City of Shoreline

NE 148TH STREET INFILTRATION FACILITIES

DESIGN REPORT FOR ECOLOGY'S CONSTRUCTION GRANT

March 2, 2016

Site Location:
NE 148th Street between 12th Avenue NE and 15th Avenue NE
Shoreline, WA 98155

Prepared for:
City of Shoreline
Public Works
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City of Shoreline

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DESIGN REPORT FOR ECOLOGY'S CONSTRUCTION GRANT

March 2, 2016

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1.0 INTRODUCTION

The City of Shoreline has worked to implement green stormwater infrastructure (GSI) strategies to improve water quality, provide flow control/flood reduction and restore habitat. The Project, located along NE 148th Street between 12th and 15th Avenues NE, will redirect runoff from the roadway into multiple roadside storage and infiltration facilities. The facilities will be constructed using stackable structural grid units that are designed to enhance storage capacity and infiltration of runoff, while allowing for a number of different surface treatments. Some of these facilities will feature bioretention surface treatments, while others will be surfaced with pavement to accommodate parking and/or pedestrian access. The proposed GSI facilities will not only reduce local flooding and improve water quality, but they will also serve as a pilot project to evaluate the stackable structural grid units for potential city-wide use at sites with similar drainage conditions. The proposed project site is shown in Figure 1 - Vicinity Map.

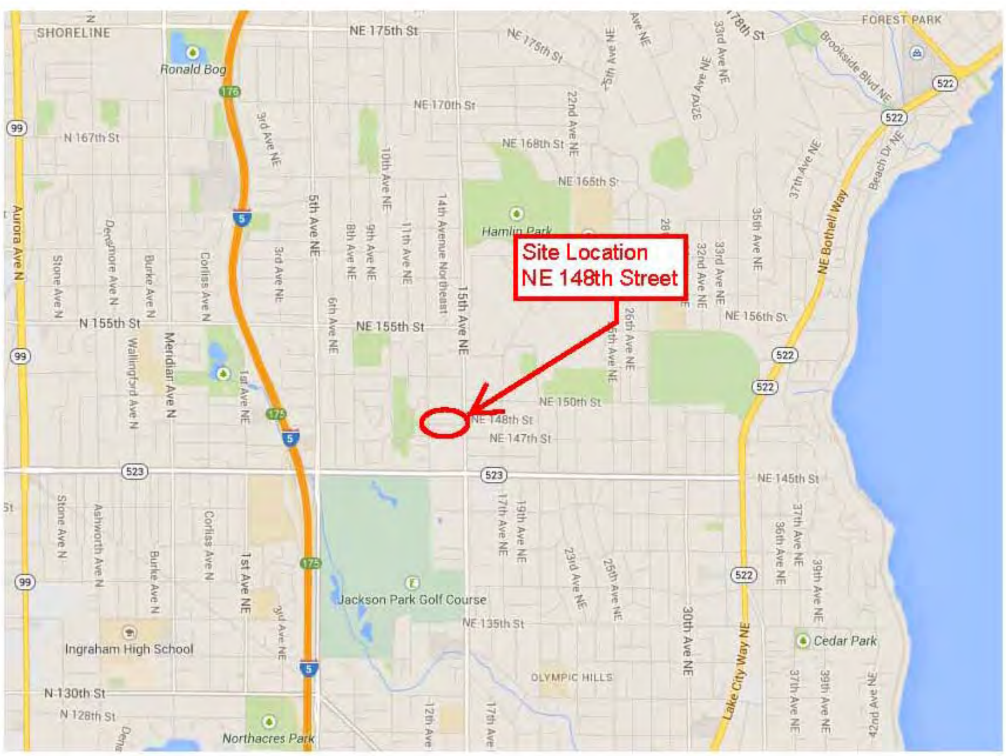

Figure 1 – Vicinity Map

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2.0 BASIN DESCRIPTION

The Project is part of the Thornton Creek basin and headwaters of Littles Creek which is tributary to Thornton Creek. The closed depression on NE 148th Street, between 12th Avenue NE and 15th Avenue NE, is the low point of a 9.8-acre basin bounded by NE 150th Avenue to the north, NE 147th Street to the south, 12th Avenue NE to the west, and 15th Avenue NE to the east. The limits of the closed depression were determined using topographic information from the King County Geographic Information System (GIS) Mapping program. Within the 9.8 acre “maximum” basin, there are several large developments with existing storm drain connections that direct stormwater runoff from approximately 4.0-acres of land into the existing piped storm drain system. This reduces the total surface area potentially contributing stormwater runoff to the low point on NE 148th Street, to approximately 5.8-acres. This 5.8-acre area, for the purposes of this report is defined as the “full basin”; see Figure 2 - Basin Area Map. Due to existing development and depression storage likely present on the parcels and possible future development that would further reduce potential runoff, this basin area was further reduced to a targeted area of just the right-of-way along NE 148th Street. This directly contributing Project Area is approximately 0.87-acres, is paved right-of-way along 148th and is identified within the bounds of a blue box shown on Figure 2 - Basin Area Map. This 0.87-acre basin is the basis of the following analysis. The Project Area is roughly 80-percent impervious with pavement and gravel making up the majority of the surfacing based on topographic survey information.

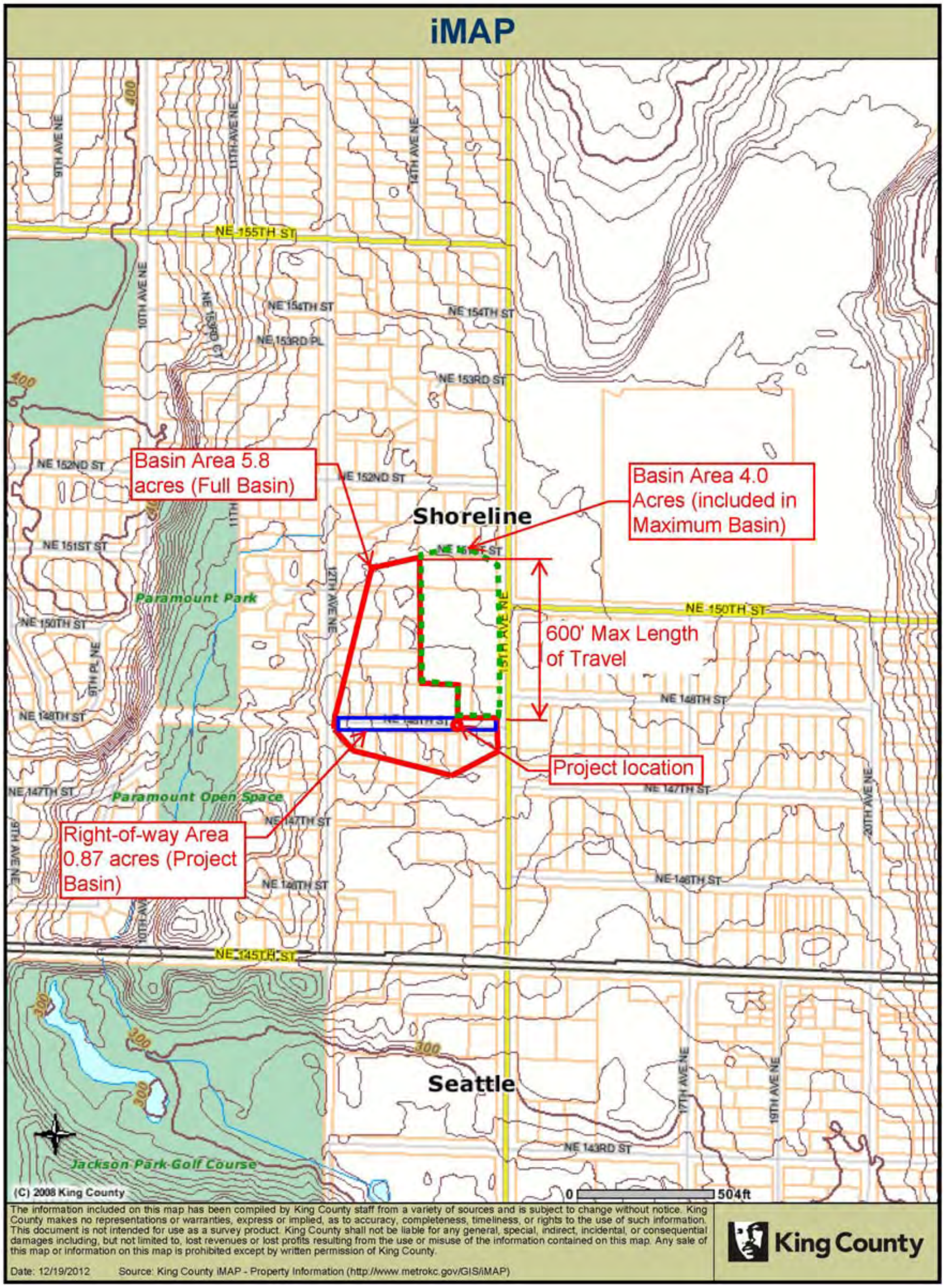

Figure 2 – Basin Area Map

3.0 SITE DESCRIPTION

NE 148th Street is a 660-foot long, asphalt-surfaced, residential roadway in northeast Shoreline. The street is bounded on the east by the arterial roadway of 15th Avenue NE and on the west by the residential 12th Avenue NE and Paramount Park open space. The neighborhood is a mix of single family and multifamily homes and is located on the edge of a local business district. Several of the frontages along the street have sidewalks and curb and gutter, however, a sidewalk is not present along the majority of the roadway and a wide gravel parking strip serves as the parking and pedestrian spaces along these edges. Within the right-of-way, asphalt, concrete and compacted gravel are the primary surfaces, and approximately 20-percent is permeable landscape or grass. See Table 1 - Existing Project Surface Conditions Summary

Table 1 – Existing Project Area Surface Conditions Summary

Description	Area (acres)
Impervious Surface (pollution generating roadway)	0.70
Landscape/Lawn	0.17
Total Basin Area	***0.87***

The street falls from 12th Avenue NE eastward with a slope of approximately 4% and from 15th Avenue NE westward at a slope of approximately 2%, to a low point located 220-feet west of the 15th Avenue intersection. There is an 8-inch sanitary sewer main within the roadway along 148th and an existing drywell with an overflow pipe, connected to the sanitary sewer, shown on record drawings. During rain events significant ponding develops along the roadway, indicating that the drywell and overflow pipe are not functioning.

Geotechnical information has been provided by GeoEngineers in the April 2013 document titled "Infiltration Recommendations NE 148th Street Drainage Improvements" (see Appendix A). The document indicates that the soils in the project area consist of glacial till overlain by fill/ice contact deposits between 3.5 to 5-feet with estimated long term infiltration rates of 0.25”/hr. According to the report, seepage was encountered in one of the test pits which appeared to be coming from the existing dry well facility. There are no wetlands delineated within the project area.

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4.0 MINIMUM REQUIREMENTS

This project, per Vol. 1, Section 2.4 of Ecology Stormwater Management Manual for Western Washington (Ecology Manual), is classified as a redevelopment project. The following is a summary of the applicable stormwater requirements for this Project.

Minimum Requirement #1: Preparation of Stormwater Site Plans

This document, together with its attachments, constitutes the “Stormwater Site Plans” for the project.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPPP)

A SWPPP will be prepared for the Project by the Contractor after the contract is awarded.

Minimum Requirement #3: Source Control of Pollution

Source control BMPs for Maintenance of Stormwater Drainage and Treatment Systems (Ecology 2012, Vol IV, pg 2-40) and the operation and maintenance procedures outlined in Appendix B will be followed in order to meet minimum requirement #3.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Currently there is no drainage system or outfall downstream of the site. The site is within a closed depression and all runoff from the site is infiltrated within the closed depression. The project aims to increase infiltration capacity within the closed depression and provide storage to reduced localized flooding during larger storm events.

Minimum Requirement #5: On-Site Stormwater Management

The Project is proposing to use LID stormwater management BMPs in order to meet the project goals of increased infiltration capacity and stormwater storage. See Section 6.3 for a discussion of the LID facility sizing approach.

Minimum Requirement #6: Runoff Treatment

The Project does not propose to do the following; therefore, minimum requirement #6 is not applicable per Vol. 1, section 2.4.2 of the Stormwater Manual:

- Add 5,000 square feet or more of new hard surfaces
- Convert ¾ acres, or more, of vegetation to lawn or landscaped areas
- Convert 2.5 acres, or more, of native vegetation to pasture

Minimum Requirement #7: Flow Control

The Project does not propose to do the following; therefore, minimum requirement #7 is not applicable per Vol. 1, section 2.4.2 of the Stormwater Manual:

- Add 5,000 square feet or more of new hard surfaces
- Convert ¾ acres, or more, of vegetation to lawn or landscaped areas
- Convert 2.5 acres, or more, of native vegetation to pasture

Minimum Requirement #8: Wetlands Protection

The Project does not propose to do the following; therefore, minimum requirement #8 is not applicable per Vol. 1, section 2.4.2 of the Stormwater Manual:

- Add 5,000 square feet or more of new hard surfaces
- Convert ¾ acres, or more, of vegetation to lawn or landscaped areas
- Convert 2.5 acres, or more, of native vegetation to pasture

Minimum Requirement #9: Operations and Maintenance

The Project does not propose to do the following; therefore, minimum requirement #9 is not applicable per Vol. 1, section 2.4.2 of the Stormwater Manual:

- Add 5,000 square feet or more of new hard surfaces
- Convert ¾ acres, or more, of vegetation to lawn or landscaped areas
- Convert 2.5 acres, or more, of native vegetation to pasture

5.0 ALTERNATIVES CONSIDERED

In an effort to decrease the frequency of nuisance flooding (Photos 1 through 3) that occurs during rain events, the City of Shoreline investigated opportunities to replace the existing dry well facility and storm drain catch basin with green stormwater infrastructure (GSI) facilities.

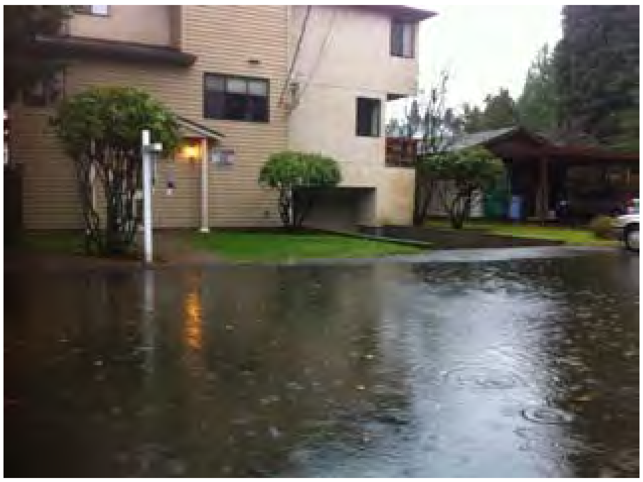

Photo 1 – November 19, 2012 Rain Event Ponding along 148th*

Photo 2 - November 19, 2012 Rain Event Ponding along 148th*

*Photos by D. Hensley, resident, provided by City of Shoreline. April 2013

Photo 3 - November 19, 2012 Rain Event Ponding along 148th*

*Photos by D. Hensley, resident, provided by City of Shoreline. April 2013

Several infiltration facility types were investigated, including infiltration pipes and proprietary storage structures such as the Cudo Cube, Silva Cell and Rainstore3. Stormwater storage volumes, facility cover and depth requirements, structural requirements, and costs were all considerations in the selection of the preferred alternative; the Rainstore3. See the May 9th, 2013 'Storm Event Volumes and Treatment Options Summary' (Appendix C) for additional information related to the proprietary products.

6.0 DESIGN ANALYSIS

The Rainstore3 is a 40-inch x 40-inch x 4-inch tall, modular, stackable, mat structure made up of thin-walled cylindrical columns supported by a structural grid. The shallow depth and simple stackable unit format of the Rainstore3 provided a more versatile installation layout and with 94% voids, greater storage capacity than the other products and BMPs considered.

Additional constraints identified by the City of Shoreline for the design of the infiltration facilities along 148th include:

- Minimize utility relocation,
- Limit removal of existing trees and
- Limit impact on residential driveway access.

In order to minimize the impacts to existing trees and utilities and to retain the existing right-of-way surface conditions as requested by the City, two Rainstore3 facility design approaches were investigated: modified bioretention and various pavement surfaces with enhanced subsurface storage. Both BMP approaches included replacing existing subsurface soils with the Rainstore3 stackable units to increase the volume of stormwater storage within the subgrade. The permeable pavement-type facility will allow for vehicular movements and parking. The bioretention-type facility will restore the surface to landscape. Both designs allow stormwater to enter the enhanced subsurface Rainstore3 storage units through either an infiltrative surface or the installation of adjacent storm drain structures.

Bioretention/Raingarden BMP with Rainstore3 Storage and Infiltration System:

- 6-inch ponding depth
- 18- inches of bioretention soil
- 28-inch (average) Rainstore3 units (7 units stacked beneath bioretention soil)

Pavement BMP with Rainstore3 Storage and Infiltration System:

- 18-inch section of pavement (Gravelpave2 if permeable or asphalt if impermeable) and base aggregate
- 36-inch Rainstore3 units (9 units stacked beneath subbase)

For the purposes of cost estimating, a "unit" size has been identified. This "unit" is a pavement or bioretention-surfaced system that is 80-inches (6.67-feet) wide and 240-inches (20-feet) long.

Figure 3 identifies the total void volume present within the bioretention-surfaced unit. From the bottom up, the stack of 7 units beneath the raingarden system is a total of 312-cf. at 94% void, that provides 293-cf of storage space for stormwater. The 201-cf of bioretention soil at 20% void provides an additional 40-cf of void volume. The 6-inches of surface ponding provides another 67-cf of storage area. The raingarden surfaced unit provides a total of 400-cf of storage area for stormwater.

Figure 4 identifies the total void volume present within the pavement-surfaced unit. The stack of 9 units beneath the pavement system is a total 0f 402-cf, with 94% void space this allows for storage of approximately 380-cf of stormwater. The pavement base and pavement wearing course are assumed to provide no storage volume.

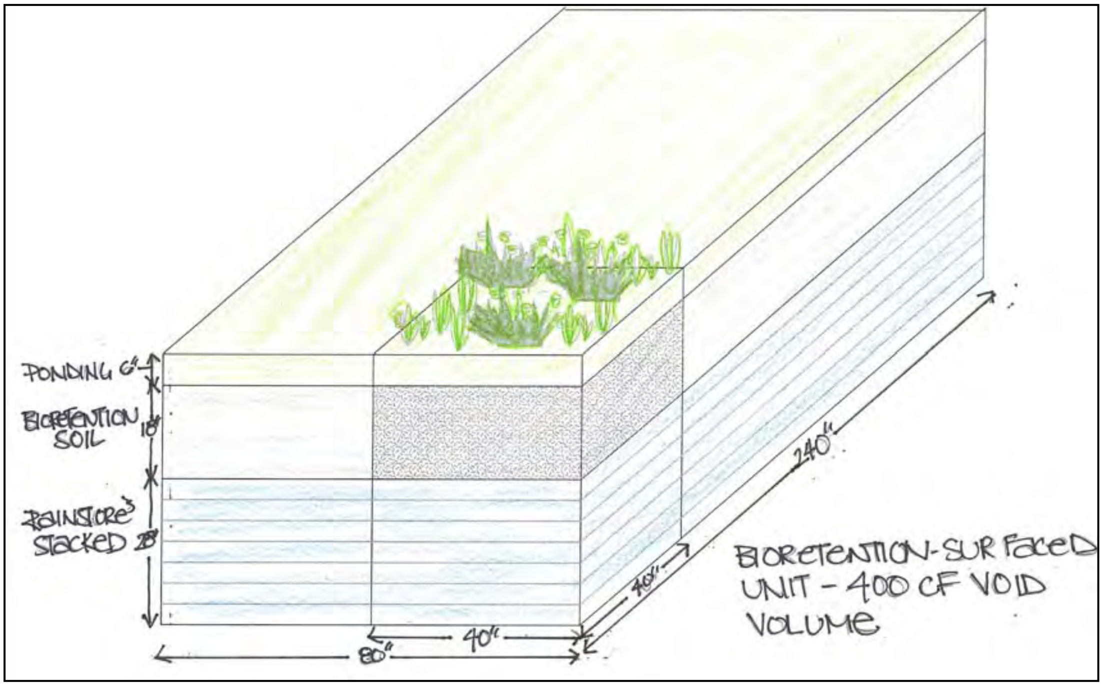

Figure 3 – Bioretention BMP with Rainstore3 "Unit" Facility – Storage Volume (NTS)

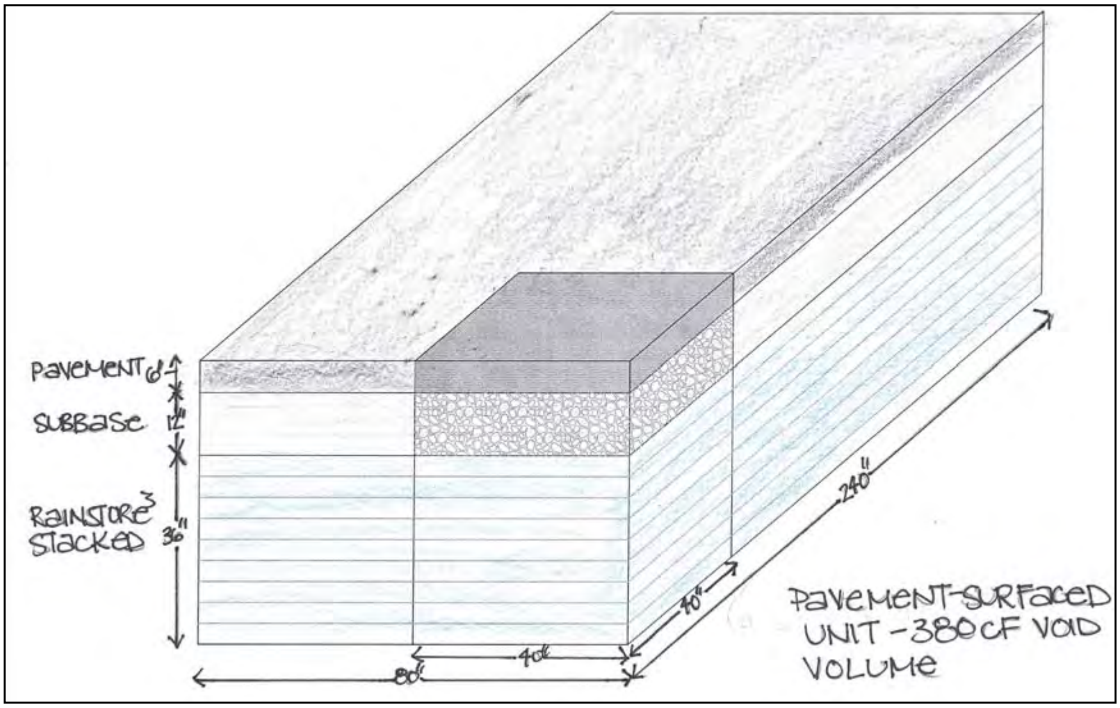

Figure 4 – Permeable Pavement BMP with Rainstore3 "Unit" Facility – Storage Volume (NTS)

6.1 Existing Site Hydrology

See Section 1.3 for information on the existing roadway conditions and surface flows for NE 148th Street. Based on geotechnical soils maps and topography, any stormwater that infiltrates in the closed depression, described in Section 1.3, eventually flows as groundwater through the outwash soil lens to Little's Creek located within the Paramount Park Open Space approximately 400 feet west of 12th Avenue NE. Little's Creek is tributary to Thornton Creek.

6.2 Developed Site Hydrology

The Project aims to reduce stormwater flows that contribute to ponding at the low point of the 148th Street roadway. The proposed facilities will provide both water quality treatment and flow control benefits. Water quality treatment will occur via filtration through bioretention soils and infiltration. The enhanced storage capacity of the Rainstore® units and bioretention cells will provide the flow control benefit

Each facility has been designed such that, if its capacity is exceeded, overflow will be directed back into the right-of-way and downstream to the next facility. Each facility provides a reduction in flow from the existing (impervious) condition. The model results for the existing condition, forested condition, and proposed condition for each facility and associated catchment area presented in Table 2. Note that these values do not account for the potential for receiving overflows from upstream facilities. The "unit" sized facilities described in the feasibility report provided in Appendix C and used in the cost estimates provided 400-cf and 380-cf of storage for the raingarden/bioretention BMP with Rainstore3 and permeable pavement-surfaced BMP with Rainstore3, respectively. The units provide small increments of flow control; with the installation of multiple facilities, the City can further reduce the stormwater run-off during rain events.

Table 2 –Facility Modeled Flow Rates*

Facility (Basin Area)	Storm Event	Forested Condition Run-off (cfs)	Existing Roadway Run-Off (cfs)	BMPs w/ Rainstore3 (cfs)
Facility 1 (1665sf)	2-yr, 24-hr	8.444E-04	1.493E-02	3.339E-06
	25-yr, 24-hr	2.296E-03	3.192E-02	9.497E-06
Facility 2 (1375sf)	2-yr, 24-hr	7.111E-04	1.285E-02	2.252E-06
	25-yr, 24-hr	1.933E-03	2.749E-02	7.297E-06
Facility 3, 4 & 5 (2610sf)	2-yr, 24-hr	1.333E-03	2.405E-02	4.064E-06
	25-yr, 24-hr	3.623E-03	5.143E-02	1.122E-06
Facility 6 & 7 (1890sf)	2-yr, 24-hr	9.555E-04	1.741E-02	4.109E-06
	25-yr, 24-hr	2.598E-03	3.724E-02	1.138E-05
Facility 8 & 9 (1545sf)	2-yr, 24-hr	7.777E-04	1.368E-02	1.961E-06
	25-yr, 24-hr	2.114E-03	2.926E-02	5.890E-05
Facility 10 (4915sf)	2-yr, 24-hr	2.511E-03	4.685E-02	2.240E-05
	25-yr, 24-hr	6.827E-03	0.100	4.547E-02
Facility 11 (1635sf)	2-yr, 24-hr	8.444E-04	1.534E-02	7.932E-06
	25-yr, 24-hr	2.296E-03	3.281E-02	2.016E-05
Facility 12 (1835sf)	2-yr, 24-hr	9.333E-04	1.700E-02	1.984E-05
	25-yr, 24-hr	2.537E-03	3.636E-02	1.946E-02
Facility 13 (2345sf)	2-yr, 24-hr	1.200E-03	2.239E-02	9.360E-03
	25-yr, 24-hr	3.262E-03	4.788E-02	2.859E-02
Facility 14 (575sf)	2-yr, 24-hr	2.889E-04	5.390E-03	4.385E-07
	25-yr, 24-hr	7.854E-04	1.150E-02	1.155E-06
Facility 15 (3330sf)	2-yr, 24-hr	3.151E-02	3.110E-02	1.712E-02
	25-yr, 24-hr	6.739E-02	6.651E-02	4.093E-02
Facility 16 (6765sf)	2-yr, 24-hr	3.444E-03	6.427E-02	1.366E-02
	25-yr, 24-hr	9.364E-03	0.137	7.389E-02
Facility 17 (860sf)	2-yr, 24-hr	4.444E-04	8.293E-03	2.692E-07
	25-yr, 24-hr	1.208E-03	1.770E-02	7.785E-07
Facility 18 (4055sf)	2-yr, 24-hr	2.067E-03	3.856E-02	1.347E-05
	25-yr, 24-hr	5.618E-03	8.247E-02	1.114E-02

*See Appendix D for full modeling reports.

6.3 Performance Standards

Section 4 of the "City of Shoreline Surface Water Master Plan Update," describes approaches to achieve the three basic goals of the Surface Water Utility: flood reduction; water quality protection/improvement; and stream/wetland enhancement. The section outlines the preferred level of service for the program areas that balance regulatory, utility and rate payer requirements and goals.

As part of initial studies, the City looked at developing LID facilities that could be installed along roadways throughout the City, with NE 148th Street as a pilot location. This approach was achieved by creating the modified BMP systems of bioretention and permeable pavements with enhanced subsurface storage and infiltration. These modified BMPs can be customized for any site by choosing the appropriate surface treatment and varying the depth of the Rainstore3 units. At the location of NE 148th Street, the geotechnical information, existing surface conditions and utilities provided the design constraints for the pilot units. The modeling performed for the initial design phase utilized the existing infiltration rates and the available volume of each facility to determine potential flow reductions and water quality benefits. BMPs T5.15: Permeable Pavements and BMP T7.30: Bioretention Cells, Swales and Planter Boxes are the basis for the design criteria. BMP T5.16: Tree Retention and Tree Planting has been employed where feasible. Appendix D - Calculations and Modeling describe in greater detail the preliminary analysis.

The major advantage of these modified BMPs with enhanced storage and infiltration is that they can be installed at very shallow depths which allow greater access to the shallow infiltration layers that are common throughout the City of Shoreline. Because the 148th project site is one such site with a shallow infiltration zone and the presence of a non-infiltrative till layer, the goal for the installation of these systems is to provide more storage volume within the shallow subgrade in order to promote the horizontal infiltration and subsurface flow through the shallow infiltration layers.

A. Flood/Flow Control Facilities

In the last decade, the City has made progress installing flood controls, reducing flood hazard/nuisance flooding and addressing closed depression stormwater problem locations; however, there are still areas of localized flooding and standing water in roadways as is the case in the Project Area at NE 148th Street. It is the goal of the City to address these flooding problems while protecting public safety, public and private property, and downstream receiving waters. The facilities proposed at NE 148th Street will reduce the total volume of stormwater flowing to the roadway low point and reduce flooding in the roadway and adjacent properties. Table 3 - Project Area Flow Control, identifies the pre-developed and post-developed flow rates from the whole 0.87-acres project area. Figure 5 shows the Flow Duration Plots of the 0.87-acre project area comparing the forested condition to the existing and developed conditions with all proposed Rainstore3 units installed. The flow rates indicated by the Post-developed line represent values well under the flow rates for the existing roadway condition and show that the facilities bring the site closer to Ecology standards. With implementation of all three phases of work the basin could see approximately a 70-percent reduction in storm water runoff and flooding.

Table 3 – Project Flow Control - Basin Area 0.87-acres

Storm Event	Forested Run-Off (cfs)	Existing Roadway Run-Off (cfs)	Run-Off Post Rainstore3 Installation (cfs)
2-yr, 24-hr	1.935E-02	0.293	0.105
10-yr, 24-hr	4.007E-02	0.551	0.156
25yr, 24-hr	5.262E-02	0.640	0.178

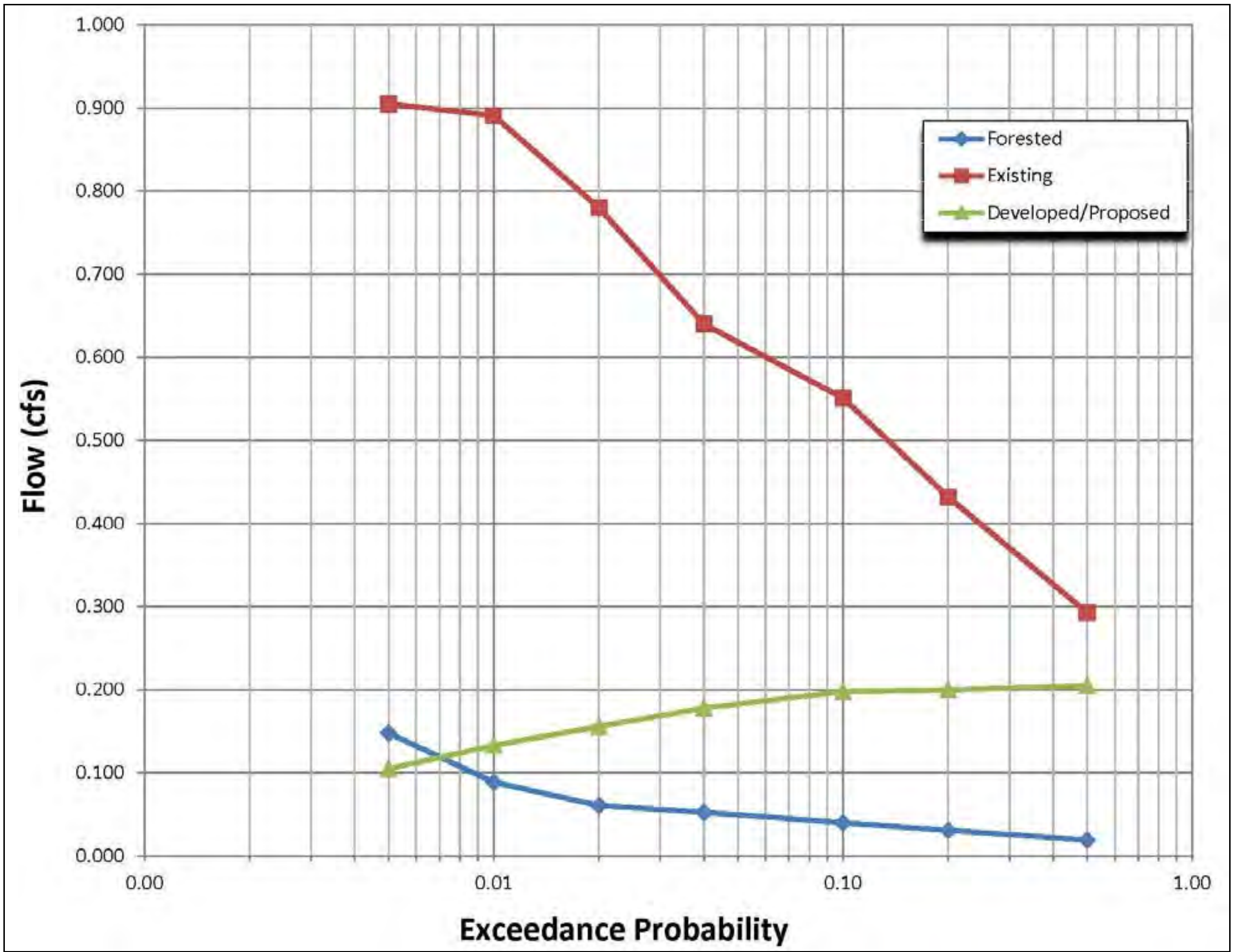

Figure 5 – Flow Duration Plot showing 0.87-acre Project Area in a Forested vs Existing and Developed Conditions

B. Water Quality Facilities

The Project's infiltration/bioretention retrofit facilities will treat runoff from the street in an area that currently lacks treatment systems of any kind.

The Project will treat runoff from the 0.87-acres of urban roadway. Stormwater from this site has no direct outlet to Littles Creek, approximately 400 feet west, but pollutant-laden stormwater and sediment is likely tracked out of this sub-basin and into nearby drainages that outfall to Littles Creek, a tributary to Thornton Creek.

Urban runoff has well-established water quality and public health issues, including sediment, oil, coliform bacteria, nutrients and toxic or otherwise detrimental chemicals, compounds and substances.

The bioretention/infiltration retrofit facilities are designed in accordance with Ecology standards. In particular, the design corresponds to guidelines provided by the 2012 Ecology SWMMWW Volume V - Runoff Treatment BMP T7.30: Bioretention Cells, Swales, and Planter Boxes for the bioretention features. The design has been modeled using a mix of elements to represent the hybrid of facilities. See Appendix D for modeling assumptions.

With the completion of all three construction phases, (see Figure 6 through 8- NE 148th Street: Infiltration Facilities, Phases 1, 2, and 3) the cumulative stormwater facilities models indicate treatment/infiltration of more than 33% of the total 0.87-acres Project Area run-off.

C. Greenworks Program Projects

In the 2011-2016 Capital Improvement Program, the City of Shoreline elected to fund Surface Water Management Greenworks Projects which utilize techniques of low impact development to improve water quality and provide flow/flooding controls. Greenworks projects, including the NE 148th Street Infiltration Facilities, use green stormwater solutions to drainage problems while providing education and public awareness

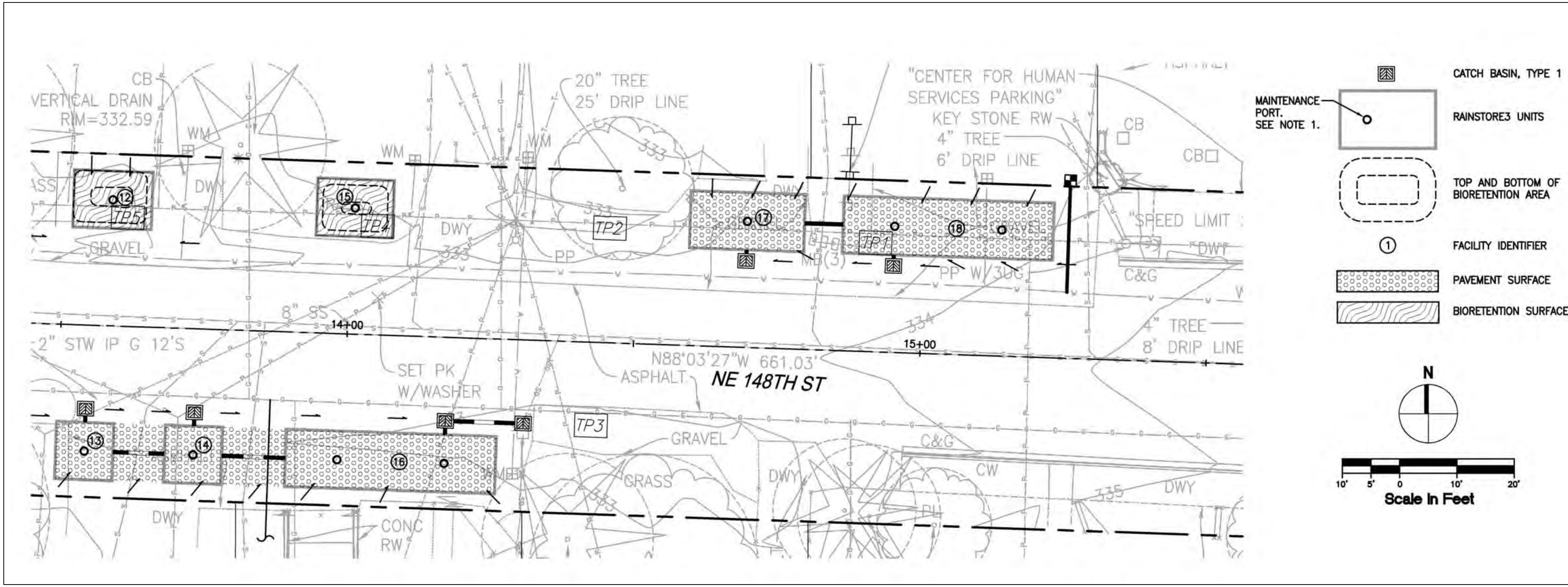

Figure 6 – NE 148th Street: Infiltration Facilities, Phase 1

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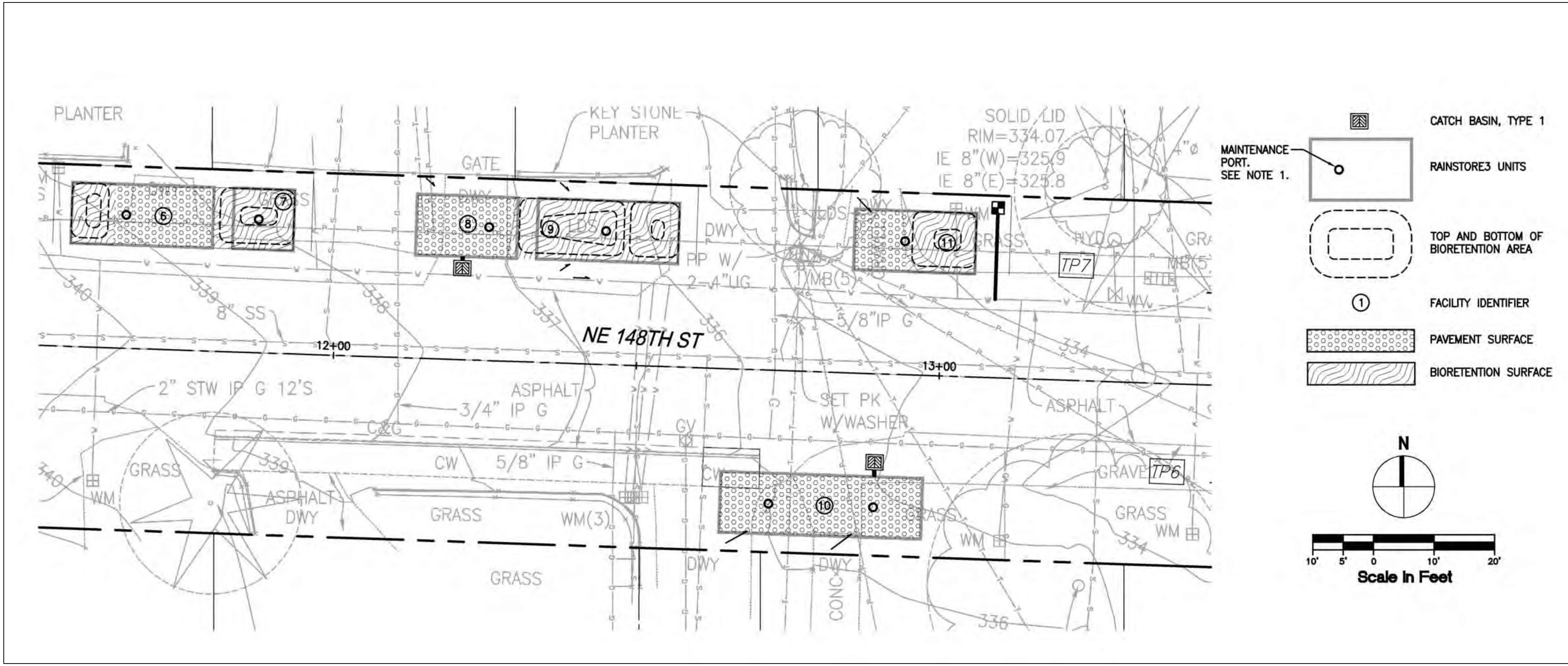

Figure 7 – NE 148th Street: Infiltration Facilities, Phase 2

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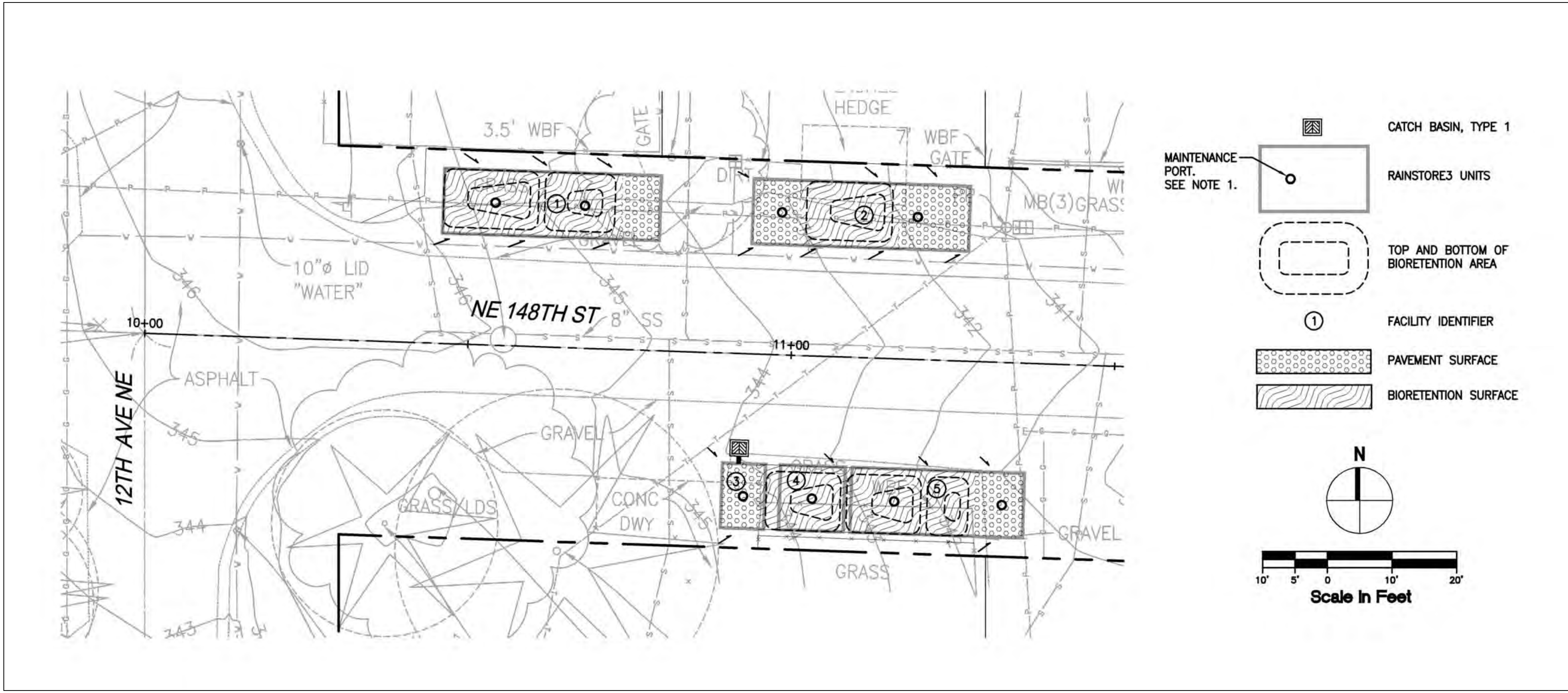

Figure 8 – NE 148th Street: Infiltration Facilities, Phase 3

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7.0 QUANTIFY THE WATER QUALITY BENEFIT

As the Project does not trigger minimum requirements six and seven (runoff treatment and flow control), the runoff treatment and flow control benefit have been calculated per Section D of the Ecology document “Design Deliverables for Stormwater Projects with Ecology Funding” in order to quantify the benefit provided by the facilities. Based on the calculations provided in Appendix E, the proposed project will provide flow control for an Equivalent New/Redevelopment Area of 0.52 acres and will provide water quality treatment for an Equivalent New/Redevelopment Area of 0.82 acres. Tables 4 and 5 provide the water quality benefit provided by the facilities compared to the Ecology forested standard.

Table 4 – Flow Control Benefits

Facility #	**Catchment Area (ac)**	**Volume at Riser Crest (ft^3)**
1	0.04	935
2	0.03	991
3, 4, 5	0.12	1270
6, 7	0.04	901
8, 9	0.04	1163
10	0.11	936
11	0.04	620
12	0.04	329
13	0.05	281
14	0.01	281
15	0.08	319
16	0.16	1031
17	0.02	568
18	0.09	1094
Total	**0.87**	**10719**
Entire Site	0.87	**17988**
	Ratio (WFC-1)	**0.60**
	Area (WFC-1)	**0.52**

Table 5 – Water Quality Benefit

Analysis	Catchment Area (ac)	Surface Area at Bottom of Facility (ft^2)
Full Site to Proposed Raingardens	0.87	935
Full Site to Meet Ecology WQ Requirements	0.87	991
Ratio (WRT-2)	**0.94**	
Area (WRT-2)	**0.82**	

8.0 ENGINEERS OPINION OF PROBABLE CONSTRUCTION COSTS

Based on preliminary modeling and the choice of surface treatment for the Rainstore3 facility, unit facility construction cost estimates were developed. These unit costs with the preliminary facility locations and sizes (based on available space for preliminary design) were used to determine the estimated costs for treatment of target storm levels, 6-month, 2-year, and 25-year storms. Figures 7 and 8 show the preliminary type and location of the Rainstore3 facilities and Appendix F provides select Rainstore3 Standard Details. Tables 6 and 7 provide the calculated treatment volume and costs for the unit and preliminary facilities. Table 8 provides the storm event relative to the facilities required to capture that storm event and associated cost. Appendix G contains assumptions for a summary of probable construction costs identified by unit type.

Table 6 – Unit Treatment Volume and Costs

Unit Type	Width (in), (ft)	Length (in), (ft)	Depth of unit (in), (ft)	Storage Volume (CF)	Total Cost	Unit Cost per 1 CF ($/CF)	Unit Cost per 1 SF of Foot Print ($/SF)
Bioretention/ Swale	80, 6.7	240, 20	52, 4.33	400	$18,000	$45	$134
Gravel Pave Surface	80, 6.7	240, 20	54, 4.5	380	$21,900	$58	$163
Asphalt Surface	80, 6.7	240, 20	54, 4.5	380	$20,300	$53	$151
Concrete Surface	80, 6.7	240 20	54, 4.5	380	$22,100	$58	$165

Table 7 – Facility Treatment Volume and Costs

Construction Phase*	Facility (#)	Type	Treatment Volume (CF)	Total Cost
Phase 1:* 6-Mnth Storm Control	18	Gravel Pave	1160	$67,250
	17	Gravel Pave	600	$34.800
	16	Gravel Pave	1100	$63,800
	15	Bioretention/Swale	310	$13,950
	14	Gravel Pave	300	$17,400
Phase 2:* 2-Year Storm Control	13	Gravel Pave	300	$17,400
	12	Bioretention/Swale	310	$13,950
	11	Bioretention/Gravel	630	$32,450
	10	Gravel Pave	995	$57,710
	9	Bioretention/Swale	680	$30,600
	8	Gravel Pave	495	$28,710
	7	Bioretention/Swale	230	$10,350
	6	Bioretention/Gravel	635	$33,528
Phase 3:* 85% of 25-Year Storm Control	5	Bioretention/Gravel	745	$35,945
	4	Bioretention	230	$10,395
	3	Gravel Pave	200	$11,600
	2	Bioretention/Gravel	1010	$53,330
	1	Bioretention/Gravel	890	$42,365

See Appendix G for assumption basis of cost estimate
* Phase 1 is currently scheduled and budgeted for construction in 2015. Phase 2 and 3 construction dates have not been determined.

Table 8 – Facility Costs Relative to Storm Event Captured

Construction Phase* : Storm Event Captured	Facility Installation Costs ($)	Storm Volume (cf)	Volume of Void Space within Unit (cf)**	Facilities Required to Capture Storm Volume (#)
Phase 1:* 6-month	$197,000	3,400	3,470**	14 through 18
Phase 2:* 2-year	$422,000	7,750	7,745**	6 through 18
Phase 3:* 85% of 25-year***	$575,500	12,800	10,820**	All facilities

* Phase 1 is currently scheduled and budgeted for construction in 2015. Phase 2 and 3 construction dates have not been determined.
** Volumes shown indicate void storage capacity within the proposed units and do not reflect subsurface infiltration rates - Modeling indicates infiltration rates significantly increase capacity.
*** Percentage shown indicates the percentage of stormwater volume stored within the void capacity of the units and does not include the additional run-off volumes that infiltrate into the existing soils.

9.0 PROPOSED SCHEDULE

The City of Shoreline currently has Phase 1 of the NE 148th Street Infiltration Facilities scheduled and budgeted for construction in 2016. Phase 2 and 3 construction dates have not been determined. The current project design deliverables and construction schedule is as follows.

- 60% Design: Sept 15, 2014
- 90% Design: October 13, 2014
- 95% Design/Construction Grant Application: November 6, 2014
- Grant Agreement: December 31, 2015
- 100% Design: March 31, 2016
- Construction Advertisement: April 1, 2016
- Begin Construction: June 1, 2016
- Construction Complete: July 31, 2016

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10.0 APPENDICES

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10.1 Appendix A – Geotechnical

"Infiltration Recommendations: NE 148th Street Drainage Improvements", April 23, 2013, by GeoEngineers.

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GeoEngineers
Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

April 23, 2013

City of Shoreline
c/o SvR Design Company
1205 Second Avenue, Suite 200
Seattle, Washington 98101

Attention: Patty Buchanan, PE

Subject: Infiltration Recommendations
NE 148th Street Drainage Improvements
Shoreline, Washington
File No. 7345-014-00

INTRODUCTION AND PROJECT UNDERSTANDING

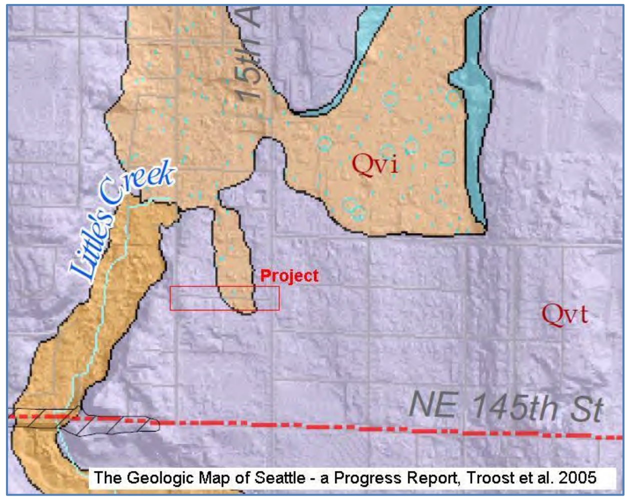
This letter presents our geotechnical conclusions are recommendations for infiltration for the proposed NE 148th Street Drainage Improvements project located between 12th Avenue NE and 15th Avenue NE in Shoreline, Washington. Our understanding of this project is based on discussions with Brian Landau with the City of Shoreline and Patty Buchanan at SvR Design Company (SvR), review of a letter prepared by SvR dated January 16, 2013 and review of geotechnical and geologic information available in our files.

We understand an existing rock catchment facility at this location appears to be clogged and is no longer infiltrating sufficient flows to prevent flooding along the roadway. This flooding has resulted in a nuisance for local residents. Due to the topography, we understand there is not a simple overflow option, so infiltration is the preferred approach for dealing with stormwater. We understand that SvR has evaluated the concept of an infiltration pipe, likely on the north side of the roadway, and has provided preliminary sizes of pipe based on a range of infiltration rates compiled from previous projects in the vicinity of this section of roadway. This evaluation was summarized in their letter dated January 16, 2013.

The purpose of our geotechnical services was to evaluate the subsurface soil and groundwater conditions at the site in order to provide design infiltration recommendations for design of the stormwater facility. Our services were completed in accordance with our proposal dated February 21, 2013.

SITE DESCRIPTION

Geology



The Geologic Map of Seattle - a Progress Report, Troost et al. 2005

We reviewed the Geologic Map of Seattle – a Progress Report (Troost et al, 2005). The soils in the area are mapped as glacial till, with ice contact deposits overlying the glacial till in a portion of the project area. Borings from nearby projects we reviewed indicated glacial till. Glacial till generally consists of an unsorted mixture of silt, sand, gravel, cobbles and boulders deposited below glaciers and subsequently glacially consolidated. Glacial till often has an upper weathered zone that is medium dense, becoming very dense with increasing depth. Ice contact deposits vary in consistency from glacial till to outwash sand and gravel. Based on our subsurface explorations, it appears the ice contact deposits in the project area are similar to glacial till in consistency.

Surface Conditions

The site is bounded by 12th Avenue NE on the west and 15th Avenue NE, with single- and multi-family residential properties north and south of the roadway. Commercial properties are also located along the roadway, adjacent to 15th Avenue NE. The topography slopes gently downward toward the low spot in the roadway approximately one-third of the length of the roadway west of 15th Avenue NE.

Subsurface Conditions

We completed seven test pits at the site (TP-1 through TP-7) to evaluate subsurface conditions. Details and logs of our explorations are presented in Appendix A, along with laboratory test results and photos of the test pits. Subsurface conditions generally consisted of fill/ice contact deposits overlying glacial till. The fill/ice contact deposits generally consisted of loose to medium dense brown silty sand with varying amounts of gravel and extended to depths of 3.5 to 5 feet in the test pits. The underlying glacial till generally consisted of very dense gray silty sand with varying amounts of gravel. The test pits were terminated once the glacial till was encountered.

Seepage was encountered in one of our test pits (TP-2) and appeared to be coming from the existing rock catchment facility. The groundwater appeared to be perched on top of the relatively impermeable glacial till. Groundwater levels are anticipated to vary as a function of season, precipitation, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

Stormwater Management and Infiltration

Pursuant to the 2005 Department of Ecology (DOE) Stormwater Management Manual for Western Washington (SMMWW), which has been adopted by the City of Shoreline, design infiltration rates shall be determined using one of the three methods outlined in Volume III, Chapter 3 and Appendix C of the

SMMWW. These methods include United States Department of Agriculture (USDA) Textural Classification, American Society for Testing and Materials (ASTM) Gradation, or In-Situ Infiltration Measurements.

The USDA and ASTM methods were used to evaluate design infiltration rates for the fill/ice contact deposits encountered at the site. The methods consist of correlations based on sieve analysis and textural classification, as discussed in Section 3.3.6 of the SMMWW (Ecology, 2005).

The table below presents a summary of the estimated long-term (design) infiltration rates for the fill/ice contact deposits in the upper 3.5 to 5 feet, based on USDTA and ASTM correlations for infiltration. We anticipate the underlying glacial till will have infiltration rates much lower than the values presented in the table below.

Exploration	Sample	Depth (feet)	USDA Textural Class	USDA Long-term Infiltration Rate (in/hr)	ASTM Long-term Infiltration Rate (in/hr)
TP-1	1	2.5	sandy loam	0.25	< 0.8
TP-2	1	2.5	sandy loam	0.25	< 0.8
TP-3	1	2.5	sandy loam	0.25	< 0.8
TP-4	1	2.5	sandy loam	0.25	< 0.8

It should be noted that the infiltration rates presented above are based on design guidelines that are generally conservative, not on actual in-situ infiltration performance testing. Although we were limited in project budget and therefore could not complete pilot infiltration testing (PIT), we recommend completing PITs to establish better site-specific infiltration performance values, if feasible. In our experience, site-specific testing often demonstrates higher infiltration performance than the values presented above.

Based on our explorations and evaluation of the soils, we recommend that stormwater infiltration facilities be located within the upper fill/ice contact deposits. We do not recommend the use of facilities founded in the glacial till because these soils are relatively impermeable. Due to the presence of the existing water line on the north side of the roadway, we recommend consideration of shallow infiltration trenches. Infiltration trenches could consist of perforated pipes surrounded by washed rock, with the washed rock wrapped with a geotextile filter fabric to limit intrusion of fines into the washed rock. Although shallow infiltration trenches might not provide sufficient storage for the design stormwater event, these facilities would still provide better stormwater management than is currently present.

LIMITATIONS

We have prepared this report for the City of Shoreline and their authorized agents, including SvR. Client may distribute copies of this report to their authorized agents and regulatory agencies as may be required for the project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments should be considered a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

If you have any questions or require additional information please contact us.

Sincerely,
GeoEngineers, Inc.

Timothy D. Bailey, PE
Senior Geotechnical Engineer

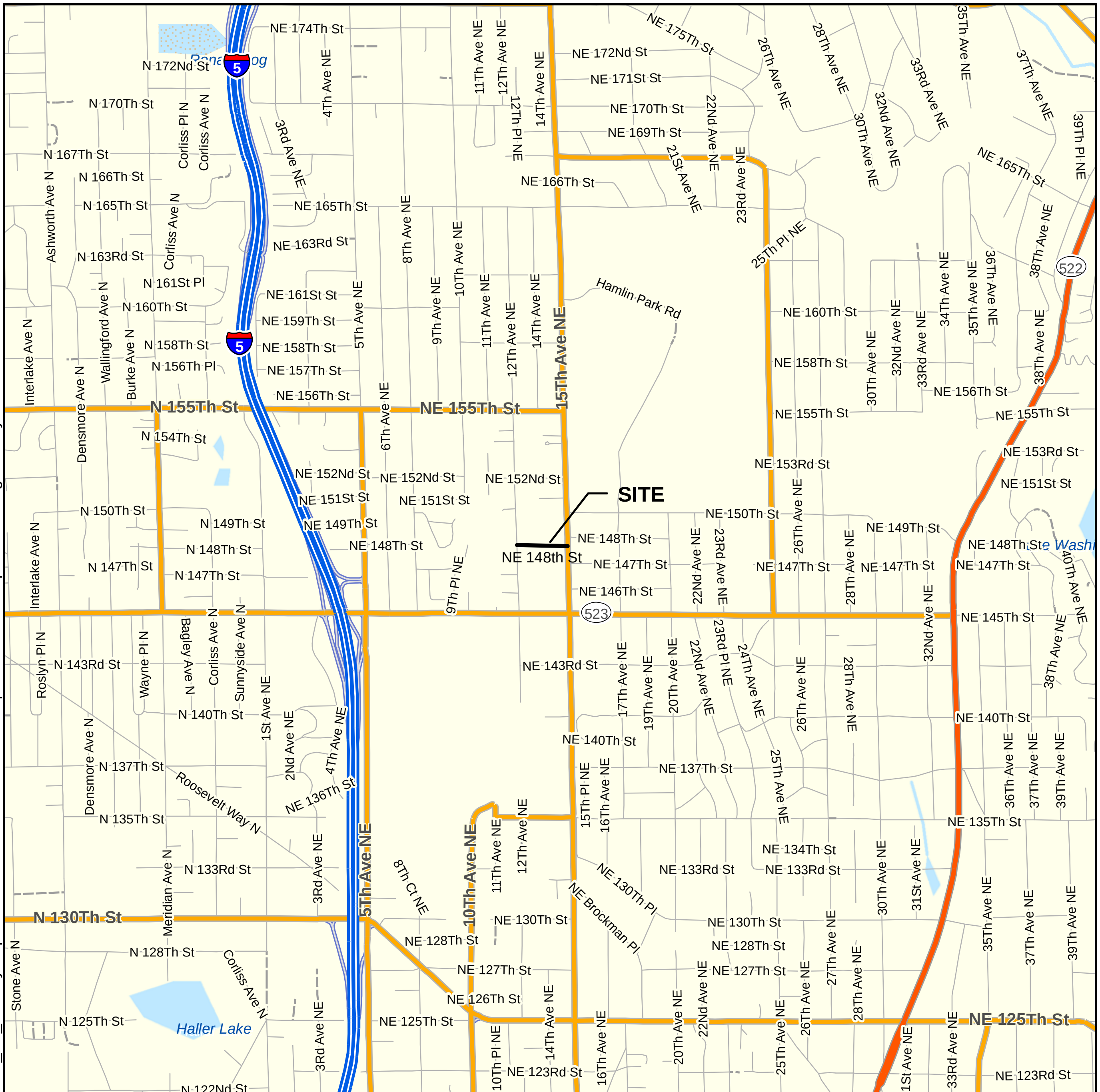
Shaun D. Stauffer, PE, LEED AP
Principal

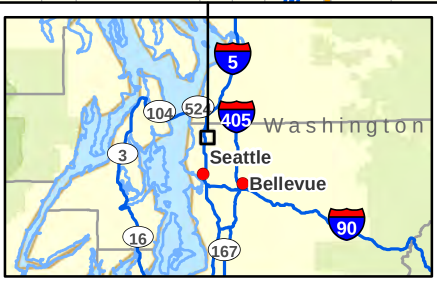
SHAUN D. STAUFFER
STATE OF WASHINGTON
33250
REGISTERED
PROFESSIONAL ENGINEER
4/23/13

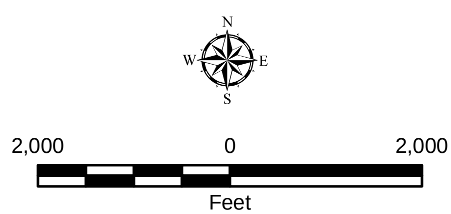
TDB:SDS:nld

One copy submitted via email

Attachments:
Figure 1. Vicinity Map
Figure 2. Site Plan
Appendix A. Field Explorations and Laboratory Testing
Figure A-1. Key to Exploration Logs
Figures A-2 through A-8. Log of Test Pits
Figure A-9. Sieve Analysis Results
Figures A-10 through A-13. Photographs of Test Pits
Appendix B. Report Limitations and Guidelines for Use







Office: SEA Path: \\sea\projects\7\7345014\GIS\734501400_F1_VicinityMap.mxd Map Revised: 15 April 2013 glohrmeyer

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps

Projection: NAD 1983 UTM Zone 10N

Vicinity Map

NE 148th Street Drainage Improvements
Shoreline, Washington

GeoEngineers

Figure 1

Notes

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Base topographic survey by Lin & Associates Consulting Engineers dated 2/02/2012.

Legend

TP-1 Test Pit by GeoEngineers, 2013

N W E S

50 0 50
FEET

Site Plan

NE 148th Street Drainage Improvements
Shoreline, Washington

GEOENGINEERS

Figure 2

P:\17\1734501400\CAD\1734501400 Fig 2 Site Plan.dwg\TAB:Layout2 modified by tmichaud on Apr 11, 2013 - 14:30

APPENDIX A
Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

Field Explorations

General

Subsurface conditions were explored by completing seven test pits (TP-1 through TP-7) at the site. The test pits were completed by Kelly's Excavating, on April 9, 2013. The locations of the explorations were estimated from existing site features. The exploration locations are shown on the Site Plan, Figure 2. Test pit locations should be considered accurate to the degree implied by the method used.

Test Pits

The test pits were excavated using a rubber-tired backhoe. The test pits were continuously observed by a geotechnical technician from our firm who examined and classified the soils encountered, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each test pit.

Soils encountered in the test pits were visually classified in general accordance with the classification system described in Figure A-1. A key to the exploration log symbols is also presented in Figure A-1. The logs of the test pits are presented in Figures A-2 through A-8, and photos of the test pits are presented in Figures A-10 through A-13. The logs reflect our interpretation of the field conditions and the results of laboratory testing and evaluation of samples. They also indicate the depths at which the soil types or their characteristics change, although the change might actually be gradual.

The test pits were backfilled with the excavated soils and compacted to the extent practical with the bucket of the excavator. The fill was not compacted to the requirements for structural fill.

Groundwater Conditions

Groundwater conditions observed during the explorations represent a short-term condition and may or may not be representative of the long-term groundwater conditions at the site.

Laboratory Testing

General

Soil samples obtained from the field explorations were transported to our laboratory and examined to confirm or modify field classifications, as well as to evaluate index properties of the soil samples. Representative samples were selected for laboratory testing consisting of moisture content and grain size distribution (sieve analysis). The tests were performed in general accordance with test methods of the American Society for Testing and Materials (ASTM) or other applicable procedures.

Moisture Content

Moisture content of selected samples was completed in general accordance with ASTM D 2216. The results of these tests are presented on the exploration logs at the depths at which the samples were obtained.

Sieve Analyses

Sieve analyses were performed on selected samples in general accordance with ASTM D 422 to determine the sample grain size distribution. The wet sieve analysis method was used to determine the percentage of soil greater than the U.S. No. 200 mesh sieve. The results of the sieve analyses were plotted, were classified in general accordance with the Unified Soil Classification System (USCS), and are presented in Figure A-9.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	TS	Topsoil/ Forest Duff/Sod

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Material Description Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

Laboratory / Field Tests

%F	Percent fines
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PP	Pocket penetrometer
PPM	Parts per million
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

GEOENGINEERS

FIGURE A-1

Date Excavated:	4/9/2013	Logged By:	JQS
Equipment:	Backhoe	Total Depth (ft)	4.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				GP		Gray sand and gravel (maintenance rock)		
	0.5–3.5				SM		Brown silty fine to medium sand with gravel and trace organics (loose to medium dense, moist) (fill/ice contact deposits)		
	2.5	X	1					17	SA (%F = 27)
	3.5–4				SM		Gray silty fine to medium sand with occasional gravel (very dense) (glacial till)		Probed glacial till at~ 4 feet, probe depth ~1 to 2 inches.

