Lake Oswego and Tigard
Water Treatment Plant Expansion Project

Preliminary Stormwater Management Report

LAND USE SUBMITTAL
DRAFT

January 12th, 2012

Site Address: 4260 Kenthorpe Way, West Linn, OR

Designer's Certification and Statement

"I hereby certify that this Stormwater Management Report for **Lake Oswego and Tigard Water Treatment Expansion Project** has been prepared by me or under my supervision and meets minimum standards of the City of West Linn and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."

Jude Grounds, P.E.
MWH
January 12th, 2012

Table of Contents

1. Project Area Description

The Water Treatment Plant expansion is proposed at the existing City of Lake Oswego Water Treatment Plant located at 4260 Kenthorpe Way, West Linn, OR. The proposed project includes upgrades to an existing water treatment plant owned by the City of Lake Oswego. The water treatment plant expansion includes the addition of new buildings, mechanical facilities, pavement, and landscape improvements. The existing Water Treatment Plant property covers a total area of approximately 9.24 acres (402,426 square feet). The site is located in a neighborhood with single family residences and immediate neighbors on both the east and west sides of the property. The north and south sides of the property are bordered by Kenthorpe Way and Mapleton Drive respectively. The property is located within both the Trillium and Heron Creek watersheds in the City of West Linn.

While this facility is owned by the City of Lake Oswego, it is located within the City of West Linn and therefore is required to meet the stormwater management requirements of West Linn's Public Works code.

2. Existing Site Coverage

Currently, approximately 1.51 acres (16%) of the site is covered by impervious rooftops, driveways, and other paved surfaces. 6.65 acres (72%) of the site is pervious, and is covered with native trees and vegetation and including parking lot landscaping. Approximately 1.08 acres (12%) of the site is covered by the existing lagoons and other open process tanks. **Figure 1** (attached) identifies locations of the various areas of the site, and **Table G-1** below summarizes square footage for each of these areas.

Table G-1: Existing Conditions

Impervious Surfaces	*Square Feet*	*Acres*	*% of Total*
Building / Roof Area	19,743	0.45	5%
Pavement	45,973	1.06	11%
Subtotal of Impervious Surfaces	***65,716***	***1.51***	***16%***

Pervious Surfaces	*Square Feet*	*Acres*	*% of Total*
Vegetated Areas	**289,808**	**6.65**	**72%**

Other Surfaces	*Square Feet*	*Acres*	*% of Total*
Open Process Tanks / Lagoons	**46,902**	**1.08**	**12%**

Total Project Area	**402,426**	**9.24**	**100%**

The expansion of the treatment plant will also include development of sidewalks along both Kenthorpe Way and Mapleton Drive to meet the City's half-street improvement standards. The existing areas of the half street impervious and pervious areas along both street frontages are provided in **Table G-2** below.

Table G-2: Right-of-Way Existing Conditions

Impervious Surfaces	*Square Feet*	*Acres*
Existing Public ROW – Street	15,655	0.36

Pervious Surfaces	*Square Feet*	*Acres*
Existing Public ROW – Vegetated	9,389	0.22

Total ROW Area	**25,044**	**0.58**

3. Design Methodology / Requirements

Stormwater runoff from any new impervious areas of the site is required to be managed on site per City of West Linn development code. The City code allows for management of stormwater runoff through vegetated facilities to meet water quality and detention requirements. Specifically the Public Works Design Standards are as follows:

2.0013 Minimum Design Criteria

A. Storm Detention Facility

1. *Storm detention facilities shall be designed to provide storage up to the 25-year storm event, with the safe overflow conveyance of the 100-year storm event. Calculations of site discharge for both the existing and proposed conditions shall be required using the Unit Hydrograph Method.*

2. *Storms to be evaluated shall include the 2, 5, 10, 25, and 100-year events. Allowable post-development discharge rate for the 2, 5, 10, and 25-year events shall be that of the pre-development discharge rate. An outfall structure such as a "V-Notch" weir or a single or multiple orifice structure shall be designed to control the release rate for the above events. No flow control orifice smaller than 1 in. shall be allowed. If the maximum release rate cannot be met with all the site drainage controlled by a single 1 in. orifice, the allowable release rate provided by a 1 in. orifice will be considered adequate as approved by the City Engineer.*

3. *Hydrologic analysis methods to be used in conjunction with and/or to support the Unit Hydrograph Method, shall follow commonly accepted hydrologic principles and practices for drainage/subdrainage area delineation, estimating time of concentration, time of travel, loss rates, curve numbers, pervious and impervious land coverages, and hydrograph routing/combining methods.*

4. *Reference sources for commonly accepted hydrologic principles and practices include:*
    a. *Oregon Department of Transportation – Hydraulics Manual*
    b. *City of Portland Bureau of Environmental Services – Sewer and Drainage Facilities Design Manual*

B. Water Quality Facility

1. *All Water Quality Facilities shall meet the design requirements of the current City of Portland, Stormwater Management Manual, as amended and adopted by the City of West Linn and the requirements of Subsection 2.0050, Water Quality Facilities of this manual.*

2.0040 Stormwater Detention and/or Treatment

2.0041 Development Requiring Detention and / or Treatment

All development creating 500 sq. ft. or more of new impervious area will be required to provide treatment of the stormwater runoff from the new impervious area. For development or redevelopment creating more than 5,000 sq. ft. of new impervious area, treatment as well as detention will be required. Developers may mitigate impervious area by various means, as approved by the City Engineer, to reduce the new effective impervious area (EIA) below the thresholds listed above or to reduce facility size required for detention and/or treatment. Methods contained in the City of Portland Stormwater Manual, as modified by the City of West Linn, may be used in mitigation as approved by the City Engineer. Stormwater facilities must be aesthetically blended into surrounding landscaping to greatest possible extent.

Since the project will affect over 5,000 square feet of impervious area, the site is required per City code, to manage the 25 year runoff event to pre-development standards. It is the intent of this project to incorporate vegetated stormwater facilities throughout the site to manage stormwater to meet the pre-development discharge rate requirements per the City of West Linn's code requirements.

4. New Impervious Surfaces

Generally the proposed plant expansion will increase the overall impervious surfaces of the site from 16% (65,716 square feet) to 32% (129,147 square feet). The upgrades include the addition of six new buildings in addition to new filter structures, gravity thickener tanks, and washwater equalization and recovery area. The internal roadway area will be expanded to accommodate access to the new buildings and structures. Additionally, an emergency access / public trail is provided in the south east corner of the site, and will be paved to provide all weather access to the site.

For the purposes of this stormwater report, it is assumed that this project will manage the stormwater runoff from all 129,147 square feet of new impervious surface from the project

upgrades. This assumption is intended to provide the project with a conservative estimate of stormwater management needs at this time. As further refinement is made to the design and a more detailed understanding of impervious area calculations are made, the stormwater management design can be adjusted as necessary.

The open water lagoons and other process basins were not included as a new impervious surface because stormwater management is not required for these areas.

Figure 2 (attached) identifies approximate locations for various areas of the proposed site plan, and a summary of the approximate square footage of each area can be found in **Table G-3** below.

Table G-3: Proposed Site Improvement Areas

Impervious Surfaces	*Square Feet*	*Acres*	*% of Total*
Building / Roof Area	51,595	1.18	13%
Pavement	77,552	1.78	19%
Subtotal of Impervious Surfaces	***129,147***	***2.96***	***32%***

Pervious Surfaces	*Square Feet*	*Acres*	*% of Total*
Landscape Areas	229,491	5.27	57%
Pervious Pavement	6,021	0.14	2%
Green Roofs	7,713	0.18	2%
Subtotal of Pervious Surfaces	***243,225***	***5.58***	***61%***

Other	Square Feet	Acres	*% of Total*
Process Tanks *(not included in stormwater management area)*	30,054	0.69	7%

Total Project Area	**402,426**	**9.24**	**100%**

The addition of a new 6' wide sidewalk along both Kenthorpe Way and Mapleton Drive will increase the overall impervious surfaces within the public right-of-way by approximately 3,175 square feet (0.07 acres). The proposed impervious and pervious square footages are provided in **Table G-4** below:

Table G-4: ROW Proposed Conditions

	Square Feet	*Acres*
Proposed Public ROW – Street	18,830	0.43
Proposed Public ROW – Vegetated	6,192	0.14
Total Project Area	**25,022**	**0.57**

New Roof

The addition of six new buildings will increase the overall area of roof from approximately 19,743 square feet (.45 acres or 5% of the site) to 59,308 square feet (1.36 acres or 15% of the site). This is an overall increase of 39,565 square feet of roof area. But, it is the intent of this project to use innovative stormwater management techniques to reduce the overall impact of

impervious surfaces on the watershed. Therefore, the project includes 7,713 square feet (.18 acres) of green roofs as an impervious area reduction technique to reduce the overall effective roof area to approximately 51,595 square feet (1.18 acres). **Figure 2** in Appendix A identifies locations of proposed new roofs and green roofs on the site.

New Pavement Areas

The overall pavement area will be expanded from 1.06 acres (11% of site) to approximately 1.92 acres (21% of the site). Approximately 6,021 square feet of pervious pavement has been proposed as an impervious area reduction technique for the parking stalls near the administration building. The use of pervious pavement will reduce the overall effective impervious pavement area to 77,552 square feet, or approximately 19% of the site.

Impervious Area Reduction

Approximately 7,713 square feet of green roofs have been proposed for three new roof surfaces throughout the project. The application of green roofs will provide multiple benefits to the project beyond stormwater management. The green roofs will also provide:

- increased lifespan of the roof membrane
- additional insulation for reduction of both noise and energy usage
- reduction of heat island effect
- potential habitat

In addition to the green roofs, approximately 6,021 square feet of pervious pavers have been proposed for the visitor and employee parking areas. These impervious area reduction techniques have been included in the overall pervious area calculations.

5. Existing Stormwater Drainage System

The existing stormwater drainage system for the site is divided into two separate systems. The northern portion of the site drains to a 15" storm drain pipe located in Kenthorpe Way which flows west and eventually drains into Trillium Creek. The remainder of the site drains south to a 12" storm drain located in Mapleton Drive at the southern edge of the project. This southern storm drain flows east, connecting with Heron Creek, which eventually flows into the Willamette River just east of the project site.

Six existing storm drain inlets were found throughout the site. It appears from site inspections that a majority of roof drains are directly connected to existing storm drain piping on the site. Currently all six area inlets and the roof drains are assumed to be connected to the 15" storm drain pipe system in Kenthorpe Way.

The existing area drain inlet in the northwest corner of the site is located at the northern end of a narrow grassy swale that flows from south to north. Stormwater flows into the grassy swale via an existing pipe outlet located at its southern end. It appears that drainage flows from the vegetated area along the west side of the site into the grassy swale.

6. Subsurface Conditions

The US Natural Resources Conservation Service soils maps identified the project site as having three separate types of soils: Aloha silt loam (1B), Amity silt loam (3), and Woodburn silt loam (91B). Woodburn silt loam covers a majority of the northern portion of the site and is described as moderately well drained soil. The Amity silt loam covers the southern portion of the project site and is described as somewhat poorly drained soil. The Aloha silt loam is located in the western portion of the site and is described as somewhat poorly drained. A map and description of the soils has been included in **Appendix C**.

The Draft Geotechnical Engineering Report by Shannon & Wilson Inc. (Geotechnical and Environmental Consultants) dated, December 16th, 2011, confirmed the NRCS information and identified that the majority of the site is covered with sandy silt to a depth of approximately 14 feet. The geotechnical investigation did not report the presence of groundwater in any of the boring logs. A copy of the report will be included in the land use application.

A stormwater infiltration test was performed on October 19th, 2011. The test was performed in accordance with the City of Portland's Stormwater Management Manual's Simplified Approach Open Pit Infiltration Test requirements found in Appendix F.2 of the manual. The test pit was dug in the northwest corner of the site in a location identified to have a future infiltration facility. Two tests were performed in order to provide sufficient data to identify any trends in the infiltration rate. Both tests started with high infiltration rates, but as the soil was saturated, the infiltration rates leveled to a range of approximately 5 to 7 inches per hour. These rates are generally considered to be high, and were only provided to confirm that the use of 1 inch per hour for an average infiltration rate was a relatively conservative approach to the stormwater facility calculations.

7. Stormwater Facility Design

The City of West Linn requires the use of the City of Portland Stormwater Management Manual for design of vegetated stormwater management facilities. Since the overall catchment areas for the stormwater system are greater than 10,000 sf, the Presumptive Approach Calculator was be used to size the vegetated stormwater management facilities.

Both stormwater swales and basins (Details SW-120 and SW-140 respectively from the City of Portland Stormwater Management Manual, 2008 edition) will be used in various locations on the site to manage the stormwater runoff. These facilities will be designed as infiltration facilities and be sized to manage the 25 year storm event from the required impervious surfaces. Larger storm events will be passed through the facilities via an overflow pipe to the existing storm system in the public ROW.

The City of Portland's Presumptive Approach Calculator (PAC) was used to determine the approximate facility size that may be necessary to manage runoff from the new impervious areas to the pre-development 25 year storm event condition. The pre-development peak flow for the site was determined to be 0.331 cubic feet per second (cfs) for the 25 year storm event. A runoff curve number (CN) of 55 was used assuming the site was in a forested condition before development. The output from the PAC for the pre-development condition can be found if **Appendix B**.

Based on calculations from the Presumptive Approach Calculator, 129,147 square feet of impervious area will generate a peak flow of 3.029 cfs during a 25-year event. The A summary of the pre and post development runoff rates and volumes is summarized in **Table G-5** below.

Table G-5: Pre and Post Development Runoff Rates for 25 year Storm Event

Pre Development (25 yr)		Post Development (25 yr)	
Peak (cfs)	Volume (cf)	Peak (cfs)	Volume (cf)
0.331	16,455	3.029	39,447

The site was divided into nine separate basins to determine runoff volumes. Calculations to reduce the 25-year storm event runoff from the proposed impervious surfaces show the PAC requiring a facility sizing of approximately 19,715 square feet of facility area to manage the 25-year storm event to a pre-development condition of 0.331 cubic feet per second.

A variety of stormwater facilities have been located throughout the site to manage the stormwater runoff. The primary goal of the stormwater facilities is to manage the 25 year storm event to the pre-development flows. The secondary goal is to manage as much additional runoff from the existing impervious surfaces of the plant as possible, in order to reduce the plant's overall impact to the Heron and Trillium Creek corridors. **Figure 3** (attached) identifies the approximate proposed locations of the various vegetated stormwater facilities planned for the site. **Table G-6** provides a summary of the sizes of each of the catchment, impervious, and stormwater facility areas. Both catchments C and F do not have stormwater facilities identified because there are no impervious areas proposed for these catchment areas.

Table G-6: Private Property / Catchment, Impervious, and Stormwater Facility Areas

	Total Area			Impervious Area		Stormwater Facilities		
Stormwater Catchment Areas	**SF**	**Acres**	**% of Total**	**SF**	**Acres**	**SF**	**Acres**	**Peak cfs**
Catchment A	42,925	0.99	11%	15,355	0.35	4,693	0.11	0.00
Catchment B	26,031	0.60	6%	12,055	0.28	2,008	0.05	0.078
Catchment C	30,780	0.71	8%	0	0.00	0	0.00	N/A
Catchment D	32,591	0.75	8%	13,357	0.31	1,786	0.04	0.043
Catchment E	29,241	0.67	7%	23,839	0.55	3,200	0.07	0.076
Catchment F	6,783	0.16	2%	0	0.00	0	0.00	N/A
Catchment G	55,204	1.27	14%	24,710	0.57	2,528	0.06	0.077
Catchment H	29,680	0.68	7%	2,896	0.07	0	0.00	0.00
Catchment I	149,191	3.42	37%	36,935	0.85	5,500	0.13	0.036
Total Area	**402,426**	**9.24**	**100%**	**129,147**	**2.96**	**19,715**	**0.45**	**0.31**

The project is required to manage stormwater runoff from the new sidewalk that will be constructed along both Kenthorpe Way and Mapleton Drive. There is additional stormwater runoff that flows from the existing street to the new sidewalk. It is the intent of the design to explore options to manage the additional stormwater runoff from the street pavement if feasible considering design and cost implications. **Table G-7** includes both street and sidewalk

impervious area, and sufficient stormwater facility area to manage this additional runoff. Further refinement of the design will determine if collection of the additional runoff is feasible.

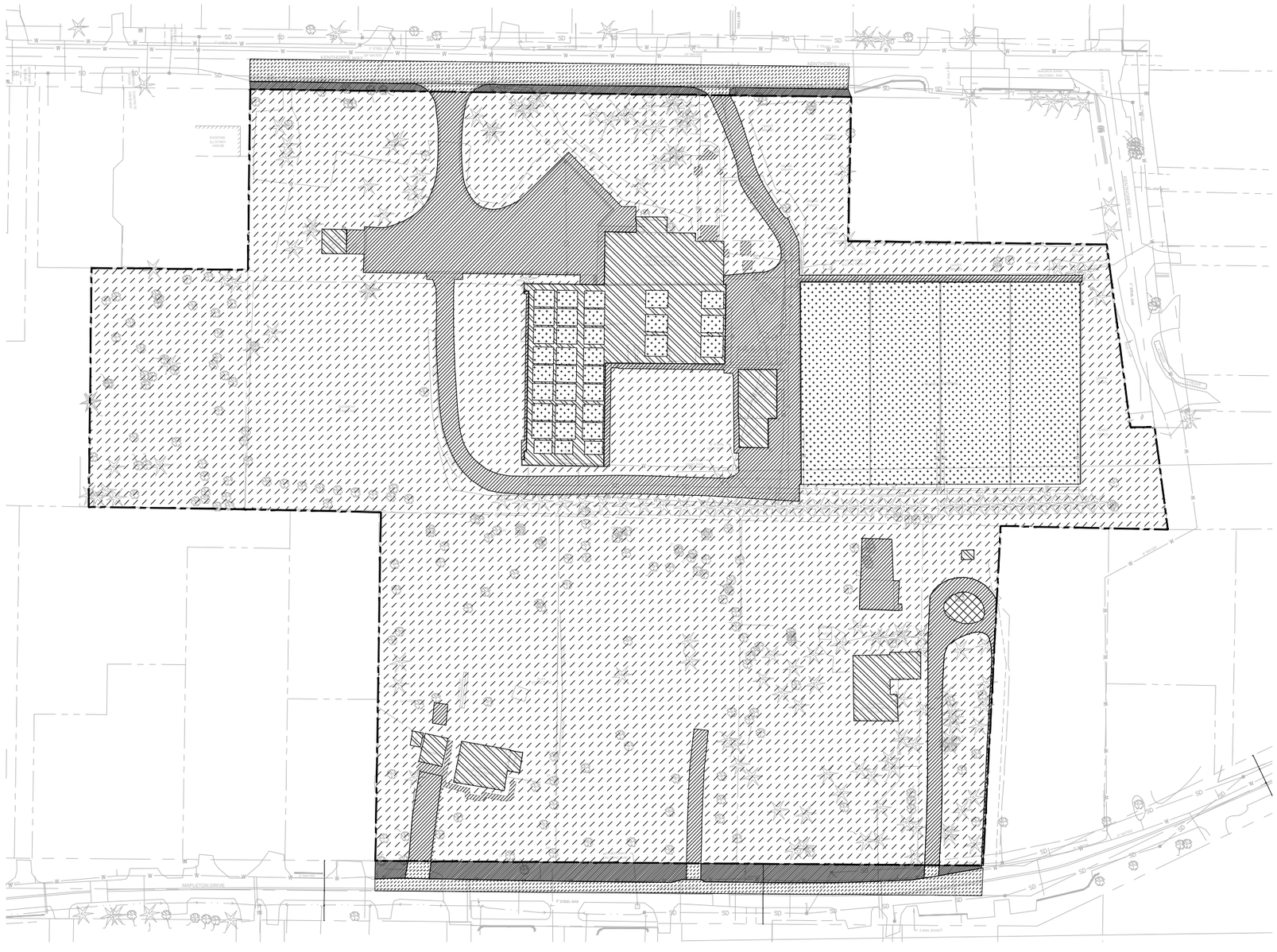
Table G-7: Public Right-of-Way / Catchment, Impervious, and Stormwater Facility Areas

	Total Area		Impervious Area		Stormwater Facility Area		
Stormwater Catchment Areas	**SF**	**Acres**	**SF**	**Acres**	**SF**	**Acres**	**% of Total**
Catchment J	12,595	0.29	8,366	0.19	3,367	0.08	57%
Catchment K	12,427	0.29	10,464	0.24	2,578	0.06	43%
Total Area	**25,022**	**0.57**	**18,830**	**0.43**	**5,945**	**0.14**	**100%**

8. Conclusion

The current proposed stormwater management area of 19,715 square feet (0.45 acres), 7,713 square feet of green roofs, and 6,021 square feet of pervious pavement provides sufficient stormwater facility area to meet City of West Linn Public Works Design Standards, which requires runoff flows to meet the pre-development 25-year storm event of .331 cubic feet per section, and safe overflow of a 100-year event to the City storm/sewer system. It is the overall intent of this project to design stormwater facilities that are integral to the landscape design, and when designed properly with appropriate plant and soil material, will provide a constant landscape benefit during both wet and dry periods.

Appendix A
Stormwater Facility Plans



Existing - Site

Pervious Surfaces	SF	Acres	% of Total
Open Space / Landscaped Area	289,808	6.65	72%
Impervious Surfaces	**SF**	**Acres**	**% of Total**
Road & Paved Surfaces	45,973	1.06	11%
Roof	19,743	0.45	5%
Subtotal Impervious Surfaces	**65,716**	**1.51**	**16%**
Other	**SF**	**Acres**	**% of Total**
Open Process Tanks/Lagoons	46,902	1.08	12%
Total Pervious, Impervious & Other Surfaces on Site	**402,426**	**9.24**	**100%**

Existing - Right-of-Way

Pervious Surfaces	SF	Acres	% of Total
Open Space / Landscaped Area	9,389	0.22	37%
Impervious Surfaces	**SF**	**Acres**	**% of Total**
Street & Paved Surfaces	15,655	0.36	62%
Total Pervious & Impervious Surfaces in ROW	**25,044**	**0.58**	**100%**

Property Boundary/ROW

GreenWorks, P.C.
Landscape Architecture
Environmental Design
24 NW 2nd Avenue, Suite 100
Portland, Oregon 97209
Ph:503.222.5612/F:503.222.2283
Email: info@greenworkspc.com

MWH®
806 SW BROADWAY, SUITE 200
PORTLAND, OREGON 97205

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: _____
DRAWN: _____
CHECKED: _____
CHECKED: _____
APPROVED: _____

REVISIONS

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OWNER:
CITY OF LAKE OSWEGO
380 A AVENUE
LAKE OSWEGO, OR 97034
PHONE: 503-635-0270

Lake Oswego · Tigard Water Partnership
sharing water · connecting communities

LAKE OSWEGO AND TIGARD WATER TREATMENT PLANT

DESIGN REVIEW AND CONDITIONAL USE

STORMWATER REPORT
EXISTING PERVIOUS & IMPERVIOUS SURFACES

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PROJECT NUMBER	
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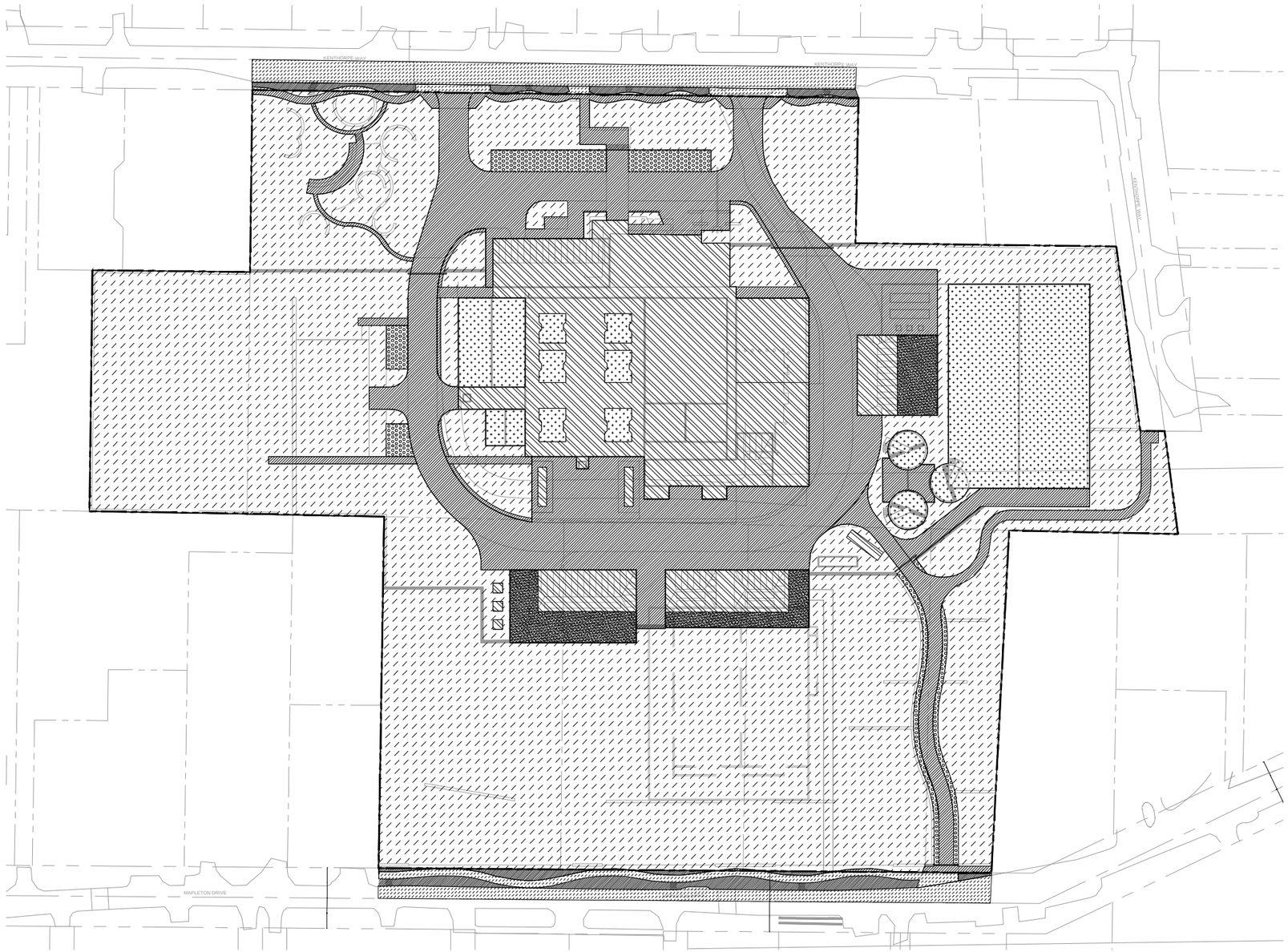

Proposed - Site

Pervious Surfaces		SF	Acres	% of Total
	Open Space / Landscaped Area	229,491	5.27	57%
	Pervious Paving	6,021	0.14	1%
	Green Roof	7,713	0.18	2%
	Subtotal Pervious Surfaces	**243,225**	**5.58**	**60%**
Impervious Surfaces		**SF**	**Acres**	**% of Total**
	Road & Paved Surfaces	77,552	1.78	19%
	Roof	51,595	1.18	13%
	Subtotal Impervious Surfaces	**129,147**	**2.96**	**32%**
Other		**SF**	**Acres**	**% of Total**
	Open Process Tanks (not incuded in storm water mngmt. area)	30,054	0.69	7%
Subtotal Pervious & Impervious Surfaces on Site		**402,426**	**9.24**	**100%**

Proposed - Right-of-Way

Pervious Surfaces		SF	Acres	% of Total
	Open Space / Landscaped Area	6,192	0.14	25%
Impervious Surfaces		**SF**	**Acres**	**% of Total**
	Street & Paved Surfaces	18,830	0.43	75%
Total Pervious & Impervious Surfaces in ROW		**25,022**	**0.57**	**100%**

Property Boundary/ROW

GREENWORKS
GreenWorks, P.C.
Landscape Architecture
Environmental Design
24 NW 2nd Avenue, Suite 100
Portland, Oregon 97209
Ph:503.222.5612/F:503.222.2283
Email: info@greenworkspc.com

MWH®
806 SW BROADWAY, SUITE 200
PORTLAND, OREGON 97205

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: _____
DRAWN: _____
CHECKED: _____
CHECKED: _____
APPROVED: _____

REVISIONS

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OWNER:
CITY OF LAKE OSWEGO
380 A AVENUE
LAKE OSWEGO, OR 97034
PHONE: 503-635-0270

