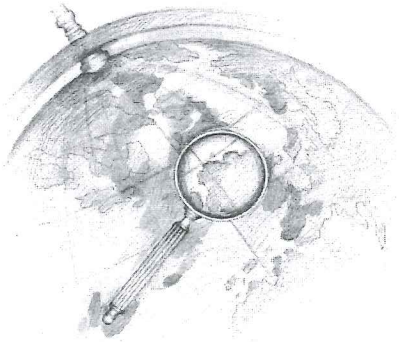
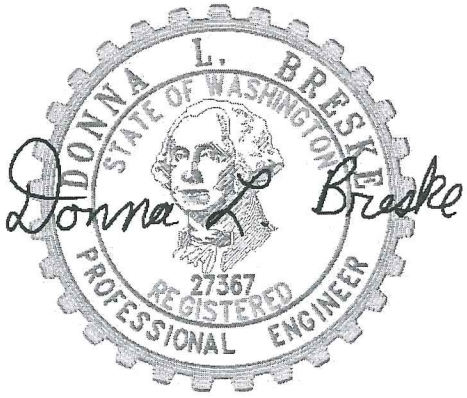


RECEIVED
JUL 23 2015
CITY OF MILL CREEK

Preliminary Drainage Report for Raj Gill 3-Lot Short Plat

Date Prepared: July 29, 2014

Site Address: 2726 132nd Street, Mill Creek, WA 98012



7-29-14

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CITY OF MILL CREEK
ZONING CASE
No. PL 2015-0022
DATE 7-23-15
BY

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Preliminary Drainage Report – Raj Gill 3-Lot Short Plat
2726 132nd ST SE, Mill Creek, WA 98012
July 18, 2014

EXECUTIVE SUMMARY:

A 3-lot Short Plat is proposed for a 0.89 acre parcel of land located in the City of Mill Creek. A 1-story dilapidated wood house has been recently removed from the site. The site is relatively flat with a very mild slope downward toward the northwest corner. It is peppered with mostly alder trees, a few fir trees, some poplar, maple, and fruit trees. The majority of trees are proposed to be removed with the exception of a few trees that may remain in the required 50-foot native vegetative buffer which is to be located adjacent to the north property line.

The north property line backs-up to the 132nd Street SE right-of-way. It is adjacent to this right-of-way that the City of Mill Creek code requires a 50-foot vegetative buffer is established.

The current access is via a drop curb driveway from 132nd. For the developed project, access will no longer be from 132nd, but instead a panhandle connecting the property to 27th Dr. SE will be paved with an access road and used for ingress and egress to the proposed 3-lots.

This proposed design utilizes Low Impact Development, (LID), for storm water management. The proposed LID techniques include rain gardens, vegetated flow paths for downspout dispersion, and vegetated sheet flow path for driveway dispersion. The design relies upon proper finish grading of the site once the houses are built to ensure the correct sloping of the ground in order to direct storm water flows along the required flow paths.

Test pits were dug and filled with water to determine the infiltration rate used for the rain garden designs. Overflow pipes are designed for the two larger rain gardens and connect to an existing catch basin located in 132nd Street.

Per the Mill Creek Municipal Code Section 15.14.060 and Stormwater Management Manual for Western Washington, Minimum requirements #1-10 are triggered for this development and are addressed within this report.

A Stormwater Pollution Prevention Plan (SWPPP) narrative is also included in this report. A few of the methods utilized include straw wattles, inlet protection, plastic covering, as well as temporary and permanent seeding.

Vicinity Map

2726 132nd ST SE, Mill Creek, WA, 98012

VICINITY MAP

N. T. S.

Washington State Department of Ecology's Minimum Requirements MCMC 15.14.060

Minimum Requirement #1: Stormwater Site Planning Process, Steps 1-10

Step 1: Collect and Analyze Information on Existing Conditions.

- This Engineer, Donna L. Breske P.E., visited the site July 14th 2014 to conduct the infiltration tests. Also, a brief site visit took place 6-8 weeks prior when clearing of significant debris and trash left on site by the previous owner was ongoing.
    a. The aerial view of the site in Google Earth was congruent to the site visit.
    b. No wet areas were present on the site.
    c. An existing catch basin is located north of the site within the 132nd ST SE right-of- way. This catch basin is shown on the topography and boundary survey provided by ALL Land Surveying.
    d. No channelization was observed during the site visit.
    e. An infiltration test was performed onsite. The infiltration results are shown in Appendix B.
- A boundary and topographic survey dated 06/10/2014 was provided by ALL Land Surveying. Information obtained from this map includes parcel boundaries, distances, topography, existing utilities, trees and existing structures.

Step 2: Prepared Preliminary Development Layout

- Information from the topographic and boundary survey, the existing conditions, City of Mill Creek's Standard Plans, Mill Creek Municipal Code Requirements, and Department of Ecology's Stormwater Manual were harmonized to create an overall site plan.

Step 3: Perform off-site (upstream and downstream) analysis.

- Observations were made during the July 14, 2014 site visit and harmonized with the topography shown on the survey in order to assess the upstream and downstream conditions.

Upstream Analysis:

It appears that the property adjacent and to the south is upstream of the subject property. However, the topography shown on the survey which indicates a mild mounded area at elevation 467 straddling the south property line coupled together with the flat nature of the property to the south, indicates that there is no significant flow that enters the subject lot from the upstream.

