Edgewood East

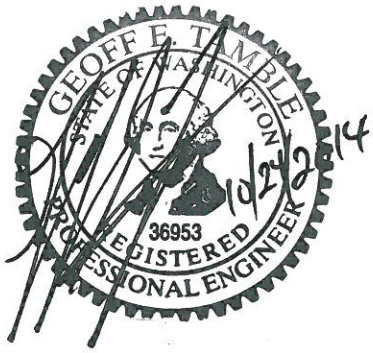
City of Redmond, Washington

Preliminary Storm Drainage Report

Prepared for
Quadrant Homes
14725 SE 36th Street, Suite 100
Bellevue, WA 98006

Original Date: **July 23, 2014**

Revision Date: **October 24, 2014**



Blueline Job No. 14-036

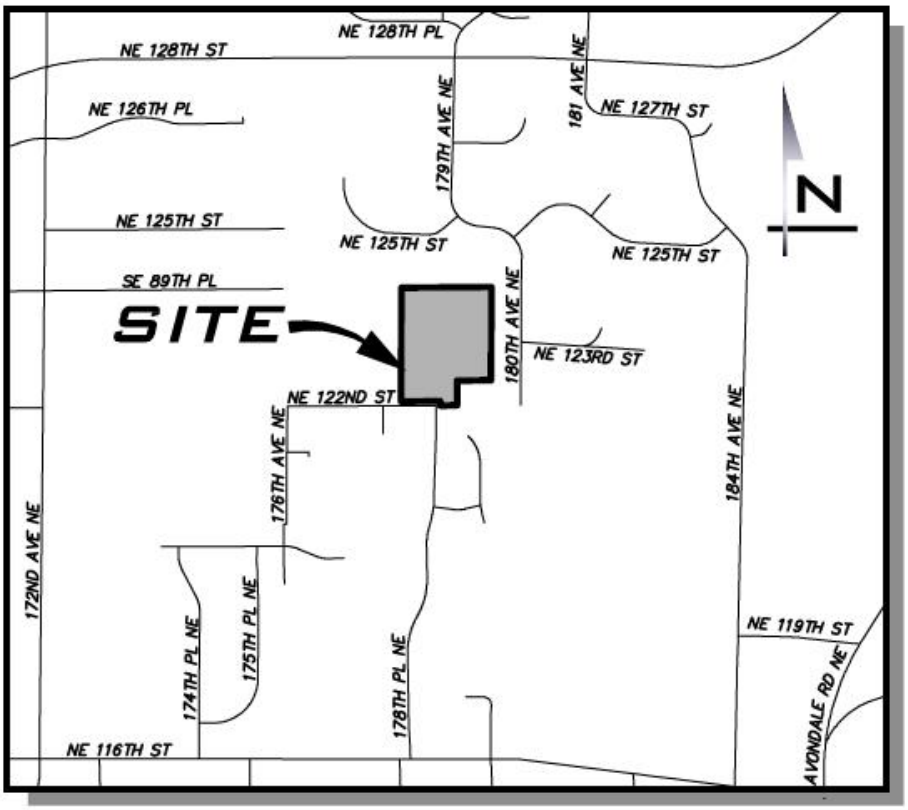
Prepared by: Chad Bissette
Reviewed by: Geoff E. Tamble, PE

BLUELINE LAND DEVELOPMENT CONSULTING
25 CENTRAL WAY SUITE 400 KIRKLAND WA 98033 ■ TEL 425-216-4051 FAX 425-216-4052 ■ THEBLUELINEGROUP.COM

Table of Contents

Section 1 Project Overview

The site is located at 17811 NE 124th St, Redmond, WA 98052. More generally, the site is located in the SE Section 25, Township 26 N, Range 5 E, W.M. Please see the vicinity map below.



VICINITY MAP
Not to Scale

Please refer to the *Existing & Developed Conditions Exhibits* at the end of this section. The project consists of a single parcel (#252605-9023) which contains approximately 6.89 acres, located north of the existing Fischer Village Subdivision. An existing garage with impervious rooftop and gravel driveway constitutes minimal existing impervious coverage. The remainder of the site is a mix of overgrown lawn, forest, and underbrush. A Class II stream crosses the northeastern corner of the existing parcel, flowing southeast through neighboring parcels.

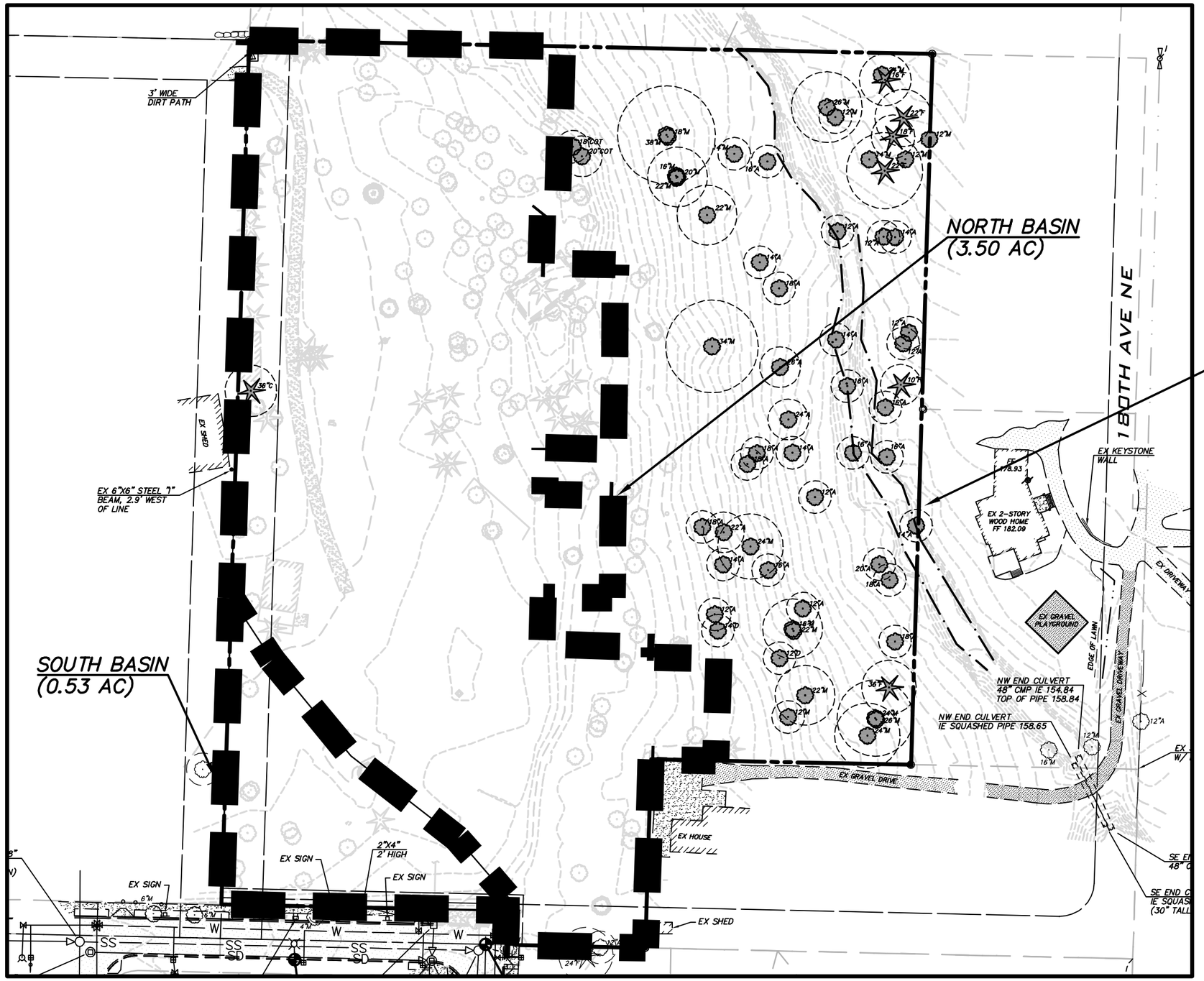
A majority of the site drains east toward the Class II stream. However, approximately 0.53 acres in the southwest corner of the site drains south into the Fischer Village conveyance system. Onsite topography is generally 6-15% onsite, though portions of the stream ravine exceed 30%. Detailed descriptions of both downstream drainage basins are provided in the Offsite Analysis (Section 3). A *Subsurface Exploration and Geotechnical Engineering Assessment*, dated March 3, 2014, prepared

by Associated Earth Sciences, Inc. identifies onsite soils as Vashon glacial till (see Section 6 for full report).

The project proposes to subdivide the existing 6.89-acre parcel into 25 lots with supporting infrastructure including standard utilities, roadway, sidewalks, open space and drainage/access tracts.

Stormwater elements will be designed according to the City of Redmond 2012 Technical Notebook and the 2005 Department of Ecology Stormwater Management Manual for Western Washington (2005 DOE Manual), as amended by the City of Redmond.

EXISTING CONDITIONS EXHIBIT



BLUELINE

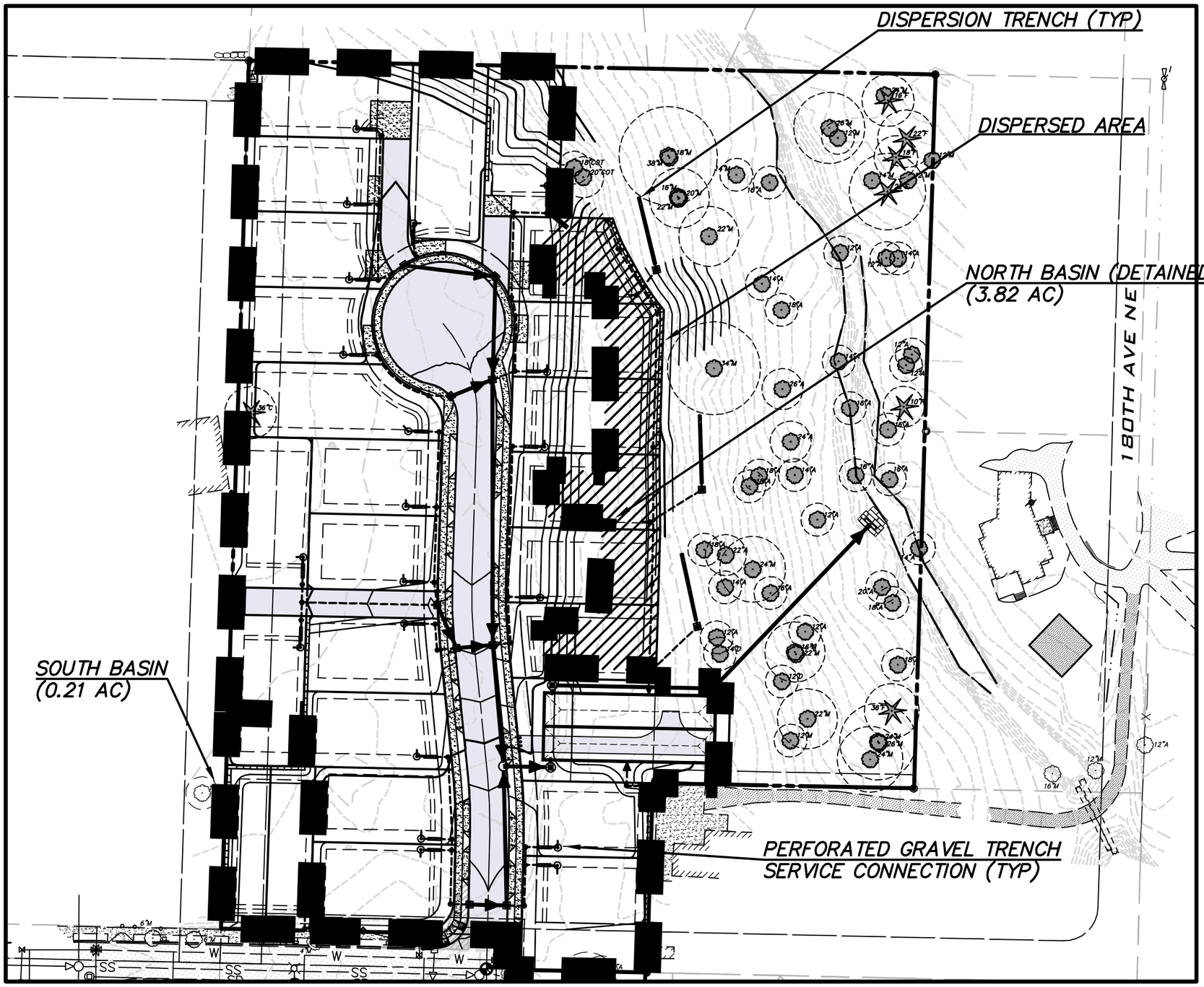
EXISTING CONDITIONS EXHIBIT
EDGEWOOD EAST
STORM DRAINAGE REPORT

SCALE	AS NOTED
PROJECT MANAGER	GEOFF E. TAMBLE, PE
DESIGNED BY	CHAD BISSETTE
DRAWN BY	CHAD BISSETTE
PLOT DATE	October 24, 2014

JOB NUMBER: 14-036

FIGURE: EC-01

DEVELOPED CONDITIONS EXHIBIT



N

SCALE: 1" = 80'

0 20 40 80

BLUELINE

DEVELOPED CONDITIONS EXHIBIT
EDGEWOOD EAST
STORM DRAINAGE REPORT

SCALE	AS NOTED
PROJECT MANAGER	GEOFF E. TAMBLE, PE
DESIGNED BY	CHAD BISSETTE
DRAWN BY	CHAD BISSETTE
PLOT DATE	October 24, 2014

JOB NUMBER: 14-036

FIGURE: DC-01

Oct 24, 2014 - 12:24pm - User CBissette
E:\Projects\14036\Dwg\SDR Exhibits\14036 Developed Conditions.dwg

Section 2 Minimum Requirements

The project will comply with all minimum requirements of the 2005 DOE Manual and the 2012 Redmond Technical Notebook.

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): A SWPPP is provided under separate cover.

Minimum Requirement #3: Source Control Pollution: The Edgewood East project does is not in the category of urban stormwater pollutant sources as defined in Chapter 2, Volume IV of the 2005 DOE Manual; therefore no source control is required for the developed site. Minimum Requirement #2 addresses BMPs for construction sites. Source Control Pollution created during construction is addressed by the SWPPP.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: Runoff will leave the site at the existing natural discharge locations. See Section 3 of this Report for the Downstream Analysis.

Minimum Requirement #5: On-Site Stormwater Management: The project will implement Low-Impact-Development (LID) Stormwater Best Management Practices (BMPs). Design information is provided in Section 4.1.

Permeable pavement and infiltration BMPs are not feasible for this project due to low permeability till-soils. Perforated pipe gravel trench service connections will be installed for roof downspouts to maximize the possibility of infiltration. An overflow will be provided to the tight-line conveyance system.

Full Dispersion BMPs as descried in Section 7.2 in Appendix C, Volume III of the 2005 DOE will be implemented to the maximum extent feasible using three 50-ft dispersion trenches.

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 support 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 in relation to the proposed cul de sac and stream ravine.

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, space requirements, and minimum required depth to an impermeable layer. Geotechnical exploration pits encountered unweathered lodgement till and groundwater seepage at depths as shallow as three feet.

BMP T5.13 Post-Construction Soil Quality and Depth per Section 5.3.1 in Volume V of the 2005 DOE Manual will be applied to all disturbed pervious areas.

Minimum Requirement #6: Runoff Treatment: Design of the stormwater treatment facility is described in Section 4 of this Report. Placement of the treatment facility is shown on the Preliminary Plans under separate cover, and on the *Developed Conditions Exhibit*.

Minimum Requirement #7: Flow Control: Design of the flow control facility is described in Section 4 of this Report. Placement of the flow control facility 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 or within the vicinity of the project site; therefore this requirement is not applicable.

Minimum Requirement #9: Operation and Maintenance: Operation and Maintenance guidelines from the 2005 DOE are located in Section 9 of this Report.