Test pit completed at 4 feet.
No groundwater seepage observed.
No caving observed.
Disturbed soil samples obtained at 2.5 feet.

Notes: Please see Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-1

GeoEngineers

Project: NE 148th Street Drainage Improvements
Project Location: Shoreline, Washington
Project Number: 7345-014-00

Date Excavated:	4/9/2013	Logged By:	JQS
Equipment:	Backhoe	Total Depth (ft)	4.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				GP		Gray sand and gravel (maintenance rock)		
	0.5				SM		Brown silty fine sand with gravel and trace organics (loose to medium dense, moist) (fill/ice contact deposits)		
	1								
	2								
	2.5	X	1					20	SA (%F = 36)
	3								
	4				SM		Gray silty fine to medium sand with gravel (very dense, moist to wet) (glacial till)		Seepage at 4 feet from existing trench

Test pit completed at 4 feet.
Groundwater seepage observed at 4 feet.
No caving observed.
Disturbed soil samples obtained at 2.5 feet.

Notes: Please see Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-2

GEOENGINEERS

Project: NE 148th Street Drainage Improvements
Project Location: Shoreline, Washington
Project Number: 7345-014-00

Figure A-3
Sheet 1 of 1

Date Excavated: 4/9/2013

Equipment: Backhoe

Logged By: JQS

Total Depth (ft) 4.5

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				GP		Gray sand and gravel (maintenance rock)		
	0.5				SM		Brownish-gray silty fine to medium sand with gravel and trace organics (loose to medium dense, moist) (fill/ice contact deposits)		
	2.5	X	1					26	SA (%F = 38)
	4.2				SM		Gray silty fine to medium sand with occasional gravel (very dense, moist) (glacial till)		

Test pit completed at 4.5 feet.
No groundwater seepage observed.
No caving observed.
Disturbed soil samples obtained at 2.5 feet.

Notes: Please see Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-3

GEOENGINEERS

Project: NE 148th Street Drainage Improvements
Project Location: Shoreline, Washington
Project Number: 7345-014-00

Date Excavated: 4/9/2013
Equipment: Backhoe

Logged By: JQS
Total Depth (ft) 3.5

Elevation (feet)	Depth (feet)	SAMPLE Testing Sample	SAMPLE Sample Name Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
					GP		Gray sand and gravel (maintenance rock)		
	1				SM		Brown silty fine sand with gravel and trace organics (loose to medium dense, moist) (fill/ice contact deposits)		
	2								
	3		1					16	SA (%F = 35)
					SM		Gray silty fine to medium sand with gravel (very dense, moist) (glacial till)		

Test pit completed at 3.5 feet.
No groundwater seepage observed.
No caving observed.
Disturbed soil samples obtained at 2.5 feet.

Notes: Please see Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-4

GeoEngineers

Project: NE 148th Street Drainage Improvements
Project Location: Shoreline, Washington
Project Number: 7345-014-00

Figure A-5
Sheet 1 of 1

Date Excavated: 4/9/2013
Equipment: Backhoe

Logged By: JQS
Total Depth (ft) 3.5

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0–0.5				GP		Gray sand and gravel (maintenance rock)		
	0.5–3.0	X (2.0)	1		SM		Brown silty fine to coarse sand with occasional gravel and organics, roots (moist) (fill/ice contact deposits)		
	3.0–3.5				SM		Gray silty fine to medium sand with occasional gravel (very dense, moist) (glacial till)		

Test pit completed at 3.5 feet.
No groundwater seepage observed.
No caving observed.
Disturbed soil samples obtained at 2.0 feet.

Notes: Please see Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-5

GeoEngineers

Project: NE 148th Street Drainage Improvements
Project Location: Shoreline, Washington
Project Number: 7345-014-00

Date Excavated: 4/9/2013

Equipment: Backhoe

Logged By: JQS

Total Depth (ft) 5.0

Elevation (feet)	Depth (feet)	SAMPLE Testing Sample	SAMPLE Sample Name Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				GP		Gray sand and gravel (maintenance rock)		
	0.5				SM		Brown silty fine to medium sand with occasional gravel and trace organics (loose to medium dense, moist) (fill/ice contact deposits)		
	2						Grades to lighter brown		
	3	X	1						
	4.7				SM		Gray silty fine to medium sand with occasional gravel (very dense, moist) (glacial till)		

Test pit completed at 5.0 feet.
No groundwater seepage observed.
No caving observed.
Disturbed soil samples obtained at 3.0 feet.

Notes: Please see Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-6

GeoEngineers

Project: NE 148th Street Drainage Improvements
Project Location: Shoreline, Washington
Project Number: 7345-014-00

Figure A-7
Sheet 1 of 1

Date Excavated: 4/9/2013
Equipment: Backhoe

Logged By: JQS
Total Depth (ft) 4.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
					GP		Gray sand and gravel (maintenance rock)		
	1				SM		Brown silty fine to medium sand with gravel and trace organics (loose to medium dense, moist) (fill/ice contact deposits)		
	2								
	3	X	1						
	4				SM		Gray silty fine to medium sand with occasional gravel (very dense, moist) (glacial till)		

Test pit completed at 4.0 feet.
No groundwater seepage observed.
No caving observed.
Disturbed soil samples obtained at 2.5 feet.

Notes: Please see Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

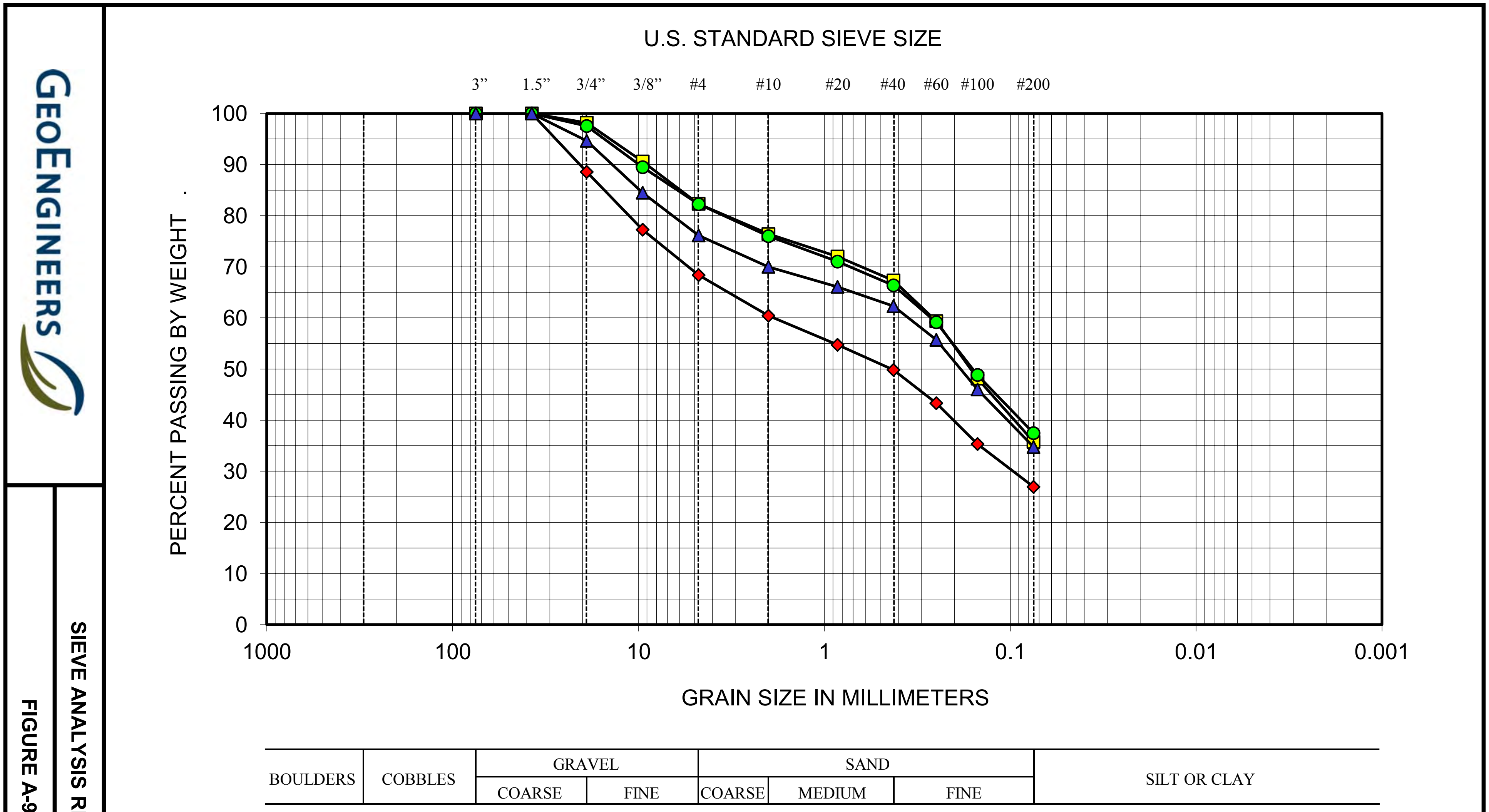
Seattle: Date:4/23/13 Path:W:\SEATTLE\PROJECTS\7\734501400\GINT\734501400.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_TESTPIT_1P_GEOTEC

Log of Test Pit TP-7

GEOENGINEERS

Project: NE 148th Street Drainage Improvements
Project Location: Shoreline, Washington
Project Number: 7345-014-00

Figure A-8
Sheet 1 of 1



SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆	TP-1	2½	Silty fine to medium sand with gravel (SM)
■	TP-2	2½	Silty fine sand with gravel (SM)
●	TP-3	2½	Silty fine to medium sand with gravel (SM)
▲	TP-4	2½	Silty fine sand with gravel (SM)

SIEVE ANALYSIS RESULTS

FIGURE A-9

Photograph of TP-1

Photograph of TP-2

GeoEngineers
Earth Science + Technology

Photographs of Test Pits

Figure A-10

Photograph of TP-3

Photograph of TP-4

GEOENGINEERS Earth Science + Technology

Photographs of Test Pits

Figure A-11

Photograph of TP-5

Photograph of TP-6

GeoEngineers
Earth Science + Technology

Photographs of Test Pits

Figure A-12

Photograph of TP-7

Photographs of Test Pits

Figure A-13

APPENDIX B
Report Limitations and Guidelines for Use

APPENDEIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for the City of Shoreline and SvR Design Company for the Project specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with our Agreement with NAME OF CLIENT dated DATE and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is Based on a Unique Set of Project-Specific Factors

This report has been prepared for the NE 148th Street Drainage Improvements in Shoreline, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure; or
- elevation, configuration, location, orientation or weight of the proposed structure

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

The construction recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.

10.2 Appendix B – Operation and Maintenance Manual

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All LID BMPs

The maintenance recommendations included in this section are applicable to all LID BMPs.

Maintenance Standards and Procedures

Table 1 provides the recommended maintenance frequencies, standards, and procedures for spill prevention, spill response, and pest management actions common to all LID BMP facilities included in this guidance document.

Table 1. Maintenance Standards and Procedures for All LID BMPs.

Category	Recommended Frequency: Inspection	Recommended Frequency: Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
General				
Facility presence	All visits		None (ongoing inspections)	Inspect to ensure the facility is present on site as shown on the as-built (or record drawings) and previous photos.
Spill Prevention and Response				
Spill prevention	Ongoing		None (ongoing inspections)	All sites must implement BMPs to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater.
Spill cleanup	As needed		Release of pollutants	• Call your local or regional hotline number to report any spills or other illicit discharges • Clean up spills as soon as possible to prevent contamination of stormwater • Restore BMP facility design and function per the record drawings
Pests				
Pest management	As needed		Pest of concern is present and impacting BMP facility function	• Pesticide use should be generally discouraged, even conditionally prohibited in some cases • Pesticides include the following: herbicides, fungicides, insecticides, rodenticides, and pediculicides • If pesticide use is planned in or near LID BMPs, make sure to check the following current regulations: 1) Federal- Environmental Protection Agency (EPA) Federal Insecticide and Rodenticide Act 2) State- Ecology, Washington State Department of Agriculture, Washington Department of Fish and Wildlife, Natural Resources Conservation Services 3) Local city or county ordinances/codes, and/or applicable Integrated Pest Management (IPM) plan • For the protection of health and safety, check the following: 1) Washington State Department of Labor & Industries 2) Washington State Department of Health (local branch if applicable)

Equipment and Materials

Table 2 includes recommendations for equipment and materials common to all LID BMPs included in this guidance document.

Table 2. Equipment and Materials List for All LID BMPs.

- ☐ **Camera**
- ☐ **Safety gear/equipment (including boots, long sleeves and pants, gloves, eye and ear protection, and/or high visibility safety vest)**
- ☐ **Shovel (to check depth and condition of soils)**
- ☐ **Measuring tape**
- ☐ **Photos, reports, and/or checklists from past maintenance visits (to help identify changes such as thinning plants and changing pavement conditions)**
- ☐ **Copy of the site's O&M manual or maintenance plan**
- ☐ **O&M checklist**
- ☐ **As-built (i.e., record) drawings of the facility, including site drawings with facility location(s)**
- ☐ **Manufacturer information (if applicable)**

Skills

The required skills common to maintenance of all LID BMPs are listed in the text box to the right.

Skills Needed for Maintenance of all LID BMPs

- Understanding of as-built (or record) drawings of the facility
- Understanding of facility design and intent (to identify issues that would inhibit function)
- General labor (manual tool skills)

Bioretention Facilities

Bioretention facilities are engineered facilities that store and treat stormwater by filtering it through a specified soil profile. Water that enters the facility ponds in an earthen depression or other basin (e.g., concrete planter) before it infiltrates into the underlying bioretention soil. Stormwater that exceeds the surface storage capacity overflows to an adjacent drainage system. Treated water is either infiltrated into the underlying native soil or collected by an underdrain and discharged. Bioretention facilities are considered Stormwater Treatment and Flow Control BMPs/Facilities when used to help meet Minimum Requirements #6 (treatment), #7 (flow control), or both.

Key Maintenance Considerations

The main components of bioretention facilities are listed below with descriptions of their function and key maintenance considerations.

- **Inlet**: Stormwater can flow into a bioretention facility in a number of ways including: dispersed flow across vegetated areas, sheet flow across impervious areas, or concentrated flow through curb cuts and/or piped flow inlets. Inlets must be maintained to be unobstructed to ensure that stormwater enters the facility as designed. Erosion control measures must also be maintained in areas of concentrated flows (e.g., pipes inlets or narrow curb cuts).
- **Facility footprint**: The facility footprint is typically an earthen depression or another type of basin (e.g., concrete planter box) that provides surface storage for stormwater before it infiltrates into the underlying bioretention soil. If the facility is located on a slope, low permeability check dams may be included (oriented perpendicular to the slope) to encourage ponding. Key maintenance considerations for the facility footprint include the following:
    - The integrity of earthen berms and basin walls must be maintained, soil areas must be protected from erosion, and accumulated sediment must be removed.
    - Bioretention facilities are designed to infiltrate all ponded water within a 24- to 48-hour “drawdown” time after the end of a storm. This allows the soil to dry out periodically in order to restore the hydraulic capacity of the system and prevent conditions supportive of mosquito breeding. Slower drawdown times may indicate that the underdrain (if present) is plugged or the bioretention soil is overly compacted, clogged, or does not meet design specifications. Corrective maintenance may include clearing underdrain obstructions or partial or complete replacement of bioretention soil to restore bioretention facility function.
- **Bioretention soil**: Infiltration of stormwater through the engineered bioretention soil mix provides water quality treatment. All maintenance activities must be performed in a manner to prevent compaction of the bioretention soil.
- **Mulch**: The bioretention soil is covered by a layer of mulch, comprised of arborist wood chips, compost, and/or rocks. Mulch reduces weed establishment. Organic

mulches regulate soil temperatures and moisture, and add organic matter to soil. The mulch layer must be supplemented regularly.

- **Vegetation**: Bioretention systems rely on vegetation (i.e., grasses, shrubs, and sometimes trees) to intercept, uptake, and evapotranspire stormwater. In addition, plant roots improve soil structure and increase infiltration capacity. Regular maintenance activities associated with vegetation include weeding and pruning. Plants also require irrigation during the first 2 to 3 years of establishment and during extended dry periods.
- **Overflow**: Flows exceeding the capacity of the facility are discharged via an overflow structure (e.g., pipe, curb cut, earthen channel). It is important to maintain clear outlet pipes and overflow structures to ensure that stormwater can be safely conveyed to a designated discharge point (e.g., storm drain system).
- **Underdrains (optional)**: Underdrains are optional components of a bioretention facility that may be included in bioretention systems where, for example, infiltration to underlying soil is not prudent or feasible. Underdrains are installed under the bioretention soil layer to collect and convey treated water. An underdrain system can be comprised of perforated or slotted pipe, wrapped in an aggregate blanket. It is important to maintain clear drains so that water moves through system as designed. Maintenance may include occasional cleaning to remove plant roots or debris. If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be inspected and cleaned regularly.

Nutrient sensitivity of the receiving water is also an important maintenance consideration, particularly in watersheds draining to phosphorous limited water bodies. The addition of excess fertilizers to the system and/or systems operating in bypass, can increase the potential for export of phosphorous found in bioretention soil or compost and increase nutrient loads to downstream receiving waters.

Key Operations to Preserve Facility Function

For a bioretention system to function properly, stormwater must infiltrate freely through the bioretention soil. The soil infiltration rate can be reduced if the soil is subject to compaction (e.g., foot and vehicle traffic loads). To limit the likelihood of corrective maintenance (e.g., bioretention soil replacement), the facility footprint area should be protected from external loads. Because the risk of compaction is higher when soils are saturated, any type of loading in the bioretention facility (including foot traffic) should be avoided during wet conditions.

Signage can also be used to identify the vegetated area as a stormwater BMP and inform maintenance crews and the general public about protecting the facility’s function.

Maintenance Standards and Procedures

Table 3 provides the recommended maintenance frequencies, standards, and procedures for bioretention facility components. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities subject to high sediment loads from the contributing drainage area.

Table 3. Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility Footprint				
Earthen side slopes and berms	B, S		Erosion (gullies/ rills) greater than 2 inches deep around inlets, outlet, and alongside slopes	• Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made. • Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
	A		Erosion of sides causes slope to become a hazard	Take actions to eliminate the hazard and stabilize slopes
	A, S		Settlement greater than 3 inches (relative to undisturbed sections of berm)	Restore to design height
	A, S		Downstream face of berm wet, seeps or leaks evident	Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)
	A		Any evidence of rodent holes or water piping in berm	• Eradicate rodents (see "Pest control") • Fill holes and compact (may require consultation with engineer, particularly for larger berms)
Concrete sidewalls	A		Cracks or failure of concrete sidewalls	• Repair/ seal cracks • Replace if repair is insufficient
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Facility area		All maintenance visits (at least biannually)	Trash and debris present	Clean out trash and debris
Facility bottom area	A, S		Accumulated sediment to extent that infiltration rate is reduced (see "Ponded water") or surface storage capacity significantly impacted	• Remove excess sediment • Replace any vegetation damaged or destroyed by sediment accumulation and removal • Mulch newly planted vegetation • Identify and control the sediment source (if feasible) • If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet
		During/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
Low permeability check dams and weirs	A, S		Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice	Clear the blockage
	A, S		Erosion and/or undercutting present	Repair and take preventative measures to prevent future erosion and/or undercutting
	A		Grade board or top of weir damaged or not level	Restore to level position

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a] Inspection	Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Facility Footprint (cont'd)				
Ponded water	B, S		Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.	Determine cause and resolve in the following order: 1) Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2) Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3) Check for other water inputs (e.g., groundwater, illicit connections). 4) Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.
Bioretention soil media	As needed		Bioretention soil media protection is needed when performing maintenance requiring entrance into the facility footprint	• Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. • Never drive equipment or apply heavy loads in facility footprint. • Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. • Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. • If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the facility and away from the inlet structure	Reconfigure/ repair blocks to direct water to facility and away from structure
Curb cut inlet/outlet	M during the wet season and before severe storm is forecasted	Weekly during fall leaf drop	Accumulated leaves at curb cuts	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
Pipe inlet/outlet	A		Pipe is damaged	Repair/ replace
	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
		Weekly during fall leaf drop	Accumulated leaves at inlets/outlets	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
		A	Maintain access for inspections	• Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Erosion control at inlet	A		Concentrated flows are causing erosion	Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Inlets/Outlets/Pipes (cont'd)				
Trash rack	S		Trash or other debris present on trash rack	Remove/dispose
	A		Bar screen damaged or missing	Repair/replace
Overflow	A, S		Capacity reduced by sediment or debris	Remove sediment or debris/dispose
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	• Plant roots, sediment or debris reducing capacity of underdrain • Prolonged surface ponding (see "Ponded water")	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.
Vegetation				
Facility bottom area and upland slope vegetation	Fall and Spring		Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more or less than 75% survival rate).	• Determine cause of poor vegetation growth and correct condition • Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the LID Technical Guidance Manual for Puget Sound). • Confirm that plant selection is appropriate for site growing conditions • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Vegetation (general)	As needed		Presence of diseased plants and plant material	• Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • See Pacific Northwest Plant Disease Management Handbook for information on disease recognition and for additional resources • Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Trees and shrubs		All pruning seasons (timing varies by species)	Pruning as needed	• Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques • All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	• Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. • Remove trees and shrubs, if necessary.
	Fall and Spring		Standing dead vegetation is present	• Remove standing dead vegetation • Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season) • If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. • Determine cause of dead vegetation and address issue, if possible • If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.
	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Trees and shrubs (cont'd)	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	• Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage • Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree. • Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. • Backfill stake holes after removal.
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	• Maintain appropriate height for sight clearance • When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. • Remove or transplant if continual safety hazard • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Flowering plants		A	Dead or spent flowers present	Remove spent flowers (deadhead)
Perennials		Fall	Spent plants	Cut back dying or dead and fallen foliage and stems
Emergent vegetation		Spring	Vegetation compromises conveyance	• Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)
Ornamental grasses (perennial)		Winter and Spring	Dead material from previous year's growing cycle or dead collapsed foliage	• Leave dry foliage for winter interest • Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow
Ornamental grasses (evergreen)		Fall and Spring	Dead growth present in spring	• Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring • Clean, rake, and comb grasses when they become too tall • Cut back to ground or thin every 2-3 years as needed
Noxious weeds		M (March – October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions • Apply mulch after weed removal (see “Mulch”)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.				
	Recommended Frequency [a]			
Component	Inspection	Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Vegetation (cont'd)				
Weeds		M (March – October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
Excessive vegetation		Once in early to mid- May and once in early- to mid-September	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil	• Edge or trim groundcovers and shrubs at facility edge • Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks • While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging
	As needed		Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety	• Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics • Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) • Remove plants that are weak, broken or not true to form; replace in-kind • Thin grass or plants impacting facility function without leaving visual holes or bare soil areas • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
	As needed		Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass	• Remove vegetation and sediment buildup
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels) • Keep all mulch away from woody stems
Watering				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	• Follow manufacturer's instructions for O&M
	A		Sprinklers or drip irrigation not directed/located to properly water plants	• Redirect sprinklers or move drip irrigation to desired areas

Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree
				• 3 to 5 gallons per shrub
				• 2 gallons water per square foot for groundcover areas
				• Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist
				• Use soaker hoses or spot water with a shower type wand when irrigation system is not present
				  ○ Pulse water to enhance soil absorption, when feasible
				  ○ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
				• Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a] Inspection	Recommended Frequency [a] Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Watering (cont'd)				
Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present ○ Pulse water to enhance soil absorption, when feasible ○ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear • Water during drought conditions or more often if necessary to maintain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority. • Do not use pesticides or *Bacillus thuringiensis israelensis* (Bti)
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.) • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols) • Remove pet waste regularly • For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.
Insect pests	Every site visit associated with vegetation management		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources" section for more information on IPM protocols)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
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Additional Maintenance Resources

Useful related guidance documents include the following:

- LID Technical Guidance Manual for Puget Sound: http://www.wastormwatercenter.org/files/library/lid-manual-2012-final-secure.pdf.
- Natural Lawn and Garden Care resources (King County and SPU 2008; Saving Water Partnership 2006, 2007, and 2012) include guidance on building healthy soil with compost and mulch, selecting appropriate plants, watering, using alternatives to pesticides, and implementing natural lawn care techniques.
- Integrated Pest Management (IPM) protocols (the term "pest" covers a broad range of species including harmful insects, plant pathogens, rodents, and weedy vegetation) provide an approach to pest control that uses regular monitoring to determine if and when treatments are needed, and employs physical, mechanical, cultural, and biological tactics to keep pest numbers low enough to prevent intolerable damage or annoyance (Ecology 2012c) while avoiding or minimizing the use of pesticides and fertilizers herbicides as a management strategy.
- See EPA's website for general information on IPM: www.epa.gov/pesticides/factsheets/ipm.htm
- See the City of Seattle's website for IPM Fact Sheets and Washington specific resources: www.seattle.gov/util/forbusinesses/landscapes/integrated_pest_management
- The International Society of Arboriculture (ISA) is a group that promotes the professional practice of arboriculture and fosters a greater worldwide awareness of the benefits of trees through research, technology, and education. ISA standards used for managing trees, shrubs, and other woody plants are the American National Standards Institute (ANSI) A300 standards. The ANSI A300 standards are voluntary industry consensus standards developed by the Tree Care Industry Association (TCIA) and written by the Accredited Standards Committee (ASC). The ANSI standards can be found on the ISA website: www.isa-arbor.com/education/publications/index.aspx.
- Volume IV (Source Control) of Ecology's 2012 SWMMWW provides guidance on herbicide and pesticide application and alternative management strategies for controlling weeds and pests.
- WSU Weeding Guidelines: http://gardening.wsu.edu
- Pacific Northwest Plant Disease Management Handbook for information on disease recognition and for additional resources: http://pnwhandbooks.org/plantdisease/diagnosis-and-testing/disease-diagnosis-and-control

These resources are supplemental and do not supersede guidance provided in the S*tandards and Procedures* tables.

Equipment and Materials

Table 4 includes recommendations for equipment and materials commonly used to maintain bioretention facilities. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 4. Bioretention Equipment and Materials List.

Landscaping equipment	Landscaping materials*
☐ Gloves	☐ Plants
☐ Weeding tool	☐ Stakes and ties
☐ Soil knife	**Erosion control material***
☐ Pruners	☐ Rock or cobbles for rock pad
☐ Loppers	☐ Erosion control matting
☐ Stakes and guys	**Mulch**
☐ Manual edger	☐ Arborist wood chip mulch
☐ Line trimmer (also known as a string trimmer, weed eater, or weed whacker)	☐ Coarse compost mulch
☐ Rototiller	☐ Rock mulch
☐ Hoe	**Pipe/structure inspection and maintenance equipment**
☐ Rake	☐ Hand tools
☐ Wheelbarrow	☐ Wrench or manhole lifter (for opening manhole lids, grates, etc.)
☐ Shovel	☐ Flashlight
☐ Push broom	☐ Mirror (for viewing pipes without entering structure)
☐ Hand tamper	☐ Garden hose
☐ Blade sharpeners	☐ Plumbing snake
☐ Tarp/ Buckets (to remove leaf litter/debris)	☐ Measuring tape or ruler
☐ Garbage bags (for disposal of trash/noxious weeds)	**Specialized equipment***
☐ Bark and mulch blower	☐ Mini excavator
☐ Boards to stand on during maintenance to prevent soil compaction (if maintenance is necessary during periods when Bioretention media is wet)	☐ Vactor truck
Watering equipment	☐ Manual seed broadcaster
☐ Soaker hose	☐ Soil monitoring equipment (T handle core sampler, soil auger, soil nutrient test kit)
☐ Hose/shower-type wand	☐ Flame weeder or hot water weeder
☐ Sprinklers	☐ Water jet or root saw (Vactor truck tools) for clearing roots from underdrains
☐ Tree watering bags	☐ Equipment for infiltration testing
☐ Buckets	**Bioretention soil***
☐ Keys for irrigation boxes	☐ Bioretention soil per design specifications
☐ Water source (e.g., watering truck), if necessary	

* Items not required for routine maintenance

Skills and Staffing

The skills required for maintenance of bioretention facilities are listed in the text box to the right. Additional specialized skills may also be required for corrective maintenance such as: horticulturalists, arborists, erosion control specialists, engineers, landscape architects, and soil scientists.

The staff effort required for maintenance varies. Table 5 provides some examples of staffing estimates from Washington jurisdictions, the City of Portland, a study conducted among Minnesota jurisdictions (Wilson et al. 2008), and the BMP and LID Whole Life Cost Models (WERF 2009). Annual staff hours are listed for an individual facility (i.e., a "typical" facility of undefined area), 1,000 square feet of facility, or 1,000 linear feet of facility.

Skills Needed for Maintenance of Bioretention Facilities

- Landscaping skills (e.g., general plant care)
- Plant identification skills (weeds vs. planted species, invasive vs. common weeds, how to dispose of invasive weeds, timing of weed seed dispersal)
- Erosion control knowledge
- General drainage system maintenance skills (e.g., inlet/pipe/underdrain cleaning experience, inlet/ pipe maintenance or repair experience)
- Operation of specialized equipment
- Engineer and/or landscape architect for major maintenance
- Certified arborist (or equivalently trained staff) for pruning of mature trees

Table 5. Maintenance Frequency and Staffing for Bioretention Facilities.

Routine Maintenance Activity	Frequency [a]	Annual Staff Hours	Source
General (no activity specified)	A or B	1 to 16 hours (per facility)	Maintenance of Stormwater BMPs: Frequency, Effort, and Cost (Wilson et al. 2008)
Vegetation management	A	0 to 2 hours (per facility)	BMP and LID Whole Life Cost Models (WERF 2009)
General (no activity specified)	M	24 hours (per 1,000 sf)	City of Bellevue
General (no activity specified)	M	16 hours (per facility)	Kitsap County
Weeding	M (May-Sept)	7 hours (per 1,000 lf)	Thurston County
Replanting and mulching	A		
Typical facility maintenance	Q	10 to 30 hours [b] (per 1,000 sf)	City of Portland
More complex site maintenance [c]	> Q	14 to 38 hours [b] (per 1,000 sf)	
General (no activity specified)	Unspecified	10 hours (per 1,000 sf)	City of Olympia

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; Q = Quarterly (four times per year)
[b] Low end of range pertains to City staff and high end of range pertains to Contractor staff
[c] Deciduous canopy, poor soils, adjacent weed vectors, unmaintained commercial right-of-way
lf = linear feet
sf = square feet

Staffing estimates averaged approximately 16 to 22 hours per bioretention facility on an annual basis. The City of Portland estimated that bioretention facilities with more complex maintenance requirements could require up to 38 hours of staff time when using less seasoned maintenance crews.

Rain Gardens

Rain gardens are non-engineered, shallow, landscaped depressions with compost-amended soils and adapted plants. The depression temporarily stores stormwater runoff from adjacent areas. Some or all of the influent stormwater passes through the amended soil profile and into the underlying native soil. Stormwater that exceeds the storage capacity is designed to overflow to an adjacent drainage system.

Key Maintenance Considerations

The main components of rain gardens (and the associated maintenance considerations) are very similar to those listed for bioretention facilities. However, rain gardens do not require an engineered soil mix (native soils may be amended) and usually do not have underdrains or other control structures.

Fertilizer use should be avoided in rain gardens, particularly those located in watersheds draining to phosphorous limited water bodies.

Key Operations to Preserve Facility Function

As explained for bioretention facilities, rain gardens must be protected from foot traffic, vehicles and other loads, particularly during wet conditions, to prevent compaction of the amended soil and preserve infiltration capacity.

Signage can also be used to identify the vegetated area as a stormwater BMP and inform maintenance crews and the general public about protecting the rain garden's function (e.g., no walking in the garden).

Maintenance Standards and Procedures

Table 6 provides the recommended maintenance frequencies, standards, and procedures for rain garden components. For guidance on underdrains, check dams and other control structures, see "Bioretention Facilities".

Table 6. Maintenance Standards and Procedures for Rain Gardens.				
	Recommended Frequency [a]			
Component	Inspection	Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Rain Garden Footprint				
Earthen side slopes	B (during the wet season)		Persistent soil erosion on slopes	If erosion persists, water may be flowing into the garden too rapidly. In this case, the slope of the pipe or swale directing water to the garden, or the amount of water may need to be reduced (see "Erosion control at inlet")
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Rain garden footprint		B	Trash and debris present	Clean out trash and debris
Rain garden bottom area	A		Visible sediment deposition in the rain garden that reduces drawdown time of water in the rain garden	• Remove sediment accumulation • If sediment is deposited from water entering the rain garden, determine the source and stabilize the area
		During/after fall leaf drop	Accumulated leaves in rain garden (may reduce infiltration capacity of rain garden or clog overflow)	Remove leaves
Ponded water	B, S		Excessive ponding water: Ponded water remains in the basin more than 3 days after the end of a storm	Confirm leaf, debris or sediment buildup in the bottom of the rain garden is not impeding infiltration. If necessary, remove leaf litter/debris/sediment. If this does not solve the problem, consultation with a professional with rain garden expertise is recommended to evaluate the following: • Check for other water inputs (e.g., groundwater, illicit connections) • Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased • Determine if the soil is clogged by sediment accumulation at the surface or if the soil has become overly compacted

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.				
	Recommended Frequency [a]			
Component	Inspection	Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the rain garden and away from the building	Reconfigure/ repair blocks to direct water to the rain garden and away from building
Pipe inlet/ outlet	A		Pipe capacity is reduced by sediment or debris (can cause backups and flooding)	Clear pipes of sediment and debris
	A		Damaged/cracked drain pipes	• Repair/seal cracks • Replace when repair is insufficient
Erosion control at inlet	A		Rock or cobble is removed or missing and concentrated flows are contacting soil	Maintain a cover of rock or cobbles to protect the ground where concentrated water flows into the rain garden from a pipe or swale
Vegetation				
Vegetation		As needed	Dying, dead, or unhealthy plants	• Maintain a healthy cover of plants • Remove any diseased plants or plant parts and dispose of in commercial landfill to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • Re-stake trees if they need more support, but plan to remove stakes and ties after the first year • Cars can damage roots – protect root areas of trees and plants from vehicle traffic
		As needed	Vegetation inhibits sight distances and sidewalks	Keep sidewalks and sight distances on roadways clear
		As needed	Broken, dead, or sucker vegetation is present	Remove broken or dead branches and suckers
		As needed	Vegetation is crowding inlets and outlets	Keep water inlets and outlets in the rain garden clear of vegetation

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.

Component	Recommended Frequency [a] Inspection	Recommended Frequency [a] Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Vegetation (cont'd)				
Vegetation (cont'd)		As needed	Broken, dead, or sucker vegetation is present	Remove broken or dead branches and suckers
		As needed	Vegetation is crowding inlets and outlets	Keep water inlets and outlets in the rain garden clear of vegetation
	One time March through June		• Yellowing: possible Nitrogen (N) deficiency • Poor growth: possible Phosphorous (P) deficiency • Poor flowering, spotting or curled leaves, or weak roots or stems: possible Potassium (K) deficiency	• Test soil to identify specific nutrient deficiencies • Consult with a professional knowledgeable in the area of natural amendments or refer to Natural Lawn and Garden Care resources and avoid synthetic fertilizers • Consider selecting different plants for soil conditions
Weeds		As needed, preceding seed dispersal	Problem weeds are present	• Remove weeds by hand, especially in spring when the soil is moist and the weeds are small • Dig or pull weeds out by the roots before they go to seed • Apply mulch after weeding (see "Mulch")
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Use coarse compost in the bottom of the rain garden and arborist wood chips on side slopes and rim (above typical water levels) • Keep all mulch from being in contact with woody stems.

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.				
	Recommended Frequency [a]			
Component	Inspection	Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Watering				
Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Tree, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present • Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present
Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Tree, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Water during drought conditions or more often if necessary to maintain plant cover • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different rain garden species and water immediately after initial signs of stress appear

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.				
	Recommended Frequency [a]			
Component	Inspection	Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • Do not use pesticides or *Bacillus thuringiensis israelensis* (Bti)

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Additional Maintenance Resources

In addition to the resources listed for bioretention, useful guidance for rain gardens can be found in the Rain Garden Handbook for Western Washington Homeowners (http://www.wastormwatercenter.org/low-impact/). These resources are supplemental and do not supersede guidance provided in the Standards and Procedures tables.

Equipment and Materials

Table 7 includes recommendations for equipment and materials commonly used to maintain rain gardens. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 7. Rain Garden Equipment and Materials List.

Landscaping equipment	***Watering equipment***
☐ **Gloves**	☐ **Soaker hose**
☐ **Weeding tool**	☐ **Hose/shower-type wand**
☐ **Soil knife**	☐ **Sprinklers**
☐ **Pruners**	☐ **Tree watering bags**
☐ **Loppers**	☐ **Buckets**
☐ **Stakes and guys**	***Mulch***
☐ **Manual edger**	☐ **Arborist wood chip mulch**
☐ **Line trimmer (also known as a string trimmer, weed eater, or weed whacker)**	☐ **Coarse compost mulch**
☐ **Rototiller**	☐ **Rock mulch**
☐ **Hoe**	***Landscaping materials****
☐ **Rake**	☐ **Plants**
☐ **Wheelbarrow**	***Erosion control materials****
☐ **Shovel**	☐ **Rock or cobbles for rock pad**
☐ **Push broom**	☐ **Erosion control matting**
☐ **Hand tamper**	***Soil****
☐ **Blade sharpeners**	☐ **Compost (for soil amendment)**
☐ **Tarp/Buckets (to remove leaf litter/debris)**	☐ **Bioretention soil mix**
☐ **Garbage bags (for disposal of trash/noxious weeds)**	

* Items not required for routine maintenance

Permeable Pavement

Permeable pavement is a paving system which allows rainfall to percolate through the surface into the underlying soil or an aggregate bed, where stormwater is stored and infiltrated to underlying subgrade, or removed by an overflow drainage system. Permeable pavement facilities are considered Stormwater Treatment and Flow Control BMPs and can be used to meet Minimum Requirements #6 (treatment), #7 (flow control), or both. To satisfy Minimum Requirement #6, stormwater must be infiltrated into underlying soils that meet Ecology's soil treatment requirements or filtered through an engineered treatment layer included in the pavement section.

Key Maintenance Considerations

The main components of permeable pavement facilities are listed below with descriptions of their function and key maintenance considerations.

- **Wearing course**: The surface layer of any permeable pavement system is the wearing course. Categories of wearing courses include:
    - Porous asphalt**:** A flexible pavement similar to standard asphalt that uses a bituminous binder to adhere aggregate. However, the fine material (sand and finer) is reduced or eliminated, resulting in the formation of voids between the aggregate in the pavement surface that allows water to infiltrate to the underlying aggregate base.
    - Pervious concrete**:** A rigid pavement similar to conventional concrete that uses a cementitious material to bind aggregate together. However, the fine aggregate (sand) component is reduced or eliminated in the gradation, resulting in the formation of voids between the aggregate in the pavement surface that allows water to infiltrate to the underlying aggregate base.
    - Interlocking concrete paver blocks: Solid, precast, manufactured modular units. Pavements constructed with these units create joints that are filled with permeable aggregate and installed on an open-graded aggregate base.
    - Aggregate Pavers (or Pervious Pavers): Modular precast paving units made with uniformly sized aggregates and bound with Portland cement concrete using a high strength adhesive. Unlike concrete paver blocks, these pavers are permeable. Pavements constructed with these units create joints that are filled with permeable aggregate and installed on an open-graded aggregate base.
    - Open-celled paving grid with gravel**:** Concrete or plastic grids that are filled with permeable aggregate. The system can be installed on an open-graded aggregate base.
    - Open-celled paving grid with grass**:** Concrete or plastic grids that are filled with a mix of sand, gravel, and topsoil for planting vegetation. The cells can be planted with a variety of non-turf forming grasses or low-growing groundcovers. The system can be installed on an open-graded aggregate base.

A critical component of a successful maintenance program is regular removal of sediment and debris, excessive moss from the facility surface to prevent clogging of the permeable wearing course.

- **Inlet (optional):** While permeable pavement facilities often manage only the rain falling directly on the pavement surface, they may also be designed to accept stormwater runoff from additional areas (e.g., adjacent impervious areas, nearby rooftops). Runoff can be directed to the facility by two main methods:
    - <u>Sheet flow to the surface</u>: Surface areas of the facility receiving runoff contributions will likely be prone to clogging due to sediment inputs, particularly in areas of concentrated inflow. These areas should be carefully inspected and corrective maintenance should be performed as necessary to maintain the function of the pavement at these sites. In addition, the source of the sediment loads should be evaluated to determine if modifications to features in the drainage area landscape (e.g., stabilization of adjacent planted areas) would help to prevent clogging.
    - <u>Piped flow into the aggregate base</u>: Pipes dispersing water into the aggregate bed should be designed with cleanout access to allow pipe maintenance. Runoff that is piped into the aggregate base should be pretreated for sediment removal (e.g., screens, sumps) to protect the subbase from sedimentation and clogging. The pretreatment system must be maintained to remove accumulated sediment.
- **Aggregate Base / Storage Reservoir:** Stormwater passes through the wearing course to an underlying aggregate storage reservoir where it is stored prior to infiltration into the underlying soil. This aggregate bed also provides the structural function of supporting design loads (e.g., vehicle loading) for flexible pavement systems. To allow inspection of the aggregate course, some facilities have an observation port (typically installed during construction) that allows monitoring of the water levels in the aggregate bed to determine if the facility is draining properly.
- **Overflow:** Unless designed to provide full infiltration of stormwater, permeable pavement facilities have an overflow. Facility overflow can be provided by subsurface slotted drain pipe(s) (elevated in the aggregate bed) routed to an inlet or catch basin structure or by lateral flow through the storage reservoir to a daylighted drainage system.
- **Underdrain with flow restrictor (optional):** A slotted drain pipe with flow restrictor assembly may be installed at the bottom of or elevated within the aggregate storage reservoir. Permeable pavement facilities with underdrains and flow restrictors operate as underground detention systems with some infiltration.

Key Operations to Preserve Facility Function

There are several permeable pavement operational actions that can limit the likelihood of corrective maintenance actions or replacement including the following:

- Prohibiting use of sealant on porous asphalt
- Protecting from construction site runoff with proper temporary erosion and sediment controls and flow diversion measures
- Modifying utility cut procedures for permeable pavements. Protocols should *recommend* restoring permeable pavement section in-kind, where feasible, and *require* restoring permeable pavement section in-kind where replacement with conventional pavement would impact overall facility function. Replacing permeable pavement with conventional pavement is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function.
- Modifying snow removal procedures such as:
  - Using a snow plow with skids or rollers to slightly raise the blade above permeable pavers or open-celled paving grid systems to prevent loss of top course aggregate and damage to paver blocks or grids
  - Avoiding stockpiling plowed snow (i.e., dirty snow) directly on top of permeable pavement
  - Avoiding application of sand to pervious pavement and adjacent streets where vehicles may track it onto the pervious pavement. If sand is applied, on an emergency basis during snowy conditions, vacuum sweep surface as soon as possible after the sand is no longer needed.
  - Use alternative deicers in moderation (e.g., salt, molasses-based and chemical deicers).
- Protecting the surface from stockpiles of landscaping materials (e.g., mulch, soil, compost) being used for adjacent pervious areas
- Stabilizing adjacent landscaped areas to avoid eroding soil and clogging surfaces or sloping adjacent landscaped areas away from permeable pavement , if possible

Signage or pavement marking can also be used to identify permeable pavement as a stormwater BMP and inform maintenance crews and the general public about protecting the facility's function (e.g., no stockpiling of soils or mulch on pavement surface).

Maintenance Standards and Procedures

Table 8 provides the recommended maintenance frequencies, standards, and procedures for permeable pavement components. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities receiving high sediment loads (e.g., sanding) or facilities subject to extended wet, shady conditions where moss may accumulate.

Table 8. Maintenance Standards and Procedures for Permeable Pavement.				
Component	Recommended Frequency [a] Inspection	Recommended Frequency [a] Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
Surface/Wearing Course				
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface
Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ○ Walk-behind vacuum (sidewalks) ○ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ○ ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.
	A[b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods: • Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate. • Hand held pressure washer or power washer with rotating brushes • Pure vacuum sweepers Note: If the annual/biannual routine maintenance standard to clean the pavement surface is conducted using equipment from the list above, corrective maintenance may not be needed.
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.
	A		Major cracks or trip hazards and concrete spalling and raveling	• Fill potholes or small cracks with patching mixes • Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. • Take appropriate precautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.

Compost-amended Soils

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. Compaction from construction can reduce the soils natural ability to provide these functions. Establishing a minimum soil quality and depth in the post-development landscape can regain some of these stormwater functions including increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals. Sufficient organic content is a key to soil quality. Soil organic matter can be attained through numerous amendments such as compost, composted woody material, biosolids, and forest product residuals.

Key Maintenance Considerations

Key maintenance considerations for compost-amended soils include the replenishment of soil media as needed (as a result of erosion) and addressing compacted, poorly draining soils. Site uses should protect vegetation and avoid compaction.

Key Operations to Preserve Facility Function

The full benefits of compost-amended soils are realized when desired soil media depths are maintained and soil compaction is minimized. Care should be taken to prevent compaction of soils via vehicular loads and/or excessive foot traffic, especially during wet conditions.

Maintenance Standards and Procedures

Table 18 provides the recommended maintenance frequencies, standards, and procedures for compost-amended soils. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities prone to erosion due to site conditions such as steep slopes or topography tending to concentrate flows.

Table 18. Maintenance Standards and Procedures for Compost-amended Soils.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
General				
Soil media (maintain high organic soil content)	A		Vegetation not fully covering ground surface or vegetation health is poor	• Maintain 2 to 3 inches of mulch over bare areas in landscape beds • Add plants if sufficient space • Re-seed bare turf areas until the vegetation fully covers ground surface
		Ongoing	None (routine maintenance)	Return leaf fall and shredded woody materials from the landscape to the site when possible in order to replenish soil nutrients and structure
		Ongoing	None (routine maintenance)	On turf areas, "grasscycle" (mulch-mow or leave the clippings) to build turf health
		Ongoing	None (routine maintenance)	Avoiding use of pesticides (bug and weed killers), like "weed & feed", which damage the soil
		A	None (routine maintenance)	• Where fertilization is needed (mainly turf and annual flower beds), a moderate fertilization program should be used which relies on compost, natural fertilizers or slow-release synthetic balanced fertilizers • Follow IPM protocols for fertilization procedures (see "Additional Maintenance Resources" in Bioretention Facilities section for more information on IPM protocols)
Soil media (maintain infiltration)	A[b]		Soils become waterlogged, do not appear to be infiltrating	• To remediate compaction, aerate soil, till to at least 8-inch depth, or further amend soil with compost and re-till • If areas are turf, aerate compacted areas and topdress them with 1/4 to 1/2 inch of compost to renovate them • If drainage is still slow, consider investigating alternative causes (e.g., high wet season groundwater levels, low permeability soils) • Also consider site use and protection from compacting activities

[a] Frequency: A= Annually; B= Biannually (twice per year); M = monthly; S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval); W = At least one inspection/maintenance visit should occur during the wet season (for debris/clog related maintenance, this maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Table 18 (continued). Maintenance Standards and Procedures for Compost-amended Soils.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
General (cont'd)				
Erosion/ Scouring	A, W, S		Areas of potential erosion are visible	• Identify and address cause of erosion (e.g., concentrate flow entering area, channelization of runoff) and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made.
Grass/ Vegetation		A	Less than 75% of planted vegetation is healthy with a generally good appearance.	• Take appropriate maintenance actions (e.g., remove/ replace plants) • If problem persists, evaluate if vegetation is appropriate for the location (e.g., exposure, soil, soil moisture)
Noxious weeds		M (March – October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions

[a] Frequency: A= Annually; B= Biannually (twice per year); M = monthly; S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).; W = At least one inspection/maintenance visit should occur during the wet season (for debris/clog related maintenance, this maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Table 18 (continued). Maintenance Standards and Procedures for Compost-amended Soils.				
Component	Recommended Frequency [a] Inspection	Recommended Frequency [a] Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
General (cont'd)				
Weeds		M (March – October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management(see "Additional Maintenance Resources" in Bioretention Facilities section for more information on IPM protocols)

[a] Frequency: A= Annually; B= Biannually (twice per year); M = monthly; S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).; W = At least one inspection/maintenance visit should occur during the wet season (for debris/clog related maintenance, this maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Equipment and Materials

Table 19 includes recommendations for equipment and materials commonly used to maintain compost-amended soils. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 19. Compost Amended Soils Equipment and Materials List.

General landscaping equipment
☐ **Gloves**
☐ **Pincer-type weeding tool**
☐ **Soil knife**
☐ **Pruners**
☐ **Loppers**
☐ **Hoe**
☐ **Rake**
☐ **Wheelbarrow**
☐ **Shovel**
☐ **Push broom**
☐ **Garbage bags (for disposal of noxious weeds)**
General landscaping materials
☐ **Arborist wood chip mulch (around trees and woody plants)**
☐ **Compost or leaf mulch (around annuals)**
☐ **Fertilizer (natural fertilizers or slow-release synthetic balanced fertilizers)**
Specialized equipment*
☐ **Deep tine aerator and compost (or compost/sand mixture) to fill aeration holes (if necessary to correct overly compacted soil)**
☐ **Flame weeder or hot water weeder**
☐ **Rototiller**
☐ **Soil probe**

* Items not required for routine maintenance

Skills

The skills required for the maintenance of compost-amended soils are listed in the text box to the right. Additional specialized skills may also be required for corrective maintenance of compost-amended soils such as: horticulturalists, arborists, erosion control specialists, and soil scientists.

Skills Needed for Maintenance of Compost-amended Soils

- Landscaping skills (e.g., general plant care)
- Landscaper for major maintenance

10.3 Appendix C - Storm Event Volumes and Treatment Options Summary

- E-mail, “148th/15th Infiltration Facility Investigation,” dated May 13, 2013
- Table – Storm Event Volumes and Treatment Options Summary
- Figures – Facility Options Sections and Locations
- Product Cut Sheets

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Patty Buchanan

From: Lolly Kunkler
Sent: Monday, May 13, 2013 4:58 PM
To: 'Brian Landau (blandau@shorelinewa.gov)'
Cc: Regina Derda; Patty Buchanan
Subject: 148th/15th Infiltration Facility Investigation
Attachments: Storm Event Volumes and Treatment Options Summary.pdf; Stormwater Facility Cut Sheets.pdf; 2013-05-13 Infiltration Facility Installation Opportunities.pdf

Categories: Filed by Newforma

Brian,

Attached you will find documentation related to the investigation of infiltration opportunities to alleviate the nuisance flooding at NE 148th St.

1. Storm Event Volumes and Treatment Options Summary
2. Stormwater Infiltration/Storage Facility Product Cut Sheets
3. Infiltration Facility Installation Opportunities

Geotechnical information indicates an infiltration rate limited to 0.25 in/hr, with a lens of subgrade till at a depth of only 3.5+/- below finished grade. As you are aware, this limits the depth at which infiltration facilities can be effectively installed and the quantity of flows that can be infiltrated.

With these parameters in mind we researched four modular-type infiltration facilities to determine an easy to use structure that can be installed at shallow. The facilities and available costing information are outlined in the attached Storm Event Volumes and Treatment Options Summary spreadsheet. See below for a brief summary of the information.

- Rainstore^3 is a 40" square by 4" high structure of linked hollow cylindrical columns that can be stacked to increase facility stormwater storage capacity. The storage volume for each unit is 3.5 cu-ft (26 gallons).
- The CUDO Cube is a modular plastic cube measuring 24"x24"x24" which can store nearly 7.6 cu-ft (57 gallons) of stormwater per unit making it the most efficient volume storage of the four systems reviewed. However, with a cover requirement of 36", the CUDO Cube would be bedded in the till layer, preventing infiltration in the bottom 12"-24". The CUDO Cube will therefore not be proposed.
- The modular SIlva Cell pavement support systems come in a 48"x24"x16" frame and deck system which hold 10 cu-ft of soil. Stormwater is stored within the voids of the soil/aggregate. Because of the increased cost and decreased stormwater storage capacity of this system, Silva Cells will not be proposed.
- The Triton Stormwater Mini Chamber (M-6) is a 34" diameter, by 17.5" high hollow half pipe that can be installed at 32" increment lengths and provides 5.6 cu-ft (41 gallons) of storage per unit.

For both the Rainstore and Triton stormwater detention/infiltration systems, conventional storm drain inlets collection systems would be employed to direct stormwater into the subsurface units. As identified in the exhibit notes, the facility locations shown assume that no underground services will be moved to accommodate installation and that all trees will be preserved. Facility sizing could be increased if it is the desire of the City of Shoreline to relocate existing utilities or remove existing tree canopy.

Please review the documentation and call if you have any questions. We would like to have a phone conference this week to discuss design/budget parameters and to determine next steps.

lolly kunkler P.E | civil engineer
SvR Design Company 1205 Second Avenue, Suite 200 Seattle, WA 98101
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Shoreline On-Call

Storm Event Volumes and Treatment Options Summary

May 9, 2013

Stormwater Volume and Precipitation Rates for Storm Events

Event	Vol (cu-ft)*	Precipitation (inch)
6mth	3395	1.12
2yr	7752	1.55
25yr	12750	2.7

*Volumes calculated include subgrade infitration of 0.25 in/hr infiltration

Facility Unit Sizing and Costs

Facility	Dimension	Storage Vol/Unit [b] (cu-ft)	Cost/Unit ($)[a]	$/cu-ft of volume
~~Silva Cells~~ [c]	~~24"Wx48"Lx16"H~~	~~5.3~~	~~$ 135.00~~	~~$ 25.47~~
~~Cudo Cube~~ [d]	~~24"Wx24"Lx24"H~~	~~7.7~~	~~$ 90.00~~	~~$ 11.69~~
Rainstore^3	40"Wx40"Lx4"H	3.5	$ 22.50	$ 6.43
Triton Stormwater M6	34"Wx 32"Lx 17.5"H	5.8	$ 60.00	$ 10.34

[a] Cost is for product only and does not include construction cost associated with installation

[b] Volume available for storage is the void area within the dimensioned unit

[c] Silva cell system require the inclusion of aggregate within the unit and therefore have less available volume for storage

[d] Cudo Cube requires 3 ft of cover to meet H20 rating and thus would sit partially in the till layer

Costs for Capture of Storm Events per Facility Type [e]

Facility	Purchase Cost 6mth Storm Capture [f]	Purchase Cost 2yr Storm Capture [f]	Purchase Cost 25yr Storm Capture [f]
~~Silva Cells~~	~~$ 86,476.42~~	~~$ 197,456.60~~	~~$ 324,764.15~~
~~Cudo Cube~~	~~$ 39,681.82~~	~~$ 90,607.79~~	~~$ 149,025.97~~
Rainstore^3	$ 21,825.00	$ 49,834.29	$ 81,964.29
Triton Stormwater M6	$ 35,120.69	$ 80,193.10	$ 131,896.55

[e] Costs do no reflect feasibility of installation. See the Infiltration Feasibility Exhibit for documentation of infiltration area opportunities

[f] Cost is for product only and does not include construction cost associated with installation

Water Quality Background

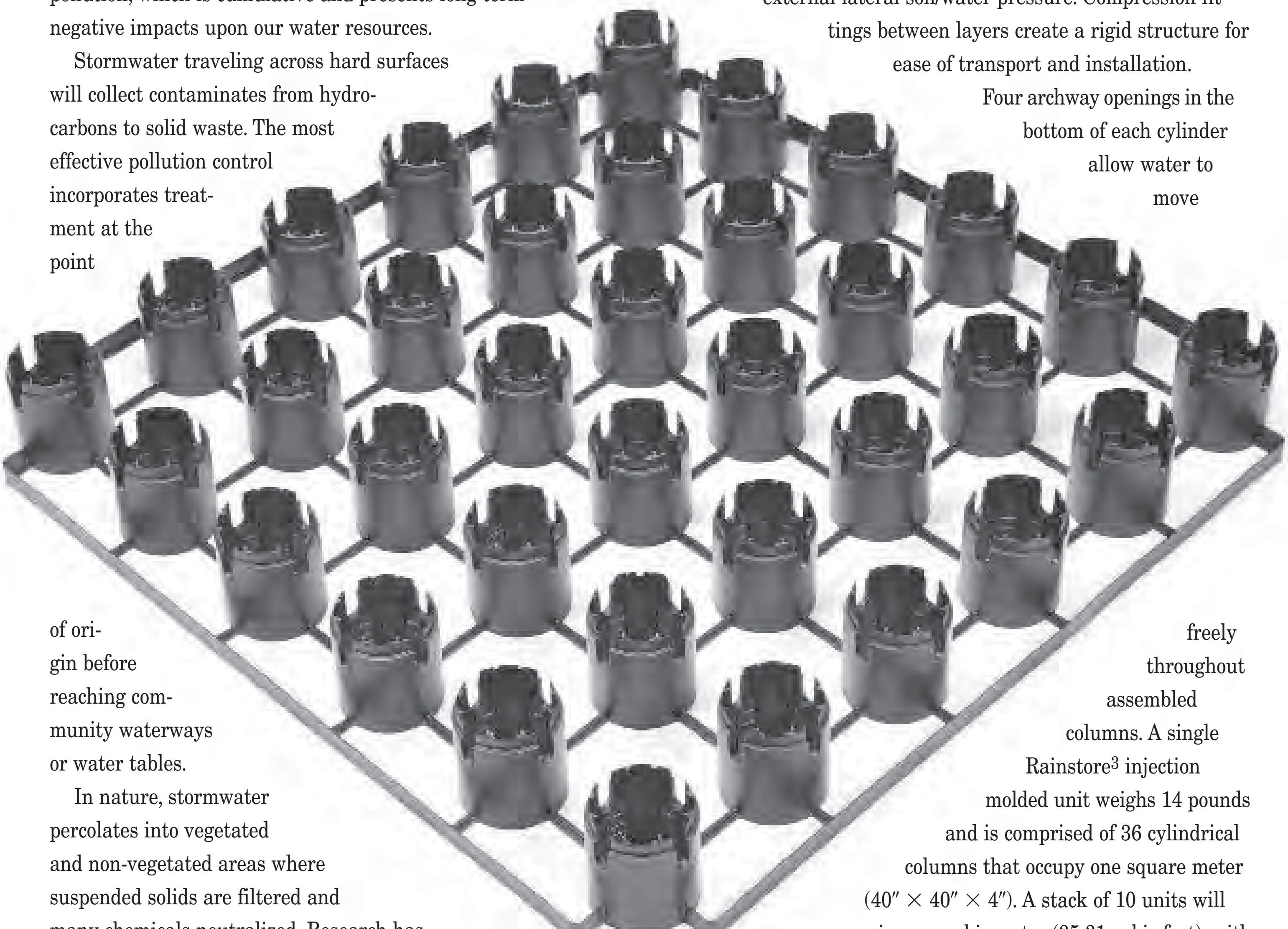
Water quality is critical and must be considered when dealing with stormwater management. In the past, point-source pollution (contaminates from a concentrated source) was of primary concern. Today, non-point source pollution (contaminates from a large area such as a parking lot) is important due to its magnitude and frequency.

The EPA has regulated point source pollution for years and is now implementing strict regulations to control non-point source pollution, which is cumulative and presents long term negative impacts upon our water resources.

Stormwater traveling across hard surfaces will collect contaminates from hydrocarbons to solid waste. The most effective pollution control incorporates treatment at the point of origin before reaching community waterways or water tables.

In nature, stormwater percolates into vegetated and non-vegetated areas where suspended solids are filtered and many chemicals neutralized. Research has shown that hydrocarbons are consumed by bio-organisms found in the root zone without killing the vegetation.

Invisible Structures' porous pavement and bio-swale products provide one of the most effective means of removing pollutants at the source. Refer to Sand-Bio Filter Inlet Detail for ways to reduce or eliminate catch basins and elaborate cleaning systems. Rainstore^3 in combination with ISI's other outstanding products provide a complete stormwater management package.



PRODUCT DESCRIPTION

Basic Structure

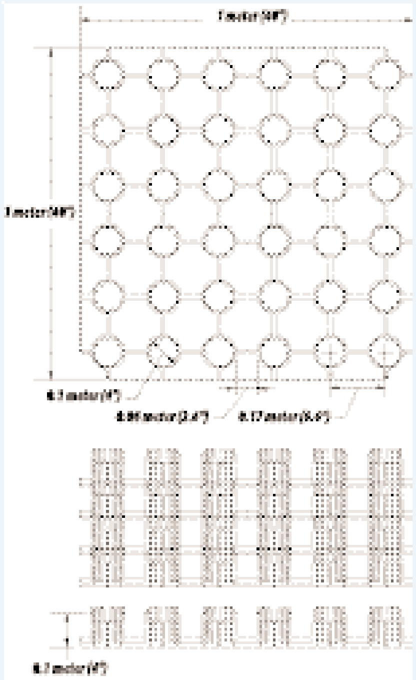
Rainstore^3 is a structure of thin-walled cylindrical columns injection molded of recycled resins of either high impact polypropylene (HIPP), or high density polyethylene (HDPE) plastic for strength, durability, and green industry benefit. For potable water storage, virgin plastic is used. Cylinders are 10 cm (4″) diameter, 5mm (0.2″) average wall thickness, 10 cm (4″) tall, and spaced 16.7 cm (4.6″) apart. T-shaped beams connect the cylinders and resist external lateral soil/water pressure. Compression fittings between layers create a rigid structure for ease of transport and installation.

Four archway openings in the bottom of each cylinder allow water to move freely throughout assembled columns. A single Rainstore^3 injection molded unit weighs 14 pounds and is comprised of 36 cylindrical columns that occupy one square meter (40″ × 40″ × 4″). A stack of 10 units will comprise one cubic meter (35.31 cubic feet), with approximately 250 gallons of net water storage.

RS^3 allows for water containment depths from 10 cm to 2.5 meters (4″ to 94″ or 8.2′). The following standard depths are stocked: *in meters* (0.2, 0.3, 0.4, 0.6, 0.8, 1.2, and 2.4) *in feet* (0.7, 1.0, 1.3, 2.0, 2.6, 4.0, and 7.9). Custom depths are also available.

Side bumpers provide foolproof, accurate spacing. Structures may be moved by hand. A layer of geogrid, below the cells and above the existing subsoil, provides a stable surface and will insure proper alignment.

RS3 withstands repeated freeze-thaw cycles, will not rust, break down, crack, is not affected by chemicals, extremes of pH, oils, salts, or fertilizers. Ethylene plastics have a projected service life in excess of 100 years provided they are not exposed to UV light.



Rainstore3 Unit Detail
Single Rainstore3 injection molded unit geometry and dimensions

Overall System
RS3, wrapped with a geotextile filter fabric or geomembrane, and placed side by side in an excavated void create a variety of water storage structures. Inflow, outflow, visual inspection pipes, catch basins, pumps and water filters are installed as needed. Backfilling and compacting the sides, geogrid, base course, and surfacing complete the system.

STORMWATER MANAGEMENT APPLICATIONS
Land development significantly affects the natural course of stormwater. Prior to development, land is semi-porous enabling rainfall to directly infiltrate, which filters pollutants, recharges subsurface water tables, and reduces flooding. Sealing the earth's surface with parking lots, roads, walks, and roofs, results in rapid runoff to storm sewers and rivers, causing flooding and unacceptable pollution of valuable water resources.

To combat these serious problems, national (EPA) and regional regulatory agencies require all or a portion of stormwater to be managed on site.

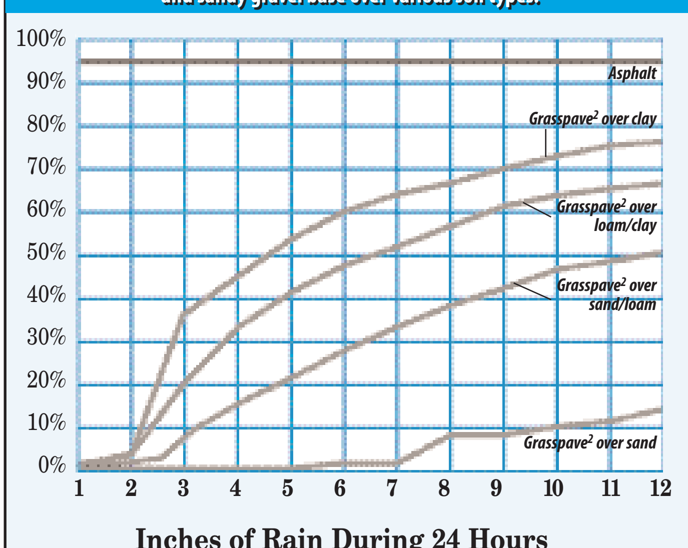
Surface detention basins and ponds are common, but often occupy valuable real estate and create safety hazards, insects, weeds, and odor problems. Increasingly, the most economical and convenient solution is an "underground pond," where the water may be stored temporarily before it is released to a storm sewer (detention), stored until it exfiltrates (retention), or stored for reuse (harvesting).

Porous Paving
The most direct stormwater management technique is to allow the rain to penetrate the surface where it falls. This can be done with Grasspave2 or Gravelpave2 porous paving. The base course below these plastic reinforcement structures will typically store at least 2.5″ of rain, or more, if subsoils are porous. Firelanes and overflow parking areas are frequently used as infiltration basins.

Rainstore3 Detention
Short term storage and releasing stormwater at a predetermined rate through the use of small outlet pipes or pumps is detention. Downstream stormwater facilities may exist but have a limited flow rate capacity. While the water is held awaiting gradual release, it may or may not be allowed to exfiltrate into the site soils. A porous non-woven geotextile is used to encase RS3. Geomembranes are used when exfiltration must be avoided.

Rainstore3 Retention
When downstream stormwater facilities do not exist or the amount of water released from a site is limited for some other reason, stormwater retention is utilized. Typically, there are no outflow pipes. RS3 is encased in non-woven geotextile and placed above porous soil. Replenishing existing aquifers is a benefit.

Runoff Comparison Chart
Runoff coefficients, Grasspave2 or Gravelpave2 and sandy gravel base over various soil types.

