Comm.L62
           30   POC7714 Burk Pond without Landon Comm1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND      1
      IMPLND      2
      RCHRES      1
      RCHRES      2
      COPY        1
      COPY      501
      COPY      601
      DISPLY      1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1        MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  501        1    1
  601        1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #        K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out            ***
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2          ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3          ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------> Unit-systems  Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT            1    1    1   27    0
    2      ROADS/MOD             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    2         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2          ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    2            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3          ***
```

```
    # -   # ***PETMAX    PETMIN
    1             0         0
    2             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -   # ***  RETS      SURS
    1             0         0
    2             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK    ***
<Name>   #                  <-factor->     <Name>   #   Tbl#    ***
Basin  1***
IMPLND   1                         5.5     RCHRES   1      5
Basin  2***
IMPLND   2                        0.45     RCHRES   2      5

******Routing******
IMPLND   1                         5.5     COPY     1     15
IMPLND   2                        0.45     COPY   501     15
IMPLND   2                        0.45     COPY   601     15
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name          Nexits   Unit Systems   Printer               ***
    # -   #<------------------><---> User T-series  Engl Metr LKFG           ***
                                             in  out                         ***
    1      Trapezoidal Pond-005   1     1    1    1    28    0    1
    2      Gravel Trench Be-009   2     1    1    1    28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -   # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -   # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -   #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
             FG FG FG FG  possible   exit *** possible  exit      possible  exit
              *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
    1         0  1  0  0    4  0  0  0  0       0  0  0  0  0      2  2  2  2  2
```

```
    2          0  1  0  0    4  5  0  0  0        0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN      DELTH      STCOR         KS       DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
    1              1      0.02        0.0        0.0        0.5        0.0
    2              2      0.08        0.0        0.0        0.5        0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                               ***
    # -  # ***  VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1          0           4.0  0.0  0.0  0.0  0.0        0.0  0.0  0.0  0.0  0.0
    2          0           4.0  5.0  0.0  0.0  0.0        0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs) (ft/sec)    (Minutes)***
  0.000000  0.192948  0.000000  0.000000
  0.038889  0.193991  0.007524  0.066900
  0.077778  0.195037  0.015088  0.094611
  0.116667  0.196085  0.022693  0.115875
  0.155556  0.197135  0.030339  0.133801
  0.194444  0.198188  0.038026  0.149594
  0.233333  0.199244  0.045754  0.163872
  0.272222  0.200302  0.053523  0.177002
  0.311111  0.201362  0.061333  0.189223
  0.350000  0.202425  0.069185  0.200701
  0.388889  0.203491  0.077077  0.211557
  0.427778  0.204559  0.085012  0.221883
  0.466667  0.205629  0.092987  0.231749
  0.505556  0.206702  0.101005  0.241212
  0.544444  0.207778  0.109064  0.250318
  0.583333  0.208856  0.117166  0.259104
  0.622222  0.209936  0.125309  0.267601
  0.661111  0.211019  0.133494  0.275837
  0.700000  0.212105  0.141721  0.283834
  0.738889  0.213193  0.149991  0.291612
  0.777778  0.214283  0.158303  0.299187
  0.816667  0.215376  0.166658  0.306576
  0.855556  0.216471  0.175055  0.313790
  0.894444  0.217569  0.183494  0.320842
  0.933333  0.218670  0.191977  0.327743
  0.972222  0.219773  0.200502  0.334501
  1.011111  0.220878  0.209070  0.341126
  1.050000  0.221986  0.217681  0.347624
  1.088889  0.223097  0.226336  0.354003
  1.127778  0.224210  0.235033  0.360269
  1.166667  0.225325  0.243774  0.366428
  1.205556  0.226443  0.252559  0.372485
  1.244444  0.227564  0.261387  0.378445
  1.283333  0.228687  0.270258  0.384313
  1.322222  0.229812  0.279174  0.390092
  1.361111  0.230940  0.288133  0.395787
  1.400000  0.232071  0.297136  0.401402
  1.438889  0.233204  0.306183  0.406939
  1.477778  0.234339  0.315274  0.412401
  1.516667  0.235477  0.324409  0.417792
  1.555556  0.236618  0.333589  0.423115
  1.594444  0.237761  0.342813  0.428371
  1.633333  0.238906  0.352081  0.433563
  1.672222  0.240054  0.361394  0.438694
```

1.711111	0.241205	0.370752	0.443766
1.750000	0.242358	0.380155	0.448781
1.788889	0.243513	0.389602	0.453740
1.827778	0.244671	0.399095	0.458645
1.866667	0.245831	0.408632	0.463499
1.905556	0.246994	0.418215	0.468302
1.944444	0.248160	0.427843	0.473056
1.983333	0.249328	0.437516	0.477764
2.022222	0.250498	0.447235	0.482425
2.061111	0.251671	0.457000	0.487041
2.100000	0.252847	0.466810	0.491615
2.138889	0.254025	0.476666	0.496146
2.177778	0.255205	0.486567	0.500636
2.216667	0.256388	0.496515	0.505086
2.255556	0.257574	0.506509	0.509497
2.294444	0.258762	0.516548	0.513871
2.333333	0.259952	0.526635	0.518207
2.372222	0.261145	0.536767	0.522508
2.411111	0.262341	0.546946	0.526773
2.450000	0.263539	0.557171	0.531005
2.488889	0.264739	0.567443	0.569410
2.527778	0.265942	0.577762	0.656997
2.566667	0.267148	0.588128	0.844958
2.605556	0.268356	0.598540	1.098588
2.644444	0.269566	0.609000	1.403639
2.683333	0.270779	0.619507	1.752460
2.722222	0.271994	0.630061	2.140062
2.761111	0.273212	0.640662	2.562852
2.800000	0.274433	0.651310	3.018087
2.838889	0.275656	0.662007	3.503578
2.877778	0.276881	0.672750	4.017530
2.916667	0.278109	0.683542	4.558432
2.955556	0.279340	0.694381	5.124992
2.994444	0.280573	0.705268	5.716088
3.033333	0.281808	0.716204	6.330733
3.072222	0.283046	0.727187	6.968050
3.111111	0.284287	0.738218	7.627254
3.150000	0.285530	0.749298	8.307637
3.188889	0.286775	0.760426	9.008554
3.227778	0.288023	0.771603	9.729415
3.266667	0.289274	0.782828	10.46968
3.305556	0.290527	0.794102	11.22885
3.344444	0.291782	0.805425	12.00647
3.383333	0.293040	0.816796	12.80210
3.422222	0.294300	0.828217	13.61533
3.461111	0.295563	0.839686	14.44581
3.500000	0.296829	0.851205	15.29317

END FTABLE 1
FTABLE 2
92 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.059229	0.000000	0.000000	0.000000		
0.022222	0.059229	0.000263	0.000000	0.005972		
0.044444	0.059229	0.000526	0.000000	0.005972		
0.066667	0.059229	0.000790	0.000000	0.005972		
0.088889	0.059229	0.001053	0.000000	0.005972		
0.111111	0.059229	0.001316	0.000000	0.005972		
0.133333	0.059229	0.001579	0.000000	0.005972		
0.155556	0.059229	0.001843	0.000000	0.005972		
0.177778	0.059229	0.002106	0.000000	0.005972		
0.200000	0.059229	0.002369	0.000000	0.005972		
0.222222	0.059229	0.002632	0.000000	0.005972		
0.244444	0.059229	0.002896	0.000000	0.005972		
0.266667	0.059229	0.003159	0.000000	0.005972		
0.288889	0.059229	0.003422	0.000000	0.005972		
0.311111	0.059229	0.003685	0.000000	0.005972		
0.333333	0.059229	0.003949	0.000000	0.005972		
0.355556	0.059229	0.004212	0.000000	0.005972		
0.377778	0.059229	0.004475	0.000000	0.005972		

0.400000	0.059229	0.004738	0.000000	0.005972
0.422222	0.059229	0.005002	0.000000	0.005972
0.444444	0.059229	0.005265	0.000000	0.005972
0.466667	0.059229	0.005528	0.000000	0.005972
0.488889	0.059229	0.005791	0.000000	0.005972
0.511111	0.059229	0.006054	0.000000	0.005972
0.533333	0.059229	0.006318	0.000000	0.005972
0.555556	0.059229	0.006581	0.000000	0.005972
0.577778	0.059229	0.006844	0.000000	0.005972
0.600000	0.059229	0.007107	0.000000	0.005972
0.622222	0.059229	0.007371	0.000000	0.005972
0.644444	0.059229	0.007634	0.000000	0.005972
0.666667	0.059229	0.007897	0.000000	0.005972