City of Redmond Minimum Requirement Flow Chart

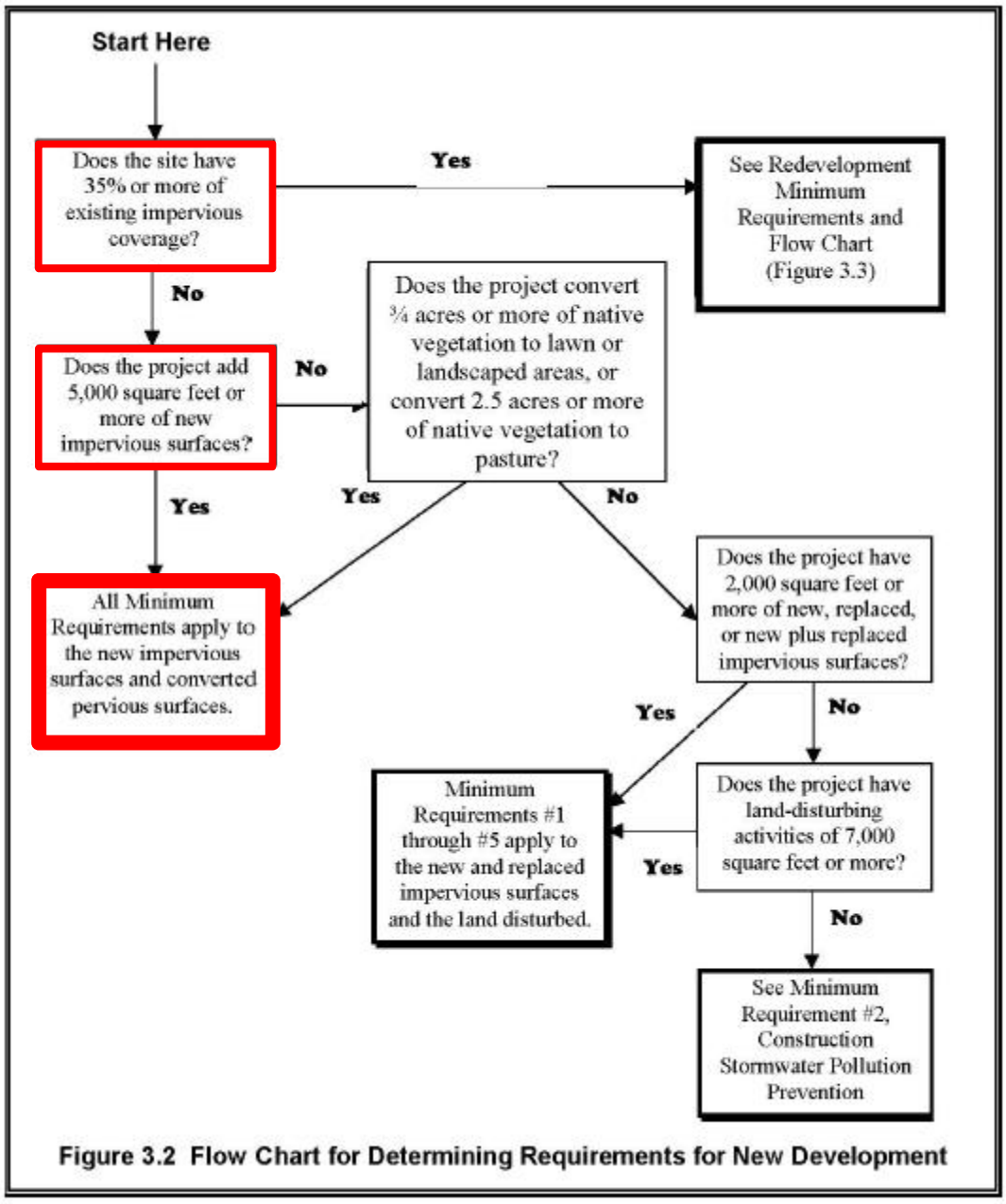


Figure 3.2 Flow Chart for Determining Requirements for New Development

Section 3 Offsite Analysis

3.1 Task 1: Study Area Definition and Maps

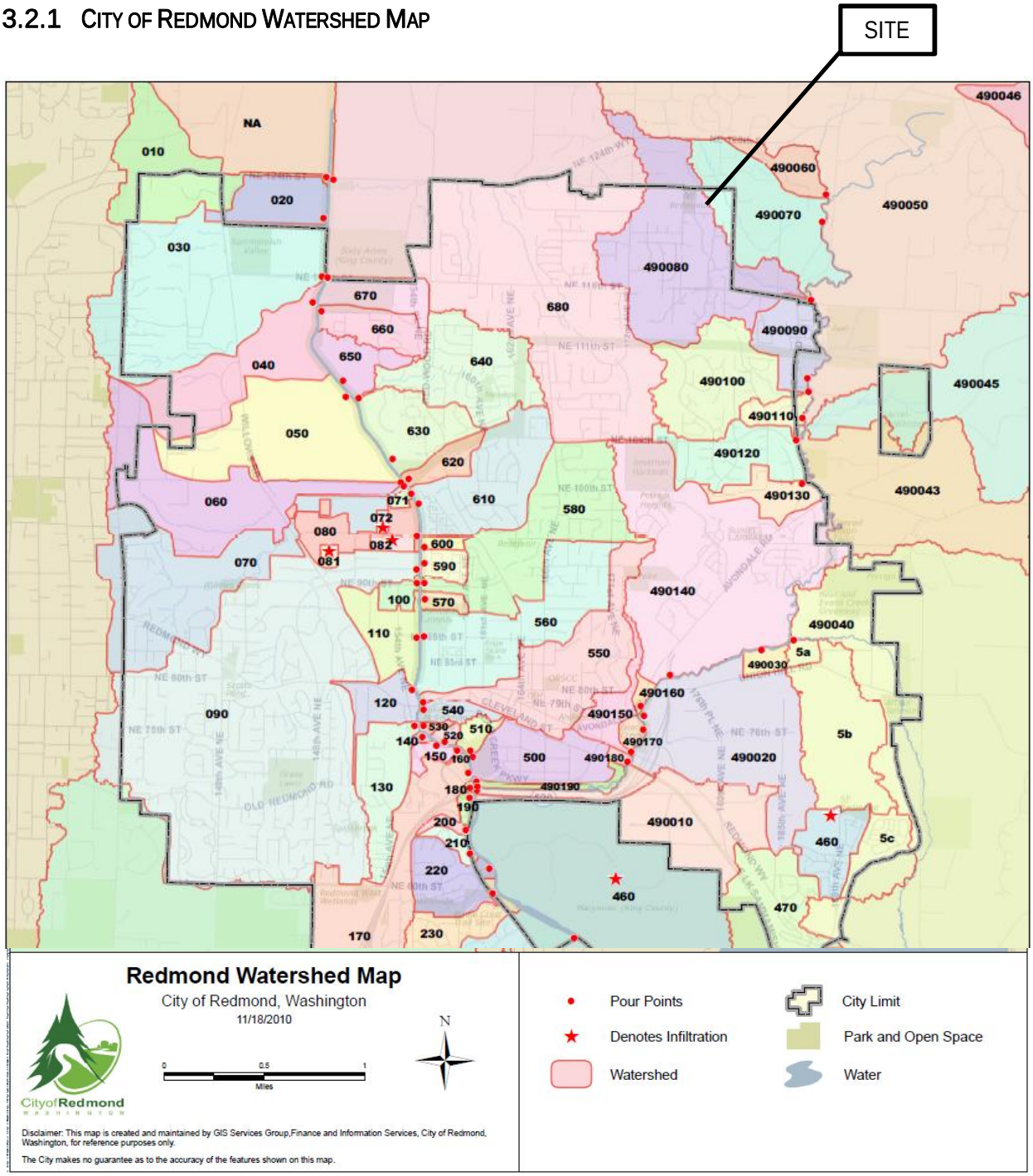
The site contains two drainage basins identified on the Redmond Watershed Map as Watershed 490070 and Watershed 490080. Both drainage basins are ultimately tributary to Bear Creek but do not combine within ¼-mile of the site. The approximate location of each onsite drainage basin is shown on both the *Existing Conditions Exhibit* (Section 1) and *Downstream Drainage Exhibit* (at the end of this section).

3.2 Task 2: Study Area Definition and Maps

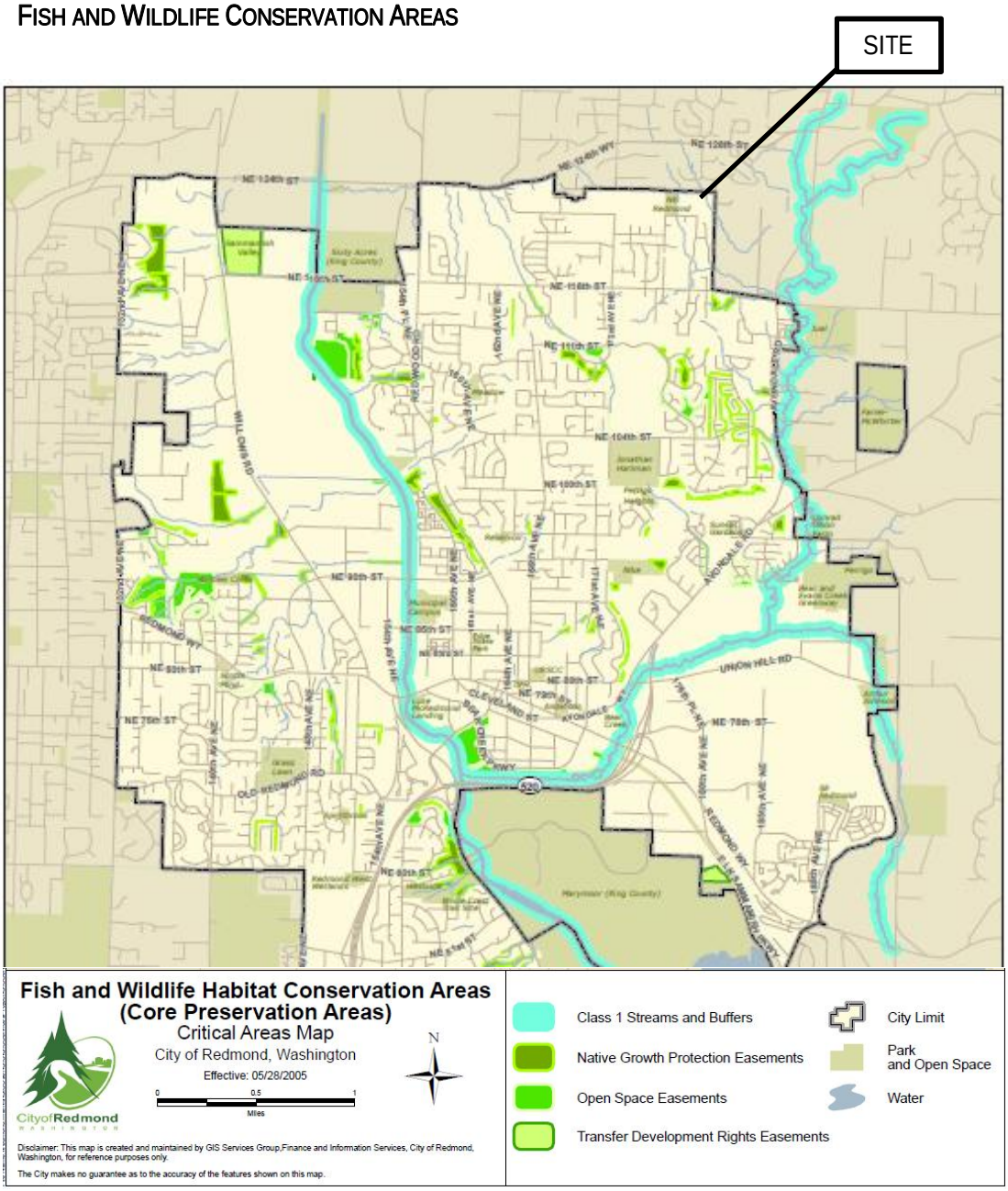
The following is a summary of the best available information used to identify existing or potential problems associated with the onsite or downstream drainage system:

- According to the geotechnical report, onsite soils are Vashon glacial till.
- The site is located in the Bear Creek Drainage Basin
- The site does not contain wetlands
- The site contains a Class II stream that is tributary to Bear Creek
- The site is not located within a floodplain
- The site is not located in an Erosion Hazard Area
- The site is not located in a Landslide/Liquefaction Hazard Area
- The site is not located in a Seismic Hazard Area
- The site is located in a Wellhead Protection Zone 2

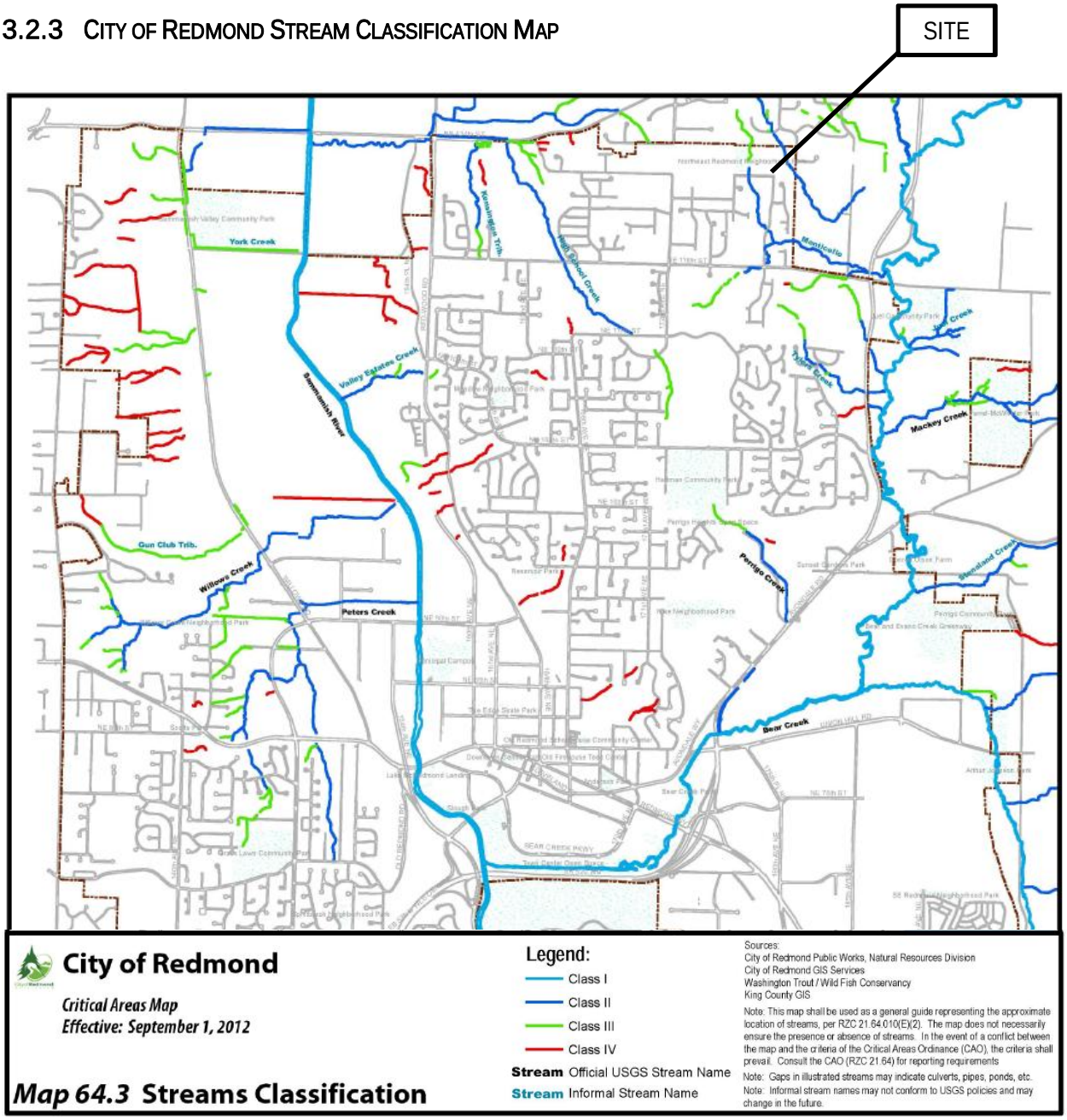
3.2.1 CITY OF REDMOND WATERSHED MAP



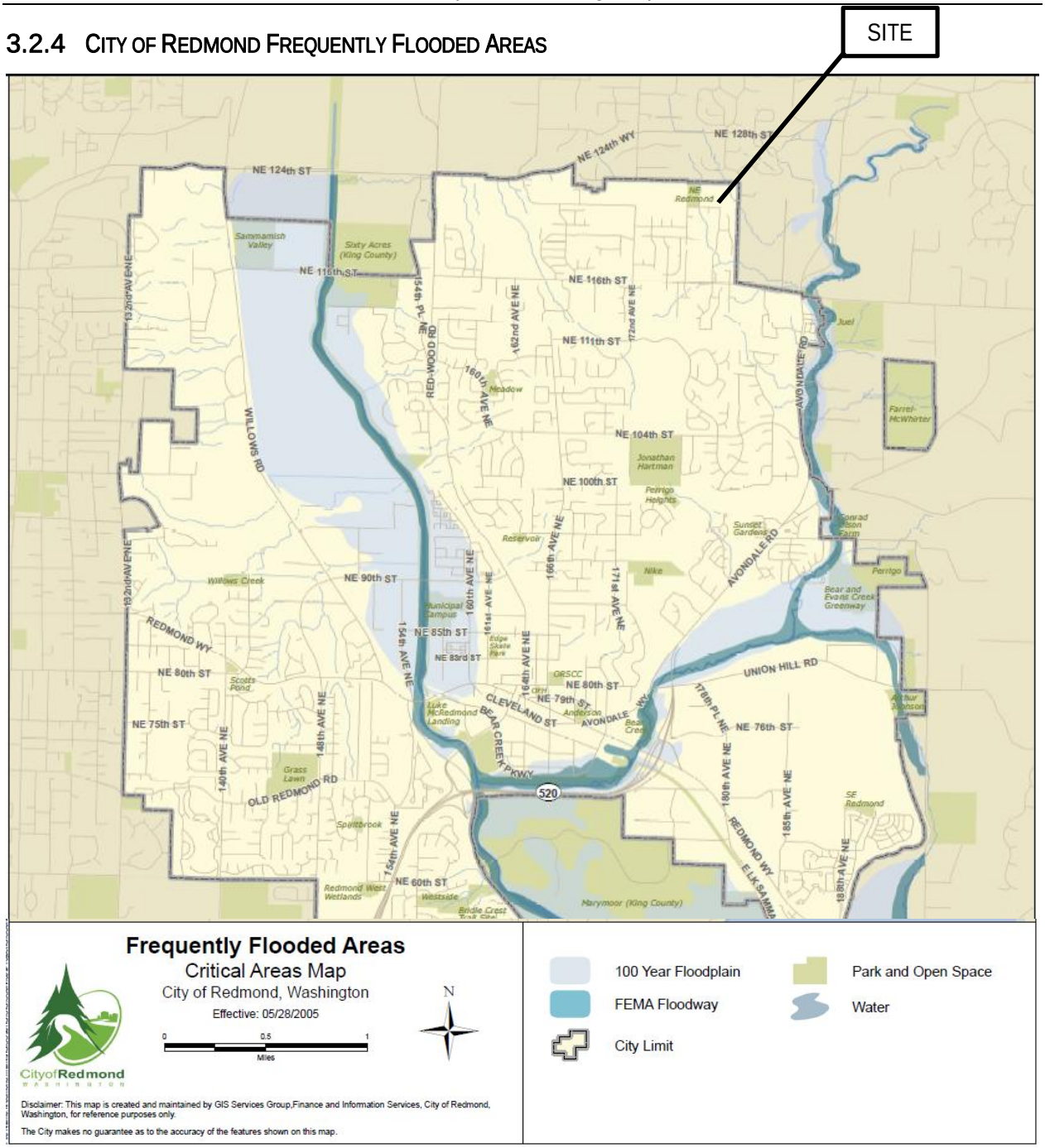
3.2.2 FISH AND WILDLIFE CONSERVATION AREAS



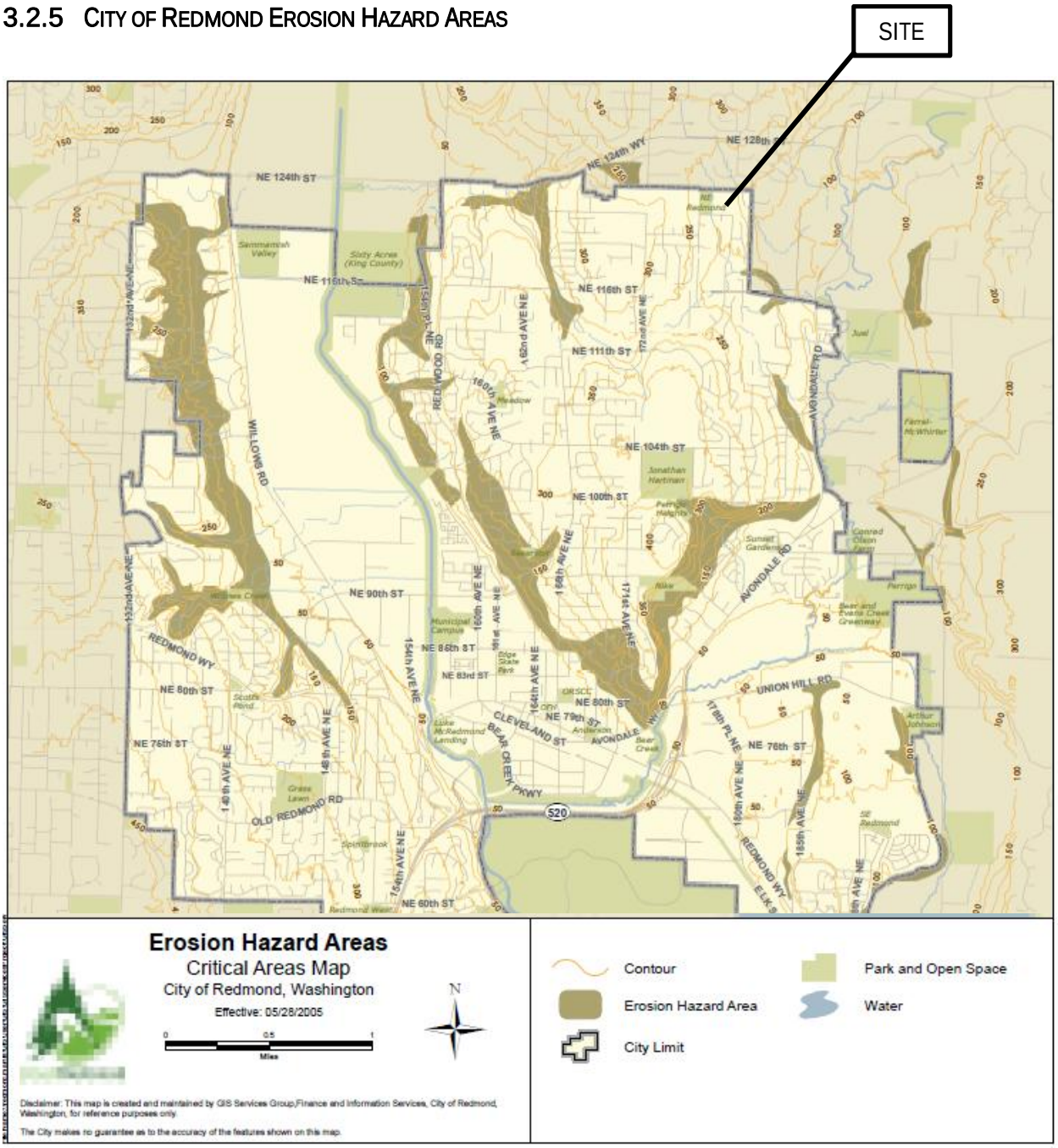
3.2.3 CITY OF REDMOND STREAM CLASSIFICATION MAP