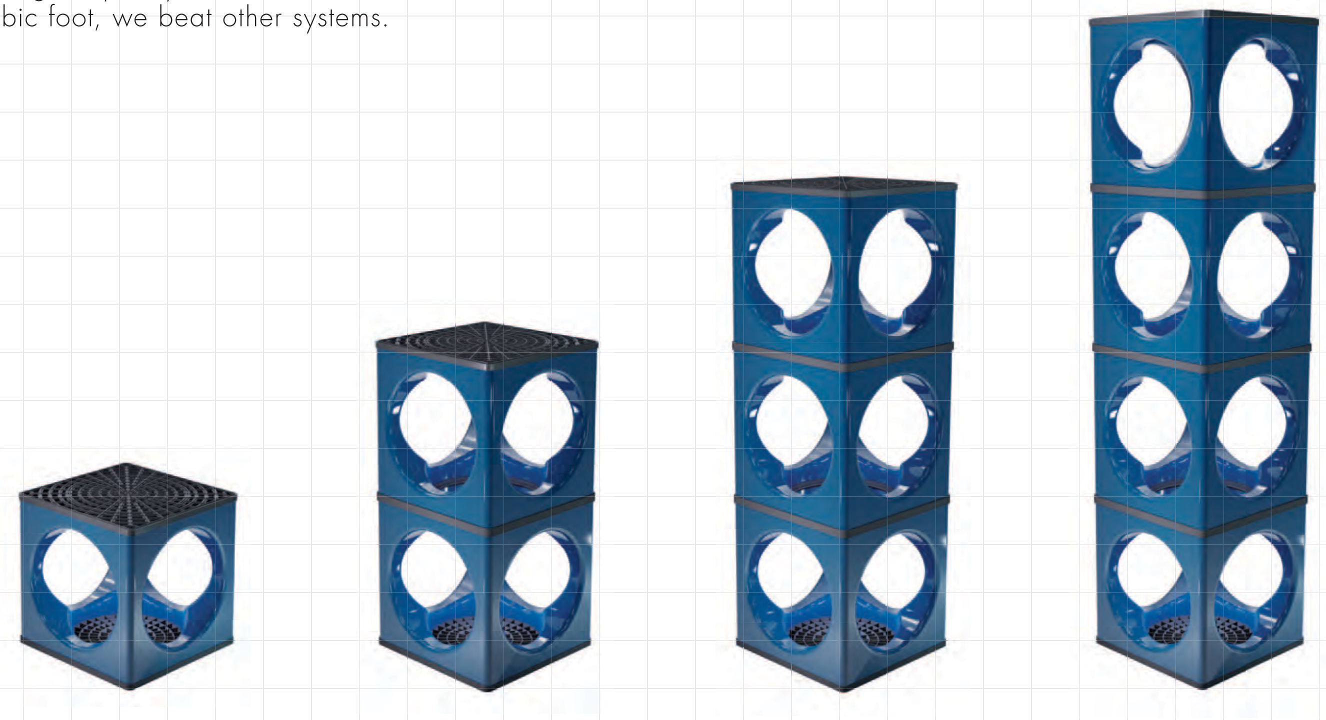


Calculations include Grasspave2 or Gravelpave2 placed over 6″ of sandy gravel base course, laid over native soils indicated.

MORE CAPACITY – EIGHT CUBIC FEET AT A TIME

HOW WE STACK UP

Each CUDO® module measures a large eight cubic feet, with 95% storage capacity. Cubic foot vs. cubic foot, we beat other systems.



2 ft. x 2 ft. x 2 ft.	2 ft. x 2 ft. x 4 ft.	2 ft. x 2 ft. x 6 ft.	2 ft. x 2 ft. x 8 ft.

MORE CAPACITY PER CUBIC FOOT

CUDO ASSEMBLY	UNIT WEIGHT (LBS.)	STORAGE (CUBIC FT.)	CAPACITY (GALLONS – 95%)
CUDO 1	21	7.7	57
CUDO 2	41	15.4	115
CUDO 3	62	23.0	172
CUDO 4	86	30.6	229

US PATENT PENDING

MADE IN THE U.S.A.

ALL DIMENSIONAL MEASUREMENTS ARE NOMINAL

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CUDO®
C U D O
WATER STORAGE SYSTEM

The French Connection

Derived from the French "Cube d'eau", meaning "cube of water", the CUDO® is a modular plastic cube used to construct underground water storage systems.

The unique cube incorporates an arched design that adds structural integrity, increased water storage and enhanced access for inspection and maintenance. CUDO sets the new standard for storm-water management by incorporating features that are not available with other systems currently on the market.

CUDO is made in the U.S.A. using injection molded, polypropylene plastic. A single CUDO assembly requires just two modules and two end caps.

The CUDO may be installed as a single-level system, or connected vertically, to form a CUDO stack, increasing storage capacity. Formed stacks can be easily moved about a construction site.

Per application, either a filter fabric or plastic liner is placed beneath and around the CUDO modules, forming an envelope around the entire system. Geo-grid or other structural enhancement may be incorporated into the CUDO installation, depending on the loading requirements.

Features and Benefits of the Standard CUDO

- large interior openings offer ease of access for inspection and maintenance
- high water storage capacity (95%)
- CUDO size (24" x 24" x 24") offers ease of handling and installation
- unique shape offers superior strength
- minimum number of components required for assembly

Added Components, Features and Benefits

- built-in gross pollutant filter (GPF) or media filter devices (RMF, VMF) eliminate the need for separate pre-treatment systems and reduce or eliminate related piping
- integral "metered outlet" device eliminates the need for separate outlet and flow control structure
- BLUE (color) CUDO identifies the location of filter devices, simplifying assembly, installation and system maintenance
- CUDO flow-through bypass feature forms a virtual pipeline through the system, reducing or eliminating separate bypass piping. The use of BLUE CUDO offers ease of assembly and installation by identifying the location and direction of virtual flow channels.
- potential LEED® NC credits for Sustainable Sites (6.1, 6.2) Materials & Resources (4, 5 in CA, AZ, NV, OR, UT) and Water Efficiency (1, 3) [1]

Other Applications for CUDO

- downspout sand filter device
- individual drain inlet sand filter device
- modular sand filter system

CUDO Modular Bio-retention System

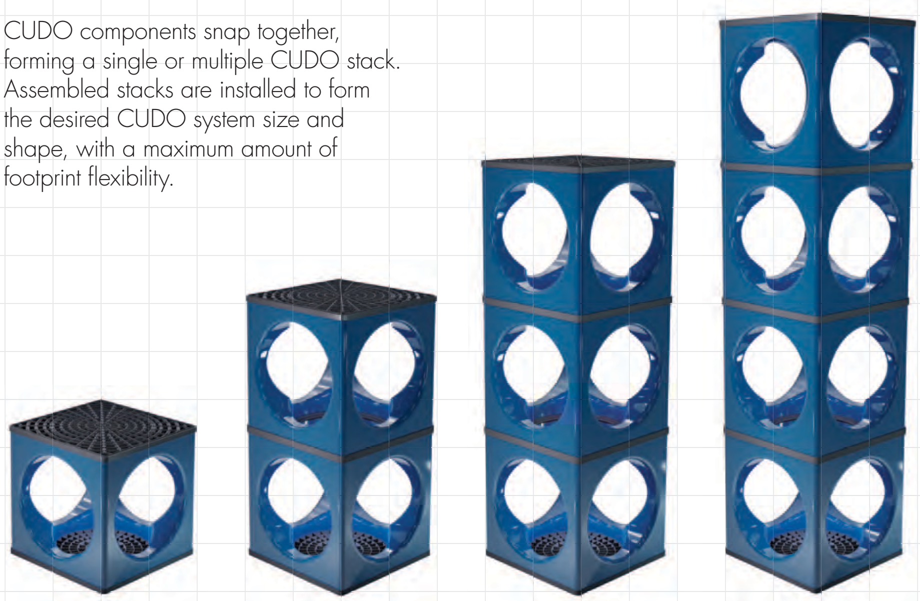
- CUDO may be integrated into bio-retention systems (rain gardens) replacing drain pipe and aggregate with a highly porous matrix
- additional storage volume enhances retention
- more opportunity for on-site rain water reuse through passive or active irrigation
- mitigates temperature increase typical of surface storage

The Concrete CUDO

CUDO water storage systems are also available in pre-cast concrete designs to address many problematic applications. Contact your local CUDO distributor for availability of concrete CUDO in your area.

- severe loading conditions – shallow or deep burial depths, heavy loading areas
- high water tables – anti-floatation features
- enhanced maintenance access – the larger CUDO allows full access for equipment and personnel
- plastic filter CUDO devices may be used in conjunction with concrete CUDO to offer integral pre-filter capabilites

CUDO components snap together, forming a single or multiple CUDO stack. Assembled stacks are installed to form the desired CUDO system size and shape, with a maximum amount of footprint flexibility.



CUDO 1 CUDO 2 CUDO 3 CUDO 4

[1] LEED® for New Construction and Major Renovation, US Green Building Council, v2.2, October 2005

SILVA CELL OVERVIEW

GETTING STARTED

- DESIGNERS
- CONTRACTORS
- ENGINEERS

THE SILVA CELL

h Height: 16" (400 mm)

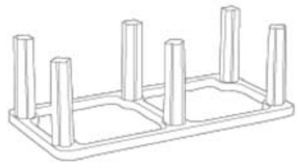
w Width: 24" (600 mm)

l Length: 48" (1200 mm)

The Silva Cell is a modular suspended pavement system that uses soil volumes to support large tree growth and provide powerful on-site stormwater management through absorption, evapotranspiration, and interception.

Each Silva Cell is composed of a frame and a deck. Frames are 48" (1200 mm) long x 24" (600 mm) wide x 16" (400 mm) high, and each one holds 10 cubic feet (.28 cubic meters) of soil. They can be stacked one, two, or three high before they are topped with a deck to create a maximum containment area for lightly compacted loam soil. Silva Cells can be spread laterally as wide as necessary. Each unit is about 92% void space, making it easy to accommodate utilities.

FRAME



Six rigid vertical posts protrude from the bottom of the frame to support hardscape along with the weight of any load they carry. Their rounded edged prevent significant stress concentrations, meaning that the supported hardscapes are in no danger of sinking due to compressive forces.

DECK

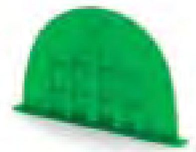
The deck is a rigid platform with six recesses position to snap securely on the six posts of the frame. Openings on the deck allow ample room for air and water to penetrate to the enclosed soil.

Triton Chambers

Ultimate

TRITON

Model: S-29
59" W x 36" H x 35" L 32 lbs
1498.6mm x 914.4mm x 889mm 14.5 kg.
Bare Chamber Storage 29 cf (.82 m³)
*With 6" (160mm) Stone Above and Below
41.1 cf (1.161 m³)



Model: S-29 End Cap
Bare End Cap Storage 2.13 cf (.06 m³)

Model: S-29 Sediment Floor

Model: S-29 Sediment Dumpster
Bare Storage Volume: 20 cf (.57 m³)

Model: S-29 Sediment Bin
Bare Storage Volume: 34 cf (.97 m³)

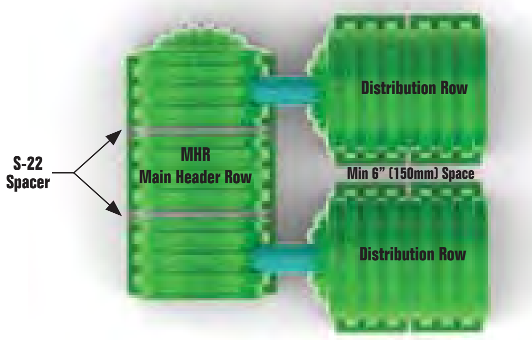
Mega

Model: S-22
55" W x 35" H x 30" L 28 lbs
1397mm x 863.6mm x 762mm 12.7kg
Bare Chamber Storage 23.2 cf (.66 m³)
*With 6" (150mm) Stone Above and Below
33.8 cf (.96 m³)

Model: S-22 End Cap
Bare End Cap Storage 3.91 cf (.11 m³)

Model: S-22 MHR Spacer
Add Spacer To MHR Chambers Only
To Allow Distribution Row Chamber
Rows To Be Spaced 6" (150mm) Apart

S-22 Spacer in MHR to ensure the proper spacing and alignment of the S-22 Distribution Rows with the MHR



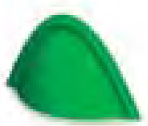
Compact

Model: C-10
40" W x 25" H x 32" L 15 lbs
1016mm x 635mm x 812.8mm 6.8 kg.
Bare Chamber Storage 9.8 cf (.28 m³)
*With 6" (160mm) Stone Above and Below
17.6 cf (.498 m³)

Model: C-10 End Cap
Bare End Cap Storage 1.21 cf (.03 m³)

Mini

Model: M-6
34" W x 17.5" H x 32" L 12 lbs
863.6mm x 44.5mm x 812.8mm 6.8 kg.
Bare Chamber Storage 5.6 cf (.16 m³)
*With 6" (160mm) Stone Above and Below
11.5 cf (.326 m³)



Model: M-6 End Cap
Bare End Cap Storage .6 cf (.02 m3)

Examples of how the MHR Filter Elbow and the Stainless Steel Filter Media Pucks can be used

Model:MHR Filter Elbow

Model:
Stainless Steel
MHR Filter With Media
Puck-Deep
31.4 Cubic Inches

***Only Use One
Media Puck
Per Elbow
Depending on
what Option You
Choose
Export USA

Model:
Stainless Steel
MHR Filter With Media
Puck-Shallow
27.73 Cubic Inches

Model:MHR Filter Option 1

Model:MHR Filter Option 2

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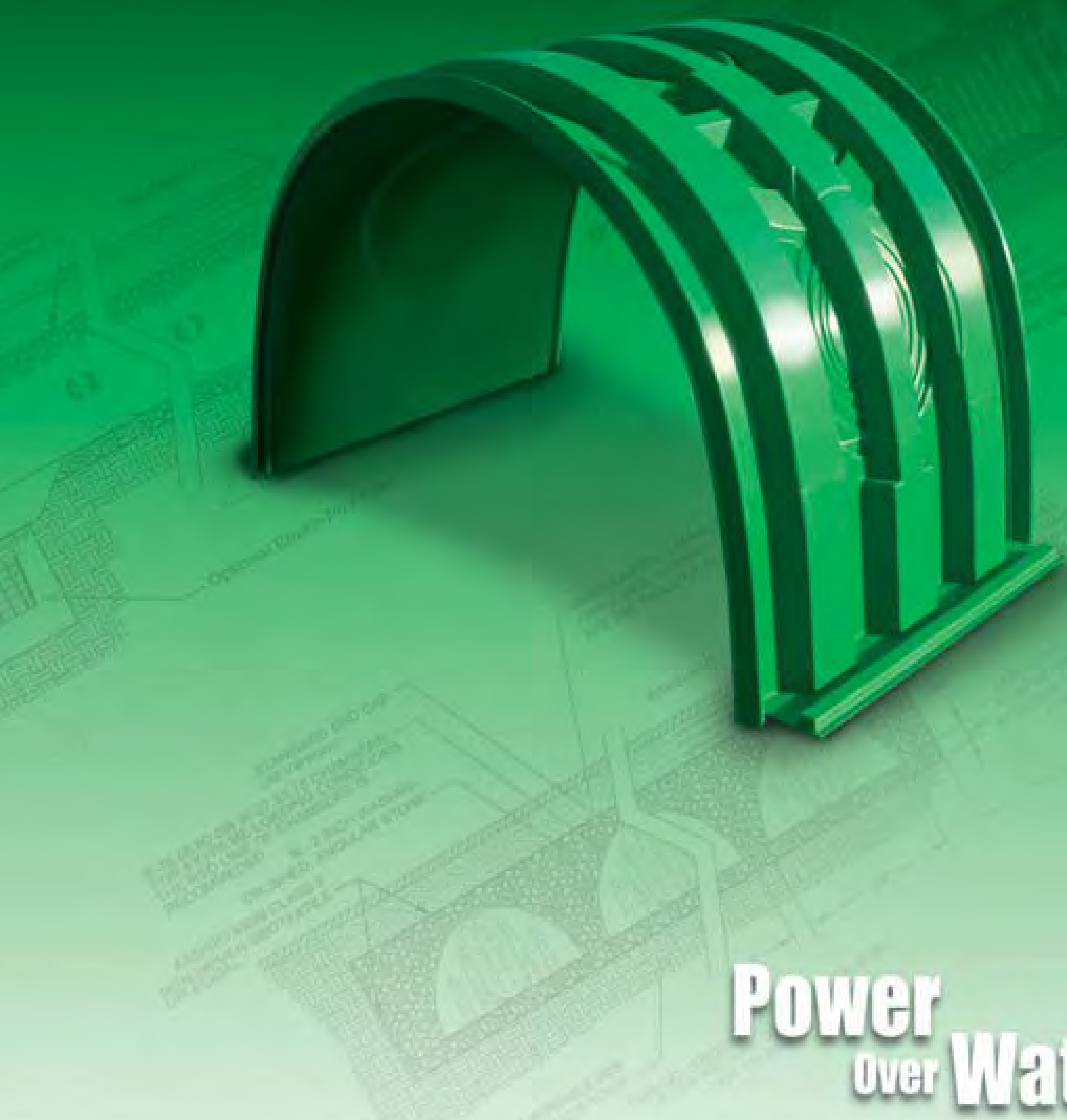

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10.4 Appendix D – Calculations and Modeling

- Modeling Assumptions for Bioretention/Swale surfacing, Gravel Pave surfacing and Rainstore3 infiltration facilities
- Data - MGS Flood Outputs for each of the catchment areas along 148th directed to the 18 facilities.

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Modeling Assumptions

The MGS Flood program was used to model the site conditions and proposed Rainstore3 infrastructure facilities. Basin analysis was performed to determine contributing basin areas and flows to each facility (identified as #1-#18 per plan). The models were set up as follows:

Bioretention surfaced unit:
Pre Developed condition: Forested Basin Area
Post Developed condition: Impervious Basin Area flowing to Bioretention flowing to Rainstore3

Bioretention areas were modeled using the Bioretention Facility link-type, inputting the actual bioretention dimension (total bioretention length within the facility multiplied by the average width of the bioretention.) Bioretention soil infiltration rates were identified as 2-in/hr. An underdrain was included to convey discharge to the "downstream" Rainstore3 facility. The native infiltration rate beneath the bioretention was identified as 0.0-in/hr because all infiltration will discharge into the Rainstore3 facility beneath the bioretention (modeled as "downstream" of the bioretention). The Rainstore3 structures were modeled using the Structure link-type, inputting the actual dimensions of the proposed Rainstore3 units. Because the Rainstore3 has a 94% void volume, the height of the Rainstore3 units was reduced by 6%. The native infiltration rate of the subgrade beneath the Rainstore3 units is identified in the Geotechnical report at 0.25in/hr.

Pavement surfaced unit:
Pre Developed condition: Forested Basin Area
Post Developed condition: Impervious flowing to Rainstore3

Surface flow was modeled to discharge directly into the Rainstore3 facility because the infiltration rates identified by the Gravel Pave supplier indicate an average infiltration rate (with common base course) to be 7.37-in/hr. This infiltration rate is assumed to be non-limiting infiltration rate when compared to storm event flow rates. The Rainstore3 structures were modeled using the Structure link-type, inputting the actual dimensions of the proposed Rainstore3 units. Because the Rainstore3 has a 94% void volume, the height of the Rainstore3 units was reduced by 6%. The native infiltration rate of the subgrade beneath the Rainstore3 units is identified in the Geotechnical report at 0.25in/hr.

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MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 09/16/2015 8:13 AM
Report Generation Date: 09/16/2015 8:17 AM

Input File Name:	2015-09-15 Project Area Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Project Area Run-off Forested Condition
Comments:	

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 14

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

	-------Area(Acres) --------
Till Forest	0.038
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.038

---------- Subbasin : 2 ----------

	-------Area(Acres) --------
Till Forest	0.032
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.032

---------- Subbasin : 3,4,5 ----------

	-------Area(Acres) --------
Till Forest	0.119
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.119

---------- Subbasin : 6,7 ----------

	-------Area(Acres) --------
Till Forest	0.043
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.043

---------- Subbasin : 8,9 ----------

	-------Area(Acres) --------
Till Forest	0.035
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000

Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.035

---------- Subbasin : 10 ----------

	-------Area(Acres) --------
Till Forest	0.113
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.113

---------- Subbasin : 11 ----------

	-------Area(Acres) --------
Till Forest	0.038
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.038

---------- Subbasin : 12 ----------

	-------Area(Acres) --------
Till Forest	0.042
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.042

---------- Subbasin : 13 ----------

	-------Area(Acres) --------
Till Forest	0.054
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.054

---------- Subbasin : 14 ----------

	-------Area(Acres) --------
Till Forest	0.013
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.013

---------- Subbasin : 15 ----------

	-------Area(Acres) --------
Till Forest	0.076
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.076

---------- Subbasin : 16 ----------

	-------Area(Acres) --------
Till Forest	0.155
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000

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

Subbasin Total	0.155

---------- Subbasin : 17 ----------

	-------Area(Acres) --------
Till Forest	0.020
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total	0.020

---------- Subbasin : 18 ----------

	-------Area(Acres) --------
Till Forest	0.093
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total	0.093

---------------------SCENARIO: IMPERVIOUS

Number of Subbasins: 14

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

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.009
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.029

Subbasin Total 0.038

---------- Subbasin : 2 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.008
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.024
Subbasin Total	0.032

---------- Subbasin : 3,4,5 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.028
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.090
Subbasin Total	0.118

---------- Subbasin : 6,7 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.010
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.033
Subbasin Total	0.043

---------- Subbasin : 8,9 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000

Till Grass	0.008
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.027
Subbasin Total	0.035

---------- Subbasin : 10 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.026
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.087
Subbasin Total	0.113

---------- Subbasin : 11 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.009
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.029
Subbasin Total	0.038

---------- Subbasin : 12 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.009
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.033

Subbasin Total 0.042

---------- Subbasin : 13 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.012
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.042
Subbasin Total	0.054

---------- Subbasin : 14 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.013
Subbasin Total	0.013

---------- Subbasin : 15 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.018
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.058
Subbasin Total	0.076

---------- Subbasin : 16 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000

Till Grass	0.035
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.120
Subbasin Total	0.155

---------- Subbasin : 17 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.005
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.016
Subbasin Total	0.021

---------- Subbasin : 18 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.021
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.072
Subbasin Total	0.093

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

----------------------SCENARIO: BASIN AREA
Number of Links: 1

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

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

---------------------SCENARIO: IMPERVIOUS
Number of Links: 1

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

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 14
Number of Links: 1

************ Subbasin: 1 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	8.444E-04
5-Year	1.351E-03
10-Year	1.748E-03
25-Year	2.296E-03
50-Year	2.656E-03
100-Year	3.875E-03
200-Year	6.439E-03

************ Subbasin: 2 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	7.111E-04
5-Year	1.138E-03
10-Year	1.472E-03
25-Year	1.933E-03
50-Year	2.236E-03
100-Year	3.263E-03
200-Year	5.423E-03

************ Subbasin: 3,4,5 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.644E-03

5-Year	4.231E-03
10-Year	5.475E-03
25-Year	7.189E-03
50-Year	8.317E-03
100-Year	1.213E-02
200-Year	2.017E-02

************ Subbasin: 6,7 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	9.555E-04
5-Year	1.529E-03
10-Year	1.978E-03
25-Year	2.598E-03
50-Year	3.005E-03
100-Year	4.384E-03
200-Year	7.287E-03

************ Subbasin: 8,9 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	7.777E-04
5-Year	1.244E-03
10-Year	1.610E-03
25-Year	2.114E-03
50-Year	2.446E-03
100-Year	3.569E-03
200-Year	5.931E-03

************ Subbasin: 10 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.511E-03
5-Year	4.017E-03
10-Year	5.199E-03
25-Year	6.827E-03
50-Year	7.897E-03
100-Year	1.152E-02
200-Year	1.915E-02

************ Subbasin: 11 ************

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	8.444E-04
5-Year	1.351E-03
10-Year	1.748E-03
25-Year	2.296E-03
50-Year	2.656E-03
100-Year	3.875E-03
200-Year	6.439E-03

************ Subbasin: 12 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	9.333E-04
5-Year	1.493E-03
10-Year	1.932E-03
25-Year	2.537E-03
50-Year	2.935E-03
100-Year	4.282E-03
200-Year	7.117E-03

************ Subbasin: 13 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.200E-03
5-Year	1.920E-03
10-Year	2.484E-03
25-Year	3.262E-03
50-Year	3.774E-03
100-Year	5.506E-03
200-Year	9.151E-03

************ Subbasin: 14 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.889E-04
5-Year	4.622E-04
10-Year	5.981E-04
25-Year	7.854E-04
50-Year	9.085E-04
100-Year	1.326E-03
200-Year	2.203E-03

************ Subbasin: 15 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.689E-03
5-Year	2.702E-03
10-Year	3.496E-03
25-Year	4.591E-03
50-Year	5.311E-03
100-Year	7.749E-03
200-Year	1.288E-02

************ Subbasin: 16 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.444E-03
5-Year	5.511E-03
10-Year	7.131E-03
25-Year	9.364E-03
50-Year	1.083E-02
100-Year	1.580E-02
200-Year	2.627E-02

************ Subbasin: 17 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	4.444E-04
5-Year	7.111E-04
10-Year	9.201E-04
25-Year	1.208E-03
50-Year	1.398E-03
100-Year	2.039E-03
200-Year	3.389E-03

************ Subbasin: 18 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.067E-03
5-Year	3.306E-03
10-Year	4.279E-03
25-Year	5.618E-03

50-Year	6.499E-03
100-Year	9.482E-03
200-Year	1.576E-02

********** Link: New Copy Lnk1 ********** Link Inflow Frequency Stats

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.935E-02
5-Year	3.097E-02
10-Year	4.007E-02
25-Year	5.262E-02
50-Year	6.087E-02
100-Year	8.881E-02
200-Year	0.148

----------------------SCENARIO: IMPERVIOUS

Number of Subbasins: 14
Number of Links: 1

********** Subbasin: 1 **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.267E-02
5-Year	1.868E-02
10-Year	2.391E-02
25-Year	2.768E-02
50-Year	3.387E-02
100-Year	3.848E-02
200-Year	3.917E-02

********** Subbasin: 2 **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.053E-02
5-Year	1.553E-02
10-Year	1.999E-02
25-Year	2.303E-02
50-Year	2.834E-02
100-Year	3.196E-02
200-Year	3.261E-02

********** Subbasin: 3,4,5 **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.933E-02
5-Year	5.799E-02
10-Year	7.424E-02
25-Year	8.593E-02
50-Year	0.105
100-Year	0.119
200-Year	0.122

************ Subbasin: 6,7 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.440E-02
5-Year	2.123E-02
10-Year	2.712E-02
25-Year	3.145E-02
50-Year	3.840E-02
100-Year	4.374E-02
200-Year	4.449E-02

************ Subbasin: 8,9 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.177E-02
5-Year	1.735E-02
10-Year	2.213E-02
25-Year	2.569E-02
50-Year	3.131E-02
100-Year	3.575E-02
200-Year	3.634E-02

************ Subbasin: 10 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.794E-02
5-Year	5.593E-02
10-Year	7.137E-02
25-Year	8.283E-02
50-Year	0.101
100-Year	0.115

200-Year	0.117

************ Subbasin: 11 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.267E-02
5-Year	1.868E-02
10-Year	2.391E-02
25-Year	2.768E-02
50-Year	3.387E-02
100-Year	3.848E-02
200-Year	3.917E-02

************ Subbasin: 12 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.433E-02
5-Year	2.112E-02
10-Year	2.676E-02
25-Year	3.123E-02
50-Year	3.783E-02
100-Year	4.354E-02
200-Year	4.414E-02

************ Subbasin: 13 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.828E-02
5-Year	2.694E-02
10-Year	3.426E-02
25-Year	3.987E-02
50-Year	4.846E-02
100-Year	5.552E-02
200-Year	5.637E-02

************ Subbasin: 14 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	5.390E-03
5-Year	7.898E-03

10-Year	9.655E-03
25-Year	1.153E-02
50-Year	1.348E-02
100-Year	1.594E-02
200-Year	1.634E-02

*********** Subbasin: 15 ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.534E-02
5-Year	3.736E-02
10-Year	4.783E-02
25-Year	5.537E-02
50-Year	6.774E-02
100-Year	7.696E-02
200-Year	7.834E-02

*********** Subbasin: 16 ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	5.227E-02
5-Year	7.705E-02
10-Year	9.813E-02
25-Year	0.114
50-Year	0.139
100-Year	0.159
200-Year	0.161

*********** Subbasin: 17 ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	6.993E-03
5-Year	1.031E-02
10-Year	1.321E-02
25-Year	1.528E-02
50-Year	1.871E-02
100-Year	2.124E-02
200-Year	2.162E-02

*********** Subbasin: 18 ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.136E-02
5-Year	4.623E-02
10-Year	5.888E-02
25-Year	6.844E-02
50-Year	8.331E-02
100-Year	9.527E-02
200-Year	9.678E-02

********** Link: New Copy Lnk1 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.293
5-Year	0.432
10-Year	0.551
25-Year	0.640
50-Year	0.780
100-Year	0.891
200-Year	0.905

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: 1	6.204
Subbasin: 2	5.225
Subbasin: 3,4,5	19.430
Subbasin: 6,7	7.021
Subbasin: 8,9	5.715
Subbasin: 10	18.450
Subbasin: 11	6.204
Subbasin: 12	6.857
Subbasin: 13	8.817
Subbasin: 14	2.123
Subbasin: 15	12.409
Subbasin: 16	25.307
Subbasin: 17	3.265
Subbasin: 18	15.184
Link: New Copy Lnk1	Not Applicable
Total:	142.211

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: 1	1.048
Subbasin: 2	0.931

Subbasin: 3,4,5	3.259
Subbasin: 6,7	1.164
Subbasin: 8,9	0.931
Subbasin: 10	3.027
Subbasin: 11	1.048
Subbasin: 12	1.048
Subbasin: 13	1.397
Subbasin: 14	0.000
Subbasin: 15	2.095
Subbasin: 16	4.074
Subbasin: 17	0.582
Subbasin: 18	2.445
Link: New Copy Lnk1	Not Applicable
Total:	23.049

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.900 ac-ft/year, Post Developed: 0.146 ac-ft/year

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

----------------------SCENARIO: BASIN AREA

Number of Links: 1

----------------------SCENARIO: IMPERVIOUS

Number of Links: 1

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

Scenario Basin Area Compliance Link: New Copy Lnk1
Scenario Impervious Compliance Link: New Copy Lnk1

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.935E-02	2-Year	0.293
5-Year	3.097E-02	5-Year	0.432
10-Year	4.007E-02	10-Year	0.551
25-Year	5.262E-02	25-Year	0.640
50-Year	6.087E-02	50-Year	0.780
100-Year	8.881E-02	100-Year	0.891
200-Year	0.148	200-Year	0.905

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

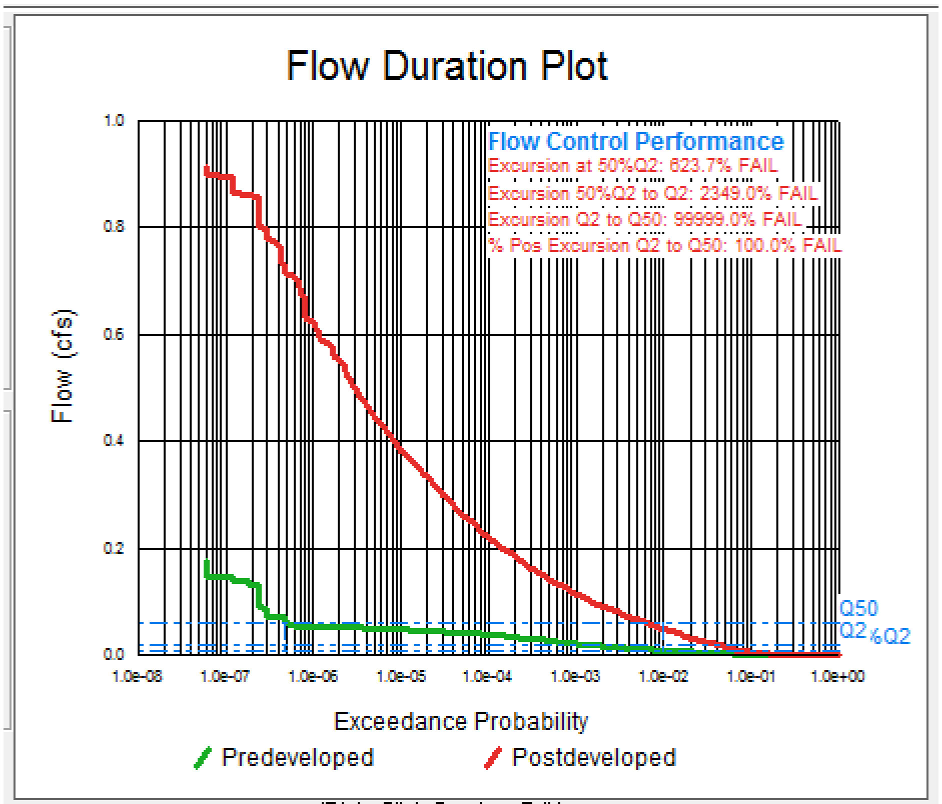
****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 623.7% FAIL

Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 2349.0% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 100.0% FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

****** LID Duration Performance ******
Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 85.9% FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 623.7% FAIL

LID DURATION DESIGN CRITERIA: FAIL



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 09/16/2015 3:34 PM
Report Generation Date: 09/16/2015 3:38 PM

Input File Name: 2015-09-15 Project Area Forested to RS Developed.fld
Project Name: Shoreline On Call 148th
Analysis Title: Project Area Run-off Forested Condition
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 14

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

	-------Area(Acres) --------
Till Forest	0.038
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total	0.038

---------- Subbasin : 2 ----------

	-------Area(Acres) --------
Till Forest	0.032
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.032

---------- Subbasin : 3,4,5 ----------

	-------Area(Acres) --------
Till Forest	0.119
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.119

---------- Subbasin : 6,7 ----------

	-------Area(Acres) --------
Till Forest	0.043
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.043

---------- Subbasin : 8,9 ----------

	-------Area(Acres) --------
Till Forest	0.035
Till Pasture	0.000
Till Grass	0.000

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

Subbasin Total	0.035

---------- Subbasin : 10 ----------

	-------Area(Acres) --------
Till Forest	0.113
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total	0.113

---------- Subbasin : 11 ----------

	-------Area(Acres) --------
Till Forest	0.038
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total	0.038

---------- Subbasin : 12 ----------

	-------Area(Acres) --------
Till Forest	0.042
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total	0.042

---------- Subbasin : 13 ----------

	-------Area(Acres) --------
Till Forest	0.054
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.054

---------- Subbasin : 14 ----------

	-------Area(Acres) --------
Till Forest	0.013
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.013

---------- Subbasin : 15 ----------

	-------Area(Acres) --------
Till Forest	0.076
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.076

---------- Subbasin : 16 ----------

	-------Area(Acres) --------
Till Forest	0.155
Till Pasture	0.000
Till Grass	0.000

Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.155

---------- Subbasin : 17 ----------

	-------Area(Acres) --------
Till Forest	0.020
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.020

---------- Subbasin : 18 ----------

	-------Area(Acres) --------
Till Forest	0.093
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000
Subbasin Total	0.093

---------------------SCENARIO: IMPERVIOUS

Number of Subbasins: 14

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

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.009
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000

User	0.000
Impervious	0.028
--	
Subbasin Total	0.037

---------- Subbasin : 2 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.007
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.024
--	
Subbasin Total	0.031

---------- Subbasin : 3,4,5 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.027
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.090
--	
Subbasin Total	0.117

---------- Subbasin : 6,7 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.010
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.032
--	
Subbasin Total	0.042

---------- Subbasin : 8,9 ----------

-------Area(Acres) --------

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.007
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.026
Subbasin Total	0.033

---------- Subbasin : 10 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.026
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.087
Subbasin Total	0.113

---------- Subbasin : 11 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.008
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.029
Subbasin Total	0.037

---------- Subbasin : 12 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.009
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000

User 0.000
Impervious 0.032

Subbasin Total 0.041

---------- Subbasin : 13 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.012
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.042
Subbasin Total	0.054

---------- Subbasin : 14 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.013
Subbasin Total	0.013

---------- Subbasin : 15 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.017
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.058
Subbasin Total	0.075

---------- Subbasin : 16 ----------
-------Area(Acres) --------

Till Forest	0.000
Till Pasture	0.000
Till Grass	0.035
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.120
Subbasin Total	0.155

---------- Subbasin : 17 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.005
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.016
Subbasin Total	0.021

---------- Subbasin : 18 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.021
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.072
Subbasin Total	0.093

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

----------------------SCENARIO: BASIN AREA
Number of Links: 1

Link Name: New Copy Lnk1
Link Type: Copy

Downstream Link: None

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 23

--
Link Name: POC
Link Type: Copy
Downstream Link: None

--
Link Name: RS1
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.51
Max Pond Elevation (ft) : 102.67
Storage Depth (ft) : 2.51
Pond Bottom Length (ft) : 33.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 333.
Area at Riser Crest El (sq-ft) : 333.
(acres) : 0.008
Volume at Riser Crest (cu-ft) : 836.
(ac-ft) : 0.019
Area at Max Elevation (sq-ft) : 333.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 922.
(ac-ft) : 0.021

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.51 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal

Elbow : Yes

Link Name: RG1
Link Type: Bioretention Facility
Downstream Link Name: RS1

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 15.0
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 75.
Area at Riser Crest El (sq-ft) : 144.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 76.
(ac-ft) : 0.002

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: RS2
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.84
Max Pond Elevation (ft) : 103.03
Storage Depth (ft) : 2.84
Pond Bottom Length (ft) : 33.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00

Bottom Area (sq-ft)	:	333.
Area at Riser Crest El (sq-ft)	:	333.
(acres)	:	0.008
Volume at Riser Crest (cu-ft)	:	946.
(ac-ft)	:	0.022
Area at Max Elevation (sq-ft)	:	333.
(acres)	:	0.008
Vol at Max Elevation (cu-ft)	:	1,042.
(ac-ft)	:	0.024

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.84 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

--
Link Name: RG2
Link Type: Bioretention Facility
Downstream Link Name: RS2

Base Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	100.50
Storage Depth (ft)	:	0.50
Bottom Length (ft)	:	8.3
Bottom Width (ft)	:	5.0
Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft)	:	42.
Area at Riser Crest El (sq-ft)	:	90.
(acres)	:	0.002
Volume at Riser Crest (cu-ft)	:	45.
(ac-ft)	:	0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties

Biosoil Thickness (ft)	:	1.50
Biosoil Saturated Hydraulic Conductivity (in/hr)	:	2.00
Biosoil Porosity (Percent)	:	20.00
Maximum Elevation of Bioretention Soil	:	101.00
Native Soil Hydraulic Conductivity (in/hr)	:	0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: RS3,4,5
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.57
Max Pond Elevation (ft) : 102.74
Storage Depth (ft) : 2.57
Pond Bottom Length (ft) : 46.7
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 467.
Area at Riser Crest El (sq-ft) : 467.
(acres) : 0.011
Volume at Riser Crest (cu-ft) : 1,200.
(ac-ft) : 0.028
Area at Max Elevation (sq-ft) : 467.
(acres) : 0.011
Vol at Max Elevation (cu-ft) : 1,326.
(ac-ft) : 0.030

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.57 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal

Elbow : Yes

--
Link Name: RG3,4,5
Link Type: Bioretention Facility
Downstream Link Name: RS3,4,5

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 15.2
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 76.
Area at Riser Crest El (sq-ft) : 146.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 77.
(ac-ft) : 0.002

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

--
Link Name: RS6,7
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.57
Max Pond Elevation (ft) : 102.73
Storage Depth (ft) : 2.57
Pond Bottom Length (ft) : 33.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00

Bottom Area (sq-ft) : 333.
Area at Riser Crest El (sq-ft) : 333.
(acres) : 0.008
Volume at Riser Crest (cu-ft) : 856.
(ac-ft) : 0.020
Area at Max Elevation (sq-ft) : 333.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 942.
(ac-ft) : 0.022

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.57 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

--
Link Name: RG 6,7
Link Type: Bioretention Facility
Downstream Link Name: RS6,7

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 8.4
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 42.
Area at Riser Crest El (sq-ft) : 91.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 45.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: RS8,9
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.74
Max Pond Elevation (ft) : 102.91
Storage Depth (ft) : 2.74
Pond Bottom Length (ft) : 40.0
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 400.
Area at Riser Crest El (sq-ft) : 400.
(acres) : 0.009
Volume at Riser Crest (cu-ft) : 1,096.
(ac-ft) : 0.025
Area at Max Elevation (sq-ft) : 400.
(acres) : 0.009
Vol at Max Elevation (cu-ft) : 1,204.
(ac-ft) : 0.028

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.74 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal

Elbow : Yes

Link Name: RG8,9
Link Type: Bioretention Facility
Downstream Link Name: RS8,9

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 14.5
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 73.
Area at Riser Crest El (sq-ft) : 140.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 74.
(ac-ft) : 0.002

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: RS10
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.81
Max Pond Elevation (ft) : 102.99
Storage Depth (ft) : 2.81
Pond Bottom Length (ft) : 33.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00

Bottom Area (sq-ft) : 333.
Area at Riser Crest El (sq-ft) : 333.
(acres) : 0.008
Volume at Riser Crest (cu-ft) : 936.
(ac-ft) : 0.021
Area at Max Elevation (sq-ft) : 333.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 1,029.
(ac-ft) : 0.024

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

--
Link Name: RS11
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.94
Max Pond Elevation (ft) : 103.16
Storage Depth (ft) : 2.94
Pond Bottom Length (ft) : 20.0
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 200.
Area at Riser Crest El (sq-ft) : 200.
(acres) : 0.005
Volume at Riser Crest (cu-ft) : 588.
(ac-ft) : 0.013
Area at Max Elevation (sq-ft) : 200.
(acres) : 0.005
Vol at Max Elevation (cu-ft) : 652.
(ac-ft) : 0.015

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.94 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

--
Link Name: RG11
Link Type: Bioretention Facility
Downstream Link Name: RS11

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 4.4
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 22.
Area at Riser Crest El (sq-ft) : 59.
(acres) : 0.001
Volume at Riser Crest (cu-ft) : 26.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: RS12
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.17
Max Pond Elevation (ft) : 102.31
Storage Depth (ft) : 2.17
Pond Bottom Length (ft) : 13.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 133.
Area at Riser Crest El (sq-ft) : 133.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 289.
(ac-ft) : 0.007
Area at Max Elevation (sq-ft) : 133.
(acres) : 0.003
Vol at Max Elevation (cu-ft) : 321.
(ac-ft) : 0.007

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.17 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

Link Name: RG12
Link Type: Bioretention Facility
Downstream Link Name: RS12

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 7.2

Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 36.
Area at Riser Crest El (sq-ft) : 82.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 39.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

--
Link Name: RS13
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.81
Max Pond Elevation (ft) : 102.99
Storage Depth (ft) : 2.81
Pond Bottom Length (ft) : 10.0
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 100.
Area at Riser Crest El (sq-ft) : 100.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 281.
(ac-ft) : 0.006
Area at Max Elevation (sq-ft) : 100.
(acres) : 0.002
Vol at Max Elevation (cu-ft) : 309.
(ac-ft) : 0.007

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

--
Link Name: RS14
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.81
Max Pond Elevation (ft) : 102.99
Storage Depth (ft) : 2.81
Pond Bottom Length (ft) : 10.0
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 100.
Area at Riser Crest El (sq-ft) : 100.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 281.
(ac-ft) : 0.006
Area at Max Elevation (sq-ft) : 100.
(acres) : 0.002
Vol at Max Elevation (cu-ft) : 309.
(ac-ft) : 0.007

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---

Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

Link Name: RS15
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.17
Max Pond Elevation (ft) : 102.91
Storage Depth (ft) : 2.17
Pond Bottom Length (ft) : 13.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 133.
Area at Riser Crest El (sq-ft) : 133.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 289.
(ac-ft) : 0.007
Area at Max Elevation (sq-ft) : 133.
(acres) : 0.003
Vol at Max Elevation (cu-ft) : 400.
(ac-ft) : 0.009

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.17 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

Link Name: RG15
Link Type: Bioretention Facility
Downstream Link Name: RS15

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 5.2
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 26.
Area at Riser Crest El (sq-ft) : 66.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 30.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

--
Link Name: RS16
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.81
Max Pond Elevation (ft) : 102.99
Storage Depth (ft) : 2.81
Pond Bottom Length (ft) : 36.7
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 367.
Area at Riser Crest El (sq-ft) : 367.
(acres) : 0.008
Volume at Riser Crest (cu-ft) : 1,031.
(ac-ft) : 0.024
Area at Max Elevation (sq-ft) : 367.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 1,134.

(ac-ft) : 0.026

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

--
Link Name: RS17
Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.81
Max Pond Elevation (ft) : 102.99
Storage Depth (ft) : 2.81
Pond Bottom Length (ft) : 20.2
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 202.
Area at Riser Crest El (sq-ft) : 202.
(acres) : 0.005
Volume at Riser Crest (cu-ft) : 568.
(ac-ft) : 0.013
Area at Max Elevation (sq-ft) : 202.
(acres) : 0.005
Vol at Max Elevation (cu-ft) : 624.
(ac-ft) : 0.014

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---

Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

Link Name: RS18

Link Type: Structure
Downstream Link Name: POC

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.98
Max Pond Elevation (ft) : 103.17
Storage Depth (ft) : 2.98
Pond Bottom Length (ft) : 36.7
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 367.
Area at Riser Crest El (sq-ft) : 367.
(acres) : 0.008
Volume at Riser Crest (cu-ft) : 1,094.
(ac-ft) : 0.025
Area at Max Elevation (sq-ft) : 367.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 1,200.
(ac-ft) : 0.028

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.98 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---

Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : Yes

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 14
Number of Links: 1

************ Subbasin: 1 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	8.444E-04
5-Year	1.351E-03
10-Year	1.748E-03
25-Year	2.296E-03
50-Year	2.656E-03
100-Year	3.875E-03
200-Year	6.439E-03

************ Subbasin: 2 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	7.111E-04
5-Year	1.138E-03
10-Year	1.472E-03
25-Year	1.933E-03
50-Year	2.236E-03
100-Year	3.263E-03
200-Year	5.423E-03

************ Subbasin: 3,4,5 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.644E-03
5-Year	4.231E-03
10-Year	5.475E-03
25-Year	7.189E-03
50-Year	8.317E-03
100-Year	1.213E-02
200-Year	2.017E-02

************ Subbasin: 6,7 ************

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

Tr (yrs)	Flood Peak (cfs)

2-Year	9.555E-04
5-Year	1.529E-03
10-Year	1.978E-03
25-Year	2.598E-03
50-Year	3.005E-03
100-Year	4.384E-03
200-Year	7.287E-03

************ Subbasin: 8,9 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	7.777E-04
5-Year	1.244E-03
10-Year	1.610E-03
25-Year	2.114E-03
50-Year	2.446E-03
100-Year	3.569E-03
200-Year	5.931E-03

************ Subbasin: 10 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.511E-03
5-Year	4.017E-03
10-Year	5.199E-03
25-Year	6.827E-03
50-Year	7.897E-03
100-Year	1.152E-02
200-Year	1.915E-02

************ Subbasin: 11 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	8.444E-04
5-Year	1.351E-03
10-Year	1.748E-03
25-Year	2.296E-03
50-Year	2.656E-03
100-Year	3.875E-03
200-Year	6.439E-03

************ Subbasin: 12 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	9.333E-04
5-Year	1.493E-03
10-Year	1.932E-03
25-Year	2.537E-03
50-Year	2.935E-03
100-Year	4.282E-03
200-Year	7.117E-03

************ Subbasin: 13 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.200E-03
5-Year	1.920E-03
10-Year	2.484E-03
25-Year	3.262E-03
50-Year	3.774E-03
100-Year	5.506E-03
200-Year	9.151E-03

************ Subbasin: 14 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.889E-04
5-Year	4.622E-04
10-Year	5.981E-04
25-Year	7.854E-04
50-Year	9.085E-04
100-Year	1.326E-03
200-Year	2.203E-03

************ Subbasin: 15 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.689E-03
5-Year	2.702E-03
10-Year	3.496E-03
25-Year	4.591E-03
50-Year	5.311E-03
100-Year	7.749E-03
200-Year	1.288E-02

************ Subbasin: 16 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.444E-03
5-Year	5.511E-03
10-Year	7.131E-03
25-Year	9.364E-03
50-Year	1.083E-02
100-Year	1.580E-02
200-Year	2.627E-02

************ Subbasin: 17 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	4.444E-04
5-Year	7.111E-04
10-Year	9.201E-04
25-Year	1.208E-03
50-Year	1.398E-03
100-Year	2.039E-03
200-Year	3.389E-03

************ Subbasin: 18 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.067E-03
5-Year	3.306E-03
10-Year	4.279E-03
25-Year	5.618E-03
50-Year	6.499E-03
100-Year	9.482E-03
200-Year	1.576E-02

********** Link: New Copy Lnk1 **********   Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.935E-02
5-Year	3.097E-02
10-Year	4.007E-02

25-Year	5.262E-02
50-Year	6.087E-02
100-Year	8.881E-02
200-Year	0.148

----------------------SCENARIO: IMPERVIOUS

Number of Subbasins: 14

Number of Links: 23

************ Subbasin: 1 ************

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.226E-02
5-Year	1.807E-02
10-Year	2.320E-02
25-Year	2.680E-02
50-Year	3.288E-02
100-Year	3.722E-02
200-Year	3.793E-02

************ Subbasin: 2 ************

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.045E-02
5-Year	1.541E-02
10-Year	1.963E-02
25-Year	2.281E-02
50-Year	2.777E-02
100-Year	3.176E-02
200-Year	3.226E-02

************ Subbasin: 3,4,5 ************

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.925E-02
5-Year	5.787E-02
10-Year	7.387E-02
25-Year	8.571E-02
50-Year	0.105
100-Year	0.119
200-Year	0.121

************ Subbasin: 6,7 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.399E-02
5-Year	2.062E-02
10-Year	2.641E-02
25-Year	3.056E-02
50-Year	3.741E-02
100-Year	4.248E-02
200-Year	4.325E-02

************ Subbasin: 8,9 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.128E-02
5-Year	1.663E-02
10-Year	2.105E-02
25-Year	2.459E-02
50-Year	2.975E-02
100-Year	3.428E-02
200-Year	3.475E-02

************ Subbasin: 10 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.794E-02
5-Year	5.593E-02
10-Year	7.137E-02
25-Year	8.283E-02
50-Year	0.101
100-Year	0.115
200-Year	0.117

************ Subbasin: 11 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.260E-02
5-Year	1.857E-02
10-Year	2.355E-02
25-Year	2.747E-02
50-Year	3.329E-02

100-Year	3.828E-02
200-Year	3.882E-02

************ Subbasin: 12 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.391E-02
5-Year	2.051E-02
10-Year	2.605E-02
25-Year	3.034E-02
50-Year	3.684E-02
100-Year	4.227E-02
200-Year	4.290E-02

************ Subbasin: 13 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.828E-02
5-Year	2.694E-02
10-Year	3.426E-02
25-Year	3.987E-02
50-Year	4.846E-02
100-Year	5.552E-02
200-Year	5.637E-02

************ Subbasin: 14 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	5.390E-03
5-Year	7.898E-03
10-Year	9.655E-03
25-Year	1.153E-02
50-Year	1.348E-02
100-Year	1.594E-02
200-Year	1.634E-02

************ Subbasin: 15 ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.527E-02

5-Year	3.725E-02
10-Year	4.746E-02
25-Year	5.515E-02
50-Year	6.716E-02
100-Year	7.676E-02
200-Year	7.799E-02

*********** Subbasin: 16 **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	5.227E-02
5-Year	7.705E-02
10-Year	9.813E-02
25-Year	0.114
50-Year	0.139
100-Year	0.159
200-Year	0.161

*********** Subbasin: 17 **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	6.993E-03
5-Year	1.031E-02
10-Year	1.321E-02
25-Year	1.528E-02
50-Year	1.871E-02
100-Year	2.124E-02
200-Year	2.162E-02

*********** Subbasin: 18 **********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.136E-02
5-Year	4.623E-02
10-Year	5.888E-02
25-Year	6.844E-02
50-Year	8.331E-02
100-Year	9.527E-02
200-Year	9.678E-02

********** Link: POC ********** Link Inflow
Frequency Stats

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.105
5-Year	0.133
10-Year	0.156
25-Year	0.178
50-Year	0.198
100-Year	0.200
200-Year	0.205

********** Link: RS1 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.181E-03
5-Year	6.145E-03
10-Year	1.114E-02
25-Year	1.710E-02
50-Year	1.876E-02
100-Year	2.009E-02
200-Year	2.719E-02

********** Link: RS1 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.112E-03
5-Year	4.023E-03
10-Year	5.237E-03
25-Year	7.218E-03
50-Year	7.954E-03
100-Year	8.310E-03
200-Year	9.032E-03

********** Link: RS1 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.011
1.11-Year	100.011
1.25-Year	100.012
2.00-Year	100.015

3.33-Year	100.021
5-Year	100.025
10-Year	100.043
25-Year	100.060
50-Year	100.099
100-Year	100.108

********** Link: RG1 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.226E-02
5-Year	1.807E-02
10-Year	2.320E-02
25-Year	2.680E-02
50-Year	3.288E-02
100-Year	3.722E-02
200-Year	3.793E-02

********** Link: RG1 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.181E-03
5-Year	6.145E-03
10-Year	1.114E-02
25-Year	1.710E-02
50-Year	1.876E-02
100-Year	2.009E-02
200-Year	2.719E-02

********** Link: RG1 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.109
1.11-Year	100.150
1.25-Year	100.180
2.00-Year	100.283
3.33-Year	100.371
5-Year	100.426
10-Year	100.502
25-Year	100.504
50-Year	100.504

100-Year 100.505

********** Link: RS2 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.061E-03
5-Year	1.005E-02
10-Year	1.372E-02
25-Year	2.022E-02
50-Year	2.398E-02
100-Year	2.562E-02
200-Year	2.571E-02

********** Link: RS2 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.493E-03
5-Year	4.586E-03
10-Year	5.711E-03
25-Year	6.967E-03
50-Year	7.742E-03
100-Year	7.907E-03
200-Year	8.195E-03

********** Link: RS2 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.009
1.11-Year	100.009
1.25-Year	100.010
2.00-Year	100.012
3.33-Year	100.022
5-Year	100.033
10-Year	100.052
25-Year	100.071
50-Year	100.096
100-Year	100.100

********** Link: RG2 ********** Link Inflow

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.045E-02
5-Year	1.541E-02
10-Year	1.963E-02
25-Year	2.281E-02
50-Year	2.777E-02
100-Year	3.176E-02
200-Year	3.226E-02

********** Link: RG2 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.061E-03
5-Year	1.005E-02
10-Year	1.372E-02
25-Year	2.022E-02
50-Year	2.398E-02
100-Year	2.562E-02
200-Year	2.571E-02

********** Link: RG2 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.256
1.11-Year	100.286
1.25-Year	100.340
2.00-Year	100.476
3.33-Year	100.502
5-Year	100.502
10-Year	100.503
25-Year	100.506
50-Year	100.507
100-Year	100.508

********** Link: RS3,4,5 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) Flood Peak (cfs)
=======================================

2-Year	3.690E-02
5-Year	5.488E-02
10-Year	7.220E-02
25-Year	8.481E-02
50-Year	9.328E-02
100-Year	0.109
200-Year	0.120

********** Link: RS3,4,5 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.152E-02
5-Year	1.470E-02
10-Year	1.648E-02
25-Year	1.836E-02
50-Year	1.948E-02
100-Year	2.135E-02
200-Year	2.250E-02

********** Link: RS3,4,5 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.075
1.11-Year	100.096
1.25-Year	100.127
2.00-Year	100.208
3.33-Year	100.285
5-Year	100.337
10-Year	100.421
25-Year	100.516
50-Year	100.590
100-Year	100.710

********** Link: RG3,4,5 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.925E-02
5-Year	5.787E-02
10-Year	7.387E-02
25-Year	8.571E-02
50-Year	0.105

100-Year	0.119
200-Year	0.121

********** Link: RG3,4,5 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.690E-02
5-Year	5.488E-02
10-Year	7.220E-02
25-Year	8.481E-02
50-Year	9.328E-02
100-Year	0.109
200-Year	0.120

********** Link: RG3,4,5 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.504
1.11-Year	100.505
1.25-Year	100.507
2.00-Year	100.511
3.33-Year	100.514
5-Year	100.517
10-Year	100.521
25-Year	100.523
50-Year	100.525
100-Year	100.528

********** Link: RS6,7 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.078E-02
5-Year	1.639E-02
10-Year	2.080E-02
25-Year	2.792E-02
50-Year	3.342E-02
100-Year	3.925E-02
200-Year	4.335E-02

********** Link: RS6,7 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.610E-03
5-Year	6.671E-03
10-Year	7.862E-03
25-Year	9.304E-03
50-Year	1.028E-02
100-Year	1.050E-02
200-Year	1.088E-02

********** Link: RS6,7 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.009
1.11-Year	100.010
1.25-Year	100.011
2.00-Year	100.034
3.33-Year	100.055
5-Year	100.071
10-Year	100.097
25-Year	100.125
50-Year	100.165
100-Year	100.173

********** Link: RG 6,7 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.399E-02
5-Year	2.062E-02
10-Year	2.641E-02
25-Year	3.056E-02
50-Year	3.741E-02
100-Year	4.248E-02
200-Year	4.325E-02

********** Link: RG 6,7 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.078E-02
5-Year	1.639E-02
10-Year	2.080E-02
25-Year	2.792E-02
50-Year	3.342E-02
100-Year	3.925E-02
200-Year	4.335E-02

********** Link: RG 6,7 ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.380
1.11-Year	100.424
1.25-Year	100.485
2.00-Year	100.502
3.33-Year	100.504
5-Year	100.504
10-Year	100.506
25-Year	100.508
50-Year	100.510
100-Year	100.512

********** Link: RS8,9 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.867E-03
5-Year	5.771E-03
10-Year	8.742E-03
25-Year	1.487E-02
50-Year	1.579E-02
100-Year	1.707E-02
200-Year	2.282E-02

********** Link: RS8,9 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.662E-03
5-Year	3.280E-03
10-Year	3.985E-03

25-Year	5.940E-03
50-Year	6.460E-03
100-Year	6.899E-03
200-Year	7.615E-03

********** Link: RS8,9 ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.009
1.11-Year	100.010
1.25-Year	100.010
2.00-Year	100.012
3.33-Year	100.014
5-Year	100.017
10-Year	100.025
25-Year	100.039
50-Year	100.067
100-Year	100.076

********** Link: RG8,9 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.128E-02
5-Year	1.663E-02
10-Year	2.105E-02
25-Year	2.459E-02
50-Year	2.975E-02
100-Year	3.428E-02
200-Year	3.475E-02

********** Link: RG8,9 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.867E-03
5-Year	5.771E-03
10-Year	8.742E-03
25-Year	1.487E-02
50-Year	1.579E-02
100-Year	1.707E-02
200-Year	2.282E-02

********** Link: RG8,9 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.100
1.11-Year	100.136
1.25-Year	100.164
2.00-Year	100.257
3.33-Year	100.345
5-Year	100.397
10-Year	100.500
25-Year	100.503
50-Year	100.503
100-Year	100.504

********** Link: RS10 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.794E-02
5-Year	5.593E-02
10-Year	7.137E-02
25-Year	8.283E-02
50-Year	0.101
100-Year	0.115
200-Year	0.117

********** Link: RS10 ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.350E-02
5-Year	1.636E-02
10-Year	1.891E-02
25-Year	2.077E-02
50-Year	2.198E-02
100-Year	2.298E-02
200-Year	2.431E-02

********** Link: RS10 ********** Link WSEL Stats
WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   WSEL Peak (ft)
======================================

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.144
1.11-Year	100.162
1.25-Year	100.188
2.00-Year	100.284
3.33-Year	100.358
5-Year	100.417
10-Year	100.558
25-Year	100.619
50-Year	100.752
100-Year	100.822

********** Link: RS11 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   Flood Peak (cfs)
======================================

Tr (yrs)	Flood Peak (cfs)
2-Year	1.163E-02
5-Year	1.762E-02
10-Year	2.237E-02
25-Year	2.721E-02
50-Year	2.994E-02
100-Year	3.473E-02
200-Year	3.846E-02

********** Link: RS11 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   Flood Peak (cfs)
======================================

Tr (yrs)	Flood Peak (cfs)
2-Year	5.969E-03
5-Year	7.704E-03
10-Year	9.155E-03
25-Year	1.078E-02
50-Year	1.170E-02
100-Year	1.194E-02
200-Year	1.203E-02

********** Link: RS11 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   WSEL Peak (ft)
======================================

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.017
1.11-Year	100.021

1.25-Year	100.032
2.00-Year	100.056
3.33-Year	100.084
5-Year	100.095
10-Year	100.132
25-Year	100.166
50-Year	100.214
100-Year	100.223

********** Link: RG11 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.260E-02
5-Year	1.857E-02
10-Year	2.355E-02
25-Year	2.747E-02
50-Year	3.329E-02
100-Year	3.828E-02
200-Year	3.882E-02

********** Link: RG11 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.163E-02
5-Year	1.762E-02
10-Year	2.237E-02
25-Year	2.721E-02
50-Year	2.994E-02
100-Year	3.473E-02
200-Year	3.846E-02

********** Link: RG11 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.501
1.11-Year	100.501
1.25-Year	100.502
2.00-Year	100.503
3.33-Year	100.504
5-Year	100.505
10-Year	100.507

25-Year	100.509
50-Year	100.510
100-Year	100.511

********** Link: RS12 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.158E-02
5-Year	1.803E-02
10-Year	2.241E-02
25-Year	2.831E-02
50-Year	3.295E-02
100-Year	3.868E-02
200-Year	4.281E-02

********** Link: RS12 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.857E-03
5-Year	9.291E-03
10-Year	1.046E-02
25-Year	1.300E-02
50-Year	1.402E-02
100-Year	1.423E-02
200-Year	1.433E-02

********** Link: RS12 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.012
1.11-Year	100.014
1.25-Year	100.030
2.00-Year	100.075
3.33-Year	100.115
5-Year	100.135
10-Year	100.169
25-Year	100.245
50-Year	100.306
100-Year	100.316

********** Link: RG12 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.391E-02
5-Year	2.051E-02
10-Year	2.605E-02
25-Year	3.034E-02
50-Year	3.684E-02
100-Year	4.227E-02
200-Year	4.290E-02

********** Link: RG12 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.158E-02
5-Year	1.803E-02
10-Year	2.241E-02
25-Year	2.831E-02
50-Year	3.295E-02
100-Year	3.868E-02
200-Year	4.281E-02

********** Link: RG12 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.440
1.11-Year	100.491
1.25-Year	100.501
2.00-Year	100.503
3.33-Year	100.504
5-Year	100.505
10-Year	100.507
25-Year	100.508
50-Year	100.510
100-Year	100.512

********** Link: RS13 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs) Flood Peak (cfs)
=======================================

2-Year	1.828E-02
5-Year	2.694E-02
10-Year	3.426E-02
25-Year	3.987E-02
50-Year	4.846E-02
100-Year	5.552E-02
200-Year	5.637E-02

********** Link: RS13 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.121E-02
5-Year	1.354E-02
10-Year	1.537E-02
25-Year	1.736E-02
50-Year	1.947E-02
100-Year	1.998E-02
200-Year	2.053E-02

********** Link: RS13 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.085
1.11-Year	100.098
1.25-Year	100.120
2.00-Year	100.196
3.33-Year	100.242
5-Year	100.286
10-Year	100.368
25-Year	100.447
50-Year	100.590
100-Year	100.622

********** Link: RS14 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.390E-03
5-Year	7.898E-03
10-Year	9.655E-03

25-Year	1.153E-02
50-Year	1.348E-02
100-Year	1.594E-02
200-Year	1.634E-02

********** Link: RS14 ********** Link Outflow 1

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.827E-03
5-Year	5.065E-03
10-Year	5.825E-03
25-Year	6.367E-03
50-Year	7.259E-03
100-Year	7.903E-03
200-Year	8.399E-03

********** Link: RS14 ********** Link WSEL

Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.011
1.11-Year	100.013
1.25-Year	100.015
2.00-Year	100.023
3.33-Year	100.032
5-Year	100.041
10-Year	100.053
25-Year	100.061
50-Year	100.084
100-Year	100.098

********** Link: RS15 ********** Link Inflow

Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.496E-02
5-Year	3.704E-02
10-Year	4.835E-02
25-Year	5.570E-02
50-Year	6.786E-02
100-Year	7.824E-02
200-Year	7.943E-02

********** Link: RS15 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.308E-02
5-Year	1.604E-02
10-Year	1.783E-02
25-Year	2.092E-02
50-Year	2.311E-02
100-Year	2.337E-02
200-Year	2.344E-02

********** Link: RS15 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.110
1.11-Year	100.137
1.25-Year	100.165
2.00-Year	100.267
3.33-Year	100.350
5-Year	100.400
10-Year	100.494
25-Year	100.636
50-Year	100.831
100-Year	100.850

********** Link: RG15 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.527E-02
5-Year	3.725E-02
10-Year	4.746E-02
25-Year	5.515E-02
50-Year	6.716E-02
100-Year	7.676E-02
200-Year	7.799E-02

********** Link: RG15 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   Flood Peak (cfs)
=====================================
2-Year   2.496E-02
5-Year   3.704E-02
10-Year   4.835E-02
25-Year   5.570E-02
50-Year   6.786E-02
100-Year   7.824E-02
200-Year   7.943E-02

********** Link: RG15   **********   Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   WSEL Peak (ft)
=====================================
1.05-Year   100.504
1.11-Year   100.505
1.25-Year   100.506
2.00-Year   100.508
3.33-Year   100.510
5-Year   100.512
10-Year   100.516
25-Year   100.518
50-Year   100.521
100-Year   100.523

********** Link: RS16   **********   Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   Flood Peak (cfs)
=====================================
2-Year   5.227E-02
5-Year   7.705E-02
10-Year   9.813E-02
25-Year   0.114
50-Year   0.139
100-Year   0.159
200-Year   0.161

********** Link: RS16   **********   Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)   Flood Peak (cfs)
=====================================
2-Year   1.670E-02
5-Year   2.042E-02

10-Year	2.278E-02
25-Year	2.556E-02
50-Year	2.616E-02
100-Year	2.817E-02
200-Year	2.975E-02

********** Link: RS16 ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.218
1.11-Year	100.246
1.25-Year	100.292
2.00-Year	100.434
3.33-Year	100.544
5-Year	100.649
10-Year	100.806
25-Year	100.988
50-Year	101.065
100-Year	101.235

********** Link: RS17 ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.993E-03
5-Year	1.031E-02
10-Year	1.321E-02
25-Year	1.528E-02
50-Year	1.871E-02
100-Year	2.124E-02
200-Year	2.162E-02

********** Link: RS17 ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.882E-03
5-Year	5.025E-03
10-Year	5.937E-03
25-Year	6.423E-03
50-Year	7.476E-03
100-Year	8.049E-03
200-Year	8.105E-03

********** Link: RS17 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.011
1.11-Year	100.012
1.25-Year	100.015
2.00-Year	100.024
3.33-Year	100.033
5-Year	100.040
10-Year	100.056
25-Year	100.063
50-Year	100.089
100-Year	100.101

********** Link: RS18 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.136E-02
5-Year	4.623E-02
10-Year	5.888E-02
25-Year	6.844E-02
50-Year	8.331E-02
100-Year	9.527E-02
200-Year	9.678E-02

********** Link: RS18 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.109E-02
5-Year	1.363E-02
10-Year	1.564E-02
25-Year	1.741E-02
50-Year	1.866E-02
100-Year	1.916E-02
200-Year	2.029E-02

********** Link: RS18 ********** Link WSEL
Stats

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

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.096
1.11-Year	100.113
1.25-Year	100.129
2.00-Year	100.192
3.33-Year	100.251
5-Year	100.290
10-Year	100.382
25-Year	100.426
50-Year	100.542
100-Year	100.572

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: 1	6.204
Subbasin: 2	5.225
Subbasin: 3,4,5	19.430
Subbasin: 6,7	7.021
Subbasin: 8,9	5.715
Subbasin: 10	18.450
Subbasin: 11	6.204
Subbasin: 12	6.857
Subbasin: 13	8.817
Subbasin: 14	2.123
Subbasin: 15	12.409
Subbasin: 16	25.307
Subbasin: 17	3.265
Subbasin: 18	15.184
Link: New Copy Lnk1	Not Applicable
Total:	142.211

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: 1	1.048
Subbasin: 2	0.815
Subbasin: 3,4,5	3.143
Subbasin: 6,7	1.164
Subbasin: 8,9	0.815
Subbasin: 10	3.027
Subbasin: 11	0.931
Subbasin: 12	1.048
Subbasin: 13	1.397
Subbasin: 14	0.000
Subbasin: 15	1.979
Subbasin: 16	4.074

Subbasin: 17		0.582
Subbasin: 18		2.445
Link:	POC	Not Applicable
Link:	RS1	5.734
Link:	RG1	0.000
Link:	RS2	4.623
Link:	RG2	0.000
Link:	RS3,4,5	20.262
Link:	RG3,4,5	0.000
Link:	RS6,7	6.409
Link:	RG 6,7	0.000
Link:	RS8,9	5.927
Link:	RG8,9	0.000
Link:	RS10	14.416
Link:	RS11	3.787
Link:	RG11	0.000
Link:	RS12	3.311
Link:	RG12	0.000
Link:	RS13	3.113
Link:	RS14	0.930
Link:	RS15	5.426
Link:	RG15	0.000
Link:	RS16	19.420
Link:	RS17	2.242
Link:	RS18	12.969

Total: 131.037

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.900 ac-ft/year, Post Developed: 0.829 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 1

---------------------SCENARIO: IMPERVIOUS

Number of Links: 23

********** Link: RS1 **********

Basic Wet Pond Volume (91% Exceedance): 148. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 222. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.32
Total Runoff Infiltrated (ac-ft): 5.73, 40.05%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 40.05%

********** Link: RG1 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.30
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 14.30, 100.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

********** Link: RS2 **********

Basic Wet Pond Volume (91% Exceedance): 125. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 188. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 12.00
Total Runoff Infiltrated (ac-ft): 4.62, 38.51%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 38.51%

********** Link: RG2 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 11.92
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 11.92, 100.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

********** Link: RS3,4,5 **********

Basic Wet Pond Volume (91% Exceedance): 456. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 684. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 44.66
Total Runoff Infiltrated (ac-ft): 20.26, 45.37%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 45.37%

********** Link: RG3,4,5 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 44.14
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 42.17, 95.54%
Percent Treated (Infiltrated+Filtered)/Total Volume: 95.54%

********** Link: RS6,7 **********

Basic Wet Pond Volume (91% Exceedance): 167. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 250. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 16.07

Total Runoff Infiltrated (ac-ft): 6.41, 39.89%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 39.89%

********** Link: RG 6,7 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 15.91
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 15.88, 99.80%
Percent Treated (Infiltrated+Filtered)/Total Volume: 99.80%

********** Link: RS8,9 **********

Basic Wet Pond Volume (91% Exceedance): 136. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 205. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 13.07
Total Runoff Infiltrated (ac-ft): 5.93, 45.36%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 45.36%

********** Link: RG8,9 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 13.05
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 13.05, 100.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

********** Link: RS10 **********

Basic Wet Pond Volume (91% Exceedance): 433. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 649. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 41.84
Total Runoff Infiltrated (ac-ft): 14.42, 34.45%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 34.45%

********** Link: RS11 **********

Basic Wet Pond Volume (91% Exceedance): 146. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 219. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.20
Total Runoff Infiltrated (ac-ft): 3.79, 26.68%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 26.68%

********** Link: RG11 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.10
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 13.68, 97.01%
Percent Treated (Infiltrated+Filtered)/Total Volume: 97.01%

********** Link: RS12 **********

Basic Wet Pond Volume (91% Exceedance): 163. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 244. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 15.85
Total Runoff Infiltrated (ac-ft): 3.31, 20.90%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 20.90%

********** Link: RG12 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 15.67
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 15.55, 99.19%
Percent Treated (Infiltrated+Filtered)/Total Volume: 99.19%

********** Link: RS13 **********

Basic Wet Pond Volume (91% Exceedance): 208. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 313. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 20.10
Total Runoff Infiltrated (ac-ft): 3.11, 15.49%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 15.49%

********** Link: RS14 **********

Basic Wet Pond Volume (91% Exceedance): 60. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 91. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 5.52
Total Runoff Infiltrated (ac-ft): 0.93, 16.85%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 16.85%

********** Link: RS15 **********

Basic Wet Pond Volume (91% Exceedance): 292. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 438. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 28.38
Total Runoff Infiltrated (ac-ft): 5.43, 19.12%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 19.12%

********** Link: RG15 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 28.21
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 24.67, 87.45%
Percent Treated (Infiltrated+Filtered)/Total Volume: 87.45%

********** Link: RS16 **********

Basic Wet Pond Volume (91% Exceedance): 596. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 894. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 57.55
Total Runoff Infiltrated (ac-ft): 19.42, 33.74%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 33.74%

********** Link: RS17 **********

Basic Wet Pond Volume (91% Exceedance): 80. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 120. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 7.74
Total Runoff Infiltrated (ac-ft): 2.24, 28.98%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 28.98%

********** Link: RS18 **********

Basic Wet Pond Volume (91% Exceedance): 358. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 536. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 34.53
Total Runoff Infiltrated (ac-ft): 12.97, 37.56%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 37.56%

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

Scenario Basin Area Compliance Link: New Copy Lnk1

Scenario Impervious Compliance Link: POC

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.935E-02	2-Year	0.105
5-Year	3.097E-02	5-Year	0.133
10-Year	4.007E-02	10-Year	0.156
25-Year	5.262E-02	25-Year	0.178
50-Year	6.087E-02	50-Year	0.198
100-Year	8.881E-02	100-Year	0.200
200-Year	0.148	200-Year	0.205

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

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

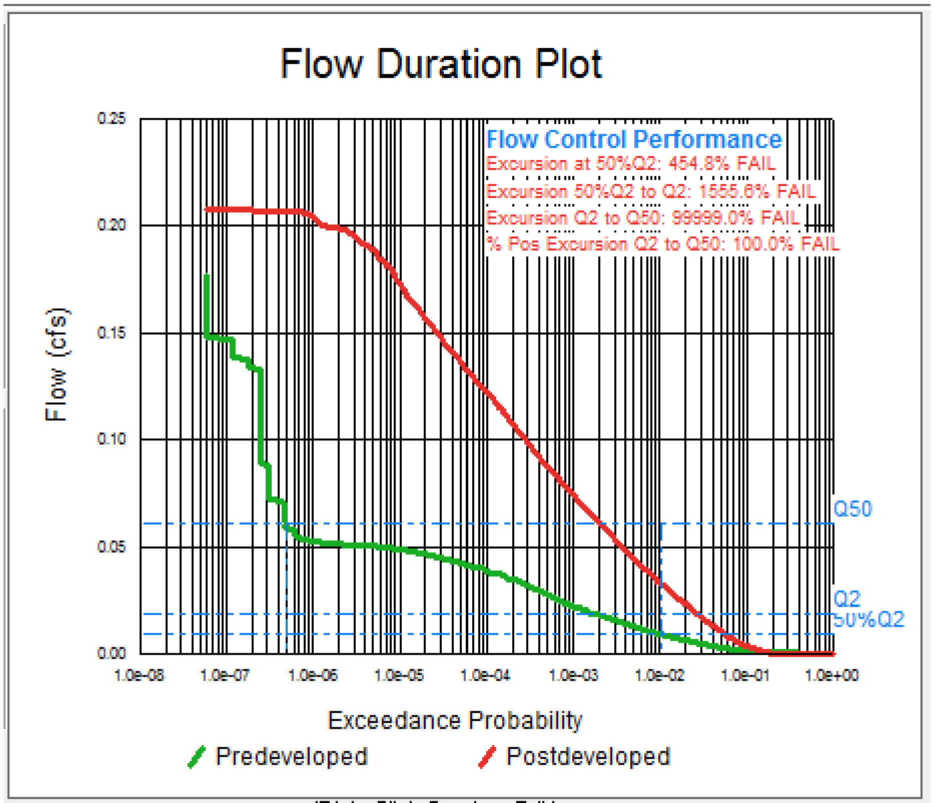
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 454.8% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 1555.6% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 100.0% FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 50.6% FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 454.8% FAIL

LID DURATION DESIGN CRITERIA: FAIL


Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: 454.8% FAIL
Excursion 50%Q2 to Q2: 1555.6% FAIL
Excursion Q2 to Q50: 99999.0% FAIL
% Pos Excursion Q2 to Q50: 100.0% FAIL
Flow (cfs)
0.25
0.20
0.15
0.10
0.05
0.00
Q50
Q2
50%Q2
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:02 PM
Report Generation Date: 08/27/2015 3:04 PM

Input File Name:	2015-09-02 Facility 2 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 2 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 2 for a forested basin of 1375

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.032
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.032

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.032ac Basin ----------

-------Area(Acres) --------	
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.007
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.024
Subbasin Total	0.031

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.84
Max Pond Elevation (ft) : 103.03
Storage Depth (ft) : 2.84
Pond Bottom Length (ft) : 33.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 333.
Area at Riser Crest El (sq-ft) : 333.