Downstream Analysis:

The site has a low elevation contour of 464 in the northwest corner. The northwest corner is adjacent to the right-of-way of 132nd St. SE and no adverse stormwater flows are anticipated to sheet flow into the right-of-way. The overflow from rain gardens will however be connected to a catch basin within the 132nd right-of-way.

Step 4: Determine Applicable Minimum Requirements.

- **Minimum Requirements** #1-#10 are applicable as follows:
  The project proposes more than 5,000 SF of new impervious area. Therefore the Stormwater Management Manual for Western Washington Minimum Requirements #1 - #10 applies to this drainage plan.

Step 5: Prepare a Permanent Stormwater Control Plan

- A Permanent Stormwater Control Plan is included within the titled Road and Drainage Plan Drawing. Several specific design elements are included on the plan including rain gardens and splash blocks with the required flow paths.

Step 6: Prepare a Stormwater Pollution Prevention Plan (SWPPP)

- The twelve elements of the SWPPP are discussed in this report on pages 10-12. Additionally, the TESC Plan included with this submittal depicts application elements that are to be used.

Step 7: Complete the Stormwater Site Plan

- A Permanent Stormwater Site Plan signed by Donna L. Breske, P.E. is included in the submittal for this project.

Minimum Requirement 2: SWPPP

A two page SWPPP narrative is included with this report.

Minimum Requirement 3: Water Pollution Source Control for New Development

Source control shall be provided through the application of source control Best Management Practices during construction and on the developed site following construction. The applicable source control BMPs include silt fence, stockpile cover methods, temporary construction entrance on the Temporary Erosion Control Plan Sheet.

Minimum Requirement 4: Natural Drainage Systems and Outfalls

There is no anticipated change to the drainage patterns as a result of this project.

Minimum Requirement 5: On-site Stormwater Management.

Minimum Requirement #5 requires that stormwater is infiltrated, retained, or dispersed on site to the maximum extent feasible without causing flooding or erosion impacts, and to reduce hydrologic disruption to the maximum extent feasible. Accordingly, Low Impact Development Rain Gardens, and flow dispersion techniques are utilized in the proposed design.

For this report this engineer obtained infiltration rates from five test holes on site. An infiltration rate was determined and the WWHM2012 program used to determine how much square footage of rain garden is required for each 100 sf of impervious area. Refer to Appendices A, B, & C for detail.

Minimum Requirement 6: Runoff Treatment

This project proposes approximately 7,000 sf of total PGIS. This is greater than 5,000 SF of pollution-generating impervious surface. Therefore stormwater runoff water quality control is triggered. This design proposes that stormwater runoff from the single family driveways will be routed to either rain gardens or a vegetated flow path. The remaining 2,260 SF of PGIS from the 22-ft wide shared access road, (less than 5,000SF), will leave the site as bypass flows. Refer to Appendix A for an Impervious Area and LID Exhibit.

Minimum Requirement 7: Flow Control Requirements for New Development

Flow control is proposed through the use of rain gardens, splash blocks and flow dispersion. Refer to Appendices B & C for detailed information for the design and measured infiltration rates.

Minimum Requirement 8: Detention or Treatment in Wetlands and Wetland Buffers

There are no wetlands on or near the site.

Minimum Requirement #9: Basin/Watershed Planning

There is no known specific Basin/Watershed Planning requirement for this site.

Minimum Requirement #10: Inspection, Operation and Maintenance

A Maintenance sheet for rain gardens is included in Appendix F

Stormwater Pollution Prevention Plan Narrative

The purpose of the SWPPP is to describe all temporary and permanent erosion and sediment control (TESC) measures, pollution prevention measures and inspection/monitoring activities that will be implemented during the proposed project. Applications of these elements are shown on the TESC Plan Sheet. The specific elements included in the SWPPP are:

Element #1: Mark Clearing Limits

Prior to the beginning of land disturbing activities, the clearing limits are to be marked. These limits are shown on the TESC and Clearing Plan Sheet. Existing fences depict some clearing limits. Other clearing perimeters will be marked with a high visibility orange construction fence as required.

Element #2 – Establish Construction Access

An existing drop curb driveway along 132nd will be used for initial construction access. Once clearing is completed along the panhandle connecting to 27 Dr. SE, then a second temporary construction entrance can be established if desired.

Element #3 – Control Flow Rates

It is anticipated that the relatively flat nature of the site will prohibit storm water flows from channelizing and leaving the site. In the unlikely event of sheet flow across the site, the use of straw wattles around the periphery of the site will aid in controlling and perhaps damming minor flows or water.

Element #4 – Install Sediment Controls

Specific controls include: Temporary or Permanent Seeding (BMP C120), Straw Wattles (BMP 235)

Element #5 – Stabilize Soils

Specific BMP's to be implemented include Temporary and Permanent Seeding (BMP C120), Mulching (BMP C121), Plastic Covering (BMP C123).

Element #6 – Protect Slopes

The site is basically flat and this element does not apply.

Element #7 – Protect Drain Inlets

As required, existing inlets will be protected with sediment traps (BMP C220).

Element #8 – Stabilize Channels and Outlets

River rock cobble outfalls for the rain gardens are proposed for outflow from roof drains.

Element #9 – Control Pollutants

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

Element #10 – Control Dewatering

No de-watering is anticipated for this project.