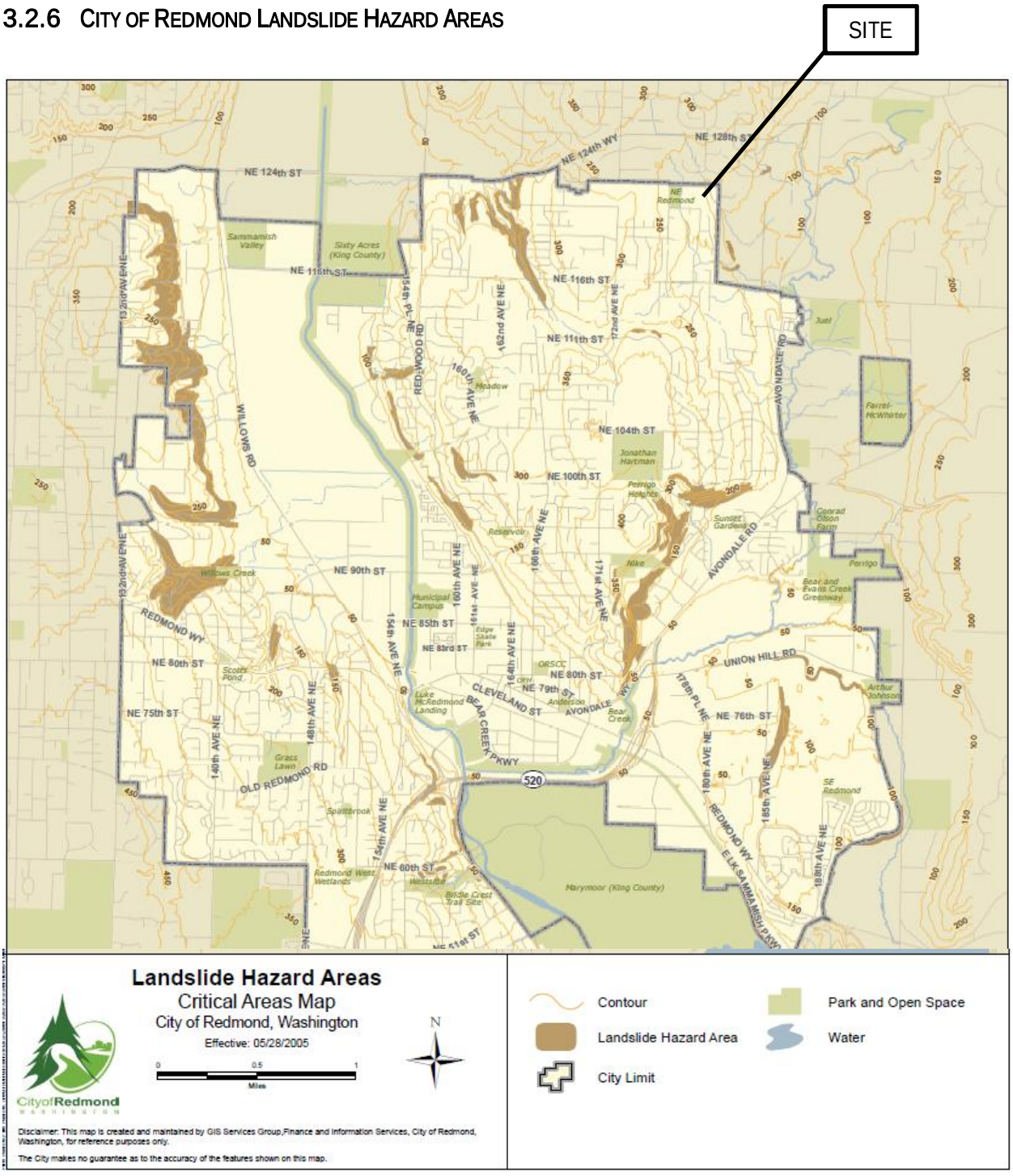
3.2.4 CITY OF REDMOND FREQUENTLY FLOODED AREAS



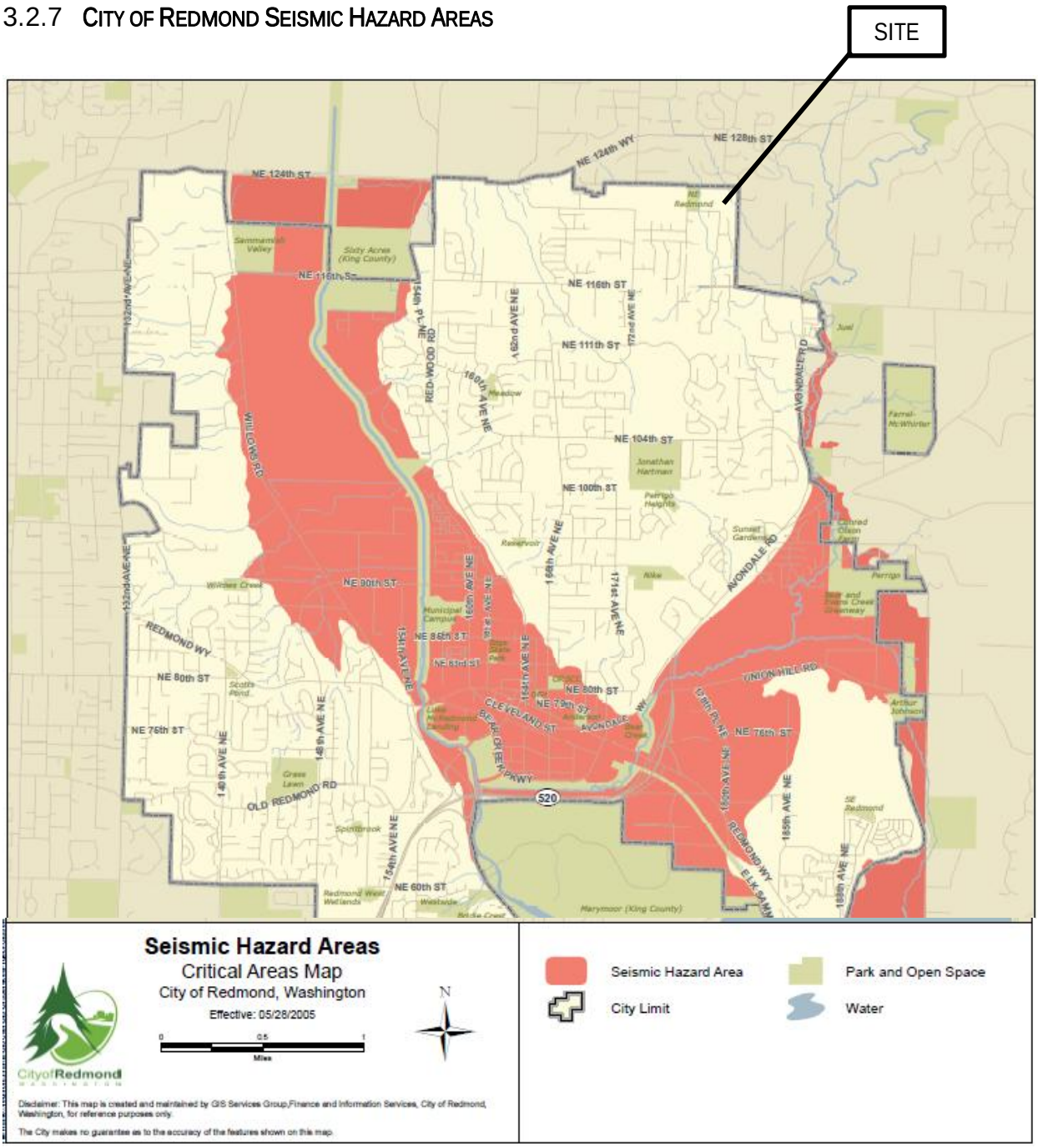
3.2.5 CITY OF REDMOND EROSION HAZARD AREAS



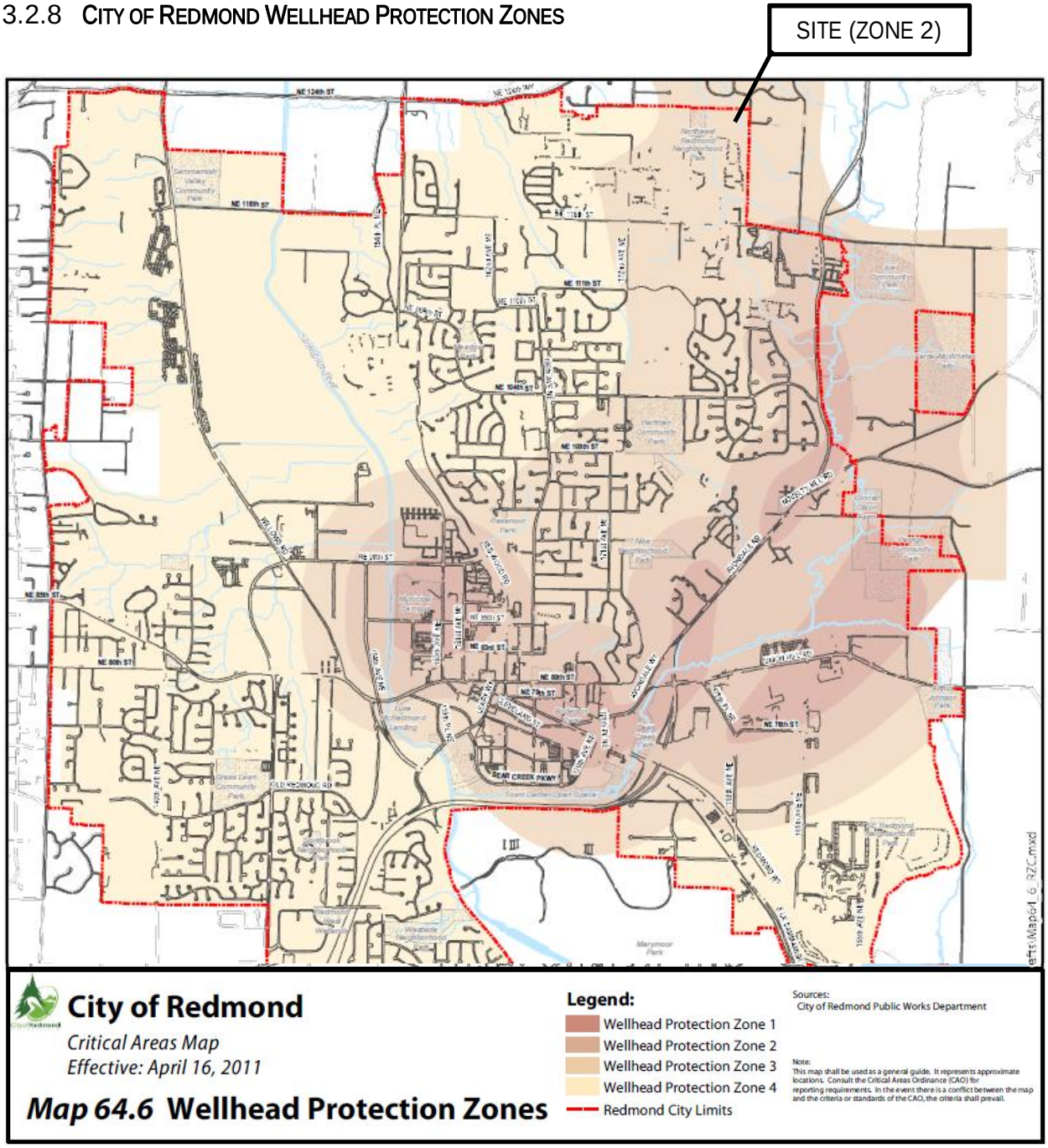
3.2.6 CITY OF REDMOND LANDSLIDE HAZARD AREAS



3.2.7 CITY OF REDMOND SEISMIC HAZARD AREAS



3.2.8 CITY OF REDMOND WELLHEAD PROTECTION ZONES



3.3 TASK 3 & TASK 4: FIELD INSPECTION AND DRAINAGE SYSTEM DESCRIPTION

A field inspection was conducted on Tuesday May 13, 2014, a clear day with temperatures around 70°F.

3.3.1 UPSTREAM ANALYSIS

A Class II stream crosses the northeastern corner of the site, flowing southeast through neighboring properties. The stream will be protected in a critical area tract and will not be altered by the proposed development. The site does not receive significant runoff from any other upstream area. See the *Existing Conditions Exhibit*.

3.3.2 DOWNSTREAM ANALYSIS

The downstream drainage path was visually inspected for each of two existing onsite drainage basins. Please reference the *Downstream Drainage Exhibit* and *Downstream Drainage Photos* at the end of this section.

3.3.3 NORTH BASIN

The North Basin contains approximately 6.36 acres, including 2.45 acres associated with the existing Class II stream and proposed critical area tract. The North Basin slopes east onsite at 6-15% toward the stream ravine. The stream passes briefly beneath a residential driveway through twin culverts approximately 100-ft southeast of the site, near the City of Redmond city limit. The stream continues southeast in the ravine for approximately 1,300 feet, flowing across neighboring residential properties in unincorporated King County. The stream passes beneath 184th Avenue NE via box culvert approximately ½ - mile downstream, then discharges into an open pond surrounded by pasture with grazing cattle. The stream is ultimately tributary to Bear Creek.

The stream was visually inspected where accessible near culverts. Generally the water flow was shallow and slow, with an average channel slope of approximately 3-4%. Visible portions of the stream near driveway culverts and 184th Avenue NE were heavily vegetated and appeared generally stable. However, a portion of the ravine observed near twin driveway culverts approximately 100-ft southeast of the site was noted to have bank erosion within 20-ft of the stream bed.

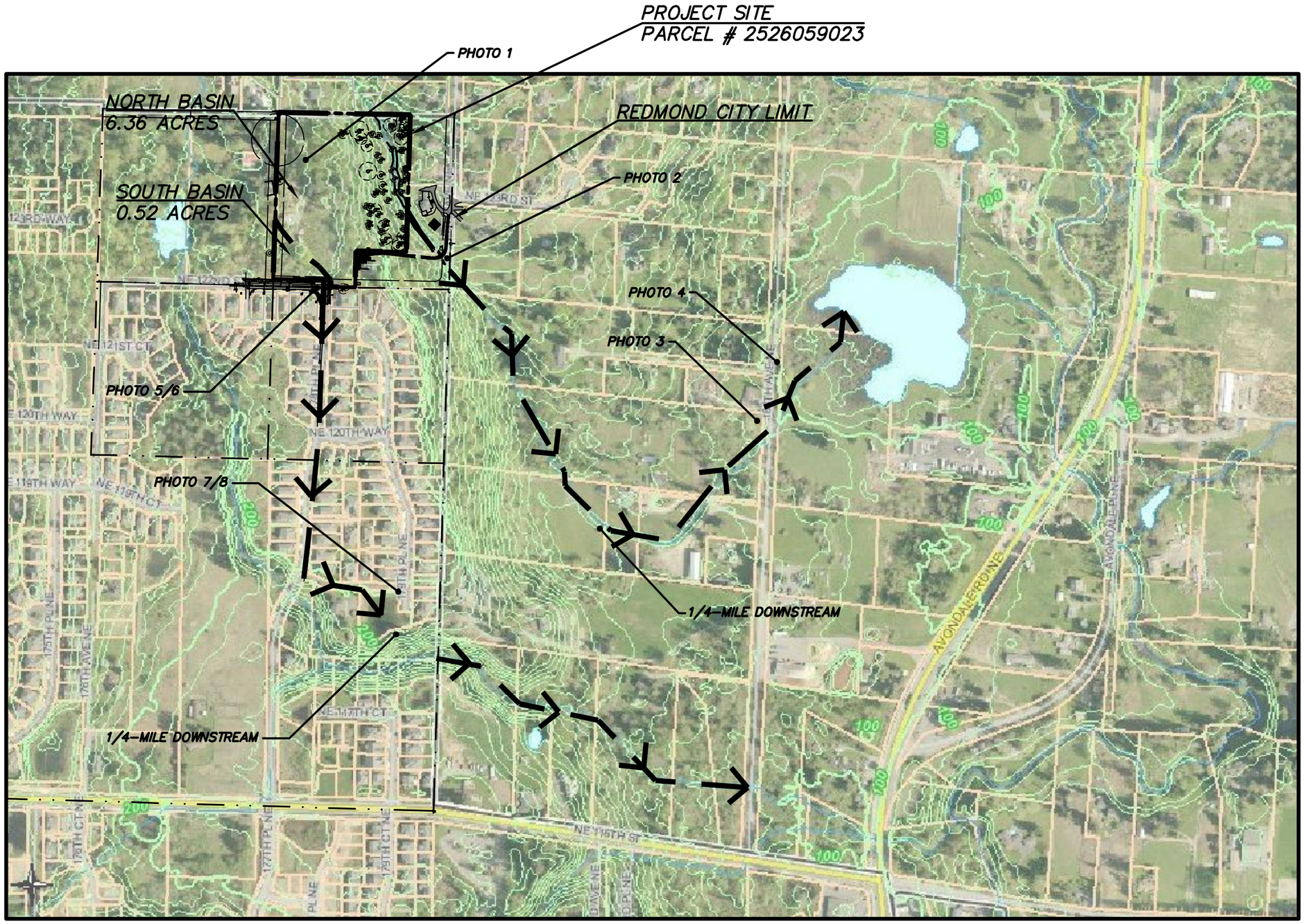
A substantial portion of the stream was inaccessible due to private fencing, gated driveways, and heavy overgrowth. Based on a list of drainage complaints provided by King County, there were no relevant drainage complaints identified to have occurred within the preceding 10-year period within ¼-mile downstream.