(acres) : 0.008
Volume at Riser Crest (cu-ft) : 946.
(ac-ft) : 0.022
Area at Max Elevation (sq-ft) : 333.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 1,042.
(ac-ft) : 0.024

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.84 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: Total Length x Avg W of Raingardens
Link Type: Bioretention Facility
Downstream Link Name: Rainstore3 L x W x Avg H

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 8.3
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 42.
Area at Riser Crest El (sq-ft) : 91.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 45.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: 0.032ac Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.045E-02
5-Year	1.541E-02
10-Year	1.963E-02
25-Year	2.281E-02
50-Year	2.777E-02
100-Year	3.176E-02
200-Year	3.226E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.483E-06
5-Year	2.843E-06
10-Year	3.667E-06
25-Year	5.461E-06
50-Year	5.860E-06
100-Year	6.086E-06
200-Year	7.158E-06

********** Link: Rainstore3 L x W x Avg H ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.063E-03

5-Year	1.005E-02
10-Year	1.369E-02
25-Year	2.022E-02
50-Year	2.398E-02
100-Year	2.562E-02
200-Year	2.571E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.483E-06
5-Year	2.843E-06
10-Year	3.667E-06
25-Year	5.461E-06
50-Year	5.860E-06
100-Year	6.086E-06
200-Year	7.158E-06

********** Link: Rainstore3 L x W x Avg H ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.049
1.11-Year	100.062
1.25-Year	100.084
2.00-Year	100.148
3.33-Year	100.203
5-Year	100.284
10-Year	100.366
25-Year	100.523
50-Year	100.586
100-Year	100.609

********** Link: Total Length x Avg W of Raingardens ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.045E-02
5-Year	1.541E-02
10-Year	1.963E-02
25-Year	2.281E-02
50-Year	2.777E-02
100-Year	3.176E-02

200-Year	3.226E-02

********** Link: Total Length x Avg W of Raingardens ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.063E-03
5-Year	1.005E-02
10-Year	1.369E-02
25-Year	2.022E-02
50-Year	2.398E-02
100-Year	2.562E-02
200-Year	2.571E-02

********** Link: Total Length x Avg W of Raingardens ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.254
1.11-Year	100.284
1.25-Year	100.338
2.00-Year	100.473
3.33-Year	100.502
5-Year	100.502
10-Year	100.503
25-Year	100.506
50-Year	100.507
100-Year	100.508

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	5.225
Total:	5.225

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: 0.032ac Basin	0.815	
Link: New Copy Lnk2		Not Applicable
Link: Rainstore3 L x W x A	11.741	
Link: Total Length x Avg W	0.000	

Total:	12.556

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.033 ac-ft/year, Post Developed: 0.079 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

********** Link: Rainstore3 L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 125. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 188. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 20.17

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 12.00
Total Runoff Infiltrated (ac-ft): 11.74, 97.81%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 97.81%

********** Link: Total Length x Avg W of Raingardens **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 11.92
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 11.92, 100.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	7.111E-04	2-Year	1.483E-06
5-Year	1.138E-03	5-Year	2.843E-06

10-Year	1.472E-03	10-Year	3.667E-06
25-Year	1.933E-03	25-Year	5.461E-06
50-Year	2.236E-03	50-Year	5.860E-06
100-Year	3.263E-03	100-Year	6.086E-06
200-Year	5.423E-03	200-Year	7.158E-06

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

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

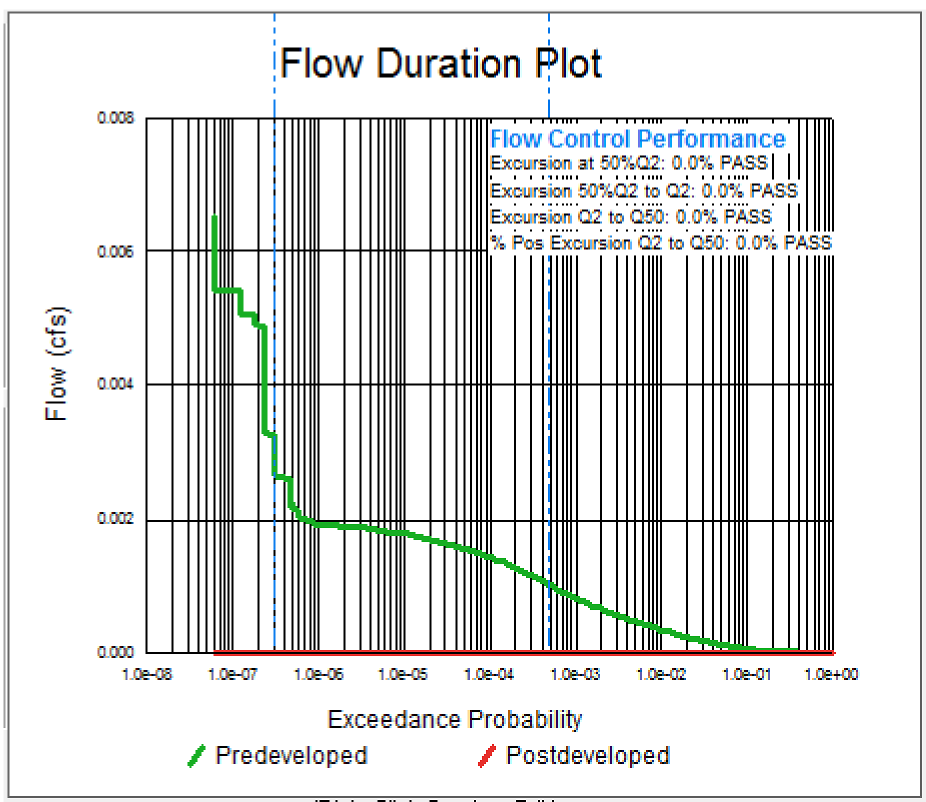
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	0.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:08 PM
Report Generation Date: 08/27/2015 3:08 PM

Input File Name:	2015-09-02 Facility 3 4 5 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 3 4 5 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 3 4 5 for a forested basin of 5223 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.119
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.119

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.119ac Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.027
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.090
Subbasin Total	0.117

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

---------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.57
Max Pond Elevation (ft) : 102.74
Storage Depth (ft) : 2.57
Pond Bottom Length (ft) : 46.7
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 467.

Area at Riser Crest El (sq-ft) : 467.
(acres) : 0.011
Volume at Riser Crest (cu-ft) : 1,200.
(ac-ft) : 0.028
Area at Max Elevation (sq-ft) : 467.
(acres) : 0.011
Vol at Max Elevation (cu-ft) : 1,326.
(ac-ft) : 0.030

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.57 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: Total Length x Avg W of Raingardens
Link Type: Bioretention Facility
Downstream Link Name: L x W x Avg H

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 15.2
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 76.
Area at Riser Crest El (sq-ft) : 145.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 70.
(ac-ft) : 0.002

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.00
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000

Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	19.430
Total:	19.430

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: 0.119ac Basin		3.143
Link:	New Copy Lnk2	Not Applicable
Link:	L x W x Avg H	Not Computed
Link:	Total Length x Avg W	Not Computed
Total:		3.143

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.123 ac-ft/year, Post Developed: 0.020 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	2.644E-03	2-Year	1.046E-05
5-Year	4.231E-03	5-Year	1.569E-05
10-Year	5.475E-03	10-Year	2.188E-05
25-Year	7.189E-03	25-Year	6.938E-03
50-Year	8.317E-03	50-Year	1.441E-02
100-Year	1.213E-02	100-Year	3.002E-02
200-Year	2.017E-02	200-Year	3.558E-02

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

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

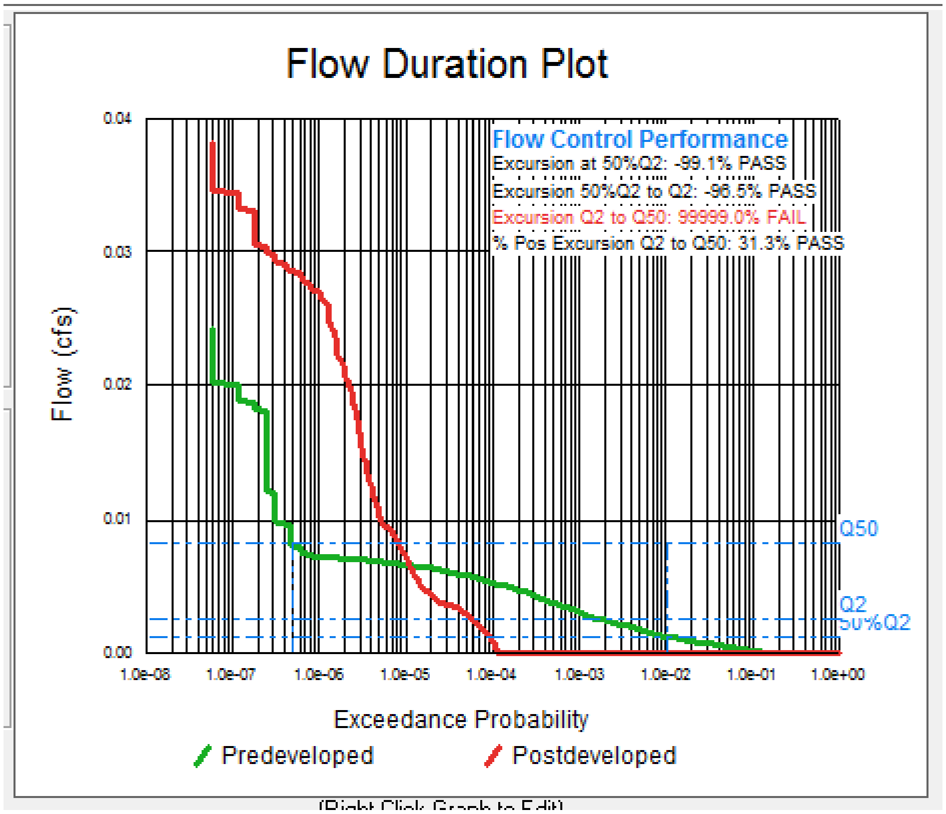
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-99.1%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-96.5%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	31.3%	PASS

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-99.9%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-99.1%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: -99.1% PASS
Excursion 50%Q2 to Q2: -96.5% PASS
Excursion Q2 to Q50: 99999.0% FAIL
% Pos Excursion Q2 to Q50: 31.3% PASS
Flow (cfs)
0.04
0.03
0.02
0.01
0.00
Q50
Q2
50%Q2
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:10 PM
Report Generation Date: 08/27/2015 3:11 PM

Input File Name:	2015-09-02 Facility 6 7 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 6 7 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 6 7 for a forested basin of 1890

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.043
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.043

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.043ac Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.010
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.032
Subbasin Total	0.042

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.57
Max Pond Elevation (ft) : 102.73
Storage Depth (ft) : 2.57
Pond Bottom Length (ft) : 33.3
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 333.
Area at Riser Crest El (sq-ft) : 333.

(acres) : 0.008
Volume at Riser Crest (cu-ft) : 856.
(ac-ft) : 0.020
Area at Max Elevation (sq-ft) : 333.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 942.
(ac-ft) : 0.022

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.57 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: Total Length x Avg W of Raingardens
Link Type: Bioretention Facility
Downstream Link Name: Rainstore L x W x Avg H

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 8.4
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 42.
Area at Riser Crest El (sq-ft) : 91.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 45.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: 0.043ac Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.399E-02
5-Year	2.062E-02
10-Year	2.641E-02
25-Year	3.056E-02
50-Year	3.741E-02
100-Year	4.248E-02
200-Year	4.325E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.687E-06
5-Year	4.840E-06
10-Year	6.522E-06
25-Year	8.689E-06
50-Year	1.033E-05
100-Year	1.176E-05
200-Year	1.192E-05

********** Link: Rainstore L x W x Avg H ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.078E-02

5-Year	1.639E-02
10-Year	2.081E-02
25-Year	2.793E-02
50-Year	3.342E-02
100-Year	3.925E-02
200-Year	4.335E-02

********** Link: Rainstore L x W x Avg H ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.687E-06
5-Year	4.840E-06
10-Year	6.522E-06
25-Year	8.689E-06
50-Year	1.033E-05
100-Year	1.176E-05
200-Year	1.192E-05

********** Link: Rainstore L x W x Avg H ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.100
1.11-Year	100.126
1.25-Year	100.167
2.00-Year	100.269
3.33-Year	100.374
5-Year	100.484
10-Year	100.654
25-Year	100.833
50-Year	101.033
100-Year	101.176

********** Link: Total Length x Avg W of Raingardens ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.399E-02
5-Year	2.062E-02
10-Year	2.641E-02
25-Year	3.056E-02
50-Year	3.741E-02
100-Year	4.248E-02

200-Year	4.325E-02

********** Link: Total Length x Avg W of Raingardens ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.078E-02
5-Year	1.639E-02
10-Year	2.081E-02
25-Year	2.793E-02
50-Year	3.342E-02
100-Year	3.925E-02
200-Year	4.335E-02

********** Link: Total Length x Avg W of Raingardens ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.379
1.11-Year	100.423
1.25-Year	100.484
2.00-Year	100.502
3.33-Year	100.504
5-Year	100.504
10-Year	100.506
25-Year	100.508
50-Year	100.510
100-Year	100.512

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	7.021
Total:	7.021

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin:	0.043ac Basin	1.164
Link:	New Copy Lnk2	Not Applicable
Link:	Rainstore L x W x Av	15.592
Link:	Total Length x Avg W	0.000

Total: 16.757

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.044 ac-ft/year, Post Developed: 0.106 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

********** Link: Rainstore L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 167. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 251. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 25.50

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 16.07
Total Runoff Infiltrated (ac-ft): 15.59, 97.05%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 97.05%

********** Link: Total Length x Avg W of Raingardens **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 15.91
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 15.88, 99.81%
Percent Treated (Infiltrated+Filtered)/Total Volume: 99.81%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	9.555E-04	2-Year	2.687E-06
5-Year	1.529E-03	5-Year	4.840E-06

10-Year	1.978E-03	10-Year	6.522E-06
25-Year	2.598E-03	25-Year	8.689E-06
50-Year	3.005E-03	50-Year	1.033E-05
100-Year	4.384E-03	100-Year	1.176E-05
200-Year	7.287E-03	200-Year	1.192E-05

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

**** Flow Duration Performance ****

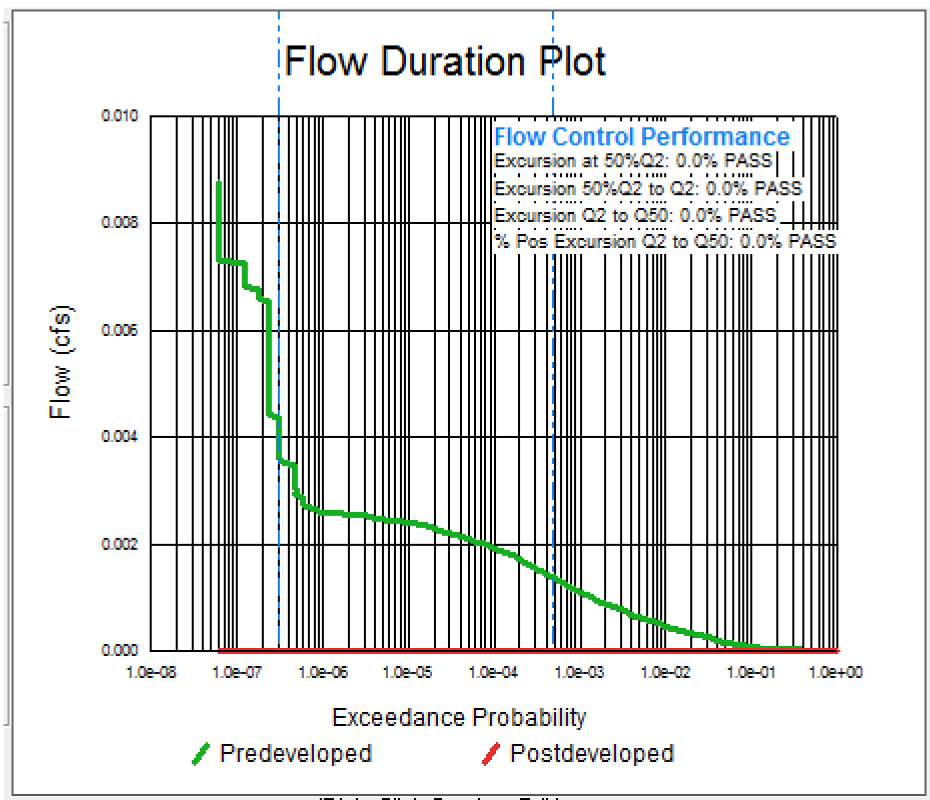
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 0.0% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 0.0% PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 0.0% PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%): 0.0% PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

**** LID Duration Performance ****

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 0.0% PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 0.0% PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:12 PM
Report Generation Date: 08/27/2015 3:13 PM

Input File Name:	2015-09-02 Facility 8 9 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 8 9 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 8 9 for a forested basin of 1545

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.035
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.035

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.035ac Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.007
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.026
Subbasin Total	0.033

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.74
Max Pond Elevation (ft)	:	102.91
Storage Depth (ft)	:	2.74
Pond Bottom Length (ft)	:	40.0
Pond Bottom Width (ft)	:	10.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	400.
Area at Riser Crest El (sq-ft)	:	400.

(acres) : 0.009
Volume at Riser Crest (cu-ft) : 1,096.
(ac-ft) : 0.025
Area at Max Elevation (sq-ft) : 400.
(acres) : 0.009
Vol at Max Elevation (cu-ft) : 1,204.
(ac-ft) : 0.028

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.74 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: Total Length x Avg W of Raingardens
Link Type: Bioretention Facility
Downstream Link Name: Rainstore3 L x W x Avg H

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 14.5
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 72.
Area at Riser Crest El (sq-ft) : 140.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 67.
(ac-ft) : 0.002

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.00
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: 0.035ac Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.128E-02
5-Year	1.663E-02
10-Year	2.105E-02
25-Year	2.459E-02
50-Year	2.975E-02
100-Year	3.428E-02
200-Year	3.475E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.354E-06
5-Year	2.438E-06
10-Year	3.127E-06
25-Year	4.580E-06
50-Year	4.815E-06
100-Year	5.073E-06
200-Year	6.109E-06

********** Link: Rainstore3 L x W x Avg H ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.866E-03

5-Year	5.770E-03
10-Year	8.744E-03
25-Year	1.487E-02
50-Year	1.579E-02
100-Year	1.705E-02
200-Year	2.256E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.354E-06
5-Year	2.438E-06
10-Year	3.127E-06
25-Year	4.580E-06
50-Year	4.815E-06
100-Year	5.073E-06
200-Year	6.109E-06

********** Link: Rainstore3 L x W x Avg H ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.051
1.11-Year	100.065
1.25-Year	100.080
2.00-Year	100.136
3.33-Year	100.179
5-Year	100.244
10-Year	100.313
25-Year	100.402
50-Year	100.482
100-Year	100.507

********** Link: Total Length x Avg W of Raingardens ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.128E-02
5-Year	1.663E-02
10-Year	2.105E-02
25-Year	2.459E-02
50-Year	2.975E-02
100-Year	3.428E-02

200-Year	3.475E-02

********** Link: Total Length x Avg W of Raingardens ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.866E-03
5-Year	5.770E-03
10-Year	8.744E-03
25-Year	1.487E-02
50-Year	1.579E-02
100-Year	1.705E-02
200-Year	2.256E-02

********** Link: Total Length x Avg W of Raingardens ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.100
1.11-Year	100.135
1.25-Year	100.164
2.00-Year	100.258
3.33-Year	100.345
5-Year	100.397
10-Year	100.500
25-Year	100.503
50-Year	100.504
100-Year	100.504

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	5.715
Total:	5.715

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin:	0.035ac Basin	0.815
Link:	New Copy Lnk2	Not Applicable
Link:	Rainstore3 L x W x A	12.787
Link:	Total Length x Avg W	0.000

Total: 13.602

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.036 ac-ft/year, Post Developed: 0.086 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

********** Link: Rainstore3 L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 136. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 205. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 18.06

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 13.07
Total Runoff Infiltrated (ac-ft): 12.79, 97.84%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 97.84%

********** Link: Total Length x Avg W of Raingardens **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 13.05
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 13.05, 100.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	7.777E-04	2-Year	1.354E-06
5-Year	1.244E-03	5-Year	2.438E-06

10-Year	1.610E-03	10-Year	3.127E-06
25-Year	2.114E-03	25-Year	4.580E-06
50-Year	2.446E-03	50-Year	4.815E-06
100-Year	3.569E-03	100-Year	5.073E-06
200-Year	5.931E-03	200-Year	6.109E-06

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

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

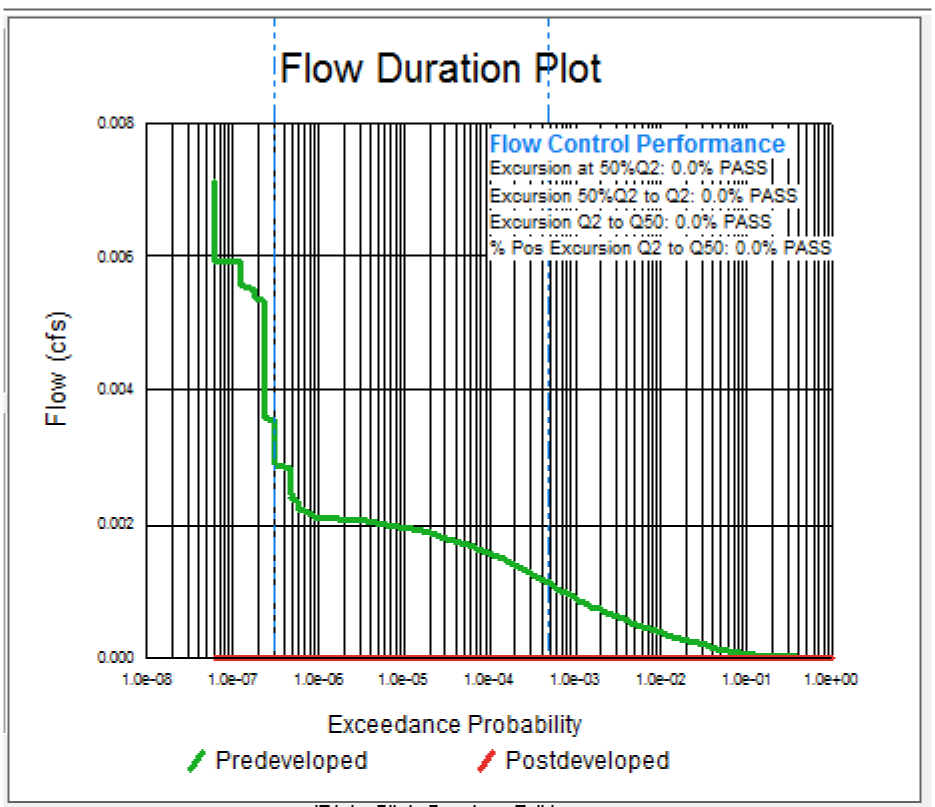
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	0.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:05 PM
Report Generation Date: 08/27/2015 3:06 PM

Input File Name:	2015-09-02 Facility 1 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 1 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 1 for a forested basin of 1665

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.038
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.038

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.038ac Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.008
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.028
Subbasin Total	0.036

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.51
Max Pond Elevation (ft)	:	102.67
Storage Depth (ft)	:	2.51
Pond Bottom Length (ft)	:	33.3
Pond Bottom Width (ft)	:	10.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	333.
Area at Riser Crest El (sq-ft)	:	333.

(acres) : 0.008
Volume at Riser Crest (cu-ft) : 836.
(ac-ft) : 0.019
Area at Max Elevation (sq-ft) : 333.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 922.
(ac-ft) : 0.021

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.51 ft

Hydraulic Structure Geometry

Number of Devices: 0

--
Link Name: Total Length x Avg W of raingardens
Link Type: Bioretention Facility
Downstream Link Name: Rainstore3 L x W x Avg H

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 15.0
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 75.
Area at Riser Crest El (sq-ft) : 144.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 76.
(ac-ft) : 0.002

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: 0.038ac Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.218E-02
5-Year	1.796E-02
10-Year	2.284E-02
25-Year	2.658E-02
50-Year	3.230E-02
100-Year	3.701E-02
200-Year	3.758E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.303E-06
5-Year	4.038E-06
10-Year	5.025E-06
25-Year	7.368E-06
50-Year	8.529E-06
100-Year	8.685E-06
200-Year	9.639E-06

********** Link: Rainstore3 L x W x Avg H ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.159E-03

5-Year	6.125E-03
10-Year	1.099E-02
25-Year	1.681E-02
50-Year	1.845E-02
100-Year	1.972E-02
200-Year	2.673E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.303E-06
5-Year	4.038E-06
10-Year	5.025E-06
25-Year	7.368E-06
50-Year	8.529E-06
100-Year	8.685E-06
200-Year	9.639E-06

********** Link: Rainstore3 L x W x Avg H ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.091
1.11-Year	100.115
1.25-Year	100.147
2.00-Year	100.230
3.33-Year	100.319
5-Year	100.404
10-Year	100.499
25-Year	100.700
50-Year	100.853
100-Year	100.869

********** Link: Total Length x Avg W of raingardens ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.218E-02
5-Year	1.796E-02
10-Year	2.284E-02
25-Year	2.658E-02
50-Year	3.230E-02
100-Year	3.701E-02

200-Year	3.758E-02

********** Link: Total Length x Avg W of raingardens ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.159E-03
5-Year	6.125E-03
10-Year	1.099E-02
25-Year	1.681E-02
50-Year	1.845E-02
100-Year	1.972E-02
200-Year	2.673E-02

********** Link: Total Length x Avg W of raingardens ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.109
1.11-Year	100.150
1.25-Year	100.178
2.00-Year	100.281
3.33-Year	100.369
5-Year	100.424
10-Year	100.501
25-Year	100.503
50-Year	100.504
100-Year	100.505

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	6.204
Total:	6.204

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: 0.038ac Basin		0.931
Link:	New Copy Lnk2	Not Applicable
Link:	Rainstore3 L x W x A	13.724
Link:	Total Length x Avg W	0.000

Total: 14.655

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.039 ac-ft/year, Post Developed: 0.093 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

********** Link: Rainstore3 L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 147. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 220. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 22.65

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.13
Total Runoff Infiltrated (ac-ft): 13.72, 97.12%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 97.12%

********** Link: Total Length x Avg W of raingardens **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.11
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 14.11, 100.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	8.444E-04	2-Year	2.303E-06
5-Year	1.351E-03	5-Year	4.038E-06

10-Year	1.748E-03	10-Year	5.025E-06
25-Year	2.296E-03	25-Year	7.368E-06
50-Year	2.656E-03	50-Year	8.529E-06
100-Year	3.875E-03	100-Year	8.685E-06
200-Year	6.439E-03	200-Year	9.639E-06

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

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

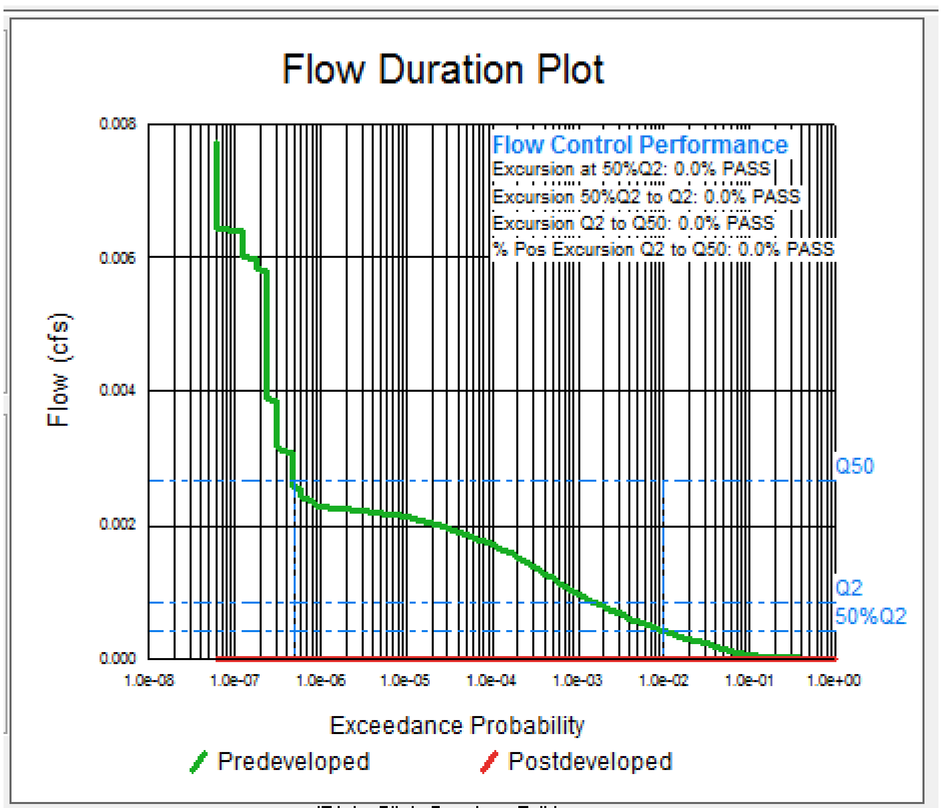
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	0.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:14 PM
Report Generation Date: 08/27/2015 3:15 PM

Input File Name:	2015-09-02 Facility 10 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 10 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 10 for a forested basin of 4915 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.113
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.113

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.113c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.026
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.087
Subbasin Total	0.113

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

---------------------SCENARIO: BASIN AREA
Number of Links: 0

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

---------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.81
Max Pond Elevation (ft)	:	102.99
Storage Depth (ft)	:	2.81
Pond Bottom Length (ft)	:	33.3
Pond Bottom Width (ft)	:	10.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	333.
Area at Riser Crest El (sq-ft)	:	333.

(acres) : 0.008
Volume at Riser Crest (cu-ft) : 936.
(ac-ft) : 0.021
Area at Max Elevation (sq-ft) : 333.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 1,029.
(ac-ft) : 0.024

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

*********** Subbasin: 0.113c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.794E-02
5-Year	5.593E-02
10-Year	7.137E-02
25-Year	8.283E-02
50-Year	0.101
100-Year	0.115
200-Year	0.117

********** Link: New Copy Lnk2 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.730E-05

5-Year	2.587E-05
10-Year	1.766E-02
25-Year	3.381E-02
50-Year	4.562E-02
100-Year	5.081E-02
200-Year	5.134E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.794E-02
5-Year	5.593E-02
10-Year	7.137E-02
25-Year	8.283E-02
50-Year	0.101
100-Year	0.115
200-Year	0.117

********** Link: Rainstore3 L x W x Avg H ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.730E-05
5-Year	2.587E-05
10-Year	1.766E-02
25-Year	3.381E-02
50-Year	4.562E-02
100-Year	5.081E-02
200-Year	5.134E-02

********** Link: Rainstore3 L x W x Avg H ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.764
1.11-Year	100.857
1.25-Year	101.115
2.00-Year	101.729
3.33-Year	102.166
5-Year	102.588
10-Year	102.818
25-Year	102.822
50-Year	102.826

100-Year 102.827

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

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

Total Predeveloped Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Forested Area	18.450	
Total:		18.450

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: 0.113c Basin	3.027	
Link: New Copy Lnk2		Not Applicable
Link: Rainstore3 L x W x A	40.278	
Total:		43.305

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.117 ac-ft/year, Post Developed: 0.274 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Rainstore3 L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 433. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 649. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 63.03

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 41.84
Total Runoff Infiltrated (ac-ft): 40.28, 96.26%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 96.26%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	2.511E-03	2-Year	1.730E-05
5-Year	4.017E-03	5-Year	2.587E-05
10-Year	5.199E-03	10-Year	1.766E-02
25-Year	6.827E-03	25-Year	3.381E-02
50-Year	7.897E-03	50-Year	4.562E-02
100-Year	1.152E-02	100-Year	5.081E-02
200-Year	1.915E-02	200-Year	5.134E-02

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

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

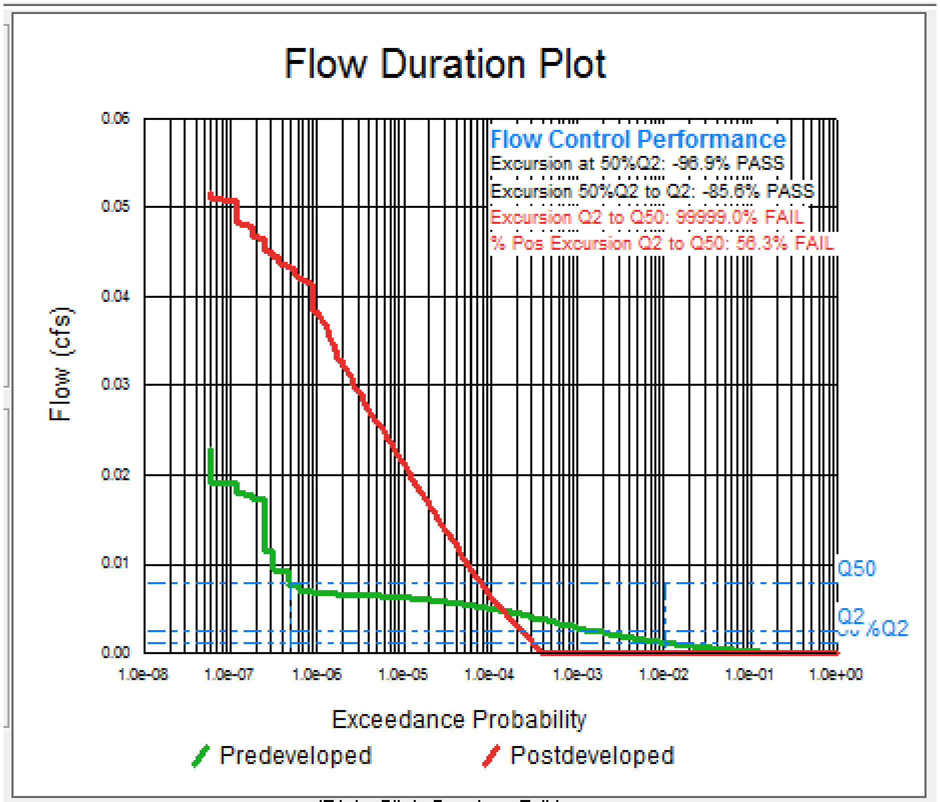
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-96.9%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-85.6%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	56.3%	FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-99.6%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-96.9%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS


Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: -96.9% PASS
Excursion 50%Q2 to Q2: -85.6% PASS
Excursion Q2 to Q50: 99999.0% FAIL
% Pos Excursion Q2 to Q50: 56.3% FAIL
Flow (cfs)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Q50
Q2
%Q2
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:16 PM
Report Generation Date: 08/27/2015 3:17 PM

Input File Name:	2015-09-02 Facility 11 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 11 Flow Control
Comments:	Analysis of the flow control provided by Facility 11 for a forested basin of 1635 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.038
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.038

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .038c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.008
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.029
Subbasin Total	0.037

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.97
Max Pond Elevation (ft) : 103.16
Storage Depth (ft) : 2.97
Pond Bottom Length (ft) : 20.0
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 200.
Area at Riser Crest El (sq-ft) : 200.

(acres) : 0.005
Volume at Riser Crest (cu-ft) : 594.
(ac-ft) : 0.014
Area at Max Elevation (sq-ft) : 200.
(acres) : 0.005
Vol at Max Elevation (cu-ft) : 652.
(ac-ft) : 0.015

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.97 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: Total Length x Avg W of Raingardens
Link Type: Bioretention Facility
Downstream Link Name: Rainstore3

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 4.4
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 22.
Area at Riser Crest El (sq-ft) : 59.
(acres) : 0.001
Volume at Riser Crest (cu-ft) : 26.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

*********** Subbasin: .038c Basin ***********

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.260E-02
5-Year	1.857E-02
10-Year	2.355E-02
25-Year	2.747E-02
50-Year	3.329E-02
100-Year	3.828E-02
200-Year	3.882E-02

********** Link: New Copy Lnk2 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.866E-06
5-Year	9.382E-06
10-Year	1.297E-05
25-Year	1.620E-05
50-Year	1.941E-05
100-Year	2.053E-05
200-Year	2.374E-05

********** Link: Rainstore3 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.162E-02

5-Year	1.762E-02
10-Year	2.237E-02
25-Year	2.721E-02
50-Year	2.994E-02
100-Year	3.473E-02
200-Year	3.845E-02

********** Link: Rainstore3 ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.866E-06
5-Year	9.382E-06
10-Year	1.297E-05
25-Year	1.620E-05
50-Year	1.941E-05
100-Year	2.053E-05
200-Year	2.374E-05

********** Link: Rainstore3 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.229
1.11-Year	100.285
1.25-Year	100.372
2.00-Year	100.587
3.33-Year	100.764
5-Year	100.938
10-Year	101.296
25-Year	101.548
50-Year	101.941
100-Year	102.053

********** Link: Total Length x Avg W of Raingardens ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.260E-02
5-Year	1.857E-02
10-Year	2.355E-02
25-Year	2.747E-02
50-Year	3.329E-02
100-Year	3.828E-02

200-Year 3.882E-02

********** Link: Total Length x Avg W of Raingardens ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.162E-02
5-Year	1.762E-02
10-Year	2.237E-02
25-Year	2.721E-02
50-Year	2.994E-02
100-Year	3.473E-02
200-Year	3.845E-02

********** Link: Total Length x Avg W of Raingardens ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.501
1.11-Year	100.501
1.25-Year	100.502
2.00-Year	100.503
3.33-Year	100.504
5-Year	100.505
10-Year	100.507
25-Year	100.509
50-Year	100.510
100-Year	100.511

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	6.204
Total:	6.204

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: .038c Basin	0.931
Link: New Copy Lnk2	Not Applicable
Link: Rainstore3	13.720
Link: Total Length x Avg W	0.000

Total: 14.651

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.039 ac-ft/year, Post Developed: 0.093 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

********** Link: Rainstore3 **********

Basic Wet Pond Volume (91% Exceedance): 146. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 219. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 36.65

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.19
Total Runoff Infiltrated (ac-ft): 13.72, 96.70%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 96.70%

********** Link: Total Length x Avg W of Raingardens **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 14.10
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 13.67, 96.98%
Percent Treated (Infiltrated+Filtered)/Total Volume: 96.98%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	8.444E-04	2-Year	5.866E-06
5-Year	1.351E-03	5-Year	9.382E-06

10-Year	1.748E-03	10-Year	1.297E-05
25-Year	2.296E-03	25-Year	1.620E-05
50-Year	2.656E-03	50-Year	1.941E-05
100-Year	3.875E-03	100-Year	2.053E-05
200-Year	6.439E-03	200-Year	2.374E-05

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

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

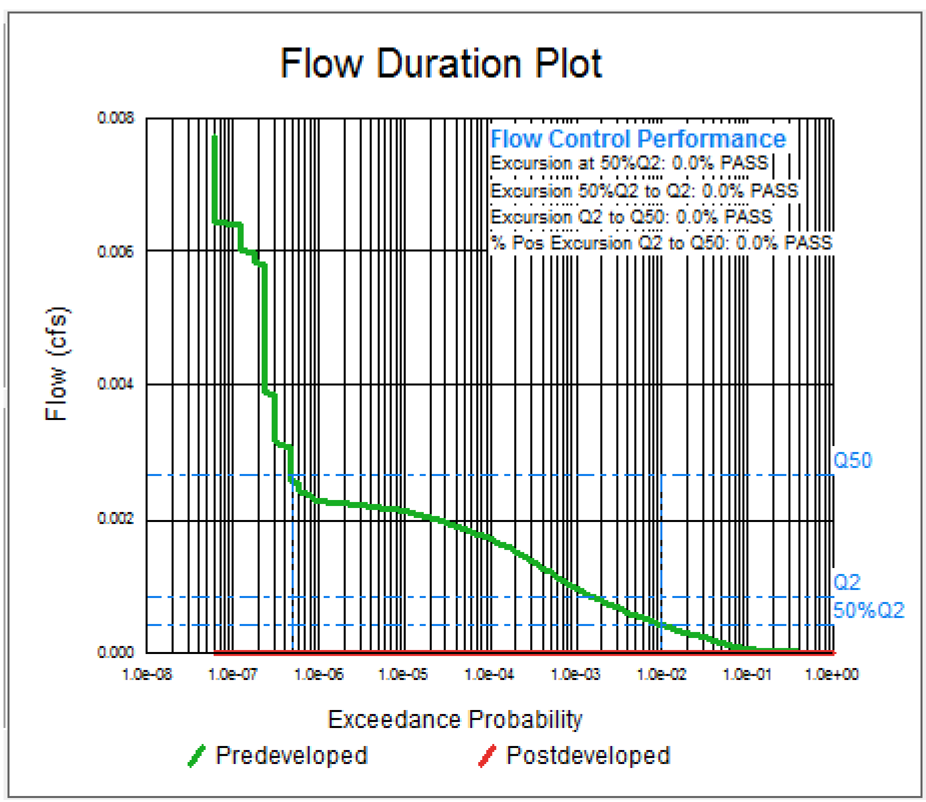
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 0.0% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 0.0% PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 0.0% PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%): 0.0% PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 0.0% PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 0.0% PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:19 PM
Report Generation Date: 08/27/2015 3:19 PM

Input File Name:	2015-09-02 Facility 12 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 12 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 1 for a forested basin of 1835 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.042
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.042

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .042c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.009
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.032
Subbasin Total	0.041

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.17
Max Pond Elevation (ft)	:	102.31
Storage Depth (ft)	:	2.17
Pond Bottom Length (ft)	:	13.3
Pond Bottom Width (ft)	:	10.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	133.
Area at Riser Crest El (sq-ft)	:	133.

(acres) : 0.003
Volume at Riser Crest (cu-ft) : 289.
(ac-ft) : 0.007
Area at Max Elevation (sq-ft) : 133.
(acres) : 0.003
Vol at Max Elevation (cu-ft) : 321.
(ac-ft) : 0.007

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.17 ft

Hydraulic Structure Geometry

Number of Devices: 0

--
Link Name: Total Length x Avg W of Raingardens
Link Type: Bioretention Facility
Downstream Link Name: Rainstore3 L x W x Avg H

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 7.2
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 36.
Area at Riser Crest El (sq-ft) : 82.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 40.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: .042c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.391E-02
5-Year	2.051E-02
10-Year	2.605E-02
25-Year	3.034E-02
50-Year	3.684E-02
100-Year	4.227E-02
200-Year	4.290E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.560E-05
5-Year	1.708E-03
10-Year	5.307E-03
25-Year	1.430E-02
50-Year	1.749E-02
100-Year	1.986E-02
200-Year	2.432E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.159E-02

5-Year	1.803E-02
10-Year	2.241E-02
25-Year	2.831E-02
50-Year	3.295E-02
100-Year	3.868E-02
200-Year	4.281E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.560E-05
5-Year	1.708E-03
10-Year	5.307E-03
25-Year	1.430E-02
50-Year	1.749E-02
100-Year	1.986E-02
200-Year	2.432E-02

********** Link: Rainstore3 L x W x Avg H ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.691
1.11-Year	100.764
1.25-Year	100.998
2.00-Year	101.561
3.33-Year	101.961
5-Year	102.171
10-Year	102.172
25-Year	102.176
50-Year	102.177
100-Year	102.178

********** Link: Total Length x Avg W of Raingardens ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.391E-02
5-Year	2.051E-02
10-Year	2.605E-02
25-Year	3.034E-02
50-Year	3.684E-02
100-Year	4.227E-02

200-Year	4.290E-02

********** Link: Total Length x Avg W of Raingardens ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.159E-02
5-Year	1.803E-02
10-Year	2.241E-02
25-Year	2.831E-02
50-Year	3.295E-02
100-Year	3.868E-02
200-Year	4.281E-02

********** Link: Total Length x Avg W of Raingardens ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.438
1.11-Year	100.489
1.25-Year	100.501
2.00-Year	100.503
3.33-Year	100.504
5-Year	100.505
10-Year	100.507
25-Year	100.508
50-Year	100.510
100-Year	100.512

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	6.857
Total:	6.857

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: .042c Basin	1.048
Link: New Copy Lnk2	Not Applicable
Link: Rainstore3 L x W x A	15.100
Link: Total Length x Avg W	0.000

Total:	16.147

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.043 ac-ft/year, Post Developed: 0.102 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

********** Link: Rainstore3 L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 163. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 245. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 59.58

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 15.81
Total Runoff Infiltrated (ac-ft): 15.10, 95.52%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 95.52%

********** Link: Total Length x Avg W of Raingardens **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 15.67
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 15.55, 99.19%
Percent Treated (Infiltrated+Filtered)/Total Volume: 99.19%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	9.333E-04	2-Year	1.560E-05
5-Year	1.493E-03	5-Year	1.708E-03

10-Year	1.932E-03	10-Year	5.307E-03
25-Year	2.537E-03	25-Year	1.430E-02
50-Year	2.935E-03	50-Year	1.749E-02
100-Year	4.282E-03	100-Year	1.986E-02
200-Year	7.117E-03	200-Year	2.432E-02

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

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

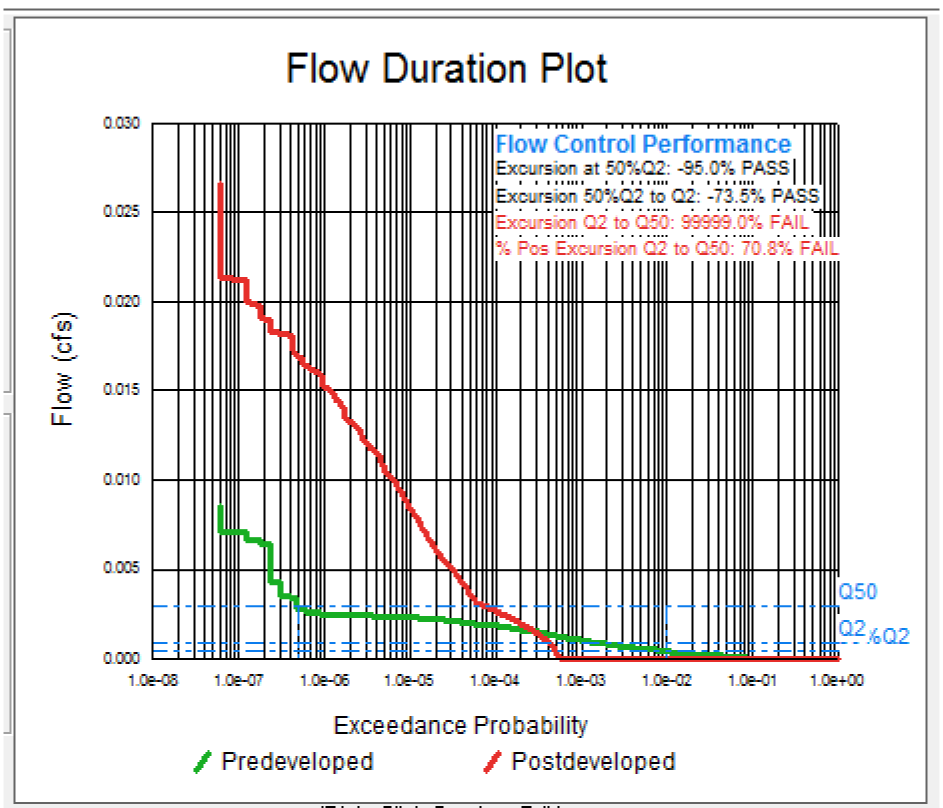
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-95.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-73.5%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	70.8%	FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-99.5%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-95.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:20 PM
Report Generation Date: 08/27/2015 3:21 PM

Input File Name:	2015-09-02 Facility 13 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 13 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 1 for a forested basin of 2345 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.054
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.054

--------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .054c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.012
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.042
Subbasin Total	0.054

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

--------------------SCENARIO: BASIN AREA
Number of Links: 0

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

--------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	: 100.00
Riser Crest Elevation (ft)	: 102.81
Max Pond Elevation (ft)	: 102.99
Storage Depth (ft)	: 2.81
Pond Bottom Length (ft)	: 10.0
Pond Bottom Width (ft)	: 10.0
Pond Side Slopes (ft/ft)	: L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	: 100.
Area at Riser Crest El (sq-ft)	: 100.

(acres) : 0.002
Volume at Riser Crest (cu-ft) : 281.
(ac-ft) : 0.006
Area at Max Elevation (sq-ft) : 100.
(acres) : 0.002
Vol at Max Elevation (cu-ft) : 309.
(ac-ft) : 0.007

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: .054c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	1.828E-02
5-Year	2.694E-02
10-Year	3.426E-02
25-Year	3.987E-02
50-Year	4.846E-02
100-Year	5.552E-02
200-Year	5.637E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.036E-03

5-Year	1.379E-02
10-Year	1.694E-02
25-Year	2.370E-02
50-Year	2.774E-02
100-Year	3.384E-02
200-Year	3.693E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.828E-02
5-Year	2.694E-02
10-Year	3.426E-02
25-Year	3.987E-02
50-Year	4.846E-02
100-Year	5.552E-02
200-Year	5.637E-02

********** Link: Rainstore3 L x W x Avg H ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.036E-03
5-Year	1.379E-02
10-Year	1.694E-02
25-Year	2.370E-02
50-Year	2.774E-02
100-Year	3.384E-02
200-Year	3.693E-02

********** Link: Rainstore3 L x W x Avg H ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	101.634
1.11-Year	101.954
1.25-Year	102.407
2.00-Year	102.813
3.33-Year	102.814
5-Year	102.816
10-Year	102.817
25-Year	102.820
50-Year	102.822

100-Year 102.824

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	8.817
Total:	8.817

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: .054c Basin	1.397
Link: New Copy Lnk2	Not Applicable
Link: Rainstore3 L x W x A	18.457
Total:	19.854

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.056 ac-ft/year, Post Developed: 0.126 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Rainstore3 L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 208. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 313. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 100.31

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 20.10
Total Runoff Infiltrated (ac-ft): 18.46, 91.84%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 91.84%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.200E-03	2-Year	6.036E-03
5-Year	1.920E-03	5-Year	1.379E-02
10-Year	2.484E-03	10-Year	1.694E-02
25-Year	3.262E-03	25-Year	2.370E-02
50-Year	3.774E-03	50-Year	2.774E-02
100-Year	5.506E-03	100-Year	3.384E-02
200-Year	9.151E-03	200-Year	3.693E-02

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

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

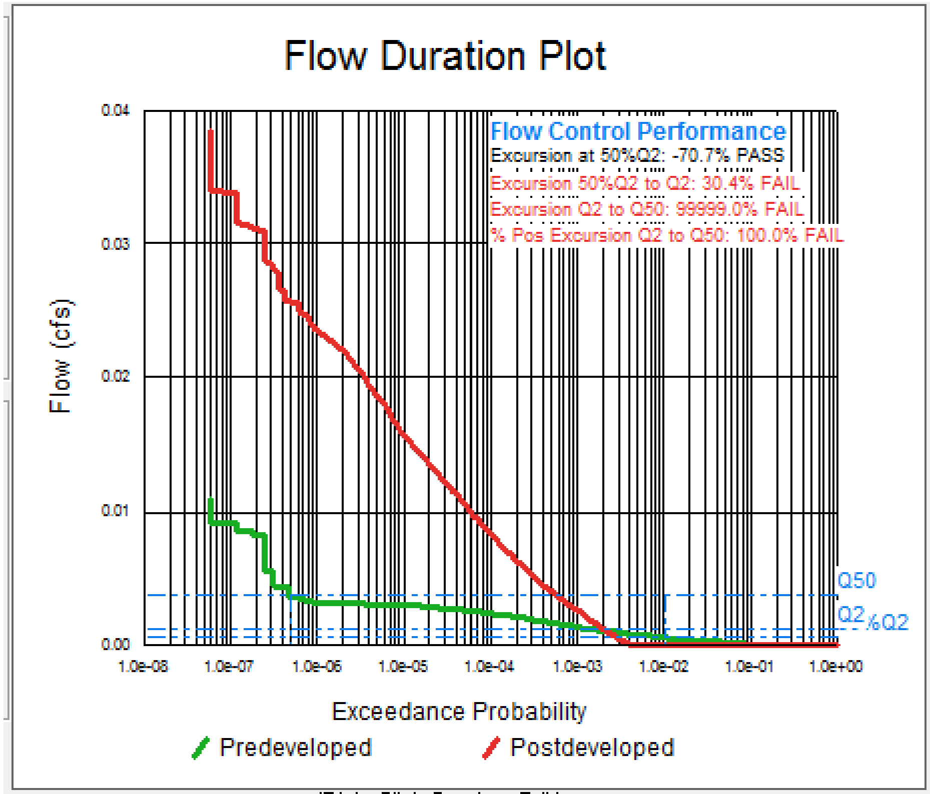
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-70.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	30.4%	FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	100.0%	FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-96.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-70.7%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: -70.7% PASS
Excursion 50%Q2 to Q2: 30.4% FAIL
Excursion Q2 to Q50: 99999.0% FAIL
% Pos Excursion Q2 to Q50: 100.0% FAIL
Flow (cfs)
0.04
0.03
0.02
0.01
0.00
Q50
Q2
%Q2
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:22 PM
Report Generation Date: 08/27/2015 3:23 PM

Input File Name: 2015-09-02 Facility 14 Flow Control Forested.fld
Project Name: Shoreline On Call 148th
Analysis Title: Facility 14 Flow Control X TEN Forested
Comments: Analysis of the flow control provided by Facility 14 for a forested basin of 575 sf (multiplied by a factor of ten)

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.130
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.130

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .013c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.030
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.100
Subbasin Total	0.130

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.81
Max Pond Elevation (ft)	:	102.99
Storage Depth (ft)	:	2.81
Pond Bottom Length (ft)	:	10.0
Pond Bottom Width (ft)	:	100.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	1000.

Area at Riser Crest El (sq-ft) : 1,000.
(acres) : 0.023
Volume at Riser Crest (cu-ft) : 2,810.
(ac-ft) : 0.065
Area at Max Elevation (sq-ft) : 1000.
(acres) : 0.023
Vol at Max Elevation (cu-ft) : 3,090.
(ac-ft) : 0.071

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

*********** Subbasin: .013c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	4.362E-02
5-Year	6.430E-02
10-Year	8.208E-02
25-Year	9.524E-02
50-Year	0.116
100-Year	0.132
200-Year	0.135

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) Flood Peak (cfs)
==

2-Year	3.044E-06
5-Year	5.008E-06
10-Year	6.623E-06
25-Year	8.804E-06
50-Year	1.044E-05
100-Year	1.184E-05
200-Year	1.194E-05

********** Link: Rainstore3 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	4.362E-02
5-Year	6.430E-02
10-Year	8.208E-02
25-Year	9.524E-02
50-Year	0.116
100-Year	0.132
200-Year	0.135

********** Link: Rainstore3 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.044E-06
5-Year	5.008E-06
10-Year	6.623E-06
25-Year	8.804E-06
50-Year	1.044E-05
100-Year	1.184E-05
200-Year	1.194E-05

********** Link: Rainstore3 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.125
1.11-Year	100.147
1.25-Year	100.190
2.00-Year	100.305
3.33-Year	100.397
5-Year	100.501
10-Year	100.660
25-Year	100.863

50-Year	101.044
100-Year	101.184

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	21.226
Total:	21.226

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: .013c Basin		3.492
Link:	New Copy Lnk2	Not Applicable
Link:	Rainstore3	46.808
Total:		50.300

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.134 ac-ft/year, Post Developed: 0.318 ac-ft/year

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

----------------------SCENARIO: BASIN AREA

Number of Links: 0

----------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Rainstore3 **********

Basic Wet Pond Volume (91% Exceedance): 497. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 746. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 25.30

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 48.12
Total Runoff Infiltrated (ac-ft): 46.81, 97.28%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 97.28%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff Tr (Years)	Predevelopment Runoff Discharge (cfs)	Postdevelopment Runoff Tr (Years)	Postdevelopment Runoff Discharge (cfs)
2-Year	2.889E-03	2-Year	3.044E-06
5-Year	4.622E-03	5-Year	5.008E-06
10-Year	5.981E-03	10-Year	6.623E-06
25-Year	7.854E-03	25-Year	8.804E-06
50-Year	9.085E-03	50-Year	1.044E-05
100-Year	1.326E-02	100-Year	1.184E-05
200-Year	2.203E-02	200-Year	1.194E-05

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

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

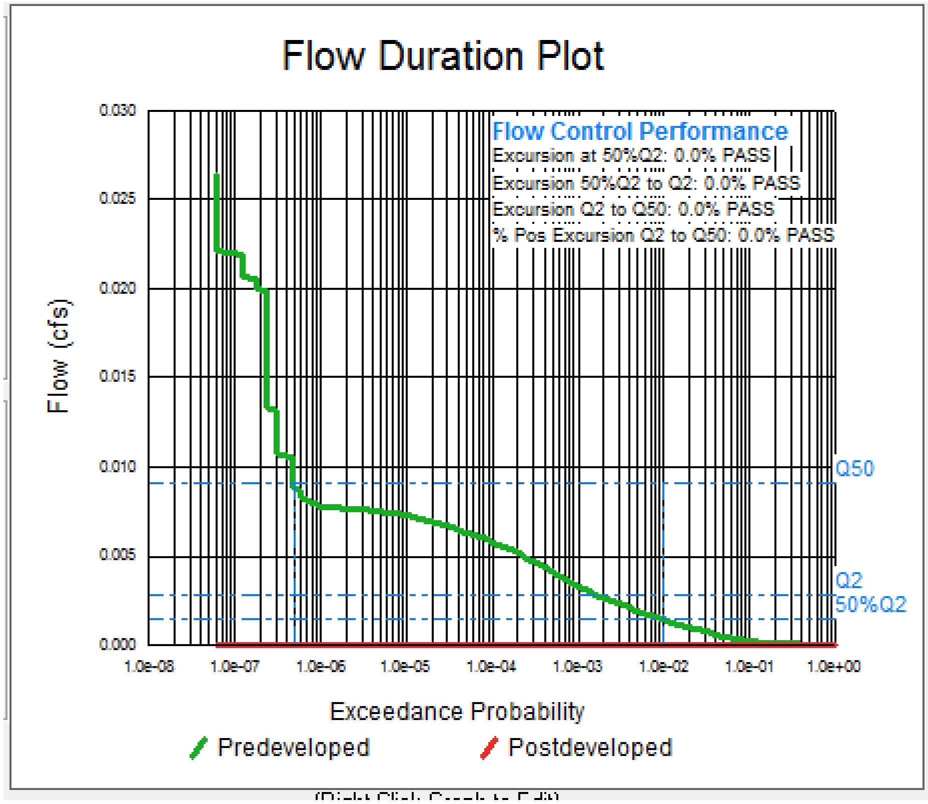
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	0.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: 0.0% PASS
Excursion 50%Q2 to Q2: 0.0% PASS
Excursion Q2 to Q50: 0.0% PASS
% Pos Excursion Q2 to Q50: 0.0% PASS
Flow (cfs)
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Q50
Q2
50%Q2
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:24 PM
Report Generation Date: 08/27/2015 3:24 PM

Input File Name:	2015-09-02 Facility 15 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 15 Flow Control
Comments:	Analysis of the flow control provided by Facility 15 for a forested basin of 1330 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Impervious Area ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.076

Subbasin Total 0.076

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .076c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.017
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.058
Subbasin Total	0.075

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 3

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.17
Max Pond Elevation (ft)	:	102.31
Storage Depth (ft)	:	2.17
Pond Bottom Length (ft)	:	13.3
Pond Bottom Width (ft)	:	10.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	133.
Area at Riser Crest El (sq-ft)	:	133.

