Point Wells Development
Urban Center Submittal
PFN: 11 101008LDA

Targeted Stormwater Site Plan Report

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Prepared for: BSRE/Point Wells, LP
c/o Karr Tuttle Campbell
701 Fifth Avenue, Suite 3300
Seattle, WA 98104

Prepared by: **MIG|SvR**
615 Second Avenue, Suite 280
Seattle, Washington 98104
Mark Davies, PE

MIG|SvR Project No. 09038

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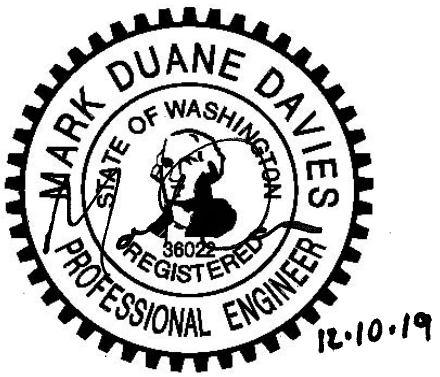

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A. MINIMUM REQUIREMENT 1 – TARGETED STORMWATER SITE PLAN NARRATIVE

Project Overview and Executive Summary

The Point Wells Development Project (Project) is in the southwest corner of unincorporated Snohomish County at the northern end of Richmond Beach Drive. The Project site is bordered by the town of Woodway to the north and east, the City of Shoreline to the south, and Puget Sound to the west (see Figure 1–Vicinity Map). The Burlington Northern Santa Fe Railroad (BNSF) bisects the Project site near its eastern edge.

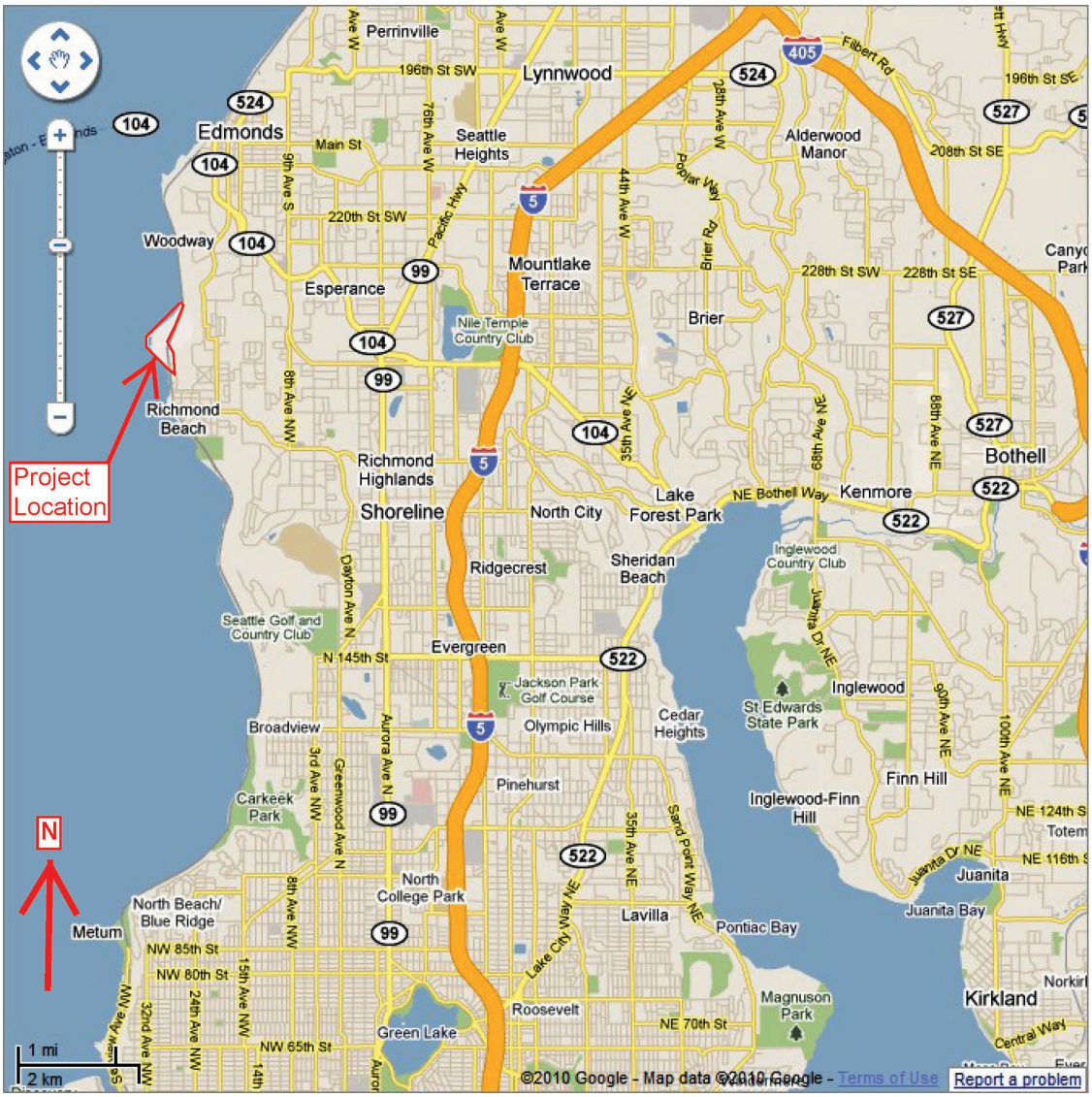


Figure 1– Vicinity Map: Wells Point, Snohomish County, Washington

The Project is in the Point Wells Drainage Basin, a sub-basin of the Snohomish County Puget Sound Drainage Basin, managed by the Snohomish County ("County") Surface Water Management Division (SWMD). See Appendix A for an on-site drainage basin figure. A full size plan is also provided with the Urban Center Plan application.

Snohomish County has adopted the "2016 Snohomish County Drainage Manual" (SCDM). In accordance with the SCDM, the water quality facilities were modeled using DOE's Western Washington Hydraulic Model (WWHM). The Project will be required to meet SWDM Minimum Requirements 1 through 9. Due to the site being utilized as an asphalt and marine fuels terminal, the site will require environmental remediation (see Hart Crowser Point Wells Urban Center, Environmental Remediation Approach dated April 2018). For this reason, this Project will not utilize Low Impact Development (LID) strategies such as bioswales, pervious pavements, dispersion, or soil amendment to infiltrate a portion of the site's stormwater runoff. To provide water quality treatment for the Project proprietary treatment facilities manufactured by Contech will be utilized. These Filterra systems are contained within a concrete vault or lined system. Water quality measures for the site during construction include sediment traps and portable storage tanks with chitosan filtration systems. Additional information on proposed measures to meet the construction water quality requirements can be found in the Project's Stormwater Pollution Prevention Plan (SWPPP) dated March 4, 2011 and previously submitted with the 2011 Urban Center Application to the County.

Proposed improvements for the site include the construction of multistory, multifamily housing with ground floor retail and underground parking facilities, office and commercial space, and a central energy facility.

The eastern upper portion of the site will be the main entry to the new development via Richmond Beach Drive. Transit and vehicles accessing the office and residential buildings will follow the center road to the lower parking garage and transit station. Other vehicles, pedestrians and cyclists will follow a ramp up to the upper road to the new bridge spanning the existing BNSF tracks. A second access will also be provided from the east, from the Town of Woodway.

The lower west development will include three separate building masses, each in a crescent shape - referred to as the south, central, and northern crescents. Each crescent will be built up above existing grade and contain a central parking structure.

Upstream land cover is a combination of forest, pasture, and residential neighborhoods. Stormwater is conveyed onto and/or through the site at four locations: a stream near the northeast corner of the site, Chevron Creek, a 24-inch storm drainpipe originating from the Town of Woodway, and South Creek (see sheet C-010 On-site Existing Storm Drainage Basins Map in Appendix A and also included in the Urban Center Plan set.).

Existing Site Conditions Summary

The existing site is approximately 61.2 acres with 5 acres located east of the BNSF Railroad and approximately 56 acres located west of BNSF Railroad. The east area is comprised of a number of smaller buildings located on a rectangular bench area. The bench is between elevation 35 and 45 (NAVD88), with the highest elevation on the 5-acre portion of the site at about 92 and the lowest elevation at about 30.

A geotechnical assessment has been prepared for the Project site by Hart Crowser, Inc dated April 20, 2018. Borings conducted as part of the report indicate the site is underlain by approximately five feet of sand and sandy gravel fill. Beneath the fill layer, Colluvium, Pre-Fraser Nonglacial Fluvial Deposits, and Pre-Fraser Nonglacial Lacustrine Deposits were encountered. Groundwater was observed between 1.5 and 7.5 feet below the existing ground surface for the lower bench and between 2.5 feet and 40 feet in the upper bench. At the east edge of the upper bench begins a vegetated slope approximately 150 to 200 feet high with slopes ranging from 2H:1V to 3H:1V. To the west of the bench is a short slope down to the BNSF Railroad. Hart Crowser also encountered a strong petroleum hydrocarbon (TPH) odor during the exploration in the lowland at B09-2. Additional soil analysis, meeting the requirements of Volume V, Chapter 5 of the Drainage Manual, will be conducted in a future phase of the Project.

According to the 1983 Soil Survey of Snohomish County Area Washington, prepared by the U.S. Department of Agriculture, the Project site is underlain by Urban Land. Urban Land is defined as "Nearly level to gently sloping areas covered by streets, buildings, parking lots, and other structures that obscure or alter the soils so that identification is not feasible. Soils to the north and east of the Project site are classified as Alderwood-Everett gravelly sandy loam, 25 to 70-percent slopes and Alderwood-Urban land complex, 8 to 15-percent slopes. Both soil types on adjacent parcels are described as moderately well drained. As part of the Project reconnaissance, a targeted drainage plan, dated February 2004 and created by Herrera Environmental Consultants, Inc., in association with HDR, Inc., for the Point Wells Portal and Marine Outfall Project was reviewed. The geotechnical report contained within that document states that the Portal site "is underlain by loose to medium dense silty sand (fill) to a depth of 11 feet, dense to very dense gravely sand and sandy gravel with cobbles to a depth of 42 feet, hard organic silt and peat to a depth of 46 feet, and very dense silty gravel to the bottom of the boring depth of 80.

The west 56 acres contains a petroleum storage, asphalt processing, and distribution plant. The relatively level western area is mostly impervious and consists of several buildings, petroleum storage tanks, roads, and parking lots (see photos in Appendix C). There is also a pier off the west edge of the site. A two-lane bridge currently accesses the west lowland. There is also another bridge to the north that is currently not operational. Both bridges are scheduled to be replaced with the proposed development.

Several types of seawalls separate the sandy beach and the industrial paved site. The types of walls range from a rockery to the north, to a metal coffer dam and concrete wall through

the central area, changing then to a rockery to the south. The lower paved area ranges in elevation from 10 feet along the west edge, up to an elevation of 20 feet along the eastern edge.

David Evans and Associates Critical Areas Report identified Wetland A immediately to the east of the upper bench. This wetland and associated buffer are indicated on the Plans in Appendix B.

There are three existing piped outfalls to Puget Sound located within the Point Wells development site. Outfall 1 is the main outfall that discharges all the on-site storm water collected west of the BNSF railroad. Stormwater is collected by catch basins and conveyed through storm drain pipes to an existing Point Wells industrial wastewater treatment system prior to discharging through Outfall 1. Outfall 1, an 18-inch diameter pipe, is only exposed at extreme low tides and is located on the north side of the north pier. Outfall 2 is located along the shoreline, near the middle of the site, between the two pier access docks, and discharges stormwater from the eastern, upper bench and ditch along the BNSF tracks. A 24-inch HDPE pipe was slipped line in an existing steel pipe and is exposed during low tides. Outfall 3 is located along the southern portion of the site and discharges stormwater originating from offsite areas upstream of the Project: Chevron Creek, South Creek and about 3 acres of existing on-site area. Per a David Evans and Associates (DEA) memorandum, dated January 4, 2010, Chevron Creek is classified as a Type N stream. A stream classification for South Creek was not identified in the memo by DEA. The upstream drainage basin for Outfall 3 is approximately 80 acres and consists of the steep slope bordering the Project to the east and residential neighborhoods located at the top of the steep slope, in the Town of Woodway. Outfall 3 is a 24-inch HDPE pipe with steel anchor casings. Based on the rim of existing storm drain manholes being approximately 7 feet above existing grade, it is assumed that the hydraulic grade line for the piped drainage upstream of Outfall 3 is above the average grade of the existing site.

Off-Site Analysis and Mitigation Analysis

Off-site flows will not be managed by on-site stormwater management BMPs; all off-site flows conveyed through the Project Site will remain in piped conveyance system and be discharged directly to Puget Sound through existing outfalls. For innovative design approach, this project proposes to intercept portion of Chevron creek and divert the flow to a new Chevron Creek Daylighted Watercourse. This new channel will require permitting for a new outfall that will be completed at a future date.

Upstream Analysis

Upstream land cover is a combination of forest, pasture, and residential neighborhoods. Stormwater is conveyed onto and/or through the site at four locations: a stream near the northeast corner of the site, Chevron Creek, a 24-inch storm drainpipe originating from the Town of Woodway, and south creek. (See B3 Point Wells Upstream Drainage Basins Map located in Appendix A.)

North Stream

Stream #2 collects stormwater runoff from an upstream area of approximately 42 acres. This area extends from the edge of the BNSF tracks to the west side of 114th Avenue West in Woodway. The basin includes housing, roads, and a forested steep hillside. Runoff, once collected in a ditch along the east side of BNSF Railroad, is piped under the railroad, north in a stream running along the eastern edge of the Point Wells property, and then west through a stream running along the north boundary of the property before discharging into Puget Sound.

Chevron Creek, 24-inch Pipe and South Creek

Currently, flow from approximately 80.2 acres of upstream offsite is piped through the Point Wells site and discharged at Outfall 3. The Outfall 3 basin area consists of forested land, low density and high density neighborhoods, and roads. Currently most of this flow is conveyed through the site via Chevron Creek and the South Creek. Per conversations with the Town of Woodway, during neighborhood development, some of the flow was diverted to a 24-inch pipe from 24th Avenue SW which is routed through an easement to the upper east bench of Point Wells, under the BNSF Railroad just north of the existing bridge, and then south where it connects to the piped system of Chevron and South Creeks before being discharged at Outfall 3.

Downstream Analysis & Hydraulic Modeling

Summary

For the hydraulic model it is assumed the Chevron Creek Daylighted Watercourse is not constructed. All runoff from the Project is discharged directly into Puget Sound via one of the existing outfalls or creeks. Based on available information, the existing outfalls have capacity for the existing condition. The Project will reduce the amount of impervious area on-site. Design analysis is outlined below.

Design Inputs

The proposed storm drain network is sized to convey the 100-year storm. See Appendix G for the hydraulic analysis for outfalls 1 and 2. Routing was modeled using Storm & Sanitary Analysis 2018, using the hydrodynamic calculation method to represent backwater conditions caused by high tides. Outfalls were modeled with a fixed water elevation of 11.17 NAVD. This is a combination of mean higher water level (8.84) with 100 years of sea level rise (+28”). These values were obtained from the Point Wells Redevelopment Coastal Engineering Assessment Draft prepared by Moffatt & Nichol dated April 23,2018.

Runoff from the site was calculated using the Rational Method per SCC 30.63A.740. To develop Intensity-Duration-Frequency (IDF) curves, documentation was not found from

Snohomish County drainage design documentation. Therefore, due to the project's proximity, the King County Stormwater Design Manual, Section 3.2.1 was used to develop IDF curves for modeling. Those curves have minimum time of concentration of 6.3 minutes. This was used for almost all subbasins because the calculated time of concentration for typical street and building basins were less than the 6.3 minutes. For the few areas that were larger, SCS TR-55 was used to compute the time of concentration between 7 and 20 minutes.

Water quality vaults (Filterra units) were modeled as weirs based on manufacturer's recommendations and did not have a significant impact on the overall performance of the system.

Extreme Storm Conditions (beyond 100-year events)
In storm events exceeding the design storm, stormwater overflow will be routed out of grated manhole covers between the coastal row of buildings and the esplanade. In this extreme event, sheet flow will flow over the esplanade and onto the beach.

B. MINIMUM REQUIREMENT 2 - SWPPP NARRATIVE

The following outlines how each of the applicable 13 SWPPP elements will be addressed on the Project Site:

1. **Preserve Vegetation/Mark Clearing Limits** - To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin. Trees and vegetation that are to be preserved, as well as all sensitive areas and their buffers, shall be clearly delineated, both in the field and on the plans. In general, natural vegetation and native topsoil shall be retained in an undisturbed state to the maximum extent possible.

   Existing trees and vegetation will be preserved as shown on the TESC plans. Tree preservation will be accomplished using chain link fencing positioned around the perimeter of the areas to be preserved. Installation of fencing to delineate and secure each construction phase will occur before the clearing and grubbing operations of each phase commences.

2. **Establish Construction Access** - Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public and private constructed roads. Wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering waters of the State. All wash wastewater shall be controlled on-site.

   A stabilized construction entrance and wheel wash will be constructed, as located on the TESC plans, at the beginning of each phase of the Project and prior to the

commencement of clearing and grubbing. As construction progresses, these facilities will be adjusted/modified by the Contractor to accommodate different stages of construction.

3. **Control Flow Rates** - To protect the properties and waterways downstream of the Project site, stormwater discharges from the site will be controlled. As the Project Site currently outfalls to the Puget Sound, the control of flows will not always be necessary. Bypasses will be installed at the beginning of each phase to reroute storm water runoff that is currently flowing on to the site around the proposed construction in a dedicated system to the existing outfall.

4. **Install Sediment Controls** - All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction-site or prior to being discharged to an infiltration facility.

   For each phase, interceptor dikes or gravel filter berms will be installed around the perimeter of the construction area. Catch basin filters will be installed in existing and proposed catch basins throughout the site and along Richmond Beach Drive as shown on the TESC plans. Straw wattles will be used, as needed, to disperse stormwater flows and lower the velocities of stormwater in drainage swales and on slopes. Portable water storage tanks and other approved treatment systems may be used to remove sediment from stormwater runoff. Sediment control BMPs will be installed and operational prior to the commencement of clearing and grubbing.

5. **Stabilize Soils** - Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the Project.

   For each phase, temporary seeding and mulching will be used, as necessary, to stabilize exposed soils and protect against erosion. Erosion control nets and blankets will be used to line drainage swales and provide erosion protection. Plastic covering will be utilized, as necessary, to protect temporary slopes (such as those created during the construction of retaining walls and stockpiles) and minimize the erosion of topsoil and stockpiles during periods of heavy rain. During dry weather periods, water will be used to spray down project areas that may generate large amounts of dust. In areas of proposed paving, the gravel base course will be installed as soon as feasible after grading has been completed. The gravel base course will both stabilize soils and provide erosion protection. However, the base course for porous pavement shall be protected after installation from sediment. All soil stabilization BMPs will be implemented as soon as practical after soil disturbance.

6. **Protect Slopes** - All cut and fill slopes will be designed, constructed, and protected in a manner that minimizes erosion.

For each phase, grass lined channels, or interceptor dikes and swales will be utilized, as shown on the TESC plans, to intercept and divert stormwater from running down a slope to either the stormwater bypass (for clean offsite runoff) or to a sediment control facility. These BMP's will be constructed prior to slope excavation.

7. **Protect Drain Inlets** - All new and existing storm drain inlets and culverts made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the priority will be to keep all access roads free of sediment and to keep street wash water from entering storm drains until treatment can be provided. Storm Drain Inlet Protection (BMP C220) will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the Project site. All inlet protection measures shall be in place before commencement of soil disturbance activities.

8. **Stabilize Channels and Outlets** - Where site runoff is to be conveyed in channels or discharged to a stream or some other natural drainage point, efforts will be taken to prevent downstream erosion.

   Either grass or engineered channel lining will be used as lining for interceptor swales. Check dams and Triangular Silt Dikes will be used to slow the velocities in the channels. Outlet protection will protect soils at the outfalls. Due to the topography of the site, it is anticipated that interceptor dikes and channels will drain to sumps, from which they will be pumped via a collection manifold (system of surface placed water tight pipes) to a storage tank/portable treatment system. Installation of these BMPs will immediately follow excavation of swales and be installed before they are subjected to stormwater flows.

9. **Control Pollutants** - All pollutants, including waste materials and demolition debris, that occur on-site shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well-organized, and free of debris.

10. **Control Dewatering** - All dewatering water from open cut excavation, tunneling, foundation work, trenching, or underground vaults shall be discharged into a controlled conveyance system prior to being discharged to a sediment trap, sediment pond, or filtration treatment system. Channels will be stabilized, per Element #8- Stabilize Channels and Outlets. Clean, non-contaminated, non-turbid dewatering water will not be routed through stormwater sediment ponds, and will be discharged to systems tributary to the receiving waters of the State in a manner that does not cause erosion, flooding, or a violation of State water quality standards in the receiving water. Contaminated and/or highly turbid dewatering water from soils known or suspected to be contaminated, or from use of construction

equipment, will require additional monitoring and treatment as required for the specific pollutants based on the receiving waters into which the discharge is occurring.

11. **Maintain BMPs** - All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired, as needed, to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specification. Visual monitoring of the BMPs will be conducted at least once a day, prior to any forecasted rain and within 24 hours of any rainfall event that causes a discharge from the site. If the site becomes inactive and is temporarily stabilized, the inspection frequency will be reduced to once every month and within 24 hours of any rainfall event that causes a discharge from the site.

    All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on-site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

12. **Manage the Project** - Erosion and sediment control BMPs for this Project have been designed based on the following principles:
    - Design the Project to fit the existing topography, soils, and drainage patterns.
    - Emphasize erosion control rather than sediment control.
    - Minimize the extent and duration of the area exposed.
    - Keep runoff velocities low.
    - Retain sediment on-site.
    - Thoroughly monitor site and maintain all ESC measures.
    - Schedule major earthwork during the dry season, if possible.

    In addition, project management will incorporate the following key components: phasing of construction, seasonal work limitations, coordination with utilities and other jurisdictions, and maintaining an updated SWPPP.

13. **Protect Low Impact Development BMPs** – Due to the environmental remediation required for the site, no LID facilities are proposed for the site.

Erosion Control Best Management Practices (BMPs)

A Stormwater Pollution Prevention Plan (SWPPP) has been prepared for the Project development as part of the Project's Urban Center submittal. The SWPPP outlines the proposed Erosion Control BMP's that will be implemented during construction to prevent the transport of sediment and other impacts that increase runoff during the land disturbing activities of clearing and grading. A summary of the erosion and sedimentation control best management practices for the Project included in the SWPPP include the following:

Clearing Limits

Prior to any clearing or grading activities, clearing limits shown on the Plans will be visibly delineated in the field.

Cover Measures

Temporary cover (e.g. plastic cover, mulch, etc.) will be installed if a disturbed area is to remain untouched. Any area to remain undisturbed for more than 7 days in the dry season (may 1 to September 30) and two days during the wet season (Oct 1 to April 30) shall be seeded, sodded, or covered, unless the County determines that winter weather makes vegetation establishment unfeasible. During the wet season, slopes and stockpiles 3H:1V or steeper, with more than 10-feet of vertical relief, will be covered if they are to remain undisturbed for more than 12 hours.

Perimeter Protections

Silt fence and wattles or other protection will be used along edges of the Project area where existing contours show the possibility for sediment to leave the site during construction. A sediment trap and/or portable tanks will be used for sediment control during construction.

Traffic Area Stabilization

A stabilized construction entrance and wheel wash will be installed to minimize the tracking of dirt off-site.

Sediment Pond and Portable Filtration System

Surface water collected from disturbed areas of the Project area will be filtered or routed to a temporary sediment pond and portable filtration system prior to release from the site. The sediment pond will be sized in accordance with the SCDM.

Surface Water Collection

Interceptor swales, culverts, slope drains, and stabilized ditches will be used to convey surface runoff to the sediment trap. A sand cone discharge pipe will be installed in the temporary sediment trap to allow sediment-free runoff to connect to the existing storm system.

Dust Control

Water trucks will be used to control dust during construction, as needed. Permanent

erosion and sediment control measures will consist of establishing vegetation in landscape areas, installing buildings and paving, and establishing vegetation in areas disturbed by construction.

C. MINIMUM REQUIREMENT 3 - WATER POLLUTION SOURCE CONTROL FOR NEW DEVELOPMENT

For construction source control see the Stormwater Pollution Prevention Plan dated March 4, 2011. Following full development of the site, there will be typical operations of maintenance of roadways, landscape and paving and operation of sewer pumps stations. Source control BMP's shall be implemented in accordance with SMC 30.63A.515 and identified in Snohomish County Drainage Manual Volume IV, Chapters 3, 4, and 5.

D. MINIMUM REQUIREMENT 4 - PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS AND PROVISIONS OF OFF-SITE MITIGATION

Historical site conditions consist of a relatively small alluvial deposit with several small creeks coming off the hillside to the east, crossing the project, and discharging into Puget Sound. When the site was developed, a large quantity of fill was brought in to raise the site above sea level and the creeks were tight lined on the east side of the property and then routed to a discharge point along Puget Sound.

Currently most of the site discharges to the Puget Sound at Outfall 1 with the exception of the upper bench which discharges partially to Outfall 2 and partially to Outfall 3.

For the developed condition, natural drainage patterns for the site (both historical and existing) will be restored and/or maintained to the maximum extent practicable. Runoff from roughly 45% of the site will sheet flow directly into Puget Sound (originally 25%) because the project removes existing wall structures, and development retreats from the coastline. The remaining runoff from the site will be routed to the existing outfalls with the majority going to Outfalls 1 and 2 and only a small portion going to Outfall 3. Sheet flow will be dispersed prior to being discharged into Puget Sound. Existing outfalls 1, 2, and 3 do not require energy dissipation as they are generally submerged in Puget Sound. For innovative design approach, this project proposes to intercept portion of Chevron creek and divert the flow to a new Chevron Creek Daylighted Watercourse. This new channel will require permitting for a new outfall that will be completed at a future date. This new outfall may also include redirected flow from outfall#1.

E. MINIMUM REQUIREMENT 5 - ON-SITE STORMWATER MANAGEMENT (INCLUDING LID FEASIBILITY ANALYSIS)

On-site stormwater BMPs for the site will be implemented in accordance with SCC 30.63A.525. Per 2.5.5 of the SCDM, the Project must implement List #2 BMPs as the site is a redevelopment project inside an Urban Growth Area. As the Project is exempt from the flow control requirement (Minimum Requirement #7) the LID Performance Standard, bioretention, raingardens, permeable pavement, and full dispersion do not need to be

considered per 2.5.5 of the SCDM; however, BMP T5.13 – Post Construction Soil Quality and Depth, BMP T5.10 – Downspout Full Infiltration Systems, Downspout Dispersion Systems, or Perforated Stub-out Connections, and BMP T5.11 - Concentrated Flow Dispersion or BMP T5.12 – Sheet Flow Dispersion must be implemented if feasible. In addition, the following non-exempt List#2 BMPs must be considered for other hard surfaces: BMP T5.12 – Sheet Flow Dispersion or BMP T5.11 – Concentrated Flow Dispersion.

