INSIGHT ENGINEERING CO.

PRELIMINARY TECHNICAL INFORMATION REPORT
For
Woodinville 10

Prepared for
The City of Woodinville
Development Services Department
17301 133rd Avenue NE
Woodinville, WA 98072

Project Site Location:
13215 NE 205th St
Woodinville, WA 98072

Applicant / Contact:
Southend Holdings, LLC
P.O. Box 430
Marysville, WA 98270

Contact:
IECO
P.O. Box 1478
Everett, WA 98206
425-303-9363

Tax Id: 0326059034
IECO Project: 15-0716

Certified Erosion and Sedimentation Control Lead:
To be named by contractor

Stormwater Site Plan Prepared By:

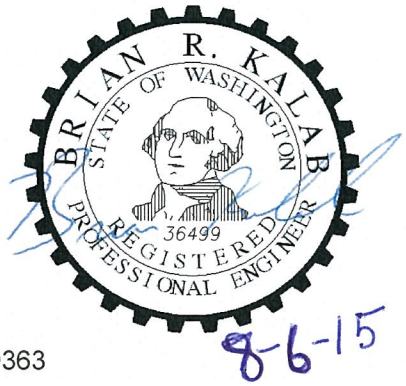
Jacob D. Mealey, E.I.T.

Stormwater Site Plan Preparation Date:

June 25, 2015

Approximate Construction Date:

May 1, 2016



8-6-15

P.O Box 1478 • Everett, WA 98206 • P: 425.303.9363
F: 425.303.9362 • info@insightengineering.net

TABLE OF CONTENTS

Figures

Acronyms and Abbreviations

CR	Core Requirement
BMP	Best Management Practices
DOE	Department of Ecology
ESC	Erosion and Sediment Control
IECO	Insight Engineering Company
KCSWDM	King County Surface Water Design Manual
MR	Minimum Requirement
NEPA	National Environmental Protection Act
PUD	Public Utility District
ROW	Right-of-Way
SEPA	State Environmental Protection Act
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sediment Control
TIR	Technical Information Report
UBC	Uniform Building Code
WMC	Woodinville Municipal Code
WSDOT	Washington State Department of Transportation

1.0 Project Overview

The proposed project ***Woodinville 10*** is located at 13215 NE 205th St S Woodinville, Washington. More generally, the site is located in Section 03, Township 26 North, and Range 5 East of the Willamette Meridian in Snohomish County, Washington. Please refer to the Vicinity Map attached later in the section. This report follows the requirements defined in the City of Woodinville's 2010 Stormwater Management Plan and the 2009 Surface Water Design Manual.

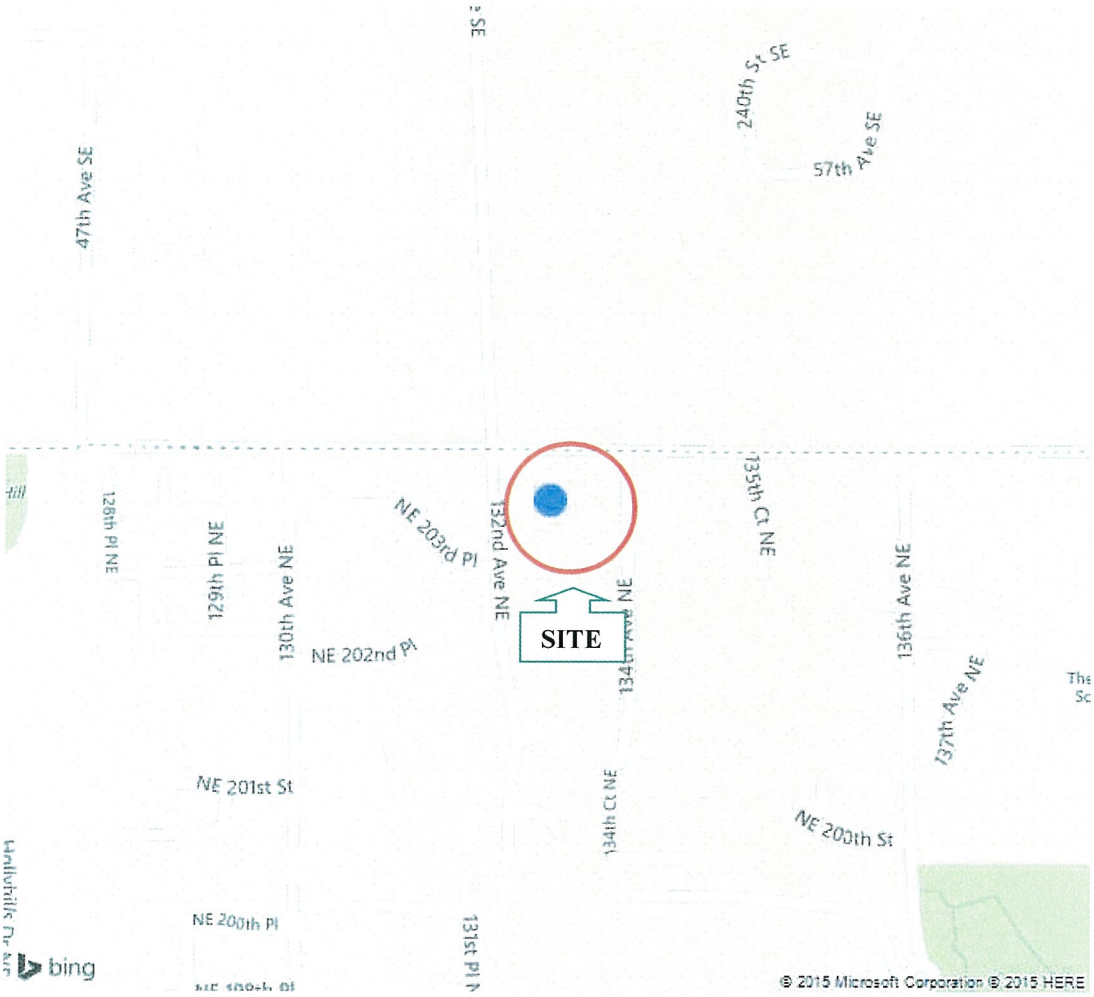
The site contains 1.69 Acres and is currently developed with a single family home, two detached sheds and an existing gravel driveway from N.E. 205th St. SE, the remainder of the site exists as low to medium growing vegetation with several trees. There is a category III wetland located on the southern portion of the site. The majority of the site gradually slopes towards the southwest. The northeast portion of the site slopes to the northeast toward N.E. 205th St. Please refer to the downstream analysis map for more details. Per SCC survey of King County, a majority of the site contains Alderwood type soils that have a hydrologic classification of Type "C and a small portion of the site on the eastern side contains Everett soils that have a hydrologic classification of Type "A". Please refer to the soils map and descriptions attached later in this report for more details. A geotechnical investigation of the site has reviled that the entire site is suitable for infiltration. Refer to section 5 of this report for the Geotechnical Investigation by Liu and Associates, Inc. dated May 5, 2015.

The proposal is to construct 10 new single family homes with associated utilities. The accesses for lots 1-4 will be provided on 132nd Ave. N.E., and the access for lots 5-10 will be provided from N.E. 205th St. The project is subject to a full drainage review per Figure 1.1.2.A (Flow Chart for Determining Type of Drainage Review Required) according to section 1.1.2.3 (Full Drainage Review). Flow control for the site will be provided by basic infiltration facilities per section C.2.4 and section 5.4.5 of the 2009 KCSWDM. Individual infiltration trenches will be provided for each lot, the trenches have been designed to be 5-ft deep and will provide a minimum of 20 SF of trench for every 297 SF of the contributing impervious areas per the hydrologic calculations. Frontage improvements per the city of Woodinville's standards will be

provided along 132nd Ave. N.E. and N.E. 205th St. A 129-ft by 10-ft by 5-ft infiltration trench will be provided underneath the private access to provide flow control for the private access as well as the frontage along 132nd Ave. N.E. and N.E. 205th St. The infiltration trenches were sized in Western Washington Hydrology Model (WWHM 2012), refer to section 4 - Flow Control and Water Quality Analysis – for the sizing calculations. The runoff from the previous areas of the site will infiltrate and disperse through the lawn and onsite vegetation. In order to prevent erosion and trap sediments within the project site, the following BMPs will be used approximately as shown on the Grading and ESC plan:

- Clearing limits will be marked by fencing or other means on the ground.
- The driveway will be constructed and graveled immediately. A rocked construction entrance will be placed at the entrance of the site. Cleared areas accepting sheet flow from the driveway and parking area will be seeded and mulched.
- Runoff will not be allowed to concentrate and no water will be allowed to point discharge onto slopes.
- Silt fencing will be placed along slope contours at the downslope clearing limit.
- Mulch will be spread over all cleared areas of the site when they are not being worked. Mulch will consist of air-dried straw and chipped site vegetation.

FIGURE 1. VICINITY MAP



INSIGHT ENGINEERING CO.

P.O. Box 1478 Everett, WA 98206
425-303-9363, 425-303-9362 f.
Info@insightengineering.net

Figure 1 -Vicinity Map
Woodinville 10
Woodinville, Washington

SCALE: NTS	**DATE:** 6/30/15	**JOB #:** 15-0716
BY: JDM	**FILE NAME:** 15-0716/doc/TIR	

2.0 Conditions and Requirements Summary

2009 King County Surface Water Core Requirements Summary

CR: Core Requirement

CR #1 Discharge at the Natural Location: **The proposal is to infiltrate the runoff via infiltration trenches and subsequent soils.**

CR #2 Offsite Analysis: **The western portion of the site drains to the south toward the category III wetland located near the southern property line. The southeastern portion of the site drains to towards the southwest. The northeast portion of the site drains to the northeast toward N.E. 205th St. See the Section III Offsite Analysis for more information.**

CR #3 Flow Control: **Flow control for the site will be provided by basic infiltration facilities per section C.2.4 and section 5.4.5 of the 2009 KCSWDM. Individual infiltration trenches will be provided for each lot, the trenches have been designed to be 5-ft deep and will provide a minimum of 20 SF of trench for every 297 SF of the contributing impervious areas per the hydrologic calculations. Frontage improvements per the city of Woodinville's standards will be provided along 132nd Ave. N.E. and N.E. 205th St. A 129-ft by 10-ft by 5-ft infiltration trench will be provided underneath the private access to provide flow control for the private access as well as the frontage along 132nd Ave. N.E. and N.E. 205th St. Refer to section 4 - Flow Control and Water Quality Analysis – for the sizing calculations for the infiltration trenches. The runoff from the previous areas of the site will infiltrate and disperse through the lawn and onsite vegetation.**

CR #4 Conveyance System: **The roof and yard drains will be connected to each individual lot infiltration trench.**

CR #5 Erosion and Sediment Control: **Refer to the Preliminary Grading and SWPP Plan.**

CR #6 Maintenance and Operations: **Refer to Section 7.0 of the drainage report.**

CR #7 Financial Guarantees and Liability: **This will be provided to the city upon approval.**

CR #8 Water Quality: **Water quality will be provided for the total proposed pollution generating impervious surfaces by implementing water quality units upstream of the infiltration trench.**

2009 King County Surface Water Special Requirements Summary

SR: Special Requirement

SR #1 Other Adopted Area-Specific requirements: **This project is not located in the "other adopted area" that require any area specific requirements.**

SR #2 Floodplain / Floodway Delineation: **The project is not located within the 100-yr floodplain.**

SR #3 Flood Protection Facilities: **Stringent control for the site is not required.**

SR #4 Source Control: **No source control applies to the residential project.**

SR #5 Oil Control: **Water quality will be provided for the site, no additional oil control is required.**

FIGURE 2. SOIL MAP

SOILS LEGEND

AgC—Alderwood gravelly sandy loam, 8 to 15 percent slopes

EvC—Everett gravelly sandy loam, 5 to 15 percent slopes

IECO
INSIGHT ENGINEERING CO.
P.O. Box 1478 Everett, WA
98206
425-303-9363, 425-303-9362 f.
Info@insightengineering.net

Figure 2 - Soil Map
Woodinville 10
Woodinville, Washington

SCALE: NONE	DATE: 6/30/15	JOB #: 15-0716
BY: JDM	FILE NAME: 15-0716/doc/TIR	

King County Area, Washington

AgC—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

- *National map unit symbol:* 2t626
- *Elevation:* 0 to 1,000 feet
- *Mean annual precipitation:* 20 to 60 inches
- *Mean annual air temperature:* 46 to 52 degrees F
- *Frost-free period:* 160 to 240 days
- *Farmland classification:* Farmland of statewide importance

Map Unit Composition

- *Alderwood and similar soils:* 85 percent
- *Minor components:* 15 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Alderwood

Setting

- *Landform:* Hills, ridges
- *Landform position (two-dimensional):* Shoulder
- *Landform position (three-dimensional):* Nose slope, talf
- *Down-slope shape:* Convex, linear
- *Across-slope shape:* Convex
- *Parent material:* Glacial drift and/or glacial outwash over dense glaciomarine deposits

Typical profile

- *A - 0 to 7 inches:* gravelly sandy loam
- *Bw1 - 7 to 21 inches:* very gravelly sandy loam
- *Bw2 - 21 to 30 inches:* very gravelly sandy loam
- *Bg - 30 to 35 inches:* very gravelly sandy loam
- *2Cd1 - 35 to 43 inches:* very gravelly sandy loam
- *2Cd2 - 43 to 59 inches:* very gravelly sandy loam

Properties and qualities

- *Slope:* 8 to 15 percent
- *Depth to restrictive feature:* 20 to 39 inches to densic material
- *Natural drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 18 to 37 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Very low (about 2.7 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* B
- *Other vegetative classification:* Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XS301WA), Limited Depth Soils (G002XF303WA)

Minor Components

Everett

- *Percent of map unit:* 5 percent
- *Landform:* Moraines, eskers, kames
- *Landform position (two-dimensional):* Shoulder, summit
- *Landform position (three-dimensional):* Nose slope
- *Down-slope shape:* Convex
- *Across-slope shape:* Convex
- *Other vegetative classification:* Droughty Soils (G002XN402WA)

Indianola

- *Percent of map unit:* 5 percent
- *Landform:* Hillslopes, kames, eskers, terraces
- *Landform position (two-dimensional):* Backslope, summit
- *Landform position (three-dimensional):* Side slope, crest, tread
- *Down-slope shape:* Linear, convex
- *Across-slope shape:* Linear, convex
- *Ecological site:* Thuja plicata-Pseudotsuga menziesii/Gaultheria shallon/Polystichum munitum (F002XN903WA)
- *Other vegetative classification:* Droughty Soils (G002XN402WA)

Shalcar

- *Percent of map unit:* 3 percent
- *Landform:* Depressions
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Concave
- *Across-slope shape:* Concave
- *Other vegetative classification:* Wet Soils (G002XN102WA)

Norma

- *Percent of map unit:* 2 percent
- *Landform:* Depressions, drainageways
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Concave, linear
- *Across-slope shape:* Concave
- *Other vegetative classification:* Wet Soils (G002XS101WA)

King County Area, Washington

EvC—Everett gravelly sandy loam, 5 to 15 percent slopes

Map Unit Setting

- *National map unit symbol:* 1hmt3
- *Mean annual precipitation:* 30 to 45 inches
- *Mean annual air temperature:* 50 degrees F
- *Frost-free period:* 180 days
- *Farmland classification:* Farmland of statewide importance

Map Unit Composition

- *Everett and similar soils:* 100 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Everett

Setting

- *Landform:* Terraces
- *Parent material:* Glacial outwash with a component of volcanic ash in the upper part

Typical profile

- *H1 - 0 to 17 inches:* gravelly ashy sandy loam
- *H2 - 17 to 32 inches:* very gravelly sandy loam
- *H3 - 32 to 60 inches:* very gravelly coarse sand

Properties and qualities

- *Slope:* 5 to 15 percent
- *Depth to restrictive feature:* More than 80 inches
- *Natural drainage class:* Somewhat excessively drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Low (about 5.0 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 3e
- *Hydrologic Soil Group:* A
- *Other vegetative classification:* Droughty Soils (G002XN402WA)

3.0 Offsite Analysis

A site reconnaissance was performed by Jacob D. Mealey of Insight engineering on June 26, 2015 to verify the downstream flow paths and observe any drainage problems downstream of the site. The sky was clear and was overcast with a temperature of 78 degrees.