(acres) : 0.003
Volume at Riser Crest (cu-ft) : 289.
(ac-ft) : 0.007
Area at Max Elevation (sq-ft) : 133.
(acres) : 0.003
Vol at Max Elevation (cu-ft) : 321.
(ac-ft) : 0.007

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.17 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: Total Length x Avg W of Raingardens
Link Type: Bioretention Facility
Downstream Link Name: Rainstore3

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 5.2
Bottom Width (ft) : 5.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 26.
Area at Riser Crest El (sq-ft) : 66.
(acres) : 0.002
Volume at Riser Crest (cu-ft) : 30.
(ac-ft) : 0.001

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 20.00
Maximum Elevation of Bioretention Soil : 101.00
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: .076c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	2.527E-02
5-Year	3.725E-02
10-Year	4.746E-02
25-Year	5.515E-02
50-Year	6.716E-02
100-Year	7.676E-02
200-Year	7.799E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.043E-02
5-Year	2.142E-02
10-Year	2.798E-02
25-Year	3.622E-02
50-Year	4.328E-02
100-Year	4.784E-02
200-Year	5.204E-02

********** Link: Rainstore3 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.496E-02

5-Year	3.704E-02
10-Year	4.835E-02
25-Year	5.570E-02
50-Year	6.786E-02
100-Year	7.824E-02
200-Year	7.943E-02

********** Link: Rainstore3 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.043E-02
5-Year	2.142E-02
10-Year	2.798E-02
25-Year	3.622E-02
50-Year	4.328E-02
100-Year	4.784E-02
200-Year	5.204E-02

********** Link: Rainstore3 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	101.716
1.11-Year	102.152
1.25-Year	102.172
2.00-Year	102.174
3.33-Year	102.178
5-Year	102.179
10-Year	102.182
25-Year	102.184
50-Year	102.186
100-Year	102.187

********** Link: Total Length x Avg W of Raingardens ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.527E-02
5-Year	3.725E-02
10-Year	4.746E-02
25-Year	5.515E-02
50-Year	6.716E-02
100-Year	7.676E-02

200-Year 7.799E-02

********** Link: Total Length x Avg W of Raingardens ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.496E-02
5-Year	3.704E-02
10-Year	4.835E-02
25-Year	5.570E-02
50-Year	6.786E-02
100-Year	7.824E-02
200-Year	7.943E-02

********** Link: Total Length x Avg W of Raingardens ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.504
1.11-Year	100.505
1.25-Year	100.506
2.00-Year	100.508
3.33-Year	100.510
5-Year	100.512
10-Year	100.516
25-Year	100.518
50-Year	100.521
100-Year	100.523

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Impervious Area	0.000
Total:	0.000

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: .076c Basin	1.979
Link: New Copy Lnk2	Not Applicable
Link: Rainstore3	25.113
Link: Total Length x Avg W	0.000

Total: 27.092

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.000 ac-ft/year, Post Developed: 0.171 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 3

********** Link: Rainstore3 **********

Basic Wet Pond Volume (91% Exceedance): 292. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 438. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 28.31
Total Runoff Infiltrated (ac-ft): 25.11, 88.72%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 88.72%

********** Link: Total Length x Avg W of Raingardens **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 28.21
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 24.68, 87.48%
Percent Treated (Infiltrated+Filtered)/Total Volume: 87.48%

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

Scenario Basin Area Compliance Subbasin: Impervious Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	3.151E-02	2-Year	1.043E-02
5-Year	4.617E-02	5-Year	2.142E-02
10-Year	5.644E-02	10-Year	2.798E-02
25-Year	6.739E-02	25-Year	3.622E-02

50-Year	7.881E-02	50-Year	4.328E-02
100-Year	9.320E-02	100-Year	4.784E-02
200-Year	9.552E-02	200-Year	5.204E-02

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

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

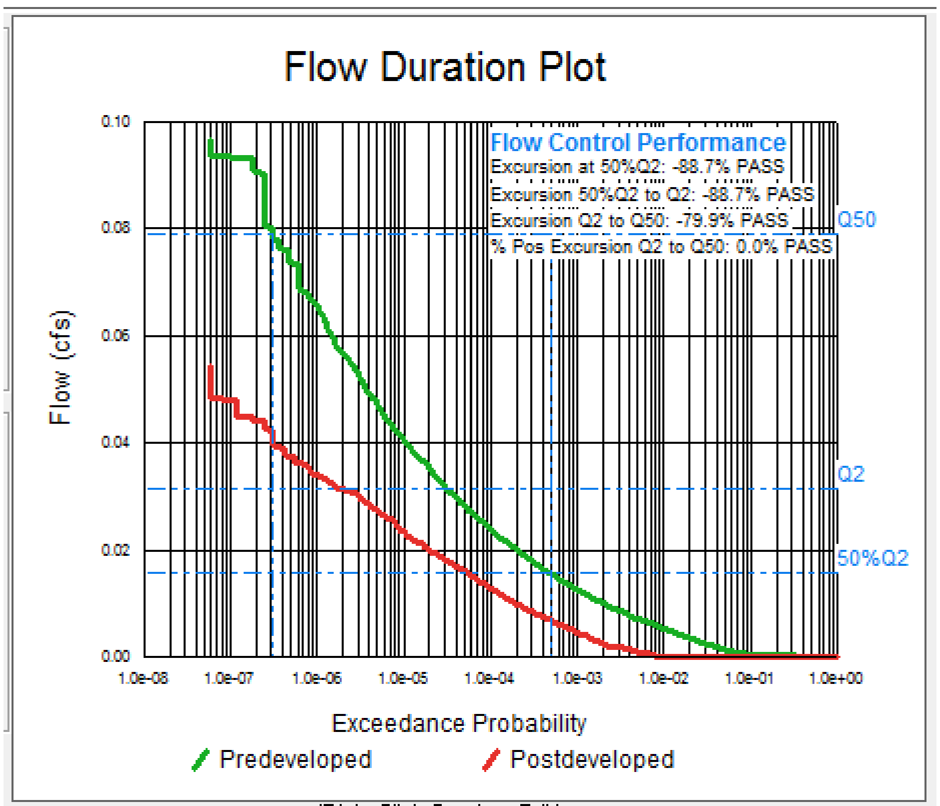
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): -88.7% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): -88.7% PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%): -79.9% PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%): 0.0% PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): -93.7% PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): -88.7% PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:27 PM
Report Generation Date: 08/27/2015 3:27 PM

Input File Name:	2015-09-02 Facility 16 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 16 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 16 for a forested basin of 6765 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.155
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.155

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .155c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.035
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.120
Subbasin Total	0.155

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg W
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.81
Max Pond Elevation (ft)	:	102.99
Storage Depth (ft)	:	2.81
Pond Bottom Length (ft)	:	36.7
Pond Bottom Width (ft)	:	10.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	367.
Area at Riser Crest El (sq-ft)	:	367.

(acres) : 0.008
Volume at Riser Crest (cu-ft) : 1,031.
(ac-ft) : 0.024
Area at Max Elevation (sq-ft) : 367.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 1,134.
(ac-ft) : 0.026

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: .155c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	5.227E-02
5-Year	7.705E-02
10-Year	9.813E-02
25-Year	0.114
50-Year	0.139
100-Year	0.159
200-Year	0.161

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.551E-05

5-Year	2.168E-02
10-Year	3.936E-02
25-Year	5.622E-02
50-Year	6.939E-02
100-Year	7.238E-02
200-Year	8.691E-02

********** Link: Rainstore3 L x W x Avg W ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.227E-02
5-Year	7.705E-02
10-Year	9.813E-02
25-Year	0.114
50-Year	0.139
100-Year	0.159
200-Year	0.161

********** Link: Rainstore3 L x W x Avg W ********** Link Outflow 1 Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	2.551E-05
5-Year	2.168E-02
10-Year	3.936E-02
25-Year	5.622E-02
50-Year	6.939E-02
100-Year	7.238E-02
200-Year	8.691E-02

********** Link: Rainstore3 L x W x Avg W ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	101.098
1.11-Year	101.285
1.25-Year	101.626
2.00-Year	102.553
3.33-Year	102.816
5-Year	102.819
10-Year	102.825
25-Year	102.828
50-Year	102.832

100-Year 102.832

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

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

Total Predeveloped Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Forested Area	25.307	
Total:		25.307

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: .155c Basin	4.074	
Link: New Copy Lnk2		Not Applicable
Link: Rainstore3 L x W x A	54.817	
Total:		58.892

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.160 ac-ft/year, Post Developed: 0.373 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Rainstore3 L x W x Avg W **********

Basic Wet Pond Volume (91% Exceedance): 596. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 894. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 78.45

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 57.55
Total Runoff Infiltrated (ac-ft): 54.82, 95.24%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 95.24%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	3.444E-03	2-Year	2.551E-05
5-Year	5.511E-03	5-Year	2.168E-02
10-Year	7.131E-03	10-Year	3.936E-02
25-Year	9.364E-03	25-Year	5.622E-02
50-Year	1.083E-02	50-Year	6.939E-02
100-Year	1.580E-02	100-Year	7.238E-02
200-Year	2.627E-02	200-Year	8.691E-02

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

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

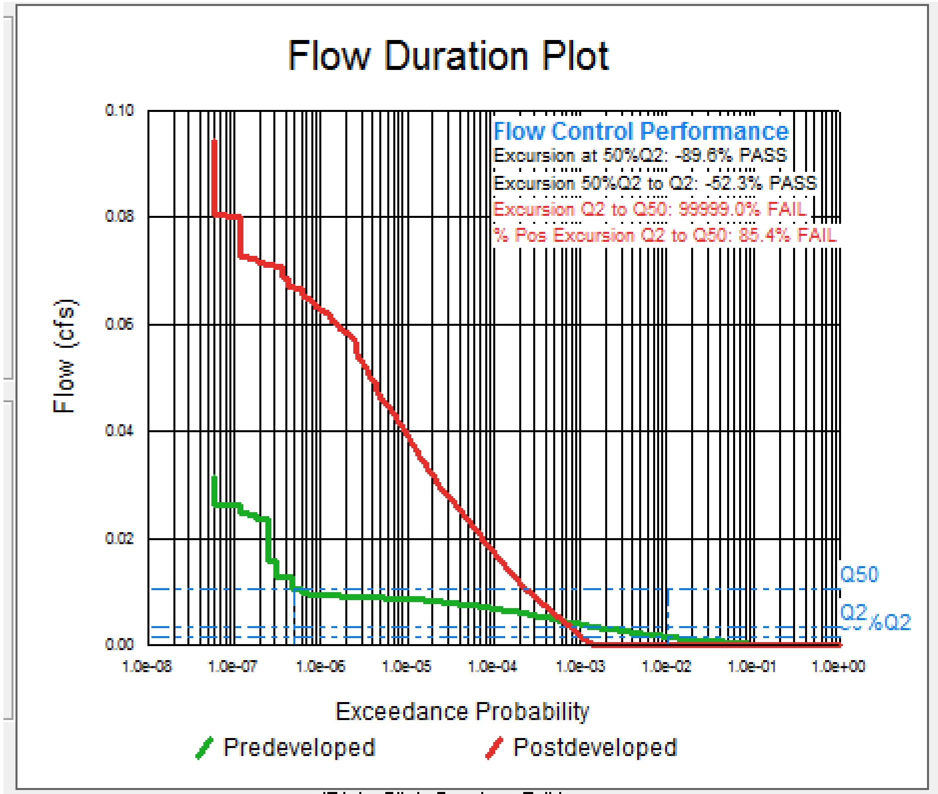
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-89.6%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-52.3%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	99999.0%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	85.4%	FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-98.7%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-89.6%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: -89.6% PASS
Excursion 50%Q2 to Q2: -52.3% PASS
Excursion Q2 to Q50: 99999.0% FAIL
% Pos Excursion Q2 to Q50: 85.4% FAIL
Flow (cfs)
0.10
0.08
0.06
0.04
0.02
0.00
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Q50
Q2
%Q2
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:29 PM
Report Generation Date: 08/27/2015 3:29 PM

Input File Name:	2015-09-02 Facility 17 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 17 Flow Control X TEN Forested
Comments:	860 sf Basin X TEN

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

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

Subbasin Total 0.200

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .020c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.045
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.155
Subbasin Total	0.200

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3 L x W x Avg H
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.81
Max Pond Elevation (ft) : 102.99
Storage Depth (ft) : 2.81
Pond Bottom Length (ft) : 20.2
Pond Bottom Width (ft) : 100.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 2020.
Area at Riser Crest El (sq-ft) : 2,020.

(acres) : 0.046
Volume at Riser Crest (cu-ft) : 5,676.
(ac-ft) : 0.130
Area at Max Elevation (sq-ft) : 2020.
(acres) : 0.046
Vol at Max Elevation (cu-ft) : 6,242.
(ac-ft) : 0.143

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.81 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: .020c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	6.750E-02
5-Year	9.949E-02
10-Year	0.127
25-Year	0.147
50-Year	0.179
100-Year	0.205
200-Year	0.208

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.825E-06

5-Year	3.129E-06
10-Year	4.042E-06
25-Year	5.760E-06
50-Year	6.263E-06
100-Year	6.380E-06
200-Year	7.439E-06

********** Link: Rainstore3 L x W x Avg H ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	6.750E-02
5-Year	9.949E-02
10-Year	0.127
25-Year	0.147
50-Year	0.179
100-Year	0.205
200-Year	0.208

********** Link: Rainstore3 L x W x Avg H ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.825E-06
5-Year	3.129E-06
10-Year	4.042E-06
25-Year	5.760E-06
50-Year	6.263E-06
100-Year	6.380E-06
200-Year	7.439E-06

********** Link: Rainstore3 L x W x Avg H ********** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.068
1.11-Year	100.087
1.25-Year	100.109
2.00-Year	100.183
3.33-Year	100.243
5-Year	100.313
10-Year	100.406
25-Year	100.551
50-Year	100.626

100-Year 100.638

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Forested Area	32.655
Total:	32.655

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: .020c Basin	5.238
Link: New Copy Lnk2	Not Applicable
Link: Rainstore3 L x W x A	72.781
Total:	78.020

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.207 ac-ft/year, Post Developed: 0.494 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Rainstore3 L x W x Avg H **********

Basic Wet Pond Volume (91% Exceedance): 770. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 1155. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 19.91

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 74.30
Total Runoff Infiltrated (ac-ft): 72.78, 97.95%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 97.95%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	4.444E-03	2-Year	1.825E-06
5-Year	7.111E-03	5-Year	3.129E-06
10-Year	9.201E-03	10-Year	4.042E-06
25-Year	1.208E-02	25-Year	5.760E-06
50-Year	1.398E-02	50-Year	6.263E-06
100-Year	2.039E-02	100-Year	6.380E-06
200-Year	3.389E-02	200-Year	7.439E-06

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

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

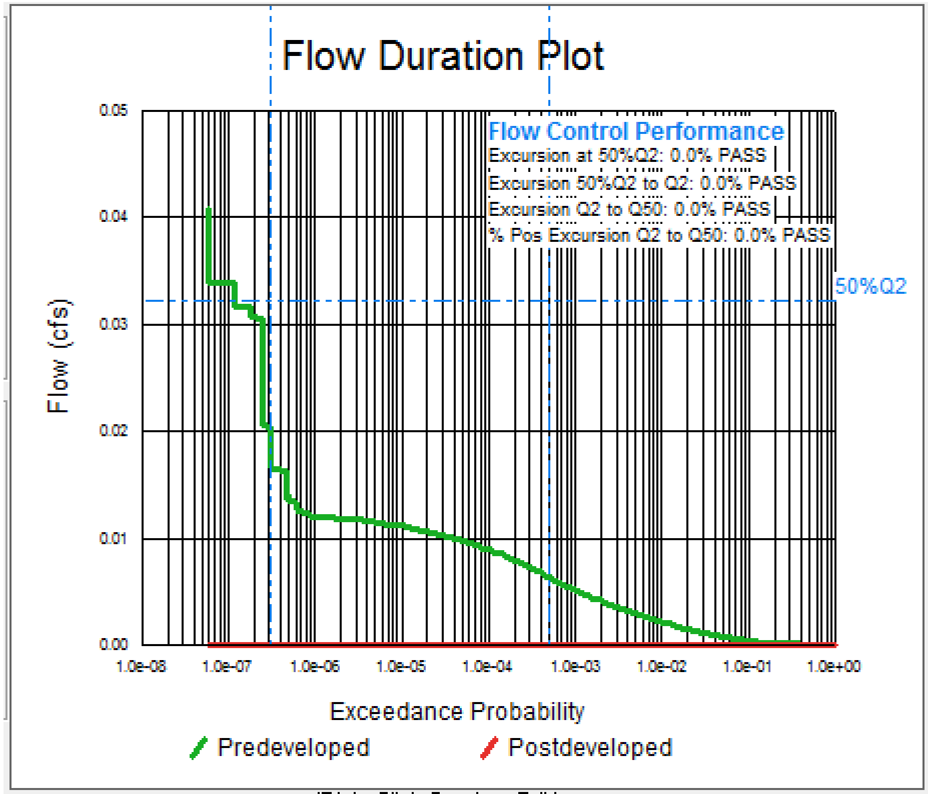
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	0.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: 0.0% PASS
Excursion 50%Q2 to Q2: 0.0% PASS
Excursion Q2 to Q50: 0.0% PASS
% Pos Excursion Q2 to Q50: 0.0% PASS
50%Q2
Flow (cfs)
0.05
0.04
0.03
0.02
0.01
0.00
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/27/2015 3:30 PM
Report Generation Date: 08/27/2015 3:31 PM

Input File Name:	2015-09-02 Facility 18 Flow Control Forested.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	Facility 18 Flow Control Forested
Comments:	Analysis of the flow control provided by Facility 18 for a forested basin of 4055 sf

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

----------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Forested Area ----------

	-------Area(Acres) --------
Till Forest	0.093
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.000

Subbasin Total 0.093

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : .093c Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.021
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.072
Subbasin Total	0.093

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Rainstore3
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 102.98
Max Pond Elevation (ft) : 103.17
Storage Depth (ft) : 2.98
Pond Bottom Length (ft) : 36.7
Pond Bottom Width (ft) : 10.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 367.
Area at Riser Crest El (sq-ft) : 367.

(acres) : 0.008
Volume at Riser Crest (cu-ft) : 1,094.
(ac-ft) : 0.025
Area at Max Elevation (sq-ft) : 367.
(acres) : 0.008
Vol at Max Elevation (cu-ft) : 1,200.
(ac-ft) : 0.028

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.98 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

--------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: .093c Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	3.136E-02
5-Year	4.623E-02
10-Year	5.888E-02
25-Year	6.844E-02
50-Year	8.331E-02
100-Year	9.527E-02
200-Year	9.678E-02

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.028E-05

5-Year	1.568E-05
10-Year	2.168E-05
25-Year	2.754E-05
50-Year	3.450E-03
100-Year	1.015E-02
200-Year	1.847E-02

********** Link: Rainstore3 ********** Link Inflow
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	3.136E-02
5-Year	4.623E-02
10-Year	5.888E-02
25-Year	6.844E-02
50-Year	8.331E-02
100-Year	9.527E-02
200-Year	9.678E-02

********** Link: Rainstore3 ********** Link Outflow 1
Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	1.028E-05
5-Year	1.568E-05
10-Year	2.168E-05
25-Year	2.754E-05
50-Year	3.450E-03
100-Year	1.015E-02
200-Year	1.847E-02

********** Link: Rainstore3 ********** Link WSEL
Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.455
1.11-Year	100.518
1.25-Year	100.684
2.00-Year	101.027
3.33-Year	101.306
5-Year	101.568
10-Year	102.174
25-Year	102.455
50-Year	102.945

100-Year 102.984

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

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

Total Predeveloped Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Forested Area	15.184	
Total:		15.184

Total Post Developed Recharge During Simulation

Model Element			Recharge Amount (ac-ft)
Subbasin: .093c Basin		2.445	
Link:	New Copy Lnk2		Not Applicable
Link:	Rainstore3	33.374	
Total:			35.819

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.096 ac-ft/year, Post Developed: 0.227 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Rainstore3 **********

Basic Wet Pond Volume (91% Exceedance): 358. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 536. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 48.04

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 34.53
Total Runoff Infiltrated (ac-ft): 33.37, 96.65%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 96.65%

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

Scenario Basin Area Compliance Subbasin: Forested Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	2.067E-03	2-Year	1.028E-05
5-Year	3.306E-03	5-Year	1.568E-05
10-Year	4.279E-03	10-Year	2.168E-05
25-Year	5.618E-03	25-Year	2.754E-05
50-Year	6.499E-03	50-Year	3.450E-03
100-Year	9.482E-03	100-Year	1.015E-02
200-Year	1.576E-02	200-Year	1.847E-02

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

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

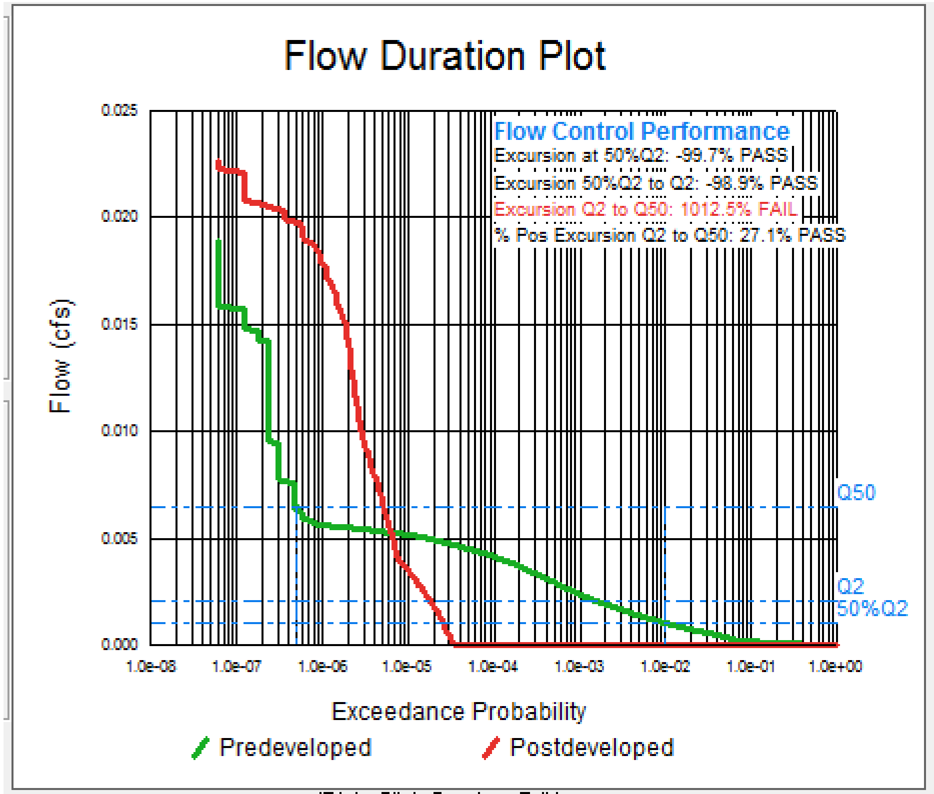
Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-99.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-98.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	1012.5%	FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):	27.1%	PASS

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-99.7%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS



Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: -99.7% PASS
Excursion 50%Q2 to Q2: -98.9% PASS
Excursion Q2 to Q50: 1012.5% FAIL
% Pos Excursion Q2 to Q50: 27.1% PASS
Flow (cfs)
0.025
0.020
0.015
0.010
0.005
0.000
Q50
Q2
50%Q2
1.0e-08
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/25/2015 3:16 PM
Report Generation Date: 08/25/2015 3:17 PM

Input File Name:	2015-09-02 0.88 380CF UNIT Infilration Facility Flow Control.fld
Project Name:	Shoreline On Call 148th
Analysis Title:	380CF Pavement Unit Flow Control
Comments:	Height of facillity has been adjusted to 94% of actual 36" to acccount for 94% volume capacity of total unit

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Impervious Area ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.200
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.680

Subbasin Total 0.880

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.88ac Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.200
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.680
Subbasin Total	0.880

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

---------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Infiltration Pond
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.82
Max Pond Elevation (ft)	:	103.00
Storage Depth (ft)	:	2.82
Pond Bottom Length (ft)	:	20.0
Pond Bottom Width (ft)	:	10.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	200.

Area at Riser Crest El (sq-ft) : 200.
(acres) : 0.005
Volume at Riser Crest (cu-ft) : 564.
(ac-ft) : 0.013
Area at Max Elevation (sq-ft) : 200.
(acres) : 0.005
Vol at Max Elevation (cu-ft) : 620.
(ac-ft) : 0.014

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.82 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: 0.88ac Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.296
5-Year	0.437
10-Year	0.557
25-Year	0.647
50-Year	0.788
100-Year	0.900
200-Year	0.915

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) Flood Peak (cfs)
==

2-Year	0.286
5-Year	0.425
10-Year	0.545
25-Year	0.633
50-Year	0.741
100-Year	0.806
200-Year	0.881

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.296
5-Year	0.437
10-Year	0.557
25-Year	0.647
50-Year	0.788
100-Year	0.900
200-Year	0.915

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.286
5-Year	0.425
10-Year	0.545
25-Year	0.633
50-Year	0.741
100-Year	0.806
200-Year	0.881

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

Tr (yrs)	WSEL Peak (ft)
1.05-Year	102.861
1.11-Year	102.863
1.25-Year	102.868
2.00-Year	102.877
3.33-Year	102.888
5-Year	102.894
10-Year	102.907
25-Year	102.914
50-Year	102.927

100-Year 102.933

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Impervious Area	23.282
Total:	23.282

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: 0.88ac Basin	23.282
Link: New Copy Lnk2	Not Applicable
Link: Infiltration Pond	82.161
Total:	105.443

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.147 ac-ft/year, Post Developed: 0.667 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Infiltration Pond **********

Basic Wet Pond Volume (91% Exceedance): 3378. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 5067. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 326.46
Total Runoff Infiltrated (ac-ft): 82.16, 25.17%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 25.17%

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

Scenario Basin Area Compliance Subbasin: Impervious Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff Tr (Years)	Discharge (cfs)	Postdevelopment Runoff Tr (Years)	Discharge (cfs)
2-Year	0.296	2-Year	0.286
5-Year	0.437	5-Year	0.425
10-Year	0.557	10-Year	0.545
25-Year	0.647	25-Year	0.633
50-Year	0.788	50-Year	0.741
100-Year	0.900	100-Year	0.806
200-Year	0.915	200-Year	0.881

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

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

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-8.9%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-8.1%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-10.2%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-16.4%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-8.6%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 08/25/2015 3:27 PM
Report Generation Date: 08/25/2015 3:27 PM

Input File Name: 2015-09-02 0.88 400CF UNIT Infilration Facility.fld
Project Name: Shoreline On Call 148th
Analysis Title: 400CF Bioretention Unit
Comments: Analysis of the flow control capabilities of a single 400CF bioretention "unit" within the 0.88 acre project area - Height of Facility has been adjust to account for the capacity of each layer

PRECIPITATION INPUT

Computational Time Step (Minutes): 5

Extended Precipitation Timeseries Selected
Climatic Region Number: 42

Full Period of Record Available used for Routing
Precipitation Station : 99003805 Seattle 38 in_5min 10/01/1939-10/01/2097
Evaporation Station : 991038 Seattle 38 in MAP
Evaporation Scale Factor : 0.750

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

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

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1

---------- Subbasin : Impervious Area ----------

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

Impervious	0.680
Subbasin Total	0.880

---------------------SCENARIO: IMPERVIOUS
Number of Subbasins: 1

---------- Subbasin : 0.88ac Basin ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.200
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User	0.000
Impervious	0.680
Subbasin Total	0.880

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

----------------------SCENARIO: BASIN AREA
Number of Links: 0

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

----------------------SCENARIO: IMPERVIOUS
Number of Links: 2

--
Link Name: New Copy Lnk2
Link Type: Copy
Downstream Link: None

--
Link Name: Infiltration Pond
Link Type: Structure
Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	102.99
Max Pond Elevation (ft)	:	104.33
Storage Depth (ft)	:	2.99
Pond Bottom Length (ft)	:	20.0
Pond Bottom Width (ft)	:	6.8
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00

Bottom Area (sq-ft) : 135.
Area at Riser Crest El (sq-ft) : 135.
(acres) : 0.003
Volume at Riser Crest (cu-ft) : 405.
(ac-ft) : 0.009
Area at Max Elevation (sq-ft) : 135.
(acres) : 0.003
Vol at Max Elevation (cu-ft) : 600.
(ac-ft) : 0.014

Constant Infiltration Option Used
Infiltration Rate (in/hr): 0.25

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 102.99 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

---------------------SCENARIO: BASIN AREA
Number of Subbasins: 1
Number of Links: 0

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

************ Subbasin: 0.88ac Basin ************

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.296
5-Year	0.437
10-Year	0.557
25-Year	0.647
50-Year	0.788
100-Year	0.900
200-Year	0.915

********** Link: New Copy Lnk2 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) Flood Peak (cfs)

2-Year	0.288
5-Year	0.426
10-Year	0.556
25-Year	0.646
50-Year	0.787
100-Year	0.899
200-Year	0.914

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.296
5-Year	0.437
10-Year	0.557
25-Year	0.647
50-Year	0.788
100-Year	0.900
200-Year	0.915

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

Tr (yrs)	Flood Peak (cfs)
2-Year	0.288
5-Year	0.426
10-Year	0.556
25-Year	0.646
50-Year	0.787
100-Year	0.899
200-Year	0.914

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

Tr (yrs)	WSEL Peak (ft)
1.05-Year	103.031
1.11-Year	103.034
1.25-Year	103.038
2.00-Year	103.047
3.33-Year	103.058
5-Year	103.064
10-Year	103.079
25-Year	103.086

50-Year	103.101
100-Year	103.112

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

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Impervious Area	23.282
Total:	23.282

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: 0.88ac Basin	23.282
Link: New Copy Lnk2	Not Applicable
Link: Infiltration Pond	58.992
Total:	82.274

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.147 ac-ft/year, Post Developed: 0.521 ac-ft/year

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

---------------------SCENARIO: BASIN AREA

Number of Links: 0

---------------------SCENARIO: IMPERVIOUS

Number of Links: 2

********** Link: Infiltration Pond **********

Basic Wet Pond Volume (91% Exceedance): 3378. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 5067. cu-ft

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 326.46
Total Runoff Infiltrated (ac-ft): 58.99, 18.07%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Percent Treated (Infiltrated+Filtered)/Total Volume: 18.07%

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

Scenario Basin Area Compliance Subbasin: Impervious Area

Scenario Impervious Compliance Link: New Copy Lnk2

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.296	2-Year	0.288
5-Year	0.437	5-Year	0.426
10-Year	0.557	10-Year	0.556
25-Year	0.647	25-Year	0.646
50-Year	0.788	50-Year	0.787
100-Year	0.900	100-Year	0.899
200-Year	0.915	200-Year	0.914

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

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

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-5.2%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-4.6%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-10.5%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-5.1%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

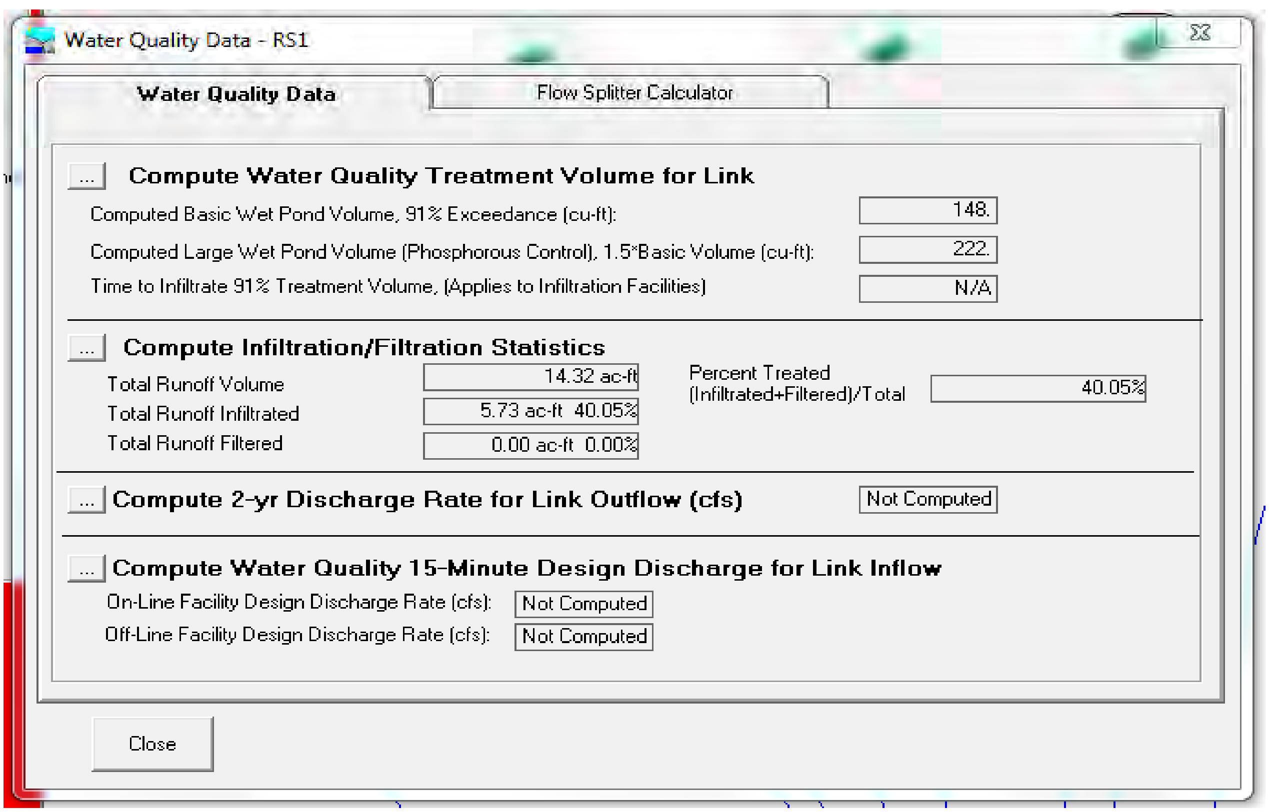
148th/15th - Shoreline

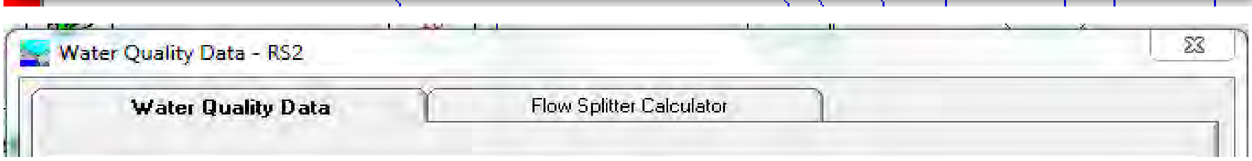
Water Quality Stats

SvR Design #13044.51

9/16/2015

Unit	Total Runoff Vol	Total Runoff Infiltrated	Percent Infiltrated
RS1	14.32	5.73	40.01%
RS2	12	4.62	38.50%
RS3,4,5	44.66	20.26	45.36%
RS6,7	16.07	6.41	39.89%
RS8,9	13.07	5.93	45.37%
RS10	41.84	14.42	34.46%
RS11	14.2	3.79	26.69%
RS12	15.85	3.31	20.88%
RS13	20.1	3.11	15.47%
RS14	5.52	0.93	16.85%
RS15	28.38	5.43	19.13%
RS16	57.55	19.42	33.74%
RS17	7.74	2.24	28.94%
RS18	34.53	12.97	37.56%
Total	325.83	108.57	**33.32%**





Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):	125.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):	188.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)	N/A

Compute Infiltration/Filtration Statistics

Total Runoff Volume	12.00 ac-ft
Total Runoff Infiltrated	4.62 ac-ft 38.51%
Total Runoff Filtered	0.00 ac-ft 0.00%

Percent Treated (Infiltrated+Filtered)/Total: 38.51%

Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed

Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS3,4,5

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):	456.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):	684.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)	N/A

Compute Infiltration/Filtration Statistics

Total Runoff Volume	44.66 ac-ft
Total Runoff Infiltrated	20.26 ac-ft 45.37%
Total Runoff Filtered	0.00 ac-ft 0.00%

Percent Treated (Infiltrated+Filtered)/Total: 45.37%

Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed

Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS6,7

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):	167.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):	250.

Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities) N/A

Compute Infiltration/Filtration Statistics

Total Runoff Volume	16.07 ac-ft	Percent Treated (Infiltrated+Filtered)/Total	39.89%
Total Runoff Infiltrated	6.41 ac-ft 39.89%		
Total Runoff Filtered	0.00 ac-ft 0.00%		

Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed

Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS8,9

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft): 136.

Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft): 205.

Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities) N/A

Compute Infiltration/Filtration Statistics

Total Runoff Volume	13.07 ac-ft	Percent Treated (Infiltrated+Filtered)/Total	45.36%
Total Runoff Infiltrated	5.93 ac-ft 45.36%		
Total Runoff Filtered	0.00 ac-ft 0.00%		

Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed

Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS10

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft): 433.

Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft): 649.

Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities) N/A

Compute Infiltration/Filtration Statistics

Total Runoff Volume	41.84 ac-ft	Percent Treated (Infiltrated+Filtered)/Total	34.45%
Total Runoff Infiltrated	14.42 ac-ft 34.45%		

Total Runoff Filtered | 0.00 ac-ft 0.00%

... Compute 2-yr Discharge Rate for Link Outflow (cfs) | Not Computed

... Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS11

Water Quality Data | Flow Splitter Calculator

... **Compute Water Quality Treatment Volume for Link**

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):	146.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):	219.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)	N/A

... **Compute Infiltration/Filtration Statistics**

Total Runoff Volume	14.20 ac-ft
Total Runoff Infiltrated	3.79 ac-ft 26.68%
Total Runoff Filtered	0.00 ac-ft 0.00%
Percent Treated (Infiltrated+Filtered)/Total	26.68%

... **Compute 2-yr Discharge Rate for Link Outflow (cfs)** | Not Computed

... **Compute Water Quality 15-Minute Design Discharge for Link Inflow**

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS12

Water Quality Data | Flow Splitter Calculator

... **Compute Water Quality Treatment Volume for Link**

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):	163.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):	244.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)	N/A

... **Compute Infiltration/Filtration Statistics**

Total Runoff Volume	15.85 ac-ft
Total Runoff Infiltrated	3.31 ac-ft 20.90%
Total Runoff Filtered	0.00 ac-ft 0.00%
Percent Treated (Infiltrated+Filtered)/Total	20.90%

... **Compute 2-yr Discharge Rate for Link Outflow (cfs)** | Not Computed

... **Compute Water Quality 15-Minute Design Discharge for Link Inflow**

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS13

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):	208.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):	313.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)	N/A

Compute Infiltration/Filtration Statistics

Total Runoff Volume	20.10 ac-ft
Total Runoff Infiltrated	3.11 ac-ft 15.49%
Total Runoff Filtered	0.00 ac-ft 0.00%

Percent Treated (Infiltrated+Filtered)/Total: 15.49%

Compute 2-yr Discharge Rate for Link Outflow (cfs)

Not Computed

Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs): Not Computed

Off-Line Facility Design Discharge Rate (cfs): Not Computed

Close

Water Quality Data - RS14

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):	60.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):	91.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)	N/A

Compute Infiltration/Filtration Statistics

Total Runoff Volume	5.52 ac-ft
Total Runoff Infiltrated	0.93 ac-ft 16.85%
Total Runoff Filtered	0.00 ac-ft 0.00%

Percent Treated (Infiltrated+Filtered)/Total: 16.85%

Compute 2-yr Discharge Rate for Link Outflow (cfs)

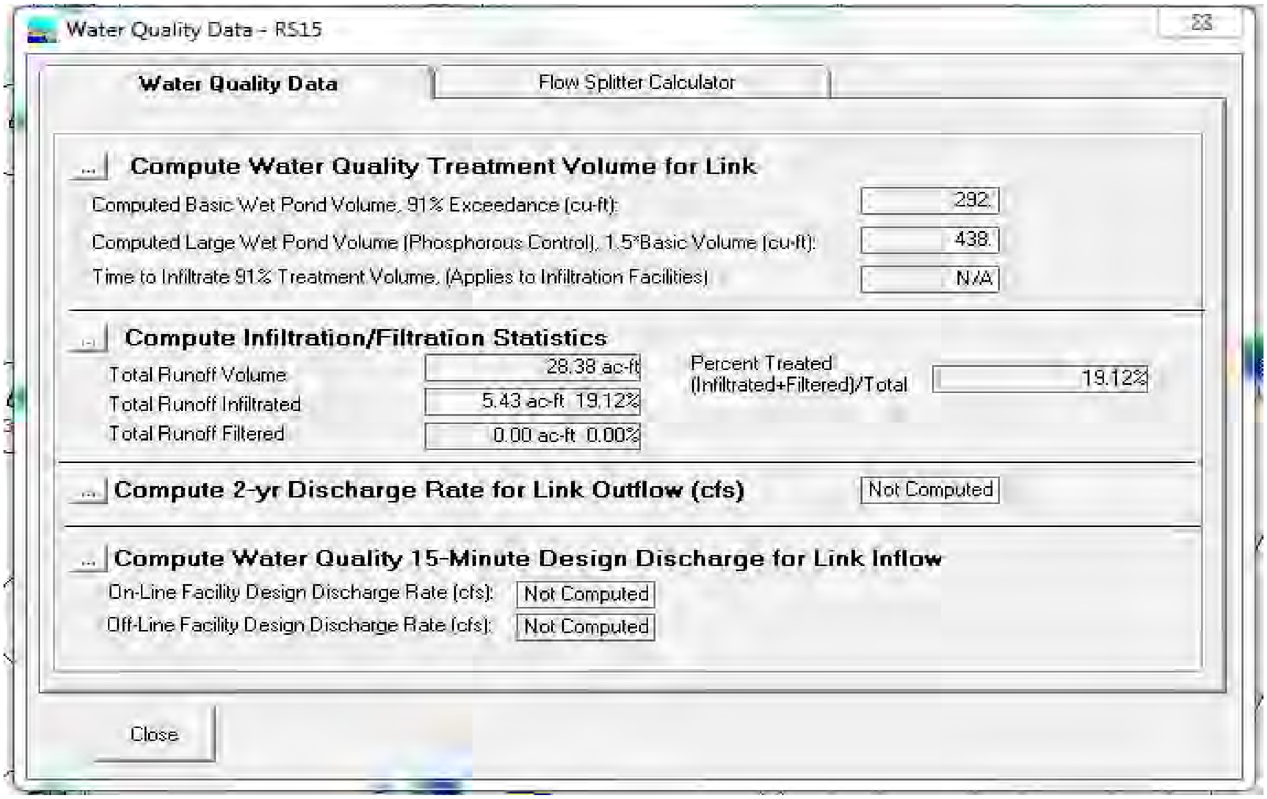
Not Computed

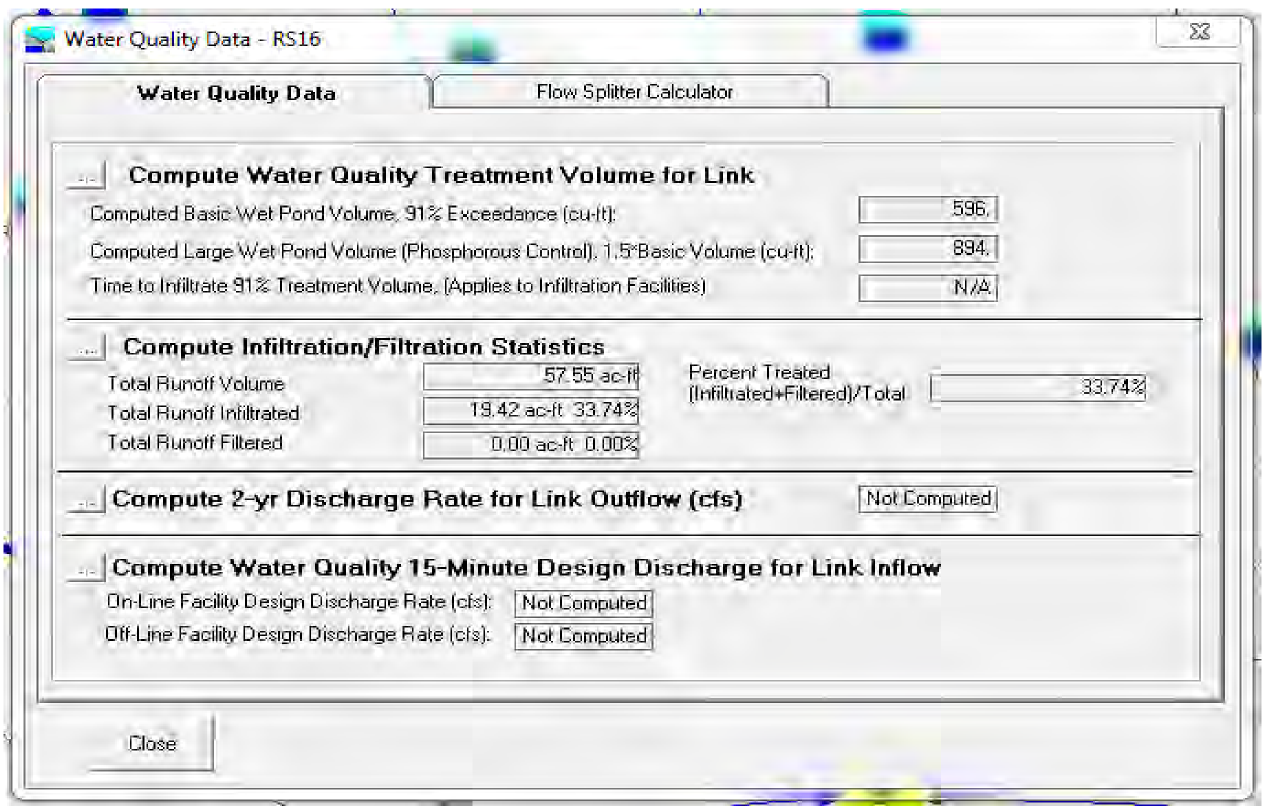
Compute Water Quality 15-Minute Design Discharge for Link Inflow

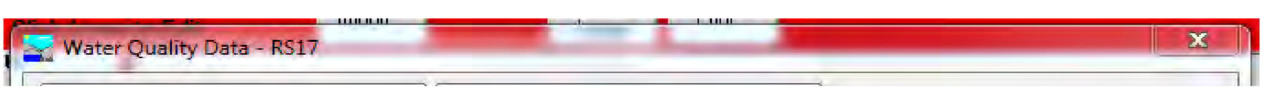
On-Line Facility Design Discharge Rate (cfs): Not Computed

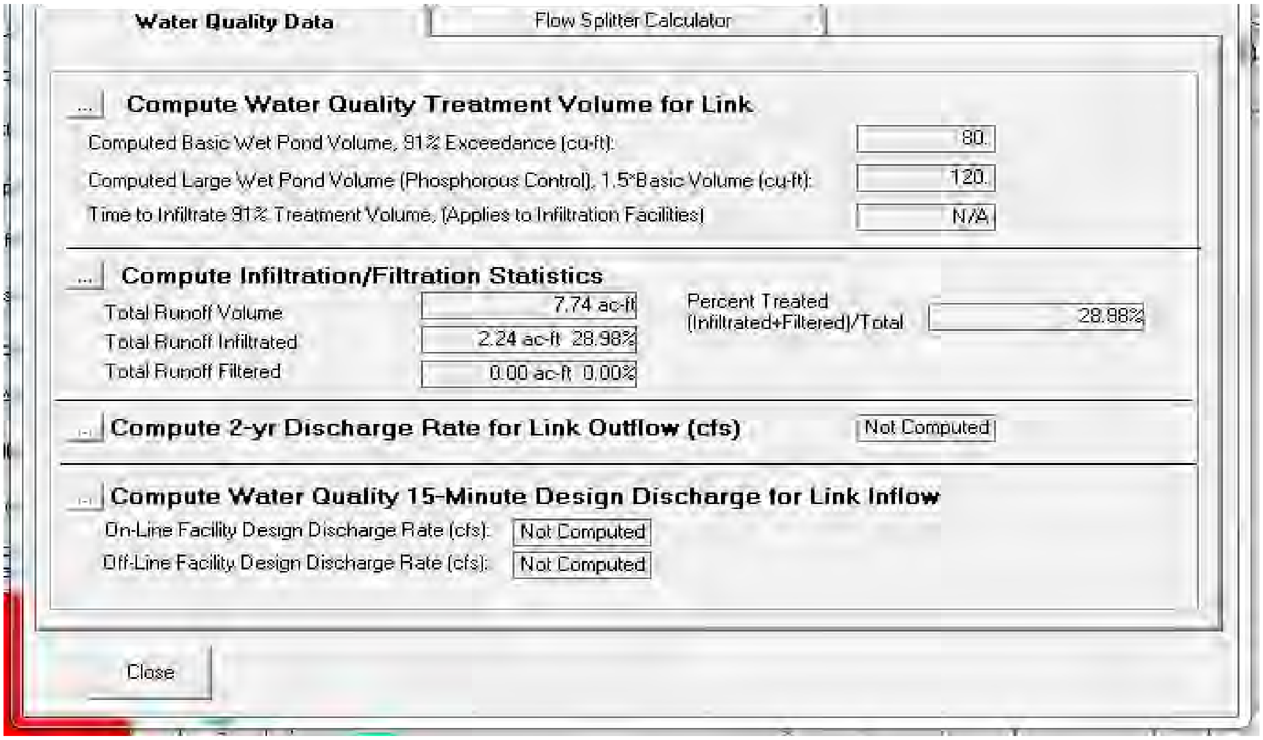
Off-Line Facility Design Discharge Rate (cfs): Not Computed

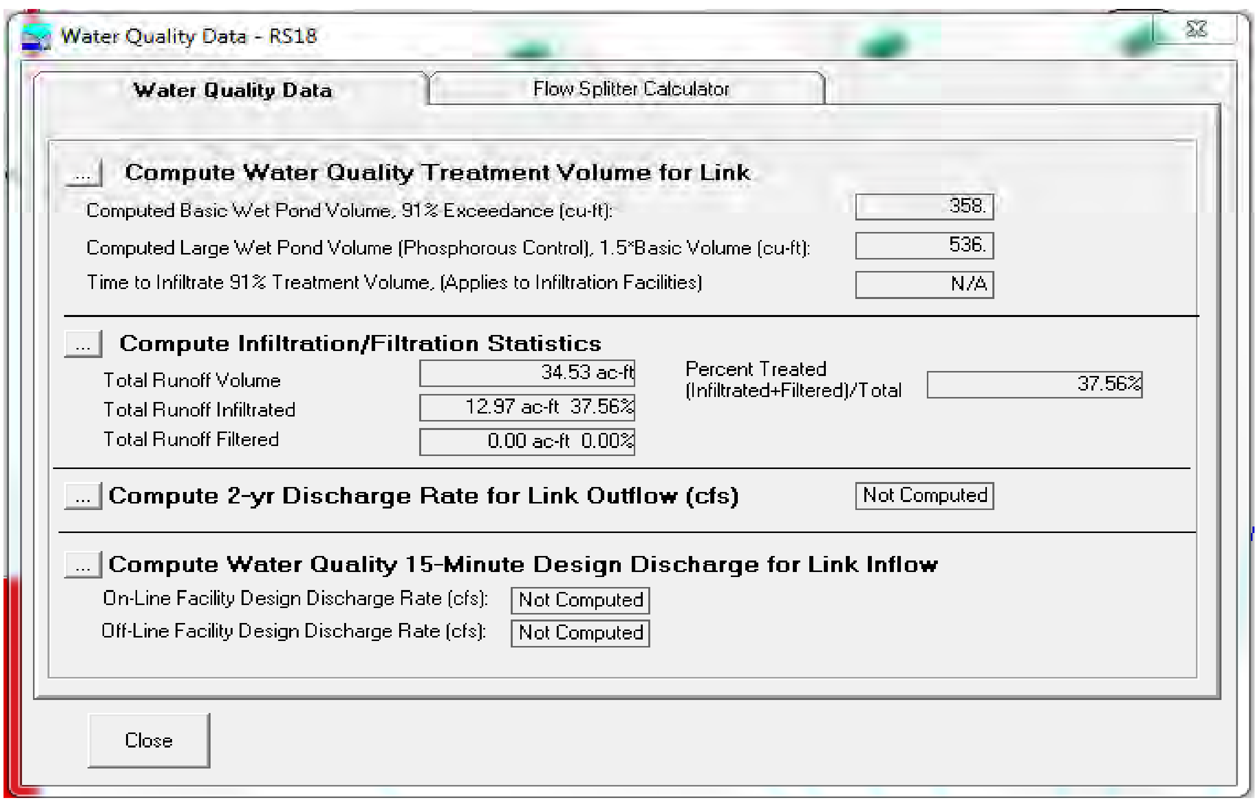
Close


Water Quality Data - RS15
Water Quality Data
Flow Splitter Calculator
Compute Water Quality Treatment Volume for Link
Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft): 292.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft): 438.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities) N/A
Compute Infiltration/Filtration Statistics
Total Runoff Volume 28.38 ac-ft
Total Runoff Infiltrated 5.43 ac-ft 19.12%
Total Runoff Filtered 0.00 ac-ft 0.00%
Percent Treated (Infiltrated+Filtered)/Total 19.12%
Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed
Compute Water Quality 15-Minute Design Discharge for Link Inflow
On-Line Facility Design Discharge Rate (cfs): Not Computed
Off-Line Facility Design Discharge Rate (cfs): Not Computed
Close


Water Quality Data - RS16
Water Quality Data
Flow Splitter Calculator
Compute Water Quality Treatment Volume for Link
Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft): 596.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft): 894.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities) N/A
Compute Infiltration/Filtration Statistics
Total Runoff Volume 57.55 ac-ft
Total Runoff Infiltrated 19.42 ac-ft 33.74%
Total Runoff Filtered 0.00 ac-ft 0.00%
Percent Treated (Infiltrated+Filtered)/Total 33.74%
Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed
Compute Water Quality 15-Minute Design Discharge for Link Inflow
On-Line Facility Design Discharge Rate (cfs): Not Computed
Off-Line Facility Design Discharge Rate (cfs): Not Computed
Close


Water Quality Data - RS17


Water Quality Data
Flow Splitter Calculator
Compute Water Quality Treatment Volume for Link
Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft): 80.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft): 120.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities) N/A
Compute Infiltration/Filtration Statistics
Total Runoff Volume 7.74 ac-ft
Total Runoff Infiltrated 2.24 ac-ft 28.98%
Total Runoff Filtered 0.00 ac-ft 0.00%
Percent Treated (Infiltrated+Filtered)/Total 28.98%
Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed
Compute Water Quality 15-Minute Design Discharge for Link Inflow
On-Line Facility Design Discharge Rate (cfs): Not Computed
Off-Line Facility Design Discharge Rate (cfs): Not Computed
Close


Water Quality Data - RS18
Water Quality Data
Flow Splitter Calculator
Compute Water Quality Treatment Volume for Link
Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft): 358.
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft): 536.
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities) N/A
Compute Infiltration/Filtration Statistics
Total Runoff Volume 34.53 ac-ft
Total Runoff Infiltrated 12.97 ac-ft 37.56%
Total Runoff Filtered 0.00 ac-ft 0.00%
Percent Treated (Infiltrated+Filtered)/Total 37.56%
Compute 2-yr Discharge Rate for Link Outflow (cfs) Not Computed
Compute Water Quality 15-Minute Design Discharge for Link Inflow
On-Line Facility Design Discharge Rate (cfs): Not Computed
Off-Line Facility Design Discharge Rate (cfs): Not Computed
Close

10.5 Appendix E – Ecology Water Quality Benefit Calculations

- MSG Flood – Developed: Proposed Facilities
- MGS Flood – Baseline: Ecology Standard Sized Facilities

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MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 03/01/2016 12:27 PM
Report Generation Date: 03/01/2016 12:27 PM

Input File Name:	Total Site WQ Dev.fld
Project Name:	Shoreline 148 WQ Developed
Analysis Title:	
Comments:	

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Timeseries Selected
Climatic Region Number: 1

Full Period of Record Available used for Routing
Precipitation Station : 95003205 Puget West 32 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951032 Puget West 32 in MAP
Evaporation Scale Factor : 0.750

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

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

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

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

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

-------Area(Acres) --------	
Till Forest	0.870
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
Subbasin Total	0.870

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

Number of Subbasins: 1

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

-------Area(Acres) --------	
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.170
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.691
Subbasin Total	0.861

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

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

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

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

--

Link Name: New Bio Lnk1
Link Type: Bioretention Facility
Downstream Link: None

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 20.6
Bottom Width (ft) : 19.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 391.
Area at Riser Crest El (sq-ft) : 519.
(acres) : 0.012
Volume at Riser Crest (cu-ft) : 462.
(ac-ft) : 0.011

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 40.00
Maximum Elevation of Bioretention Soil : 101.00

Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry

Riser Structure Type	: Circular
Riser Diameter (in)	: 24.00
Common Length (ft)	: 0.000
Riser Crest Elevation	: 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

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

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

********** Link: New Bio Lnk1 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.530
1.11-Year	100.535
1.25-Year	100.539
2.00-Year	100.548
3.33-Year	100.555
5-Year	100.559
10-Year	100.565
25-Year	100.573
50-Year	100.585
100-Year	100.597

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	114.864
Total:	114.864

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	17.007
Link: New Bio Lnk1	0.000
Total:	17.007

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.727 ac-ft/year, Post Developed: 0.108 ac-ft/year

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

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

Number of Links: 0

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

Number of Links: 1

********** Link: New Bio Lnk1 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 264.32
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 214.28, 81.07%
Percent Treated (Infiltrated+Filtered)/Total Volume: 81.07%

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

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Bio Lnk1

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.563E-02	2-Year	0.251
5-Year	2.629E-02	5-Year	0.327
10-Year	3.592E-02	10-Year	0.379
25-Year	4.246E-02	25-Year	0.457
50-Year	4.935E-02	50-Year	0.558
100-Year	5.631E-02	100-Year	0.669
200-Year	5.829E-02	200-Year	0.693

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

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

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 796.5% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 2855.8% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 100.0% FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

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

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 138.5% FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 796.5% FAIL

LID DURATION DESIGN CRITERIA: FAIL

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.37
Program License Number: 200910004
Project Simulation Performed on: 03/01/2016 12:30 PM
Report Generation Date: 03/01/2016 12:31 PM

Input File Name:	Total Site WQ Baseline.fld
Project Name:	Shoreline 148 WQ Baseline
Analysis Title:	
Comments:	

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Timeseries Selected
Climatic Region Number: 1

Full Period of Record Available used for Routing
Precipitation Station : 95003205 Puget West 32 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951032 Puget West 32 in MAP
Evaporation Scale Factor : 0.750

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

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

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

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

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

	-------Area(Acres) --------
Till Forest	0.870
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
Subbasin Total	0.870

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

Number of Subbasins: 1

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

-------Area(Acres) --------	
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.170
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.691
Subbasin Total	0.861

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

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

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

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

--

Link Name: New Bio Lnk1
Link Type: Bioretention Facility
Downstream Link: None

Base Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 100.50
Storage Depth (ft) : 0.50
Bottom Length (ft) : 35.0
Bottom Width (ft) : 19.0
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 665.
Area at Riser Crest El (sq-ft) : 836.
(acres) : 0.019
Volume at Riser Crest (cu-ft) : 773.
(ac-ft) : 0.018

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 2.00
Biosoil Porosity (Percent) : 40.00
Maximum Elevation of Bioretention Soil : 101.00

Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice NOT Present in Under Drain

Riser Geometry

Riser Structure Type	: Circular
Riser Diameter (in)	: 24.00
Common Length (ft)	: 0.000
Riser Crest Elevation	: 100.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

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

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

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

********** Link: New Bio Lnk1 ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.522
1.11-Year	100.527
1.25-Year	100.532
2.00-Year	100.544
3.33-Year	100.552
5-Year	100.556
10-Year	100.561
25-Year	100.566
50-Year	100.581
100-Year	100.593

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

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	114.864
Total:	114.864

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	17.007
Link: New Bio Lnk1	0.000
Total:	17.007

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.727 ac-ft/year, Post Developed: 0.108 ac-ft/year

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

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

Number of Links: 0

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

Number of Links: 1

********** Link: New Bio Lnk1 **********

Infiltration/Filtration Statistics--------------------
Total Runoff Volume (ac-ft): 264.93
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 242.01, 91.35%
Percent Treated (Infiltrated+Filtered)/Total Volume: 91.35%

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

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Bio Lnk1

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

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.563E-02	2-Year	0.238
5-Year	2.629E-02	5-Year	0.325
10-Year	3.592E-02	10-Year	0.363
25-Year	4.246E-02	25-Year	0.449
50-Year	4.935E-02	50-Year	0.535
100-Year	5.631E-02	100-Year	0.647
200-Year	5.829E-02	200-Year	0.692

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

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

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%): 714.6% FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%): 2337.3% FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%): 99999.0% FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%): 100.0% FAIL

FLOW DURATION DESIGN CRITERIA: FAIL

****** LID Duration Performance ******
Excursion at Predeveloped 8%Q2 (Must be Less Than 0%): 140.6% FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): 714.6% FAIL

LID DURATION DESIGN CRITERIA: FAIL

10.6 Appendix F – Rainstore3 Standard Details

- “Rainstore3 Unit Detail”
- “Rainstore3 System”
- “Porous Paving Inflow Method”
- “RS3 Maintenance Port”
- “Rainstore3 Bio-Retention Raingarden System”

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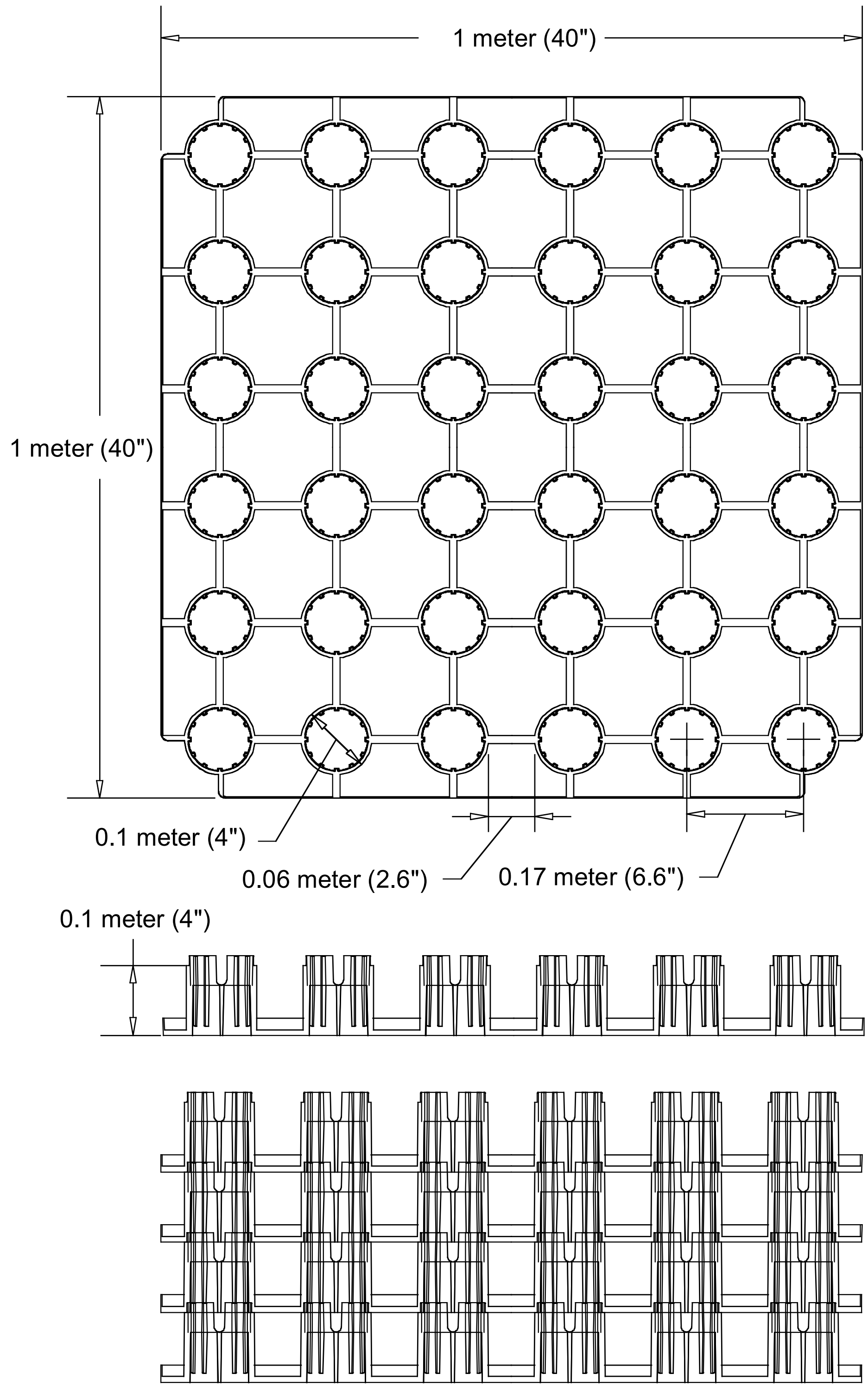
Rainstore3 Unit Dimensions



Rainstore3 Unit Detail

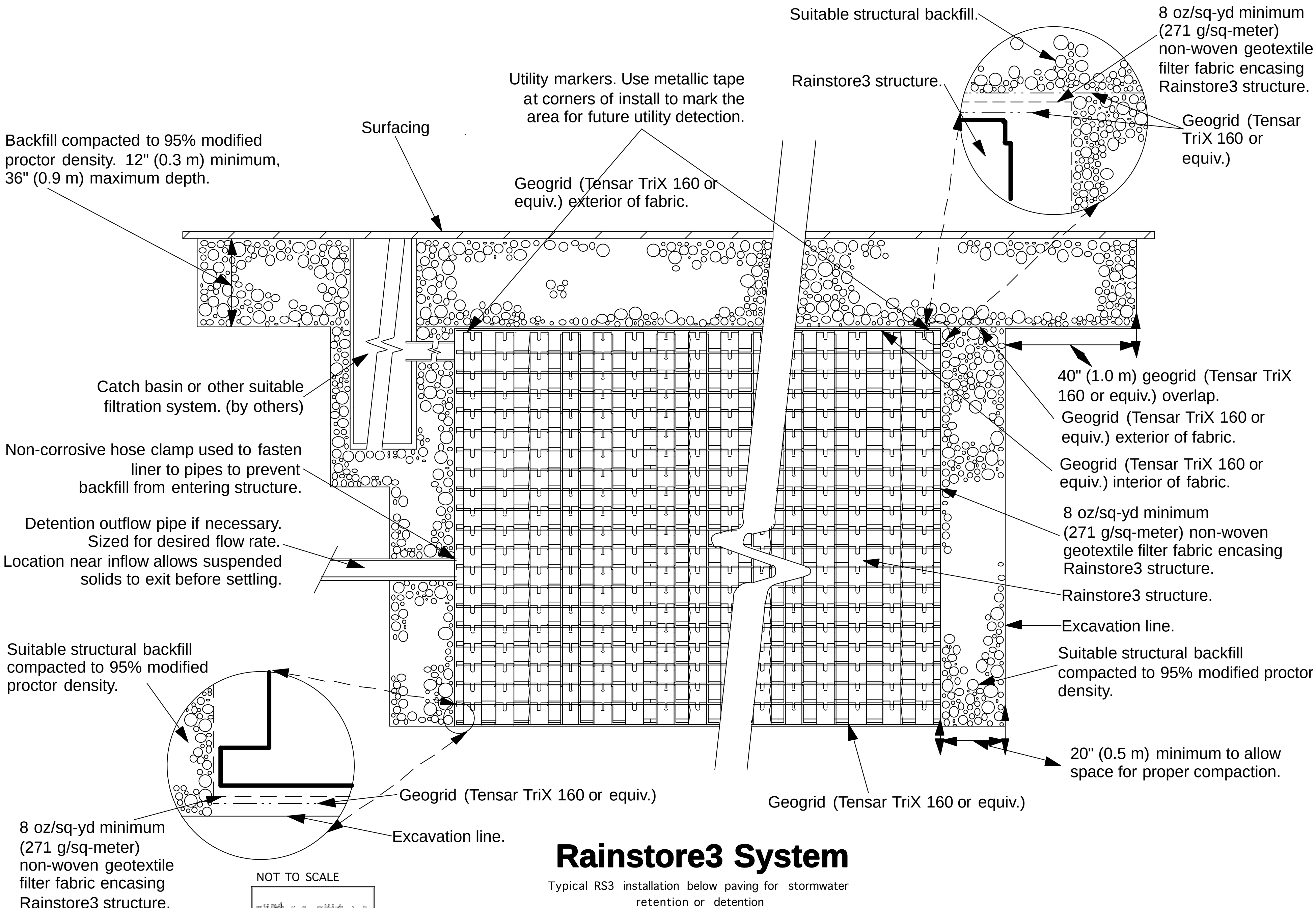
NOT TO SCALE

Single Rainstore3 injection molded unit geometry and dimensions

Invisible
Structures, Inc.

