Attachment 21

Report still references use of canister filters for stormwater treatment. The calculations show a wet vault which is accepted.

Terrene at 132nd Ave NE Plat

City of Redmond, Washington

Preliminary Storm Drainage Report

Prepared for

Terrene Homes
520 6th St S
Kirkland WA 98033

Original Date: December 23, 2014
Revision Date: February 26, 2015, **May 18, 2015**

Blueline Job No. 14-171

Prepared by: Chester Bennett

Reviewed by: Todd Oberg, PE

BLUELINE LAND DEVELOPMENT CONSULTING
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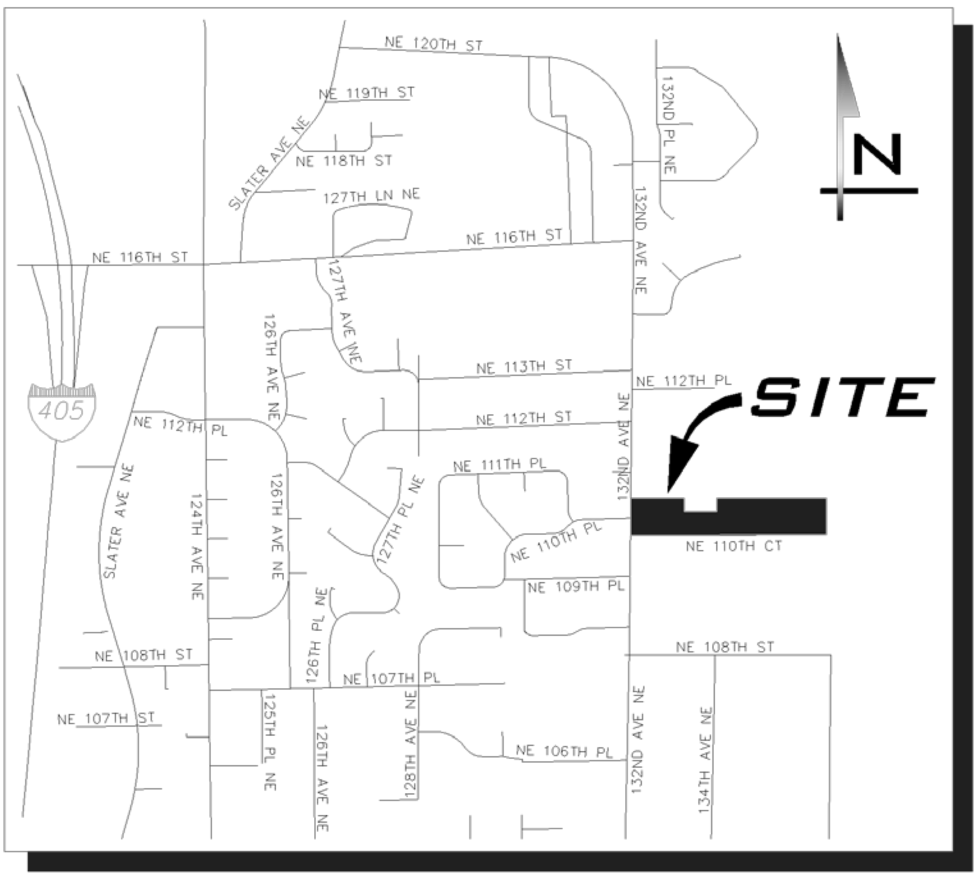
Table of Contents

Section 1 Project Overview

The Terrene at 132nd Ave NE Plat project is associated with the addresses 11016, 11020, and 11026 132nd Ave NE in Redmond WA 98052 and consists of multiple parcels (3426059093, 3426059046, and 3426059087) totaling an onsite private property area of approximately 6.55 acres. The project proposes frontage improvements along 132nd Ave NE as well as development of the existing site into a residential neighborhood of 22 single family lots with associated infrastructure, stormwater drainage facilities, and open space. More generally the site is located in the NW Section 34, Township 26N, Range 5 E. Please see the vicinity map below:



Vicinity Map
not to scale

The site contains 3 single family residences and garages with driveways of crushed gravel and asphalt as well as associated structures with impervious roofs, sidewalks, and patios. Ground cover consists of lawn, residential landscaping and scattered trees surrounding the residences heavier forested areas toward the east and fringes of the site. Access to the parcels is via two shared driveways off of 132nd Ave NE. These structures and ground cover will be demolished and cleared in preparation for development. The eastern portion of the site is undeveloped with heavy forest cover and thick underbrush. The eastern portion of the site contains steep slopes and will remain undeveloped during construction and in the final condition of the site, see the *Developed and Existing Conditions Exhibit* included in Section 4.

The subject property was analyzed as a Single Threshold Discharge area, per section 2.3 of 2005 SWMMWW DOE Volume I, with flows that discharge the site a primary natural discharge point and a secondary discharge area. The project area is tributary to sub-basin 030 according the City of Redmond GIS Watershed boundaries. Flows ultimately discharge into the Sammamish River over 1 mile from the subject property. The basin areas and path are shown in the *Downstream Path Exhibit* included in section 3 of this report.

Soils onsite were determined to be predominately subglacial till deposits and native silty sand soils consistent with characteristics of weathered glacial till as site in the *Geotechnical Engineering Study* included in Section 6 of this report.

The proposed improvements for this project add greater than 5,000 SF of new impervious area, thus the project, per Redmond Technical Notebook 2012, is categorized as a Large Project and required to meet Minimum Requirements #1 - #9 as detailed in Chapter 2 of the Stormwater Notebook.

The stormwater elements to serve the developed drainage will be designed based on the City of Redmond 2012 Technical Notebook and the Washington State Department of Ecology's Stormwater Management Manual for Western Washington 2005 (2005 DOE Manual).

Section 2 Minimum Requirements

The project will comply with all minimum requirements of the 2005 DOE Manual and the City of Redmond 2012 Technical Notebook. Minimum requirements are listed and met as detailed below and determined from the City of Redmond (COR) Flow Chart, Figure 3.2, included at the end of this section.

Minimum Requirement #1: Preparation of Stormwater Site Plans: Preliminary Plans are provided under separate cover and in addition to this Preliminary Storm Drainage Report.

Minimum Requirement #2: Construction Stormwater Pollution Prevention Plan (SWPPP): See Section 5. A Construction SWPPP will be provided at final engineering under separate cover.

Minimum Requirement #3: Source Control Pollution: The project is not a source of urban stormwater pollutants as described in Chapter 2, Volume IV of the 2005 DOE Manual; thus the need to reduce or eliminate stormwater pollutants is not present and no Operational or Structural source control BMPs will be required for the developed site. Minimum Requirement #2 addresses BMPs for construction sites. Source Control Pollution created during construction will be addressed by the SWPPP.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: See Sections 3 and 4. Runoff for the proposed development will be routed to leave the site at an existing natural discharge location and will not cause adverse impacts downstream. Appropriate energy dissipation will be provided as recommended in the Geotechnical Letter included in this report based on the 100-year peak discharge flow from the detention facility per 2.5.4b of the COR 2012 Technical Notebook.

Minimum Requirement #5: On-Site Stormwater Management: See Section 4. The project evaluated the following Low-Impact-Development (LID) Stormwater Best Management Practices (BMPs) as well as the required BMP's to control roof runoff as described in Section 2.5.5 of the COR 2012 Technical Notebook.

Roof Downspout Infiltration BMPs as described in Section 3.1.1, Volume III of the 2005 DOE will be used in areas of the site underlain by fine sands and sufficiently distanced from slopes to the east. See Section 4 of this Report for further detail.

Permeable pavement as described in Section 7.1 in Appendix C, Volume III of the 2005 DOE, is not feasible for this project due to low permeability till-soils.

Dispersion BMPs as described in Chapter III and Section 7.2 in Appendix C, Volume III of the 2005 DOE are not feasible due to steep slopes as well as limited flow paths imposed by the site.

Vegetated Roofs per Section 7.3 in Appendix C in Volume III of the 2005 DOE are not economically feasible for this single-family project due to added structural requirements to meet design criterion.

Rainwater Harvesting per Section 7.4 in Appendix C, Volume III of the 2005 DOE is not economically feasible for the project.

Reverse Slope Sidewalks per Section 7.5 in Appendix C, Volume III of the 2005 DOE are not feasible throughout the majority of the site due to topography and grading.

Minimal Excavation Foundations per Section 7.6 in Appendix C, Volume III of the 2005 DOE are not feasible for this project due to the use of grading equipment exceeding 650 psf for extensive mass grading.

Bioretention Areas per Section 7.7 in Appendix C, Volume III of the 2005 DOE are not feasible due to physical site constraints and low permeability till-soils.

Disturbed landscaped areas within the project site will have compost amended soils per City of Redmond Standard Detail 632.

Minimum Requirement #6: Runoff Treatment: See Section 4. According to Section 2.5.6 of the City of Redmond 2012 Technical Notebook, a treatment facility will be required as well as onsite stormwater BMPs due to > 5,000 SF of Pollution Generating Impervious Soil (PGIS) onsite. The site will provide a filter system to meet the Basic Treatment criterion per Figure 4.1 from 2005 DOE

Manual; placement is shown on the Preliminary Plans under separate cover, and on the *Developed Conditions Exhibit*.

Minimum Requirement #7: Flow Control: See Section 4. According to Section 2.5.7 of the City of Redmond 2012 Technical Notebook, a flow control facility as well as onsite stormwater BMPs will be required onsite due to > 10,000 of impervious area onsite. A flow control facility will be provided and designed to meet the Standard Flow Control Requirement as specified by the City. Additionally infiltration trenches will be provided per Section 5.3.1.1 of the 2005 DOE Manual. Placement of the flow control facility and infiltration trenches is shown on the Preliminary Plans under separate cover, and on the *Developed Conditions Exhibit*.

Minimum Requirement #8: Wetlands Protection: There are no wetlands onsite according to the COR GIS Wetland map and the project does not discharge into a wetland via a conveyances system. Therefore this requirement does not apply.

Minimum Requirement #9 Operation and Maintenance: See Section 9. Operation and Maintenance guidelines from the 2005 DOE will be included at final engineering.

Minimum Requirement Flow Chart per Section 2.4 of the COR 2012 Technical Notebook.

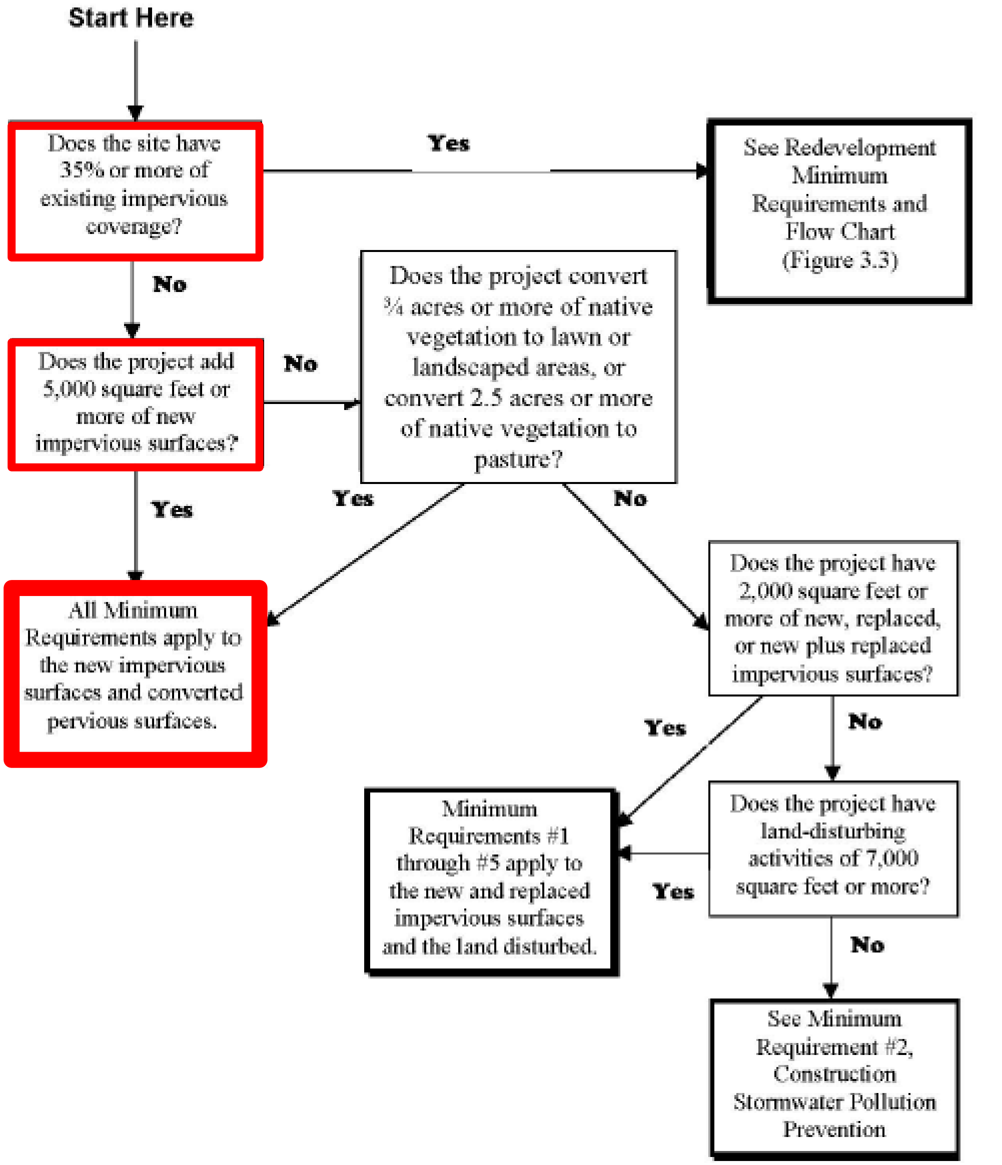


Figure 3.2 Flow Chart for Determining Requirements for New Development

Section 3 Offsite Analysis

An offsite analysis was conducted for the Terrene at 132nd Ave NE Plat project located at 11016 132nd Ave NE, Redmond WA, on November 4th, 2014, an overcast day with light rains in the low 60's as well as on November 24th, 2014.

TASK 1: DEFINE AND MAP THE STUDY AREA

The project is comprised of three parcels (3426059046, 3426059087 and 3426059100). See Section 4 of this report for the *Existing Conditions Exhibit* and the *Developed Conditions Exhibit.* A Photo Exhibit, Downstream Path Exhibits, and an Offsite Slopes Analysis Exhibit are provided at the end of this section that show the study area boundaries, wetlands associated with the downstream path, as well as the observed stormwater runoff flow path from the site. The project site consists of one drainage basin which is further described in Task 3 and 4.

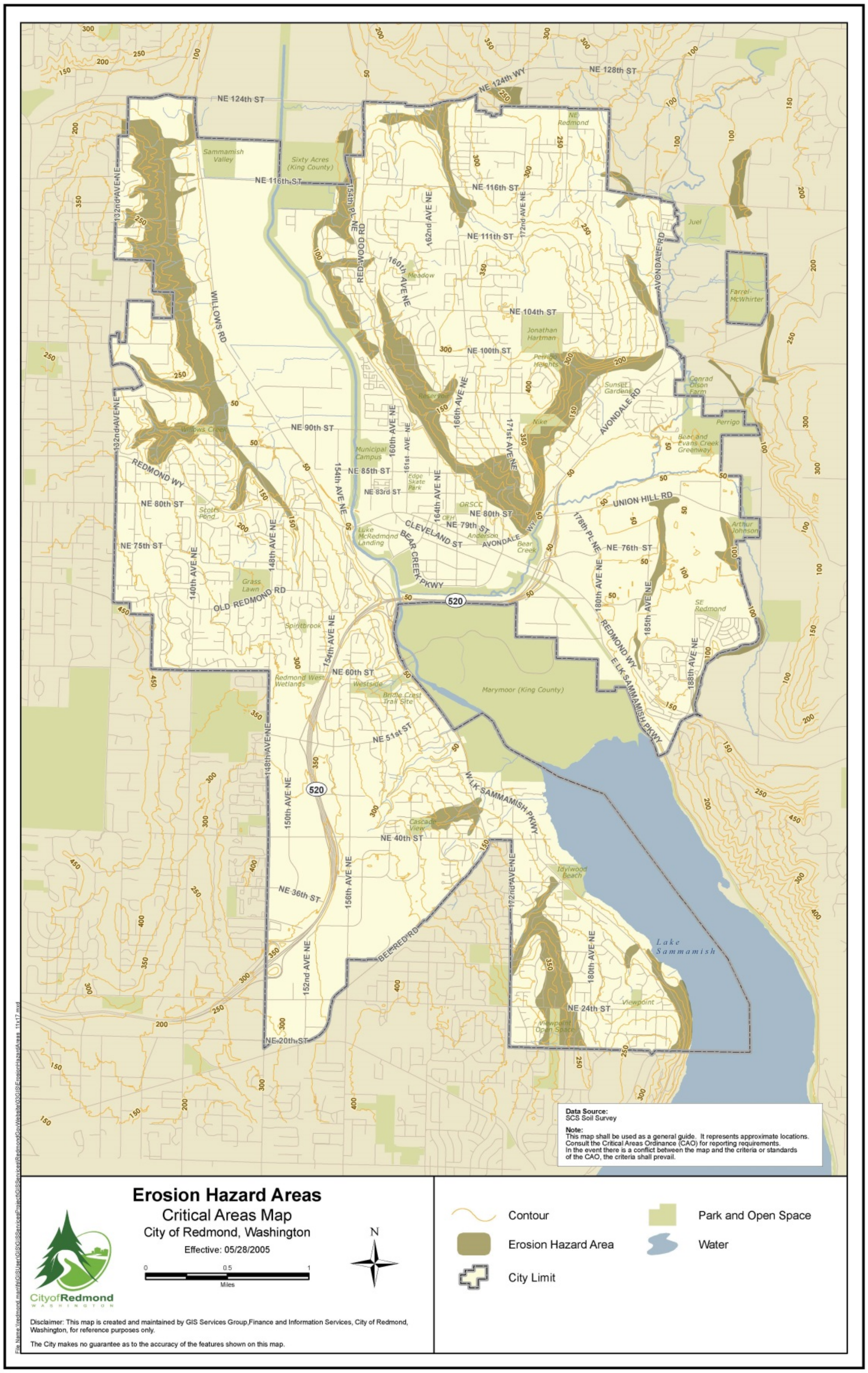
TASK 2: RESOURCE REVIEW

The best available resource information, including King County iMAP and City of Redmond resource maps, were reviewed for existing or potential problems. The following is a summary of the findings from the information used in preparing this report.