0.688889	0.059229	0.008160	0.000000	0.005972
0.711111	0.059229	0.008424	0.000000	0.005972
0.733333	0.059229	0.008687	0.000000	0.005972
0.755556	0.059229	0.008950	0.000000	0.005972
0.777778	0.059229	0.009213	0.000000	0.005972
0.800000	0.059229	0.009477	0.000000	0.005972
0.822222	0.059229	0.009740	0.000000	0.005972
0.844444	0.059229	0.010003	0.000000	0.005972
0.866667	0.059229	0.010266	0.000000	0.005972
0.888889	0.059229	0.010530	0.000000	0.005972
0.911111	0.059229	0.010793	0.000000	0.005972
0.933333	0.059229	0.011056	0.000000	0.005972
0.955556	0.059229	0.011319	0.000000	0.005972
0.977778	0.059229	0.011582	0.000000	0.005972
1.000000	0.059229	0.011846	0.000000	0.005972
1.022222	0.059229	0.012109	0.000000	0.005972
1.044444	0.059229	0.012372	0.000000	0.005972
1.066667	0.059229	0.012635	0.000000	0.005972
1.088889	0.059229	0.012899	0.000000	0.005972
1.111111	0.059229	0.013162	0.000000	0.005972
1.133333	0.059229	0.013425	0.000000	0.005972
1.155556	0.059229	0.013688	0.000000	0.005972
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1.200000	0.059229	0.014215	0.000000	0.005972
1.222222	0.059229	0.014478	0.000000	0.005972
1.244444	0.059229	0.014741	0.000000	0.005972
1.266667	0.059229	0.015005	0.000000	0.005972
1.288889	0.059229	0.015268	0.000000	0.005972
1.311111	0.059229	0.015531	0.000000	0.005972
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1.355556	0.059229	0.016058	0.000000	0.005972
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1.400000	0.059229	0.016584	0.000000	0.005972
1.422222	0.059229	0.016847	0.000000	0.005972
1.444444	0.059229	0.017110	0.000000	0.005972
1.466667	0.059229	0.017374	0.000000	0.005972
1.488889	0.059229	0.017637	0.000000	0.005972
1.511111	0.059229	0.018953	0.380215	0.005972
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1.711111	0.059229	0.030799	31.48906	0.005972
1.733333	0.059229	0.032115	36.58965	0.005972
1.755556	0.059229	0.033431	41.93929	0.005972
1.777778	0.059229	0.034747	47.52689	0.005972
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1.822222	0.059229	0.037380	59.37811	0.005972
1.844444	0.059229	0.038696	65.62539	0.005972
1.866667	0.059229	0.040012	72.07759	0.005972
1.888889	0.059229	0.041328	78.72840	0.005972
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1.933333	0.059229	0.043961	92.60326	0.005972

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  1.955556  0.059229  0.045277  99.81714  0.005972
  1.977778  0.059229  0.046593  107.2092  0.005972
  2.000000  0.059229  0.047909  114.7752  0.005972
  2.022222  0.059229  0.049226  122.5113  0.005972
  END FTABLE  2
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.11           PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.11           IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.8            IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.11           RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.8            RCHRES   1     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1         1     WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1         1     WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1      48.4     WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1      48.4     WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1      48.4     WDM    901 FLOW     ENGL      REPL
RCHRES   2 HYDR   RO     1 1         1     WDM   1010 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      1 1         1     WDM   1011 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      2 1         1     WDM   1012 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1         1     WDM   1013 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Olympia, WA. 98501
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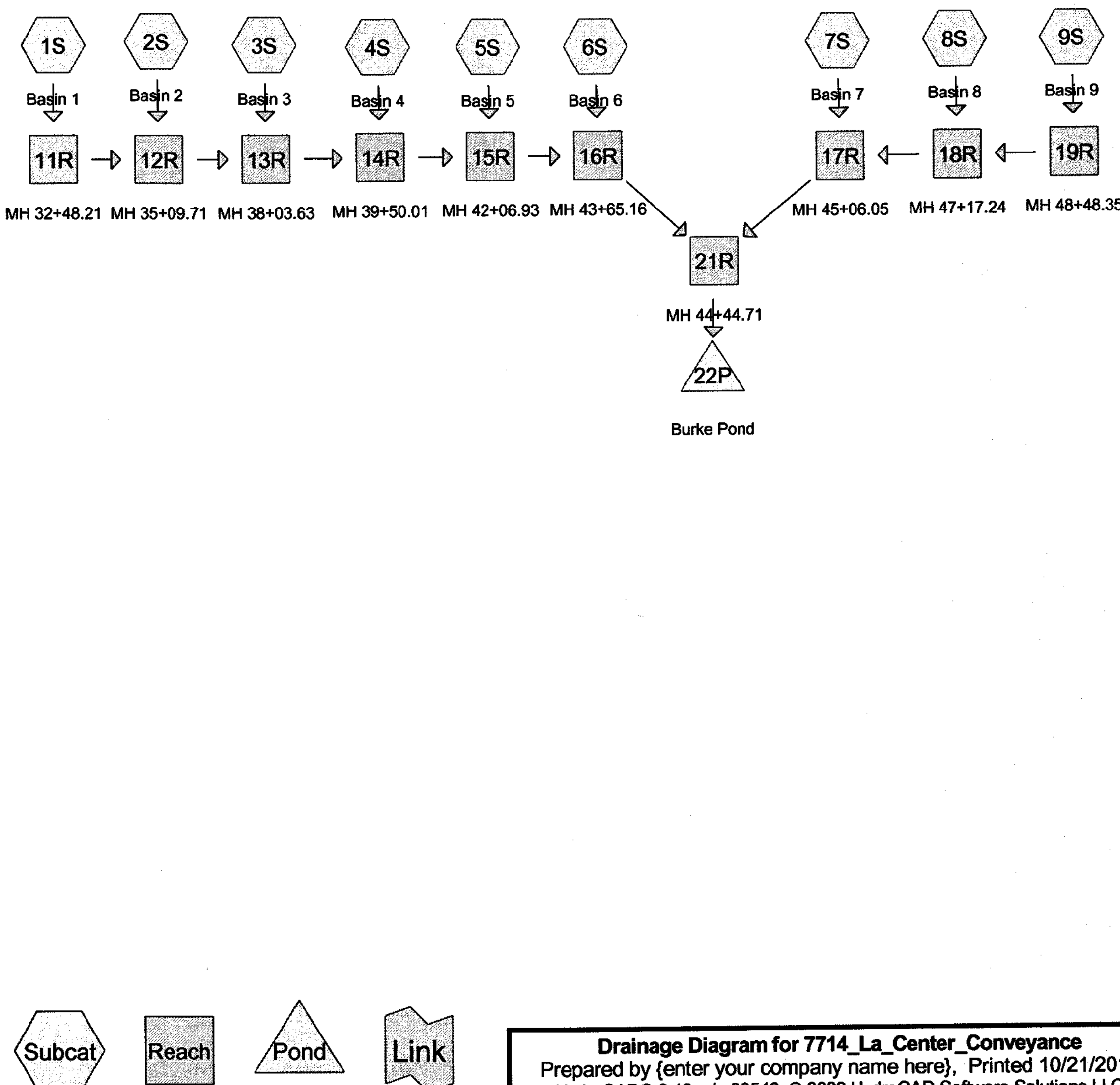
Local (360)943-0304

www.clearcreeksolutions.com

D



Drainage Diagram for 7714_La_Center_Conveyance
Prepared by {enter your company name here}, Printed 10/21/2015

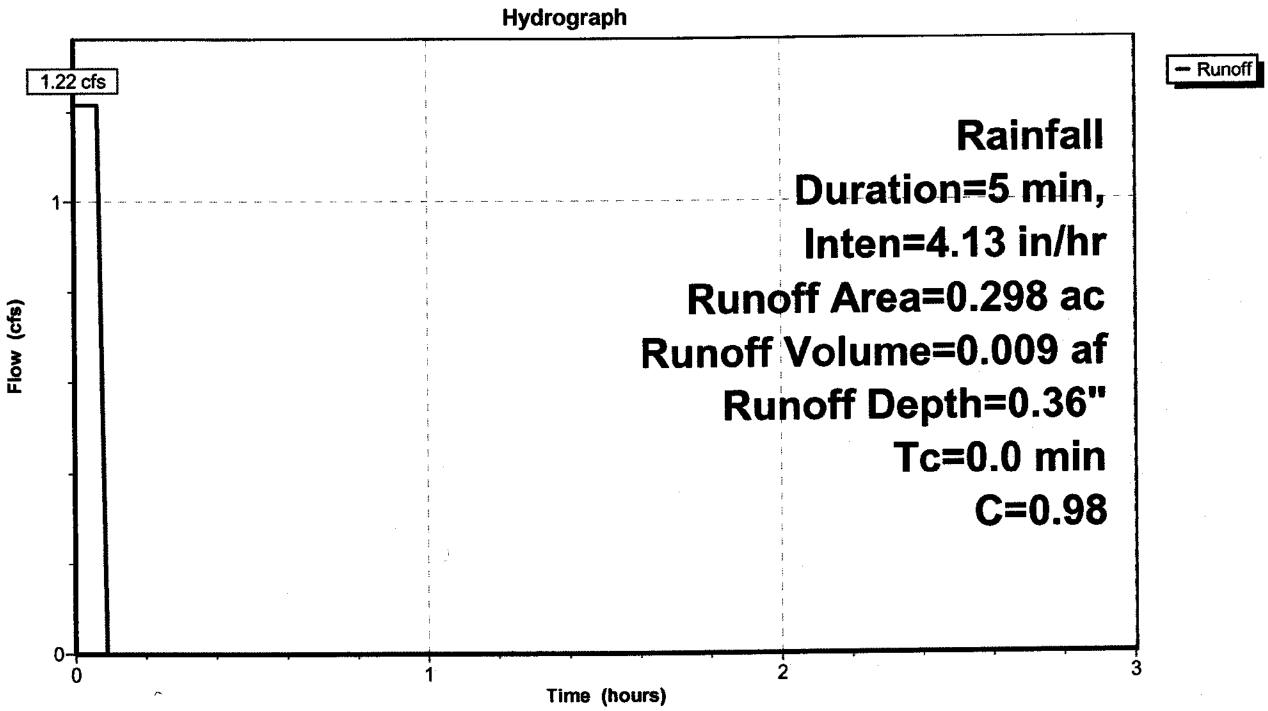
Summary for Subcatchment 1S: Basin 1

Runoff = 1.22 cfs @ 0.00 hrs, Volume= 0.009 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.298	0.98	
0.298		100.00% Impervious Area

Subcatchment 1S: Basin 1



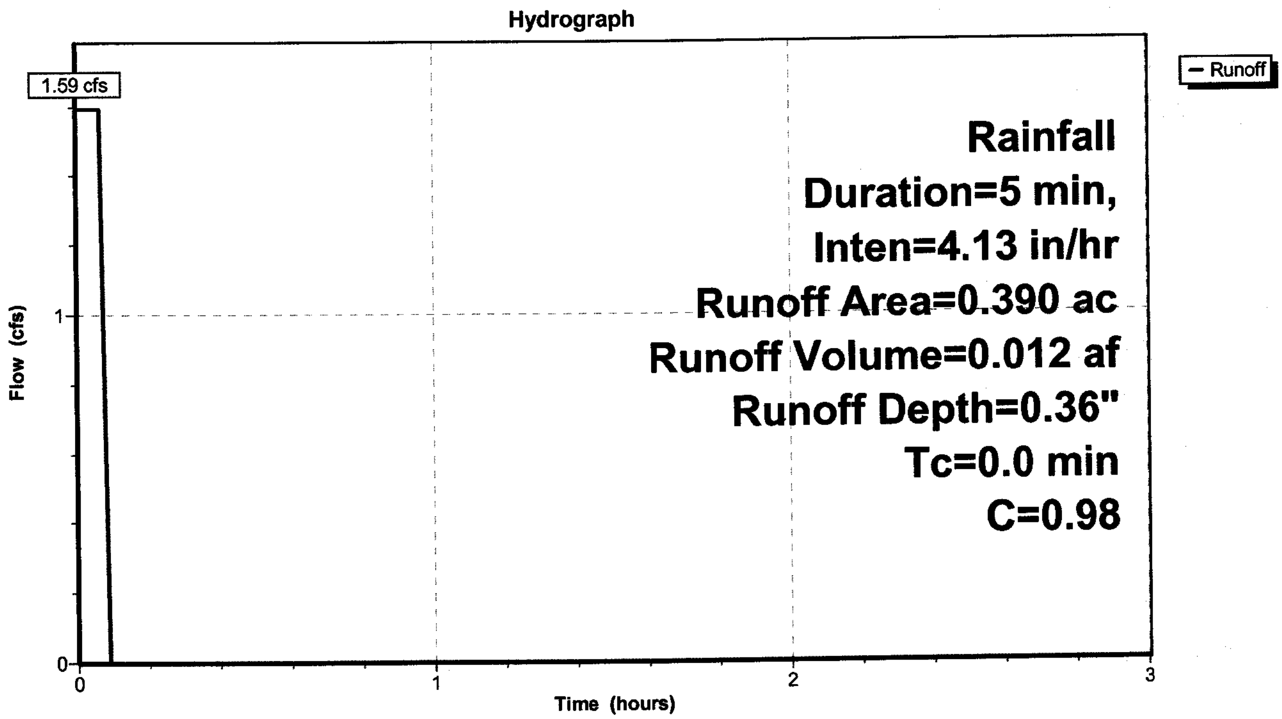
Summary for Subcatchment 2S: Basin 2

Runoff = 1.59 cfs @ 0.00 hrs, Volume= 0.012 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.390	0.98	
0.390		100.00% Impervious Area

Subcatchment 2S: Basin 2



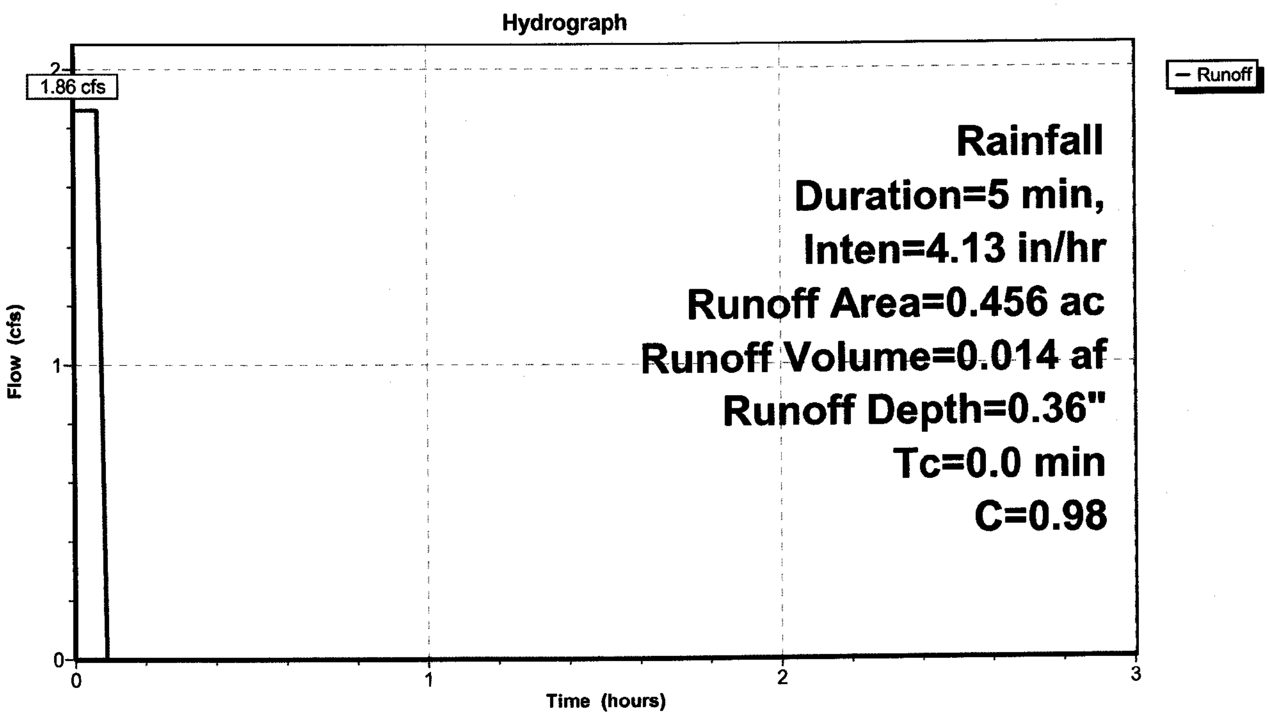
Summary for Subcatchment 3S: Basin 3

Runoff = 1.86 cfs @ 0.00 hrs, Volume= 0.014 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.456	0.98	
0.456		100.00% Impervious Area

Subcatchment 3S: Basin 3



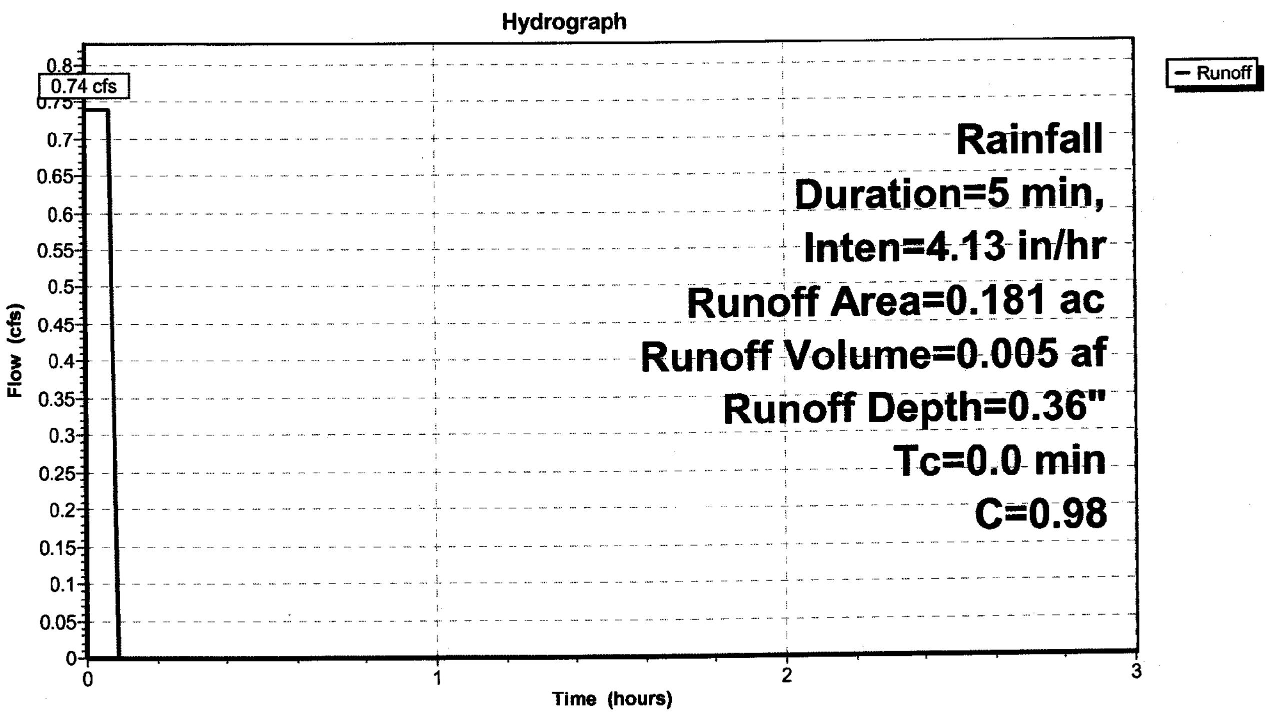
Summary for Subcatchment 4S: Basin 4

Runoff = 0.74 cfs @ 0.00 hrs, Volume= 0.005 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.181	0.98	
0.181		100.00% Impervious Area

Subcatchment 4S: Basin 4



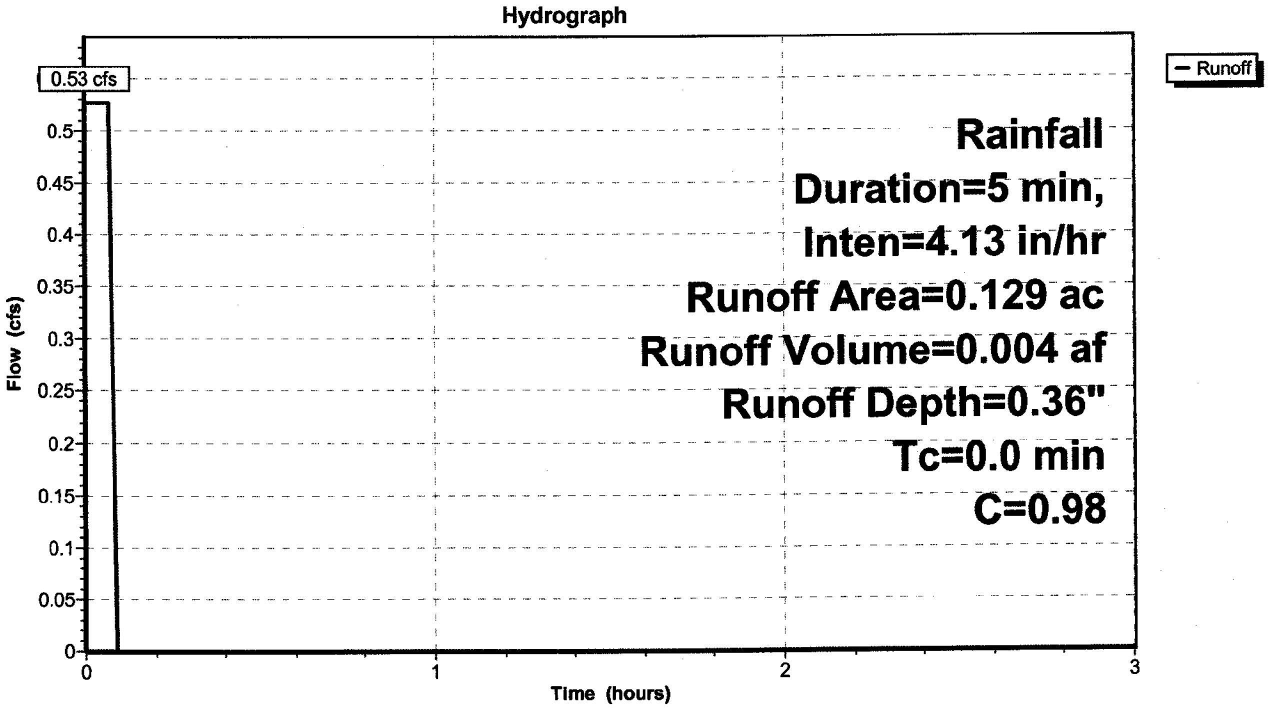
Summary for Subcatchment 5S: Basin 5

Runoff = 0.53 cfs @ 0.00 hrs, Volume= 0.004 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.129	0.98	
0.129		100.00% Impervious Area

Subcatchment 5S: Basin 5



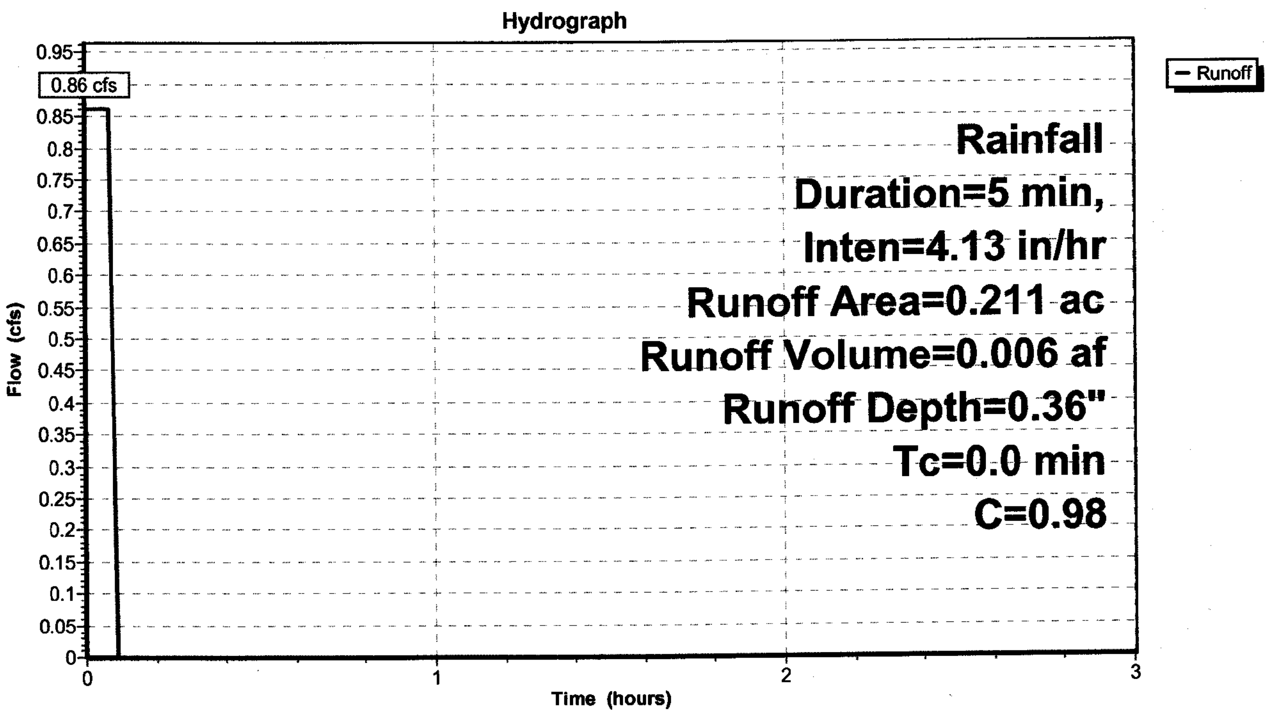
Summary for Subcatchment 6S: Basin 6

Runoff = 0.86 cfs @ 0.00 hrs, Volume= 0.006 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.211	0.98	
0.211		100.00% Impervious Area

Subcatchment 6S: Basin 6



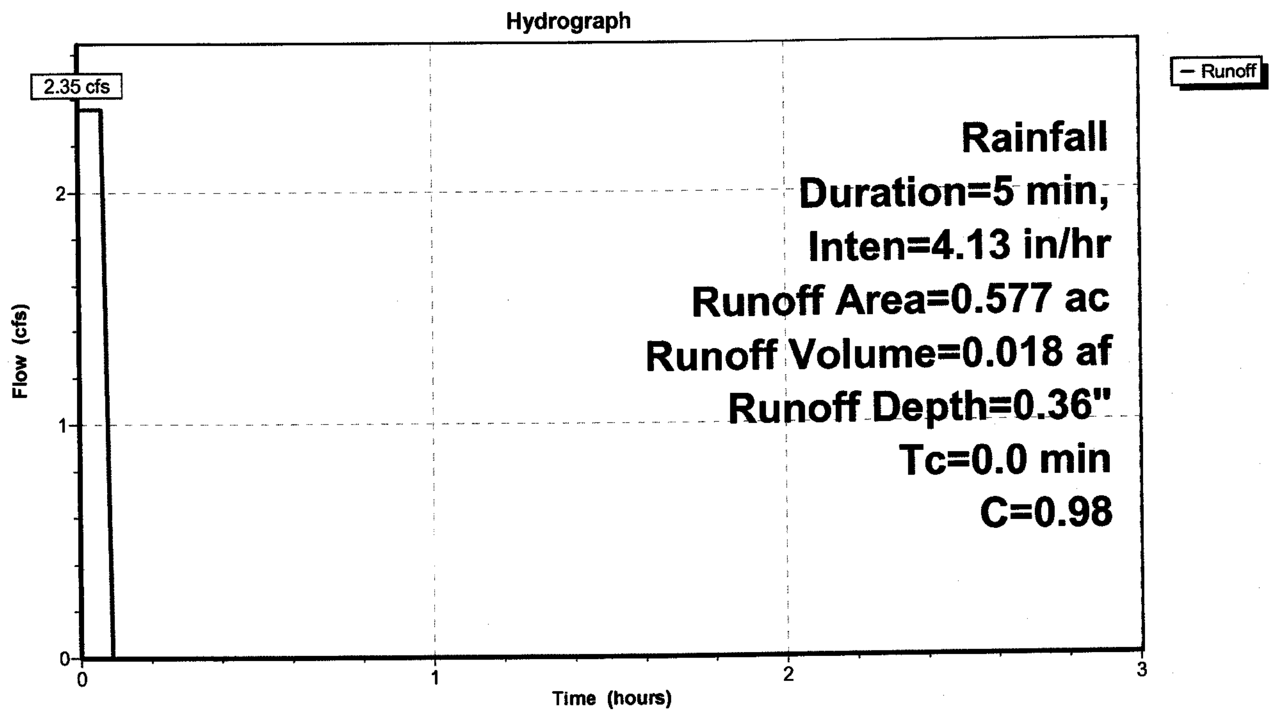
Summary for Subcatchment 7S: Basin 7

Runoff = 2.35 cfs @ 0.00 hrs, Volume= 0.018 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.577	0.98	
0.577		100.00% Impervious Area

Subcatchment 7S: Basin 7



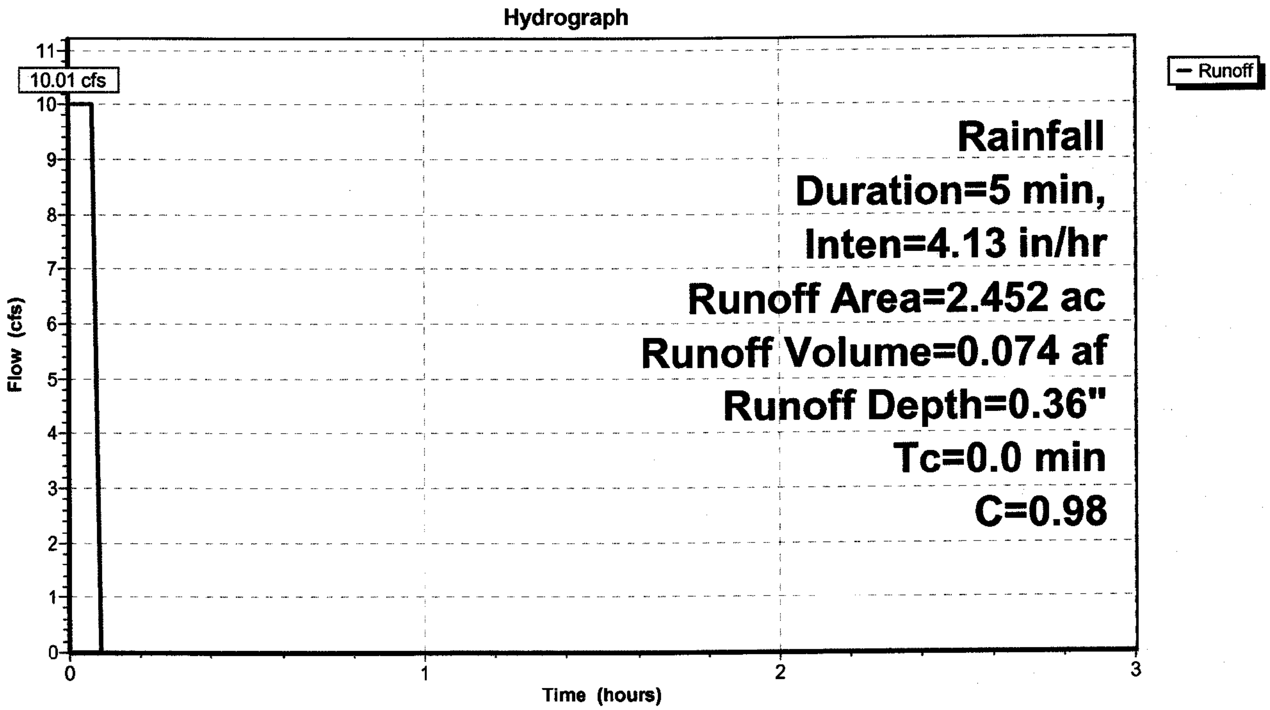
Summary for Subcatchment 8S: Basin 8

Runoff = 10.01 cfs @ 0.00 hrs, Volume= 0.074 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
2.452	0.98	
2.452		100.00% Impervious Area

Subcatchment 8S: Basin 8



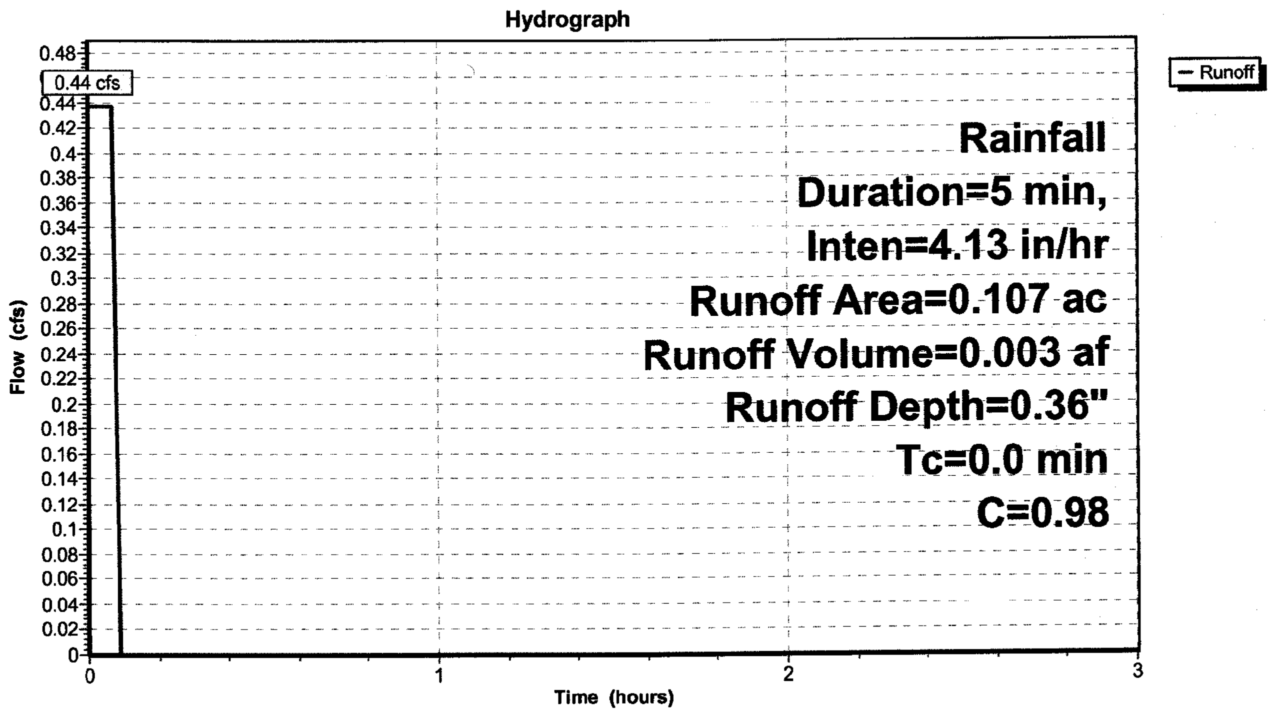
Summary for Subcatchment 9S: Basin 9

Runoff = 0.44 cfs @ 0.00 hrs, Volume= 0.003 af, Depth= 0.36"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Rainfall Duration=5 min, Inten=4.13 in/hr

Area (ac)	C	Description
0.107	0.98	
0.107		100.00% Impervious Area

Subcatchment 9S: Basin 9



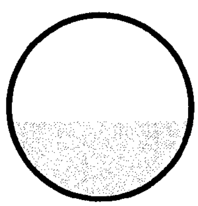
Summary for Reach 11R: MH 32+48.21

Inflow Area = 0.298 ac,100.00% Impervious, Inflow Depth = 0.36"
Inflow = 1.22 cfs @ 0.00 hrs, Volume= 0.009 af
Outflow = 1.21 cfs @ 0.09 hrs, Volume= 0.009 af, Atten= 1%, Lag= 5.3 min

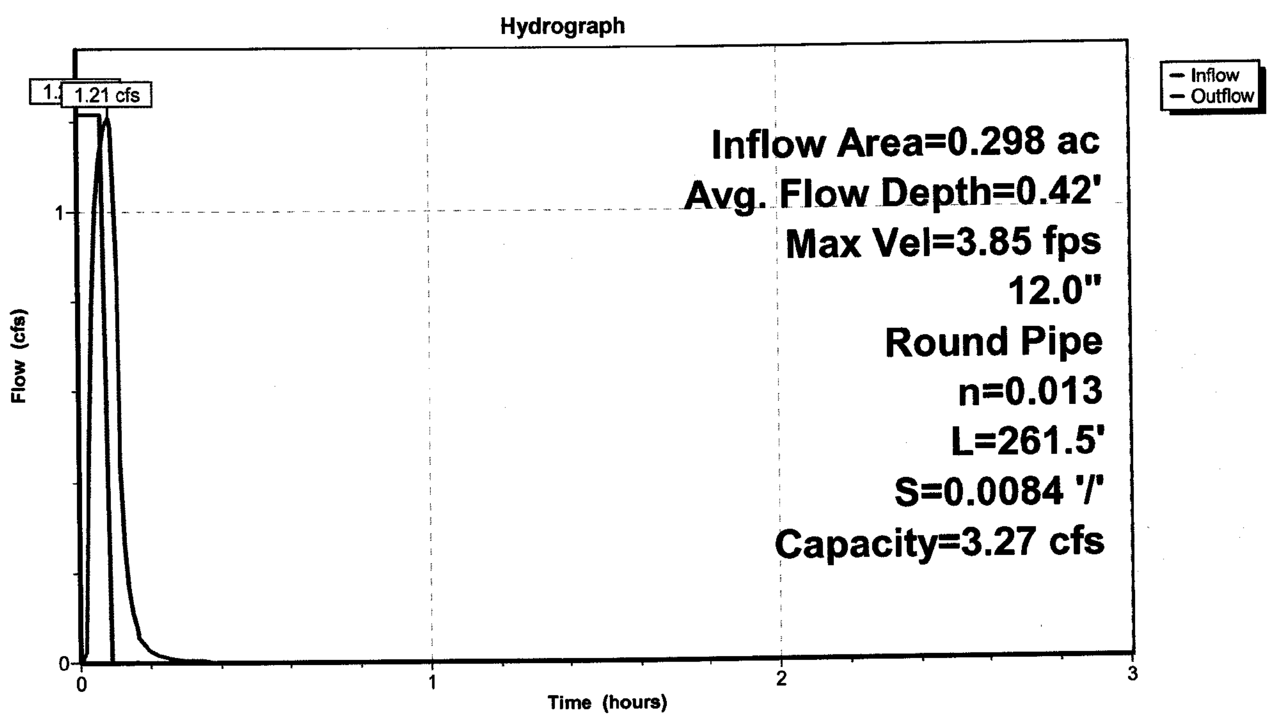
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.85 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 4.9 min

Peak Storage= 82 cf @ 0.08 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 3.27 cfs

12.0" Round Pipe
n= 0.013
Length= 261.5' Slope= 0.0084 '/'
Inlet Invert= 258.69', Outlet Invert= 256.49'



Reach 11R: MH 32+48.21



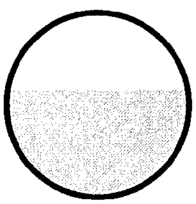
Summary for Reach 12R: MH 35+09.71

Inflow Area = 0.688 ac,100.00% Impervious, Inflow Depth = 0.36"
Inflow = 2.79 cfs @ 0.08 hrs, Volume= 0.020 af
Outflow = 2.56 cfs @ 0.10 hrs, Volume= 0.020 af, Atten= 8%, Lag= 1.2 min

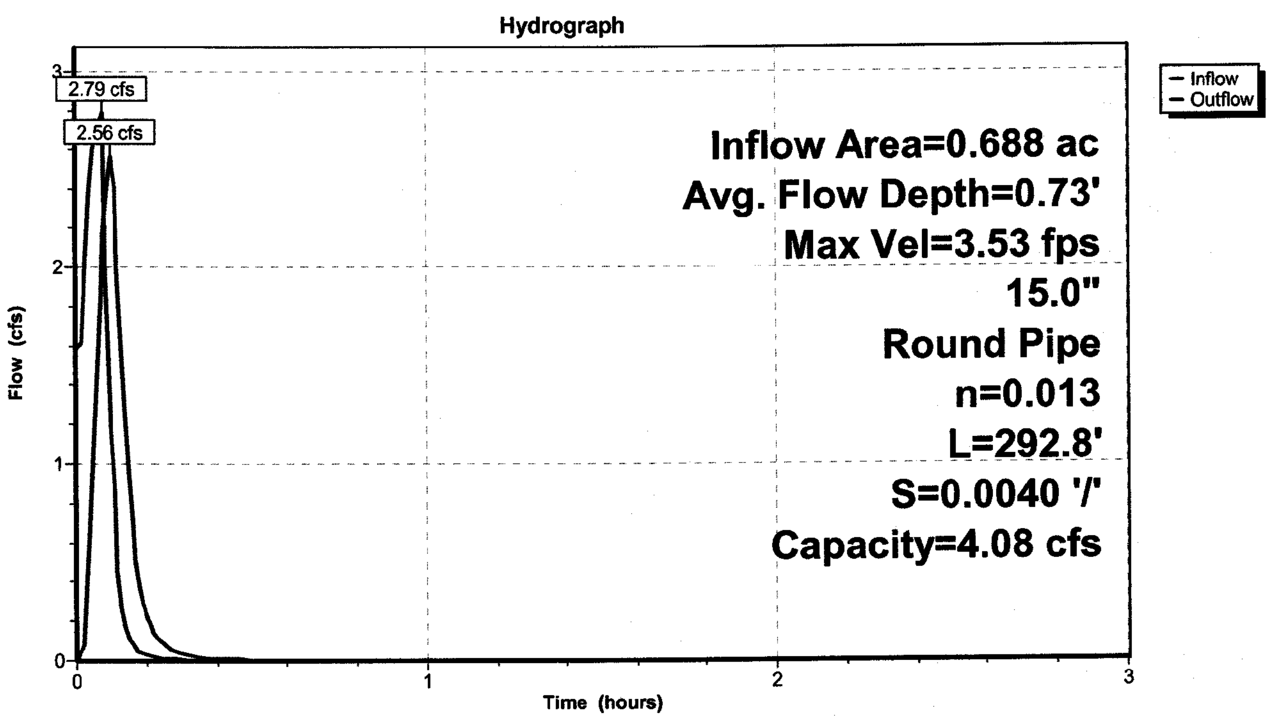
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.53 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 7.1 min

Peak Storage= 216 cf @ 0.08 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.25', Capacity at Bank-Full= 4.08 cfs

15.0" Round Pipe
n= 0.013
Length= 292.8' Slope= 0.0040 '/'
Inlet Invert= 256.29', Outlet Invert= 255.12'



Reach 12R: MH 35+09.71



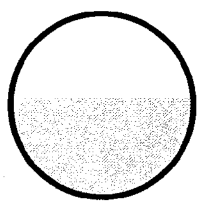
Summary for Reach 13R: MH 38+03.63

Inflow Area = 1.144 ac,100.00% Impervious, Inflow Depth = 0.35"
Inflow = 4.15 cfs @ 0.08 hrs, Volume= 0.034 af
Outflow = 3.75 cfs @ 0.09 hrs, Volume= 0.033 af, Atten= 9%, Lag= 0.8 min

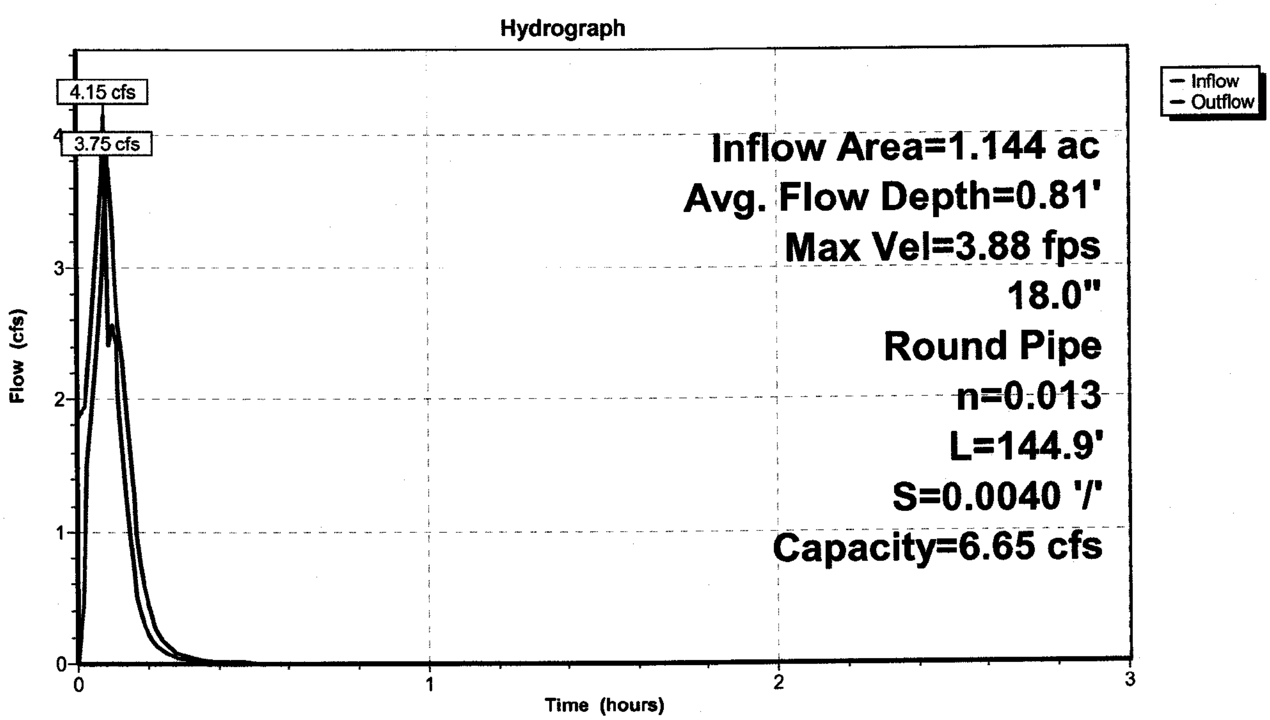
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.88 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 3.1 min

Peak Storage= 141 cf @ 0.08 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 6.65 cfs

18.0" Round Pipe
n= 0.013
Length= 144.9' Slope= 0.0040 '/'
Inlet Invert= 254.92', Outlet Invert= 254.34'



Reach 13R: MH 38+03.63



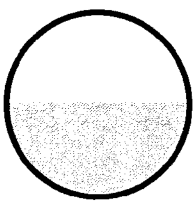
Summary for Reach 14R: MH 39+50.01

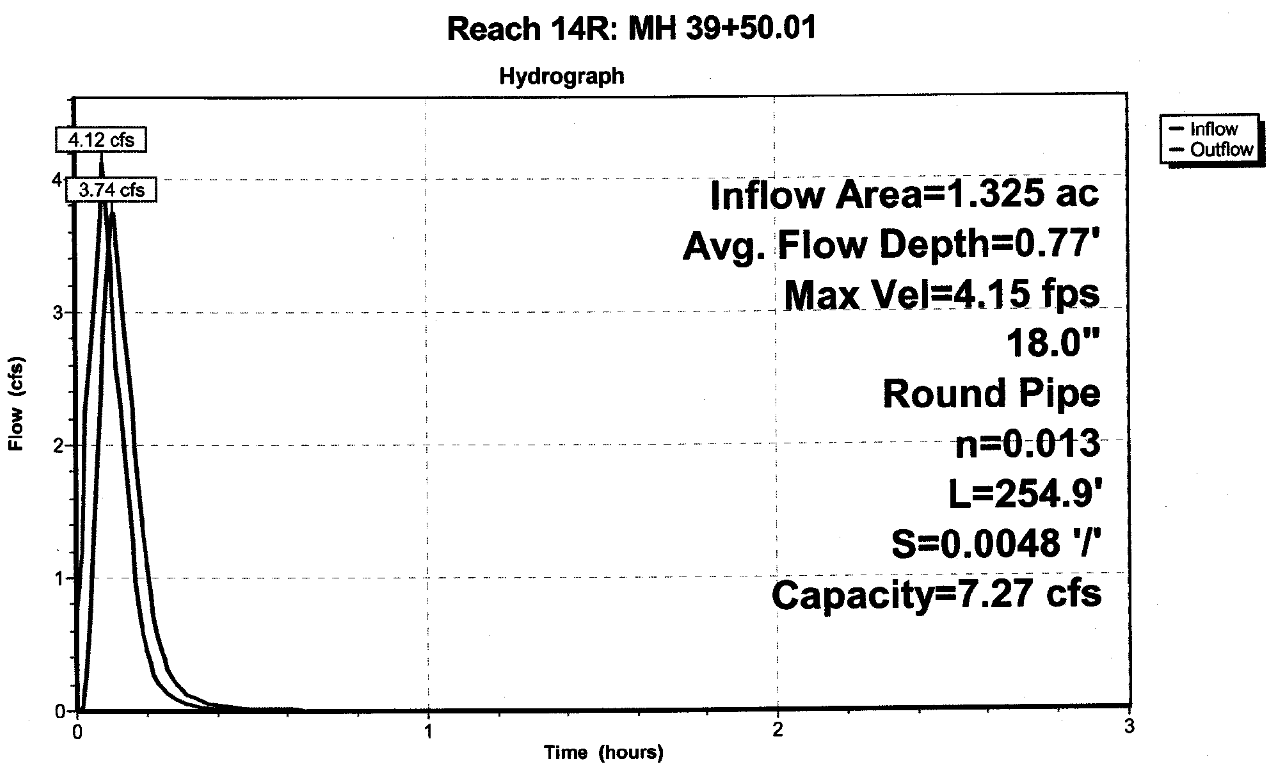
Inflow Area =	1.325 ac,100.00% Impervious,		Inflow Depth = 0.35"		
Inflow =	4.12 cfs @	0.08 hrs,	Volume=	0.038 af	