1600 Jackson St. Suite 310
Golden, Colorado 80401
800-233-1510 FAX: 800-233-1522
www.invisiblestructures.com 08/04

RS3detail.dwg

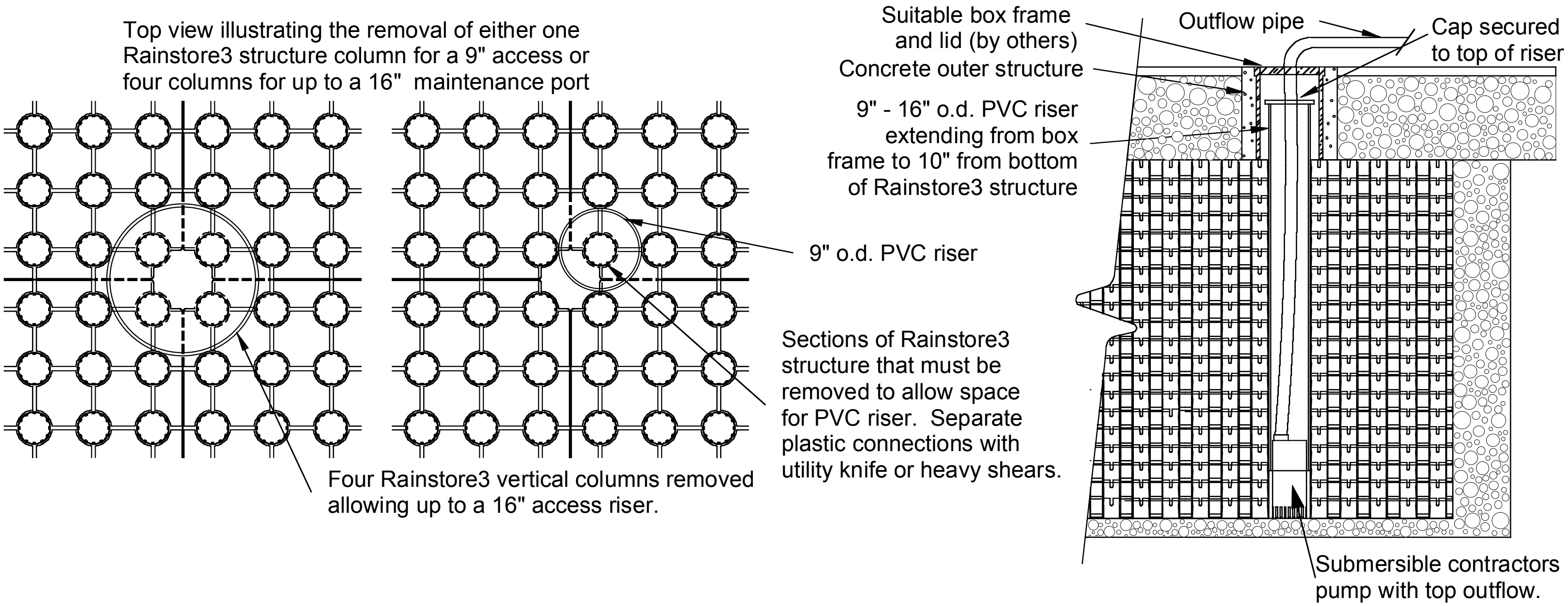


Rainstore3 System

Typical RS3 installation below paving for stormwater retention or detention

RS3detret10.dwg

1600 Jackson Street., Suite 310
Golden, Colorado 80401
800-233-1510 FAX:800-233-1522
www.invisiblestructures.com rev12/2010



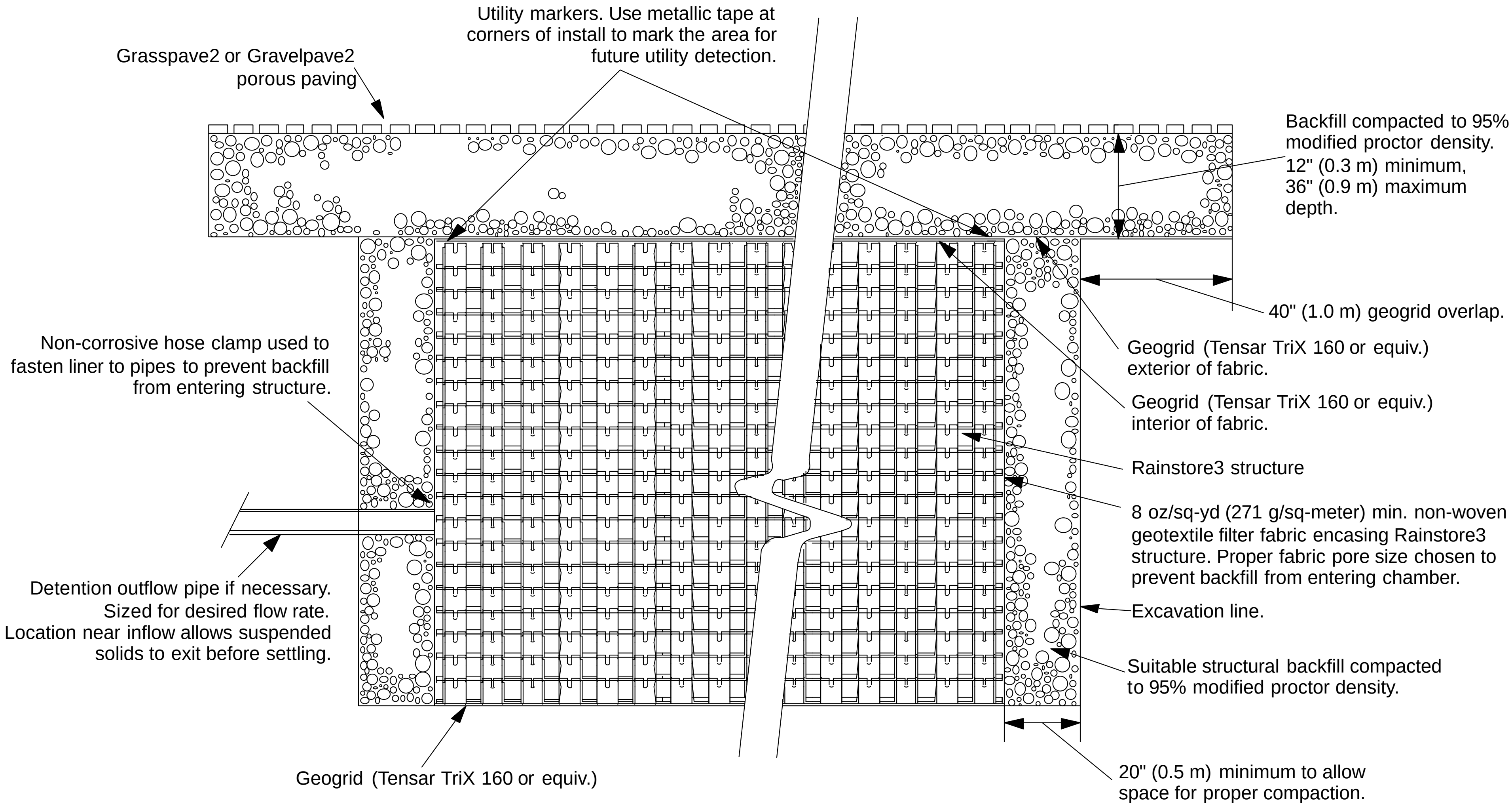
RS3 Maintenance Port

NOT TO SCALE

Method for providing inspection and cleanout access

Invisible
Structures, Inc.
RS3maintenport.dwg

1600 Jackson Street, Suite 310
Golden, Colorado 80401
800-233-1510 FAX: 800-233-1522
www.invisiblestructures.com 02/04



Porous Paving Inflow Method

Eliminates structural inlets and provides thorough filtration

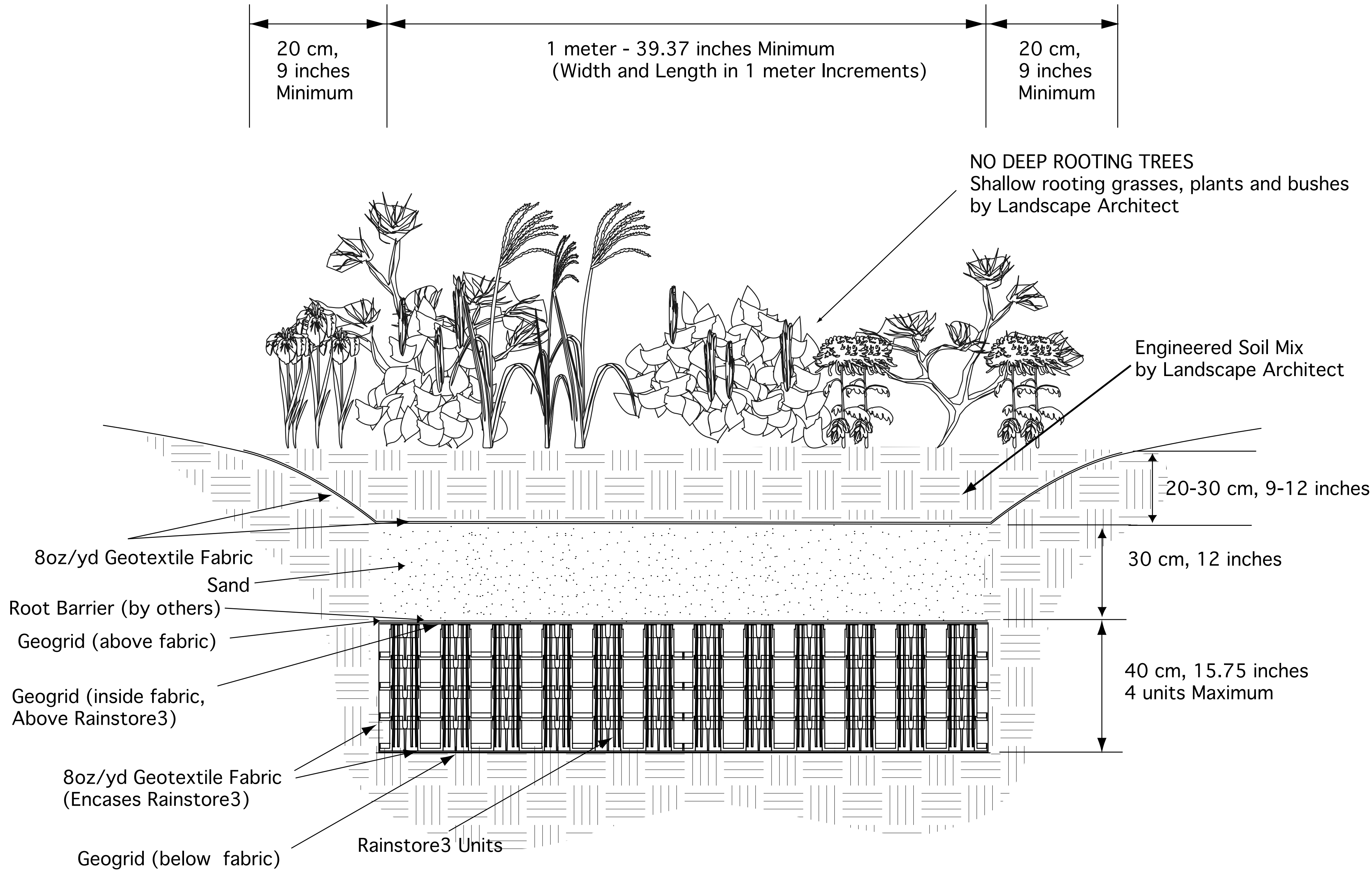
NOT TO SCALE

Invisible Structures, Inc.

RS3porouspaveinflow10.dwg

1600 Jackson Street, Suite 310
Golden, Colorado 80401
800-233-1510 FAX: 800-233-1522
www.invisiblestructures.com

rev. 12/2010



NOT TO SCALE

Rainstore3 Bio-Rentention Raingarden System

Rainstore3 Water Quality / Raingarden / Infiltration

1600 Jackson Street., Suite 310
Golden, Colorado 80401
800-233-1510 FAX: 800-233-1522
www.invisiblestructures.com
rev 05/2008

RS3rainGarden08.dwg

10.7 Appendix G – Summary of Probable Construction Cost Estimate

- Bioretention Facility
- Asphalt Surface
- Concrete Surface

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City of Shoreline, 148th
SvR Job # 13044.50
Prepared by RM, LK; Checked by LK, PB **July 18, 2014**
Bioretention Facility - Summary of Probable Construction Cost Estimate for Civil
Unit Size 6.7' W x 20'L x 4.33'D
Storage Volume within RS3 units beneath swale and within bioretention soils 400CF

DEMOLITION AND SITE PREPARATION

Item	Quantity	Unit	Unit Cost	Total Cost
Excavation*	47	CY	$ 25.00	$ 1,175.00
Geogrid (heavy duty soil stabilization material	62	SY	$ 2.43	$ 150.66
Geotextile (bioretention facility)	76	SY	$ 2.30	$ 174.80
Rainstore	84	Units	$ 22.50	$ 1,890.00
Bio Retention Soil Mix	6.6	CY	$ 80.00	$ 528.00
Bioretention Planting	225	SF	$ 10.00	$ 2,250.00
Maintenance Port (2/unit 9"pipe 4.5' long w/cap)	2	Each	$ 300.00	$ 600.00
Unclassified Borrow Backfill	30	TN	$ 28.00	$ 840.00
Mulch	1.75	CY	$ 45.00	$ 78.75
Beehive Grate + 4' of 8" SD Pipe**	1	Each	$ 270.00	$ 270.00
Catch Basin**	1	Each	$ 2,100.00	$ 2,100.00
8" PVC SD Pipe**	10	LF	$ 60.00	$ 600.00

subtotal		$ 10,657.21
design and administration		$ 3,197.16
Subtotal		**$ 13,854.37**
Contingency	30%	$ 4,156.31
Total		**$ 18,010.68**

Assumptions:
General Conditions not included
Taxes and Overhead not included
Agency Utility Connection Fees not included
*Estimate includes overexcavation along outer egdes of each unit, this cost will vary based on the number of consecutive units installed
**Units or sets of units will require an inlet and outlet structure. The costs associated with the CB's and piping for conveyance will vary dependant upon the number of consecutive units installed

SvR DESIGN COMPANY

City of Shoreline, 148th
SvR Job # 13044.50
Prepared by RM, LK; Checked by LK, PB **July 18, 2014**
Asphalt Surface - Summary of Probable Construction Cost Estimate for Civil
Unit Size 6.7' W x 20'L x 4.5'D
Storage Volume with RS3 Units beneath pavement 380CF

DEMOLITION AND SITE PREPARATION

Item	Quantity	Unit	Unit Cost	Total Cost
Excavation*	49	CY	$ 25.00	$ 1,225.00
Geogrid	62	SY	$ 2.43	$ 150.66
Geotextile	48	SY	$ 2.30	$ 110.40
Rainstore	108	Units	$ 22.50	$ 2,430.00
Maintenance Port (2/unit 9"pipe 4.5' long w/cap)	2	Each	$ 300.00	$ 600.00
Unclassified Borrow Backfill	24	TN	$ 28.00	$ 672.00
2" Asphalt Paving	3.5	TN	$ 200.00	$ 700.00
4" ATB	33	SY	$ 17.80	$ 587.40
12" Mineral Aggregate Type 2	11	CY	$ 66.00	$ 726.00
Catch Basin**	2	Each	$ 2,100.00	$ 4,200.00
8" PVC SD Pipe**	10	LF	$ 60.00	$ 600.00

subtotal		$ 12,001.46
design and administration		$ 3,600.44
Subtotal		**$ 15,601.90**
Contingency	30%	$ 4,680.57
Total		**$ 20,282.47**

Assumptions:
General Conditions not included
Taxes and Overhead not included
Agency Utility Connection Fees not included
*Estimate includes overexcavation along outer egdes of each unit, this cost will vary based on the number of consecutive units installed
**Units or sets of units will require an inlet and outlet structure. The costs associated with the CB's and piping for conveyance will vary dependant upon the number of consecutive units installed or the units adjacency to bioretention inflows

SvR DESIGN COMPANY

City of Shoreline, 148th
SvR Job # 13044.50
Prepared by RM, LK; Checked by LK, PB **July 18, 2014**

Concrete Surface - Summary of Probable Construction Cost Estimate for Civil
Unit Size 6.7' W x 20'L x 4.5'D
Storage Volume with RS3 Units beneath pavement 380CF

DEMOLITION AND SITE PREPARATION

Item	Quantity	Unit	Unit Cost	Total Cost
Excavation*	49	CY	$ 25.00	$ 1,225.00
Geogrid	62	SY	$ 2.43	$ 150.66
Geotextile	48	SY	$ 2.30	$ 110.40
Rainstore	108	Units	$ 22.50	$ 2,430.00
Maintenance Port (2/unit 9"pipe 4.5' long w/cap)	2	Each	$ 300.00	$ 600.00
Unclassified Borrow Backfill	24	TN	$ 28.00	$ 672.00
6" Concrete Pavement	32.5	SY	$ 72.00	$ 2,340.00
12" Mineral Aggregate Type 2	11	CY	$ 66.00	$ 726.00
Catch Basin**	2	Each	$ 2,100.00	$ 4,200.00
8" PVC SD Pipe**	10	LF	$ 60.00	$ 600.00

subtotal		$ 13,054.06
design and administration		$ 3,916.22
Subtotal		**$ 16,970.28**
Contingency	30%	$ 5,091.08
Total		**$ 22,061.36**

Assumptions:
General Conditions not included
Taxes and Overhead not included
Agency Utility Connection Fees not included
*Estimate includes overexcavation along outer egdes of each unit, this cost will vary based on the number of consecutive units installed
**Units or sets of units will require an inlet and outlet structure. The costs associated with the CB's and piping for conveyance will vary dependant upon the number of consecutive units installed or the units adjacency to bioretention inflows

City of Shoreline, 148th
SvR Job # 13044.50
Prepared by RM, LK; Checked by LK, PB **August 26, 2014**
Gravel Surface - Summary of Probable Construction Cost Estimate for Civil
Unit Size 6.7' W x 20'L x 4.5'D
Storage Volume with RS3 Units beneath pavement 380CF

DEMOLITION AND SITE PREPARATION

Item	Quantity	Unit	Unit Cost	Total Cost
Excavation*	49	CY	$ 25.00	$ 1,225.00
Geogrid	62	SY	$ 2.43	$ 150.66
Geotextile	48	SY	$ 2.30	$ 110.40
Rainstore	108	Units	$ 22.50	$ 2,430.00
Maintenance Port (2/unit 9"pipe 4.5' long w/cap)	2	Each	$ 300.00	$ 600.00
Unclassified Borrow Backfill	24	TN	$ 28.00	$ 672.00
6" Concrete Pavement	32.5	CY	$ 72.00	$ 2,340.00
1/4" Minus Crushed Surfacing Top Course (4")	11	CY	$ 55.00	$ 605.00
Catch Basin**	2	Each	$ 2,100.00	$ 4,200.00
8" PVC SD Pipe**	10	LF	$ 60.00	$ 600.00

subtotal		$ 12,933.06
design and administration		$ 3,879.92
Subtotal		**$ 16,812.98**
Contingency	30%	$ 5,043.89
Total		**$ 21,856.87**

Assumptions:
General Conditions not included
Taxes and Overhead not included
Agency Utility Connection Fees not included
*Estimate includes overexcavation along outer egdes of each unit, this cost will vary based on the number of consecutive units installed
**Units or sets of units will require an inlet and outlet structure. The costs associated with the CB's and piping for conveyance will vary dependant upon the number of consecutive units installed or the units adjacency to bioretention inflows

10.8 Appendix H – Ecology Historical & Cultural Resources Review, EZ1

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PROJECT REVIEW SHEET – EZ1
HISTORIC & CULTURAL RESOURCES REVIEW

PROPERTY / CLIENT NAME: City of Shoreline **FUNDING AGENCY:** WA State Dept of Ecology, City of Shoreline

Project Applicant:	City of Shoreline		
Contact Person:	John Featherstone		
Address:	17500 Midvale Avenue N		
City, State:	Shoreline **Zip:** 98133-4905	**County:**	King
Phone/ FAX:	Ph 206-801-2478/Fx 206-801-2785		
E-Mail:	jfeatherstone@shorelinewa.gov		

Funding Agency:

Organization:	WA State Depy of Ecology / City of Shoreline
Address:	300 Desmond Drive
City, State:	Lacey, WA **Zip:** 98503-1274
Phone:	360-407-6000

PLEASE DESCRIBE THE TYPE OF WORK TO BE COMPLETED
(Be as detailed as possible to avoid having to provide additional information)

☐ **Provide a detailed description of the proposed project:**

The project site is located along NE 148th Street between 12th and 15th Avenues NE. The project proposes to use shallow storage and infiltration facilites in the right-of-way along the shoulder of a primarily residential/multi-family street to control and infiltrate surface runoff. The street is a closed depression with periodic, nuisance flooding. Based on geotechnicall investigations, the site is underlain with a shallow lens of outwash soils that the City of Shoreline wishes to access to help allievate the flooding issues. Through a feasibility anaylsis of many infiltration facility technologies and BMPs, the City has determined that the most feasible infiltration facility is the proprietary RainStore3® units for temporary storage and infiltration with either bioretention facilities or pavement surface treatments with catchbasin inlets to the RainStore3® facilities.The two configurations will be applied based on current uses at the particular location and also to direct future use of the right-of-way shoulder along the street.

☐ **Describe the existing project site conditions:**

The closed depression at NE 148th Street is the low point of an approximately 9.8-acre basin bounded roughly by 15th Avenue NE and NE 147th Street on the north and south sides respectively, and by 12th Avenue NE and 15th Avenue NE on the west and east sides respectively. This area is the rough estimation of the drainage basin taken from the King County Geographic Information System (GIS) Mapping program. Within this "maximum basin" (9.8 acres), there are several large developments that have existing stormwater infrastructure and likely redirect stormwater runoff from as much as 4.0-acres of land into the existing pipe infrastructure system. This reduces the total surface area likely contributing stormwater to the low point on NE 148th Street to approximately 5.8-acres, defined as the "full basin". Within the full basin, approximately 0.80-acre is paved right-of-way which is the facility design area. Using aerial imaging from the King County GIS Mapping program, the full basin is estimated to be approxiamtely 50% pervious/impervious and the design basin is approximately 100% impervious with surface coverage being comprised of asphalt pavement, gravel shoulders, and limited tree overhang into the right-of-way.

☐ **Describe the proposed ground disturbing activities:**

Ground disturbing activities will include excavation at select locations along the edges of the right-of-way along NE 148th Street between 12th and 15th Avenues NE. Due to existing trees and utilities, the excavations will be limited to a maximum of 13 locations along the shoulder of the right-of-way with the largest finished facility of approximately 2,000 sf (approximately 20ft x 100ft). Total depth of the facilities are approximately 5 ft.

☐ **Check if building(s) will be altered or demolished. If so please complete a DAHP Determination of Eligibility "EZ2 form" using our on-line Historic Property Inventory Database for each building effected by the proposed project.**

PLEASE ATTACH A COPY OF THE RELEVANT PORTION OF A 7.5 SERIES USGS QUAD MAP AND OUTLINE THE PROJECT INPACT AREA.
USGS Quad maps are available on-line at **http://maptech.mytopo.com/onlinemaps/index.cfm**

Project Location

Township: 06 N **Range:** 4 E **Section:** SE 1/4 SEC 17

Address: NE 148th St between 12th and 15th Avenues NE **City:** Shoreline **County:** King

- To paste the USGS quad map and outline the project area on the map in the box below, unlock the document by going into the Review tab/menu, "protect document," 'restrict formatting and editing," and "stop protection".
- Mark location of project on map.

The Department of Ecology will mail this form to:

Department of Archaeology and Historic Preservation
1063 S. Capitol Way, Suite 106
P.O. Box 48343
Olympia, WA 98504-8343

or E-mail to:

Robert Whitlam, Ph.D.
State Archaeologist, DAHP
(360) 586-3080
rob.whitlam@dahp.wa.gov

(Within 30 days DAHP will mail their opinion back to you.)

Please be aware that this form may only initiate consultation. For some projects, DAHP may require additional information to complete our review such as plans, specifications, and photographs. An historic property inventory form may need to be completed by a qualified preservation professional.

10.9 Appendix I – 95% Plan Set

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CITY OF SHORELINE

17500 Midvale Avenue North
Shoreline, WA 98133
(206) 801-2700

SHORELINE CITY COUNCIL

SHARI WINSTEAD
MAYOR

CHRIS EGGEN
DEPUTY MAYOR

CHRISTOPHER ROBERTS
DORIS McCONNELL
JESS SALOMON
KEITH McGLASHAN
WILL HALL

DIRECTOR OF PUBLIC WORKS
MARK RELPH, P.E.

PROJECT MANAGER
JOHN FEATHERSTONE, P.E.

CIVIL ENGINEER
SvR DESIGN COMPANY
PATTY BUCHANAN, P.E.

LANDSCAPE ARCHITECT
SvR DESIGN COMPANY
BRICE MARYMAN, P.L.A.

NE 148th Street
Infiltration Facilities

A PORTION OF THE SE 1/4, SEC 17, TWP 26 N, RGE 4 E, W.M.

Bid Number:

Date: NOVEMBER 2014, 95% GRANT APPLICATION SET
NOT FOR CONSTRUCTION

APPROVED FOR CONSTRUCTION

TRICIA JUHNKE, P.E., CITY ENGINEER   DATE

Funded in Part by Washington State Department of Ecology

INDEX OF SHEETS

SHEET	PAGE NUMBER	DESCRIPTION
COVER	1	COVER SHEET
C0.1	2	CITY OF SHORELINE STANDARD NOTES
C0.2	3	NOTES
C0.3	4	TOPOGRAPHIC SURVEY (EXISTING SITE)
C0.4	5	TOPOGRAPHIC SURVEY (EXISTING SITE)
C1.0	6	TESC AND DEMOLITION, PHASE 3
C1.1	7	TESC AND DEMOLITION, PHASE 2
C1.2	8	TESC AND DEMOLITION, PHASE 1
C2.0	9	STORM DRAIN PLAN AND PROFILE, PHASE 3
C2.1	10	STORM DRAIN PLAN AND PROFILE, PHASE 2
C2.2	11	STORM DRAIN PLAN AND PROFILE, PHASE 1
C3.0	12	PAVING AND GRADING, PHASE 3
C3.1	13	PAVING AND GRADING, PHASE 2
C3.2	14	PAVING AND GRADING, PHASE 1
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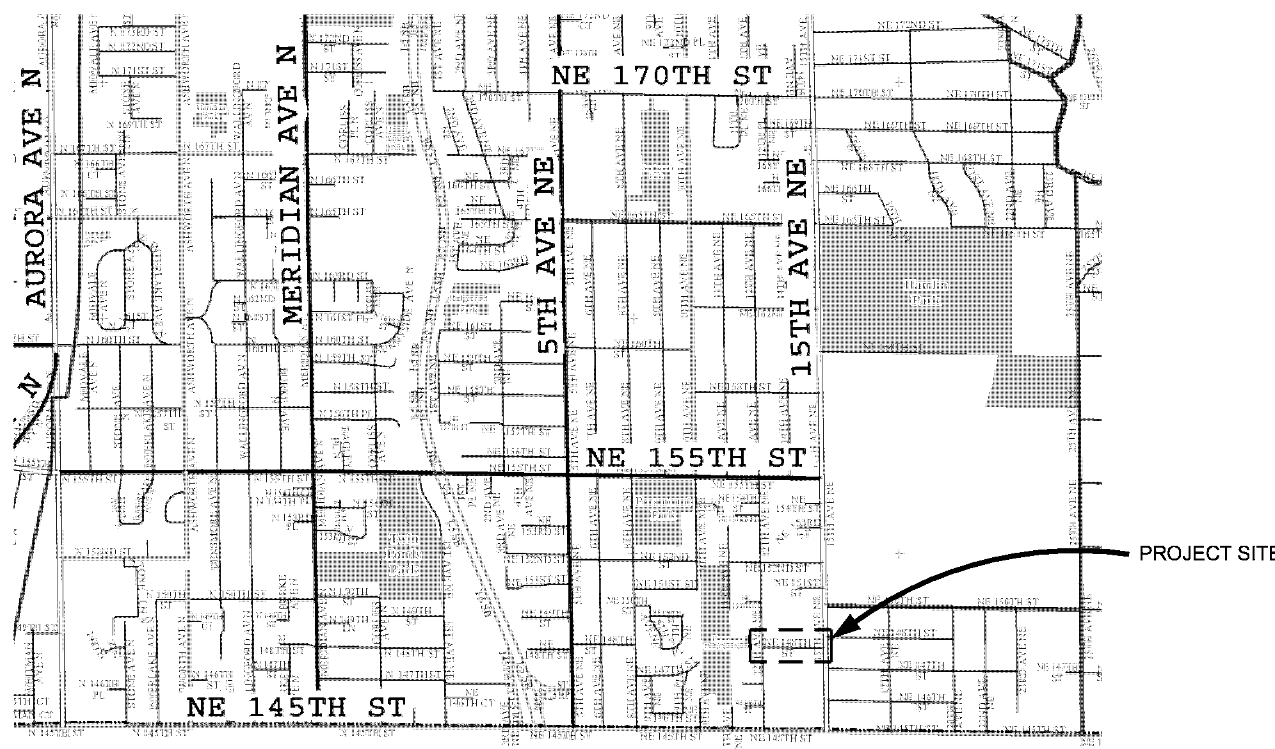
D1.0	18	DETAILS, CIVIL
D1.1	19	DETAILS, CIVIL
D1.2	20	DETAILS, INVISIBLE STRUCTURES
D1.3	21	DETAILS, INVISIBLE STRUCTURES
D1.4	22	DETAILS, LANDSCAPE

SERVICES

ELECTRICAL:	SEATTLE CITY LIGHT (206) 684-3000
NATURAL GAS:	PUGET SOUND ENERGY (888) 225-5773
TELEPHONE:	CENTURY LINK (800) 244-1111 or FRONTIER (877) 462-8188
CABLE:	COMCAST (877) 824-2288 or FRONTIER (877) 462-8188
WASTEWATER (SEWER):	RONALD WASTEWATER DISTRICT (206) 546-2494
WATER:	SHORELINE WATER DISTRICT (206) 362-8100 or SEATTLE PUBLIC UTILITIES (206) 684-3000
STATION MASTER/ POST OFFICE:	17233 15th Ave NE (800) 275-8777
CALL BEFORE YOU DIG	(800) 424-5555

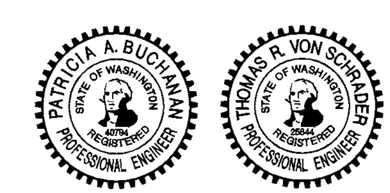


LOCATION MAP   NTS
SHORELINE, WA

SURVEYOR: Lin and Associates
901 5th Ave., Suite 1610
Seattle, WA 98164
(206) 621-1218
Dates of field surveys: December 2012

Horizontal Datum/Basis of Bearings
North American Datum of 1983 (Adjusted 1991) -NAD83
Washington State Plane Coordinate System - North Zone 83/91

Vertical Datum/Basis of Elevations
North American Vertical Datum of 1988 - NAVD88



QA/QC REVIEWER

CALL TWO BUSINESS DAYS BEFORE YOU DIG
1-800-424-5555

CITY OF SHORELINE (COS) STANDARD PLAN NOTES

GENERAL NOTES:

1. THE CONTRACTOR SHALL ADHERE TO ALL APPLICABLE NOTES UNLESS OTHERWISE DIRECTED BY THESE PLANS, THE ENGINEER OR A CITY OF SHORELINE REPRESENTATIVE.
2. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. ALL WORK SHALL COMPLY WITH, IN ORDER OF PRECEDENCE:
   * THE CITY OF SHORELINE "ENGINEERING DEVELOPMENT MANUAL", 2012 EDITION (SHORELINE STANDARDS AND SHORELINE ENGINEERING DETAILS).
   * WSDOT/APWA "2014 STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION" (WSDOT/APWA).
3. THE CONTRACTOR SHALL VERIFY ALL EXISTING DATA SHOWN IN THESE DOCUMENTS AND NOTIFY ENGINEER IMMEDIATELY OF ANY CONFLICTS WITH PROPOSED FEATURES PRIOR TO CONSTRUCTION.
4. ALL COMPACTION METHODS, MATERIALS AND PERFORMANCE CRITERIA SHALL BE IN ACCORDANCE WITH THE PROJECT PLANS AND SPECIFICATIONS.
5. ALL EXISTING AND PROPOSED CATCH BASINS DOWNSTREAM OF DISTURBED AREA SHALL BE PROTECTED DURING CONSTRUCTION PER THE WSDOT STD PLAN I-40.20-00.
6. STORM DRAINAGE (SD) PIPE SHALL BE CORRUGATED POLYETHYLENE PIPE WITH SMOOTH INTERIOR WALLS UNLESS NOTED OTHERWISE.
7. ALL PIPE LENGTHS, INVERT ELEVATIONS AND DRAINAGE STRUCTURE LOCATIONS ARE MEASURED AT THE CENTER OF THE DRAINAGE STRUCURE UNLESS NOTED OTHERWISE.
8. ALL LOCATIONS OF EXISTING UTILITIES SHOWN HAVE BEEN ESTABLISHED BY FIELD SURVEY OR OBTAINED FROM AVAILABLE RECORDS AND SHOULD THEREFORE BE CONSIDERED APPROXIMATE ONLY AND NOT NECESSARILY COMPLETE. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE ACCURACY OF ALL UTILITY LOCATIONS SHOWN AND AVOID OTHER UTILITIES NOT SHOWN ON THE PLANS. EXISTING UTILITIES SHALL BE PROTECTED, SUPPORTED, OR MAINTAINED DURING CONSTRUCTION.
9. CONTACT THE UNDERGROUND UTILITIES LOCATION SERVICE (1-800-424-5555) AT LEAST 48 HOURS PRIOR TO CONSTRUCTION.
10. SEE THE PROJECT SPECIFICATIONS FOR ADDITIONAL INFORMATION.

COS SITE NOTES (SN)

SN.1. THE CONTRACTOR SHALL HAVE ANY REQUIRED PERMIT(S) AND CONDITIONS AND THE APPROVED PLANS AVAILABLE AT THE JOB SITE.

SN.2. ALL WORK SHALL CONFORM TO THESE APPROVED PLANS AND SPECIFICATIONS, THE SHORELINE MUNICIPAL CODE, THE ENGINEERING DEVELOPMENT GUIDE, AND FEDERAL AND STATE REQUIREMENTS.

SN.3. ALL INSTALLATION METHODS AND MATERIALS SHALL MEET THE WSDOT/APWA STANDARD SPECIFICATIONS.

SN.4. ANY CHANGES FROM THE APPROVED PLANS REQUIRE PRE-APPROVAL FROM THE ENGINEER.

SN.5. SEE SPECIFICATIONS SECTION 1-08.0(2) FOR HOURS OF WORK.

SN.6. NOT USED.

SN.7. LOCATIONS FOR EXISTING UTILITIES ARE APPROXIMATE.

SN.8. THE CONTRACTOR ASSUMES SOLE RESPONSIBILITY FOR WORKER SAFETY AND DAMAGE FROM CONSTRUCTION OPERATIONS TO STRUCTURES AND OTHER IMPROVEMENTS.

SN.9. SURVEYING FOR PUBLIC FACILITIES SHALL BE PERFORMED UNDER THE DIRECTION OF A WASHINGTON LICENSED LAND SURVEYOR. VERTICAL DATUM SHALL BE NAVD 1988. HORIZONTAL DATUM SHALL BE WASHINGTON STATE (GRID) COORDINATES, NORTH ZONE, USING NAD 83/91 SURVEY CONTROL AND TO ANY TWO CITY OF SHORELINE HORIZONTAL CONTROL MONUMENTS. FOR PROJECTS WITHIN A FLOOD CONTROL ZONE, THE SURVEYOR SHALL PROVIDE CONVERSION CALCULATIONS TO NGVD 1929.

SN.10. REPLACE OR RELOCATE ALL SIGNS, STRIPING, POLES AND OTHER ITEMS IN THE RIGHT-OF-WAY THAT ARE DAMAGED OR REMOVED DURING CONSTRUCTION.

SN.11. RETAIN, REPLACE OR RESTORE ALL VEGETATION IN RIGHTS-OF-WAY, EASEMENTS, AND ACCESS TRACTS DISTURBED DURING CONTRACTION.

SN.12. INTERRUPTION OF NORMAL TRAFFIC FLOW SHALL REQUIRE TRAFFIC CONTROL. REFER TO THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) AND WSDOT STANDARD SPECIFICATIONS. TRAFFIC CONTROL IS REQUIRED FOR ALL TRANSVERSE CUTS IN ROADWAY. FOR INFORMATION CONTACT THE CITY OF SHORELINE RIGHT-OF-WAY INSPECTOR.

SN.13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE SAFEGUARDS, SAFETY DEVICES, PROTECTIVE EQUIPMENT, FLAGGERS, AND ANY OTHER NEEDED ACTIONS TO PROTECT THE LIFE, HEALTH, AND SAFETY OF THE PUBLIC, AND TO PROTECT PROPERTY IN CONNECTION WITH THE PERFORMANCE OF WORK COVERED BY THE CONTRACTOR. ANY WORK WITHIN THE TRAVELED RIGHT-OF-WAY REQUIRES A RIGHT-OF-WAY USE PERMIT, TO BE REVIEWED PRIOR TO CONSTRUCTION AND INSPECTED DURING CONSTRUCTION.

SN.14. THE CONTRACTOR SHALL RESTORE TO CURRENT STANDARDS CRITICAL AREAS, AND PUBLIC AND PRIVATE PROPERTY DAMAGED BY CONTRACTOR'S OPERATIONS.

SN.15. AT ALL TIMES MAINTAIN ACCESS TO BUILDINGS FOR FIRE, PEDESTRIAN AND VEHICULAR ACCESS.

SN.16. BEFORE BEGINNING ANY CONSTRUCTION ACTIVITIES, ESTABLISH CLEARING LIMITS, INSTALL CONSTRUCTION ENTRANCE, AND INSTALL BEST MANAGEMENT PRACTICES.

SN17. ALL UTILITY TRENCHES AND ROADWAY SUBGRADES WITHIN CITY RIGHT-OF-WAY SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH KING COUNTY ROAD STANDARDS. 100% CRUSHED ROCK OR CONTROLLED DENSITY FILL (CDF)

COS SITE GRADING CONDITIONS (SG)

SG.1. THIS PERMIT IS BEING APPROVED SUBJECT TO THE CONDITIONS IN THE SHORELINE MUNICIPAL CODE. ALL APPLICABLE CITY, STATE AND FEDERAL REQUIREMENTS APPLY.

SG.2. BEFORE ANY CLEARING OR GRADING OCCURS, MARK CLEARING LIMITS IN A PROMINENT AND DURABLE MANNER. MAINTAIN UNTIL FINAL APPROVAL.

SG.3. NO SLOPE OF CUT AND FILL SURFACES SHALL BE STEEPER THAN IS SAFE FOR THE INTENDED USE AND SHALL NOT EXCEED THREE (3) HORIZONTAL TO ONE (1) VERTICAL, UNLESS OTHERWISE APPROVED.

SG.4. ALL DISTURBED AREAS INCLUDING FACES OF CUT AND FILL SLOPES SHALL BE PREPARED AND MAINTAINED TO CONTROL EROSION. THIS CONTROL MAY CONSIST OF EFFECTIVE PLANTING. THE PROTECTION FOR THESE AREAS SHALL BE INSTALLED AND MAINTAINED AS SOON AS PRACTICAL AND PRIOR TO BOND RELEASE.

SG.5. THE GROUND SURFACE SHALL BE PREPARED TO RECEIVE FILL BY REMOVING UNSUITABLE MATERIAL SUCH AS CONCRETE SLABS, TREE STUMPS AND BRUSH.

SG.6. PROVISIONS SHALL BE MADE TO PREVENT ANY SURFACE WATER OR SEEPAGE FROM DAMAGING THE CUT FACE OF ANY EXCAVATION OR THE SLOPING FACE OF A FILL. CARRY ANY SURFACE WATER THAT IS OR MIGHT BE CONCENTRATED AS A RESULT OF A FILL OR EXCAVATION TO A NATURAL WATERCOURSE OR DESIGNATED RETENTION FACILITY. PREVENT ANY SEDIMENT FROM LEAVING THE SITE.

SG.7. ACCESS ROADS TO GRADING SITES SHALL BE MAINTAINED AND LOCATED TO THE SATISFACTION OF THE CITY OF SHORELINE, TO MINIMIZE THE PROBLEMS OF DUST, MUD AND CIRCULATION.

SG.8. SIGNS OF WARNING OF HAZARDOUS CONDITIONS, IF SUCH EXIST, SHALL BE AFFIXED AT LOCATIONS AS REQUIRED BY THE ENGINEER.

SG.9. FENCING, WHERE REQUIRED, TO PROTECT LIFE, LIMB AND PROPERTY, SHALL BE INSTALLED WITH LOCKABLE GATES WHICH MUST BE CLOSED AND LOCKED WHEN NOT WORKING THE SITE. THE FENCE MUST BE NO LESS THAN FIVE (5) FEET IN HEIGHT AND THE FENCE MATERIAL SHALL HAVE NO HORIZONTAL OPENING LARGER THAN TWO (2) INCHES.

SG.10. THE TOPS AND THE TOES OF CUT AND FILL SLOPES SHALL BE SET BACK FROM STRUCTURES AS FAR AS IS NECESSARY FOR ADEQUACY OF FOUNDATION SUPPORT AND TO PREVENT DAMAGE AS A RESULT OF WATER RUNOFF OR EROSION OF THE SLOPES.

COS EROSION AND SEDIMENTATION CONTROL REQUIREMENTS (TESC)

TESC.1. THE IMPLEMENTATION AND MAINTENANCE OF EROSION CONTROL FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR ON A DAILY BASIS AND UNTIL ALL CONSTRUCTION IS APPROVED.

TESC.2. AT ALL TIMES PROTECT CRITICAL AREAS AND THEIR BUFFERS, ADJACENT PRIVATE PROPERTIES AND PUBLIC PROPERTY AND SURVEY MONUMENTS.

TESC.3. EROSION SEDIMENTATION CONTROL (ESC) FACILITIES MUST BE CONSTRUCTED PRIOR TO AND IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO ENSURE THAT SEDIMENT-LADEN WATER OR AIRBORNE SEDIMENT DOES NOT ENTER THE DRAINAGE SYSTEM OR VIOLATE APPLICABLE WATER OR AIR QUALITY STANDARDS DURING THE CONSTRUCTION PERIOD. THESE ESC FACILITIES SHALL BE UPGRADED TO INCLUDE ADDITIONAL SUMPS, DITCHES, FENCES, ETC. AS NEEDED FOR UNEXPECTED STORM EVENTS.

TESC.4 STABILIZED CONSTRUCTION ENTRANCES AND WASH PADS SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED BY THE CITY OF SHORELINE TO ENSURE THAT PAVED AREAS ARE KEPT CLEAN FOR THE PROJECT DURATION.

TESC.5. ANY AREA STRIPPED OF VEGETATION (INCLUDING ROADWAY EMBANKMENTS), WHERE NO FURTHER WORK IS ANTICIPATED FOR A PERIOD OF 2 DAYS, SHALL BE IMMEDIATELY STABILIZED WITH APPROVED ESC METHODS AS FOLLOWS.
- FROM MAY 1 THROUGH SEPTEMBER 30, INSTALL TESC COVER MEASURES TO PROTECT DISTURBED AREAS THAT WILL REMAIN UNWORKED FOR SEVEN DAYS OR MORE.
- FROM OCTOBER 1 THROUGH APRIL 30:

A) INSTALL TESC COVER MEASURES TO PROTECT DISTURBED AREAS THAT WILL REMAIN UNWORKED FOR TWO DAYS OR MORE.

B) PROTECT STOCKPILES AND STEEP CUT/FILL SLOPES IF UNWORKED FOR MORE THAN 12 HOURS

C) STOCKPILE ON SITE ENOUGH COVER MATERIALS TO COVER ALL DISTURBED AREAS.

ANY AREA NEEDING ESC MEASURES, NOT REQUIRING IMMEDIATE ATTENTION, SHALL BE ADDRESSED WITHIN 15 DAYS.

TESC.6. ESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN 48 HOURS FOLLOWING A STORM EVENT.

TESC.7. BY OCTOBER 8, SEED ALL AREAS THAT WILL REMAIN UNWORKED FROM OCTOBER 1 THROUGH APRIL 30. MULCH ALL SEEDED AREAS.

TESC.8. AT NO TIME SHALL MORE THEN ONE (1) FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A CATCH BASIN. ALL CATCH BASINS & CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT-LADEN WATER INTO A DOWNSTREAM SYSTEM.

TESC.9. WHERE SEEDING FOR TEMPORARY EROSION CONTROL IS REQUIRED, FAST-GERMINATING GRASSES SHALL BE APPLIED AT AN APPROPRIATE RATE (E.G. ANNUAL OR PERENNIAL RYE APPLIED AT APPROXIMATELY 80 POUNDS PER ACRE). WHERE STRAW MULCH FOR TEMPORARY EROSION CONTROL IS REQUIRED, IT SHALL BE APPLIED AT A MINIMUM THICKNESS OF TWO INCHES.

TESC.10. FILTER FABRIC FENCING SHALL BE PURCHASED IN A CONTINUOUS ROLL AND CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST WITH A MINIMUM 24 INCHES OVERLAP AND BOTH ENDS SECURELY FASTENED TO THE POST.

TESC.11. THE FILTER FABRIC FENCE SHALL BE INSTALLED TO FOLLOW THE CONTOURS WHERE FEASIBLE. THE FENCE POSTS SHALL BE SPACED A MAXIMUM OF SIX FEET APART AND DRIVEN SECURELY INTO THE GROUND MINIMUM OF 30 INCHES. A TRENCH SHALL BE EXCAVATED UPGRADIENT AND ADJACENT TO THE WOOD POST TO ALLOW THE FILTER FABRIC TO BE BURIED.

TESC.12. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPGRADIENT SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES, TIE WIRES, OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF FOUR INCHES. THE STANDARD STRENGTH FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.

TESC.13. WHEN EXTRA-STRENGTH FILTER FABRIC AND CLOSER POST SPACING ARE USED, THE WIRE MESH SUPPORT FENCE MAY BE ELIMINATED. IN SUCH A CASE, THE FILTER FABRIC IS STAPLED OR WIRED DIRECTLY TO THE POSTS WITH ALL OTHER PROVISIONS OF STANDARD NOTES APPLY. FILTER FABRIC FENCES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE, BUT NOT BEFORE THE UPGRADIENT SLOPE AREA HAS BEEN PERMANENTLY STABILIZED. FILTER FABRIC FENCES SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.

TESC.14. THE EROSION PREVENTION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES SHOWN ON THE TESC ARE MINIMUM REQUIREMENTS. FIELD ADJUSTMENTS SHALL BE MADE TO ENSURE THE TESC PERFORMS IN ACCORDANCE WITH THE 2012 DEPARTMENT OF ECOLOGY STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON, VOLUME II.

TESC.15. BEFORE ANY GROUND DISTURBANCE OCCURS ALL DOWNSTREAM BEST MANAGEMENT PRACTICES MUST BE CONSTRUCTED AND OPERATIONAL.

TESC.16. BEST MANAGEMENT PRACTICES SHALL REMAIN IN PLACE UNTIL FINAL SITE CONSTRUCTION IS COMPLETED AND PERMANENT STABILIZATIONS IS ESTABLISHED AND APPROVED BY THE CITY.

TESC.17. INSPECT AND MAINTAIN BEST MANAGEMENT PRACTICES DAILY IN ACCORDANCE WITH THE 2012 DEPARTMENT OF ECOLOGY STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON, VOLUME II.

TESC.18. FAILURE TO MAINTAIN TESC MEASURES IN ACCORDANCE WITH ADOPTED STANDARDS MAY RESULT IN THE WORK BEING PERFORMED AT THE CITY'S DIRECTION AND THE COSTS DEDUCTED FROM MONIES OWED TO CONTRACTOR.

TESC.19. DURING THE LIFE OF THE PROJECT, THE CONTRACTOR SHALL MAINTAIN IN GOOD CONDITION AND PROMPTLY REPAIR, RESTORE OR REPLACE ALL GRADE SURFACES; WALLS, DRAINS, DAMS, STRUCTURES, VEGETATION, TESC MEASURES, AND OTHER PROTECTIVE DEVICES IN ACCORDANCE WITH APPROVED PLANS.

TESC.20. THE CONTRACTOR SHALL MONITOR DOWNSTREAM DRAINAGE FEATURES, AND, WITH THE CITY'S APPROVAL, SHALL REMOVE ALL SEDIMENT DEPOSITION RESULTING FORM THE PROJECT-RELATED WORK.

TESC.21. ALL WORK SHALL BE PERFORMED PER APPROVED PLANS AND SPECIFICATIONS. THE CONTRACTOR SHALL MAINTAIN A SET OF APPROVED PLANS AND SPECIFICATIONS AND ASSOCIATED PERMITS ONSITE.

TESC.22. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL LAWS.

TESC.23. BEFORE REMOVING ANY TEMPORARY MEASURES, INSTALL AND ESTABLISH THE UPSTREAM PERMANENT MEASURES.

COS TRAFFIC CONTROL CONDITIONS (TC)

TC.1. INTERIM TRAFFIC CONTROL: THE CONTRACTOR SHALL BE RESPONSIBLE FOR INTERIM TRAFFIC CONTROL DURING CONSTRUCTION ON OR ALONG TRAVELED CITY ROADS.

TC.2. WHEN ROAD OR DRAINAGE WORK IS TO BE PERFORMED ON CITY ROADS THAT ARE OPEN TO TRAFFIC, THE CONTRACTOR WILL BE REQUIRED TO SUBMIT A WRITTEN TRAFFIC CONTROL PLAN FOR APPROVAL BY THE REVIEWING AGENCY 10 DAYS PRIOR TO BEGINNING THE WORK. TRAFFIC CONTROL SHALL FOLLOW THE GUIDELINES OF SECTION 1-07.23 OF THE WSDOT/APWA STANDARD SPECIFICATIONS.

TC.3. ALL BARRICADES, SIGNS AND FLAGGING SHALL CONFORM TO THE REQUIREMENTS OF THE MUTCD. FOR MORE SPECIFIC REQUIREMENTS FOR BARRICADES, SEE SECTION 5.7 AND DRAWING NO. 5-003 OF KING COUNTY ROAD STANDARDS. SIGNS MUST BE LEGIBLE AND VISIBLE AND SHALL BE REMOVED AT THE END OF EACH WORK DAY IF NOT APPLICABLE AFTER CONSTRUCTION HOURS.

TC.4. TEMPORARY ROAD CLOSURES AND DETOURS: WHEN TEMPORARY ROAD CLOSURES CANNOT BE AVOIDED THE CONTRACTOR SHALL POST "TO BE CLOSED" SIGNS A MINIMUM OF FIVE DAYS PRIOR TO THE CLOSING. THE TYPES AND LOCATIONS OF THE SIGNS SHALL BE SHOWN ON A DETOUR PLAN.

TC.5. A DETOUR PLAN MUST BE PREPARED AND SUBMITTED TO THE CITY OF SHORELINE PLANNING AND DEVELOPMENT SERVICES DEPARTMENT AT LEAST 10 WORKING DAYS IN ADVANCE, AND APPROVED PRIOR TO CLOSING ANY CITY ROAD. IN ADDITION, THE CONTRACTOR MUST NOTIFY, IN WRITING, LOCAL FIRE, SCHOOL, LAW ENFORCEMENT AUTHORITIES, METRO TRANSIT, AND ANY OTHER AFFECTED PERSONS AS DIRECTED BY THE ENGINEER AT LEAST FIVE DAYS PRIOR TO CLOSING.

TC.6. HAUL ROUTES: IF THE CONSTRUCTION OF A PROPOSED DEVELOPMENT IS DETERMINED BY THE REVIEWING AGENCY TO REQUIRE SPECIAL ROUTING OF LARGE TRUCKS OR HEAVY CONSTRUCTION EQUIPMENT TO PREVENT IMPACTS TO SURROUNDING ROADS, RESIDENCES OR BUSINESSES, THE CONTRACTOR SHALL BE REQUIRED TO DEVELOP AND USE AN APPROVED HAUL ROUTE.

TC.7. WHEN REQUIRED, THE HAUL ROUTE PLAN MUST BE PREPARED AND SUBMITTED TO THE REVIEWING AGENCY AND APPROVED PRIOR TO BEGINNING CONSTRUCTION. THE HAUL ROUTE PLAN SHALL ADDRESS ROUTING, HOURS OF OPERATION, SIGNAGE AND FLAGGING, AND DAILY MAINTENANCE.

TC.8. IF THE CONTRACTOR'S TRAFFIC FAILS TO USE THE DESIGNATED HAUL ROUTE, THE REVIEWING AGENCY MAY PROHIBIT OR LIMIT FURTHER WORK ON THE DEVELOPMENT UNTIL SUCH TIME AS THE REQUIREMENTS OF THE HAUL ROUTE ARE COMPLIED WITH.

TC.9. FLAGGING SHALL BE MAINTAINED BY THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION. INTERRUPTION OF NORMAL TRAFFIC FLOW SHALL REQUIRE TRAFFIC CONTROL (SEE #SN.12. FOR DETAILS).

TC.10. CONTRACTOR SHALL PROTECT EXISTING TRAFFIC CONTROL SIGNS WITHIN THE LIMITS OF WORK.

DATUM

BASIS OF BEARING: NAD 83/91

DATUM: NAVD 88

CALL TWO BUSINESS DAYS BEFORE YOU DIG 1-800-424-5555

NOT FOR CONSTRUCTION

NE 148TH STREET INFILTRATION FACILITIES

95% GRANT APPLICATION SET

CITY OF SHORELINE STANDARD NOTES

	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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CITY OF SHORELINE

17500 Midvale Ave. N
Shoreline, WA 98133
(206) 801-2700

IF SHEET IS LESS THAN 22" X 34", IT IS A REDUCTION

Project No.

Sheet C0.1

Sheet X

GENERAL NOTES

1. STANDARD PLANS REFERENCED FROM 2012 CITY OF SHORELINE ENGINEERING DEVELOPMENT GUIDE.

3. PROTECTION OF THE ENVIRONMENT: NO CONSTRUCTION RELATED ACTIVITY SHALL CONTRIBUTE TO THE DEGRADATION OF THE ENVIRONMENT, ALLOW MATERIAL TO ENTER SURFACE OR GROUND WATERS, OR ALLOW PARTICULATE EMISSIONS TO THE ATMOSPHERE, WHICH EXCEED STATE OR FEDERAL STANDARDS. ANY ACTIONS THAT POTENTIALLY ALLOW A DISCHARGE TO STATE WATERS MUST HAVE PRIOR APPROVAL OF THE WASHINGTON STATE DEPARTMENT OF ECOLOGY.

EARTHWORK AND GRADING NOTES

1. NONCOMPLIANCE WITH EROSION CONTROL REQUIREMENTS, WATER QUALITY REQUIREMENTS, AND CLEARING LIMITS MAY RESULT IN REVOCATION OF PROJECT PERMITS, PLAN APPROVAL, AND BOND FORECLOSURES.
2. PRIOR TO ANY WORK INCLUDING GROUND DISTURBANCE, THE CONTRACTOR SHALL CONTACT CITY OF SHORELINE TO SCHEDULE A PRE-CONSTRUCTION MEETING.
3. PRIOR TO ANY SITE CONSTRUCTION (WHICH INCLUDES CLEARING/LOGGING, DEMOLITION, OR GRADING THE SITE), CLEARING LIMITS SHALL BE LOCATED AND FIELD IDENTIFIED BY THE CONTRACTOR'S SURVEYOR FOR REVIEW BY CITY OF SHORELINE INSPECTOR.
4. APPROVAL BY CITY OF SHORELINE OF THE DRAINAGE AND TEMPORARY EROSION CONTROL PLANS DOES NOT INCLUDE APPROVAL OF THE GRADING ACTIVITIES SHOWN HEREIN. GRADING ACTIVITIES WITHIN THE RIGHT-OF-WAY REQUIRES A PERMIT FROM CITY OF SHORELINE. GRADING ACTIVITIES ON ADJACENT PROPERTIES REQUIRES WRITTEN APPROVAL BY THE ADJACENT PROPERTY OWNER.
5. GRADING AND EXPOSED SOILS MUST BE STABILIZED BY OCTOBER 15TH AND NO EXCAVATION TO BE PERFORMED BETWEEN OCTOBER 31ST AND APRIL 1ST UNLESS CONTRACTOR HAS SUBMITTED DRY SEASON EXTENSION LETTER APPLICATION AND OBTAINED APPROVAL BY CITY OF SHORELINE.
6. MATCH EXISTING GRADES AT EDGE CONDITIONS AND PROVIDE SMOOTH TRANSITION.
7. COORDINATE FINE GRADING FOR SURFACE DRAINAGE WITH LANDSCAPE INSTALLATION. FINE GRADING FOR SURFACE DRAINAGE SHALL OCCUR PRIOR TO PLANTING AND MULCHING. GRADE TO PROVIDE POSITIVE DRAINAGE AWAY FROM BUILDINGS AT BOTH SUBGRADE AND FINISH GRADE.
8. FINISHED GRADING: FINE GRADE BEDS TO CONTOUR LINES AND GRADES SHOWN ON DRAWINGS, 1/4" BELOW THE LEVEL OF ADJACENT WALLS, WALKS AND CURBS UNLESS NOTED OTHERWISE. ALLOW ROOM IN PLANT BEDS, COORDINATE WITH LANDSCAPING PLANS. FINE FINISH TOPSOIL TO MAKE SMOOTH AND EVEN AND REMOVING ALL EXTRANEOUS MATTER.

GENERAL SEWER AND DRAINAGE NOTES

1. THE CONTRACTOR SHALL VERIFY THE LOCATION AND ELEVATION OF THE EXISTING SIDE SEWER OR SERVICE DRAIN AT THE POINT OF CONNECTION PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE CITY OF SHORELINE INSPECTOR AND OWNER'S REPRESENTATIVE OF ANY DISCREPANCIES.
2. BEDDING FOR PIPES AND STRUCTURES SHALL BE IN ACCORDANCE WITH CITY OF SHORELINE STANDARDS AND SPECIFICATIONS. BEDDING MATERIAL FOR PVC PIPE SHALL BE MECHANICALLY COMPACTED TO 95% OF MAXIMUM DRY DENSITY AS MEASURED BY ASTM D-698.
3. TEES AND CATCH BASIN CONNECTIONS SHALL BE PLACED AT A MINIMUM SLOPE OF 2% AND A MAXIMUM SLOPE OF 50% UNLESS OTHERWISE INDICATED ON THE PLANS.
4. RELAY EXISTING SERVICE DRAINS AND SIDE SEWERS TO CLEAR OVER OR UNDER THE NEW UTILITY AS APPROVED BY THE CITY OF SHORELINE INSPECTOR.
5. WHERE A NEW PIPE CLEARS AN EXISTING OR NEW UTILITY BY 6" OR LESS, POLYETHYLENE PLASTIC FOAM SHALL BE PLACED AS A CUSHION BETWEEN THE UTILITIES.
6. PROVIDE DUCTILE IRON PIPE SLEEVE WHERE SS, SSS, OR SD PASSES UNDERNEATH OR THROUGH ANY FOOTINGS, STEM WALLS, RETAINING WALLS, OR ROCKERIES.
7. PROVIDE FITTINGS AS REQUIRED TO CONNECT TO EXISTING UTILITIES IN RIGHT-OF-WAY.
8. ADJUST RIM ELEVATION OF CATCH BASINS, AREA DRAINS AND CLEANOUT CASTINGS TO MATCH SURROUNDING GRADES, UNLESS OTHERWISE NOTED.
9. IF EXISTING SIDE SEWER IS ENCOUNTERED DURING CONSTRUCTION, THE CONTRACTOR IS TO LAY GREEN DETECTABLE MARKING TAPE PER WSDOT STANDARD SPECIFICATION 9-15.18 OVER THE PIPE.

STORM DRAINAGE NOTES

1. A COPY OF THE APPROVED DRAINAGE CONTROL PLANS MUST BE ON THE JOB SITE WHENEVER CONSTRUCTION IS IN PROGRESS.
2. TYPE 1 AND TYPE 2 CATCH BASIN STRUCTURES PER 2014 WSDOT STANDARD PLANS AND SPECIFICATIONS.

INFILTRATION AND LID FACILITIES PROTECTION NOTES

1. REDIRECT SHEET FLOW, BLOCK DRAIN INLETS AND/OR CURB OPENINGS IN PAVEMENT AND INSTALL FLOW DIVERSION MEASURES TO PREVENT CONSTRUCTION SILT LADEN WATER AND DEBRIS FROM ENTERING EXCAVATIONS AND FINISH SURFACES FOR RAIN GARDENS AND BIORETENTION FACILITIES.
2. WHERE AMENDED SOILS, BIORETENTION FACILITIES, AND OTHER INFILTRATION FACILITIES ARE INSTALLED, THESE AREAS MUST BE PROTECTED AT ALL TIMES FROM BEING OVER COMPACTED. IF AREAS BECOME COMPACTED, REMEDIATE AND TILL SOIL IN ACCORDANCE WITH GEOTECHNICAL ENGINEER REPRESENTATIVE REQUIREMENTS AT NO ADDITIONAL COST TO OWNER IN ORDER TO RESTORE INFILTRATION.
3. INSTALL FLOW DIVERSION MEASURES OUTSIDE OF THE CRITICAL ROOT ZONE OF TREES TO BE PROTECTED. AT NO TIME SHALL CONSTRUCTION STORMWATER BE DIRECTED TO TREES TO BE PROTECTED. CONSTRUCTION STORMWATER SHALL NOT POND WITHIN A TREE'S CRITICAL ROOT ZONE.
4. INFILTRATION AND LID FACILITIES SHALL BE CONSTRUCTED AND PROTECTED IN COMPLIANCE WITH THESE DOCUMENTS, CITY OF SHORELINE STANDARDS AND THE LOW IMPACT DEVELOPMENT TECHNICAL GUIDANCE FOR PUGET SOUND MANUAL. WHEN THERE IS CONFLICT BETWEEN STANDARDS, THESE PLANS AND SPECIAL PROVISIONS RULE.