The following on-site stormwater management BMPs are proposed for the site:

- BMP T5.13 - Post Construction Soil Quality and Depth – Soils on the site will be amended as shown on plan sheet C-020 (See Appendix B).
- BMP T5.10B – Downspout Dispersion Systems – Downspout Dispersion Systems are not feasible for the site due to the limited amount of area which is suitable for dispersion being used to disperse runoff from other, non-roof hard surfaces (See BMP T5.11 below). Perforated stub out connections are also not feasible for the same reason; all areas suitable for stub out connection installations will be used to disperse runoff from other, non-roof hard surfaces.
- BMP T5.11 – Concentrated Flow Dispersion – Concentrated Flow Dispersion is not feasible due to no infiltration facilities within the environmental remediation area for the Point Wells Site.

F. MINIMUM REQUIREMENT 6 - RUNOFF TREATMENT REQUIREMENTS

Drainage areas were identified utilizing a survey provided by David Evans and Associates, dated April 2006 and updated through October 2019.

Per Volume I, Section 2.5.6 of the SCDM, runoff treatment is required as the project has more than 5,000 sf of new pollution generating impervious surface in a threshold discharge area. The Project does not qualify as a “high-use site” per the criteria listed in Volume I, Section 4.2 and therefore, an oil control facility will not be required. Phosphorous treatment will not be required per volume I, Section 4.2 of the SCDM as the Project drains to a saltwater body and a non-fish bearing creek. Enhanced stormwater treatment will also not be required per Volume I, Section 4.2 of the SCDM as the Project does not discharge to fresh waters designated for aquatic life or that have existing aquatic life use, to conveyance systems tributary to such waters, or to stormwater infiltration systems that are not designed to provide treatment in accordance with the requirements of the SCDM and that are within ¼ mile of such waters. Basic water quality treatment will be provided for runoff generated from pollution generating surfaces across the site.

Per Volume V, Chapter 4, Section4.1.2 of the SCDM, stormwater treatment is required for pollution generating surfaces with the design intent of removing 80-percent of total suspended solids (TSS). The water quality flowrate is defined as “the flow rate at or below which 91% of the runoff volume, as estimated by and approved continuous runoff model, will be treated”.

Due to the site being utilized as an asphalt and marine fuels terminal and will require environmental remediation (see Hart Crowser Point Wells Urban Center, Environmental Remediation Approach), Project will not utilize Low Impact Development (LID) strategies such as bioswales, pervious pavements, dispersion, or soil amendment to infiltrate a portion of the site's stormwater runoff. To provide water quality treatment for the Project proprietary treatment facilities manufactured by Contech will be utilized. These Filterra systems are contained within a concrete vault or lined system. The project will meet the enhance water quality requirement as the Filterra water quality systems selected have the Department of Ecology State of Washington General Use Level Designation (GULD). These are technologies whose evaluation report demonstrates confidently it can achieve Ecology's performance goals and is part of the innovative design approach for the project. One "typical" water quality facility has been sized for each type of treatment facility being proposed. "Typical" water quality facility sizing calculations are included in Appendix D. Once the proposed design concept has been accepted, future calculations will provide a complete breakdown of each treatment facility.

G. MINIMUM REQUIREMENT 7 - FLOW CONTROL

Per Volume 1, Chapter 2, Section 2.5.7 of the SCDM, flow control will not be required for the Project as the site discharges directly to the Puget Sound. Existing and proposed stormwater flows for the site were calculated and are provided in the Drainage Information Summary Table on the next page.

DRAINGE BASIN SUMMARY TABLE

Project Total Area	61.19 acres	See C-010 & C-015 for area breakdown
Project Development Area	45.65 acres	See C-010 & C-015 for area breakdown
Number of Lots	3	

Peak Flow Summary***					
	Outfall 1*	Outfall 2	Outfall 3	Coastal Sheet Flow	Ex Stream #2
Ex. On-site Sub-basin Area (Acres)	39.81	1.70	3.34	15.54	0.80
Developed On-site Sub-Basin Area (Acres)	12.10	14.58	2.94	30.77	0.80
Type of Storage Proposed	N/A	N/A	N/A	N/A	N/A
Approx. Storage Volume (cu. Ft)	N/A	N/A	N/A	N/A	N/A
Soil Types (NRCS)	Urban Land	Urban Land	Urban Land	Urban Land	Urban Land
Onsite Predeveloped Runoff Rates (cfs)					
2 yr.	N/C	N/C	N/C	N/C	N/C
10 yr.	N/C	N/C	N/C	N/C	N/C
50 yr,	N/C	N/C	N/C	N/C	N/C
100 yr.	N/C	N/C	N/C	N/C	N/C
Onsite Ex. Coverage Runoff Rates (cfs)					
2 yr.	18.2	0.28	1.16	N/C	0.31
10 yr.	36.5	0.57	2.4	N/C	0.65
50 yr.	57	0.89	3.7	N/C	1
100 yr.	57.3	0.9	3.8	N/C	1
Developed Unconstrained Discharge Rates (cfs)					
2 yr.	3.4	4.42	1.06	N/C	0.08
10 yr.	9	9.8	2.56	N/C	0.17
50 yr.	15.03	15.7	4.28	N/C	0.26
100 yr.	15.11	15.8	4.3	N/C	0.27
Developed Modeled Discharge Rates Through Outfall (cfs) with MHHWL +					
2 yr.	2.94	5.28	N/C	N/C	N/C
10 yr.	6.12	10.81	N/C	N/C	N/C
50 yr.	14.34	17.18	N/C	N/C	N/C
100 yr.	14.41	17.22	N/C	N/C	N/C
Offsite Upstream Area					
Existing Contributing Acreage	0	7.5	80.2	N/C	40
Developed Contributing Acreage	0.69	7.5	79.51	N/C	40
Offsite Downstream Flow					
Q(cfs.) 100 yr.	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

N/C = Not Calculated

*Existing coverage for Outfall 1 exceeds 25 acres, however, rational method was used for consistency between calculation methods.

**Values for Outfalls 1 and 2 shown as peak flow through outfall pipe. Sea water level assumed constant at MHHWL with 100-years of sea level rise. See Appendix G and coastal report for additional information.

***Peak runoff calculated using Rational Method based off impervious/pervious assumptions summarized in Appendix A.

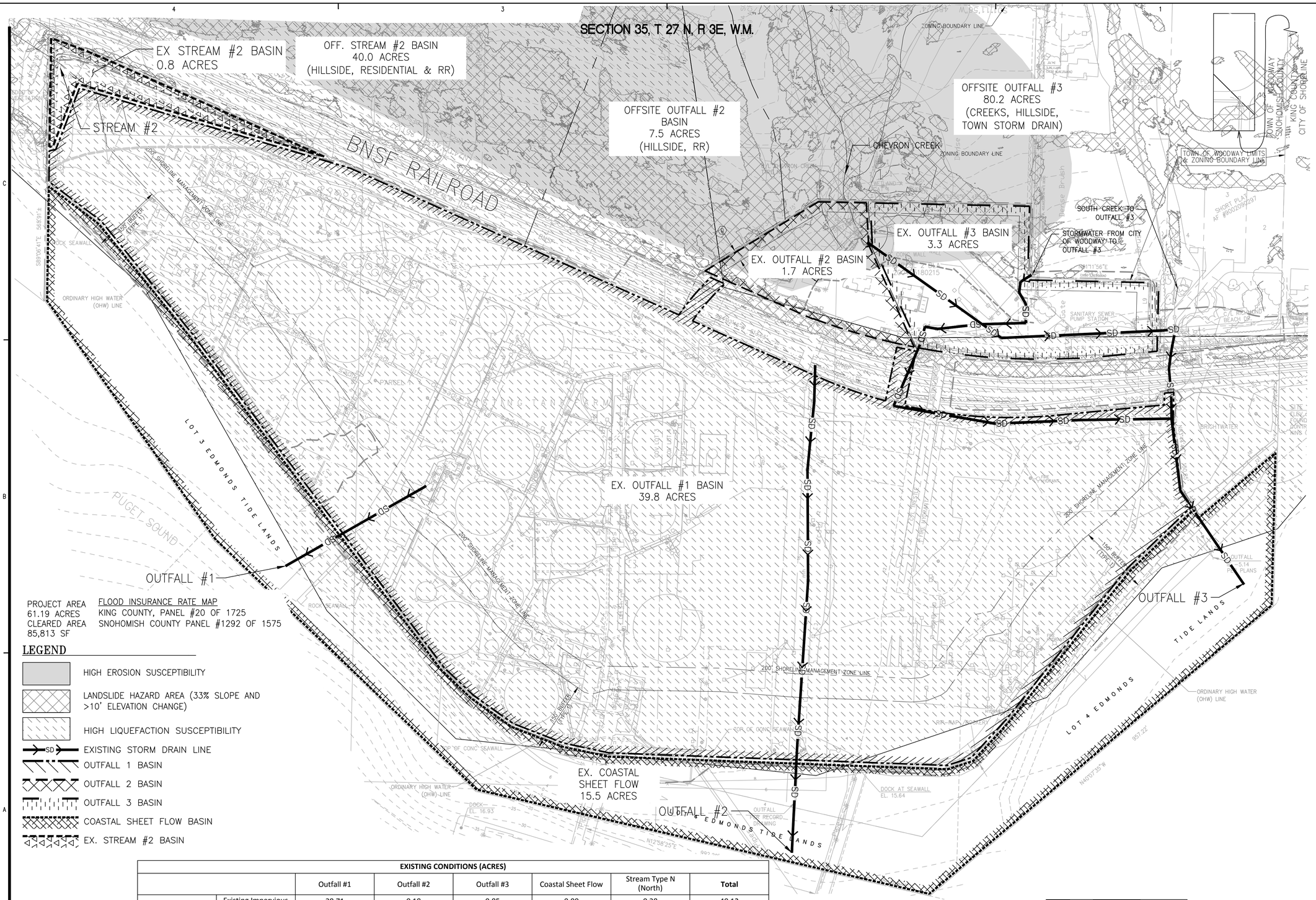
MINIMUM REQUIREMENT 8 – STORMWATER DISCHARGES TO WETLANDS

This minimum requirement is not applicable per SCC 30.63A.570 as the Project discharges neither directly nor indirectly to neither a wetland nor a wetland buffer.

H. MINIMUM REQUIREMENT 9 – OPERATIONS AND MAINTENANCE

Drainage facilities will be inspected, operated, and maintained as described in Appendix E of this report.

APPENDIX A
BASIN MAPS



PROJECT AREA
61.19 ACRES
CLEARED AREA
85,813 SF

FLOOD INSURANCE RATE MAP
KING COUNTY, PANEL #20 OF 1725
SNOHOMISH COUNTY PANEL #1292 OF 1575

LEGEND

- HIGH EROSION SUSCEPTIBILITY
- LANDSLIDE HAZARD AREA (33% SLOPE AND >10' ELEVATION CHANGE)
- HIGH LIQUEFACTION SUSCEPTIBILITY
- SD — EXISTING STORM DRAIN LINE
- OUTFALL 1 BASIN
- OUTFALL 2 BASIN
- OUTFALL 3 BASIN
- COASTAL SHEET FLOW BASIN
- EX. STREAM #2 BASIN

EXISTING CONDITIONS (ACRES)							
		Outfall #1	Outfall #2	Outfall #3	Coastal Sheet Flow	Stream Type N (North)	Total
Onsite	Existing Impervious	38.71	0.18	0.85	0.00	0.38	40.12
	Existing Pervious	1.10	1.52	2.49	15.54	0.42	21.07
	Subtotal	**39.81**	**1.70**	**3.34**	**15.54**	**0.80**	**61.19**
Offsite	Existing Impervious	0	0	44.03	0	11.58	55.61
	Existing Pervious	0.00	7.50	36.173	0.00	28.42	72.09
	Subtotal	**0.00**	**7.50**	**80.20**	**0.00**	**40.00**	**127.70**
Total		**39.81**	**9.20**	**83.54**	**15.54**	**40.80**	**188.89**

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Scale In Feet
100' 50' 0 100' 200'

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Suite 2300
Seattle, WA 98101
t: 206.381.6000
www.perkinswill.com

Point Wells Development

BSRE Point Wells, LP
c/o Karr Tuttle Campbell
701 Fifth Avenue, Suite 3300
Seattle, Washington 98104

in association with:

CIVIL ENGINEER

MIG | SvR
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SEATTLE, WA 98104
T 206.223.0326
F 206.223.0125
www.svrdesign.com

Snohomish County Planning & development Services
APPROVED FOR CONSTRUCTION
By:
Randolph R. Sleight, P.E., P.L.S.
R/W Permit No.

MARK DUANE DAVIES
STATE OF WASHINGTON
36602
REGISTERED
PROFESSIONAL ENGINEER

REV.	ISSUE	DATE
1	CORRECTION	04.18.2017
2	CORRECTION	04.24.2018
3	CORRECTION	12.12.2019

Sheet Information	
Date	12/12/2019
Job Number	169009.000
Drawn	
Checked	
Approved	

Title

On-Site Existing Drainage Basins

Sheet

C-010

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Dec 10, 2019 – 4:29pm
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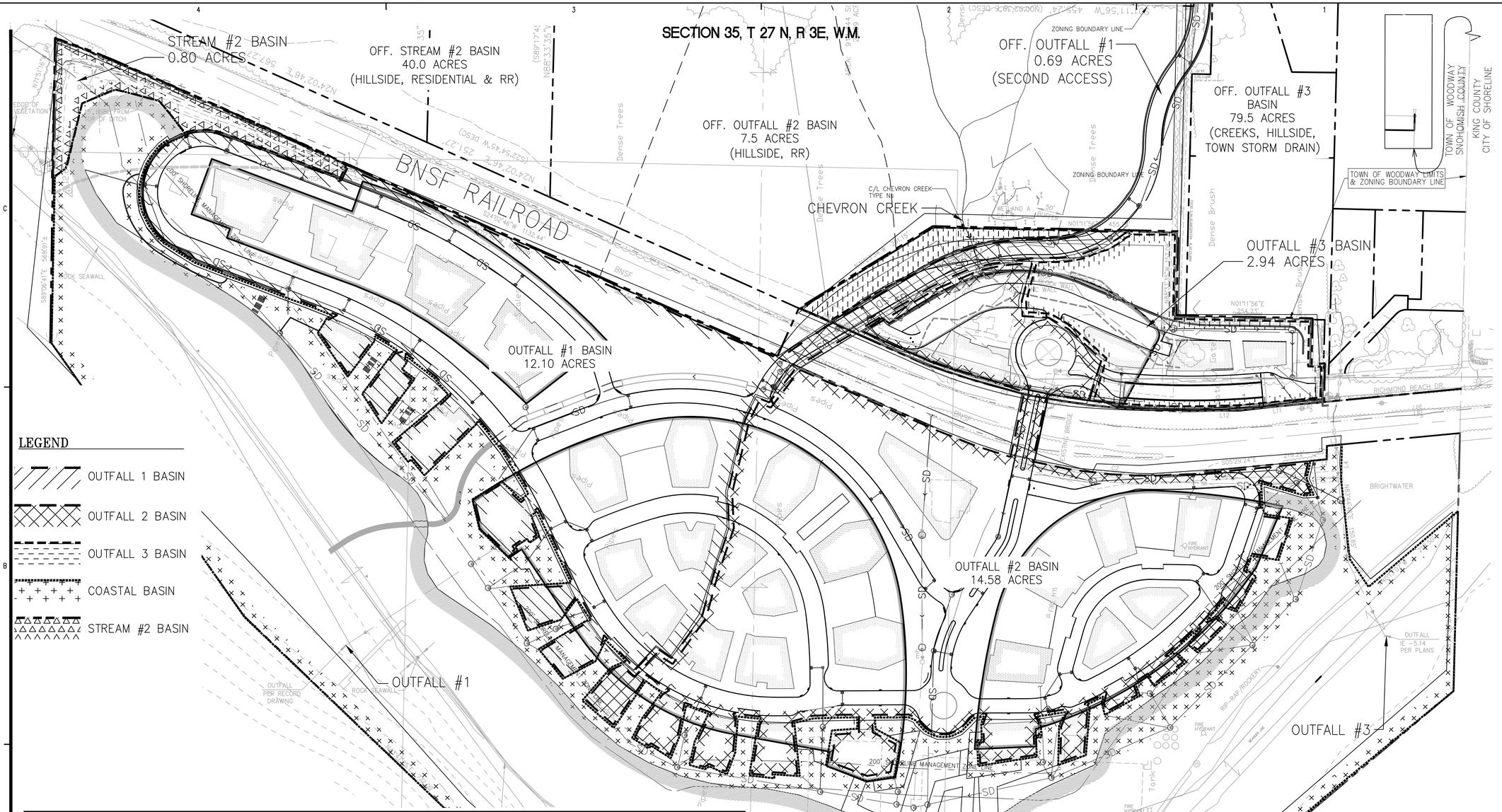

DEVELOPED CONDITIONS (ACRES)							
		Outfall #1	Outfall #2	Outfall #3	Coastal Sheet Flow	Stream Type N (North)	Total
Onsite	Undisturbed Imp	0.00	0.00	0.00	0.00	0.38	
	Undisturbed Perv	0.00	0.00	0.00	14.39	0.00	
	Proposed Impervious	7.55	9.87	1.54	3.20	0.00	
	Pollution Gen Imp Surf	4.30	5.17	1.20	0.00	0.00	
	Proposed Pervious	4.55	4.71	1.40	13.18	0.42	
	Impervious Subtotal	**7.55**	**9.87**	**1.54**	**3.20**	**0.38**	**22.54**
	Pervious Subtotal	**4.55**	**4.71**	**1.40**	**27.57**	**0.42**	**38.65**
	Total	**12.10**	**14.58**	**2.94**	**30.77**	**0.80**	**61.19**
Offsite	Undisturbed Imp	0.00	0.00	44.03	0.00	11.58	
	Undisturbed Perv	0.00	7.50	35.48	0.00	28.42	
	Proposed Impervious	0.59	0.00	0.00	0.00	0.00	
	Pollution Gen Imp Surf	0.59	0.00	0.00	0.00	0.00	
	Proposed Pervious	0.10	0.00	0.00	0.00	0.00	
	Impervious Subtotal	**0.59**	**0.00**	**44.03**	**0.00**	**11.58**	**56.20**
	Pervious Subtotal	**0.10**	**7.50**	**35.48**	**0.00**	**28.42**	**71.50**
	Total	**0.69**	**7.50**	**79.51**	**0.00**	**40.00**	**127.70**
Total		**12.79**	**22.08**	**82.45**	**30.77**	**40.80**	**188.89**

NOTES:

1) 4' OR MORE OF SOIL DEPTH IS ASSUMED TO BE 100% PERVIOUS
2) GREEN ROOF AREAS ARE ASSUMED TO BE 50% IMPERVIOUS, 50% PERVIOUS
3) CONVERTED VEGETATION AREAS ARE ONLY WITHIN OUTFALL #1 AS OFF-SITE PROPOSED PERVIOUS
4) ALL SUBBASINS DRAIN TO A SINGLE THRESHOLD DISCHARGE AREA (PUGET SOUND)
5) ALL IMPERVIOUS SURFACES ARE EFFECTIVE IMPERVIOUS AREAS
6) ALL AREAS ARE IN ACRES

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Sheet Information	
Date	12/12/2019
Job Number	169009.000
Drawn	
Checked	
Approved	

Title

Preliminary Site and Targeted Stormwater Plan

Sheet

C-015

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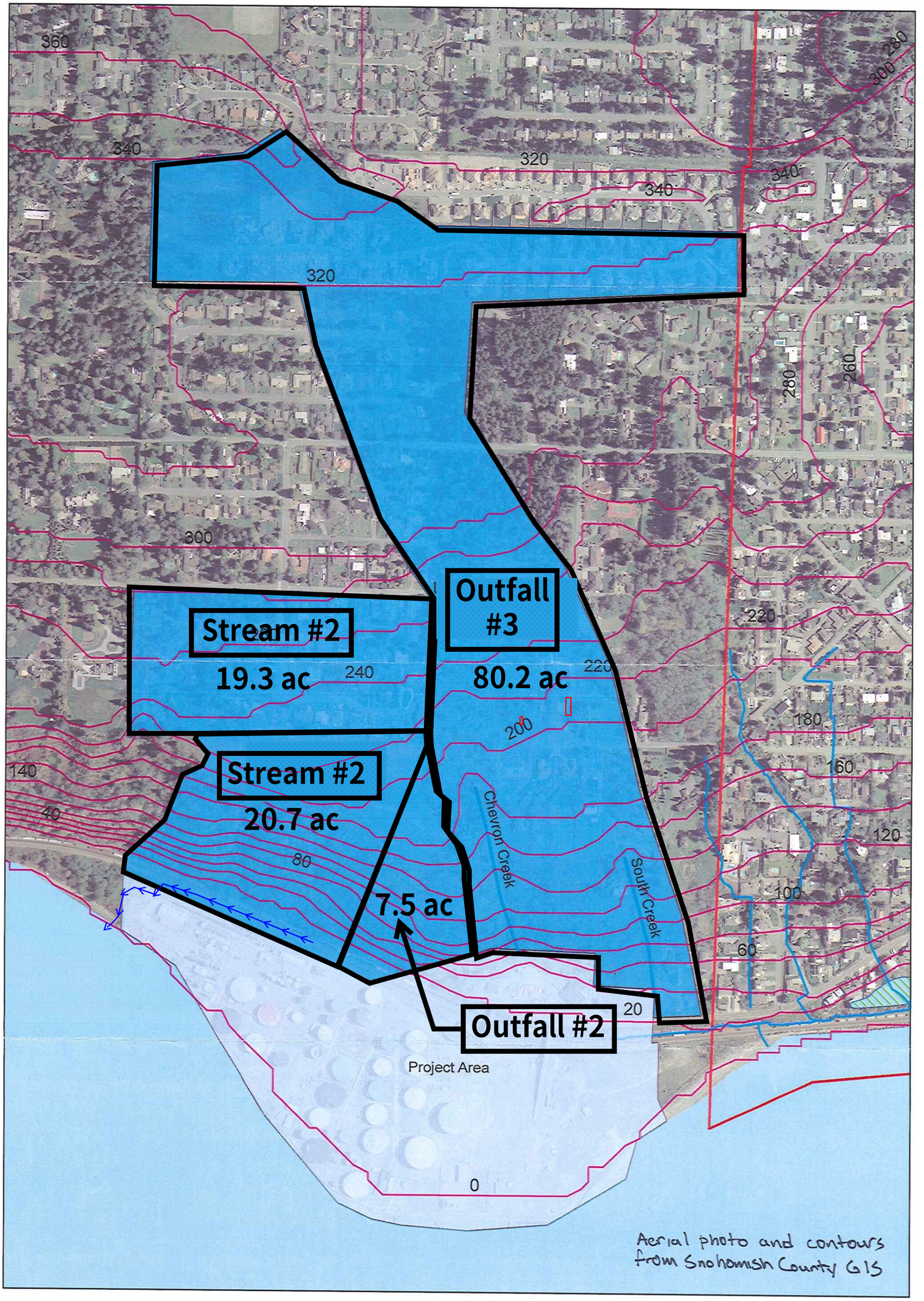
Point Wells - Upstream Drainage Basins



0 200 400 800 1,200 1,600 Feet

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MIG|SvR Project #09038
April 24, 2018