Element #11 – Maintain BMPs

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

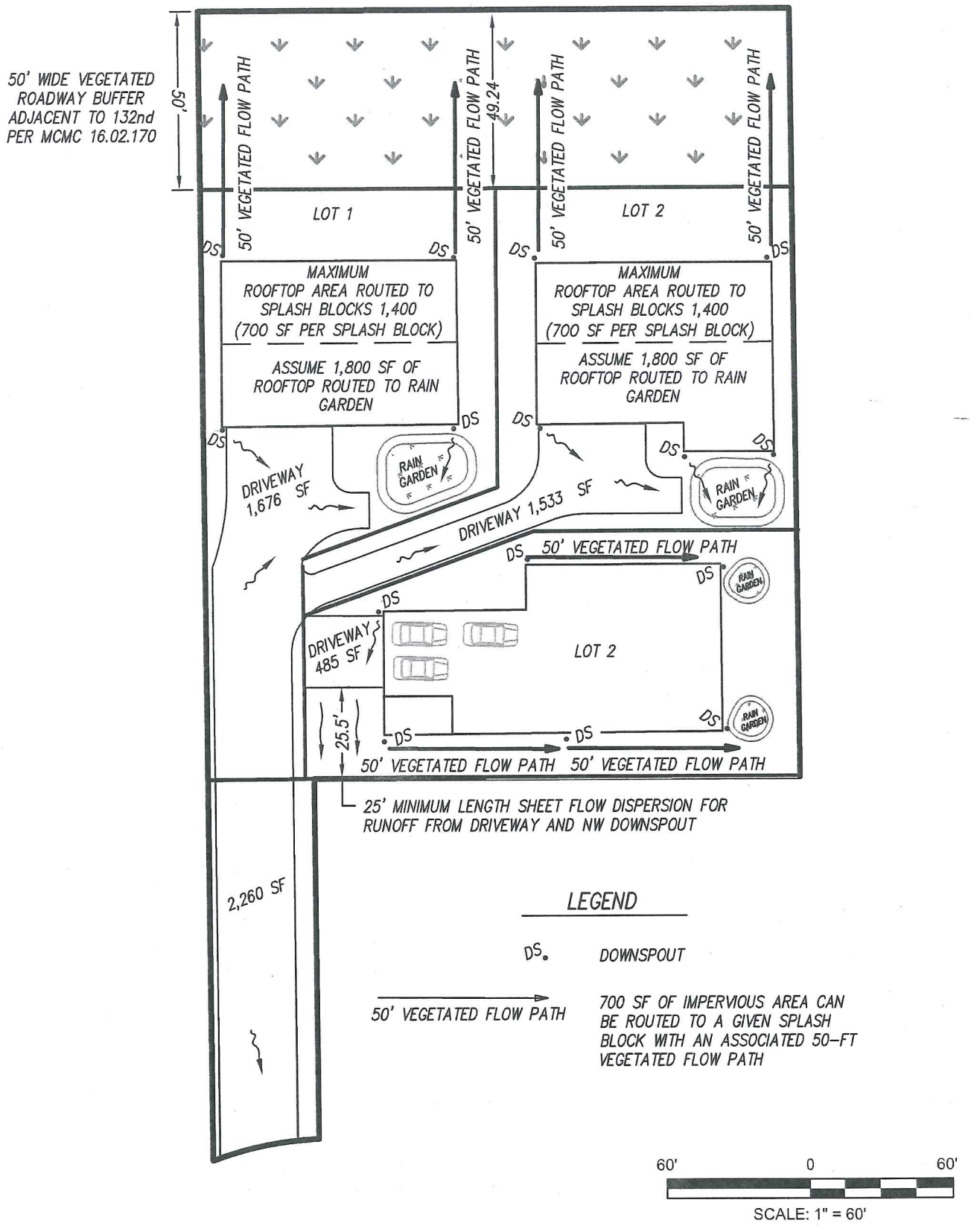
All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be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

Element #12 – Manage the Project

Erosion and sediment control BMPs for this project have been designed based on the following principles:

- Design the project to fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures.
- Schedule major earthwork during the dry season.