ELECTRONIC INFORMATION TRANSFER AGREEMENT (EITA)

AN AUTOCAD® 2010 FILE (IN 2D) WILL BE PROVIDED TO THE CONTRACTOR FOR HORIZONTAL LAYOUT OF CIVIL UTILITIES (STORM AND WATER), GRADING CONTOURS, LANDSCAPING, AND SPOT ELEVATIONS AND/OR PAVING (DRIVES) SHOWN ON PLAN VIEW OF THIS SHEET. PRIOR TO RELEASE OF AUTOCAD FILE, CONTRACTOR WILL BE REQUIRED TO SIGN AN ELECTRONIC INFORMATION TRANSFER AGREEMENT (EITA) FORM FROM SvR DESIGN COMPANY. PLEASE NOTIFY PROJECT CONTACT AT SvR DESIGN COMPANY AT (206) 223-0326 FOR A COPY OF THE EITA FORM.

COS TREE PROTECTION CONDITIONS (TP)

BEFORE SITE WORK BEGINS.

TP.1. BEFORE ANY CLEARING OR GRADING OCCURS INSTALL PROTECTION FOR TREES AND CRITICAL AREAS/BUFFERS.
TP.2. INSTALL TEMPORARY CONSTRUCTION FENCES AROUND THE DRIP LINES OF SINGLE TREES TO BE PRESERVED.
TP.3. INSTALL FENCING AROUND THE EDGE FORMED BY THE DRIP LINES OF A CLUSTER OF TREES TO BE RETAINED. FENCING SHALL BE AT LEAST FOUR FEET HIGH, CONSTRUCTED OF CHAIN LINK, OR POLYETHYLENE LAMINAR SAFETY FENCING OR SIMILAR MATERIAL, SUBJECT TO APPROVAL BY THE DIRECTOR.
TP.4. NOT USED.
TP.5. RETAIN SMALL TREES, BUSHES AND UNDER-STORY PLANTS WITHIN THE TREE PROTECTION ZONE.
TP.6. POST "TREE PROTECTION AREA" SIGNS ON ALL SIDES OF THE FENCED AREAS.
TP.7. NOT USED.
TP.8. NOT USED.
TP.9. DO NOT ALLOW FILL, EXCAVATION, THE STORAGE OF TOOLS, EQUIPMENT, CONSTRUCTION MATERIALS OR STOCKPILE SOIL OR TRAFFIC OR UTILITY CONSTRUCTION INCLUDING IRRIGATION SYSTEMS WITHIN THE DRIP-LINE AREAS OF TREES THAT ARE TO BE RETAINED.
TP.10. PROTECT AS MUCH OPEN SOIL SURFACE BELOW THE TREE'S CROWN (AND OUTSIDE THE FENCED TREE PROTECTION ZONE) AS POSSIBLE.
TP.11. WHEN TRENCHING NEAR PROTECTED TREES, ALLOW ONLY HAND-DIGGING WITHIN THE TREE PROTECTION ZONE. TUNNEL UNDER ROOTS GREATER THAN 1" IN DIAMETER. CLEANLY CUT TORN ROOTS TO THE EDGE OF THE TRENCH. COVER EXPOSED ROOTS WITH VISQUEEN OR LIKE MATERIAL AND KEEP MOIST DURING OPEN GROUND PROCEDURES.
TP.12. PROVIDE 1" OF IRRIGATION WATER PER WEEK TO AS LARGE AN AREA OF ROOT ZONES AS POSSIBLE DURING THE GROWING SEASON AND DRIER MONTHS, APRIL TO OCTOBER. PROVIDING EXTRA WATER FOR PROTECTED TREES IS THE MOST CRITICAL FACTOR IN SAVING TREES DURING AND AFTER CONSTRUCTION.

POST CONSTRUCTION

TP.13. SOIL AERATION MAY BE NECESSARY IN SITUATIONS WHERE COMPACTION HAS OCCURRED. IDENTIFY APPROPRIATE PROCEDURES AND SPECIFICATIONS FROM A CERTIFIED ARBORIST.
TP.14. PRUNE TREES FOLLOWING CONSTRUCTION TO REMOVE DEADWOOD TO ENCOURAGE REGROWTH. TREES SHOULD BE MONITORED THROUGHOUT THE CONSTRUCTION PROCESS FOR ANY INCREASE IN HAZARD POTENTIAL.

PROJECT SPECIFIC TREE PROTECTION MEASURES

1. TREE PROTECTION FENCES SHALL BE PLACED AROUND EACH TREE OR GROUP OF TREES TO BE RETAINED.
   A. TREE PROTECTION FENCES ARE TO BE PLACED ACCORDING TO THE DRAWINGS C1.0 THROUGH C1.2 FOR THE TREE OR GROUP OF TREES TO BE PROTECTED.
   B. NOTHING MUST BE PARKED OR STORED WITHIN THE TREE PROTECTION FENCES. NO EQUIPMENT, VEHICLES, SOIL, DEBRIS, OR CONSTRUCTION SUPPLIES OF ANY SORT.
2. CONCRETE TRUCKS SHALL NOT BE ALLOWED TO DEPOSIT WASTE OR WASH OUT MATERIALS FROM THEIR TRUCKS WITHIN THE TREE PROTECTION FENCES, EXISTING LANDSCAPE, PAVEMENT OR IN AREAS THAT DRAIN TO TREE PROTECTION ZONES.
3. THE TREE PROTECTION FENCES NEED TO BE CLEARLY MARKED WITH THE FOLLOWING OR SIMILAR TEXT IN FOUR INCH OR LARGER LETTERS:
   "TREE PROTECTION FENCE
   THIS TREE IS VALUED AT [VALUE PER CITY OF SHORELINE ARBORIST]
   DO NOT ENTER THIS AREA
   DO NOT PARK OR STORE MATERIALS WITHIN THE PROTECTION AREA
   ANY QUESTIONS, CALL CITY CODE ENFORCEMENT
   OFFICER @ (206) 801-2700"
4. WHEN EXCAVATION OCCURS NEAR TREES THAT ARE SCHEDULED FOR RETENTION, THE FOLLOWING PROCEDURE MUST BE FOLLOWED TO PROTECT THE LONG TERM SURVIVABILITY OF THE TREE:
   A. AN INTERNATIONAL SOCIETY OF ARBORICULTURE, (ISA) CERTIFIED ARBORIST MUST BE WORKING WITH ALL EQUIPMENT OPERATORS.
      i. THE CERTIFIED ARBORIST SHALL BE OUTFITTED WITH A SHOVEL, HAND PRUNERS, A PAIR OF LOPPERS, A HANDSAW, AND A POWER SAW (A "SAWSALL" IS RECOMMENDED).
   B. THE HOE MUST BE PLACED TO "COMB" THE MATERIAL DIRECTLY AWAY FROM THE TRUNK AS OPPOSED TO CUTTING ACROSS THE ROOTS.
      i. COMBING IS THE GRADUAL EXCAVATION OF THE GROUND COVER PLANTS AND SOIL IN DEPTHS THAT ONLY EXTEND AS DEEP AS THE TINES OF THE HOE.
   C. WHEN ANY ROOTS OF ONE INCH DIAMETER OR GREATER OF THE TREE TO BE RETAINED IS STRUCK BY THE EQUIPMENT, THE CERTIFIED ARBORIST SHALL STOP THE EQUIPMENT OPERATOR.
   D. THE CERTIFIED ARBORIST SHALL THEN EXCAVATE AROUND THE TREE ROOT BY HAND/SHOVEL AND CLEANLY CUT THE TREE ROOT.
      i.THE CERTIFIED ARBORIST SHALL THEN INSTRUCT THE EQUIPMENT OPERATOR TO CONTINUE.

PATRICIA A. BUCHANAN
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

THOMAS R. VON SCHRADER
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
QA/QC REVIEWER

DATUM

BASIS OF BEARING: NAD 83/91
DATUM: NAVD 88

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NOT FOR CONSTRUCTION

	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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Sheet
C0.2

Sheet X

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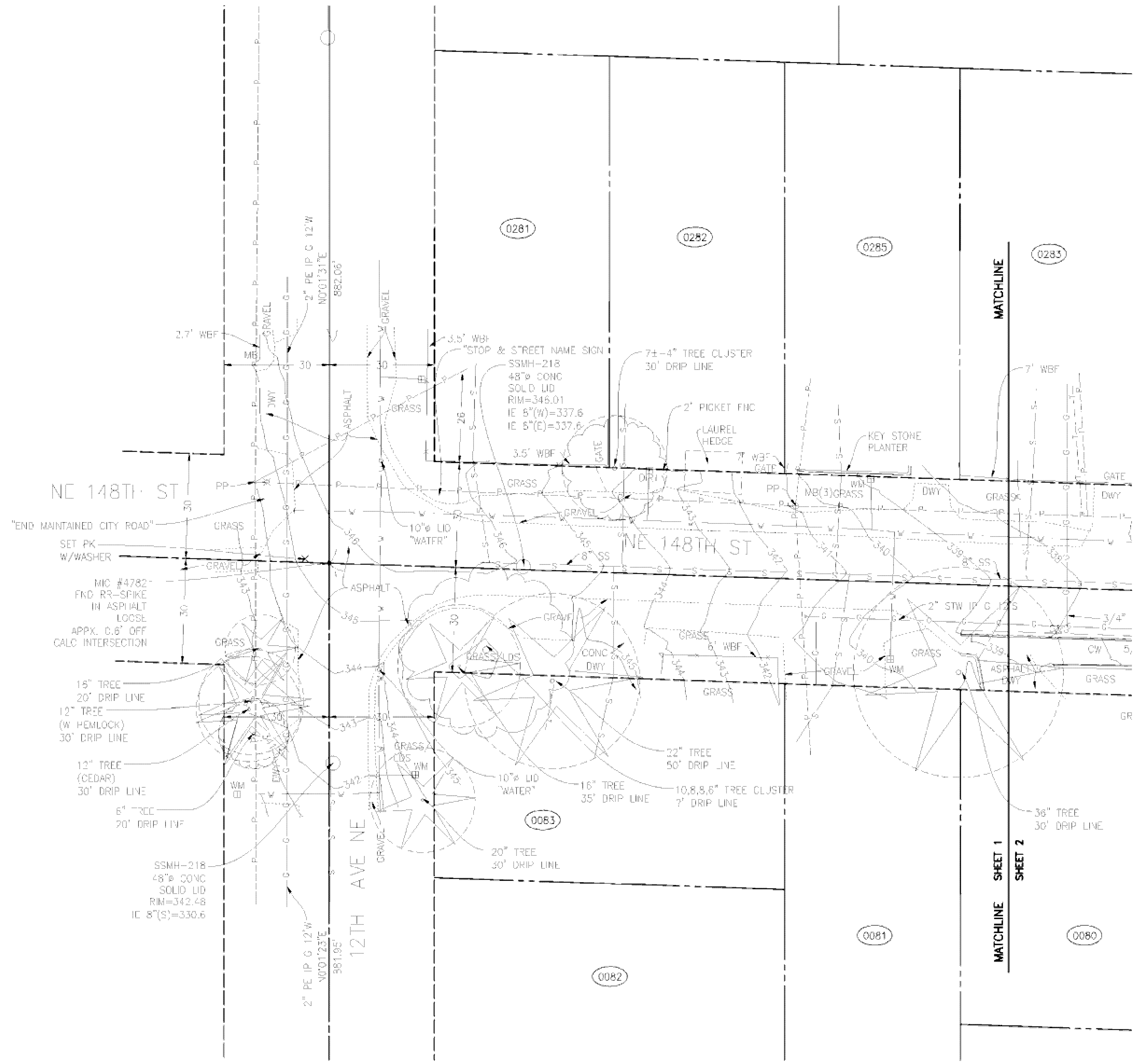
TOPOGRAPHIC SURVEY

A PORTION OF THE SE 1/4, SEC 17, TWP 26 N, RGE 4 E, W.M.



LEGEND

(P)	PAINTED-UTILITIES
(R)	RECORD-UTILITIES
TL	TAX LOT
L&T	LEAD & TACK
FND	FOUND
FOD	FIBER OPTIC DUCT
N	NORTH
S	SOUTH
E	EAST
W	WEST
IE	INVERT ELEVATION
CAB	CABINET
XWALK	CROSSWALK
INTERX	INTERSECTION
CL	CENTERLINE
BTM	SUMP LEVEL
WTR	WATER LEVEL
MH	MANHOLE
AVE	AVENUE
RXR	RAILROAD
HI	HIGH
EXT	EXTRUDED
ASPH	ASPHALT
BLDG	BLDG
FF	FINISHED FLOOR
CONC	CONCRETE
GVL	GRAVEL
DWY	DRIVEWAY
C&G	CONC CURB & GUTTER
CW	CONC WALK
CF	CURB FACE
FL	FLOWLINE
LDS	LANDSCAPE

RIGHT-OF-WAY LINE
PROPERTY LINE
LOT LINE
CENTER LINE
SECTION LINE
QUARTER SECTION LINE
16TH SECTION LINE
GOV'T MEANDER LINE
EASEMENT LINE
FENCE LINE
POWER LINE AERIAL
POWER LINE BURIED
COMMUNICATION LINE AERIAL
COMMUNICATION LINE BURIED
GAS LINE
SANITARY SEWER LINE
STORM SEWER LINE
WATER LINE
PAVEMENT LINE

LEGEND

MIC	MONUMENT IN CASE
MON	SURFACE MONUMENT
BM	BENCHMARK
MIC	IRON PIPE
	PROPERTY CORNER
	ANGLE / TRAVERSE POINT
	OWNERSHIP TIE
9045	TAX LOT / PARCEL NUMBER
NW NE SW SE	SECTION CORNER
NW SE	QUARTER SECTION CORNER
W E	CLOSING CORNER
MC	MEANDER CORNER
WC	WITNESS CORNER
CO	CLEANOUT
CB	CATCH BASIN
SDMH	STORM DRAIN MANHOLE
SSMH	SEWER MANHOLE
WMH	WATER MANHOLE
WM	WATER METER
MW	MONITORING WELL
FH	FIRE HYDRANT
WV	WATER VALVE
GM	GAS METER
GV	GAS VALVE
PP	POWER POLE
LP	LIGHT POLE
GP	GUARD POST
	GUY WIRE
LUM	LUMINAIRE
POW V	ELECTRICAL VAULT
PM	POWER METER
JB	JUNCTION BOX
TJB	TRAFFIC JUNCTION BOX
TMH	TELEPHONE MANHOLE
TEL V	TELEPHONE VAULT
MB	MAIL BOX
	SIGN
PMH	POWER MANHOLE
	TRAFFIC MAST ARM
	TRAFFIC SIGNAL HEAD
	WETLAND FLAG
	RIP RAP
	ROCKERY
	STUMP OR SNAG TREE
	SHRUB
	DECIDUOUS TREE
	CONIFER TREE

MERIDIAN:
WASHINGTON COORDINATE SYSTEM, NAD83/91, NORTH ZONE

BASIS OF BEARINGS AND COORDINATES:
(PER WGA SURVEY DATA WAREHOUSE SURVEY CONTROL POINTS)

INSTRUMENT:
TRIMBLE R8, TRIMBLE S8 TOTAL STATION
PROJECT HORIZONTAL CONTROL POINTS:

1. CONC. MON W/ BRASS TACK IN CASE AT INTERSECTION OF NE 148TH ST & 15TH AVE NE
   0.5' BELOW GRADE
   N272103.382' E1276384.544' ELEV. 336.09'

2. CONC. MON W/ W/ BRASS TACK IN CASE AT INTERSECTION OF NE 146TH ST & 15TH AVE NE
   0.5' BELOW GRADE
   N271553.728' E1276384.029' ELEV. 325.66'

UNITS OF MEASURE: U.S. SURVEY FEET.

VERTICAL DATUM:
(PER WGA SURVEY DATA WAREHOUSE SURVEY CONTROL POINTS)

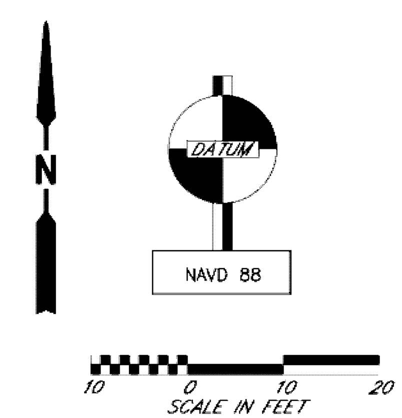
PROJECT BENCHMARK:

1. CONC. MON W/ BRASS TACK IN CASE AT INTERSECTION OF NE 148TH ST & 15TH AVE NE
   0.5' BELOW GRADE
   N272103.382' E1276384.544' ELEV. 336.093'

CONTOUR INTERVAL: N/A

DATE OF SURVEY: DEC 2012

REFERENCE SURVEYS:
RECORD OF SURVEY, REC NO. 20070924900004
KING COUNTY ASSESSOR MAP SE 17-26-04



NOT FOR CONSTRUCTION

NE 148TH STREET
INFILTRATION FACILITIES
95% GRANT APPLICATION SET
TOPOGRAPHIC SURVEY (EXISTING SITE)

	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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Project No.

Sheet C0.3

Sheet X

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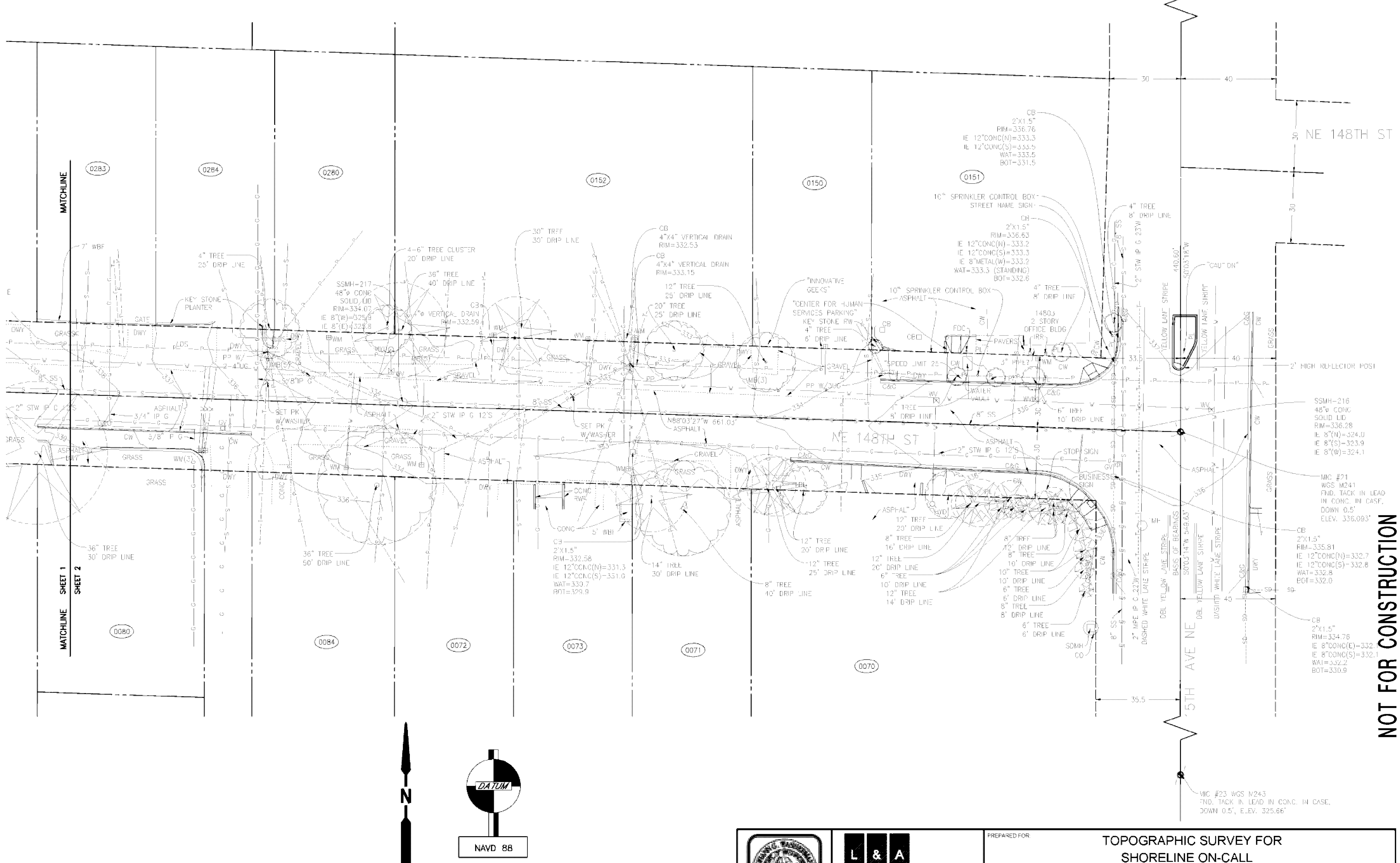
L & A
LIN & ASSOCIATES
Consulting Engineers
901 5TH AVE., SUITE 1610
SEATTLE, WA 98164
PHONE (206) 621-1318

PREPARED FOR:	TOPOGRAPHIC SURVEY FOR SHORELINE ON-CALL		
DRAWN BY: JGW	DATE: 10/07/2014	DRAWING NAME: NE 148TH ST .DWG	
CHECKED BY: AGS	SCALE: 1" = 20	SHEET: 1 OF 2	

G:\13c\13044.50c 148-15\148-15\Current\148-15_C0-3_SURVEY.dwg kyleo Nov 06, 2014 - 4:28pm

TOPOGRAPHIC SURVEY
A PORTION OF THE SE 1/4, SEC 17, TWP 26 N, RGE 4 E, W.M.



10 0 10 20
SCALE IN FEET

NOT FOR CONSTRUCTION

NE 148TH STREET
INFILTRATION FACILITIES
95% GRANT APPLICATION SET
TOPOGRAPHIC SURVEY (EXISTING SITE)

Revisions	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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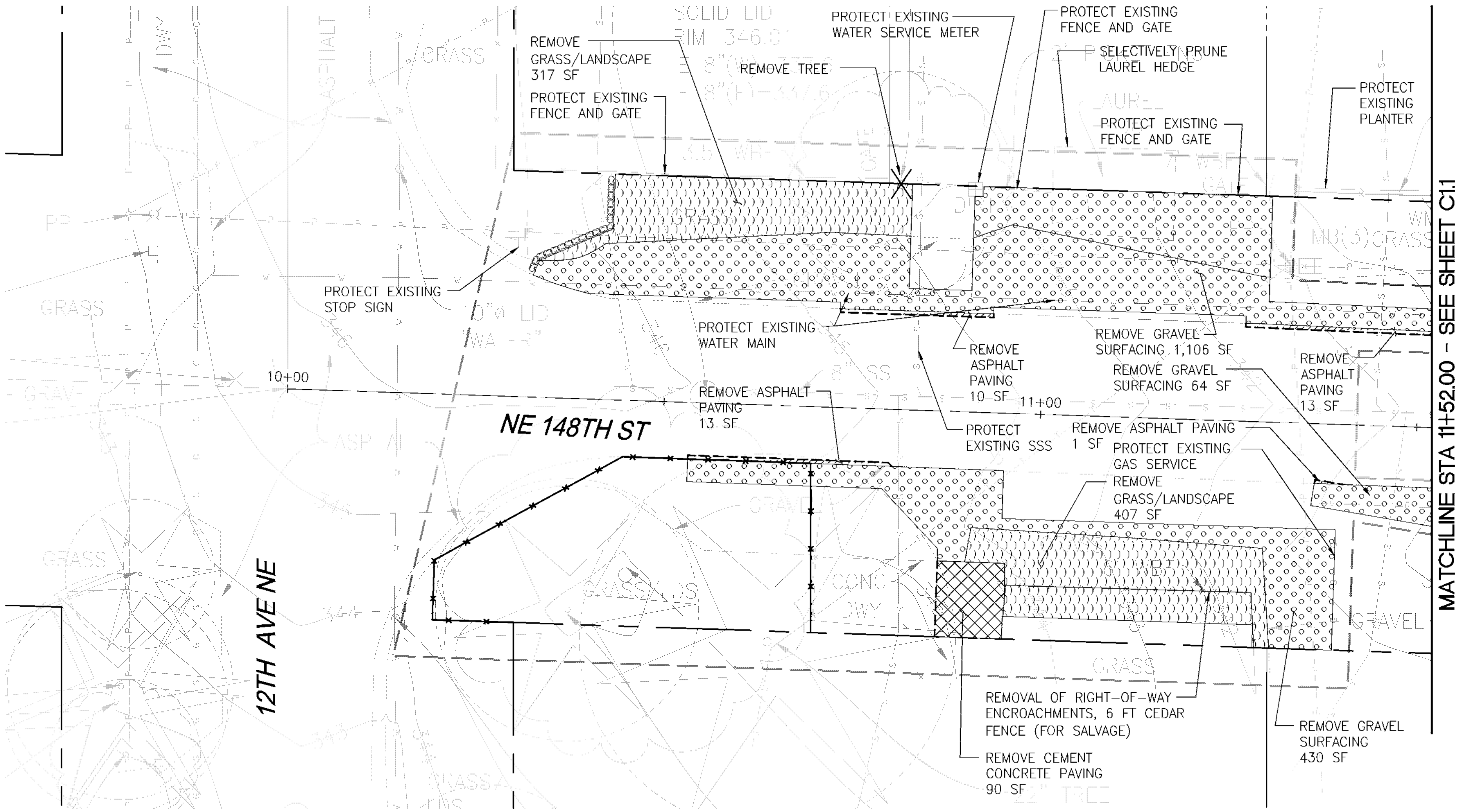
SEATTLE, WA 98164
PHONE (206) 621-1218

PREPARED FOR:
TOPOGRAPHIC SURVEY FOR SHORELINE ON-CALL

DRAWN BY: JGW	DATE: 10/07/2014	DRAWING NAME: NE 148TH ST .DWG
CHECKED BY: AGS	SCALE: 1" = 20	SHEET: 2 OF 2



N
10' 5' 0 10' 20'
Scale In Feet

NOTES

1. CONTRACTOR SHALL COORDINATE RELOCATION OF EXISTING SERVICES WITH UTILITY PROVIDER, AND OWNER'S REPRESENTATIVE.
2. SEE C0.1 AND C0.2 FOR NOTES.
3. PERFORM SELECTIVE PRUNING OF EXISTING TREES AND SHRUBS AS NEEDED FOR CONSTRUCTION OF IMPROVEMENTS.

LEGEND

- RIGHT-OF-WAY LINE
- APPROXIMATE LIMITS OF WORK
- TREE PROTECTION FENCING (4 / D1.0)
- SAW CUT
- REMOVE GRAVEL SURFACING
- REMOVE CEMENT CONCRETE PAVING
- REMOVE ASPHALT PAVING
- REMOVE GRASS/LANDSCAPE
- REMOVE OBJECT
- ABANDON SD PER SHORELINE STANDARDS
- REMOVE
- CAP UTILITY PER UTILITY/SHORELINE STANDARDS
- STRAW WATTLE (3 / D1.0)
- CB/INLET PROTECTION (2 / D1.0)
- EXISTING TREE DRIPLINE/ CRITICAL ROOT ZONE

PATRICIA A. BUCHANAN — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER
THOMAS R. VON SCHRADER — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER
QA/QC REVIEWER

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BASIS OF BEARING: NAD 83/91
DATUM: NAVD 88

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Description	Date	Initials	
95% Grant Application Set	11/6/14	KA	Drawn
95% Grant Application Set	11/6/14	LK/PB	Designed
95% Grant Application Set	11/6/14	KG	Checked
			Revisions
			Revisions

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

TESC AND DEMOLITION, PHASE 3

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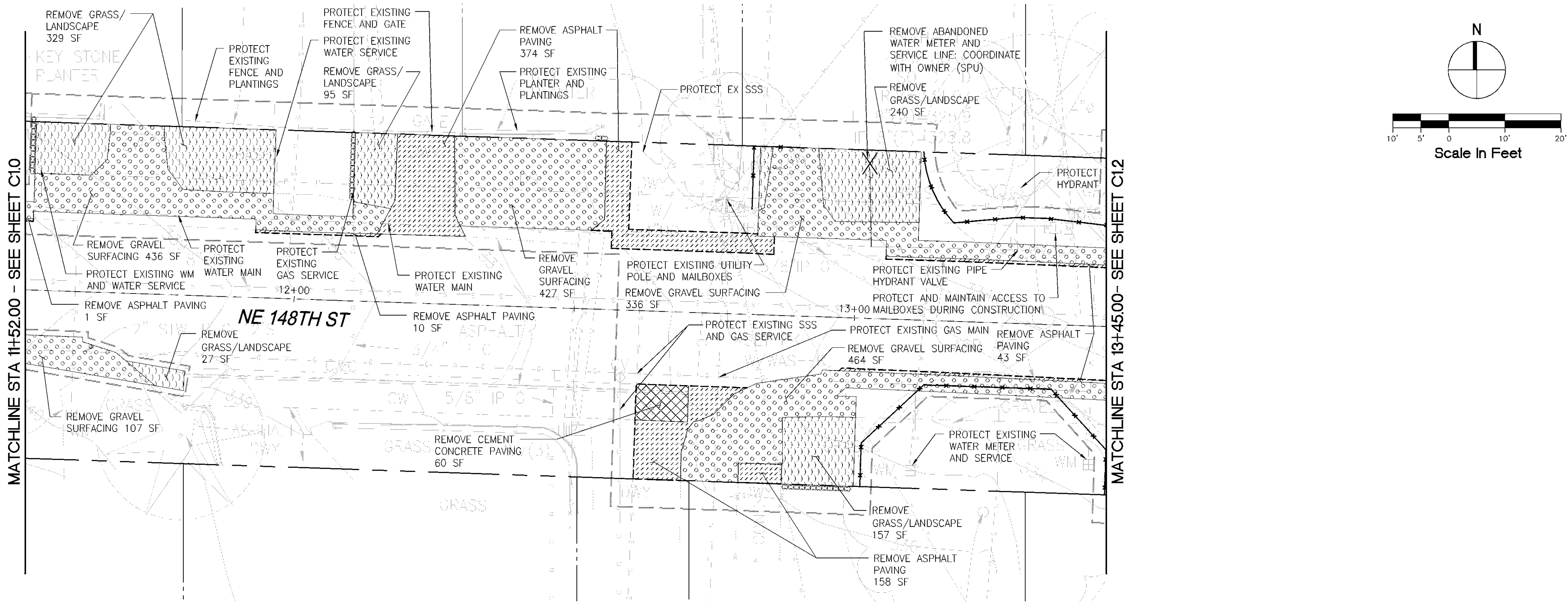
Project No.

Sheet C1.0

Sheet X



NOTES

1. CONTRACTOR SHALL COORDINATE RELOCATION OF EXISTING SERVICES WITH UTILITY PROVIDER, AND OWNER'S REPRESENTATIVE.
2. SEE C0.1 AND C0.2 FOR NOTES.
3. PERFORM SELECTIVE PRUNING OF EXISTING TREES AND SHRUBS AS NEEDED FOR CONSTRUCTION OF IMPROVEMENTS.

LEGEND

- RIGHT-OF-WAY LINE
- APPROXIMATE LIMITS OF WORK
- TREE PROTECTION FENCING (4 / D1.0)
- SAW CUT
- REMOVE GRAVEL SURFACING
- REMOVE CEMENT CONCRETE PAVING
- REMOVE ASPHALT PAVING
- REMOVE GRASS/LANDSCAPE
- REMOVE OBJECT
- ABANDON SD PER SHORELINE STANDARDS
- REMOVE
- CAP UTILITY PER UTILITY/SHORELINE STANDARDS
- STRAW WATTLE (3 / D1.0)
- CB/INLET PROTECTION (2 / D1.0)
- EXISTING TREE DRIPLINE/ CRITICAL ROOT ZONE

PATRICIA A. BUCHANAN STATE OF WASHINGTON 40794 REGISTERED PROFESSIONAL ENGINEER

THOMAS R. VON SCHRADER STATE OF WASHINGTON 35644 REGISTERED PROFESSIONAL ENGINEER

QA/QC REVIEWER

DATUM

BASIS OF BEARING: NAD 83/91

DATUM: NAVD 88

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

TESC AND DEMOLITION, PHASE 2

Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

Initials / Date / Description

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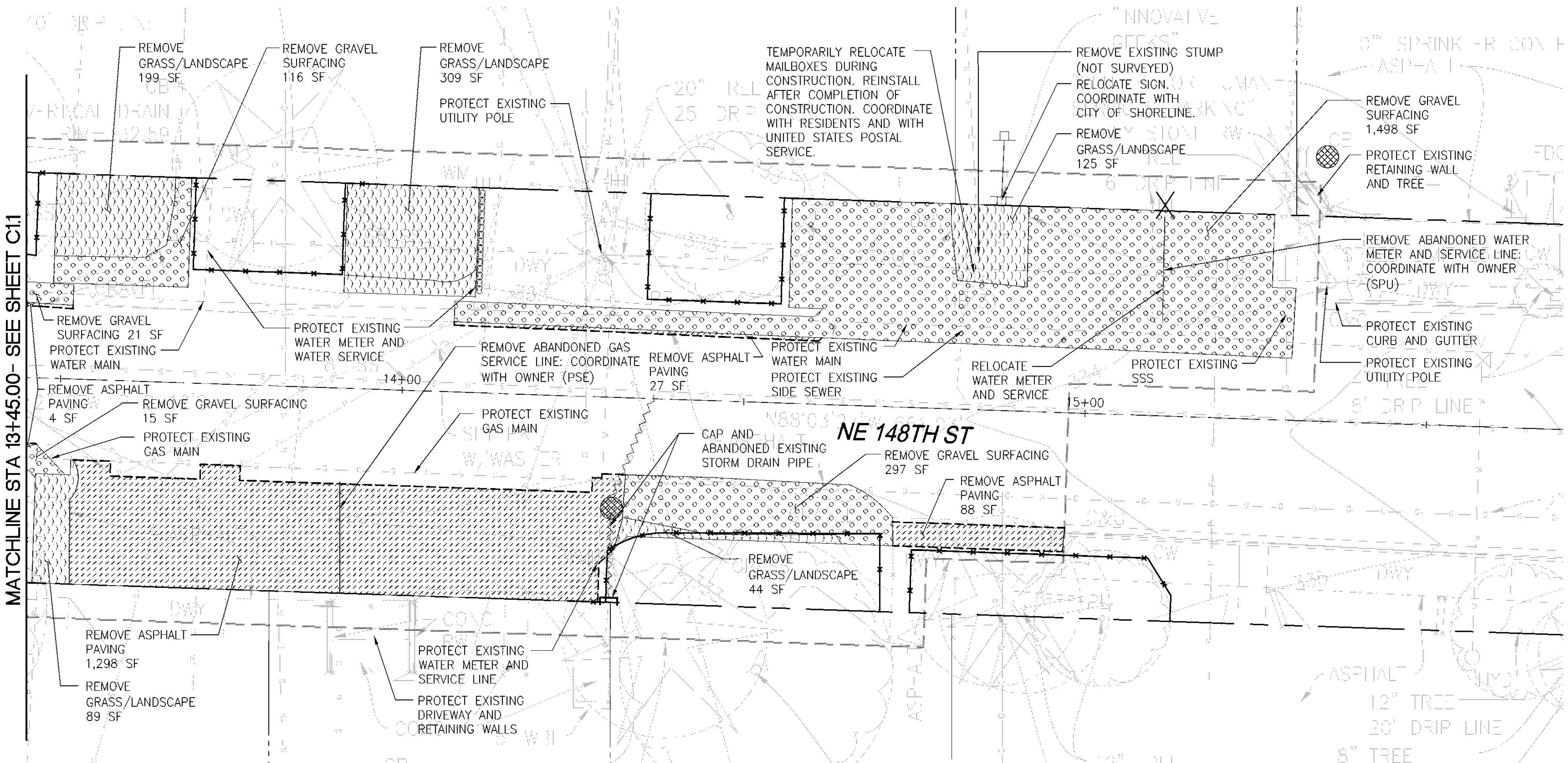

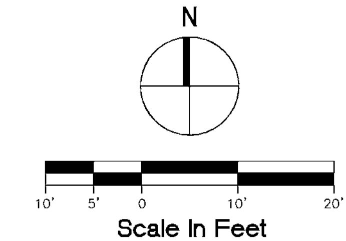

NOTES

1. CONTRACTOR SHALL COORDINATE RELOCATION OF EXISTING SERVICES WITH UTILITY PROVIDER, AND OWNER'S REPRESENTATIVE.
2. SEE C0.1 AND C0.2 FOR NOTES.
3. PERFORM SELECTIVE PRUNING OF EXISTING TREES AND SHRUBS AS NEEDED FOR CONSTRUCTION OF IMPROVEMENTS.

LEGEND

- RIGHT-OF-WAY LINE
- APPROXIMATE LIMITS OF WORK
- TREE PROTECTION FENCING 4/D1.0
- SAW CUT
- REMOVE GRAVEL SURFACING
- REMOVE CEMENT CONCRETE PAVING
- REMOVE ASPHALT PAVING
- REMOVE GRASS/LANDSCAPE
- REMOVE OBJECT
- ABANDON SD PER SHORELINE STANDARDS
- REMOVE
- CAP UTILITY PER UTILITY/SHORELINE STANDARDS
- STRAW WATTLE 3/D1.0
- CB/INLET PROTECTION 2/D1.0
- EXISTING TREE DRIPLINE/ CRITICAL ROOT ZONE

PATRICIA A. BUCHANAN, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

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TESC AND DEMOLITION, PHASE 1

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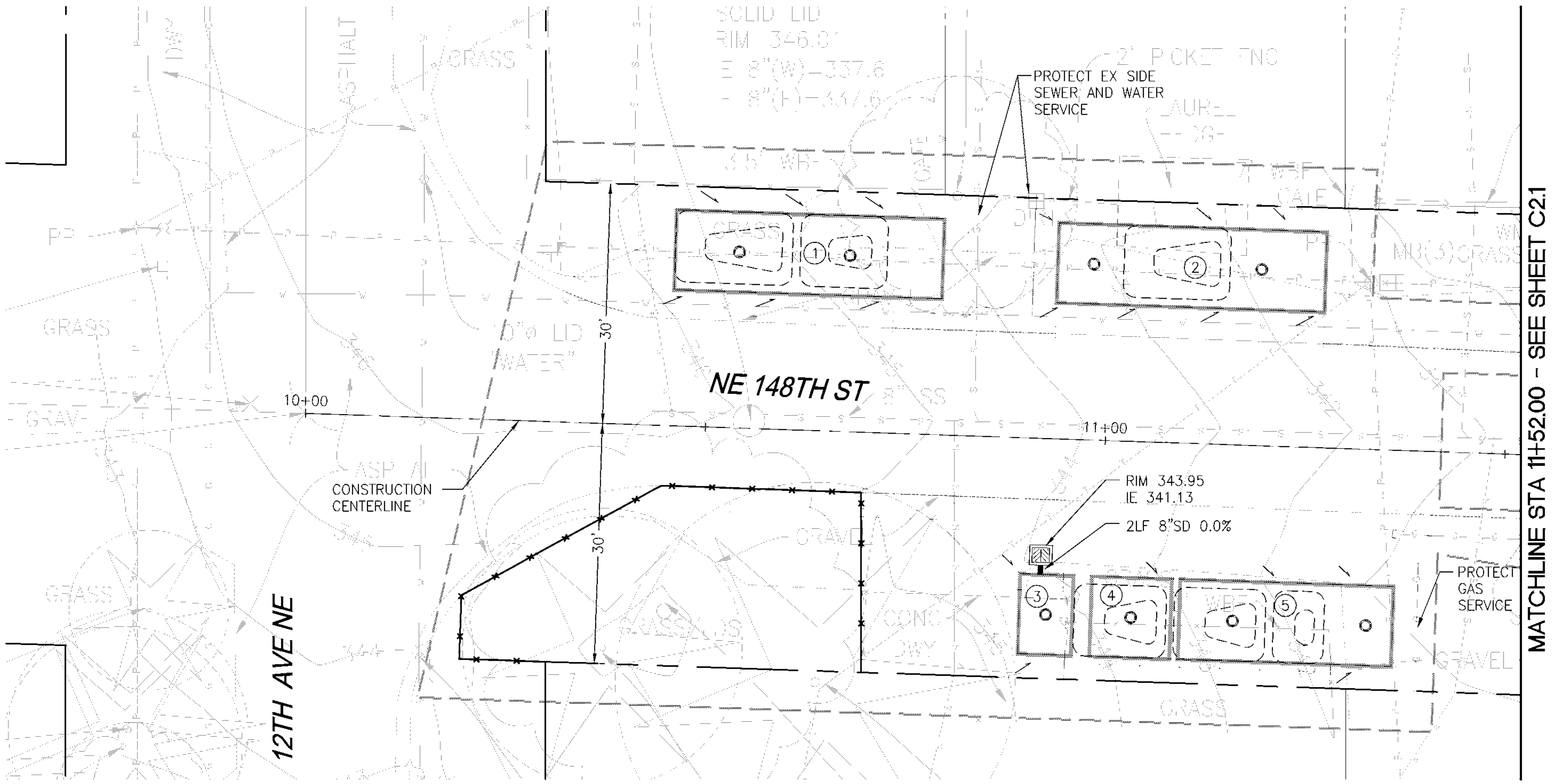
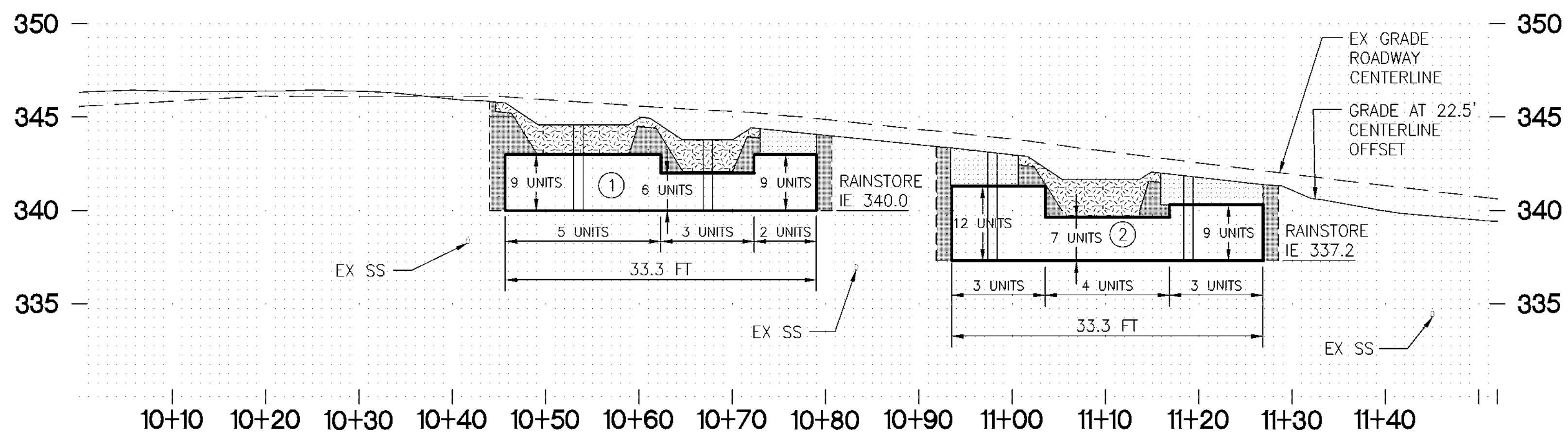
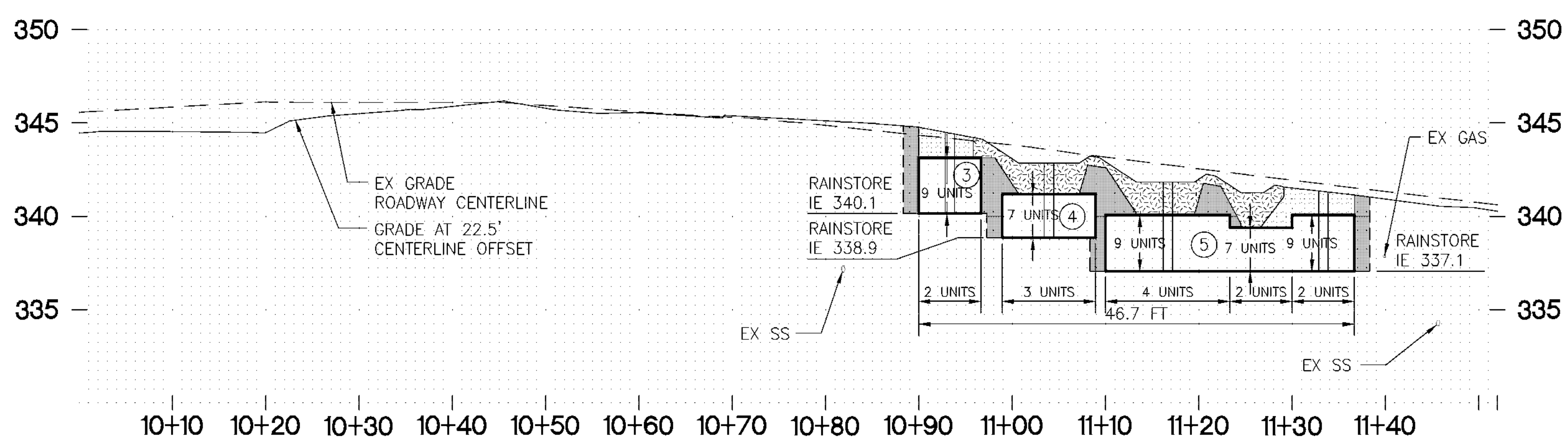




PROFILE NORTH SIDE STORM DRAINAGE @ 22.5' LT FROM CENTERLINE



PROFILE SOUTH SIDE STORM DRAINAGE @ 22.5' RT FROM CENTERLINE

N

10' 5' 0 10' 20'
Scale In Feet

LEGEND

- RIGHT-OF-WAY LINE
- APPROX LIMITS OF WORK
- TREE PROTECTION FENCING
- EXISTING CONTOURS
- CATCH BASIN, TYPE 1
- SHEET FLOW DIRECTION
- MAINTENANCE PORT. SEE NOTE 1. — RAINSTORE3 UNITS
- SOIL BACKFILL
- PAVEMENT BASE BACKFILL
- COMPACTED STRUCTURAL SIDE BACKFILL
- TOP AND BOTTOM OF BIORETENTION AREA
- FACILITY IDENTIFIER
- EXCAVATION LINE TO ALLOW SPACE FOR PROPER COMPACTION (3/D1.2)

NOTES

1. MAINTENANCE PORTS SHALL BE 9" PORTS PER DETAIL 2/D1.2. CONTRACTOR SHALL PROVIDE MIN 12" CLEANOUT FRAME AND COVER AND CONCRETE COLLAR AS NECESSARY FOR GRAVEL AREAS. FOR PLANTED AREAS, CONTRACTOR TO PROVIDE THREADED PVC PIPE AND CAP TO BE FINISHED 6" ABOVE BOTTOM OF BIORETENTION AREA IF LOCATED AT BOTTOM OR 2" ABOVE FINISHED GRADE IF AT TOP OF BIORETENTION AREA.

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DATUM

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DATUM: NAVD 88

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THOMAS R. VON SCHRADER — STATE OF WASHINGTON — 35044 — REGISTERED PROFESSIONAL ENGINEER

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	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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NE 148TH STREET INFILTRATION FACILITIES
95% GRANT APPLICATION SET
STORM DRAIN PLAN AND PROFILE, PHASE 3

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Sheet C2.0

Sheet X

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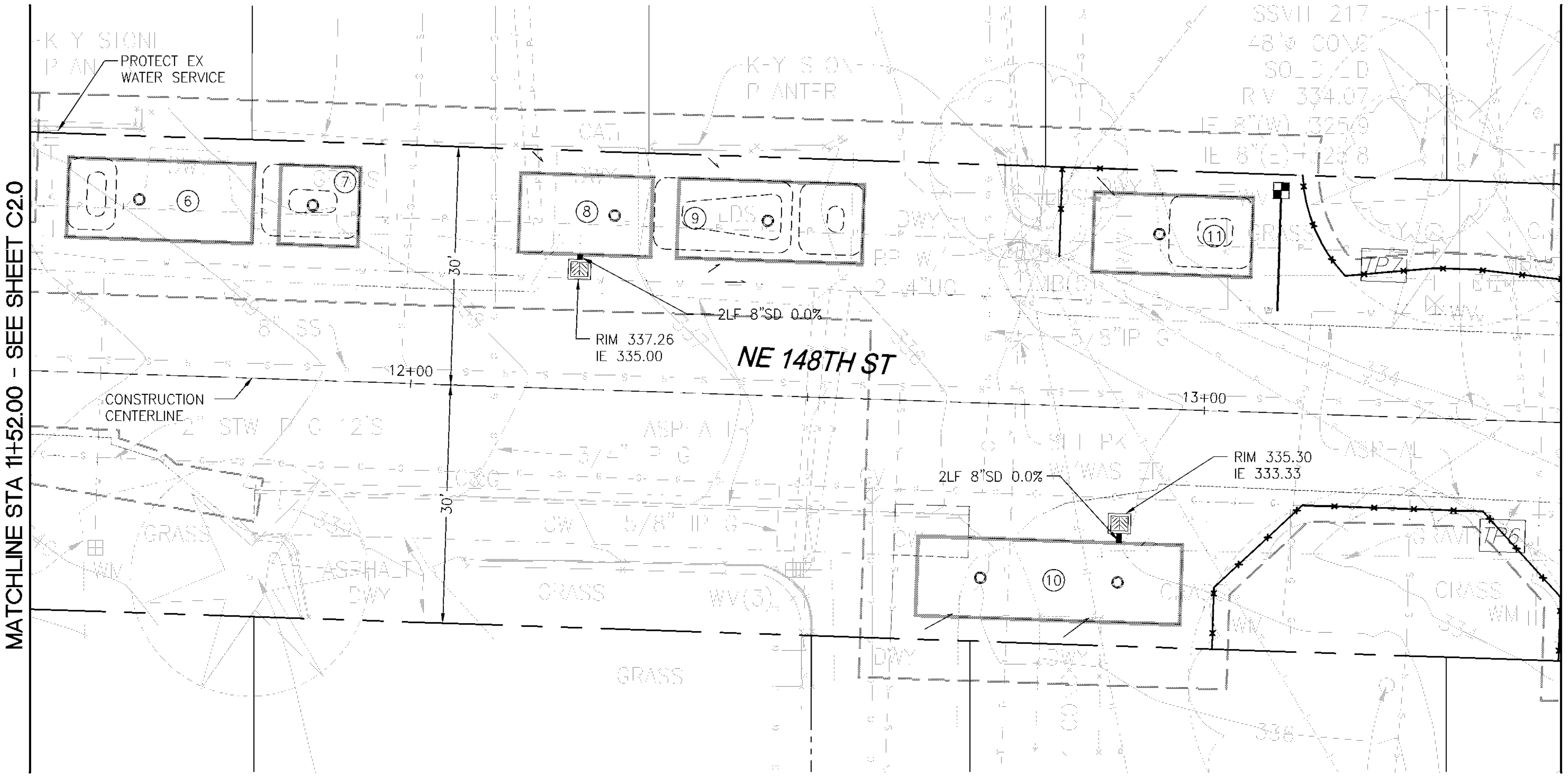
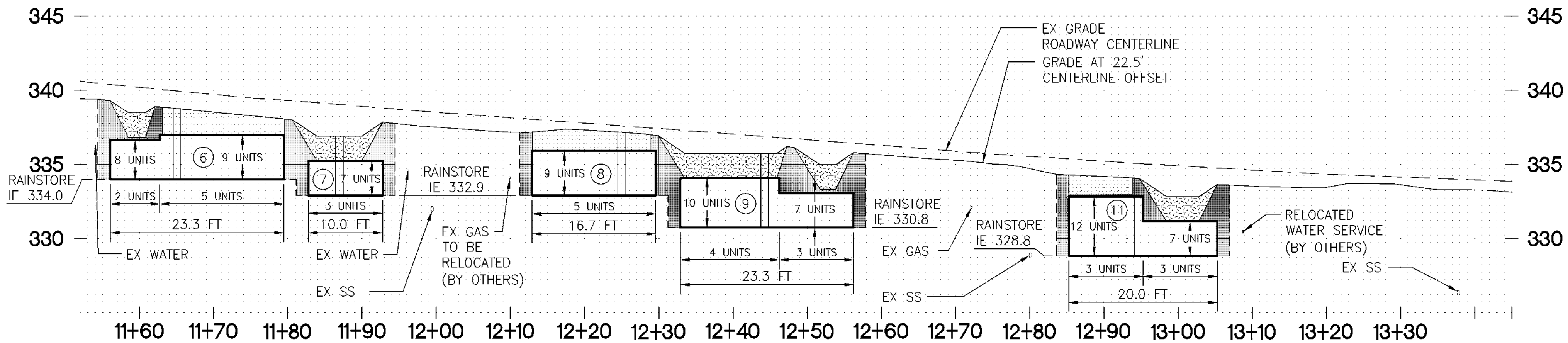
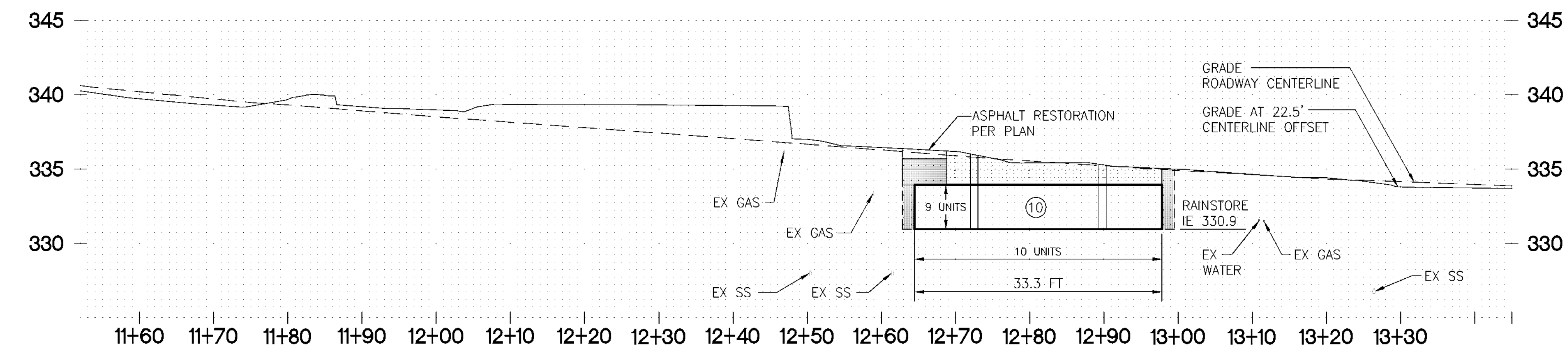




PROFILE NORTH SIDE STORM DRAINAGE @ 22.5' LT FROM CENTERLINE



PROFILE SOUTH SIDE STORM DRAINAGE @ 22.5' RT FROM CENTERLINE

N

10' 5' 0 10' 20'
Scale In Feet

LEGEND

- RIGHT-OF-WAY LINE
- APPROX LIMITS OF WORK
- TREE PROTECTION FENCING
- EXISTING CONTOURS
- CATCH BASIN, TYPE 1
- SHEET FLOW DIRECTION
- MAINTENANCE PORT. SEE NOTE 1. — RAINSTORE3 UNITS
- SOIL BACKFILL
- PAVEMENT BASE BACKFILL
- COMPACTED STRUCTURAL SIDE BACKFILL
- TOP AND BOTTOM OF BIORETENTION AREA
- FACILITY IDENTIFIER
- EXCAVATION LINE TO ALLOW SPACE FOR PROPER COMPACTION (3/D1.2)

NOTES

1. MAINTENANCE PORTS SHALL BE 9" PORTS PER DETAIL 2/D1.2. CONTRACTOR SHALL PROVIDE MIN 12" CLEANOUT FRAME AND COVER AND CONCRETE COLLAR AS NECESSARY FOR GRAVEL AREAS. FOR PLANTED AREAS, CONTRACTOR TO PROVIDE THREADED PVC PIPE AND CAP TO BE FINISHED 6" ABOVE BOTTOM OF BIORETENTION AREA IF LOCATED AT BOTTOM OR 2" ABOVE FINISHED GRADE IF AT TOP OF BIORETENTION AREA.

DATUM

BASIS OF BEARING: NAD 83/91

DATUM: NAVD 88

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

STORM DRAIN PLAN AND PROFILE, PHASE 2

	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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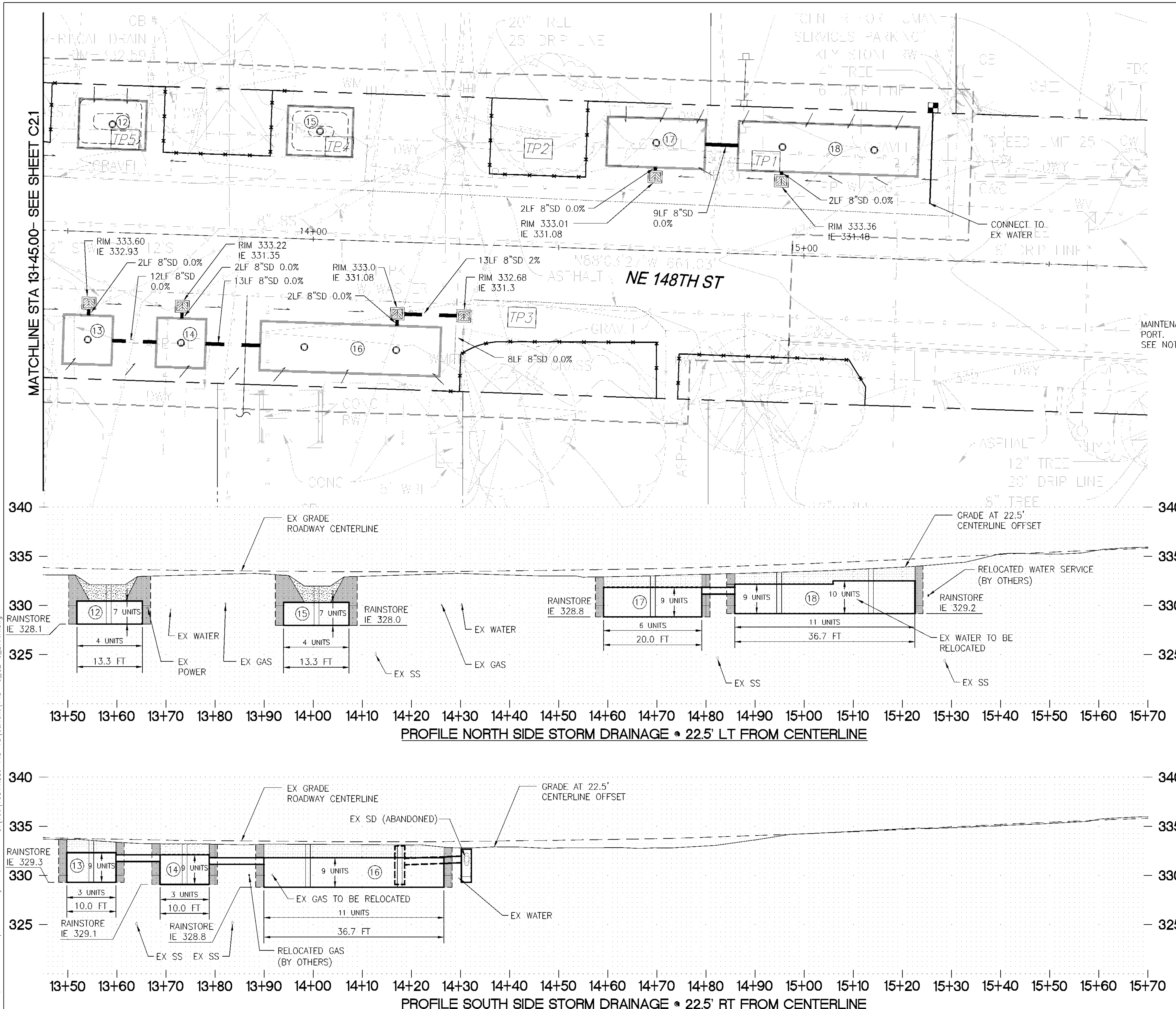

N

Scale In Feet (10' 5' 0 10' 20')

LEGEND

- RIGHT-OF-WAY LINE
- APPROX LIMITS OF WORK
- TREE PROTECTION FENCING
- EXISTING CONTOURS
- CATCH BASIN, TYPE 1
- SHEET FLOW DIRECTION
- MAINTENANCE PORT. SEE NOTE 1. — RAINSTORE3 UNITS
- SOIL BACKFILL
- PAVEMENT BASE BACKFILL
- COMPACTED STRUCTURAL SIDE BACKFILL
- TOP AND BOTTOM OF BIORETENTION AREA
- (1) FACILITY IDENTIFIER
- EXCAVATION LINE TO ALLOW SPACE FOR PROPER COMPACTION (3/D1.2)

NOTES

1. MAINTENANCE PORTS SHALL BE 9" PORTS PER DETAIL 2/D1.2. CONTRACTOR SHALL PROVIDE MIN 12" CLEANOUT FRAME AND COVER AND CONCRETE COLLAR AS NECESSARY FOR GRAVEL AREAS. FOR PLANTED AREAS, CONTRACTOR TO PROVIDE THREADED PVC PIPE AND CAP TO BE FINISHED 6" ABOVE BOTTOM OF BIORETENTION AREA IF LOCATED AT BOTTOM OR 2" ABOVE FINISHED GRADE IF AT TOP OF BIORETENTION AREA.

NOT FOR CONSTRUCTION

DATUM

BASIS OF BEARING: NAD 83/91

DATUM: NAVD 88

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PATRICIA A. BUCHANAN, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

THOMAS R. VON SCHRADER, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

QA/QC REVIEWER

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	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

STORM DRAIN PLAN AND PROFILE, PHASE 1

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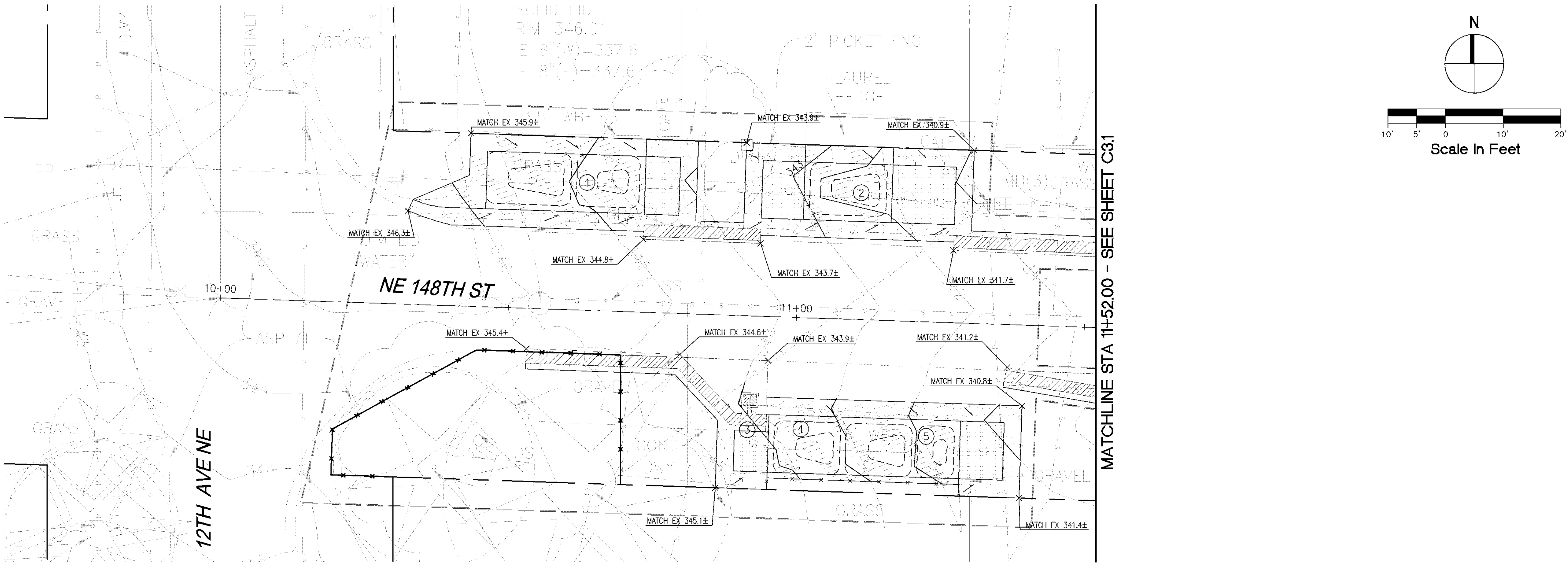
Sheet X



NOTES

1. RESTORATION ZONE MAY BE USED TO PROVIDE MINOR ADJUSTMENTS TO EXISTING GRADES SO THAT POSITIVE DRAINAGE IS PROVIDED TO FACILITIES.
2. PROVIDE FINE GRADING ADJUSTMENTS TO DIRECT SURFACE FLOWS AWAY FROM PROPERTY LINES TOWARDS FACILITY SURFACE AND INLETS.