TASK 1: STUDY AREA DEFINITION & MAPS

The site contains 1.69 Acres and is currently developed with a single family home, two detached sheds and an existing gravel driveway from N.E. 205th St. SE, the remainder of the site exists as low to medium growing vegetation with several trees. There is a category III wetland located on the southern portion of the site. The majority of the site gradually slopes towards the southwest No visible on-site drainage problems were observed at the time of field investigations.

The site is located in the Sammamish River Drainage Basin.

Upstream Drainage Analysis

Due to the topography of the site, all upstream flows appear to be minimal.

TASK 2: RESOURCE REVIEW

Support documentation for the following items shall be found in the Appendix.

Drainage Basin

The project site is located in the Sammamish River Drainage Basin. See Drainage Basin Map in the Appendix.

Sensitive Area Map Folio

Wetlands: There is a category III wetland located on the southern portion of the site.

100-year Floodplain: The 100-year floodplain is not located on the site.

Landslide and Erosion Hazard area: There are no landslide and erosion areas located on site or downstream of the site.

See Appendix for the Sensitive Area Folio Maps.

TASK 3: FIELD OBSERVATIONS

Based on the topography of the existing site, the site drains to several locations. The western portion of the site drains to the south toward the category III wetland located near the southern property line. The southeastern portion of the site drains to towards the southeast. The northeast portion of the site drains to the northeast toward N.E. 205th St. All flows converge within a quarter of a mile.

The downstream flow path of the category III wetland and the southeastern portion of the site converge to the southeast within 50-ft and drain to the east through an open channel ditch. The ditch flows into an 18-in ADS pipe that flows southeast underneath 134th Ave NE and discharges into a wetland. At the time of the investigations, the 18-in ADS pipe was almost ¾ full of sediment and rock due to erosion from the upstream flows. However the runoff that was currently flowing through the pipe at the time of investigation was free flowing without being restricted by the erosion. The drainage flows through the wetland to the northeast for about 200-ft. This is where the flows converge with the runoff from the northeastern basin.

The drainage from the northeastern portion of the site drains to the existing roadside ditch along NE 205th St. The drainage flows into a 12-in conveyance system along NE 205th St for about 300-ft and then discharges into a wetland located on the southern portion of NE 205th St. This is where the flows converge with the runoff from the southern basins.

At the point of convergence, the drainage flows underneath NE 205th St through a 24-in concrete pipe. At the time of the investigation, the 24-in concrete pipe was almost ¾ full of sediment, rock and debris due to erosion from the upstream flows. However the runoff that was currently flowing through the pipe at the time of investigation was free flowing without being

restricted by the erosion. The drainage then flowed east through an open ditch for about 400-ft, where the flows discharge into Little Bear Creek. The creek flows to the south in an unrestricted manner. This is where the visual inspection of the 1 mile downstream concluded.

TASK 4: DRAINAGE SYSTEM AND PROBLEM DESCRIPTION

Basic infiltration per Section C.2.4 will meet the flow control BMP requirement. The roof runoff will be a connected to infiltration trenches per Section 5.4.5 to infiltrate the runoff onsite through the designed infiltration trenches and subsequent soils.

TASK 5: MITIGATION OF EXISTING OR POTENTIAL PROBLEMS

The project will not aggravate any downstream restrictions as the onsite storm water will be infiltrated and the soils are acceptable for infiltration.

FIGURE 3. DOWNSTREAM ANALYSIS MAP

Figure 4 - Downstream Analysis Map
Woodinville 10
Woodinville, Washington

IECO
INSIGHT ENGINEERING CO.
P.O. Box 1478 Everett, WA 98206
425-303-9363, 425-303-9362 f.
Info@insightengineering.net

SCALE: NONE	DATE: 7/2/15	JOB #: 15-0716
BY: JDM	FILE NAME: 15-0716/doc/TIR	

4.0 Flow Control and Water Quality Analysis and Design

The site contains one drainage basin that sheet flows to the southwest across the site. From the Soil Conservation Service Map of Snohomish County, the majority of the site contains Alderwood that have a hydrologic classification of Type "C and a small portion of the site on the eastern side contains Everett soils that have a hydrologic classification of Type "A".

Total Site Area	= 1.69 Acres
Wetlands (-)	= 0.11 Acres
Frontage (+)	= 0.09 Acres
Cleared Area	= 1.67 Acres

4.1 Existing Basin Summary

Existing Basin = 1.67 Acres

4.2 Developed Basin Summary

Developed Basin = 1.67 Acres

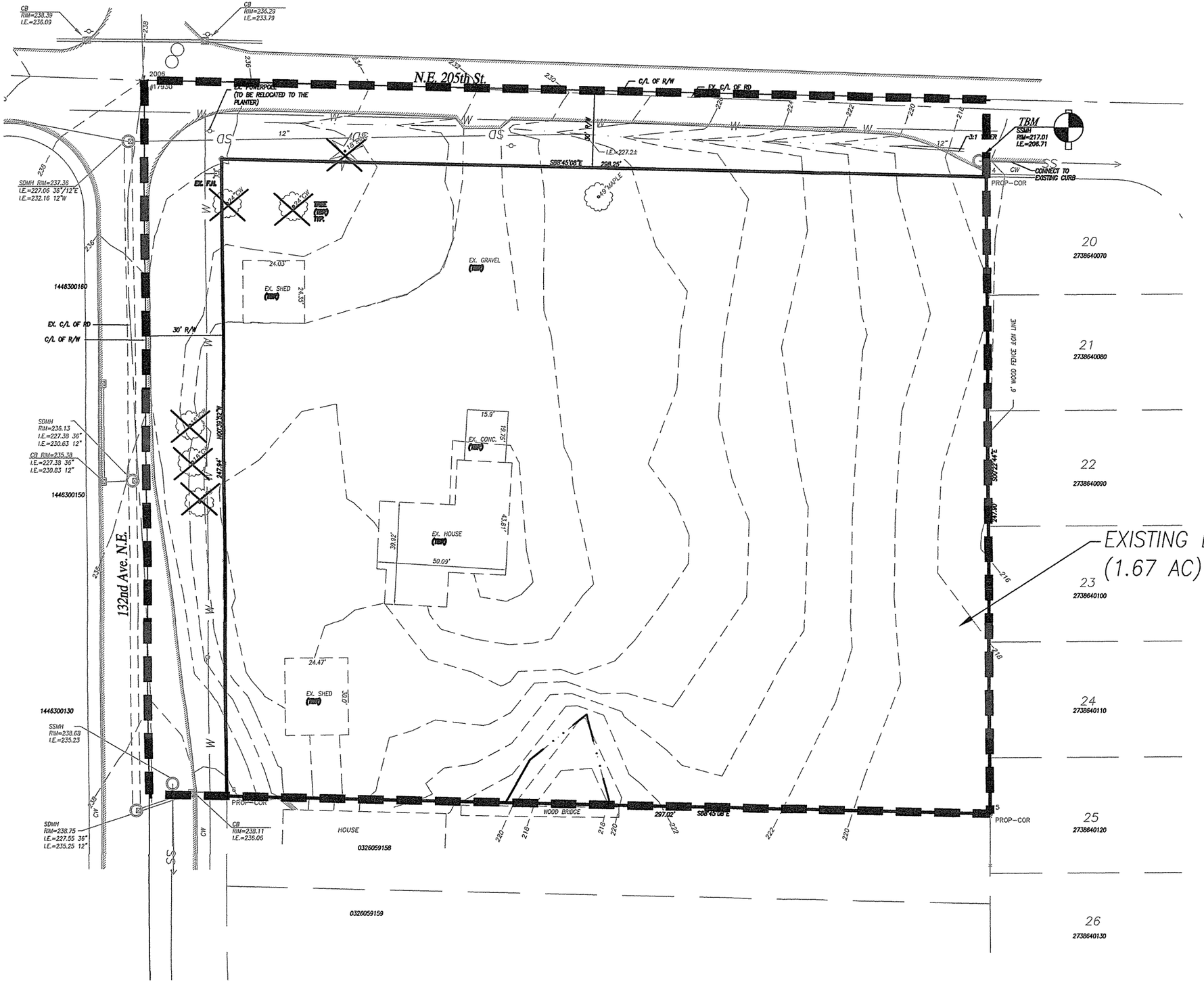
Designed Impervious Area for Individual Lot Infiltration:

Home	= 2,178 SF (0.05 Acres)
Driveway	= 500 SF (0.01 Acres)
Total Impervious	= 2,678 SF (0.06 Acres)

Designed Impervious Area for the Frontage and Private Access Tract Infiltration:

Sidewalk	= 3,969 SF (0.09 Acres)
New Asphalt	= 4,909 SF (0.11 Acres)
Ex. Asphalt	= 10,454 SF (0.24 Acres)
Private Access	= 4,727 SF (0.11 Acres)
Total Impervious	= 24,059 SF (0.55 Acres)

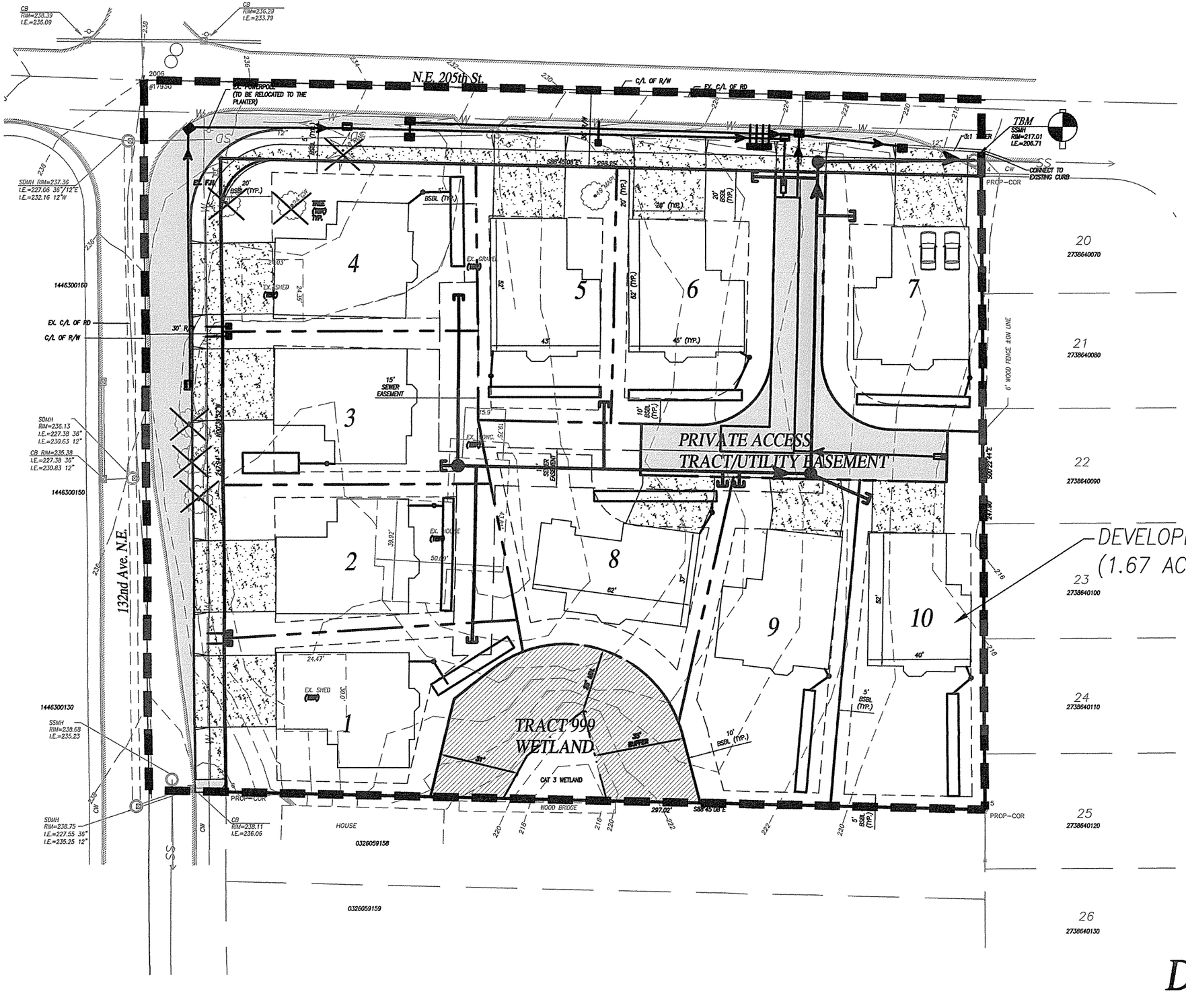
All pervious areas will infiltrate and disperse through the lawn and vegetation.



SCALE: 1" = 40'

0 20 40

EXISTING BASIN MAP



SCALE: 1" = 40'

0 20 40

DEVELOPED BASIN MAP

WWHM2012
PROJECT REPORT

Project Name: Woodinville 10-Inv lot infl
Site Name: Woodinville 10
Site Address: 13215 NE 205th St
City : Woodinville
Report Date: 6/30/2015
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version : 2015/03/18

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Ex
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	.06
Pervious Total	0.06

Impervious Land Use	Acres
Impervious Total	0
Basin Total	0.06

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Dv
Bypass: No

GroundWater: No

Pervious Land Use	Acres
Pervious Total	0

Impervious Land Use	Acres
ROOF TOPS FLAT	0.05
DRIVEWAYS FLAT	0.01
Impervious Total	0.06
Basin Total	0.06

Element Flows To:

Surface	Interflow	Groundwater
Infiltration Trench	Infiltration Trench	

Name : Infiltration Trench
Bottom Length: 44.00 ft.
Bottom Width: 4.00 ft.
Trench bottom slope 1: 0.001 To 1
Trench Left side slope 0: 0.001 To 1
Trench right side slope 2: 0.001 To 1
Material thickness of first layer: 5
Pour Space of material for first layer: 0.4
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 2.75
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft): 9.363
Total Volume Through Riser (ac-ft): 0.001
Total Volume Through Facility (ac-ft): 9.363
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 5 ft.
Riser Diameter: 10 in.