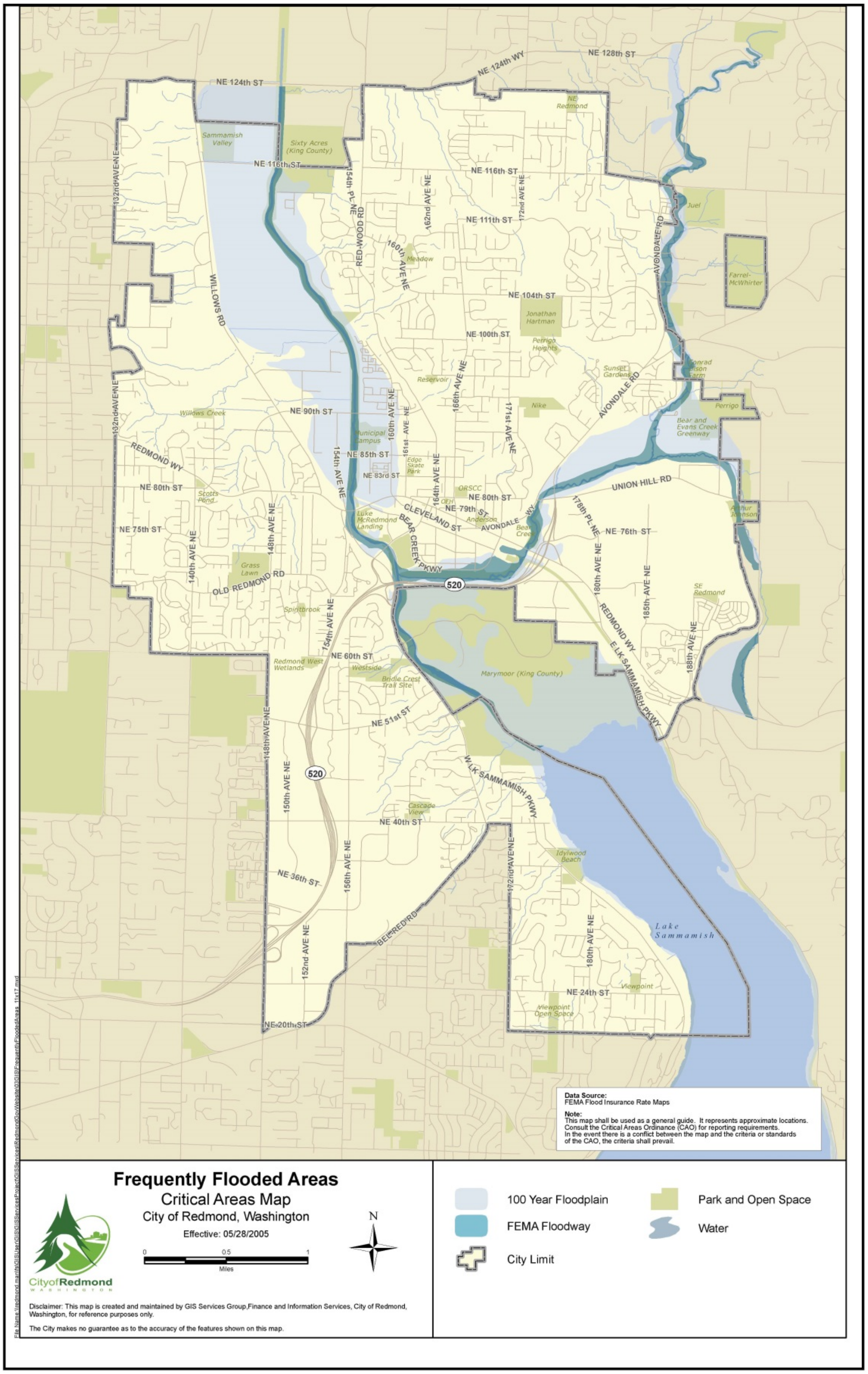
- The site is comprised of predominately subglacial till deposits and native silty sand as sited in the *Geotechnical Engineering Study* included in Section 6.
- The site is located within the Sammamish River Drainage Basin, part of the Lake Sammamish / Sammamish River Watershed. (King County Water Features map)
- The site does not contain a stream or wetland. (Redmond Critical Areas Map – Wetlands)
- The site is not located in a 100 year flood plain or a FEMA floodway. (Redmond Critical Areas Map – Flood Areas)
- The site is located in an Erosion Hazard Area. (Redmond Critical Areas Map – Erosion)
- The site is not located in a Landslide Hazard Area (Redmond Critical Areas Map - Landslide)
- The site is not located in a Seismic Hazard Area (Redmond Critical Areas Map – Seismic)
- The site is not located in a Core Preservation Area. (Redmond Critical Areas Map – Fish & Wildlife).
- The site does contain slopes and gradients in excess of 40 percent. (See Existing Conditions Exhibit)