Outflow =	3.74 cfs @	0.11 hrs,	Volume=	0.038 af,	Atten= 9%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.15 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.83 fps, Avg. Travel Time= 5.1 min

Peak Storage= 232 cf @ 0.09 hrs
Average Depth at Peak Storage= 0.77'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 7.27 cfs

18.0" Round Pipe
n= 0.013
Length= 254.9' Slope= 0.0048 '/'
Inlet Invert= 254.14', Outlet Invert= 252.92'





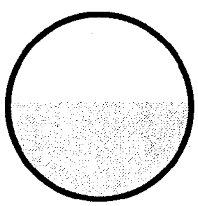
Summary for Reach 15R: MH 42+06.93

Inflow Area = 1.454 ac,100.00% Impervious, Inflow Depth = 0.35"
Inflow = 3.74 cfs @ 0.11 hrs, Volume= 0.042 af
Outflow = 3.63 cfs @ 0.13 hrs, Volume= 0.042 af, Atten= 3%, Lag= 1.1 min

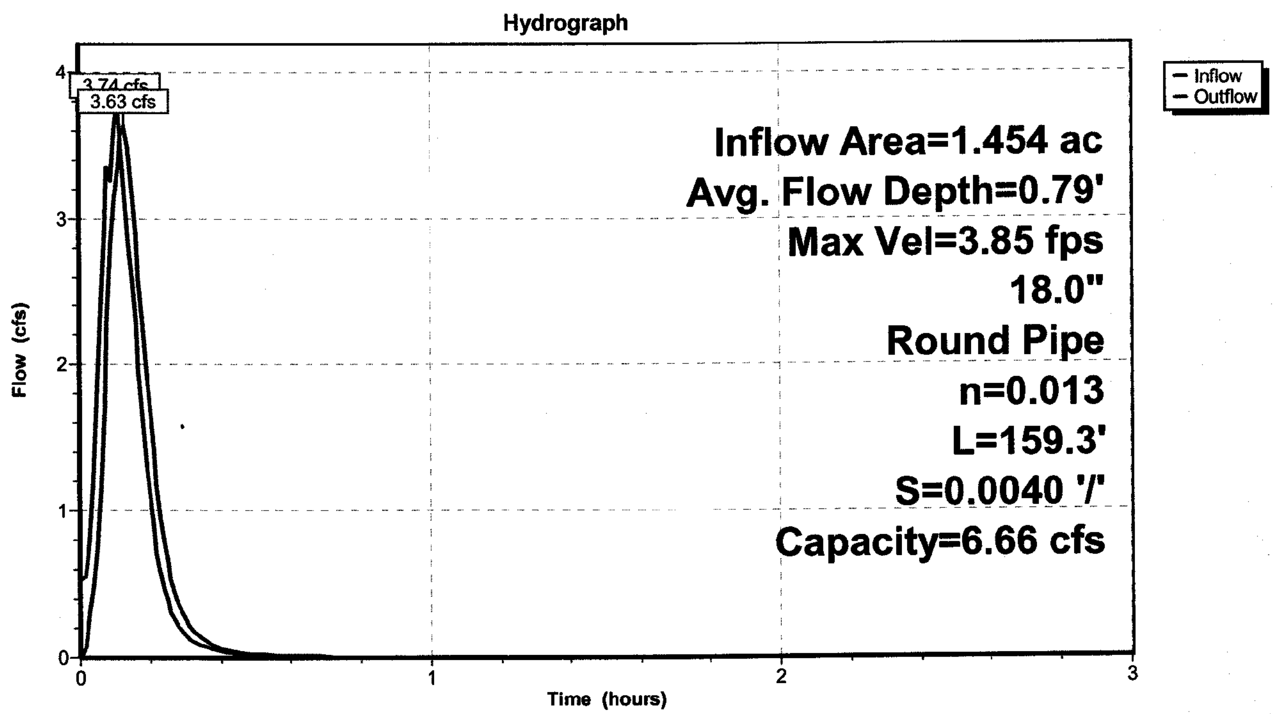
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.85 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 3.4 min

Peak Storage= 151 cf @ 0.12 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 6.66 cfs

18.0" Round Pipe
n= 0.013
Length= 159.3' Slope= 0.0040 '/'
Inlet Invert= 252.72', Outlet Invert= 252.08'



Reach 15R: MH 42+06.93



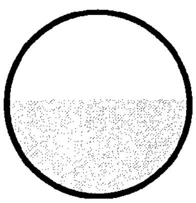
Summary for Reach 16R: MH 43+65.16

Inflow Area = 1.665 ac,100.00% Impervious, Inflow Depth = 0.35"
Inflow = 3.63 cfs @ 0.13 hrs, Volume= 0.048 af
Outflow = 3.58 cfs @ 0.14 hrs, Volume= 0.048 af, Atten= 1%, Lag= 0.6 min

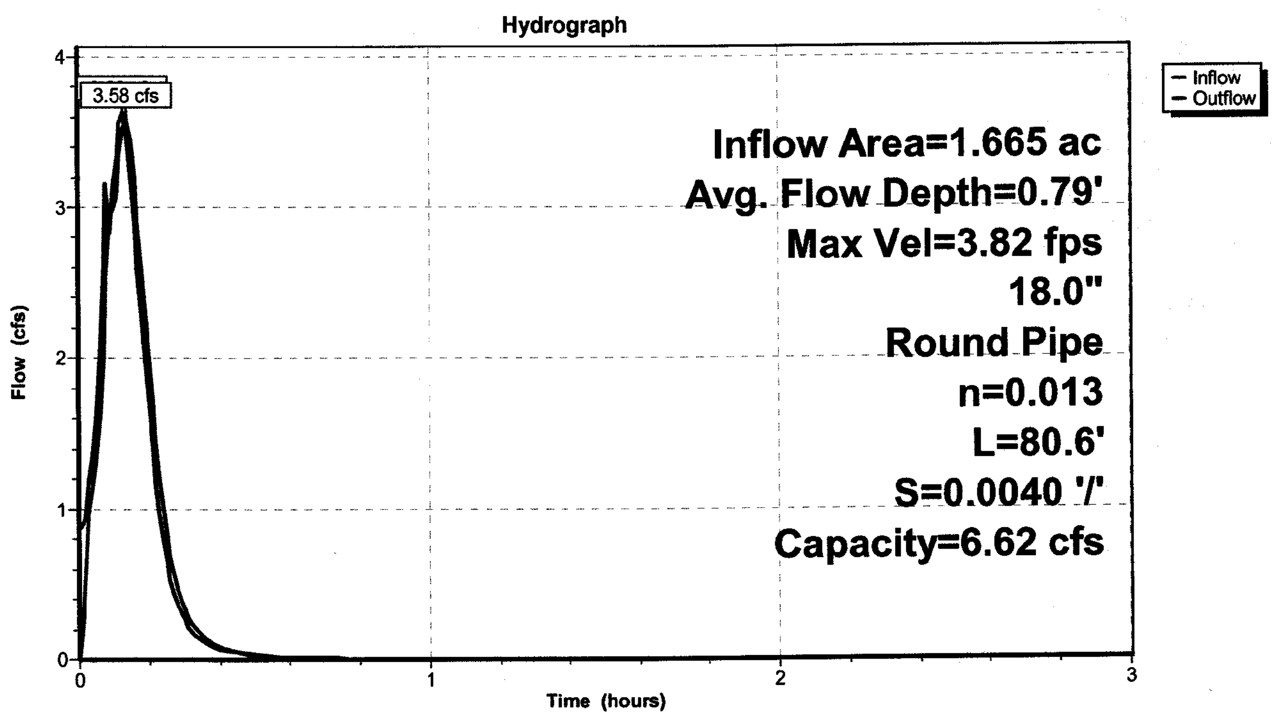
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.82 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 1.7 min

Peak Storage= 76 cf @ 0.13 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 6.62 cfs

18.0" Round Pipe
n= 0.013
Length= 80.6' Slope= 0.0040 '/'
Inlet Invert= 251.88', Outlet Invert= 251.56'



Reach 16R: MH 43+65.16



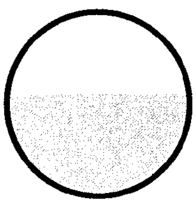
Summary for Reach 17R: MH 45+06.05

Inflow Area = 3.136 ac,100.00% Impervious, Inflow Depth = 0.35"
Inflow = 12.80 cfs @ 0.08 hrs, Volume= 0.091 af
Outflow = 12.80 cfs @ 0.07 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min

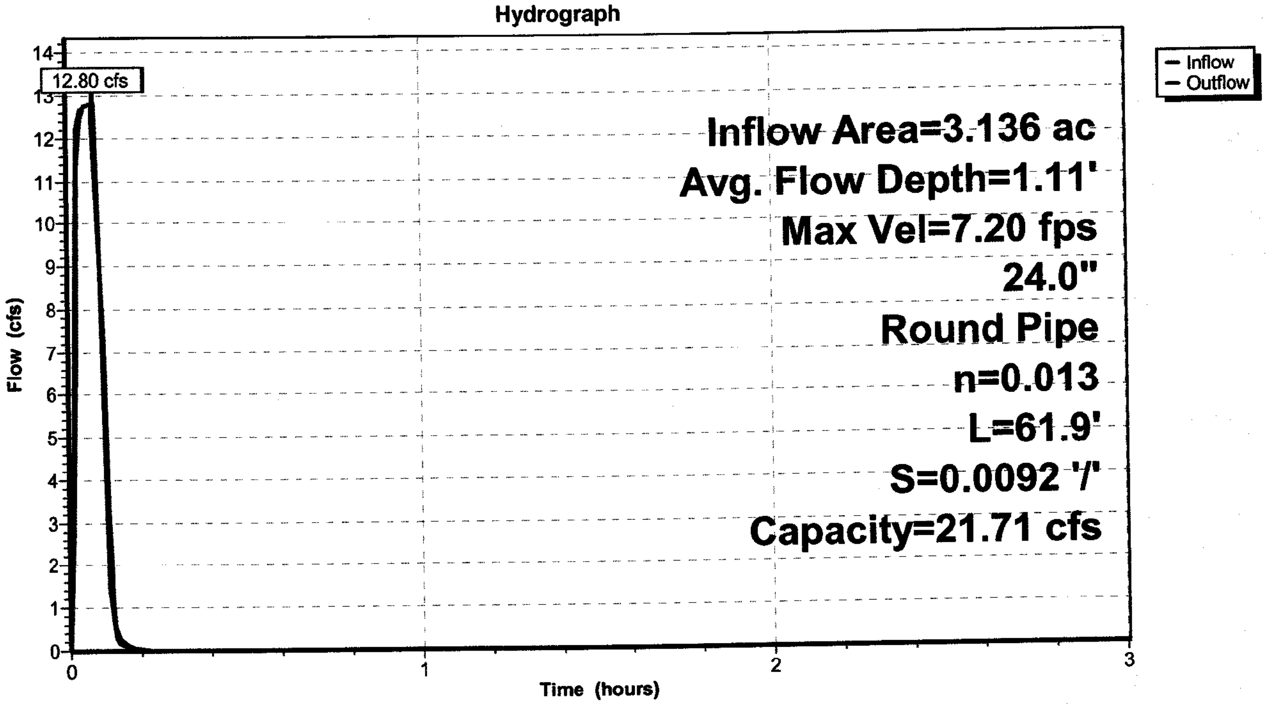
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.20 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.77 fps, Avg. Travel Time= 0.6 min

Peak Storage= 111 cf @ 0.05 hrs
Average Depth at Peak Storage= 1.11'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 21.71 cfs

24.0" Round Pipe
n= 0.013
Length= 61.9' Slope= 0.0092 '/'
Inlet Invert= 252.13', Outlet Invert= 251.56'



Reach 17R: MH 45+06.05



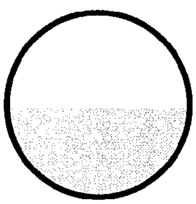
Summary for Reach 18R: MH 47+17.24

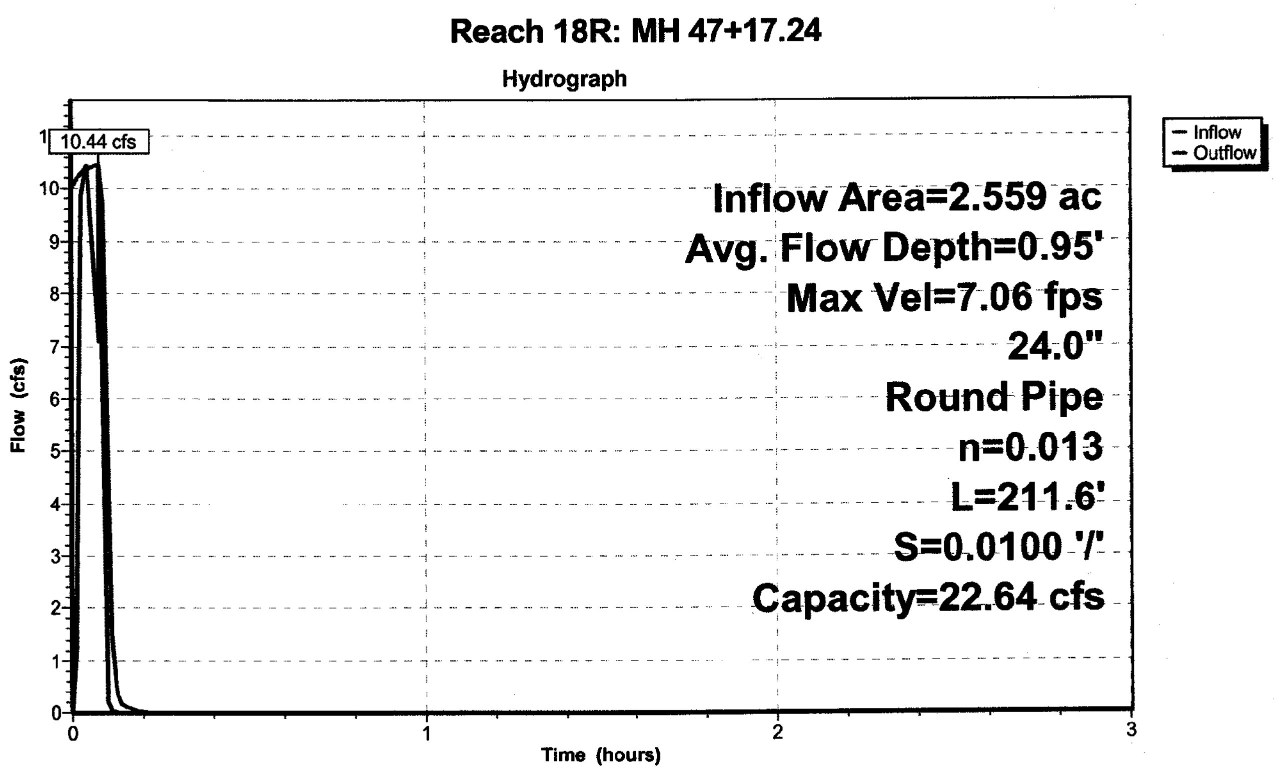
Inflow Area = 2.559 ac,100.00% Impervious, Inflow Depth = 0.36"
Inflow = 10.44 cfs @ 0.08 hrs, Volume= 0.077 af
Outflow = 10.44 cfs @ 0.08 hrs, Volume= 0.073 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.06 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.77 fps, Avg. Travel Time= 2.0 min

Peak Storage= 313 cf @ 0.08 hrs
Average Depth at Peak Storage= 0.95'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 22.64 cfs

24.0" Round Pipe
n= 0.013
Length= 211.6' Slope= 0.0100 '/'
Inlet Invert= 254.45', Outlet Invert= 252.33'





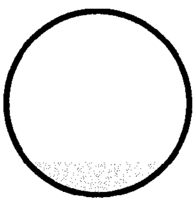
Summary for Reach 19R: MH 48+48.35

Inflow Area = 0.107 ac,100.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.44 cfs @ 0.00 hrs, Volume= 0.003 af
Outflow = 0.44 cfs @ 0.08 hrs, Volume= 0.003 af, Atten= 0%, Lag= 4.8 min

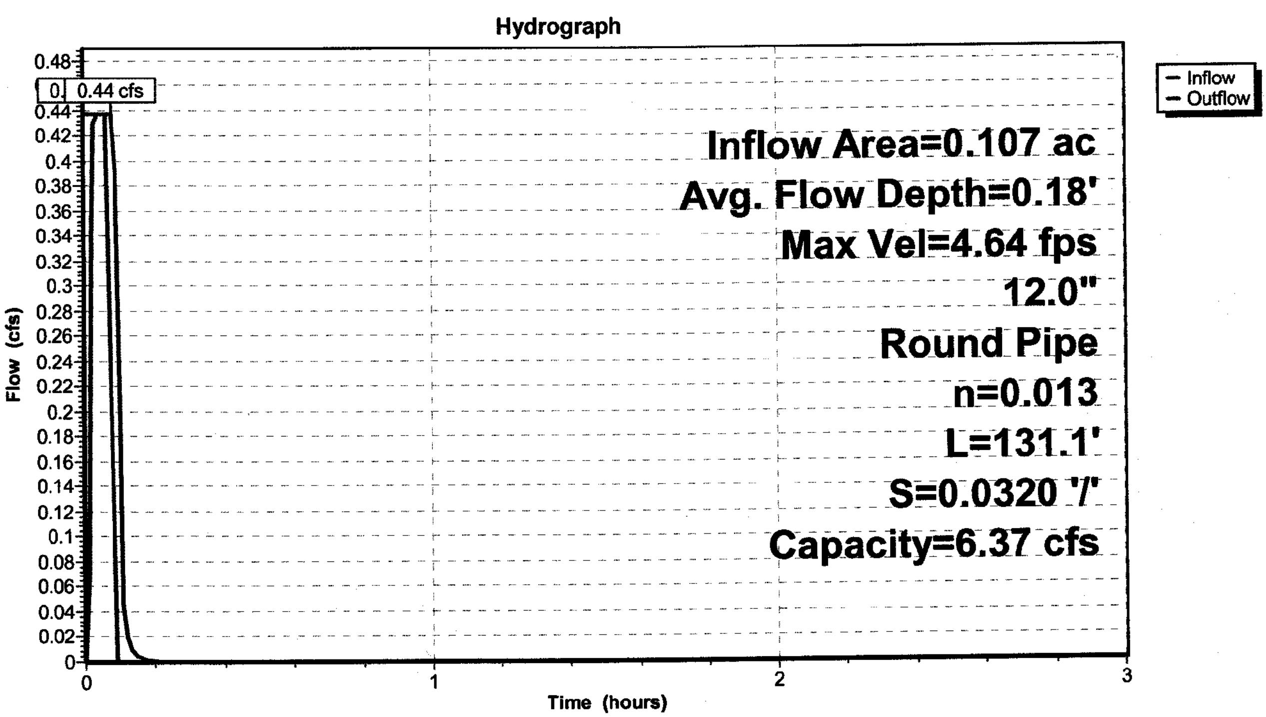
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.64 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.03 fps, Avg. Travel Time= 1.1 min

Peak Storage= 12 cf @ 0.08 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 6.37 cfs

12.0" Round Pipe
n= 0.013
Length= 131.1' Slope= 0.0320 '/'
Inlet Invert= 258.84', Outlet Invert= 254.65'



Reach 19R: MH 48+48.35



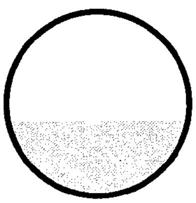
Summary for Reach 21R: MH 44+44.71

Inflow Area = 4.801 ac,100.00% Impervious, Inflow Depth = 0.34"
Inflow = 15.38 cfs @ 0.08 hrs, Volume= 0.138 af
Outflow = 15.04 cfs @ 0.09 hrs, Volume= 0.138 af, Atten= 2%, Lag= 0.5 min

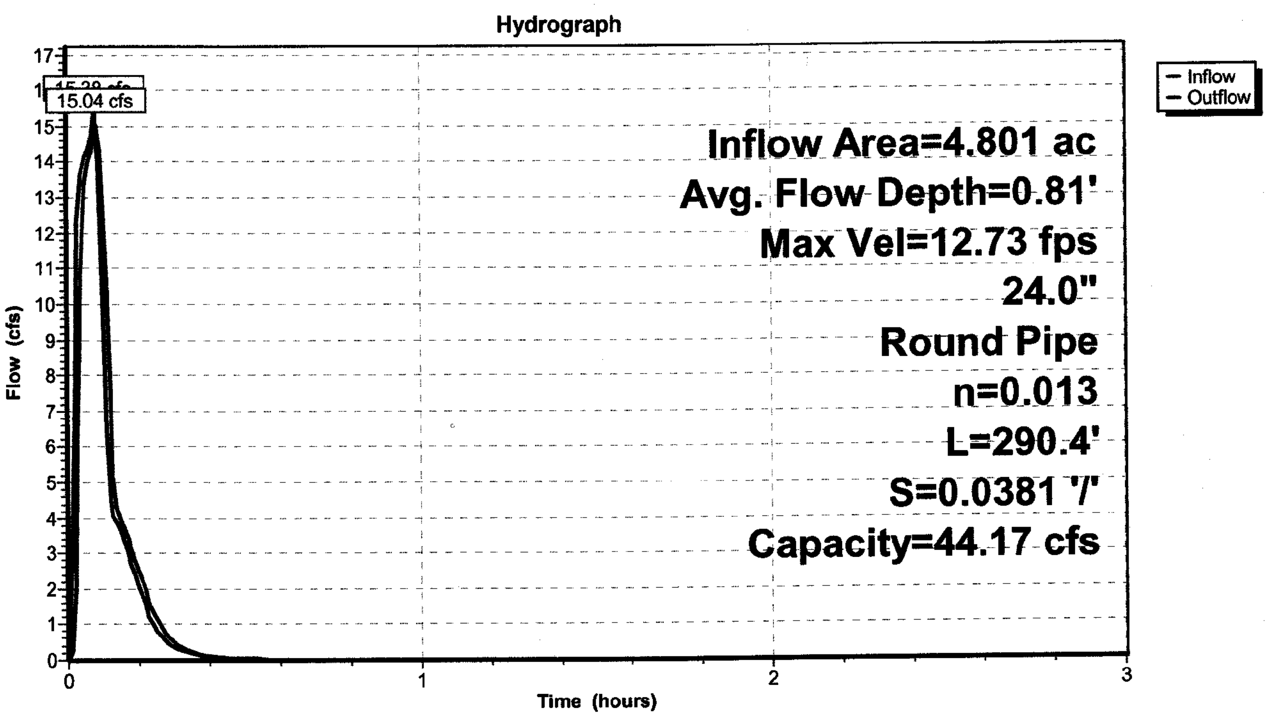
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Max. Velocity= 12.73 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.52 fps, Avg. Travel Time= 1.9 min

Peak Storage= 344 cf @ 0.08 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 44.17 cfs

24.0" Round Pipe
n= 0.013
Length= 290.4' Slope= 0.0381 '/'
Inlet Invert= 251.36', Outlet Invert= 240.29'



Reach 21R: MH 44+44.71



Summary for Pond 22P: Burke Pond

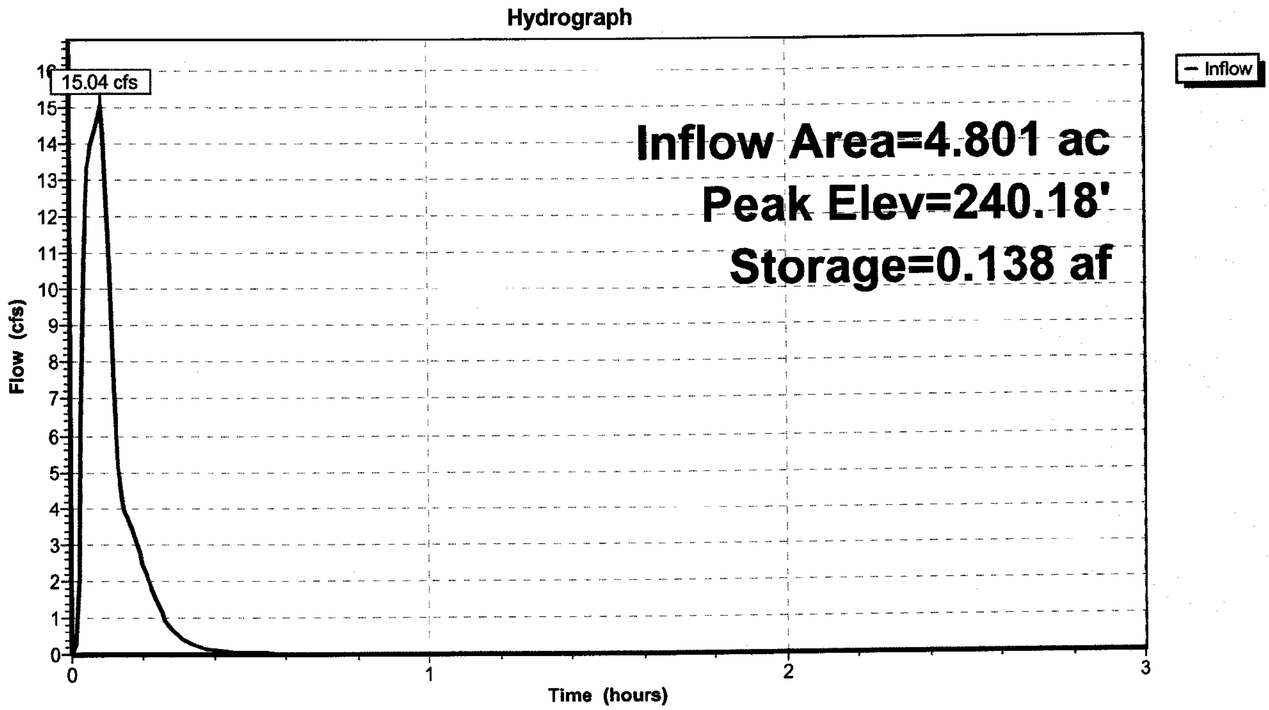
Inflow Area = 4.801 ac,100.00% Impervious, Inflow Depth = 0.34"
Inflow = 15.04 cfs @ 0.09 hrs, Volume= 0.138 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 240.18' @ 3.00 hrs Surf.Area= 0.212 ac Storage= 0.138 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

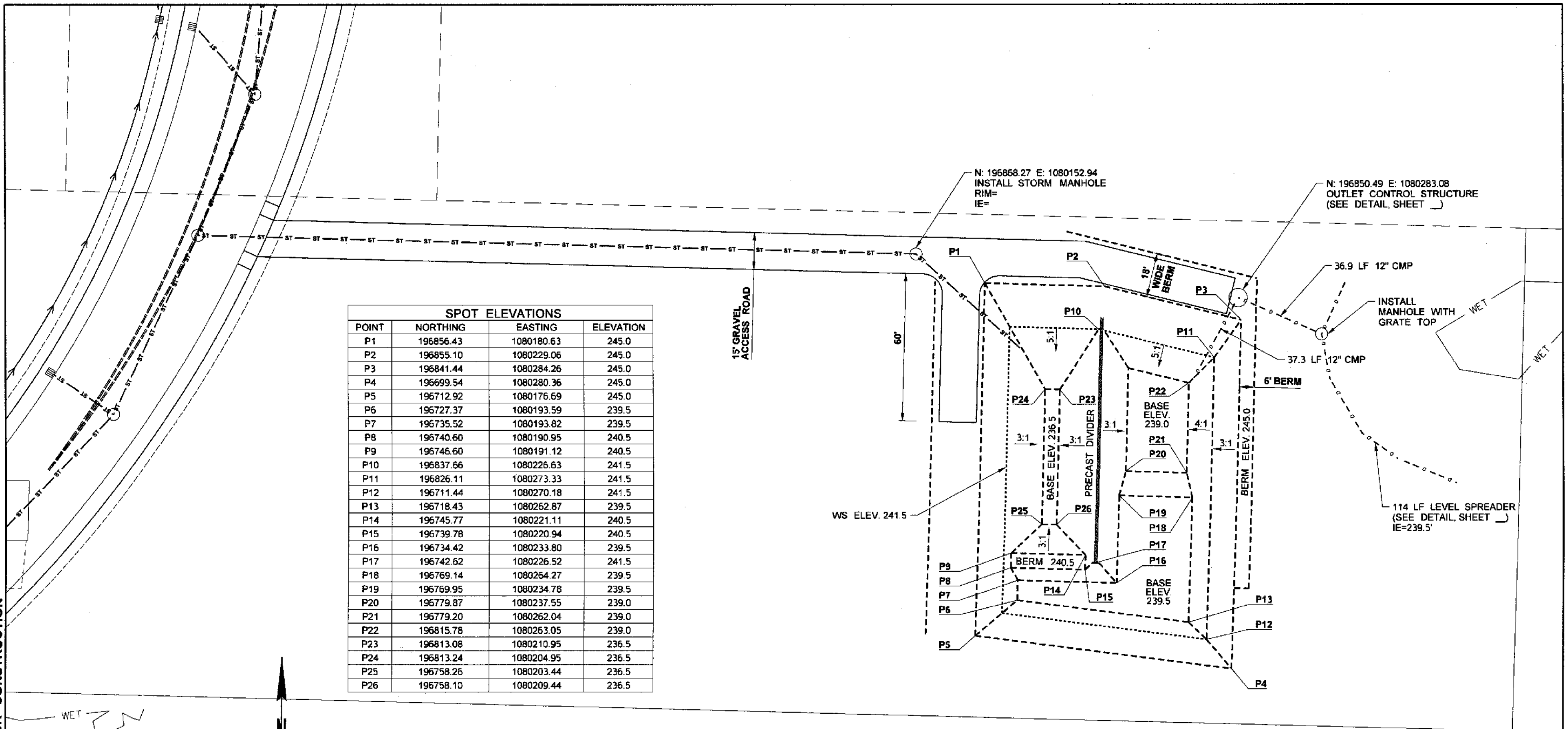
Volume	Invert	Avail.Storage	Storage Description
#1	239.50'	0.851 af	**64.83'W x 129.65'L x 3.50'H Prismatoid Z=3.0**

Pond 22P: Burke Pond



E

90% SUBMITTAL - NOT FOR CONSTRUCTION



SPOT ELEVATIONS			
POINT	NORTHING	EASTING	ELEVATION
P1	196856.43	1080180.63	245.0
P2	196855.10	1080229.06	245.0
P3	196841.44	1080284.26	245.0
P4	196699.54	1080280.36	245.0
P5	196712.92	1080176.69	245.0
P6	196727.37	1080193.59	239.5
P7	196735.52	1080193.82	239.5
P8	196740.60	1080190.95	240.5
P9	196746.60	1080191.12	240.5
P10	196837.66	1080226.63	241.5
P11	196826.11	1080273.33	241.5
P12	196711.44	1080270.18	241.5
P13	196718.43	1080262.87	239.5
P14	196745.77	1080221.11	240.5
P15	196739.78	1080220.94	240.5
P16	196734.42	1080233.80	239.5
P17	196742.62	1080226.52	241.5
P18	196769.14	1080264.27	239.5
P19	196769.95	1080234.78	239.5
P20	196779.87	1080237.55	239.0
P21	196779.20	1080262.04	239.0
P22	196815.78	1080263.05	239.0
P23	196813.08	1080210.95	236.5
P24	196813.24	1080204.95	236.5
P25	196758.26	1080203.44	236.5
P26	196758.10	1080209.44	236.5

POND CONSTRUCTION NOTES:

* PRECAST DIVIDER SHALL CONSIST OF A SINGLE ROW OF ECOLOGY BLOCK, STONE TERRA BLOCK, OR ULTRABLOCK SET SO THAT THE TOP OF BLOCK ELEVATION IS AT ELEVATION 242.5

FILE NAME c:\pw_workdir\ch2mhill_tbg\ms033672\d0289454\7714.e.V5DR-6.dgn
TIME 11:24:31 AM
DATE 10/19/2015
PLOTTED BY MS033672
DESIGNED BY CEM
ENTERED BY
CHECKED BY PAT
PROJ. ENGR. PAT
REGIONAL ADM.

REVISION | DATE | BY

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

PRELIMINARY
PETER A. TUCK
STATE OF WASHINGTON
37857
REGISTERED PROFESSIONAL ENGINEER
10/2015
DATE
P.E. STAMP BOX

P.E. STAMP BOX
DATE

COWLITZ INDIAN RESERVATION

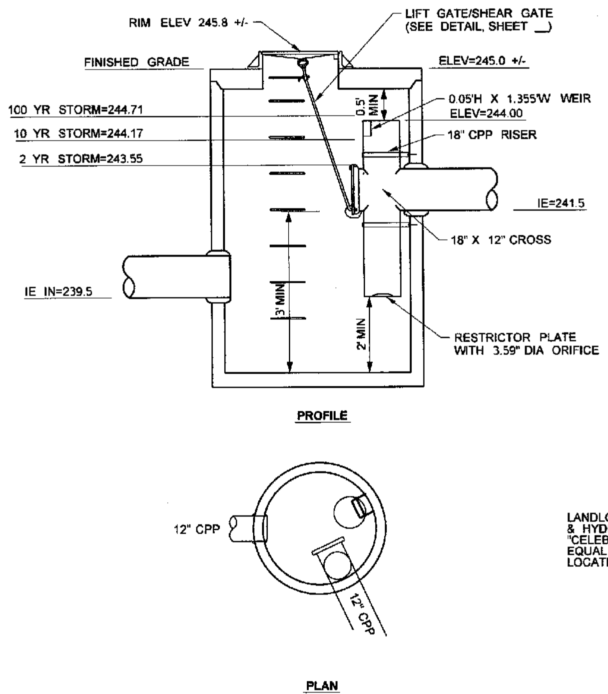
OLSON ENGINEERING INC.

COWLITZ RESERVATION DEVELOPMENT
NW LA CENTER RD/I-5 INTERCHANGE
IMPROVEMENT PROJECT

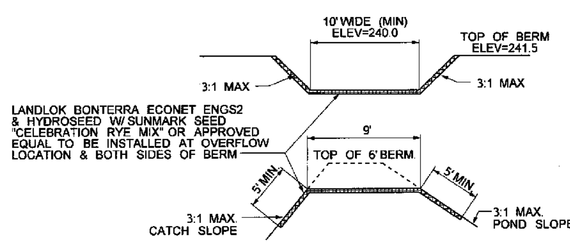
NW PARADISE PARK RD. DRAINAGE DETAIL

PLAN REF NO V5
DR-6
SHEET
OF 100 SHEETS

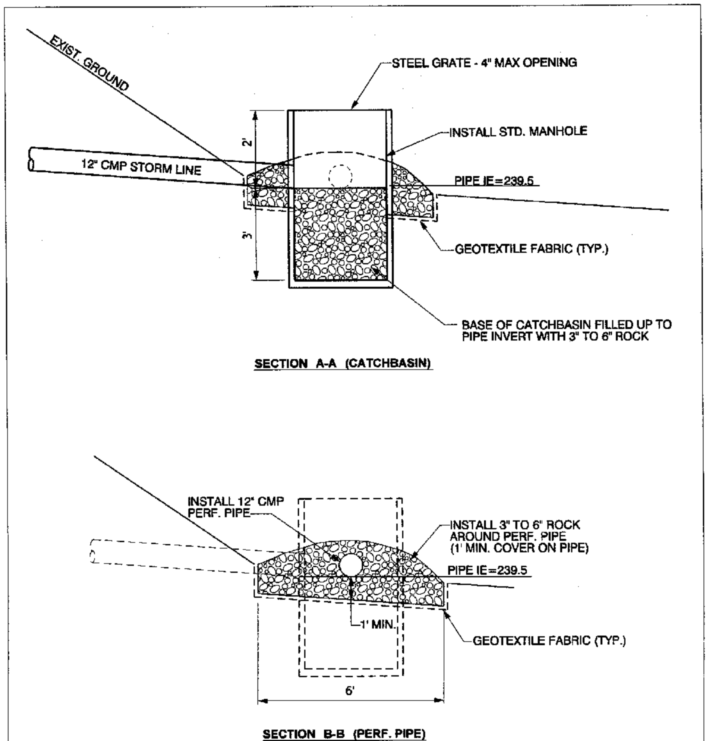
90% SUBMITTAL - NOT FOR CONSTRUCTION



OUTLET CONTROL STRUCTURE DETAIL
NTS



EMERGENCY OVERFLOW DETAIL
NTS



STORM FACILITY OUTFALL DETAILS (TYP.)
NTS

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TIME	1:10:07 PM
DATE	10/19/2015
PLOTTED BY	MS033672
DESIGNED BY	CEM
ENTERED BY	
CHECKED BY	PAT
PROJ. ENGR.	PAT
REGIONAL ADM.	

REVISION | DATE | BY

REGION NO. | STATE: WASH | FED.AID PROJ.NO.
JOB NUMBER
CONTRACT NO. | LOCATION NO.

PRELIMINARY
PETER A. TUCK
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
10/2/15
DATE
P.E. STAMP BOX

P.E. STAMP BOX
DATE

COWLITZ INDIAN RESERVATION
OLSON ENGINEERING INC.

COWLITZ RESERVATION DEVELOPMENT
I-5/NW LA CENTER RD INTERCHANGE
IMPROVEMENT PROJECT

BURKE POND DRAINAGE DETAILS

PLAN REF NO: V5 DRD-1
SHEET
OF 100 SHEETS

F

Downstream Analysis
Paradise Park Road Improvements Project
May 7, 2015

1.1 Introduction

During the review of the Final Stormwater Plan included in the I-5/La Center Road Interchange Improvement Project Reevaluation Report, the City of La Center's City Engineer, Tony Cooper, requested a Hydraulic and Hydrologic Analysis of the capacity of the downstream conveyance system in accordance with Section 18.320.220(2)(c) of the La Center Municipal Code. As approved by Mr. Cooper, this analysis is to extend downstream from the proposed point of discharge to the unnamed stream's confluence with McCormick Creek, approximately 1700 feet downstream. McCormick Creek is significantly larger than the tributary; capacity of that channel to accommodate runoff from the project site is not in question at this time.