Element Flows To:

Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.004	0.000	0.000	0.000
0.0556	0.004	0.000	0.000	0.011
0.1111	0.004	0.000	0.000	0.011
0.1667	0.004	0.000	0.000	0.011
0.2222	0.004	0.000	0.000	0.011
0.2778	0.004	0.000	0.000	0.011
0.3333	0.004	0.000	0.000	0.011
0.3889	0.004	0.000	0.000	0.011
0.4444	0.004	0.000	0.000	0.011
0.5000	0.004	0.000	0.000	0.011
0.5556	0.004	0.000	0.000	0.011
0.6111	0.004	0.001	0.000	0.011
0.6667	0.004	0.001	0.000	0.011
0.7222	0.004	0.001	0.000	0.011
0.7778	0.004	0.001	0.000	0.011
0.8333	0.004	0.001	0.000	0.011
0.8889	0.004	0.001	0.000	0.011
0.9444	0.004	0.001	0.000	0.011
1.0000	0.004	0.001	0.000	0.011
1.0556	0.004	0.001	0.000	0.011
1.1111	0.004	0.001	0.000	0.011
1.1667	0.004	0.001	0.000	0.011
1.2222	0.004	0.002	0.000	0.011
1.2778	0.004	0.002	0.000	0.011
1.3333	0.004	0.002	0.000	0.011
1.3889	0.004	0.002	0.000	0.011
1.4444	0.004	0.002	0.000	0.011
1.5000	0.004	0.002	0.000	0.011
1.5556	0.004	0.002	0.000	0.011
1.6111	0.004	0.002	0.000	0.011
1.6667	0.004	0.002	0.000	0.011
1.7222	0.004	0.002	0.000	0.011
1.7778	0.004	0.002	0.000	0.011
1.8333	0.004	0.003	0.000	0.011
1.8889	0.004	0.003	0.000	0.011
1.9444	0.004	0.003	0.000	0.011
2.0000	0.004	0.003	0.000	0.011
2.0556	0.004	0.003	0.000	0.011
2.1111	0.004	0.003	0.000	0.011
2.1667	0.004	0.003	0.000	0.011
2.2222	0.004	0.003	0.000	0.011
2.2778	0.004	0.003	0.000	0.011
2.3333	0.004	0.003	0.000	0.011
2.3889	0.004	0.003	0.000	0.011
2.4444	0.004	0.004	0.000	0.011
2.5000	0.004	0.004	0.000	0.011
2.5556	0.004	0.004	0.000	0.011
2.6111	0.004	0.004	0.000	0.011
2.6667	0.004	0.004	0.000	0.011
2.7222	0.004	0.004	0.000	0.011
2.7778	0.004	0.004	0.000	0.011
2.8333	0.004	0.004	0.000	0.011
2.8889	0.004	0.004	0.000	0.011

2.9444	0.004	0.004	0.000	0.011
3.0000	0.004	0.004	0.000	0.011
3.0556	0.004	0.004	0.000	0.011
3.1111	0.004	0.005	0.000	0.011
3.1667	0.004	0.005	0.000	0.011
3.2222	0.004	0.005	0.000	0.011
3.2778	0.004	0.005	0.000	0.011
3.3333	0.004	0.005	0.000	0.011
3.3889	0.004	0.005	0.000	0.011
3.4444	0.004	0.005	0.000	0.011
3.5000	0.004	0.005	0.000	0.011
3.5556	0.004	0.005	0.000	0.011
3.6111	0.004	0.005	0.000	0.011
3.6667	0.004	0.005	0.000	0.011
3.7222	0.004	0.006	0.000	0.011
3.7778	0.004	0.006	0.000	0.011
3.8333	0.004	0.006	0.000	0.011
3.8889	0.004	0.006	0.000	0.011
3.9444	0.004	0.006	0.000	0.011
4.0000	0.004	0.006	0.000	0.011
4.0556	0.004	0.006	0.000	0.011
4.1111	0.004	0.006	0.000	0.011
4.1667	0.004	0.006	0.000	0.011
4.2222	0.004	0.006	0.000	0.011
4.2778	0.004	0.006	0.000	0.011
4.3333	0.004	0.007	0.000	0.011
4.3889	0.004	0.007	0.000	0.011
4.4444	0.004	0.007	0.000	0.011
4.5000	0.004	0.007	0.000	0.011
4.5556	0.004	0.007	0.000	0.011
4.6111	0.004	0.007	0.000	0.011
4.6667	0.004	0.007	0.000	0.011
4.7222	0.004	0.007	0.000	0.011
4.7778	0.004	0.007	0.000	0.011
4.8333	0.004	0.007	0.000	0.011
4.8889	0.004	0.007	0.000	0.011
4.9444	0.004	0.008	0.000	0.011
5.0000	0.004	0.008	0.000	0.011

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.06
Total Impervious Area:0

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

Total Impervious Area:0.06

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.001764
5 year	0.002771
10 year	0.003341
25 year	0.003945
50 year	0.004319
100 year	0.004637

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	0.002	0.000
1950	0.002	0.000
1951	0.004	0.000
1952	0.001	0.000
1953	0.001	0.000
1954	0.002	0.000
1955	0.002	0.000
1956	0.002	0.000
1957	0.002	0.000
1958	0.002	0.000
1959	0.002	0.000
1960	0.003	0.000
1961	0.001	0.000
1962	0.001	0.000
1963	0.001	0.000
1964	0.002	0.000
1965	0.001	0.000
1966	0.001	0.000
1967	0.002	0.000
1968	0.001	0.000
1969	0.001	0.000
1970	0.001	0.000
1971	0.001	0.000
1972	0.003	0.000
1973	0.001	0.000
1974	0.001	0.000
1975	0.002	0.000
1976	0.001	0.000
1977	0.000	0.000
1978	0.001	0.000

1979	0.001	0.000
1980	0.003	0.000
1981	0.001	0.000
1982	0.002	0.000
1983	0.002	0.000
1984	0.001	0.000
1985	0.001	0.000
1986	0.003	0.000
1987	0.003	0.000
1988	0.001	0.000
1989	0.001	0.000
1990	0.006	0.000
1991	0.003	0.000
1992	0.001	0.000
1993	0.001	0.000
1994	0.000	0.000
1995	0.002	0.000
1996	0.004	0.000
1997	0.003	0.000
1998	0.001	0.000
1999	0.003	0.000
2000	0.001	0.000
2001	0.000	0.000
2002	0.001	0.000
2003	0.002	0.000
2004	0.002	0.009
2005	0.002	0.000
2006	0.002	0.000
2007	0.004	0.000
2008	0.005	0.000
2009	0.003	0.000

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

Rank	Predeveloped	Mitigated
1	0.0057	0.0094
2	0.0054	0.0000
3	0.0042	0.0000
4	0.0041	0.0000
5	0.0039	0.0000
6	0.0035	0.0000
7	0.0034	0.0000
8	0.0032	0.0000
9	0.0031	0.0000
10	0.0029	0.0000
11	0.0027	0.0000
12	0.0027	0.0000
13	0.0027	0.0000
14	0.0026	0.0000
15	0.0025	0.0000
16	0.0024	0.0000
17	0.0024	0.0000
18	0.0022	0.0000
19	0.0021	0.0000

20	0.0021	0.0000
21	0.0020	0.0000
22	0.0019	0.0000
23	0.0019	0.0000
24	0.0019	0.0000
25	0.0019	0.0000
26	0.0018	0.0000
27	0.0018	0.0000
28	0.0017	0.0000
29	0.0017	0.0000
30	0.0016	0.0000
31	0.0015	0.0000
32	0.0015	0.0000
33	0.0015	0.0000
34	0.0015	0.0000
35	0.0015	0.0000
36	0.0015	0.0000
37	0.0014	0.0000
38	0.0014	0.0000
39	0.0014	0.0000
40	0.0014	0.0000
41	0.0013	0.0000
42	0.0013	0.0000
43	0.0013	0.0000
44	0.0013	0.0000
45	0.0012	0.0000
46	0.0012	0.0000
47	0.0012	0.0000
48	0.0012	0.0000
49	0.0012	0.0000
50	0.0011	0.0000
51	0.0011	0.0000
52	0.0011	0.0000
53	0.0010	0.0000
54	0.0009	0.0000
55	0.0008	0.0000
56	0.0007	0.0000
57	0.0007	0.0000
58	0.0007	0.0000
59	0.0005	0.0000
60	0.0002	0.0000
61	0.0002	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0009	17547	6	0	Pass
0.0009	16191	6	0	Pass
0.0010	14979	6	0	Pass
0.0010	13854	5	0	Pass

0.0010	12831	5	0	Pass
0.0011	11819	5	0	Pass
0.0011	10902	5	0	Pass
0.0011	10119	5	0	Pass
0.0012	9396	5	0	Pass
0.0012	8737	5	0	Pass
0.0012	8147	5	0	Pass
0.0013	7608	5	0	Pass
0.0013	7071	5	0	Pass
0.0013	6592	5	0	Pass
0.0014	6145	5	0	Pass
0.0014	5784	5	0	Pass
0.0014	5437	5	0	Pass
0.0015	5099	5	0	Pass
0.0015	4815	5	0	Pass
0.0015	4528	5	0	Pass
0.0016	4254	5	0	Pass
0.0016	4017	5	0	Pass
0.0016	3788	5	0	Pass
0.0017	3551	5	0	Pass
0.0017	3339	5	0	Pass
0.0017	3138	5	0	Pass
0.0018	2954	5	0	Pass
0.0018	2787	5	0	Pass
0.0019	2599	5	0	Pass
0.0019	2449	5	0	Pass
0.0019	2308	5	0	Pass
0.0020	2162	5	0	Pass
0.0020	2028	5	0	Pass
0.0020	1901	5	0	Pass
0.0021	1790	5	0	Pass
0.0021	1687	5	0	Pass
0.0021	1590	5	0	Pass
0.0022	1483	5	0	Pass
0.0022	1380	5	0	Pass
0.0022	1293	5	0	Pass
0.0023	1221	5	0	Pass
0.0023	1155	5	0	Pass
0.0023	1098	5	0	Pass
0.0024	1049	3	0	Pass
0.0024	997	3	0	Pass
0.0024	930	3	0	Pass
0.0025	884	3	0	Pass
0.0025	838	3	0	Pass
0.0025	789	3	0	Pass
0.0026	743	3	0	Pass
0.0026	713	3	0	Pass
0.0027	669	3	0	Pass
0.0027	631	3	0	Pass
0.0027	595	3	0	Pass
0.0028	567	3	0	Pass
0.0028	539	3	0	Pass
0.0028	496	3	0	Pass
0.0029	473	3	0	Pass
0.0029	435	3	0	Pass

0.0029	399	3	0	Pass
0.0030	366	3	0	Pass
0.0030	348	3	0	Pass
0.0030	323	3	0	Pass
0.0031	296	3	1	Pass
0.0031	273	3	1	Pass
0.0031	256	3	1	Pass
0.0032	235	3	1	Pass
0.0032	217	3	1	Pass
0.0032	197	3	1	Pass
0.0033	180	3	1	Pass
0.0033	158	3	1	Pass
0.0033	145	3	2	Pass
0.0034	129	3	2	Pass
0.0034	119	3	2	Pass
0.0035	109	3	2	Pass
0.0035	97	3	3	Pass
0.0035	91	3	3	Pass
0.0036	82	3	3	Pass
0.0036	76	3	3	Pass
0.0036	69	3	4	Pass
0.0037	61	3	4	Pass
0.0037	54	3	5	Pass
0.0037	48	3	6	Pass
0.0038	41	3	7	Pass
0.0038	38	3	7	Pass
0.0038	33	3	9	Pass
0.0039	27	3	11	Pass
0.0039	22	3	13	Pass
0.0039	21	3	14	Pass
0.0040	20	2	10	Pass
0.0040	19	2	10	Pass
0.0040	17	2	11	Pass
0.0041	14	2	14	Pass
0.0041	12	2	16	Pass
0.0041	9	2	22	Pass
0.0042	4	2	50	Pass
0.0042	3	2	66	Pass
0.0042	3	2	66	Pass
0.0043	3	2	66	Pass
0.0043	3	2	66	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	Total Volumn	Volumn	Infiltration	Cumulative

Percent Volumn Infiltrated	Water Quality	Percent Treatment? Water Quality Treated	Comment Needs Treatment (ac-ft)	Through Facility (ac-ft)	Volumn (ac-ft)	Volumn Infiltration Credit
Infiltration Trench POC 99.29		N	8.58			N
Total Volume Infiltrated 99.29	0.00	0%	8.58 No Treat. Credit	0.00	0.00	

Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: Woodinville 10 - Front and int rd
Site Name: Woodinville 10
Site Address: 13215 NE 205th St
City : Woodinville
Report Date: 6/30/2015
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version : 2015/03/18

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Ex
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	.44
Pervious Total	0.44

Impervious Land Use	Acres
Impervious Total	0
Basin Total	0.44

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Dv
Bypass: No

GroundWater: No

Pervious Land Use	Acres
Pervious Total	0

Impervious Land Use	Acres
ROADS FLAT	0.35
SIDEWALKS FLAT	0.09
Impervious Total	0.44
Basin Total	0.44

Element Flows To:

Surface	Interflow	Groundwater
Infiltration Trench	Infiltration Trench	

Name : Infiltration Trench
Bottom Length: 129.00 ft.
Bottom Width: 10.00 ft.
Trench bottom slope 1: 0.001 To 1
Trench Left side slope 0: 0.001 To 1
Trench right side slope 2: 0.001 To 1
Material thickness of first layer: 5
Pour Space of material for first layer: 0.4
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 2.75
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft): 69.062
Total Volume Through Riser (ac-ft): 0.004
Total Volume Through Facility (ac-ft): 69.066
Percent Infiltrated: 99.99
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 5 ft.
Riser Diameter: 12 in.