3.3.4 SOUTH BASIN

The South Basin contains approximately 0.53 acres at the southwest corner of the site. Runoff sheet flows across the southern site boundary and is collected by catch basins in the neighboring Fischer Village Subdivision right of way. A series of 12 to 24 inch pipes conveys runoff south along 178th Place NE approximately 1,140-ft through the Fischer Village plat, then another 240-ft east into the Taloora Aye detention pond. The Taloora Aye pond, which is located approximately ¼ - mile downstream of the site, discharges into a Class III stream that is eventually tributary to Bear Creek. Runoff from the North Basin and South Basin do not combine within ¼ - mile downstream of the site.

The locations of all catch basins and manholes within the ¼-mile downstream path area were verified and inspected. There appeared to be no existing problems or any immediate need for corrective maintenance.

DOWNSTREAM DRAINAGE EXHIBIT



BLUELINE

DOWNSTREAM DRAINAGE EXHIBIT
EDGEWOOD EAST
STORM DRAINAGE REPORT

SCALE	AS NOTED
PROJECT MANAGER	GEOFF E. TAMBLE, PE
DESIGNED BY	CHAD BISSETTE
DRAWN BY	CHAD BISSETTE
PLOT DATE	October 24, 2014

JOB NUMBER: 14-036

FIGURE: DS-01

Oct 24, 2014 - 12:19pm - User: CBissette
E:\Projects\14036\Dwg\SDR Exhibits\14036 Downstream Exhibit.dwg

3.3.6 NORTH BASIN DOWNSTREAM PHOTOGRAPHS

Photo 1: Facing southeast along existing gravel driveway, from northwest corner of site.

Photo 2: Facing southeast along stream within vegetated ravine (approx. 100-ft downstream of site). Outfall of twin culverts in bottom right of photo. Visible evidence of ravine erosion within 20-30 ft of stream, in upper left of photo.

Photo3: Facing west along stream from inlet of box culvert which passes beneath 18th Ave NE.

Photo 4: Facing east from 18th Ave NE toward pond and surrounding pasture.

3.3.7 SOUTH BASIN DOWNSTREAM PHOTOGRAPHS

Photo 5: Facing east along southern boundary of site. Runoff from South Basin sheet flows into catch basins within NE 122nd St.

Photo 6: Facing southeast across NE 122nd St toward 178th Pl NE from the southern boundary of the site. Runoff is conveyed south within 178th Pl NE by 12" pipes.

Photo 7: Facing west along pond access drive from 179th Pl NE toward 178th Pl NE.

Photo 8: Facing southeast across Taloora Aye pond toward overflow structures. Stream fencing in background.

Section 4 PERMANENT STORMWATER CONTROL PLAN

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

4.1 LOW IMPACT DEVELOPMENT BMPS

Infiltration BMP's (drywells, porous pavement, etc) were not feasible for this project due to impermeable till soils. Perforated pipe gravel trench storm service connections (10-ft length) will be provided to maximize the possibility of infiltration.

Full dispersion (BMP T5.30) will be implemented for multiple lots according to Section 7.2, Appendix C, Volume III of the 2005 DOE Manual. The table listed in Section 7.2.2 allows an effective impervious area of up to 5.5% of a threshold discharge area to be fully dispersed into native vegetation if a minimum of 35% of the threshold discharge area is preserved as native vegetation.

The percent native vegetation preserved is summarized below.

Proposed Sensitive Area Tract:	106,984 square feet
Stream Area:	7,627 square feet
Threshold Discharge Area (Site minus South Basin):	277,015 square feet

Native Vegetation Preserved: 106,984 – 7,627 = 99,357 square feet

Percent Native Vegetation Preserved: **35.9%** = 99,357 square feet/277,015 square feet

Based on the table listed under Section 7.2.2 in in Appendix C in Volume III of the 2005 DOE Manual, the percent effective impervious allowed to be dispersed is 5.5% of the threshold discharge area. The percent of lawn/landscaping allowed to be dispersed is 65% of the threshold discharge area.

Full Dispersion Max. Impervious Area: **16,506 square feet** = 5.5%*277,015 square feet

Full Dispersion Max. Pervious Area: **180,060 square feet** = 65%*277,015 square feet

The rear yard area of Lots 17-23 (8,462 square feet) is less than the maximum allowable pervious area that can be fully dispersed (180,060 square feet as calculated above). Therefore, the lots meet the requirements for pervious area full dispersion.

The roof area of Lots 18, 21, and 23 (9,430 square feet) is less than the maximum allowable impervious area that can be fully dispersed (16,506 square feet as calculated above). Therefore, the lots meet the requirements for impervious area full dispersion.

The dispersion device for each lot will be a standard dispersion trench with notch grade board per Figure 5.2 under BMP T5.10. Per Figure 5.2, the trench is 50 lineal feet for every 0.5 cfs of flow. Conservatively, each trench was sized based on the total maximum impervious area of the largest lot to be disbursed (Lot 21-- 6,064 square feet), for which the combined impervious and pervious 100-year flow rate (15-minute time steps) does not exceed 0.20 cfs. Accordingly, the 50 lineal foot trench shown on the plans for each of Lots 18, 21, and 23 is a conservative length.

A maximum of three dispersion trenches are feasible upslope of the vegetated sensitive area due to minimum trench spacing and tree retention considerations.

BMP T5.13 Post-Construction Soil Quality and Depth per Section 5.3.1 in Volume V of the 2005 DOE Manual will be applied to all disturbed pervious areas.

4.2 FLOW CONTROL ANALYSIS AND DESIGN

Each 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 existing site is modeled as 100% Forest. A critical area tract will contain the onsite stream and stream buffer. Since this area will remain undeveloped, it was excluded from the hydraulic analysis.

4.2.1 EXISTING CONDITIONS (NORTH BASIN)

The North Basin consists of 6.36 acres, including 2.45 acres associated with the stream and critical area tract. The following table summarizes the area used to model the North Basin existing conditions:

EXISTING CONDITIONS (NORTH BASIN)

Forest	
Gross North Basin Area	6.36 acres
Less Critical Areas Tract	*(2.45) acres*
Less Area to be Fully Dispersed	*(0.41) acres*
Total North Basin Forest Area	**3.50 acres**

Existing Conditions Runoff Rates:	**2-year**	**=**	**0.106 cfs**
	10-year	**=**	**0.217 cfs**
	100-year	**=**	**0.337 cfs**

Approximately 0.41 acres of the developed area will be fully dispersed into a 100-ft vegetated flowpath as described in the Developed Conditions section below. Since this area is fully dispersed, it is excluded from the hydraulic analysis.

4.2.2 EXISTING CONDITIONS (SOUTH BASIN)

The South Basin consists of approximately 0.53 acres of tall grass with minimal trees. Runoff from the South Basin sheet flows into the Fischer Village Subdivision conveyance system. The following table summarizes the areas used to model the South Basin existing conditions:

EXISTING CONDITIONS (SOUTH BASIN)

Forest	
South Basin Area	0.53 acres
Total South Basin Forest Area	**0.53 acres**

Existing Conditions Runoff Rates:	**2-year**	=	**0.016 cfs**
	10-year	=	**0.032 cfs**
	100-year	=	**0.050 cfs**

4.2.3 DEVELOPED CONDITIONS (NORTH BASIN)

The developed North Basin area is 0.32 acres larger in the developed conditions, because a portion of the original South Basin becomes tributary to the North Basin. Accordingly, the North Basin vault is sized to over-detain runoff in order to mitigate the additional area. The following table summarizes the areas used to model the North Basin developed conditions:

DEVELOPED CONDITIONS (NORTH BASIN)

Impervious	
Lot Coverage at 60% (Excluding Roof of Lots 18, 21, 23)	1.71 acres
Access Tracts	0.13 acres
Asphalt	0.41 acres
Sidewalk	0.13 acres
Driveways in ROW	0.03 acres
Detention Tract Impervious Area	0.05 acres
Total North Basin Impervious Area	**2.46 acres**
Pervious	
Lot Lawn (Excl. Rear of Lots 17-23)	1.05 acres
ROW Lawn	0.10 acres
Detention Tract	0.21 acres
Total North Basin Pervious Area (Lawn)	**1.36 acres**
Total North Basin Developed Conditions	**3.82 acres**

A summary of South Basin runoff rates is provided in the following table:

(cfs)	Existing Conditions	Developed Conditions	
		Unmitigated	Mitigated
2-year	0.106	1.043	0.063
10-year	0.217	1.581	0.136
100-year	0.337	2.337	0.287

The required and provided live storage volume at the 100-year water surface elevation for a 10'-deep detention vault is based off the bottom of live surface area of 120' * 47' * 10.3' of storage depth. The total volume at the maximum water surface requires 58,092 CF, which is the amount shown on the preliminary development plans.

4.2.4 DEVELOPED CONDITIONS (SOUTH BASIN)

The Developed South Basin contains the entire area of Lots 1-2, plus half of the pervious lawn area of Lot 6. The following table summarizes the areas used to model the South Basin developed conditions:

DEVELOPED CONDITIONS (SOUTH BASIN)

Impervious	
Lots 1-2 Coverage (60%)	0.11 acres
Total South Basin Impervious Area	**0.11 acres**
Pervious	
Lots 1-2 Lawn	0.07 acres
Half of Lot 6 Lawn	0.03 acres
Total South Basin Pervious Area (Lawn)	**0.10 acres**
Total South Basin Developed Conditions	**0.21 acres**

A summary of South Basin runoff rates is provided in the following table:

(cfs)	Existing Conditions	Developed Conditions	
		Unmitigated	Mitigated
2-year	0.016	0.052	n/a
10-year	0.032	0.083	n/a
100-year	0.05	0.128	n/a

The modeled peak flow rate of the South Basin increases less than 0.1 CFS between the existing and developed conditions. Accordingly, the South Basin is exempt from providing a flow control facility.

4.2.5 WWHM2012 OUTPUT: NORTH BASIN

WWHM2012
PROJECT REPORT

Project Name: 14036prelim
Site Name:
Site Address:
City :
Report Date: 9/15/2014
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version : 2014/04/14

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	3.55
Pervious Total	3.55

Impervious Land Use	Acres
Impervious Total	0
Basin Total	3.55

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	1.36
Pervious Total	**1.36**

Impervious Land Use	Acres
ROADS FLAT	2.46
Impervious Total	**2.46**
Basin Total	**3.82**

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 47 ft.
Length : 120 ft.
Depth: 11 ft.
Discharge Structure
Riser Height: 10.3 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.875 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 1.5 in. **Elevation:** 6.8 ft.
Orifice 3 Diameter: 0.9375 in. **Elevation:** 8.3 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.129	0.000	0.000	0.000
0.1222	0.129	0.015	0.007	0.000
0.2444	0.129	0.031	0.009	0.000
0.3667	0.129	0.047	0.012	0.000
0.4889	0.129	0.063	0.014	0.000
0.6111	0.129	0.079	0.015	0.000
0.7333	0.129	0.094	0.017	0.000
0.8556	0.129	0.110	0.018	0.000
0.9778	0.129	0.126	0.019	0.000
1.1000	0.129	0.142	0.021	0.000
1.2222	0.129	0.158	0.022	0.000
1.3444	0.129	0.174	0.023	0.000
1.4667	0.129	0.189	0.024	0.000
1.5889	0.129	0.205	0.025	0.000
1.7111	0.129	0.221	0.026	0.000

1.8333	0.129	0.237	0.027	0.000
1.9556	0.129	0.253	0.028	0.000
2.0778	0.129	0.269	0.029	0.000
2.2000	0.129	0.284	0.029	0.000
2.3222	0.129	0.300	0.030	0.000
2.4444	0.129	0.316	0.031	0.000
2.5667	0.129	0.332	0.032	0.000
2.6889	0.129	0.348	0.033	0.000
2.8111	0.129	0.364	0.033	0.000
2.9333	0.129	0.379	0.034	0.000
3.0556	0.129	0.395	0.035	0.000
3.1778	0.129	0.411	0.035	0.000
3.3000	0.129	0.427	0.036	0.000
3.4222	0.129	0.443	0.037	0.000
3.5444	0.129	0.458	0.037	0.000
3.6667	0.129	0.474	0.038	0.000
3.7889	0.129	0.490	0.039	0.000
3.9111	0.129	0.506	0.039	0.000
4.0333	0.129	0.522	0.040	0.000
4.1556	0.129	0.538	0.041	0.000
4.2778	0.129	0.553	0.041	0.000
4.4000	0.129	0.569	0.042	0.000
4.5222	0.129	0.585	0.042	0.000
4.6444	0.129	0.601	0.043	0.000
4.7667	0.129	0.617	0.043	0.000
4.8889	0.129	0.633	0.044	0.000
5.0111	0.129	0.648	0.045	0.000
5.1333	0.129	0.664	0.045	0.000
5.2556	0.129	0.680	0.046	0.000
5.3778	0.129	0.696	0.046	0.000
5.5000	0.129	0.712	0.047	0.000
5.6222	0.129	0.727	0.047	0.000
5.7444	0.129	0.743	0.048	0.000
5.8667	0.129	0.759	0.048	0.000
5.9889	0.129	0.775	0.049	0.000
6.1111	0.129	0.791	0.049	0.000
6.2333	0.129	0.807	0.050	0.000
6.3556	0.129	0.822	0.050	0.000
6.4778	0.129	0.838	0.051	0.000
6.6000	0.129	0.854	0.051	0.000
6.7222	0.129	0.870	0.052	0.000
6.8444	0.129	0.886	0.065	0.000
6.9667	0.129	0.902	0.077	0.000
7.0889	0.129	0.917	0.085	0.000
7.2111	0.129	0.933	0.091	0.000
7.3333	0.129	0.949	0.097	0.000
7.4556	0.129	0.965	0.102	0.000
7.5778	0.129	0.981	0.107	0.000
7.7000	0.129	0.997	0.111	0.000
7.8222	0.129	1.012	0.116	0.000
7.9444	0.129	1.028	0.119	0.000
8.0667	0.129	1.044	0.123	0.000
8.1889	0.129	1.060	0.127	0.000
8.3111	0.129	1.076	0.133	0.000
8.4333	0.129	1.091	0.142	0.000
8.5556	0.129	1.107	0.148	0.000
8.6778	0.129	1.123	0.154	0.000

8.8000	0.129	1.139	0.159	0.000
8.9222	0.129	1.155	0.164	0.000
9.0444	0.129	1.171	0.168	0.000
9.1667	0.129	1.186	0.173	0.000
9.2889	0.129	1.202	0.177	0.000
9.4111	0.129	1.218	0.181	0.000
9.5333	0.129	1.234	0.185	0.000
9.6556	0.129	1.250	0.189	0.000
9.7778	0.129	1.266	0.192	0.000
9.9000	0.129	1.281	0.196	0.000
10.022	0.129	1.297	0.200	0.000
10.144	0.129	1.313	0.203	0.000
10.267	0.129	1.329	0.206	0.000
10.389	0.129	1.345	0.597	0.000
10.511	0.129	1.360	1.630	0.000
10.633	0.129	1.376	3.027	0.000
10.756	0.129	1.392	4.711	0.000
10.878	0.129	1.408	6.638	0.000
11.000	0.129	1.424	8.781	0.000
11.122	0.129	1.440	11.12	0.000
11.244	0.000	0.000	13.64	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:3.55
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.36
Total Impervious Area:2.46

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.105702
5 year	0.173202
10 year	0.216603
25 year	0.268231
50 year	0.303991
100 year	0.337394

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.06324
5 year	0.102913
10 year	0.136338
25 year	0.187898
50 year	0.233871

100 year 0.287027

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

Year	Predeveloped	Mitigated
1949	0.122	0.044
1950	0.144	0.062
1951	0.231	0.185
1952	0.072	0.039
1953	0.059	0.056
1954	0.090	0.046
1955	0.144	0.044
1956	0.116	0.124
1957	0.093	0.045
1958	0.104	0.049
1959	0.089	0.044
1960	0.159	0.132
1961	0.088	0.081
1962	0.055	0.039
1963	0.075	0.050
1964	0.106	0.074
1965	0.071	0.100
1966	0.068	0.048
1967	0.162	0.060
1968	0.091	0.047
1969	0.089	0.047
1970	0.071	0.051
1971	0.081	0.048
1972	0.175	0.161
1973	0.078	0.095
1974	0.086	0.049
1975	0.120	0.044
1976	0.086	0.047
1977	0.013	0.038
1978	0.072	0.051
1979	0.044	0.036
1980	0.206	0.159
1981	0.065	0.048
1982	0.134	0.108
1983	0.115	0.048
1984	0.069	0.039
1985	0.041	0.040
1986	0.181	0.051
1987	0.160	0.118
1988	0.063	0.044
1989	0.042	0.040
1990	0.383	0.145
1991	0.203	0.148
1992	0.083	0.052
1993	0.081	0.039
1994	0.027	0.034
1995	0.116	0.079
1996	0.268	0.177
1997	0.207	0.180
1998	0.051	0.041
1999	0.227	0.146

2000	0.081	0.050
2001	0.014	0.031
2002	0.093	0.068
2003	0.139	0.045
2004	0.149	0.162
2005	0.111	0.045
2006	0.124	0.115
2007	0.289	0.207
2008	0.353	0.156
2009	0.164	0.088

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

Rank	Predeveloped	Mitigated
1	0.3828	0.2068
2	0.3526	0.1853
3	0.2893	0.1795
4	0.2681	0.1765
5	0.2309	0.1624
6	0.2268	0.1613
7	0.2069	0.1591
8	0.2064	0.1557
9	0.2030	0.1484
10	0.1811	0.1465
11	0.1753	0.1449
12	0.1644	0.1319
13	0.1623	0.1237
14	0.1599	0.1176
15	0.1593	0.1147
16	0.1490	0.1075
17	0.1444	0.1001
18	0.1437	0.0953
19	0.1395	0.0879
20	0.1338	0.0812
21	0.1244	0.0795
22	0.1217	0.0744
23	0.1199	0.0675
24	0.1160	0.0624
25	0.1157	0.0604
26	0.1145	0.0564
27	0.1106	0.0519
28	0.1062	0.0514
29	0.1037	0.0509
30	0.0934	0.0506
31	0.0934	0.0499
32	0.0914	0.0496
33	0.0899	0.0493
34	0.0890	0.0486
35	0.0889	0.0483
36	0.0876	0.0483
37	0.0861	0.0482
38	0.0857	0.0480
39	0.0829	0.0472
40	0.0809	0.0470
41	0.0806	0.0465
42	0.0806	0.0463

43	0.0777	0.0455
44	0.0749	0.0453
45	0.0725	0.0452
46	0.0724	0.0442
47	0.0714	0.0441
48	0.0706	0.0437
49	0.0690	0.0436
50	0.0678	0.0435
51	0.0648	0.0407
52	0.0631	0.0400
53	0.0586	0.0398
54	0.0545	0.0393
55	0.0506	0.0392
56	0.0438	0.0391
57	0.0418	0.0385
58	0.0409	0.0377
59	0.0272	0.0356
60	0.0145	0.0343
61	0.0126	0.0309