1.2 Analysis Requirements

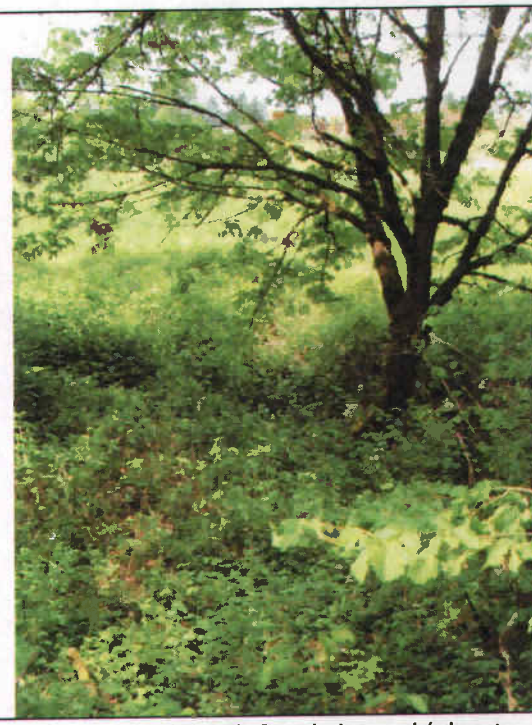
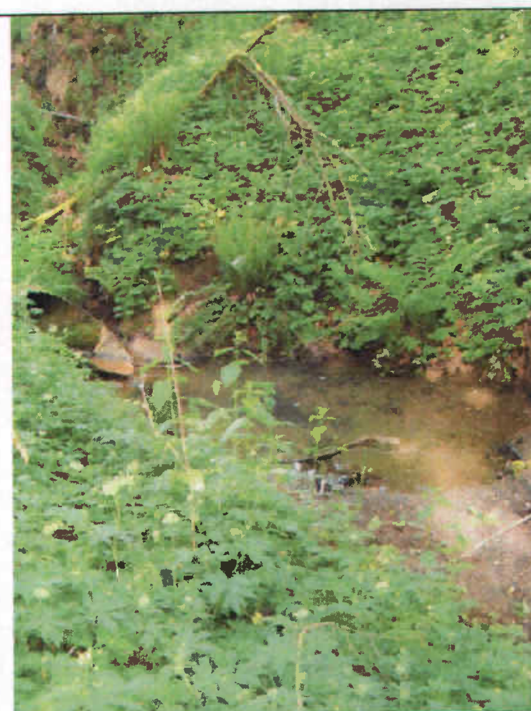
Section 18.320.220(2)(c) of the La Center Municipal Code reads as follows:

> *(c) If surface runoff leaves a development site and the predevelopment runoff calculations do not assume undisturbed forest in determining the runoff curve number, then a hydraulic and hydrologic analysis of the capacity of the downstream conveyance system shall be required.*
>
> *(i) The analysis shall analyze both the natural and manmade conveyance system to the East Fork Lewis River or a point at least one mile downstream from the development site, whichever is less. This distance may be extended by the city if impacts further downstream are likely due to the development activity.*
>
> *(ii) Based on the analysis, the system will be assumed to be at capacity if one of the following conditions exists currently or will exist as a result of the proposed development activity:*
>
> *(A) The conveyance system fails to meet the requirements of this section.*
>
> *(B) Streams that are part of the conveyance system overflow their banks during a two-year storm.*
>
> *(C) Significant stream bank erosion is evident.*
>
> *(D) Existing downstream residences are flooded during the 100-year storm.*

Each item will be addressed in the following paragraphs.

2.1 Field Reconnaissance

A field visit was made of the stream from the top of the defined draw to the confluence with McCormick Creek. Generally speaking, this stream is typical of many small streams in this area; it runs through a deeply incised draw in a series of small cascades with a well-defined channel at the base of the draw. The base of the channel varies from silt and small gravel in the upper reaches to cobbles and gravel in the lower reaches. The sides of the draw are generally well vegetated, but show evidence of both recent and historical slides; this is evident in the landforms and in the number of leaning or "pistol-butt" trees. Again, this is typical of streams of this nature. The following photographs are typical of the channel and draw.

	
A typical section of the draw taken about 500 feet downstream from La Center Road. Note the channel traversing the center of the picture and the bent and leaning trees.	The upstream end of the defined channel (about 200 feet upstream from La Center Road).
	
The inlet of the culvert upstream from La Center Road	The outfall of the culvert below La Center Road.

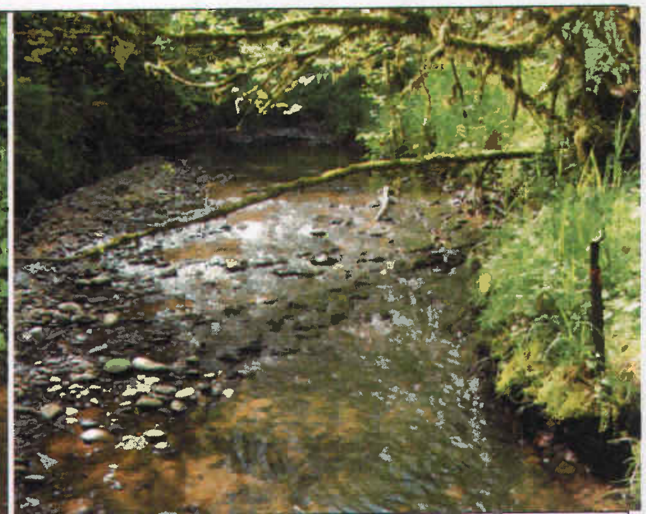
A typical section of the channel in the upstream reaches of the draw. Note the gravel bottom and near-vertical (though stable) slopes. This section is not far below the outfall of the culvert.

The narrowest incised portion of the channel in the upper reaches. Note the consolidated silt bottom and sides. For scale, the machete included in the photo is 2.3' in length.

Farther downstream, the bottom of the channel transitions to larger gravel and cobbles.

Nearing the confluence with McCormick Creek, the channel begins to flatten and meander, becoming braided as it crosses the McCormick Creek floodplain.

The largest of the braided channels as it enters McCormick Creek.



McCormick Creek at the confluence.

3.1 Analysis

La Center Road Culvert: The culvert below La Center Road is a standard 24" CMP with a heavy asphalt (or similar material) lining. Since the lining will be much smoother than a standard CMP, we have assumed the roughness coefficient for the standard CMP for this analysis (Manning's n=0.015). The pipe is laid at about 8% slope and is mitered at each end to roughly conform to the fill slopes. Using the WSDOT "Corrugated Metal and Thermoplastic Pipe Inlet Control Nomograph" and assuming inlet control and an upstream water level at the top of the culvert, the capacity of the culvert was estimated at approximately 12 cfs. Adding another foot of surcharge above the pipe increases the capacity to more than 17 cfs. Flows from the contributing basin were estimated using the USGS's regression equations (see the StreamSTATS website for further information). The 500 year flow event for the area upstream from La Center Road is predicted at 9.46 cfs, significantly less than the capacity of the culvert.

Channel Capacity: The capacity of the incised channel was also evaluated using Manning's equation at the narrowest point observed in the field and shown in the photos. Assuming n=0.025-0.030 (smoother for the side slopes, rougher for the bottom), 0.5:1 side slopes, and a 2 percent channel slope, this is capable of conveying up to 42 cfs, but at excessive velocity (8.5 ft/sec). The 500 year flow for the entire unnamed tributary is only 13.5 cfs; therefore, the channel has adequate conveyance capacity.

4.0 Conclusion

OEI's analysis shows that the 2 year peak flow for the basin of the unnamed tributary to McCormick Creek is approximately 4.09 cfs. With a conveyance capacity of 42 cfs, the existing channel is more than sufficient to carry this flow. The capacity of the La Center Road culvert (the only man-made portion of the drainage) is 12 cfs, compared with a 100-year peak flow of 7.46 cfs. There are no residences downstream of the proposed development. Finally, there is no evidence of excessive erosion in the channel. This meets the requirements for a Downstream Analysis under Section 18.320.220(2)(c) of the La Center Municipal Code. No additional detention requirements apply beyond the minimum specified in the La Center Stormwater and Erosion Control Code.

USGS
Washington StreamStats

Streamstats Ungaged Site Report

Area above La Center Rd.

e: Wed Apr 22 2015 18:19:50 Mountain Daylight Time
Location: Washington
NAD27 Latitude: 45.8522 (45 51 08)
NAD27 Longitude: -122.6953 (-122 41 43)
NAD83 Latitude: 45.8520 (45 51 07)
NAD83 Longitude: -122.6965 (-122 41 47)
Drainage Area: 0.04 mi2

Peak-Flow Basin Characteristics
100% Region 3 (0.04 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.04 (below min value 0.36)	0.36	2198
Mean Annual Precipitation (inches)	54.4	42	132

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Peak-Flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	2.86		1		
PK10	4.81		1		
PK25	5.87		2		
PK50	6.66		2		
PK100	7.46		3		
PK500	9.46				

USGS
Washington StreamStats

Streamstats Ungaged Site Report

ENTIRE SUB-BASIN

: Thu Apr 30 2015 08:49:09 Mountain Daylight Time
Site Location: Washington
NAD27 Latitude: 45.8528 (45 51 10)
NAD27 Longitude: -122.6919 (-122 41 31)
NAD83 Latitude: 45.8527 (45 51 10)
NAD83 Longitude: -122.6932 (-122 41 35)
Drainage Area: 0.06 mi2

Peak-Flow Basin Characteristics

100% Region 3 (0.06 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.06 (below min value 0.36)	0.36	2198
Mean Annual Precipitation (inches)	54.5	42	132

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Peak-Flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	4.09		1		
PK10	6.87		1		
PK25	8.39		2		
PK50	9.5		2		
PK100	10.6		3		
PK500	13.5				

USGS
Washington StreamStats

Streamstats Ungaged Site Report

M^c^Cormick Creek

e: Thu Apr 23 2015 12:34:05 Mountain Daylight Time
Location: Washington
NAD27 Latitude: 45.8605 (45 51 38)
NAD27 Longitude: -122.6863 (-122 41 11)
NAD83 Latitude: 45.8603 (45 51 37)
NAD83 Longitude: -122.6875 (-122 41 15)
Drainage Area: 4.61 mi2

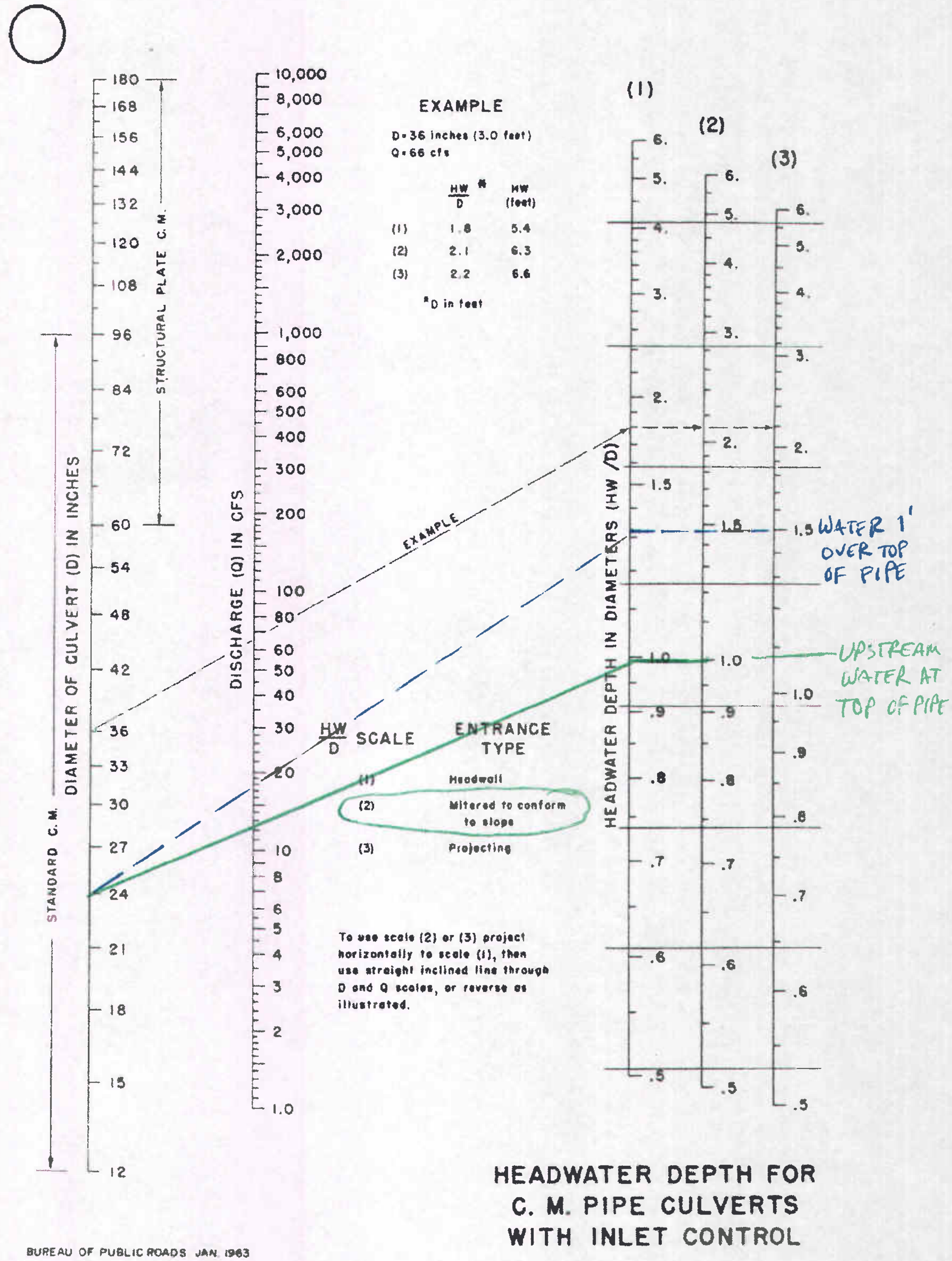
Peak-Flow Basin Characteristics

100% Region 3 (4.61 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	4.61	0.36	2198
Mean Annual Precipitation (inches)	55.1	42	132

Peak-Flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	186	57	1		
PK10	311	55	1		
PK25	378	54	2		
PK50	424	54	2		
PK100	474	55	3		
PK500	592				



Corrugated Metal and Thermoplastic Pipe Inlet Control Nomograph

Figure –3-3.4.2B

La Center Junction

Downstream Analysis

Natural Channels

CI OOLS PRO
English Units
04-30-2015 08:03:33

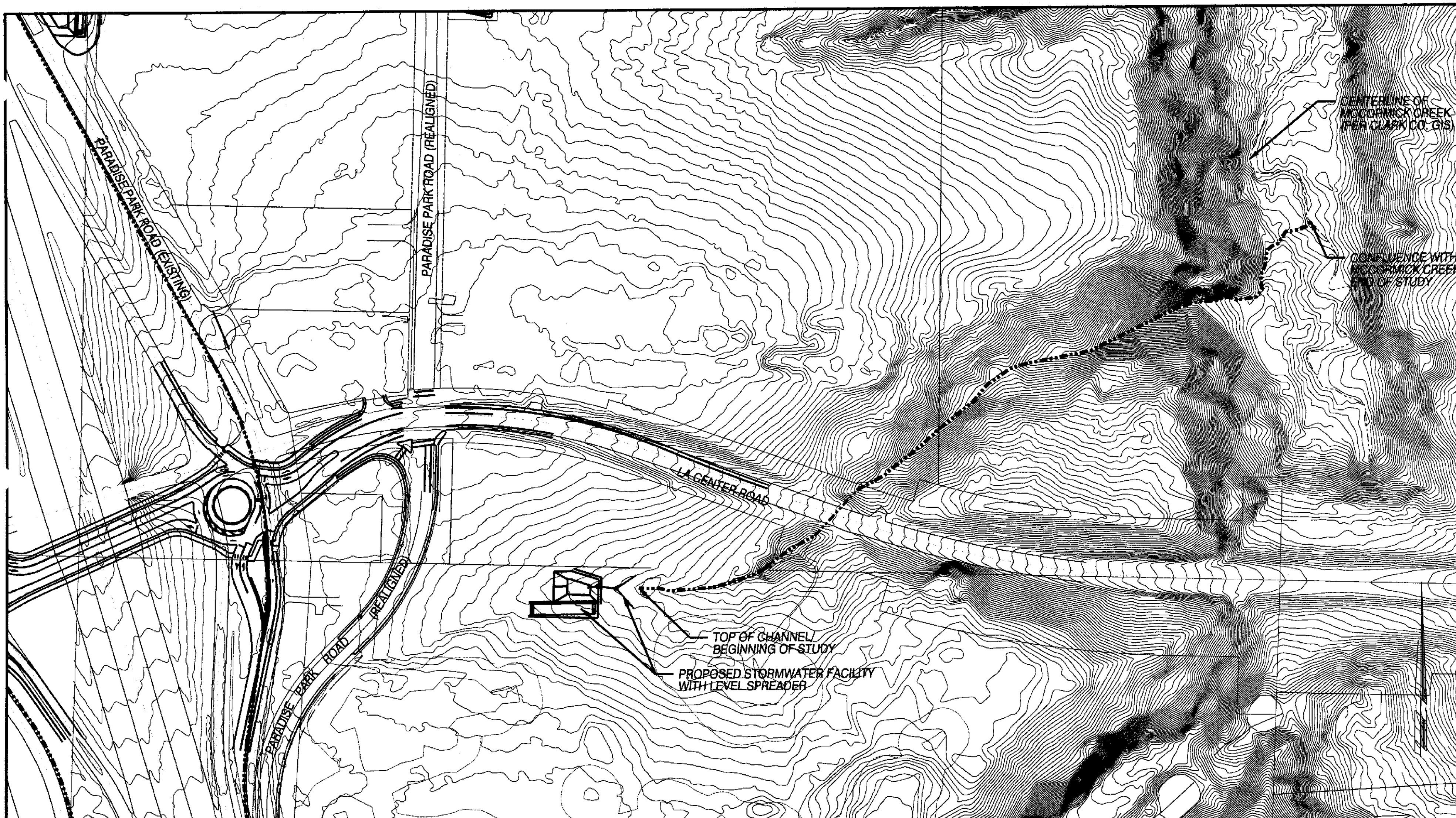
Data Entered

Flow Depth	=	2.00 ft
Channel Slope	=	0.0200 V:H

Distance (ft)	Elevation (ft)	Manning's N
0.00	3.00	0.025
1.50	0.00	0.030
3.00	0.00	0.030
4.50	3.00	0.025

Results

Flow Depth	=	2.00 ft
Flow Rate	=	42.37 cfs
Channel Slope	=	0.0200 V:H
Wetted Area	=	5.00 sq ft
Wetted Perimeter	=	5.97 ft
Flow Velocity	=	8.47 ft/s
Froude's Number	=	1.25
Flow Regime	=	super-critical flow



7714\Engineering\Final Roads\Exhibits\7714.e.20150505.dwnstrm.exhibit.dgn

LIMITS OF DOWNSTREAM ANALYSIS

OLSON ENGINEERING INC. LAND SURVEYORS ENGINEERS 222 E. EVERGREEN BLVD., VANCOUVER, WA 98660

PROJECT: LA CENTER JUNCTION IMPROVEMENTS

SCALE: 1"=200'
DATE: 05/05/15
ISSUED BY: CEM
JOB NO. 7714.02.01
DWG. NO. 1 OF 1

Olson Engineering, Inc.

Memo

To: Reevaluation Report Reviewers

From: Peter Tuck, Olson Engineering

Date: November 2, 2015

Re: La Center Interchange Improvement – Revisions to Final Stormwater Report to accommodate Paradise Park Road realignment

---

The original Stormwater Technical Information Reports for the La Center Interchange Improvement Projects assumed the extension of new Paradise Park Road north to NW 324th Street, then a new extension of 324th Street to old Paradise Park Road. With the removal of those extensions and the work along NW 324th Street from the project, new Paradise Park Road will be relocated along the north line of the Minit Mart property, connecting old Paradise Park Road and the new alignment of Paradise Park Road approximately 375 feet north of the new Paradise Park Road/La Center Road intersection.

With this realignment, there is no longer a need for any stormwater management facilities within unincorporated Clark County. As a result, all of the work described within the volume titled "Final Stormwater Plan – Technical Information Report – La Center Junction Road Improvements" is deleted from the project. To offset this, the new paved surface north of the previously designed high point in new Paradise Park Road just north of La Center Road will be captured and brought back to the pond proposed on the Burke property south of La Center Road. This pond is detailed in the October 21, 2015 revision of the document titled "Final Stormwater Plan – Technical Information Report – Paradise Park Road Improvements." This pond has been designed to provide enhanced water quality treatment and to meet the detention requirements of the *Stormwater Management Manual for Western Washington.*

The Minit Mart is currently served by a stormwater facility partially located within the proposed right-of-way. This facility will be reconstructed outside of the proposed right-of-way in accordance with City of La Center standards.

PETER A. TUCK
STATE OF WASHINGTON
31817
REGISTERED
PROFESSIONAL ENGINEER

11/02/15

APPENDIX B

WATER RESOURCES TECHNICAL MEMORANDUM UPDATE

Water Resources Technical Memorandum Update

Date:	November 25, 2015
Subject:	NW La Center Road /I-5 Interchange Improvement Project (MP 16.80)
From:	Richard Attanasio (CH2M HILL)
Reviewed By:	Deva Alves (CH2M HILL)
To:	AES

Route to:

1.0 INTRODUCTION

Pursuant to the National Environmental Policy Act (NEPA), the "Cowlitz Indian Tribe Trust Acquisition and Casino Project" (the "Trust project") and associated off-site transportation improvements were analyzed in detail within an Environmental Impact Statement (EIS) prepared by the Bureau of Indian Affairs (BIA). FHWA and WSDOT served as Cooperating Agencies throughout the EIS process. Through consultation with FHWA and WSDOT, improvements to the NW La Center Road/I-5 interchange and frontage roads were identified as traffic mitigation measures and the environmental consequences of constructing the improvements were thoroughly analyzed within the Final EIS, which was issued by the BIA on May 30, 2008. Following preparation of an Evaluation of Adequacy Report which concluded that the current conditions of the project area remain largely unchanged from the time of preparation of the 2008 Final EIS, the BIA issued a Record of Decision (ROD) on April 22, 2013. The ROD approved the construction of a casino-resort complex and associated facilities on the 152-acre Cowlitz Reservation property and adopted mitigation measures recommended within the Final EIS, including improvements to the NW La Center Road/I-5 interchange and frontage roads.

An Environmental Reevaluation of the EIS was prepared and submitted in May 2015. This Technical Memorandum Update (Update) was prepared to revise the Water Resources Technical Memorandum dated April 15, 2015, which was included as Appendix A to the May 2015 Environmental Reevaluation Report. Specifically, this Update revises: Sections 2.0, Project description; Section 3.1.1, Design Standards, Section 3.2.2, Design Standards; Section 3.2.2.2, Stormwater Management Guidelines; Section 5.2, Long-Term Impact Mitigation; and Section 7, Pending Issues of the April 2015 Water Resources Technical Memorandum. Therefore, this Update should be considered in conjunction with the April 2015 Water Resources Technical Memorandum. These water resource updates are to incorporate changes in the Stormwater Management Plans and the new proposed alignment of NW Paradise Park Road.

2.0 CHANGES TO PROJECT DESCRIPTION

Project improvements within City of La Center right-of-way have been revised consistent with the Washington Department of Ecology Stormwater Management Manual for Western Washington (SMMWW). The facilites within City of La Center right-of-way are composed of NW La Center Road from the west side of the new overpass to the end of the new tapers on the east side of the overpass. It also inlcudes approximately 400 feet of the newly relocated NW Paradise Park Road north of NW La Center Road and all of the relocated NW Paradise Park Road south of NW La Center Road.

All the parties to the project will now be using similar stormwater management guidelines either WSDOT's Hydraulic Runoff Manual (HRM) or Washington Department of Ecology Stormwater Management Manual for Western Washington (SMMWW). These two guidelines are extremely similar, both require continuous simulation modeling with similar treatment requirements. There are now no sections of the project are within Clark County jurisdiction.

3.2.2 Changes to Design Standards

Design standards for the stormwater management facilities and stormwater conveyance system were taken from the 2014 *Highway Runoff Manual* (HRM) (WSDOT, M 31-16.04), and the Washington State Department of Ecology (Ecology) 2012 *Stormwater Management Manual for Western Washington (SMMWW)*. The 1992 *Stormwater Management Manual for the Puget Sound Basin* (Puget Sound Manual) is no longer used on this project. The HRM and SMMWW are considered equivalent documents, but vary in certain specifics of project guidance.

3.2.2.1 Changes to Stormwater Management Guidelines

Both flow control and runoff treatment issues will be addressed to satisfy minimum requirements from the HRM for the project on WSDOT right-of-way. For segments of the Project on City of La Center right-of-way, stormwater guidelines from the SMMWW will be used.

Flow Control

The flow control design criteria for detention facilities in Western Washington, in the SMMWW, dictate that the stormwater discharges match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The 100-year peak flow rate must also be checked for downstream flooding and property damage. The designer is required to use a continuous simulation model using 15-minute time steps. For this project, WSDOT flow control and water quality treatment facilities will be sized according to WSDOT standards in the HRM and modeled with MGS Flood hydrologic modeling software. City of La Center facilities will use the Western Washington Hydrology Model (WWHM).

Runoff Treatment

The Project is required to meet one of two treatment targets based on Ecology SMMWW guidance and in concordance with the HRM. The project meets requirements for both basic treatment and enhanced treatment. The basic treatment threshold is based on the roadway ADT (under 15,000 for roadways outside an Urban Growth Area) and amount of new impervious area (5,000 square feet or more of new pollution-generating impervious surface). Based on the ADT of some of the roadway segments, the Project is also subject to enhanced treatment requirements. The performance goals for both treatment targets are, respectively: 80% removal of total suspended solids (TSS); and enhanced treatment provides a higher rate of removal of dissolved metals than basic treatment provides. For project segments in WSDOT right-of-way, treatment is to be selected, designed and sized using the HRM as guidance. For project segments in City of La Center right-of-way, treatment is to be selected, designed and sized using the SMMWW as guidance.

2.1 Changes to Long-Term Impact Mitigation

Applicable flow control BMPs for this project will include detention ponds. Applicable water treatment BMPs will include media filter drains and biofiltration swales.

7.0 CHANGES TO PENDING ISSUES

Detailed stormwater management plans for the WSDOT and City or County facilities will be in their final forms. Work on these plans for detention and treatment will be finalized.

APPENDIX C

BIOLOGICAL RESOURCES TECHNICAL MEMORANDUM ADDENDUM

210 East 13th Street, Suite 300, Vancouver, Washington 98660-3231
360/823-6100 • 360/823-6101 Fax • www.abam.com

Biological Resources Technical Memorandum

Date:	13 January 2016
Subject:	Biological Resources Technical Memorandum Addendum – NW La Center Road /Interstate-5 Interchange Improvement Project (MP 16.80)
From:	Dustin Day, BergerABAM
To:	Mark Butorac, Kittelson & Associates Ryan Lee Sawyer, Analytical Environmental Services Ali Middlekauff, Analytical Environmental Services
cc:	Don Hardy, BergerABAM

1.0 INTRODUCTION

Pursuant to the National Environmental Policy Act (NEPA), the "Cowlitz Indian Tribe Trust Acquisition and Casino Project" (the "Trust project") and associated off-site transportation improvements were analyzed in detail in an environmental impact statement (EIS) prepared by the Bureau of Indian Affairs (BIA). The Federal Highways Administration (FHWA) and the Washington State Department of Transportation (WSDOT) served as cooperating agencies throughout the EIS process. Through consultation with FHWA and WSDOT, improvements to the NW La Center Road/Interstate-5 (I-5) interchange and frontage roads were identified as traffic mitigation measures and the environmental consequences of constructing the improvements were analyzed within the Final EIS (FEIS), which was issued by the BIA on 30 May 2008. Following the preparation of a report evaluating the adequacy of the FEIS, which concluded that the current conditions of the project area remain largely unchanged from the time of preparation of the FEIS, the BIA issued a Record of Decision (ROD) on 22 April 2013. The ROD approved the construction of a casino-resort complex and associated facilities on the 152-acre Cowlitz Reservation property and adopted mitigation measures recommended within the FEIS, including improvements to the NW La Center Road/I-5 interchange and frontage roads.

Typically, an FEIS is reevaluated when there is substantial new information or there is a change in the proposed action; the reevaluation determines whether the documentation addresses the environmental impacts of the project adequately. The purpose of this technical memorandum is to establish whether the NEPA documents, determination, and/or final project decision remain valid for the subsequent federal action. This memo will assess the environmental consequences of the proposed road realignment and stormwater redesign from those assessed for the I-5/La Center Road interchange improvements project (interchange improvements project) on biological resources in its vicinity. The interchange improvements project is located within the City of La Center (City), at the existing interchange of I-5 and NW La Center Road (NW 319th Street) (Figure 1). The location is approximately 3 miles north of the Ridgefield interchange and 4 miles south of the Woodland interchange.

The previously evaluated interchange improvements project included realigning Paradise Park Road on the east side of I-5; realign NW 31st Avenue and NW 319th Street on its west side; construct a new overpass ultimately accommodating two eastbound lanes and two westbound lanes; improve I-5 on and off-ramps; construct three roundabouts; demolish the existing overpass; and stormwater and utility modifications. This reevaluation address the changes to the stormwater design and the change in the Paradise Park Road realignment, north of NW La Center Road. Section 2.0 includes a complete description of these changes.

The acreage of the interchange improvement project site reduced from 78 acres to 74.5 acres, and consists of Washington Department of Transportation (WSDOT) right of way, NW La Center Road right of way, portions of three tax lots adjacent to Paradise Park Road south of NW La Center Road, and two tax lots north of NW La Center Road up city limits, all located east of I-5 (Figure 2). The tax lots listed in Table 1 are located within portions of sections 4 and 9 of Township 04 North, Range 01 East, Willamette Base Meridian.

Table 1. Parcels within the Project Site

Current Property Owners	Area Addressed	Parcel Number
	North of NW La Center Road	
Minit Management LLC	Right of Way Only	209738000
Fudge, Linda	Right of Way Only	209705000
	South of NW La Center Road	
Landon, Gloria	Full Property Acquisition	209704000 & 209403000
Burk, Deford & Laura	Full Property Acquisition	211230000
Carlson Investments LLC	Partial Property Acquisition	211215-000

2.0 CHANGES TO PROJECT DESCRIPTION

2.1 Road Realignments

2.1.1 Paradise Park Road Realignment

Paradise Park Road north of NW La Center Road will travel approximately 400 feet north then turn to the west and travel along the northern portion of tax lot 209738000 and reconnect with the existing Paradise Park Road. All work will occur within the City. All stormwater will be collected and treated in accordance with the stormwater described below.

2.1.2 Temporary Highway Access Ramp Realignments

The interchange improvements project will require the installation of temporary northbound off- and southbound on-ramps for traffic control and staging. Both temporary ramps will occur in the City, within WSDOT right of way, as discussed in above in Section 1.0. Upon completion, the temporary ramps will be removed and all applicable best management practices for erosion and sediment control will be employed. The disturbed areas will be landscaped in accordance with landscape plans approved by WSDOT. Finally, treatment of runoff from the temporary access ramps during construction is under the jurisdiction of the 1200-C Permit and all requirements of the 1200-C Permit will be met for the temporary facilities.

2.2 Stormwater Redesign

Project improvements within City right-of-way will be designed to meet the Washington State Department of Ecology (Ecology) "Stormwater Management Manual for Western Washington" (2014 Ecology manual). The facilities within City right-of-way are composed of NW La Center Road from the west side of the new overpass to the end of the new tapers on the east side of the overpass. City facilities also include approximately 400 feet of the newly relocated NW Paradise Park Road north of NW La Center Road and all of the relocated NW Paradise Park Road south of NW La Center Road.

All the parties to the project will now use similar stormwater management guidelines, either WSDOT's 2014 "Hydraulic Runoff Manual" (HRM; WSDOT M 31-16.04) or the Ecology manual. These two guides are very similar; both require continuous simulation modeling with similar treatment requirements

2.2.1 Changes to Design Standards

Design standards for the stormwater management facilities and stormwater conveyance system were taken from the HRM and the Ecology manual. The HRM and the Ecology manual are considered equivalent documents, but vary in certain specifics of project guidance.

Both flow control and runoff treatment issues will be addressed to satisfy minimum requirements from the HRM for the project on WSDOT right-of-way. For segments of the project on City right-of-way, stormwater guidelines from the Ecology manual will be used.