Critical Areas Maps

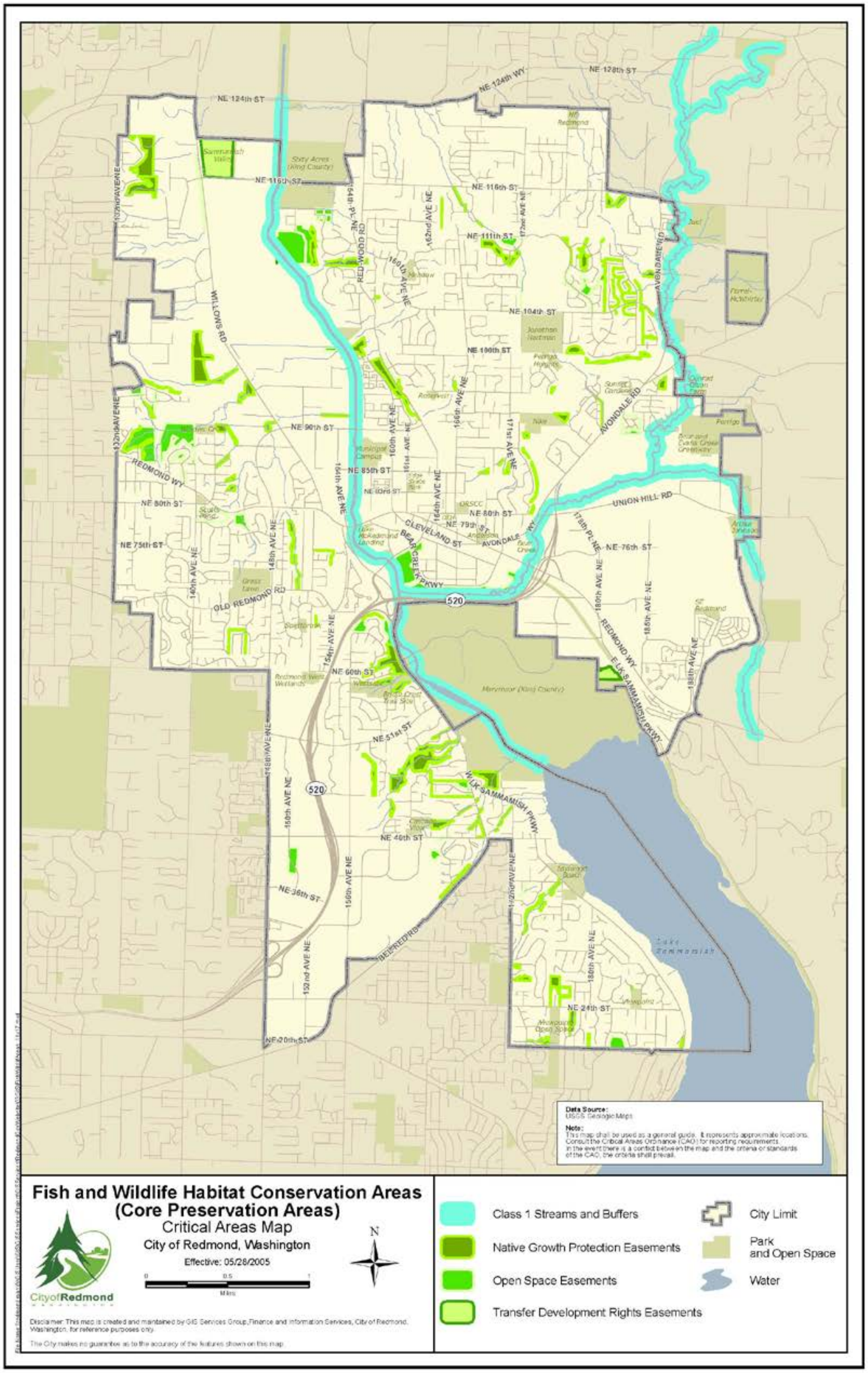
Redmond Erosion Map



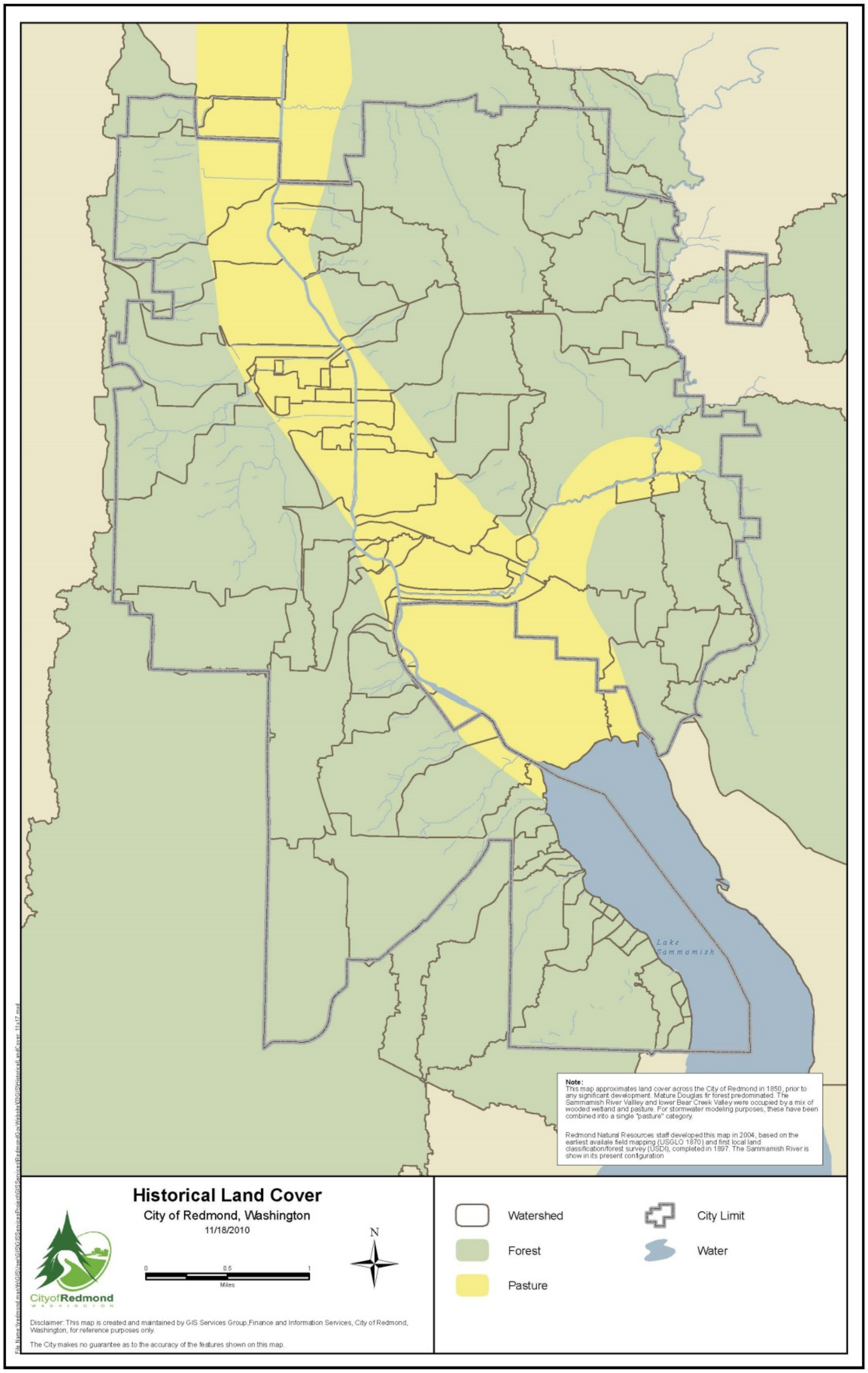
Redmond Flood Map



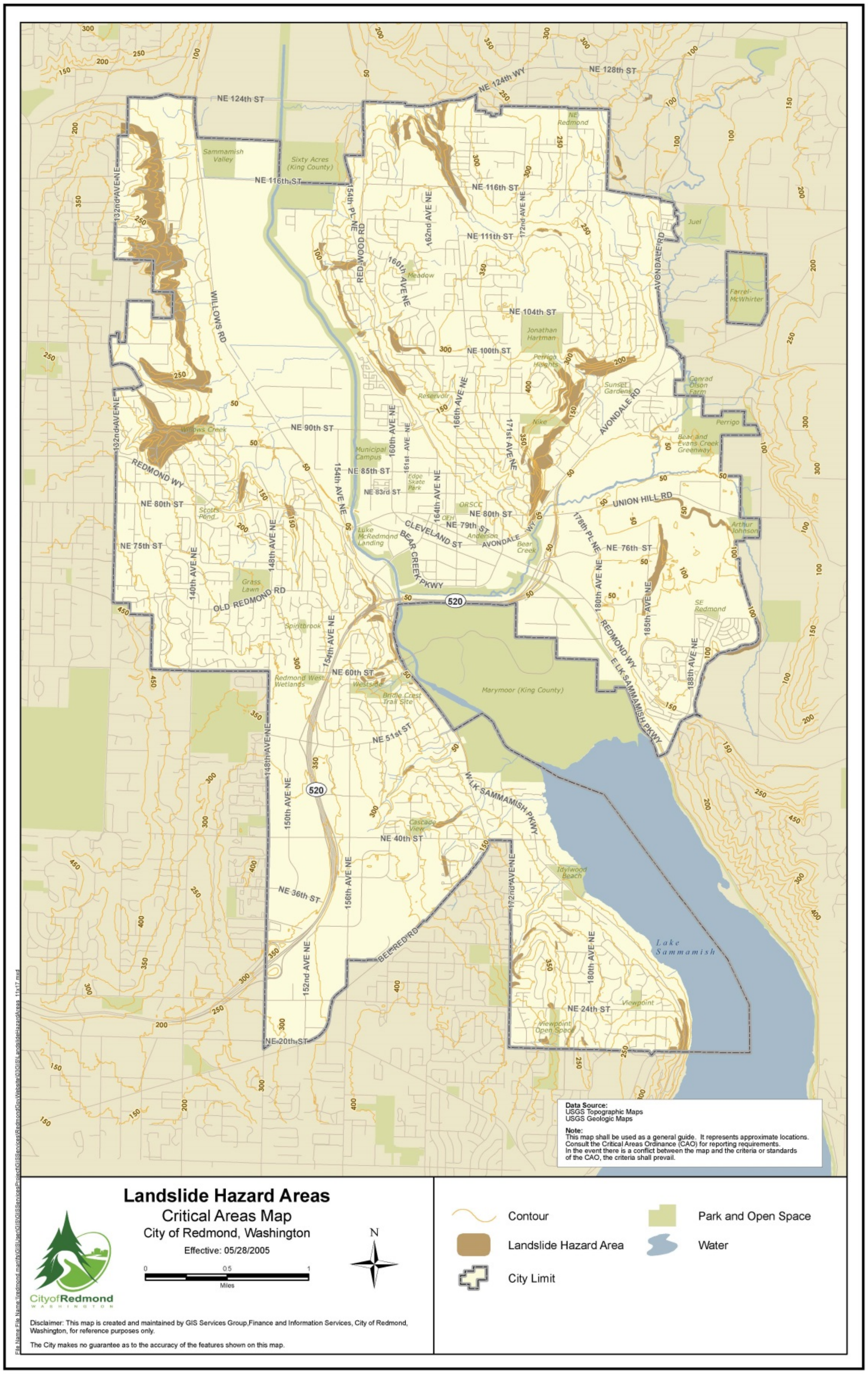
FWHC Core Preservation Areas Map



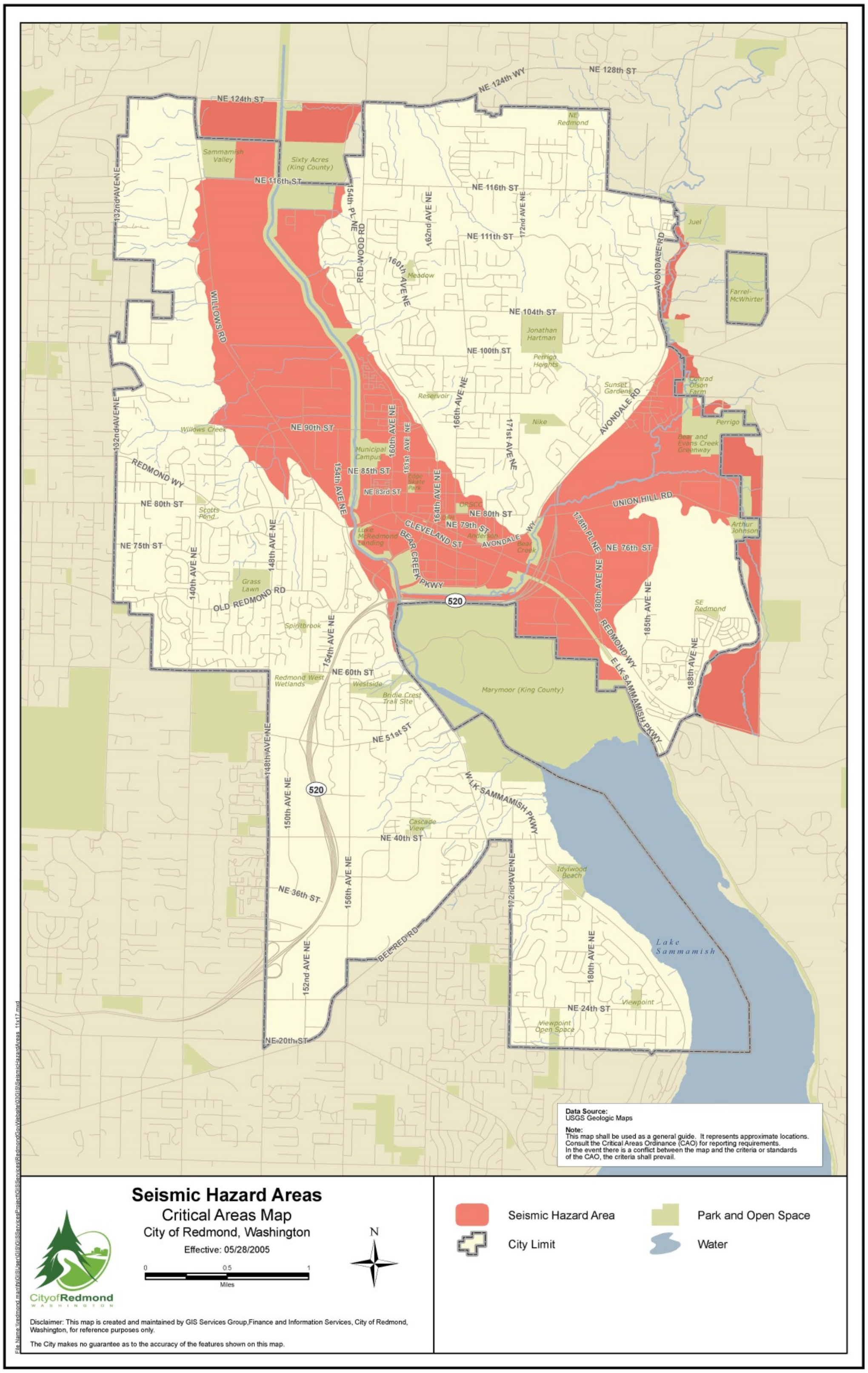
Historical Land Cover Map



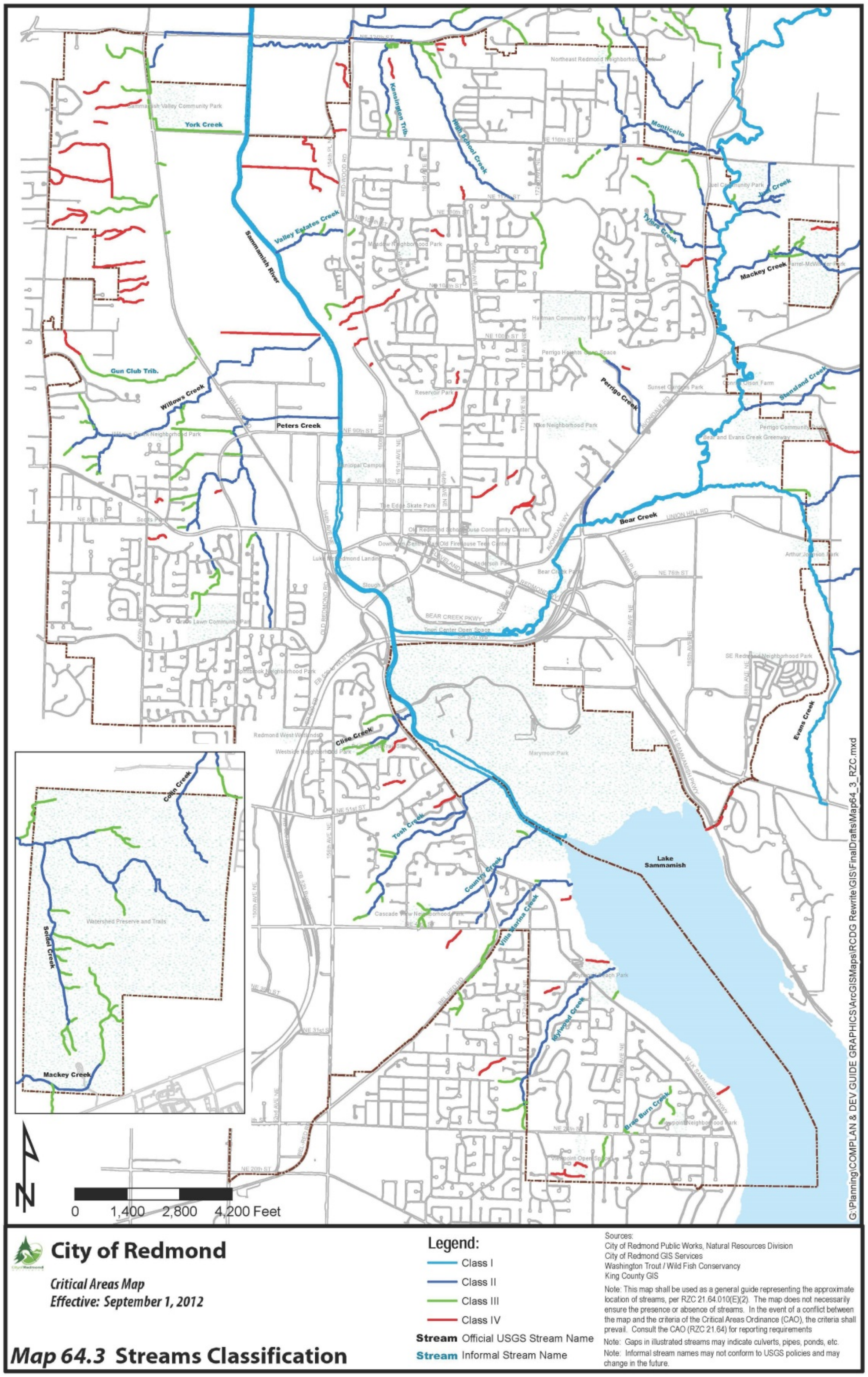
Landslide Map



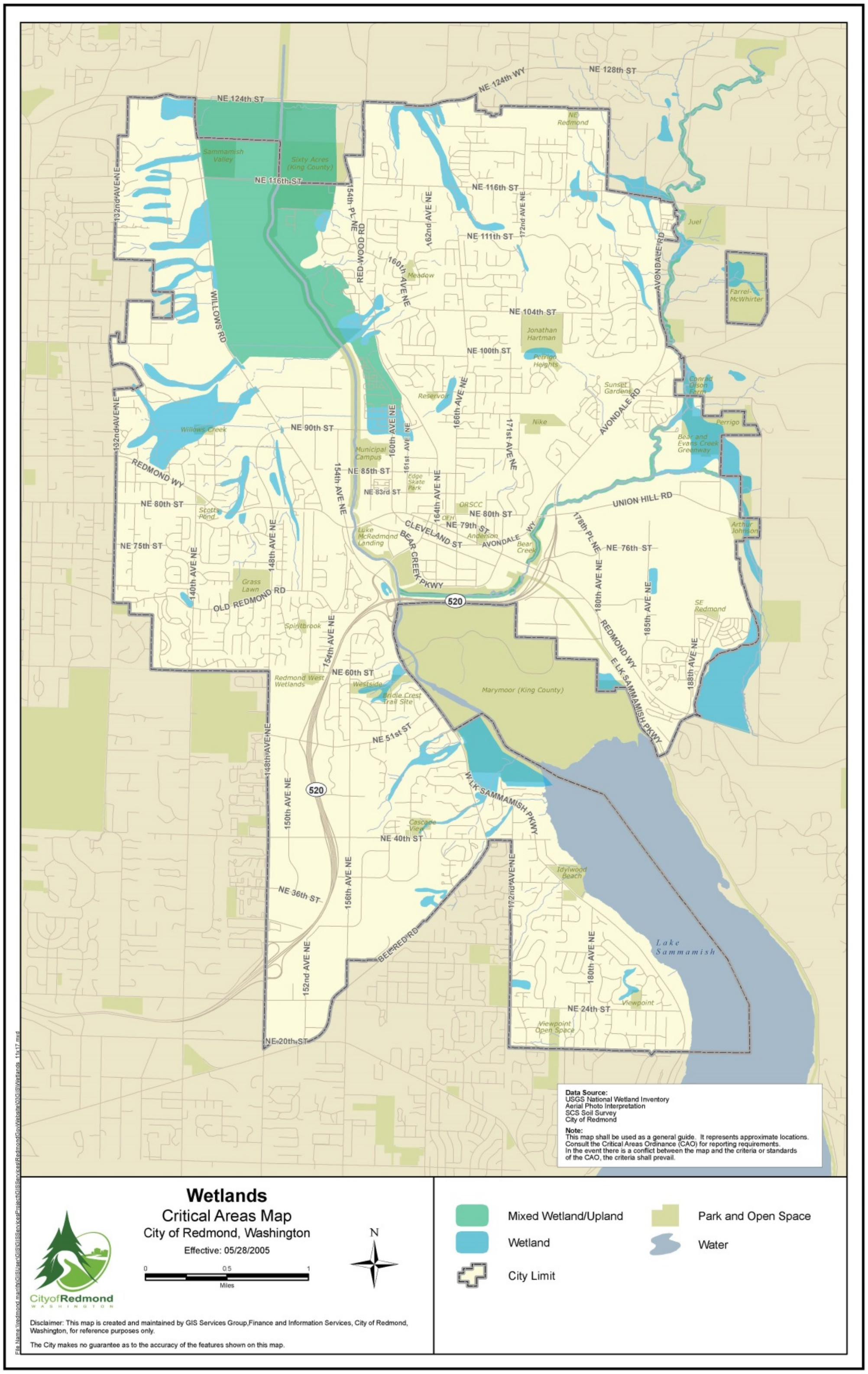
Redmond Seismic Map



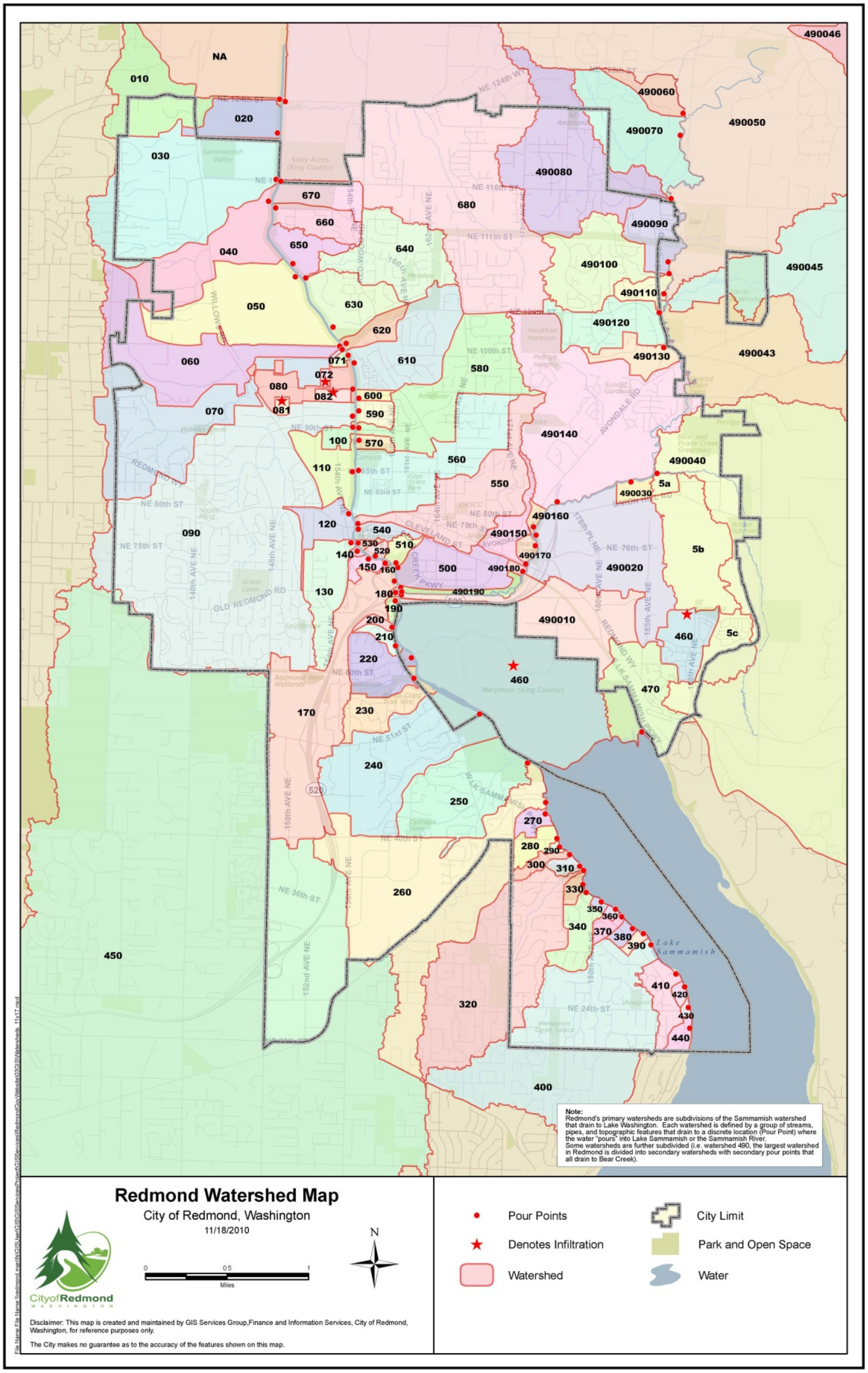
Redmond Stream Classification Map



Redmond Wetlands Map

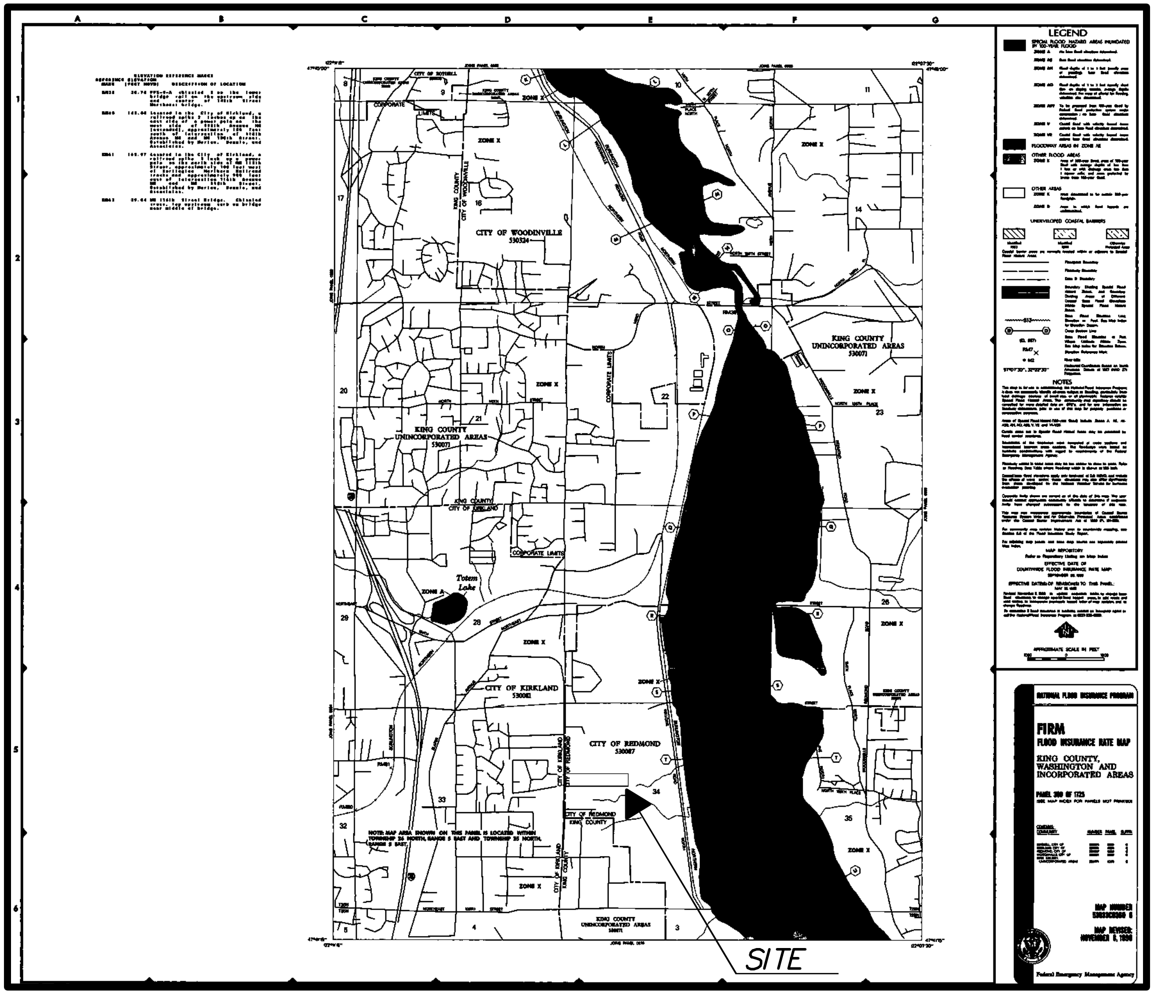


Redmond Watershed Map



Attachment 21

FEMA Flood Map



TASK 3: FIELD INSPECTION

A field inspection was conducted for the project at 11016 132nd Ave NE, Redmond WA, on November 4th, 2014 with weather conditions overcast and light rains in the low 60's. An inspection of adjacent properties to the southeast was conducted on November 24th, 2014. Task 4 of this section contains a detailed drainage path description for the onsite basin as well as a *Downstream Path Exhibit*.

ONSITE BASIN

The site consists of one drainage basin with topography that drains outward toward the southeast and the eastern boundaries of the site. The site includes three single-family residences, various sheds, a garage along with paved and gravel access drives and driveways. The residences are surrounded by lawn with residential landscaping dissipating into scattered trees, thick brush, and mature forest cover in the eastern portion of the site, which also contains a utility corridor of grass running north - south through the property.

The geotechnical report included in the Appendix prepared by Earth Solutions NW indicates onsite native soils consist predominantly of medium dense silty sand with gravel (USCS: SM) and considered typical of subglacial till deposits.

UPSTREAM BASIN

The north upstream tributary basin is small and minor, resulting in negligible flows from the north due to topography, curb and gutter, fencing, landscaping, access drives and roadways. The western upstream basin, 0.172 acres, within the ROW of 132nd Ave NE contributes to onsite flows and is comprised of paved roadway and pervious areas.

DOWNSTREAM DRAINAGE PATH

The project's single basin drains to the eastern and southern boundaries. The western portion of the project site contains gradual to moderate slopes to the east increasing to moderate to steep slopes at the eastern portion of the site. A subtle ridge that runs east / west begins to form near the center of the site and in the middle of the site. The site is surrounded by residential properties to the north and the south. The site is bordered by 132nd Ave NE to the west and to the east by a utility corridor and heavily vegetated mature forest.

Runoff sheet flows over lawn and forest cover as it moves east and is separated into two natural discharge locations; a primary discharge location at the north eastern boundary and a secondary discharge location along southeastern corner.

After leaving the site runoff continues east and is collected in widening and deepening ravines on the east side of the Olympic Pipe Corridor. When the northern flow to the primary discharge location reaches the Olympic Pipe Corridor there is some ponding that occurs on the eastern edge of the cleared area. The ponding seen was shallow and appeared to continue east to follow the path delineated in the attached exhibit. When the topography of the area was consulted analysis indicated flow would continue east as described.

The flows from the two discharge locations flow to the southeast and combine after leaving the site approximately 540 feet from the eastern boundary. Runoff is collected into a stream and conveyed east for approximately 2,180 feet when it is conveyed under Willows Rd NE and the Redmond Connector. Runoff continues to flow via an unnamed stream through a series of open channels and ponds on the Willows Run Golf Complex for approximately 2,677 feet before reaching the receiving waters of the Sammamish River just over 1 mile from the project site boundary.

Reported Drainage Problems

The best available resource information (King County iMap) was reviewed for existing or potential drainage problems. According to iMAP stormwater maps no drainage complaints are adjacent to the downstream path or the subject parcels. The City of Redmond Public Works and GIS departments have been contacted requesting Storm Utility Maps. The staff had no records of drainage complaints relevant to the downstream path.

Existing / Potential Drainage Problems

No existing or potential erosion or drainage concerns were observed during onsite inspection of the subject parcels and the downstream drainage path of runoff from the site.

Aeroject Rocketdyne - Offsite Basin Analysis

Directly east of the subject property is the Aerojet Rocketdyne campus, 11411 139th Place NE Redmond WA. In order to confirm that the downstream path of runoff from the site does not impact the property or conveyance systems on the campus, the western boundary of Aerojet Rocketdyne's was investigated. Please see the *Downstream Path Exhibit* and *Downstream Path Photos* included at the end of Task 4 within this section for photos and corresponding locations.

A paved access road on Aerojet's campus, approximately 1,200 feet in length, parallels the western boundary of the Aerojet's property beginning at *Point A* and ending at *Point B.* A significant ridge / berm extends, as far as could be reasonably seen, down the western border of the property. (photos 9-14) There is a ditch with steady open channel flow free of debris directly west of the access road that conveys runoff south from the ridge to the west (photos 9-14). Flow is conveyed east under the access road via a 48-inch culvert (photo 14). Runoff discharges the culvert and is conveyed east into a ravine on the Aerojet campus (photo 15).

In order to ensure security of the campus, pictures of buildings and structures were prohibited south of the culvert. However, the observed topography in this area was similar to previous pictures, with a ridge separating flows from the west and a ravine running to the south of the structures and buildings at the south end of the property.

Aerojet basin investigation conclusion: The runoff and flow in these conveyance elements discussed above is confined to that from Aerojet's property and properties to the north of the photos herein. Runoff from the slopes west of Aerojet's parcel boundaries would reach the ridge described above and be directed south around the property as drawn and depicted in the *Downstream Path Exhibit*. Therefore, from these observations and best available GIS mapping resources, it is determined that the subject property is not tributary to the flows within the developed Aerojet campus, nor is the Aerojet campus impacted by these subject flows.

Task 4: Drainage System Description

Please see the *Existing Conditions Exhibit* and the *Developed Drainage Exhibit* in reference to the narrative included in this Report. *Downstream Drainage Photos* are included in this section for reference.

Runoff sheet flow begins onsite at the western boundary of the property and moves east over moderate to steep slopes for approximately 978 feet where a subtle ridge begins to develop and flow splits to the north and south both flows moving east.

Flow split to the north moves northeasterly into a ravine onsite before reaching a path of short meadow grass of the Olympic Pipe Line Corridor (photo 1). Flow crosses the Olympic Pipe Corridor and exits thick forested cover (photo 2,3). Here flow continues to move easterly in the ravine to enter heavy brush and thick ground cover to the eastern boundary of the site (photo 4).

Flow split to the south moves southeasterly along a gradual knob and slope and is conveyed south and east before reaching a path of short meadow grass of the Olympic Pipe Line Corridor. (photo 5,6). Flow continues to move easterly along the slope east and south to be caught by a flattening ravine and directed east over heavy brush and thick ground cover for up to the eastern boundary of the site. (photo 7).

Flows from the north and south continue through such conditions into a steeper and wider ravines moving to the southeast to discharge from the eastern boundary of the site and combine after an average of 557 feet. Runoff is then collected by a small stream (photo 8) Runoff is conveyed in open channel flow to the east in a small stream moving through dense foliage, ferns, tall grasses, and thick underbrush for approximately 874 feet. The offsite analysis was concluded at this point approximately ¼ mile from the property.

DOWNSTREAM PATH PHOTOS

Photo 1: Looking south along Olympic Pipe Corridor

Photo 2: Looking west at edge of Olympic Pipe Corridor.

Photo 3: Looking east at edge of Olympic Pipe Corridor.

Photo 4: Looking southeast

Photo 5: Looking west at edge of Olympic Pipe Corridor

Photo 6: Looking east at edge of Olympic Pipe Corridor

Photo 7: Looking northeast into ravine at edge of property line.

Photo 8: Looking east at unnamed stream (typical conditions)

Photo 9: Looking north along west side of Aerojet access road at western boundary of the property approximately 1,100 feet north of the subject property.

Photo 10: Looking south along west side of Aerojet access road at western boundary of the property.

Photo 11: Looking west at slope of ridge west of ditch and access road on Aerojet's campus.

Photo 12: Looking west at slope of ridge to the west of ditch and access road on Aerojet's campus. In the distance you can see the power lines of the Olympic Pipeline Corridor (see following picture for close-up).