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0529	17708	8729	49	Pass
0.0554	15708	7948	50	Pass
0.0579	14570	7726	53	Pass
0.0605	13019	7420	56	Pass
0.0630	12016	7217	60	Pass
0.0655	10712	6889	64	Pass
0.0681	9593	6573	68	Pass
0.0706	8943	6402	71	Pass
0.0731	8081	6166	76	Pass
0.0757	7537	5982	79	Pass
0.0782	6789	5692	83	Pass
0.0808	6348	5463	86	Pass
0.0833	5777	5153	89	Pass
0.0858	5443	4919	90	Pass
0.0884	4971	4522	90	Pass
0.0909	4693	4297	91	Pass
0.0934	4291	4015	93	Pass
0.0960	4053	3826	94	Pass
0.0985	3705	3548	95	Pass
0.1010	3390	3311	97	Pass
0.1036	3191	3166	99	Pass
0.1061	2926	2945	100	Pass
0.1087	2759	2759	100	Pass
0.1112	2502	2470	98	Pass
0.1137	2363	2340	99	Pass
0.1163	2152	2088	97	Pass
0.1188	2022	1954	96	Pass
0.1213	1841	1759	95	Pass
0.1239	1746	1614	92	Pass

0.1264	1596	1435	89	Pass
0.1290	1496	1348	90	Pass
0.1315	1346	1222	90	Pass
0.1340	1232	1127	91	Pass
0.1366	1167	1090	93	Pass
0.1391	1087	1018	93	Pass
0.1416	1034	969	93	Pass
0.1442	954	889	93	Pass
0.1467	901	820	91	Pass
0.1492	833	716	85	Pass
0.1518	785	662	84	Pass
0.1543	727	601	82	Pass
0.1569	690	546	79	Pass
0.1594	633	446	70	Pass
0.1619	601	378	62	Pass
0.1645	561	315	56	Pass
0.1670	506	277	54	Pass
0.1695	475	258	54	Pass
0.1721	428	233	54	Pass
0.1746	393	212	53	Pass
0.1772	357	175	49	Pass
0.1797	335	158	47	Pass
0.1822	299	141	47	Pass
0.1848	278	130	46	Pass
0.1873	245	113	46	Pass
0.1898	227	108	47	Pass
0.1924	202	102	50	Pass
0.1949	181	88	48	Pass
0.1974	155	65	41	Pass
0.2000	138	56	40	Pass
0.2025	121	42	34	Pass
0.2051	104	28	26	Pass
0.2076	97	0	0	Pass
0.2101	84	0	0	Pass
0.2127	78	0	0	Pass
0.2152	69	0	0	Pass
0.2177	64	0	0	Pass
0.2203	54	0	0	Pass
0.2228	47	0	0	Pass
0.2254	40	0	0	Pass
0.2279	33	0	0	Pass
0.2304	25	0	0	Pass
0.2330	22	0	0	Pass
0.2355	20	0	0	Pass
0.2380	17	0	0	Pass
0.2406	14	0	0	Pass
0.2431	12	0	0	Pass
0.2456	11	0	0	Pass
0.2482	7	0	0	Pass
0.2507	7	0	0	Pass
0.2533	7	0	0	Pass
0.2558	6	0	0	Pass
0.2583	6	0	0	Pass
0.2609	6	0	0	Pass
0.2634	6	0	0	Pass
0.2659	6	0	0	Pass
0.2685	6	0	0	Pass

0.2710	5	0	0	Pass
0.2735	5	0	0	Pass
0.2761	5	0	0	Pass
0.2786	5	0	0	Pass
0.2812	5	0	0	Pass
0.2837	5	0	0	Pass
0.2862	4	0	0	Pass
0.2888	4	0	0	Pass
0.2913	3	0	0	Pass
0.2938	3	0	0	Pass
0.2964	3	0	0	Pass
0.2989	3	0	0	Pass
0.3015	3	0	0	Pass
0.3040	3	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.3771 **acre-feet**
On-line facility target flow: 0.4282 **cfs.**
Adjusted for 15 min: 0.4282 **cfs.**
Off-line facility target flow: 0.24 **cfs.**
Adjusted for 15 min: 0.24 **cfs.**

4.2.6 WWHM2012 OUTPUT: SOUTH BASIN

WWHM2012
PROJECT REPORT

Project Name: 14036prelim
Site Name:
Site Address:
City :
Report Date: 7/20/2014
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version : 2014/04/14

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	.53
Pervious Total	0.53

Impervious Land Use	Acres
Impervious Total	0
Basin Total	0.53

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	.12
Pervious Total	0.12

Impervious Land Use	Acres
ROADS FLAT	0.11
Impervious Total	0.11
Basin Total	0.23

Element Flows To:
Surface **Interflow** **Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.53
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.12
Total Impervious Area:0.11

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.015781
5 year	0.025858
10 year	0.032338
25 year	0.040046
50 year	0.045385
100 year	0.050371

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.05159
5 year	0.069623
10 year	0.082514
25 year	0.099919
50 year	0.113715
100 year	0.128241

4.3 WATER QUALITY ANALYSIS AND DESIGN

The project will provide a wetvault for runoff treatment. As specified in Minimum Requirement #6 of the DOE 2005 SWMM, the wetvault is designed to provide a water quality storage volume greater than the 91st percentile, 24-hour runoff volume indicated by WWHM 2012 for the developed conditions (16,426 ft^3). Both cells within the proposed vault will include four feet of dead storage, providing 22,560 ft^3 of storage volume. Conceptual detail of the wetvault facility is provided in the preliminary development plans.

4.4 CONVEYANCE SYSTEM ANALYSIS AND DESIGN

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

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. See SWPPP under separate cover (to be submitted at a later date).

Section 6 Special Reports and Studies

Additional reports and studies within this section include a *Subsurface Exploration and Geotechnical Engineering Assessment*, dated March 3, 2014, prepared by Associated Earth Sciences, Inc., and a Critical Areas Report, dated November 3, 2014, prepared by Raedeke Associates, Inc.

Associated Earth Sciences, Inc.

Serving the Pacific Northwest Since 1981

March 3, 2014
Project No. KE140047A

Quadrant Corporation
14725 SE 36th Street, Suite 100
Bellevue, Washington 98006

Attention: Mr. Mike Behn

Subject: Subsurface Exploration and Geotechnical Engineering Assessment
Hussey Property
NE 122nd Street and 178th Avenue NE
Redmond, Washington

Dear Mr. Behn:

Associated Earth Sciences, Inc. (AESI) is pleased to present this report providing a summary of our subsurface exploration and limited geotechnical engineering study for Hussey Property in Redmond, Washington. This report has been prepared for the exclusive use of Quadrant Corporation, and their agents, for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to Quadrant Corporation.

INTRODUCTION

We understand that Quadrant Corporation is currently in the feasibility stage of purchasing the subject parcel with the intent of constructing single-family homes. We anticipate that the homes would be of wood-frame construction and would utilize conventional foundations with relatively light loading conditions.

The primary purpose of this study was to evaluate foundation bearing soil conditions. As such, AESI completed a series of exploration pits at the site using a backhoe excavator subcontracted to AESI. Our current work included use of this subsurface information to evaluate the thickness and quality of the subsurface sediments. Preparation of a Phase I Environmental Site Assessment (ESA) for this property by AESI is being prepared concurrently with this study.

SITE AND PROJECT DESCRIPTION

The site is located north of the intersection of NE 122nd Street and 178th Place NE in Redmond, Washington (Figure 1). The project site consists of one parcel (Parcel Number 252605-9023), totaling about 7 acres in area. The site is occupied by several abandoned outbuildings and an abandoned home foundation. The site is generally surrounded by existing single-family residential development. Vegetation on the site primarily consists of grass lawn areas in the southwest quadrant of the site, surrounding the existing buildings. The remainder of the site is undeveloped and vegetated with various trees and brush. A creek runs approximately north-south along the eastern site boundary. From this creek the site topography slopes up 50 to 60 feet to the west at an inclination of about 30 percent to a plateau that occupies the western side of the site. We understand that the project will include the construction of a residential development on the western plateau.

LITERATURE REVIEW

The following documents and plans were reviewed as part of our study. These documents were provided for our use by Quadrant Corporation.

Site reports: "Reports on Site Geology, Hydrogeology, and Engineering Geology" by RH2 Engineering, dated February, 2014.

The above-referenced reports by RH2 Engineering included exploration pit data for the above-referenced parcels and are discussed in greater detail below.

SUBSURFACE EXPLORATION

AESI observed the excavation of six exploration pits to depths up to 10.5 feet at the site on February 24, 2014. The approximate location of the pits are shown on the "Site and Exploration Plan," Figure 2. The exploration pits were excavated with a track-mounted mini excavator. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by an engineering geologist from our firm. Disturbed soil samples were selected from the pits, placed in moisture-tight containers, and transported to our laboratory for further visual classification. After logging the exposed soils the exploration pits were backfilled with the excavated soil and lightly tamped with the excavator bucket. Detailed descriptions of the sediments encountered are provided on the exploration logs included in the Appendix.

Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between explorations is necessary. It should be noted that differing subsurface

conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

Topsoil

An approximately 6- to 12-inch-thick layer of grass and topsoil was encountered at the surface. Topsoil is not suitable for structural support, and should be stripped from structural areas.

Fill

Fill soils (those not naturally placed) were encountered in explorations EP-2, EP-5, and EP-6 and are anticipated to be found around the outbuildings, other areas of past grading, and over buried utilities. The fill encountered extended to about 5 feet in depth at the location of EP-2 and may be related to past grading in relation to the abandoned home foundation just east of EP-2. The fill observed in EP-2 consisted of loose, very moist, brown fine sand with silt and few amounts of gravel. Organic-rich fill was encountered at the location of EP-5, extending to 7 feet in depth and consisting of dark brown to black, fine sand with silt with abundant woody debris. Fill encountered at the location of EP-6 extended to about 3 feet and consisted of loose, brown, fine sand with silt and trace to few amounts of organics. The approximate extent of existing fill based on our explorations and the explorations completed by RH2 Engineering is shown on Figure 2, "Site and Exploration Plan".

Fill soils are considered to be unsuitable for foundation or pavement support. Existing fill should be removed from below planned building areas. The fill encountered at the south end of the site (especially at the location of EP-5) contained a significant amount of organics and woody debris is not considered suitable for reuse as structural fill. Non-organic, excavated existing fill material may be suitable for reuse in structural fill applications if it is at a moisture content that allows compaction to the specified level for the intended use, and if all organic materials and any other deleterious materials are removed prior to use in structural fill applications. At the time of exploration, we estimate that the existing fill that we observed was above optimum moisture content for compaction purposes, and therefore will require drying during favorable weather prior to compaction in structural fill applications.

Vashon Lodgement Till

Below the existing fill, where encountered, all explorations encountered lodgement till sediments. Lodgement till consists of an unsorted mixture of sand, silt, clay, gravel, and occasional cobbles. It was deposited at the base of an active continental glacier and was subsequently compacted to a very dense condition by the weight of the overlying glacial ice.

Lodgement till typically possesses high-strength and low-compressibility attributes that are favorable for support of foundations, floor slabs, and paving, with proper preparation. Lodgement till is silty and moisture-sensitive. In the presence of moisture contents above the optimum moisture content for compaction purposes, lodgement till can be easily disturbed by vehicles and earthwork equipment. Careful management of moisture-sensitive soils will be needed to reduce the potential for disturbance of wet lodgement till soils and costs associated with repairing disturbed soils. Excavated lodgement till material is suitable for use in structural fill applications if it can be compacted to the specified level for the intended use. At the time of exploration, we estimate that most of the lodgement till soils that we observed were above optimum moisture content for compaction purposes, and therefore may require drying during favorable weather prior to compaction in structural fill applications.

Previous Work by Others

The report prepared by RH2 Engineering, referenced previously, contained logs of 15 exploration pits completed in January 2005. The locations of these pits are shown on Figure 2. The near-surface soil conditions described in this report describe site soils as existing fill, in areas, over Vashon-age lodgement till. Existing fill was encountered at the locations of TP-2, TP-3, TP-9, and TP-10 to depths up to 7 feet. All of the pits were terminated in the lodgement till. AESI is in general agreement with the soil conditions described in the report described above. The natural, near surface site soils encountered during our explorations are similarly classified.

Geologic Mapping

Review of the regional geologic map (J.P. Minard, and D.B. Booth, 1988, *Geologic Map of the Redmond Quadrangle, King County, Washington*: U.S. Geological Survey [USGS], Miscellaneous Field Studies Map MF-2016, scale 1:24,000.) indicates that the subject site is underlain by Vashon lodgement till. Our interpretation of the sediments encountered in our explorations is in general agreement with the regional geologic map.

Hydrology

Slow to moderate ground water seepages were observed in all exploration pits at varying depths, generally deeper than 3 feet below existing ground surface. The seepages were typically observed near the contact between the existing fill and underlying till and the contact between the weathered and unweathered till. The observed seepages are interpreted to represent perched ground water. Perched water conditions can occur when surface water infiltrates down through relatively permeable soils, such as existing fill or weathered till and becomes trapped or "perched" atop a comparatively impermeable barrier such as unweathered till. This water may travel as interflow and typically will follow the ground surface topography. The duration and quantity of interflow seepage will largely depend on the soil

grain-size distribution, topography, seasonal precipitation, on- and off-site land usage, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Our exploration indicates that, from a geotechnical standpoint, the subject site is suitable for the proposed project. Dense native sediments were observed to be relatively shallow in most explorations and will provide suitable support for structural fills, paving, and conventional spread-footing building foundations. Existing fill was encountered in several locations and should be removed from building and paving areas prior to placing structural fill. The following sections provide our recommendations for foundation support and support of slab-on-grade floors.

Site Preparation

Site preparation should include removal of all trees, brush, debris, existing buried utilities that are not to remain in service, and any other deleterious material. Additionally, the upper organic topsoil should be removed and the remaining roots should be grubbed. Once demolition has been completed, any existing fill should be addressed. Existing fill was observed at the locations EP-2, EP-5, and EP-6 to depths up to 7 feet. As described above, RH2 Engineering also encountered existing fill at the locations of TP-2, TP-3, TP-9, and TP-10 to depths up to 7 feet. We anticipate that existing fill will also be encountered surrounding the existing outbuildings and the abandoned house foundation (just east of EP-2). We recommend that existing fill be removed from below areas of planned foundations to expose underlying undisturbed native sediments. Once stripping and removal of existing fill has been completed, the exposed material should be recompacted to a firm and unyielding condition, as determined by an on-site AESI representative. Any soft or yielding areas may require further removal or other measures to provide a more stable surface for fill placement. After recompaction of the exposed ground is tested and approved by the geotechnical engineer structural fill may be placed to attain desired grades. Erosion and surface water control should be established around the clearing limits to satisfy local requirements.

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in the lodgement till may be made at a maximum slope of 1H:1V (Horizontal:Vertical). Temporary, unsupported cut slopes in the existing fill may be made at a maximum slope of 1.5H:1V. As is typical with earthwork operations, some sloughing and raveling may occur, especially if ground water seepage is present in the excavation cuts, and cut slopes may have to be adjusted in the field. In addition,

WISHA/OSHA regulations should be followed at all times. Permanent cut slopes in medium dense to dense, native sediments or structural fill must not exceed a 2H:1V inclination. Special approval from both the geotechnical engineer and the reviewing agency must be granted for proposed slopes steeper than 2H:1V.

A high percentage of fine-grained material within some of the on-site soils makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill. Consideration should be given to protecting access and staging areas with an appropriate section of crushed rock or asphalt treated base (ATB).

Structural Fill

After recompaction of the exposed ground is completed and approved by the geotechnical engineer as described above, structural fill may be placed as required to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of the modified Proctor maximum density using *American Society for Testing and Materials* (ASTM):D 1557 as the standard. The on-site native soils that are free of deleterious materials are suitable for reuse as structural fill provided they are present at a moisture content suitable for achieving the specified compaction. Use of the on-site materials containing high silt contents as structural fill will likely require some moisture conditioning. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the perimeter footings or parking lot edges before sloping down at an angle of 2H:1V.

Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills will, on a practicable basis, be limited to favorable dry weather conditions. The on-site soils contain a relatively high content of silt and are considered moisture-sensitive. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance. If structural fill is to be placed during wet weather or if proper compaction cannot be obtained, a select material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction.

A representative from AESI should inspect the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and any problem areas may be corrected at that time. Our field technicians and

engineer are available to aid the owner in developing a suitable monitoring and testing program, such that quality control is adequately provided.

Foundations

The foundation bearing stratum, consisting of medium dense to very dense native soils was observed to be relatively shallow (2 to 3 feet) in most exploration pits. The depth to bearing soils at the location of EP-2 and EP-5 was approximately 7 feet. For residential footings founded either directly on medium dense to very dense native soils prepared as described above, or on structural fill placed over these materials, we recommend that an allowable bearing pressure of 2,000 pounds per square foot (psf) be used for design purposes, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. Perimeter footings for the proposed buildings should be buried a minimum of 18 inches into the surrounding soil for frost protection. No minimum burial depth is required for interior footings; however, all footings must penetrate to the prescribed stratum, and no footings should be founded in or above loose, organic, or existing fill soils.

The area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edges of steps or cuts in the bearing soils.

All footing areas should be observed by AESI prior to placing concrete to verify that the exposed soils can support the design foundation bearing capacity and that construction conforms with the recommendations in this report. Foundation bearing verification may also be required by the governing municipality.

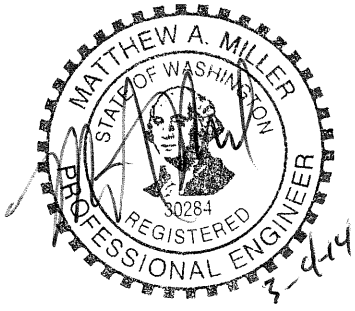
Floor Support

Slab-on-grade floors may be constructed either directly on the undisturbed, medium dense to very dense, native soils, or on structural fill placed over these materials. Areas of the slab subgrade that are disturbed (loosened) during construction should be recompacted to an unyielding condition prior to placing capillary break material, as described below. In order to control moisture vapor transfer through the slab, slab-on-grade floors should be constructed atop a capillary break consisting of a minimum thickness of 4 inches of washed pea gravel or $^{5}/_{8}$"-minus clean, washed crushed rock. The pea gravel or clean crushed rock should be overlain by a 10-mil (minimum thickness) plastic vapor retarder.

CLOSURE

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report or other geotechnical aspects of the project, please call us at your earliest convenience.