2.2.2 Flow Control

The flow control design criteria for detention facilities in Western Washington, in the 2014 Ecology manual, dictate that the stormwater discharges match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50 percent of the 2-year peak flow up to the full 50-year peak flow. The 100-year peak flow rate must also be checked for downstream flooding and property damage. The designer is required to use a continuous simulation model using 15-minute time steps. For this project, WSDOT flow control and water quality treatment facilities will be sized according to WSDOT standards in the HRM and modeled with MGS Flood hydrologic modeling software. City facilities will use the Western Washington Hydrology Model.

2.2.3 Runoff Treatment

The project is required to meet one of two treatment targets based on the guidance of the Ecology manual and in accordance with the HRM. The project meets requirements for both basic treatment and enhanced treatment. The basic treatment threshold is based on the average daily traffic (ADT) on the roadway (under 15,000 for roadways outside an urban growth area) and on the amount of new impervious area (5,000 square feet or more of new pollution-generating impervious surface). Based on the ADT of some of the roadway segments, the project is also subject to enhanced treatment requirements. The performance goals for the treatment targets are, for basic treatment, 80 percent removal of total suspended solids and, for enhanced treatment, a higher rate of removal of dissolved metals. For project segments in WSDOT right-of-way, treatment is to be selected, designed, and sized using the HRM. For project segments in City right-of-way, treatment is to be selected, designed, and sized using the Ecology manual.

3.0 AFFECTED ENVIRONMENT

This section identifies and discusses the existing biological resource setting of the road realignment and stormwater redesign. The stormwater redesign is identical with the setting of the interchange improvements project as previously assessed and the road realignment is located in area of previous development for the existing gas station. Resources such as habitat types, waters of the United States (waters of the U.S.), including wetlands, plants, and wildlife (including Endangered Species Act [ESA] listed species), are discussed in detail.

3.1 Existing Conditions

I-5 may be the most heavily traveled interstate in WSDOT's jurisdiction. Farmland borders the right-of-way for most of the project length. Rural residential and ruderal fields exist to the east of the project site and rural residential and commercial exist to the south. The roadside area outside the shoulders and interior areas of the interchange within the project limits are currently vegetated. The median of the I-5 mainline is also vegetated within project limits. The vegetation is dominated by grasses and herbaceous vegetation; however, some trees are located along the interchange ramps and outside shoulders. The highway lanes in the project area are generally crowned along straight segments and super elevated when curved (and along ramps) to shed to the median and/or outside shoulders, depending on the alignment. As previously mentioned, the stormwater redesign is identical with the setting of the interchange improvements project as previously assessed and the road realignment is located in area of previous development for the existing gas station, which consists of impervious surfaces, weedy and non-native herbaceous cover, and the stormwater facility for the existing gas station.

The interchange site lies within the western portion of the Lewis Water Resource Inventory Area (WRIA) watershed basin. The downstream receiving waters for the project are an unnamed tributary to McCormick Creek and an unnamed stream, both of which flow to the major surface waterbody of the project, the East Fork Lewis River, located north-northeast of the project site. The East Fork Lewis River Watershed is a sub-watershed of the greater Lewis WRIA watershed basin.

3.2 Regulatory Framework

The interchange improvements reevaluation detailed the regulatory setting of the interchange project, which includes federal special status species, waters of the U.S., the Clark County wetlands protection ordinance and its habitat conservation ordinance, and the City critical areas ordinance.

The Federal Special Status Species section documented the efforts conducted during the NEPA interchange improvements reevaluation process to identify "federally listed special-status" plant and animal species that are listed as endangered or threatened under the ESA, formally proposed for listing, or listed by the Western Washington office of the U.S. Fish and Wildlife Service (USFWS) as a Federal Species of Special Concern. A biological assessment was prepared and submitted to the USFWS and National Marine Fisheries Service (NMFS) in April 2015 to initiate informal consultation in compliance with Section 7 of the ESA.

The Waters of the U.S. section of the NEPA reevaluation defined the term "waters of the U.S." and indicated that the Clean Water Act requires a permit for the dredge and fill of waters of the U.S. The Waters of the U.S. section also discussed the intent of the County wetlands protection ordinance and City critical areas ordinance, and the jurisdictional authority over wetlands in their respective jurisdictions. For the road and stormwater redesign, the Federal Special Status Species, Waters of the U.S. and City ordinance sections are still accurate and applicable.

3.3 Habitat Types

Habitat types occurring within the road realignment and stormwater redesign area are consistent with the habitat types described in the biological resources technical memorandum developed for the NEPA evaluation by BergerABAM in March 2015 (BergerABAM 2015a). The habitat types within the vicinity of the proposed interchange improvements project have not changed; they include ruderal/developed lands, pasture, deciduous woodland, palustrine emergent wetland, and roadside ditches (Figure 3). A summary of habitat types, acreage, and percent coverage within the proposed interchange improvements site did not change significantly for the road and stormwater redesign, and is provided in Table 2.

Table 2. Summary of Habitat Types Found in Interchange Improvement Site

Habitat Type	Acres	Percent Area
Ruderal/Developed	64.12	86
Pasture	8.24	11
Deciduous Woodland	1.21	1.6
Palustrine Emergent Wetland	0.34	0.5
Roadside Ditch	0.65	0.9
Total	74.56	100

3.4 Waters of the United States

A formal delineation of jurisdictional wetlands and waterbodies that are subject to USACE regulations under Section 404 of the Clean Water Act was conducted within the site of the interchange improvements project and subsequent road and stormwater redesign. The jurisdictional waters of the U.S. that were identified include the palustrine emergent wetlands discussed above in section 3.3 (BergerABAM 2015a). The acreage of wetlands found within the site of the interchange improvements project is approximately 0.34 acre and are shown in Figure 4. According to the City's critical areas ordinance, which uses Ecology's wetland rating system for western Washington (Ecology 2014), these wetlands are categorized as Category IV wetlands. Most of roadside ditches identified did not have an ordinary high water mark, were ephemeral, appear to be excavated wholly in uplands and drain only uplands, and were not described as waters of the U.S. A jurisdictional determination conducted by the USACE determined that the ditches are not subject to regulation under Section 404 of the Clean Water Act (USACE 2015).

3.5 Wildlife

Wildlife observed for the interchange improvements project include coyote (*Canis latrans*), American robins (*Turdus migratorious*), swallows (*Tachycineta* spp.), and various passerine birds (BergerABAM 2015b). In addition, evidence of deer (*Odocoileus* spp.) beds, in the form of flattened vegetation, was observed within the tall grass areas of the site. No additional wildlife species were observed during the development of this memorandum for the road and stormwater redesign.

3.6 Federally Listed Special Status Species

A biological assessment prepared by BergerABAM addressed the potential impacts of the interchange improvements project, including a complete stormwater analysis, on ESA-listed species and designated and proposed critical habitats (BergerABAM 2015c). As part of the NEPA reevaluation processes for the interchange, in accordance with Section 7 of the ESA, this biological assessment was submitted for USFWS and NMFS consultation on the effects of the interchange project.

Letters of concurrence were issued by USFWS on 8 July 2015 and by NMFS on 2 June 2015. The letters concurred that the interchange improvements project "may affect, not likely to adversely affect" ESA-listed bull trout, Pacific salmon species, and Pacific eulachon, and would not adversely affect essential fish habitat. The USFWS also determined that the project would have "no effect" on several additional species and critical habitat known to occur in Clark County. The USFWS determinations were based on the findings that (1) the project does not include any in-water work; (2) best management practices will be implemented to minimize sediment and turbidity during construction; (3) stormwater treatment will be provided for all new PGIS as well as 2.04 acres of existing PGIS; (4) elevated pollutant concentrations from stormwater runoff will be diluted to below biological thresholds before reaching waterbodies potentially containing bull trout; and (5) federal, state, and local regulations requiring stormwater treatment and mitigation for environmental impacts will minimize impacts to water quality, hydrology, and streams resulting from land use changes in the action area (USFWS 2015).

NMFS concurred with the "may affect, not likely to adversely affect" determinations for ESA-listed salmonids because (1) enhanced stormwater treatment to biological thresholds will be provided for all new pollution-generating impervious surfaces (PGIS) as well as 2.04 acres of existing PGIS; and (2) the proposed stormwater treatment system was expected to treat stormwater runoff to the extent that metal and suspended solids in treated stormwater would be expected to dilute to background levels prior to reaching ESA-listed fish-bearing waters (NMFS 2015).

Based on the results of a stormwater pollutant loading and dilution analysis conducted as part of the biological assessment addendum, stormwater treatment proposed for new impervious areas has been designed to meet Ecology standards, and any elevated levels of pollutants or suspended solids would be below levels where adverse effects to any primary constituent elements of critical habitat in McCormick Creek or the East Fork Lewis River would be adversely affected. The road realignment and stormwater redesign will not affect ESA-listed species or their designated critical habitat, and no change in the effect determination will occur from the proposed road and stormwater redesign.

3.7 State Listed Species

The list of known occurrences of rare plants and plant communities within Clark County was consulted through the Washington Natural Heritage Program (WNHP). The reevaluation document prepared by BergerABAM determined that while 29 rare plant species are documented in Clark County, no occurrences of these species had been documented on the interchange improvements project site (BergerABAM 2015a). The proposed stormwater redesign is located in the same physical footprint and, as such, the area associated with the proposed stormwater redesign does not support rare plant communities identified by the WNHP. The proposed road realignment is located in area of previous development for the existing gas station and this area does not support rare plant communities identified by the WNHP.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Potential Effects to Habitat

The approved interchange improvements project could affect approximately 74.56 acres of habitat within the interchange improvements project site. Most of the habitat impacts (86 percent) would occur to 64.12 acres of ruderal/developed and pasture habitats. The road realignment and stormwater redesign will not result in new impacts or impacts that are different from those analyzed for habitat types in the previous NEPA reevaluation.

4.2 Potential Effects to Waters of the United States

The approved interchange improvements project identified impacts to approximately 0.34 acre of waters of the U.S.; this acreage included several roadside ditches. However, through avoidance and minimization measures, project impacts were reduced to 0.084 acre of wetlands and 0.039 acre of stream and were authorized under a nationwide permit (NWP-2005-0017) for the interchange and casino project (USACE 2015). The project also includes less than 0.03 acre of temporary wetland impact from the temporary highway access ramp realignment. These impacts are temporary in nature and will be restored to original contours and conditions upon completion of the project.

No additional direct impacts to waters of the U.S. are anticipated from the road realignment and stormwater redesign and will comply with all the terms and conditions of the Section 404 permit from the USACE.

The interchange improvements project identifies permanent impacts of approximately 0.09 acre to buffers of waters of the U.S. (i.e., wetland buffers) from the road realignment and stormwater redesign. The project also identifies 0.3 acre of temporary wetland buffer impacts from the temporary highway access ramp realignment. These impacts to wetland buffers could have a negative effect to waters of the U.S. by reducing the effectiveness of the wetland buffer in protecting wetland functions and minor water quality impacts. However, the proposed buffer impacts have been minimized to the greatest extent practicable where the buffer will still protect wetland functions. In addition, permanent wetland buffer impacts will be mitigated in accordance with the City's critical areas ordinance through approved mitigation measures and temporary wetland buffer impacts will be restored to original contours and conditions, seeded with a native grass seed mixture, and landscaped in accordance with plans approved by WSDOT. Therefore, potential effects to waters of the U.S. from the loss of wetland buffer protection will be negligible.

The stormwater resulting from the stormwater redesign will ultimately reach the waters of the U.S. indirectly through overland flow. Common pollutants from roadway activity and infrastructure consist of suspended solids, polycyclic aromatic hydrocarbons (whether leaked directly or through emissions air deposited), heavy metals (such as zinc, copper, and iron), and lubricants (grease and oils). The new roadwork contributes large amounts of impervious surface that increase the amount of stormwater runoff to receiving waterbodies. This can increase stream volume, stream velocity, and peak discharge, altering the natural environment. This runoff can transport the above pollutants to receiving waterbodies. This could negatively affect water quality in those waterbodies. However, proposed new impervious surface areas will be treated and have flow control to meet preexisting conditions in accordance with state requirements. In addition, the application of the minimization measures laid out in the NEPA reevaluation will ensure that the impacts to waters of the U.S. remain minor.

4.3 Potential Effects to Wildlife

As discussed above, the NEPA reevaluation concluded that the interchange improvements project would not result in impacts to wildlife, federally listed and species of concern, or state-listed species. The proposed road realignment and stormwater redesign is consistent with the interchange improvements project and does not increase the amount of impacts from the project. The terrestrial portions of the site are relatively disturbed habitats, and do not represent high quality habitat or habitat used by federally listed, species of concern, or state-listed species. An increase in infrastructure from the stormwater redesign would not result in a substantial effect on local wildlife populations, which is consistent with the conclusions discussed in the FEIS.

The stormwater redesign could affect fisheries resources, including critical habitat for ESA-listed salmon and/or bull trout, through the discharge of treated stormwater associated with the project similar to the interchange improvements project evaluation. However, it is likely that the redesign will result in lesser effects to fisheries resources because of the use of the updated 2014 Ecology manual within the City rather than the 1992 manual.

Treated stormwater from the project would be discharged to a non-fish-bearing portion of the unnamed tributary to the East Fork Lewis River on the west side of the action area, and into another non-fish-bearing unnamed tributary to McCormick Creek at the eastern end of the project area. Based on the results of a stormwater pollutant loading and dilution analysis conducted as part of the biological assessment addendum, stormwater treatment proposed for new impervious areas has been designed to meet Ecology standards, and any elevated levels of pollutants or suspended solids would be below levels where adverse effects to any primary constituent elements of critical habitat in McCormick Creek or the East Fork Lewis River would be adversely affected. It is anticipated that the effects determinations for listed species concurred with by USFWS and NMFS in their letters of concurrence would be unchanged by the stormwater redesign.

4.4 Unavoidable Adverse Effects

The road realignment will include street lighting consistent with that of the interchange improvements project, which has the potential to contribute to the impact to migratory bird species. Any type of artificial light can cause spatial disorientation in birds. While no buildings with windows are associated with the road realignment, the potential for impacts to migratory birds still exists as passing vehicles could collide with birds. The project will install downcast lighting to minimize the attraction to birds. A careful project design and the incorporation of the mitigation measures previously detailed in the interchange improvements evaluation will reduce the significance of this unavoidable impact.

5.0 SUMMARY

The Tribe is proposing a road realignment and stormwater redesign to address Ecology and WSDOT stormwater requirements. The proposed stormwater redesign will not result in new impacts or impacts that are different from those analyzed for biological resources in the NEPA reevaluation. The proposed road realignment and stormwater redesign will not result in any additional impacts to, or loss of, habitats, waters of the U.S., wildlife, or federally listed species.

Therefore, no additional minimization or mitigation measures beyond those described in the NEPA reevaluation for the interchange improvements project are proposed. As a result, there is no substantive change to the potential impacts to biological resources discussed as part of the previous NEPA documentation.

6.0 REFERENCES

BergerABAM. 2015a. "Biological Resources Technical Memorandum," 17 March 2015, 27 pp.

BergerABAM. 2015b. "I-5/NW La Center Road Intersection Improvements Project – Wetland Delineation and Assessment," Vancouver, WA, February 2015, 13 pp.

BergerABAM. 2015c. "I-5/NW La Center Road Interchange Improvements Project – Biological Assessment," Vancouver, WA, February 2015, 62 pp.

Bureau of Indian Affairs (BIA). 2008. "Final Environmental Impact Statement: Cowlitz Indian Tribe Trust Acquisition and Casino Project," Portland, OR, May 2008.

National Marine Fisheries Service (NMFS). 2015. Letter of concurrence dated 2 June 2015.

U.S. Army Corps of Engineers (USACE). 2015. NWS-2005-0017 – Cowlitz Indian Tribe (Casino Project) Nationwide Permit. 29 September 2015.

U.S. Fish and Wildlife Service (USFWS). 2015. Letter of concurrence dated 8 July 2015.

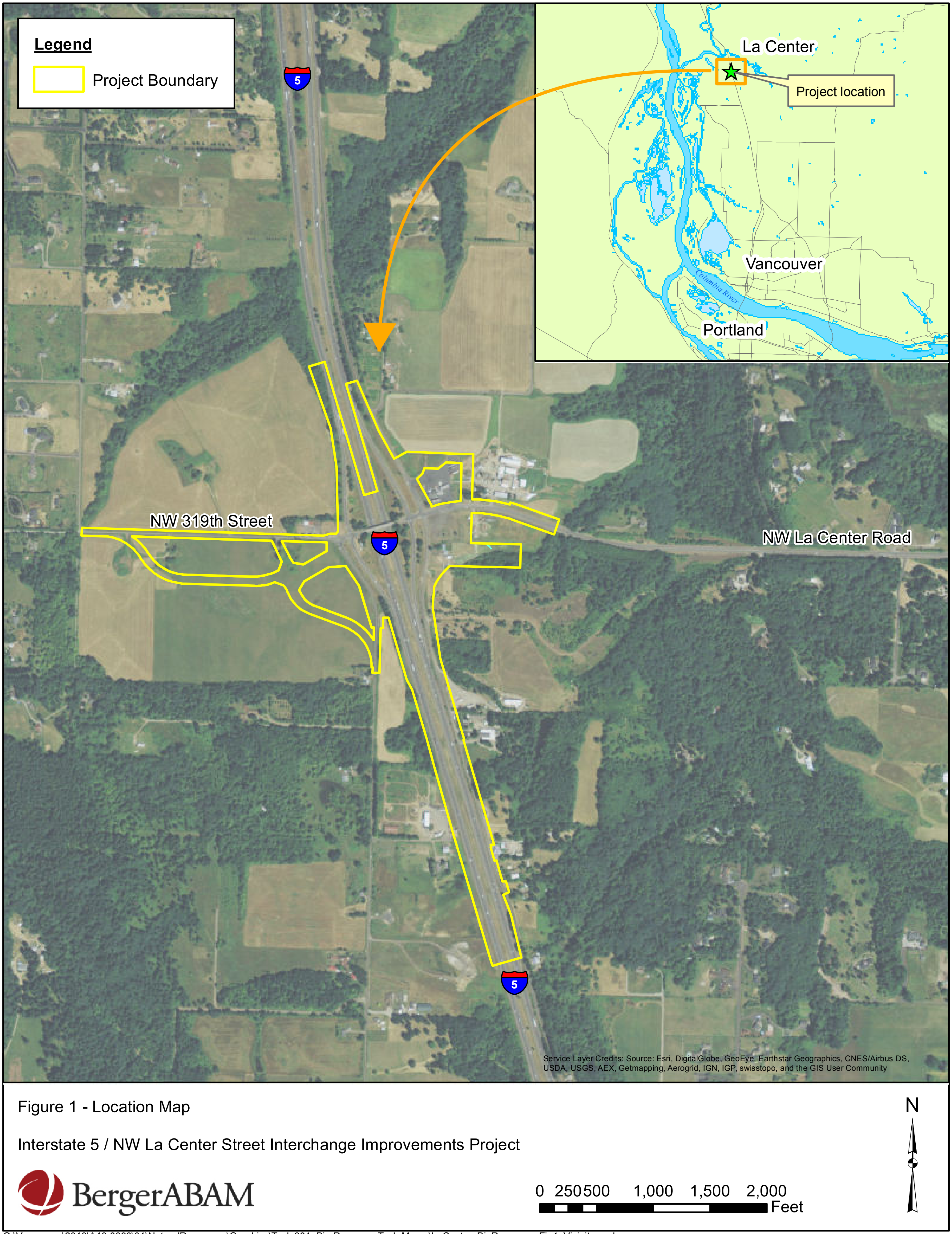


Figure 1 - Location Map

Interstate 5 / NW La Center Street Interchange Improvements Project

BergerABAM

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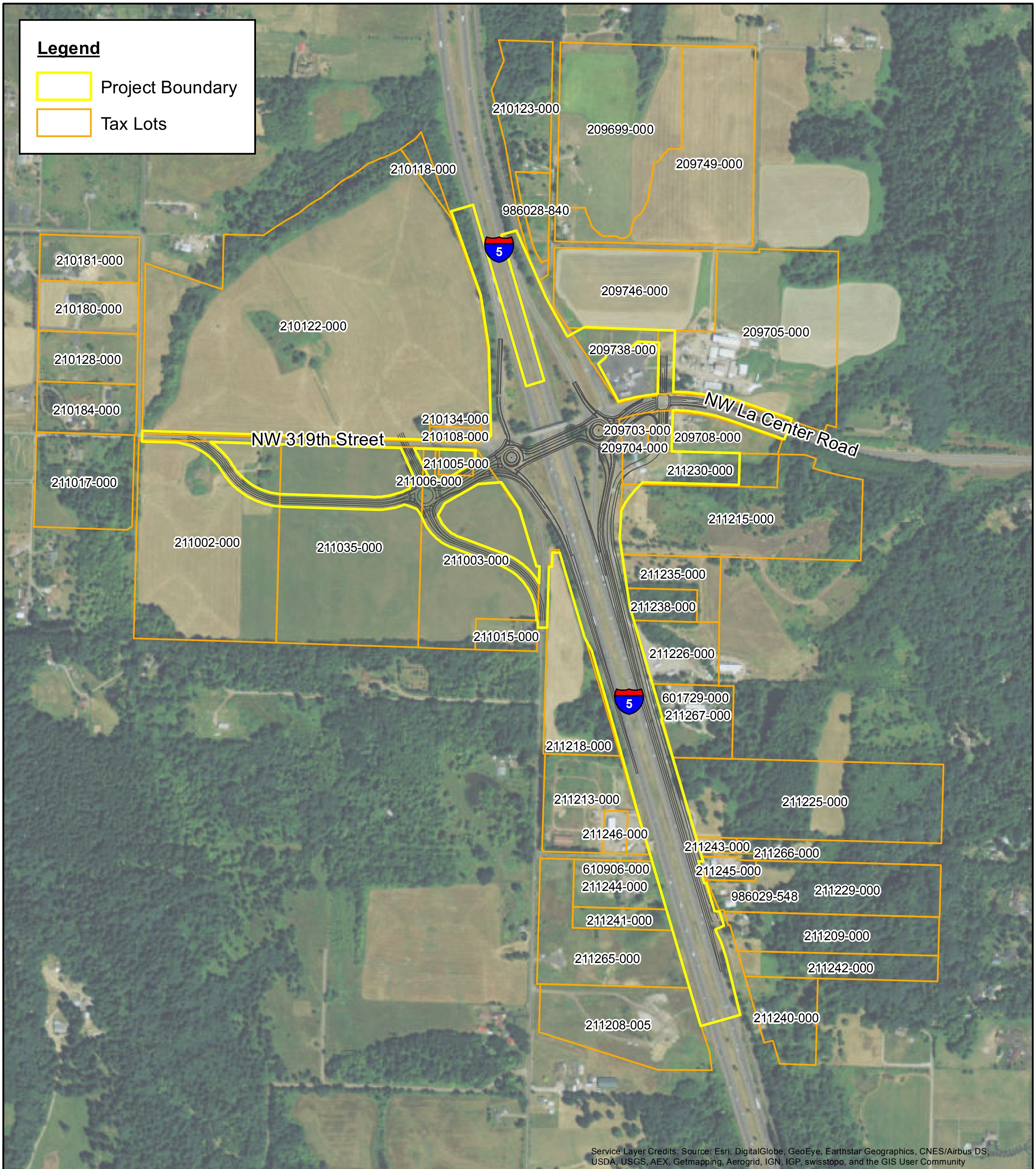

Figure 2 - Tax Lot Map

Interstate 5 / NW La Center Street Interchange Improvements Project

BergerABAM

0 250 500 1,000 1,500 2,000 Feet

N

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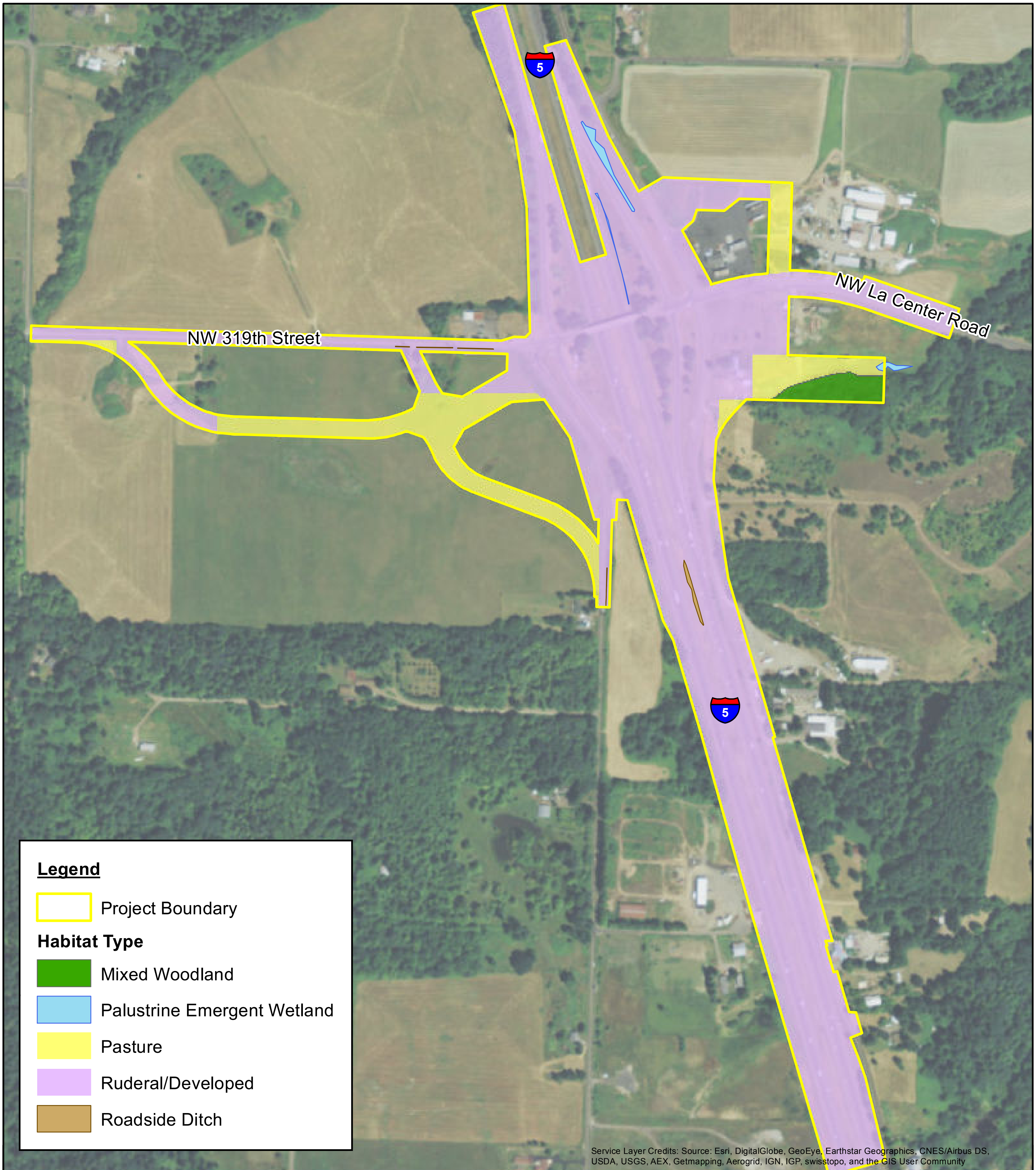

Figure 3 - Habitat Types Map

Interstate 5 / NW La Center Street Interchange Improvements Project

BergerABAM

0 250 500 1,000 1,500 2,000 Feet

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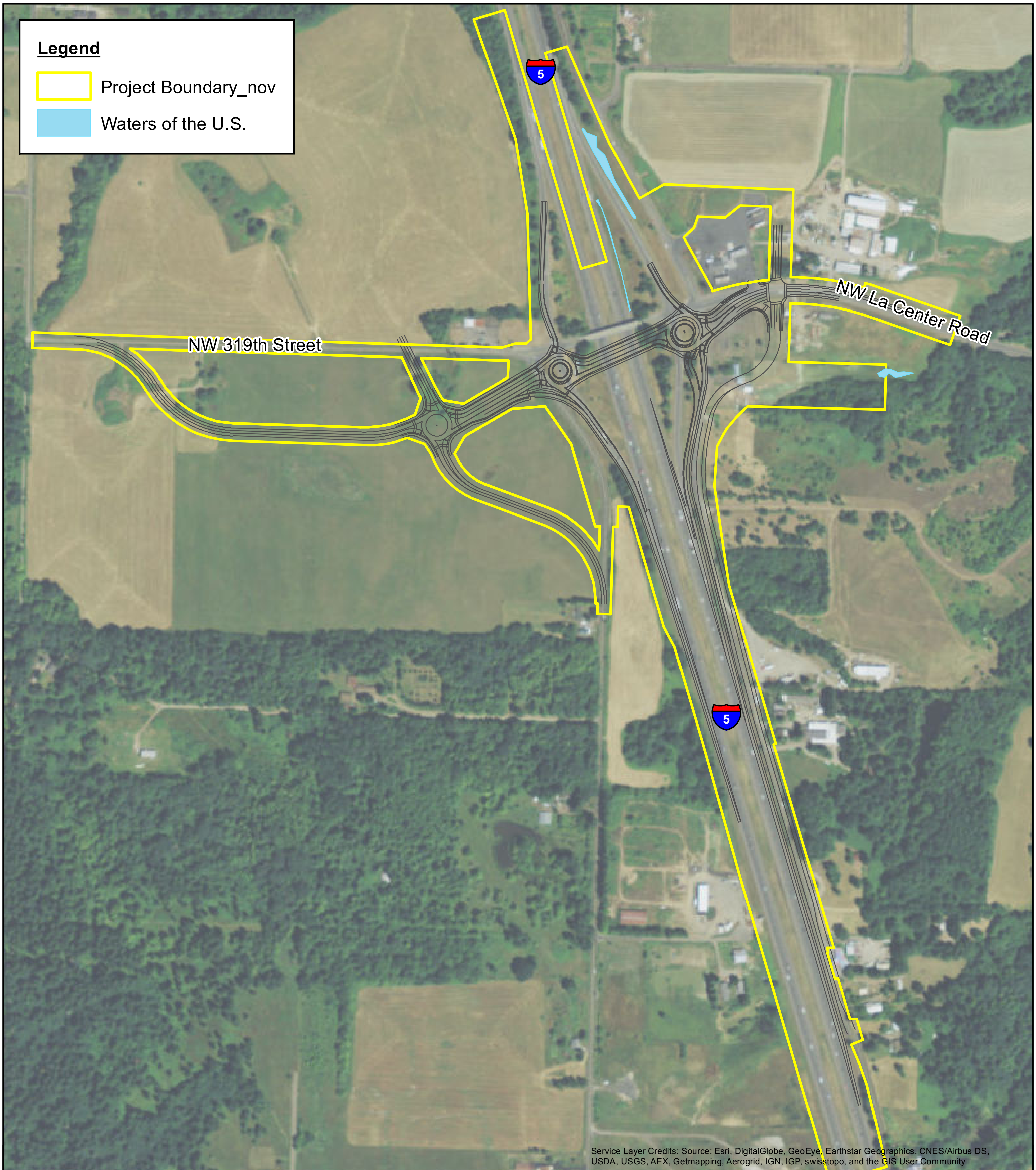
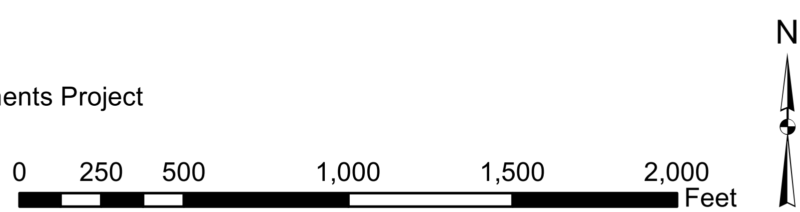


Figure 4 - Waters of the U.S. Map

Interstate 5 /NW La Center Street Interchange Improvements Project

BergerABAM



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APPENDIX D

BIOLOGICAL ASSESSMENT ADDENDUM

BergerABAM
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Technical Memorandum

Date: 13 January 2016

Subject: Biological Assessment Addendum – Stormwater Redesign, Paradise Park Road Realignment, and Temporary Highway Access Ramps
NW La Center Road/Interstate-5 Interchange Improvement Project (MP 16.80)

From: Dustin Day, BergerABAM

To: Mark Butorac, Kittelson & Associates
Ryan Lee Sawyer, Analytical Environmental Services
Ali Middlekauff, Analytical Environmental Services

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1.0 INTRODUCTION

This biological assessment addendum addresses the potential impacts of the stormwater redesign, temporary highway access ramps, and Paradise Park Road realignment to Endangered Species Act (ESA) listed species, species proposed for listing, designated and proposed critical habitats, and essential fish habitat (EFH), as defined under the Magnuson-Stevens Fishery Conservation and Management Act.