Lake Oswego · Tigard Water Partnership
sharing water · connecting communities

LAKE OSWEGO AND TIGARD WATER TREATMENT PLANT

DESIGN REVIEW AND CONDITIONAL USE

STORMWATER REPORT
PROPOSED PERVIOUS & IMPERVIOUS SURFACES

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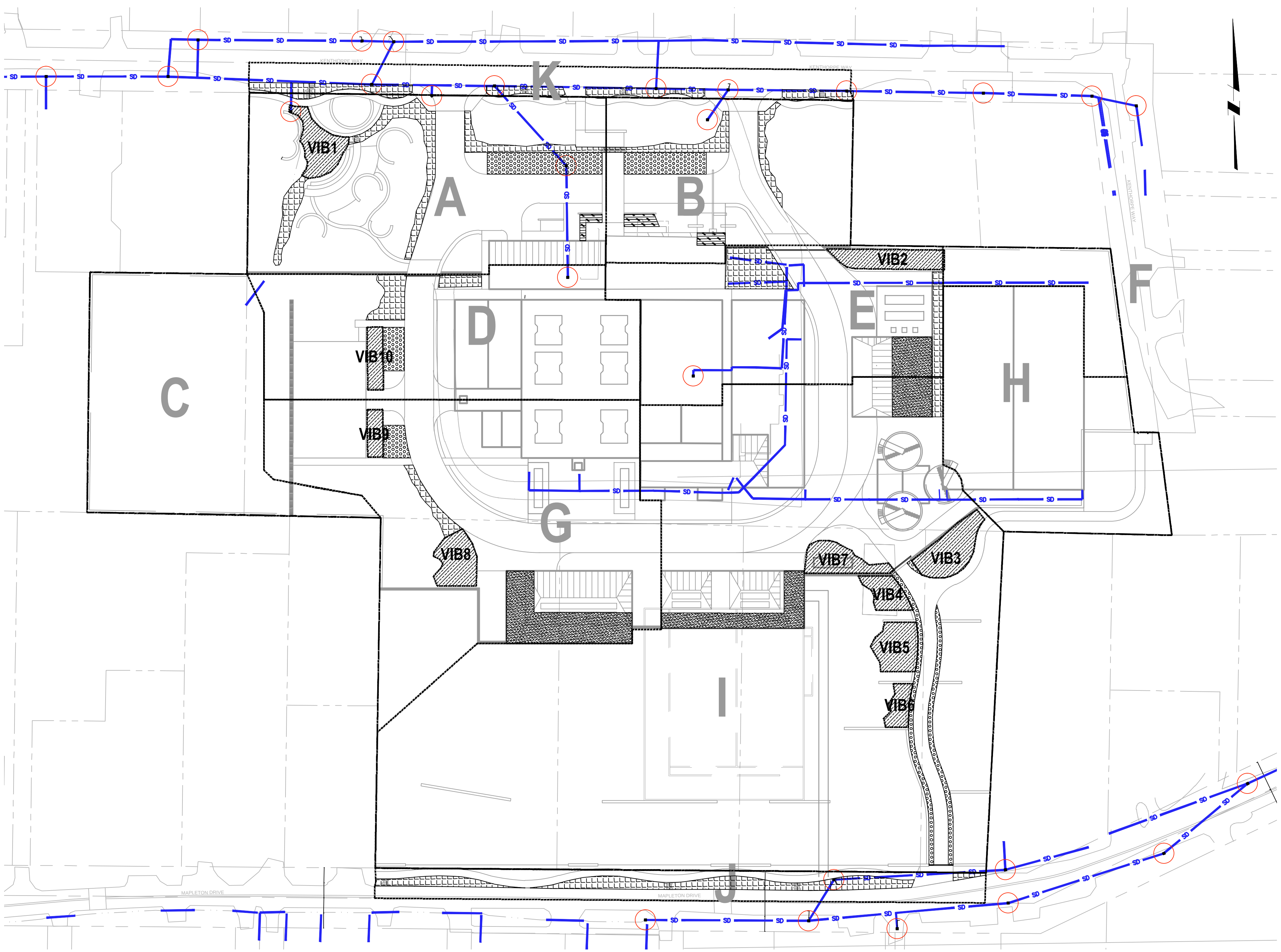


Proposed Stormwater Management Area - Site & Right-of-Way

Impervious Area Reduction Techniques	SF	Acres
Green Roof	7,713	0.18
Pervious Paving	6,021	0.14
Total Impervious Reduction Area	**13,734**	**0.32**

Stormwater Management Facilities	SF	Acres	% of Total
Vegetated Swales	14,150	0.32	55%
Vegetated Planters	727	0.02	3%
VIB1 Vegetated Infiltration Basin #1	1,371	0.03	5%
VIB2 Vegetated Infiltration Basin #2	1,429	0.03	6%
VIB3 Vegetated Infiltration Basin #3	1,656	0.04	6%
VIB4 Vegetated Infiltration Basin #4	687	0.02	3%
VIB5 Vegetated Infiltration Basin #5	1,331	0.03	5%
VIB6 Vegetated Infiltration Basin #6	680	0.02	3%
VIB7 Vegetated Infiltration Basin #7	1,146	0.03	4%
VIB8 Vegetated Infiltration Basin #8	1,300	0.03	5%
VIB9 Vegetated Infiltration Basin #9	507	0.01	2%
VIB10 Vegetated Infiltration Basin #10	676	0.02	3%
Total Management Area (including Right-of-way)	**25,660**	**0.59**	**100%**

Stormwater Catchment Areas - Site	Total Area			Impervious Area			Stormwater Facility Area		
	SF	Acres	% of Total	SF	Acres	% of Total	SF	Acres	% of Total
A Catchment A	42,925	0.99	11%	15,355	0.35	12%	4,693	0.11	24%
B Catchment B	26,031	0.60	6%	12,055	0.28	9%	2,008	0.05	10%
C Catchment C	30,780	0.71	8%	0	0.00	0%	0	0.00	0%
D Catchment D	32,591	0.75	8%	13,357	0.31	10%	1,786	0.04	9%
E Catchment E	29,241	0.67	7%	23,839	0.55	18%	3,200	0.07	16%
F Catchment F	6,783	0.16	2%	0	0.00	0%	0	0.00	0%
G Catchment G	55,204	1.27	14%	24,710	0.57	19%	2,528	0.06	13%
H Catchment H	29,680	0.68	7%	2,896	0.07	2%	0	0.00	0%
I Catchment I	149,191	3.42	37%	36,935	0.85	29%	5,500	0.13	28%
Total Area	**402,426**	**9.24**	**100%**	**129,147**	**2.96**	**100%**	**19,715**	**0.45**	**100%**

Stormwater Catchment Areas - Right-of-Way	Total Area			Impervious Area			Stormwater Facility Area		
	SF	Acres	% of Total	SF	Acres	% of Total	SF	Acres	% of Total
J Catchment J	12,595	0.29	50%	8,366	0.19	44%	3,367	0.08	57%
K Catchment K	12,427	0.29	50%	10,464	0.24	56%	2,578	0.06	43%
Total Area	**25,022**	**0.57**	**100%**	**18,830**	**0.43**	**100%**	**5,945**	**0.14**	**100%**

- Existing Storm Drain Pipe
- Existing Drain Inlet
- Property Boundary/ROW

GREENWORKS
GreenWorks, P.C.
Landscape Architecture
Environmental Design
24 NW 2nd Avenue, Suite 100
Portland, Oregon 97209
Ph:503.222.5612/F:503.222.2283
Email: info@greenworkspc.com

MWH®
806 SW BROADWAY, SUITE 200
PORTLAND, OREGON 97205

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED:
DRAWN:
CHECKED:
CHECKED:
APPROVED:

REVISIONS

REV	DESCRIPTION	BY		APP.
	45817-RWTP.dwg			
	138564- TITLE BLOCK FOR PERMITTING.dwg			
	GW LOGO SQUARE.DWG			
	LOWTP_L_STORMWATER_BASE.dwg			
	LOWTP_L_DESIGN_BASE.dwg			
	LOWTP_Site_MODEL.dwg			
	W01424-BORDER.dwg			
	LOWTP_L_DESIGN_BASE_cad_2004.dwg			
	LOWTP_fence_model.dwg			

OWNER:
CITY OF LAKE OSWEGO
380 A AVENUE
LAKE OSWEGO, OR 97034
PHONE: 503-635-0270

Lake Oswego · Tigard Water Partnership
sharing water · connecting communities

LAKE OSWEGO AND TIGARD WATER TREATMENT PLANT
DESIGN REVIEW AND CONDITIONAL USE

STORMWATER REPORT
PROPOSED STORMWATER MANAGEMENT AREAS

FILENAME
PROJECT NUMBER
SCALE
1" = 50'
DRAWING/FIGURE NUMBER
3.0

PLOT DATE: January 4, 2012 - 8:17AM USER: jeffb
FILE: C:\pwworkdir\dms55316\LOWTP-GL-SW-FIG-3.dwg

Appendix B
Presumptive Approach Calculator (PAC) Data Sheets

Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**Pre Dev.**
Project Name:	**LO Water Treatment Plant**
Date:	**12/16/11**
Project Address:	**4200 Kenthorpe Way**
Permit Number:	**0**
	West Linn, OR
Run Time	1/4/2012 12:01:06 PM
Designer:	**D. Elkin**
Company:	**GreenWorks**

Drainage Catchment Information

Catchment ID	Pre Dev.		
	Catchment Area		
Impervious Area	402,426	SF	**Catchment Area Exceeds 1 Acre**
Impervious Area	9.24	ac	
Impervious Area Curve Number, CN_{imp}	55		
Time of Concentration, Tc, minutes	30	min.	

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

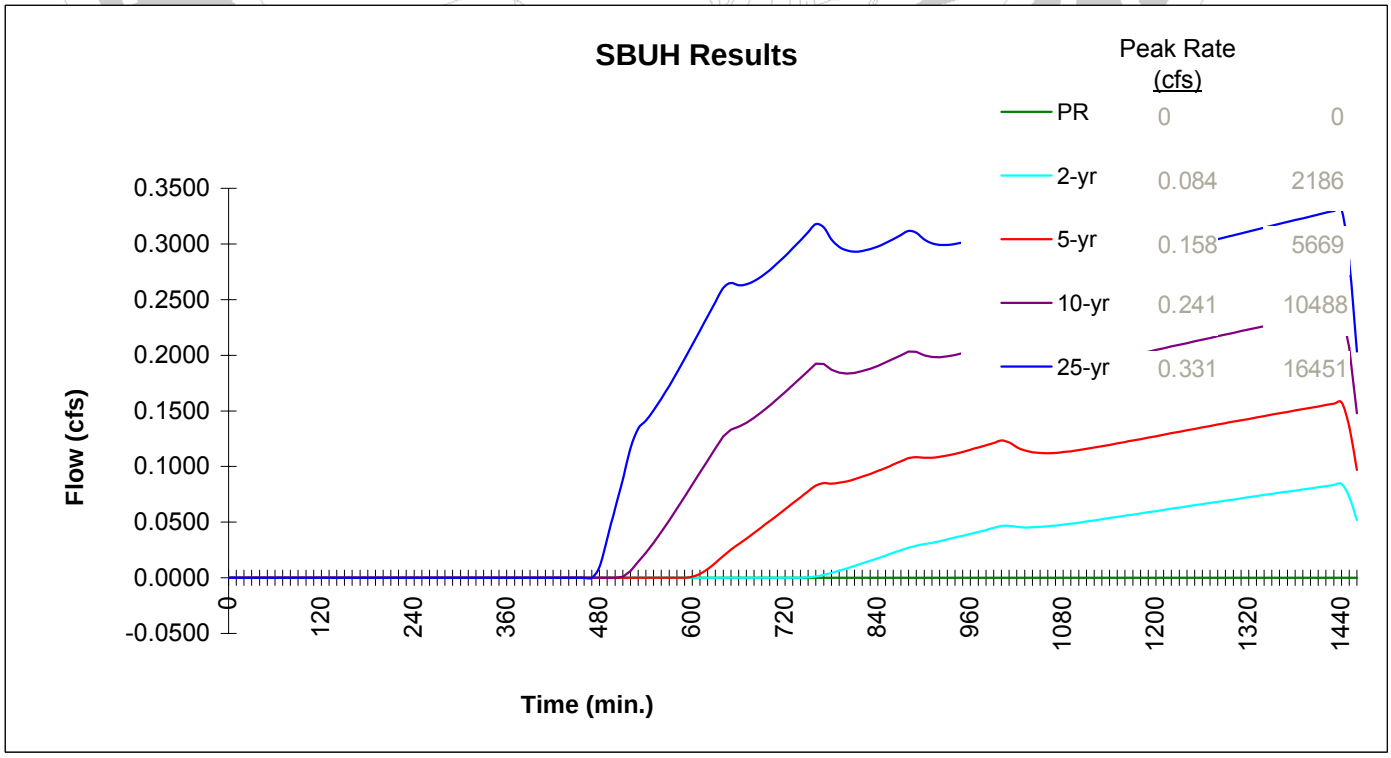
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



Printed: 1/4/2012 12:01 PM

Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**Post Dev.**
Project Name:	**LO Water Treatment Plant**
Date:	**12/16/11**
Project Address:	**4200 Kenthorpe Way**
Permit Number:	**0**
	West Linn, OR
Run Time	1/3/2012 4:46:35 PM
Designer:	**D. Elkin**
Company:	**GreenWorks**

Drainage Catchment Information

Catchment ID	Post Dev.	
	Catchment Area	
Impervious Area	129,147	SF
Impervious Area	2.96	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Catchment Area Exceeds 1 Acre

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	1	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

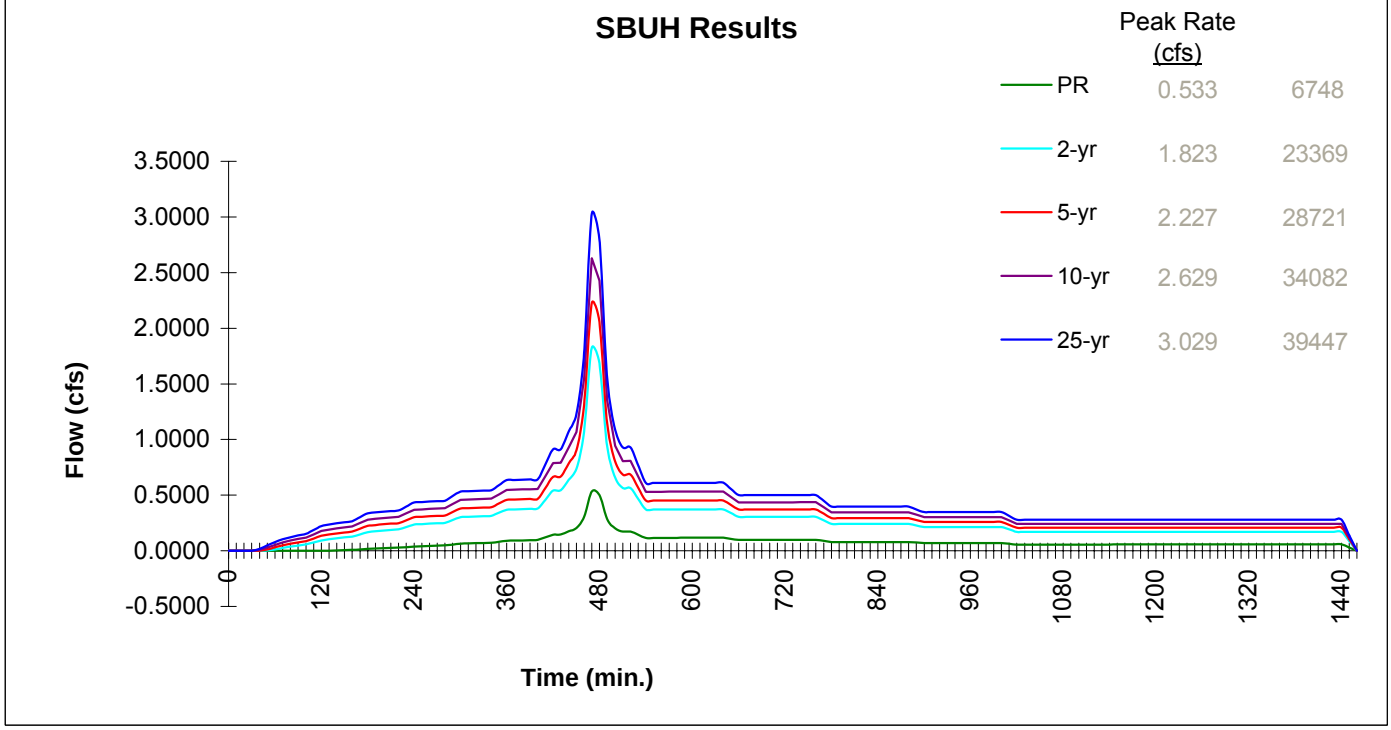
CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	0.50	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results



Printed: 1/3/2012 4:47 PM

Presumptive Approach Calculator ver. 1.2

Catchment ID: Post Dev.

Run Time: 12/16/2011 6:14:28 PM

Project Name: LO Water Treatment Plant **Catchment ID:** Post Dev. **Date:** 12/16/2011

Instructions:

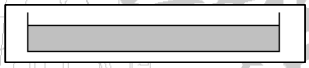
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: **1**

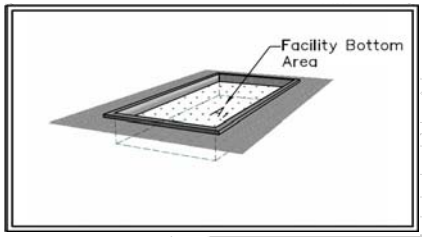
Goal Summary:

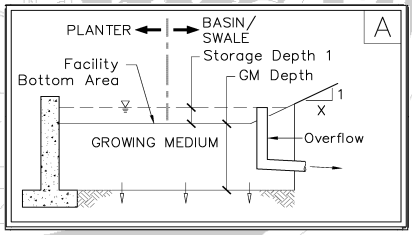
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…	
		Pollution Reduction as a	10-yr (aka disposal) as a
1	On-site infiltration with a surface infiltration facility.	PASS	PASS

Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square **Facility Configuration:** A





Calculation Guide
Max. Rock Stor. Bottom Area
19,000 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area =	19,000	sf
Bottom Width =	200.0	ft
Facility Side Slope =	0	to 1
Storage Depth 1 =	12	in
Growing Medium Depth =	18	in
Freeboard Depth =	N/A	in

BELOW GRADE STORAGE

Rock Storage Bottom Area =	19,000	sf
Rock Storage Depth =	0	in

Surface Capacity at Depth 1 =	19,000	cf
GM Design Infiltration Rate =	2.00	in/hr
Infiltration Capacity =	0.880	cfs

Rock Storage Capacity =	0	cf
Native Design Infiltration Rate =	0.50	in/hr
Infiltration Capacity =	0.220	cfs

Native Infiltration Rate Used in PA

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	2%	Surf. Cap. Used
10-yr	PASS	0 CF	74%	Surf. Cap. Used

Run PAC

FACILITY FACTS

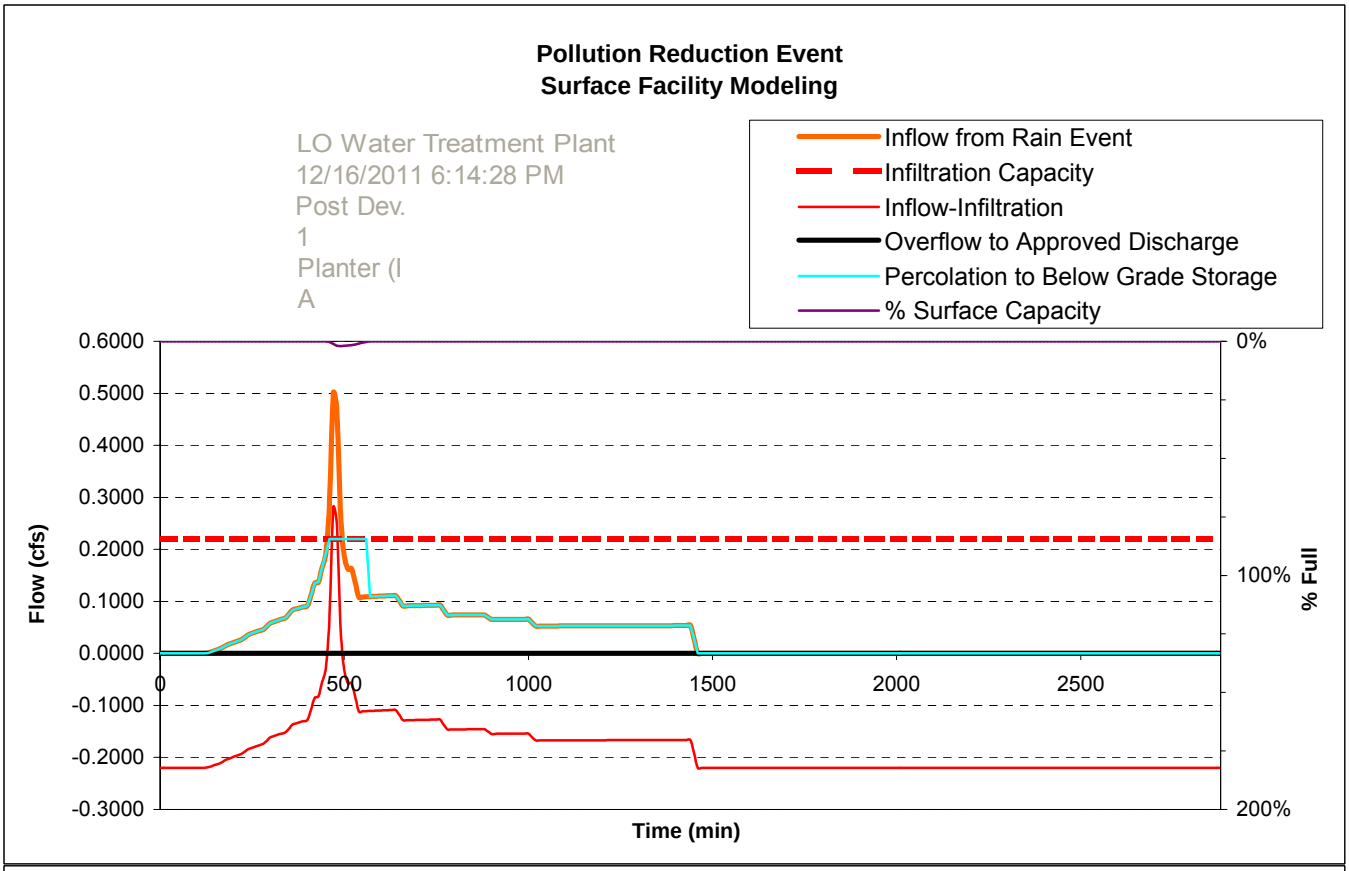
Total Facility Area Including Freeboard =	19,000 SF
Sizing Ratio (Total Facility Area / Catchment Area) =	0.157

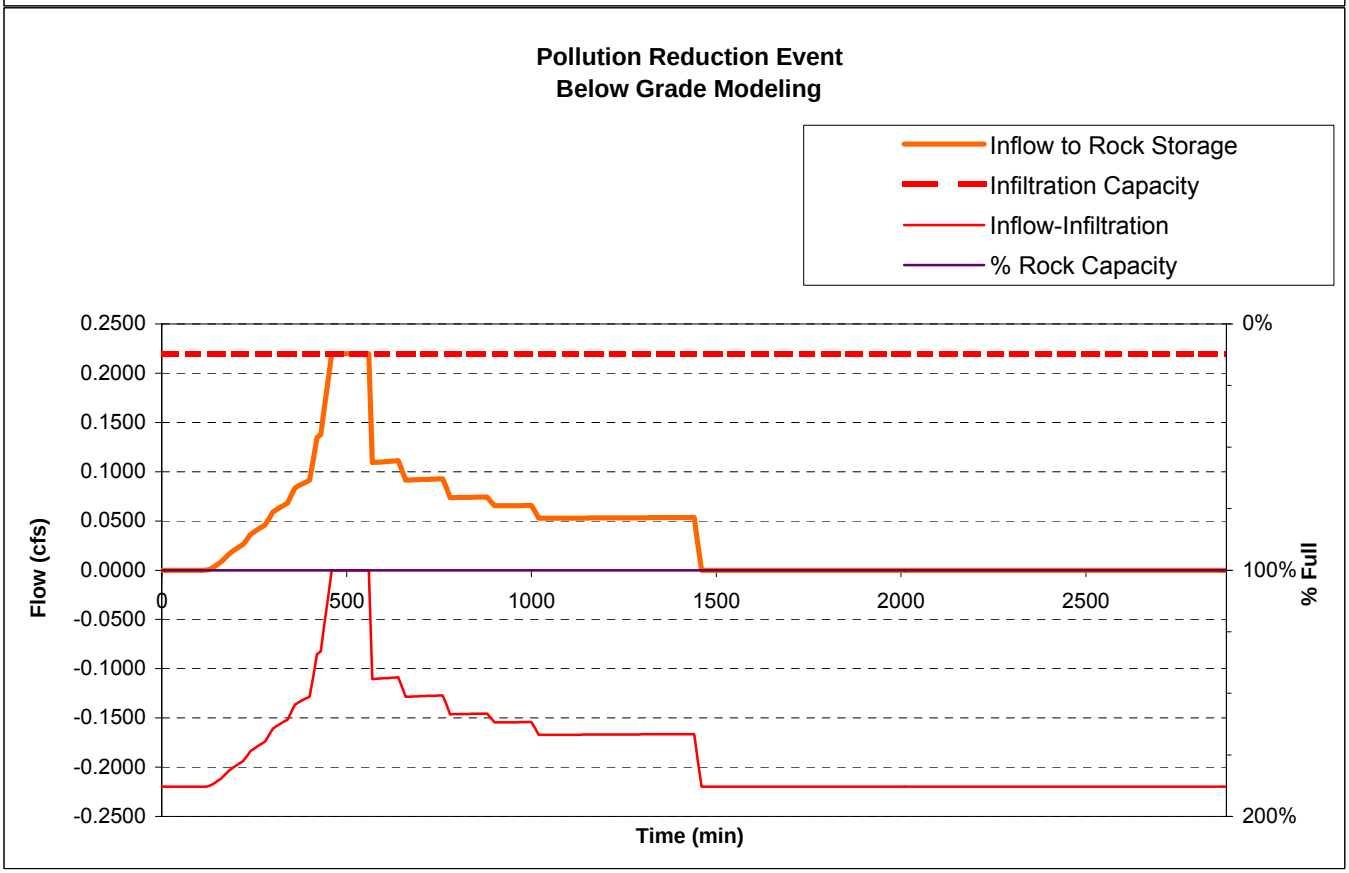
Current data has been exported:

Post Development Condition.xls
12/16/2011 6:14:54 PM

BES - Presumptive Approach Calculator - Ver 1.2

PR Con-A&B





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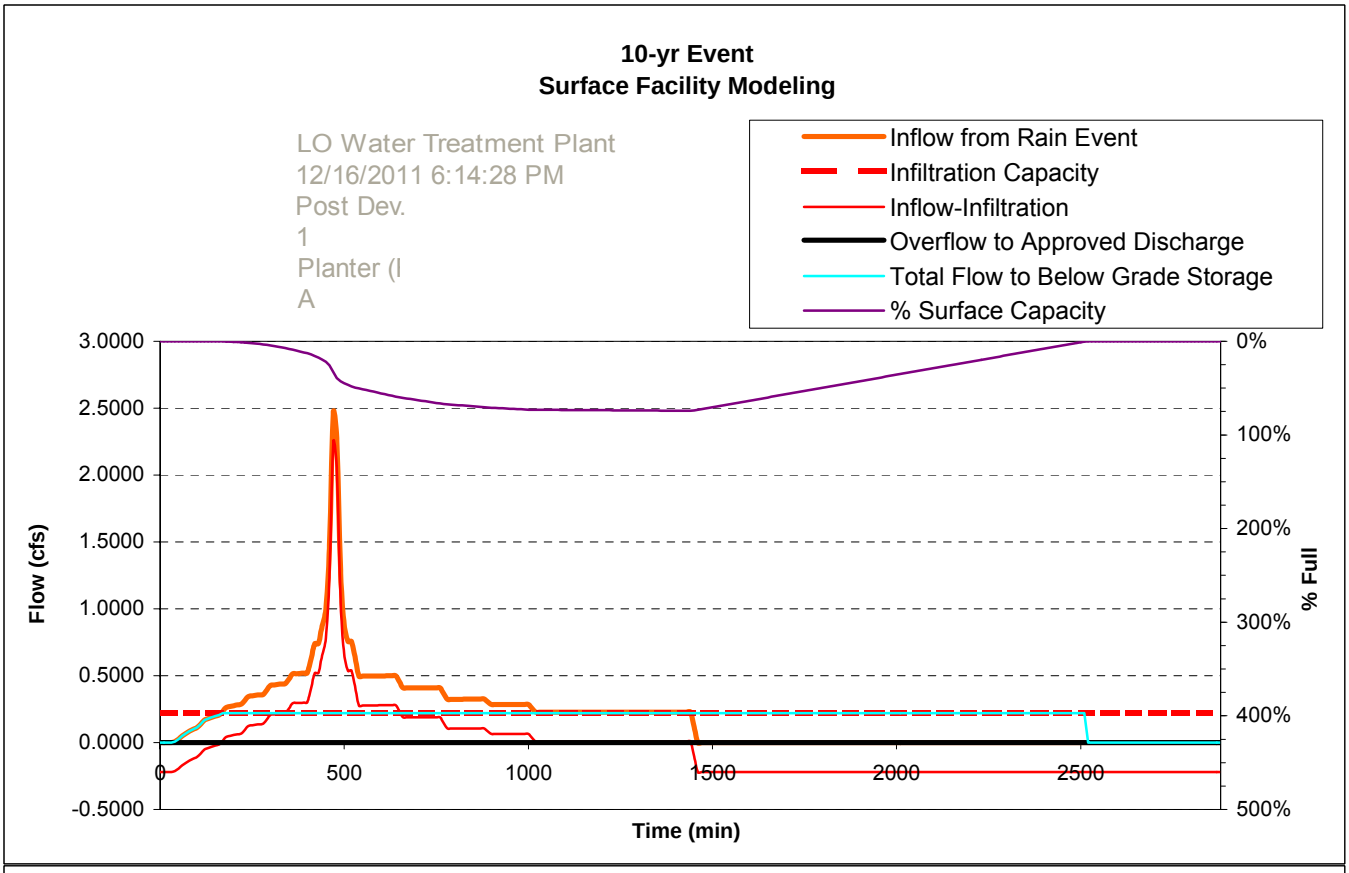
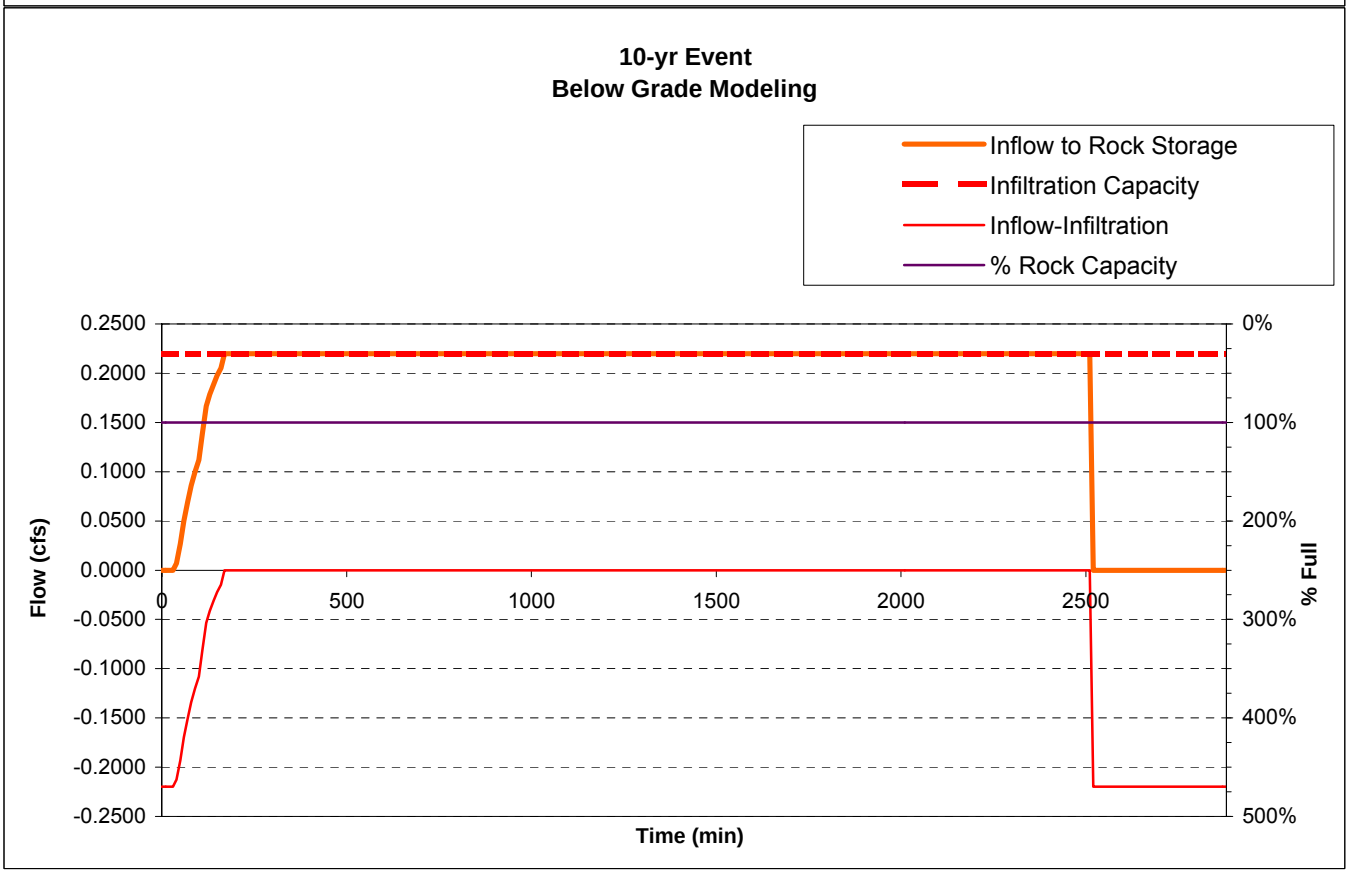
BES - Presumptive Approach Calculator - Ver 1.2

10-yr Con-A&B





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Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**A**
Project Name:	**LO Water Treatment Plant**
Project Address:	**4200 Kenthorpe Way**
	West Linn, OR
Designer:	**D. Elkin**
Company:	**GreenWorks**
Date:	**12/16/11**
Permit Number:	**0**
Run Time	12/16/2011 3:52:36 PM

Drainage Catchment Information

Catchment ID	A	
	Catchment Area	
Impervious Area	15,355	SF
Impervious Area	0.35	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	1	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

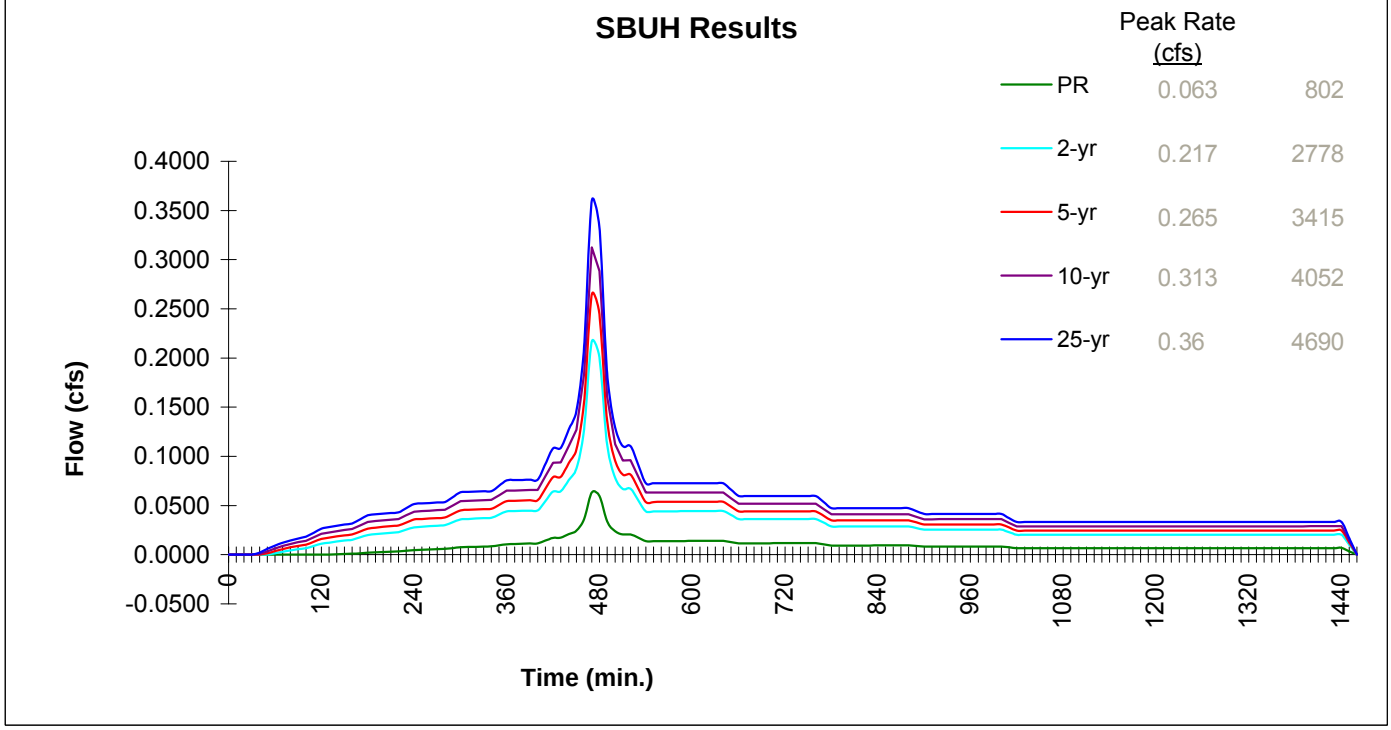
CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	0.50	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results



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Presumptive Approach Calculator ver. 1.2

Catchment ID: A

Run Time: 12/16/2011 3:52:36 PM

Project Name: LO Water Treatment Plant **Catchment ID:** A **Date:** 12/16/2011

imported file LO WTP_Catchment_A_Export_2011-12-16.xls - 12/16/2011 3:52:37 PM

Instructions:

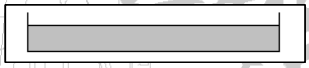
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

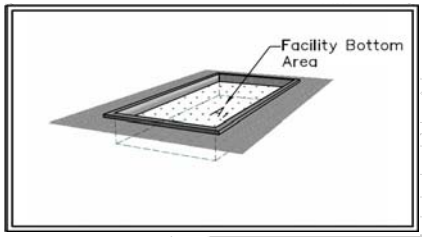
Goal Summary:

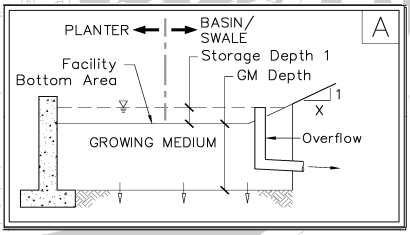
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…	
		Pollution Reduction as a	10-yr (aka disposal) as a
1	On-site infiltration with a surface infiltration facility.	PASS	PASS

Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square **Facility Configuration:** A





Calculation Guide
Max. Rock Stor. Bottom Area
4,693 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area =	4,693	sf
Bottom Width =	20.0	ft
Facility Side Slope =	0	to 1
Storage Depth 1 =	6	in
Growing Medium Depth =	18	in
Freeboard Depth =	N/A	in

BELOW GRADE STORAGE

Rock Storage Bottom Area =	4,693	sf
Rock Storage Depth =	0	in

Surface Capacity at Depth 1 =	2,347	cf
GM Design Infiltration Rate =	2.00	in/hr
Infiltration Capacity =	0.217	cfs

Rock Storage Capacity =	0	cf
Native Design Infiltration Rate =	0.50	in/hr
Infiltration Capacity =	0.054	cfs

Native Infiltration Rate Used in PA

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	0%	Surf. Cap. Used
10-yr	PASS	0 CF	33%	Surf. Cap. Used

Run PAC

FACILITY FACTS

Total Facility Area Including Freeboard =	4,693 SF
Sizing Ratio (Total Facility Area / Catchment Area) =	0.306

Current data has been imported:

LO WTP_Catchment_A_Export_2011-12-16.xls
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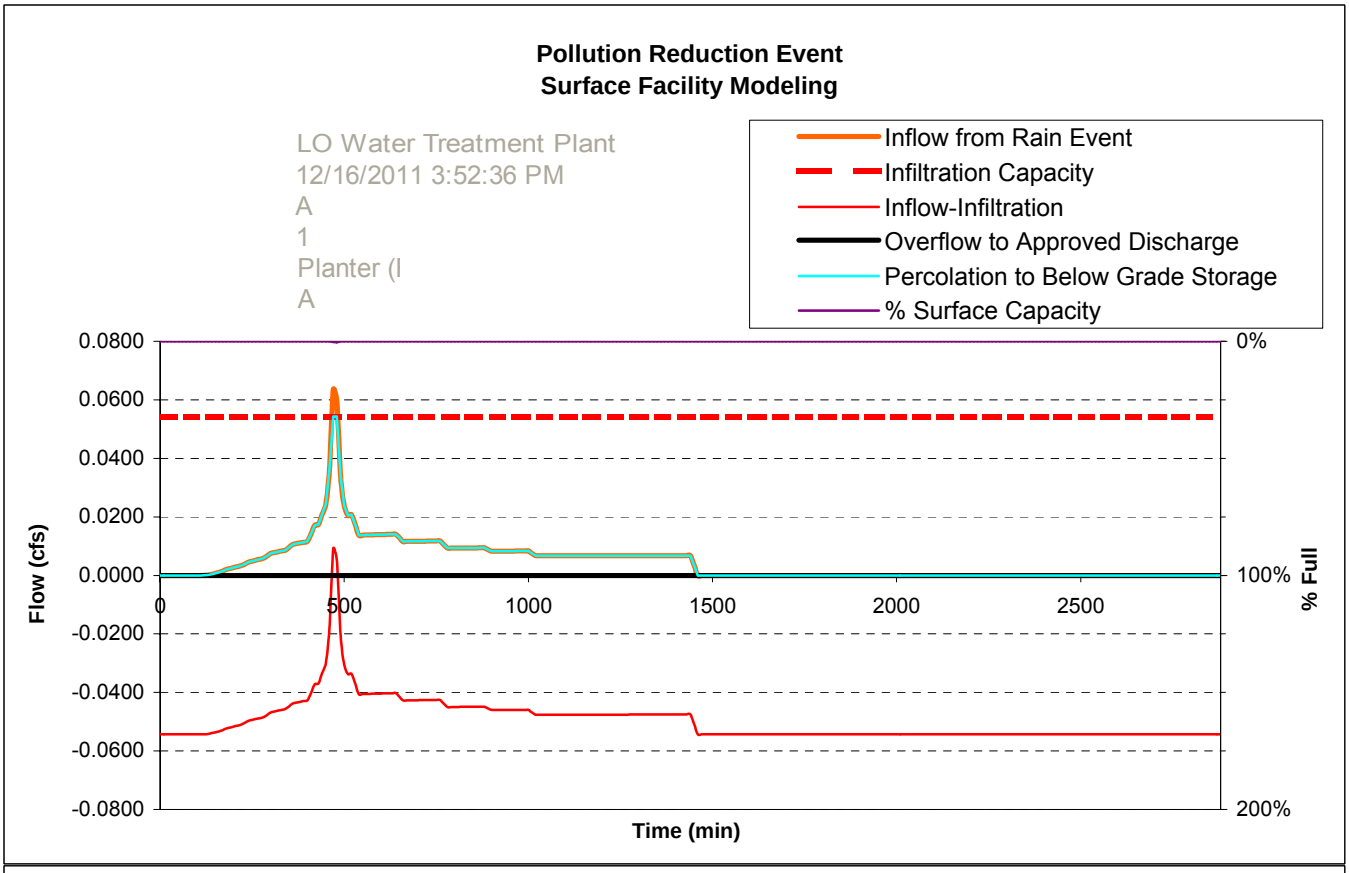
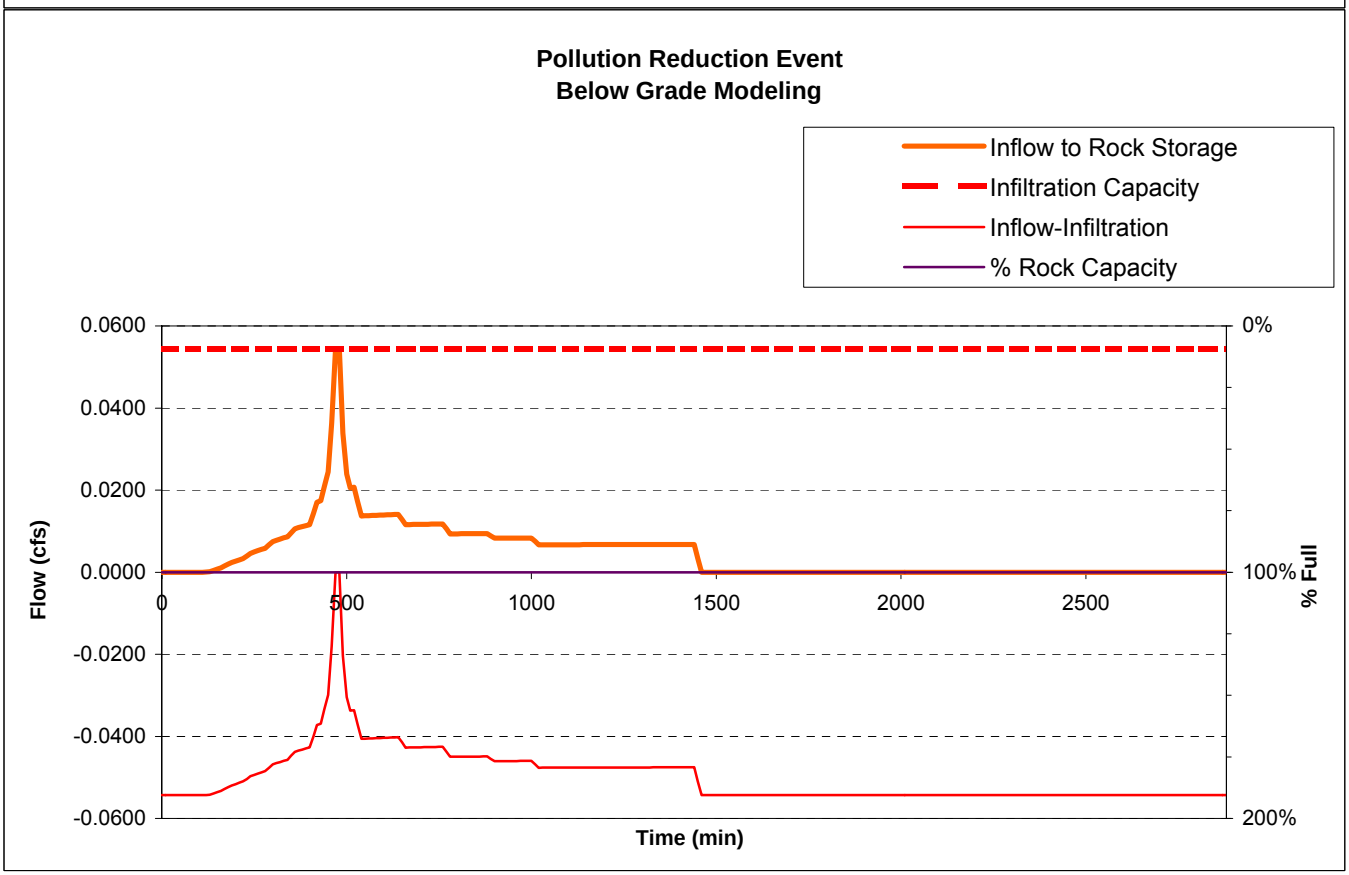
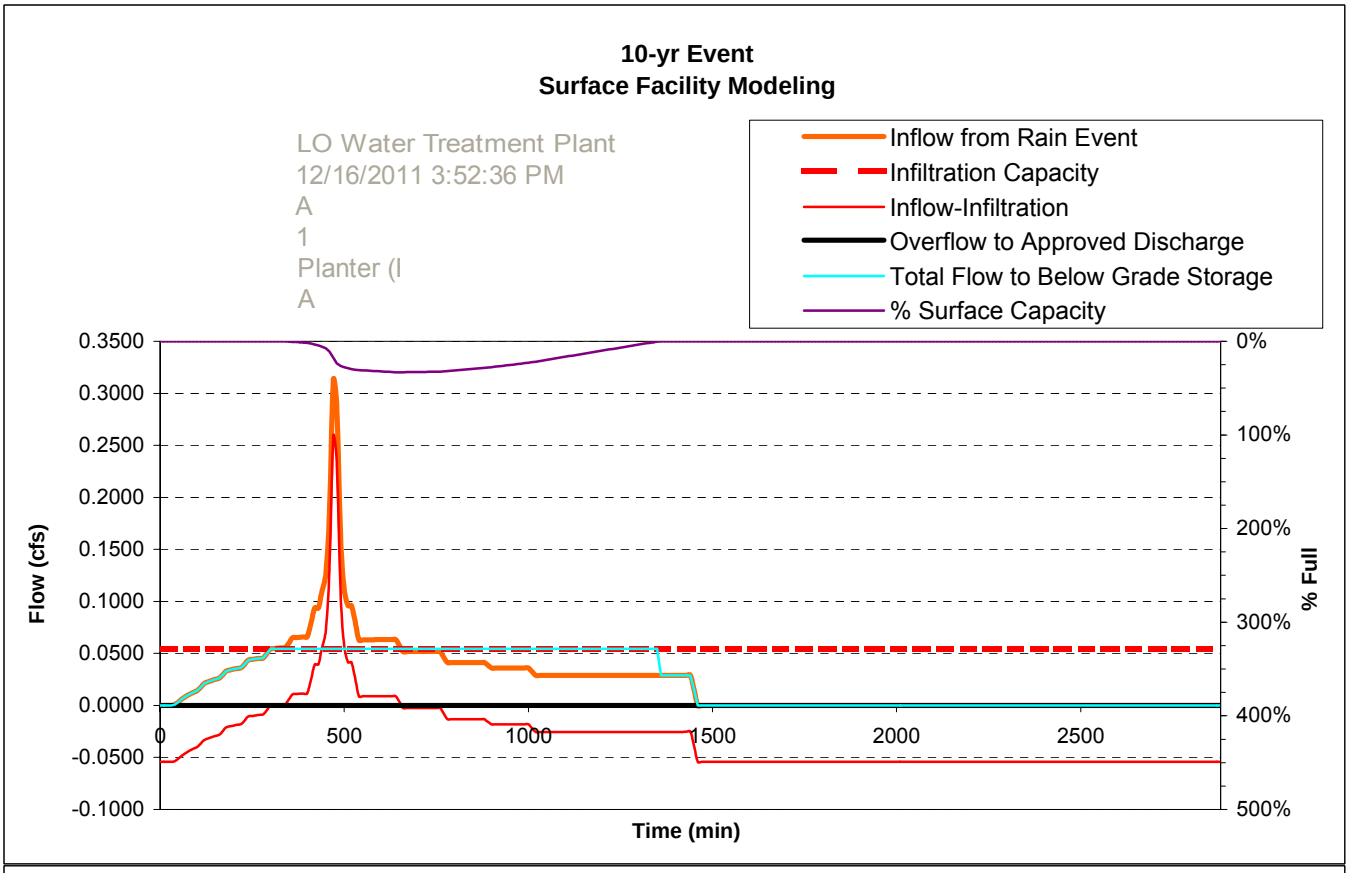
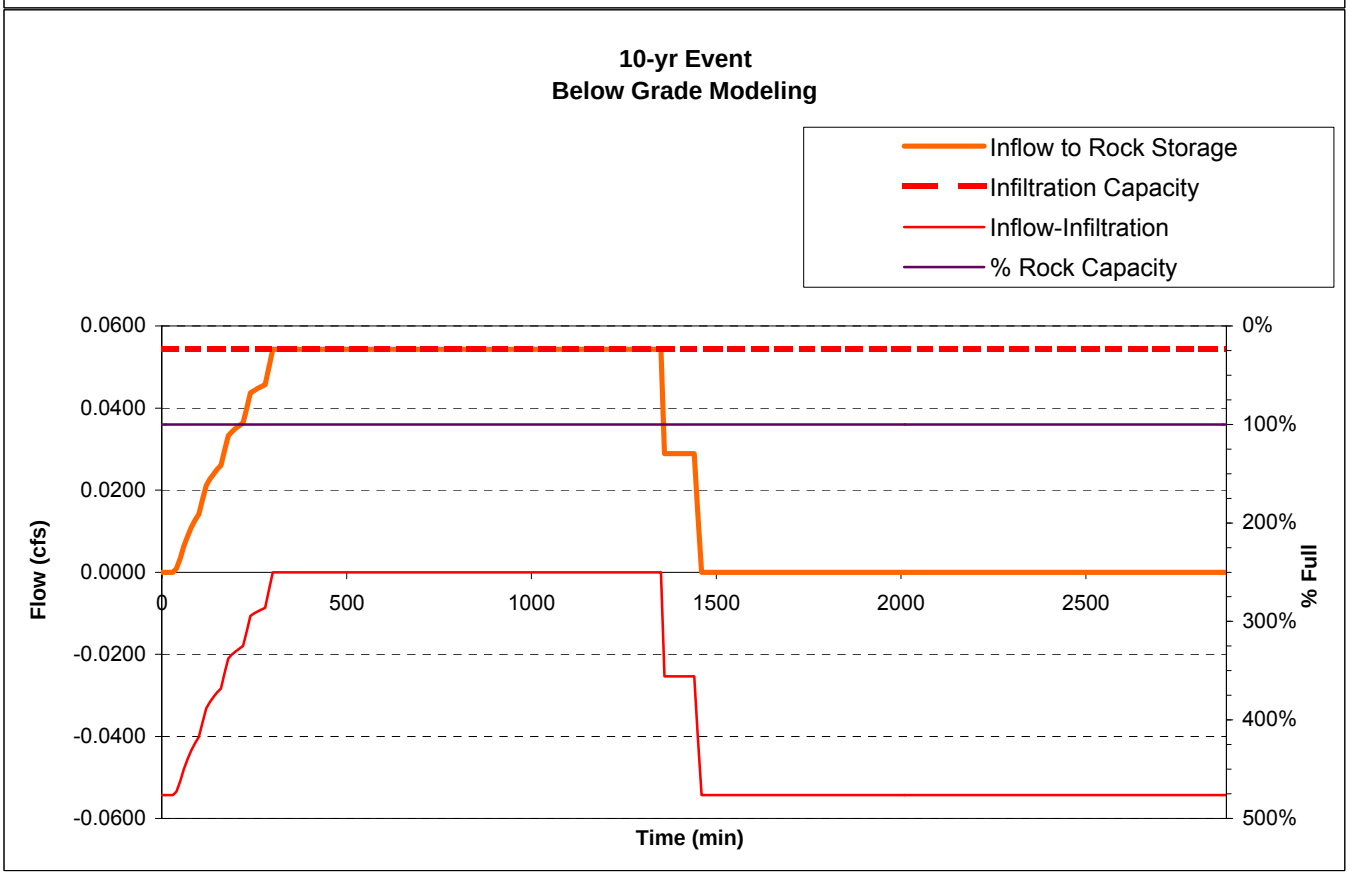

Pollution Reduction Event
Surface Facility Modeling
LO Water Treatment Plant
12/16/2011 3:52:36 PM
A
1
Planter (I
A
Inflow from Rain Event
Infiltration Capacity
Inflow-Infiltration
Overflow to Approved Discharge
Percolation to Below Grade Storage
% Surface Capacity
0.0800
0.0600
0.0400
0.0200
0.0000
-0.0200
-0.0400
-0.0600
-0.0800
0%
100%
200%
0
500
1000
1500
2000
2500
Flow (cfs)
% Full
Time (min)


Pollution Reduction Event
Below Grade Modeling
Inflow to Rock Storage
Infiltration Capacity
Inflow-Infiltration
% Rock Capacity
0.0600
0.0400
0.0200
0.0000
-0.0200
-0.0400
-0.0600
0%
100%
200%
0
500
1000
1500
2000
2500
Flow (cfs)
% Full
Time (min)

BES - Presumptive Approach Calculator - Ver 1.2





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Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**B**
Project Name:	**LO Water Treatment Plant**
Date:	**12/16/11**
Project Address:	**4200 Kenthorpe Way**
Permit Number:	**0**
	West Linn, OR
Run Time	12/16/2011 4:04:14 PM
Designer:	**D. Elkin**
Company:	**GreenWorks**

Drainage Catchment Information

Catchment ID	B	
	Catchment Area	
Impervious Area	12,055	SF
Impervious Area	0.28	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	1	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

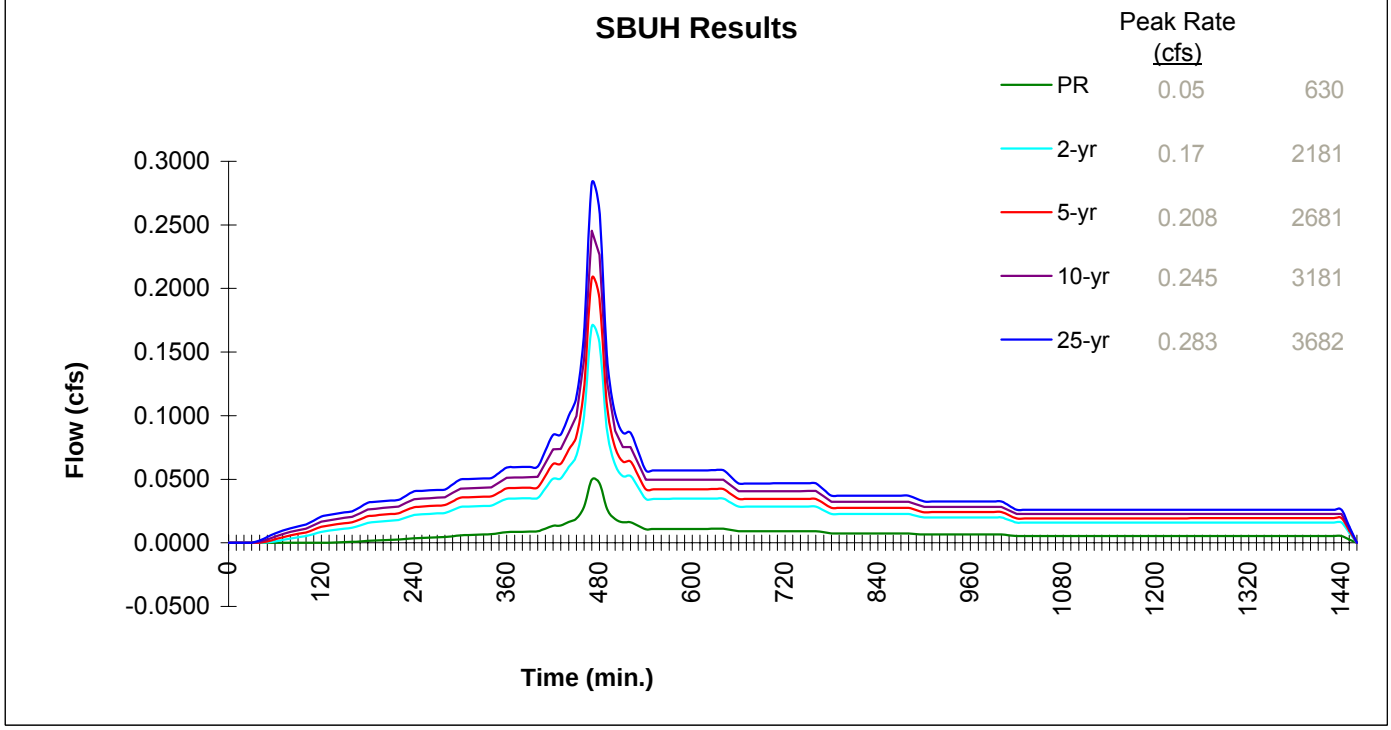
CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	0.50	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results