LEGEND

- RIGHT-OF-WAY LINE
- APPROXIMATE LIMITS OF WORK
- TREE PROTECTION FENCING 4/D1.0
- 310 / 309 PROPOSED CONTOURS
- XXX.X SPOT ELEVATION
- GRAVEL PAVE 2 2/D1.3
- GRAVEL SURFACING 9/D1.1
- LANDSCAPE/RAINGARDEN (SEE C4.0–C4.2)
- ASPHALT DRIVEWAY
- CONCRETE DRIVEWAY
- ASPHALT THICKENED EDGE 6/D1.1
- TOP AND BOTTOM OF BIORETENTION AREA
- FLOW DIRECTION. SEE NOTE 1 AND 2.
- TP# GEOTECHNICAL TEST PIT SITE
- 1 FACILITY IDENTIFIER
- MAINTENANCE PORT

PATRICIA A. BUCHANAN, STATE OF WASHINGTON, 40794, REGISTERED PROFESSIONAL ENGINEER

THOMAS R. VON SCHRADER, STATE OF WASHINGTON, 25644, REGISTERED PROFESSIONAL ENGINEER

QA/QC REVIEWER

DATUM

BASIS OF BEARING: NAD 83/91

DATUM: NAVD 88

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

PAVING AND GRADING, PHASE 3

	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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Sheet C3.0

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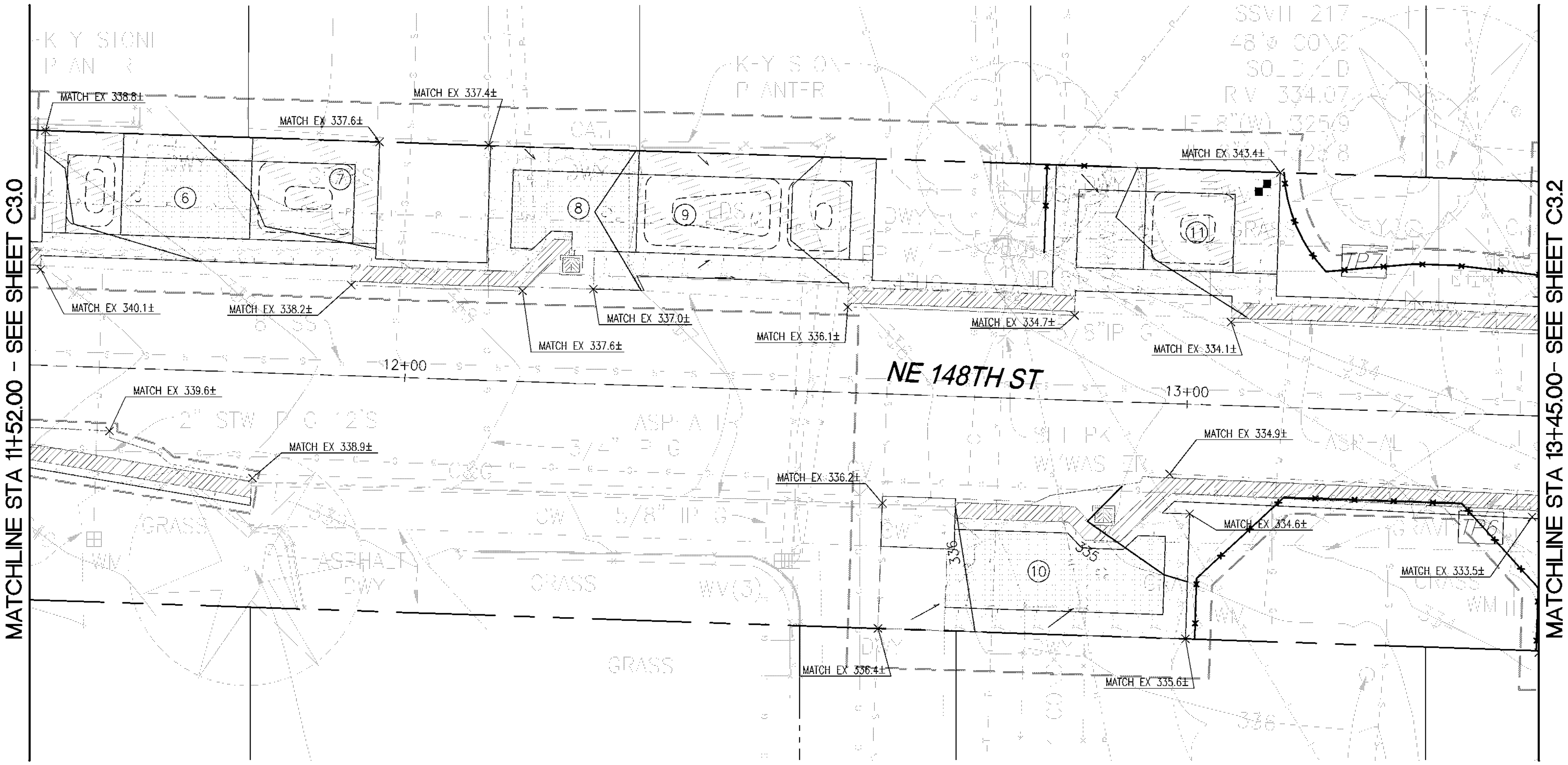

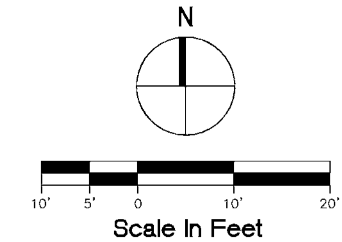

NOTES

1. RESTORATION ZONE MAY BE USED TO PROVIDE MINOR ADJUSTMENTS TO EXISTING GRADES SO THAT POSITIVE DRAINAGE IS PROVIDED TO FACILITIES.
2. PROVIDE FINE GRADING ADJUSTMENTS TO DIRECT SURFACE FLOWS AWAY FROM PROPERTY LINES TOWARDS FACILITY SURFACE AND INLETS.

LEGEND

- RIGHT-OF-WAY LINE
- APPROXIMATE LIMITS OF WORK
- TREE PROTECTION FENCING (4 / D1.0)
- 310 / 309 PROPOSED CONTOURS
- XXX.X SPOT ELEVATION
- GRAVEL PAVE 2 (2 / D1.3)
- GRAVEL SURFACING (9 / D1.1)
- LANDSCAPE/RAINGARDEN (SEE C4.0–C4.2)
- ASPHALT DRIVEWAY
- CONCRETE DRIVEWAY
- ASPHALT THICKENED EDGE (6 / D1.1)
- TOP AND BOTTOM OF BIORETENTION AREA
- FLOW DIRECTION. SEE NOTE 1 AND 2.
- TP# GEOTECHNICAL TEST PIT SITE
- 1 FACILITY IDENTIFIER
- MAINTENANCE PORT

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DATUM: NAVD 88

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Revisions			
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Drawn	KA	11/6/14	95% Grant Application Set
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Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

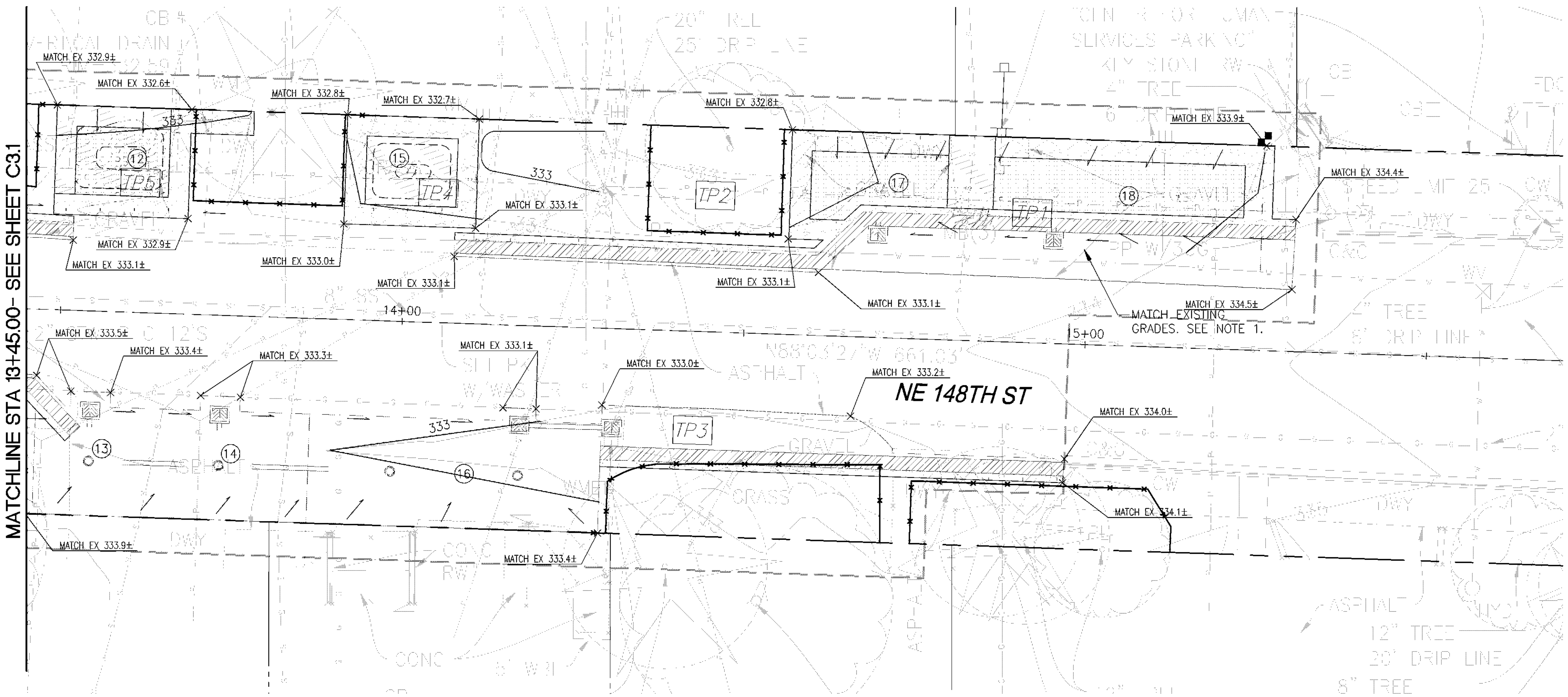
PAVING AND GRADING, PHASE 2

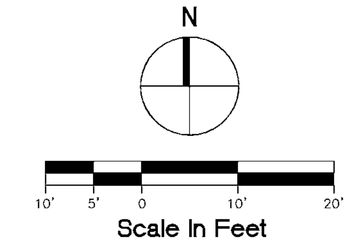
IF SHEET IS LESS THAN 22" X 34", IT IS A REDUCTION

Project No.

Sheet C3.1

Sheet X





NOTES

1. RESTORATION ZONE MAY BE USED TO PROVIDE MINOR ADJUSTMENTS TO EXISTING GRADES SO THAT POSITIVE DRAINAGE IS PROVIDED TO FACILITIES.
2. PROVIDE FINE GRADING ADJUSTMENTS TO DIRECT SURFACE FLOWS AWAY FROM PROPERTY LINES TOWARDS FACILITY SURFACE AND INLETS.

LEGEND

	RIGHT–OF–WAY LINE
	APPROXIMATE LIMITS OF WORK
	TREE PROTECTION FENCING 4/D1.0
310 / 309	PROPOSED CONTOURS
XXX.X	SPOT ELEVATION
	GRAVEL PAVE 2 2/D1.3
	GRAVEL SURFACING 9/D1.1
	LANDSCAPE/RAINGARDEN (SEE C4.0–C4.2)
	ASPHALT DRIVEWAY
	CONCRETE DRIVEWAY
	ASPHALT THICKENED EDGE 6/D1.1
	TOP AND BOTTOM OF BIORETENTION AREA
	FLOW DIRECTION. SEE NOTE 1 AND 2.
TP#	GEOTECHNICAL TEST PIT SITE
1	FACILITY IDENTIFIER
	MAINTENANCE PORT

PATRICIA A. BUCHANAN — STATE OF WASHINGTON — 40794 — REGISTERED PROFESSIONAL ENGINEER

THOMAS R. VON SCHRADER — STATE OF WASHINGTON — 25644 — REGISTERED PROFESSIONAL ENGINEER

QA/QC REVIEWER

DATUM

BASIS OF BEARING: NAD 83/91

DATUM: NAVD 88

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

PAVING AND GRADING, PHASE 1

Description	Date	Initials	
95% Grant Application Set	11/6/14	KA	Drawn
95% Grant Application Set	11/6/14	LK/PB	Designed
95% Grant Application Set	11/6/14	KG	Checked
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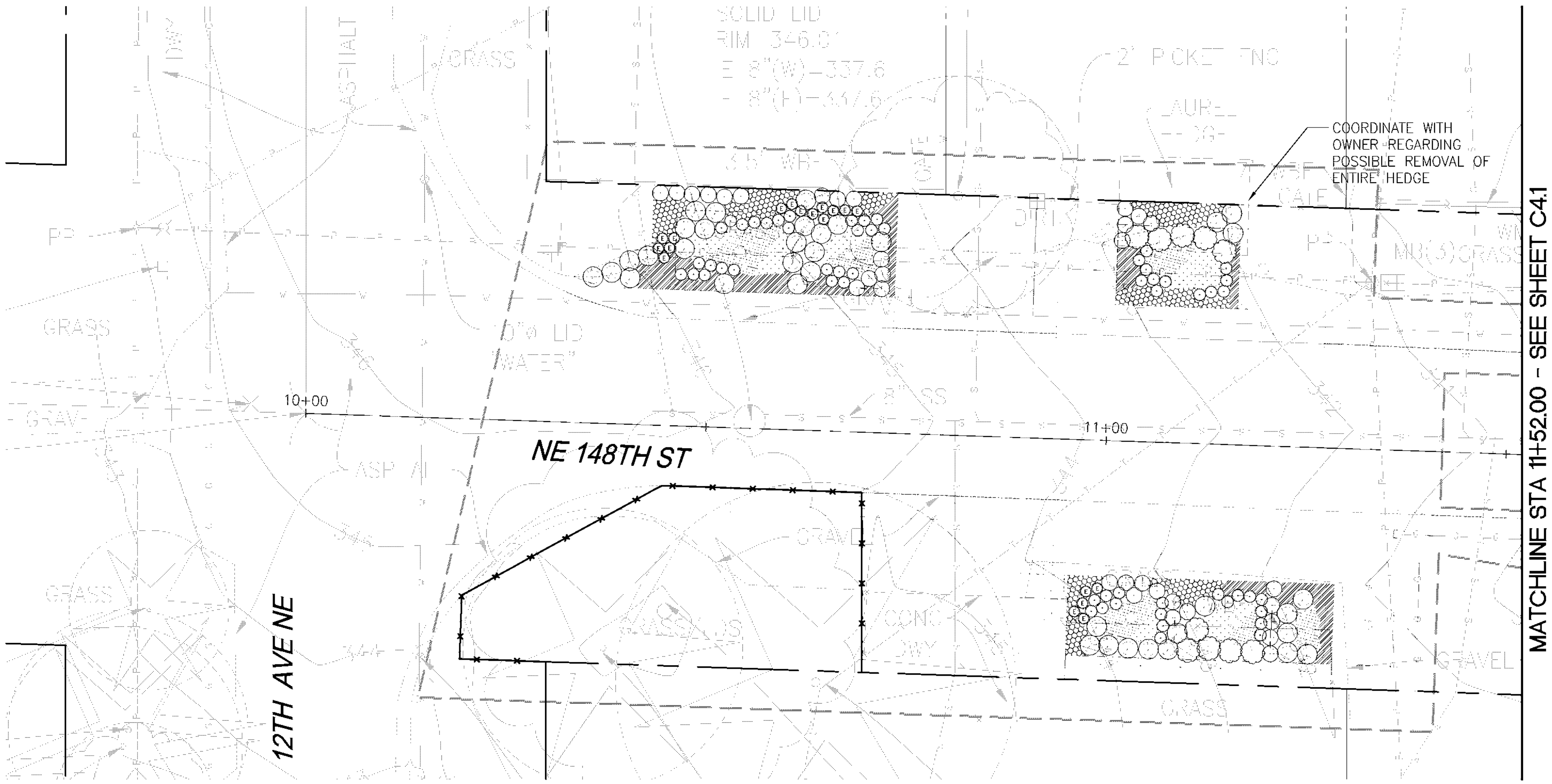

N

Scale In Feet

NOTES

1. SEE SHEET D1.4 FOR LANDSCAPE DETAILS.

Plant Schedule - Phase 3

DT=DROUGHT TOLERANT, NWN=NORTHWEST NATIVE OR CULTIVAR

SYMBOL	DT	NWN	BOTANICAL NAME	COMMON NAME	SIZE/ SPACING	QTY.	NOTES	DETAIL #/ SHEET
	X	X	MAHONIA REPENS	CREEPING OREGON GRAPE	1 GAL. / 18" O.C.	60		2/D1.4
		X	SPIREA BETULIFOLIA 'TOR'	BIRCHLEAF SPIREA	2 GAL. / AS SHOWN	32		1/D1.4
	X		ECHINACEA PURPUREA	CONEFLOWER	1 GAL. / 18" O.C.	19		2/D1.4
	X	X	CORNUS SERICEA 'KELSEYII'	REDSTEM DOGWOOD	5 GAL. / AS SHOWN	37		1/D1.4
	X		GERANIUM MACRORRHIZUM 'ALBUM'	HARDY GERANIUM	1 GAL. / 18" O.C.	58		2/D1.4
	X		ILEX GLABRA 'SHAMROCK'	INKBERRY	5 GAL. / 36" O.C.	10		1/D1.4
	X		IRIS FOETIDISSIMA 'VARIEGATA'	VARIEGATED IRIS	1 GAL. / AS SHOWN	56		2/D1.4
	X	X	CAREX OBNUPTA	SLOUGH SEDGE	10 IN.³ TUBE / 9" O.C.	187		3/D1.4
	X		DESCHAMPSIA FLEXUOSA 'AUREA'	GOLDEN CRINKLED HAIR GRASS	10 IN.³ TUBE / 9" O.C.	155		3/D1.4

LEGEND

- RIGHT-OF-WAY LINE
- APPROXIMATE LIMITS OF WORK
- TREE PROTECTION FENCING 4/D1.0
- TOP AND BOTTOM OF BIORETENTION AREA
- EXISTING TREE DRIPLINE/ CRITICAL ROOT ZONE

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
BRCE MARYMAN
CERTIFICATE NO. 1147

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
MARGARET ROSE STAEHELI
CERTIFICATE NO. 458
QA/QC REVIEWER

DATUM

BASIS OF BEARING: NAD 83/91
DATUM: NAVD 88

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

LANDSCAPE, PHASE 3

Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
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Initials / Date / Description

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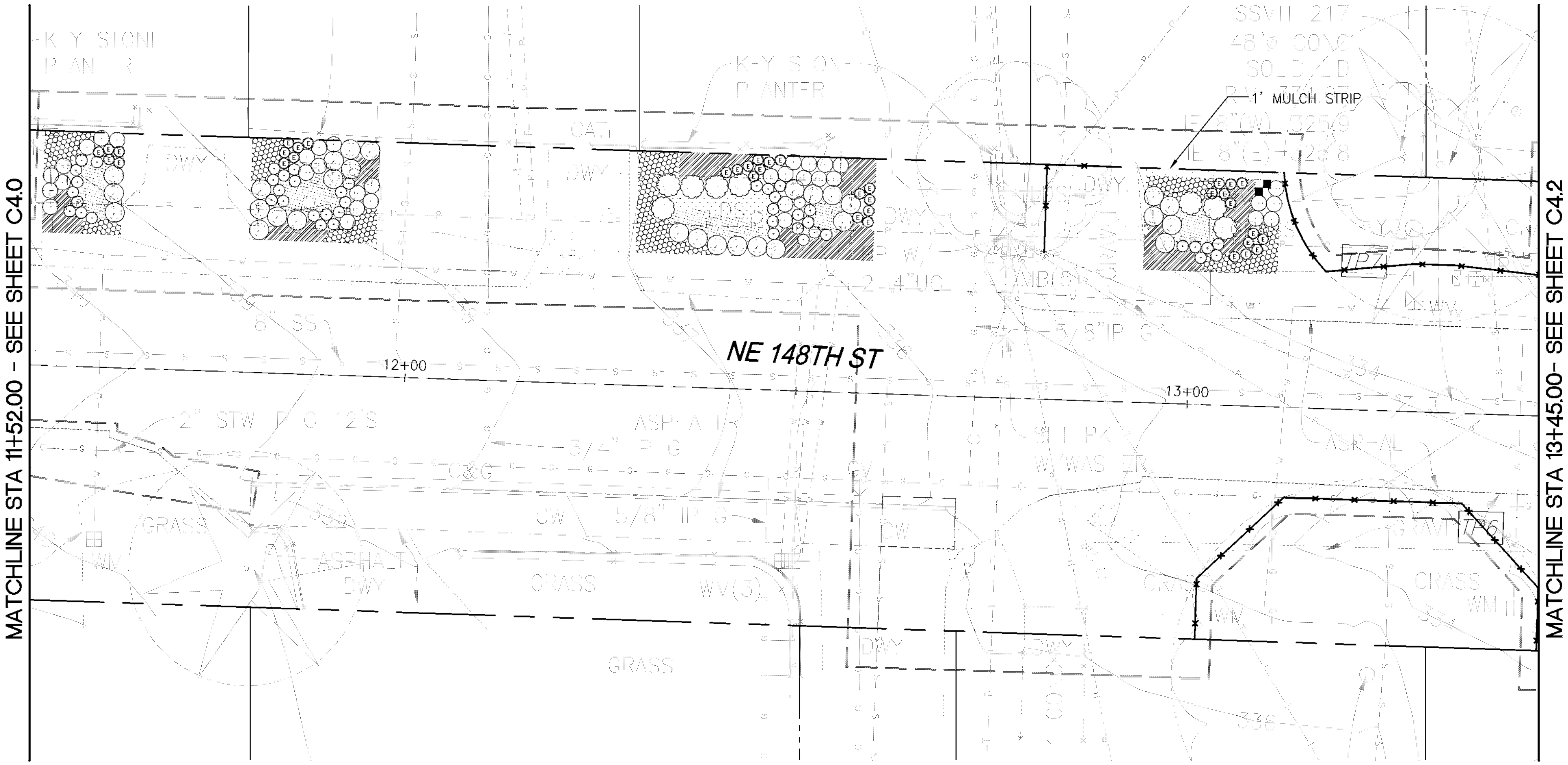

N

10' 5' 0 10' 20'
Scale In Feet

NOTES

1. SEE SHEET D1.4 FOR LANDSCAPE DETAILS.

Plant Schedule - Phase 2

DT=DROUGHT TOLERANT, NWN=NORTHWEST NATIVE OR CULTIVAR

SYMBOL	DT	NWN	BOTANICAL NAME	COMMON NAME	SIZE/ SPACING	QTY.	NOTES	DETAIL #/ SHEET
	X	X	MAHONIA REPENS	CREEPING OREGON GRAPE	1 GAL. / 18" O.C.	72		2/D1.4
		X	SPIREA BETULIFOLIA 'TOR'	BIRCHLEAF SPIREA	2 GAL. / AS SHOWN	34		1/D1.4
	X		ECHINACEA PURPUREA	CONEFLOWER	1 GAL. / 18" O.C.	37		2/D1.4
	X	X	CORNUS SERICEA 'KELSEYII'	REDSTEM DOGWOOD	5 GAL. / AS SHOWN	29		1/D1.4
	X		GERANIUM MACRORRHIZUM 'ALBUM'	HARDY GERANIUM	1 GAL. / 18" O.C.	72		2/D1.4
	X		ILEX GLABRA 'SHAMROCK'	INKBERRY	5 GAL. / 36" O.C.	8		1/D1.4
	X		IRIS FOETIDISSIMA 'VARIEGATA'	VARIEGATED IRIS	1 GAL. / AS SHOWN	46		2/D1.4
	X	X	CAREX OBNUPTA	SLOUGH SEDGE	10 IN.^{3} TUBE / 9" O.C.	168		3/D1.4
	X		DESCHAMPSIA FLEXUOSA 'AUREA'	GOLDEN CRINKLED HAIR GRASS	10 IN.^{3} TUBE / 9" O.C.	57		3/D1.4

LEGEND

RIGHT-OF-WAY LINE

APPROXIMATE LIMITS OF WORK

TREE PROTECTION FENCING 4/D1.0

TOP AND BOTTOM OF BIORETENTION AREA

EXISTING TREE DRIPLINE/ CRITICAL ROOT ZONE

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT

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CERTIFICATE NO. 1147

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT

MARGARET ROSE STAEHELI
CERTIFICATE NO. 458
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LANDSCAPE, PHASE 2

	Initials	Date	Description
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Checked	KG	11/6/14	95% Grant Application Set
Revisions			
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Sheet X

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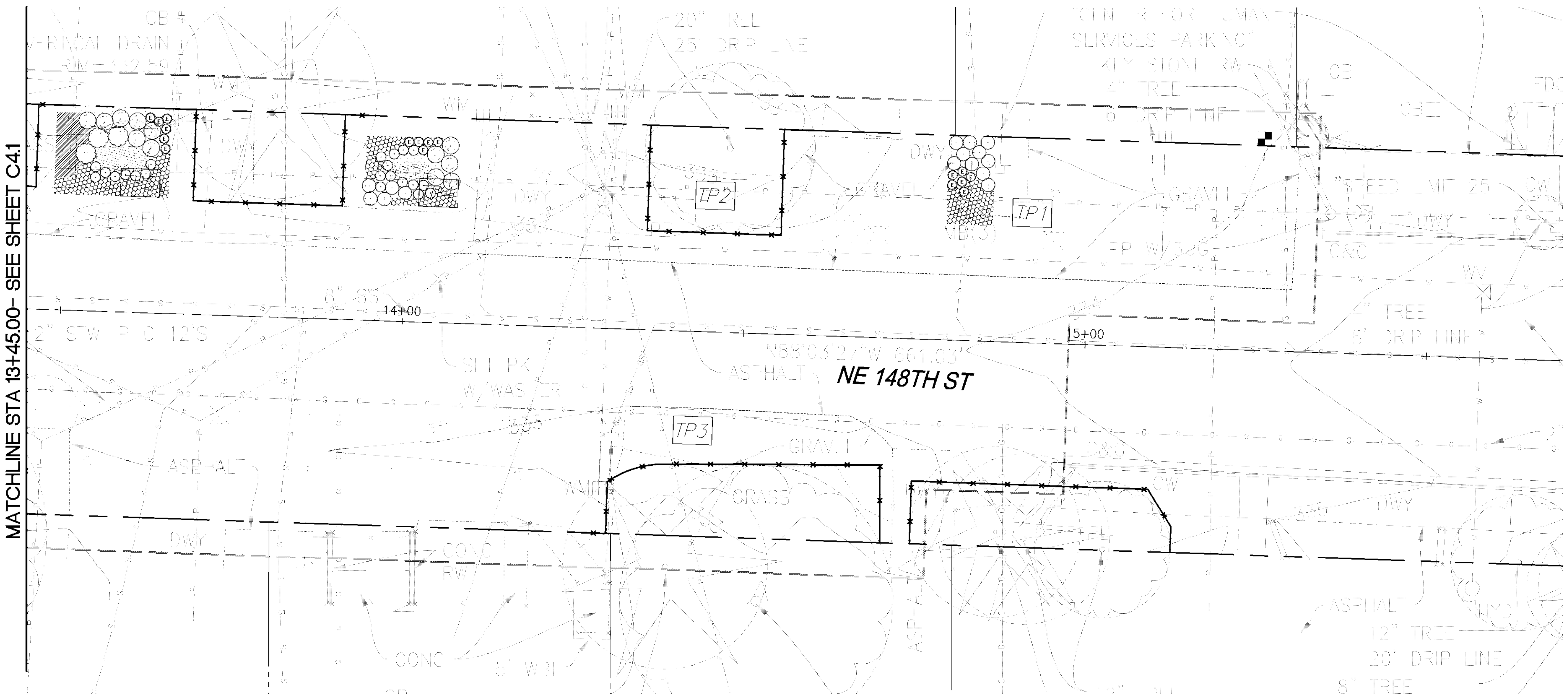
Nov 06, 2014 - 4:33pm kyleo



NOTES

1. SEE SHEET D1.4 FOR LANDSCAPE DETAILS.

Plant Schedule - Phase 1

DT=DROUGHT TOLERANT, NWN=NORTHWEST NATIVE OR CULTIVAR

SYMBOL	DT	NWN	BOTANICAL NAME	COMMON NAME	SIZE/ SPACING	QTY.	NOTES	DETAIL #/ SHEET
	X	X	MAHONIA REPENS	CREEPING OREGON GRAPE	1 GAL. / 18" O.C.	56		2/D1.4
		X	SPIREA BETULIFOLIA 'TOR'	BIRCHLEAF SPIREA	2 GAL. / AS SHOWN	15		1/D1.4
	X		ECHINACEA PURPUREA	CONEFLOWER	1 GAL. / 18" O.C.	17		2/D1.4
	X	X	CORNUS SERICEA 'KELSEYII'	REDSTEM DOGWOOD	5 GAL. / AS SHOWN	12		1/D1.4
	X		GERANIUM MACRORRHIZUM 'ALBUM'	HARDY GERANIUM	1 GAL. / 18" O.C.	16		2/D1.4
	X		ILEX GLABRA 'SHAMROCK'	INKBERRY	5 GAL. / 36" O.C.	3		1/D1.4
	X		IRIS FOETIDISSIMA 'VARIEGATA'	VARIEGATED IRIS	1 GAL. / AS SHOWN	21		2/D1.4
	X	X	CAREX OBNUPTA	SLOUGH SEDGE	10 IN.^{3} TUBE / 9" O.C.	51		3/D1.4
	X		DESCHAMPSIA FLEXUOSA 'AUREA'	GOLDEN CRINKLED HAIR GRASS	10 IN.^{3} TUBE / 9" O.C.	18		3/D1.4

LEGEND

- RIGHT-OF-WAY LINE
- APPROXIMATE LIMITS OF WORK
- TREE PROTECTION FENCING 4/D1.0
- TOP AND BOTTOM OF BIORETENTION AREA
- EXISTING TREE DRIPLINE/ CRITICAL ROOT ZONE

	Initials	Date	Description
Drawn	KA	11/6/14	95% Grant Application Set
Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
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LANDSCAPE, PHASE 1

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CERTIFICATE NO. 1147

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CERTIFICATE NO. 458
QA/QC REVIEWER

DATUM

BASIS OF BEARING: NAD 83/91
DATUM: NAVD 88

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L1.2

Sheet X

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kyleo
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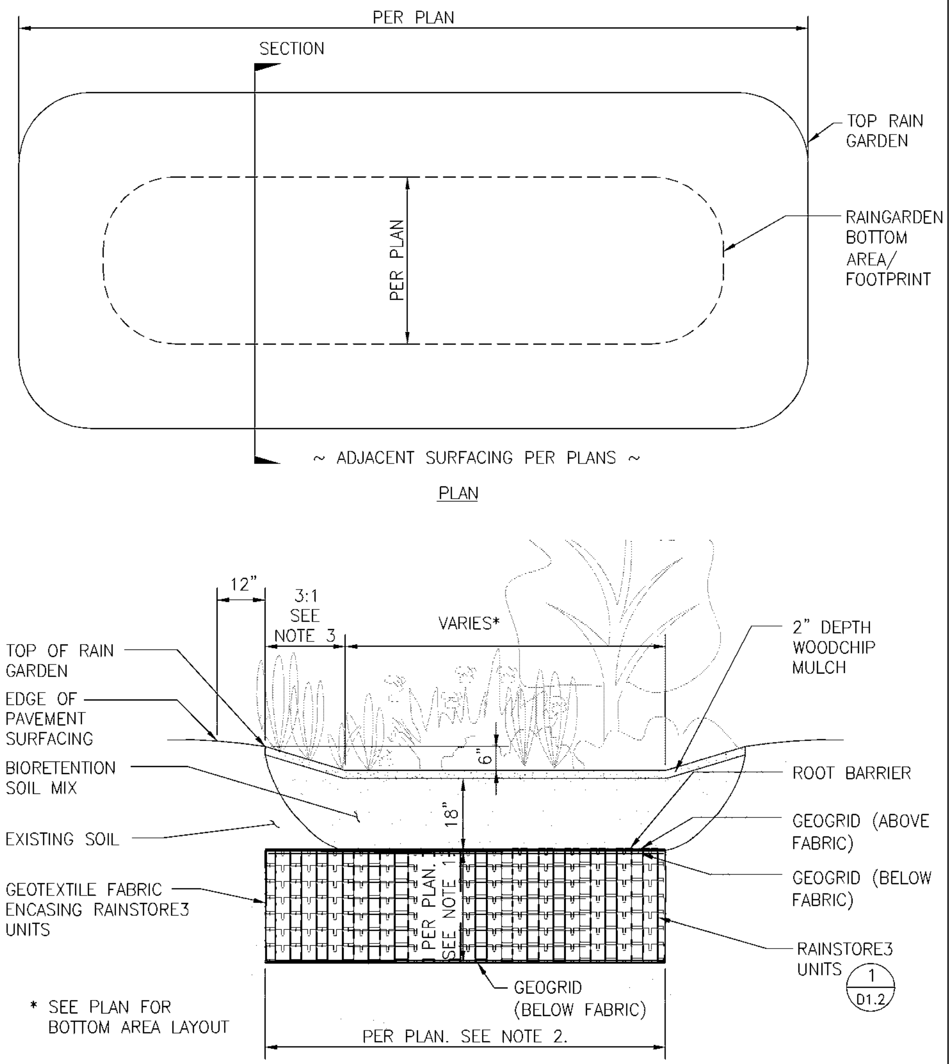
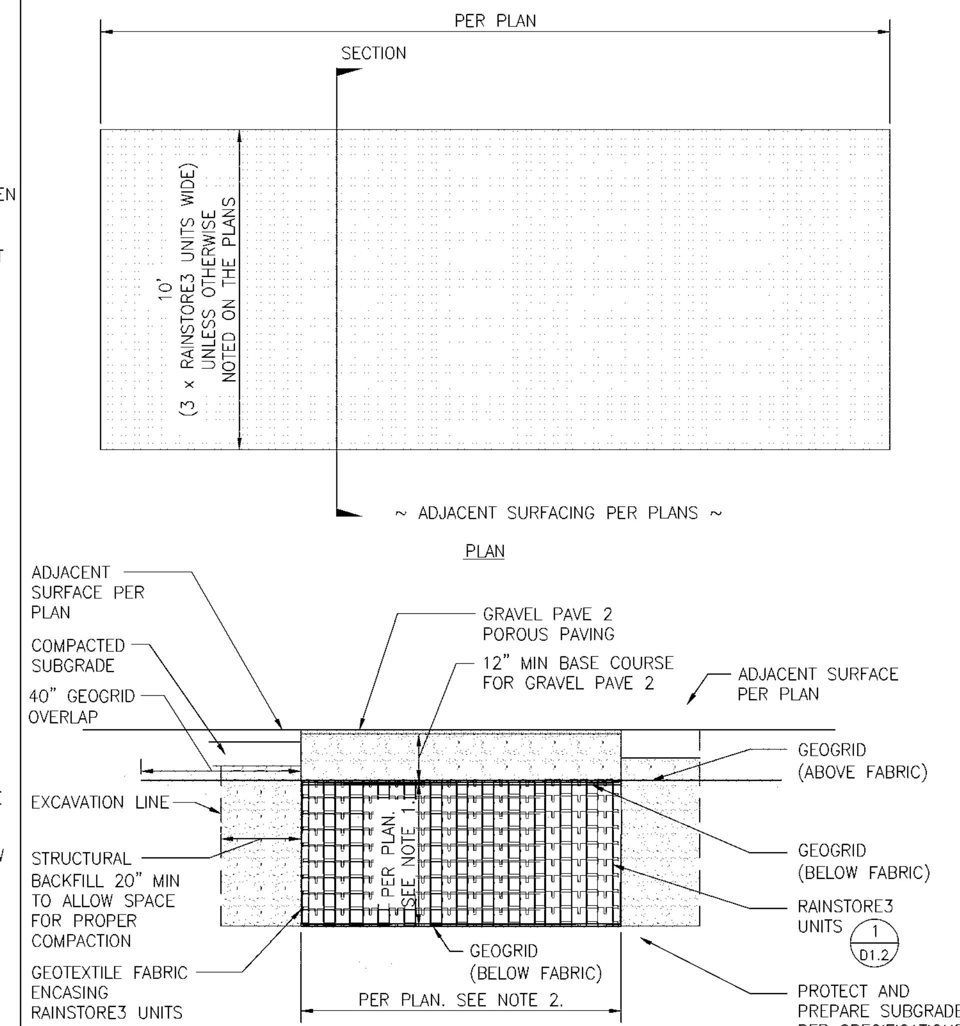


NOTES:
1. DEPTH OF RAINSTORE3 FACILITY STACK SHALL BE MULTIPLES OF WHOLE UNITS ONLY. SEE DETAIL 1/D1.2.
2. FOOTPRINT (LENGTH AND WIDTH) OF RAINSTORE3 FACILITY STACK SHALL BE MULTIPLES OF WHOLE UNITS ONLY. SEE DETAIL 1/D1.2.
3. SEE DETAIL 4/D1.2 FOR RAINSTORE3 INSTALLATION DETAILS.

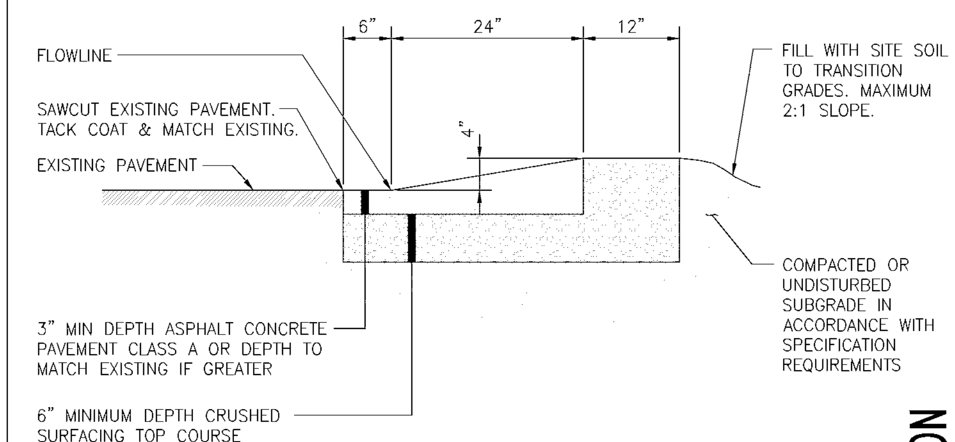
NTS
Bioretention Area Surface Rainstore3 Typical Detail 4



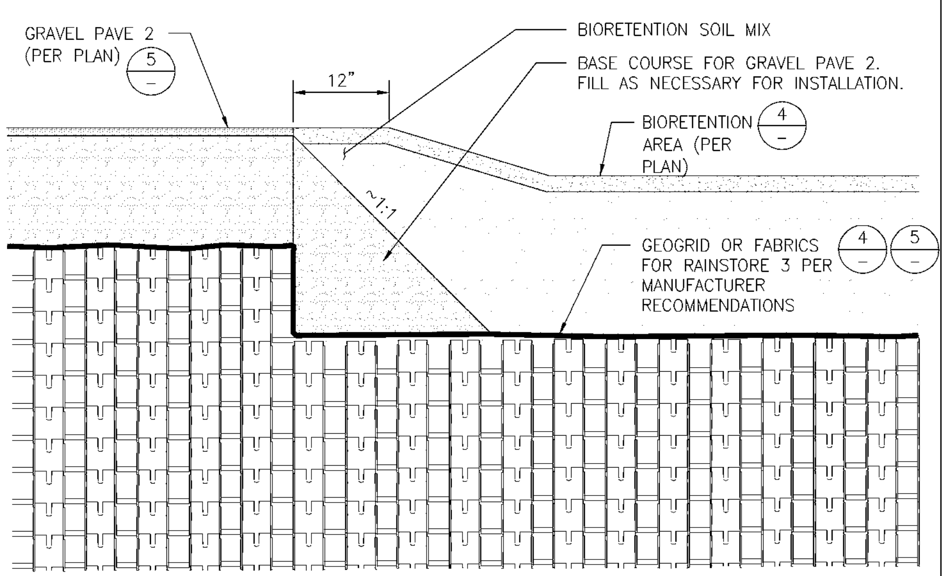
NOTES:
1. DEPTH OF RAINSTORE3 FACILITY STACK SHALL BE MULTIPLES OF WHOLE UNITS ONLY. SEE DETAIL 1/D1.2.
2. FOOTPRINT (LENGTH AND WIDTH) OF RAINSTORE3 FACILITY STACK SHALL BE MULTIPLES OF WHOLE UNITS ONLY. SEE DETAIL 1/D1.2.
3. SEE DETAIL 4/D1.2 FOR RAINSTORE3 INSTALLATION DETAILS.

NTS
Gravel Pave 2 Surface Rainstore3 Typical Detail 5

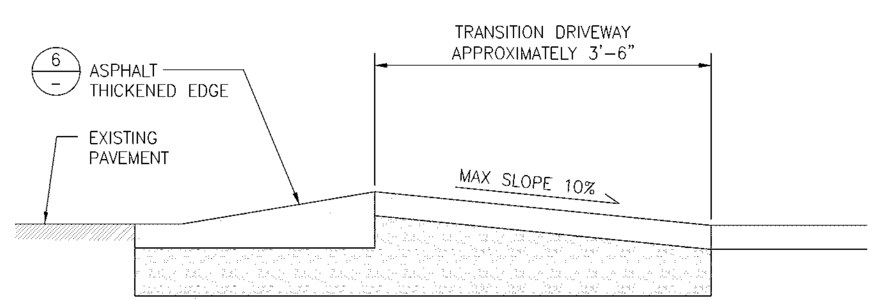
NTS
Not Used 3



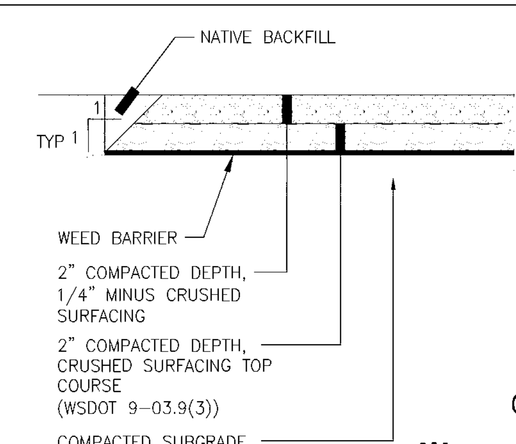
NTS
Asphalt Thickened Edge 6



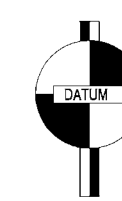
NTS
Gravel Pave 2/Bioretention Area Edge 7



NTS
Asphalt Driveway Transition 8



NTS
Gravel Surfacing 9



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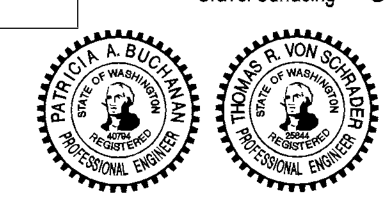

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Drawn	Designed	Checked	Revisions	Revisions
Initials: KA	LK/PB	KG		
Date: 11/6/14	11/6/14	11/6/14		
Description: 95% Grant Application Set	95% Grant Application Set	95% Grant Application Set		

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Sheet D1.1

Sheet X

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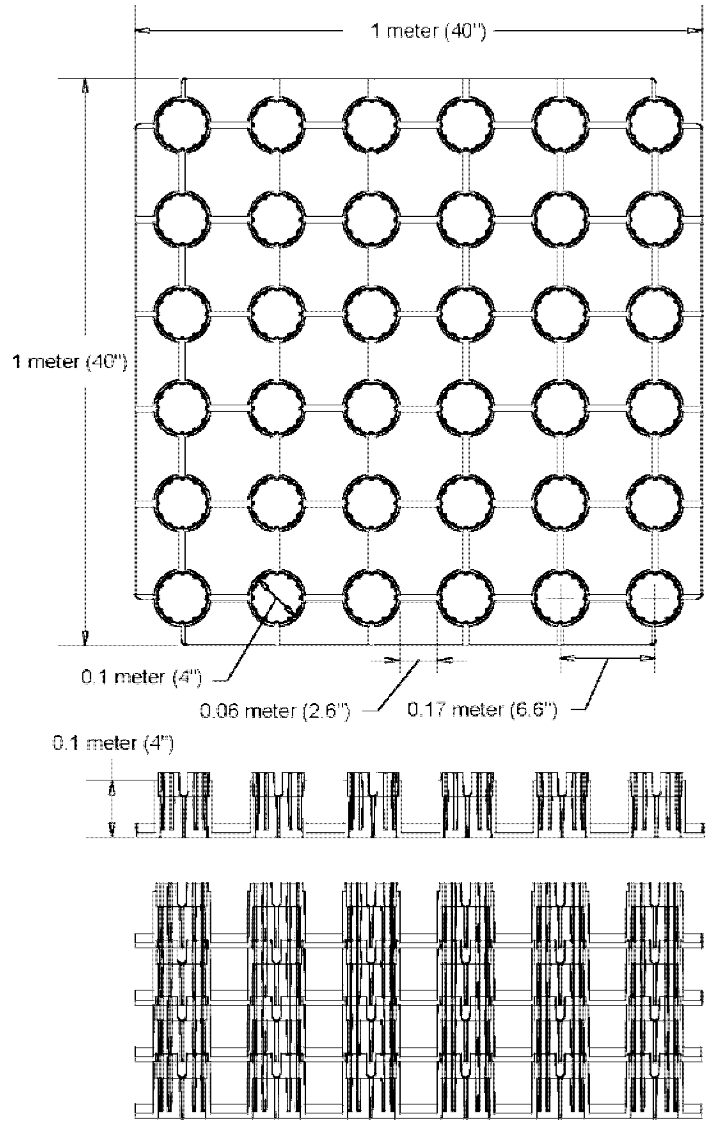
Rainstore3 Unit Dimensions



Rainstore3 Unit Detail

Single Rainstore3 injection molded unit geometry and dimensions

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RS3detail.dwg

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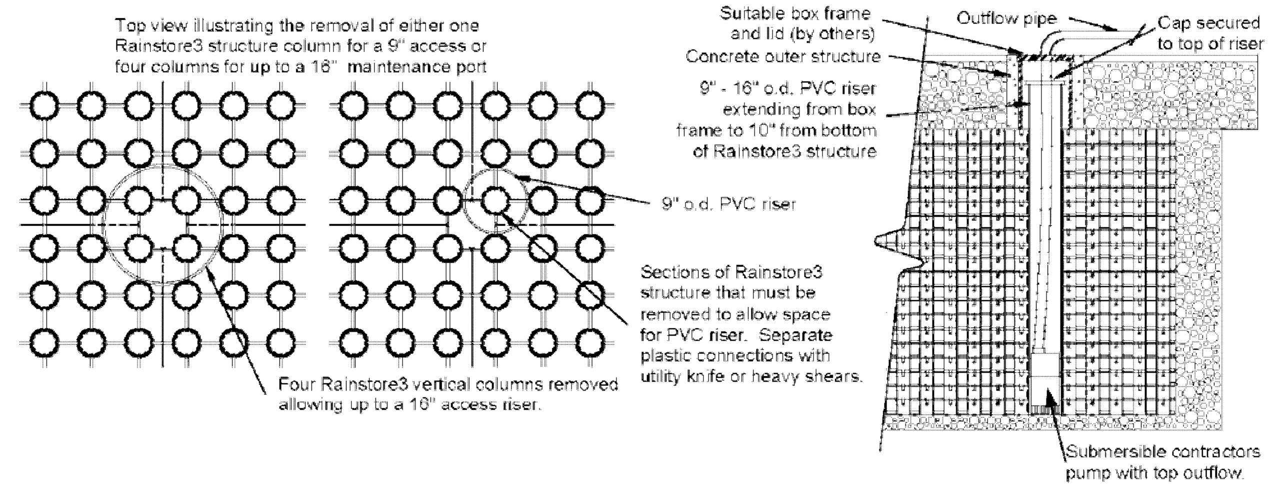
NTS
Rainstore3 Unit Detail 1



RS3 Maintenance Port

Method for providing inspection and cleanout access

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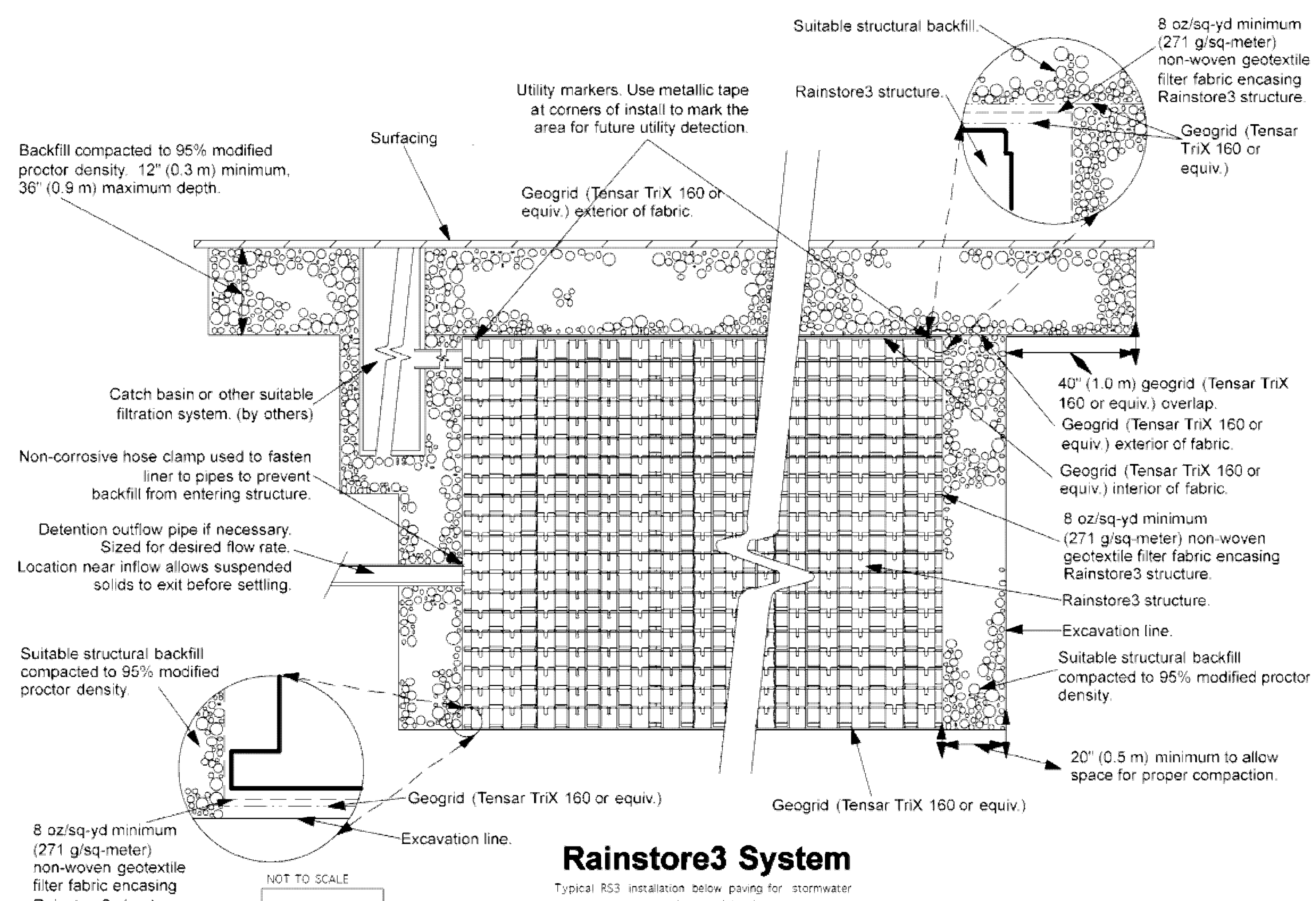
NTS
RS3 Maintenance Port 2



Rainstore3 System

Typical RS3 installation below paving for stormwater retention or detention

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RS3detret10.dwg

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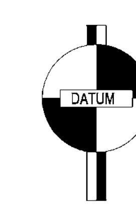
NTS
Rainstore3 System 4



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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

DETAILS, INVISIBLE STRUCTURES

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Sheet D1.2

Sheet X

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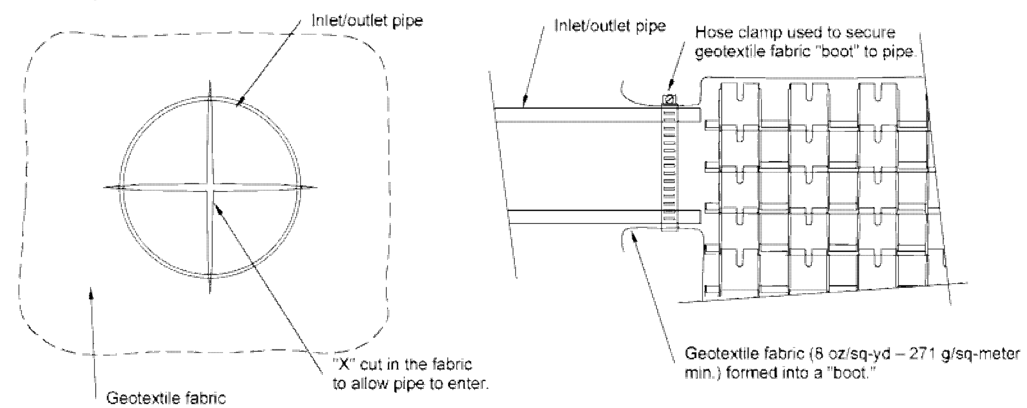
End view of pipe/fabric connection. Cut an X in the fabric slightly larger than pipe, pull the fabric around the pipe to create the "boot" and then secure with a hose-clamp.



End View **Side View**

Rainstore3 Inlets/Outlets With Fabric

Connecting pipe to the Rainstore3 structure

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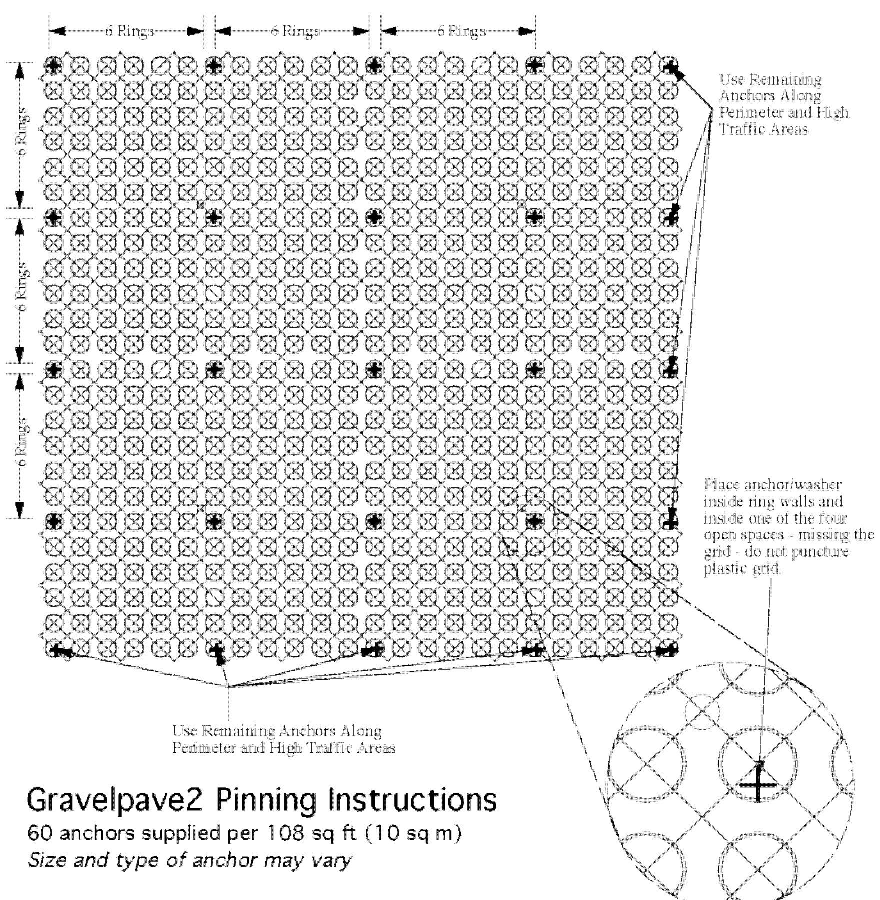
NTS
Rainstore3 Inlets/Outlets With Fabric 1



Gravelpave2 Pinning Instructions

60 anchors supplied per 108 sq ft (10 sq m)
Size and type of anchor may vary

1. Place one anchor (minimum) every six rings
2. Place anchor inside rings, in one of the four open spaces (do not puncture grid).
3. Place remaining anchors around perimeter of site and in high traffic areas

GRAVELPAVE2 PINNING INSTRUCTIONS 1 / 1 OF 1

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GV2Pinning.dwg

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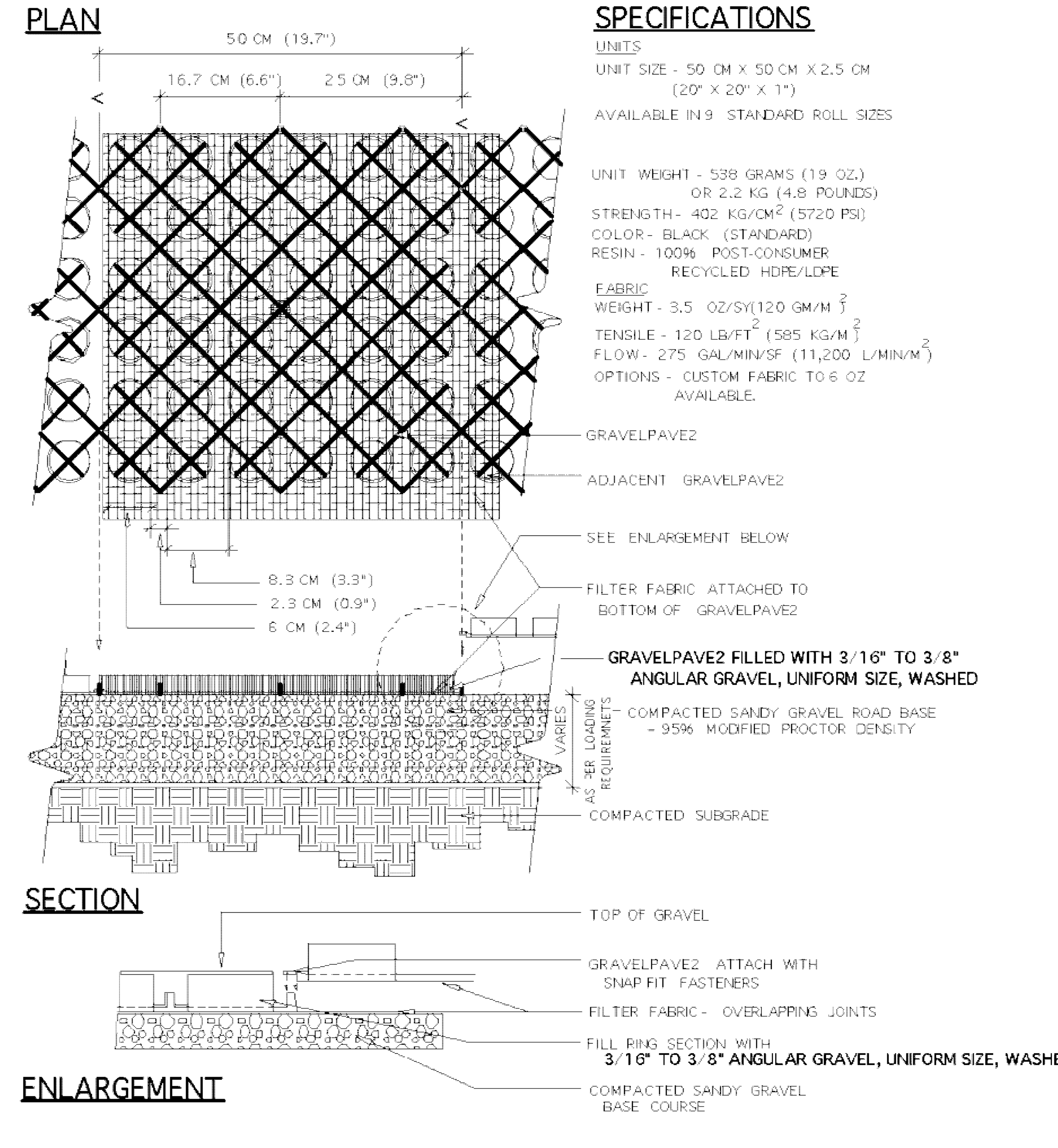
www.invisiblestructures.com
Rev. 06/05

NTS
Typical Gravelpave2 Detail 3

NOTES: TURN OFF DOFF LAYER PRIOR TO PLOTTING.
HATCH DOFF HATCH LIMITS IN PLAN & ENLARGEMENT TO MATCH YOUR PLOT CONFIG.



SPECIFICATIONS

UNITS
UNIT SIZE - 50 CM X 50 CM X 2.5 CM (20" X 20" X 1")
AVAILABLE IN 9 STANDARD ROLL SIZES

UNIT WEIGHT - 538 GRAMS (19 OZ.) OR 2.2 KG (4.8 POUNDS)
STRENGTH - 402 KG/CM^2 (5720 PSI)
COLOR - BLACK (STANDARD)
RESIN - 100% POST-CONSUMER RECYCLED HDPE/LDPE

FABRIC
WEIGHT - 3.5 OZ/SY (120 GM/M^2)
TENSILE - 120 LB/FT^2 (585 KG/M^2)
FLOW - 275 GAL/MIN/SF (11,200 L/MIN/M^2)
OPTIONS - CUSTOM FABRIC TO 6 OZ AVAILABLE.

TYPICAL GRAVELPAVE2 DETAIL

1 / 1 OF 1

NOT TO SCALE
CHOOSE THIS PRODUCT FOR REINFORCING GRAVEL WEARING SURFACES

Invisible Structures, Inc.
Gvdet.dwg

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800-233-1510 OR 303-233-8383
FAX: 303-233-8282
Version 05/10

NTS
Gravelpave2 Pinning Instructions 2

DATUM

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DATUM: NAVD 88

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Designed	LK/PB	11/6/14	95% Grant Application Set
Checked	KG	11/6/14	95% Grant Application Set
Revisions			
Revisions			

SvR DESIGN COMPANY
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CITY OF SHORELINE
17500 Midvale Ave. N
Shoreline, WA 98133
(206) 801-2700

NOT FOR CONSTRUCTION

NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

DETAILS, INVISIBLE STRUCTURES

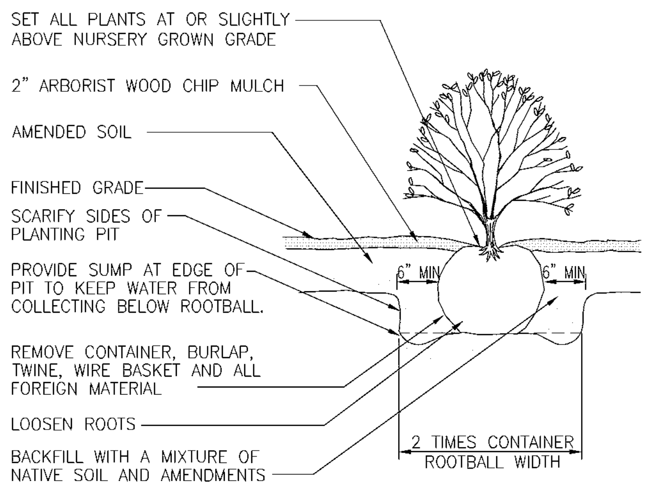
IF SHEET IS LESS THAN 22" X 34", IT IS A REDUCTION

Project No.

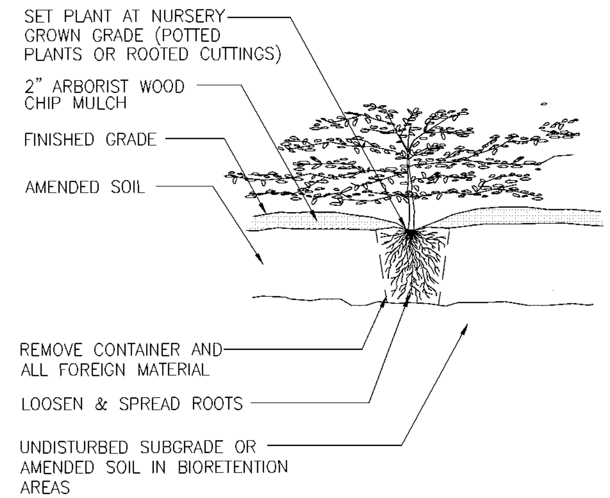
Sheet
D1.3

Sheet X

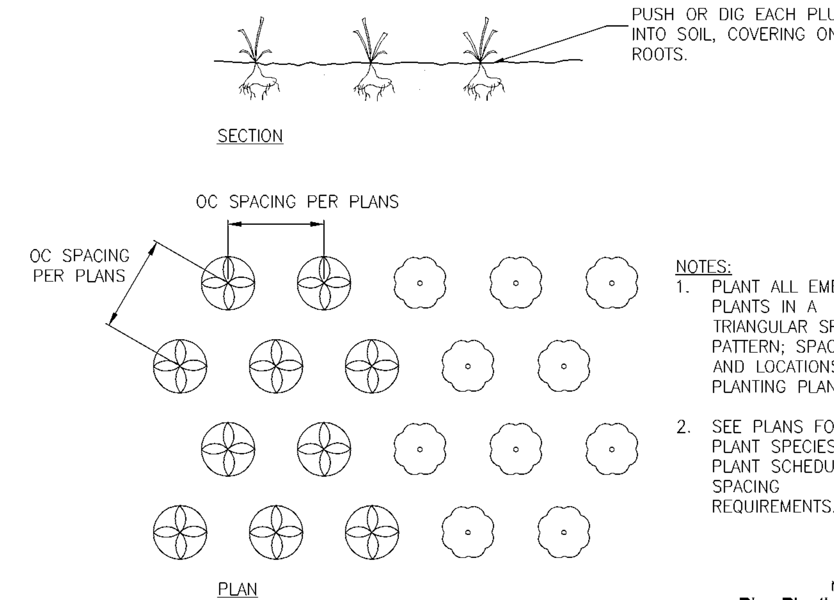
G:\1.3c\13044.50c 148-15\Current\148-15_D1-3_DETAILS-INVISIBLE.dwg
kyleo
Nov 06, 2014 - 4:32pm



NTS
Shrub Planting 1



NTS
Groundcover Planting 2



NOTES:

1. PLANT ALL EMERGENT PLANTS IN A TRIANGULAR SPACING PATTERN; SPACING AND LOCATIONS PER PLANTING PLANS.
2. SEE PLANS FOR PLANT SPECIES. SEE PLANT SCHEDULE FOR SPACING REQUIREMENTS.

NTS
Plug Planting 3

NTS
Not Used 4

NTS
Not Used 5

NTS
Not Used 6

NTS
Not Used 7

NTS
Not Used 8

NTS
Not Used 9

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
BRCE MARYMAN
CERTIFICATE NO. 1147

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
MARGARET ROSE STAEHELI
CERTIFICATE NO. 458
QA/QC REVIEWER

DATUM
BASIS OF BEARING: NAD 83/91
DATUM: NAVD 88

CALL TWO BUSINESS DAYS BEFORE YOU DIG
1-800-424-5555

NOT FOR CONSTRUCTION

Description	Date	Initials	
95% Grant Application Set	11/6/14	KA	Drawn
95% Grant Application Set	11/6/14	LK/PB	Designed
95% Grant Application Set	11/6/14	KG	Checked
			Revisions
			Revisions

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NE 148TH STREET INFILTRATION FACILITIES 95% GRANT APPLICATION SET

DETAILS, LANDSCAPE

IF SHEET IS LESS THAN 22" X 34", IT IS A REDUCTION

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Sheet
D1.4

Sheet X

Nov 06, 2014 - 4:32pm kyleo G:\13c\13044.50c 148-15\Current\148-15_D1-4_DETAILS-LAND.dwg