APPENDIX A
LID & IMPERVIOUS AREA EXHIBIT



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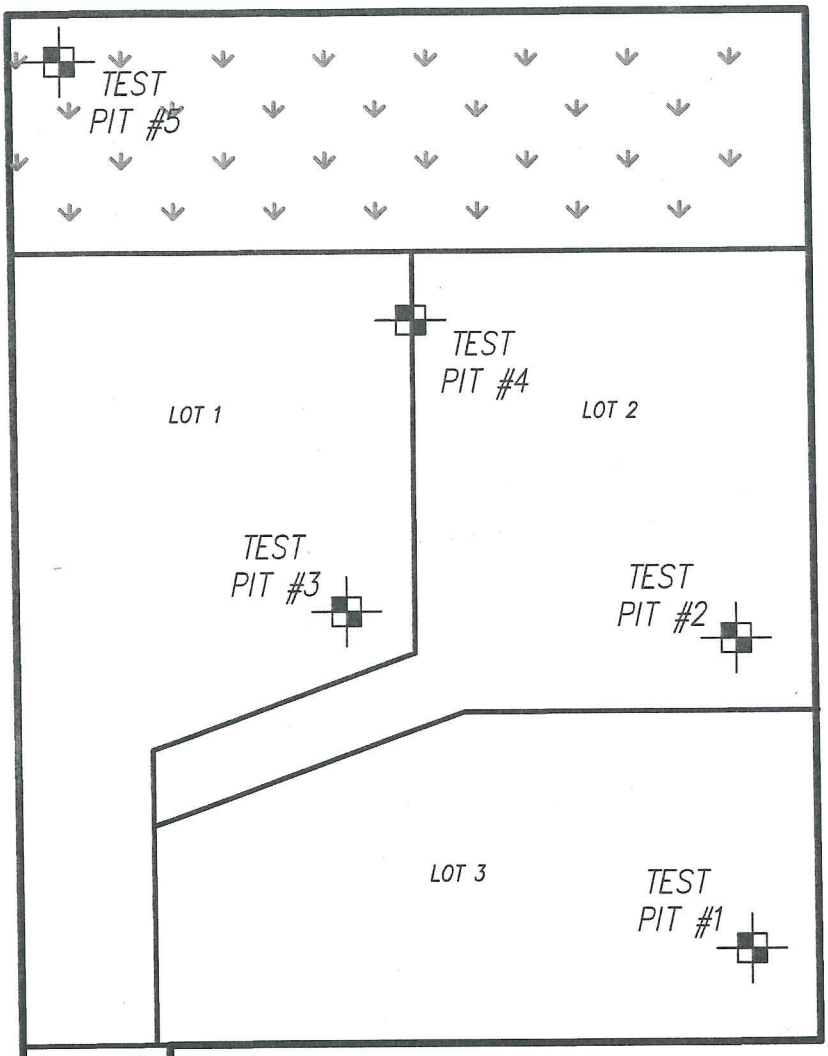
IMPERVIOUS & LID EXHIBIT FOR RAJ GILL 3-LOT SP

SITE ADDRES: 2726 132ND ST SE, MILL CREEK, WA

SCALE: 1" = 60'	DATE: 7-28-2014	EXHIBIT "A"

APPENDIX B
INFILTRATION TEST EXHIBIT



	MEASURED INFILTRATION RATE in/hr.
TEST PIT #1	16
TEST PIT #2	6.5
TEST PIT #3	20
TEST PIT #4	8.5
TEST PIT #5	40

TEST HOLE PROCEDURE

TEST HOLES WERE DUG WITH A POST HOLE DIGGER, 10' DIAMETER X 2-FEET DEEP.

EACH HOLE WAS FILLED TWICE AND ALLOWED TO DRAIN. THE HOLES WERE THEN FILLED A THIRD TIME AND MEASURE DOWN RATES RECORDED.

NOTE: TEST HOLES MEASRUEMENTS WERE CONDUCTED ON MONDAY, JULY 14, 2014, A SUNNY DAY.

60' 0 60'

SCALE: 1" = 60'

N

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INFILTRATION TEST HOLE EXHIBIT

SITE ADDRES: 2726 132ND ST SE, MILL CREEK, WA

SCALE: 1" = 60'	DATE: 7-28-2014	EXHIBIT "B"

APPENDIX C
RAIN GARDEN SIZING CALCULATIONS

RAIN GARDEN DESIGN OVERVIEW FOR RAJ GILL 3-LOT SHORT PLAT

July 29, 2014

On July 14, 2014 this engineer conducted infiltration rate measurements on five test holes on the Raj Gill Site. The infiltration rates ranged from 6.5 inches per hour to 40 inches per hour.

Per the USGS Web Soil Survey the soils on Site are Alderwood Urban Land Complex. Published permeability rates for Alderwood soils are 2.0 – 6.0 inches/hour. Therefore, this engineer used the most conservative infiltration rate measured, 6.5 inches/hr, coupled together with a factor of safety of 2 for input into the WWHM2012 software program

The exact footprints of the proposed houses are not known at this time. In order to provide rain garden sizing this engineer used 10,000 sf as the total impervious area for input into the WWHM2012 program. This resulted in rain garden bottom area of 6 sf for every 100 sf of impervious area routed to a given rain garden. Alternatively, the bottom area of a rain garden must be 6% of the impervious area from which storm water runoff is routed to.

RAIN GARDEN SIZING:

Provide 6 square feet of rain garden bottom area for every 100 sf of impervious area routed to a given rain garden.

WWHM2012
PROJECT REPORT

Project Name: Raj Gill 4-lot Mill Creek 7-28-14
Site Name: Raj Gill 4-lot
Site Address: 2726 132nd St, Mill Creek, WA
City : Mill Creek
Report Date: 7/30/2014
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version : 2014/04/17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Lot 1
Bypass: No
GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	.2295
Pervious Total	0.2295

Impervious Land Use	Acres
Impervious Total	0
Basin Total	0.2295

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE
Name : Basin 1
Bypass: No
GroundWater: No

Pervious Land Use	Acres
Pervious Total	0

Impervious Land Use	Acres
ROOF TOPS FLAT	0.1606
DRIVEWAYS FLAT	0.0689
Impervious Total	0.2295
Basin Total	0.2295