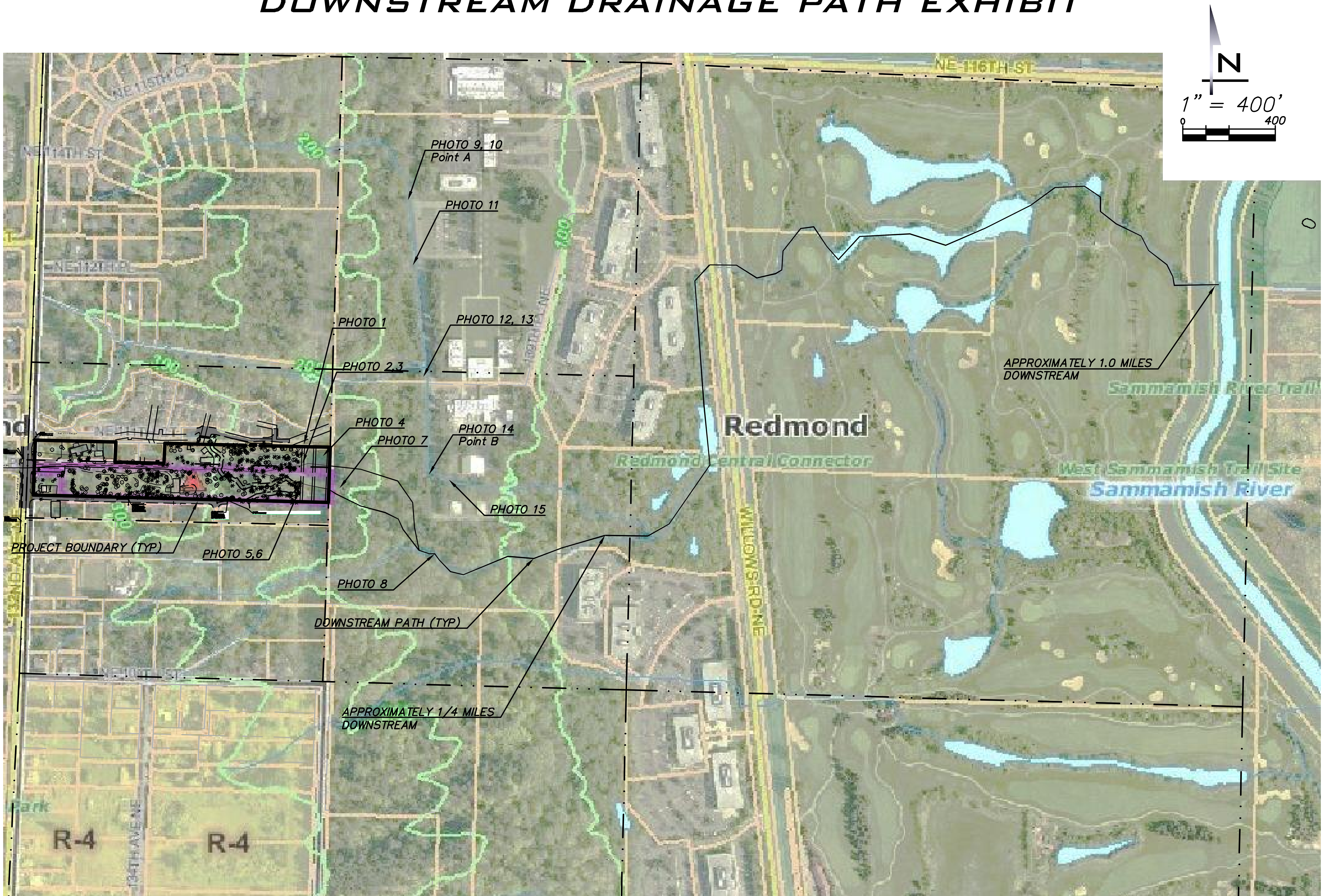
Photo 13: Looking west at slope of ridge to the west of ditch and access road on Aerojet's campus. See bottom third of photo for power lines of the Olympic Pipeline Corridor.

Photo 14: Looking south along west side of Aerojet access road at western boundary of the property. 48-inch culvert middle of photo and just to the right.

Photo 15: Looking east at outfall of 48-inch culvert into ravine just to the east of Aerojet access road. Culvert is located in the bottom middle of the picture.

DOWNSTREAM DRAINAGE PATH EXHIBIT

Attachment 21



BLUELINE

DOWNSTREAM DRAINAGE PATH
TERRENE AT 132ND NE PLAT
TECHINCAL INFORMATION REPORT

SCALE	AS NOTED
PROJECT MANAGER	TODD OBERG
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHESTER BENNETT
PLOT DATE	February 24, 2015

JOB NUMBER: 14-171

FIGURE: DS-1

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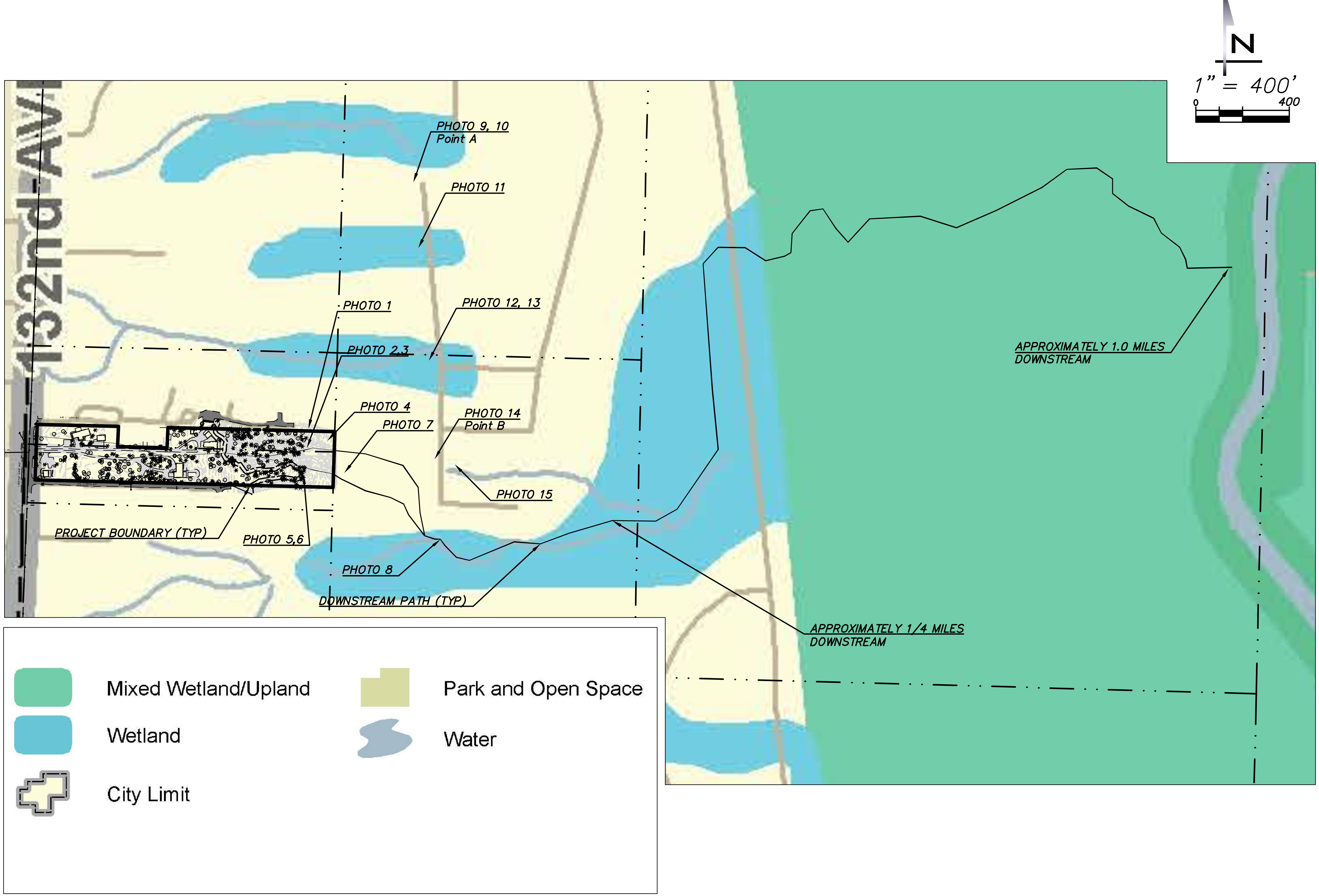
WETLAND DOWNSTREAM DRAINAGE PATH EXHIBIT

Attachment 21

BLUELINE



DOWNSTREAM DRAINAGE PATH
TERRENE AT 132ND NE PLAT
TECHINCAL INFORMATION REPORT

SCALE	AS NOTED
PROJECT MANAGER	TODD OBERG, PE
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHESTER BENNETT
PLOT DATE	February 24, 2015

JOB NUMBER: 14-171

FIGURE: DS-2

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Attachment 21

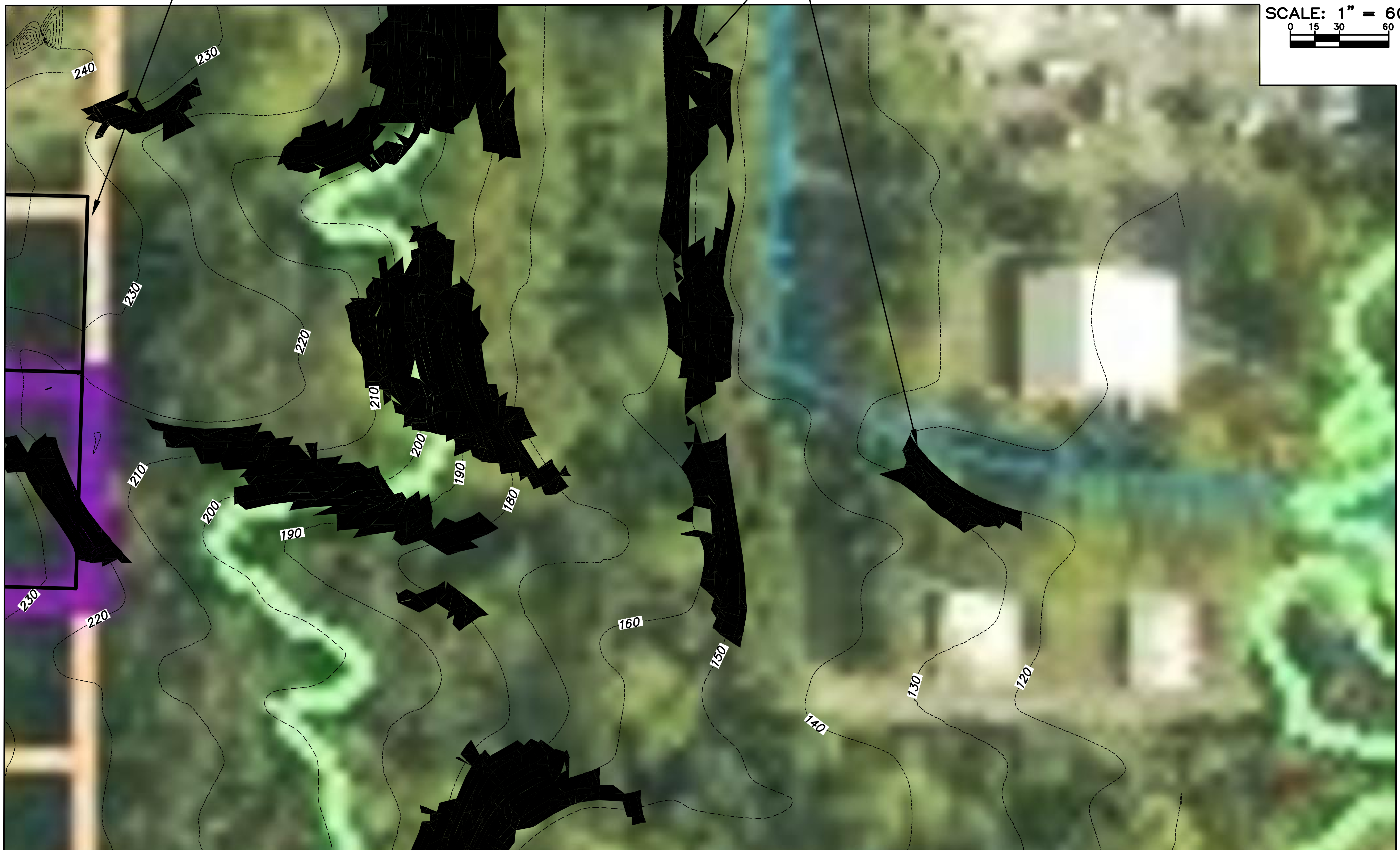
OFFSITE SLOPE ANALYSIS

PROPERTY EASTERN BOUNDARY

SHADING (TYP) INDICATING SLOPES > 40%
FOR AT LEAST 10-FT ELEVATION CHANGE

N

SCALE: 1" = 60'
0 15 30 60



BLUELINE

OFFSITE SLOPE ANALYSIS
TERRENE AT 132ND AVE NE
STORM DRAINAGE REPORT

SCALE	AS NOTED
PROJECT MANAGER	TODD OBERG
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHESTER BENNETT
PLOT DATE	February 24, 2015

JOB NUMBER:
14-171

FIGURE:
SA

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Section 4 PERMANENT STORMWATER CONTROL PLAN

The permanent stormwater control plan includes both flow control and water quality treatment facilities designed and sized according to the City of Redmond 2012 Technical Notebook and the adopted 2005 Stormwater Management Manual for Western Washington.

Onsite flows will be collected by the proposed conveyance system and conveyed via pipe flow to the stormwater facilities located within the drainage tract in the southeastern portion of the developable site boundary. Flows will enter a cartridge filter system upstream of the detention facility as shown in the *Developed Conditions Exhibit* to meet water quality treatment requirements. Flow will then enter a concrete detention vault to meet flow control requirements and discharge via an outfall pipe that will convey flow to the northeast into the ravine with a Gabion outfall located within the natural discharge path and location.

Later in the report it is stated that water quality treatment will be accomplished in a wet-vault. Change this to indicate use of a wet-vault.

FLOW CONTROL ANALYSIS AND DESIGN

The project basin was modeled using the Western Washington Hydrology Model, Version 2012 (WWHM 2012), a continuous rainfall simulation program recognized by the Washington State Department of Ecology (DOE). Soils were modeled as Hydrologic Soil Group C with a regional scale factor of 1.0 (SeaTac). The Standard Flow Control Requirement and other conditions were met according to section 2.5.7 of the City of Redmond 2012 Technical Notebook.

Flow control BMP's required by the COR as described in Section 2.5.5 of the COR 2012 Technical Notebook will be implemented as feasible.

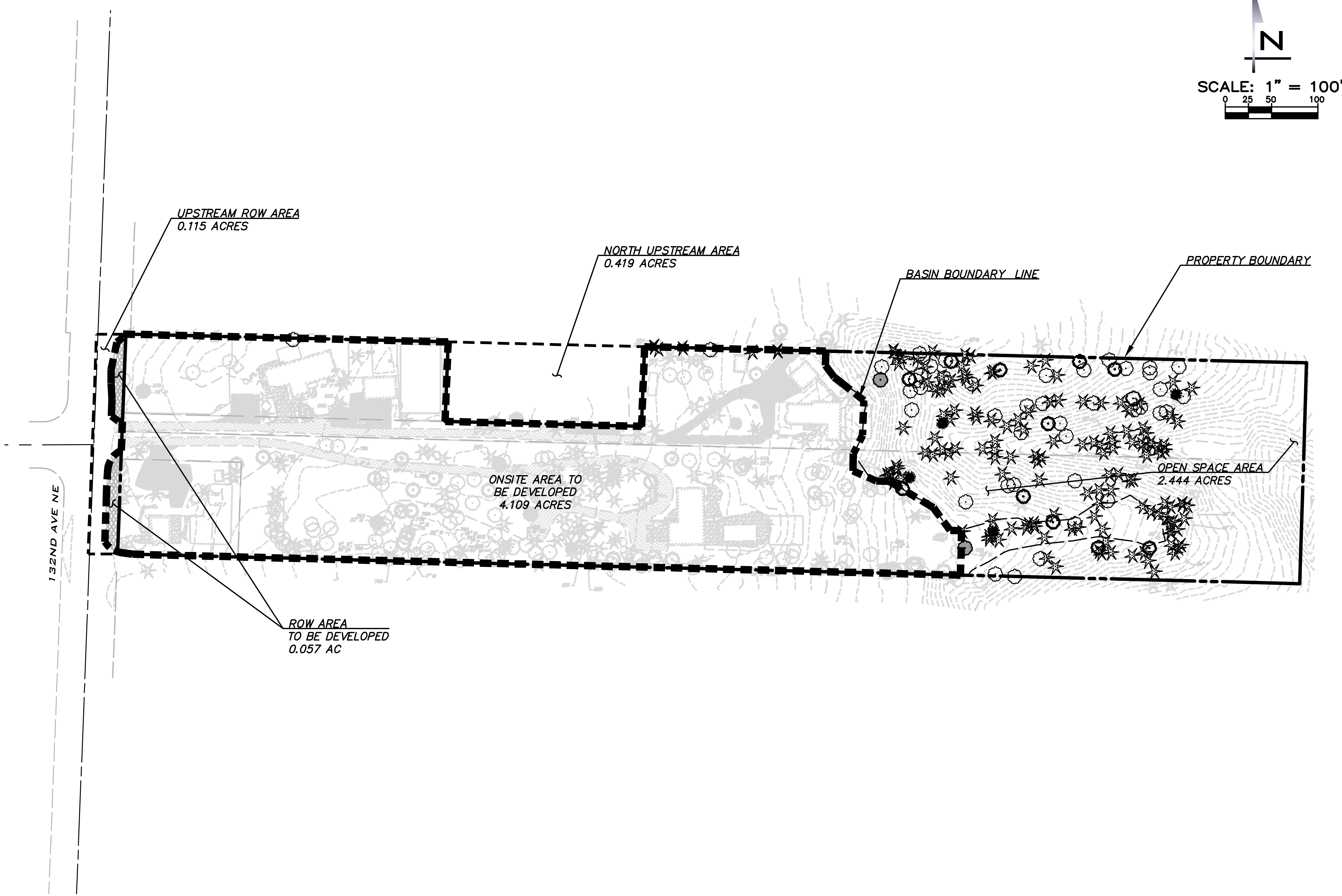
EXISTING CONDITIONS AREA TOTALS

The project basin totals 4.700 acres and excludes open space in the eastern portion of the property of 2.444 acres. In the existing conditions the developable area of 4.166 acres was modeled as forested land cover. Upstream areas, that will not be changed, were modeled as the existing land cover with 0.209 acres impervious land cover and 0.325 acres lawn. The following table summarizes the areas in the existing conditions:

EXISTING CONDITIONS TRIBUTARY BASIN		
Impervious		
Offsite		
ROW roadway	0.115	ac
North upstream Road	0.012	ac
North upstream Roof	0.082	ac
Imperv Total	0.209	ac
Pervious		
Offsite		
North upstream lawn	0.325	ac
ROW forested	0.057	ac
Onsite		
Forested	4.109	ac
Pervious Total	4.491	ac
Basin Total	**4.700**	**ac**

Attachment 21

EXISTING CONDITIONS EXHIBIT



BLUELINE

EXISITING CONDITIONS EXHIBIT

TERRENE AT 132ND AVE NE PLAT

PRELIMINARY STORM DRAINAGE REPORT

SCALE	AS NOTED
PROJECT MANAGER	TODD OBERG, PE
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHRIS WISCOMB
PLOT DATE	May 18, 2015

JOB NUMBER:
14-171

FIGURE:
EC

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DEVELOPED CONDITIONS AREA TOTALS

In the developed conditions the onsite basin area matches the existing conditions total of 4.700 acres. The basin is made up of two upstream areas and the onsite area. The upstream area is comprised of an unchanged upstream ROW area of 0.115 acres, a developable area of .057 acres, and an additional offsite area of 0.419 acres. The onsite area is comprised of a drainage tract of 0.227 acres, a ROW of 0.853 acres, and lot areas of 3.029 acres. The area tributary to the vault totals 4.700 ac. The table on the following page summarizes impervious and pervious land cover totals for the area tributary to the treatment facilities.