Element Flows To:

Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.029	0.000	0.000	0.000
0.0556	0.029	0.000	0.000	0.082
0.1111	0.029	0.001	0.000	0.082
0.1667	0.029	0.002	0.000	0.082
0.2222	0.029	0.002	0.000	0.082
0.2778	0.029	0.003	0.000	0.082
0.3333	0.029	0.003	0.000	0.082
0.3889	0.029	0.004	0.000	0.082
0.4444	0.029	0.005	0.000	0.082
0.5000	0.029	0.005	0.000	0.082
0.5556	0.029	0.006	0.000	0.082
0.6111	0.029	0.007	0.000	0.082
0.6667	0.029	0.007	0.000	0.082
0.7222	0.029	0.008	0.000	0.082
0.7778	0.029	0.009	0.000	0.082
0.8333	0.029	0.009	0.000	0.082
0.8889	0.029	0.010	0.000	0.082
0.9444	0.029	0.011	0.000	0.082
1.0000	0.029	0.011	0.000	0.082
1.0556	0.029	0.012	0.000	0.082
1.1111	0.029	0.013	0.000	0.082
1.1667	0.029	0.013	0.000	0.082
1.2222	0.029	0.014	0.000	0.082
1.2778	0.029	0.015	0.000	0.082
1.3333	0.029	0.015	0.000	0.082
1.3889	0.029	0.016	0.000	0.082
1.4444	0.029	0.017	0.000	0.082
1.5000	0.029	0.017	0.000	0.082
1.5556	0.029	0.018	0.000	0.082
1.6111	0.029	0.019	0.000	0.082
1.6667	0.029	0.019	0.000	0.082
1.7222	0.029	0.020	0.000	0.082
1.7778	0.029	0.021	0.000	0.082
1.8333	0.029	0.021	0.000	0.082
1.8889	0.029	0.022	0.000	0.082
1.9444	0.029	0.023	0.000	0.082
2.0000	0.029	0.023	0.000	0.082
2.0556	0.029	0.024	0.000	0.082
2.1111	0.029	0.025	0.000	0.082
2.1667	0.029	0.025	0.000	0.082
2.2222	0.029	0.026	0.000	0.082
2.2778	0.029	0.027	0.000	0.082
2.3333	0.029	0.027	0.000	0.082
2.3889	0.029	0.028	0.000	0.082
2.4444	0.029	0.029	0.000	0.082
2.5000	0.029	0.029	0.000	0.082
2.5556	0.029	0.030	0.000	0.082
2.6111	0.029	0.030	0.000	0.082
2.6667	0.029	0.031	0.000	0.082
2.7222	0.029	0.032	0.000	0.082
2.7778	0.029	0.032	0.000	0.082

2.8333	0.029	0.033	0.000	0.082
2.8889	0.029	0.034	0.000	0.082
2.9444	0.029	0.034	0.000	0.082
3.0000	0.029	0.035	0.000	0.082
3.0556	0.029	0.036	0.000	0.082
3.1111	0.029	0.036	0.000	0.082
3.1667	0.029	0.037	0.000	0.082
3.2222	0.029	0.038	0.000	0.082
3.2778	0.029	0.038	0.000	0.082
3.3333	0.029	0.039	0.000	0.082
3.3889	0.029	0.040	0.000	0.082
3.4444	0.029	0.040	0.000	0.082
3.5000	0.029	0.041	0.000	0.082
3.5556	0.029	0.042	0.000	0.082
3.6111	0.029	0.042	0.000	0.082
3.6667	0.029	0.043	0.000	0.082
3.7222	0.029	0.044	0.000	0.082
3.7778	0.029	0.044	0.000	0.082
3.8333	0.029	0.045	0.000	0.082
3.8889	0.029	0.046	0.000	0.082
3.9444	0.029	0.046	0.000	0.082
4.0000	0.029	0.047	0.000	0.082
4.0556	0.029	0.048	0.000	0.082
4.1111	0.029	0.048	0.000	0.082
4.1667	0.029	0.049	0.000	0.082
4.2222	0.029	0.050	0.000	0.082
4.2778	0.029	0.050	0.000	0.082
4.3333	0.029	0.051	0.000	0.082
4.3889	0.029	0.052	0.000	0.082
4.4444	0.029	0.052	0.000	0.082
4.5000	0.029	0.053	0.000	0.082
4.5556	0.029	0.054	0.000	0.082
4.6111	0.029	0.054	0.000	0.082
4.6667	0.029	0.055	0.000	0.082
4.7222	0.029	0.056	0.000	0.082
4.7778	0.029	0.056	0.000	0.082
4.8333	0.029	0.057	0.000	0.082
4.8889	0.029	0.057	0.000	0.082
4.9444	0.029	0.058	0.000	0.082
5.0000	0.029	0.059	0.000	0.082

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.44
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.44

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.012936
5 year	0.020317
10 year	0.0245
25 year	0.028931
50 year	0.031673
100 year	0.034005

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	0.013	0.000
1950	0.016	0.000
1951	0.028	0.000
1952	0.009	0.000
1953	0.007	0.000
1954	0.011	0.000
1955	0.018	0.000
1956	0.014	0.000
1957	0.011	0.000
1958	0.013	0.000
1959	0.011	0.000
1960	0.019	0.000
1961	0.011	0.000
1962	0.007	0.000
1963	0.009	0.000
1964	0.012	0.000
1965	0.009	0.000
1966	0.008	0.000
1967	0.018	0.000
1968	0.011	0.000
1969	0.011	0.000
1970	0.009	0.000
1971	0.009	0.000
1972	0.021	0.000
1973	0.010	0.000
1974	0.010	0.000
1975	0.014	0.000
1976	0.010	0.000

1977	0.001	0.000
1978	0.009	0.000
1979	0.005	0.000
1980	0.020	0.000
1981	0.008	0.000
1982	0.015	0.000
1983	0.014	0.000
1984	0.009	0.000
1985	0.005	0.000
1986	0.022	0.000
1987	0.020	0.000
1988	0.008	0.000
1989	0.005	0.000
1990	0.041	0.000
1991	0.025	0.000
1992	0.010	0.000
1993	0.010	0.000
1994	0.003	0.000
1995	0.014	0.000
1996	0.030	0.000
1997	0.025	0.000
1998	0.006	0.000
1999	0.024	0.000
2000	0.010	0.000
2001	0.002	0.000
2002	0.011	0.000
2003	0.014	0.000
2004	0.018	0.054
2005	0.013	0.000
2006	0.015	0.000
2007	0.031	0.000
2008	0.040	0.000
2009	0.019	0.000

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

Rank	Predeveloped	Mitigated
1	0.0415	0.0539
2	0.0397	0.0000
3	0.0308	0.0000
4	0.0303	0.0000
5	0.0285	0.0000
6	0.0253	0.0000
7	0.0250	0.0000
8	0.0238	0.0000
9	0.0224	0.0000
10	0.0212	0.0000
11	0.0201	0.0000
12	0.0198	0.0000
13	0.0195	0.0000
14	0.0193	0.0000
15	0.0181	0.0000
16	0.0178	0.0000
17	0.0176	0.0000

18	0.0158	0.0000
19	0.0155	0.0000
20	0.0153	0.0000
21	0.0144	0.0000
22	0.0142	0.0000
23	0.0141	0.0000
24	0.0140	0.0000
25	0.0139	0.0000
26	0.0130	0.0000
27	0.0129	0.0000
28	0.0127	0.0000
29	0.0122	0.0000
30	0.0114	0.0000
31	0.0111	0.0000
32	0.0110	0.0000
33	0.0110	0.0000
34	0.0110	0.0000
35	0.0109	0.0000
36	0.0107	0.0000
37	0.0105	0.0000
38	0.0102	0.0000
39	0.0100	0.0000
40	0.0100	0.0000
41	0.0096	0.0000
42	0.0096	0.0000
43	0.0095	0.0000
44	0.0093	0.0000
45	0.0090	0.0000
46	0.0090	0.0000
47	0.0089	0.0000
48	0.0087	0.0000
49	0.0086	0.0000
50	0.0084	0.0000
51	0.0080	0.0000
52	0.0078	0.0000
53	0.0073	0.0000
54	0.0068	0.0000
55	0.0057	0.0000
56	0.0054	0.0000
57	0.0051	0.0000
58	0.0051	0.0000
59	0.0034	0.0000
60	0.0018	0.0000
61	0.0012	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	**Predev**	**Mit**	**Percentage**	**Pass/Fail**
0.0065	17547	7	0	Pass
0.0067	16164	7	0	Pass

0.0070	14964	7	0	Pass
0.0072	13854	7	0	Pass
0.0075	12812	5	0	Pass
0.0077	11811	5	0	Pass
0.0080	10900	5	0	Pass
0.0083	10119	5	0	Pass
0.0085	9383	5	0	Pass
0.0088	8729	5	0	Pass
0.0090	8145	5	0	Pass
0.0093	7593	5	0	Pass
0.0095	7060	5	0	Pass
0.0098	6590	5	0	Pass
0.0100	6149	5	0	Pass
0.0103	5784	5	0	Pass
0.0105	5433	5	0	Pass
0.0108	5106	5	0	Pass
0.0111	4808	5	0	Pass
0.0113	4528	5	0	Pass
0.0116	4263	5	0	Pass
0.0118	4019	5	0	Pass
0.0121	3794	5	0	Pass
0.0123	3551	5	0	Pass
0.0126	3341	5	0	Pass
0.0128	3138	5	0	Pass
0.0131	2954	5	0	Pass
0.0133	2787	5	0	Pass
0.0136	2601	5	0	Pass
0.0139	2447	5	0	Pass
0.0141	2308	5	0	Pass
0.0144	2160	5	0	Pass
0.0146	2028	5	0	Pass
0.0149	1904	5	0	Pass
0.0151	1790	5	0	Pass
0.0154	1694	5	0	Pass
0.0156	1588	5	0	Pass
0.0159	1484	5	0	Pass
0.0161	1381	5	0	Pass
0.0164	1293	5	0	Pass
0.0167	1219	5	0	Pass
0.0169	1155	5	0	Pass
0.0172	1098	5	0	Pass
0.0174	1049	5	0	Pass
0.0177	997	5	0	Pass
0.0179	930	5	0	Pass
0.0182	884	5	0	Pass
0.0184	838	5	0	Pass
0.0187	790	5	0	Pass
0.0189	743	5	0	Pass
0.0192	713	5	0	Pass
0.0195	668	5	0	Pass
0.0197	633	5	0	Pass
0.0200	595	5	0	Pass
0.0202	567	5	0	Pass
0.0205	539	4	0	Pass
0.0207	497	4	0	Pass

0.0210	473	4	0	Pass
0.0212	435	4	0	Pass
0.0215	401	4	0	Pass
0.0217	366	4	1	Pass
0.0220	348	4	1	Pass
0.0223	323	4	1	Pass
0.0225	296	4	1	Pass
0.0228	272	3	1	Pass
0.0230	256	3	1	Pass
0.0233	235	3	1	Pass
0.0235	217	3	1	Pass
0.0238	195	3	1	Pass
0.0240	180	3	1	Pass
0.0243	158	3	1	Pass
0.0245	145	3	2	Pass
0.0248	129	3	2	Pass
0.0251	119	3	2	Pass
0.0253	109	3	2	Pass
0.0256	97	3	3	Pass
0.0258	91	3	3	Pass
0.0261	82	3	3	Pass
0.0263	76	3	3	Pass
0.0266	69	3	4	Pass
0.0268	61	3	4	Pass
0.0271	54	3	5	Pass
0.0273	48	3	6	Pass
0.0276	41	3	7	Pass
0.0279	38	3	7	Pass
0.0281	33	3	9	Pass
0.0284	27	3	11	Pass
0.0286	22	3	13	Pass
0.0289	21	3	14	Pass
0.0291	20	3	15	Pass
0.0294	19	3	15	Pass
0.0296	17	3	17	Pass
0.0299	13	3	23	Pass
0.0301	12	3	25	Pass
0.0304	8	3	37	Pass
0.0307	4	3	75	Pass
0.0309	3	3	100	Pass
0.0312	3	3	100	Pass
0.0314	3	3	100	Pass
0.0317	3	3	100	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 Percent Water Quality Treatment?	Total Volumn Needs Treatment (ac-ft)	Volumn Through Facility (ac-ft)	Infiltration Volumn (ac-ft)	Cumulative Volumn Infiltration Credit	Percent Volumn Infiltrated	Comment Water Quality Treated
Infiltration Trench POC	N	62.92			N	99.88	
Total Volume Infiltrated		62.92	0.00	0.00		99.88	0.00
	0%	No Treat. Credit					

Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

5.0 Special Reports and Studies

A. Geotechnical Report by Liu & Associates, Inc. dated May 5, 2015

LIU & ASSOCIATES, INC.

Geotechnical Engineering | Engineering Geology | Earth Science

May 5, 2015

Mr. Mike Appleby
Clearwater Homes, LLC
14227 Evergreen Way
Stanwood, WA 98292

Dear Mr. Appleby:

Subject: Geotechnical Investigation
Southend - Woodinville
NE 205th Street & 132nd Avenue NE
Woodinville, Washington
L&A Job No. 15-028

INTRODUCTION

We understand that a residential development project is proposed for the subject property, located at the southeast corner of the intersection of NE 205th Street and 132nd Avenue NE in Woodinville, Washington. We also understand the proposed development is to plat the site into nine single-family building lots with supporting infrastructure. The wetland located on the central south side of the project site is to remain undisturbed. At your request, we have completed a geotechnical investigation for the subject development project. The purpose of this investigation is to explore and characterize subsurface conditions of the project site and provide geotechnical recommendations of grading, site stabilization, onsite stormwater disposal, erosion mitigation, surface and ground water drainage control, and foundation support to buildings for the proposed development. Presented in this report are our findings of the site conditions, conclusion, and geotechnical recommendations.

PROJECT DESCRIPTION

For our use in this investigation, you provided us with a topographic survey and plat plan of the proposed development. According to this plan, a wetland is outlined on the central south side of the project site where a south-trending trough is located. The tract at the northeast corner of the site is reserved for stormwater disposal. The remaining area of the site is to be platted into 9 lots with a paved driveway off NE 205th Street to access the central and eastern lots. The western lots will be accessed from 132nd Avenue SE. The project site slopes down generally easterly with the central south side slopes down to the south. There will be minor to some cut and fill for site grading. Stormwater collected over impervious surfaces will be disposed on site in the tract at the northeast corner of the site. The residential buildings to be built on the lots will be above-grade, wood-framed structures.

SCOPE OF SERVICES

Our scope of services for this study comprises specifically the following:

1. Review geologic and soil conditions at and in the vicinity of the project site based on a published geologic map.

2. Explore subsurface (soil and groundwater) conditions of the site with test pits to depths where a firm bearing soil layer and/or an infiltratable soil stratum is encountered or to the maximum depth (about 10 feet) capable by the backhoe used in subsurface exploration, whichever is encountered first.

3. Conduct laboratory soil particle size distribution test in accordance with ASTM D422 on two to four soil samples obtained from targeted soil layers in test pits

suitable for stormwater disposal by infiltration. The results of the tests will be used in determining design infiltration rates of the soil layers in accordance with the USDA Texture Triangle and the 2012 Stormwater Management Manual for Western Washington by Washington State Department of Ecology.

4. Perform necessary geotechnical engineering analyses based on subsurface data obtained from test pits.

5. Prepare a written report to present our findings, conclusion, and geotechnical recommendations.

SITE CONDITIONS

SURFACE CONDITION

The general location of the project site is shown on Plate 1 – Vicinity Map. The site is situated on a broad, gentle to moderately-steep, easterly-to-southeasterly declining slope. It is located at the southeast corner of the intersection of NE 205th Street and 132nd Avenue NE, and is adjoined by residential development to the east and south. The ground within the site generally slopes down very gently to gently to the east with it central south side, where the wetland is, sloping moderately to steeply to the south.