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 60 ft.
Length : 10 ft.
Depth: 1 ft.
Infiltration On
Infiltration rate: 6.5
Infiltration safety factor: 0.5
Wetted surface area On
Total Volume Infiltrated (ac-ft): 37.646
Total Volume Through Riser (ac-ft): 0.003
Total Volume Through Facility (ac-ft): 37.649
Percent Infiltrated: 99.99
Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 6 in.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.013	0.000	0.000	0.000
0.0111	0.013	0.000	0.000	0.045
0.0222	0.013	0.000	0.000	0.045
0.0333	0.013	0.000	0.000	0.045
0.0444	0.013	0.000	0.000	0.045
0.0556	0.013	0.000	0.000	0.045
0.0667	0.013	0.000	0.000	0.045
0.0778	0.013	0.001	0.000	0.045
0.0889	0.013	0.001	0.000	0.045
0.1000	0.013	0.001	0.000	0.045
0.1111	0.013	0.001	0.000	0.045
0.1222	0.013	0.001	0.000	0.045
0.1333	0.013	0.001	0.000	0.045
0.1444	0.013	0.002	0.000	0.045
0.1556	0.013	0.002	0.000	0.045
0.1667	0.013	0.002	0.000	0.045
0.1778	0.013	0.002	0.000	0.045
0.1889	0.013	0.002	0.000	0.045
0.2000	0.013	0.002	0.000	0.045
0.2111	0.013	0.002	0.000	0.045
0.2222	0.013	0.003	0.000	0.045
0.2333	0.013	0.003	0.000	0.045

0.2444	0.013	0.003	0.000	0.045
0.2556	0.013	0.003	0.000	0.045
0.2667	0.013	0.003	0.000	0.045
0.2778	0.013	0.003	0.000	0.045
0.2889	0.013	0.004	0.000	0.045
0.3000	0.013	0.004	0.000	0.045
0.3111	0.013	0.004	0.000	0.045
0.3222	0.013	0.004	0.000	0.045
0.3333	0.013	0.004	0.000	0.045
0.3444	0.013	0.004	0.000	0.045
0.3556	0.013	0.004	0.000	0.045
0.3667	0.013	0.005	0.000	0.045
0.3778	0.013	0.005	0.000	0.045
0.3889	0.013	0.005	0.000	0.045
0.4000	0.013	0.005	0.000	0.045
0.4111	0.013	0.005	0.000	0.045
0.4222	0.013	0.005	0.000	0.045
0.4333	0.013	0.006	0.000	0.045
0.4444	0.013	0.006	0.000	0.045
0.4556	0.013	0.006	0.000	0.045
0.4667	0.013	0.006	0.000	0.045
0.4778	0.013	0.006	0.000	0.045
0.4889	0.013	0.006	0.000	0.045
0.5000	0.013	0.006	0.000	0.045
0.5111	0.013	0.007	0.000	0.045
0.5222	0.013	0.007	0.000	0.045
0.5333	0.013	0.007	0.000	0.045
0.5444	0.013	0.007	0.000	0.045
0.5556	0.013	0.007	0.000	0.045
0.5667	0.013	0.007	0.000	0.045
0.5778	0.013	0.008	0.000	0.045
0.5889	0.013	0.008	0.000	0.045
0.6000	0.013	0.008	0.000	0.045
0.6111	0.013	0.008	0.000	0.045
0.6222	0.013	0.008	0.000	0.045
0.6333	0.013	0.008	0.000	0.045
0.6444	0.013	0.008	0.000	0.045
0.6556	0.013	0.009	0.000	0.045
0.6667	0.013	0.009	0.000	0.045
0.6778	0.013	0.009	0.000	0.045
0.6889	0.013	0.009	0.000	0.045
0.7000	0.013	0.009	0.000	0.045
0.7111	0.013	0.009	0.000	0.045
0.7222	0.013	0.009	0.000	0.045
0.7333	0.013	0.010	0.000	0.045
0.7444	0.013	0.010	0.000	0.045
0.7556	0.013	0.010	0.000	0.045
0.7667	0.013	0.010	0.000	0.045
0.7778	0.013	0.010	0.000	0.045
0.7889	0.013	0.010	0.000	0.045
0.8000	0.013	0.011	0.000	0.045
0.8111	0.013	0.011	0.000	0.045
0.8222	0.013	0.011	0.000	0.045
0.8333	0.013	0.011	0.000	0.045
0.8444	0.013	0.011	0.000	0.045
0.8556	0.013	0.011	0.000	0.045
0.8667	0.013	0.011	0.000	0.045

0.8778	0.013	0.012	0.000	0.045
0.8889	0.013	0.012	0.000	0.045
0.9000	0.013	0.012	0.000	0.045
0.9111	0.013	0.012	0.000	0.045
0.9222	0.013	0.012	0.000	0.045
0.9333	0.013	0.012	0.000	0.045
0.9444	0.013	0.013	0.000	0.045
0.9556	0.013	0.013	0.000	0.045
0.9667	0.013	0.013	0.000	0.045
0.9778	0.013	0.013	0.000	0.045
0.9889	0.013	0.013	0.000	0.045
1.0000	0.013	0.013	0.000	0.045
1.0111	0.013	0.013	0.005	0.045
1.0222	0.000	0.000	0.016	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.2295
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.2295

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.00492
5 year	0.007282
10 year	0.008899
25 year	0.010985
50 year	0.012563
100 year	0.014158