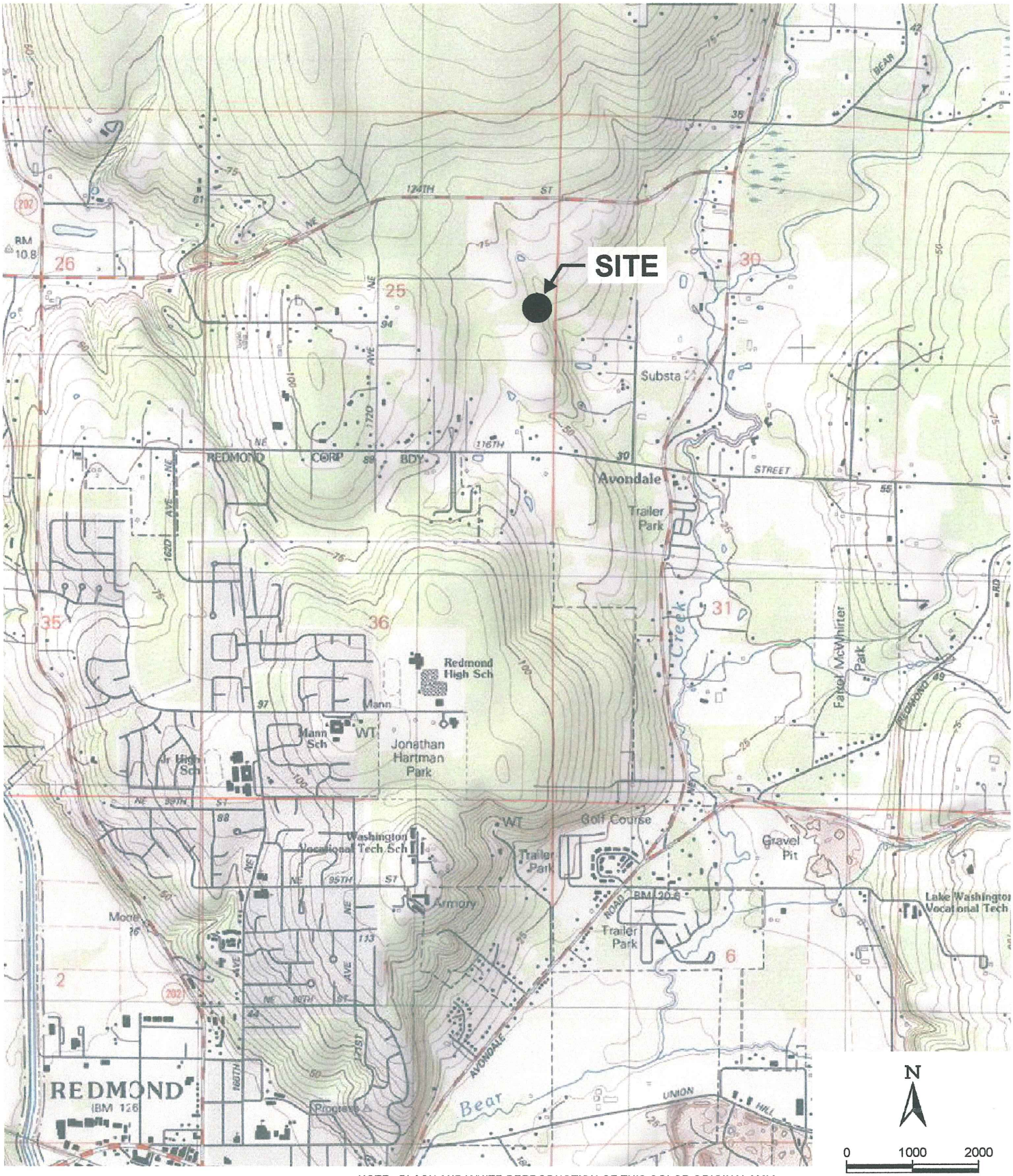
Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington



Luke Mioduszewski
Senior Staff Geologist

Matthew A. Miller, P.E.
Principal Engineer

Attachments: Figure 1: Vicinity Map
Figure 2: Site and Exploration Plan
Appendix: Exploration Pit Logs



REFERENCE: USGS TOPO!

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

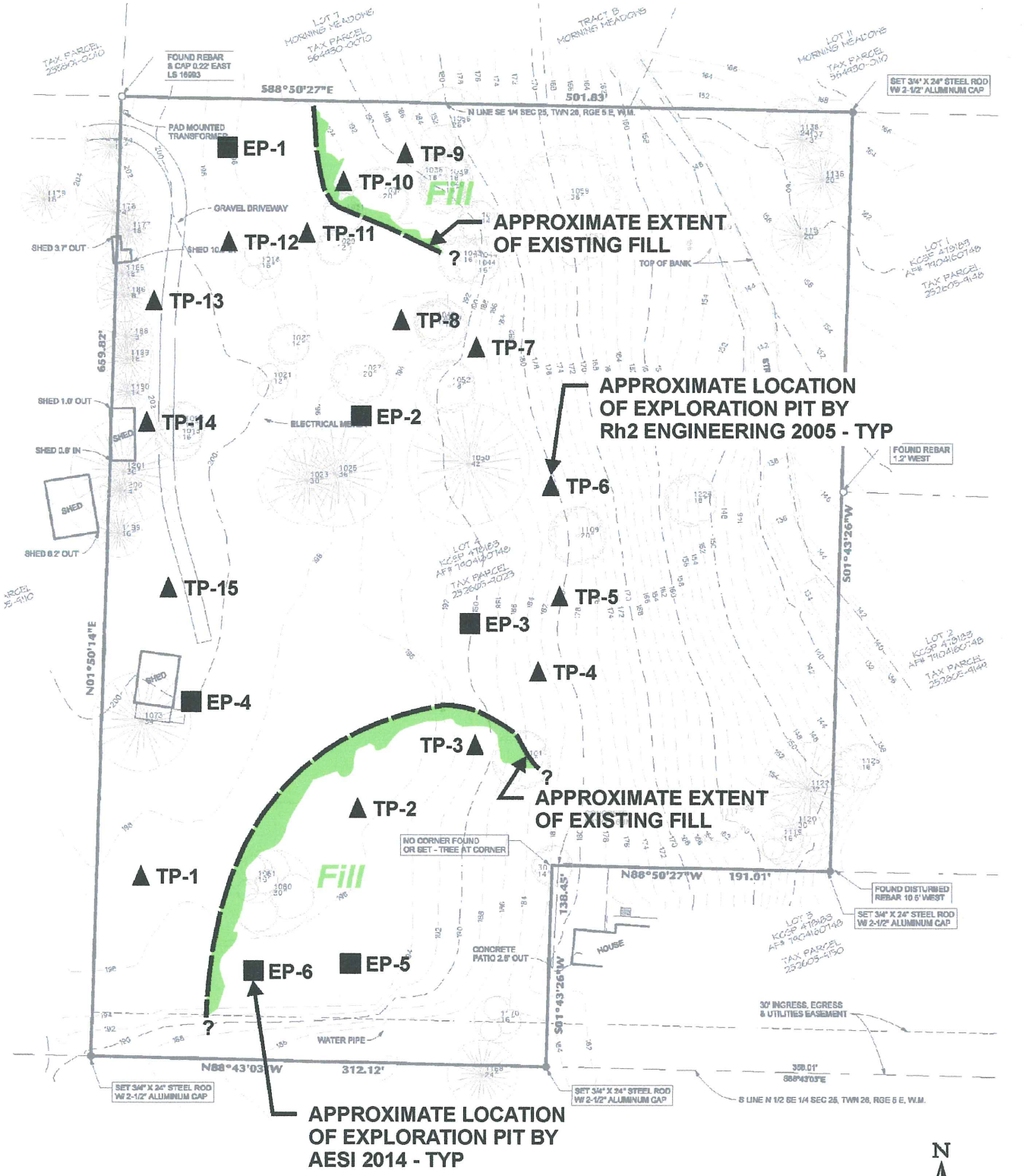
Associated Earth Sciences, Inc.

VICINITY MAP

HUSSEY PROPERTY
REDMOND, WASHINGTON

FIGURE 1
DATE 2/14
PROJ. NO. KE140047A

140047 Hussey Property \ 140047 Vicinity.cdr PAGE 2: KE



REFERENCE: GEO DATUM

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

Associated Earth Sciences, Inc.

SITE AND EXPLORATION PLAN

HUSSEY PROPERTY
REDMOND, WASHINGTON

FIGURE 2
DATE 2/14
PROJ. NO. KE140047A

140047 Hussey Property \ 140047 Site and Expl.cdr

APPENDIX

Exploration Pit Logs

Coarse-Grained Soils - More than 50% [1] Retained on No. 200 Sieve	Gravels - More than 50% [1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines [5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥15% Fines [5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50% [1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines [5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥15% Fines [5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50% [1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT [2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50
	Consistency	**SPT [2] blows/foot**
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

[3] Estimated Percentage

Component	Percentage by Weight
Trace	<5
Few	5 to 10
Little	15 to 25
With	- Non-primary coarse constituents: ≥ 15%
	- Fines content between 5% and 15%

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

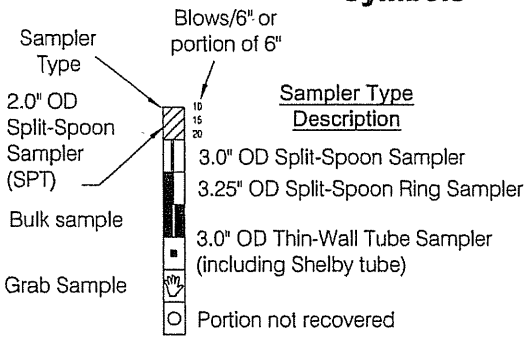
Slightly Moist - Perceptible moisture

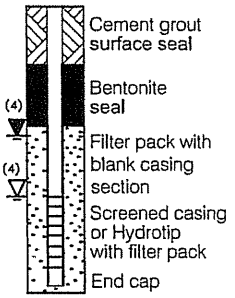
Moist - Damp but no visible water

Very Moist - Water visible but not free draining

Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 15%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Associated Earth Sciences, Inc.

EXPLORATION LOG KEY

FIGURE A1

blockslog_key.dwg LAYOUT: Layout2

LOG OF EXPLORATION PIT NO. EP-1

Depth (ft)

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

DESCRIPTION

Topsoil

1

Weathered Vashon Lodgement Till

2 Loose, very moist to wet, reddish brown to brown, fine SAND, with silt, few fine to coarse gravel, trace organics (SM).

3

Vashon Lodgement Till

4 Dense to very dense, very moist, mottled brown to gray, fine SAND, trace medium to coarse sand, with silt, few fine to coarse gravel; diamict (SM).

5 Few cobbles.

6 Becomes gray.

7

8 Very dense, very moist, gray, fine SAND, few medium to coarse sand, with silt, few fine to coarse gravel, trace cobbles; diamict (SM).

9

10 Bottom of exploration pit at depth 9.5 feet
Seepage at 3.5 feet. No caving.

11

12

13

14

15

16

17

18

19

20

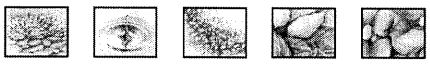
KCTP3 140047.GPJ February 28, 2014

Hussey Property
Redmond, WA

Logged by: LDM

Approved by:

Associated Earth Sciences, Inc.



Project No. KE140047A

2/24/14

LOG OF EXPLORATION PIT NO. EP-2

Depth (ft)

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

DESCRIPTION

Fill

Loose, very moist, dark brown, fine SAND, with silt, few fine to coarse gravel (SM),

Loose, very moist, brown, fine to medium SAND, with silt, few fine to coarse gravel (SM).

Relict topsoil (6 to 12 inches thick).

Weathered Vashon Lodgement Till

Loose to medium dense, very moist to wet, reddish brown, fine SAND, with silt, few fine to coarse gravel (SM).

Vashon Lodgement Till

Dense, very moist, brown, fine to coarse SAND, with silt, few to little fine to coarse gravel (SM).

Bottom of exploration pit at depth 10.5 feet
Seepage at 6 feet. Slight caving abover 6 feet.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

KCTP3 140047.GPJ February 25, 2014

Hussey Property
Redmond, WA

Logged by: LDM

Approved by:

Associated Earth Sciences, Inc.

Project No. KE140047A

2/24/14

LOG OF EXPLORATION PIT NO. EP-3

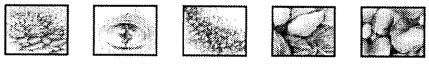
Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**	
	Topsoil	
1	**Weathered Vashon Lodgement Till**	
2	Medium dense, very moist to wet, reddish brown, fine SAND, with silt, trace medium to coarse sand, few fine to coarse gravel (SM).	
3		
	Vashon Lodgement Till	
4	Dense to very dense, very moist, brown to gray, fine SAND, trace medium to coarse sand, with silt, few fine to coarse gravel, with thin layers (2 to 4 inches) of fine to medium sand, few silt; diamict (SM).	
5		
6		
7		
8	As above.	
9		
10	Bottom of exploration pit at depth 9 feet Mderate seepage at approximately 3 feet. No caving.	
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Hussey Property
Redmond, WA

Logged by: LDM

Approved by:

Associated Earth Sciences, Inc.



Project No. KE140047A

2/24/14

KCTP3 140047.GPJ February 28, 2014

LOG OF EXPLORATION PIT NO. EP-4

Depth (ft)

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

DESCRIPTION

Topsoil

Weathered Vashon Lodgement Till

Medium dense, very moist to wet, reddish brown, fine SAND, with silt, trace medium to coarse sand, few fine to coarse gravel (SM).

Vashon Lodgement Till

Very dense, very moist, gray, fine SAND, trace medium to coarse sand, with silt, few fine to coarse gravel; diamict (SM).

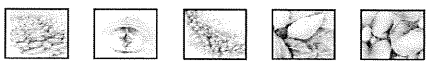
Bottom of exploration pit at depth 6.5 feet
Slight seepage at 3 to 4 feet. No caving.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Hussey Property
Redmond, WA

Logged by: LDM
Approved by:

Associated Earth Sciences, Inc.



Project No. KE140047A

2/24/14

KCTP3 140047.GPJ February 25, 2014

LOG OF EXPLORATION PIT NO. EP-5

Depth (ft)

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

DESCRIPTION

Fill

1 Very loose to loose, very moist to wet, black to dark brown, fine SAND, with silt, with organics and wood debris (SM).

2

3

4

5

6

7

Weathered Vashon Lodgement Till

8 Medium dense, very moist to wet, brown, fine SAND, trace medium to coarse sand, with silt, few fine to coarse gravel; diamict (SM).

9 Becomes gray with occasional mottling.

10 Bottom of exploration pit at depth 9.5 feet
Moderate seepage at 6 to 7 feet. Moderate caving above 7 feet.

11

12

13

14

15

16

17

18

19

20

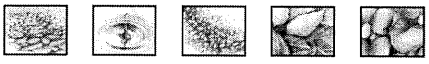
KCTP3 140047.GPJ February 28, 2014

Hussey Property
Redmond, WA

Logged by: LDM

Approved by:

Associated Earth Sciences, Inc.



Project No. KE140047A

2/24/14

LOG OF EXPLORATION PIT NO. EP-6

Depth (ft)

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

DESCRIPTION

Fill

1 Loose, very moist to wet, brown, fine SAND, with silt, few fine to coarse gravel, with organics (SM).

2

3

Weathered Vashon Lodgement Till

4 Loose to medium dense, very moist to wet, reddish brown to brown, fine SAND, with silt, few fine to coarse gravel (SM).

5

Vashon Lodgement Till

6 Dense to very dense, very moist, gray to brown, fine SAND, trace medium to coarse sand, with silt, few fine to coarse gravel; diamict (SM).

7

8 Bottom of exploration pit at depth 7 feet
Moderate seepage at 3 to 4 feet. No caving.

9

10

11

12

13

14

15

16

17

18

19

20

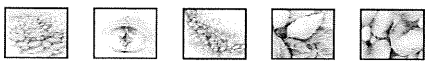
KCTP3 140047.GPJ February 25, 2014

Hussey Property
Redmond, WA

Logged by: LDM

Approved by:

Associated Earth Sciences, Inc.



Project No. KE140047A

2/24/14

Test Pit Logs – Redmond Low Impact Development

TEST PIT 1 (TP1)

Depth	*Soil Interpretation*
0-0.5 ft	O Horizon; dark brown; roots, silty sand/sandy silt, bioturbated; moist (ALDERWOOD SOIL)
0.5-1.0 ft	A Horizon; orange-brown; roots, silty sand/sandy silt, bioturbated; moist (ALDERWOOD SOIL)
1-2.5 ft	B Horizon; brown-gray, mottling; fewer roots, silty sand/sandy silt, firm but bioturbated; moist (ALDERWOOD SOIL)
2.0-4.5 ft	C Horizon; brown to gray, mottling; silty sand/sandy silt with occasional gravel, firm but bioturbated; moist (ALDERWOOD SOIL)
4-6 ft	Unweathered; brownish gray; silty sand/sandy silt with gravel and occasional cobble; massive (no bedding) and dense; moist; stable pit walls; (TILL)
Notes:	Test pit completed at approx. 6'. No groundwater seepage or caving observed. Test pit observed and logged by Andrea Mast on 01/27/2005.

TEST PIT 2 (TP2)

Depth	*Soil Interpretation*
0-4 ft	Dark brown; roots, sandy silt very organic-rich, occasional gravel or small cobble, moist to damp, bioturbated; (FILL)
~3.5-4 ft	Transition from fill to Alderwood soils.
3.5-4.5 ft	O & A Horizons; brown; roots, silty sand/sandy silt, (ALDERWOOD SOIL)
4-5ft	B Horizon; brown; fewer roots, silty sand/sandy silt, firm but bioturbated; (ALDERWOOD SOIL)
5-7 ft	C Horizon; brown to gray, mottling; silty sand with occasional gravel, moist to wet; medium-dense. Seepage at 5'. (ALDERWOOD SOIL)
6.5-7 ft	Unweathered; brownish gray; silty sand with occasional gravel; massive (no bedding) and dense; moist; stable pit walls; (TILL)
Notes:	Test pit completed at approx. 7'. No caving observed. Groundwater seepage observed at 5'. Piezometer (P1) installed on west side of test pit. Test pit observed and logged by Andrea Mast on 01/27/2005.

TEST PIT 5 (TP5)

Depth	*Soil Interpretation*
0-9 in	O Horizon; dark brown; roots, silty sand/sandy silt, bioturbated; (ALDERWOOD SOIL)
6-10 in	A Horizon; brown; roots, silty sand/sandy silt, bioturbated; (ALDERWOOD SOIL)
10 in-4 ft	B Horizon; brown; fewer roots, silty sand/sandy silt, firm but bioturbated; (ALDERWOOD SOIL)
4-7.5 ft	C Horizon; brown to gray, moist to damp; mottling; silty sand with gravel, firm; (ALDERWOOD SOIL)
7.5-8 ft	Unweathered; blue-gray; silty sand with gravel and occasional cobble; massive (no bedding) and dense; moist; stable pit walls; (TILL)
Notes:	Test pit completed at approx. 8'. No groundwater seepage or caving observed. Piezometer (P2) installed in test pit. Test pit observed and logged by Andrea Mast & Geoff Clayton on 01/27/2005.