An existing house and a storage shed occupy the southwest quadrant of the site. The open space of the site is mostly covered by lawn grass with brush growing along the east boundary. Scattered trees dot the north and west boundaries of the site.

GEOLOGIC SETTING

The Geologic Map of King County, Washington, by Derek B. Booth, Kathy A. Troost and Aaron P. Wisher (2007) was referenced for the geologic and soil conditions at the property. According to this publication, the surficial geologic units at and in the vicinity of the project site are mapped Vashon Till (Q_{vt}) underlain by Advance Outwash (Q_{va}).

The geology of the Puget Sound Lowland has been modified by the advance and retreat of several glaciers in the past one million years or so and the subsequent deposits and erosions. The latest glacier advanced to the Puget Sound Lowland is referred to as the Vashon Stade of the Fraser Glaciation which had occurred during the later stages of the Pleistocene Epoch, and retreated from the region some 12,500 years ago.

The deposits of the Vashon till soil unit were plowed directly under glacial ice during the most recent glacial period as the glacier advanced over an eroded, irregular surface of older formations and sediments. This soil unit is composed of a mixture of unsorted clay, silt, sand, gravel, and scattered cobbles and boulders. The Vashon till soil over the top two to three feet is normally weathered to a medium-dense state, and is moderately permeable and compressible. The underlying fresh till deposit, commonly referred to as "hard pan", is very-dense and cemented. The fresh till soil possesses a compressive strength comparable to that of low-grade concrete and can remain stable on steep natural slopes or man-make cuts for a long period. The fresh till deposit can provide excellent foundation support with little or no settlement, but is also of extremely low permeability and would hardly allow stormwater to seep through.

The deposits of the advance outwash soil unit, normally underlying the Vashon till soil unit, are composed of stratified sand and gravel with very minor amount of silt and clay, deposited by the meltwater of advancing glacial ice of the last glacier then overridden by the still advancing glacier. Due to their generally granular composition, the advance outwash deposits are of moderately high permeability and drains fairly well. The advance outwash deposits are generally dense to very dense in their natural, undisturbed state. The underlying fresh advance outwash deposits in their native, undisturbed state can provide good foundation support with little settlement expected for light to moderately heavy structures.

SOIL CONDITION

Subsurface conditions of the project site were explored with five test pits. The test pits were excavated on March 23, 2015, with a rubber-track backhoe to depths from 8.0 to 11.0 feet. The approximate locations of the test pits are shown on Plate 2 - Site and Exploration Location Plan. The test pits were located with either a tape measure or by visual reference to existing topographic features in the field and on the topographic survey map, and their locations should be considered as only accurate to the measuring method used.

A geotechnical engineer from our office was present during subsurface exploration, examined the soil and geologic conditions encountered, and completed logs of the test pits. Soil samples obtained from each soil layer in the test pits were visually classified in general accordance with United Soil Classification System, a copy of which is presented

on Plate 3. Detailed descriptions of soils encountered during site exploration are presented in test pit logs on Plates 4 through 6.

Test Pits 1 and 2, located on the east and west sides of the site, respectively, encountered a layer of loose, organic, fill/topsoil about 2 feet thick. More and thicker fill may exist along the east side of the site and near the wetland. Test Pits 1, 4 and 5 encountered a layer of loose, organic topsoil, about 12 to 16 inches, mantling the site. A thin layer of relic topsoil was found underlying the fill in Test Pit 3. The fill and topsoil are underlain by a layer of weathered soil of brown to light-brown to light-gray, medium-dense, silty fine sand with trace gravel, about 1.5 to 3.4 feet thick. The weathered soil layer is underlain by a layer of glacial till soil of light-gray, very-dense, gravelly, silty, fine sand with occasional cobble, about 2.4 to 3.0 feet thick. Underlying the glacial till soil to the depths explored is an advance outwash deposit of light-gray, dense, gravelly, silty, fine to medium sand.

GROUNDWATER CONDITION

Groundwater was encountered in the advance outwash deposit in all test pits but Test Pit 5. Groundwater seepage varied from a trickle at 9.5 feet deep in Test Pits 1 and 2, to 1 to 2 gallons per minute at 8.0 to 9.5 feet deep in Test Pits 3 and 4. The test pits were excavated in late winter to early spring when the groundwater level is normally at its highest.

The very-dense, cemented, fresh till deposit underlying the site at shallow depth is of extremely low permeability and would perch stormwater infiltrating into the more

permeable surficial soils, but this shallow perched groundwater was not encountered by the test pits. The advance outwash deposit underlying the till soil layer is of moderately high permeability and would allow stormwater to seep through. The amount of and the depth to the near-surface groundwater perched on the glacial till soil layer would fluctuate seasonally, depending on precipitation, surface runoff, ground vegetation cover, site utilization, and other factors.

GEOLOGIC HAZARDS AND MITIGATION

Landslide Hazard

The site is underlain at shallow depth by very-dense till and dense advance outwash soils. These deposits are of very-high to high shear strength and are highly resistant against slope failures. Also, the site is gently to moderately sloped. Therefore, the potential for deep-seated slides to occur on the site should be minimal.

Erosion Hazard

The surficial fill, topsoil, and weathered soil are of low resistance against erosion, while the underlying very-dense till deposits are of high resistance against erosion. The weaker surficial soils on steeper areas of the site could be gradually eroded if they are devoid of vegetation cover and saturated. However, because the site is gentle to moderate-steep, the erosion hazard of the site should be minimal. To further mitigated erosion hazard of the site, vegetation cover outside of construction areas should be protected and maintained and concentrated stormwater should not be discharged uncontrolled onto the ground within the site. Stormwater over impervious surfaces, such as roofs and paved driveways, should be captured by underground drain line systems connected to roof downspouts and

catch basins installed in paved areas. Water collected into these drain line systems should be tightlined to discharge into a storm sewer or suitable stormwater disposal facilities, such as infiltration trenches.

Seismic Hazard

The Puget Sound region is in an active seismic zone. The project site is underlain at shallow depth by very-dense till and dense advance outwash deposits of very-high to high shear strength. Therefore, the potential for seismic hazards, such as landslides, liquefaction, lateral soil spreading, to occur on the site should be minimal if the erosion mitigation, drainage control, and site stabilization measures recommended in this report are fully implemented. The proposed residential buildings, however, should be designed for seismic forces induced by strong earthquakes. Based on the soil conditions encountered by the test pits, it is our opinion that Seismic Use Group I and Site Class C should be used in the seismic design of the proposed residences in accordance with the 2012 International Building Code (IBC).

DISCUSSION AND RECOMMENDATIONS

GENERAL

Based on the soil conditions encountered by test pits excavated on the site, it is our opinion that the project site is suitable for the proposed development from the geotechnical engineering viewpoint, provided that the recommendations in this report are fully implemented and observed during and following completion of construction. Conventional footing foundations constructed on or into the underlying very-dense fresh till and/or dense advance outwash soil may be used to support the proposed residential

buildings. Unsuitable surficial fill, topsoil, and weathered soil should be stripped within footprint of driveways and areas of structural fill.

The fill, surficial topsoil, and weathered soil contain a high percentage of fines and can be easily disturbed when saturated. Grading work in wet winter months may cause complication and difficulty. Therefore, earth work should be scheduled and completed between April 1 and October 31, if possible. Otherwise, erosion protection and drainage control measures recommended in this report should be implemented for site stabilization and to facilitate earthwork if grading work is to be carried out beyond the above dryer period.

TEMPORARY DRAINAGE AND EROSION CONTROL

The onsite surficial weak soils are sensitive to moisture and can be easily disturbed by construction traffic. A layer of clean, 2-to-4-inch quarry spalls should be placed over areas of frequent traffic, such as the entrances to the site, as required, to protect the subgrade soils from disturbance by construction traffic.

A silt fence should be installed along the downhill sides of construction areas to minimize transport of sediment by storm runoff onto neighboring properties or the street. The bottom of the filter cloth of the silt fences should be anchored in a trench filled with onsite soil.

Intercepting ditches or trench drains should be installed around construction areas, as required, to intercept and drain away storm runoff and near-surface groundwater seepage.

Water captured by such ditches or trench drains should be stored in temporary holding and settling pits onsite. Only clear and clean water may be discharged into the wetland within the site. Discharged water should dispersed over a well vegetated area through a perforated spreader pipe of sufficient length to keep discharged water from causing erosion problem.

Spoil soils should be hauled off of the site as soon as possible. Spoil soils and imported structural fill material to be stored onsite should be stockpiled in areas where the ground is no steeper than 15% grade. Stockpiled spoil soils should be securely covered with plastic tarps, as required, for protection against erosion.

SITE PREPARATION AND GENERAL GRADING

Vegetation within construction limits should be cleared and grubbed. Existing structures to be demolished should have their foundations removed, too. Loose fill, topsoil, and weak weathered soil should be completely stripped down to the very-dense glacial till and/or dense advance outwash soil within the building pads of the proposed residences; while fill, topsoil and unsuitable soil in the root zone should be stripped down to the medium-dense weathered soil, and/or very-dense glacial till, and/or dense advance outwash soil within paved driveways. The exposed soils should be compacted to a non-yielding state with a mechanical compactor and proof-rolled with a piece of heavy earthwork equipment prior to driveway construction.

EXCAVATION AND FILL SLOPES

Under no circumstance should excavation slopes be steeper than the limits specified by local, state and federal safety regulations if workers have to perform construction work in excavated areas. Unsupported temporary cuts greater than 4 feet in height should be no steeper than 1H:1V in fill, topsoil, weathered soil, and may be vertical in the underlying very-dense fresh till and dense advance outwash soils if the overall depth of cut does not exceed 15 feet. Otherwise, cut in fresh till and advance outwash soils should be no steeper than 3/4H:1V. Permanent cut banks should be no steeper than 2-1/4H:1V in fill, topsoil and weathered soil, and no steeper than 1-1/2H:1V in the underlying very-dense fresh till and dense advance outwash soils. The soil units and the stability of cut slopes should be observed and verified by a geotechnical engineer during excavation.

Permanent fill embankments required to support structural or traffic load should be constructed with compacted structural fill placed over undisturbed, proof-rolled, firm, native soils after the surficial unsuitable soils are completely stripped. The slope of permanent fill embankments should be no steeper than 2-1/4H:1V. Upon completion, the sloping face of permanent fill embankments should be thoroughly compacted to a non-yielding state with a hoe-pack. Permanent fill embankments constructed over ground of 15% or more should be structurally supported laterally.

The above recommended cut slopes and fill embankments are under the condition that groundwater seepage would not be encountered during construction. If groundwater is encountered, the grading work should be immediately halted and the slope stability re-evaluated. The slopes may have to be flattened and other measures taken to stabilize the

slopes. Stormwater should not allowed to flow uncontrolled over cut slopes and fill embankments. Temporary cuts should be covered by plastic sheets, as required, for erosion protection. Permanent cut slopes or fill embankments should be seeded and vegetated as soon as possible for erosion protection and long-term stability, and should be covered with clear plastic sheets, as required, to protect them from erosion until the vegetation is fully established.

STRUCTURAL FILL

Structural fill is the fill that supports structural or traffic load. Structural fill should consist of clean granular soils free of organic, debris and other deleterious substances and with particles not larger than three inches. Structural fill should have a moisture content within one percent of its optimum moisture content at the time of placement. The optimum moisture content is the water content in the soils that enable the soils to be compacted to the highest dry density for a given compaction effort. Onsite soils meeting the above requirements may be used as structural fill. Imported material to be used as structural fill should be clean, free-draining, granular soils containing no more than 5 percent by weight finer than the No. 200 sieve based on the fraction of the material passing No. 4 sieve, and should have individual particles not larger than three inches.

The ground over which structural fill is to be placed should be prepared in accordance with recommendations in the SITE PREPARATION AND GENERAL GRADING and EXCAVATION AND FILL SLOPES sections of this report. Structural fill should be placed in lifts no more than 10 inches thick in its loose state, with each lift compacted to a

minimum percentage of the maximum dry density determined by ASTM D1557 (Modified Proctor Method) as follows:

Application	% of Maximum Dry Density
Within building pads and under foundations	95%
Roadway/driveway subgrade	95% for top 3 feet and 90% below
Retaining/foundation wall backfill	92%
Utility trench backfill	95% for top 4 feet and 90% below

In-situ density of structural fill should be tested with a nuclear densometer by a testing agency specialized in fill placement and construction work. Testing frequency should be one test per every 250 square feet per lift of fill.

ONSITE STORMWATER DISPOSAL

General

The advance outwash deposit underlying the project site is of moderately high permeability, and disposal of stormwater onsite by infiltrating into this soil deposit is feasible. Soil samples were obtained from the advance outwash deposit in the test pits. Soil Particle Size Distribution test was conducted on selected soil samples to determine design infiltration rate of the advance outwash deposit.

Soil Samples

Three soil samples, one from each of Test Pits 1, 3, and 5 in the advance outwash deposit were selected for Soil Particle Size Distribution test. These soil samples are described in the table below:

LIST OF SOIL SAMPLES

Sample No.	Test Pit No.	Depth feet	Soil Description
1	TP-1	8 - 9	Dark olive-brown, silty SAND
2	TP-3	7 - 8	Dark-brown, poorly-graded, SAND with silt and gravel
3	TP-5	8 - 9	Olive-brown, silty SAND

The percentages of clay, silt and sand/gravel of the soil samples determined from the soil particle size distribution tests are summarized on Plate A-1. Based on these percentages the soil samples were classified according to the USDA (U.S. Department of Agriculture) Texture Triangle chart, a copy of which is shown on Plate A-2 in the attached Appendix. The classifications of soil samples are presented in the table below:

USDA TEXTURE TRIANGLE CLASSIFICATION OF SOIL SAMPLES

Sample No.	Test Pit No.	Percentage Clay	Percentage Silt	Percentage Sand/Gravel	USDA Texture Triangle Classification
1	TP-1	1.7	11.8	86.5	Sand
2	TP-3	1.6	5.5	92.9	Sand
3	TP-5	2.5	10.6	86.9	Sand

Infiltration Rates

Volume III, Section 3.3.6, Article 3 - Soil Grain Size Analysis Method, of the 2012 Stormwater Management Manual for Western Washington, published by Washington State Department of Ecology, was used to determine estimated design infiltration rates of the targeted advance outwash deposit. This method uses D_{10} , D_{60}, D_{90}, and f_{fines} in calculating the saturated infiltration rate (conductivity), K_{sat} in cm/sec; where D_{10} , D_{60}, D_{90} are the sizes in millimeters of soil particles of 10%, 60%, and 90%, respectively, passing by weight, and f_{fines} is the fraction of the fines passing the No. 200 sieve by weight (i.e., the sum of clay and silt). The values of D_{10} , D_{60}, D_{90}, and f_{fines} are shown or obtained from test result on Plate A-1, and the determination of K_{sat} for the three soil samples are shown in the table below:

ESTIMATED INITIAL INFILTRATION RATES, K_{sat}

Sample No.	Test Pit No.	D_{10} Size	D_{60} Size	D_{90} Size	f_{fines}	[a] K_{sat} cm/sec	K_{sat} in/hour	Design K_{sat} in/hour
1	TP-1	0.0308	0.35	0.91	0.135	0.0158	22.39	5.6
2	TP-3	0.1038	2.06	14.04	0.071	0.0214	30.33	7.58
3	TP-5	0.0282	0.40	7.51	0.131	0.0131	18.71	4.68

[a] $\log_{10}(K_{sat}) = -1.57 + 1.90(D_{10}) + 0.015(D_{60}) - 0.013(D_{90}) - 2.08(f_{fines})$

Recommended Design Infiltration Rate

By applying a factor of safety of 4.0 to K_{sat} values, the design infiltration rates of the soil samples, Design K_{sat}, are determined and presented in the table above. On conservative side, we recommend a design infiltration rate of the advance outwash deposit not to

exceed 2.75 iph (inches per hour) be used for the design of infiltration trenches to be used for onsite stormwater disposal for the subject project.