INCLUDED WITH PERMIT SUBMITTAL

APPENDIX B
SITE PLANS

APPENDIX C
SITE PHOTOS

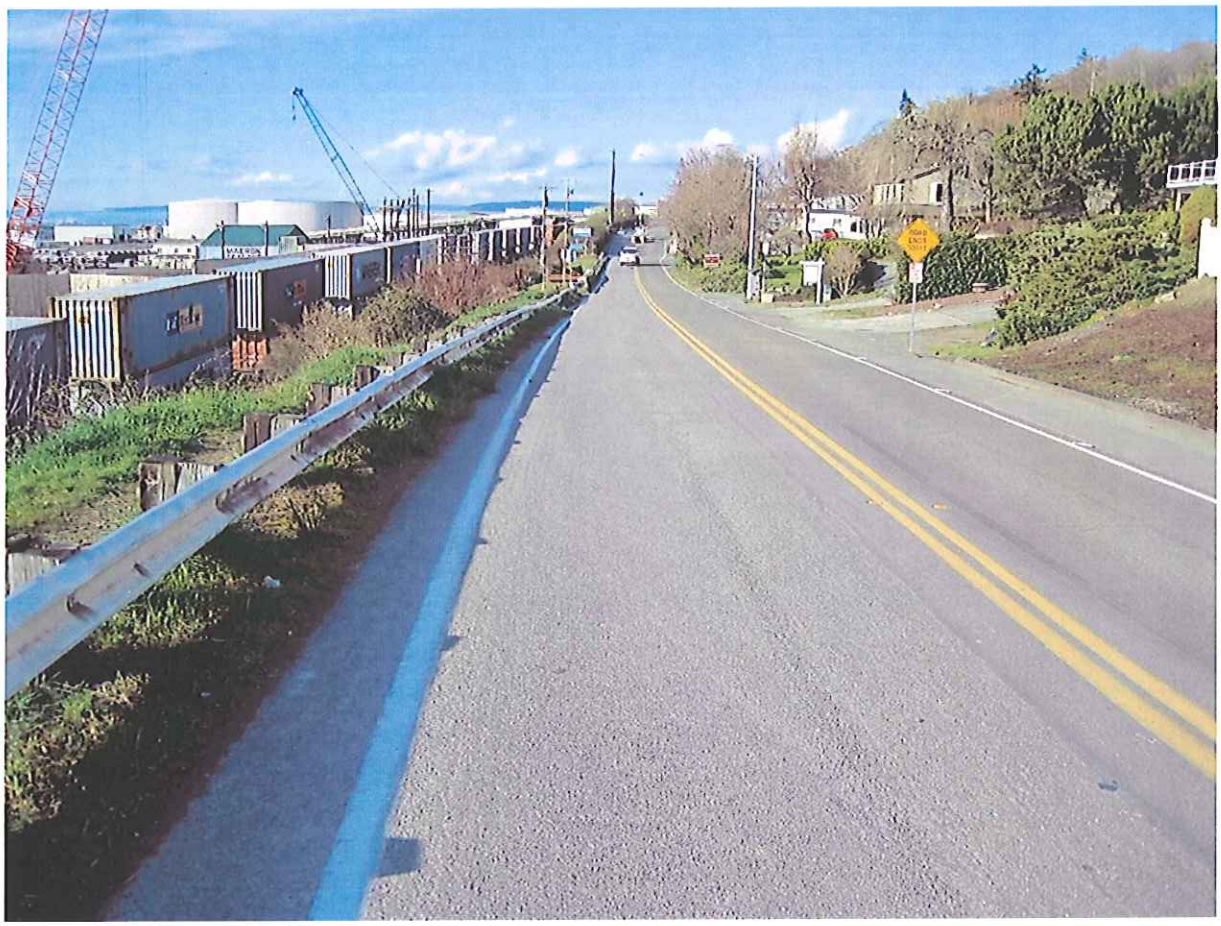


Photo 1. Richmond Beach Drive Looking North Towards Point Wells

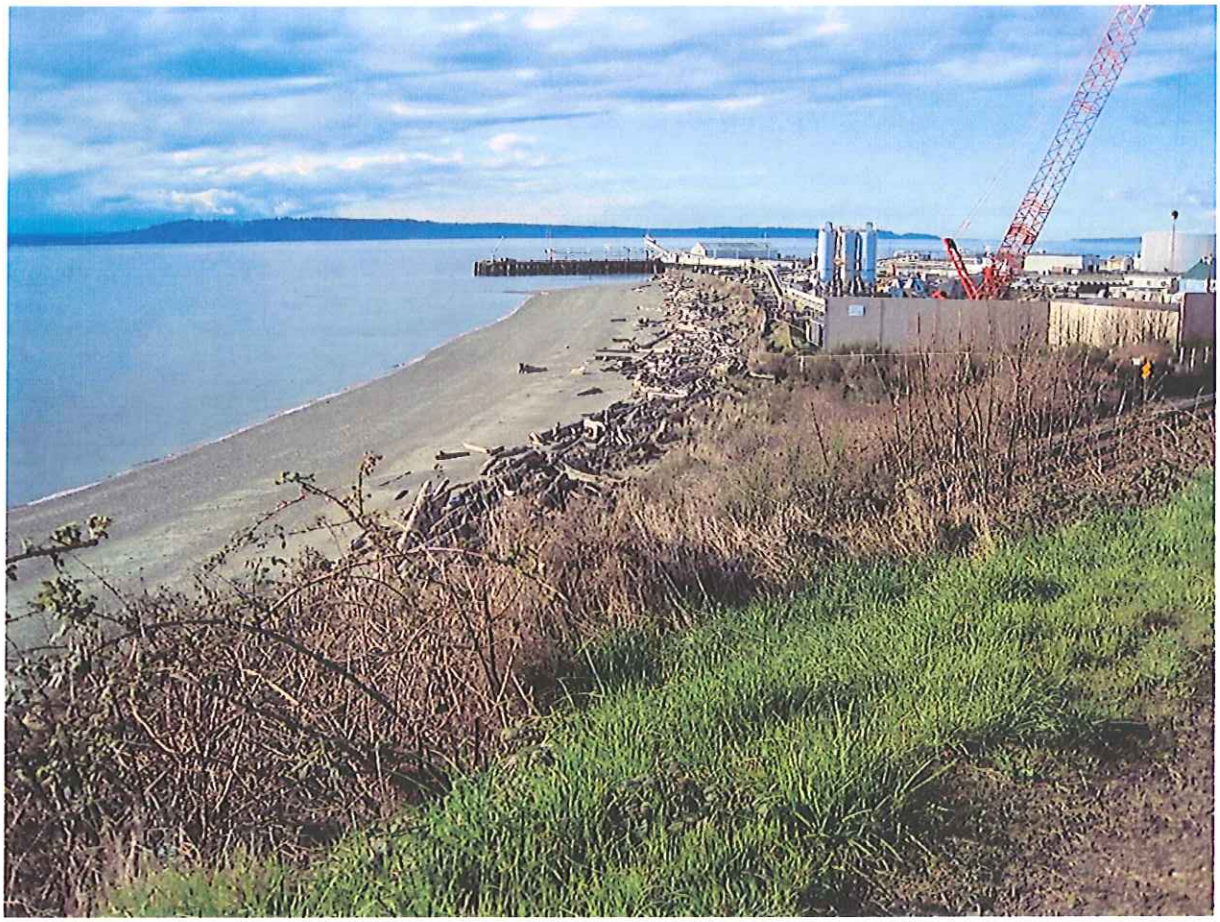


Photo 2. Bright Water – South end of Point Wells

Photo 3. Looking North along BNSF Railroad

Photo 4. Looking South along BNSF Railroad

Photo 5. Discharge to east side of BNSF Railroad

Photo 6. Chevron Creek Sediment Basin prior to Conveyance Pipe

Photo 7. Point Wells Northern Petroleum Plant

Photo 8. Point Wells Northern Asphalt Plant

Photo 9. Point Wells northern ditch west side of BNSF Railroad

APPENDIX D
STORMWATER QUALITY CALCULATIONS

WATER QUALITY SIZING SUMMARY

WWHM2012
PROJECT REPORT

Project Name: default[0]
Site Name:
Site Address:
City :
Report Date: 4/18/2018
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

MITIGATED LAND USE

Filterra Bioscape Planter-301

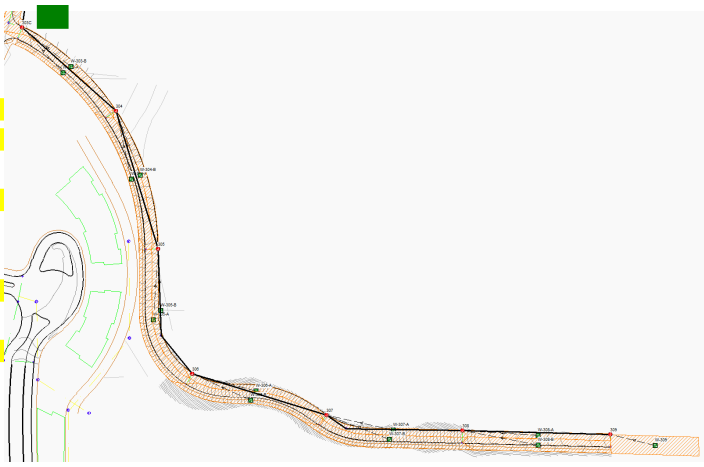
Outfall 1 Basins: W-303 to W-309 (see appendix G)

Name : 10x26
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Mod	.325
Pervious Total	0.325

Impervious Land Use	acre
ROADS MOD	2.01
Impervious Total	2.01
Basin Total	2.335



Element Flows To:

Surface	Interflow	Groundwater
10x26	10x26	

Name : 10x26
Bottom Length: 24.00 ft.
Bottom Width: 10.00 ft.
Depth: 0.75 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1
Filtration On
Hydraulic conductivity: 24.82
Depth of filter medium: 1.8
Total Volume Infiltrated (ac-ft.): 241.189
Total Volume Through Riser (ac-ft.): 13.91
Total Volume Through Facility (ac-ft.): 255.099
Percent Infiltrated: 94.55
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 0.7 ft.
Riser Diameter: 500 in.

Element Flows To:
Outlet 1 **Outlet 2**

Sand Filter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.005	0.000	0.000	0.000
0.0083	0.005	0.000	0.000	0.138
0.0167	0.005	0.000	0.000	0.139
0.0250	0.005	0.000	0.000	0.139
0.0333	0.005	0.000	0.000	0.140
0.0417	0.005	0.000	0.000	0.141
0.0500	0.005	0.000	0.000	0.141
0.0583	0.005	0.000	0.000	0.142
0.0667	0.005	0.000	0.000	0.143
0.0750	0.005	0.000	0.000	0.143
0.0833	0.005	0.000	0.000	0.144
0.0917	0.005	0.000	0.000	0.144
0.1000	0.005	0.000	0.000	0.145
0.1083	0.005	0.000	0.000	0.146
0.1167	0.005	0.000	0.000	0.146
0.1250	0.005	0.000	0.000	0.147
0.1333	0.005	0.000	0.000	0.148
0.1417	0.005	0.000	0.000	0.148
0.1500	0.005	0.000	0.000	0.149
0.1583	0.005	0.000	0.000	0.150
0.1667	0.005	0.000	0.000	0.150
0.1750	0.005	0.001	0.000	0.151
0.1833	0.005	0.001	0.000	0.151
0.1917	0.005	0.001	0.000	0.152
0.2000	0.005	0.001	0.000	0.153
0.2083	0.005	0.001	0.000	0.153
0.2167	0.005	0.001	0.000	0.154

0.2250	0.005	0.001	0.000	0.155
0.2333	0.005	0.001	0.000	0.155
0.2417	0.005	0.001	0.000	0.156
0.2500	0.005	0.001	0.000	0.157
0.2583	0.005	0.001	0.000	0.157
0.2667	0.005	0.001	0.000	0.158
0.2750	0.005	0.001	0.000	0.159
0.2833	0.005	0.001	0.000	0.159
0.2917	0.005	0.001	0.000	0.160
0.3000	0.005	0.001	0.000	0.160
0.3083	0.005	0.001	0.000	0.161
0.3167	0.005	0.001	0.000	0.162
0.3250	0.005	0.001	0.000	0.162
0.3333	0.005	0.001	0.000	0.163
0.3417	0.005	0.001	0.000	0.164
0.3500	0.005	0.001	0.000	0.164
0.3583	0.005	0.002	0.000	0.165
0.3667	0.005	0.002	0.000	0.166
0.3750	0.005	0.002	0.000	0.166
0.3833	0.005	0.002	0.000	0.167
0.3917	0.005	0.002	0.000	0.167
0.4000	0.005	0.002	0.000	0.168
0.4083	0.005	0.002	0.000	0.169
0.4167	0.005	0.002	0.000	0.169
0.4250	0.005	0.002	0.000	0.170
0.4333	0.005	0.002	0.000	0.171
0.4417	0.005	0.002	0.000	0.171
0.4500	0.005	0.002	0.000	0.172
0.4583	0.005	0.002	0.000	0.173
0.4667	0.005	0.002	0.000	0.173
0.4750	0.005	0.002	0.000	0.174
0.4833	0.005	0.002	0.000	0.174
0.4917	0.005	0.002	0.000	0.175
0.5000	0.005	0.002	0.000	0.176
0.5083	0.005	0.002	0.000	0.176
0.5167	0.005	0.002	0.000	0.177
0.5250	0.005	0.002	0.000	0.178
0.5333	0.005	0.002	0.000	0.178
0.5417	0.005	0.003	0.000	0.179
0.5500	0.005	0.003	0.000	0.180
0.5583	0.005	0.003	0.000	0.180
0.5667	0.005	0.003	0.000	0.181
0.5750	0.005	0.003	0.000	0.181
0.5833	0.005	0.003	0.000	0.182
0.5917	0.005	0.003	0.000	0.183
0.6000	0.005	0.003	0.000	0.183
0.6083	0.005	0.003	0.000	0.184
0.6167	0.005	0.003	0.000	0.185
0.6250	0.005	0.003	0.000	0.185
0.6333	0.005	0.003	0.000	0.186
0.6417	0.005	0.003	0.000	0.187
0.6500	0.005	0.003	0.000	0.187
0.6583	0.005	0.003	0.000	0.188
0.6667	0.005	0.003	0.000	0.189
0.6750	0.005	0.003	0.000	0.189
0.6833	0.005	0.003	0.000	0.190
0.6917	0.005	0.003	0.000	0.190

0.7000	0.005	0.003	0.000	0.191
0.7083	0.005	0.003	0.336	0.192
0.7167	0.005	0.003	0.952	0.192
0.7250	0.005	0.004	1.749	0.193
0.7333	0.005	0.004	2.693	0.194
0.7417	0.005	0.004	3.764	0.194
0.7500	0.005	0.004	4.947	0.195
0.7583	0.005	0.004	6.234	0.196

Name : 6x10
Bypass: No

GroundWater: No

Filterra Vault 302-1
Outfall 1 Basins: W-301 TO W-302
(see appendix G)

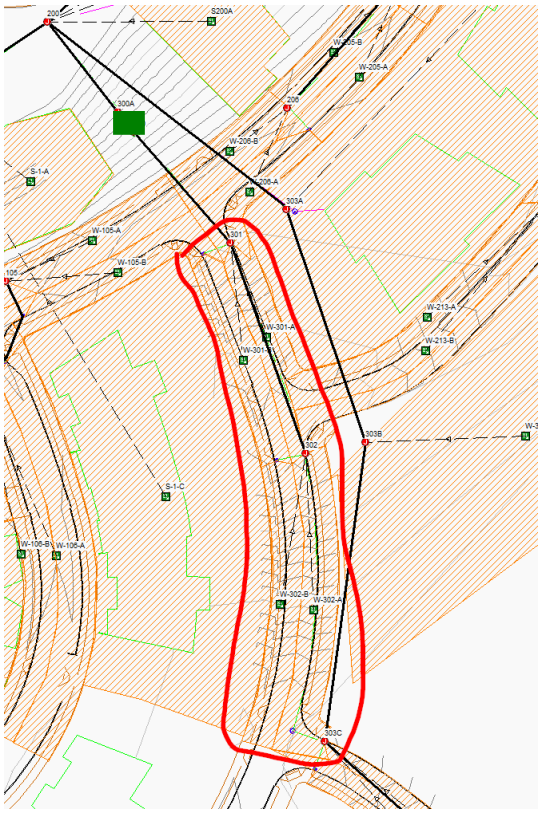
Pervious Land Use	**acre**
C, Lawn, Mod	**.09**
Pervious Total	**0.09**

Impervious Land Use	**acre**
ROADS MOD	**0.43**
Impervious Total	**0.43**
Basin Total	**0.52**

Element Flows To:

Surface	**Interflow**	**Groundwater**
6x10	6x10	

Name : 6x10
Bottom Length: 6.00 ft.
Bottom Width: 10.00 ft.
Depth: 0.75 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1
Filtration On
Hydraulic conductivity: 24.82
Depth of filter medium: 1.8
Total Volume Infiltrated (ac-ft.): 51.711
Total Volume Through Riser (ac-ft.): 2.103
Total Volume Through Facility (ac-ft.): 53.814
Percent Infiltrated: 96.09
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 0.7 ft.
Riser Diameter: 100 in.



Element Flows To:
Outlet 1 **Outlet 2**

Sand Filter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.001377	0.000000	0.000	0.000
0.0083	0.001377	0.000011	0.000	0.034
0.0167	0.001377	0.000023	0.000	0.034
0.0250	0.001377	0.000034	0.000	0.035
0.0333	0.001377	0.000046	0.000	0.035
0.0417	0.001377	0.000057	0.000	0.035
0.0500	0.001377	0.000069	0.000	0.035
0.0583	0.001377	0.000080	0.000	0.035
0.0667	0.001377	0.000092	0.000	0.035
0.0750	0.001377	0.000103	0.000	0.035
0.0833	0.001377	0.000115	0.000	0.036
0.0917	0.001377	0.000126	0.000	0.036
0.1000	0.001377	0.000138	0.000	0.036
0.1083	0.001377	0.000149	0.000	0.036
0.1167	0.001377	0.000161	0.000	0.036
0.1250	0.001377	0.000172	0.000	0.036
0.1333	0.001377	0.000184	0.000	0.037
0.1417	0.001377	0.000195	0.000	0.037
0.1500	0.001377	0.000207	0.000	0.037
0.1583	0.001377	0.000218	0.000	0.037
0.1667	0.001377	0.000230	0.000	0.037
0.1750	0.001377	0.000241	0.000	0.037
0.1833	0.001377	0.000253	0.000	0.038
0.1917	0.001377	0.000264	0.000	0.038
0.2000	0.001377	0.000275	0.000	0.038
0.2083	0.001377	0.000287	0.000	0.038
0.2167	0.001377	0.000298	0.000	0.038
0.2250	0.001377	0.000310	0.000	0.038
0.2333	0.001377	0.000321	0.000	0.038
0.2417	0.001377	0.000333	0.000	0.039
0.2500	0.001377	0.000344	0.000	0.039
0.2583	0.001377	0.000356	0.000	0.039
0.2667	0.001377	0.000367	0.000	0.039
0.2750	0.001377	0.000379	0.000	0.039
0.2833	0.001377	0.000390	0.000	0.039
0.2917	0.001377	0.000402	0.000	0.040
0.3000	0.001377	0.000413	0.000	0.040
0.3083	0.001377	0.000425	0.000	0.040
0.3167	0.001377	0.000436	0.000	0.040
0.3250	0.001377	0.000448	0.000	0.040
0.3333	0.001377	0.000459	0.000	0.040
0.3417	0.001377	0.000471	0.000	0.041
0.3500	0.001377	0.000482	0.000	0.041
0.3583	0.001377	0.000494	0.000	0.041
0.3667	0.001377	0.000505	0.000	0.041
0.3750	0.001377	0.000517	0.000	0.041
0.3833	0.001377	0.000528	0.000	0.041
0.3917	0.001377	0.000539	0.000	0.042

0.4000	0.001377	0.000551	0.000	0.042
0.4083	0.001377	0.000562	0.000	0.042
0.4167	0.001377	0.000574	0.000	0.042
0.4250	0.001377	0.000585	0.000	0.042
0.4333	0.001377	0.000597	0.000	0.042
0.4417	0.001377	0.000608	0.000	0.042
0.4500	0.001377	0.000620	0.000	0.043
0.4583	0.001377	0.000631	0.000	0.043
0.4667	0.001377	0.000643	0.000	0.043
0.4750	0.001377	0.000654	0.000	0.043
0.4833	0.001377	0.000666	0.000	0.043
0.4917	0.001377	0.000677	0.000	0.043
0.5000	0.001377	0.000689	0.000	0.044
0.5083	0.001377	0.000700	0.000	0.044
0.5167	0.001377	0.000712	0.000	0.044
0.5250	0.001377	0.000723	0.000	0.044
0.5333	0.001377	0.000735	0.000	0.044
0.5417	0.001377	0.000746	0.000	0.044
0.5500	0.001377	0.000758	0.000	0.045
0.5583	0.001377	0.000769	0.000	0.045
0.5667	0.001377	0.000781	0.000	0.045
0.5750	0.001377	0.000792	0.000	0.045
0.5833	0.001377	0.000803	0.000	0.045
0.5917	0.001377	0.000815	0.000	0.045
0.6000	0.001377	0.000826	0.000	0.046
0.6083	0.001377	0.000838	0.000	0.046
0.6167	0.001377	0.000849	0.000	0.046
0.6250	0.001377	0.000861	0.000	0.046
0.6333	0.001377	0.000872	0.000	0.046
0.6417	0.001377	0.000884	0.000	0.046
0.6500	0.001377	0.000895	0.000	0.046
0.6583	0.001377	0.000907	0.000	0.047
0.6667	0.001377	0.000918	0.000	0.047
0.6750	0.001377	0.000930	0.000	0.047
0.6833	0.001377	0.000941	0.000	0.047
0.6917	0.001377	0.000953	0.000	0.047
0.7000	0.001377	0.000964	0.000	0.047
0.7083	0.001377	0.000976	0.067	0.048
0.7167	0.001377	0.000987	0.190	0.048
0.7250	0.001377	0.000999	0.349	0.048
0.7333	0.001377	0.001010	0.538	0.048
0.7417	0.001377	0.001022	0.752	0.048
0.7500	0.001377	0.001033	0.989	0.048
0.7583	0.001377	0.001045	1.246	0.049

Name : 6x8
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Mod	**.13**

Pervious Total **0.13**

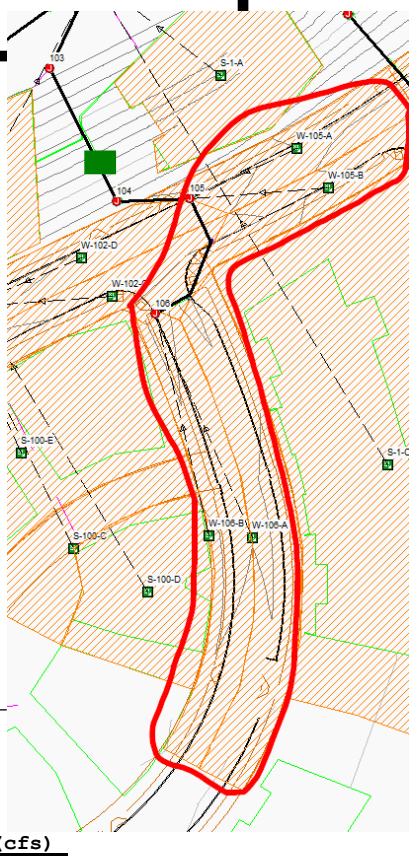
Impervious Land Use	**acre**

ROADS MOD	**0.57**
Impervious Total	**0.57**
Basin Total	**0.7**

Element Flows To:

Surface	**Interflow**	**Groundwater**
6x8	6x8	

Filterra Vault 302-2
Outfall 1 Basins: W-105 TO W-106
(see appendix G)



Name : 6x8
Bottom Length: 6.00 ft.
Bottom Width: 10.00 ft.
Depth: 0.75 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1
Filtration On
Hydraulic conductivity: 24.82
Depth of filter medium: 1.8
Total Volume Infiltrated (ac-ft.): 67.107
Total Volume Through Riser (ac-ft.): 5.25
Total Volume Through Facility (ac-ft.): 72.356
Percent Infiltrated: 92.75
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 0.7 ft.
Riser Diameter: 100 in.

Element Flows To:

Outlet 1	**Outlet 2**

Sand Filter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.001377	0.000000	0.000	0.000
0.0083	0.001377	0.000011	0.000	0.034
0.0167	0.001377	0.000023	0.000	0.034
0.0250	0.001377	0.000034	0.000	0.035
0.0333	0.001377	0.000046	0.000	0.035
0.0417	0.001377	0.000057	0.000	0.035
0.0500	0.001377	0.000069	0.000	0.035
0.0583	0.001377	0.000080	0.000	0.035
0.0667	0.001377	0.000092	0.000	0.035
0.0750	0.001377	0.000103	0.000	0.035
0.0833	0.001377	0.000115	0.000	0.036
0.0917	0.001377	0.000126	0.000	0.036

0.1000	0.001377	0.000138	0.000	0.036
0.1083	0.001377	0.000149	0.000	0.036
0.1167	0.001377	0.000161	0.000	0.036
0.1250	0.001377	0.000172	0.000	0.036
0.1333	0.001377	0.000184	0.000	0.037
0.1417	0.001377	0.000195	0.000	0.037
0.1500	0.001377	0.000207	0.000	0.037
0.1583	0.001377	0.000218	0.000	0.037
0.1667	0.001377	0.000230	0.000	0.037
0.1750	0.001377	0.000241	0.000	0.037
0.1833	0.001377	0.000253	0.000	0.038
0.1917	0.001377	0.000264	0.000	0.038
0.2000	0.001377	0.000275	0.000	0.038
0.2083	0.001377	0.000287	0.000	0.038
0.2167	0.001377	0.000298	0.000	0.038
0.2250	0.001377	0.000310	0.000	0.038
0.2333	0.001377	0.000321	0.000	0.038
0.2417	0.001377	0.000333	0.000	0.039
0.2500	0.001377	0.000344	0.000	0.039
0.2583	0.001377	0.000356	0.000	0.039
0.2667	0.001377	0.000367	0.000	0.039
0.2750	0.001377	0.000379	0.000	0.039
0.2833	0.001377	0.000390	0.000	0.039
0.2917	0.001377	0.000402	0.000	0.040
0.3000	0.001377	0.000413	0.000	0.040
0.3083	0.001377	0.000425	0.000	0.040
0.3167	0.001377	0.000436	0.000	0.040
0.3250	0.001377	0.000448	0.000	0.040
0.3333	0.001377	0.000459	0.000	0.040
0.3417	0.001377	0.000471	0.000	0.041
0.3500	0.001377	0.000482	0.000	0.041
0.3583	0.001377	0.000494	0.000	0.041
0.3667	0.001377	0.000505	0.000	0.041
0.3750	0.001377	0.000517	0.000	0.041
0.3833	0.001377	0.000528	0.000	0.041
0.3917	0.001377	0.000539	0.000	0.042
0.4000	0.001377	0.000551	0.000	0.042
0.4083	0.001377	0.000562	0.000	0.042
0.4167	0.001377	0.000574	0.000	0.042
0.4250	0.001377	0.000585	0.000	0.042
0.4333	0.001377	0.000597	0.000	0.042
0.4417	0.001377	0.000608	0.000	0.042
0.4500	0.001377	0.000620	0.000	0.043
0.4583	0.001377	0.000631	0.000	0.043
0.4667	0.001377	0.000643	0.000	0.043
0.4750	0.001377	0.000654	0.000	0.043
0.4833	0.001377	0.000666	0.000	0.043
0.4917	0.001377	0.000677	0.000	0.043
0.5000	0.001377	0.000689	0.000	0.044
0.5083	0.001377	0.000700	0.000	0.044
0.5167	0.001377	0.000712	0.000	0.044
0.5250	0.001377	0.000723	0.000	0.044
0.5333	0.001377	0.000735	0.000	0.044
0.5417	0.001377	0.000746	0.000	0.044
0.5500	0.001377	0.000758	0.000	0.045
0.5583	0.001377	0.000769	0.000	0.045
0.5667	0.001377	0.000781	0.000	0.045

0.5750	0.001377	0.000792	0.000	0.045
0.5833	0.001377	0.000803	0.000	0.045
0.5917	0.001377	0.000815	0.000	0.045
0.6000	0.001377	0.000826	0.000	0.046
0.6083	0.001377	0.000838	0.000	0.046
0.6167	0.001377	0.000849	0.000	0.046
0.6250	0.001377	0.000861	0.000	0.046
0.6333	0.001377	0.000872	0.000	0.046
0.6417	0.001377	0.000884	0.000	0.046
0.6500	0.001377	0.000895	0.000	0.046
0.6583	0.001377	0.000907	0.000	0.047
0.6667	0.001377	0.000918	0.000	0.047
0.6750	0.001377	0.000930	0.000	0.047
0.6833	0.001377	0.000941	0.000	0.047
0.6917	0.001377	0.000953	0.000	0.047
0.7000	0.001377	0.000964	0.000	0.047
0.7083	0.001377	0.000976	0.067	0.048
0.7167	0.001377	0.000987	0.190	0.048
0.7250	0.001377	0.000999	0.349	0.048
0.7333	0.001377	0.001010	0.538	0.048
0.7417	0.001377	0.001022	0.752	0.048
0.7500	0.001377	0.001033	0.989	0.048
0.7583	0.001377	0.001045	1.246	0.049

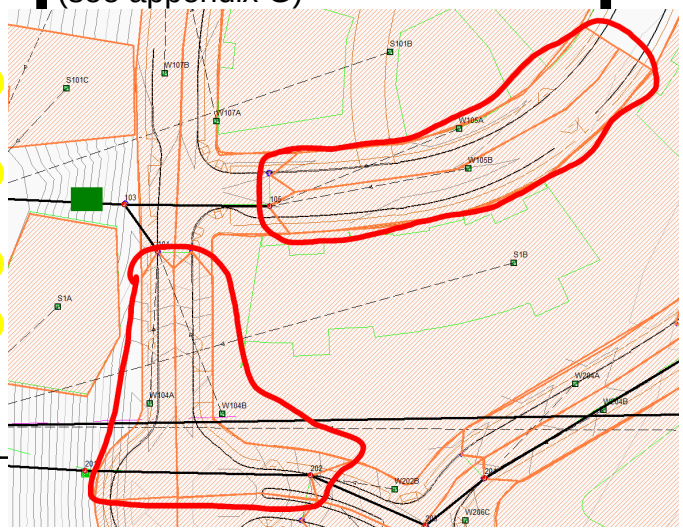
Name : 6x12
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Mod	**.08**
Pervious Total	**0.08**

Impervious Land Use	**acre**
ROADS MOD	**0.37**
Impervious Total	**0.37**
Basin Total	**0.45**

Filterra Vault 302-5
Outfall 2 Basins: W-104 TO W-105
(see appendix G)



Element Flows To:

Surface	**Interflow**	**Groundwater**
6x12	6x12	

Name : 6x12
Bottom Length: 6.00 ft.
Bottom Width: 8.00 ft.
Depth: 0.75 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1
Filtration On
Hydraulic conductivity: 24.82
Depth of filter medium: 1.8
Total Volume Infiltrated (ac-ft.): 44.054
Total Volume Through Riser (ac-ft.): 2.144
Total Volume Through Facility (ac-ft.): 46.198
Percent Infiltrated: 95.36
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 0.7 ft.
Riser Diameter: 100 in.