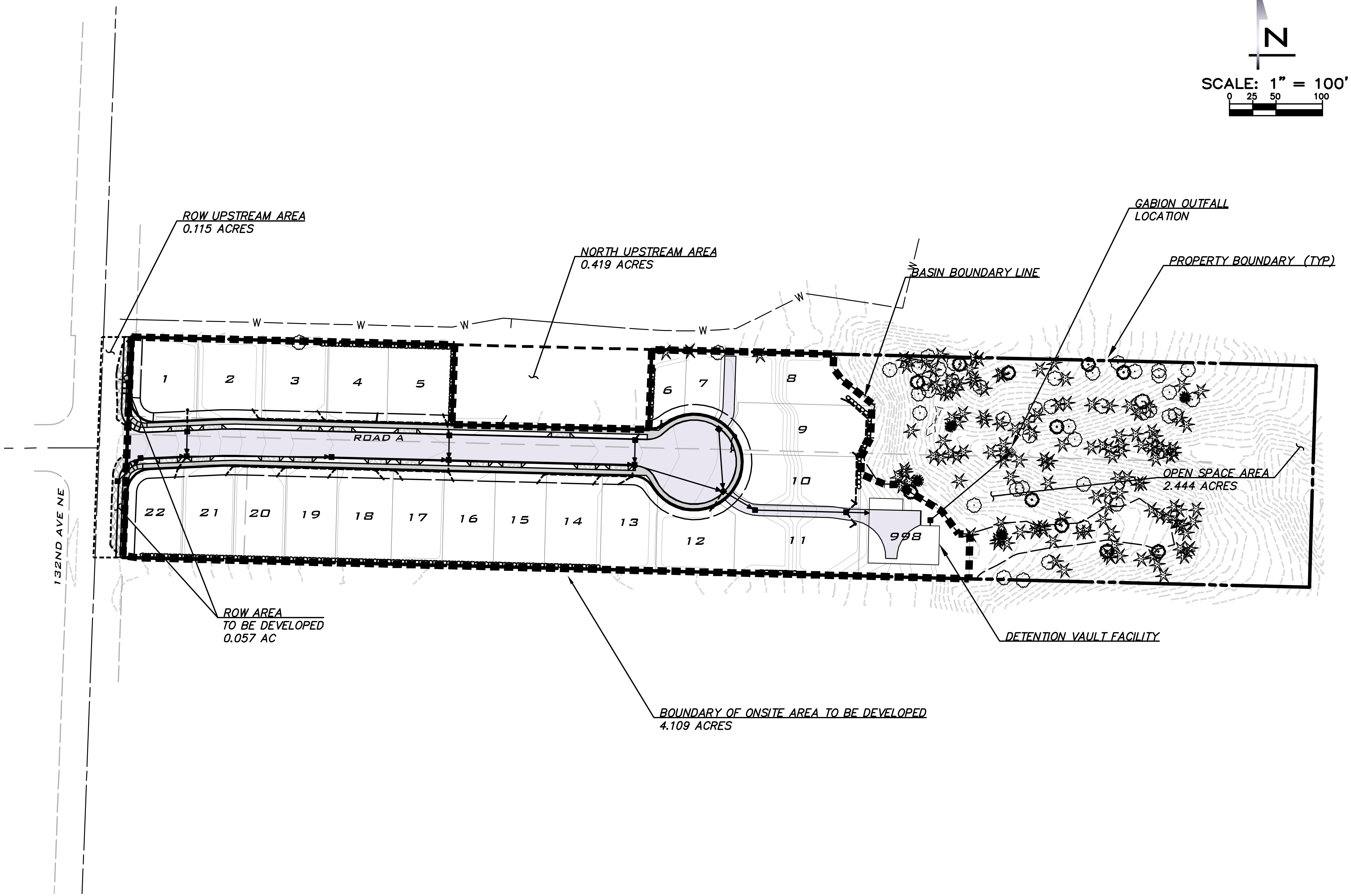
DEVELOPED CONDITIONS TRIBUTARY BASIN

Impervious		
Offsite		
ROW roadway	0.115	ac
ROW sidewalk	0.012	ac
North upstream Road	0.012	ac
North upstream Roof	0.082	ac
Onsite		
Lots	1.763	ac
Road A drive	0.597	ac
Road A sidewalk	0.171	ac
Drainage Tract Drive	0.030	ac
Easement Access Drive	0.054	ac
Imperv Total	2.836	ac
Pervious		
Offsite		
ROW lawn	0.045	ac
North upstream lawn	0.325	ac
Onsite		
Lots	1.211	ac
Road A	0.085	ac
Drainage Tract	0.198	ac
Pervious Total	1.864	ac
Basin Total	**4.700**	**ac**

According to The Standard Flow Control Requirement in section 2.5.7 of the City of Redmond 2012 Technical Notebook the development is required to match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The detention vault passes these requirements. Please see the WWHM2012 Project Report included at the end of this section. The areas used to compute the drainage calculations associated with the developed conditions, as well as the corresponding WWHM2012 output are summarized on the following pages.

DEVELOPED CONDITIONS EXHIBIT

Attachment 21



BLUELINE

DEVELOPED CONDITIONS EXHIBIT
TERRENE AT 132ND AVE NE PLAT
PRELIMINARY STORM DRAINAGE REPORT

SCALE	AS NOTED
PROJECT MANAGER	TODD OBERG, PE
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHRIS WISCOMB
PLOT DATE	May 18, 2015

JOB NUMBER:
14-171

FIGURE:
DC

May 18, 2015 – 2:29pm – User dkuzaro
E:\Projects\14171\DWG\Exhibit\TIR exhibits\14171DC – prelim.dwg

The following table summarizes tributary areas used to size and model stormwater facilities in WWHM2012:

WWHM2012 LAND COVER AREAS

Impervious		
Roof	1.643	ac
Road	1.011	ac
Sidewalk	0.182	ac
	2.836	ac
Pervious		
Lawn (C)	1.864	ac
Perv Total	1.864	ac
Basin Total	4.700	ac

Detention Vault Information

Live Volume = 13.95 ft x 4068 SF = 56,749 CF

Minimum Free Board Height = 0.5 ft

Minimum Sediment Storage Height = 0.5 ft

100-year flow stage Height = 13.96 ft

WWHM2012 Peak Flows from Vault – Developed Conditions

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.099501
5 year	0.154311
10 year	0.200733
25 year	0.272855
50 year	0.337693
100 year	0.413266

WWHM2012
PROJECT REPORT

Project Name: 14171 Rose Hill no trenches 2015-03-26 CRB
Site Name:
Site Address:
City :
Report Date: 3/27/2015
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 : PreDev Hydrologic
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Flat	.325
C, Forest, Flat	2.5
C, Forest, Mod	1.666
Pervious Total	4.491

Impervious Land Use	Acres
ROADS FLAT	0.127
ROOF TOPS FLAT	0.082
Impervious Total	0.209
Basin Total	4.7

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Hydrologic Tributary Area Basin
Bypass: No

GroundWater: No

Pervious Land Use	**Acres**
C, Lawn, Flat	**1.305**
C, Lawn, Mod	**.559**
Pervious Total	**1.864**

Impervious Land Use	**Acres**
ROADS FLAT	**0.708**
ROADS MOD	**0.303**
ROOF TOPS FLAT	**1.643**
SIDEWALKS FLAT	**0.127**
SIDEWALKS MOD	**0.055**
Impervious Total	**2.836**
Basin Total	**4.7**

Element Flows To:

Surface	**Interflow**	**Groundwater**
Vault 1	Vault 1	

Name : Vault 1
Width : 20 ft.
Length : 203.4 ft.
Depth: 14.95 ft.
Discharge Structure
Riser Height: 13.95 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.125 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 1.625 in. **Elevation:** 9.25 ft.
Orifice 3 Diameter: 1.5 in. **Elevation:** 12.2 ft.

Element Flows To:

Outlet 1	**Outlet 2**

Vault Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.093	0.000	0.000	0.000
0.1661	0.093	0.015	0.013	0.000
0.3322	0.093	0.031	0.019	0.000
0.4983	0.093	0.046	0.023	0.000
0.6644	0.093	0.062	0.027	0.000
0.8306	0.093	0.077	0.030	0.000
0.9967	0.093	0.093	0.033	0.000
1.1628	0.093	0.108	0.035	0.000

1.3289	0.093	0.124	0.038	0.000
1.4950	0.093	0.139	0.040	0.000
1.6611	0.093	0.155	0.042	0.000
1.8272	0.093	0.170	0.044	0.000
1.9933	0.093	0.186	0.046	0.000
2.1594	0.093	0.201	0.048	0.000
2.3256	0.093	0.217	0.050	0.000
2.4917	0.093	0.232	0.052	0.000
2.6578	0.093	0.248	0.054	0.000
2.8239	0.093	0.263	0.055	0.000
2.9900	0.093	0.279	0.057	0.000
3.1561	0.093	0.294	0.059	0.000
3.3222	0.093	0.310	0.060	0.000
3.4883	0.093	0.325	0.062	0.000
3.6544	0.093	0.341	0.063	0.000
3.8206	0.093	0.356	0.065	0.000
3.9867	0.093	0.372	0.066	0.000
4.1528	0.093	0.387	0.067	0.000
4.3189	0.093	0.403	0.069	0.000
4.4850	0.093	0.418	0.070	0.000
4.6511	0.093	0.434	0.071	0.000
4.8172	0.093	0.449	0.073	0.000
4.9833	0.093	0.465	0.074	0.000
5.1494	0.093	0.480	0.075	0.000
5.3156	0.093	0.496	0.076	0.000
5.4817	0.093	0.511	0.077	0.000
5.6478	0.093	0.527	0.079	0.000
5.8139	0.093	0.542	0.080	0.000
5.9800	0.093	0.558	0.081	0.000
6.1461	0.093	0.574	0.082	0.000
6.3122	0.093	0.589	0.083	0.000
6.4783	0.093	0.605	0.084	0.000
6.6444	0.093	0.620	0.085	0.000
6.8106	0.093	0.636	0.086	0.000
6.9767	0.093	0.651	0.087	0.000
7.1428	0.093	0.667	0.088	0.000
7.3089	0.093	0.682	0.089	0.000
7.4750	0.093	0.698	0.090	0.000
7.6411	0.093	0.713	0.091	0.000
7.8072	0.093	0.729	0.092	0.000
7.9733	0.093	0.744	0.093	0.000
8.1394	0.093	0.760	0.094	0.000
8.3056	0.093	0.775	0.095	0.000
8.4717	0.093	0.791	0.096	0.000
8.6378	0.093	0.806	0.097	0.000
8.8039	0.093	0.822	0.098	0.000
8.9700	0.093	0.837	0.099	0.000
9.1361	0.093	0.853	0.100	0.000
9.3022	0.093	0.868	0.117	0.000
9.4683	0.093	0.884	0.134	0.000
9.6344	0.093	0.899	0.146	0.000
9.8006	0.093	0.915	0.155	0.000
9.9667	0.093	0.930	0.163	0.000
10.133	0.093	0.946	0.171	0.000
10.299	0.093	0.961	0.177	0.000
10.465	0.093	0.977	0.184	0.000
10.631	0.093	0.992	0.189	0.000

10.797	0.093	1.008	0.195	0.000
10.963	0.093	1.023	0.200	0.000
11.129	0.093	1.039	0.206	0.000
11.296	0.093	1.054	0.210	0.000
11.462	0.093	1.070	0.215	0.000
11.628	0.093	1.085	0.220	0.000
11.794	0.093	1.101	0.224	0.000
11.960	0.093	1.116	0.229	0.000
12.126	0.093	1.132	0.233	0.000
12.292	0.093	1.148	0.255	0.000
12.458	0.093	1.163	0.271	0.000
12.624	0.093	1.179	0.284	0.000
12.791	0.093	1.194	0.294	0.000
12.957	0.093	1.210	0.304	0.000
13.123	0.093	1.225	0.313	0.000
13.289	0.093	1.241	0.322	0.000
13.455	0.093	1.256	0.330	0.000
13.621	0.093	1.272	0.338	0.000
13.787	0.093	1.287	0.345	0.000
13.953	0.093	1.303	0.355	0.000
14.119	0.093	1.318	1.378	0.000
14.286	0.093	1.334	3.206	0.000
14.452	0.093	1.349	5.563	0.000
14.618	0.093	1.365	8.351	0.000
14.784	0.093	1.380	11.51	0.000
14.950	0.093	1.396	15.00	0.000
15.116	0.093	1.411	18.79	0.000
15.282	0.000	0.000	22.86	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:4.491
Total Impervious Area:0.209

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.864
Total Impervious Area:2.836

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.195668
5 year	0.297622
10 year	0.374036
25 year	0.480664
50 year	0.567444
100 year	0.660562

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.099501
5 year	0.154311
10 year	0.200733
25 year	0.272855
50 year	0.337693
100 year	0.413266

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

Year	Predeveloped	Mitigated
1949	0.279	0.072
1950	0.292	0.093
1951	0.337	0.266
1952	0.140	0.064
1953	0.107	0.080
1954	0.149	0.086
1955	0.223	0.087
1956	0.206	0.098
1957	0.218	0.085
1958	0.166	0.089
1959	0.144	0.076
1960	0.282	0.216
1961	0.169	0.092
1962	0.098	0.062
1963	0.157	0.085
1964	0.188	0.084
1965	0.184	0.097
1966	0.135	0.079
1967	0.311	0.090
1968	0.194	0.081
1969	0.179	0.074
1970	0.166	0.078
1971	0.197	0.090
1972	0.272	0.181
1973	0.134	0.095
1974	0.184	0.089
1975	0.253	0.083
1976	0.181	0.088
1977	0.090	0.070
1978	0.142	0.090
1979	0.120	0.063
1980	0.371	0.214
1981	0.145	0.080
1982	0.320	0.169
1983	0.189	0.088
1984	0.130	0.071
1985	0.106	0.076
1986	0.275	0.100
1987	0.275	0.190
1988	0.110	0.072
1989	0.084	0.073
1990	0.679	0.219
1991	0.410	0.207
1992	0.166	0.091

1993	0.134	0.073
1994	0.069	0.061
1995	0.184	0.091
1996	0.420	0.270
1997	0.313	0.231
1998	0.141	0.074
1999	0.428	0.183
2000	0.168	0.093
2001	0.096	0.061
2002	0.188	0.142
2003	0.261	0.079
2004	0.297	0.272
2005	0.217	0.089
2006	0.215	0.093
2007	0.547	0.548
2008	0.541	0.289
2009	0.303	0.110

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

Rank	Predeveloped	Mitigated
1	0.6794	0.5482
2	0.5467	0.2895
3	0.5410	0.2720
4	0.4278	0.2703
5	0.4199	0.2660
6	0.4105	0.2314
7	0.3706	0.2188
8	0.3369	0.2159
9	0.3198	0.2144
10	0.3133	0.2071
11	0.3109	0.1896
12	0.3029	0.1826
13	0.2975	0.1810
14	0.2923	0.1691
15	0.2820	0.1423
16	0.2785	0.1097
17	0.2753	0.1004
18	0.2752	0.0983
19	0.2718	0.0974
20	0.2615	0.0952
21	0.2525	0.0934
22	0.2226	0.0927
23	0.2182	0.0927
24	0.2170	0.0915
25	0.2151	0.0912
26	0.2062	0.0912
27	0.1973	0.0902
28	0.1945	0.0901
29	0.1894	0.0896
30	0.1884	0.0895
31	0.1878	0.0894
32	0.1841	0.0887
33	0.1840	0.0878
34	0.1836	0.0876
35	0.1812	0.0867

36	0.1793	0.0862
37	0.1694	0.0855
38	0.1676	0.0854
39	0.1664	0.0840
40	0.1662	0.0835
41	0.1657	0.0807
42	0.1573	0.0804
43	0.1492	0.0804
44	0.1450	0.0795
45	0.1436	0.0790
46	0.1422	0.0782
47	0.1415	0.0760
48	0.1401	0.0758
49	0.1347	0.0743
50	0.1340	0.0743
51	0.1337	0.0730
52	0.1298	0.0728
53	0.1197	0.0722
54	0.1101	0.0720
55	0.1068	0.0713
56	0.1063	0.0698
57	0.0980	0.0644
58	0.0955	0.0632
59	0.0895	0.0621
60	0.0844	0.0615
61	0.0694	0.0610

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0978	9843	5289	53	Pass
0.1026	8652	3463	40	Pass
0.1073	7670	3326	43	Pass
0.1121	6804	3191	46	Pass
0.1168	6162	3101	50	Pass
0.1216	5523	2982	53	Pass
0.1263	4947	2885	58	Pass
0.1310	4440	2781	62	Pass
0.1358	4068	2704	66	Pass
0.1405	3672	2577	70	Pass
0.1453	3311	2428	73	Pass
0.1500	2990	2310	77	Pass
0.1548	2742	2197	80	Pass
0.1595	2470	2040	82	Pass
0.1642	2229	1906	85	Pass
0.1690	2052	1789	87	Pass
0.1737	1834	1620	88	Pass
0.1785	1637	1474	90	Pass
0.1832	1490	1321	88	Pass
0.1880	1361	1235	90	Pass
0.1927	1222	1118	91	Pass
0.1974	1107	1011	91	Pass

0.2022	1000	888	88	Pass
0.2069	938	784	83	Pass
0.2117	867	658	75	Pass
0.2164	786	514	65	Pass
0.2212	720	428	59	Pass
0.2259	661	374	56	Pass
0.2307	600	310	51	Pass
0.2354	543	257	47	Pass
0.2401	484	238	49	Pass
0.2449	450	219	48	Pass
0.2496	391	203	51	Pass
0.2544	337	182	54	Pass
0.2591	299	159	53	Pass
0.2639	263	144	54	Pass
0.2686	226	123	54	Pass
0.2733	193	104	53	Pass
0.2781	170	95	55	Pass
0.2828	147	86	58	Pass
0.2876	135	75	55	Pass
0.2923	120	65	54	Pass
0.2971	106	62	58	Pass
0.3018	97	59	60	Pass
0.3065	84	55	65	Pass
0.3113	68	52	76	Pass
0.3160	61	49	80	Pass
0.3208	52	45	86	Pass
0.3255	44	42	95	Pass
0.3303	36	39	108	Pass
0.3350	32	35	109	Pass
0.3398	29	29	100	Pass
0.3445	28	21	75	Pass
0.3492	26	17	65	Pass
0.3540	25	14	56	Pass
0.3587	23	8	34	Pass
0.3635	21	6	28	Pass
0.3682	20	6	30	Pass
0.3730	17	6	35	Pass
0.3777	15	6	40	Pass
0.3824	15	6	40	Pass
0.3872	14	6	42	Pass
0.3919	14	5	35	Pass
0.3967	14	5	35	Pass
0.4014	13	5	38	Pass
0.4062	10	5	50	Pass
0.4109	10	4	40	Pass
0.4157	8	4	50	Pass
0.4204	7	4	57	Pass
0.4251	7	4	57	Pass
0.4299	6	4	66	Pass
0.4346	6	4	66	Pass
0.4394	6	4	66	Pass
0.4441	6	4	66	Pass
0.4489	6	3	50	Pass
0.4536	6	3	50	Pass
0.4583	6	3	50	Pass
0.4631	5	3	60	Pass
0.4678	5	3	60	Pass

0.4726	5	3	60	Pass
0.4773	5	3	60	Pass
0.4821	5	3	60	Pass
0.4868	5	3	60	Pass
0.4915	5	3	60	Pass
0.4963	5	3	60	Pass
0.5010	5	3	60	Pass
0.5058	4	3	75	Pass
0.5105	4	1	25	Pass
0.5153	4	1	25	Pass
0.5200	4	1	25	Pass
0.5248	4	1	25	Pass
0.5295	4	1	25	Pass
0.5342	4	1	25	Pass
0.5390	3	1	33	Pass
0.5437	2	1	50	Pass
0.5485	1	1	100	Pass
0.5532	1	0	0	Pass
0.5580	1	0	0	Pass
0.5627	1	0	0	Pass
0.5674	1	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.4033 **acre-feet**
On-line facility target flow: 0.4584 **cfs.**
Adjusted for 15 min: 0.4584 **cfs.**
Off-line facility target flow: 0.2561 **cfs.**
Adjusted for 15 min: 0.2561 **cfs.**

WATER QUALITY ANALYSIS AND DESIGN

The project will provide basic water quality treatment. The project may provide treatment via a combined detention water quality stormwater vault. As specified in Minimum Requirement #6 of the DOE 2005 SWMMWW, the vault is designed to provide treatment for a volume greater than the 91st percentile, 24-hour runoff volume as indicated by WWHM 2012 for the developed conditions modeled with a 15 minute time step. The dead storage volume is required to treat 91% of the runoff volume from the developed site. The dead storage volume provided will be equal to or greater than the required volume, in addition to 0.5-feet of sediment storage.