Infiltration Trench Construction

Infiltration trenches should be set back at least 5 feet from property lines and 10 feet from nearby building footing foundations or utility trenches. Infiltration trenches should be located on the downhill side of adjacent residential buildings. The bottom of infiltration trenches should be cut at least one foot into the surface of the advance outwash deposit, but no less than one foot lower than the adjacent footing foundations and utility trenches. Soil condition at bottom of infiltration trenches should be verified by a geotechnical engineer. Stability of trench cut banks should also be verified by a geotechnical engineer during excavation. Impervious collars or clay dams should be installed in tightline trenches to prevent backflow of water from the infiltration trenches to the residences.

The infiltration trenches should be at least 24 inches wide. The side walls of the trenches should be lined with a layer of non-woven filter fabric, such as MIRAFI 140NS. The trenches are then filled with clean, 3/4 to 1-1/2 inch, washed gravel or crushed rock to within about 10 inches of the finish grade. The dispersion pipes should be constructed of 4-inch, rigid, perforated, PVC pipes, and laid level in the gravel or crushed rock filled trenches at about 16 inches or more below the top of trenches. The top of the gravel or crushed rock fill should also be covered with the filter fabric liner. The remaining trenches should then be backfilled with compacted clean onsite soils. The gravel or crushed rock fill should be placed in lifts no more than 10 inches thick in loose state, with each lift compacted to a non-yielding state with a vibratory mechanical compactor. The

compaction and densification of trench fill is critical if it is to support driveways. Stormwater captured over paved driveways should be routed into catch basins equipped with an oil-water separator before being released into the infiltration trenches.

BUILDING FOUNDATIONS

Conventional footing foundations may be used to support the proposed residential buildings. The footing foundations should be constructed on or into the underlying, very-dense fresh till and/or dense advance outwash soil, or on structural fill placed over these undisturbed competent basal soils. Water should not be allowed to accumulate in excavated footing trenches. Disturbed soils in footing trenches should be completely removed down to native, undisturbed, fresh till and/or advance outwash soil prior to pouring concrete for the footings.

If the above recommendations are followed, our recommended design criteria for footing foundations are as follows:

- The allowable soil bearing pressure for design of footing foundations, including dead and live loads, should be no greater than 3,000 psf if constructed on or into very-dense fresh till and/or advance outwash soil, and no greater than 2,500 psf if constructed on structural fill placed over these competent basal soils. The footing bearing soils should be verified by a geotechnical engineer after the footing trenches are excavated and before the footings poured.
- The minimum depth to bottom of perimeter footings below adjacent final exterior grade should be no less than 18 inches. The minimum depth to bottom of the interior footings below top of floor slab should be no less than 12 inches.

- The minimum width should be no less than 16 inches for continuous footings, and no less than 24 inches for individual footings, except those footings supporting light-weight decks or porches.

A one-third increase in the above recommended allowable soil bearing pressure may be used when considering short-term, transitory, wind or seismic loads. For footing foundations designed and constructed per recommendations above, we estimate that the maximum total post-construction settlement of the buildings should be 1/2 inch or less and the differential settlement across building width should be 3/8 inch or less.

Lateral loads on the proposed buildings may be resisted by the friction force between the foundations and the subgrade soils or the passive earth pressure acting on the below-grade portion of the foundations. For the latter, the foundations must be poured "neat" against undisturbed soils or backfilled with a clean, free-draining, compacted structural fill. We recommend that an equivalent fluid density (EFD) of 300 pcf (pounds per cubic foot) for the passive earth pressure be used for lateral resistance. The above passive pressure assumes that the backfill is level or inclines upward away from the foundations for a horizontal distance at least twice the depth of the foundations below the final grade. A coefficient of friction of 0.55 between the foundations and the subgrade soils may be used. The above soil parameters are unfactored values, and a proper factor of safety should be used in calculating the resisting forces against lateral loads on the buildings.

SLAB-ON-GRADE FLOORS

Slab-on-grade floors, if used for the residential buildings, should be placed on firm subgrade soil prepared as outlined in the SITE PREPARATION AND GENERAL

EARTHWORK and the STRUCTURAL FILL sections of this report. Where moisture control is critical, the slab-on-grade floors should be constructed on a capillary break which is in turn placed on the compacted subgrade. The capillary break should consist of a minimum 4-inch layer of clean, free-draining, 7/8-inch crushed rock, containing no more than 5 percent by weight passing the No. 4 sieve. A vapor barrier, such as a 6-mil plastic membrane, may be placed over the capillary break, as required, to keep moisture from migrating upwards.

CAST-IN-PLACE CONCRETE WALLS

Building foundation walls restrained at the top from lateral movement are considered unyielding and should be designed for a lateral soil pressure under the at-rest condition. Retaining walls unrestrained at the top from lateral movement may be designed for active soil pressure. For static loading condition, we recommend that an at-rest soil pressure of 50 pcf EFD (equivalent fluid density) and an active soil pressure of 35 pcf EFD be used for the design of building foundation walls and retaining walls, respectively, with a level or descending backslope. For walls with ascending backslope, an additional pressure of 0.75 pcf per degree of the backslope angle above the horizontal should be added to the above design pressures. To counter the above active or at-rest pressure, a passive lateral soil pressure of 300 pcf EFD may be used. This passive pressure value is applicable only to walls with a level or ascending backslope away from the walls for a horizontal distance at least 1.5 times the wall height. For seismic loading condition (100-year earthquake), an additional uniform distribution pressure of 8H psf should be added to the above pressures for wall design. H is the height of walls in feet. To resist against sliding, the friction force between the footings and the subgrade soils may be calculated based on a

coefficient of friction of 0.55. The above soil parameters are ultimate values based on a fully drained condition of the walls, and proper factors of safety should be applied in the design of the retaining and basement walls against sliding and overturning failures for static and seismic loadings.

A vertical drainage blanket, at least 12-inch-thick horizontally, consisting of clean, free-draining, pea gravel or washed gravel should be placed against the back of foundation and retaining walls to within 18 inches of the finish grade to prevent accumulation of groundwater behind and buildup of hydrostatic pressure against the walls. This drainage blanket fill should be compacted to a non-yielding state with a vibratory compactor. Structural fill should be used for the remaining wall backfill. The top 18 inches of the backfill may consist of compacted, clean, sandy soils. Heavy compaction equipment should not be allowed within the walls of a horizontal distance equal to that of the wall heights. A 4-inch perforated PVC footing drain pipe, as recommended in the DRAINAGE CONTROL section of this report, should be provided for the basement and retaining walls. The drain lines should be hydraulically connected to the drainage blanket behind the walls and tightlined to a storm sewer.

PAVED DRIVEWAYS

Performance of driveway pavement, including the joint-use driveway from NE 205th Street NE to the project site, is critically related to the conditions of the underlying subgrade soils. We recommend that the subgrade soils under the driveways be treated and prepared as described in the SITE PREPARATION AND GENERAL EARTHWORK section of this report. Prior to placing base material, the subgrade soils

should be compacted to a non-yielding state with a vibratory roller compactor and proof-rolled with a piece of heavy construction equipment, such as a fully-loaded dump truck. Any areas with excessive flexing or pumping should be over-excavated and re-compacted or replaced with a structural fill or crushed rock placed and compacted in accordance with the recommendations provided in the STRUCTURAL FILL section of this report.

We recommend that a layer of compacted, 7/8-inch crushed rock base (CRB), be placed for the driveways. This crushed rock base should be at least 6 inches thick for the joint-use driveway and 4 inches thick for the private driveways of the residences. This crushed rock base should be overlain with a 3-inch asphalt treated base (ATB) topped by a 2-inch-thick Class B asphalt concrete (AC) surficial course for the joint-use driveway, and overlain by a 3-inch-thick Class B asphalt concrete (AC) surficial course for the private driveways of the residences.

DRAINAGE CONTROL

Building Footprint Excavation

Footprint excavation for the proposed residential buildings, if encountering groundwater seepage, should have bottom of excavation sloped slightly and ditches excavated along bases of the cut banks to direct collected groundwater into sump pits from which water can be pumped out. A layer of 2-inch crushed rock should be placed over footing bearing subgrade soils, as required, to protect the soils from disturbance by construction traffic. This crushed rock base should be built to a few inches above groundwater level, but not less than 6 inches thick. The crush rock base should be compacted in 12-inch lifts to a non-yielding state with a vibratory mechanical compactor.

Runoff over Impervious Surfaces

Storm runoff over impervious surfaces, such as roofs and paved driveways, should be collected by underground drain line systems connected to downspouts and by catch basins installed in paved roadways, driveways and parking areas. Stormwater thus collected should be tightlined to discharge into a storm sewer or suitable stormwater disposal facilities.

Building Footing Drains

A subdrain should be installed around the perimeter footings of each residential building. The subdrains should consist of a 4-inch-minimum-diameter, perforated, rigid, drain pipe, laid a few inches below bottom of the perimeter footings of the buildings. The trenches and the drain lines should have a sufficient gradient (0.5% minimum) to generate flow by gravity. The drain lines should be wrapped in a non-woven filter fabric sock and completely enclosed in clean washed gravel. The remaining trenches may be backfilled with clean onsite soils. Water collected by the perimeter footing subdrain systems should be tightlined, separately from the roof and surface stormwater drain lines, to discharge into a storm sewer or suitable stormwater disposal facilities.

Surface Drainage

Water should not be allowed to stand in any areas where footings, on-grade slabs, or pavement is to be constructed. Finish ground surface should be graded to direct surface runoff away from the residential buildings. We recommend the finish ground be sloped at a gradient of 3 percent minimum for a distance of at least 10 feet away from the townhome buildings, except in the areas to be paved.

Cleanouts

Sufficient number of cleanouts at strategic locations should be provided for underground drain lines. The underground drain lines should be cleaned and maintained periodically to prevent clogging.

RISK EVALUATION STATEMENT

The subject site is underlain at shallow depth by very-dense fresh till and dense advance outwash soils. These deposits are of very-high and high shear strength and the site should be quite stable. It is our opinion that if the recommendations in this report are fully implemented and observed during and following the completion of construction, the areas disturbed by construction will be stabilized and will remain stable, and will not increase the potential for soil movement. In our opinion, the risk for damages to the proposed development and from the development to adjacent properties from soil instability should be minimal.

LIMITATIONS

This report has been prepared for the specific application to this project for the exclusive use by Clearwater Homes, LLC, and its associates, representatives, consultants and contractors. We recommend that this report, in its entirety, be included in the project contract documents for the information of prospective contractors for their estimating and bidding purposes and for compliance with the recommendations in this report during construction. The conclusions and interpretations in this report, however, should not be construed as a warranty of the subsurface conditions. The scope of this study does not

include services related to construction safety precautions and our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in this report for design considerations. All geotechnical construction work should be monitored and inspected by a geotechnical engineer during construction.

Our recommendations and conclusions are based on the geologic and soil conditions encountered in the test pits, and our experience and engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty, expressed or implied, is made.

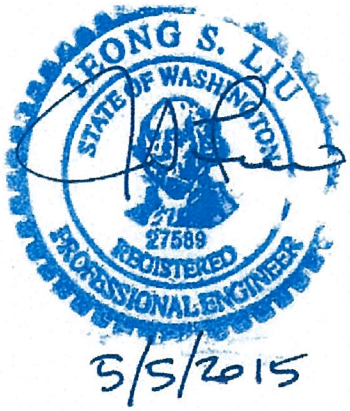
The actual subsurface conditions of the site may vary from those encountered by the test pits excavated on the site. The nature and extent of such variations may not become evident until construction starts. If variations appear then, we should be retained to re-evaluate the recommendations of this report, and to verify or modify them in writing prior to proceeding further with the construction of the proposed development of the site.

CLOSURE

We are pleased to be of service to you on this project. Please feel free to call us if you have any questions regarding this report or need further consultation.

LIU & ASSOCIATES, INC.