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.003	0.000

1950	0.005	0.000
1951	0.004	0.000
1952	0.004	0.000
1953	0.003	0.000
1954	0.011	0.000
1955	0.007	0.000
1956	0.007	0.000
1957	0.007	0.000
1958	0.005	0.005
1959	0.005	0.000
1960	0.005	0.000
1961	0.005	0.038
1962	0.004	0.000
1963	0.005	0.000
1964	0.004	0.000
1965	0.005	0.000
1966	0.003	0.000
1967	0.006	0.000
1968	0.007	0.000
1969	0.005	0.000
1970	0.004	0.000
1971	0.005	0.000
1972	0.005	0.000
1973	0.004	0.000
1974	0.007	0.000
1975	0.004	0.000
1976	0.004	0.000
1977	0.003	0.000
1978	0.004	0.000
1979	0.007	0.000
1980	0.004	0.000
1981	0.004	0.000
1982	0.005	0.000
1983	0.007	0.000
1984	0.005	0.000
1985	0.006	0.000
1986	0.016	0.000
1987	0.007	0.000
1988	0.004	0.000
1989	0.003	0.000
1990	0.005	0.000
1991	0.005	0.000
1992	0.004	0.000
1993	0.003	0.000
1994	0.003	0.000
1995	0.005	0.000
1996	0.009	0.000
1997	0.017	0.000
1998	0.003	0.000
1999	0.005	0.000
2000	0.003	0.000
2001	0.001	0.000
2002	0.005	0.000
2003	0.004	0.000
2004	0.006	0.000
2005	0.004	0.000
2006	0.010	0.000

2007	0.008	0.000
2008	0.013	0.000
2009	0.004	0.000

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0172	0.0383
2	0.0157	0.0054
3	0.0132	0.0000
4	0.0109	0.0000
5	0.0097	0.0000
6	0.0090	0.0000
7	0.0083	0.0000
8	0.0074	0.0000
9	0.0072	0.0000
10	0.0070	0.0000
11	0.0070	0.0000
12	0.0069	0.0000
13	0.0067	0.0000
14	0.0066	0.0000
15	0.0065	0.0000
16	0.0064	0.0000
17	0.0060	0.0000
18	0.0057	0.0000
19	0.0054	0.0000
20	0.0054	0.0000
21	0.0054	0.0000
22	0.0053	0.0000
23	0.0053	0.0000
24	0.0052	0.0000
25	0.0051	0.0000
26	0.0051	0.0000
27	0.0050	0.0000
28	0.0049	0.0000
29	0.0049	0.0000
30	0.0049	0.0000
31	0.0048	0.0000
32	0.0048	0.0000
33	0.0047	0.0000
34	0.0047	0.0000
35	0.0047	0.0000
36	0.0044	0.0000
37	0.0043	0.0000
38	0.0043	0.0000
39	0.0043	0.0000
40	0.0042	0.0000
41	0.0041	0.0000
42	0.0041	0.0000
43	0.0039	0.0000
44	0.0039	0.0000
45	0.0038	0.0000
46	0.0038	0.0000
47	0.0038	0.0000
48	0.0037	0.0000
49	0.0036	0.0000

50	0.0035	0.0000
51	0.0035	0.0000
52	0.0033	0.0000
53	0.0033	0.0000
54	0.0031	0.0000
55	0.0029	0.0000
56	0.0028	0.0000
57	0.0027	0.0000
58	0.0027	0.0000
59	0.0026	0.0000
60	0.0025	0.0000
61	0.0009	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0025	22629	9	0	Pass
0.0026	20520	8	0	Pass
0.0027	18572	8	0	Pass
0.0028	16797	8	0	Pass
0.0029	15143	8	0	Pass
0.0030	13702	8	0	Pass
0.0031	12457	7	0	Pass
0.0032	11293	7	0	Pass
0.0033	10235	7	0	Pass
0.0034	9302	7	0	Pass
0.0035	8453	7	0	Pass
0.0036	7681	7	0	Pass
0.0037	6941	7	0	Pass
0.0038	6312	7	0	Pass
0.0039	5773	7	0	Pass
0.0040	5283	7	0	Pass
0.0041	4851	7	0	Pass
0.0042	4440	7	0	Pass
0.0043	4092	7	0	Pass
0.0044	3700	7	0	Pass
0.0045	3371	7	0	Pass
0.0046	3050	7	0	Pass
0.0047	2748	7	0	Pass
0.0048	2505	7	0	Pass
0.0049	2299	7	0	Pass
0.0050	2106	7	0	Pass
0.0051	1949	7	0	Pass
0.0052	1820	7	0	Pass
0.0053	1698	7	0	Pass
0.0054	1580	6	0	Pass
0.0055	1479	6	0	Pass
0.0056	1398	6	0	Pass
0.0057	1329	6	0	Pass
0.0058	1260	6	0	Pass
0.0059	1197	6	0	Pass
0.0060	1138	6	0	Pass