Element Flows To:
Outlet 1 **Outlet 2**

Sand Filter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.001102	0.000000	0.000	0.000
0.0083	0.001102	0.000009	0.000	0.027
0.0167	0.001102	0.000018	0.000	0.027
0.0250	0.001102	0.000028	0.000	0.028
0.0333	0.001102	0.000037	0.000	0.028
0.0417	0.001102	0.000046	0.000	0.028
0.0500	0.001102	0.000055	0.000	0.028
0.0583	0.001102	0.000064	0.000	0.028
0.0667	0.001102	0.000073	0.000	0.028
0.0750	0.001102	0.000083	0.000	0.028
0.0833	0.001102	0.000092	0.000	0.028
0.0917	0.001102	0.000101	0.000	0.029
0.1000	0.001102	0.000110	0.000	0.029
0.1083	0.001102	0.000119	0.000	0.029
0.1167	0.001102	0.000129	0.000	0.029
0.1250	0.001102	0.000138	0.000	0.029
0.1333	0.001102	0.000147	0.000	0.029
0.1417	0.001102	0.000156	0.000	0.029
0.1500	0.001102	0.000165	0.000	0.029
0.1583	0.001102	0.000174	0.000	0.030
0.1667	0.001102	0.000184	0.000	0.030
0.1750	0.001102	0.000193	0.000	0.030
0.1833	0.001102	0.000202	0.000	0.030
0.1917	0.001102	0.000211	0.000	0.030
0.2000	0.001102	0.000220	0.000	0.030
0.2083	0.001102	0.000230	0.000	0.030
0.2167	0.001102	0.000239	0.000	0.030

0.2250	0.001102	0.000248	0.000	0.031
0.2333	0.001102	0.000257	0.000	0.031
0.2417	0.001102	0.000266	0.000	0.031
0.2500	0.001102	0.000275	0.000	0.031
0.2583	0.001102	0.000285	0.000	0.031
0.2667	0.001102	0.000294	0.000	0.031
0.2750	0.001102	0.000303	0.000	0.031
0.2833	0.001102	0.000312	0.000	0.031
0.2917	0.001102	0.000321	0.000	0.032
0.3000	0.001102	0.000331	0.000	0.032
0.3083	0.001102	0.000340	0.000	0.032
0.3167	0.001102	0.000349	0.000	0.032
0.3250	0.001102	0.000358	0.000	0.032
0.3333	0.001102	0.000367	0.000	0.032
0.3417	0.001102	0.000376	0.000	0.032
0.3500	0.001102	0.000386	0.000	0.032
0.3583	0.001102	0.000395	0.000	0.033
0.3667	0.001102	0.000404	0.000	0.033
0.3750	0.001102	0.000413	0.000	0.033
0.3833	0.001102	0.000422	0.000	0.033
0.3917	0.001102	0.000432	0.000	0.033
0.4000	0.001102	0.000441	0.000	0.033
0.4083	0.001102	0.000450	0.000	0.033
0.4167	0.001102	0.000459	0.000	0.034
0.4250	0.001102	0.000468	0.000	0.034
0.4333	0.001102	0.000478	0.000	0.034
0.4417	0.001102	0.000487	0.000	0.034
0.4500	0.001102	0.000496	0.000	0.034
0.4583	0.001102	0.000505	0.000	0.034
0.4667	0.001102	0.000514	0.000	0.034
0.4750	0.001102	0.000523	0.000	0.034
0.4833	0.001102	0.000533	0.000	0.035
0.4917	0.001102	0.000542	0.000	0.035
0.5000	0.001102	0.000551	0.000	0.035
0.5083	0.001102	0.000560	0.000	0.035
0.5167	0.001102	0.000569	0.000	0.035
0.5250	0.001102	0.000579	0.000	0.035
0.5333	0.001102	0.000588	0.000	0.035
0.5417	0.001102	0.000597	0.000	0.035
0.5500	0.001102	0.000606	0.000	0.036
0.5583	0.001102	0.000615	0.000	0.036
0.5667	0.001102	0.000624	0.000	0.036
0.5750	0.001102	0.000634	0.000	0.036
0.5833	0.001102	0.000643	0.000	0.036
0.5917	0.001102	0.000652	0.000	0.036
0.6000	0.001102	0.000661	0.000	0.036
0.6083	0.001102	0.000670	0.000	0.036
0.6167	0.001102	0.000680	0.000	0.037
0.6250	0.001102	0.000689	0.000	0.037
0.6333	0.001102	0.000698	0.000	0.037
0.6417	0.001102	0.000707	0.000	0.037
0.6500	0.001102	0.000716	0.000	0.037
0.6583	0.001102	0.000725	0.000	0.037
0.6667	0.001102	0.000735	0.000	0.037
0.6750	0.001102	0.000744	0.000	0.037
0.6833	0.001102	0.000753	0.000	0.038
0.6917	0.001102	0.000762	0.000	0.038

0.7000	0.001102	0.000771	0.000	0.038
0.7083	0.001102	0.000781	0.067	0.038
0.7167	0.001102	0.000790	0.190	0.038
0.7250	0.001102	0.000799	0.349	0.038
0.7333	0.001102	0.000808	0.538	0.038
0.7417	0.001102	0.000817	0.752	0.038
0.7500	0.001102	0.000826	0.989	0.039
0.7583	0.001102	0.000836	1.246	0.039

Filterra Bioscape 302-6
Outfall 2 Basins: W-202 TO W-206
(see appendix G)

Name : bioscape
Bypass: No

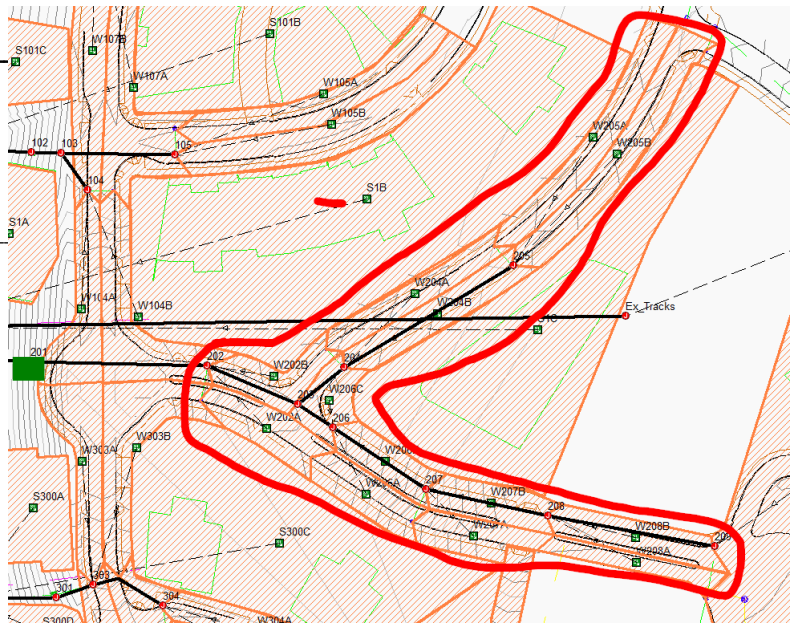
GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Mod	**.236**
Pervious Total	**0.236**

Impervious Land Use	**acre**
ROADS MOD	**1.45**
Impervious Total	**1.45**
Basin Total	**1.686**

Element Flows To:

Surface	**Interflow**
bioscape	bioscape



Name : bioscape
Bottom Length: 17.00 ft.
Bottom Width: 10.00 ft.
Depth: 0.75 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1
Filtration On
Hydraulic conductivity: 24.82
Depth of filter medium: 1.8
Total Volume Infiltrated (ac-ft.): 172.96
Total Volume Through Riser (ac-ft.): 10.467
Total Volume Through Facility (ac-ft.): 183.427
Percent Infiltrated: 94.29
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 0.7 ft.
Riser Diameter: 500 in.

Element Flows To:
Outlet 1 **Outlet 2**

Sand Filter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.003	0.000	0.000	0.000
0.0083	0.003	0.000	0.000	0.098
0.0167	0.003	0.000	0.000	0.098
0.0250	0.003	0.000	0.000	0.099
0.0333	0.003	0.000	0.000	0.099
0.0417	0.003	0.000	0.000	0.099
0.0500	0.003	0.000	0.000	0.100
0.0583	0.003	0.000	0.000	0.100
0.0667	0.003	0.000	0.000	0.101
0.0750	0.003	0.000	0.000	0.101
0.0833	0.003	0.000	0.000	0.102
0.0917	0.003	0.000	0.000	0.102
0.1000	0.003	0.000	0.000	0.103
0.1083	0.003	0.000	0.000	0.103
0.1167	0.003	0.000	0.000	0.104
0.1250	0.003	0.000	0.000	0.104
0.1333	0.003	0.000	0.000	0.104
0.1417	0.003	0.000	0.000	0.105
0.1500	0.003	0.000	0.000	0.105
0.1583	0.003	0.000	0.000	0.106
0.1667	0.003	0.000	0.000	0.106
0.1750	0.003	0.000	0.000	0.107
0.1833	0.003	0.000	0.000	0.107
0.1917	0.003	0.000	0.000	0.108
0.2000	0.003	0.000	0.000	0.108
0.2083	0.003	0.000	0.000	0.109
0.2167	0.003	0.000	0.000	0.109
0.2250	0.003	0.000	0.000	0.109
0.2333	0.003	0.000	0.000	0.110
0.2417	0.003	0.000	0.000	0.110
0.2500	0.003	0.001	0.000	0.111
0.2583	0.003	0.001	0.000	0.111
0.2667	0.003	0.001	0.000	0.112
0.2750	0.003	0.001	0.000	0.112
0.2833	0.003	0.001	0.000	0.113
0.2917	0.003	0.001	0.000	0.113
0.3000	0.003	0.001	0.000	0.113
0.3083	0.003	0.001	0.000	0.114
0.3167	0.003	0.001	0.000	0.114
0.3250	0.003	0.001	0.000	0.115
0.3333	0.003	0.001	0.000	0.115
0.3417	0.003	0.001	0.000	0.116
0.3500	0.003	0.001	0.000	0.116
0.3583	0.003	0.001	0.000	0.117
0.3667	0.003	0.001	0.000	0.117
0.3750	0.003	0.001	0.000	0.118
0.3833	0.003	0.001	0.000	0.118
0.3917	0.003	0.001	0.000	0.118

0.4000	0.003	0.001	0.000	0.119
0.4083	0.003	0.001	0.000	0.119
0.4167	0.003	0.001	0.000	0.120
0.4250	0.003	0.001	0.000	0.120
0.4333	0.003	0.001	0.000	0.121
0.4417	0.003	0.001	0.000	0.121
0.4500	0.003	0.001	0.000	0.122
0.4583	0.003	0.001	0.000	0.122
0.4667	0.003	0.001	0.000	0.123
0.4750	0.003	0.001	0.000	0.123
0.4833	0.003	0.001	0.000	0.123
0.4917	0.003	0.001	0.000	0.124
0.5000	0.003	0.002	0.000	0.124
0.5083	0.003	0.002	0.000	0.125
0.5167	0.003	0.002	0.000	0.125
0.5250	0.003	0.002	0.000	0.126
0.5333	0.003	0.002	0.000	0.126
0.5417	0.003	0.002	0.000	0.127
0.5500	0.003	0.002	0.000	0.127
0.5583	0.003	0.002	0.000	0.128
0.5667	0.003	0.002	0.000	0.128
0.5750	0.003	0.002	0.000	0.128
0.5833	0.003	0.002	0.000	0.129
0.5917	0.003	0.002	0.000	0.129
0.6000	0.003	0.002	0.000	0.130
0.6083	0.003	0.002	0.000	0.130
0.6167	0.003	0.002	0.000	0.131
0.6250	0.003	0.002	0.000	0.131
0.6333	0.003	0.002	0.000	0.132
0.6417	0.003	0.002	0.000	0.132
0.6500	0.003	0.002	0.000	0.132
0.6583	0.003	0.002	0.000	0.133
0.6667	0.003	0.002	0.000	0.133
0.6750	0.003	0.002	0.000	0.134
0.6833	0.003	0.002	0.000	0.134
0.6917	0.003	0.002	0.000	0.135
0.7000	0.003	0.002	0.000	0.135
0.7083	0.003	0.002	0.336	0.136
0.7167	0.003	0.002	0.952	0.136
0.7250	0.003	0.002	1.749	0.137
0.7333	0.003	0.002	2.693	0.137
0.7417	0.003	0.002	3.764	0.137
0.7500	0.003	0.002	4.947	0.138
0.7583	0.003	0.003	6.234	0.138

ANALYSIS RESULTS

POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.Perlnd and Implnd Changes

No changes have been made.

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APPENDIX E
MAINTENANCE MANUAL

4.6 Maintenance Standards for Drainage Facilities and Catch Basins

4.6.1 Purpose

The purpose of this chapter is to set forth maintenance standards for different components of drainage facilities and catch basins. These standards match specific facility components and features with approved uniform maintenance procedures.

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required, as identified through inspection. The following definitions apply to maintenance described in this chapter.

"Drainage facility" means a catch basin or stormwater flow control or treatment facility described in Table 5.3 of this chapter.

"Maintenance" for this chapter shall be used to mean regular maintenance, repair or replacement actions. The maintenance standards are not intended to be measures of a facility's required condition at all times between inspections. In other words, if these conditions are exceeded at any time between inspections and/or maintenance, this does not automatically constitute a violation of these standards.

4.6.2 Applicability

This chapter applies to drainage facilities identified in Table 5.3 of this chapter that are owned or operated by Snohomish County, catch basins owned or operated by the County, and such drainage facilities and catch basins owned by other entities.

4.6.3 Enforcement

Chapter 7.54 Snohomish County Code (SCC) requires any owner or operator of a drainage facility described in this chapter to maintain the facility in accordance with the standards set forth in this chapter.

4.6.4 Tracking Maintenance and Repair Costs

Chapter 7.54 Snohomish County Code (SCC) requires property owners to keep records of their maintenance actions for their drainage facilities. In addition, Snohomish County requests that owners and operators of drainage facilities track the cost of maintenance and repairs and provide these costs to the County. The request for cost information is not a regulatory requirement. The information will be used by the County to estimate general maintenance and repair cost information and to provide that information to members of the public who may need to perform such work and estimate costs. The County does not intend to provide cost information that can be traced to a specific facility.

4.6.5 Drainage Facility Maintenance Schedule

A) Maintenance actions to be completed within thirty days of the date of notice

1) When a County-initiated inspection of a flow control structure finds that the hydraulic function of the structure is significantly impaired, the owner or operator shall have thirty days from the date of the notice issued by the County in which to complete maintenance actions required by the notice.

2) If, after thirty days, the required maintenance actions have not been completed, the owner or operator will be in violation of County code and will be subject to enforcement action by the County. In such cases, the County may, at its option, perform the necessary maintenance actions, in which case the owner or operator will be charged for all costs the County incurs for performing these maintenance actions.

B) Maintenance actions to be completed within one year of the date of notice

1) In addition to the requirements of section 4.6.5A, when a County-initiated inspection of a drainage facility identifies one or more conditions for any component listed in Table 5.3 for which maintenance is needed, and for which the necessary maintenance actions are estimated to cost less than $25,000, the owner or operator has one year from the date of the notice issued by the County in which to complete maintenance actions required by the notice. If maintenance of a flow control structure is required under section 4.6.5A, the cost of those maintenance actions shall be considered part of the total maintenance cost for the entire drainage facility.

2) The owner or operator is responsible for obtaining all required permits and permissions before starting work.

3) If, after one year from the date of the notice, the required maintenance actions have not been completed, the owner or operator will be subject to enforcement action by the County. In such cases, the County may, at its option, perform the necessary maintenance actions, in which case the owner or operator will be charged for all costs the County incurs for performing these maintenance actions.

4) With the exception of work described in 4.6.5A and 4.6.5D, maintenance actions may not be allowed the period from October 1 to April 30 in order to ensure that downstream property and stream corridors will not be subject to flooding, habitat degradation, or pollutant contamination as a result of these actions.

5) Depending on the scope of work and seasonal conditions, the County reserves the right to require the owner or operator to complete necessary maintenance actions in the first year during the period from May 1 to September 30.

C) Maintenance actions to be completed within two years of the date of notice

1) In addition to the requirements of section 4.6.5A, when a County-initiated inspection of a drainage facility identifies one or more conditions for any component listed in Table 5.3 for which maintenance is needed, and for which the necessary maintenance actions are estimated to cost $25,000 or more, the owner or operator has two years from the date of the notice issued by the County in which to complete maintenance actions required by the notice as well as any other actions needed to produce the expected results in Table 5.3. If maintenance of a flow control

structure is required under section 4.6.5A, the cost of those maintenance actions shall considered part of the total maintenance cost for the entire drainage facility.

2) The owner or operator shall be responsible for acquiring all needed permits and permissions before commencing work.

3) If, after two years from the date of the notice, the required maintenance actions have not been completed, the owner or operator will be subject to enforcement action by the County. In such cases, the County may, at its option, perform the necessary maintenance actions, in which case the owner or operator will be charged for all costs the County incurs for performing these maintenance actions.

4) With the exception of work described in 4.6.5A and 4.6.5D, maintenance actions may not be allowed the period from October 1 to April 30 in order to ensure that downstream property and stream corridors will not be subject to flooding, habitat degradation, or pollutant contamination as a result of these actions.

5) Depending on the scope of work and seasonal conditions, the County reserves the right to require the owner or operator to complete necessary maintenance actions in the first year during the period from May 1 to September 30.

6) In order for the owner or operator of the drainage facility to receive two (2) years to perform the necessary maintenance actions, he/she must provide the County with a good faith estimate or bid for the total cost of these maintenance actions no later than the 60th day after the date of the notice.

D) Emergency orders

1) In addition to any requirements described above, and in accordance with the provisions of Chapter 30.85 SCC, if the County determines that a condition exists at a drainage facility that endangers public or private property, creates an immediate hazard, creates a violation of critical areas provisions or surface water protection, or threatens the health and safety of the occupants of any premises or members of the public, the County may issue an emergency order. Upon issuance of an emergency order, the owner or operator of the drainage facility shall remedy the condition immediately.

4.6.6 Maintenance Standards

Maintenance standards are set forth in Table 5.3.

Table 5.3 – Maintenance Standards

No. 1 – Detention Ponds Not Proposed

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Function of facility is impaired by or likely to be impaired by trash and debris.	Trash and debris is removed.
	Vegetation	Function of facility is impaired by vegetation.	Vegetation is removed or managed to restore proper function of facility. Use of herbicides shall be in accordance with applicable regulations.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. Note: Contact Snohomish County Surface Water Management if removal of beavers is contemplated.
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects are destroyed or removed from site. Use of pesticides shall be in accordance with applicable regulations
	Tree Growth and Hazard Trees	Function of facility is impaired by trees. Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove Hazard trees (i.e., dead, diseased, or dying trees) need to be identified Note: A certified Arborist may be needed to determine health of trees or removal requirements.	Trees are removed or managed to restore proper function of facility. Trees do not hinder maintenance activities. Hazard trees are identified and those that pose an imminent danger are removed.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
General	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner is repaired or replaced. Liner is fully covered.
Berms	Settling	Any part of a berm which has settled at least 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. Note: A licensed civil engineer may be needed to determine the cause of the settlement.	Berm is repaired and restored to the design elevation.

No. 1 – Detention Ponds Not Proposed

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Erosion	Any erosion observed on a compacted structural berm embankment. Note: A licensed civil engineer may be needed to inspect, evaluate and recommend a repair plan.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
	Piping	Discernable water flow through a compacted structural berm. Ongoing erosion with potential for erosion to continue. Tree growth on a compacted structural berm over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. Evidence of rodent holes in berm, and/or water piping through berm via rodent holes Note: A geotechnical engineer may be needed to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
Emergency Overflow/ Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. Note: A licensed civil engineer may be needed to determine proper berm/spillway restoration.
	Rock Armoring	Rock layer on subgrade is less than 1.0 feet deep and/or subgrade is exposed	Rocks and pad depth are restored to a minimum depth of 1.0 feet.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

NOTE: The above maintenance standards also apply to naturally-occurring closed depressions used to meet the flow control requirements set forth in SCC 30.63A.550.

No. 2 – Infiltration Facilities Not Proposed

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Function of facility is impaired by or likely to be impaired by trash and debris.	Trash and debris is removed.
	Vegetation	Function of facility is impaired by vegetation.	Vegetation is removed or managed to restore proper function of facility. Use of herbicides shall be in accordance with applicable regulations.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove).	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
Filter Bags (if applicable)	Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Berms	Settling	Any part of a berm which has settled at least 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. Note: A licensed civil engineer may be needed to determine the cause of the settlement.	Berm is repaired and restored to the design elevation.
	Erosion	Any erosion observed on a compacted structural berm embankment. Note: A licensed civil engineer may be needed to inspect, evaluate and recommend a repair plan.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

No. 2 – Infiltration Facilities Not Proposed

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Piping	Discernable water flow through a compacted structural berm. Ongoing erosion with potential for erosion to continue. Tree growth on a compacted structural berm over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. Evidence of rodent holes in berm, and/or water piping through berm via rodent holes Note: A geotechnical engineer may be needed to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. Note: A licensed civil engineer may be needed to determine proper berm/spillway restoration.
	Rock Armoring	Rock layer on subgrade is less than 1.0 feet deep and/or subgrade is exposed	Rocks and pad depth are restored to a minimum depth of 1.0 feet.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	The settling area or sump contains sediment/debris up to a depth of either 6 inches or the sedimentation design depth.	Sediment/debris is removed.

No. 3 – Underground Detention Pipes/Tanks Not Proposed

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	The average sediment depth measured at multiple locations exceeds 10% of the detention pipe diameter (or the depth of the storage area) or the sediment depth measured at any single point exceeds 15% of the pipe diameter. (Example: The sediment depth in a 60-inch diameter detention pipe is measured at three locations. The sediment would need to be removed if the average depth of the three measurements is at least 6 inches or if the depth of any single measurement is at least 9 inches.	All sediment, debris, and organic matter removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids at section joint allowing material to seep into or water to leak out of facility. Note: This may need an engineering analysis to assess the structural stability.	All joints between tank/pipe sections are sealed.
	Tank or Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. Note: This may need an engineering analysis to assess the structural stability.	Tank/pipe section is repaired or replaced to design.
	Tank/Pipe Material	Any visible holes or cracks wider than a quarter of an inch or evidence of material seeping into or water leaking out of pipe wall, or qualified maintenance or inspection personnel determine that tank/pipe is not structurally sound.	Tank/pipe is repaired or replaced to design specifications and is structurally sound.
Access Hole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, misalignment, rungs not securely attached to structure wall, rust, or cracks.	Ladder meets design standards and allows maintenance person safe access.
Catch Basins	See “Catch Basins” (No. 5)	See “Catch Basins” (No. 5).	See “Catch Basins” (No. 5).
Standpipe, Cleanout Gate, Orifice Plate	Obstructions, Damaged, or Missing	See “Control Structure/Flow Restrictors” (No. 4)	See “Control Structure/Flow Restrictors” (No. 4)

No. 4 – Control Structure/Flow Restrictors Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Standpipe	Obstructions	Any material blocking (or having the potential of blocking) the pipe overflow.	Pipe is free of all obstructions and works as designed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure is securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure is in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes other than designed holes in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Access Hole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, misalignment, rungs not securely attached to structure wall, rust, or cracks.	Ladder meets design standards and allows maintenance person safe access.

No. 4 – Control Structure/Flow Restrictors Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).
	Sediment & Debris	Sediment, trash, vegetation, and/or other debris material exceeds 25% of the catch basin sump depth or is 1 foot below the orifice plate.	Control structure orifice is not blocked. All sediment and debris removed.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Sediment & Debris	Sediment, trash, and/or other debris material is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No sediment or debris is located immediately in front of catch basin or on grate opening.
		Sediment, trash, and/or other debris material (located in the catch basin) exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No sediment or debris is in the catch basin.
		Sediment, trash, and/or other debris material located in any inlet or outlet pipe is blocking more than 1/3 of its height.	Inlet and outlet pipes are free of sediment and debris.
		Dead animals or vegetation that impair catch basin function or that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation are present within the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is seeping into the catch basin).	Top slab is free of holes and cracks. No water and/or soil is seeping into the catch basin
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Catch basin is replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	Settlement of misalignment of the catch basin causes a safety, function, or design problem.	Catch basin is replaced or repaired to design standards.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed.
Access Hole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is fully in place
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, rungs not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

No. 7 – Energy Dissipaters

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil where pad was originally installed.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Rock Gabion Structures	Wire basket matrix deteriorated or broken	Deterioration determined to be near to breaking. Broken wire results in hole large enough to allow rocks to protrude out of basket	Rewire area of concern or replace basket and/or rocks as necessary
	Wire basket misaligned	Baskets have shifted and no longer providing full energy dissipations or may be prone to tipping or collapse	Realign or relocate as necessary to meet design intent
Dispersion Trench	Perforated Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth or over 1/3 of perforations in pipe are plugged.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Water is discharging at a few concentrated points along the top of the trench rather than flowing uniformly along the entire length of trench lip.	Trench redesigned or rebuilt to standards.
	"Distributor" Catch Basin Overflows	Water is observed or reported to be flowing out of top of basin during any storm less than the design storm.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Catch Basins	Other Defects	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 8 – Typical Biofiltration Swales Not Proposed

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased. Reseed any bare spots as needed in loosened, fertile soil.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or reseed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes. In addition, reseed bare spots with shade tolerant grass seed mix and/or replant with plugs of slough sedge or other sedges.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from swale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

No. 9 – Wet Biofiltration Swales Not Proposed

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation	Sediment depth exceeds 2 inches in 10% of the swale treatment area.	Remove sediment deposits in treatment area.
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed with wetland plants. For excessive cattail growth, cut cattail shoots back and compost offsite. Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.
	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.
	Erosion/Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. Bypass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as Juncus effusus (soft rush) in wet areas or snowberry (Symphoricarpos albus) in dryer areas.