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Presumptive Approach Calculator ver. 1.2

Catchment ID: B

Run Time: 12/16/2011 4:04:14 PM

Project Name: LO Water Treatment Plant **Catchment ID:** B **Date:** 12/16/2011

Instructions:

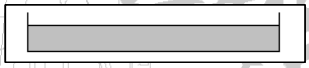
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: **1**

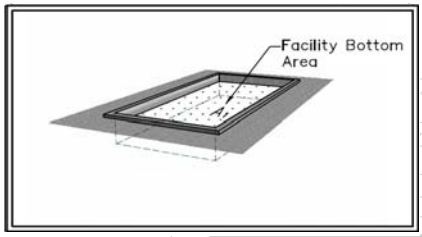
Goal Summary:

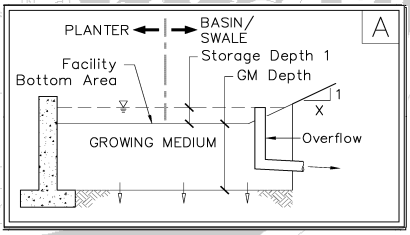
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…	
		Pollution Reduction as a	10-yr (aka disposal) as a
1	On-site infiltration with a surface infiltration facility.	PASS	PASS

Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square **Facility Configuration:** A





Calculation Guide
Max. Rock Stor. Bottom Area
2,008 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area =	2,008	sf
Bottom Width =	20.0	ft
Facility Side Slope =	0	to 1
Storage Depth 1 =	6	in
Growing Medium Depth =	18	in
Freeboard Depth =	N/A	in

BELOW GRADE STORAGE

Rock Storage Bottom Area =	2,008	sf
Rock Storage Depth =	0	in

Surface Capacity at Depth 1 =	1,004	cf
GM Design Infiltration Rate =	2.00	in/hr
Infiltration Capacity =	0.093	cfs

Rock Storage Capacity =	0	cf
Native Design Infiltration Rate =	0.50	in/hr
Infiltration Capacity =	0.023	cfs

Native Infiltration Rate Used in PA

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	4%	Surf. Cap. Used
10-yr	FAIL	314 CF	100%	Surf. Cap. Used

Run PAC

FACILITY FACTS

Total Facility Area Including Freeboard =	2,008 SF
Sizing Ratio (Total Facility Area / Catchment Area) =	0.167

Current data has been exported:

LO WTP_Catchment_B_Export_2011-12-16.xls
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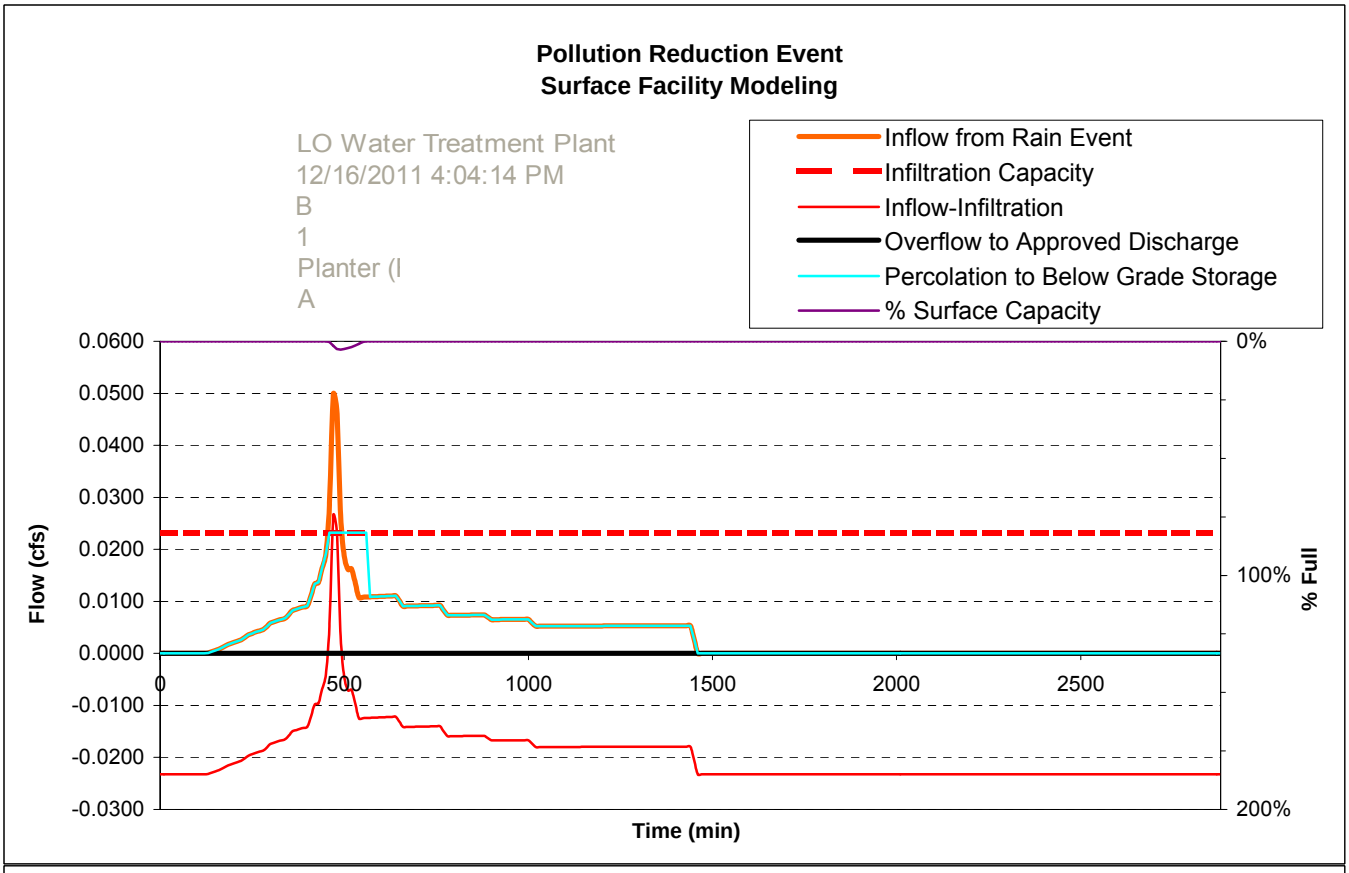
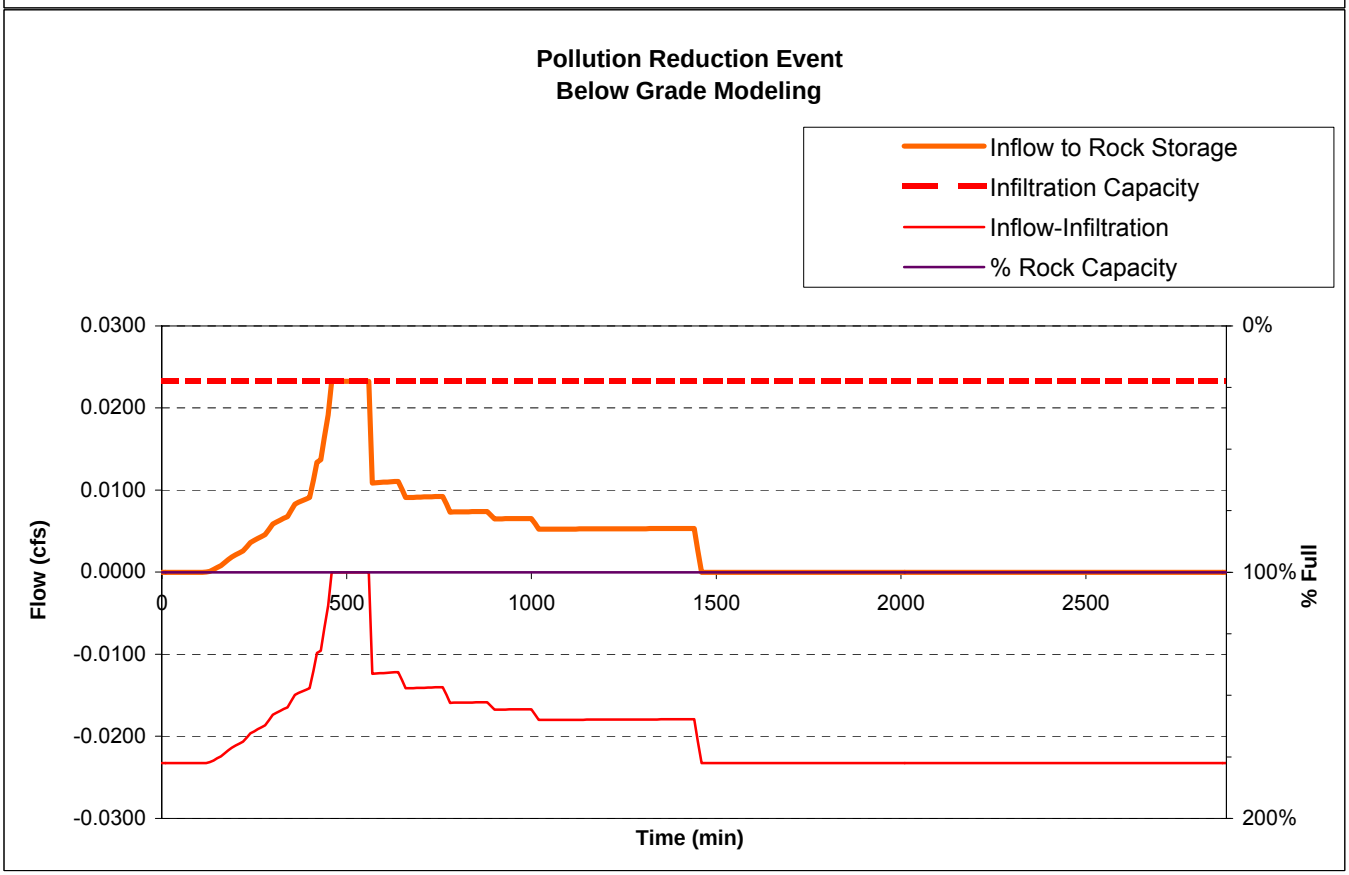
BES - Presumptive Approach Calculator - Ver 1.2

PR Con-A&B





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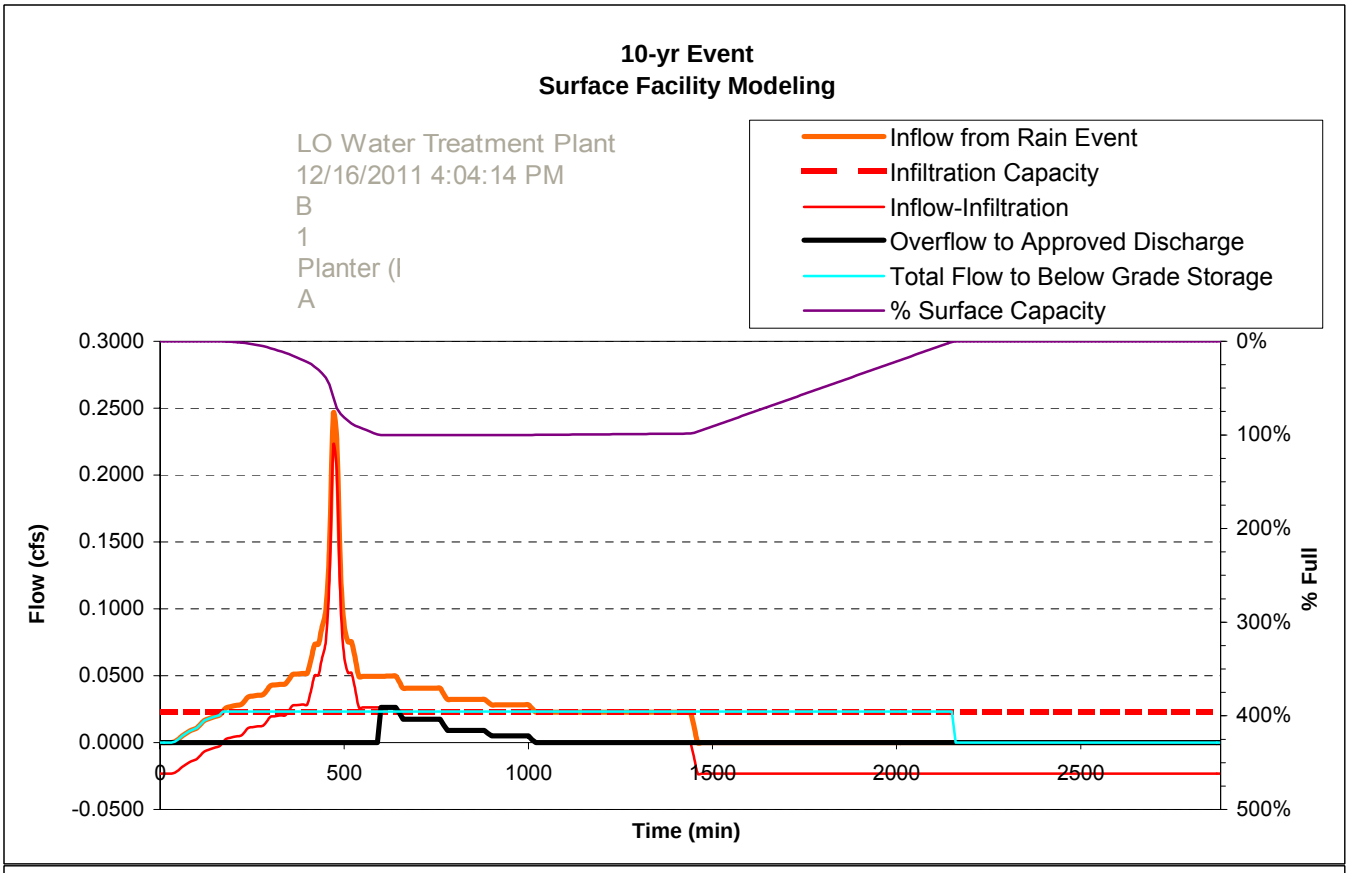
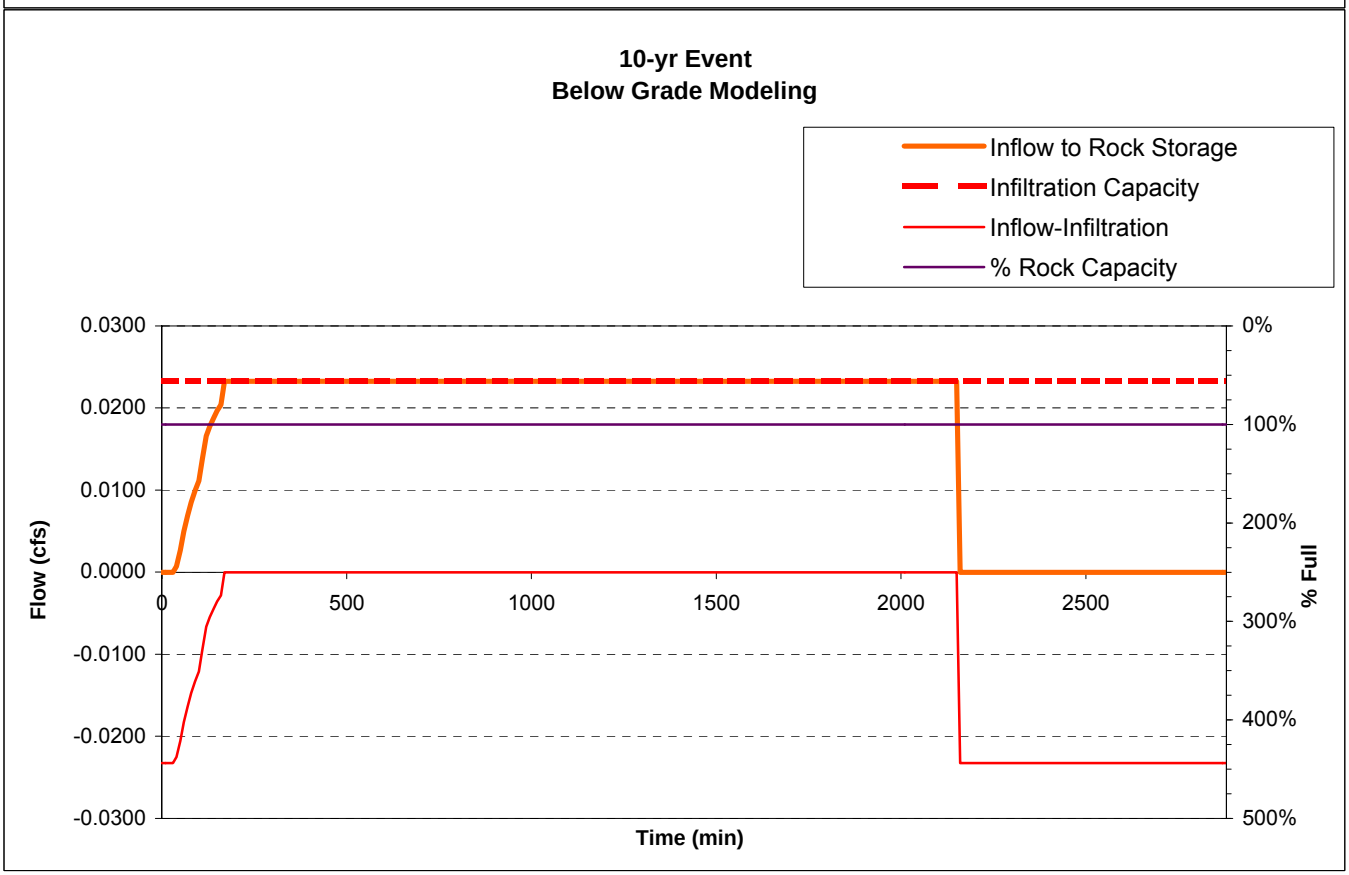
BES - Presumptive Approach Calculator - Ver 1.2





Printed: 12/16/2011 4:05 PM

Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**D**
Project Name:	**LO Water Treatment Plant**
Date:	**12/16/11**
Project Address:	**4200 Kenthorpe Way**
Permit Number:	**0**
	West Linn, OR
Run Time	12/16/2011 4:19:10 PM
Designer:	**D. Elkin**
Company:	**GreenWorks**

Drainage Catchment Information

Catchment ID	D	
	Catchment Area	
Impervious Area	13,357	SF
Impervious Area	0.31	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	1	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

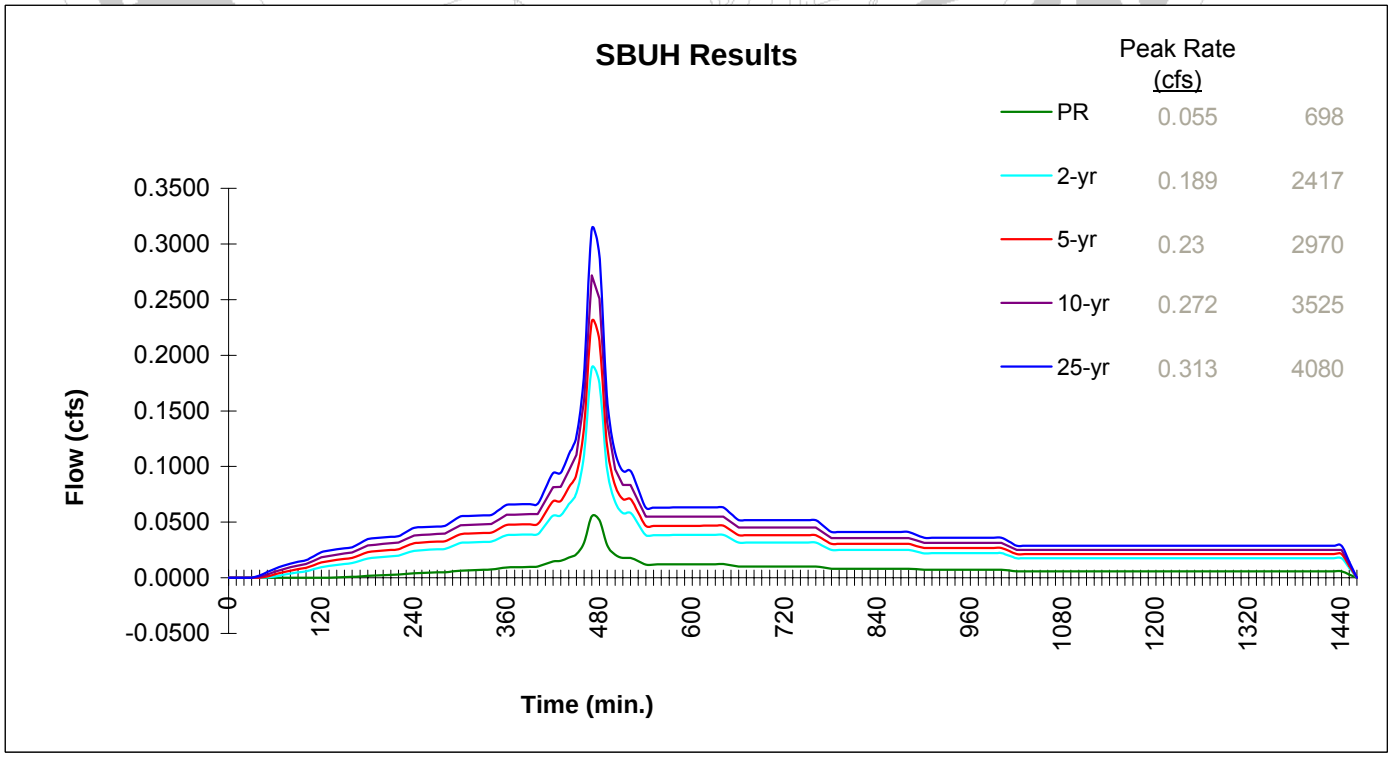
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	0.50	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



Printed: 12/16/2011 4:19 PM

Presumptive Approach Calculator ver. 1.2

Catchment ID: D

Run Time: 12/16/2011 4:19:10 PM

Project Name: LO Water Treatment Plant **Catchment ID:** D **Date:** 12/16/2011

Instructions:

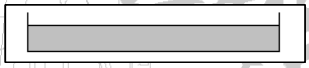
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

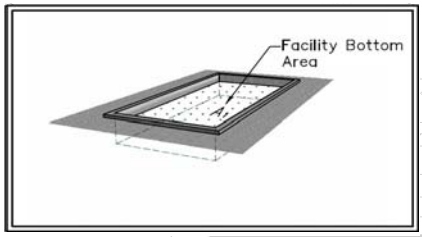
Goal Summary:

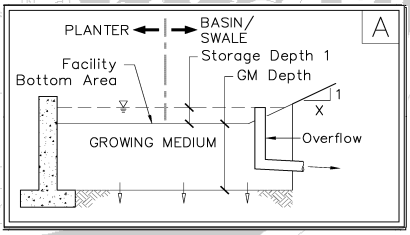
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…	
		Pollution Reduction as a	10-yr (aka disposal) as a
1	On-site infiltration with a surface infiltration facility.	PASS	PASS

Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square **Facility Configuration:** A





Calculation Guide
Max. Rock Stor. Bottom Area
1,786 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area =	1,786	sf
Bottom Width =	20.0	ft
Facility Side Slope =	0	to 1
Storage Depth 1 =	10	in
Growing Medium Depth =	18	in
Freeboard Depth =	N/A	in

BELOW GRADE STORAGE

Rock Storage Bottom Area =	1,786	sf
Rock Storage Depth =	0	in

Surface Capacity at Depth 1 =	1,488	cf
GM Design Infiltration Rate =	2.00	in/hr
Infiltration Capacity =	0.083	cfs

Rock Storage Capacity =	0	cf
Native Design Infiltration Rate =	0.50	in/hr
Infiltration Capacity =	0.021	cfs

Native Infiltration Rate Used in PA

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	3%	Surf. Cap. Used
10-yr	FAIL	353 CF	100%	Surf. Cap. Used

Run PAC

FACILITY FACTS

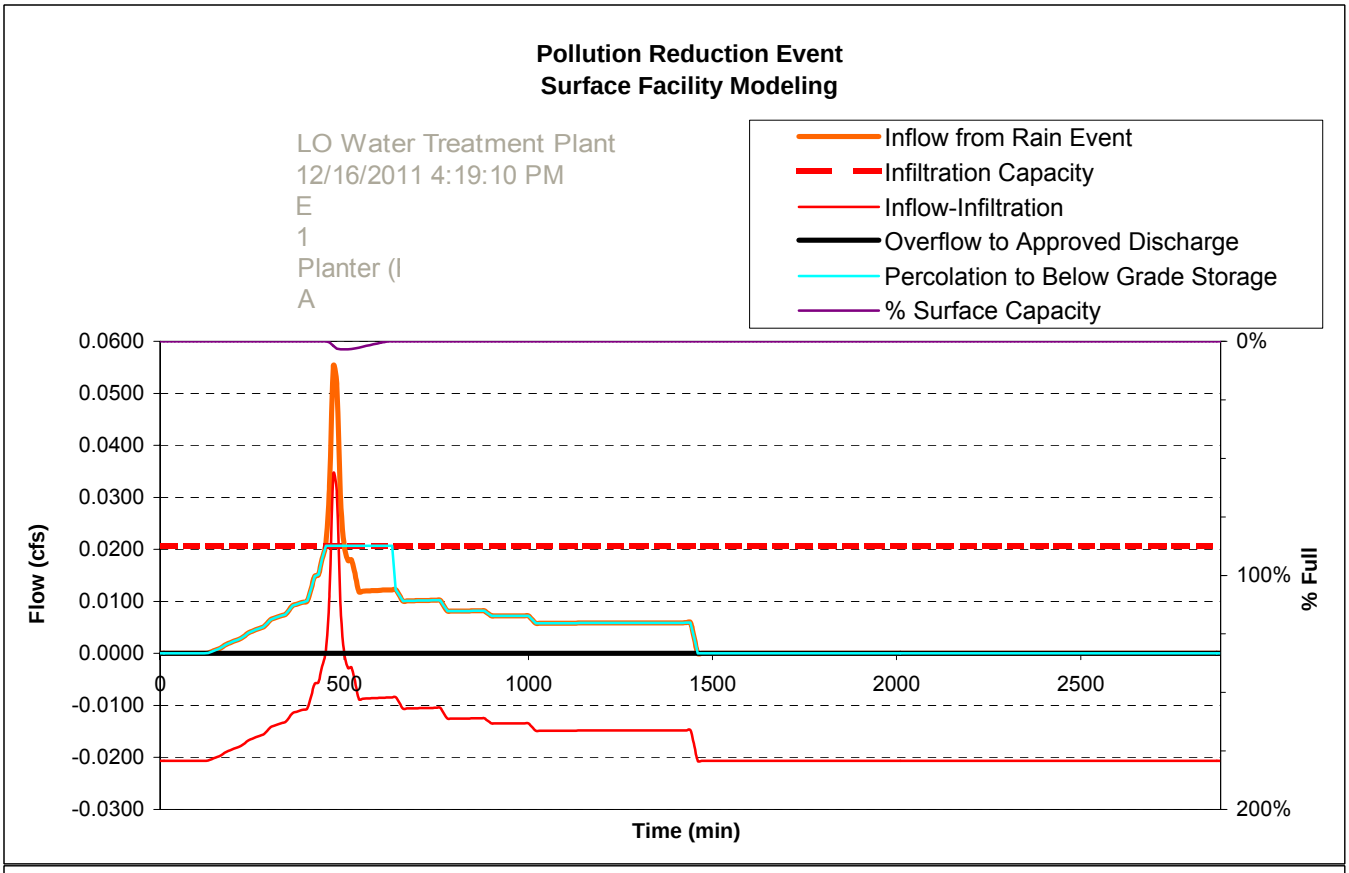
Total Facility Area Including Freeboard =	1,786 SF
Sizing Ratio (Total Facility Area / Catchment Area) =	0.134