2.0 CONSULTATION HISTORY

A biological assessment prepared by BergerABAM addressed the potential impacts of the interchange improvements project, including a complete stormwater analysis, on ESA-listed species and designated and proposed critical habitats (BergerABAM 2015). As part of the NEPA reevaluation processes for the interchange, in accordance with Section 7 of the ESA, this biological assessment was submitted for U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) consultation on the effects of the interchange project.

Letters of concurrence were issued by USFWS on 8 July 2015 (01EWFW00-2015-I-0545 XRef 13410-2007-I-0310) and by NMFS on 2 June 2015 (WCR-2015-2571). The letters concurred that the interchange improvements project "may affect, not likely to adversely affect" ESA-listed bull trout, Pacific salmon species, and Pacific eulachon, and would not adversely affect essential fish habitat. The USFWS also determined that the project would have "no effect" on several additional species and critical habitat known to occur in Clark County. The USFWS determinations were based on the findings that (1) the project does not include any in-water work; (2) best management practices will be implemented to minimize sediment and turbidity during construction; (3) stormwater treatment will be provided for all new pollution-generating impervious surface (PGIS), as well as 2.04 acres of existing PGIS; (4) elevated pollutant concentrations from stormwater runoff will be diluted to below biological thresholds before reaching waterbodies potentially containing bull trout; and (5) federal, state, and local regulations requiring stormwater treatment and mitigation for environmental impacts will minimize impacts to water quality, hydrology, and streams resulting from land use changes in the action area (USFWS 2015).

NMFS concurred with the "may affect, not likely to adversely affect" determinations for ESA-listed salmonids because (1) enhanced stormwater treatment to biological thresholds will be provided for all new PGIS, as well as 2.04 acres of existing PGIS; and (2) the proposed stormwater treatment system was expected to treat stormwater runoff to the extent that metal and suspended solids in treated stormwater would be expected to dilute to background levels prior to reaching ESA-listed fish-bearing waters (NMFS 2015).

3.0 CHANGES TO PROJECT DESCRIPTION

Since the last consultation that concluded in July 2015, several minor adjustments have been proposed to the La Center Interchange Improvements project. These include the inclusion of temporary highway access ramps, and modifications to the alignment of Paradise Park Road and the proposed stormwater facilities based primarily on additional input from the Washington State Department of Transportation (WSDOT), Washington Department of Ecology (Ecology), and the City of La Center (City). Detailed descriptions of the proposed changes are provided below.

3.1 Temporary Highway Access Ramps

The interchange improvements project will require the installation of temporary northbound off- and southbound on-ramps for traffic control and staging during the construction of the new interchange. Both temporary ramps will occur within the City and WSDOT right of way. The proposed temporary highway access ramps will temporarily impact approximately 0.03 acre of palustrine emergent wetland located adjacent to I-5, as well as, approximately 0.3 acre of wetland buffer. Upon completion, the temporary ramps will be removed and all applicable best management practices for erosion and sediment control will be employed. The disturbed areas will be landscaped in accordance with landscape plans approved by WSDOT. Finally, treatment of runoff from the temporary access ramps during construction is under the jurisdiction of the

Construction Stormwater General Permit authorized by Washington Department of Ecology, and all requirements of the permit will be met for the temporary facilities.

3.2 NW Paradise Park Road Realignment

Paradise Park Road was previously designed to extend north from NW La Center Road to NW 324th Street. The current proposed alignment of NW Paradise Park Road extends north from its intersection with NW La Center Road for approximately 400 feet, then turns west and extends approximately 600 feet to reconnect with the existing alignment of NW Paradise Park Road. With the new alignment of NW Paradise Park Road, improvements along NW 324th Street would no longer be necessary and are eliminated from the La Center Interchange Improvements design. Thus, no improvements would take place within Clark County jurisdiction. Figure 1 shows the La Center Interchange improvements, including the proposed realignment of NW Paradise Park Road.

3.3 Changes in Stormwater Design

Refinements from the design previously considered in the April 2015 Biological Assessment include: elimination of compost-amended vegetation filter strips (CAVFS) in WSDOT right-of-way, addition of two newly proposed stormwater detention ponds to accommodate runoff from WSDOT right-of-way, stormwater treatment to meet the enhanced treatment standard of Ecology's *Stormwater Management Manual for Western Washington* (SMMWW), and expansion of the previously proposed City of La Center detention pond to meet SMMWW requirements. All proposed changes are located within the action area analyzed within the April 2015 Biological Assessment. Figure 2 depicts the proposed stormwater facilities under WSDOT and City jurisdiction. Stormwater design refinements are described in detail below by jurisdiction.

3.3.1 WSDOT Stormwater Facilities

As described and analyzed in the April 2015 Biological Assessment, proposed WSDOT stormwater facilities would be constructed in accordance with the 2010 Hydraulics Manual and the 2014 Highway Runoff Manual (HRM). In addition, the following guiding documents were used to develop the design standards for the currently proposed stormwater collection and treatment facilities within WSDOT jurisdiction: WSDOT's Design Manual, Roadside Manual, 2008 Environmental Manual, Standard Plans and Specifications, and 2013 Maintenance Manual, and Ecology's 2005 SMMWW.

Within the April 2015 Biological Assessment, enhanced stormwater treatment and flow control requirements for improvements within WSDOT jurisdiction were assumed to be met through the use of CAVFS. Under the current proposed stormwater design, CAVFS would be eliminated and enhanced treatment of stormwater runoff would instead be provided by media filter drains (MFDs) located along the roadway shoulder in areas that meet the slope and size requirements described in the HRM. Additionally, two new detention ponds are proposed to meet flow control requirements for stormwater generated by improvements within WSDOT jurisdiction. The western pond would be located on the west side of the southbound on-ramp and the eastern pond would be located on the west side of the northbound off-ramp (CH2M Hill 2015). The western pond has been sized to detain runoff from 0.9 acre of roadway impervious area and the eastern pond has been sized to detain runoff from 1.8 acres of roadway impervious area. Both ponds are designed to allow runoff from grass to pass through undetained such that they meet the "50 percent rule." The 50 percent rule states that the undetained area may pass through the detention facility, so long as 100-year flow from the pass-through area does not exceed 50 percent of the 100-year undetained flow from the area requiring flow control. The outlet flow from the western pond would be metered by a primary control structure containing an orifice and riser designed to match the required predeveloped storm durations. The outlet flow from the eastern pond would be metered by a primary control structure containing lower and upper orifices and a riser designed to match the required predeveloped storm durations. Emergency overflow structures (birdcages) would be placed and sized to accommodate the 100-year undetained storm event for both ponds. After being stored within the ponds, water would be conveyed to surface waters, as described within the April 2015 Biological Assessment. Implementation of these stormwater best management practices (BMPs) would, at a minimum, reduce peak flow rates to pre-project conditions and treat a total impervious area greater than that being installed (CH2M Hill 2015).

3.3.2 Clark County Stormwater Facilities

With the proposed realignment of NW Paradise Park Road, no roadway improvements are proposed within the jurisdiction of Clark County. Previously proposed stormwater treatment facilities within Clark County have been removed from the stormwater design.

3.3.3 City of La Center Stormwater Facilities

The City stormwater collection and treatment facilities analyzed within the April 2015 Biological Assessment were designed and sized in accordance with the La Center Municipal Code Chapter 18.320 and the 1992 *Stormwater Management Manual for the Puget Sound Basin* (Puget Sound Manual), and included biofiltration swales for stormwater treatment and a 120-foot-long by 65-foot-wide detention pond for flow control. Since preparation of the April 2015 Biological Assessment, the City's stormwater facilities have been refined to address Ecology's SMMWW. Design refinements, including expansion, are proposed to the City's detention pond. The refined pond would contain a combination facility consisting of a constructed wetland and detention facility that would meet both enhanced treatment and flow control requirements. The pond would be divided into two cells separated by a berm. The first cell would consist of a sedimentation forebay that would be 4 feet deep and occupy approximately 3,663 square feet of the wetted area, while the remainder of the pond would be of varying depths from 1 to 2.5 feet. The Western Washington Hydrology Model was used to determine the minimum pond base area necessary to satisfy the SMMWW flow control requirements. The City's detention pond was designed with a total base area of approximately 9,793 square feet, including the berm that separates the forebay and the second wetland. The outlet structure was designed based on the minimum base area, so the pond is expected to exceed the detention standard (Olson Engineering 2015). The expanded pond was sized to accommodate runoff from the proposed alignment of NW Paradise Park Road. An existing stormwater facility is partially located within the proposed right-of-way for the realigned NW Paradise Park Road, which serves the Minit Mart gas station on the corner of the existing NW La Center Road/NW Paradise Park Road intersection. This stormwater facility would be reconstructed outside of the proposed right-of-way in accordance with City of La Center standards.

4.0 STORMWATER ANALYSIS

As described above, project improvements within City right-of-way will now be designed to meet Ecology's SMMWW requirements.

4.1 Existing Drainage Basins

This section documents the existing drainage basins within the project limits. There are three applicable existing basins within the project limits based on pre-project conditions. These three basins are applicable to the proposed project and are discussed as threshold discharge areas (TDAs) below. The basin delineation was based on the following sources of data:

- WSDOT roadway as-built
- Survey base maps showing existing 1-foot topographic contours, highway lanes and shoulders, stormwater conveyance features, streams, and roadway stationing along the existing median
- Site visit field observations
- U.S. Geological Survey 7.5 minute topographic maps
- GIS delineation/mapping of watershed basins

Existing roadway cross sections also aided in determining the direction of sheet flow runoff resulting from crowned and superelevated road surfaces. The existing road surface profiles were used to note high and low elevations along the longitudinal axis of the roadway. Information from the roadway cross sections and roadway profiles was used in combination with the resources listed above to provide a continuous layout of stormwater drainage paths within the project corridor.

The basins for the project include Basin 1, the area draining to the unnamed tributary to the East Fork Lewis River (unnamed tributary); Basin 2, the small area (less than 10,000 square feet) draining to an unnamed tributary to McCormick Creek; and Basin 3, the large area south of the existing interchange that drains to a separate unnamed tributary to McCormick Creek. The description of each basin is broken down according to these drainage basin designations. It is assumed that none of the runoff in the three basins within project limits is currently water quality treated or controlled for peak flow rate reduction in engineered facilities. Figure 2 shows the basin boundaries within the project limits and the receiving waterways to which they flow.

4.1.1 Basin 1 – Unnamed Tributary to East Fork Lewis River

In TDA 1, stormwater sheet flows off the ramps and collects in ditches or overland flows directly to Interstate 5 (I-5) mainline shoulder ditches. The ramp ditch flow is conveyed by drainage pipes to I-5 mainline shoulder ditches. Stormwater is conveyed north outside of project limits by ditch and drainage pipes along the outside shoulders of I-5 to discharge into the unnamed tributary to East Fork Lewis River, approximately 1,400-feet north of project limits.

4.1.2 Basin 2 – Unnamed Tributary to McCormick Creek

In TDA 2, stormwater from the east side of the interchange and NW La Center Road flows east along a roadway ditch to an unnamed tributary to McCormick Creek. For the rest of TDA 2, stormwater will be captured using curb inlets and catch basins, then routed via storm sewer to the proposed stormwater treatment facility; this facility consists of a combined constructed wetland and detention facility. After flow control, this runoff is distributed across the existing landscape using a pair of level spreaders. Runoff then flows to the tributary through an existing wetland buffer, wetland, and natural drainage swale.

4.1.3 Basin 3 – Unnamed Tributary to McCormick Creek

In TDA 3, stormwater on the west side of I-5 sheet flows off the ramp and I-5 mainline to ditches on the outside shoulder of I-5. The ditches convey the runoff to local low points within TDA 3 before conveying it to the east, outside of project limits to discharge to a separate unnamed tributary to McCormick Creek, approximately 2,500 feet east of I-5 right-of-way. Stormwater on the east side of I-5 sheet flows off the ramp and I-5 mainline to the outside shoulder of I-5 and is conveyed by ditch and drainage pipe to discharge into the unnamed tributary of McCormick Creek. Where the frontage road is in close proximity to the ramp extension and I-5 mainline, runoff is conveyed by overland flow to the east of the frontage road and outside of project limits, where it is conveyed by existing ditches and drainage to McCormick Creek.

4.2 Existing Pollution Generating Impervious Surface and Treatment Methods

There is a total of 15.85 acres of existing PGIS within the project area. Existing hydraulic features within WSDOT project limits consist primarily of roadside shoulder ditches. At low sag points along the roadway, culverts convey stormwater runoff from these ditches under the interstate roadway to downstream drainage channels leading to the receiving waters. Currently, there are no engineered facilities within WSDOT project limits that provide for flow control or water quality treatment. Additionally, there is no formal stormwater treatment currently provided for any PGIS within the City. Untreated stormwater enters action area waterbodies through an existing system of culverts and roadside ditches from pavement runoff and overland flow.

4.3 New Impervious Surface and Proposed Treatment

The proposed project will result in the creation of approximately 6.86 acres of PGIS. All new PGIS within the WSDOT right-of-way will receive treatment and flow control that will meet the requirements of the HRM. All new PGIS created in the City from the frontage road improvements will receive treatment and flow control that meet the requirements of the SMMWW. Stormwater treatment for all newly created impervious surfaces will be provided through Enhanced treatment. Table 1 below shows a summary of the existing impervious surface and Table 2 shows the proposed treatment within each TDA. The ESA stormwater design checklist provides more information on existing and proposed impervious surfaces and is found in Appendix A. Figure 2 shows the TDA boundaries and general stormwater design.

Table 1 – Existing Impervious Surfaces

TDA Baseline Conditions				
	Subbasin Area (acres)			TDA Impervious Area (acres)
Treatment Type	1	2	3	
Basic	0.07	0.00	0.00	0.07
Enhanced	0.00	0.00	0.00	0.00
Infiltration BMP	0.00	0.00	0.00	0.00
None	7.51	1.2	7.07	15.78
Total	*7.58*	*1.2*	*7.07*	*15.85*

Table 2 – Proposed Impervious Surfaces

TDA Baseline Conditions				
	Subbasin Area (acres)			Total Impervious Area (acres)
Treatment Type	**1**	**2**	**3**	
Basic	0.00	0.00	0.00	0.00
Enhanced	0.7	5.95	1.6	8.25
Infiltration BMP	0.00	0.00	0.00	0.00
None	7.5	0.21	6.75	14.46
Total	*8.2*	*6.16*	*8.35*	*22.71*

4.4 Stormwater Treatment

The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff by using physical, biological, and chemical removal mechanisms so that the beneficial uses of the receiving waters are maintained and, where applicable, restored.

The volume-based runoff treatment requirement is that treatment needed is the storage volume that is necessary to achieve treatment of 91 percent of the influent runoff file as predicted using a continuous runoff model and a design infiltration/filtration rate.

The purpose of flow control is to control the peak design release rate and volume to prevent increases in the stream channel beyond those characteristic of natural or reestablished conditions. The intent is to prevent cumulative future impacts from increased stormwater runoff volumes and flow rates on streams.

The flow control criteria for detention and combination detention/treatment facilities for Western Washington state that the storage volume must be provided for stormwater discharge to match the duration of predeveloped flows from 50 percent of the 2-year peak storm flow up to the full 50-year peak storm flow. The predeveloped condition to be matched is defined as forested land cover. The 100-year peak flow must also be checked for potential property damage.

The sections below describe the stormwater treatment based on the location and stormwater manual used. All new PGIS within the WSDOT right-of-way will receive treatment and flow control that meet the requirements of the HRM. Based on the type of traffic for this project, the WSDOT right-of-way area requires Enhanced treatment. All new PGIS created by the frontage road improvements in the City will receive treatment and flow control that meet the requirements of the SMMWW. Stormwater treatment for all newly created impervious surfaces in the City will be provided through Enhanced treatment. In total, the project will have a net increase of 6.86 acres of PGIS and will provide treatment for 8.25 acres of PGIS, resulting in a net increase in the treatment of stormwater generated from impervious surfaces.

4.4.1 WSDOT Right-of-Way

This portion of the design was prepared using the HRM. The combined BMP method known as Type 3 MFDs will be constructed within WSDOT right-of-way wherever practicable to meet water quality treatment requirements. MFDs are a vegetative approach to stormwater management that provide enhanced treatment with some limited infiltration.

MFDs are designed to maintain sheet flow, which slows runoff and traps sediment and pollutants coming directly off the pavement. Soil compost amendments are added to the roadside embankment. These amendments improve infiltration characteristics, increase surface roughness, and improve plant sustainability. Once vegetation is established, some advantages are higher surface roughness, greater retention and infiltration capacity, and improved removal of soluble cationic contaminants.

This project is required to meet the following criteria as defined by the HRM:

- Basic Treatment: 80 percent removal of total suspended solids
- Enhanced Treatment: Provide a higher rate of removal of dissolved metals than Basic Treatment facilities for influent concentrations ranging from 0.003 to 0.02 mg/L for dissolved copper and 0.02-0.3 mg/L for dissolved zinc.

MFDs are an approved method to meet the requirements of both Basic and Enhanced Treatment, as enhanced treatment will be employed within WSDOT right-of-way.

4.4.2 City Portion

The area of the project within the City includes La Center Road from the east boundary of the trust lands to the end of the new tapers on the east side of the overpass. It also includes all of the relocated NW Paradise Park Road north and south of NW La Center Road.

To meet the water quality treatment requirements, a constructed wetland will be used for most impervious areas; MFDs will be used for the easternmost portion of La Center Road. These are approved water quality BMPs. The constructed wetland was sized in accordance with the SMMWW design methodology, which is based on the water quality design storm as specified in that manual.

Water quantity treatment includes the use of a stormwater detention pond. The pond is located east of the realigned Paradise Park Road, south of NW La Center Road. A storm conveyance pipe will extend east to two level spreaders that will discharge treated and detained water to a wetland buffer that is composed of grass and herbaceous species.

4.5 HI-RUN Analysis

Using the numbers in tables 1 and 2 above and the information found in the ESA stormwater checklist (Appendix A), an analysis using the Highway Runoff Dilution and Loading (HI-RUN) model was conducted. The P(exceed) value for zinc (Zn) loading is used to determine what level of analysis (if any) is needed of water quality effects in the receiving water. Based on the results of the HI-RUN analysis for loading for dissolved zinc (DZn), the resulting P(exceed) values were above the 0.45 upper threshold value and a complete HI-RUN dilution analysis is required. Model outputs for loading are found in Appendix B.

To complete the dilution analysis, background concentrations of dissolved copper and dissolved zinc, and average stream depth, velocity, channel width, and slope were required to run the model. Background concentrations were not available for the unnamed tributary to the East Fork Lewis River or for McCormick Creek. However, background concentrations were found for Burnt Bridge Creek, which is a stream of similar size and surrounding land uses (i.e., agriculture). Stream depth, velocity, width, and slope were found for McCormick Creek and were used for this analysis.

The HI-RUN subbasin dilution analysis was conducted for each TDA subbasin and the results from the analysis were summarized for each TDA to include the greatest distances for each month, therefore, providing a conservative analysis for dilution. Only the results of the dilution analysis for zinc for each TDA were summarized and compiled in Table 3 below because the dilution analysis results for copper were less than that for zinc for all TDAs and subbasins. All of the results are found in Appendix B. The summary output generated by the model for TDA 1 indicates that the distance the biological threshold for zinc would travel downstream of a theoretical outfall at the receiving water were unchanged for pre- and post- conditions for most months. The months of June, July, August, and October saw a decrease in the distance needed for dilution concentrations to meet biological thresholds. Only the month of September had both the existing and proposed conditions indicate that zinc could travel more than 1,000 feet, which indicates a slightly improved condition in the post-project scenario for most months. The distance downstream during any month defines the area within which ESA-listed species could be exposed to pollutant concentrations sufficient to cause adverse sublethal effects.

Table 3 – 1 HI-RUN Dilution Subroutine Analysis Results (Zinc) in Feet*

TDA	Jan	Feb	Mar	April	May	Jun
1	1/1	3/3	1/1	4/4	4/4	130/70
2	1/1	1/1	1/1	1/1	1/1	1/1
3	1/1	2/2	1/1	3/3	3/3	10/11
TDA	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
1	5/4	550/320	1,000/1,000	1,000/970	2/2	3/3
2	1/1	2/1	170/280	2/4	1/1	1/1
3	3/3	44/170	1,000/1,000	720/730	1/1	2/2

*Existing /Proposed conditions

The summary output generated by the model for TDA 2 indicated a slight increase in the distance at which the biological threshold for zinc could be exceeded downstream of a theoretical outfall, but was still less than that of TDA 1.

The summary output generated by the model for TDA 3 indicates that the distance at which the biological threshold for zinc could be exceeded downstream of a theoretical outfall stayed the same for most months. However, for the months of June, August, September, and October, there was a slight increase in the exceedance distance. The analysis of stormwater pollutant loading and dilution indicates that the worst-case scenario of pollutant load and dilution concentrations in these tributaries would be expected to dilute to background concentrations in approximately 1,000 feet from the point of discharge in all TDAs.

Section 9.0 below provides a qualitative analysis of site-specific conditions that help further reduce the concentrations of stormwater pollutants reaching receiving waterbodies. Specific conditions that have been shown to help reduce pollutant concentrations in receiving waterbodies include soil infiltration, distance from the outfall to the receiving waterbody, and the characteristics of receiving waterbody, which are all discussed in below.

5.0 COMPARISON OF STORMWATER DETAILS

This section provides a comparison of stormwater details between the previous stormwater design and the current design. The design change includes stormwater treatment and detention in accordance with the updated Ecology manual and does not use the 1992 Puget Sound manual for the City portion of the project, nor does it include treatment in the County. Table 4 summarizes the comparison.

Table 4. Comparison of Previous and Current Stormwater Design

Design Element	Previous Stormwater Design		Current Stormwater Design		
	TDA 1	TDA 2	TDA 1	TDA 2	TDA 3
Existing PGIS	3.49 Acres	3.27 Acres	7.58 Acres	1.2 Acres	7.07 Acres
Proposed PGIS	11.22 Acres	7.2 Acres	8.2 Acres	6.16 Acres	8.35 Acres
Total Proposed PGIS	18.42 Acres		22.71 Acres		
Net Increase in PGIS	11.66 Acres		6.86 Acres		
Stormwater Treatment Retrofit	2.04 Acres		1.39 Acres		
Dilution Distance from Outfall	350 Feet	210 Feet	1,000 Feet	270 Feet	1,000 Feet
Distance to Fish Bearing Waters from Outfall	1,800 Feet	1,500 Feet	2,700 Feet	1,587 Feet	2,700 Feet

The proposed stormwater design has a net decrease in the amount of PGIS created and also a net decrease in the amount of stormwater retrofit. Based on the current stormwater design, pollutant load and dilution concentrations would be expected to dilute to background concentrations in approximately 1,000 feet from the point of discharge. This is a maximum increase in 790 feet from the previous design. The increase in distance to dilution is likely due to the change in stormwater design from mostly CAVFS is the WSDOT right-of-way to the use of MFD. This design change eliminates most of the infiltration associated with CAVFS and increases the distance where pollution concentrations are expected to dilute below the effects threshold for listed fish species.

6.0 CHANGES TO THE ACTION AREA

The proposed action will provide treatment for approximately 8.25 acres of new PGIS, which includes all of the new PGIS associated with the project. Treated stormwater would be directed to the East Fork Lewis River (TDA 1) and to two separate unnamed tributaries to McCormick Creek (TDAs 2 and 3). The analysis of stormwater pollutant loading and dilution indicates that the worst-case scenario of pollutant load and dilution concentrations in these tributaries would be expected to dilute to background concentrations in more than 1,000 feet of the point of discharge in all TDAs. For purposes of making a conservative estimate of the effects of the action, the action area for stormwater-related effects has been assumed to include the aquatic portion of all tributaries downstream a distance of 1,000 feet (Figure 3).

7.0 STATUS/PRESENCE OF LISTED SPECIES AND DESIGNATED CRITICAL HABITAT IN THE ACTION AREA

There have been no changes is the status of listed species or designated critical habitat in the action acre since biological assessment was prepared for the project in April 2015.

8.0 ENVIRONMENTAL SETTING

The environmental setting has not changed since the biological assessment was completed in April 2015.

9.0 EFFECTS OF THE ACTION

No changes to effects from interrelated and interdependent actions, indirect effects from changes in land use, or cumulative effects have occurred since the biological assessment was completed in April 2015. The direct effects from the temporary highway access ramps will not result in any changes to the effect determination. The indirect effects from stormwater redesign will also not result in any change to the effects determinations. Evidence to support the effects determinations is presented below.

9.1 Direct Effects

The proposed temporary highway access ramps will temporarily impact approximately 0.03 acre of palustrine emergent wetland located adjacent to I-5, as well as, approximately 0.3 acre of wetland buffer. All temporary impacts will be restored to original contours and conditions upon completion of the project and will be landscaped in accordance with WSDOT approved landscape plans.

The proposed project would not directly remove or impact any suitable habitat for any ESA-listed species, and no ESA-listed species or critical habitat would be affected by direct habitat impacts. Therefore, the temporary habitat impacts resulting from the temporary highway access ramps is discountable.

9.2 Indirect Effects

Stormwater and effluent discharge from the proposed interchange improvements project have the potential to impact listed species in the aquatic action area. Stormwater runoff from roads is known to contain pollutants, such as hydrocarbons and metals, which could reach aquatic systems and decrease water quality. Stormwater can also increase water quantity in aquatic systems by contributing flows that may have naturally infiltrated or dispersed elsewhere prior to construction of impervious surfaces. Increased flows can lead to channel erosion, downcutting, and changes in hydrology.

Stormwater will be collected from all new impervious surfaces within the project area and directed to a system of MFDs and detention ponds for treatment and detention. This system would minimize the effects to adjacent tributaries.

This analysis of stormwater impacts is based on the joint WSDOT/Federal Highway Administration approach outlined in *BA Writers Guidance* (February 2015) (Washington State Department of Transportation 2015). Section 4.0 of this biological assessment addendum provides a detailed analysis of the proposed stormwater treatment.

The exposure/response of listed fish within the project action area is discussed below for each receiving water body/TDA.

Unnamed Tributary to East Fork Lewis River (TDA 1)
Within TDA 1, the HI-RUN model predicts that the proposed action has a greater than 50 percent probability of an increase in loading for dissolved zinc and dissolved copper. A description of this treatment is found below.

The proposed work within TDA 1 is located in WSDOT right-of-way and treatment has been design to meet the HRM. Stormwater treatment will sheet flow to adjacent ditches and MFDs along the roadway shoulder. The requisite amount (0.7 acres) of runoff is detained in a detention pond to match pre-project conditions. The MFD and ditches convey stormwater to an existing vegetated ditch on the west side of I-5, north of NW La Center Road, and travel approximately 1,400 feet to the unnamed tributary to East Fork Lewis River. The surface water body receiving overland flow are non-fish-bearing and effluent must travel approximately 4,275 feet before reaching the 12-foot-high waterfall and 2,700 feet before reaching the portion of the unnamed tributary that is listed as critical habitat (Figure 3). The additional distance traveled will allow significant additional stormwater infiltration, further reducing the overall quantity and concentration of pollutants reaching the ESA-listed waters. During small storm events, stormwater may infiltrate completely.

Access by ESA-listed species to the unnamed tributary to the East Fork Lewis River is limited to the lower 600 feet of stream because of a natural fish barrier. The points of discharge are to grassy fields and roadside ditches that ultimately drain to the unnamed tributary to the East Fork Lewis River. Under summer low flow conditions, the unnamed tributary is mostly dry. For this reason, it was assumed that any late summer runoff will be completely contained in low-lying pools and will be infiltrated or evaporate, and will not flow downstream to the lower portion of the unnamed tributary. The zone of impact for stormwater-related impacts will not reach the portion of the unnamed tributary to the East Fork Lewis River that is fish accessible and will not expose ESA-listed species to increased levels of stormwater pollutants.

Given the significant opportunity for infiltration and treatment, it is anticipated that most, if not all, pollutants will be fully diluted to background levels within 1,000 feet of the discharge points and will not reach any portion of the streams that could contain ESA-listed species. The opportunity for ESA-listed fish species to be exposed to increased pollutant loads associated with treated stormwater from new impervious surface in TDA 1 is discountable.

Unnamed Tributary to McCormick Creek (TDA 2)

The WSDOT portion of TDA 2 is less than 10,000 square feet and is exempt from runoff treatment or flow control, thus no BMPs are proposed. In addition, the HI-RUN model predicts that the proposed action would not result in increased pollutant loads beyond 1 foot from the theoretical discharge, and the receiving waterbody does not contain ESA-listed species. Therefore, the opportunity for ESA-listed fish species to be exposed to increased pollutant loads associated with stormwater from new impervious surface in TDA 2 is discountable.

For the City portion of TDA 2, most of the stormwater will be treated with a biofiltration swale and constructed wetland detention pond. The treatment facility will discharge in an open field to a wetland buffer, south of NW La Center Road, where additional stormwater conveyance will occur via the wetland buffer and wetland, and then continue through a vegetated field to an unnamed tributary to McCormick Creek, a distance of 317 feet. At this point, the water will travel an additional 1,270 feet to the confluence with McCormick Creek. The additional distance traveled will allow significant additional stormwater infiltration and dilution, further reducing the overall quantity and concentration of pollutants reaching McCormick Creek. During small storm events, stormwater may infiltrate completely.

The dilution analysis indicates that pollutants within treated stormwater will be diluted to concentrations below the effects threshold for listed fish species more than 1,000 feet from the discharge location. However, the points of discharge are to grassy fields which drains to the northern non-fish-bearing tributary to McCormick Creek. Under summer low flow conditions, the unnamed tributary is mostly dry. For this reason, it was assumed that any late summer runoff will be completely contained in low-lying pools and will be infiltrated or evaporate, and will not flow downstream to McCormick Creek. The zone of impact for stormwater-related impacts will not reach McCormick Creek and will not expose ESA-listed species to increased levels of stormwater pollutants.

Given the significant opportunity for dilution, infiltration and treatment, it is anticipated that most, if not all, pollutants will be fully diluted to background levels before entering McCormick Creek. The opportunity for ESA-listed fish species to be exposed to increased pollutant loads associated with treated stormwater from new impervious surface in TDA 2 is discountable.

Unnamed Tributary to McCormick Creek (TDA 3)

Within TDA 3, the HI-RUN model predicts that the proposed action has a greater than 50 percent probability of an increase loading for dissolved zinc and dissolved copper. Stormwater will be treated differently based on the jurisdiction in the TDA.

For all areas located in WSDOT right of way in TDA 3, stormwater will sheet flow to adjacent ditches and MFD along the road shoulder. The requisite amount of runoff (1.6 acre) is detained in a detention pond to match pre-project conditions. The surface water body receiving overland flow is non-fish-bearing and must travel a minimum of 2,700 feet before discharging into McCormick Creek (Figure 3). The zone of impact for stormwater-related impacts will not reach McCormick Creek and will not expose ESA-listed species to increased levels of stormwater pollutants for the WSDOT portion of TDA 3.

Access by ESA-listed species is limited to McCormick Creek. The dilution analysis indicates that pollutants within treated stormwater will be diluted to concentrations below the effects threshold for listed fish species more than 1,000 feet from the discharge location. However, the points of discharge are to the southern non-fish-bearing tributary to McCormick Creek. Under summer low flow conditions, the unnamed tributary is mostly dry. For this reason, it was assumed that any late summer runoff will be completely contained in low-lying pools and will be infiltrated or evaporate, and will not flow downstream to McCormick Creek. The zone of impact for stormwater-related impacts will not reach McCormick Creek and will not expose ESA-listed species to increased levels of stormwater pollutants.

Given the significant opportunity for dilution, infiltration and treatment, it is anticipated that most, if not all, pollutants will be fully diluted to background levels before entering McCormick Creek. The opportunity for ESA-listed fish species to be exposed to increased pollutant loads associated with treated stormwater from new impervious surface in TDA 3 is discountable.