No. 10 – Filter Strips Not Proposed

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits, re-level so slope is even and flows pass evenly through strip. Reseed any bare spots as needed in loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10 inches); when nuisance weeds and/or other vegetation starts to take over.	Mow grass, control nuisance vegetation, such that flow is not impeded. Grass should be mowed to a height between 3-4 inches.
	Erosion/Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width.

No. 11 – Wetponds Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain water per the original design. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6 inches, usually in the first cell.	Sediment removed from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as Juncus effusus (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom that exceeds 6 inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
Berms	Settling	Any part of a berm which has settled at least 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. Note: A licensed civil engineer may be needed to determine the cause of the settlement.	Berm is repaired and restored to the design elevation.
	Internal Berm	Berm dividing cells should be level.	Berm surface is leveled so that water flows evenly over entire length of berm.
	Erosion	Any erosion observed on a compacted structural berm embankment. Note: A licensed civil engineer may be needed to inspect, evaluate and recommend a repair plan.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

No. 11 – Wetponds Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Piping	Discernable water flow through a compacted structural berm. Ongoing erosion with potential for erosion to continue. Tree growth on a compacted structural berm over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. Evidence of rodent holes in berm, and/or water piping through berm via rodent holes Note: A geotechnical engineer may be needed to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. Note: A licensed civil engineer may be needed to determine proper berm/spillway restoration.
	Rock Armoring	Rock layer on subgrade is less than 1.0 feet deep and/or subgrade is exposed	Rocks and pad depth are restored to a minimum depth of 1.0 feet.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

No. 12 – Wetvaults

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
	Sediment Accumulation	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	Remove sediment from vault.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. Specified % of the vault surface area provides ventilation to the vault interior (see design specifications).
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracked/broken rungs and/or is misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and allows maintenance person safe access. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.

No. 13 – Sand Filters (above ground/open) Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Above Ground (open sand filter)	Sediment Accumulation on top layer	Sediment depth exceeds 1/2 inch.	No sediment deposit on top layer of sand filter that would impede permeability of the filter section.
	Trash and Debris Accumulations	Trash and debris accumulated on sand filter bed.	Trash and debris removed from sand filter bed.
	Sediment/ Debris in Clean-Outs	When the clean-outs become fully or partially plugged with sediment and/or debris.	Sediment removed from clean-outs.
	Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24 hours, and/or flow through the overflow pipes occurs frequently.	Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).
	Prolonged Flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities.	Low, continuous flows are limited to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.
	Short Circuiting	When flows become concentrated over one section of the sand filter rather than dispersed.	Flow and percolation of water through sand filter is uniform and dispersed across the entire filter area.
	Erosion Damage to Slopes	Erosion over 2 inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes stabilized using proper erosion control measures.
	Rock Pad Missing or Out of Place	Soil beneath the rock is visible.	Rock pad replaced or rebuilt to design specifications.
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

No. 14 –Sand Filters (below ground/enclosed) Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2 inch.	No sediment deposits on sand filter section that would impede permeability of the filter section.
	Sediment Accumulation in Presettling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	No sediment deposits in first chamber of vault.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
	Sediment/Debris in Drain Pipes/Cleanouts	Sediment, trash, and/or other debris material located in any inlet, outlet, or cleanout pipe is blocking more than 1/3 of its height.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. Specified % of the vault surface area provides ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired to specifications, and allows maintenance person safe access.

No. 15 – Stormfilter™

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accumulation on Media.	Sediment depth exceeds 1/4 inch.	No sediment deposits which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6 inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment/Debris in Drain Pipes/Cleanouts	Sediment, trash, and/or other debris material located in any inlet, outlet, or cleanout pipe is blocking more than 1/3 of its height.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media clogged	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Flow short Circuited	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

Check manufacturer's operation and maintenance manual for complete maintenance instructions.

No. 16 – API Baffle Oil/Water Separators Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Discharged Water Not Clean	Water discharged from facility has obvious signs of poor water quality.	Treated stormwater discharged from vault should be clear without thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulations that exceed 1 inch, at the surface of the water.	Extract oil from vault by vactoring. Disposal in accordance with state and local regulations.
	Damaged Pipes	Inlet or outlet pipes damaged or broken and in need of repair.	Pipes repaired or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

No. 17 – Coalescing Plate Oil/Water Separators Not Proposed

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Discharged Water Not Clean	Water discharged from facility has obvious signs of poor water quality.	Treated stormwater discharged from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1 inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet pipes damaged or broken and in need of repair.	Pipes repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

No. 18 – Catchbasin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Normal Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

No. 19 – Media Filter Drain

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased. Reseed any bare spots as needed in loosened, fertile soil.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or reseed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from swale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

No. 20 – Compost Amended Vegetated Filter Strip (CAVFS) Not Proposed

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased. Reseed any bare spots as needed in loosened, fertile soil.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or reseed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from swale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

No. 21 – Bioretention Facilities Not Proposed

Component	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
Inlet	Energy dissipaters are damaged	Visible soil, missing rock, or other evidence of damage	Replace or rebuild energy dissipaters to design specifications
	Inlet is blocked	Flow into bioretention bed is impeded	Remove blockage to restore flow
Bioretention bed / plants	Sediment accumulation	Sediment depth exceeds 1 inch	Remove sediment to restore permeability
	Trash or debris accumulation	Trash or debris are accumulated on bed	Remove trash and debris
	Excessive drawdown time	Drawdown time > 48 hours	Remove and replace mulch or bioretention soil mix to restore permeability, and/or clean underdrain
	Uneven ponding	Water does not pond evenly on bed	Remove, replace, or reposition mulch to restore even ponding
	Bioretention plants	Bioretention plants are missing, diseased, or dead	Replace plants with healthy bioretention plants selected per the planting plan
	Weeds or invasive plants	Weeds or invasive plants growing in bioretention facility	Remove weeds and invasive plants, replace with bioretention plants or cover affected areas with mulch, as appropriate
	Mulch is inadequate	Mulch is missing	Replace mulch to maintain 2-3 inch depth in mulched areas of bioretention system
	Bed compaction	Bed is compacted due to foot or vehicle traffic or other reason	Loosen compacted bed material, or replace as needed, to restore permeability
Sidewalls, check dams, weirs	Visible damage or erosion	Sidewalls, check dams, or weirs have visible erosion or other structural damage	Repair to bring into conformance with facility design
	Flow over check dams or weirs is blocked	Flow is blocked so that design ponding depth is exceeded	Clear blockage to restore design ponding depth
	Flow around check dams or weirs	Flow is going around check dams or weirs so that design ponding depth is not attained	Repair check dams, weirs, and sidewalls to restore design ponding depth
	Grade board or weir top not level	Uneven flow over check dams or weirs so that design ponding depth is not attained	Repair check dams and weirs to restore design ponding depth
Overflow	Energy dissipaters are damaged	Visible soil, missing rock, or other evidence of damage	Replace or rebuild energy dissipaters to design specifications
	Overflow is blocked	Flow is blocked so that standing pool depth is above design depth	Clear overflow structure to restore design ponding depth
Underdrain system	Underdrain is blocked or damaged	Flow does not pass as designed through underdrain system	Clean or repair underdrain system to restore design flow capacity

No. 22 – Permeable Pavement

Not Proposed

Pavement type	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
All types	Unstable soil on adjacent area	Runoff from adjacent areas deposits soil, mulch, or sediment on permeable pavement	Remove deposited material from pavement, and stabilize adjacent areas so that further deposition of material on pavement will not occur.
	Adjacent vegetation is covering permeable pavement	Vegetation impedes infiltration in permeable pavement	Trim or remove vegetation so that infiltration is not impeded
	Unwanted vegetation or moss is growing in or on permeable pavement	Unwanted vegetation impedes infiltration in permeable pavement or displaced desired vegetation	Remove unwanted vegetation, repair permeable pavement as needed, replace desired vegetation as needed
	None (routine maintenance)	N/A	Vacuum or sweep according to equipment manufacturer's specifications so that infiltration is not impeded
	Debris or sediment on pavement	Sediment or debris deposits are visible on pavement	Remove sediment or debris and vacuum or sweep according to equipment manufacturer's specifications so that infiltration is not impeded
	Infiltration capacity is reduced	Water ponds on pavement or runs off pavement during rain events	Vacuum or sweep according to equipment manufacturer's specifications so that infiltration is not impeded
	Settlement	Settlement of pavement impedes infiltration	Restore pavement to design grade
Porous asphalt and pervious concrete	Cracks in pavement	Pavement spalls or ravels at crack edges	Patch or cut and replace the affected area with paving material similar to the original pavement. Replace in-kind where feasible. Porous asphalt may be replaced with conventional asphalt if it is a small percentage of the total permeable pavement area and does not impact the overall permeable pavement function.
Permeable pavers	Paving block missing or damaged	Paving block missing or damaged	Repair or replace missing or damaged pavers according to manufacturer's specifications
Open-celled paving grid	Paving grid missing or damaged	Three or more adjacent rings in paving grid missing or damaged	Repair or replace missing or damaged paving grid according to manufacturer's specifications
	Loss of aggregate in paving grid	Loss of aggregate in paving grid	Replenish aggregate material in grid to manufacturer's specifications
	Poor / missing grass in vegetated paving grid	Poor / missing grass in vegetated paving grid	Replace growing medium in grid, replant or reseed with grass
Pipe inlet / outlet / underdrain system	Pipe system is blocked or damaged	Flow does not pass as designed through pipe system	Clean or repair pipe system to restore design flow capacity

No. 20 – Vortechs Systems

Not Proposed

Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
General	Sediment Accumulation	Sediment depth is within 12 through 18 inches of dry weather water surface elevation.	Accumulated sediment should be removed.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1- inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	See Wet Vaults (No. 12)		

Check manufacturer's operation and maintenance manual for complete maintenance instructions.

No. 21 - Conveyance Storm Pipes

Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
General	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Use mechanical methods to remove root if possible. Use of chemicals to remove roots shall be done in accordance with applicable regulations. If necessary, remove the vegetation over the line.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced.
	Sediment & Debris	Sediment depth is greater than 20% of pipe diameter.	Install upstream debris traps (where applicable) then clean pipe and remove material.
	Debris barrier or Trash Rack Missing	A debris barrier or trash rack that had been installed on the end of a drainage pipe is missing	Debris barrier or trash rack is replaced.
	Joint/Seal Problems	The joint between pipe sections is separated and/or the seal at the joint is cracked or broken.	The joint and/or seal is repaired so that joint is not separated and is properly sealed.

No. 22 - Facility Discharge Points

Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
Monitoring	Inspection of Discharge Water for Obvious Signs of Poor Water Quality.	Sheen, obvious oil or other contaminants present.	Identify and eliminate pollution source AND report discharge to Snohomish County Surface Water Management Division. Effluent discharge from facility should be clear.
	Receiving Area Saturated	Water in receiving area is causing substrate to become saturated and unstable.	Receiving area sound.
General	Rock Pad - Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil where pad was originally installed.	Rock pad replaced to design standards.
	Rock Pad - Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
	Obstructions, Including Roots	Roots or debris enters pipe or deforms pipe, reducing flow	Use mechanical methods to remove root if possible. Use of chemicals to remove roots shall be done in accordance with applicable regulations. If necessary, remove the vegetation over the line
	Pipe Rusted or Deteriorated	Any part of the pipe that is broken, crushed or deformed more than 20% or any other failure to the piping	Pipe repaired or replaced.

No. 23 – Access Gates

Maintenance Component	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
General	Damaged or missing components	Gate and/or locking mechanism condition is such that access is impeded.	Gate and locking mechanism are fully functional for access purposes.
	Damaged or missing components	Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
	Damaged or missing components	Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical (plumb).
	Damaged or missing components	Missing stretcher bands, and ties.	Stretcher bar, bands, and ties in place.

No. 24 – Access Roads

Maintenance Component	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
General	Road Surface	Condition of road surface may lead to erosion of the facility or limit access.	Road repaired.
	Erosion of Ground Surface	Noticeable rills are seen in landscaped areas.	Causes of erosion are identified and steps taken to slow down/spread out the water. Eroded areas are filled, contoured, and seeded. If needed, regrade affected areas.
	Vegetation	Function of road is impaired by vegetation	Vegetation is removed or managed to restore proper function of facility. Use of herbicides shall be in accordance with applicable regulations.
	Tree Growth	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove.	Trees do not hinder maintenance activities.
		Trees or shrubs that have fallen over road.	Fallen trees or shrubs removed from road.

APPENDIX F
SOIL MANAGEMENT WORKSHEETS

Print Form

Soil Management Plan Summary Form

For Post-construction Soil Standard — Snohomish County Planning and Development Services

Use **Achieving the Post-construction Soil Standard** booklet instructions to carry out this Soil Management Plan.

Project Information *Complete all information on page 1, only site address and permit number on additional pages.*

Site address/Lot No.: 20500 Richmond Beach Dr. NW

Permit Type: Urban Center Application

Permit Number: PFN 11 101008LDA

Permit Holder: Douglas A. Luetjen, Esq.

Phone: 206-224-8061

Mailing Address: 701 Fith Ave, Suite 3300, Seattle, WA 98104

Contact Person: Mark Davies

Phone: 206-223-0326

Plan Prepared By: Mark Davies, MIG|SvR

Attachments - attach the following to this plan:

* Scale stormwater site plan drawings that include areas to be treated with Soil Treatment Options 1, 2, 3, 4.

* Completed Compost and Topsoil Calculation Worksheet results.

* Original compost and/or topsoil test results reports demonstrating that products contain adequate organic matter (for soil treatment options 2) and meet topsoil soil quality standard.

Provided During Construction

Note: Retain original delivery tickets for compost and/or topsoil products for verifi cation purposes.

Soil Treatment Options for Areas Identified on Site Plan

Soil treatment options available:

*__Option 1__ – Leave native soil undisturbed, and protect from compaction during construction.

*__Option 2__ – Amend existing soil in place.

*__Option 3__ – For native soil: stockpile site duff and topsoil, and reapply after grading and construction.

*__Option 4__ – Import topsoil mix with 8-13% soil organic matter content.

FOR PDS USE ONLY — Plan Approval Record

Date: _____ Reviewer: _____ Approved: _____

Revisions Required: _____

Date: _____ Reviewer: _____ Approved: _____

Revisions Required: _____

Area: A (refer to lettered areas mapped on site plan)

Square footage: 555,430

Selected soil treatment option: ☐ Option 1 ☐ Option 2 ☐ Option 3 ☒ Option 4

If using option 2, select type of amendment rate:

☐ Pre-approved (2") ☐ Custom with _____ % Target Soil Organic Matter

Area: B (refer to lettered areas mapped on site plan)

Square footage: 649,900

Selected soil treatment option: ☒ Option 1 ☐ Option 2 ☐ Option 3 ☐ Option 4

If using option 2, select type of amendment rate:

☐ Pre-approved (2") ☐ Custom with _____ % Target Soil Organic Matter

Area: _____ (refer to lettered areas mapped on site plan)

Square footage: _____

Selected soil treatment option: ☒ Option 1 ☐ Option 2 ☐ Option 3 ☐ Option 4

If using option 2, select type of amendment rate:

☐ Pre-approved (2") ☐ Custom with _____ % Target Soil Organic Matter

Record the compost and/or topsoil products to be used

Compost Product #1: _____

Test Results % organic matter: _____ Quantity in cubic yards _____

Supplier _____

Compost Product #2: _____

Test Results % organic matter: _____ Quantity in cubic yards _____

Supplier _____

Topsoil Product #3: _____

Test Results % organic matter: _____ Quantity in cubic yards _____

Supplier _____

Topsoil Product #4: _____

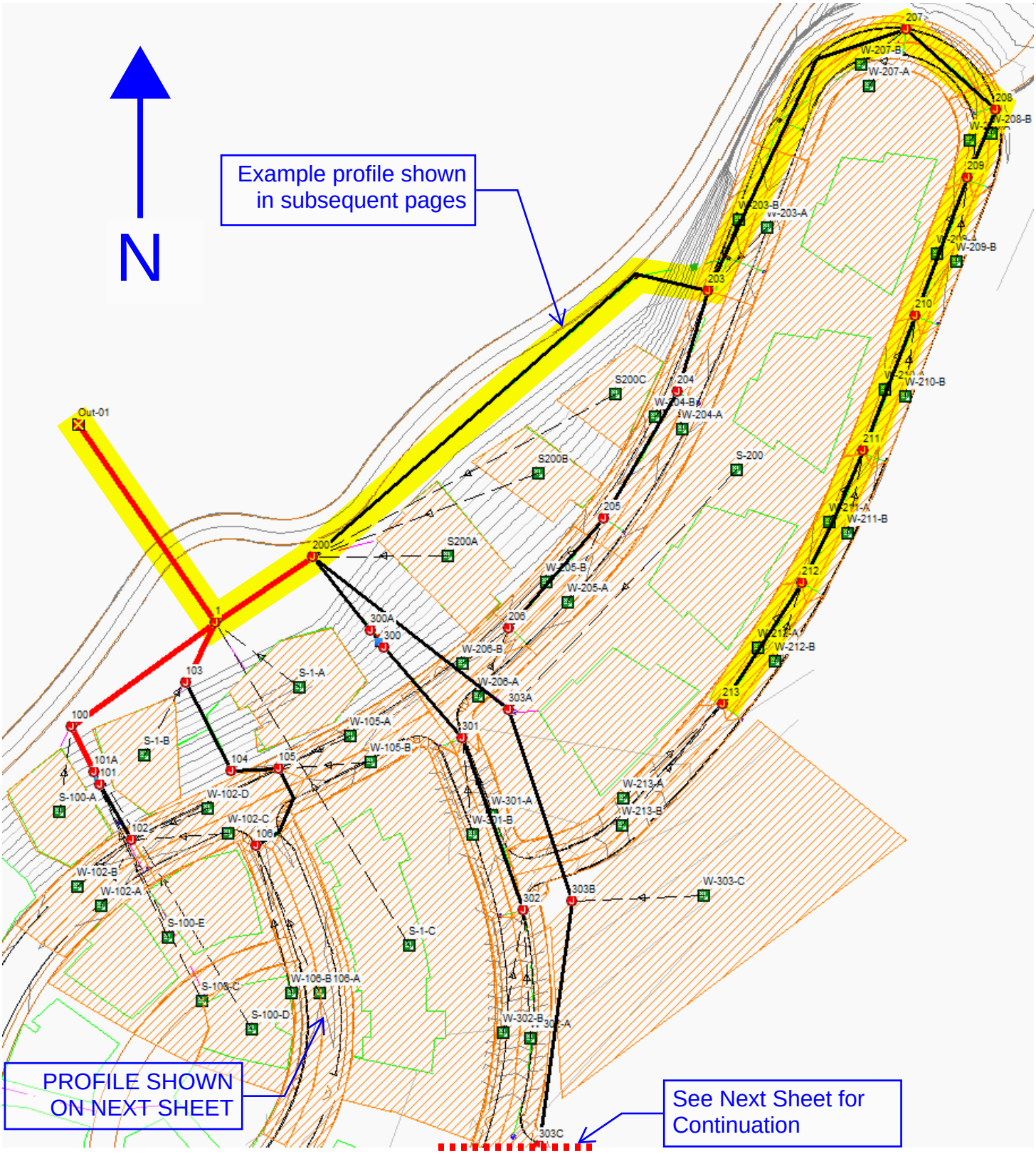
Test Results % organic matter: 8-13% Quantity in cubic yards 13,800

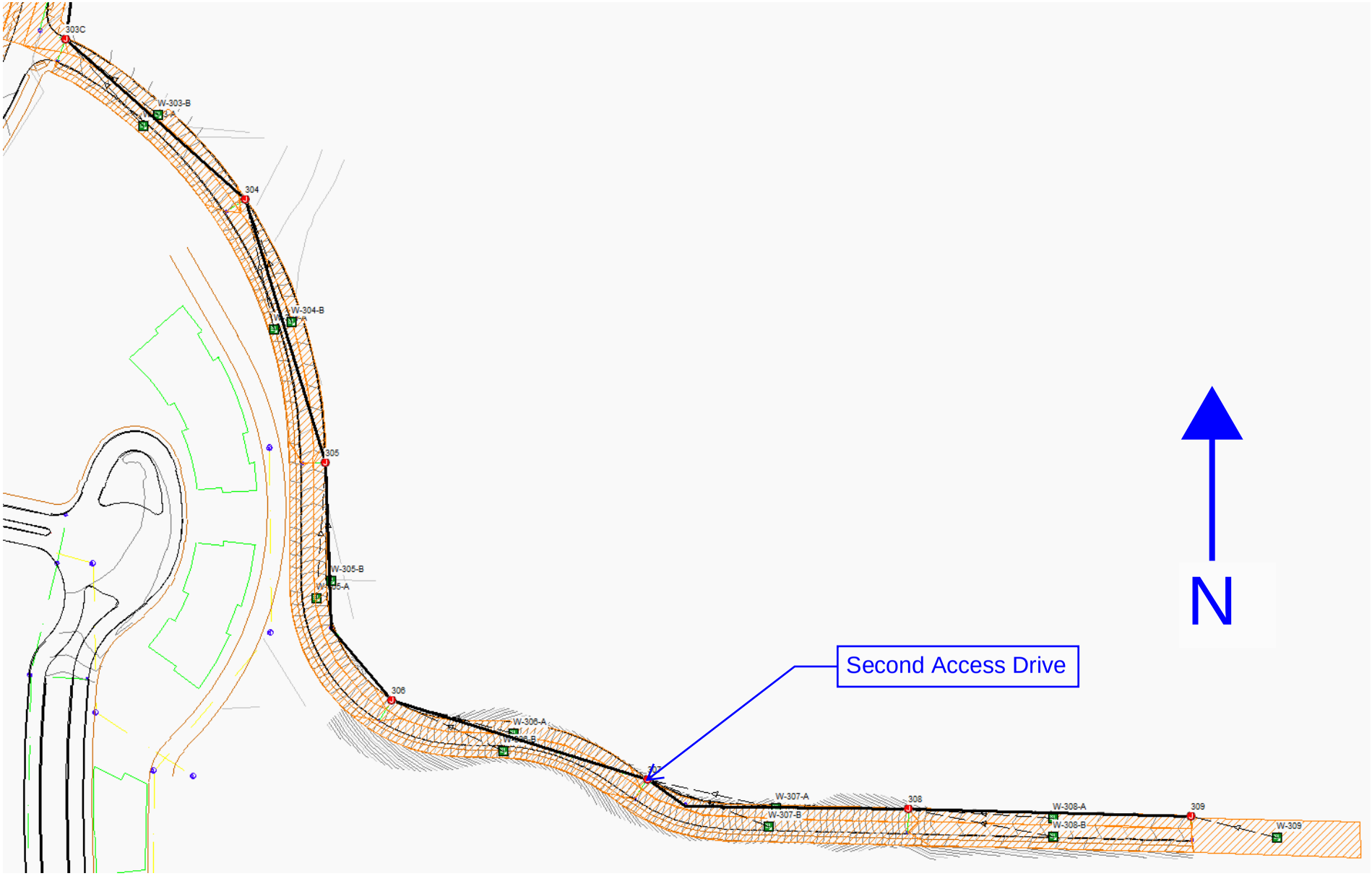
Supplier Cedar Grove

Total cubic yards compost: _____ **Total cubic yards topsoil:** 13,800

APPENDIX G
STORMWATER CONVEYANCE CALCULATIONS

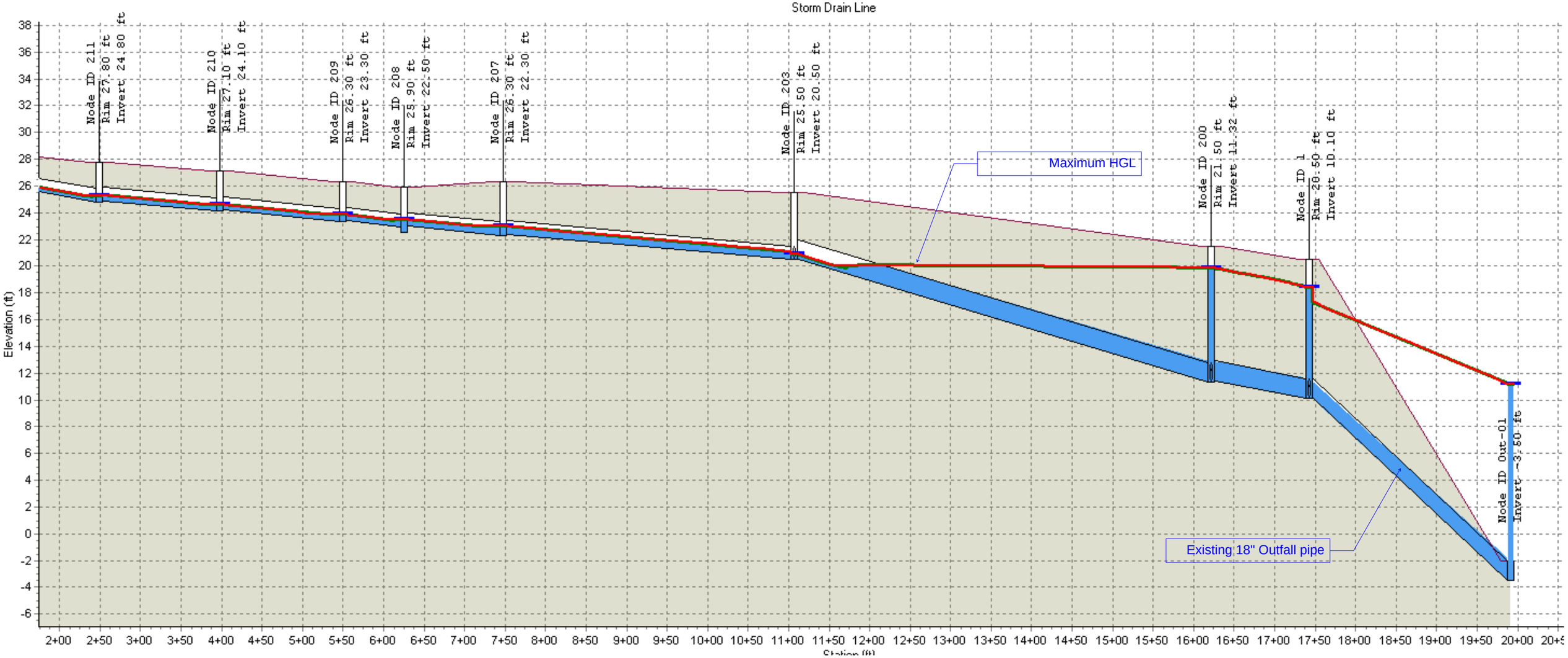
OUTFALL 1 - HYDRAULIC MODELING SUMMARY




303C
W-303-B
304
W-304-B
305
W-305-B
306
W-306-A
W-307-A
W-307-B
308
W-308-A
W-308-B
309
W-309
Second Access Drive
N