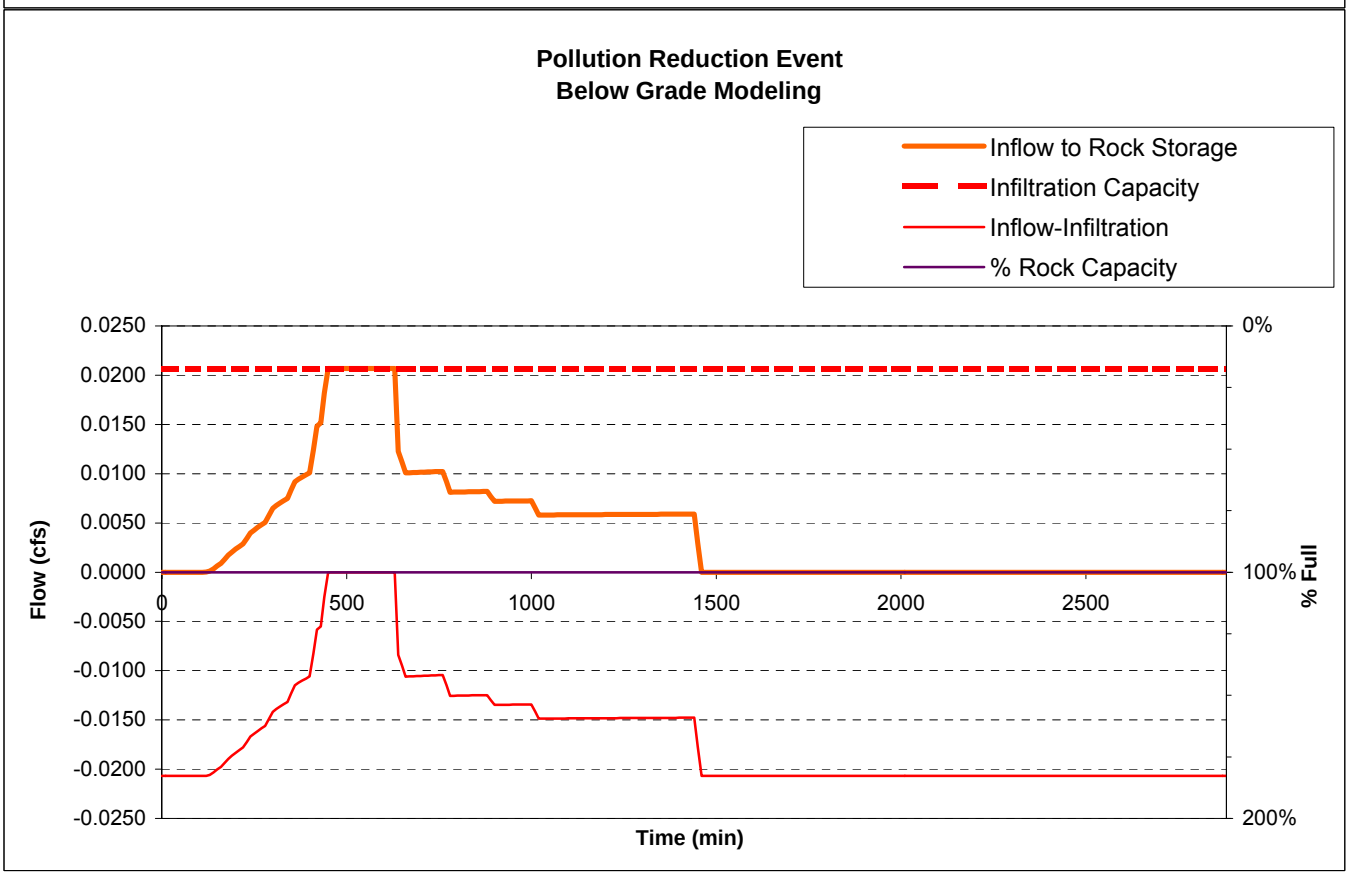
Current data has been exported:

LO WTP_Catchment_D_Export_2011-12-16.xls
12/16/2011 4:19:40 PM

BES - Presumptive Approach Calculator - Ver 1.2

PR Con-A&B





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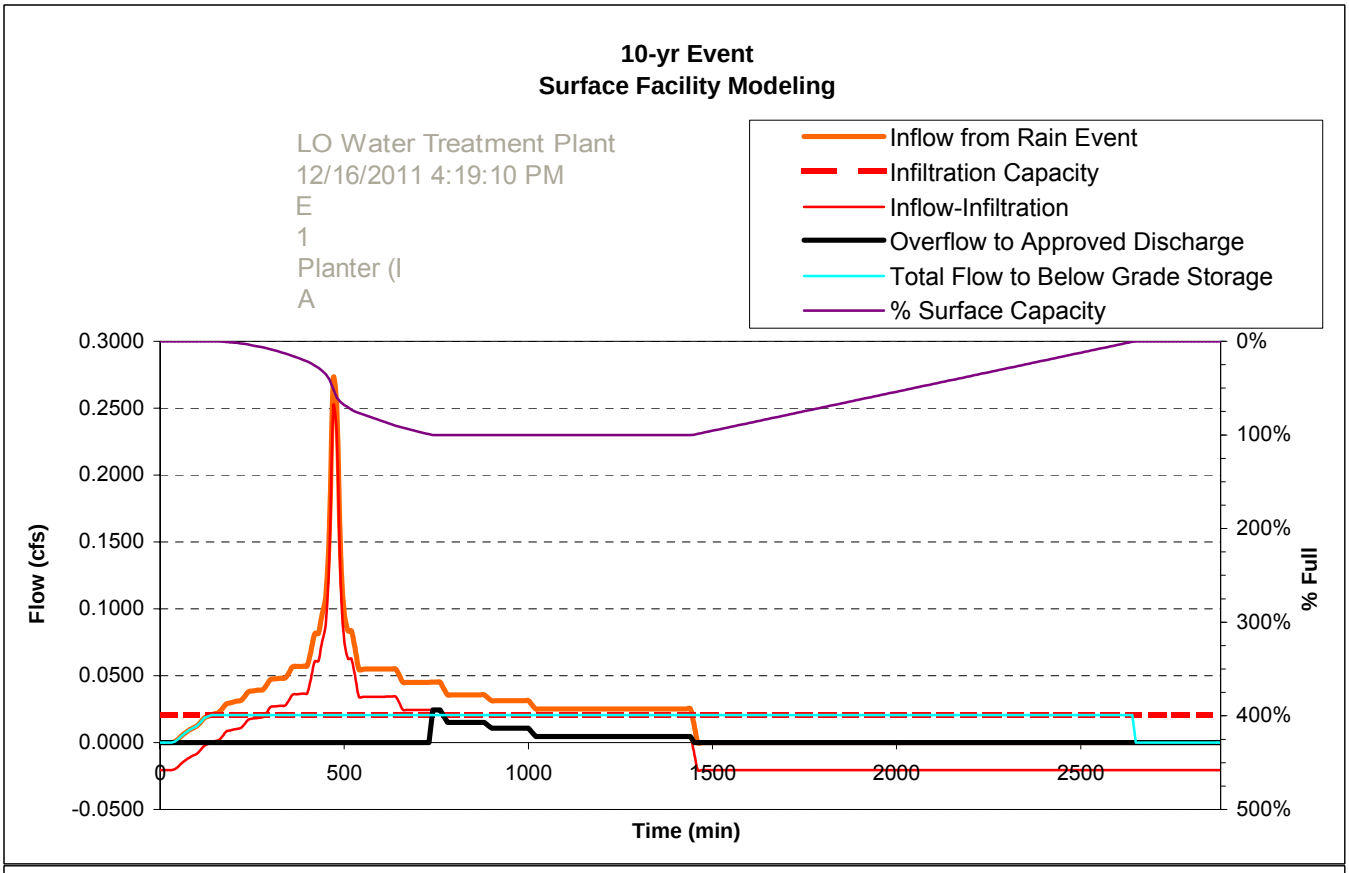
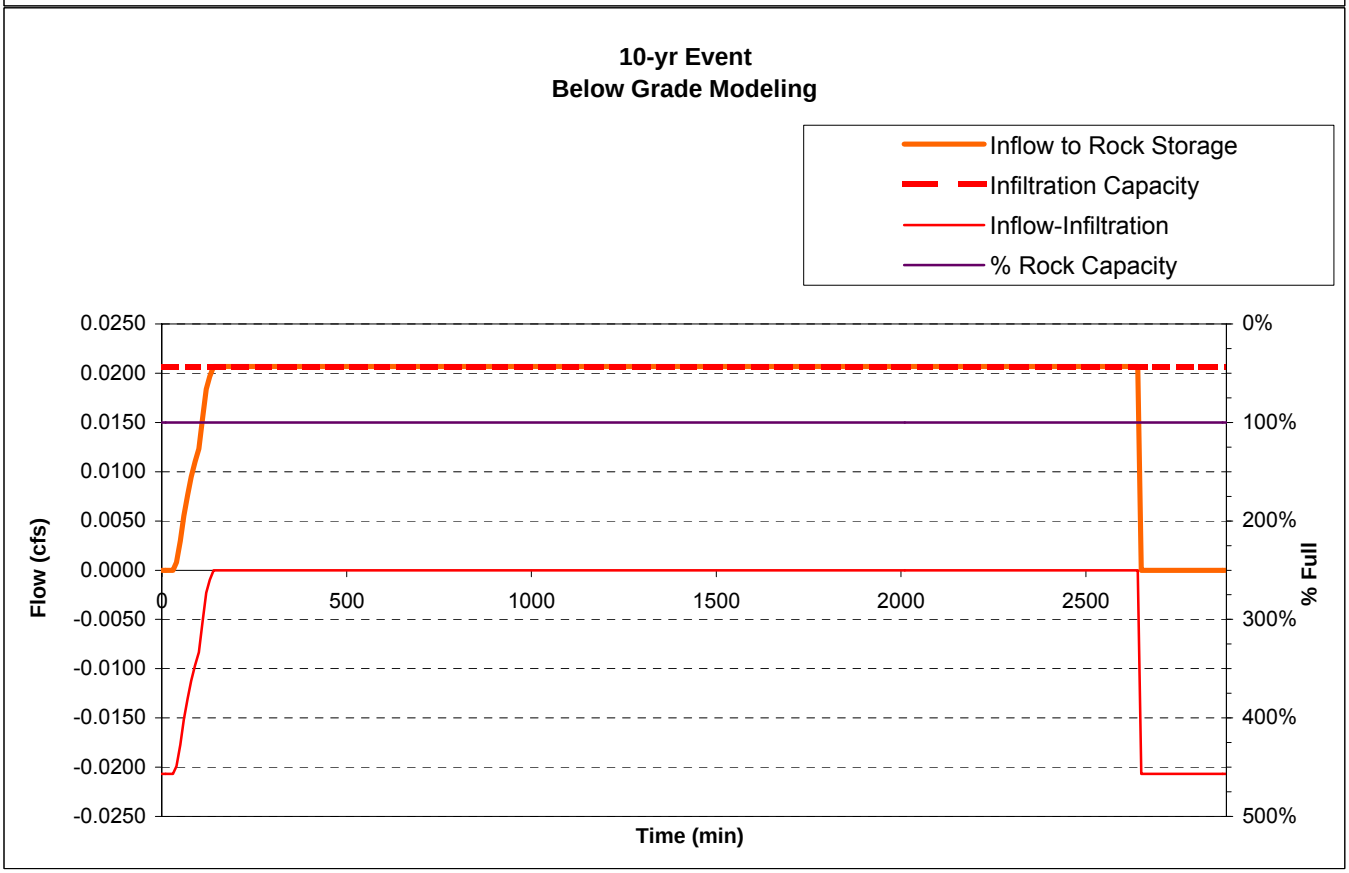
BES - Presumptive Approach Calculator - Ver 1.2





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Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**E**
Project Name:	**LO Water Treatment Plant**
Date:	**01/03/12**
Project Address:	**4200 Kenthorpe Way**
Permit Number:	**0**
	West Linn, OR
Run Time	1/3/2012 4:53:30 PM
Designer:	**D. Elkin**
Company:	**GreenWorks**

Drainage Catchment Information

Catchment ID	E	
	Catchment Area	
Impervious Area	23,839	SF
Impervious Area	0.55	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	1	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

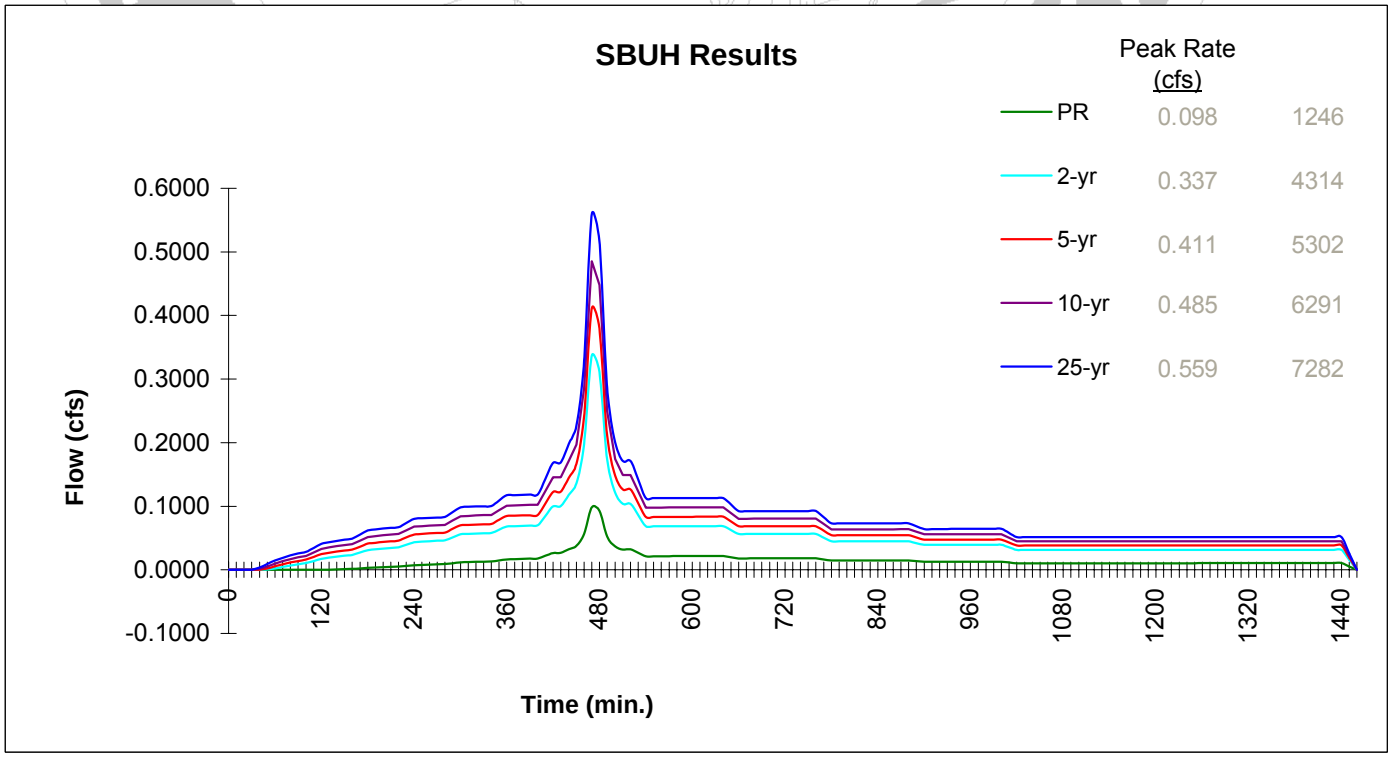
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	0.50	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



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Presumptive Approach Calculator ver. 1.2

Catchment ID: E

Run Time: 1/3/2012 4:53:30 PM

Project Name: LO Water Treatment Plant **Catchment ID:** E **Date:** 1/3/2012

Instructions:

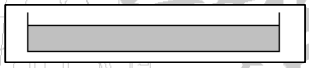
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

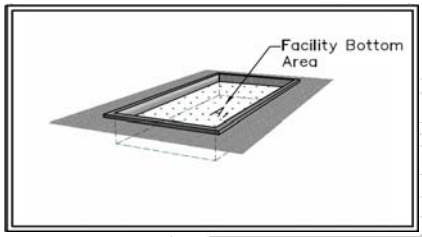
Goal Summary:

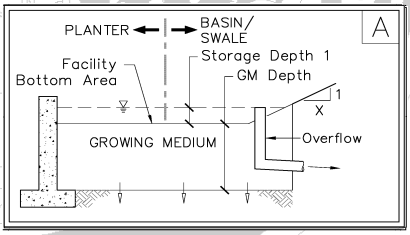
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…	
		Pollution Reduction as a	10-yr (aka disposal) as a
1	On-site infiltration with a surface infiltration facility.	PASS	PASS

Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square **Facility Configuration:** A





Calculation Guide
Max. Rock Stor. Bottom Area
3,200 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area =	3,200	sf
Bottom Width =	20.0	ft
Facility Side Slope =	0	to 1
Storage Depth 1 =	10	in
Growing Medium Depth =	18	in
Freeboard Depth =	N/A	in

BELOW GRADE STORAGE

Rock Storage Bottom Area =	3,200	sf
Rock Storage Depth =	0	in

Surface Capacity at Depth 1 =	2,667	cf
GM Design Infiltration Rate =	2.00	in/hr
Infiltration Capacity =	0.148	cfs

Rock Storage Capacity =	0	cf
Native Design Infiltration Rate =	0.50	in/hr
Infiltration Capacity =	0.037	cfs

Native Infiltration Rate Used in PA

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	3%	Surf. Cap. Used
10-yr	FAIL	598 CF	100%	Surf. Cap. Used

Run PAC

FACILITY FACTS

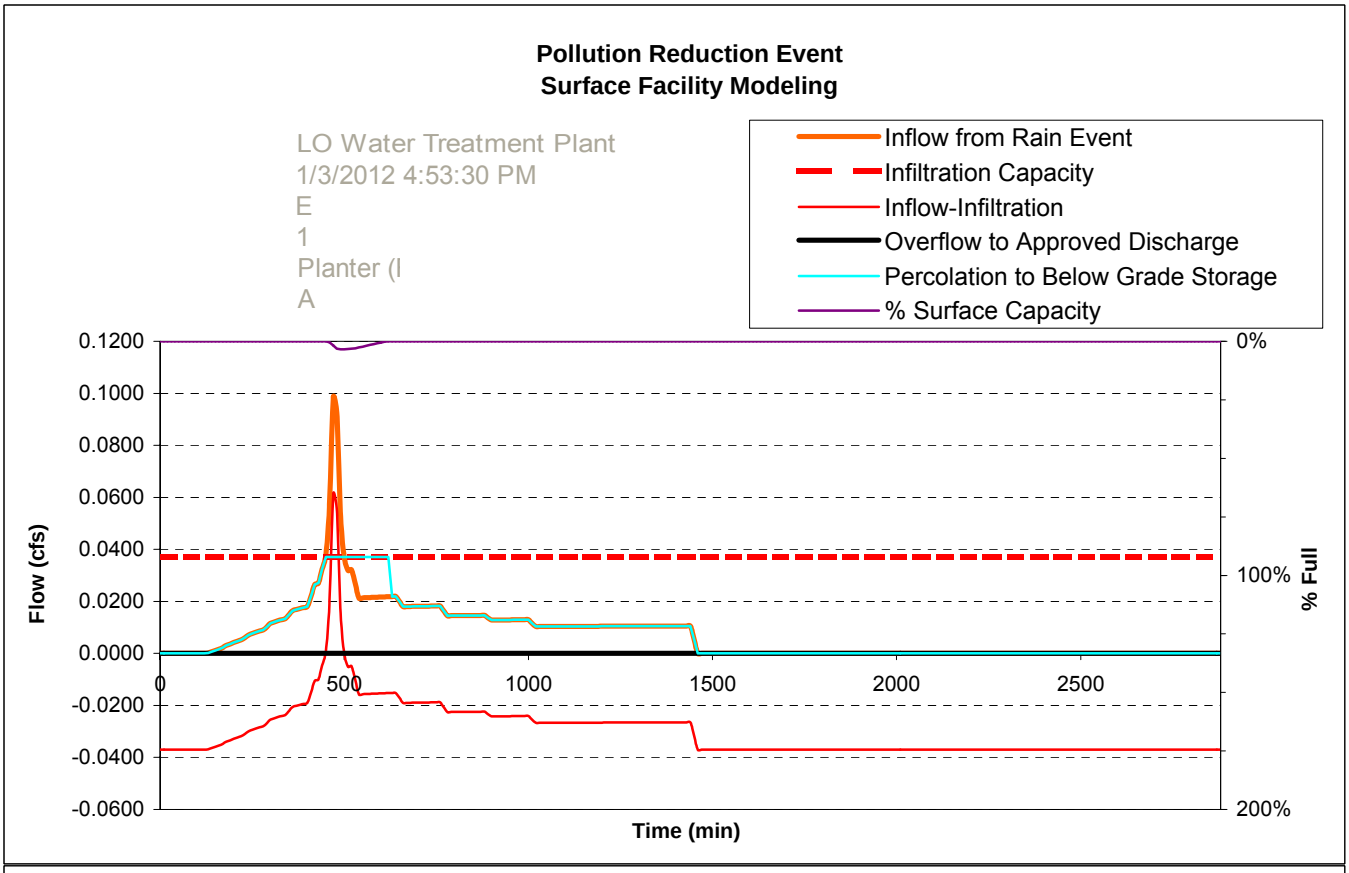
Total Facility Area Including Freeboard =	3,200 SF
Sizing Ratio (Total Facility Area / Catchment Area) =	0.134

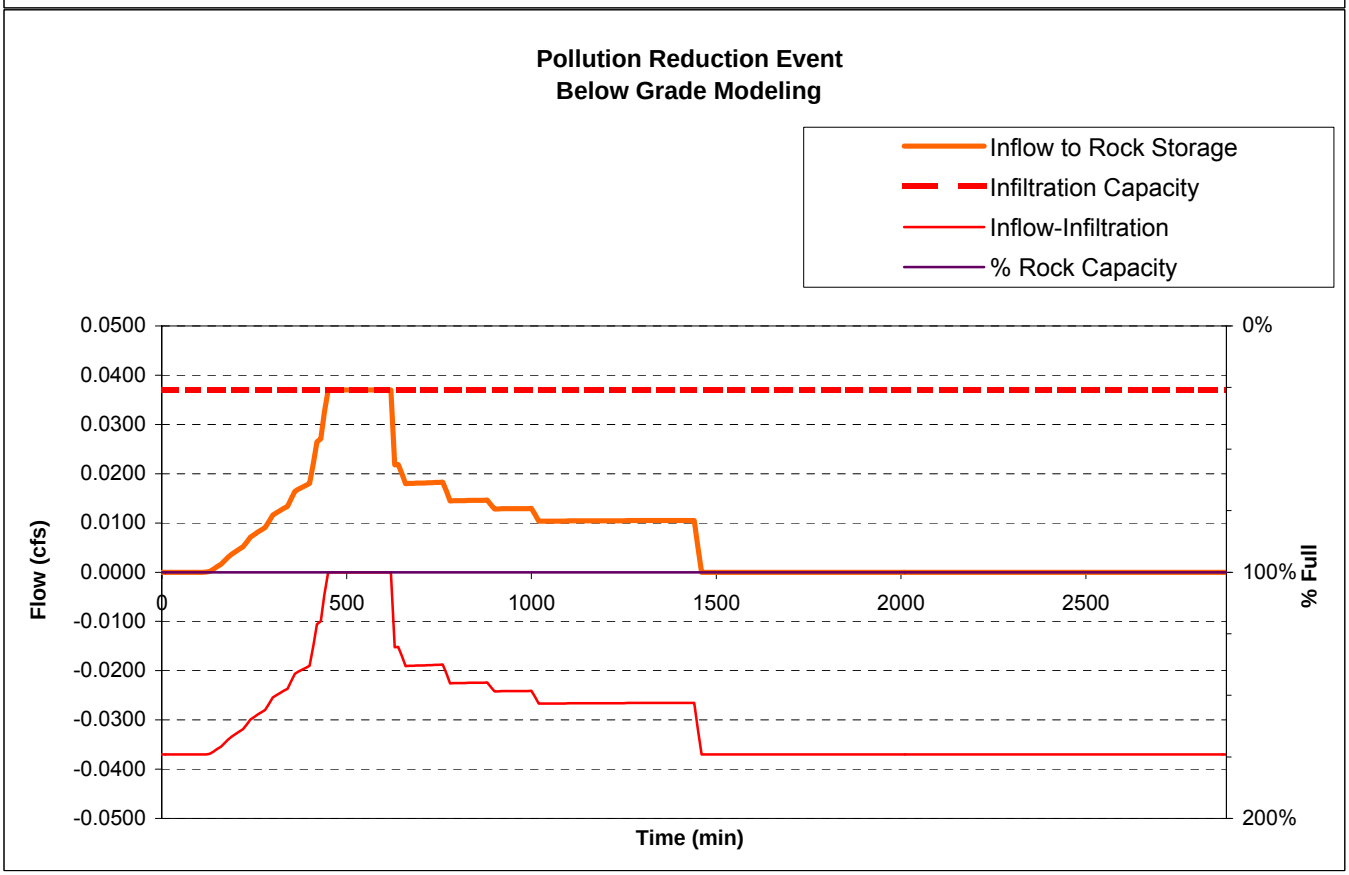
Current data has been exported:

LO WTP Catchment_E.xls 1/3/2012 4:55:20 PM

BES - Presumptive Approach Calculator - Ver 1.2

PR Con-A&B





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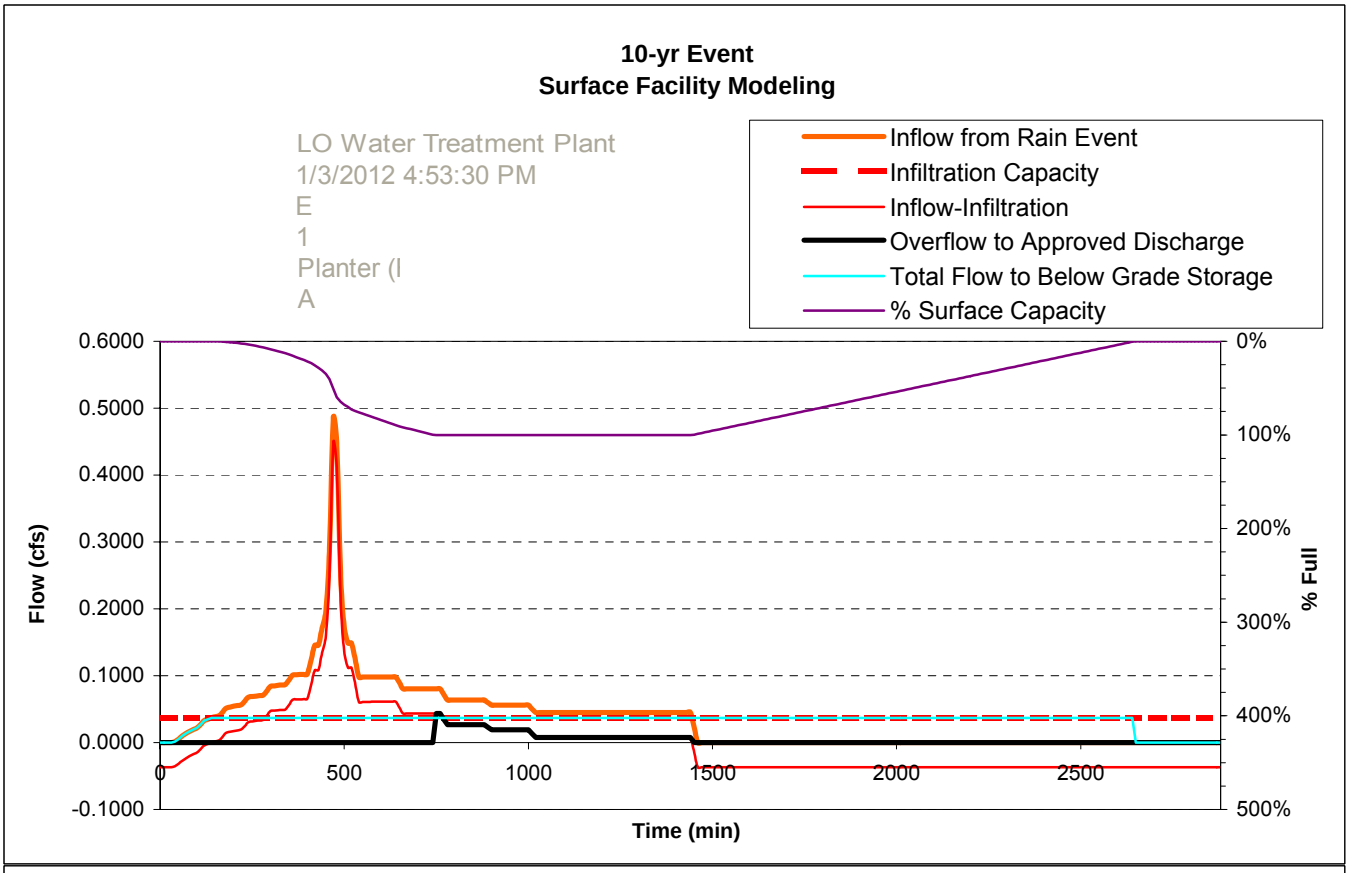
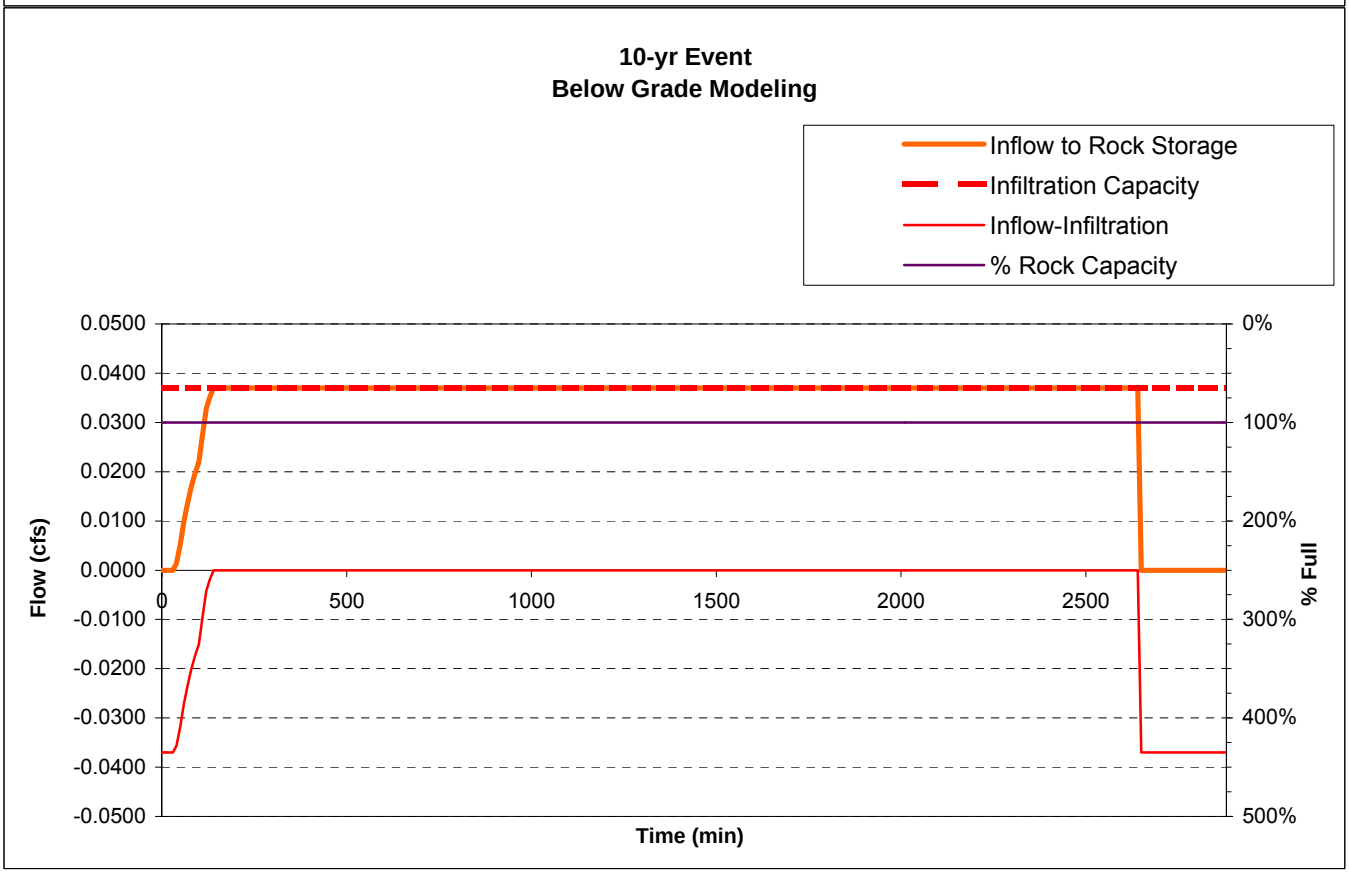
BES - Presumptive Approach Calculator - Ver 1.2





Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**G**
Project Name:	**LO Water Treatment Plant**
Date:	**12/16/11**
Project Address:	**4200 Kenthorpe Way**
Permit Number:	**0**
	West Linn, OR
Run Time	12/16/2011 5:40:44 PM
Designer:	**D. Elkin**
Company:	**GreenWorks**

Drainage Catchment Information

Catchment ID	G	
	Catchment Area	
Impervious Area	24,710	SF
Impervious Area	0.57	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	1	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

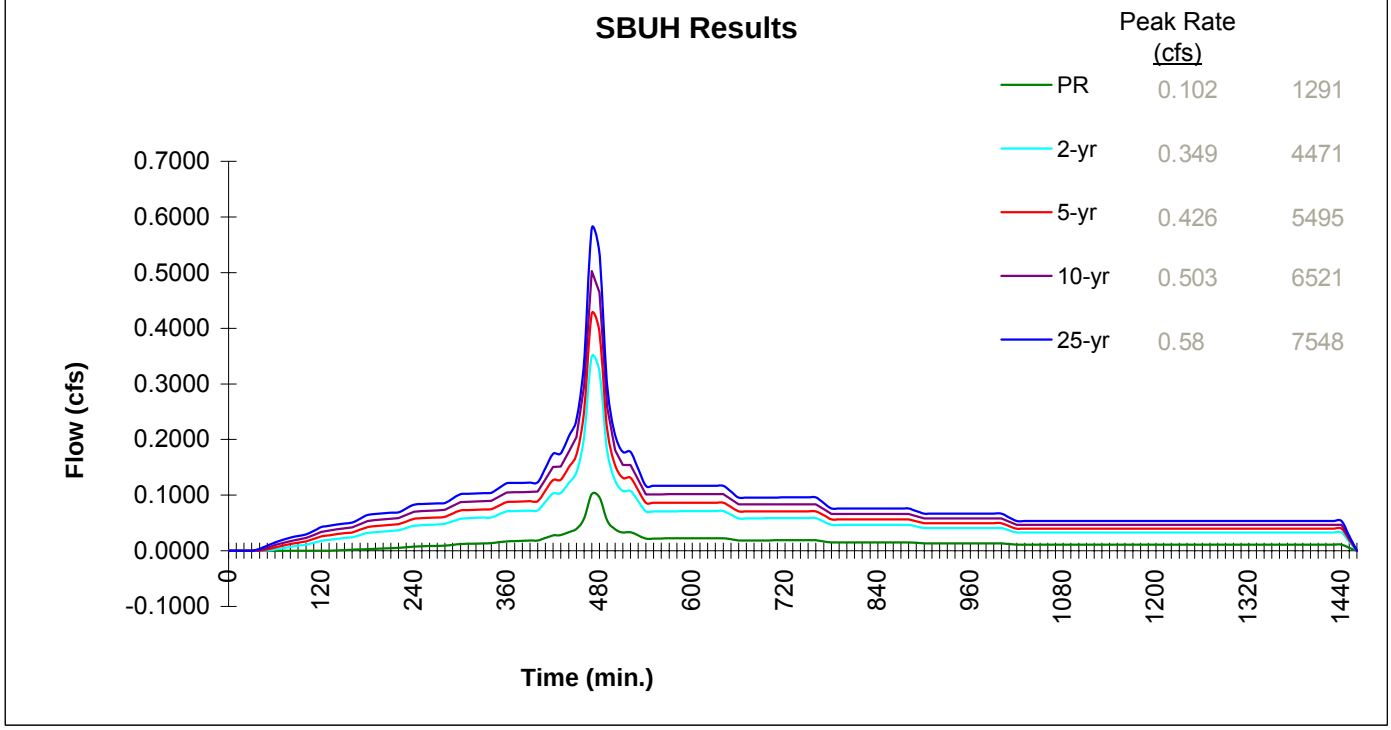
CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	0.50	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results



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Presumptive Approach Calculator ver. 1.2

Catchment ID: G

Run Time: 12/16/2011 5:40:44 PM

Project Name: LO Water Treatment Plant **Catchment ID:** G **Date:** 12/16/2011

imported file LO WTP_Catchment_G_Export_2011-12-16.xls - 12/16/2011 5:40:45 PM

Instructions:

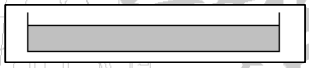
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

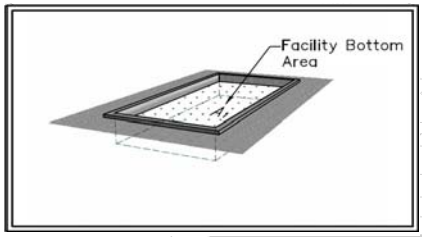
Goal Summary:

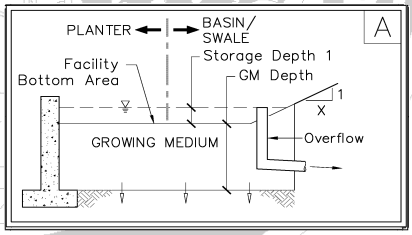
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…	
		Pollution Reduction as a	10-yr (aka disposal) as a
1	On-site infiltration with a surface infiltration facility.	PASS	PASS

Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square **Facility Configuration:** A





Calculation Guide
Max. Rock Stor. Bottom Area
3,500 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area =	3,500	sf
Bottom Width =	20.0	ft
Facility Side Slope =	0	to 1
Storage Depth 1 =	10	in
Growing Medium Depth =	18	in
Freeboard Depth =	N/A	in

BELOW GRADE STORAGE

Rock Storage Bottom Area =	3,500	sf
Rock Storage Depth =	0	in

Surface Capacity at Depth 1 =	2,917	cf
GM Design Infiltration Rate =	2.00	in/hr
Infiltration Capacity =	0.162	cfs

Rock Storage Capacity =	0	cf
Native Design Infiltration Rate =	0.50	in/hr
Infiltration Capacity =	0.041	cfs

Native Infiltration Rate Used in PA

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	3%	Surf. Cap. Used
10-yr	FAIL	305 CF	100%	Surf. Cap. Used

Run PAC

FACILITY FACTS

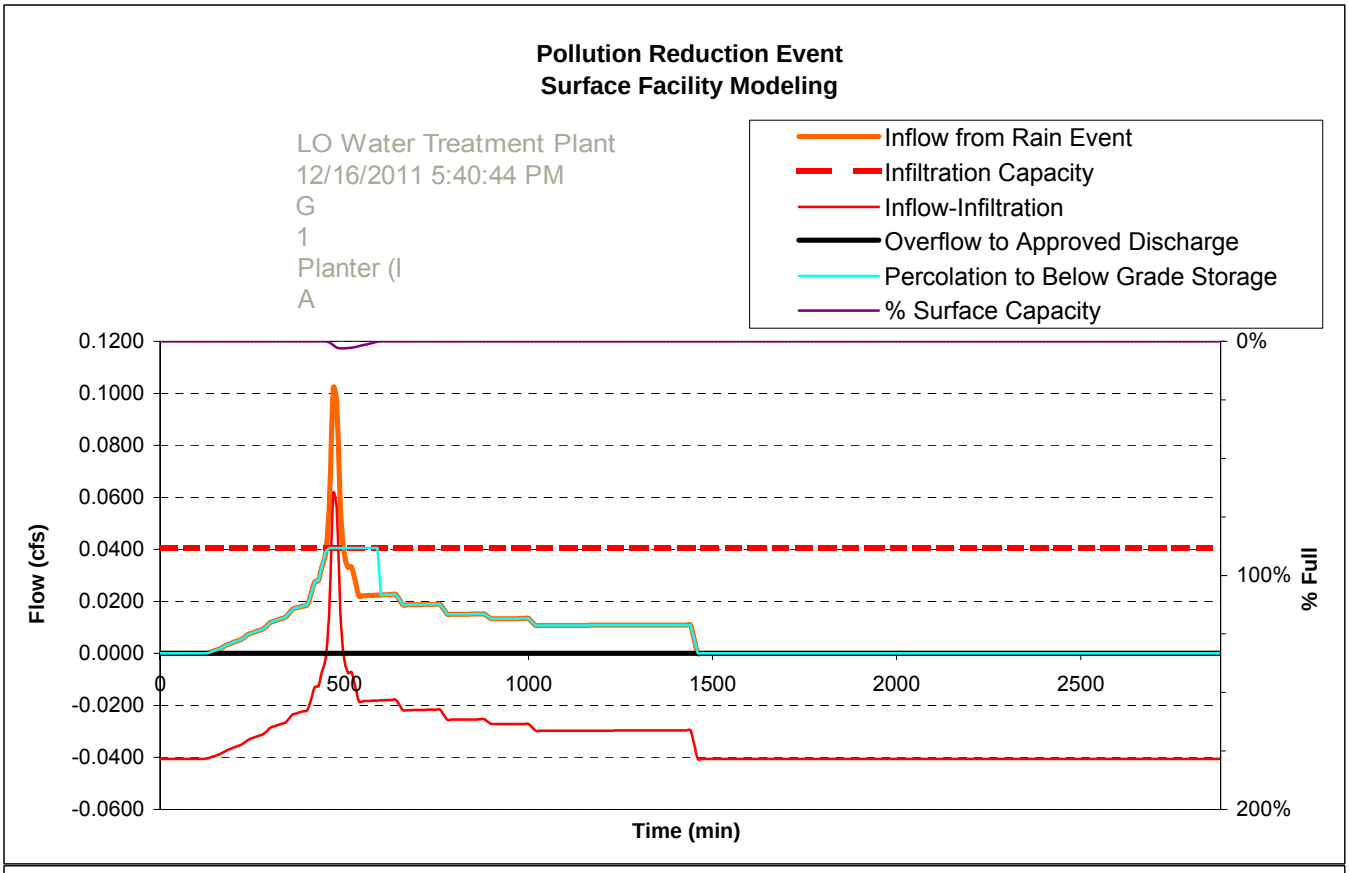
Total Facility Area Including Freeboard =	3,500 SF
Sizing Ratio (Total Facility Area / Catchment Area) =	0.142

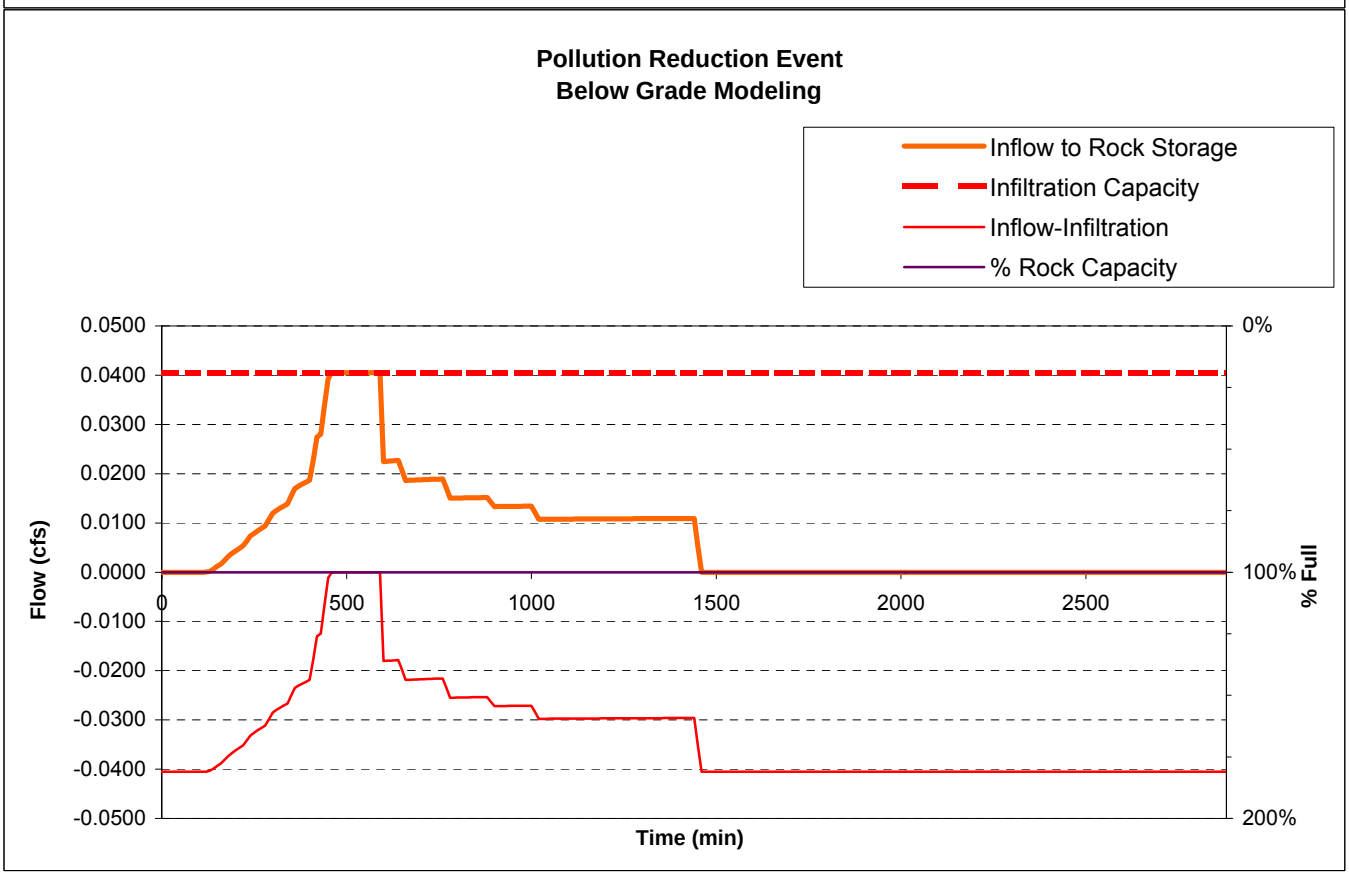
Current data has been imported:

LO WTP_Catchment_G_Export_2011-12-16.xls
12/16/2011 5:40:45 PM

BES - Presumptive Approach Calculator - Ver 1.2

PR Con-A&B





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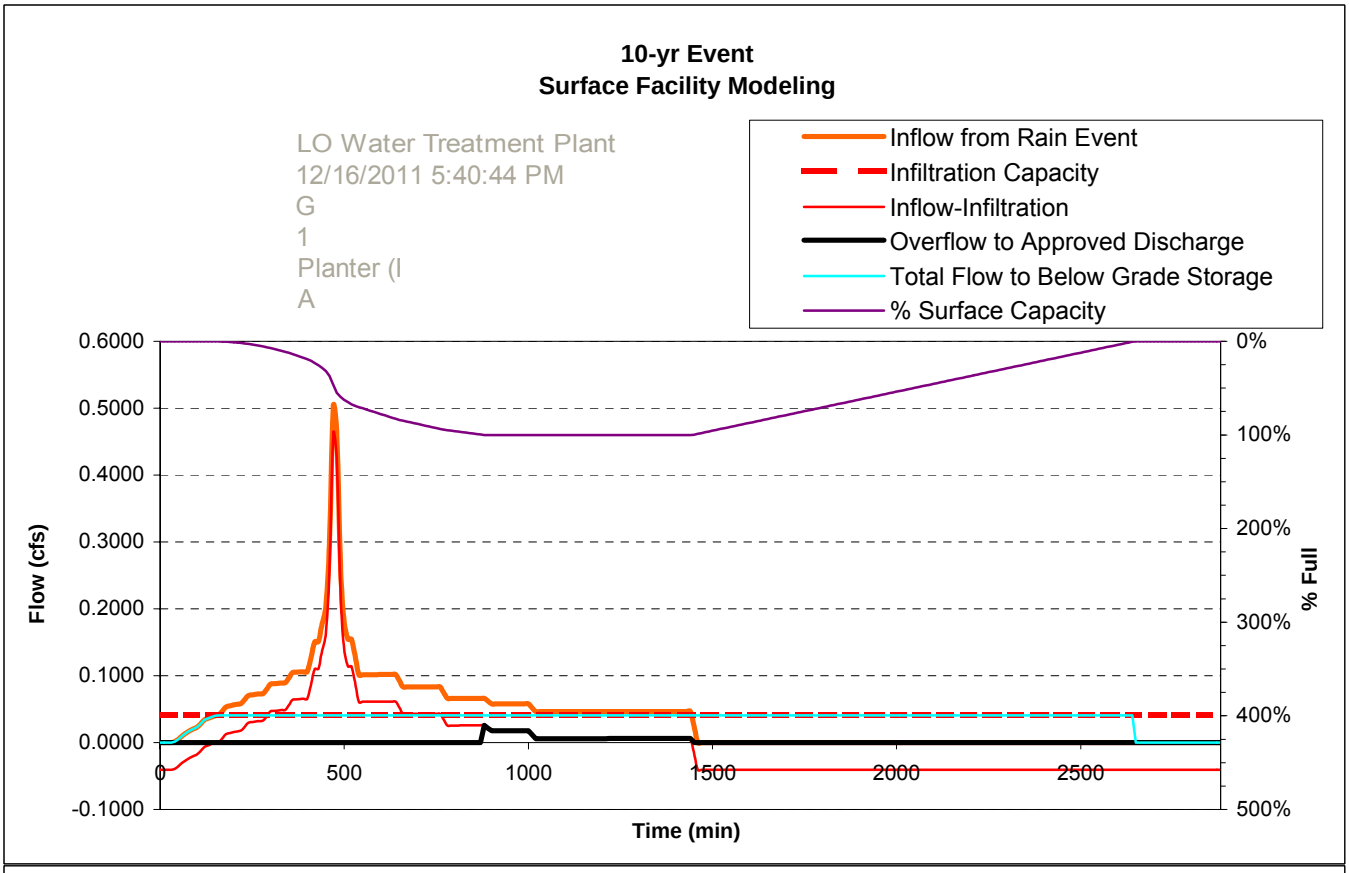
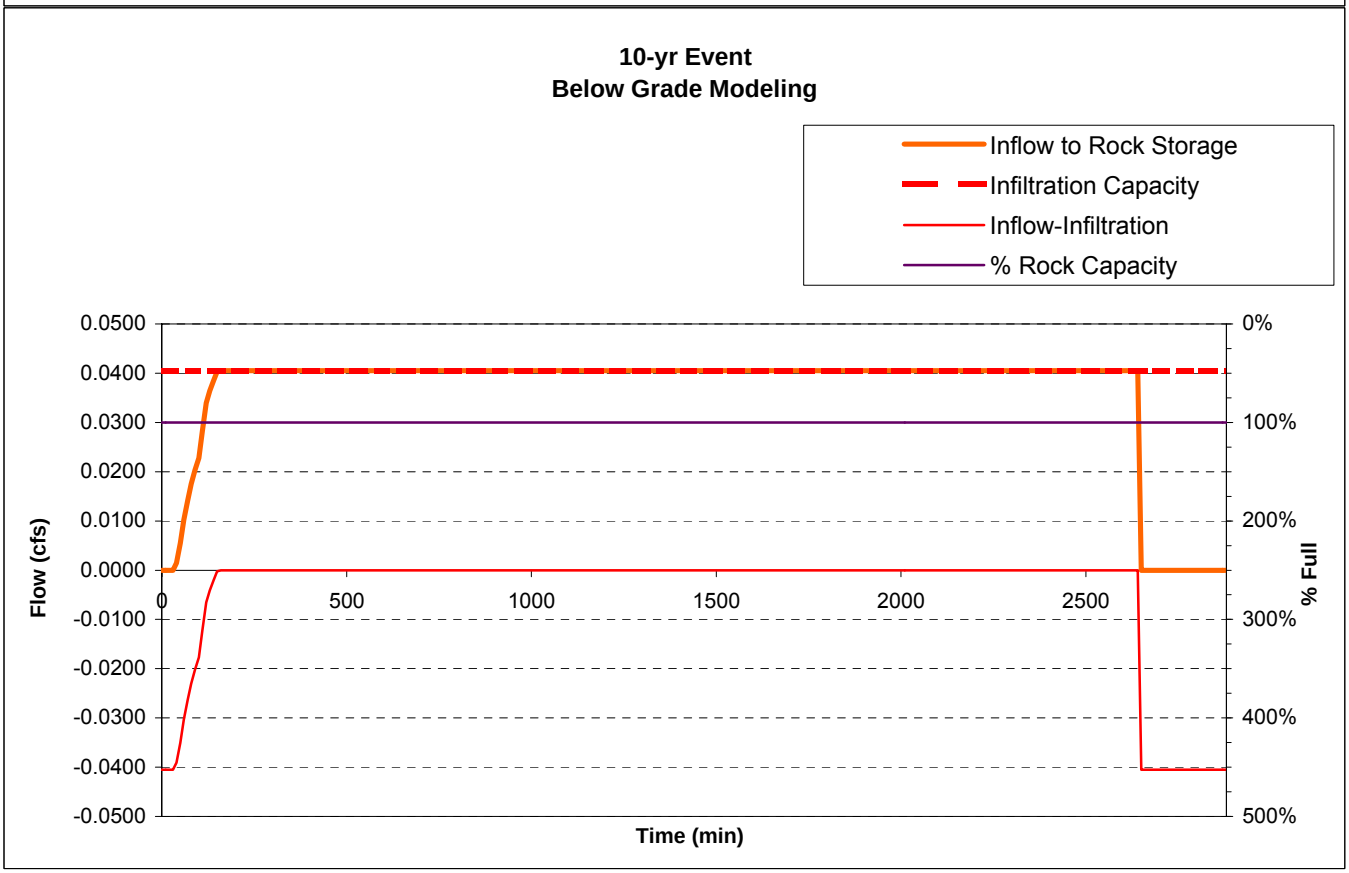
BES - Presumptive Approach Calculator - Ver 1.2





Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**I**
Project Name:	**LO Water Treatment Plant**
Date:	**01/03/12**
Project Address:	**4200 Kenthorpe Way**
Permit Number:	**0**
	West Linn, OR
Run Time	1/3/2012 4:58:06 PM
Designer:	**D. Elkin**
Company:	**GreenWorks**

Drainage Catchment Information

Catchment ID	I	
	Catchment Area	
Impervious Area	36,935	SF
Impervious Area	0.85	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	1	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

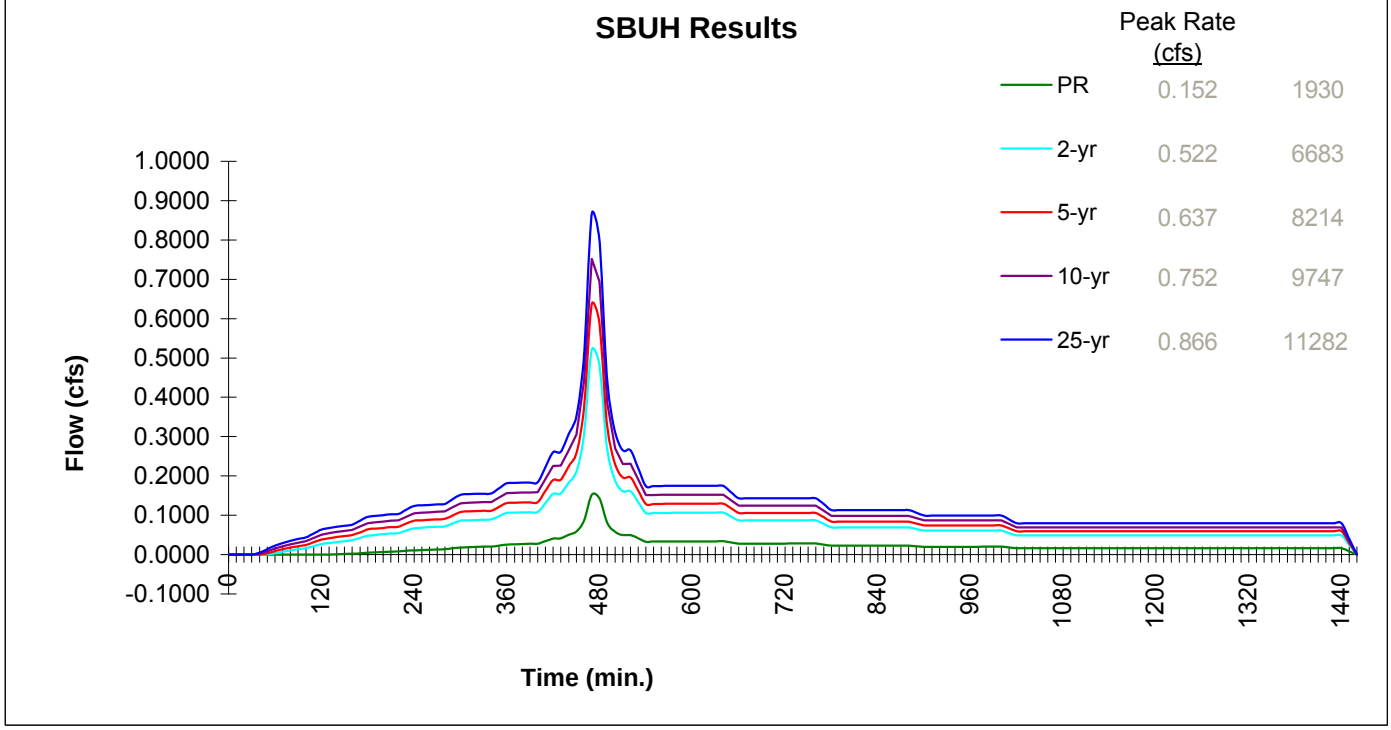
CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	0.50	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results



Printed: 1/3/2012 4:58 PM

Presumptive Approach Calculator ver. 1.2

Catchment ID: I

Run Time: 1/3/2012 4:58:06 PM

Project Name: LO Water Treatment Plant **Catchment ID:** I **Date:** 1/3/2012

Instructions:

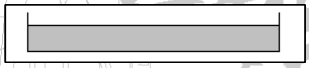
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: **1**

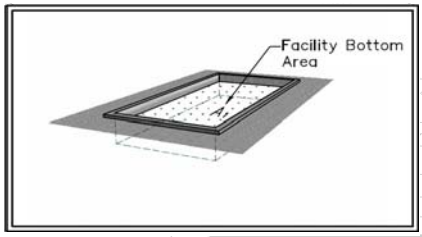
Goal Summary:

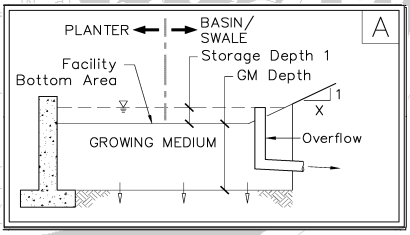
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…	
		Pollution Reduction as a	10-yr (aka disposal) as a
1	On-site infiltration with a surface infiltration facility.	PASS	PASS

Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square **Facility Configuration:** A





Calculation Guide
Max. Rock Stor. Bottom Area
5,500 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area =	5,500	sf
Bottom Width =	20.0	ft
Facility Side Slope =	0	to 1
Storage Depth 1 =	12	in
Growing Medium Depth =	18	in
Freeboard Depth =	N/A	in
Surface Capacity at Depth 1 =	5,500	cf
GM Design Infiltration Rate =	2.00	in/hr
Infiltration Capacity =	0.255	cfs