TEST PIT 6 (TP6)

Depth	*Soil Interpretation*
0-12 in	O Horizon; dark brown; roots, silty sand/sandy silt, bioturbated; (ALDERWOOD SOIL)
6-14 in	A Horizon; brown; roots, silty sand/sandy silt, bioturbated; (ALDERWOOD SOIL)
14 in-2.5 ft	B Horizon; brown; fewer roots, silty sand/sandy silt, moist to damp; firm but bioturbated; (ALDERWOOD SOIL)
2.5-10 ft	C Horizon; brown to gray, mottling; silty sand with gravel, firm and dense; moist to damp; no blue-grey till observed like in TP5. Material was starting to become "blocky" at base of pit; (ALDERWOOD SOIL)
Notes:	Test pit completed at approx. 10'. Minor groundwater seepage at 9'. No caving observed. Test pit observed and logged by Andrea Mast on 01/27/2005.

TEST PIT 9 (TP9)

Depth	*Soil Interpretation*
0-7 ft	Fill; dark brown; roots and stumps, silty sand/sandy silt, bioturbated; (FILL)
7-11 ft	C-horizon; brown; roots, sandy silt, dense; moist; no visual indication of other soil horizons; (ALDERWOOD SOIL)
Notes:	Test pit completed at approx. 11'. No groundwater seepage or caving observed. Test pit observed and logged by Andrea Mast on 01/27/2005. Test pit located near back northeast corner of existing abandoned foundation at top of slope.

TEST PIT 10 (TP10)

Depth	*Soil Interpretation*
0-2 ft	Fill; dark brown; roots, silty sand/sandy silt with gravel, bioturbated; (FILL)
1.5-2.5 ft	A Horizon; brown; roots, silty sand/sandy silt, bioturbated; (ALDERWOOD SOIL)
2-4ft	B Horizon; brown; fewer roots, silty sand/sandy silt, firm but bioturbated; (ALDERWOOD SOIL)
4-11 ft	C Horizon; brown to gray, mottling; silty sand with gravel and occasional cobble, firm and dense; moist; (ALDERWOOD SOIL)
Notes:	Test pit completed at approx. 11'. Minor seepage at 9'. No caving observed. Piezometer (P4) installed in test pit. Test pit observed and logged by Andrea Mast on 01/27/2005.

TEST PIT 11 (TP11)

Depth	*Soil Interpretation*
0-18 in	O/A Horizons; dark brown to brown; roots, sandy silt, moist; bioturbated; (ALDERWOOD SOIL)
18in-3.5 ft	B Horizon; brown; roots, sandy silt, moist; firm but bioturbated; (ALDERWOOD SOIL)
3.5-8.5 ft	C Horizon; brown to gray, mottling; silty sand with gravel, dense; damp; did not reach unweathered till, but was more dense with depth; (ALDERWOOD SOIL)
Notes:	Test pit completed at approx. 8.5'. Minor to moderate seepage observed at 7'. Very minor caving observed at 7'. Test pit observed and logged by Andrea Mast on 01/27/2005.

TEST PIT 14 (TP14)

Depth	*Soil Interpretation*
0-1 ft	O Horizon; dark brown; roots, sandy silt, bioturbated; (ALDERWOOD SOIL)
1-1.5 ft	A Horizon; brown; roots, sandy silt, bioturbated; (ALDERWOOD SOIL)
1.5-3 ft	B Horizon; brown; fewer roots, sandy silt, moist; firm but bioturbated; (ALDERWOOD SOIL)
3-5 ft	C Horizon; brown to gray, mottling; sandy silt with occasional gravel, moist; firm; very fine grained similar to TP13; (ALDERWOOD SOIL)
4.5-8 ft	Unweathered; brownish gray; very fine grained sandy silt with gravel; massive (no bedding) and dense; moist; stable pit walls; (TILL)
Notes:	Test pit completed at approx. 8'. No groundwater seepage or caving observed. Test pit observed and logged by Andrea Mast on 01/27/2005.

TEST PIT 15 (TP15)

Depth	*Soil Interpretation*
0-6 in	O/A Horizons; dark brown to brown; roots and burnt wood, silty sand/sandy silt, bioturbated; (ALDERWOOD SOIL)
6 in-2.5 ft	B Horizon; brown; fewer roots, silty sand/sandy silt, firm but bioturbated; (ALDERWOOD SOIL)
2.5-6 ft	C Horizon; brown to gray, mottling/oxidation; very fine grained sandy silt with occasional gravel, moist; firm but bioturbated; (ALDERWOOD SOIL)
6-7.5 ft	Unweathered; brownish gray; very fine grained sandy silt with gravel; massive (no bedding) and dense; blocky; moist; stable pit walls; (TILL)
Notes:	Test pit completed at approx. 7.5'. No groundwater seepage or caving observed. Test pit observed and logged by Andrea Mast on 01/27/2005.

Attachment 21

CRITICAL AREAS REPORT

Edgewood East Short Plat

Redmond, Washington

November 3, 2014

RAEDEKE ASSOCIATES, INC.

Raedeke Associates, Inc.

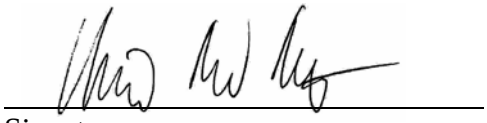
Wetland & Aquatic Sciences
Wildlife Ecology
Landscape Architecture

Report To:	Mr. Corey Watson Quadrant Homes 14725 SE 36th Suite 100 Bellevue WA 98006
Title:	Critical Areas Report Edgewood East Short Plat Redmond, Washington
Project Number:	2014-009-003
Prepared by:	RAEDEKE ASSOCIATES, INC. 9510 Stone Avenue North Seattle, Washington, 98103 (206) 525-8122
Date:	November 3, 2014

Raedeke Associates, Inc.
Wetland & Aquatic Sciences
Wildlife Ecology
Landscape Architecture

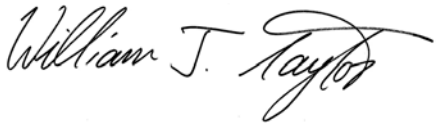
Project Manager:	Christopher W. Wright, B.S. Principal / Wetland Ecologist
Project Personnel:	Richard W. Lundquist, M.S. Vice President/ Wildlife Biologist
	William J. Taylor, M.S. Aquatic Scientist
	Kolten Kosters, M.S. Environmental Technician
	Anne Cline, P.L.A. Landscape Architect

Submitted by:



Signature

Christopher W. Wright
Printed Name



Signature

William J. Taylor
Printed Name

November 3, 2014

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Cont'd)

Page

LIST OF FIGURES

Figure **Page**

1.0 INTRODUCTION

1.1 PURPOSE

Raedeke Associates, Inc. was retained by Quadrant Homes to provide a critical areas evaluation of the proposed Edgewood East project site, including a wetland reconnaissance, wildlife habitat evaluation, and delineation and evaluation of a stream channel in the eastern end of the site. The report presents the findings of our background information review, February 4, 2014 and July 14, 2014 site investigations of the project site, and associated avoidance, minimization and mitigation measures related to the site stream channel and buffer. The report follows the City of Redmond critical areas reporting requirements (City of Redmond 2014). The report also provides a summary of mitigation measures that are to be implemented to compensate for identified impacts to the stream and riparian corridor.

1.2 PROJECT LOCATION

The Edgewood East project area is an approximately 7-acre parcel, located at 17811 NE 124th Street in the City of Redmond, Washington. The property is identified as Tax Parcel No. 2526059023. This places the property in Section 25, Township 26 North, Range 5 East W.M. (Figure 1). Parcel maps retrieved from King County (2014) iMap depict the property boundaries.

1.3 PROJECT DESCRIPTION

The proposed Edgewood East project would involve developing the western portion of the parcel into 24 single family lots. Access to the lots would be provided from NE 122nd Street which abuts the south boundary of the property. Buffer averaging is proposed along the west bank of the stream. The proposed site plan, buffer averaging plan, topographic surveys and other related existing conditions are provided in Figure 5.

2.0 METHODS

2.1 DEFINITIONS AND METHODOLOGIES

Wetlands and streams are protected by federal law as well as by state and local regulations. Federal law (Section 404 of the Clean Water Act) prohibits the discharge of dredged or fill material into "Waters of the United States," including certain wetlands, without a permit from the U.S. Army Corps of Engineers (COE 2012). The COE makes the final determination as to whether an area meets the definition of a wetland and whether the wetland is under their jurisdiction.

2.1.1 Wetland Investigation

The COE wetland definition was used to determine if any portions of the project area could be classified as wetland. A wetland is defined as an area "inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Federal Register 1986:41251).

We based our investigation upon the guidelines of the U. S. Army Corps of Engineers (COE) Wetlands Delineation Manual (Environmental Laboratory 1987) and subsequent amendments and clarifications provided by the COE (1991a, 1991b, 1992, 1994), as updated for this area by the regional supplement to the COE wetland delineation manual for the Western Mountains, Valleys, and Coast Region (COE 2010). The COE wetlands manual is required by state law (WAC 173-22-035, as revised) for all local jurisdictions, including the City of Redmond. Hydrophytic vegetation is defined as "macrophytic plant life growing in water, soil or substrate that is at least periodically deficient in oxygen as a result of excessive water content" (Environmental Laboratory 1987). The U.S. Army Corps of Engineers National Wetland Plant List wetland indicator status (WIS) ratings were used to make this determination (Lichvar and Kartesz 2009). The WIS ratings "reflect the range of estimated probabilities (expressed as a frequency of occurrence) of a species occurring in wetland versus non-wetland across the entire distribution of the species" (Reed 1988:8). Plants are rated, from highest to lowest probability of occurrence in wetlands, as obligate (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), and upland (UPL), respectively. In general, hydrophytic vegetation is present when the majority of the dominant species are rated OBL, FACW, and FAC.

A hydric soil is defined as "a soil that is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal Register 1995: 35681). The morphological characteristics of the soils in the study area were examined to determine whether any could be classified as hydric.

According to the 1987 methodology, wetland hydrology could be present if the soils were saturated (sufficient to produce anaerobic conditions) within the majority of the rooting zone (usually the upper 12 inches) for at least 5% of the growing season, which in this area is usually at least 2 weeks (COE 1991a). It should be noted, however, that areas having saturation to the surface between 5% and 12% of the growing season may or may not be wetland (COE 1991b). Depending on soil type and drainage characteristics, saturation to the surface would occur if

water tables were shallower than about 12 inches below the soil surface during this time period. Positive indicators of wetland hydrology include direct observation of inundation or soil saturation, as well as indirect evidence such as drift lines, watermarks, surface encrustations, and drainage patterns (Environmental Laboratory 1987). Hydrology was further investigated by noting drainage patterns and surface water connections between wetlands and streams within and adjacent to the project area.

2.1.2 Ordinary High Water Mark Delineation

We based our delineation of the ordinary high water mark (OHWM) of Stream A on definitions provided under the Washington State Shorelines Management Act of 1971. The Washington State definition for the OHWM is as follows:

> *Ordinary high water line" or "OHWL" means the mark on the shores of all waters that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland, provided that in any area where the ordinary high water line cannot be found, the ordinary high water line adjoining saltwater shall be the line of mean higher high water, and the ordinary high water line adjoining freshwater shall be the elevation of the mean annual flood."*…(RCW 90.58.030(2)(b) and WAC173-22-030(6); WDOE 1994).

As outlined in the WDOE (1994) Shoreline Administrators Manual, the general guidelines for determining the OHWM include: (1) a clear vegetation mark; (2) wetland/upland edge; (3) elevation; (4) a combination of changes in vegetation, elevation, and landward limit of drift deposition; (5) soil surface changes from algae or sediment deposition to areas where soils show no sign of depositional processes; and/or (6) soil profile changes from wetter conditions (low chroma, high soil organic matter, and lack of mottling) to drier conditions (higher chroma, less organic matter, or brighter mottles).

2.2 Background Research

2.2.1 Wetlands

In preparation for our site investigation, we collected and analyzed background information available for the site prior to the on-site investigation. We collected maps and information from the U.S.D.A Natural Resources Conservation Service (2014) Web Soil Survey and U.S. Fish and Wildlife Service (USFWS 2014) National Wetland Inventory on-line mapper, and the Washington State Department of Natural Resources (WDNR 2014) on-line water types map.

The USFWS (2014) NWI map shows no wetlands on the site or within at least 300 feet. The City of Redmond (2012) wetland map likewise depicts no wetlands on the site, and only shows the stream course. The USDA NRCS (2014) soil survey depicts the site as having Alderwood gravelly sandy loam soils, 6-15% slopes (AgC), which is a non-hydric soil (USDA SCS 1991, Federal Register 1995).

2.2.2 Wildlife

We also accessed the online priority habitats and species (PHS) database maintained by Washington Department of Fish and Wildlife (WDFW 2014a) for documented information on the potential occurrence of federal- or state-listed endangered, threatened, sensitive, candidate, other priority, or monitor wildlife species (hereafter "species of concern"), or priority habitats on the project site and vicinity. State priority species are defined as those fish and wildlife species "requiring protective measures and/or management actions to ensure their survival", and State priority habitats are defined as habitat types "with unique or significant value to many species" (WDFW 2008). We also reviewed database information maintained by the Washington Natural Heritage Program (2014) for occurrence of endangered, threatened, and sensitive plants in the vicinity of the project site.

Reference lists maintained by WDFW (2008) were consulted for information on the status of wildlife species of concern that could use the site during at least some part of the year. Species accounts and management recommendations provided by WDFW (e.g., Rodrick and Milner 1991, Larsen 1997, Azerrad 2004, Larsen et al. 2004) were consulted to determine habitat associations of such species and to evaluate the likelihood of their occurrence on the project site. During the field investigation, we searched for the presence of these species, or signs thereof, which could be found on the property.

The WDFW (2014a) PHS database map shows no occurrences of species of concern, including endangered, threatened, sensitive, or other priority species or habitats on or adjacent to the project site, other than potential presence of coast resident cutthroat trout (*Oncorhynchus clarki*) within Stream A. The City of Redmond's (2012) map of core preservation areas shows no mapped fish and wildlife habitat conservation areas on the project site or immediate vicinity other than a Class II stream corresponding to Stream A. The Washington Natural Heritage Program (2014) database contains no records of Natural Heritage Features (e.g., listed plant species or Natural Heritage wetlands) in the section in which the project site occurs.

2.2.3 Streams

We also collected and analyzed stream background information available for the site. In addition to the City of Redmond Stream Classification map (City of Redmond 2012), the King County iMap (2014) and Washington State Department of Wildlife (2014b) Salmon Scape on-line resources were consulted. The Proposed Bear Creek Basin Plan (King County 1990) was also reviewed.

Personal contacts were also conducted with City of Redmond Planning Department and Natural Resources Division Staff to identify personal accounts of site condition, documentation of fish use and past stream documentation (Ms. Cathy Beam, City of Redmond, pers. comm. 7/15/14; Mr. Roger Dane, City of Redmond, pers. comm. 7/16/14; Ms. Thara Johnson, City of Redmond, 7/17/14). Request for previous critical areas reports for the parcel were also made to the Planning Department but none were located by Redmond Planning Department Staff (Ms. Cameron Zapata, City of Redmond, 7/17/14). Personal email communication with the King

County Bear Creek Steward also provided a narrative description of the overall conditions of stream 0120 (Mr. Tom Beavers, King County, pers. comm. 7/22/14).

The location of the stream on site is identified in the City of Redmond Stream Classifications Map (Figure 2) and identifies the stream as a Class II stream (City of Redmond 2014). The stream is also identified in the City of Redmond, WA Citywide Watershed Management Plan as a Class II stream, but a narrative description is not provided (City of Redmond 2013). This stream is identified as stream 0120 in the Washington State Department of Fisheries Stream Catalog (1975; Mr. Tom Beavers, King County, pers. comm. 7/22/14).

2.3 FIELD RECONNAISSANCE

2.3.1 Wetlands and Streams

An initial field reconnaissance was conducted on February 4, 2014 to search the site for the presence of wetlands and streams and characterize general site conditions. This field visit included flagging the ordinary high water mark (OHWM) of Stream A. Visual characterization of the stream channel was conducted and photographs taken at various locations within the property between the north boundary where the stream flows onto the property, and the east border where the channel exits the property. More specific qualitative observations of the channel were noted on July 14, 2014 at two locations, one near the north boundary and the other near the southern boundary. These later characterizations included an estimate of stream flow, bank height, vegetative cover, substrate size, water clarity, and potential habitat conditions for fish use.

In addition to the stream channel characterization, the riparian community on the west bank of the stream channel was characterized on July 14, 2014 for common species, canopy heights, density, and terrestrial habitat features.

Vegetation, soils, and hydrology were examined in representative portions of the study area according to the procedures described in the Regional Supplement (COE 2010). Plant communities were inventoried, classified, and described during our field investigation. We estimated the percent coverage of each species. Plant identifications were made according to standard taxonomic procedures described in Hitchcock and Cronquist (1976), with nomenclature as updated by the U.S. Army Corps of Engineers National Wetland Plant List (Lichvar and Kartesz 2009). Wetland classification follows the USFWS wetland classification system (Cowardin et al. 1992). We determined the presence of a hydrophytic vegetation community using the procedure described in the Regional Supplement (COE 2010), which requires the use of the dominance test, unless positive indicators of hydric soils and wetland hydrology are also present, in which case the prevalence index or the use of other indicators of a hydrophytic vegetation community as described in the Regional Supplement (COE 2010) may also be required.

We excavated pits to at least 18 inches below the soil surface, where possible, in order to describe the soil and hydrologic conditions throughout the study area. We sampled soil at locations that corresponded with vegetation sampling areas and potential wetland areas. Soil colors were determined using the Munsell Soil Color Chart (Munsell Color 2009). We used the

indicators described in the Regional Supplement (COE 2010) to determine the presence of hydric soils and wetland hydrology.

2.3.2 Wildlife

During this field investigation, we documented wildlife presence, sign, and habitat while inventorying and describing plant communities. We recorded information regarding reproduction, habitat use, and activities of all wildlife species observed. In addition, we noted special habitat features such as large and/or hollow trees, snags [standing dead or partly dead trees at least 4 inches diameter at breast height (dbh) and 6 feet tall], and large down logs. Historic and present land-use of the site and immediate vicinity were noted from direct observations in the field and analysis of aerial photographs.

During our field surveys, we also searched specifically for the presence, sign, or habitats of any wildlife species of concern that may occur on the project site or vicinity. In particular, we searched for the presence of large stick-type nests, hollow trees, tree cavities, and pileated woodpecker foraging sign. Large stick nests are built and used by several species of concern, including bald eagles and great blue herons. Tree cavities are created and used by woodpeckers, including species of concern such as the pileated woodpecker, and can provide habitat for a host of bird and mammal species, including species of concern such as purple martins, various cavity-nesting duck species, and various bats. Hollow trees are used as daytime roost for priority species including various bat species, as well as Vaux's swifts.

3.0 EXISTING CONDITIONS

3.1 GENERAL SITE DESCRIPTION

The Edgewood East property is a largely undeveloped parcel that appears to have been previously used as a plant nursery. A gravel access drive enters the site from the northwest corner into grassy and shrubby opening with a building in the southwestern portion of the site. Piles of plant pots, irrigation pipe, and abandoned vehicles occur in this portion of the property as well. The northern and eastern portions of the property contain a deciduous forest vegetation community.