Findings

The analysis of stormwater pollutant loading and concentration that would occur as a result of the stormwater redesign indicate that the proposed new PGIS could potentially increase pollutant loads in stormwater. However, the dilution analysis shows that these pollutants will be diluted to background concentrations prior to reaching any fish-bearing waters. For this reason, the potential for any adverse effects to ESA-listed fish species associated with project stormwater generation and treatment redesign, as well as the road redesign, is considered discountable.

10.0 CONCLUSIONS

The proposed temporary highway access ramps, Paradise Park Road realignment, and stormwater redesign have not resulted in a change in the effects determinations made in the April 2015 biological assessment and associated NMFS and USFWS Letters of Concurrence. This is supported by the results of a stormwater pollutant loading and dilution analysis. The stormwater treatment proposed for new impervious areas has been designed to meet Ecology and WSDOT standards, and any elevated levels of pollutants or suspended solids would be below levels where any primary constituent elements of critical habitat in McCormick Creek or the East Fork Lewis River would be adversely affected. The proposed changes to the project design will not affect ESA-listed species or their designated critical habitat, and no impacts to federally listed species are anticipated from the proposed temporary highway access ramps, road realignment, or stormwater redesign.

11.0 REFERENCES

BergerABAM. 2015. "I-5/NW La Center Road Interchange Improvements Project – Biological Assessment," Vancouver, WA, April 2015, 62 pp.

CH2M Hill. 2015. Water Resources Technical Memorandum Update for the NW La Center Road/I-5 Interchange Improvement Project. Dated 6 November 2015.

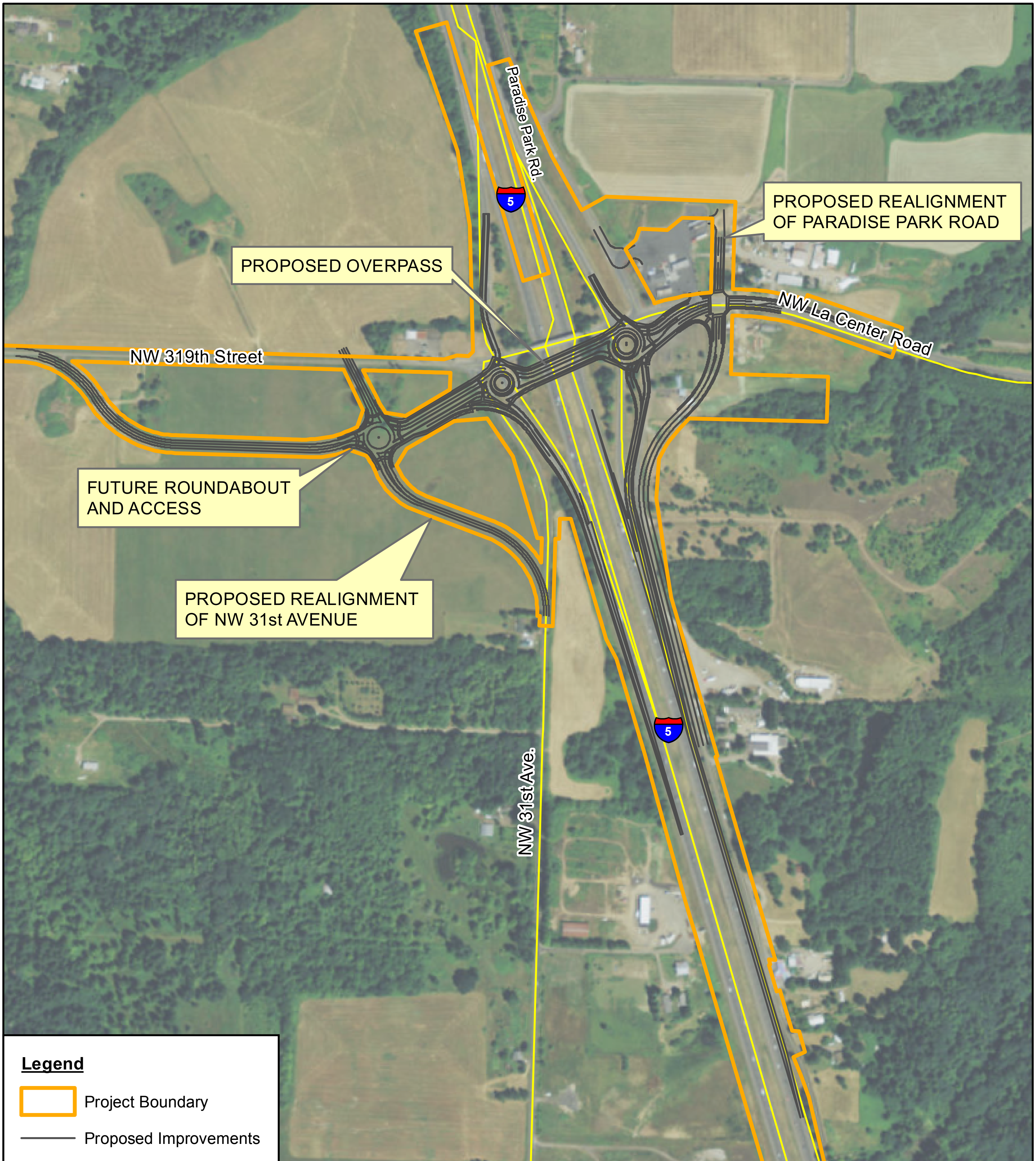
National Marine Fisheries Service (NMFS). 2015. Letter of concurrence dated 2 June 2015. Reference No. WCR-2015-2571.

Olson Engineering, Inc. 2015a. Final Stormwater Plan Technical Information Report for the Paradise Park Road Improvements. Dated 21 October 2015.

Olson Engineering, Inc. 2015b. La Center Interchange Improvement – Revisions to Final Stormwater Report to Accommodate Paradise Park Road Realignment Memo. Dated 2 November 2015.

U.S. Fish and Wildlife Service (USFWS). 2015. Letter of concurrence dated 8 July 2015. Reference No. (01EWFW00-2015-I-0545 XRef 13410-2007-I-0310) and by NMFS on 2 June 2015.

Figures



NW LA CENTER RD/I-5 INTERCHANGE IMPROVEMENT PROJECT

PREPARED FOR: WSDOT-SW REGION
11018 NE 51st CIRCLE
VANCOUVER, WA 98682

PURPOSE: BIOLOGICAL ASSESSMENT ADDENDUM

FIGURE 1 - Proposed Interchange Improvements

0 250 500 1,000 Feet

BergerABAM

PROJECT AREA IN: EAST FORK LEWIS RIVER WATERSHED

LEGAL: SECTIONS 4 & 9, T04N, R01E, W.M.
NEAR: LA CENTER
COUNTY OF: CLARK
STATE OF: WASHINGTON

SHEET 1 OF 3 DECEMBER 2015

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NW LA CENTER RD/I-5 INTERCHANGE IMPROVEMENT PROJECT

PREPARED FOR: WSDOT-SW REGION
11018 NE 51st CIRCLE
VANCOUVER, WA 98682

PURPOSE: BIOLOGICAL ASSESSMENT ADDENDUM

FIGURE 2 - Proposed Stormwater Treatment

0 250 500 1,000 Feet

BergerABAM

PROJECT AREA IN: EAST FORK LEWIS RIVER WATERSHED

LEGAL: SECTIONS 4 & 9, T04N, R01E, W.M.
NEAR: LA CENTER
COUNTY OF: CLARK
STATE OF: WASHINGTON

SHEET 2 OF 3

DECEMBER 2015

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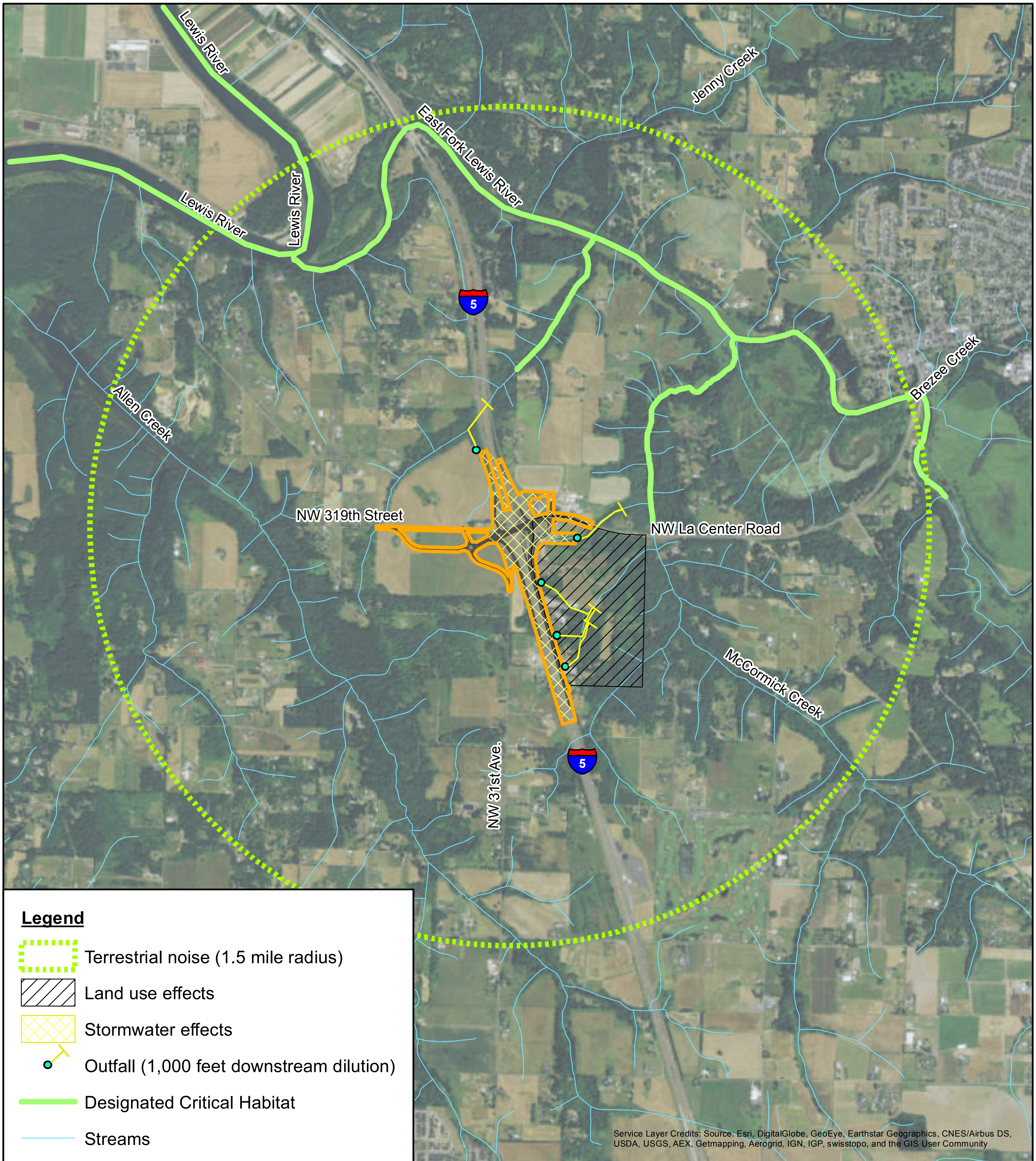

NW LA CENTER RD/I-5 INTERCHANGE IMPROVEMENT PROJECT

PREPARED FOR: WSDOT-SW REGION
11018 NE 51st CIRCLE
VANCOUVER, WA 98682

PURPOSE: BIOLOGICAL ASSESSMENT ADDENDUM

FIGURE 3 - Action Area

0 0.1 0.2 0.4 0.6 0.8 Miles

BergerABAM

PROJECT AREA IN: EAST FORK LEWIS RIVER WATERSHED

LEGAL: SECTIONS 4 & 9, T04N, R01E, W.M.
NEAR: LA CENTER
COUNTY OF: CLARK
STATE OF: WASHINGTON

SHEET 3 OF 3

DECEMBER 2015

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Appendix A
ESA Stormwater Design Checklist

Endangered Species Act

Stormwater Design Checklist

For Western Washington

Table of Contents

Endangered Species Act
Stormwater Design Checklist

Purpose and Use of the Checklist

The Stormwater Design Checklist assists project designers in providing pertinent information about a project's stormwater treatment facilities to biologists responsible for preparing biological assessments required for consultation under Section 7 of the Endangered Species Act. The use of this checklist is necessary to aid in developing biological assessments and promoting consistency in the content provided in the agency's biological assessments.

It is possible that the specific conditions of some projects may warrant modifying or adding certain checklist items. However, to maintain consistency in the type and amount of information collected and submitted for the environmental permitting process, the checklist should be modified only if necessary.

Endangered Species Act
Stormwater Design Checklist

Project Name: NW La Center Road – I-5 Interchange

Project Location: La Center, Clark County WA

Part 1

General Project Information

1. Will work occur outside existing pavement or gravel shoulders? X Yes __ No

   If *yes*, describe the nature and extent of the work:

   The Interchange Improvements Project consists of many adjustments. The project will: realign Paradise Park Road on the east side of I-5; realign NW 31st Avenue and NW 319th Street on its west side; construct a new overpass with an eastbound lane, a westbound lane, and a turn lane; improve I-5 on-ramps and off-ramps; construct three roundabouts; demolish an existing overpass; and make stormwater and utility modifications.

2. Is off-site stormwater being treated/controlled by WSDOT stormwater facilities prior to initiation of the project? __ Yes X No

   If *yes*, will this stormwater continue to be treated/controlled to the same level? ☐ Yes ☐ No

   If off-site stormwater will not continue to be treated/controlled to the same level, explain why not:

   N/A

Existing Stormwater Facilities (Pre-project)

3. How many TDAs exist within in the project area, how many outfalls or discharge point(s) are located in each TDA, and what are the receiving waterbodies?

Existing TDA Number	Number of Discharge Points/Outfalls	Receiving Waterbody
TDA 1	2	Unnamed Tributary of McCormick Creek
TDA 2	2	Unnamed Tributary of McCormick Creek
TDA 3	3	Unnamed Tributary of McCormick Creek

4. For each existing TDA/outfall (subdivide TDAs if there are multiple outfalls), identify total TDA area, area of impervious surface, area of impervious surface receiving runoff treatment, the runoff BMP type(s), area of impervious surface not receiving runoff treatment, area of impervious surface receiving flow control, the flow control BMP type(s), area of impervious surface being infiltrated via an infiltration BMP, and area of impervious surface not receiving flow control. If available, provide a map depicting drainage basin boundaries for TDAs and subbasins for individual outfalls within a TDA (if applicable), and BMP locations. This information can be summarized in the following table for each TDA/outfall. Some of this information can be provided in the table below, and some written description(s) may be necessary:

Existing TDA/ Outfall Number	Total Area (acres)	Total Impervious Surface Area (acres)	Area w/ Runoff Treatment (acres)	Runoff Treatment BMP Type(s)	Area w/ No Runoff Treatment (acres)	Area w/ Flow Control (acres)	Flow Control BMP Type(s)	Area to Infiltration BMP (acres)	Area w/ No Flow Treatment (acres)
TDA 1/1	**14.07**	**4.16**	**0**	**N/A**	**14.07**	**0**	**N/A**	**N/A**	**14.07**
TDA 1/2	**8.45**	**3.35**	**0**	**N/A**	**8.45**	**0**	**N/A**	**N/A**	**8.45**
TDA 1/3	**0.77**	**0.07**	**0.07**	**Swale**	**0.70**	**0.07**	**Pond**	**N/A**	**0.70**
TDA 2/1	**1.60**	**0.76**	**0**	**N/A**	**1.60**	**0**	**N/A**	**N/A**	**1.60**
TDA 2/2	**3.58**	**0.44**	**0**	**N/A**	**3.58**	**0**	**N/A**	**N/A**	**3.58**
TDA 3/1	**4.27**	**1.77**	**0**	**N/A**	**4.27**	**0**	**N/A**	**N/A**	**4.27**
TDA 3/2	**3.97**	**1.93**	**0**	**N/A**	**3.97**	**0**	**N/A**	**N/A**	**3.97**
TDA 3/3	**7.87**	**3.37**	**0**	**N/A**	**7.87**	**0**	**N/A**	**N/A**	**7.87**
Project Totals	**44.58**	**15.85**	**0.07**	**N/A**	**44.51**	**0.07**	**N/A**	**0**	**44.51**

WSDOT has no existing flow control or treatment facilities within right-of-way. There are no stormwater treatment or flow control facilities serving city right-of-way.

5. Describe the nature of the existing stormwater conveyance (drainage) system (e.g., pipe, culvert, channel, ditch, swale, sheet flow), including the drainage distance from project right-of-way to project receiving waterbody. If available, provide a map of the conveyance system depicting TDA/outfall subbasin boundaries.

   In TDA 1, stormwater sheet flows off of the ramps and collects in ditches or overland flows directly to I-5 mainline shoulder ditches. The ramp ditch flow is conveyed by drainage pipes to I-5 mainline shoulder ditches. It is conveyed north outside of project limits by ditch and drainage pipes along the outside shoulders of I-5 to discharge into the unnamed stream, approximately 1400’ north of project limits.

   In TDA 2, stormwater from the east side of the interchange and LaCenter Road flows east along a roadway ditch to a tributary of McCormick Creek. Stormwater from most of TDA 2 south of La Center Road flows through roadside ditches to a series of channels which drain to that same tributary.

In TDA 3, stormwater on the west side of I-5 sheet flows off the ramp and I-5 mainline to ditches on the outside shoulder of I-5. The ditches convey the runoff to local low points within the TDA before conveying it to the east, outside of project limits to discharge to McCormick Creek, approximately 2500' east of I-5 right-of-way. Stormwater on the east side of I-5 sheet flows off the ramp and I-5 mainline to the outside shoulder of I-5 and is conveyed by ditch and drainage pipe to discharge into a Tributary of McCormick Creek. Where the frontage road is in close proximity to the ramp extension and I-5 mainline, runoff is conveyed by overland flow to the east of the frontage road and outside of project limits, where it is conveyed by existing ditches and drainage to McCormick Creek.

6. To facilitate stormwater modeling efforts, for each TDA, fill out the Pre-project section of Form A (Inputs for End-of-Pipe Calculation).

Proposed Stormwater Facilities (Proposed Project)

7. How many TDAs have been identified in the project area, how many outfalls or discharge point(s) are located in each TDA, and what are the receiving waterbodies?

Proposed TDA Number	Number of Discharge Points/Outfalls	Receiving Waterbody
TDA 1 (WSDOT)	2	Unnamed Tributary of McCormick Creek
TDA 2 (WSDOT/ City of La Center)	2	Unnamed Tributary of McCormick Creek
TDA 3 (WSDOT)	3	Unnamed Tributary of McCormick Creek

8. For each proposed TDA/outfall (subdivide TDAs if there are multiple outfalls), identify total TDA area, area of impervious surface, area of impervious surface receiving runoff treatment, the runoff BMP type(s), area of impervious surface not receiving runoff treatment, area of impervious surface receiving flow control, the flow control BMP type(s), area of impervious surface being infiltrated via an infiltration BMP, and area of impervious surface not receiving flow control. If available, provide a map depicting drainage basin boundaries for TDAs and subbasins for individual outfalls within a TDA (if applicable), and BMP locations. This information can be summarized in the following table for each TDA/outfall. Some of this information can be provided in the table below, and some written description(s) may be necessary:

Existing TDA/ Outfall Number	Total Area (acres)	Total Impervious Surface Area (acres)	Area w/ Runoff Treatment (acres)	Runoff Treatment BMP Type(s)	Area w/ No Runoff Treatment (acres)	Area w/ Flow Control (acres)	Flow Control BMP Type(s)	Area to Infiltration BMP (acres)	Area w/ No Flow Treatment (acres)
TDA 1/1	**14.07**	**4.80**	**0.7**	**MFD**	**13.37**	**0.70**	**Pond**	**0**	**13.37**
TDA 1/2	**8.45**	**3.40**	**0**	**N/A**	**8.45**	**0**	**N/A**	**0**	**8.45**
TDA2/1	**5.50**	**5.50**	**5.50**	**CW**	**0.0**	**5.50**	**Pond**	**0**	**0**
TDA2/2	**0.45**	**0.45**	**0.45**	**MFD**	**0.0**	**0.0**	**N/A**	**0**	**0.45**
TDA 3/1	**4.27**	**2.73**	**1.6**	**MFD**	**2.67**	**1.6**	**Pond**	**0**	**2.67**
TDA 3/2	**3.97**	**2.13**	**0**	**N/A**	**3.97**	**0**	**N/A**	**0**	**3.97**
TDA 3/3	**7.87**	**3.49**	**0**	**N/A**	**7.87**	**0**	**N/A**	**0**	**7.87**
Project Totals	**44.58**	**22.71**	**8.25**		**36.33**	**7.80**		**0.0**	**36.33**

9. If no runoff treatment or flow control BMPs are proposed for a TDA, provide justification.

   In some cases, it is not possible to provide runoff treatment and flow control for all new and replaced PGIS due to right-of-way constraints. Thus, adjacent equivalent area within the same basin, not currently treated or flow controlled, is conveyed to a proposed facility to provide the necessary flow control and treatment in lieu of the bypassed area.

10. Describe the nature of the proposed stormwater conveyance (drainage) system (e.g., pipe, culvert, channel, ditch, swale, sheet flow), including the drainage distance from project right-of-way to project receiving waterbody. If available, provide a map of the conveyance system depicting TDA/outfall subbasin boundaries.

    In TDA 1, WSDOT ramp and highway runoff will sheet flow to adjacent ditches and Media Filter Drains along the roadway shoulder. The requisite amount of runoff is detained in a detention pond to match pre-project conditions. The runoff is conveyed to the I-5 mainline outside shoulder and is conveyed in existing drainage infrastructure to the unnamed stream to the north, approximately 1,400’ north of the project limits.

    Runoff from the eastern portion of the La Center Road widening flows southerly across the road to the ditch along the south side of La Center Road. For the rest of TDA2, stormwater will be captured using curb inlets and catch basins, then routed via storm sewer to the proposed stormwater treatment facility; this facility consists of a combined constructed wetland and detention facility. After flow control, this runoff is distributed across the existing landscape using a pair of level spreaders. Runoff is then conveyed to the tributary through existing channels.

In TDA 3, WSDOT ramp and highway runoff will sheet flow to adjacent ditches and Media Filter Drains along the roadway shoulder. The requisite amount of runoff is detained in a detention pond to match pre-project conditions. West side ditch runoff is conveyed to local low points within the TDA before conveying it to the east, outside of project limits to discharge to McCormick Creek, approximately 2500' east of I-5 right-of-way limits. Stormwater on the east side of I-5 sheet flows off the ramp and I-5 mainline to the outside shoulder of I-5 and is conveyed by ditch and drainage pipe to discharge into McCormick Creek. Where the frontage road is in close proximity to the ramp extension and I-5 mainline, runoff is conveyed by overland flow to the east of the frontage road and outside of project limits, where it is conveyed by existing ditches and drainage to McCormick Creek.

11. **For each TDA, fill out the Proposed Project section of Form A (Inputs for End-of-Pipe Calculation).**

12. Are any of the project's proposed TDAs exempt from the flow control requirement per the most recent version of the *Highway Runoff Manual*? __ Yes _X_ No

If *yes*, identify the exempt TDA(s) and basis for exemption:

____

If *no*, and the project is petitioning for an exemption, has a hydrologic analysis supporting the exemption been approved by Ecology? __ Yes __ No

- If *yes*, provide a summary of the analysis as an attachment to this checklist.
- If *no*, a hydrologic analysis justifying the exemption must be submitted to Ecology for approval or flow control must be provided.

Note: For some receiving waterbodies, the project biologist may need to acquire more detailed information flow related impacts.

13. For each non-exempt TDA, identify the total area of new impervious surface to receive flow control and for western Washington, the predeveloped land cover design standard (grass, pasture, or forested):

TDA Number	Square Feet, Acres	Predeveloped Land Cover Design Standard (western Washington only)
TDA 1 (WSDOT)	0.67 acres	Till Forest
TDA 2	5.95 acres	Clark County SG4 Forest
TDA 3 (WSDOT)	1.26 acres	Till Forest

14. Will any existing impervious surface be retrofitted for flow control? __ Yes X No

If yes, identify the total area of the existing impervious surface in each TDA will be retrofitted for flow control and for western Washington, the predeveloped land cover design standard (grass, pasture, or forested):

TDA Number	**Square Feet, Acres**	**Predeveloped Land Cover Design Standard (western Washington only)**

15. For western Washington, is the project able to provide all the required flow control for new impervious surfaces within the project limits to the historic land cover standard? X Yes __ No

If *no*, identify where and how this project-triggered retrofit obligation will be met off-site, including the location(s) and the applicable land cover design standard (grass, pasture, or forested):

On-Site/Off-Site Location TDA Numbers	**Volumetric Difference Between Off-site and On-site Volume Detained**	**Land Cover Design Standard (western Washington only)**

16. Is the project able to provide all the required flow control for replaced impervious surfaces within the project limits? _X_ Yes __ No

If *yes*, for each TDA, identify total area of the replaced pollution-generating impervious surface to receive flow control and for western Washington, the predeveloped land cover design standard (grass, pasture, or forested):

TDA Number	**Square Feet, Acres**	**Predeveloped Land Cover Design Standard (western Washington only)**
2	**44,000 sf, 1.01 Acres**	**Clark County SG4 Forest**

If *no*, identify where and how this project-triggered retrofit obligation will be met off-site, including the location(s) and the applicable land cover design standard (grass, pasture, or forested):

Off-Site Location TDA Number	**Square Feet, Acres**	**Land Cover Design Standard**

17. Does the project transfer water between watersheds? _X_ Yes __ No

18. Will the project require construction of a new stormwater outfall structure or a new point of discharge to any water body? X Yes __ No

    If *yes*, identify the receiving water body and describe areas of permanent and temporary clearing or grading, types of vegetation to be removed, amount of riprap, diameter of outfall pipe(s), and all maintenance/access roads to be constructed. If available, provide a map of outfall locations.

    Receiving body: Tributary to McCormick Creek.

19. If the project is not infiltrating all of the runoff from the new impervious surface and is unable to provide the required runoff treatment or flow control for the entire new impervious surface, explain why not. Documentation should include a completed copy of the *Engineering and Economic Feasibility (EEF) Evaluation Checklist* (Appendix 2A).

    N/A

20. What stormwater management design standards were applied?

    X WSDOT *Highway Runoff Manual*, version M 31-16.04 (2014)

    X Ecology's *Stormwater Management Manual*, version 12-10-030 (2012 Western Washington)

    _ Other:

    __ Not Applicable

21. Will project require dilution modeling? *The project biologist will determine this for each project TDA by completing the End-of-Pipe loading analysis from HI-RUN Model,based upon the information provided in this checklist.* __ Yes __ No X Not Determined

    If *no*, or not determined, this form is complete.

    If *yes*, the project biologist will contact the project engineer/designer and request that **Part 2** be filled out for each discharge point/outfall in the TDA(s) of interest: If not determined, do not continue on to Part 2, until the project biologist(s) determine if it is necessary.

Prepared by______________________________ Phone________________ Date____________

Project Engineer____________________________ Office Location________________________

Part 1 (continued)

Form A – TDA 1 (WSDOT)

Inputs for HI-RUN Model End-of-Pipe Loading Subroutine

Baseline (i.e., Pre-Project) Stormwater Facilities

Treatment Type	*Level of Infiltration*[a]	*Subbasin 1 Impervious Area (acres)*	*Subbasin 2 Impervious Area (acres)*	*Subbasin 3 Impervious Area (acres)*	*Subbasin 4 Impervious Area (acres)*	*Subbasin 5 Impervious Area (acres)*
X Basic OR	0%					
_ Phosphorus	20%					
(Check one)	40%					
	60%					
	80%					
Enhanced	0%					
	20%					
	40%					
	60%					
	80%					
None		1.73	1.20			
Infiltration BMP	100%					

[a] *Level of infiltration relates to the amount of incidental infiltration that can be expected, expressed as a percentage of annual average flow volume. If no incidental infiltration can be assumed, enter area in the row corresponding to "0%"*

Proposed (i.e., Post Project) Stormwater Facilities

Treatment Type	*Level of Infiltration*[a]	*Subbasin 1 Impervious Area (acres)*	*Subbasin 2 Impervious Area (acres)*	*Subbasin 3 Impervious Area (acres)*	*Subbasin 4 Impervious Area (acres)*	*Subbasin 5 Impervious Area (acres)*
X Basic OR	0%	1.44	5.95			
_ Phosphorus	20%					
(Check one)	40%					
	60%					
	80%					
Enhanced	0%	1.44	5.95			
	20%					
	40%					
	60%					
	80%					
None						
Infiltration BMP	100%					

[a] *Level of infiltration relates to the amount of incidental infiltration that can be expected, expressed as a percentage of annual average flow volume. If no incidental infiltration can be assumed, enter area in the row corresponding to "0%".*

See HI-RUN Users Guide for instructions on completing these tables.

Part 1 (continued)

Form A – TDA 2 (WSDOT)

Inputs for HI-RUN Model End-of-Pipe Loading Subroutine

Baseline (i.e., Pre-Project) Stormwater Facilities

Treatment Type	*Level of Infiltration*[a]	*Subbasin 1 Impervious Area (acres)*	*Subbasin 2 Impervious Area (acres)*	*Subbasin 3 Impervious Area (acres)*	*Subbasin 4 Impervious Area (acres)*	*Subbasin 5 Impervious Area (acres)*
X Basic OR	0%	0.07				
__ Phosphorus	20%					
(Check one)	40%					
	60%					
	80%					
Enhanced	0%					
	20%					
	40%					
	60%					
	80%					
None		3.27	1.20			
Infiltration BMP	100%					

[a] *Level of infiltration relates to the amount of incidental infiltration that can be expected, expressed as a percentage of annual average flow volume. If no incidental infiltration can be assumed, enter area in the row corresponding to "0%"*

Proposed (i.e., Post Project) Stormwater Facilities

Treatment Type	*Level of Infiltration*[a]	*Subbasin 1 Impervious Area (acres)*	*Subbasin 2 Impervious Area (acres)*	*Subbasin 3 Impervious Area (acres)*	*Subbasin 4 Impervious Area (acres)*	*Subbasin 5 Impervious Area (acres)*
X Basic OR	0%	3.27	5.95			
__ Phosphorus	20%					
(Check one)	40%					
	60%					
	80%					
Enhanced	0%	3.27	5.95			
	20%					
	40%					
	60%					
	80%					
None						
Infiltration BMP	100%					

[a] *Level of infiltration relates to the amount of incidental infiltration that can be expected, expressed as a percentage of annual average flow volume. If no incidental infiltration can be assumed, enter area in the row corresponding to "0%".*

See HI-RUN Users Guide for instructions on completing these tables.

Part 2

Form B – TDA ____

Inputs for HI-RUN Model Receiving Water Dilution Subroutine

Stormwater Parameter	Background Concentration (mg/L)
Total Suspended Solids	
Copper – Total	
Copper – Dissolved	
Zinc – Total	
Zinc – Dissolved	

Drainage Subbasin #_____

Receiving Water Characteristics Downstream from Discharge	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept	Oct.	Nov.	Dec.
Stream depth (ft)												
Stream velocity (fps)												
Channel width (ft)												
□ Stream slope (ft/ft) *OR*□ Manning's roughness "n" *(Check one)*												
Discharge distance into receiving waterbody from nearest shoreline												

Drainage Subbasin #_____

Receiving Water Characteristics Downstream from Discharge	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept	Oct.	Nov.	Dec.