BELOW GRADE STORAGE

Rock Storage Bottom Area =	5,500	sf
Rock Storage Depth =	0	in
Rock Storage Capacity =	0	cf
Native Design Infiltration Rate =	0.50	in/hr
Infiltration Capacity =	0.064	cfs

Native Infiltration Rate Used in PA

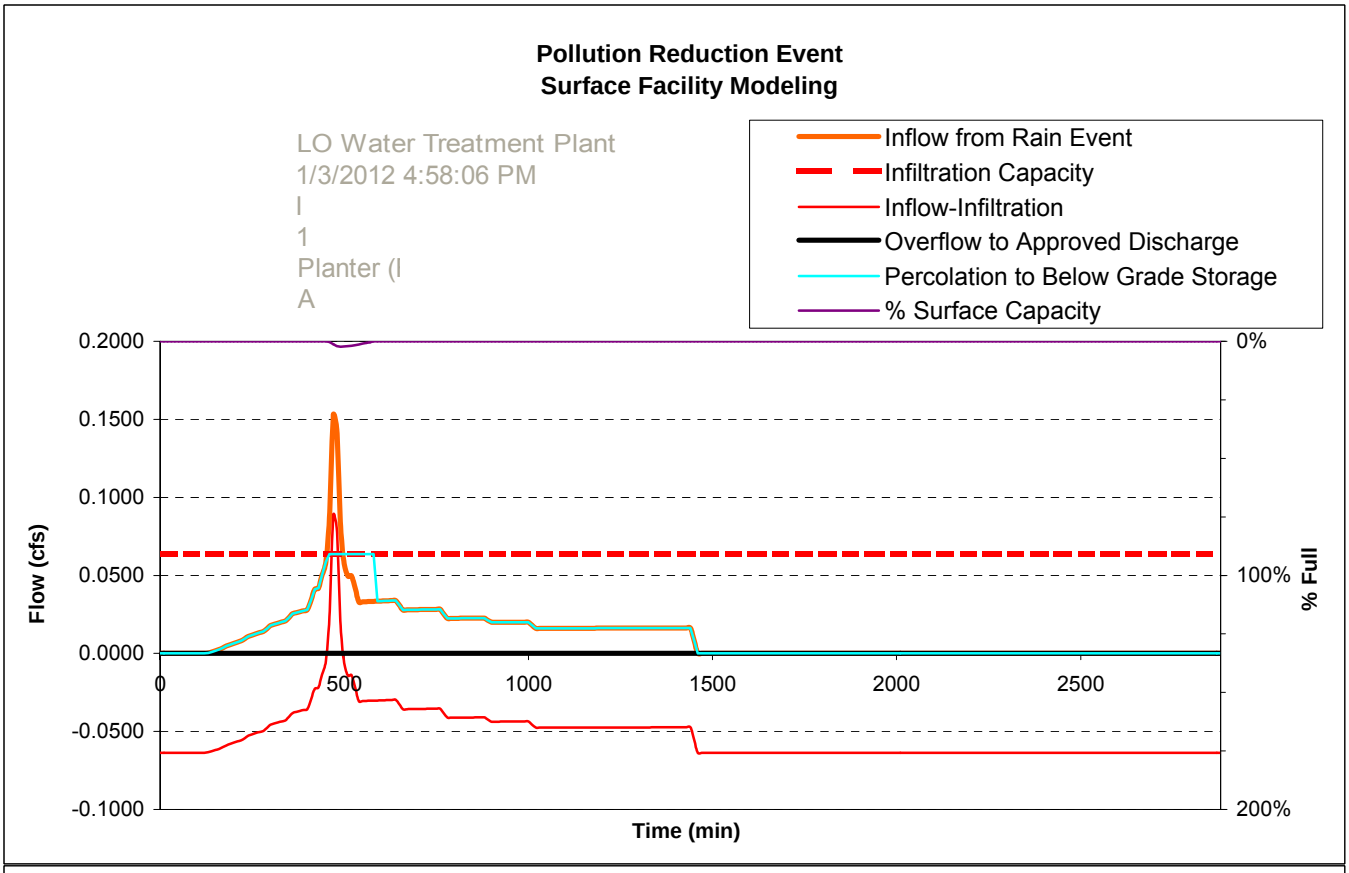
RESULTS

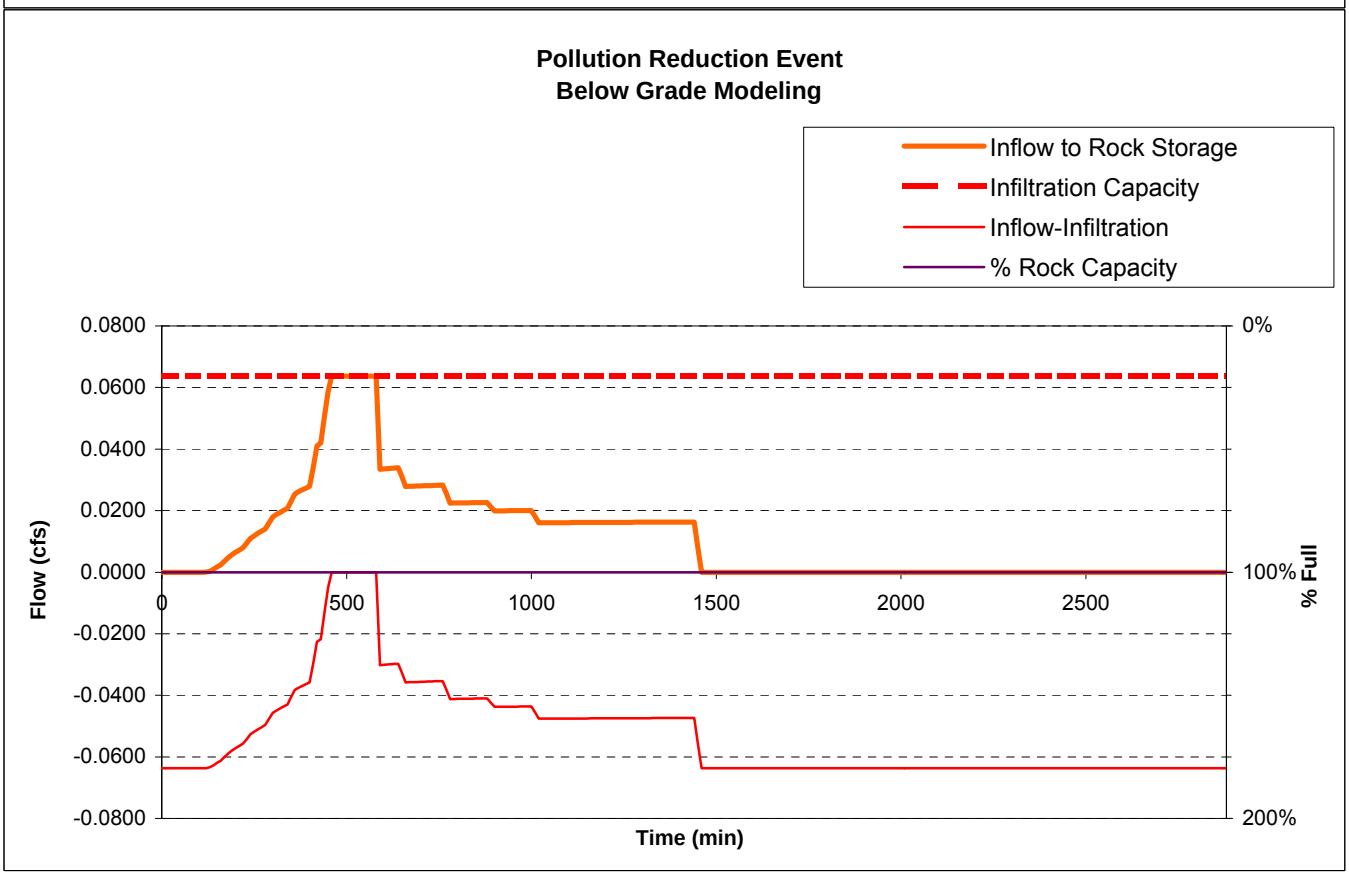
		Overflow Volume		
Pollution Reduction	PASS	0 CF	2%	Surf. Cap. Used
10-yr	PASS	0 CF	83%	Surf. Cap. Used

Run PAC

FACILITY FACTS

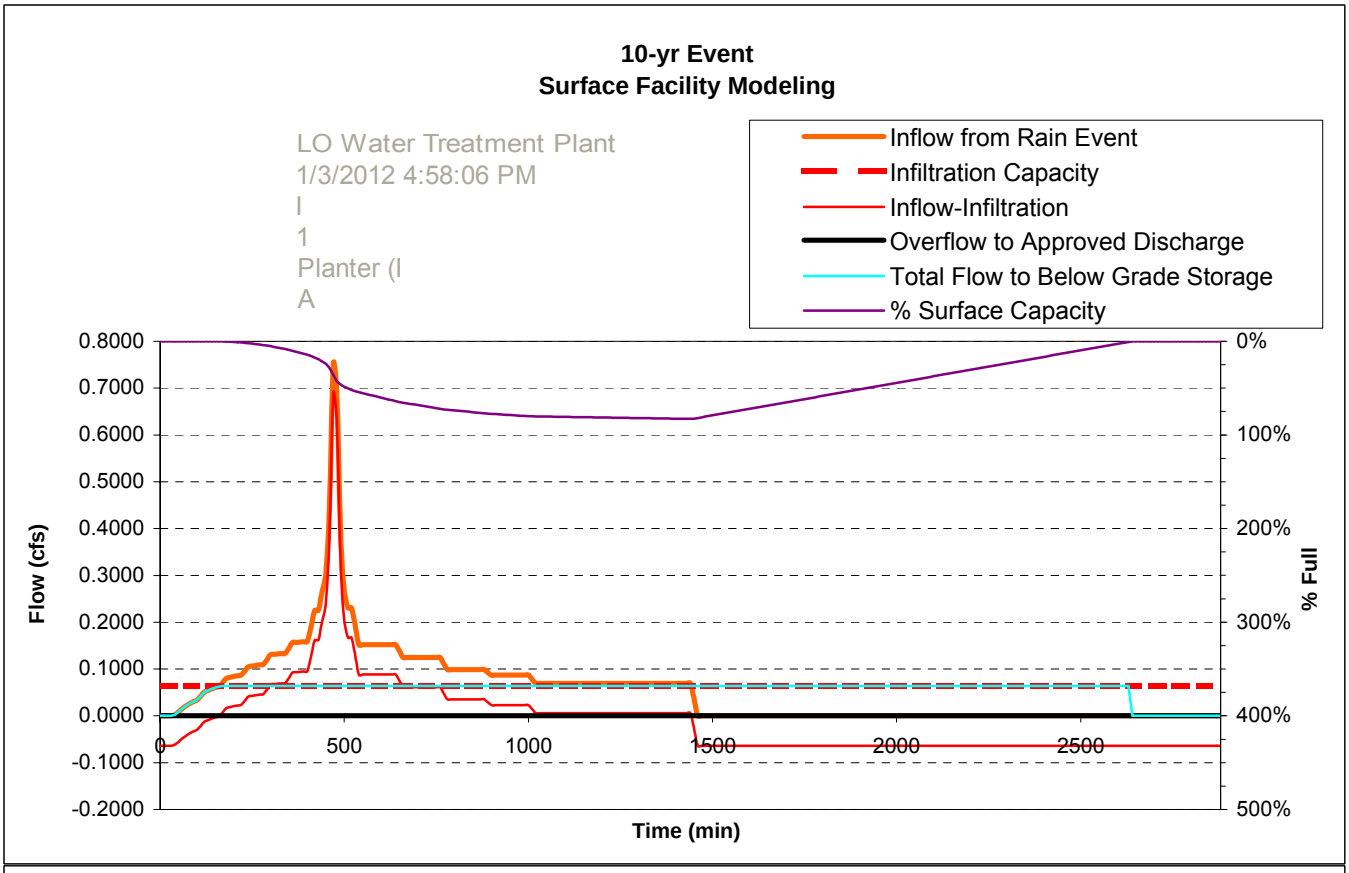
Total Facility Area Including Freeboard =	5,500 SF
Sizing Ratio (Total Facility Area / Catchment Area) =	0.149

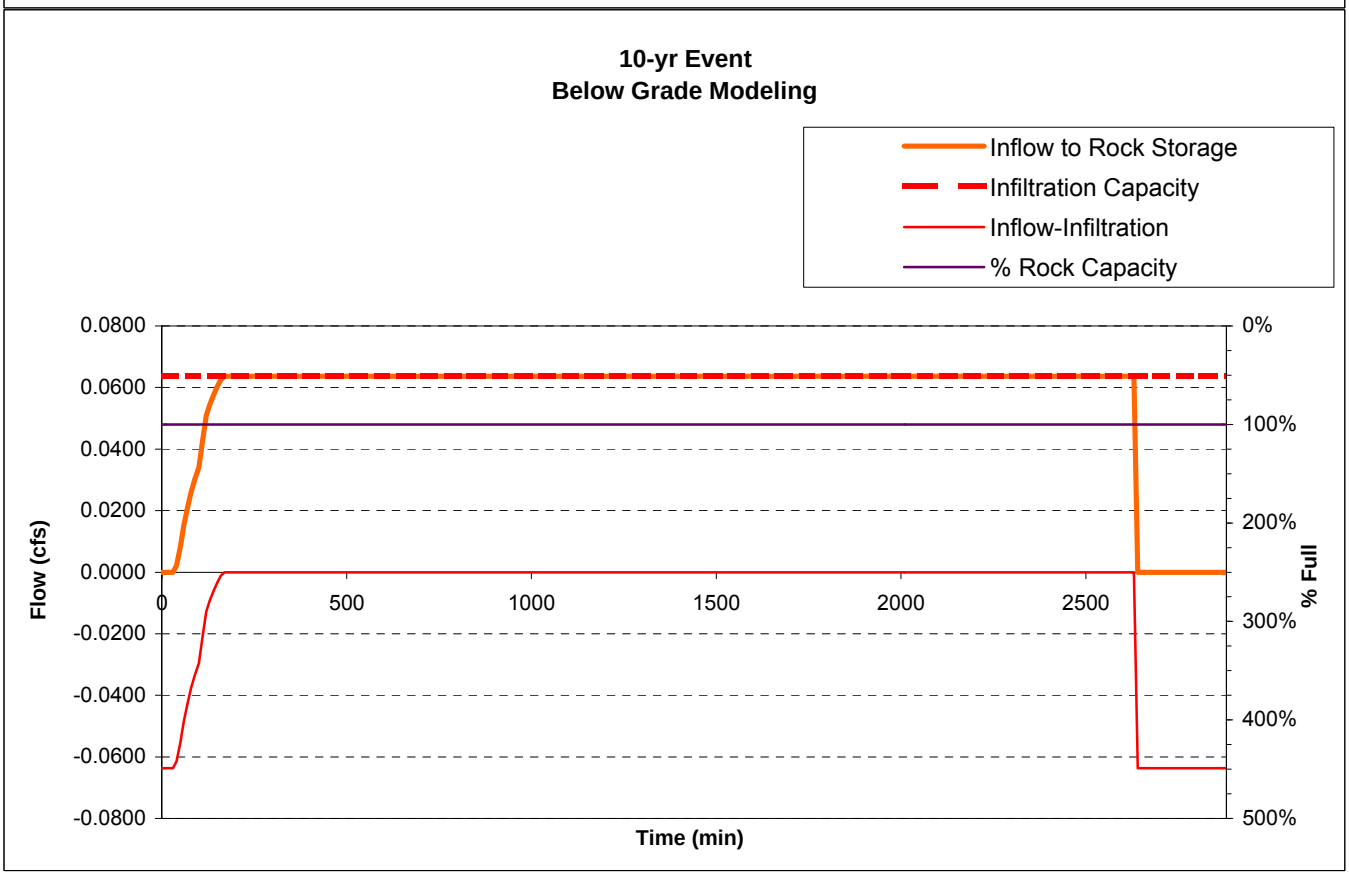

Pollution Reduction Event
Surface Facility Modeling
LO Water Treatment Plant
1/3/2012 4:58:06 PM
I
1
Planter (I
A
Inflow from Rain Event
Infiltration Capacity
Inflow-Infiltration
Overflow to Approved Discharge
Percolation to Below Grade Storage
% Surface Capacity
0.2000
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
Flow (cfs)
0
500
1000
1500
2000
2500
Time (min)
0%
100%
200%
% Full


Pollution Reduction Event
Below Grade Modeling
Inflow to Rock Storage
Infiltration Capacity
Inflow-Infiltration
% Rock Capacity
0.0800
0.0600
0.0400
0.0200
0.0000
-0.0200
-0.0400
-0.0600
-0.0800
Flow (cfs)
0
500
1000
1500
2000
2500
Time (min)
0%
100%
200%
% Full

BES - Presumptive Approach Calculator - Ver 1.2

10-yr Con-A&B





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Appendix C
NRCS Soil Map and Soils Descriptions

Map Scale: 1:1,120 if printed on B size (11" x 17") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:1,120 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 6, Feb 9, 2010

Date(s) aerial images were photographed: 8/3/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1B	Aloha silt loam, 3 to 6 percent slopes	1.3	14.6%
3	Amity silt loam	2.9	31.9%
91B	Woodburn silt loam, 3 to 8 percent slopes	4.8	53.5%
Totals for Area of Interest		**8.9**	**100.0%**

Clackamas County Area, Oregon

1B—Aloha silt loam, 3 to 6 percent slopes

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Aloha and similar soils: 85 percent
Minor components: 5 percent

Description of Aloha

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability (nonirrigated): 2w

Typical profile

0 to 8 inches: Silt loam
8 to 51 inches: Silt loam
51 to 80 inches: Silt loam

Minor Components

Huberly

Percent of map unit: 3 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Dayton

Percent of map unit: 2 percent

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Data Source Information

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 6, Feb 9, 2010

Clackamas County Area, Oregon

3—Amity silt loam

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Amity and similar soils: 85 percent
Minor components: 5 percent

Description of Amity

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability (nonirrigated): 2w

Typical profile

0 to 22 inches: Silt loam
22 to 62 inches: Silty clay loam

Minor Components

Dayton

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Data Source Information

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 6, Feb 9, 2010

Clackamas County Area, Oregon

91B—Woodburn silt loam, 3 to 8 percent slopes

Map Unit Setting

Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days

Map Unit Composition

Woodburn and similar soils: 90 percent
Minor components: 4 percent

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 2e

Typical profile

0 to 16 inches: Silt loam
16 to 38 inches: Silty clay loam
38 to 60 inches: Silt loam

Minor Components

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Aquolls

Percent of map unit: 1 percent

Landform: Flood plains

Dayton

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Data Source Information

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 6, Feb 9, 2010

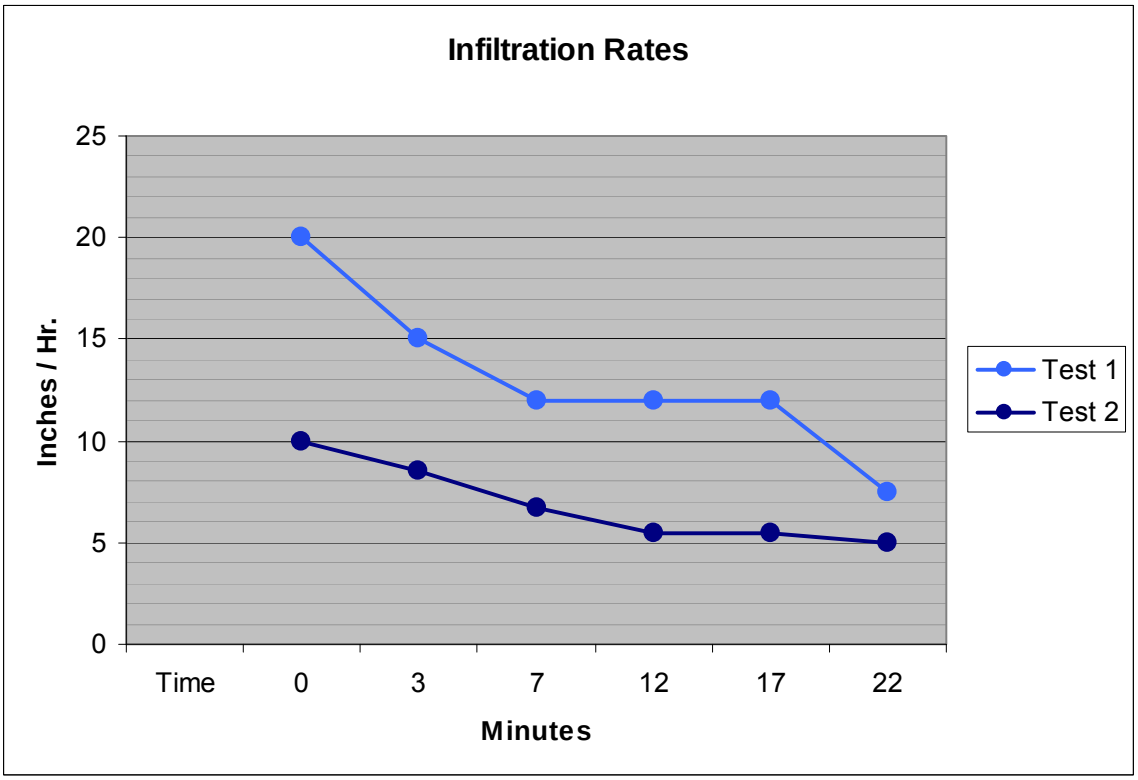
Appendix D
Infiltration Test Memo

Lake Oswego Water Treatment Plant Expansion
Stormwater Infiltration Test
October 19th, 2011

Summary

On October 19th, 2011, two infiltration tests were performed at the WTP site to determine approximate speed of water infiltration as it relates to the design of proposed vegetated swales and infiltration basins. Testing was done per the Simplified Approach Open Pit Infiltration Test guidelines described in the City of Portland Stormwater Management Manual, 2008, Appendix F.2. The tests were performed at the Northwest corner of the site, along Kenthorpe Way, where one of several infiltration basins being planned around the site is being proposed to collect and detain site runoff.

Test 1					Test 2			
Time	Time	Min	In / Hr	Depth	Time	Min	In / Hr	Depth
10:06	0	0		15	10:59			15
10:09	3	3	20	16	11:05	6	10	16
10:13	7	4	15	17	11:12	7	9	17
10:18	12	5	12	18	11:21	9	7	18
10:23	17	5	12	19	11:32	11	5	19
10:28	22	5	12	20	11:43	11	5	20
10:36	30	8	8	21	11:55	12	5	21



Testing Photos

Photo 1

Per the City of Portland Open Pit Infiltration Test Guidelines, a 2'x2'x2' pit was dug.

Photo 2

The pit was then filled with water to a depth of approximately 6", and allowed to drain, with the speed of infiltration measured and recorded.

After the initial volume was fully infiltrated, the pit was then filled to near capacity, and again allowed to drain with duration, drop in water height, and conversion into inches per hour being measured.

This process was repeated several times, allowing for full saturation of the surrounding soil profile, thus simulating the effect over time of a storm event on site soils and infiltration capabilities.

Appendix E
Portland Stormwater Management Manual, Aug. 2008

Exhibit 2-10: Henry V Swale. See **Appendix G.1 SW-120** for typical private property swale detail and **Appendix G.3 SW-300-302** for typical Green Street swale details.

Facility Description

Swales are typically long, narrow, gently sloping landscaped depressions that collect and convey stormwater runoff. They are planted with dense vegetation that treats stormwater from rooftops, parking lots, and streets. As the stormwater flows along the length of the swale, the vegetation and check dams slow the stormwater down, filter it, and allow it to infiltrate into the ground. Where soils do not drain well, swales can overflow to an approved discharge point such as a drywell or sump. Swales should be integrated into the overall site design and can be used to help fulfill landscape requirements.

Design Requirements

- **Soil suitability:** Existing infiltration rates will determine if the facility can be designed to achieve infiltration, partial infiltration, or allow the stormwater to flow through the facility. See **Appendix F.2** for infiltration testing procedures. For the Simplified Approach (**Section 2.2.1**), if the tested infiltration rate is greater than or equal to 2 inches per hour, the swale must overflow to a subsurface infiltration facility. If the tested infiltration rate is less than 2 inches per hour, the swale should be designed as a partial infiltration or flow-through facility, with an overflow to an approved discharge point. For the Presumptive Approach (**Section 2.2.2**), the existing infiltration rate also determines the type of

swale, but additional variables are factored in to determine the configuration of the facility.

- **Setbacks:** Infiltration swales must be set back 5 feet from property lines and 10 feet from building foundations. There are no setback requirements for lined flow-through swales.

- **Sizing:** For the Simplified Approach, a sizing factor of 0.09 is required. For the Performance Approach, surface area and depth of facility vary. The Presumptive Approach Calculator (PAC) allows the designer to size stormwater facilities with respect to native infiltration rates and other unique site conditions of the project. See **Appendix C.3** for the PAC and the PAC User's Manual.

- **Dimensions and slopes:** The minimum swale width is 5 feet on private property and 8 feet on streets. A 2-foot-wide flat bottom width is required where feasible. Swales designed with the Simplified Approach are 9 inches deep measured from the top of the growing medium to the overflow inlet elevation. Swales designed with the Presumptive Approach vary in depth from 6 to 12 inches. In all cases, maximum side slopes are 3 horizontal to 1 vertical and 4 horizontal to 1 vertical is required immediately adjacent to pedestrian areas. Maximum longitudinal slope is 6 percent. Freeboard for swales must be noted on the plans. Freeboard can be defined as the vertical distance between the design water surface elevation and overtopping elevation or the vertical distance between the top of the check dam and the outside berm or curb elevation (whichever is lower).

- **Check dams:** Check dams are required in swales to allow water to pool and infiltrate into the ground. They shall be constructed of durable, non-toxic materials such as rock, brick, concrete, or soil by integrating these materials into the grading of the swale. Check dams are as long as the width of the swale, perpendicular to flow line. They generally form a 12 inch wide bench on top and measure 4 to 10 inches high, depending on the depth of the facility. See **Appendix G.3 SW-340** for typical check dam details.

- **Gravel drain rock:** Drain rock may be required below the growing medium of a swale. For infiltration facilities, where drain rock is specified to retain stormwater prior to infiltration, the specification is 1½-inch – ¾-inch washed drain rock. Where drain rock is specified primarily for detention and conveyance, the specification is ¾-inch washed drain rock. For all flow-through facilities, ¾-inch wash drain rock shall be used. Drain rock and growing medium must be separated by filter fabric (see **Exhibit 2-3** for geotextile specifications), or a 2- to 3-inch layer of ¾ - ¼-inch washed, crushed rock must be used.

- **Piping:** For private property, piping shall be cast iron, ABS SCH40, or PVC SCH40. Three-inch pipe is required for facilities that drain up to 1,500 square feet of impervious area; otherwise, a 4-inch pipe minimum is required. Piping installation must follow current Uniform Plumbing Code. For streets, 6-inch or 8-inch ASTM 3034 SDR 35 PVC pipe and perforated pipe are required. Refer to the City's *Sewer and Drainage Facilities Design Manual* for more information.

- **Growing medium:** For swales designed with the Simplified Approach or swales on private property, the imported soil shall be a sandy loam mixed with compost or a sand/soil/compost blend. It shall be roughly one-third compost by volume, free-draining, and support plant growth. The compost shall be derived from plant material; animal waste is not allowed. For streets, the growing medium is specified in **Appendix F.3**. In all cases, the growing medium shall be 18 inches deep.

- **Vegetation:** The entire facility area must be planted with vegetation. The facility area is equivalent to the total area of the swale, including bottom and side slopes, as developed in the sizing calculations.

  Swales should be designed so they do not require mowing.

  See **Appendix F.4** for suggested plant material appropriate for private property and the public right-of-way. See **Appendix G.4** for typical details and planting templates. Minimum container size is 1 gallon. Minimum quantities are shown on **Exhibits 2-11 through 2-14**.

  Private Property

Exhibit 2-11: Private Swale Vegetation - ZONE A

Number of plants	Vegetation type	Per square feet	Size	Spacing density (on center)
115	**Herbaceous plants**	100	1 gallon	1‘
		OR		
100	**Herbaceous plants**	100	1 gallon	1‘
4	**Small shrubs**	100	1 gallon	3’

Exhibit 2-12: Private Swale Vegetation - ZONE B

Number of plants	Vegetation type	Per square feet	Size	Spacing density (on center)
1	**Evergreen tree**	200	Min height 6'	-
	OR			
1	**Deciduous tree**	200	Min caliper 1½" at 6" above base	-
	AND			
3	**Large shrubs**	100	3 gallon or equivalent	4'
4	**Medium to small shrubs**	100	1 gallon or equivalent	2'
70	**Groundcover**	100	1 gallon or equivalent	1'

Streets

Plantings adjacent to streets require special attention to line-of-sight and maintenance issues.

Exhibit 2-13: Street Swales - ZONE A

Number of plants	Vegetation type	Per square feet	Size	Spacing density (on center)
115	**Herbaceous plants**	100	1 gallon	1'
	OR			
100	**Herbaceous plants**	100	1 gallon	1'
4	**Small shrubs**	100	1 gallon	2'

Exhibit 2-14: Street Swales - ZONE B

Number of plants	Vegetation type	Per square feet	Spacing density (on center)	Size
12	**Small shrubs**	100	2'	1 gallon or equivalent
70	**Groundcover**	100	1'	1 gallon or equivalent

Mulch: Fine to medium hemlock bark or well-aged organic yard debris compost is recommended for swales. It should be placed in the facility only in areas above the high-water line. Care should be given to keeping mulch material out of a stormwater flow path to avoid any material from clogging inlets or outlets or otherwise escaping the facility. It must be weed free and applied 2 to 3 inches thick to cover all soil between plants. It should not be over-applied.