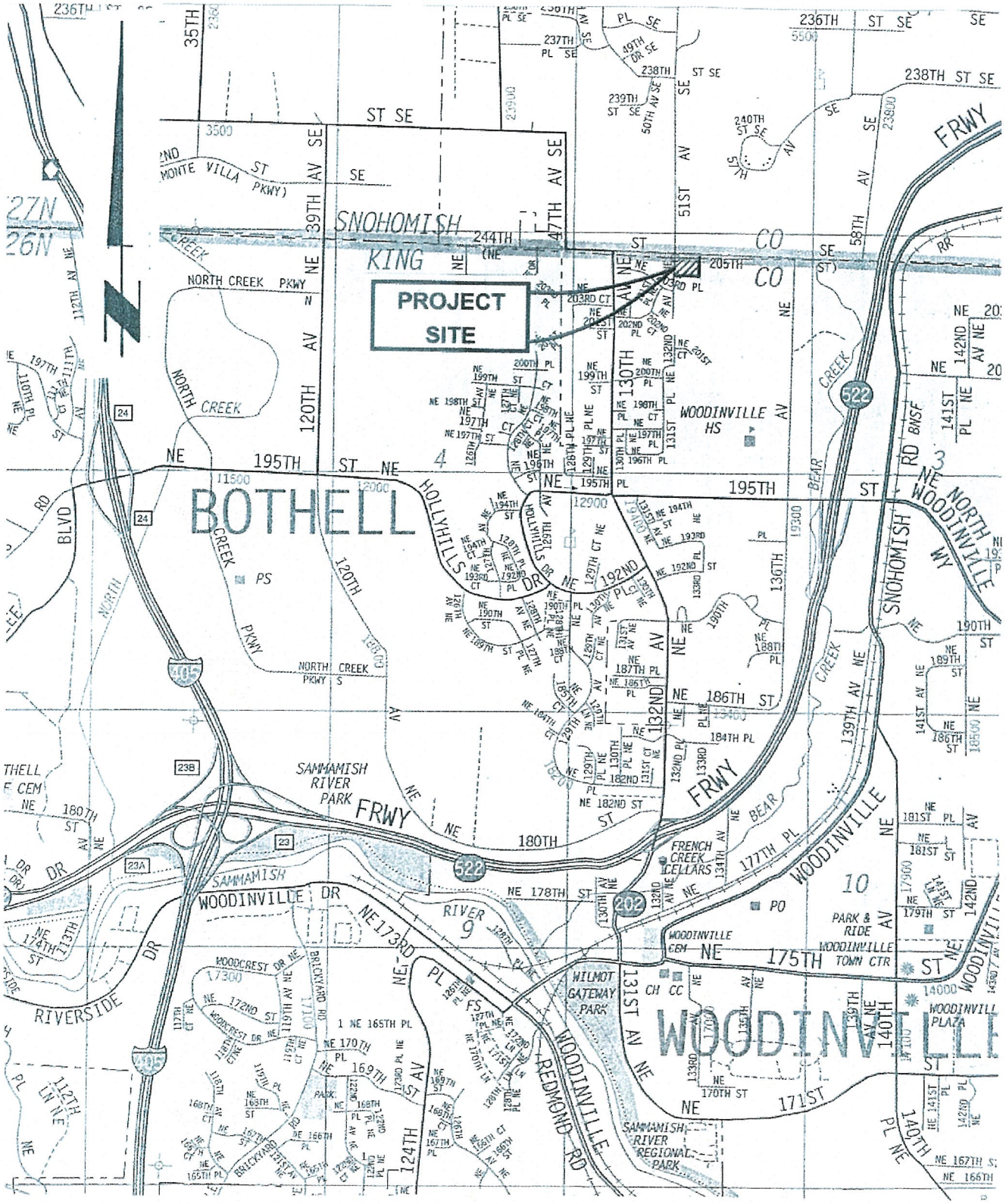
May 5, 2015
Southend - Woodinville
L&A Job No. 15-028
Page 25



Yours very truly,
LIU & ASSOCIATES, INC.

J. S. (Julian) Liu, Ph.D., P.E.
Consulting Geotechnical Engineer

Attach.: Six plates and appendix

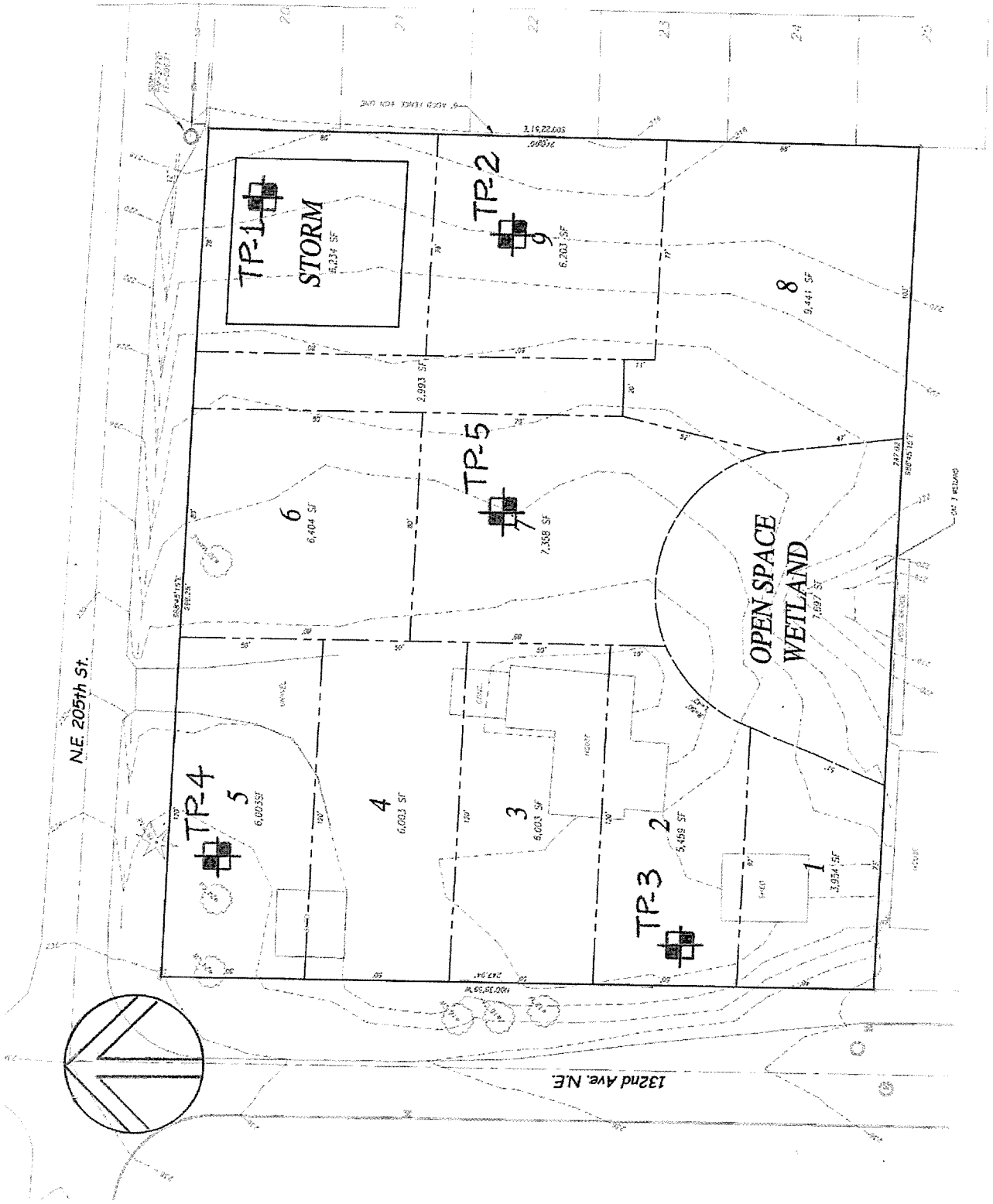


LIU & ASSOCIATES, INC.

Geotechnical Engineering · Engineering Geology · Earth Science

VICINITY MAP
SOUTHEND - WOODINVILLE
NE 205TH STREET & 132ND AVENUE NE
WOODINVILLE, WASHINGTON

JOB NO. 15-028	DATE 4/21/2015	PLATE 1



LIU & ASSOCIATES, INC.

Geotechnical Engineering · Engineering Geology · Earth Science

SITE AND EXPLORATION LOCATION PLAN
SOUTHEND - WOODINVILLE
NE 205TH STREET & 132ND AVENUE NE
WOODINVILLE, WASHINGTON

JOB NO. 15-028 | DATE 4/21/2015 | PLATE 2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS MORE THAN 50% RETAINED ON THE NO. 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS MORE THAN 50% PASSING ON THE NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50%	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILTY AND CLAY LIQUID LIMIT 50% OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC SILT, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

NOTES:

1. FIELD CLASSIFICATION IS BASED ON VISUAL EXAMINATION OF SOIL IN GENERAL ACCORDANCE WITH ASTM D2488-83.
2. SOIL CLASSIFICATION USING LABORATORY TESTS IS BASED ON ASTM D2487-83.
3. DESCRIPTIONS OF SOIL DENSITY OR CONSISTENCY ARE BASED ON INTERPRETATION OF BLOW-COUNT DATA, VISUAL APPEARANCE OF SOILS, AND/OR TEST DATA.

SOIL MOISTURE MODIFIERS:

DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH

SLIGHTLY MOIST - TRACE MOISTURE, NOT DUSTY

MOIST - DAMP, BUT NO VISIBLE WATER

VERY MOIST - VERY DAMP, MOISTURE FELT TO THE TOUCH

WET - VISIBLE FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED FROM BELOW WATER TABLE

TEST PIT NO. 1

Logged By: JSL Date: 3/23/2015 Ground El. ±

Depth ft.	USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1	OL	Dark-brown to brown, loose, organic, silty fine SAND, moist (TOPSOIL)			
2	SM	Brown to light-brown, medium-dense, silty fine SAND, trace gravel, moist			
6	SM	Light-gray, dense, gravelly, silty, fine SAND, weakly-cemented, moist GLACIAL TILL)			
8	SM	Light-gray, dense, gravelly, silty, fine to medium SAND, very moist (ADVANCE OUTWASH)			
11		Test pit terminated at 10.5 ft; trickle groundwater seepage @ 9.5 ft.			

TEST PIT NO. 2

Logged By: JSL Date: 3/23/2015 Ground El. ±

Depth ft.	USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1	OL	Dark-brown to brown, loose, organic, silty fine SAND, with logs and plastic bottles, moist (TOPSOIL/FILL)			
3	SM	Light-brown to light-gray, medium-dense, silty fine SAND, trace gravel, moist			
5	SM	Light-gray, very-dense, gravelly, silty, fine SAND, occasional cobble, cemented, moist (GLACIAL TILL)			
8	SM	Light-gray, dense, gravelly, silty, fine to medium SAND, very moist (ADVANCE OUTWASH)			
12		Test pit terminated at 11.0 ft; trickle groundwater seepage @ 9.0 ft.			

LIU & ASSOCIATES, INC.

Geotechnical Engineering · Engineering Geology · Earth Science

TEST PIT LOGS
SOUTHEND - WOODINVILLE
NE 205TH STREET & 132ND AVENUE NE
WOODINVILLE, WASHINGTON

JOB NO. 15-028 | DATE 3/27/2015 | PLATE 4

TEST PIT NO. 3

Logged By: JSL Date: 3/23/2015 Ground El. ±

Depth ft.	USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1	OL	Dark-brown to brown, loose, organic, silty fine SAND, some gravel, moist (TOPSOIL/FILL)			
2					
3	OL	Dark-brown, loose, organic, silty fine SAND, moist (relic TOPSOIL)			
	SM	Brown, medium-dense, silty fine SAND, some gravel, moist			
4					
5	SM	Brown-gray, very-dense, gravelly, silty, fine SAND, occasional cobble, cemented, moist GLACIAL TILL)			
6					
7	SM	Brown-gray, dense, gravelly, silty, fine to coarse SAND, very moist (ADVANCE OUTWASH)			
8					
9					
10					
11					
12		Test pit terminated at 11.0 ft; groundwater seepage @ 8.0 ft.			

TEST PIT NO. 4

Logged By: JSL Date: 3/23/2015 Ground El. ±

Depth ft.	USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1	OL	Dark-brown, loose, organic, silty fine SAND, moist (TOPSOIL)			
	SM	Light-brown, medium-dense, silty fine SAND, trace gravel, moist			
2					
3					
4					
5	SM	Light-gray, very-dense, gravelly, silty, fine SAND, occasional cobble, cemented, moist (GLACIAL TILL)			
6					
7					
8	SM	Light-gray, dense, silty, fine to medium SAND, trace to some gravel, very moist (ADVANCE OUTWASH)			
9					
10					
11					
12		Test pit terminated at 11.0 ft; groundwater seepage @ 9.5 ft.			

LIU & ASSOCIATES, INC.

Geotechnical Engineering · Engineering Geology · Earth Science

TEST PIT LOGS
SOUTHEND - WOODINVILLE
NE 205TH STREET & 132ND AVENUE NE
WOODINVILLE, WASHINGTON

JOB NO. 15-028 | DATE 3/27/2015 | PLATE 5

TEST PIT NO. 5

Logged By: JSL Date: 3/23/2015 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Crushed rock in dark-brown, loose, organic, silty fine SAND matrix, moist (TOPSOIL)			
2		SM	Brown, medium-dense, silty fine SAND, trace gravel, moist			
3						
4						
5		SM	Light-gray, dense, silty fine SAND, trace gravel, weakly-cemented, moist (GLACIAL TILL)			
6						
7						
8		SM	Light-gray, dense, silty, fine to medium SAND, trace gravel, moist (ADVANCE OUTWASH)			
9						
10						
11			Test pit terminated at 10.5 ft; groundwater not encountered.			
12						

TEST PIT NO. _____

Logged By: _____ Date: _____ Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

LIU & ASSOCIATES, INC.

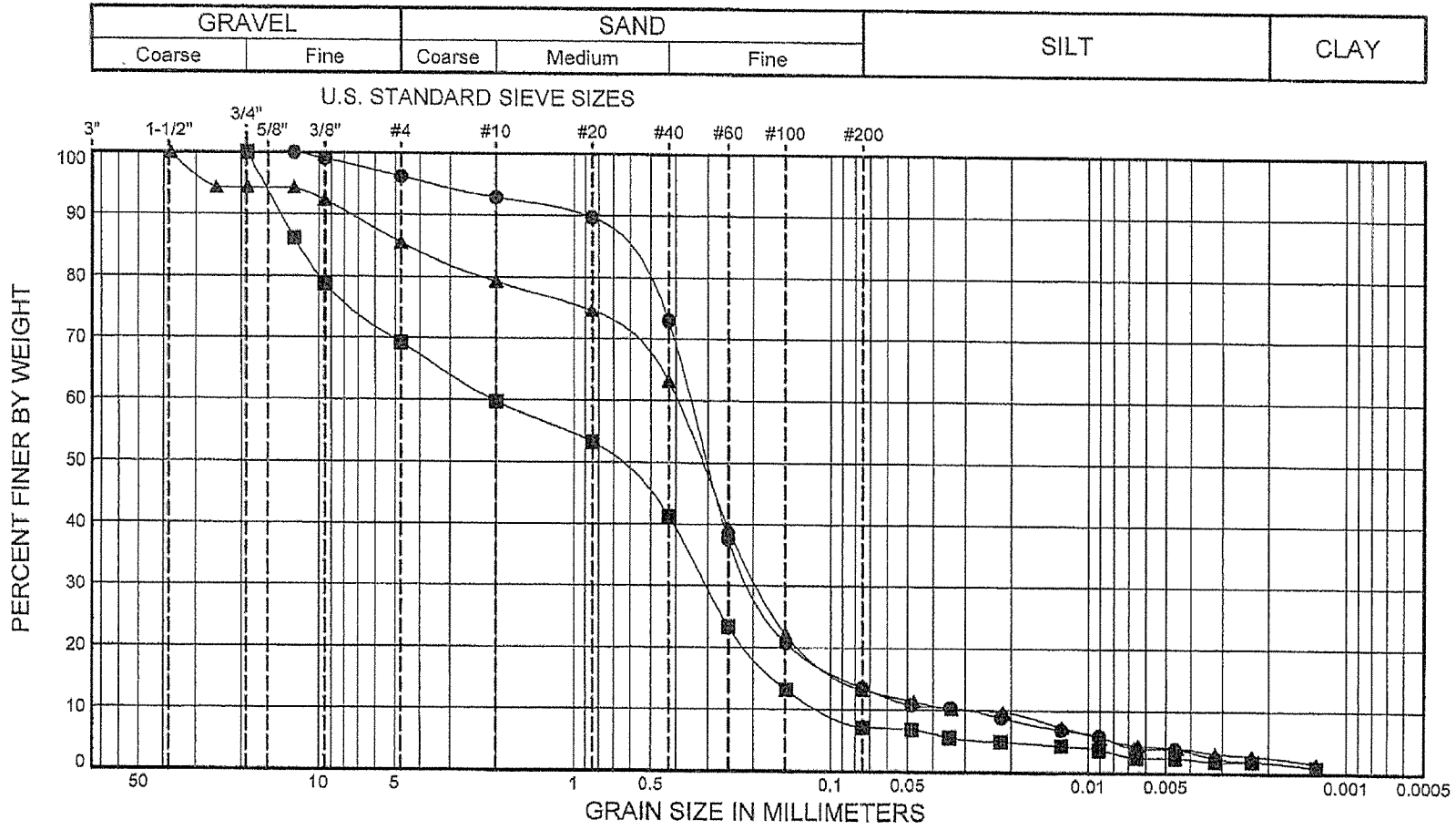
Geotechnical Engineering · Engineering Geology · Earth Science

TEST PIT LOGS
SOUTHEND - WOODINVILLE
NE 205TH STREET & 132ND AVENUE NE
WOODINVILLE, WASHINGTON

JOB NO. 15-028 | DATE 3/27/2015 | PLATE 6

APPENDIX

Soil Particle Size Distribution Test Report
Southend - Woodinville
NE 205th Street NE and 132nd Avenue NE
Woodinville, Washington
L&A Job No. 15-028



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	D90	D60	D10	Gravel %	Sand %	Silt %	Clay %
●	TP-1	S-1	8.0 - 9.0	(SM) Dark olive brown, silty SAND	18	0.91	0.35	0.0308	3.8	82.7	11.8	1.7
■	TP-3	S-2	7.0 - 8.0	(SP-SM) Dark brown, poorly graded SAND with silt and gravel	13	14.04	2.06	0.1038	30.8	62.0	5.5	1.6
▲	TP-5	S-3	8.0 - 9.0	(SM) Olive brown, silty SAND	13	7.51	0.40	0.0282	14.5	72.4	10.6	2.5

HWA GeoSciences Inc.