Profile View

Storm Drain Line



Project Description

File Name ..... 191206_Outfall 1_V1.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	Kirpich
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Apr 04, 2018	00:00:00
End Analysis On	Apr 04, 2018	01:00:00
Start Reporting On	Apr 04, 2018	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	59
Nodes	35
Junctions	34
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	34
Channels	0
Pipes	32
Pumps	0
Orifices	0
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period..... 100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Average Slope (%)	Flow Length (ft)	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	S-100-A	0.17	0.4700	0.5000	500.00	0.25	0.12	0.02	0.19	0 00:06:18
2	S-100-C	0.14	0.8000	0.5000	500.00	0.25	0.20	0.03	0.27	0 00:06:18
3	S-100-D	0.22	0.6800	0.5000	500.00	0.25	0.17	0.04	0.36	0 00:06:18
4	S-100-E	0.50	0.5500	0.5000	500.00	0.25	0.14	0.07	0.66	0 00:06:18
5	S-1-A	0.24	0.8000	0.5000	500.00	0.25	0.20	0.05	0.45	0 00:06:18
6	S-1-B	0.16	0.4700	0.5000	500.00	0.25	0.12	0.02	0.19	0 00:06:18
7	S-1-C	1.22	0.4000	0.5000	500.00	0.25	0.10	0.12	1.17	0 00:06:18
8	S-200	2.86	0.5300	0.5000	500.00	0.27	0.14	0.40	3.37	0 00:07:10
9	S200A	0.24	0.4700	0.5000	500.00	0.25	0.12	0.03	0.27	0 00:06:18
10	S200B	0.14	0.4700	0.5000	500.00	0.25	0.12	0.02	0.16	0 00:06:18
11	S200C	0.13	0.4900	0.5000	500.00	0.25	0.12	0.02	0.15	0 00:06:18
12	W-102-A	0.09	0.6500	0.5000	500.00	0.25	0.16	0.01	0.13	0 00:06:18
13	W-102-B	0.11	0.6500	0.5000	500.00	0.25	0.16	0.02	0.17	0 00:06:18
14	W-102-C	0.13	0.6500	0.5000	500.00	0.25	0.16	0.02	0.20	0 00:06:18
15	W-102-D	0.12	0.6500	0.5000	500.00	0.25	0.16	0.02	0.19	0 00:06:18
16	W-105-A	0.13	0.6500	0.5000	500.00	0.25	0.16	0.02	0.20	0 00:06:18
17	W-105-B	0.11	0.6500	0.5000	500.00	0.25	0.16	0.02	0.18	0 00:06:18
18	W-106-A	0.26	0.6000	0.5000	500.00	0.25	0.15	0.04	0.38	0 00:06:18
19	W-106-B	0.20	0.6000	0.5000	500.00	0.25	0.15	0.03	0.29	0 00:06:18
20	W-203-A	0.11	0.6000	0.5000	500.00	0.25	0.15	0.02	0.15	0 00:06:18
21	W-203-B	0.12	0.6000	0.5000	500.00	0.25	0.15	0.02	0.17	0 00:06:18
22	W-204-A	0.19	0.6000	0.5000	500.00	0.25	0.15	0.03	0.27	0 00:06:18
23	W-204-B	0.21	0.6000	0.5000	500.00	0.25	0.15	0.03	0.31	0 00:06:18
24	W-205-A	0.09	0.6800	0.5000	500.00	0.25	0.17	0.02	0.15	0 00:06:18
25	W-205-B	0.10	0.6800	0.5000	500.00	0.25	0.17	0.02	0.16	0 00:06:18
26	W-206-A	0.09	0.6800	0.5000	500.00	0.25	0.17	0.02	0.14	0 00:06:18
27	W-206-B	0.09	0.6800	0.5000	500.00	0.25	0.17	0.02	0.14	0 00:06:18
28	W-207-A	0.16	0.7300	0.5000	500.00	0.25	0.18	0.03	0.28	0 00:06:18
29	W-207-B	0.19	0.7300	0.5000	500.00	0.25	0.18	0.03	0.32	0 00:06:18
30	W-208-A	0.07	0.7300	0.5000	500.00	0.25	0.18	0.01	0.12	0 00:06:18
31	W-208-B	0.04	0.7300	0.5000	500.00	0.25	0.18	0.01	0.07	0 00:06:18
32	W-209-A	0.10	0.7300	0.5000	500.00	0.25	0.18	0.02	0.18	0 00:06:18
33	W-209-B	0.05	0.7300	0.5000	500.00	0.25	0.18	0.01	0.08	0 00:06:18
34	W-210-A	0.10	0.7300	0.5000	500.00	0.25	0.18	0.02	0.18	0 00:06:18
35	W-210-B	0.04	0.7300	0.5000	500.00	0.25	0.18	0.01	0.08	0 00:06:18
36	W-211-A	0.10	0.7300	0.5000	500.00	0.25	0.18	0.02	0.18	0 00:06:18
37	W-211-B	0.04	0.7300	0.5000	500.00	0.25	0.18	0.01	0.08	0 00:06:18
38	W-212-A	0.11	0.7300	0.5000	500.00	0.25	0.18	0.02	0.18	0 00:06:18
39	W-212-B	0.04	0.7300	0.5000	500.00	0.25	0.18	0.01	0.08	0 00:06:18
40	W-213-A	0.19	0.7300	0.5000	145.84	0.25	0.18	0.03	0.33	0 00:06:18
41	W-213-B	0.10	0.7300	0.5000	14.03	0.25	0.18	0.02	0.18	0 00:06:18
42	W-301-A	0.09	0.7400	0.5000	500.00	0.25	0.19	0.02	0.17	0 00:06:18
43	W-301-B	0.11	0.7400	0.5000	500.00	0.25	0.19	0.02	0.19	0 00:06:18
44	W-302-A	0.18	0.7400	0.5000	500.00	0.25	0.19	0.03	0.33	0 00:06:18
45	W-302-B	0.14	0.7400	0.5000	500.00	0.25	0.19	0.03	0.25	0 00:06:18
46	W-303-A	0.14	0.7600	0.5000	500.00	0.25	0.19	0.03	0.26	0 00:06:18
47	W-303-B	0.08	0.7600	0.5000	500.00	0.25	0.19	0.02	0.15	0 00:06:18
48	W-303-C	1.08	0.2600	0.5000	500.00	0.25	0.07	0.07	0.67	0 00:06:18
49	W-304-A	0.16	0.7600	0.5000	500.00	0.25	0.19	0.03	0.30	0 00:06:18
50	W-304-B	0.09	0.7600	0.5000	500.00	0.25	0.19	0.02	0.16	0 00:06:18
51	W-305-A	0.18	0.7600	0.5000	500.00	0.25	0.19	0.03	0.33	0 00:06:18
52	W-305-B	0.09	0.7600	0.5000	500.00	0.25	0.19	0.02	0.16	0 00:06:18
53	W-306-A	0.09	0.7600	0.5000	500.00	0.25	0.19	0.02	0.16	0 00:06:18
54	W-306-B	0.17	0.7600	0.5000	500.00	0.25	0.19	0.03	0.30	0 00:06:18
55	W-307-A	0.09	0.7600	0.5000	500.00	0.25	0.19	0.02	0.17	0 00:06:18
56	W-307-B	0.18	0.7600	0.5000	500.00	0.25	0.19	0.03	0.33	0 00:06:18
57	W-308-A	0.09	0.7600	0.5000	500.00	0.25	0.19	0.02	0.17	0 00:06:18
58	W-308-B	0.17	0.7600	0.5000	500.00	0.25	0.19	0.03	0.31	0 00:06:18
59	W-309	0.16	0.7600	0.5000	500.00	0.25	0.19	0.03	0.28	0 00:06:18

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1	Junction	10.10	20.50	11.17	6.00	0.00	14.41	19.27	0.00	1.23	0 00:00	0.00	0.00
2	100	Junction	11.97	20.50	11.17	6.00	0.00	6.32	20.50	0.00	0.00	0 00:07	0.00	0.00
3	101	Junction	18.70	21.70	0.00	0.00	0.00	0.68	18.95	0.00	2.75	0 00:00	0.00	0.00
4	101A	Junction	17.32	25.00	17.32	1.23	0.00	2.99	18.74	0.00	6.26	0 00:00	0.00	0.00
5	102	Junction	24.50	26.60	0.00	0.00	0.00	0.69	24.77	0.00	1.83	0 00:00	0.00	0.00
6	103	Junction	10.80	20.50	0.00	6.00	0.00	1.25	19.54	0.00	0.96	0 00:00	0.00	0.00
7	104	Junction	24.10	27.10	0.00	0.00	0.00	1.00	24.38	0.00	2.72	0 00:00	0.00	0.00
8	105	Junction	24.40	27.40	0.00	0.00	0.00	1.01	24.92	0.00	2.48	0 00:00	0.00	0.00
9	106	Junction	24.80	27.80	0.00	0.00	0.00	0.67	25.23	0.00	2.57	0 00:00	0.00	0.00
10	200	Junction	11.32	21.50	11.17	6.00	0.00	10.14	21.50	0.00	0.00	0 00:06	0.00	0.00
11	203	Junction	20.50	25.50	0.00	6.00	0.00	2.91	20.94	0.00	4.56	0 00:00	0.00	0.00
12	204	Junction	21.00	26.20	0.00	6.00	0.00	1.08	21.55	0.00	4.65	0 00:00	0.00	0.00
13	205	Junction	21.80	27.40	0.00	6.00	0.00	0.58	22.19	0.00	5.21	0 00:00	0.00	0.00
14	206	Junction	25.70	28.70	0.00	6.00	0.00	0.29	25.94	0.00	2.76	0 00:00	0.00	0.00
15	207	Junction	22.30	26.30	0.00	6.00	0.00	1.83	23.02	0.00	3.28	0 00:00	0.00	0.00
16	208	Junction	22.50	25.90	0.00	6.00	0.00	1.42	23.50	0.00	2.40	0 00:00	0.00	0.00
17	209	Junction	23.30	26.30	0.00	6.00	0.00	1.30	23.89	0.00	2.41	0 00:00	0.00	0.00
18	210	Junction	24.10	27.10	0.00	6.00	0.00	1.13	24.62	0.00	2.48	0 00:00	0.00	0.00
19	211	Junction	24.80	27.80	0.00	6.00	0.00	0.95	25.29	0.00	2.51	0 00:00	0.00	0.00
20	212	Junction	26.25	28.60	0.00	6.00	0.00	0.74	26.64	0.00	1.96	0 00:00	0.00	0.00
21	213	Junction	27.00	29.30	0.00	6.00	0.00	0.51	27.38	0.00	1.92	0 00:00	0.00	0.00
22	300	Junction	22.70	25.70	0.00	0.00	0.00	0.89	23.00	0.00	2.70	0 00:00	0.00	0.00
23	300A	Junction	20.61	23.92	20.61	1.10	0.00	0.88	20.90	0.00	3.02	0 00:00	0.00	0.00
24	301	Junction	26.80	29.80	0.00	6.00	0.00	0.91	27.14	0.00	2.66	0 00:00	0.00	0.00
25	302	Junction	33.70	36.70	0.00	6.00	0.00	0.57	33.99	0.00	2.71	0 00:00	0.00	0.00
26	303A	Junction	23.17	29.17	23.17	29.17	0.00	6.64	23.81	0.00	5.36	0 00:00	0.00	0.00
27	303B	Junction	38.00	45.00	0.00	0.00	0.00	3.34	38.47	0.00	6.53	0 00:00	0.00	0.00
28	303C	Junction	46.30	50.30	0.00	0.00	0.00	2.77	47.72	0.00	2.58	0 00:00	0.00	0.00
29	304	Junction	60.01	64.01	0.00	0.00	0.00	2.43	61.55	0.00	2.46	0 00:00	0.00	0.00
30	305	Junction	77.40	81.40	0.00	0.00	0.00	2.05	78.82	0.00	2.58	0 00:00	0.00	0.00
31	306	Junction	102.50	106.50	0.00	0.00	0.00	1.61	103.85	0.00	2.65	0 00:00	0.00	0.00
32	307	Junction	143.40	147.40	0.00	0.00	0.00	1.19	144.69	0.00	2.71	0 00:00	0.00	0.00
33	308	Junction	185.30	189.30	0.00	0.00	0.00	0.74	186.55	0.00	2.75	0 00:00	0.00	0.00
34	309	Junction	198.20	202.20	0.00	0.00	0.00	0.28	199.43	0.00	2.77	0 00:00	0.00	0.00
35	Out-01	Outfall	-3.50					14.41	11.17					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Link-03	Pipe	212	211	149.45	26.35	24.80	1.0400	12.000	0.0120	0.71	3.93	0.18	2.54	0.39	0.39	0.00	Calculated
2	Link-18	Pipe	213	212	148.27	27.10	26.25	0.5700	12.000	0.0120	0.49	2.92	0.17	2.16	0.33	0.33	0.00	Calculated
3	Link-20	Pipe	209	208	76.25	23.40	22.90	0.6600	12.000	0.0120	1.28	3.13	0.41	2.93	0.55	0.55	0.00	Calculated
4	Link-21	Pipe	208	207	122.71	23.00	22.30	0.5700	12.000	0.0120	1.42	2.92	0.49	2.83	0.61	0.61	0.00	Calculated
5	Link-24	Pipe	205	204	150.62	21.90	21.00	0.6000	12.000	0.0120	0.54	2.98	0.18	1.71	0.42	0.42	0.00	Calculated
6	Link-25	Pipe	206	205	148.05	25.80	21.80	2.7000	12.000	0.0120	0.28	6.34	0.04	1.69	0.26	0.26	0.00	Calculated
7	Link-32	Pipe	103	1	68.45	10.90	10.10	1.1700	12.000	0.0120	1.06	4.17	0.25	1.34	1.00	1.00	11.00	SURCHARGED
8	Link-35	Pipe	309	308	300.63	199.30	186.30	4.3200	12.000	0.0120	0.27	8.03	0.03	2.64	0.19	0.19	0.00	Calculated
9	Link-38	Pipe	307	306	284.68	144.50	103.50	14.4000	12.000	0.0120	1.18	14.65	0.08	6.85	0.27	0.27	0.00	Calculated
10	Link-44	Pipe	308	307	285.35	186.40	144.40	14.7200	12.000	0.0120	0.71	14.81	0.05	5.52	0.22	0.22	0.00	Calculated
11	Link-46	Pipe	304	303C	255.15	61.20	47.30	5.4500	12.000	0.0120	2.41	9.01	0.27	8.68	0.38	0.38	0.00	Calculated
12	Link-47	Pipe	306	305	276.21	103.60	78.40	9.1200	12.000	0.0120	1.60	11.66	0.14	7.01	0.33	0.33	0.00	Calculated
13	Link-49	Pipe	302	301	187.41	33.80	26.80	3.7400	12.000	0.0120	0.56	7.46	0.07	3.42	0.26	0.26	0.00	Calculated
14	Link-50	Pipe	301	300	123.00	26.90	22.70	3.4100	12.000	0.0120	0.89	7.13	0.12	5.29	0.27	0.27	0.00	Calculated
15	Link-52	Pipe	200	1	120.84	11.42	10.10	1.0900	18.000	0.0120	10.15	11.89	0.85	5.74	1.50	1.00	6.00	SURCHARGED
16	Link-53	Pipe	203	200	515.83	20.50	11.32	1.7800	18.000	0.0120	2.80	15.18	0.18	2.32	0.97	0.65	0.00	Calculated
17	Link-56	Pipe	207	203	358.29	22.40	20.50	0.5300	12.000	0.0120	1.77	2.81	0.63	4.22	0.53	0.53	0.00	Calculated
18	Link-57	Pipe	211	210	148.13	24.90	24.10	0.5400	12.000	0.0120	0.91	2.84	0.32	2.64	0.45	0.45	0.00	Calculated
19	Link-58	Pipe	210	209	151.30	24.20	23.30	0.5900	12.000	0.0120	1.10	2.98	0.37	2.75	0.51	0.51	0.00	Calculated
20	Link-59	Pipe	106	105	98.27	24.90	24.40	0.5100	12.000	0.0120	0.65	2.75	0.24	2.05	0.42	0.42	0.00	Calculated
21	Link-60	Pipe	105	104	49.37	24.50	24.10	0.8100	12.000	0.0120	1.00	3.47	0.29	4.10	0.35	0.35	0.00	Calculated
22	Link-61	Pipe	104	103	101.20	24.20	10.80	13.2400	12.000	0.0120	0.99	14.04	0.07	2.06	0.59	0.59	0.00	Calculated
23	Link-62	Pipe	102	101	66.47	24.60	18.70	8.8800	12.000	0.0120	0.68	11.50	0.06	5.83	0.21	0.21	0.00	Calculated
24	Link-64	Pipe	100	1	182.03	12.07	10.10	1.0800	18.000	0.0120	4.38	11.84	0.37	2.62	1.50	1.00	4.00	SURCHARGED
25	Link-69	Pipe	204	203	108.42	21.10	20.50	0.5500	12.000	0.0120	1.06	2.87	0.37	3.51	0.43	0.43	0.00	Calculated
26	Link-70	Pipe	305	304	292.57	78.50	61.10	5.9500	12.000	0.0120	2.03	9.41	0.22	7.30	0.38	0.38	0.00	Calculated
27	Link-72	Pipe	303C	303B	150.10	47.40	38.00	6.2600	18.000	0.0120	2.76	28.48	0.10	7.48	0.39	0.26	0.00	Calculated
28	Link-73	Pipe	303B	303A	317.71	38.10	23.17	4.7000	18.000	0.0120	3.30	24.67	0.13	6.44	0.50	0.34	0.00	Calculated
29	Link-74	Pipe	1	Out-01	248.12	10.10	-3.50	5.4800	18.000	0.0150	14.41	21.31	0.68	8.15	1.50	1.00	12.00	SURCHARGED
30	Link-75	Pipe	300A	200	95.72	20.71	11.32	9.8100	12.000	0.0120	0.95	12.09	0.08	2.36	0.60	0.60	0.00	Calculated
31	Link-76	Pipe	101A	100	52.56	17.42	11.97	10.3700	12.000	0.0120	2.37	12.43	0.19	4.15	1.00	1.00	1.00	SURCHARGED
32	Link-77	Pipe	303A	200	254.42	23.27	11.32	4.7000	18.000	0.0120	6.42	24.66	0.26	6.89	1.02	0.68	0.00	Calculated
33	Weir-01	Weir	300	300A		22.70	20.61				0.88							
34	Weir-02	Weir	101	101A		18.70	17.32				0.68							

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	1	10.10	20.50	10.40	11.17	1.07	6.00	-14.50	0.00	0.00
2	100	11.97	20.50	8.53	11.17	-0.80	6.00	-14.50	0.00	0.00
3	101	18.70	21.70	3.00	0.00	-18.70	0.00	-21.70	0.00	0.00
4	101A	17.32	25.00	7.68	17.32	0.00	1.23	-23.77	0.00	0.00
5	102	24.50	26.60	2.10	0.00	-24.50	0.00	-26.60	0.00	0.00
6	103	10.80	20.50	9.70	0.00	-10.80	6.00	-14.50	0.00	0.00
7	104	24.10	27.10	3.00	0.00	-24.10	0.00	-27.10	0.00	0.00
8	105	24.40	27.40	3.00	0.00	-24.40	0.00	-27.40	0.00	0.00
9	106	24.80	27.80	3.00	0.00	-24.80	0.00	-27.80	0.00	0.00
10	200	11.32	21.50	10.18	11.17	-0.15	6.00	-15.50	0.00	0.00
11	203	20.50	25.50	5.00	0.00	-20.50	6.00	-19.50	0.00	0.00
12	204	21.00	26.20	5.20	0.00	-21.00	6.00	-20.20	0.00	0.00
13	205	21.80	27.40	5.60	0.00	-21.80	6.00	-21.40	0.00	0.00
14	206	25.70	28.70	3.00	0.00	-25.70	6.00	-22.70	0.00	0.00
15	207	22.30	26.30	4.00	0.00	-22.30	6.00	-20.30	0.00	0.00
16	208	22.50	25.90	3.40	0.00	-22.50	6.00	-19.90	0.00	0.00
17	209	23.30	26.30	3.00	0.00	-23.30	6.00	-20.30	0.00	0.00
18	210	24.10	27.10	3.00	0.00	-24.10	6.00	-21.10	0.00	0.00
19	211	24.80	27.80	3.00	0.00	-24.80	6.00	-21.80	0.00	0.00
20	212	26.25	28.60	2.35	0.00	-26.25	6.00	-22.60	0.00	0.00
21	213	27.00	29.30	2.30	0.00	-27.00	6.00	-23.30	0.00	0.00
22	300	22.70	25.70	3.00	0.00	-22.70	0.00	-25.70	0.00	0.00
23	300A	20.61	23.92	3.31	20.61	0.00	1.10	-22.82	0.00	0.00
24	301	26.80	29.80	3.00	0.00	-26.80	6.00	-23.80	0.00	0.00
25	302	33.70	36.70	3.00	0.00	-33.70	6.00	-30.70	0.00	0.00
26	303A	23.17	29.17	6.00	23.17	0.00	29.17	0.00	0.00	0.00
27	303B	38.00	45.00	7.00	0.00	-38.00	0.00	-45.00	0.00	0.00
28	303C	46.30	50.30	4.00	0.00	-46.30	0.00	-50.30	0.00	0.00
29	304	60.01	64.01	4.00	0.00	-60.01	0.00	-64.01	0.00	0.00
30	305	77.40	81.40	4.00	0.00	-77.40	0.00	-81.40	0.00	0.00
31	306	102.50	106.50	4.00	0.00	-102.50	0.00	-106.50	0.00	0.00
32	307	143.40	147.40	4.00	0.00	-143.40	0.00	-147.40	0.00	0.00
33	308	185.30	189.30	4.00	0.00	-185.30	0.00	-189.30	0.00	0.00
34	309	198.20	202.20	4.00	0.00	-198.20	0.00	-202.20	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1	14.41	1.80	19.27	9.17	0.00	1.23	11.69	1.59	0 00:07	0 00:00	0.00	0.00
2	100	6.32	1.48	20.50	8.53	0.00	0.00	12.43	0.46	0 00:07	0 00:07	0.00	0.00
3	101	0.68	0.00	18.95	0.25	0.00	2.75	18.73	0.03	0 00:06	0 00:00	0.00	0.00
4	101A	2.99	0.00	18.74	1.42	0.00	6.26	17.46	0.14	0 00:07	0 00:00	0.00	0.00
5	102	0.69	0.69	24.77	0.27	0.00	1.83	24.62	0.12	0 00:06	0 00:00	0.00	0.00
6	103	1.25	0.00	19.54	8.74	0.00	0.96	11.69	0.89	0 00:07	0 00:00	0.00	0.00
7	104	1.00	0.00	24.38	0.28	0.00	2.72	24.23	0.13	0 00:07	0 00:00	0.00	0.00
8	105	1.01	0.37	24.92	0.52	0.00	2.48	24.56	0.16	0 00:06	0 00:00	0.00	0.00
9	106	0.67	0.67	25.23	0.43	0.00	2.57	24.95	0.15	0 00:06	0 00:00	0.00	0.00
10	200	10.14	0.58	21.50	10.18	0.00	0.00	12.07	0.75	0 00:06	0 00:06	0.00	0.00
11	203	2.91	0.32	20.94	0.44	0.00	4.56	20.61	0.11	0 00:09	0 00:00	0.00	0.00
12	204	1.08	0.58	21.55	0.55	0.00	4.65	21.18	0.18	0 00:07	0 00:00	0.00	0.00
13	205	0.58	0.30	22.19	0.39	0.00	5.21	21.95	0.15	0 00:07	0 00:00	0.00	0.00
14	206	0.29	0.29	25.94	0.24	0.00	2.76	25.82	0.12	0 00:06	0 00:00	0.00	0.00
15	207	1.83	0.60	23.02	0.72	0.00	3.28	22.54	0.24	0 00:09	0 00:00	0.00	0.00
16	208	1.42	0.19	23.50	1.00	0.00	2.40	23.09	0.59	0 00:08	0 00:00	0.00	0.00
17	209	1.30	0.26	23.89	0.59	0.00	2.41	23.50	0.20	0 00:08	0 00:00	0.00	0.00
18	210	1.13	0.25	24.62	0.52	0.00	2.48	24.28	0.18	0 00:07	0 00:00	0.00	0.00
19	211	0.95	0.26	25.29	0.49	0.00	2.51	24.97	0.17	0 00:07	0 00:00	0.00	0.00
20	212	0.74	0.26	26.64	0.39	0.00	1.96	26.40	0.15	0 00:07	0 00:00	0.00	0.00
21	213	0.51	0.51	27.38	0.38	0.00	1.92	27.15	0.15	0 00:06	0 00:00	0.00	0.00
22	300	0.89	0.00	23.00	0.30	0.00	2.70	22.74	0.04	0 00:07	0 00:00	0.00	0.00
23	300A	0.88	0.00	20.90	0.29	0.00	3.02	20.74	0.13	0 00:07	0 00:00	0.00	0.00
24	301	0.91	0.35	27.14	0.34	0.00	2.66	26.94	0.14	0 00:06	0 00:00	0.00	0.00
25	302	0.57	0.57	33.99	0.29	0.00	2.71	33.83	0.13	0 00:06	0 00:00	0.00	0.00
26	303A	6.64	3.36	23.81	0.64	0.00	5.36	23.38	0.21	0 00:08	0 00:00	0.00	0.00
27	303B	3.34	0.67	38.47	0.47	0.00	6.53	38.17	0.17	0 00:07	0 00:00	0.00	0.00
28	303C	2.77	0.41	47.72	1.42	0.00	2.58	47.42	1.12	0 00:07	0 00:00	0.00	0.00
29	304	2.43	0.45	61.55	1.54	0.00	2.46	61.23	1.22	0 00:07	0 00:00	0.00	0.00
30	305	2.05	0.49	78.82	1.42	0.00	2.58	78.52	1.12	0 00:07	0 00:00	0.00	0.00
31	306	1.61	0.46	103.85	1.35	0.00	2.65	103.61	1.11	0 00:07	0 00:00	0.00	0.00
32	307	1.19	0.50	144.69	1.29	0.00	2.71	144.50	1.10	0 00:06	0 00:00	0.00	0.00
33	308	0.74	0.48	186.55	1.25	0.00	2.75	186.39	1.09	0 00:06	0 00:00	0.00	0.00
34	309	0.28	0.28	199.43	1.23	0.00	2.77	199.28	1.08	0 00:06	0 00:00	0.00	0.00