0.0061	1081	6	0	Pass
0.0062	1025	6	0	Pass
0.0063	953	6	0	Pass
0.0064	915	6	0	Pass
0.0065	879	6	0	Pass
0.0066	845	6	0	Pass
0.0067	807	6	0	Pass
0.0068	767	6	0	Pass
0.0070	731	6	0	Pass
0.0071	700	6	0	Pass
0.0072	676	6	0	Pass
0.0073	655	6	0	Pass
0.0074	639	6	0	Pass
0.0075	620	6	0	Pass
0.0076	604	6	0	Pass
0.0077	587	6	1	Pass
0.0078	573	6	1	Pass
0.0079	560	6	1	Pass
0.0080	551	6	1	Pass
0.0081	539	5	0	Pass
0.0082	523	5	0	Pass
0.0083	510	5	0	Pass
0.0084	496	5	1	Pass
0.0085	473	5	1	Pass
0.0086	457	5	1	Pass
0.0087	448	5	1	Pass
0.0088	438	5	1	Pass
0.0089	426	5	1	Pass
0.0090	417	5	1	Pass
0.0091	402	5	1	Pass
0.0092	396	5	1	Pass
0.0093	385	5	1	Pass
0.0094	374	5	1	Pass
0.0095	362	5	1	Pass
0.0096	355	5	1	Pass
0.0097	349	5	1	Pass
0.0098	338	5	1	Pass
0.0099	329	5	1	Pass
0.0100	320	5	1	Pass
0.0101	310	5	1	Pass
0.0102	306	5	1	Pass
0.0103	301	5	1	Pass
0.0104	296	5	1	Pass
0.0105	288	5	1	Pass
0.0106	283	5	1	Pass
0.0107	277	5	1	Pass
0.0108	270	5	1	Pass
0.0109	260	5	1	Pass
0.0110	252	5	1	Pass
0.0111	246	5	2	Pass
0.0112	239	5	2	Pass
0.0113	234	5	2	Pass
0.0114	227	5	2	Pass
0.0115	215	5	2	Pass
0.0116	205	5	2	Pass
0.0117	200	5	2	Pass
0.0118	195	5	2	Pass

0.0120	188	5	2	Pass
0.0121	184	5	2	Pass
0.0122	176	5	2	Pass
0.0123	170	5	2	Pass
0.0124	165	5	3	Pass
0.0125	158	5	3	Pass
0.0126	152	5	3	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

LID Report

LID Technique	Used for Water Quality Treatment?	Total Volumn Needs Treatment (ac-ft)	Volumn Through Facility (ac-ft)	Infiltration Volumn (ac-ft)	Cumulative Volumn Infiltration Credit	Comment
Vault 1 POC	N	34.38			N	
99.65 Percent	Volumn Infiltrated	Water Quality Treated				
Total Volume Infiltrated		34.38	0.00	0.00		
99.65	0.00	0%	No Treat. Credit			

Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

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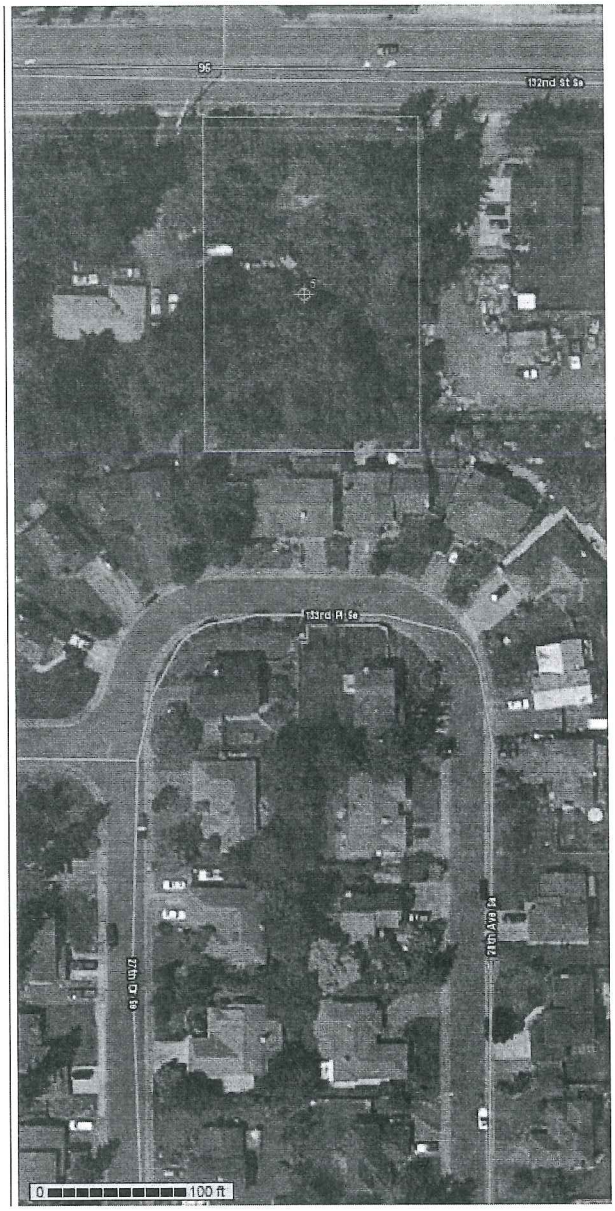
APPENDIX D
SOIL MAP & SOIL DATA

Snohomish County Area, Washington (WA661)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
5	Alderwood-Urban land complex, 2 to 8 percent slopes	0.9	100.0%
Totals for Area of Interest		0.9	100.0%



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USGA SOIL MAP FOR RAG GILL 3-LOT SHORT PLAT

SITE ADDRES: 2726 132ND ST SE, MILL CREEK, WA

SCALE: N/A	DATE: 7-28-2014	EXHIBIT "D"