Stream depth (ft)												
Stream velocity (fps)												
Channel width (ft)												
□ Stream slope (ft/ft) *OR*□ Manning's roughness "n" *(Check one)*												
Discharge distance into receiving waterbody from nearest shoreline												

See HI-RUN Users Guide for instructions on completing these tables

Appendix B
HI-RUN Analysis

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 12/15/15 10:56
Outfall ID: I-5/La Center Road TDA1-1
Rain Gauge: Vancouver 48
Description: TDA 1-1

Discharge Areas

Subbasin 1 - Baseline Conditions - 4.16 acres
no treatment - 0% infiltration - 4.16 acres

Subbasin 1 - Proposed Conditions - 4.8 acres
enhanced treatment - 0% infiltration - 0.7 acres
no treatment - 0% infiltration - 4.1 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	237572	319428	27	21	10	6.5	139	164	85.1	46
75th Percentile	4794	4831	1.06	1.1	0.245	0.27	6.48	6.6	1.97	2.1
Median	2332	2394	0.595	0.62	0.139	0.16	3.62	3.8	1.03	1.1
25th Percentile	1139	1203	0.334	0.37	0.078	0.099	2.03	2.2	0.538	0.65
Min	28.1	38	0.016	0.021	0.003	0.01	0.078	0.11	0.002	0.053
P (exceed)		**0.508**		**0.519**		**0.558**		**0.514**		**0.539**

Concentration Analysis

Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	4464.03	4943.472	0.572	0.47	0.212	0.092	3.146	3.274	1.827	2.33
75th Percentile	123.931	109.177	0.027	0.024	0.006	0.006	0.168	0.147	0.052	0.047
Median	61.39	54.721	0.016	0.014	0.004	0.004	0.095	0.085	0.027	0.026
25th Percentile	30.432	27.899	0.009	0.008	0.002	0.002	0.054	0.05	0.014	0.015
Min	0.699	1.201	0	0.001	0	0	0.003	0.005	0	0.001
P (exceed)		0.471		0.469		0.512		0.464		0.492

Highway Runoff Dilution Summary Results

Project: I-5/La Center Road TDA1-1
Precipitation Series: Vancouver 48
Description: Unnamed trib to East Fork Lewis River

Background Concentrations (mg/L)
Dissolved Copper: 0.002
Dissolved Zinc: 0.0084

Baseline Conditions: 4.16 acres
No Treatment Infiltration 0% - 4.16 acres

Proposed Conditions: 4.8 acres
Enhanced Treatment Infiltration 0% - 0.64 acres with detention
Enhanced Treatment Infiltration 0% - 0.06 acres
No Treatment Infiltration 0% - 4.1 acres

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Depth (ft)	0.5	0.4	0.4	0.28	0.28	0.23	0.24	0.16	0.16	0.23	0.47	0.42
	Velocity (fps)	1.27	0.78	1.1	0.43	0.38	0.17	0.21	0.25	0.05	0.16	1.13	0.73
	Width (ft)	16.1	14.4	14.9	13.6	13.1	10.2	8.7	8.9	8	9.1	13.2	11.7
	Slope	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Discharge Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Distance Downstream in feet to Meet Biological Threshold													
Dissolved Copper	Baseline	< 1	< 1	< 1	< 1	< 1	< 1	< 1	3	410	4	< 1	< 1
	Proposed	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	350	4	< 1	< 1
Dissolved Zinc	Baseline	< 1	3	< 1	4	4	130	5	550	> 1000	> 1000	2	3
	Proposed	< 1	3	< 1	4	4	70	4	320	> 1000	970	2	3

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 11/30/15 09:17
Outfall ID: I-5/La Center Road TDA1-2
Rain Gauge: Vancouver 48
Description: TDA 1-2

Discharge Areas

Subbasin 1 - Baseline Conditions - 3.35 acres
no treatment - 0% infiltration - 3.35 acres

Subbasin 1 - Proposed Conditions - 3.4 acres
no treatment - 0% infiltration - 3.4 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	134251	121188	18.1	16	5.52	3.7	116	191	80.5	39
75th Percentile	3860	3928	0.851	0.86	0.199	0.2	5.21	5.3	1.59	1.6
Median	1891	1921	0.478	0.49	0.112	0.11	2.92	2.9	0.827	0.84
25th Percentile	919	933	0.269	0.27	0.063	0.064	1.62	1.6	0.431	0.44
Min	16.5	11	0.011	0.014	0.002	0.003	0.079	0.085	0.008	0.007
P (exceed)		**0.504**		**0.505**		**0.505**		**0.503**		**0.503**

Concentration Analysis

Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	8820.212	5168.113	0.477	0.662	0.127	0.135	4.917	3.035	1.456	1.225
75th Percentile	124.949	124.9	0.027	0.027	0.006	0.006	0.168	0.167	0.051	0.052
Median	61.593	61.318	0.016	0.016	0.004	0.004	0.096	0.095	0.027	0.027
25th Percentile	30.422	30.447	0.009	0.009	0.002	0.002	0.055	0.054	0.014	0.014
Min	0.904	0.758	0	0	0	0	0.002	0.003	0	0
P (exceed)		0.499		0.499		0.5		0.499		0.501

Highway Runoff Dilution Summary Results

Project: I-5/La Center Road TDA1-2
Precipitation Series: Vancouver 48
Description: Unnamed trib to East Fork Lewis River

Background Concentrations (mg/L)
Dissolved Copper: 0.002
Dissolved Zinc: 0.0084

Baseline Conditions: 3.35 acres
No Treatment Infiltration 0% - 3.35 acres

Proposed Conditions: 3.4 acres
No Treatment Infiltration 0% - 3.4 acres

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Depth (ft)	0.5	0.4	0.4	0.28	0.28	0.23	0.24	0.16	0.16	0.23	0.47	0.42
	Velocity (fps)	1.27	0.78	1.1	0.43	0.38	0.17	0.21	0.25	0.05	0.16	1.13	0.73
	Width (ft)	16.1	14.4	14.9	13.6	13.1	10.2	8.7	8.9	8	9.1	13.2	11.7
	Slope	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Discharge Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Distance Downstream in feet to Meet Biological Threshold													
Dissolved Copper	Baseline	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	260	3	< 1	< 1
	Proposed	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	250	3	< 1	< 1
Dissolved Zinc	Baseline	< 1	2	< 1	3	3	10	3	27	> 1000	680	< 1	2
	Proposed	< 1	2	< 1	3	3	10	3	50	> 1000	750	< 1	2

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 12/15/15 11:58
Outfall ID: I-5/La Center Road TDA2-1
Rain Gauge: Vancouver 48
Description: TDA 2-1

Discharge Areas

Subbasin 1 - Baseline Conditions - 0.76 acres
no treatment - 0% infiltration - 0.76 acres

Subbasin 1 - Proposed Conditions - 5.5 acres
enhanced treatment - 0% infiltration - 5.5 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	43402	46030	4.93	3	1.83	2.9	25.4	22	15.5	13
75th Percentile	876	657	0.193	0.37	0.045	0.24	1.18	1.8	0.359	1.2
Median	426	286	0.109	0.25	0.025	0.15	0.662	1.2	0.188	0.78
25th Percentile	208	124	0.061	0.16	0.014	0.098	0.37	0.75	0.098	0.5
Min	5.14	1.3	0.003	0.013	0.001	0.008	0.014	0.03	0	0.038
P (exceed)		**0.404**		**0.782**		**0.953**		**0.701**		**0.886**

Concentration Analysis

Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	4464.03	951.305	0.572	0.048	0.212	0.039	3.146	0.486	1.827	0.257
75th Percentile	123.931	12.822	0.027	0.007	0.006	0.005	0.168	0.035	0.052	0.024
Median	61.39	5.68	0.016	0.005	0.004	0.003	0.095	0.023	0.027	0.016
25th Percentile	30.432	2.492	0.009	0.003	0.002	0.002	0.054	0.015	0.014	0.01
Min	0.699	0.02	0	0	0	0	0.003	0.001	0	0.001
P (exceed)		0.068		0.121		0.429		0.087		0.312

Highway Runoff Dilution Summary Results

Project: I-5/La Center Road TDA2-1
Precipitation Series: Vancouver 48
Description: TDA 2 - Unnamed Tributary to McCormick

Background Concentrations (mg/L)
Dissolved Copper: 0.002
Dissolved Zinc: 0.0084

Baseline Conditions: 0.76 acres
No Treatment Infiltration 0% - 0.76 acres

Proposed Conditions: 5.5 acres
Enhanced Treatment Infiltration 0% - 4.74 acres with detention
Enhanced Treatment Infiltration 0% - 0.76 acres

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Depth (ft)		0.5	0.4	0.4	0.28	0.28	0.23	0.24	0.16	0.16	0.23	0.47	0.42
Velocity (fps)		1.27	0.78	1.1	0.43	0.38	0.17	0.21	0.25	0.05	0.16	1.13	0.73
Width (ft)		16.1	14.4	14.9	13.6	13.1	10.2	8.7	8.9	8	9.1	13.2	11.7
Slope		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Discharge Distance (ft)		0	0	0	0	0	0	0	0	0	0	0	0
Distance Downstream in feet to Meet Biological Threshold													
Dissolved Copper	Baseline	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	Proposed	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	3	< 1	< 1	< 1
Dissolved Zinc	Baseline	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	170	2	< 1	< 1
	Proposed	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	280	4	< 1	< 1

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 11/25/15 16:00
Outfall ID: I-5/La Center Road TDA2-2
Rain Gauge: Vancouver 48
Description: TDA 2-2

Discharge Areas

Subbasin 1 - Baseline Conditions - 0.44 acres
no treatment - 0% infiltration - 0.44 acres

Subbasin 1 - Proposed Conditions - 0.45 acres
enhanced treatment - 80% infiltration - 0.45 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	36702	229	2.9	0.016	0.608	0.008	13.6	0.084	7.3	0.053
75th Percentile	510	2	0.111	0.001	0.026	0.001	0.685	0.006	0.211	0.004
Median	250	0.85	0.063	0.001	0.015	0	0.385	0.004	0.109	0.002
25th Percentile	121	0.36	0.035	0	0.008	0	0.214	0.002	0.057	0.001
Min	2.45	0	0.001	0	0	0	0.009	0	0.002	0
P (exceed)		**0**		**0**		**0.001**		**0**		**0.001**

Concentration Analysis

Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	4075.618	1287.762	0.651	0.057	0.109	0.038	3.726	0.355	1.448	0.317
75th Percentile	124.725	12.931	0.027	0.007	0.006	0.005	0.166	0.035	0.051	0.024
Median	61.884	5.68	0.015	0.005	0.004	0.003	0.095	0.023	0.027	0.016
25th Percentile	30.496	2.517	0.009	0.003	0.002	0.002	0.054	0.015	0.014	0.01
Min	0.669	0.033	0	0	0	0	0.003	0.002	0.001	0.001
P (exceed)		0.069		0.123		0.428		0.09		0.316

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 12/15/15 12:14

Outfall ID: I-5/La Center Road TDA3-1

Rain Gauge: Vancouver 48

Description: TDA 3-1

Discharge Areas

Subbasin 1 - Baseline Conditions - 1.77 acres
no treatment - 0% infiltration - 1.77 acres

Subbasin 1 - Proposed Conditions - 4.27 acres
enhanced treatment - 0% infiltration - 1.6 acres
no treatment - 0% infiltration - 2.67 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	101082	208092	11.5	14	4.26	4.2	59.1	107	36.2	30
75th Percentile	2040	3303	0.449	0.77	0.104	0.22	2.76	4.6	0.837	1.6
Median	992	1693	0.253	0.47	0.059	0.15	1.54	2.8	0.437	0.97
25th Percentile	484	888	0.142	0.3	0.033	0.097	0.863	1.7	0.229	0.6
Min	12	34	0.007	0.027	0.001	0.009	0.033	0.12	0.001	0.051
P (exceed)		**0.648**		**0.718**		**0.811**		**0.703**		**0.751**

Concentration Analysis

Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	4464.03	3621.244	0.572	0.344	0.212	0.069	3.146	2.405	1.827	1.71
75th Percentile	123.931	83.746	0.027	0.019	0.006	0.006	0.168	0.116	0.052	0.04
Median	61.39	43.565	0.016	0.012	0.004	0.004	0.095	0.07	0.027	0.025
25th Percentile	30.432	23.121	0.009	0.008	0.002	0.003	0.054	0.044	0.014	0.016
Min	0.699	1.041	0	0.001	0	0	0.003	0.005	0	0.002
P (exceed)		0.407		0.409		0.516		0.397		0.475

Highway Runoff Dilution Summary Results

Project: I-5/La Center Road TDA3-1
Precipitation Series: Vancouver 48
Description: TDA 2 - Unnamed Tributary to McCormick

Background Concentrations (mg/L)
Dissolved Copper: 0.002
Dissolved Zinc: 0.0084

Baseline Conditions: 1.77 acres
No Treatment Infiltration 0% - 1.77 acres

Proposed Conditions: 4.27 acres
Enhanced Treatment Infiltration 0% - 1.6 acres with detention
No Treatment Infiltration 0% - 0.9 acres with detention
No Treatment Infiltration 0% - 1.77 acres

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Depth (ft)		0.5	0.4	0.4	0.28	0.28	0.23	0.24	0.16	0.16	0.23	0.47	0.42
Velocity (fps)		1.27	0.78	1.1	0.43	0.38	0.17	0.21	0.25	0.05	0.16	1.13	0.73
Width (ft)		16.1	14.4	14.9	13.6	13.1	10.2	8.7	8.9	8	9.1	13.2	11.7
Slope		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Discharge Distance (ft)		0	0	0	0	0	0	0	0	0	0	0	0
Distance Downstream in feet to Meet Biological Threshold													
Dissolved Copper	Baseline	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	4	< 1	< 1	< 1
	Proposed	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	51	2	< 1	< 1
Dissolved Zinc	Baseline	< 1	< 1	< 1	< 1	< 1	3	< 1	7	> 1000	19	< 1	< 1
	Proposed	< 1	< 1	< 1	2	2	4	< 1	6	> 1000	170	< 1	< 1

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 11/25/15 16:32
Outfall ID: I-5/La Center Road TDA3-2
Rain Gauge: Vancouver 48
Description: TDA 3-2

Discharge Areas

Subbasin 1 - Baseline Conditions - 1.93 acres
no treatment - 0% infiltration - 1.93 acres

Subbasin 1 - Proposed Conditions - 2.13 acres
no treatment - 0% infiltration - 2.13 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	77345	75921	10.4	10	3.18	2.3	67	120	46.4	25
75th Percentile	2224	2461	0.491	0.54	0.114	0.13	3	3.3	0.915	1
Median	1090	1203	0.276	0.3	0.064	0.071	1.68	1.8	0.477	0.53
25th Percentile	529	585	0.155	0.17	0.037	0.04	0.934	1	0.248	0.27
Min	9.51	6.9	0.006	0.009	0.001	0.002	0.046	0.054	0.004	0.004
P (exceed)		**0.526**		**0.532**		**0.532**		**0.531**		**0.528**

Highway Runoff Dilution Summary Results

Project: I-5/La Center Road TDA3-2
Precipitation Series: Vancouver 48
Description: TDA 3-2 - Unnamed Tributary to McCormick

Background Concentrations (mg/L)
Dissolved Copper: 0.002
Dissolved Zinc: 0.0084

Baseline Conditions: 1.93 acres
No Treatment Infiltration 0% - 1.93 acres

Proposed Conditions: 2.13 acres
No Treatment Infiltration 0% - 2.13 acres

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Depth (ft)		0.5	0.4	0.4	0.28	0.28	0.23	0.24	0.16	0.16	0.23	0.47	0.42
Velocity (fps)		1.27	0.78	1.1	0.43	0.38	0.17	0.21	0.25	0.05	0.16	1.13	0.73
Width (ft)		16.1	14.4	14.9	13.6	13.1	10.2	8.7	8.9	8	9.1	13.2	11.7
Slope		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Discharge Distance (ft)		0	0	0	0	0	0	0	0	0	0	0	0
Distance Downstream in feet to Meet Biological Threshold													
Dissolved Copper	Baseline	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	35	< 1	< 1	< 1
	Proposed	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	55	< 1	< 1	< 1
Dissolved Zinc	Baseline	< 1	< 1	< 1	< 1	< 1	3	< 1	8	> 1000	120	< 1	< 1
	Proposed	< 1	< 1	< 1	2	< 1	4	2	10	> 1000	210	< 1	< 1

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 11/25/15 16:46
Outfall ID: I-5/La Center Road TDA3-3
Rain Gauge: Vancouver 48
Description: TDA 3-3

Discharge Areas

Subbasin 1 - Baseline Conditions - 3.37 acres
no treatment - 0% infiltration - 3.37 acres

Subbasin 1 - Proposed Conditions - 3.49 acres
no treatment - 0% infiltration - 3.49 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	192700	240475	24.2	30	3.7	7.5	98.4	101	68.4	53
75th Percentile	3901	4039	0.856	0.88	0.199	0.21	5.22	5.4	1.6	1.7
Median	1903	1965	0.484	0.5	0.112	0.11	2.92	3	0.831	0.87
25th Percentile	929	953	0.272	0.28	0.063	0.065	1.64	1.7	0.434	0.45
Min	19.4	23	0.011	0.012	0.003	0.003	0.036	0.03	0.01	0.009
P (exceed)		**0.508**		**0.51**		**0.51**		**0.513**		**0.511**

Concentration Analysis

Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	6926.299	7134.708	0.412	0.414	0.115	0.212	4.424	3.09	1.768	1.827
75th Percentile	124.274	124.412	0.027	0.027	0.006	0.006	0.167	0.167	0.052	0.052
Median	61.594	61.376	0.016	0.016	0.004	0.004	0.095	0.095	0.027	0.027
25th Percentile	30.357	30.264	0.009	0.009	0.002	0.002	0.054	0.054	0.014	0.014
Min	0.581	0.699	0	0	0	0	0.003	0.003	0	0
P (exceed)		0.5		0.498		0.499		0.499		0.499

Highway Runoff Dilution Summary Results

Project: I-5/La Center Road TDA3-3
Precipitation Series: Vancouver 48
Description: TDA 3-3 - Unnamed Tributary to McCormick

Background Concentrations (mg/L)
Dissolved Copper: 0.002
Dissolved Zinc: 0.0084

Baseline Conditions: 3.37 acres
No Treatment Infiltration 0% - 3.37 acres

Proposed Conditions: 3.49 acres
No Treatment Infiltration 0% - 3.49 acres

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Depth (ft)		0.5	0.4	0.4	0.28	0.28	0.23	0.24	0.16	0.16	0.23	0.47	0.42
Velocity (fps)		1.27	0.78	1.1	0.43	0.38	0.17	0.21	0.25	0.05	0.16	1.13	0.73
Width (ft)		16.1	14.4	14.9	13.6	13.1	10.2	8.7	8.9	8	9.1	13.2	11.7
Slope		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Discharge Distance (ft)		0	0	0	0	0	0	0	0	0	0	0	0
Distance Downstream in feet to Meet Biological Threshold													
Dissolved Copper	Baseline	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	260	3	< 1	< 1
	Proposed	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	280	3	< 1	< 1
Dissolved Zinc	Baseline	< 1	2	< 1	3	3	10	3	44	> 1000	720	< 1	2
	Proposed	< 1	2	< 1	3	3	11	3	170	> 1000	730	< 1	2

APPENDIX E

ARCHAEOLOGICAL RESOURCES DISCIPLINE REPORT AMENDMENT

Technical Report

Amendment to La Center Interchange Archaeological Resources Discipline Report

Prepared by

Jamelon Brown, Robin McClintock, and Doug McFarland

Prepared for

Washington Department of Transportation

January 5, 2016

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Contents

La Center Interchange Project

Purpose of Study

This technical report was prepared as an amendment to the La Center Interchange Archaeological Resources Discipline Report (McFarland and McClintock 2015). The two reports supplement previous studies conducted in order for the I-5/NW La Center Road Interchange Improvements Project ("La Center Interchange Improvements Project" or "Project") to meet the requirements of Section 106 of the National Historic Preservation Act. This amendment presents the results of additional archaeological investigation resulting from a change to the Area of Potential Effects (APE) for the Project.

Project Description

The Project includes realignment and partial relocation of Paradise Park Road on the east side of I-5 and the development of a new intersection with NW La Center Road. In the original APE, Paradise Park Road extended north from the new intersection with NW La Center Road approximately 290 meters (950 feet [ft]) to 324th Street.

The revised APE shows a modified alignment for Paradise Park Road in which it extends northward from the intersection with NW La Center Road for approximately 122 meters (400 ft) then turns west and extends approximately 183 meters (600 ft) to reconnect with the original alignment of Paradise Park Road. The revision includes an access road to the north side of an existing parking lot for a truck stop.

Additional changes to the project description include refinements to the proposed stormwater design, including the addition of two stormwater detention ponds along I-5. The first detention pond would be located just west of the I-5 southbound on-ramp, while the second detention pond would be located just south of the proposed bridge and west of the I-5 northbound off-ramp (Figures 1 and 2). The proposed detention ponds would be located within the extent of the previous APE, which was analyzed in the La Center Interchange Archaeological Resources Report prepared in April 2015. Since the conclusions within the April 2015 Report would be applicable to the stormwater design refinements, the proposed detention ponds are not discussed further within this report.

Project Location

The La Center Interchange Improvements Project APE is in Clark County, Washington, approximately a mile southwest of La Center, Washington, and 20 miles north of Portland, Oregon (Figures 1 and 2). The study area for the modified alignment is located in Township 4 North, Range 1 East, Section 4. It consists of approximately 0.8 hectares (2 acres) east of Paradise Park Road, south of an agricultural field, and north of a parking lot for a truck stop. Elevation ranges from 246 to 262 ft above sea level.

The eastern portion of the study area is level but it is 2 to 4 ft higher in elevation than the agricultural field to the north. At the bottom of the slope leading to that field is a silt fence, indicating the raised area is fill. Vegetation in this area consists of thistle and blackberry, also indicating disturbance or fill. The western portion appears to be an excavated stormwater retention area. It contains a manhole, a large rectangular steel vault, and another unidentified concrete feature possibly related to stormwater control. This area appears to have been excavated and disturbed. A strip of land along the eastern edge of Paradise Park Road forms the western edge of the study area and is part of the roadbed.

Field Methods

The archaeological investigation consisted of intensive pedestrian survey and shovel test probes (Figure 3). Fieldwork was conducted on October 29, 2015, by CH2M HILL archaeologists Robin McClintock and Erik Peters.

Six shovel test probes were excavated on the east end of the study area where native deposits may remain intact beneath fill. Shovel test probes were 30 centimeters (cm) wide and ranged from 50 to 70 cm deep.

Test probes were excavated to depths reasonably practicable for small hand dug probes and to depths that were most likely to contain undisturbed native deposits. Sediments were screened through ¼-inch mesh screen. Sediments were described as probes were excavated. Descriptions were based on visual inspection of the probes as well as contents of the screen.

Results

The pedestrian survey and shovel test probes identified no cultural material aside from asphalt and plastic debris. Table 1 contains the results of individual probes.

TABLE 1

Shovel Test Results

Probe #	Depth in cm	Sediment/Soil	Cultural	Notes
STP 1	60	0-35 cm—Loose, mixed, mottled soils with plastic and crushed basalt road gravel. 35-60 cm—Compact yellowish brown silt with less than 5% pebbles.	N/A	Unit placed on slight slope toward field to north.
STP 2	60	0-50 cm—Mixed and mottled soils with gravel and asphalt chunks throughout. 50-60 cm—Compact yellowish brown silt with less than 5% pebbles.	N/A	Unit placed on top of level area.
STP 3	65	0-65 cm—Compact, mixed and mottled soils with gravel, asphalt, and plastic debris. 45-65 cm—Slightly more compact yellowish brown silt with no pebbles.	N/A	Unit placed on edge of raised area above stormwater retention zone.
STP 4	50	0-50 cm—Mixed and mottled soils with crushed road gravel and asphalt. Unit terminated at impenetrable rock/asphalt at 50 cm.	N/A	
STP 5	60	0-60 cm—Mixed and mottled soils with very compact crushed basalt and asphalt. White plastic bag at 40 cm. Did not penetrate native soils.	N/A	
STP 6	70	0-50 cm—Compact mixed soils containing crushed gravel, asphalt, and basalt cobbles. Burned wood debris at 40 cm. 50-70 cm—Very compact yellowish brown silt with less than 5% pebbles.	N/A	

Recommendations

No archaeological cultural material was identified as part of this investigation, so the findings of the original report remain the same: implementation of the proposed intersection improvements are deemed to have no effect on historic properties and no further archaeological work is recommended for the La Center Interchange Improvements Project (McFarland and McClintock 2015).

References

McFarland, Doug, and Robin McCormick. 2015. *La Center Interchange Archaeological Resources Discipline Report*. CH2M HILL, Richland, Washington.

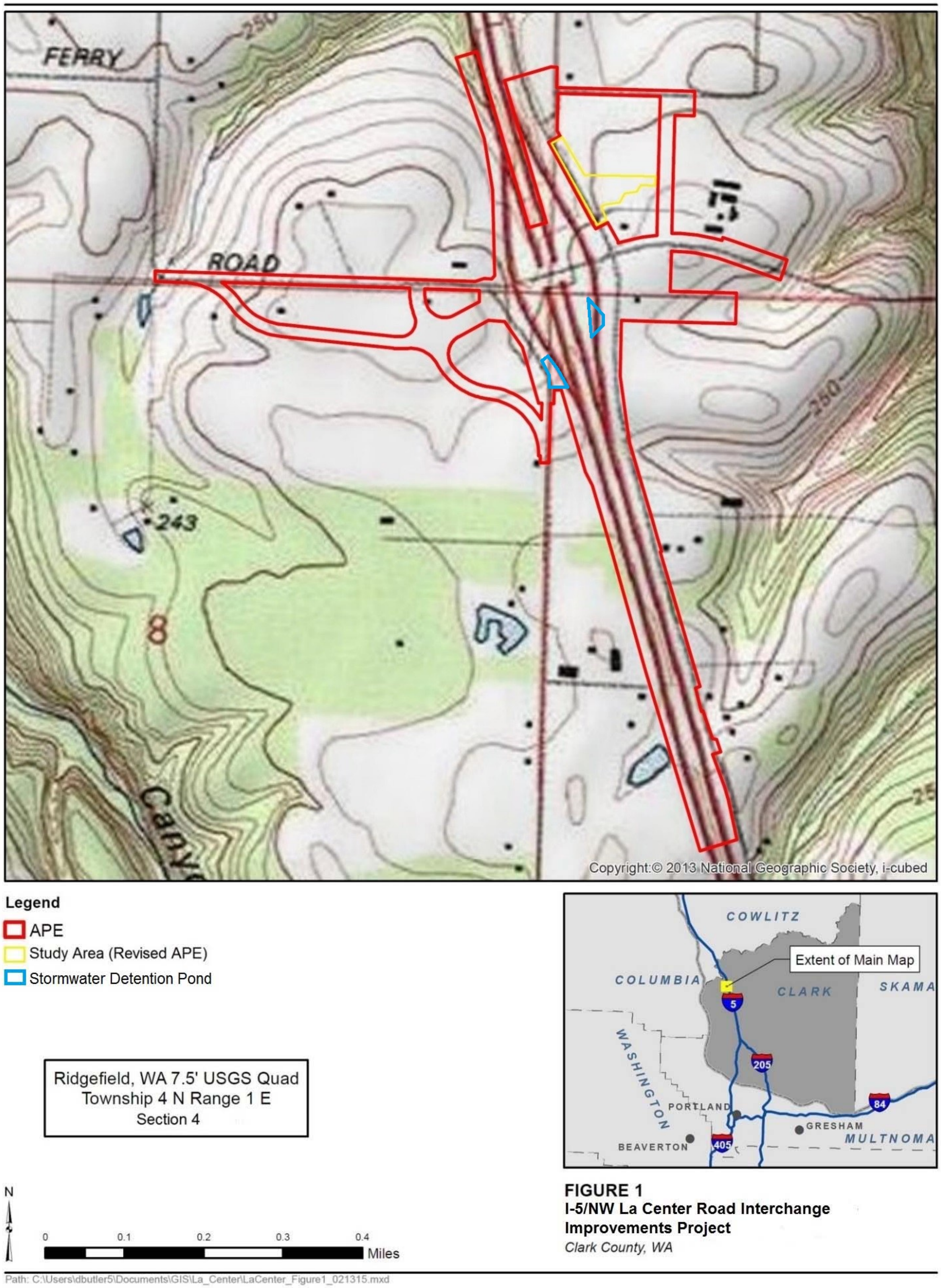

FIGURE 1
APE and 7.5' USGS Topographic Overlay

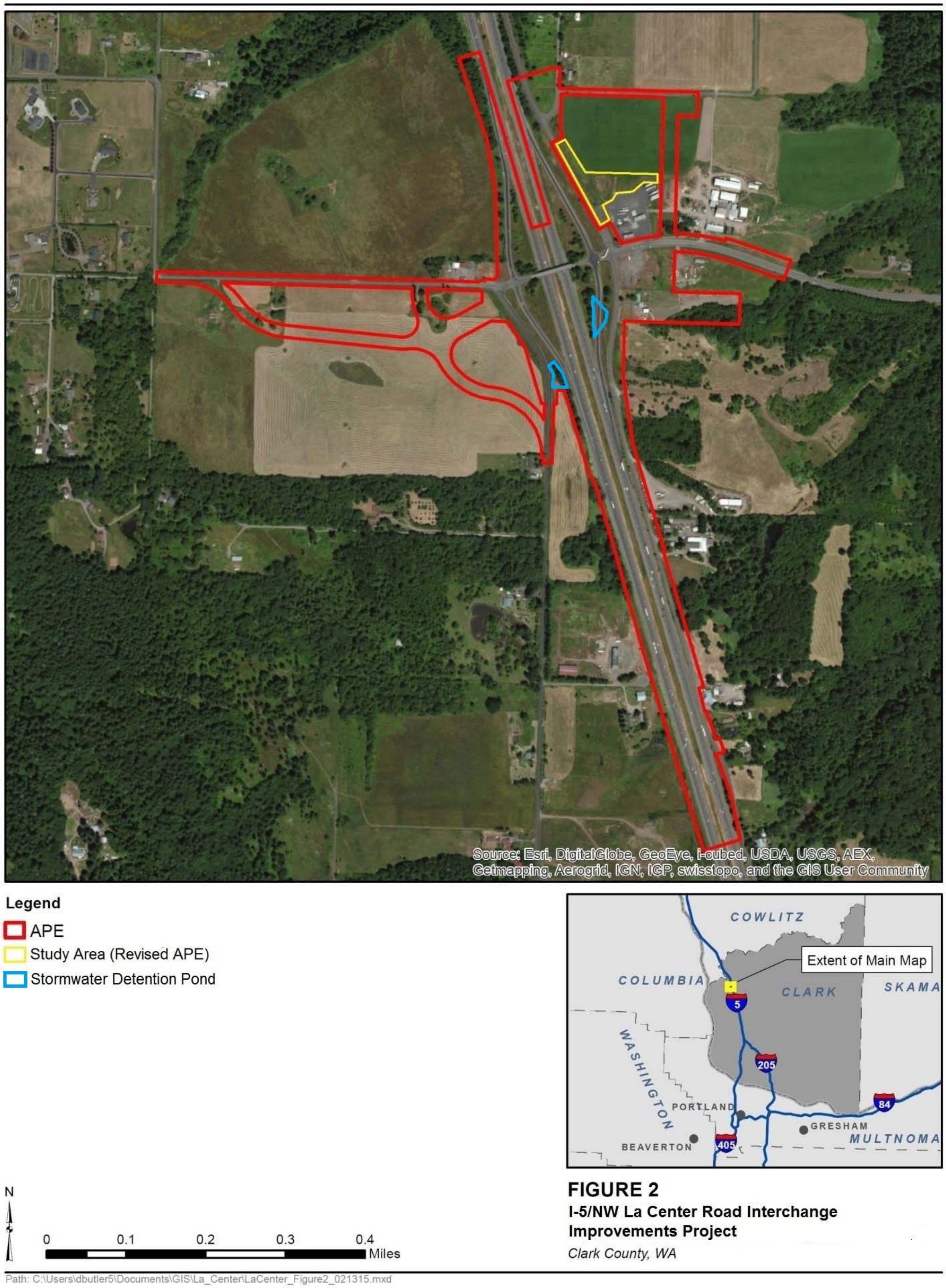

FIGURE 2
APE and Aerial Photograph Overlay

FIGURE 3
Shovel Test Probe Locations

Appendix A
Photographs

Photo 1. Overview of eastern portion of study area. View is to the east.

Photo 2. Eastern portion of study area showing silt fence at base of slope. View is to the east.

Photo 3. Transition from eastern to western portion of the study area. View is to the south.

Photo 4. Overview of western portion of study area. View is to the west.

Photo 5. Manhole and steel vault. View is to the northwest.

Photo 6. Stormwater control feature. View is to the northwest.