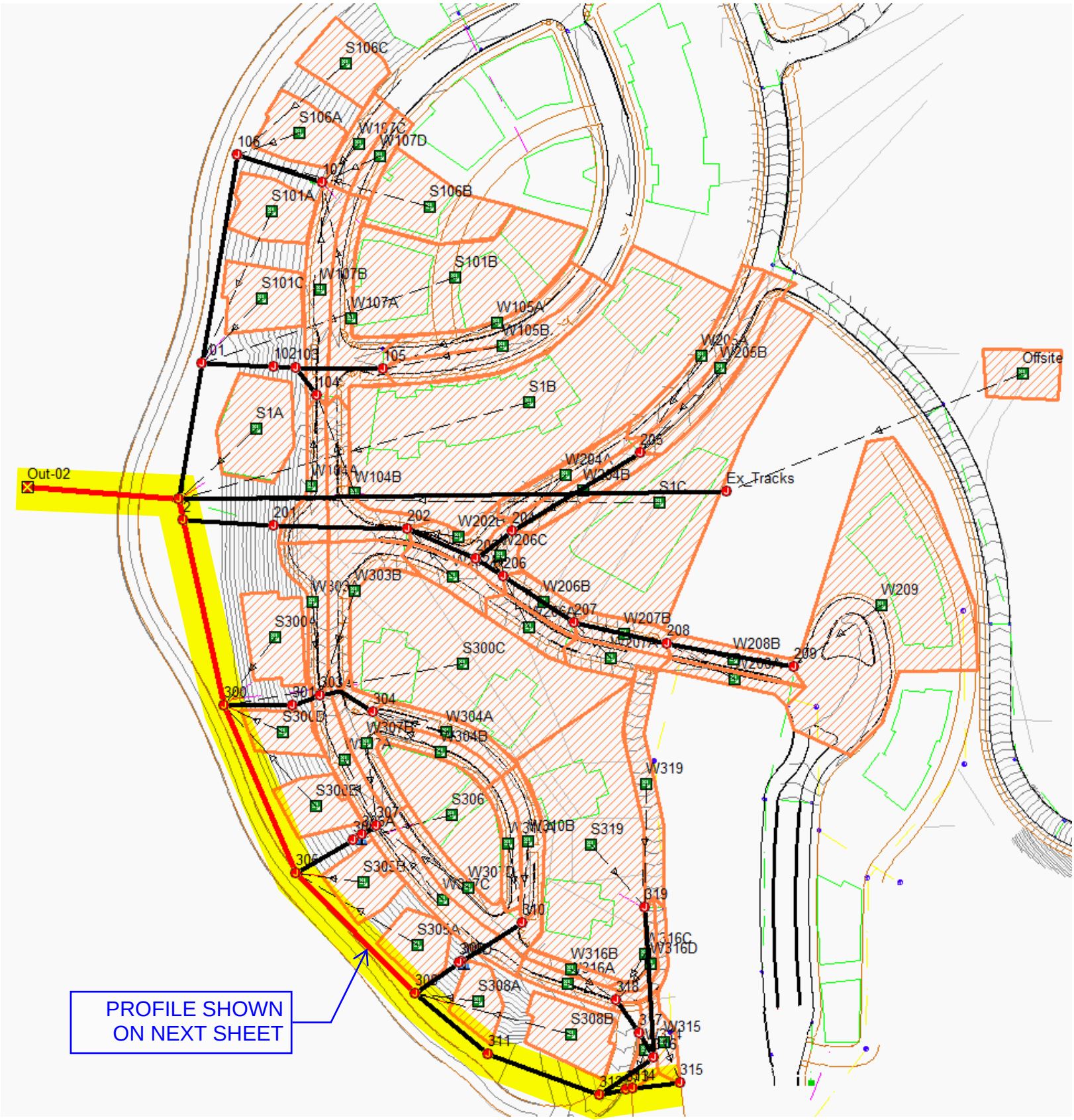
Pipe Input

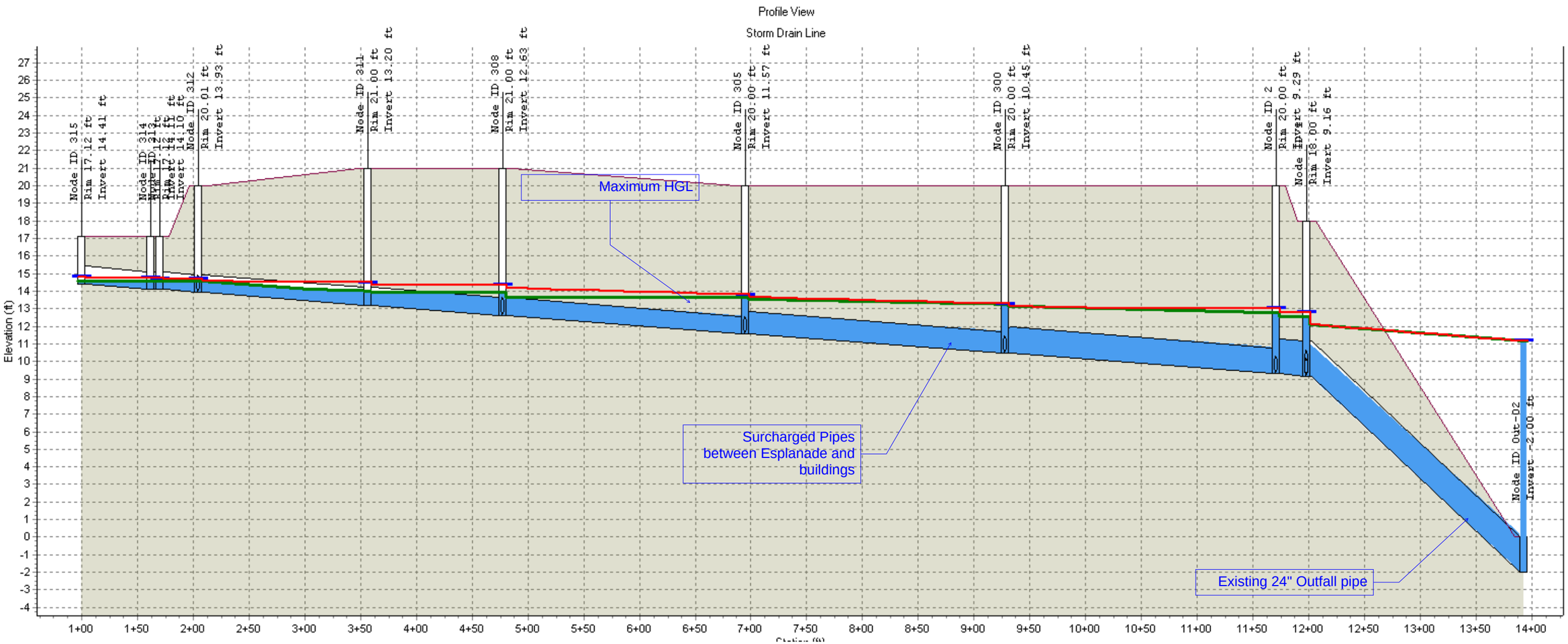
SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-03	149.45	26.35	0.10	24.80	0.00	1.55	1.0400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
2	Link-18	148.27	27.10	0.10	26.25	0.00	0.85	0.5700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
3	Link-20	76.25	23.40	0.10	22.90	0.40	0.50	0.6600	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	Link-21	122.71	23.00	0.50	22.30	0.00	0.70	0.5700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
5	Link-24	150.62	21.90	0.10	21.00	0.00	0.90	0.6000	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
6	Link-25	148.05	25.80	0.10	21.80	0.00	4.00	2.7000	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
7	Link-32	68.45	10.90	0.10	10.10	0.00	0.80	1.1700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
8	Link-35	300.63	199.30	1.10	186.30	1.00	13.00	4.3200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
9	Link-38	284.68	144.50	1.10	103.50	1.00	41.00	14.4000	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
10	Link-44	285.35	186.40	1.10	144.40	1.00	42.00	14.7200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
11	Link-46	255.15	61.20	1.19	47.30	1.00	13.90	5.4500	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
12	Link-47	276.21	103.60	1.10	78.40	1.00	25.20	9.1200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
13	Link-49	187.41	33.80	0.10	26.80	0.00	7.00	3.7400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
14	Link-50	123.00	26.90	0.10	22.70	0.00	4.20	3.4100	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
15	Link-52	120.84	11.42	0.10	10.10	0.00	1.32	1.0900	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
16	Link-53	515.83	20.50	0.00	11.32	0.00	9.18	1.7800	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
17	Link-56	358.29	22.40	0.10	20.50	0.00	1.90	0.5300	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
18	Link-57	148.13	24.90	0.10	24.10	0.00	0.80	0.5400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
19	Link-58	151.30	24.20	0.10	23.30	0.00	0.90	0.5900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
20	Link-59	98.27	24.90	0.10	24.40	0.00	0.50	0.5100	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
21	Link-60	49.37	24.50	0.10	24.10	0.00	0.40	0.8100	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
22	Link-61	101.20	24.20	0.10	10.80	0.00	13.40	13.2400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
23	Link-62	66.47	24.60	0.10	18.70	0.00	5.90	8.8800	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
24	Link-64	182.03	12.07	0.10	10.10	0.00	1.97	1.0800	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
25	Link-69	108.42	21.10	0.10	20.50	0.00	0.60	0.5500	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
26	Link-70	292.57	78.50	1.10	61.10	1.09	17.40	5.9500	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
27	Link-72	150.10	47.40	1.10	38.00	0.00	9.40	6.2600	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
28	Link-73	317.71	38.10	0.10	23.17	0.00	14.93	4.7000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
29	Link-74	248.12	10.10	0.00	-3.50	0.00	13.60	5.4800	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
30	Link-75	95.72	20.71	0.10	11.32	0.00	9.39	9.8100	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
31	Link-76	52.56	17.42	0.10	11.97	0.00	5.45	10.3700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
32	Link-77	254.42	23.27	0.10	11.32	0.00	11.95	4.7000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-03	0.71	0 00:07	3.93	0.18	2.54	0.98	0.39	0.39	0.00		Calculated
2	Link-18	0.49	0 00:06	2.92	0.17	2.16	1.14	0.33	0.33	0.00		Calculated
3	Link-20	1.28	0 00:08	3.13	0.41	2.93	0.43	0.55	0.55	0.00		Calculated
4	Link-21	1.42	0 00:08	2.92	0.49	2.83	0.72	0.61	0.61	0.00		Calculated
5	Link-24	0.54	0 00:07	2.98	0.18	1.71	1.47	0.42	0.42	0.00		Calculated
6	Link-25	0.28	0 00:06	6.34	0.04	1.69	1.46	0.26	0.26	0.00		Calculated
7	Link-32	1.06	0 00:07	4.17	0.25	1.34	0.85	1.00	1.00	11.00		SURCHARGED
8	Link-35	0.27	0 00:06	8.03	0.03	2.64	1.90	0.19	0.19	0.00		Calculated
9	Link-38	1.18	0 00:06	14.65	0.08	6.85	0.69	0.27	0.27	0.00		Calculated
10	Link-44	0.71	0 00:06	14.81	0.05	5.52	0.86	0.22	0.22	0.00		Calculated
11	Link-46	2.41	0 00:07	9.01	0.27	8.68	0.49	0.38	0.38	0.00		Calculated
12	Link-47	1.60	0 00:07	11.66	0.14	7.01	0.66	0.33	0.33	0.00		Calculated
13	Link-49	0.56	0 00:06	7.46	0.07	3.42	0.91	0.26	0.26	0.00		Calculated
14	Link-50	0.89	0 00:06	7.13	0.12	5.29	0.39	0.27	0.27	0.00		Calculated
15	Link-52	10.15	0 00:08	11.89	0.85	5.74	0.35	1.50	1.00	6.00		SURCHARGED
16	Link-53	2.80	0 00:09	15.18	0.18	2.32	3.71	0.97	0.65	0.00		Calculated
17	Link-56	1.77	0 00:09	2.81	0.63	4.22	1.42	0.53	0.53	0.00		Calculated
18	Link-57	0.91	0 00:07	2.84	0.32	2.64	0.94	0.45	0.45	0.00		Calculated
19	Link-58	1.10	0 00:07	2.98	0.37	2.75	0.92	0.51	0.51	0.00		Calculated
20	Link-59	0.65	0 00:06	2.75	0.24	2.05	0.80	0.42	0.42	0.00		Calculated
21	Link-60	1.00	0 00:06	3.47	0.29	4.10	0.20	0.35	0.35	0.00		Calculated
22	Link-61	0.99	0 00:07	14.04	0.07	2.06	0.82	0.59	0.59	0.00		Calculated
23	Link-62	0.68	0 00:06	11.50	0.06	5.83	0.19	0.21	0.21	0.00		Calculated
24	Link-64	4.38	0 00:07	11.84	0.37	2.62	1.16	1.50	1.00	4.00		SURCHARGED
25	Link-69	1.06	0 00:07	2.87	0.37	3.51	0.51	0.43	0.43	0.00		Calculated
26	Link-70	2.03	0 00:07	9.41	0.22	7.30	0.67	0.38	0.38	0.00		Calculated
27	Link-72	2.76	0 00:07	28.48	0.10	7.48	0.33	0.39	0.26	0.00		Calculated
28	Link-73	3.30	0 00:07	24.67	0.13	6.44	0.82	0.50	0.34	0.00		Calculated
29	Link-74	14.41	0 00:08	21.31	0.68	8.15	0.51	1.50	1.00	12.00		SURCHARGED
30	Link-75	0.95	0 00:07	12.09	0.08	2.36	0.68	0.60	0.60	0.00		Calculated
31	Link-76	2.37	0 00:07	12.43	0.19	4.15	0.21	1.00	1.00	1.00		SURCHARGED
32	Link-77	6.42	0 00:07	24.66	0.26	6.89	0.62	1.02	0.68	0.00		Calculated

OUTFALL 2 - HYDRAULIC MODELING SUMMARY




Profile View
Storm Drain Line
Elevation (ft)
Node ID 315
Rim 17.12 ft
Invert 14.41 ft
Node ID 314
Rim 17.21 ft
Invert 14.11 ft
Node ID 312
Rim 20.01 ft
Invert 13.93 ft
Node ID 311
Rim 21.00 ft
Invert 13.20 ft
Node ID 308
Rim 21.00 ft
Invert 12.63 ft
Node ID 305
Rim 20.00 ft
Invert 11.57 ft
Node ID 300
Rim 20.00 ft
Invert 10.45 ft
Node ID 2
Rim 20.00 ft
Invert 9.29 ft
Node ID
Rim 18.00 ft
Invert 9.16 ft
Node ID Out-02
Invert -2.00 ft
Maximum HGL
Surcharged Pipes between Esplanade and buildings
Existing 24" Outfall pipe

Project Description

File Name ..... 191205_Outfall 2_V3..SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	Kirpich
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Apr 04, 2018	00:00:00
End Analysis On	Apr 04, 2018	00:40:00
Start Reporting On	Apr 04, 2018	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	59
Nodes	41
Junctions	40
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	40
Channels	0
Pipes	38
Pumps	0
Orifices	0
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period..... 100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Average Slope (%)	Flow Length (ft)	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Offsite	7.50	0.2000	20.0000	600.00	0.40	0.08	0.59	1.79	0 00:20:00
2	S101A	0.16	0.4700	0.5000	150.00	0.25	0.12	0.02	0.18	0 00:06:18
3	S101B	0.74	0.6000	0.5000	500.00	0.25	0.15	0.11	1.07	0 00:06:18
4	S101C	0.18	0.4700	0.5000	150.00	0.25	0.12	0.02	0.21	0 00:06:18
5	S106A	0.16	0.4700	0.5000	500.00	0.25	0.12	0.02	0.18	0 00:06:18
6	S106B	0.30	0.6400	0.5000	500.00	0.25	0.16	0.05	0.46	0 00:06:18
7	S106C	0.16	0.4700	0.5000	500.00	0.25	0.12	0.02	0.18	0 00:06:18
8	S1A	0.25	0.4700	0.5000	500.00	0.25	0.12	0.03	0.28	0 00:06:18
9	S1B	1.79	0.4900	0.5000	500.00	0.25	0.12	0.22	2.10	0 00:06:18
10	S1C	1.09	0.2200	0.5000	500.00	0.25	0.06	0.06	0.58	0 00:06:18
11	S300A	0.18	0.8000	0.5000	500.00	0.25	0.20	0.04	0.35	0 00:06:18
12	S300C	1.02	0.4400	0.5000	500.00	0.25	0.11	0.11	1.08	0 00:06:18
13	S300D	0.11	0.4700	0.5000	150.00	0.25	0.12	0.01	0.12	0 00:06:18
14	S300E	0.04	0.8000	0.5000	150.00	0.25	0.20	0.01	0.07	0 00:06:18
15	S305A	0.04	0.8000	0.5000	150.00	0.25	0.20	0.01	0.07	0 00:06:18
16	S305B	0.04	0.8000	0.5000	150.00	0.25	0.20	0.01	0.07	0 00:06:18
17	S306	0.36	0.5900	0.5000	500.00	0.25	0.15	0.05	0.51	0 00:06:18
18	S308A	0.04	0.8000	0.5000	150.00	0.25	0.20	0.01	0.08	0 00:06:18
19	S308B	0.18	0.8200	0.5000	150.00	0.25	0.21	0.04	0.36	0 00:06:18
20	S319	0.98	0.5000	0.5000	1.00	0.25	0.13	0.12	1.17	0 00:06:18
21	W104A	0.14	0.6800	0.5000	500.00	0.25	0.17	0.02	0.23	0 00:06:18
22	W104B	0.20	0.6800	0.5000	500.00	0.25	0.17	0.03	0.32	0 00:06:18
23	W105A	0.18	0.6800	0.5000	500.00	0.25	0.17	0.03	0.29	0 00:06:18
24	W105B	0.24	0.6800	0.5000	500.00	0.25	0.17	0.04	0.38	0 00:06:18
25	W107A	0.24	0.6800	0.5000	500.00	0.25	0.17	0.04	0.40	0 00:06:18
26	W107B	0.21	0.6800	0.5000	500.00	0.25	0.17	0.04	0.34	0 00:06:18
27	W107C	0.10	0.6800	0.5000	500.00	0.25	0.17	0.02	0.17	0 00:06:18
28	W107D	0.07	0.6800	0.5000	500.00	0.25	0.17	0.01	0.12	0 00:06:18
29	W202A	0.11	0.6200	0.5000	500.00	0.25	0.16	0.02	0.16	0 00:06:18
30	W202B	0.10	0.6200	0.5000	500.00	0.25	0.16	0.02	0.14	0 00:06:18
31	W204A	0.11	0.6800	0.5000	500.00	0.25	0.17	0.02	0.18	0 00:06:18
32	W204B	0.14	0.6800	0.5000	500.00	0.25	0.17	0.02	0.22	0 00:06:18
33	W205A	0.16	0.6800	0.5000	500.00	0.25	0.17	0.03	0.27	0 00:06:18
34	W205B	0.20	0.6800	0.5000	500.00	0.25	0.17	0.03	0.33	0 00:06:18
35	W206A	0.10	0.6200	0.5000	500.00	0.25	0.16	0.02	0.15	0 00:06:18
36	W206B	0.09	0.6200	0.5000	500.00	0.25	0.16	0.01	0.13	0 00:06:18
37	W206C	0.08	0.6800	0.5000	500.00	0.25	0.17	0.01	0.13	0 00:06:18
38	W207A	0.09	0.6200	0.5000	500.00	0.25	0.16	0.01	0.14	0 00:06:18
39	W207B	0.10	0.6200	0.5000	500.00	0.25	0.16	0.02	0.15	0 00:06:18
40	W208A	0.07	0.6200	0.5000	500.00	0.25	0.16	0.01	0.11	0 00:06:18
41	W208B	0.12	0.6200	0.5000	500.00	0.25	0.16	0.02	0.18	0 00:06:18
42	W209	1.97	0.8000	0.5000	150.00	0.25	0.20	0.40	3.77	0 00:06:18
43	W303A	0.15	0.6800	0.5000	500.00	0.25	0.17	0.03	0.24	0 00:06:18
44	W303B	0.19	0.6800	0.5000	500.00	0.25	0.17	0.03	0.32	0 00:06:18
45	W304A	0.12	0.6700	0.5000	500.00	0.25	0.17	0.02	0.19	0 00:06:18
46	W304B	0.10	0.6200	0.5000	500.00	0.25	0.16	0.02	0.14	0 00:06:18
47	W307A	0.14	0.6800	0.5000	500.00	0.25	0.17	0.02	0.22	0 00:06:18
48	W307B	0.15	0.6800	0.5000	500.00	0.25	0.17	0.03	0.25	0 00:06:18
49	W307C	0.19	0.6800	0.5000	500.00	0.25	0.17	0.03	0.31	0 00:06:18
50	W307D	0.19	0.6800	0.5000	500.00	0.25	0.17	0.03	0.30	0 00:06:18
51	W310A	0.09	0.6200	0.5000	500.00	0.25	0.16	0.01	0.14	0 00:06:18
52	W310B	0.12	0.6700	0.5000	500.00	0.25	0.17	0.02	0.20	0 00:06:18
53	W314	0.05	0.8000	0.5000	500.00	0.25	0.20	0.01	0.10	0 00:06:18
54	W315	0.06	0.8000	0.5000	500.00	0.25	0.20	0.01	0.11	0 00:06:18
55	W316A	0.08	0.6800	0.5000	500.00	0.25	0.17	0.01	0.12	0 00:06:18
56	W316B	0.04	0.6800	0.5000	500.00	0.25	0.17	0.01	0.06	0 00:06:18
57	W316C	0.04	0.8000	0.5000	500.00	0.25	0.20	0.01	0.08	0 00:06:18
58	W316D	0.05	0.8000	0.5000	500.00	0.25	0.20	0.01	0.10	0 00:06:18
59	W319	0.18	0.8000	0.5000	500.00	0.25	0.20	0.04	0.35	0 00:06:18