See the excerpt included below taken from the WWHM2012 Analysis Report on the previous pages for detailed treatment flow rates and volumes required for the developed conditions land cover and detention vault.

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.4033 acre-feet
On-line facility target flow: 0.4584 cfs.
Adjusted for 15 min: 0.4584 cfs.
Off-line facility target flow: 0.2561 cfs.
Adjusted for 15 min: 0.2561 cfs.

CONVEYANCE SYSTEM ANALYSIS AND DESIGN

The conveyance system will be designed according to the 2005 DOE Manual and the 2012 City of Redmond Technical Notebook. The system will be sized to convey the 100-year, 24-hour storm event without overtopping.

System sizing details to be provided at final engineering.

Section 5 Stormwater Pollution Prevention Plan

The Stormwater Pollution Prevention Plan (SWPPP) will be designed according to Minimum Requirement #2 of the 2005 DOE Manual.

SWPPP will be provided at final engineering under a separate cover.

Section 6 Special Reports and Studies

Additional reports and studies within this section include a *Geotechnical Engineering Study*, dated October 7, 2014, prepared by Earth Solutions NW, LLC is included on the following pages.

Attachment 21

Earth Solutions NW LLC

Geotechnical Engineering
Geology
Environmental Scientists
Construction Monitoring

GEOTECHNICAL ENGINEERING STUDY
ROSEHILL PROPERTY
11016 - 132ND AVENUE NORTHEAST
REDMOND, WASHINGTON

ES-3519

1805 - 136th Place N.E., Suite 201   Bellevue, WA 98005
(425) 449-4704   Fax (425) 449-4711
www.earthsolutionsnw.com

Attachment 21

PREPARED FOR

TERRENE AT RH 132ND, LLC

October 7, 2014

Keven D. Hoffmann, E.I.T.
Staff Engineer

Raymond A. Coglas, P.E.
Principal

RAYMOND A COGLAS
STATE OF WASHINGTON
36018
REGISTERED
PROFESSIONAL ENGINEER

GEOTECHNICAL ENGINEERING STUDY
ROSEHILL PROPERTY
11016 – 132ND AVENUE NORTHEAST
REDMOND, WASHINGTON

ES-3519

Earth Solutions NW, LLC
1805 – 136th Place Northeast, Suite 201
Bellevue, Washington 98005
Phone: 425-449-4704 Fax: 425-449-4711
Toll Free: 866-336-8710

Important Information About Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

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

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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Earth Solutions NW LLC

Earth Solutions NW LLC

- Geotechnical Engineering
- Construction Monitoring
- Environmental Sciences

October 7, 2014
ES-3519

Terrene at RH 132nd, LLC
520 – 6th Street South, Suite B
Kirkland, Washington 98033

Attention: Mr. Mike Walsh

Dear Mr. Walsh:

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Geotechnical Engineering Study, Rosehill Property, 11016 – 132nd Avenue Northeast, Redmond, Washington". In our opinion, the proposed residential development is feasible from a geotechnical standpoint. Our study indicates the site is primarily underlain by Vashon subglacial till deposits. During our subsurface exploration completed on September 11, 2014, groundwater seepage was not encountered at the test pit locations; however, depending on the time of year grading operations take place, groundwater seepage may be encountered within site excavations.

Based on the results of our study, proposed residential structures may be supported on conventional continuous and spread footing foundations bearing on competent native soils, recompacted native soils, or new structural fill. Where encountered, fill intended for reuse as structural fill must be primarily free of organic and deleterious material, and should be evaluated by ESNW at the time of construction. In general, competent native deposits suitable for support of foundations will likely be encountered at depths of approximately two to four feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material, will be necessary. Overall stability of the descending slope areas on the east side of the property is characterized as good. Stormwater facilities (vault structure) are feasible provided the recommendations of this report are incorporated into final designs.

Recommendations for foundation design, site preparation, siting of drainage facilities, preliminary infiltration design, and other pertinent development aspects are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Keven D. Hoffmann, E.I.T.
Staff Engineer

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GEOTECHNICAL ENGINEERING STUDY
ROSEHILL PROPERTY
11016 – 132ND AVENUE NORTHEAST
REDMOND, WASHINGTON

ES-3519

INTRODUCTION

General

This geotechnical engineering study was prepared for the proposed Rosehill residential development to be completed at 11004, 11016, and 11020 – 132nd Avenue Northeast in the North Rose Hill area of Redmond, Washington. The purpose of this study was to provide geotechnical recommendations for currently proposed development plans. Our scope of services for completing this geotechnical engineering study included the following:

- Completing subsurface test pits for purposes of characterizing site soils;
- Completing laboratory testing of soil samples collected at the test pit locations;
- Conducting engineering analyses, and;
- Preparation of this report.

The following documents and maps were reviewed as part of our report preparation:

- Pre-Application Exhibit sheet 1 of 1 prepared by The Blueline Group, Job No. 14-141, dated June 6, 2014;
- Top of Slope Exhibit sheet 1 of 1 prepared by Axis Survey & Mapping, Job No. 14-149, dated August 23, 2014;
- Web Soil Survey (WSS) online resource maintained by the Natural Resources Conservation Service under the United States Department of Agriculture;
- “Landslide Hazard Areas” Map 64.7 and “Erosion Hazard Areas” Map 64.8 endorsed by the City of Redmond, Washington, effective April 16, 2011;
- Redmond Zoning Code Section 21.64.060 regarding “Geologically Hazardous Areas”, effective April 16, 2011;
- Liquefaction Susceptibility Map 11-5 prepared by the King County Flood Control District, dated May 2010, and;
- Geologic Map of King County compiled by Booth, Troost, and Wisher, March 2007.

Project Description

According to the referenced pre-application exhibit sheet, the site will be developed with 11 residential lots south of the proposed access road providing entry and egress from 132nd Avenue Northeast. Three additional elongated tracts and one open space tract are shown to the east of the proposed access road. We understand existing residential homes and associated improvements will be removed in accordance with currently proposed project development plans.

At the time of report submission, specific grading and building loading plans were not available for review; however, based on our experience with similar projects, proposed residential structures will likely be constructed utilizing relatively lightly loaded wood framing supported on conventional foundations. Perimeter footing loads will likely be on the order of 1 to 2 kips per lineal foot (klf). Slab-on-grade loading is anticipated to be on the order of 150 pounds per square foot (psf).

Due to existing topographic relief across the site, we estimate grade cuts and fills on the order of 5 feet may be necessary to establish finish grades for new residential lots south of the proposed access road. Grading activities for utility installation, infiltration facilities, and where necessary on the elongated lots within the eastern site area may be more extensive. Retaining walls or rockeries may be incorporated into final designs in order to accommodate grade transitions.

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations in this report. ESNW should review final designs to confirm that our geotechnical recommendations have been incorporated into the plans.

SITE CONDITIONS

Surface

The subject site is located east of 132nd Avenue Northeast between Northeast 111th Court and Northeast 110th Court in the North Rose Hill area of Redmond, Washington. The approximate location of the property is illustrated on Plate 1 (Vicinity Map). The primarily rectangle-shaped property consists of three adjoined tax parcels (King County Parcel Nos. 342605-9087, -9046, and -9100) totaling approximately 5.87 acres.

The subject site is bordered to the north and south by single-family residences, to the west by 132nd Avenue Northeast, and to the east by a utility corridor and forested open space. Site topography descends approximately 25 feet from 132nd Avenue Northeast to the existing single-family residence near the center of the site. The eastern site area is comprised generally of easterly descending slopes to the utility corridor along the east property line and ultimately the Sammamish Valley. Vegetation consists generally of dense, mature forest growth within the eastern site area and along the southern property line.

Subsurface

An ESNW representative observed, logged, and sampled nine test pits excavated within accessible areas of the development envelope using a mini trackhoe and operator retained by our firm on September 11, 2014. The test pits were completed for purposes of assessing soil conditions, classifying site soils, and characterizing subsurface groundwater conditions within the proposed development area and steep slopes within the eastern site area. The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Soil samples collected at the test pit locations were analyzed in accordance with both Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures.

Topsoil and Fill

Topsoil was encountered generally within the upper three to eight inches of existing grades; however, localized areas of topsoil up to 14 inches in depth were observed within areas of mature, undisturbed forest growth. Topsoil was characterized by dark brown color, the presence of fine organic material, and small root intrusions. Fill was encountered at test pit locations TP-5 and TP-9 to depths of four-and-one-half feet and one foot below existing grades, respectively, and consisted primarily of loose silty sand with gravel (USCS: SM). We anticipate fill deposits may also be encountered within proximity to existing structural improvements.

Native Soil

Underlying topsoil and fill, native soils encountered at the test pit locations consisted primarily of medium dense silty sand with gravel (USCS: SM). Weak to moderate cementation was observed within native silty sand deposits. Poorly graded sand with varying silt content (USCS: SP-SM and SP) were first observed within test pits TP-8 and TP-9 at depths of approximately five to seven feet below existing grades. Native soils were primarily encountered in a damp condition and extended to the maximum exploration depth of 10 feet below existing grades.

Geologic Setting

The referenced geologic map resource identifies Vashon subglacial till (Qvt) and Vashon advance outwash (Qva) across the site and surrounding areas. Vashon subglacial till typically consists of an unsorted, unstratified, and high compacted mixture of clay, silt, sand, gravel, and boulders which were deposited directly by glacial ice. Advance outwash deposits typically consist of glaciofluvial sand and gravel, lacustrine clay, silt, and sand deposited during glacial advance. Additionally, the referenced WSS resource identifies Alderwood gravelly sandy loam (AgB and AgD) as being present across the site and surrounding areas. The Alderwood soil series was formed in glacial till plains.

Based on our field observations, native soils likely to be exposed during grading activities will be consistent primarily with subglacial till deposits. Native silty sand soils, consistent with typical characteristics of weathered glacial till, were the primary soil type encountered during our fieldwork.

Groundwater

During our subsurface exploration completed on September 11, 2014, groundwater seepage was not encountered at the test pit locations. Iron oxide staining was observed between depths of five to seven feet below existing grades at test pit locations TP-8 and TP-9.

In our opinion, perched groundwater is not likely to be encountered within the shallower site excavations that occur during the drier, summer months. Iron oxide staining is typically indicative of fluctuating groundwater elevations, and as such, groundwater seepage may be encountered during excavation activities that occur during periods of extended rainfall or within the deeper site excavations. Seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the wetter, winter months.

Critical Areas

Based upon our review of the referenced critical areas maps as adopted by the City of Redmond, the site is not located within any geologically hazardous critical areas; however, our visual observations during the September 2014 fieldwork and available topographic data for the subject parcel confirm the site contains slopes with gradients in excess of 40 percent. With respect to native Alderwood series soils encountered during our fieldwork, we reviewed the referenced critical areas maps, as well as the referenced Redmond Zoning Code (RZC) section, for applicability of erosion hazard potential and landslide potential to development within the property boundaries.

Erosion Hazard

Pursuant to RZC Section 21.64.060(A)(1)(a), erosion hazard areas are defined as lands or areas underlain by soils indentified by the USDA Soil Conservation Service as having "severe" or "very severe" rill and inter-rill erosion hazards. This includes, but is not limited to, the following soil series when they occur on slopes of 15 percent or greater: Alderwood-Kitsap (AkF), Alderwood gravelly sandy loam (AgD), Kitsap silt loam (KpD), Everett (EvD), and Indianola (InD).

As described in the *Geologic Setting* section of this report, Alderwood gravelly sandy loam deposits are primarily present on the subject site. These soils are typically associated with high erosion hazard potential, especially during the wetter, winter months; however, provided appropriate measures for controlling erosion are incorporated into final designs, erosion potential can be adequately mitigated during construction. In our opinion, based on our experience with similar projects in similar settings, permanent landscaping and drainage control measures can adequately mitigate the erosion potential for the proposed development.

Landslide Hazard

Pursuant to RZC Section 21.64.060(A)(1)(b), landslide hazard areas are defined as areas potentially subject to significant or severe risk of landslides based on a combination of geologic, topographic, and hydrogeologic factors. Typical indicators or factors associated with landslide areas include the following:

- Areas of historic failures, such as:
  - Areas designated as quaternary slumps or landslides on maps published by the United States Geologic Survey (USGS), or;
  - Those areas designated by the USDA Soil Conservation Service (SCS) as having a "severe" limitation for building site development.
- Areas containing a combination of slopes steeper than 15 percent, springs or groundwater seepage, and hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock;
- Areas that have shown movement during the Holocene epoch (from 10,000 years ago to the present) or which are underlain or covered by mass wastage debris of that epoch;
- Slopes that are parallel or subparallel to planes of weakness in subsurface materials;
- Slopes having gradients steeper than 80 percent subject to rockfall during seismic shaking;
- Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, or;
- Any area with a slope 40 percent or steeper with a vertical relief of 10 feet or more.

The subject site meets the final criterion listed above indicating the presence of a landslide hazard; however, provided the provisions of RZC Section 21.64.060(E)(2) are incorporated into design and construction, it is our opinion, from a geotechnical standpoint, limited development of non-residential structures (such as drainage facilities) can be successfully achieved within landslide hazard areas contained within the eastern site area. In general, overall stability of the easterly descending slopes is characterized as good. Residential structures should be designed with respect to the 15-foot minimum setback buffer as outlined in RZC Section 21.64.060(B)(3). ESNW should review final project plans in order to provide supplementary recommendations for proposed development within landslide hazards areas on site.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of the proposed residential development at this site is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed development include foundation support, slab-on-grade subgrade support, the suitability of using native soils as structural fill, infiltration feasibility, and construction near or within steep slope areas.

Based on the results of our study, proposed residential structures may be supported on conventional continuous and spread footing foundations bearing on competent native soils, recompacted native soils, or new structural fill. Where encountered, fill intended for reuse as structural fill must be primarily free of organic and deleterious material, and should be evaluated by ESNW at the time of construction. In general, competent native deposits suitable for support of foundations will likely be encountered at depths of approximately two to four feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material, will be necessary.

This study has been prepared for the exclusive use of Terrene at RH 132nd, LLC and their representatives. No warranty, expressed or implied, is made. This study has been prepared 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.

Site Preparation and Earthwork

Prior to excavations for structural footings, site preparation activities will include installing temporary erosion control measures, removing existing structural improvements where necessary, establishing grading limits, and performing clearing and site stripping.

Temporary Erosion Control

The existing driveway will likely function successfully as a temporary construction entrance provided off-site soil tracking can be successfully mitigated. Where necessary, temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered in order to minimize off-site soil tracking and provide a stable access entrance surface. Geotextile fabric may also be considered underlying the quarry spalls for greater stability of the temporary construction entrance.

Erosion control measures should consist of silt fencing placed around down-gradient areas of the site perimeter. Where applicable, soil stockpiles should be covered or otherwise protected to reduce soil erosion. Temporary approaches for controlling surface water runoff should be established prior to beginning construction.

Stripping

Topsoil was encountered generally within the upper three to eight inches of existing grades; however, localized areas of topsoil up to 14 inches in depth were observed within areas of mature, undisturbed forest growth. ESNW should be retained to observe site stripping activities at the time of construction in order to thoroughly assess the required degree of stripping. Over-stripping is unnecessary, may result in increased project development costs, and should be avoided. Topsoil and organic-rich soil is neither suitable for foundation support nor is it suitable for use as structural fill. Topsoil and organic-rich soil can be used in non-structural areas if desired.

In-situ Soils

From a geotechnical standpoint, native soils encountered at the test pit locations will generally be suitable for use as structural fill. The moisture sensitivity of silty sand deposits, which are likely to be encountered during excavation activities, can be characterized as moderate to high. Successful use of native soils as structural fill will largely be dictated by the moisture content at the time of placement and compaction. During our fieldwork completed on September 11, 2014, moisture contents of native glacial till soils were observed below optimum levels. As determined by ESNW during construction, the contractor should be prepared to incorporate moisture conditioning techniques into the overall construction schedule.

Imported Soils

Where necessary, imported soil intended for use as structural fill should consist of a well-graded granular soil with a moisture content that is at or slightly above the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded granular soil with a fines content of 5 percent or less defined as the percent passing the Number 200 sieve, based on the minus three-quarter inch fraction.

Subgrade Preparation

Following the removal of existing structures and associated improvements, grade cuts will be necessary in order to establish proposed subgrade elevations for new development. ESNW should observe the subgrade during initial site preparation activities to confirm soil conditions and to provide supplemental recommendations for subgrade preparation. The process of removing the existing structures may produce voids where old foundations are removed from and where crawl space areas may have been present. Complete restoration of voids from old foundation areas must be executed as part of overall subgrade and building pad preparation activities. The following guidelines for preparing the building subgrade area should be incorporated into the final design:

- Where voids and related demolition disturbances extend below planned subgrade elevations, restoration of these areas should be completed using structural fill to restore voids or unstable areas resulting from the removal of existing structural elements;

- Recompact or overexcavate and replace areas of existing fill, if present, exposed at building subgrade elevations, with overexcavations extending into competent native soils and structural fill utilized to restore subgrade elevations, and;

- ESNW should confirm subgrade conditions and the required level of recompaction, or overexcavation and replacement with structural fill, during site preparation activities, as well as the overall suitability of prepared subgrade areas following site preparation activities.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, and roadway areas. Fills placed to construct permanent slopes and throughout retaining wall and utility trench backfill areas are also considered structural fill. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of 90 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557). The upper one foot of structural fill placed in pavement and sidewalk subgrade areas should be compacted to 95 percent. More stringent compaction specifications may be required for utility trench backfill zones, depending on the responsible utility district or jurisdiction.

Foundations

Proposed residential structures may be supported on conventional continuous and spread footing foundations bearing on competent native soils, recompacted native soils, or new structural fill. Where encountered, fill intended for reuse as structural fill must be primarily free of organic and deleterious material, and should be evaluated by ESNW at the time of construction. In general, competent native deposits suitable for support of foundations will likely be encountered at depths of approximately two to four feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material, will be necessary.

Provided the foundation will be supported as described above, the following parameters can be used for design:

- Allowable soil bearing capacity — 2,500 psf
- Passive earth pressure — 350 pcf (equivalent fluid)
- Coefficient of friction — 0.40

A one-third increase in the allowable soil bearing capacity can be assumed for short-term wind and seismic loading conditions. The above passive pressure and friction values include a minimum factor-of-safety of 1.5. With structural loading as expected, total settlement in the range of one inch and differential settlement of about one-half inch is anticipated. The majority of the settlements should occur during construction as dead loads are applied.

Seismic Design

The 2012 IBC recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. In accordance with Table 20.3-1 of the ASCE Minimum Design Loads for Buildings and Other Structures manual, Site Class D should be used for design.

The referenced liquefaction susceptibility map indicates the site and surrounding areas maintain very low liquefaction susceptibility. Liquefaction is a phenomenon where saturated or loose soils suddenly lose internal strength and behave as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or other intense ground shaking.

In our opinion, site susceptibility to liquefaction can be characterized as negligible. Relatively consistent soil densities and the absence of a uniformly established groundwater table were the primary bases for this characterization.

Slab-On-Grade Floors

Slab-on-grade floors for proposed residential structures should be supported on a firm and unyielding subgrade. Where feasible, native soils exposed at the slab-on-grade subgrade level can likely be compacted in situ to the specifications of structural fill. Unstable or yielding areas of the subgrade should be recompacted, or overexcavated and replaced with suitable structural fill, prior to construction of the slab.

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below the slab. The free-draining material should have a fines content of 5 percent or less (percent passing the Number 200 sieve, based on the minus three-quarter inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier is to be utilized, it should be a material specifically designed for use as a vapor barrier and should be installed in accordance with the specifications of the manufacturer.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters can be used for design:

- Active earth pressure (yielding condition) — 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) — 50 pcf
- Traffic surcharge* (passenger vehicles) — 70 psf (rectangular distribution)
- Passive earth pressure — 350 pcf (equivalent fluid)
- Coefficient of friction — 0.40
- Seismic surcharge — 6H**

* *Where applicable*
** *Where H equals retained height*

The above design parameters are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall, and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill can consist of a less permeable soil, if desired. A perforated drain pipe should be placed along the base of the wall, and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. If drainage is not provided, hydrostatic pressures should be included in the wall design.