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Organic matter
							K	T	
	In	Pct	In/hr	In/in	pH				Pct
1, 2, 3----------	0-7	5-10	2.0-6.0	0.07-0.11	5.1-6.5	Low----------	0.20	2	5-10
Alderwood	7-35	5-10	2.0-6.0	0.07-0.11	5.6-6.5	Low----------	0.20		
	35	---	---	---	---	----------	---		
4*:									
Alderwood-------	0-7	5-10	2.0-6.0	0.07-0.11	5.1-6.5	Low----------	0.20	2	5-10
	7-35	5-10	2.0-6.0	0.07-0.11	5.6-6.5	Low----------	0.20		
	35	---	---	---	---	----------	---		
Everett----------	0-6	5-10	2.0-6.0	0.08-0.12	5.6-6.5	Low----------	0.17	1	10-15
	6-18	5-10	6.0-20	0.05-0.08	5.6-6.5	Low----------	0.10		
	18-60	0-5	6.0-20	0.02-0.05	5.6-6.5	Low----------	0.10		
5*, 6*:									
Alderwood-------	0-7	5-10	2.0-6.0	0.07-0.11	5.1-6.5	Low----------	0.20	2	5-10
	7-35	5-10	2.0-6.0	0.07-0.11	5.6-6.5	Low----------	0.20		
	35	---	---	---	---	----------	---		
Urban land.									
----------	0-9	15-30	0.2-0.6	0.20-0.24	5.6-6.5	Low----------	0.32	5	10-15
llingham	9-60	40-60	0.06-0.2	0.20-0.24	6.1-7.3	High----------	0.24		
8----------	0-6	27-35	0.2-0.6	0.19-0.21	5.1-5.5	Moderate-------	0.32	5	10-15
Bellingham	6-42	35-45	0.06-0.2	0.18-0.21	4.5-5.5	High----------	0.32		
Variant	42-60	12-30	0.2-0.6	0.14-0.16	4.5-5.0	Moderate-------	0.32		
9, 10, 11--------	0-8	---	0.6-2.0	0.18-0.20	4.5-6.0	Low----------	0.37	5	5-10
Cathcart	8-35	---	0.6-2.0	0.13-0.17	5.1-6.5	Low----------	0.43		
	35-60	---	0.6-2.0	0.14-0.17	5.1-6.5	Low----------	0.37		
12*.									
Cryohemists									
13----------	0-9	10-15	2.0-6.0	0.13-0.15	5.6-6.0	Low----------	0.28	5	5-10
Custer	9-35	0-10	0.2-0.6	0.06-0.08	5.1-5.5	Low----------	0.24		
	35-60	0-10	>20	0.06-0.09	5.6-6.0	Low----------	0.10		
14----------	0-2	---	0.6-2.0	0.22-0.26	3.6-5.5	Low----------	0.37	2	10-15
Elwell	2-23	---	0.6-2.0	0.19-0.23	5.1-5.5	Low----------	0.43		
	23-27	---	0.6-2.0	0.09-0.13	5.1-5.5	Low----------	0.28		
	27	---	---	---	---	----------	---		
15*:									
Elwell----------	0-2	---	0.6-2.0	0.22-0.26	3.6-5.5	Low----------	0.37	2	10-15
	2-23	---	0.6-2.0	0.19-0.23	5.1-5.5	Low----------	0.43		
	23-27	---	0.6-2.0	0.09-0.13	5.1-5.5	Low----------	0.28		
	27	---	---	---	---	----------	---		
Olomount--------	0-2	---	0.6-2.0	0.13-0.16	5.1-5.5	Low----------	0.24	2	2-5
	2-18	---	0.6-2.0	0.11-0.14	5.6-6.0	Low----------	0.28		
	18-32	---	0.6-2.0	0.08-0.10	5.6-6.5	Low----------	0.28		
	32	---	---	---	---	----------	---		
16*:									
Elwell----------	0-2	---	0.6-2.0	0.22-0.26	3.6-5.5	Low----------	0.37	2	10-15
	2-23	---	0.6-2.0	0.19-0.23	5.1-5.5	Low----------	0.43		
	23-27	---	0.6-2.0	0.09-0.13	5.1-5.5	Low----------	0.28		
	27	---	---	---	---	----------	---		

See footnote at end of table.

APPENDIX D
SITE PHOTOS

Looking north across site to 132nd Street.

Looking toward southeast corner of site.

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SITE PHOTO FOR RAJ GILL MILL CREEK SHORT PLAT

SITE ADDRES: 2726 132ND ST SE, MILL CREEK, WA

SCALE: N/A	DATE: 7-28-2014	EXHIBIT "E"

APPENDIX E
RAIN GARDEN MAINTENANCE SHEETS

Table 6. Maintenance Standards and Procedures for Rain Gardens.

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

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

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

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

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Vegetation (cont'd)		As needed	Broken, dead, or sucker vegetation is present	Remove broken or dead branches and suckers
		As needed	Vegetation is crowding inlets and outlets	Keep water inlets and outlets in the rain garden clear of vegetation
	One time March through June		• Yellowing: possible Nitrogen (N) deficiency • Poor growth: possible Phosphorous (P) deficiency • Poor flowering, spotting or curled leaves, or weak roots or stems: possible Potassium (K) deficiency	• Test soil to identify specific nutrient deficiencies • Consult with a professional knowledgeable in the area of natural amendments or refer to Natural Lawn and Garden Care resources and avoid synthetic fertilizers • Consider selecting different plants for soil conditions
Weeds		As needed, preceding seed dispersal	Problem weeds are present	• Remove weeds by hand, especially in spring when the soil is moist and the weeds are small • Dig or pull weeds out by the roots before they go to seed • Apply mulch after weeding (see "Mulch")
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Use coarse compost in the bottom of the rain garden and arborist wood chips on side slopes and rim (above typical water levels) • Keep all mulch from being in contact with woody stems.

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

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

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

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

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