Construction Considerations

Infiltration swales areas should be clearly marked before site work begins to avoid soil disturbance or sedimentation during construction. No vehicular traffic, except that specifically used to construct the facility, should be allowed within 10 feet of infiltration swale areas.

Curb Extensions

Curb extensions are very similar to swales and are often used to retrofit existing developed roadway. They protrude into the roadway by removing a portion of the existing pavement and roadbed. A curb is constructed closer to the centerline of the roadway in order to install the facility. A stormwater curb extension may also be constructed with new roadway development. Existing sidewalks, plantings strips, and curbs may or may not be modified. Plantings are surrounded on all sides by curbing between the existing curb and a new curb. If total infiltration cannot be achieved, an approved conveyance and discharge method per **Section 1.3.1** is required.

Exhibit 2-15: North East Siskiyou Street Curb Extension. See **Appendix G.3** **SW-320** through **SW-324** for typical curb extension details.

Exhibit 2-16: Epler Hall Planter. See **Appendix G.1 SW-130** for typical private property planter detail and **Appendix G.3 SW-310** through **SW-313** for typical Green Street planter details.

Facility Description

Planters are structural landscaped reservoirs used to collect, filter, and infiltrate stormwater, allowing pollutants to settle and filter out as the water percolates through the vegetation, growing medium, and gravel. Depending on site conditions, planters can be designed to completely or partially infiltrate the stormwater they receive. They can also be designed as lined, flow-through facilities where stormwater is temporarily stored. Excess stormwater collects in a perforated pipe at the bottom of the flow-through planter and drains to an approved discharge point. Planters can be used to help fulfill a site's required landscaping area requirement and should be integrated into the overall site design. Numerous design variations of shape, wall treatment, and planting scheme can be used to fit the character of a site. Because flow-through planters can be constructed immediately next to buildings, they are ideal for sites with setback requirements, poorly draining soils, steep slopes, or other constraints.

Design Requirements

- **Soil suitability**: Existing infiltration rates will determine if the facility can be designed to achieve infiltration, partial infiltration, or allow the stormwater to flow through the facility. See **Appendix F.2** for infiltration testing procedures. For the Simplified Approach (**Section 2.2.1**), if the tested infiltration rate is greater than or equal to 2 inches per hour, the planter must overflow to a subsurface infiltration facility. If the tested infiltration rate is less than 2 inches

per hour, the planter should be designed as a partial infiltration or flow-through facility, with an overflow to an approved discharge point. For the Presumptive Approach (**Section 2.2.2**), the existing infiltration rate also determines the type of planter, but additional variables are factored in to determine the configuration of the facility.

- **Setbacks:** Infiltration planters require 5-foot setbacks from property lines and 10-foot setbacks from building foundations. No setbacks are required for lined flow-through planters where the height above finished grade is 30 inches or less. Lined flow-through planters can be used next to foundation walls, adjacent to property lines, or on slopes when they include a waterproof lining.

- **Sizing:** For the Simplified Approach, a sizing factor of 0.06 is required. For the Performance Approach, surface area and depth of facility vary. The Presumptive Approach Calculator (PAC) allows the designer to size the planter with respect to native infiltration rates and other unique site conditions of the project. See **Appendix C.3** for the PAC and the PAC User's Manual.

- **Dimensions and slopes:** The minimum infiltration planter width is 30 inches, and the minimum flow-through planter width is 18 inches (measured from inside the planter walls). Facility storage depth must be at least 12 inches (from inlet elevation of overflow to top of growing medium), unless a larger-than-required planter area is specified. Planters are flat facilities that shall not slope more than 0.5 percent in any direction. A minimum of 2 inches of freeboard (vertical distance between the design water surface elevation and overtopping elevation) shall be provided.

- **Planter walls:** Planter walls shall be made of stone, concrete, brick, or other durable material. Chemically treated wood that can leach out toxic chemicals and contaminate stormwater shall not be used.

- **Waterproof liners:** Flow-through facilities require a waterproof liner. There are many liner options, and installation varies. Liner shall be 30 mil PVC or equivalent.

- **Gravel drain rock:** Drain rock may be required below the growing medium of a planter. For infiltration facilities, where drain rock is specified to retain stormwater prior to infiltration, the specification is 1½ – ¾-inch washed drain rock. Where drain rock is specified primarily for detention and conveyance, the specification is ¾-inch washed drain rock. For all flow-through facilities, ¾-inch wash drain rock shall be used. Drain rock and growing medium must be separated by filter fabric (see **Exhibit 2-3** for geotextile specifications) or use a 2- to 3-inch layer of ¾ - ¼-inch washed, crushed rock.

- **Piping:** For private property, piping shall be cast iron, ABS SCH40, or PVC SCH40. Three-inch pipe is required for facilities draining up to 1,500 square feet of impervious area; otherwise, a 4-inch pipe minimum is required. Piping installation must follow current Uniform Plumbing Code. For streets, 6-inch or 8-inch ASTM 3034 SDR 35 PVC pipe and perforated pipe are required. Refer to the City's *Sewer and Drainage Facilities Design Manual* for more information.

- **Growing medium:** For planters designed with the Simplified Approach or planters on private property, the imported soil shall be a sandy loam mixed with compost or a sand/soil/compost blend. It shall be roughly one-third compost by volume, free-draining, and support plant growth. The compost shall be derived from plant material; animal waste is not allowed. For streets, the growing medium is specified in **Appendix F.3**. In all cases, the growing medium shall be 18 inches deep.

- **Vegetation:** The entire facility area must be planted with vegetation. The facility area is equivalent to the total area of the planter, as developed in the sizing calculations. The entire surface area of a planter is inundated with water and therefore requires only Zone A plants. See **Appendix F.4** for suggested plant material appropriate for private property and the public right-of-way. See **Appendix G.4** for typical details and planting templates. Minimum container size is 1 gallon. Minimum quantities are shown on **Exhibit 2-17**.

  Private and Public Property

  Exhibit 2-17: Planter Vegetation - ZONE A

Number of plants	Vegetation type	Per square feet	Size	Spacing density (on center)
115	**Herbaceous plants**	100	1 gallon	1'
		OR		
100	**Herbaceous plants**	100	1 gallon	1'
4	**Small shrubs**	100	1 gallon	2'

  Note: Tree planting is not required in planters, but is encouraged where practical. Tree planting is also encouraged near planters.

- **Mulch:** Washed pea gravel or river rock is recommended for planters. It should be applied 2 to 3 inches thick to cover all soil between plants. It should not be over-applied.

Construction Considerations

Special attention should be paid to the structural waterproofing if the planter is constructed adjacent to building structures. Infiltration planter areas should be clearly marked before site work begins to avoid soil disturbance during construction. No vehicular traffic, except that specifically used to construct the facility, should be allowed within 10 feet of infiltration planter areas.

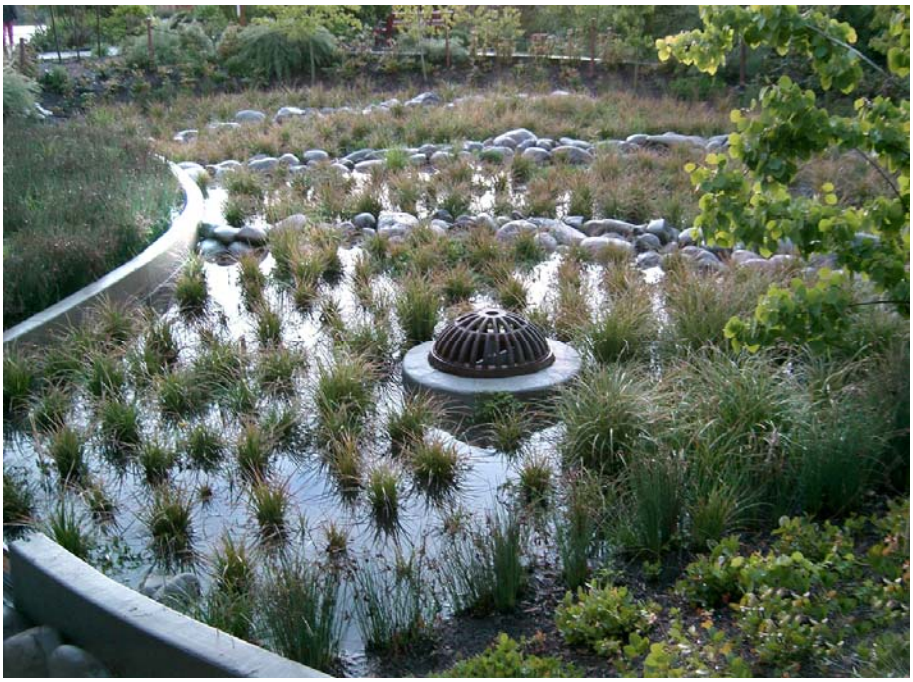


Exhibit 2-18: Glencoe School Infiltration Basin. See **Appendix G.1 SW-140** for typical basin details.

Facility Description

Vegetated infiltration basins are flat-bottomed, shallow landscaped depressions used to collect and hold stormwater runoff, allowing pollutants to settle and filter out as the water infiltrates into the ground. They are either excavated or created with bermed side slopes. An inlet pipe or sheet flow over impervious area conveys the stormwater into the basin, where it is temporarily stored until it infiltrates into the ground. Basins often provide complete onsite infiltration for small storm events. They can be sized to infiltrate large storms in areas where soils drain well or overflow to an approved discharge point. Basins can have a formal or informal design that can be used to help fulfill a site's landscape requirements.

Design Requirements

- **Site suitability:** Existing infiltration rates will determine if the facility can be designed to achieve infiltration, partial infiltration, or allow the stormwater to flow through the facility. See **Appendix F.2** for infiltration testing procedures. For the Simplified Approach (**Section 2.2.1**), if the tested infiltration rate is greater than or equal to 2 inches per hour, the basin must overflow to a subsurface infiltration facility. If the tested infiltration rate is less than 2 inches per hour, the basin should be designed as a partial infiltration or flow-through

facility, with an overflow to an approved discharge point. For the Presumptive Approach (**Section 2.2.2**), the existing infiltration rate also determines the type of basin, but additional variables are factored in to determine the configuration of the facility.

- **Setbacks:** The required setback is 5 feet from property lines and 10 feet from building foundations. Infiltration basins shall meet the following setback requirements from downstream slopes: minimum of 100 feet from slopes of 10 percent; add 5 feet of setback for each additional percent of slope up to 30 percent; infiltration basins shall not be used where slopes exceed 30 percent. There are no setback requirements for lined, flow-through basins.

- **Sizing:** For the Simplified Approach, a sizing factor of 0.09 is required. The maximum designed ponding time shall be a function of the facility storage depth. For the Presumptive Approach, surface area and depth of facility vary. The Presumptive Approach Calculator (PAC) allows the designer to size stormwater facilities with respect to native infiltration rates and other unique site conditions of the project. See **Appendix C.3** for the PAC and the PAC User's Manual.

- **Dimensions and slopes:** For basins designed with the Simplified Approach, the facility storage depth is 12 inches from the top of the growing medium to the overflow inlet elevation. For basins designed with the Presumptive Approach, the facility storage depth may vary from 9 to 18 inches. Maximum side slopes are 3 horizontal to 1 vertical. Minimum bottom width is 2 feet. A minimum of 2 inches of freeboard (vertical distance between the design water surface elevation and overtopping elevation) shall be provided.

- **Gravel drain rock**: Drain rock may be required below the growing medium of a basin. For infiltration facilities, where drain rock is specified to retain stormwater prior to infiltration, the specification is 1½-inch – ¾-inch washed drain rock. Where drain rock is specified primarily for detention and conveyance, the specification is ¾-inch washed drain rock. For all flow-through facilities, ¾-inch wash drain rock shall be used. Drain rock and growing medium must be separated by filter fabric (see **Exhibit 2-3** for geotextile specifications) or use a 2-to 3-inch layer of ¾ - ¼-inch washed, crushed rock.
- **Piping:** For private property, piping shall be cast iron, ABS SCH40, or PVC SCH40. Three-inch pipe is required for facilities draining up to 1,500 square feet of impervious area; otherwise, a 4-inch pipe minimum is required. Piping installation must follow current Uniform Plumbing Code. For streets, 6-inch or 8-inch ASTM 3034 SDR 35 PVC pipe and perforated pipe are required. Refer to the City's *Sewer and Drainage Facilities Design Manual* for more information.

- **Growing medium:** For basins designed with the Simplified Approach or planters on private property, the imported soil shall be a sandy loam mixed with compost or a sand/soil/compost blend. It shall be roughly one-third compost by volume, free-draining, and support plant growth. The compost shall be derived from plant material; animal waste is not allowed. For streets, the growing medium is specified in **Appendix F.3**. In all cases, the growing medium shall be 18 inches deep.

- **Vegetation:** The entire facility area must be planted with vegetation. The facility area is equivalent to the total area of the basin, including bottom and side slopes, as developed in the sizing calculations, plus a 10-foot buffer around the basin. See **Appendix F.4** for suggested plant material appropriate for private property and the public right-of-way. See **Appendix G.4** for typical details and planting templates. Minimum container size is 1 gallon. Minimum quantities are shown on **Exhibits 2-19 and 2-20**.

Exhibit 2-19: Basin Vegetation - ZONE A

Number of plants	Vegetation type	Per square feet	Size	Spacing density (on center)
115	**Herbaceous plants**	100	1 gallon	1’
		OR		
100	**Herbaceous plants**	100	1 gallon	1’
4	**Small shrubs**	100	1 gallon	3’
		OR		
100%	**Seed coverage**			

Exhibit 2-20: Basin Vegetation - ZONE B

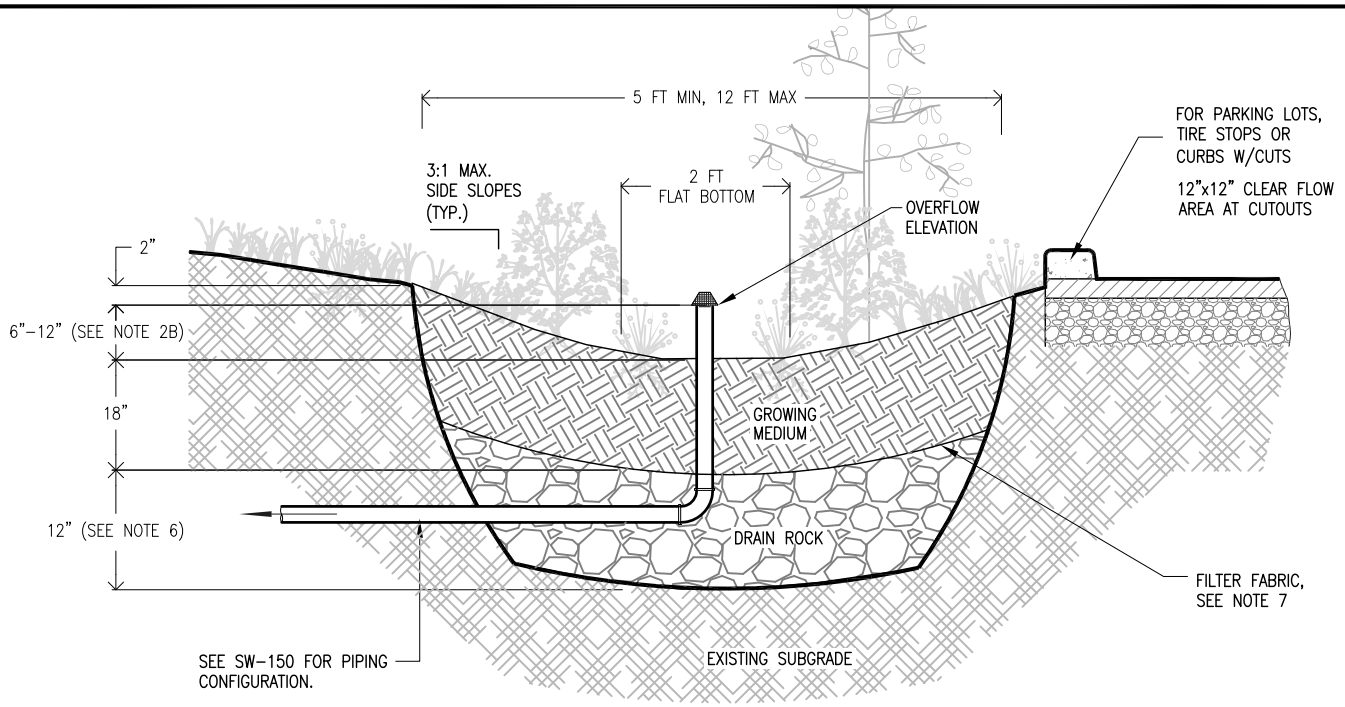
Number of plants	Vegetation type	Per square feet	Size	Spacing density (on center)
1	**Evergreen tree**	300	Min height 6’	-
		OR		
1	**Deciduous tree**	300	Min caliper 1 ½” at 6” above base	-
		AND		
4	**Large shrubs**	100	3 gallon or equivalent	4’
6	**Medium to small shrubs**	100	1 gallon or equivalent	2’
70	**Groundcover**	100	1 gallon or equivalent	1’

Wildflowers, native grasses, and ground covers shall be selected and designed to not require mowing. Turf and lawn areas are not allowed for BES-maintained facilities; any exceptions will require BES approval.

- **Mulch:** Fine to medium hemlock bark or well-aged organic yard debris compost is recommended for basins. It should be placed in the facility only in areas above the high-water line. Care should be given to keeping mulch material out of a stormwater flow path to avoid any material from clogging inlets or outlets or otherwise escaping the facility. It must be weed free and applied 2 to 3 inches thick to cover all soil between plants. It should not be over-applied.

Construction Considerations

Infiltration basin areas should be clearly marked before site work begins to avoid soil disturbance or sedimentation during construction. No vehicular traffic, except that specifically used to construct the facility, should be allowed within 10 feet of infiltration basin areas.



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of swale: 5' - 12'.
   b. Depth of swale ((from top of growing medium to overflow elevation); Simplified: 9", Presumptive: 6"-12".
   c. Longitudinal slope of swale: 6.0% or less.
   d. Flat bottom width: 2'.
   e. Side slopes of swale: 3:1 maximum.

3. Setbacks (from centerline of facility):
   a. Infiltration swales must be 10' from foundations and 5' from property lines.
   b. Flow-through swales must be lined with connection to approved discharge point according to SWMM Section 1.3.

4. Overflow:
   a. Overflow required for Simplified Approach
   b. Inlet elevation must allow for 2" of freeboard, minimum.
   c. Protect from debris and sediment with strainer or grate.

5. Piping: shall be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size for infiltration swale: 1½" - ¾" washed
   b. Size for flow-through swale: ¾" washed
   c. Depth for Simplified: 12"
   d. Depth for Presumptive: 0-48", see calcs.

7. Separation between drain rock and growing medium: Use filter fabric (see SWMM Exhibit 2-4 Geotextile table) or a gravel lens (¾ - ¼ inch washed, crushed rock 2 to 3 inches deep).

8. Growing medium:
   a. 18" minimum
   b. See Appendix F.3 for specification or use sand/loam/compost 3-way mix.

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area:
   a. Zone A (wet): 115 herbaceous plants OR 100 herbaceous plants and 4 small shrubs.
   b. Zone B (moderate to dry): 1 tree AND 3 large shrubs / small trees AND 4 small shrubs AND 140 groundcover plants.

   The delineation between Zone A and B shall be either at the outlet elevation or the check dam elevation, whichever is lowest.

10. Waterproof liner: Shall be 30 mil PVC or equivalent for flow-through facilities.

11. Install washed pea gravel or river rock to transition from inlets and splash pad to growing medium.

12. Check dams: Shall be placed according to facility design. Refer to SW-340 for profile and spacing.

13. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, for appropriate inspections.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

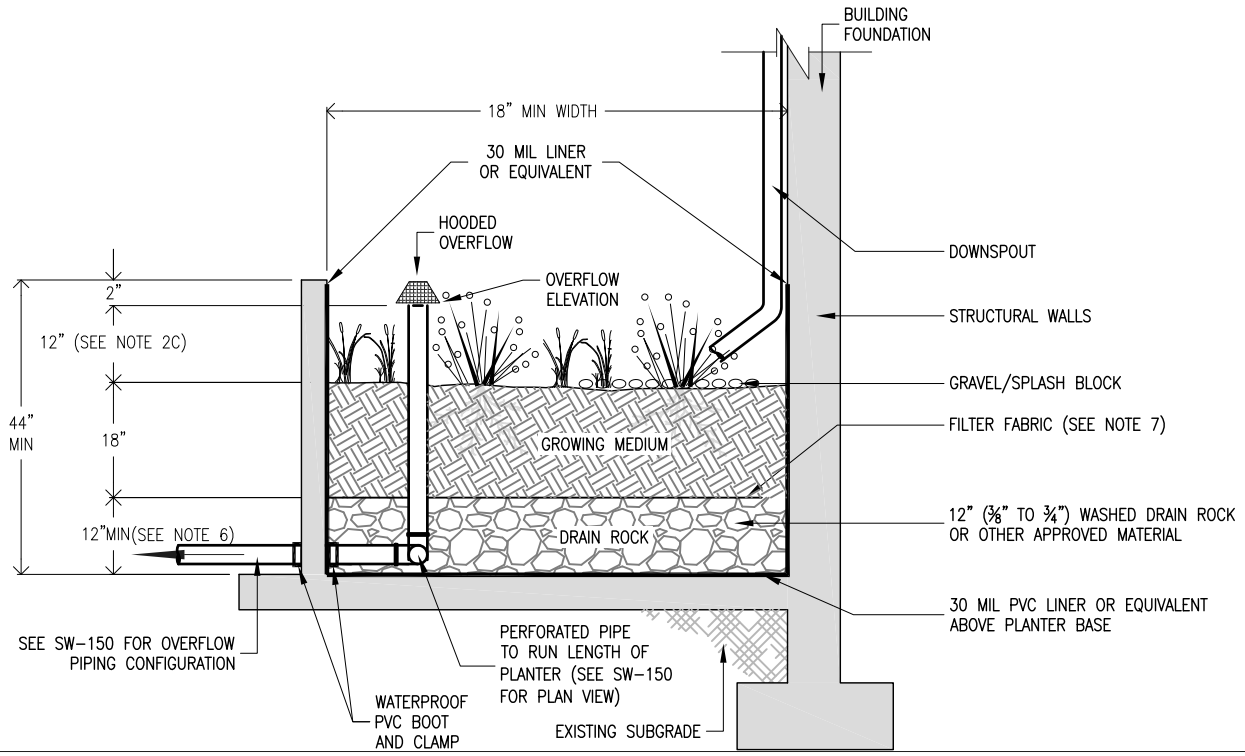
- Simplified / Presumptive Design Approach -

Swale

NUMBER

SW-120

Bureau of Environmental Services



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of flow-through planter: 18" minimum.
   b. Width of infiltration planter: 30" minimum.
   c. Depth of planter (from top of growing medium to overflow elevation). Simplified: 12"; Presumptive: 6"- 18".
   d. Slope of planter: 0.5% or less.

3. Setbacks (from centerline of facility):
   a. Infiltration planters must be 10' from foundations and 5' from property lines.
   b. Flow-through planters must be less than 30" in height above surrounding area if within 5 feet of property line.

4. Overflow:
   a. Overflow required for Simplified Approach.
   b. Inlet elevation must allow for 2" of freeboard, minimum.
   c. Protect from debris and sediment with strainer or grate.

5. Piping: shall be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size for infiltration planter: 1½" - ¾" washed
   b. Size for flow-through planter: ¾" washed
   c. Depth for Simplified: 12"
   d. Depth for Presumptive: 0-48", see calcs.

7. Separation between drain rock and growing medium: Use filter fabric (see SWMM Exhibit 2-4 Geotextile table) or a gravel lens (¾ - ¼ inch washed, crushed rock 2 to 3 inches deep).

8. Growing medium:
   a. 18" minimum
   b. See Appendix F.3 for specification or use sand/loam/compost 3-way mix.

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area:
   a. Zone A (wet) 115 herbaceous plants, OR
   b. Zone A (wet) 100 herbaceous plants and 4 small shrubs.

10. Planter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Concrete, brick, or stone walls shall be included on foundation plans.

11. Waterproof liner: Shall be 30 mil PVC or equivalent, for flow-through facilities.

12. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

13. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, for appropriate inspections.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

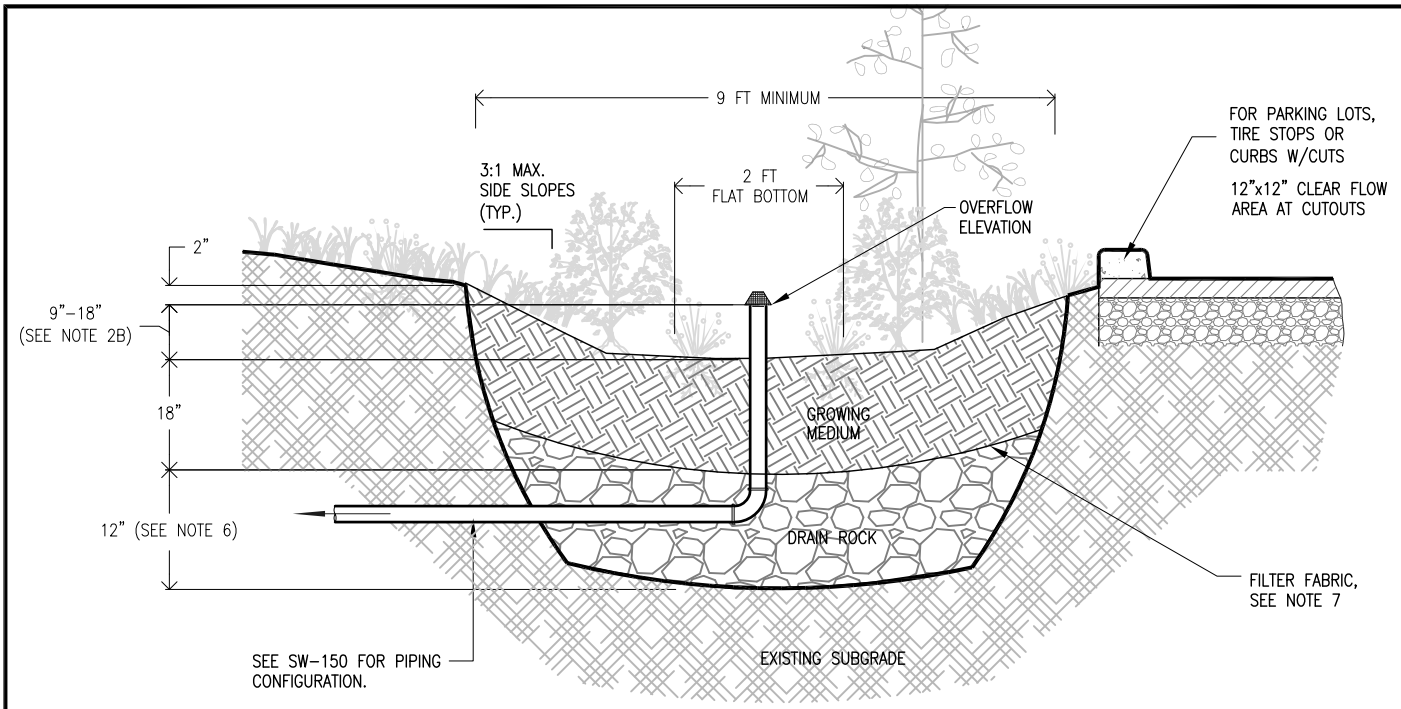
- Simplified / Presumptive Design Approach -

Planter

NUMBER

SW-130

Bureau of Environmental Services



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of basin: 9' minimum.
   b. Depth of basin (from top of growing medium to overflow elevation); Simplified: 12", Presumptive: 9"-18".
   c. Flat bottom width: 2' min.
   d. Side slopes of basin: 3:1 maximum.

3. Setbacks (from midpoint of facility):
   a. Infiltration basins must be 10' from foundations and 5' from property lines.
   b. Flow-through swales must be lined with connection to approved discharge point according to SWMM Section 1.3.

4. Overflow:
   a. Overflow required for Simplified Approach.
   b. Inlet elevation must allow for 2" of freeboard, minimum.
   c. Protect from debris and sediment with strainer or grate.

5. Piping: shall be ABS Sch.40, cast iron, or PVC Sch.40. 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size for infiltration basin: 1½" - ¾" washed
   b. Size for flow-through basin: ¾" washed
   c. Depth for Simplified: 12"
   d. Depth for Presumptive: 0-48", see calcs.

7. Separation between drain rock and growing medium: Use filter fabric (see SWMM Exhibit 2-5) or a gravel lens (¾ - ¼ inch washed, crushed rock 2 to 3 inches deep).

8. Growing medium:
   a. 18" minimum
   b. See Appendix F.3 for specification or use sand/loam/compost 3-way mix.

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area):
   a. Zone A (wet): 115 herbaceous plants OR 100 herbaceous plants and 4 shrubs
   b. Zone B (moderate to dry): 1 tree AND 3 large shrubs AND 4 medium to small shrubs.

   The delineation between Zone A and B shall be either at the outlet elevation or the check dam elevation, whichever is lowest.

10. Install washed pea gravel or river rock to transition from inlets and splash pad to growing medium.

11. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, for appropriate inspections.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- Simplified / Presumptive Design Approach -

Basin

Bureau of Environmental Services

NUMBER

SW-140