<u>Drainage</u>

Groundwater seepage may be encountered within site excavations depending on the time of year grading operations take place. Temporary measures to control surface water runoff and groundwater seepage during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and to provide recommendations to reduce the potential for instability related to seepage effects.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. In our opinion, a foundation drain should be installed along the building perimeter footing. A typical foundation drain detail is provided on Plate 4.

Preliminary Infiltration Design

The feasibility for native soils to accommodate infiltration was investigated as part of our report preparation. We understand the City of Redmond adopts an amended version of the 2005 Washington State Department of Ecology Stormwater Management Manual for Western Washington for design of stormwater facilities. The following recommendations can be utilized regarding proposed infiltration facilities on the subject site.

Based on the results of our subsurface exploration, native soils consisted primarily of medium dense, fine sandy loam. Medium dense sand and fine sand were first observed within test pits TP-8 and TP-9 at depths of approximately five to seven feet below existing grades. Infiltration characteristics typically exhibited by fine loamy sand, sand, and fine sand can be characterized as low, high, and low to moderate, respectively. Fines contents for the sandy loam deposits ranged from approximately 24 to 31 percent; within the sand and fine sand deposits, fines contents were on the order of 3 to 11 percent.

During our subsurface exploration completed on September 11, 2014, groundwater seepage was not encountered at the test pit locations. Iron oxide staining was observed between depths of five to seven feet below existing grades at test pit locations TP-8 and TP-9. In our opinion, the seasonal perched groundwater table may rise nearer to surface grades during the wetter, winter months. Adequate separation between infiltration facility bases and groundwater table elevations must be incorporated into the design.

From a geotechnical standpoint, the overall site would be described as having a marginal capacity for infiltration. Based on the test pit data, the westerly portions of the site exhibited greater potential for infiltration due to the presence of sands. Sands with relatively low fines contents will provide maximum infiltration capacity as compared with fine sand and sandy loam soils. Based on the results of our investigation and subsequent laboratory testing, the following preliminary design rates may be used for feasibility and sizing considerations of site infiltration facilities within the appropriate soil type:

- Sandy loam (USCS: SM) 0.13 inches/hour
- Fine loamy sand (USCS: SM) 0.25 inches/hour
- Fine sand (USCS: SP-SM) 1.00 inch/hour

ESNW should be contacted to review final project plans prior to submittal so as to ensure appropriate geotechnical recommendations regarding infiltration have been incorporated. In addition, ESNW should be retained to observe the construction of infiltration facilities on the subject site and to provide supplemental geotechnical recommendations as necessary. Provisions for overflow should be included in the design of site infiltration facilities.

We recommend the completion of in-situ testing prior to construction if infiltration facilities are incorporated into final project plans. In-situ testing should be completed at proposed infiltration facility locations at the earliest available opportunity, so as to confirm the preliminary recommendations provided in this report. ESNW can provide additional field services, including in-situ testing, upon request.

Preliminary Detention Vault Design

We understand a stormwater detention vault may be constructed within the eastern half of the site. According to preliminary design information, grade cuts on the order of 10 to 20 feet may be necessary to achieve the vault foundation subgrade elevation.

Vault foundations should be supported on competent native soil or crushed rock placed atop competent native soil. Final detention vault designs must incorporate adequate buffer space from property boundaries such that temporary excavations to construct the vault structure can be successfully completed. Perimeter drains should be installed around the vault and conveyed to an approved discharge point. Although not observed at the test pit locations, the presence of groundwater seepage should be anticipated during excavation activities for the vault.

The following preliminary design parameters can be used for the detention vault:

- Allowable soil bearing capacity (dense native soil) 5,000 psf
- Active earth pressure (unrestrained) 35 pcf
- Active earth pressure (unrestrained, hydrostatic) 80 pcf

- At-rest earth pressure (restrained) 50 pcf
- At-rest earth pressure (restrained, hydrostatic) 95 pcf
- Coefficient of friction 0.40
- Passive earth pressure 350 pcf

Retaining walls should be backfilled with free-draining material or suitable sheet drainage that extends along the height of the walls. The upper one foot of the wall backfill can consist of a less permeable soil, if desired. A perforated drain pipe should be placed along the base of the wall and connected to an approved discharge location. If the elevation of the vault bottom is such that gravity flow to an outlet is not possible, the portion of the vault below the drain should be designed to include hydrostatic pressure.

ESNW should observe grading operations for the detention vault and subgrade conditions prior to concrete forming and pouring in order to confirm conditions are as anticipated and to provide supplementary recommendations as necessary. Additionally, ESNW should be contacted to review final vault designs to confirm that appropriate geotechnical parameters have been incorporated.

Excavations and Slopes

The Federal Occupation Safety and Health Administration (OSHA) and the Washington Industrial Safety and Health Act (WISHA) provide soil classification in terms of temporary slope inclinations. Soils that exhibit a high compressive strength are allowed steeper temporary slope inclinations than are soils that exhibit a lower compressive strength.

Based on the soil conditions encountered at the test pit locations, native soils likely to be exposed during grading activities would be classified as Type C by OSHA and WISHA. Temporary slopes over four feet in height in Type C soils must be sloped no steeper than 1.5H:1V (Horizontal:Vertical). The presence of perched groundwater may cause caving of the temporary slopes due to excess seepage forces. ESNW should observe site excavations to confirm soil types and allowable slope inclinations. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

Permanent slopes should maintain a gradient of 2H:1V or flatter and should be planted with vegetation to enhance stability and to minimize erosion. An ESNW representative should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations as necessary.

Pavement Sections

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proofrolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. It is possible that soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas containing unsuitable or yielding subgrade conditions will require remedial measures such as overexcavation and thicker crushed rock or structural fill sections prior to pavement.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections can be considered:

- A minimum of two inches of hot mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;
- A minimum of two inches of HMA placed over three inches of asphalt treated base (ATB).

The HMA, ATB and CRB materials should conform to WSDOT specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557. Final pavement design recommendations can be provided once final traffic loading has been determined. Road standards utilized by the City of Redmond may supersede the recommendations provided in this report.

Utility Support and Trench Backfill

In our opinion, native deposits will generally be suitable for support of utilities. Organic-rich soil is not considered suitable for direct support of utilities and may require removal at utility grades if encountered. Remedial measures may be necessary in some areas in order to provide support for utilities, such as overexcavation and replacement with structural fill, or placement of geotextile fabric. Groundwater seepage may be encountered in utility excavations and caving of trench walls may occur where groundwater is encountered. Depending on the time of year and conditions encountered, dewatering, as well as temporary trench shoring, may be necessary during utility excavation and installation.

In general, native deposits will likely be suitable for use as structural backfill throughout utility trench excavations, provided the soil is at or near the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soils may be necessary at some locations prior to use as structural fill. Each section of the utility lines must be adequately supported in the bedding material. Utility trench backfill should be placed and compacted to the specifications of structural fill as previously detailed in this report, or to the applicable specifications of the City of Redmond or other responsible jurisdiction or agency.

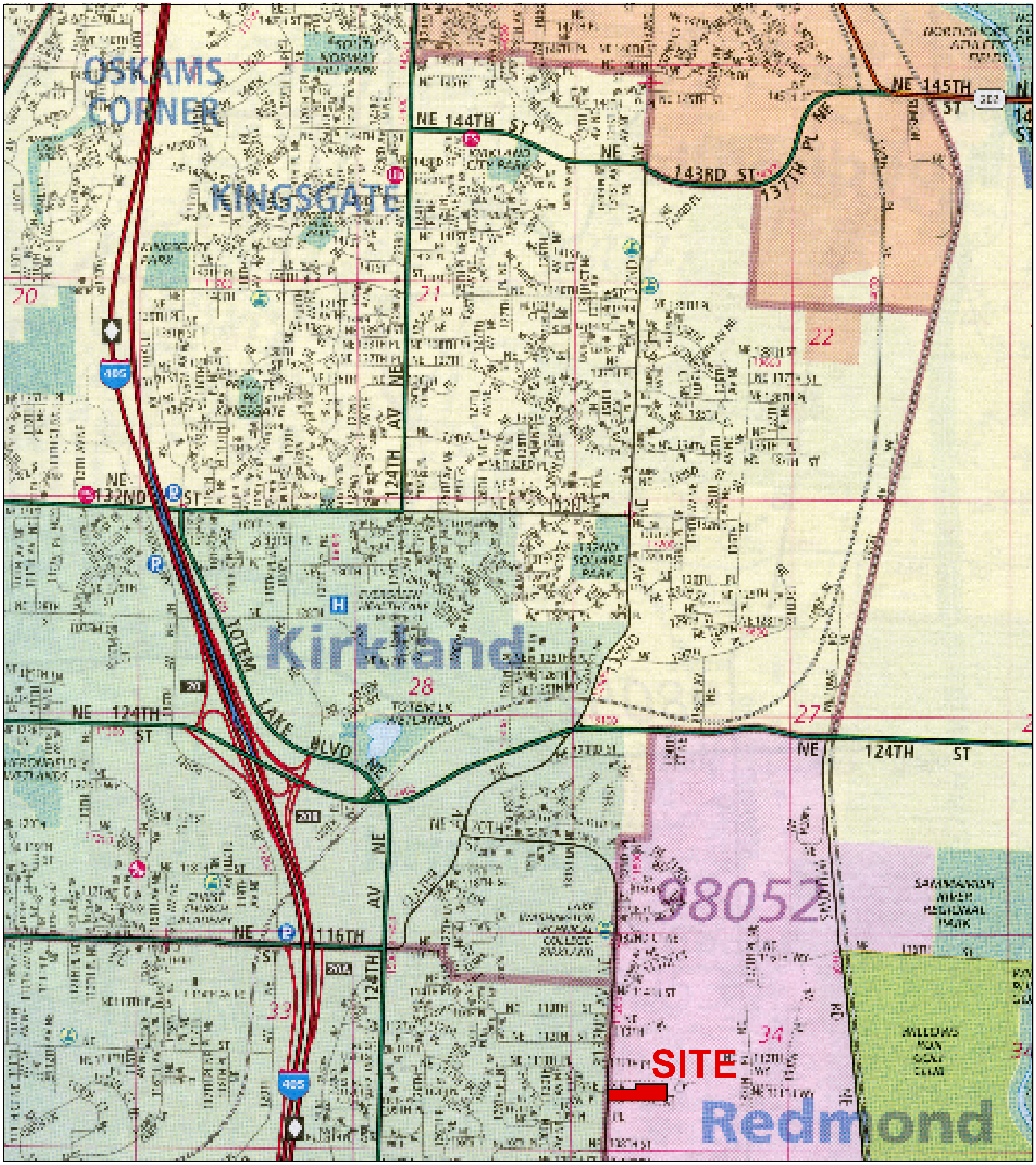
LIMITATIONS

The recommendations and conclusions provided in this geotechnical engineering study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is not expressed or implied. Variations in the soil and groundwater conditions observed at the test pit locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions in this geotechnical engineering study if variations are encountered.

Additional Services

ESNW should have an opportunity to review final project plans with respect to the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services during construction.

Attachment 21



Reference:
King County, Washington
Map 506
By The Thomas Guide
Rand McNally
32nd Edition

NORTH

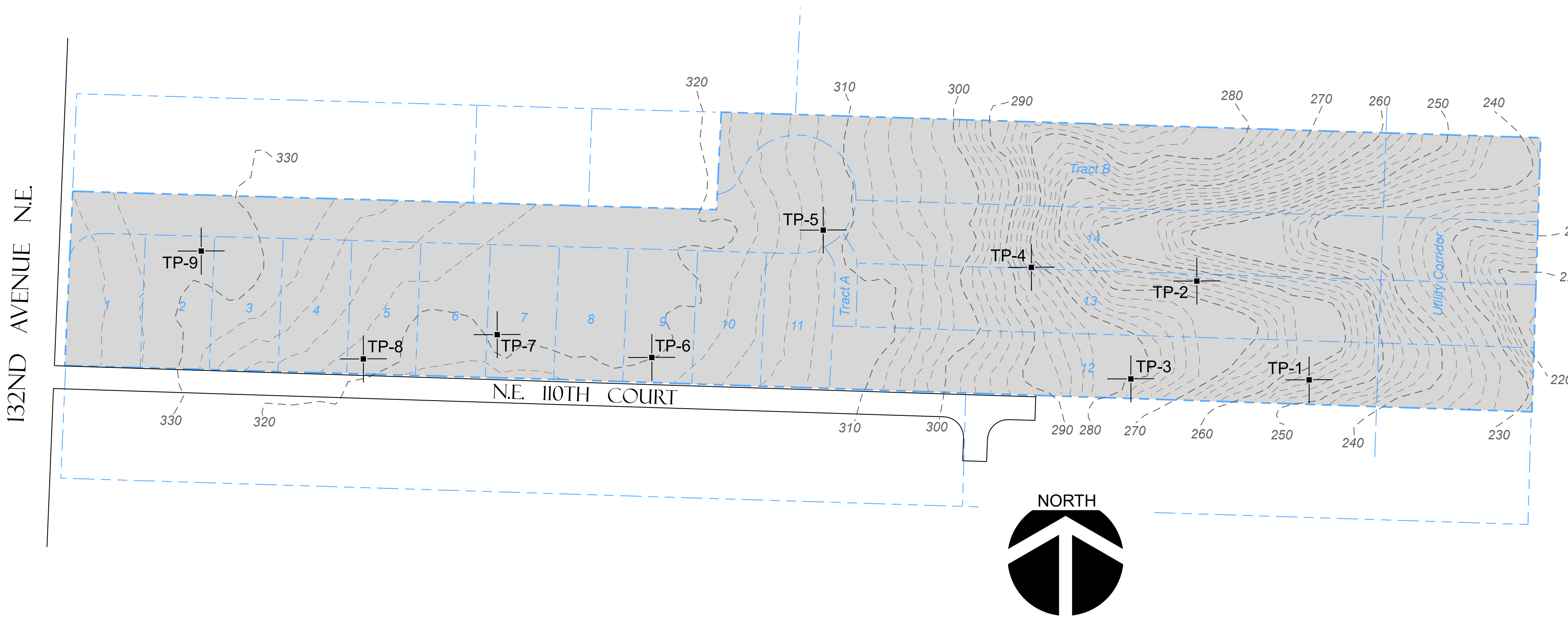
Earth Solutions NW LLC

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

Vicinity Map
Rosehill Property
Redmond, Washington

Drwn. GLS	Date 09/16/2014	Proj. No. 3519
Checked KDH	Date Sept. 2014	Plate 1

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.



LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-3519, Sept. 2014

Subject Site

3 Proposed Lot Number

0 50 100 200

1"=100' Scale in Feet

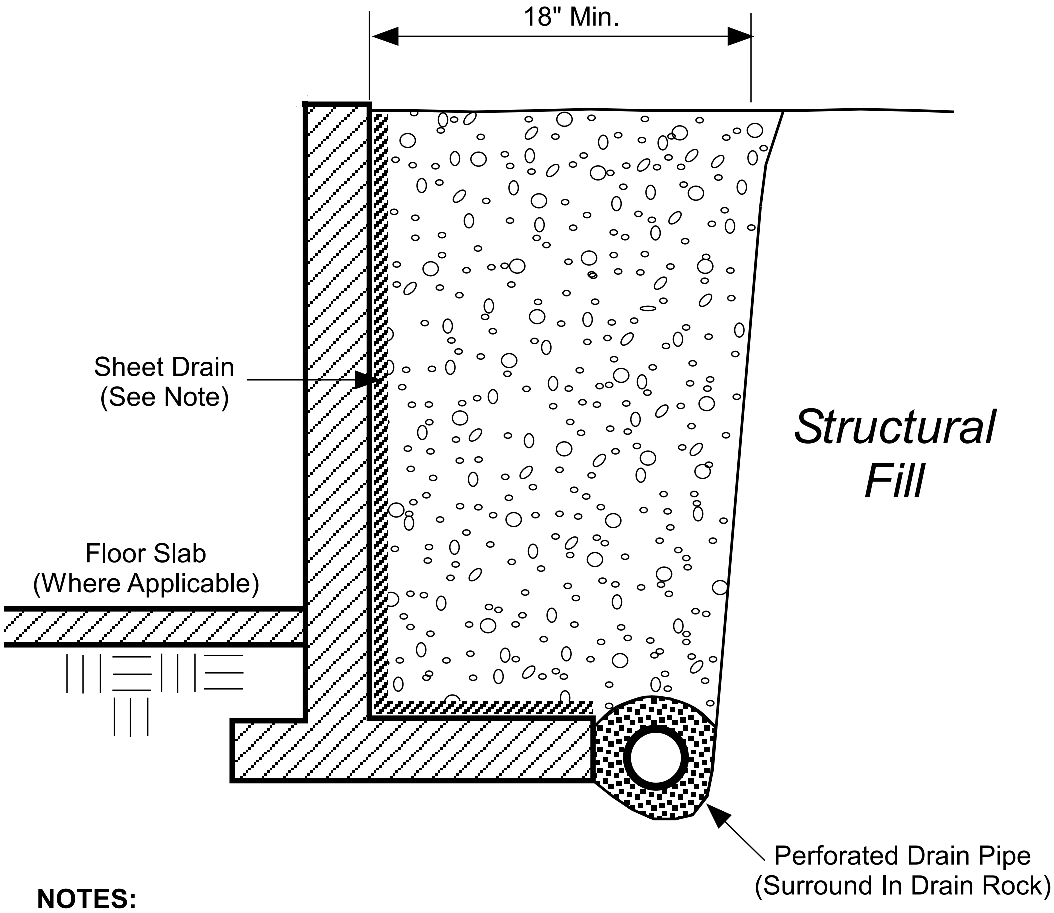
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Test Pit Location Plan
Rosehill Property
Redmond, Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

Drwn. By	GLS
Checked By	KDH
Date	09/16/2014
Proj. No.	3519
Plate	2



NOTES:

- Free Draining Backfill should consist of soil having less than 5 percent fines. Percent passing #4 should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free Draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1" Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

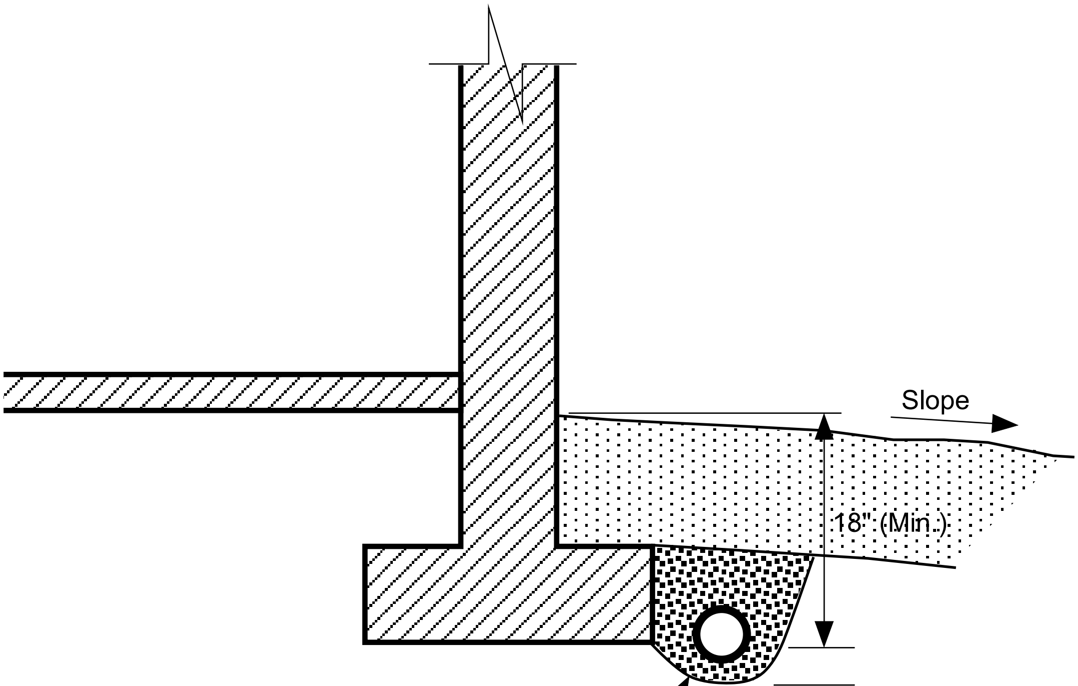
Free Draining Structural Backfill

1 inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

RETAINING WALL DRAINAGE DETAIL
Rosehill Property
Redmond, Washington

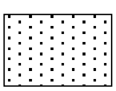
Drwn. GLS	Date 09/16/2014	Proj. No. 3519
Checked KDH	Date Sept. 2014	Plate 3

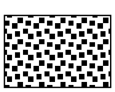


NOTES:

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

LEGEND:


Surface Seal; native soil or other low permeability material.