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1	Junction	9.16	18.00	11.17	6.00	0.00	17.19	13.37	0.00	4.63	0 00:00	0.00	0.00
2	2	Junction	9.29	20.00	11.17	6.00	0.00	10.54	13.68	0.00	6.32	0 00:00	0.00	0.00
3	101	Junction	13.89	15.99	11.17	6.00	0.00	4.31	14.69	0.00	1.30	0 00:00	0.00	0.00
4	102	Junction	15.11	18.70	0.00	6.00	0.00	1.19	15.46	0.00	3.24	0 00:00	0.00	0.00
5	103	Junction	25.68	27.98	0.00	6.00	0.00	1.19	25.83	0.00	2.15	0 00:00	0.00	0.00
6	104	Junction	26.50	28.73	0.00	6.00	0.00	0.55	26.75	0.00	1.98	0 00:00	0.00	0.00
7	105	Junction	25.75	27.98	0.00	6.00	0.00	0.67	26.23	0.00	1.75	0 00:00	0.00	0.00
8	106	Junction	15.22	16.00	0.00	6.00	0.00	1.83	15.81	0.00	0.41	0 00:00	0.00	0.00
9	107	Junction	23.69	27.23	0.00	6.00	0.00	1.02	23.90	0.00	3.33	0 00:00	0.00	0.00
10	201	Junction	26.80	28.80	11.17	6.00	0.00	5.71	27.23	0.00	1.57	0 00:00	0.00	0.00
11	202	Junction	35.06	38.06	0.00	6.00	0.00	5.72	35.66	0.00	2.40	0 00:00	0.00	0.00
12	203	Junction	38.08	41.08	0.00	6.00	0.00	5.46	38.75	0.00	2.33	0 00:00	0.00	0.00
13	204	Junction	39.73	41.73	0.00	6.00	0.00	0.96	39.99	0.00	1.74	0 00:00	0.00	0.00
14	205	Junction	41.89	45.10	0.00	6.00	0.00	0.59	42.15	0.00	2.95	0 00:00	0.00	0.00
15	206	Junction	39.44	41.76	0.00	6.00	0.00	4.55	40.22	0.00	1.54	0 00:00	0.00	0.00
16	207	Junction	45.86	47.86	0.00	6.00	0.00	4.20	46.28	0.00	1.58	0 00:00	0.00	0.00
17	208	Junction	51.61	53.93	0.00	6.00	0.00	3.96	52.09	0.00	1.84	0 00:00	0.00	0.00
18	209	Junction	52.50	55.00	0.00	0.00	0.00	3.77	53.42	0.00	1.58	0 00:00	0.00	0.00
19	300	Junction	10.45	15.99	11.17	6.00	0.00	4.89	15.99	0.00	0.00	0 00:05	0.00	0.00
20	301	Junction	24.31	27.05	0.00	6.00	0.00	0.86	24.47	0.00	2.58	0 00:00	0.00	0.00
21	303	Junction	24.97	29.14	0.00	6.00	0.00	0.88	25.31	0.00	3.83	0 00:00	0.00	0.00
22	304	Junction	25.89	27.89	0.00	6.00	0.00	0.33	26.08	0.00	1.81	0 00:00	0.00	0.00
23	305	Junction	11.57	18.00	11.17	6.00	0.00	3.21	18.00	0.00	0.00	0 00:06	0.00	0.00
24	306	Junction	19.97	22.97	0.00	6.00	0.00	1.57	20.21	0.00	2.76	0 00:00	0.00	0.00
25	306A	Junction	21.72	27.72	21.72	27.72	0.00	1.08	22.06	0.00	5.66	0 00:00	0.00	0.00
26	307	Junction	24.38	26.58	0.00	6.00	0.00	1.08	24.58	0.00	2.00	0 00:00	0.00	0.00
27	308	Junction	12.63	16.00	0.00	6.00	0.00	2.28	16.00	0.00	0.00	0 00:07	0.00	0.00
28	309	Junction	23.46	25.46	0.00	6.00	0.00	0.33	23.61	0.00	2.35	0 00:00	0.00	0.00
29	309D	Junction	22.86	28.86	22.86	28.86	0.00	0.33	22.96	0.00	5.90	0 00:00	0.00	0.00
30	310	Junction	25.37	27.50	0.00	6.00	0.00	0.34	25.54	0.00	1.96	0 00:00	0.00	0.00
31	311	Junction	13.20	16.00	0.00	6.00	0.00	1.92	16.00	0.00	0.00	0 00:07	0.00	0.00
32	312	Junction	13.93	20.01	0.00	6.00	0.00	1.81	14.69	0.00	5.32	0 00:00	0.00	0.00
33	313	Junction	14.10	17.12	0.00	6.00	0.00	0.37	14.71	0.00	2.41	0 00:00	0.00	0.00
34	314	Junction	14.11	17.12	0.00	6.00	0.00	0.32	14.72	0.00	2.40	0 00:00	0.00	0.00
35	315	Junction	14.41	17.12	0.00	6.00	0.00	0.26	14.77	0.00	2.35	0 00:00	0.00	0.00
36	316	Junction	14.32	19.74	0.00	6.00	0.00	1.79	14.99	0.00	4.75	0 00:00	0.00	0.00
37	317	Junction	14.47	21.86	0.00	6.00	0.00	0.37	15.00	0.00	6.86	0 00:00	0.00	0.00
38	318	Junction	22.50	24.75	0.00	6.00	0.00	0.37	22.61	0.00	2.14	0 00:00	0.00	0.00
39	319	Junction	28.56	32.12	0.00	6.00	0.00	1.52	28.81	0.00	3.31	0 00:00	0.00	0.00
40	Ex_Tracks	Junction	12.73	16.00	0.00	6.00	0.00	1.78	13.20	0.00	2.80	0 00:00	0.00	0.00
41	Out-02	Outfall	-2.00					17.22	11.17					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Link-04	Pipe	107	106	113.36	23.69	15.22	7.4700	12.000	0.0120	1.01	10.55	0.10	4.47	0.40	0.40	0.00	Calculated
2	Link-05	Pipe	106	101	269.93	15.22	13.89	0.4900	12.000	0.0120	1.77	2.71	0.65	3.20	0.69	0.69	0.00	Calculated
3	Link-06	Pipe	101	1	177.45	13.89	9.16	2.6700	12.000	0.0120	3.94	6.30	0.63	5.31	0.90	0.90	0.00	Calculated
4	Link-07	Pipe	105	103	111.17	25.75	25.68	0.0600	12.000	0.0120	0.65	0.97	0.68	3.08	0.32	0.32	0.00	Calculated
5	Link-08	Pipe	104	103	44.08	26.50	25.68	1.8600	12.000	0.0120	0.54	5.26	0.10	4.81	0.20	0.20	0.00	Calculated
6	Link-09	Pipe	103	102	28.60	25.68	15.11	36.9600	12.000	0.0120	1.19	23.46	0.05	7.71	0.25	0.25	0.00	Calculated
7	Link-10	Pipe	102	101	92.21	15.11	13.89	1.3200	12.000	0.0120	1.18	4.44	0.27	3.01	0.57	0.57	0.00	Calculated
8	Link-11	Pipe	205	204	192.77	41.89	39.73	1.1200	12.000	0.0120	0.57	4.09	0.14	3.56	0.26	0.26	0.00	Calculated
9	Link-12	Pipe	204	203	57.88	39.73	38.08	2.8500	12.000	0.0120	0.95	6.52	0.15	2.85	0.46	0.46	0.00	Calculated
10	Link-13	Pipe	208	207	121.99	51.61	45.86	4.7100	15.000	0.0120	3.94	15.19	0.26	9.92	0.45	0.36	0.00	Calculated
11	Link-14	Pipe	207	206	108.60	45.86	39.44	5.9100	15.000	0.0120	4.19	17.02	0.25	7.23	0.60	0.48	0.00	Calculated
12	Link-15	Pipe	206	203	40.96	39.44	38.08	3.3200	12.000	0.0120	4.53	7.03	0.64	7.43	0.73	0.73	0.00	Calculated
13	Link-16	Pipe	203	202	95.76	38.08	35.06	3.1500	15.000	0.0120	5.46	12.43	0.44	8.73	0.63	0.51	0.00	Calculated
14	Link-17	Pipe	202	201	172.18	35.06	26.80	4.8000	15.000	0.0120	5.71	15.33	0.37	12.05	0.51	0.41	0.00	Calculated
15	Link-18	Pipe	201	2	114.89	26.80	9.29	15.2400	12.000	0.0120	5.70	15.07	0.38	9.52	0.71	0.71	0.00	Calculated
16	Link-19	Pipe	304	303	76.21	25.89	24.97	1.2100	12.000	0.0120	0.32	4.24	0.08	1.94	0.27	0.27	0.00	Calculated
17	Link-20	Pipe	303	301	37.92	24.97	24.31	1.7400	12.000	0.0120	0.86	5.09	0.17	5.54	0.25	0.25	0.00	Calculated
18	Link-21	Pipe	301	300	88.36	24.31	10.45	15.6900	12.000	0.0120	0.86	15.29	0.06	1.82	0.58	0.58	0.00	Calculated
19	Link-22	Pipe	307	306A	20.91	24.38	21.72	12.7200	12.000	0.0120	1.08	13.77	0.08	6.29	0.27	0.27	0.00	Calculated
20	Link-23	Pipe	306	305	84.15	19.97	11.57	9.9800	12.000	0.0120	1.57	12.19	0.13	8.37	0.62	0.62	0.00	Calculated
21	Link-24	Pipe	305	300	233.67	11.57	10.45	0.4800	15.000	0.0120	3.41	4.84	0.70	3.02	1.25	1.00	4.00	SURCHARGED
22	Link-25	Pipe	300	2	242.84	10.45	9.29	0.4800	18.000	0.0120	4.91	7.87	0.62	2.78	1.50	1.00	7.00	SURCHARGED
23	Link-26	Pipe	310	309	91.47	25.37	23.46	2.0900	12.000	0.0120	0.33	5.58	0.06	4.01	0.16	0.16	0.00	Calculated
24	Link-28	Pipe	308	305	217.30	12.63	11.57	0.4900	12.000	0.0120	2.46	2.70	0.91	3.34	1.00	1.00	4.00	SURCHARGED
25	Link-29	Pipe	319	316	191.63	28.56	14.32	7.4300	12.000	0.0120	1.50	10.52	0.14	6.29	0.46	0.46	0.00	Calculated
26	Link-30	Pipe	316	312	84.29	14.32	13.93	0.4600	12.000	0.0120	1.68	2.63	0.64	3.12	0.69	0.69	0.00	Calculated
27	Link-31	Pipe	318	317	51.84	22.50	14.47	15.4900	12.000	0.0120	0.37	15.19	0.02	4.97	0.32	0.32	0.00	Calculated
28	Link-32	Pipe	317	316	35.93	14.47	14.32	0.4200	12.000	0.0120	0.33	2.49	0.13	0.89	0.60	0.60	0.00	Calculated
29	Link-33	Pipe	315	314	61.56	14.41	14.11	0.4900	12.000	0.0120	0.23	2.69	0.09	0.88	0.47	0.47	0.00	Calculated
30	Link-34	Pipe	314	313	8.79	14.11	14.10	0.1100	12.000	0.0120	0.37	1.30	0.29	1.42	0.61	0.61	0.00	Calculated
31	Link-35	Pipe	313	312	34.57	14.10	13.93	0.4900	12.000	0.0120	0.49	2.71	0.18	0.97	0.68	0.68	0.00	Calculated
32	Link-36	Pipe	312	311	151.52	13.93	13.20	0.4800	12.000	0.0120	1.92	2.68	0.72	3.39	0.88	0.88	0.00	Calculated
33	Link-37	Pipe	311	308	120.85	13.20	12.63	0.4700	12.000	0.0120	2.01	2.65	0.76	2.83	1.00	1.00	2.00	SURCHARGED
34	Link-39	Pipe	Ex_Tracks	1	700.58	12.73	9.16	0.5100	18.000	0.0120	1.71	8.12	0.21	1.39	0.98	0.66	0.00	Calculated
35	Link-40	Pipe	1	Out-02	194.02	9.16	-2.00	5.7500	24.000	0.0120	17.22	58.78	0.29	5.48	2.00	1.00	40.00	SURCHARGED
36	Link-42	Pipe	309D	308	68.41	22.86	12.63	14.9500	12.000	0.0120	0.33	14.93	0.02	2.51	0.55	0.55	0.00	Calculated
37	Link-45	Pipe	2	1	27.45	9.29	9.16	0.4700	24.000	0.0120	10.58	16.87	0.63	3.37	2.00	1.00	11.00	SURCHARGED
38	Link-46	Pipe	209	208	165.09	52.50	51.61	0.5400	15.000	0.0130	3.69	4.74	0.78	5.29	0.69	0.56	0.00	Calculated
39	Weir-02	Weir	309	309D		23.46	22.86				0.33							
40	Weir-03	Weir	306A	306		21.72	19.97				1.07							

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	1	9.16	18.00	8.84	11.17	2.01	6.00	-12.00	0.00	0.00
2	2	9.29	20.00	10.71	11.17	1.88	6.00	-14.00	0.00	0.00
3	101	13.89	15.99	2.10	11.17	-2.72	6.00	-9.99	0.00	0.00
4	102	15.11	18.70	3.59	0.00	-15.11	6.00	-12.70	0.00	0.00
5	103	25.68	27.98	2.30	0.00	-25.68	6.00	-21.98	0.00	0.00
6	104	26.50	28.73	2.23	0.00	-26.50	6.00	-22.73	0.00	0.00
7	105	25.75	27.98	2.23	0.00	-25.75	6.00	-21.98	0.00	0.00
8	106	15.22	16.00	0.78	0.00	-15.22	6.00	-10.00	0.00	0.00
9	107	23.69	27.23	3.54	0.00	-23.69	6.00	-21.23	0.00	0.00
10	201	26.80	28.80	2.00	11.17	-15.63	6.00	-22.80	0.00	0.00
11	202	35.06	38.06	3.00	0.00	-35.06	6.00	-32.06	0.00	0.00
12	203	38.08	41.08	3.00	0.00	-38.08	6.00	-35.08	0.00	0.00
13	204	39.73	41.73	2.00	0.00	-39.73	6.00	-35.73	0.00	0.00
14	205	41.89	45.10	3.21	0.00	-41.89	6.00	-39.10	0.00	0.00
15	206	39.44	41.76	2.32	0.00	-39.44	6.00	-35.76	0.00	0.00
16	207	45.86	47.86	2.00	0.00	-45.86	6.00	-41.86	0.00	0.00
17	208	51.61	53.93	2.32	0.00	-51.61	6.00	-47.93	0.00	0.00
18	209	52.50	55.00	2.50	0.00	-52.50	0.00	-55.00	0.00	0.00
19	300	10.45	15.99	5.54	11.17	0.72	6.00	-9.99	0.00	0.00
20	301	24.31	27.05	2.74	0.00	-24.31	6.00	-21.05	0.00	0.00
21	303	24.97	29.14	4.17	0.00	-24.97	6.00	-23.14	0.00	0.00
22	304	25.89	27.89	2.00	0.00	-25.89	6.00	-21.89	0.00	0.00
23	305	11.57	18.00	6.43	11.17	-0.40	6.00	-12.00	0.00	0.00
24	306	19.97	22.97	3.00	0.00	-19.97	6.00	-16.97	0.00	0.00
25	306A	21.72	27.72	6.00	21.72	0.00	27.72	0.00	0.00	0.00
26	307	24.38	26.58	2.20	0.00	-24.38	6.00	-20.58	0.00	0.00
27	308	12.63	16.00	3.37	0.00	-12.63	6.00	-10.00	0.00	0.00
28	309	23.46	25.46	2.00	0.00	-23.46	6.00	-19.46	0.00	0.00
29	309D	22.86	28.86	6.00	22.86	0.00	28.86	0.00	0.00	0.00
30	310	25.37	27.50	2.13	0.00	-25.37	6.00	-21.50	0.00	0.00
31	311	13.20	16.00	2.80	0.00	-13.20	6.00	-10.00	0.00	0.00
32	312	13.93	20.01	6.08	0.00	-13.93	6.00	-14.01	0.00	0.00
33	313	14.10	17.12	3.02	0.00	-14.10	6.00	-11.12	0.00	0.00
34	314	14.11	17.12	3.01	0.00	-14.11	6.00	-11.12	0.00	0.00
35	315	14.41	17.12	2.71	0.00	-14.41	6.00	-11.12	0.00	0.00
36	316	14.32	19.74	5.42	0.00	-14.32	6.00	-13.74	0.00	0.00
37	317	14.47	21.86	7.39	0.00	-14.47	6.00	-15.86	0.00	0.00
38	318	22.50	24.75	2.25	0.00	-22.50	6.00	-18.75	0.00	0.00
39	319	28.56	32.12	3.56	0.00	-28.56	6.00	-26.12	0.00	0.00
40	Ex_Tracks	12.73	16.00	3.27	0.00	-12.73	6.00	-10.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1	17.19	2.96	13.37	4.21	0.00	4.63	11.37	2.21	0 00:06	0 00:00	0.00	0.00
2	2	10.54	0.00	13.68	4.39	0.00	6.32	11.40	2.11	0 00:06	0 00:00	0.00	0.00
3	101	4.31	1.46	14.69	0.80	0.00	1.30	14.06	0.17	0 00:07	0 00:00	0.00	0.00
4	102	1.19	0.00	15.46	0.35	0.00	3.24	15.20	0.09	0 00:07	0 00:00	0.00	0.00
5	103	1.19	0.00	25.83	0.15	0.00	2.15	25.72	0.04	0 00:06	0 00:00	0.00	0.00
6	104	0.55	0.55	26.75	0.25	0.00	1.98	26.55	0.05	0 00:06	0 00:00	0.00	0.00
7	105	0.67	0.67	26.23	0.48	0.00	1.75	25.89	0.14	0 00:06	0 00:00	0.00	0.00
8	106	1.83	0.82	15.81	0.59	0.00	0.41	15.37	0.15	0 00:06	0 00:00	0.00	0.00
9	107	1.02	1.02	23.90	0.21	0.00	3.33	23.74	0.05	0 00:06	0 00:00	0.00	0.00
10	201	5.71	0.00	27.23	0.43	0.00	1.57	26.90	0.10	0 00:07	0 00:00	0.00	0.00
11	202	5.72	0.30	35.66	0.60	0.00	2.40	35.20	0.14	0 00:07	0 00:00	0.00	0.00
12	203	5.46	0.00	38.75	0.67	0.00	2.33	38.23	0.15	0 00:07	0 00:00	0.00	0.00
13	204	0.96	0.40	39.99	0.26	0.00	1.74	39.79	0.06	0 00:06	0 00:00	0.00	0.00
14	205	0.59	0.59	42.15	0.26	0.00	2.95	41.95	0.06	0 00:06	0 00:00	0.00	0.00
15	206	4.55	0.41	40.22	0.78	0.00	1.54	39.60	0.16	0 00:07	0 00:00	0.00	0.00
16	207	4.20	0.28	46.28	0.42	0.00	1.58	45.96	0.10	0 00:07	0 00:00	0.00	0.00
17	208	3.96	0.28	52.09	0.48	0.00	1.84	51.72	0.11	0 00:06	0 00:00	0.00	0.00
18	209	3.77	3.77	53.42	0.92	0.00	1.58	52.69	0.19	0 00:06	0 00:00	0.00	0.00
19	300	4.89	1.62	15.99	5.54	0.00	0.00	11.49	1.04	0 00:05	0 00:05	0.00	0.00
20	301	0.86	0.00	24.47	0.16	0.00	2.58	24.35	0.04	0 00:06	0 00:00	0.00	0.00
21	303	0.88	0.55	25.31	0.34	0.00	3.83	25.05	0.08	0 00:06	0 00:00	0.00	0.00
22	304	0.33	0.33	26.08	0.19	0.00	1.81	25.93	0.04	0 00:06	0 00:00	0.00	0.00
23	305	3.21	0.14	18.00	6.43	0.00	0.00	11.97	0.40	0 00:06	0 00:06	0.00	0.00
24	306	1.57	0.51	20.21	0.24	0.00	2.76	20.02	0.05	0 00:06	0 00:00	0.00	0.00
25	306A	1.08	0.00	22.06	0.34	0.00	5.66	21.78	0.06	0 00:06	0 00:00	0.00	0.00
26	307	1.08	1.08	24.58	0.20	0.00	2.00	24.42	0.04	0 00:06	0 00:00	0.00	0.00
27	308	2.28	0.43	16.00	3.37	0.00	0.00	12.93	0.30	0 00:07	0 00:07	0.00	0.00
28	309	0.33	0.00	23.61	0.15	0.00	2.35	23.49	0.03	0 00:06	0 00:00	0.00	0.00
29	309D	0.33	0.00	22.96	0.10	0.00	5.90	22.88	0.02	0 00:07	0 00:00	0.00	0.00
30	310	0.34	0.34	25.54	0.17	0.00	1.96	25.41	0.04	0 00:06	0 00:00	0.00	0.00
31	311	1.92	0.00	16.00	2.80	0.00	0.00	13.42	0.22	0 00:07	0 00:07	0.00	0.00
32	312	1.81	0.00	14.69	0.76	0.00	5.32	14.11	0.18	0 00:09	0 00:00	0.00	0.00
33	313	0.37	0.00	14.71	0.61	0.00	2.41	14.21	0.11	0 00:08	0 00:00	0.00	0.00
34	314	0.32	0.10	14.72	0.61	0.00	2.40	14.22	0.11	0 00:08	0 00:00	0.00	0.00
35	315	0.26	0.11	14.77	0.36	0.00	2.35	14.45	0.04	0 00:09	0 00:00	0.00	0.00
36	316	1.79	0.00	14.99	0.67	0.00	4.75	14.48	0.16	0 00:07	0 00:00	0.00	0.00
37	317	0.37	0.00	15.00	0.53	0.00	6.86	14.57	0.10	0 00:07	0 00:00	0.00	0.00
38	318	0.37	0.37	22.61	0.11	0.00	2.14	22.52	0.02	0 00:06	0 00:00	0.00	0.00
39	319	1.52	1.52	28.81	0.25	0.00	3.31	28.62	0.06	0 00:06	0 00:00	0.00	0.00
40	Ex_Tracks	1.78	1.78	13.20	0.47	0.00	2.80	13.04	0.31	0 00:21	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-04	113.36	23.69	0.00	15.22	0.00	8.47	7.4700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
2	Link-05	269.93	15.22	0.00	13.89	0.00	1.33	0.4900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
3	Link-06	177.45	13.89	0.00	9.16	0.00	4.73	2.6700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	Link-07	111.17	25.75	0.00	25.68	0.00	0.07	0.0600	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
5	Link-08	44.08	26.50	0.00	25.68	0.00	0.82	1.8600	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
6	Link-09	28.60	25.68	0.00	15.11	0.00	10.57	36.9600	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
7	Link-10	92.21	15.11	0.00	13.89	0.00	1.22	1.3200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
8	Link-11	192.77	41.89	0.00	39.73	0.00	2.16	1.1200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
9	Link-12	57.88	39.73	0.00	38.08	0.00	1.65	2.8500	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
10	Link-13	121.99	51.61	0.00	45.86	0.00	5.75	4.7100	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
11	Link-14	108.60	45.86	0.00	39.44	0.00	6.42	5.9100	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
12	Link-15	40.96	39.44	0.00	38.08	0.00	1.36	3.3200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
13	Link-16	95.76	38.08	0.00	35.06	0.00	3.02	3.1500	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
14	Link-17	172.18	35.06	0.00	26.80	0.00	8.26	4.8000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
15	Link-18	114.89	26.80	0.00	9.29	0.00	17.51	15.2400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
16	Link-19	76.21	25.89	0.00	24.97	0.00	0.92	1.2100	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
17	Link-20	37.92	24.97	0.00	24.31	0.00	0.66	1.7400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
18	Link-21	88.36	24.31	0.00	10.45	0.00	13.86	15.6900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
19	Link-22	20.91	24.38	0.00	21.72	0.00	2.66	12.7200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
20	Link-23	84.15	19.97	0.00	11.57	0.00	8.40	9.9800	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
21	Link-24	233.67	11.57	0.00	10.45	0.00	1.12	0.4800	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
22	Link-25	242.84	10.45	0.00	9.29	0.00	1.16	0.4800	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
23	Link-26	91.47	25.37	0.00	23.46	0.00	1.91	2.0900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
24	Link-28	217.30	12.63	0.00	11.57	0.00	1.06	0.4900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
25	Link-29	191.63	28.56	0.00	14.32	0.00	14.24	7.4300	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
26	Link-30	84.29	14.32	0.00	13.93	0.00	0.39	0.4600	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
27	Link-31	51.84	22.50	0.00	14.47	0.00	8.03	15.4900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
28	Link-32	35.93	14.47	0.00	14.32	0.00	0.15	0.4200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
29	Link-33	61.56	14.41	0.00	14.11	0.00	0.30	0.4900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
30	Link-34	8.79	14.11	0.00	14.10	0.00	0.01	0.1100	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
31	Link-35	34.57	14.10	0.00	13.93	0.00	0.17	0.4900	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
32	Link-36	151.52	13.93	0.00	13.20	0.00	0.73	0.4800	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
33	Link-37	120.85	13.20	0.00	12.63	0.00	0.57	0.4700	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
34	Link-39	700.58	12.73	0.00	9.16	0.00	3.57	0.5100	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	Yes	1
35	Link-40	194.02	9.16	0.00	-2.00	0.00	11.16	5.7500	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
36	Link-42	68.41	22.86	0.00	12.63	0.00	10.23	14.9500	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
37	Link-45	27.45	9.29	0.00	9.16	0.00	0.13	0.4700	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
38	Link-46	165.09	52.50	0.00	51.61	0.00	0.89	0.5400	CIRCULAR	15.000	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-04	1.01	0 00:06	10.55	0.10	4.47	0.42	0.40	0.40	0.00		Calculated
2	Link-05	1.77	0 00:06	2.71	0.65	3.20	1.41	0.69	0.69	0.00		Calculated
3	Link-06	3.94	0 00:07	6.30	0.63	5.31	0.56	0.90	0.90	0.00		Calculated
4	Link-07	0.65	0 00:06	0.97	0.68	3.08	0.60	0.32	0.32	0.00		Calculated
5	Link-08	0.54	0 00:06	5.26	0.10	4.81	0.15	0.20	0.20	0.00		Calculated
6	Link-09	1.19	0 00:06	23.46	0.05	7.71	0.06	0.25	0.25	0.00		Calculated
7	Link-10	1.18	0 00:07	4.44	0.27	3.01	0.51	0.57	0.57	0.00		Calculated
8	Link-11	0.57	0 00:06	4.09	0.14	3.56	0.90	0.26	0.26	0.00		Calculated
9	Link-12	0.95	0 00:06	6.52	0.15	2.85	0.34	0.46	0.46	0.00		Calculated
10	Link-13	3.94	0 00:07	15.19	0.26	9.92	0.20	0.45	0.36	0.00		Calculated
11	Link-14	4.19	0 00:07	17.02	0.25	7.23	0.25	0.60	0.48	0.00		Calculated
12	Link-15	4.53	0 00:07	7.03	0.64	7.43	0.09	0.73	0.73	0.00		Calculated
13	Link-16	5.46	0 00:07	12.43	0.44	8.73	0.18	0.63	0.51	0.00		Calculated
14	Link-17	5.71	0 00:07	15.33	0.37	12.05	0.24	0.51	0.41	0.00		Calculated
15	Link-18	5.70	0 00:07	15.07	0.38	9.52	0.20	0.71	0.71	0.00		Calculated
16	Link-19	0.32	0 00:06	4.24	0.08	1.94	0.65	0.27	0.27	0.00		Calculated
17	Link-20	0.86	0 00:06	5.09	0.17	5.54	0.11	0.25	0.25	0.00		Calculated
18	Link-21	0.86	0 00:06	15.29	0.06	1.82	0.81	0.58	0.58	0.00		Calculated
19	Link-22	1.08	0 00:06	13.77	0.08	6.29	0.06	0.27	0.27	0.00		Calculated
20	Link-23	1.57	0 00:06	12.19	0.13	8.37	0.17	0.62	0.62	0.00		Calculated
21	Link-24	3.41	0 00:11	4.84	0.70	3.02	1.29	1.25	1.00	4.00		SURCHARGED
22	Link-25	4.91	0 00:08	7.87	0.62	2.78	1.46	1.50	1.00	7.00		SURCHARGED
23	Link-26	0.33	0 00:06	5.58	0.06	4.01	0.38	0.16	0.16	0.00		Calculated
24	Link-28	2.46	0 00:12	2.70	0.91	3.34	1.08	1.00	1.00	4.00		SURCHARGED
25	Link-29	1.50	0 00:06	10.52	0.14	6.29	0.51	0.46	0.46	0.00		Calculated
26	Link-30	1.68	0 00:07	2.63	0.64	3.12	0.45	0.69	0.69	0.00		Calculated
27	Link-31	0.37	0 00:06	15.19	0.02	4.97	0.17	0.32	0.32	0.00		Calculated
28	Link-32	0.33	0 00:07	2.49	0.13	0.89	0.67	0.60	0.60	0.00		Calculated
29	Link-33	0.23	0 00:09	2.69	0.09	0.88	1.17	0.47	0.47	0.00		Calculated
30	Link-34	0.37	0 00:09	1.30	0.29	1.42	0.10	0.61	0.61	0.00		Calculated
31	Link-35	0.49	0 00:09	2.71	0.18	0.97	0.59	0.68	0.68	0.00		Calculated
32	Link-36	1.92	0 00:07	2.68	0.72	3.39	0.74	0.88	0.88	0.00		Calculated
33	Link-37	2.01	0 00:10	2.65	0.76	2.83	0.71	1.00	1.00	2.00		SURCHARGED
34	Link-39	1.71	0 00:21	8.12	0.21	1.39	8.40	0.98	0.66	0.00		Calculated
35	Link-40	17.22	0 00:08	58.78	0.29	5.48	0.59	2.00	1.00	40.00		SURCHARGED
36	Link-42	0.33	0 00:07	14.93	0.02	2.51	0.45	0.55	0.55	0.00		Calculated
37	Link-45	10.58	0 00:08	16.87	0.63	3.37	0.14	2.00	1.00	11.00		SURCHARGED
38	Link-46	3.69	0 00:06	4.74	0.78	5.29	0.52	0.69	0.56	0.00		Calculated