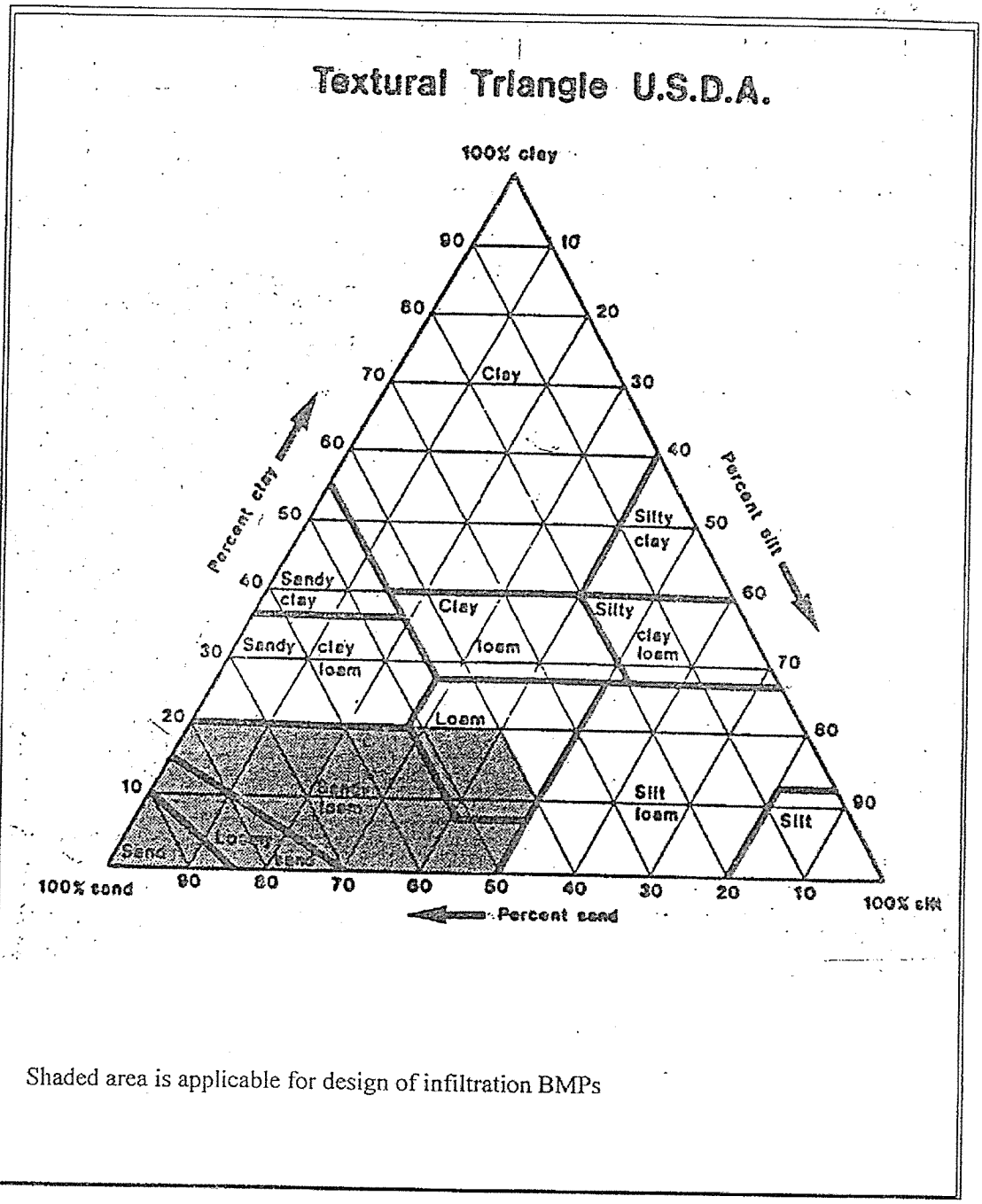
Laboratory Testing for Liu & Associates
R. Appleby Plat
Client Project #15-028

PLATE A-1

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2012-025 T6000 FIGURE: 1

HWA GRSZ D90-D60-D10 2012-025 T6000.GPJ 4/13/15



Shaded area is applicable for design of infiltration BMPs

Figure 3.27 USDA Textural Triangle

Source: U.S. Department of Agriculture

PLATE A-2

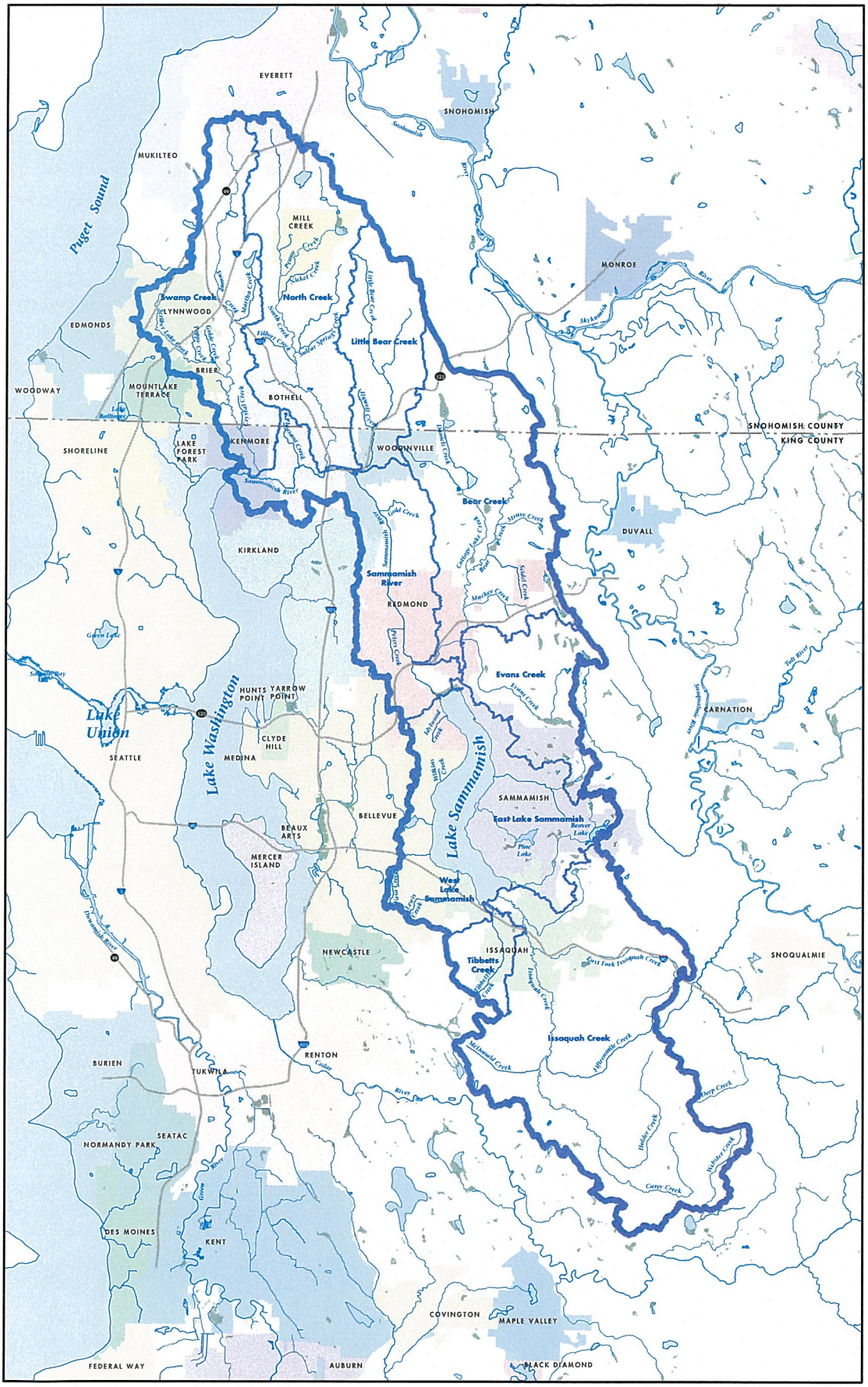
6.0 Stormwater Pollution Prevention Plan

A SWPPP will be prepared for the construction submittal.

7.0 Operations and Maintenance Manual

An Operations and Maintenance Manual will be prepared for the construction submittal.

-Appendix-



The Sammamish Watershed

- Watershed Boundary
- Basin Boundary
- Stream
- Major Road
- Lake & River

N

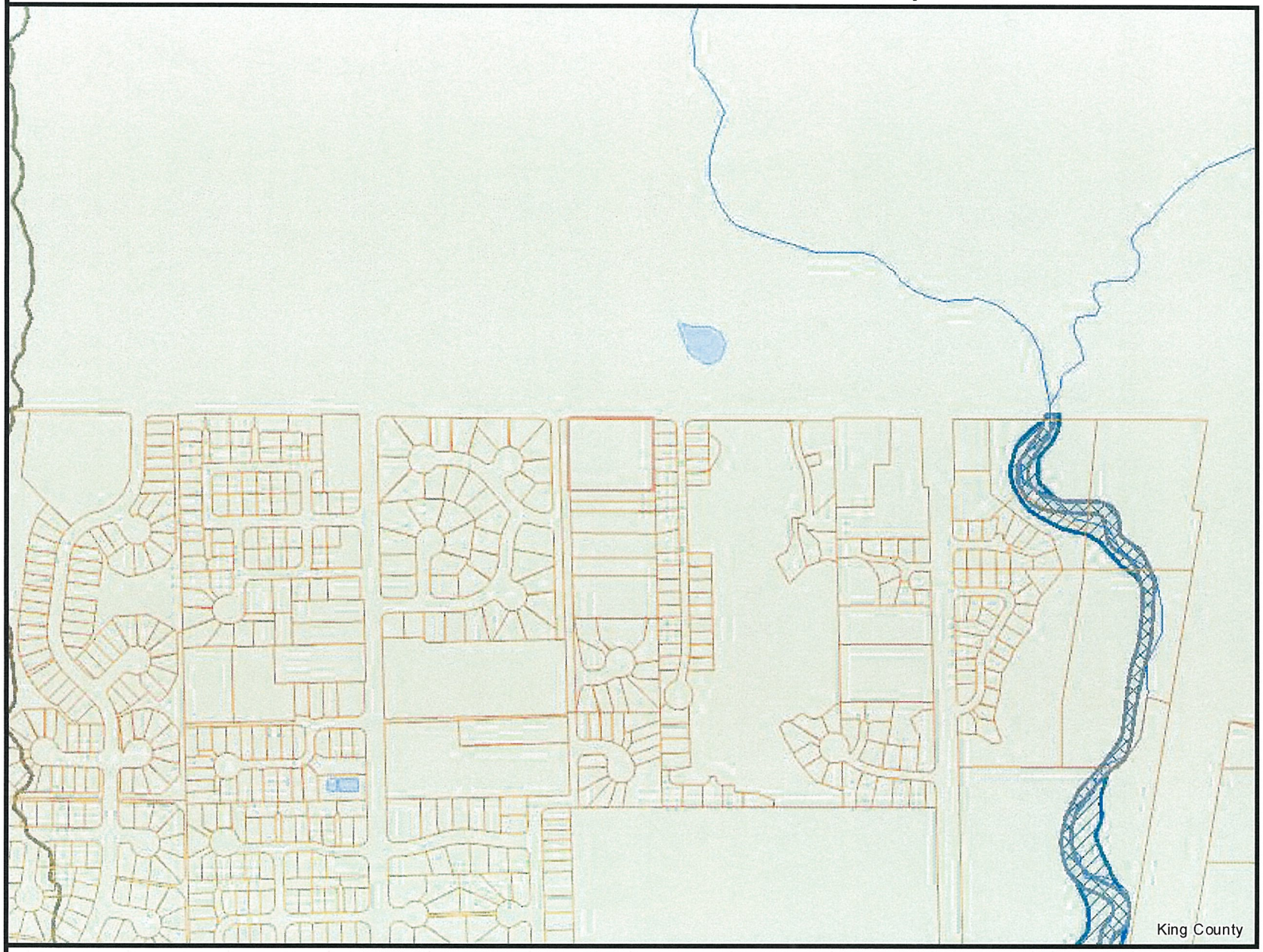
0 2 4 miles

March 2012

King County
Department of Natural Resources and Parks
Water and Land Resources Division

Produced by:
KCIT GIS, Visual Communications & Web Group
File Name: 1203_2493_SammamishBaseMap.ai skrau

Sensitive Area Map



Legend

- Parcels
- levee
- revetment
- constructed channel
- FEMA preliminary floodway
- FEMA preliminary 100-year floodplain
- active
- inactive
- active
- inactive
- Lakes and large rivers
- Streams
- severe
- moderate
- Drainage basins
- Cedar-Samm...
- Chambers-Clo...
- Cowlitz
- Duwamish-Gr...
- Kitsap
- Lower Skagit/Samish

Date: 6/30/2015 Notes:

N

King County GIS Center