1" Drain Rock

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

FOOTING DRAIN DETAIL
Rosehill Property
Redmond, Washington

Drwn. GLS	Date 09/16/2014	Proj. No. 3519
Checked KDH	Date Sept. 2014	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

ES-3519

Subsurface conditions at the site were explored on September 11, 2014 by excavating a total of nine test pits within accessible areas of the development envelope using a mini trackhoe and operator retained by our firm. The approximate locations of subsurface exploration test pits are illustrated on Plate 2 of this study. The subsurface test pit logs are provided in this Appendix. The test pits were advanced to a maximum depth of 10 feet below existing grades.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

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

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

CLIENT Terrene Ventures	PROJECT NAME Rosehill Property
PROJECT NUMBER 3519	PROJECT LOCATION Redmond, Washington
DATE STARTED 9/11/14 COMPLETED 9/11/14	GROUND ELEVATION 256 ft TEST PIT SIZE
EXCAVATION CONTRACTOR NW Excavating	GROUND WATER LEVELS:
EXCAVATION METHOD	AT TIME OF EXCAVATION ---
LOGGED BY KDH CHECKED BY KDH	AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 10"- 12": dense brush	AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, roots to 6'
1.0					255.0
			SM		Tan silty SAND with gravel, loose, dry to damp
		MC = 4.20%			
					-becomes medium dense, damp
5					
		MC = 6.20%			-weak cementation
					-increased moisture content
7.0		MC = 6.20%			249.0
					Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation.
					Bottom of test pit at 7.0 feet.

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

CLIENT Terrene Ventures
PROJECT NAME Rosehill Property
PROJECT NUMBER 3519
PROJECT LOCATION Redmond, Washington
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 264 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 8": dense brush
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	0.8	Dark brown TOPSOIL, roots to 4'	263.3
		MC = 5.10%	SM		Tan silty SAND with gravel, loose, dry to damp	
		MC = 3.20%			-becomes medium dense, damp	
5					-cobbles to BOH	
					-weak cementation	
		MC = 5.60%		6.5	-becomes damp to moist	257.5
					Test pit terminated at 6.5 feet below existing grade. No groundwater encountered during excavation.	
					Bottom of test pit at 6.5 feet.	

GENERAL BH / TP / WELL 3519.GPJ GINT US.GDT 9/25/14

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

CLIENT Terrene Ventures
PROJECT NAME Rosehill Property
PROJECT NUMBER 3519
PROJECT LOCATION Redmond, Washington
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 280 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 8": brush, moss
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	0.8	Dark brown TOPSOIL, roots to 4'	279.3
		MC = 6.70%	SM		Light brown silty SAND with gravel, loose, dry to damp	
					-becomes tan silty sand with gravel, medium dense, damp	
5		MC = 6.30% Fines = 31.20%			-weak cementation [USDA Classification: fine sandy LOAM] -cobbles to BOH	
		MC = 5.80%				
					-decreased fines content	
		MC = 6.20%		9.0		271.0
					Test pit terminated at 9.0 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 9.0 feet.	

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-4

CLIENT Terrene Ventures
PROJECT NAME Rosehill Property
PROJECT NUMBER 3519
PROJECT LOCATION Redmond, Washington
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 284 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 10"- 14": dense brush
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.0	Dark brown TOPSOIL, roots to 5'	283.0
		MC = 5.80%	SM		Light brown silty SAND with gravel, loose, dry to damp	
					-becomes medium dense, damp	
					-cobbles	
5		MC = 5.50%			-weak cementation	
					-becomes silty fine sand, medium dense, damp to moist -no cementation	
		MC = 4.90%		6.5	Test pit terminated at 6.5 feet below existing grade. No groundwater encountered during excavation.	277.5
					Bottom of test pit at 6.5 feet.	

Attachment 21

TEST PIT NUMBER TP-5

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

CLIENT Terrene Ventures | **PROJECT NAME** Rosehill Property

PROJECT NUMBER 3519 | **PROJECT LOCATION** Redmond, Washington

DATE STARTED 9/11/14 **COMPLETED** 9/11/14 | **GROUND ELEVATION** 312 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating | **GROUND WATER LEVELS:**

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY KDH **CHECKED BY** KDH

AT END OF EXCAVATION ---

NOTES Depth of Topsoil & Sod 3": duff

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SM		Brown silty SAND with gravel, loose to medium dense, damp (Fill) -root intrusions to 4' -wires	
		MC = 10.40%		4.5		307.5
5		MC = 3.80%	SM		Brown silty SAND with gravel, medium dense, damp to moist -cobbles	
		MC = 4.60%		7.0		305.0
					Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 7.0 feet.	

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-6

CLIENT Terrene Ventures
PROJECT NAME Rosehill Property
PROJECT NUMBER 3519
PROJECT LOCATION Redmond, Washington
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 320 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 6": duff
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	0.5	Dark brown TOPSOIL, roots to 5'	319.5
			SM		Light brown silty SAND with gravel, loose to medium dense, dry to damp	
		MC = 6.00%			-becomes medium dense, damp	
					-cobbles to 6.5'	
5		MC = 4.10%				
		MC = 5.90%			-becomes silty fine sand, medium dense, damp to moist	
					-weakly cemented pieces [USDA Classification: fine loamy SAND]	
		MC = 4.70% Fines = 17.90%		8.5	Test pit terminated at 8.5 feet below existing grade. No groundwater encountered during excavation.	311.5
					Bottom of test pit at 8.5 feet.	

GENERAL BH / TP / WELL 3519.GPJ GINT US.GDT 9/25/14

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-7

CLIENT Terrene Ventures
PROJECT NAME Rosehill Property
PROJECT NUMBER 3519
PROJECT LOCATION Redmond, Washington
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 320 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 10": brush, duff
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 4'	
1.0						319.0
		MC = 5.80%	SM		Tan silty SAND with gravel, loose to medium dense, dry to damp -becomes medium dense, damp -cobbles	
5		MC = 7.10%			-iron oxide staining -weak to moderate cementation, becomes dense	
7.5		MC = 7.80%				312.5
					Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 7.5 feet.	

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-8

CLIENT Terrene Ventures
PROJECT NAME Rosehill Property
PROJECT NUMBER 3519
PROJECT LOCATION Redmond, Washington
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 321 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 6"- 8": brambles, duff
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0 – 0.5			TPSL		Dark brown TOPSOIL, roots to 4'	320.5
0.5 – 7.0		MC = 7.40% Fines = 24.10% MC = 4.90%	SM		Tan silty SAND with gravel, loose, dry to damp -becomes medium dense, damp [USDA Classification: very gravelly loamy SAND] -cobbles -iron oxide staining	314.0
7.0 – 10.0		MC = 4.80% Fines = 11.10% MC = 8.00%	SP-SM		Brown poorly graded fine SAND with silt, medium dense, damp to moist -weakly cemented pieces [USDA Classification: fine SAND]	311.0

Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation.

Bottom of test pit at 10.0 feet.

Attachment 21

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-9

CLIENT Terrene Ventures | **PROJECT NAME** Rosehill Property
PROJECT NUMBER 3519 | **PROJECT LOCATION** Redmond, Washington
DATE STARTED 9/11/14 **COMPLETED** 9/11/14 | **GROUND ELEVATION** 331 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating | **GROUND WATER LEVELS:**
EXCAVATION METHOD | **AT TIME OF EXCAVATION** ---
LOGGED BY KDH **CHECKED BY** KDH | **AT END OF EXCAVATION** ---
NOTES Depth of Topsoil & Sod 3": brambles, duff | **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0			SM	1.0	Brown silty SAND with gravel and moderate organic content, loose, damp (Fill) -rusty corrugated pipe	330.0
		MC = 8.20%	SM	5.0	Light brown silty SAND with gravel, loose to medium dense, dry to damp -cobbles -becomes medium dense	326.0
5		MC = 6.40% MC = 8.20%	SP-SM	7.0	Light brown poorly graded fine SAND with silt, medium dense, damp	324.0
		MC = 6.90% Fines = 3.30%	SP	9.0	Brown poorly graded fine SAND, medium dense, damp to moist [USDA Classification: SAND]	322.0
					Test pit terminated at 9.0 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 9.0 feet.	

Appendix B

Laboratory Test Results

ES-3519

Attachment 21

GRAIN SIZE DISTRIBUTION

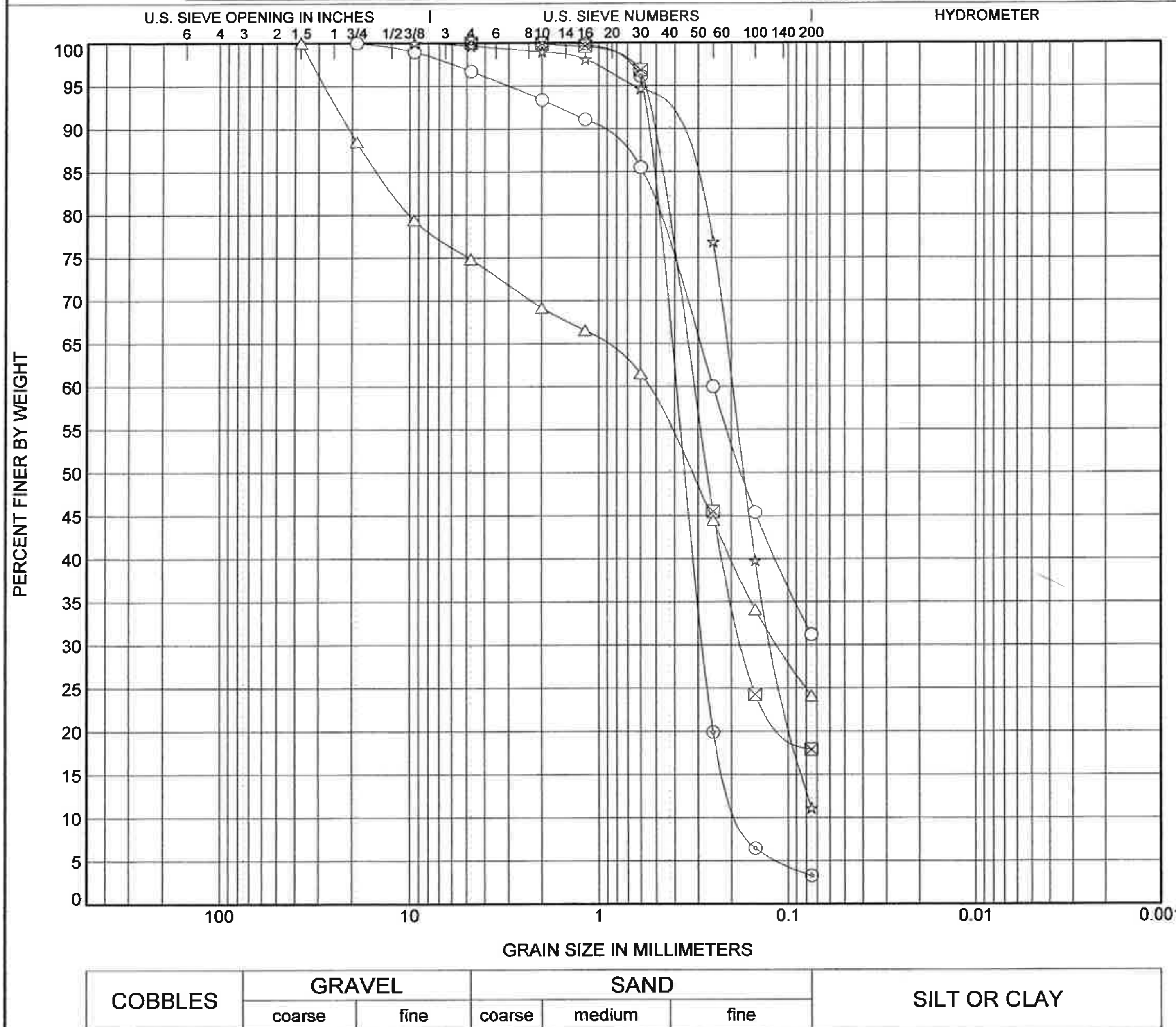
Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, WA 98005
Telephone: 425-284-3300

CLIENT Terrene at RH 132nd, LLC

PROJECT NAME Rose Hill Property

PROJECT NUMBER ES-3519

PROJECT LOCATION Redmond



Specimen Identification			Classification	Cc	Cu
○	TP-3	4.5ft.	USDA: Tan Fine Sandy Loam. USCS: Tan SM.		
⊠	TP-6	8.5ft.	USDA: Tan Fine Loamy Sand. USCS: SM w Gravel.		
△	TP-8	3.0ft.	USDA: Brown Gravelly Sandy Loam. USCS: SM w Gravel.		
☆	TP-8	8.5ft.	USDA: Tan Fine Sand. USCS: SP-SM.	0.97	2.71
⊙	TP-9	9.0ft.	USDA: Brown Sand. USCS: SP	1.16	2.31

Specimen Identification			D100	D60	D30	D10			%Silt	%Clay
○	TP-3	4.5ft.	19	0.25					31.2	
⊠	TP-6	8.5ft.	4.75	0.32	0.172				17.9	
△	TP-8	3.0ft.	37.5	0.556	0.113				24.1	
☆	TP-8	8.5ft.	9.5	0.198	0.118				11.1	
⊙	TP-9	9.0ft.	4.75	0.396	0.281	0.172			3.3	

Report Distribution

ES-3519

<u>EMAIL ONLY</u>

Terrene at RH 132nd, LLC
520 – 6th Street South, Suite B
Kirkland, Washington 98033

Attention: Mr. Mike Walsh

Section 7 Other Permits

At this time no other permits related to this storm drainage report are required.

Section 8 Operations &Maintenance

Operation and maintenance manuals will be provided at final engineering.

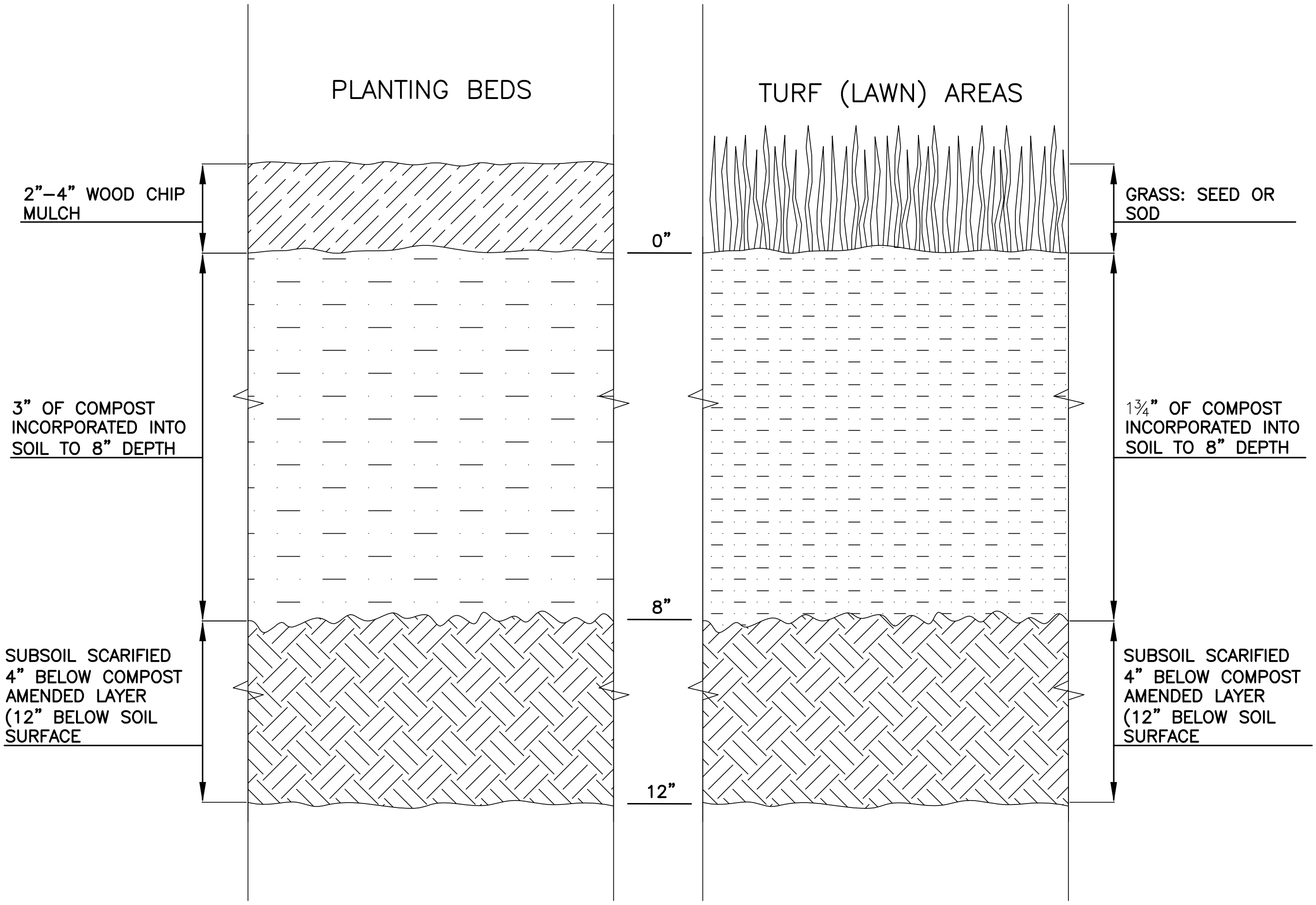
Section 9 Bond Quantities

A bond quantities worksheet will be provided at final engineering

Section 10 Appendix

- Redmond Stormwater Construction Standard Detail - 632

Attachment 21



NOTES:

1. ALL SOIL AREAS DISTURBED OR COMPACTED DURING CONSTRUCTION, AND NOT COVERED BY BUILDINGS OR PAVEMENT, SHALL BE AMENDED WITH COMPOST TO A MINIMUM 8" DEPTH, AND SUBSOIL SCARIFIED 4" BELOW THAT COMPOST–AMENDED LAYER, FOR A FINISHED 12" OF UNCOMPACTED DEPTH IN ALL LANDSCAPE AREAS.
2. PLANTING BED AND TURF AREA SOIL PREPARATION ARE THE SAME, EXCEPT FOR AMOUNT OF COMPOST AMENDMENT, AND MULCH ADDED TO PLANTING BEDS.
3. COMPOST SHALL BE TILLED IN TO 8 INCH DEPTH INTO EXISTING SOIL, OR PLACE 8 INCHES OF COMPOST–AMENDED SOIL, PER SOIL SPECIFICATION. SUBSOIL SHALL BE SCARIFIED (LOOSENED) 4 INCHES BELOW AMENDED LAYER, TO PRODUCE 12–INCH DEPTH OF UN–COMPACTED SOIL, EXCEPT WHERE SCARIFICATION WOULD DAMAGE TREE ROOTS.
4. TURF AREAS SHALL RECEIVE 1.75 INCHES OF COMPOST TILLED IN TO 8–INCH DEPTH, OR PLACE 8" OF IMPORTED SOIL CONTAINING 20–25% COMPOST BY VOLUME. THEN PLANT GRASS SEED OR SOD PER SPECIFICATION.
5. PLANTING BEDS SHALL RECEIVE 3 INCHES OF COMPOST TILLED IN TO 8–INCH DEPTH, OR PLACE 8" OF IMPORTED SOIL CONTAINING 35–40% COMPOST BY VOLUME. MULCH AFTER PLANTING, WITH 2–4 INCHES OF ARBORIST WOOD CHIP MULCH OR APPROVED EQUAL.
6. REFER TO CITY OF REDMOND STANADARD SPECIFICATIONS: 9–14.1 PLANTING SOIL AND TURF AREA SOIL, ARBORIST WOOD CHIP MULCH, AND COMPOSTED MATERIAL (COMPOST).

SOIL AMENDMENT AND DEPTH

NTS

APPROVED BY: JON C. SPANGLER NATURAL RESOURCES/STORMWATER ENGINEERING MANAGER	City of Redmond WASHINGTON	STANDARD DETAILS **SOIL AMENDMENT AND DEPTH**
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