During our site investigation on February 4, 2014 we identified and delineated Stream A on the property. The stream enters the site along the north property boundary and flows southeasterly through the parcel before leaving the site to the east. The stream is 6- to 8-feet wide and is deeply incised through the northeast corner of the site. The stream channel generally lacked vegetation and lacked fringing wetland communities.

3.2 WETLAND RECONNAISSANCE

We found no evidence of wetlands occurring on the property. Vegetation in the opening in the southwestern part of the site consisted of Himalayan blackberry (*Rubus ameniacus*), with some reed canarygrass (*Phalaris arundinacea*). The northwestern part of the site consisted of a deciduous forest dominated by black cottonwood (*Populus balsamifera*), with widely scattered conifers, and Himalayan blackberry. As described below, the reminder of the site along the stream corridor consisted of deciduous forest of variable composition, dominated by big-leaf maple (*Acer macrophyllum*) and cottonwood in the north and red alder (*Alnus rubra*) and cottonwood in the south portion. The understory consisted of dense tall shrub cover that varied in composition, ranging from dense stands of vine maple (*Acer circinatum*) and salmon raspberry (*Rubus spectabilis*), to areas dominated almost exclusively by Himalayan blackberry (*Rubus ameniacus*). Low cover included stinging nettle (*Urtica dioica*), reed canarygrass (*Phalaris arundinacea*), trailing blackberry (*Rubus ursinus*), sword fern (*Polystichum munitum*), and lady fern (*Athyrium filix-femina*).

Soils were generally consistent with the Alderwood series mapped for the site, with brown to dark brown (10YR 4/3 to 10YR 4/2) subsoil and without redoximorphic features or any indicators of hydric soil conditions. No water table or saturated soil was observed anywhere outside of the stream channel on site. Sample plots were located in the southwest portion of the site and along the west side of the stream channel (Figure 4, Appendix A).

3.3 STREAM CHANNEL ASSESSMENT

3.3.1 Stream Description

The Edgewood East Project property generally consists of relatively flat terrain except for the deeply incised stream banks of Stream A. Stream A is the only stream on site, and is identified as a Class II stream (City of Redmond 2013; Figures 2, 3). The overall stream length of Stream A on the property is approximately 425 feet, with an elevation drop of approximately 14 feet, for an overall slope of 3.3%.

Soils on the property are mapped entirely as Alderwood gravely sandy loam (USDA NRCS 2014). Stream A is a second order stream that is highly incised through the overlying gravely sandy loam. The incising process appears, however, to have reached the hardened till layer without further incision in recent years (as an indication of this, a deciduous trees fallen laterally from the bank was observed to have continued to grow back to a vertical position to a diameter of approximately 4 to 6 inches).

Stream banks in the northern portion of the site are the most incised on the site, with vertical bank walls approximately 15 feet in height (Photo 1). As the channel progresses through the property the banks are less incised (Photo 2). Stream substrate in the stream bed is primarily medium to small cobble, gravel, small gravel and sand; these substrate sizes have been graded by higher stream flows from large to small from the middle of the channel to the bed margins (Photo 3).

Canopy cover of the stream channel is dense throughout the project reach. Both high canopy deciduous trees, and lower canopy vine maple, blackberry, and other shrubs provide approximately 50 to 90 cover of the stream channel during the growing season.

Flow in Stream A is small during base flows throughout the year. Flow during the February 4, 2014 site visit was approximately 0.25 to 0.5 cfs, and only about 1 gallon per minute or less during the July 14, 2014 site visit. Water clarity was visibly good and water temperatures were approximately 50 to 60 degrees F.

Stream A is classified as a Class II stream by the City of Redmond indicating salmonid use, although there is a partial barrier to migration downstream at the Redmond City limits (City of Redmond 2013). We observed no blockages to fish passage within the project site. City of Redmond Natural Resources Division staff stated they have anecdotal documentation of salmonid use upstream in a nearby upstream King County development critical areas report (Roger Dane, City of Redmond, pers. comm. 7/16/14), and the Washington State Department of Natural Resources identifies this stream as fish bearing (WDNR 2014). Channel habitat types within the property boundary are almost exclusively riffle reaches with no pools observed in the portions of the stream assessed during the site visits.

3.3.2 Stream Value as Fish Habitat

Stream A on the site is a segment of stream 0120, a tributary to Bear Creek, as catalogued by the Washington State Department of Fisheries (1975; Tom Beavers, pers. comm. 7/22/14). This stream has reports of the presence of salmonid fishes, likely only cutthroat trout in some portions of the overall stream, juvenile salmonid use near the mouth, but no use by adult pacific salmon for spawning (WDNR 2014; Tom Beavers, Bear Creek Steward, King County, pers. comm. 7/22/14; Roger Dane, City of Redmond, pers. comm. 7/16/14). This stream is recognized as having deeply incised channels and associated sediment delivery to the lower creek reaches (King County 1990). The lower reach of stream 0120 includes wetland and pasture areas where livestock have access to the creek (Tom Beavers, King County, pers. comm. 7/22/14).

Because of the limited pool habitat and extremely low base flows throughout the year, salmonid fish use on the site is highly unlikely, except possibly transitory presence during high flows if a fish population exists upstream. Otherwise the contributing habitat values originating on the site will come from the organic inputs (both detrital and live prey organisms) contributed mostly from the riparian canopy, which is transported downstream where more fish populations may occur. The vegetative cover will also help maintain cooler water temperatures as the stream flows through the property.

3.4 RIPARIAN CORRIDOR AND SITE HABITAT CONDITIONS

Canopy cover in the riparian corridor in the northern portion of the property (upstream reach) is characterized by big-leaf maple (*Acer macrophyllum*) and black cottonwood (*Populus balsamifera*) extending approximately 100 feet upland from the stream corridor on either side. These trees appear to be approximately 30 to 40 years in age and are homogeneous in terms of stand age composition. The understory is a patchwork with sections dominated by dense stands of vine maple (*Acer circinatum*) and salmon raspberry (*Rubus spectabilis*), while other segments comprise almost exclusively of Himalayan blackberry (*Rubus ameniacus*). Scattered throughout the understory are several grasses and herbs including stinging nettle (*Urtica dioica*), reed canarygrass (*Phalaris arundinacea*), trailing blackberry (*Rubus ursinus*), sword fern (*Polystichum munitum*), and lady fern (*Athyrium filix-femina*). Very little recruitment of juvenile big-leaf maple and black cottonwood was observed in the understory community (Photo 4).

We observed at least one snag 30 feet tall and greater than 8 inches in diameter in the riparian corridor, as well as a number of downed logs of greater than 6 inches diameter. Woodpecker foraging excavations were also noted on at least one of these features. This portion of the stream is deeply incised, but primarily small diameter (4 to 8 inches) woody debris and vegetation is abundant in the stream channel. The canopy cover provided approximately 50% stream cover in this reach, greatly contributing to stream temperature moderation.

The composition of the canopy transitions as the stream meanders south. Big-leaf maple is replaced by red alder (*Alnus rubus*) and black cottonwood as the dominant canopy cover. Trees in this reach appear to be approximately 30 to 40 years in age and extend along the riparian corridor and into the upland for approximately 100 feet on either side of the stream channel. We observed very few saplings in the under story suggesting poor community recruitment. Stands of vine maple and salmon raspberry become thicker through the understory in this portion of the property, with less Himalayan blackberry observed. Cut-leaf blackberry (*Rubus laciniatus*), reed canarygrass, sword fern, and lady fern, and stinging nettle were also observed in portions of the under story.

A large down log approximately (15 inch diameter and 20 feet long) was noted approximately 50 feet up from the stream channel, in addition to several smaller standing snags in the southern part of the site. The channel is less incised at this point on the property and large woody debris was more abundant than upstream. We noted at least one log of greater than 20 inches diameter fallen across the stream channel. Our visual estimations indicate that the stream is approximately 70 to 90 percent shaded in this portion of the reach due to dense canopy overhang

from alder and cottonwood and the thick under story of vine maple and salmon raspberry growing up to the stream edge. The density of vegetation in this portion of the reach provides significant temperature regulation and opportunity for large woody debris recruitment.

As noted above, the deciduous forest continues westward from the riparian corridor in the northern part of the site, dominated mainly by cottonwood with an understory of Himalayan blackberry. The southwestern part of the site includes a building and a variety of debris within an opening dominated by Himalayan blackberry and reed canarygrass (Figure 4).

The deciduous forest vegetation community within the site has no distinct edges, other than more subtle changes in composition as noted above. The most distinct edges are those between the on-site forest and shrub and grass opening in the southwest corner, and between the on-site forest and surrounding properties, particularly on the north, east, and south. The edges are formed by residential housing and associated paved roads (Figure 4). occur off site to the west within the park property between the mixed forest cover and the lawn area of the park. Areas along habitat edges are subject to a number of special environmental factors as compared to larger, more contiguous forest patches, and these factors can positively or negatively affect wildlife. Edge habitat is preferred by many wildlife species, which may increase wildlife species richness and diversity. However, negative factors that are prevalent in edge habitat include increased likelihood for colonization by invasive plant species, increased presence of mid-sized carnivores such as raccoons (potentially leading to increased depredation and decreased reproductive success for resident wildlife), and greater fluctuations in understory temperature, among others.

3.5 WILDLIFE

3.5.1 Wildlife Use and Observations

A wide variety of wildlife species may be expected to inhabit lowland deciduous or mixed forest communities in the Pacific Northwest, such as that found on the project site. Of the more than 300 vertebrate wildlife species expected to occur in west side forests of Oregon and Washington, over 230 species occur within west side lowland mixed coniferous and deciduous forests (Johnson and O'Neil 2001). A more limited number of species are expected to occur within lowland deciduous or mixed forests of western Washington, particularly King County: over 80 species, nearly 60% of which are birds, about 25% are mammals, and the rest are amphibians and reptiles (King County 1987). The number of species expected to inhabit a particular forest stand depends on its size, landscape context, and surrounding uses. Relatively small stands such as that on the Edgewood East property that are surrounded by urban residential uses, would be expected to support a more limited number of wildlife species. Those that do occur there may be further adversely affected by surrounding human activity and predation or other influences from urban-adapted species (such as crows and starlings), or other invasive species.

We observed relatively few wildlife species or their sign during our field reconnaissance visits. Our field visits were conducted during winter and summer (February and July), outside much of the breeding season for birds. As noted above, we also saw sign of past foraging activity by pileated woodpeckers and other small woodpecker species (likely hairy or downy woodpeckers). The number of species that we observed is also likely limited by the relatively small size of the

site and the surrounding suburban land uses. Species observed primarily include those adapted to Puget Sound lowland mixed forest, as well as those that can persist in fragmented forest habitat and/or residential areas.

A variety of other bird species are likely to inhabit the site and vicinity at different times of the year. Many of these are spring and summer residents that migrate out of the area for the fall and winter, as well as year-round residents. We observed no raptors (eagles, hawks, falcons, or owls) during our field reconnaissance, and no raptor nests were found on any of the trees within the site. Most of the larger trees had intact tops and lacked appropriate branching structures to support large raptor nests such as bald eagles.

Other than deer (a doe and fawn) walking through small canopy opening of reed canarygrass in the riparian corridor, we observed no mammals or their sign during our field reconnaissance. Several species of small and medium-sized mammals likely use the site, though many are secretive and/or nocturnal and are therefore unlikely to be observed during a general site reconnaissance. The down woody debris was widely scattered the site, and although limited in extent, along with areas of dense areas of shrub and ground cover, provide potential cover and breeding habitat for small mammals. In addition, on-site trees and snags provide potential cover and breeding locations for medium-sized mammals such as raccoons and squirrels. The presence of domestic dogs and cats in the area may limit the suitability of the forest on site, as they can act as highly effective predators on native wildlife species in urban and suburban areas, particularly those that nest or inhabit the ground (Penland 1984, Maestas et al. 2003, Odell and Knight 2001, Leu et al. 2008).

We did not observe any reptiles, amphibians, or their sign during our field reconnaissance, though a small number of species of each group is likely to be present. The minimal amount of down woody debris on the site and the lack of wetlands may limit the number of Puget Sound lowland terrestrial-breeding amphibians that could occupy the site. Amphibians would most likely be expected to center activities on Stream A and the riparian corridor on site. Potential cover and foraging habitat is present on the site for some reptiles, including garter snakes, and some amphibians.

3.5.2 Endangered, Threatened, Sensitive, or Other Priority Species

We observed no species listed as endangered, threatened, or sensitive within the project site or immediate vicinity, nor are any of these species considered to have a primary association with the project site (other than potential fish habitat in the stream, as discussed above). As noted above, sign of previous foraging by pileated woodpecker, a state candidate species, was observed in one snags on site, but none of this sign appeared to be fresh (i.e., occur since at least this last fall or winter). No snags appeared to be large and tall enough to provide suitable nesting or roosting habitat for pileated woodpeckers. No other priority or other species of concern were observed or likely to occur within the project site.

3.5.3 Wildlife Habitat Movement Corridors and Networks

Wildlife habitat networks or corridors can take different forms, depending on the landscape. Corridors can be in the form of hedgerows or fencerows connecting woodlots in an agricultural landscape. In a fragmented forested landscape, corridors are linear patches of forest or forested riparian zones connecting larger patches of forest. They can also be non-forested linear patches, such as utility easements, or wetland and stream systems, in a landscape that is forested. In an urbanizing environment, open space or native forestland can act as corridors connecting otherwise disjunct habitat for wildlife species.

Corridors can provide (1) habitat for certain species; (2) movement pathways; (3) extensions of foraging ranges for large, wide-ranging species; and (4) escape from predators (Harris 1984, Levenson 1981, Noss 1987, Noss and Harris 1986, Simberloff and Cox 1987). Corridors may also have disadvantages, such as (1) providing conduits for disease, fire, pests, and exotic species; (2) increasing exposure to predation; and, (3) potentially having negative genetic impacts on a population (Noss 1987, Simberloff and Cox 1987).

The Edgewood East property is situated generally within a larger area of residential development. The forested habitat of the site (primarily along the stream corridor) is contiguous with similar forest stands that extend off site to the southeast, and for a short distance to the west, but are highly fragmented by existing development in the area. Because of the surrounding development, these habitats are relatively isolated from other native habitats within the City of Redmond and therefore do not provide linkages to other such habitats. This also is evident on the City of Redmond Map of Core Preservation Areas, none of which are located near the site. The site scored a total of 16 points on the City of Redmond Habitat Unit Assessment Form (attached in Appendix B).

4.0 REGULATORY CONSIDERATIONS

4.1 WETLANDS AND STREAMS

Wetlands and streams are protected by Section 404 of the Federal Clean Water Act and other state and local policies and ordinances including the City of Redmond (2014) code. Because no wetlands were found to occur within the property or immediate vicinity, no further discussion of wetland regulations is provided here.

The City of Redmond (2014) regulates streams as one type of "Fish and Wildlife Habitat Conservation Areas" (hereafter, FWHCA's) under Chapter 21.64 of its Zoning Code (RZC). The city classifies streams as Class I, II, III, or IV based on whether they are Shorelines of the State (Class I), and otherwise their potential as fish habitat, seasonality or persistence of flow, and whether they are headwaters. The City of Redmond (2014) determines stream buffer widths based on their classifications. Stream buffer widths are measured perpendicular from the stream Ordinary High Water Mark (OHWM) as surveyed in the field. Standard stream buffer widths may be modified by averaging or be increased, on a case by case basis by the City of Redmond.

Stream A on the project site is classified as a Class II stream because it considered accessible to salmonid fish, and is not listed as a Shoreline of the State. The Redmond (2014) code requires a standard buffer totaling 150 feet on Class II streams such as Stream A, consisting of a 100-foot inner buffer and a 50-foot outer buffer.

4.2 WILDLIFE

4.2.1 State of Washington

State law provides protections for wildlife species listed as endangered (WAC 232-12-014), as well as threatened, sensitive, or "other protected" species (WAC 232-232-011). Recently, bald eagles have been down-listed to "sensitive" at the State and de-listed at the federal level. However, in Washington, bald eagles are still protected by the Bald Eagle Protection Act of 1984 (RCW 77.12.655), and the Bald Eagle Protection Rules (WAC 232-12-292). The Bald Eagle Protection rules have been recently amended such that state bald eagle management plans are no longer required unless bald eagles are listed as Threatened or Endangered in Washington State.

The WDFW (2012) PHS and HRTG databases show no known nest or roost sites of eagles or other listed raptor species (such as hawks or owls) in the vicinity of the project site. In addition, we found no raptor nests or potentially suitable nest trees on the project site or in the vicinity.

In addition, the WDFW (2008) has developed management recommendations for "species of concern," which include state listed and other priority species, as well as priority habitats. Occurrences or signs of priority species or habitats in the vicinity of the project site are noted above. These management recommendations are often referenced in local critical area ordinances, such as the City of Redmond in protection of "Fish and Wildlife Habitat Conservation Areas," or FWHCA.

4.2.2 City of Redmond

Redmond (2014) regulates wildlife habitat as "Fish and Wildlife Habitat Conservation Areas" (hereafter, FWHCA's) under Chapter 21.64 of its Zoning Code (RZC). The Redmond Zoning Code generally identifies the following as FWHCA's: (1) federal endangered and threatened species, (2) state endangered, threatened, sensitive, and state candidate species, (3) WDFW priority habitats and species, (4) Habitats and Species of Local Importance, which in Redmond are identified as great blue herons, (5) natural ponds less than 20 acres in size, (6) waters of the state, (7) lakes, ponds, streams, and rivers planted with game fish, and (8) land essential for preserving connections between habitat blocks and open spaces.

As noted above, no federal or state endangered, threatened, or sensitive species were observed on site, nor are they considered to inhabit or have a primary association with the site. The only terrestrial priority species known to occur on site was the pileated woodpecker (a state candidate species), primarily from foraging excavations that appeared to be relatively old. No fresh sign was observed, and none of the snags found on site appeared to be large enough to provide suitable nesting habitat for this species. We found no evidence of use of the site by great blue herons, which are identified as a species of local importance by the City. No wetlands or ponds, occur within the site or immediate vicinity. Only Stream A, which is rated as a Class II Stream and considered accessible to salmonid fish (such as cutthroat trout), is located on site. Although the site is contiguous with forested habitat along the stream corridor that extends off site, this habitat becomes highly fragmented off site by surrounding suburban residential development.

5.0 IMPACTS

The following discussion of direct and indirect wetland impacts below is based on our review of revised site plans provided to us by Blue Line Group, LLC on October 20, 2014.

5.1 IMPACTS TO VEGETATION

Residential housing and an associated access road would be developed in the western portion of the property. The proposed development would remove approximately half of the forest habitat, as well as the open shrub area, on the site. The stream and associated forested riparian corridor encompassing an averaged buffer would be retained in the eastern portion of the property. Thus, no direct impact to the stream would occur as a result of the proposed development. In addition, the development would retain most of the existing snags on site. The proposed development would thus increase fragmentation of the remaining forest habitat and increase the amount of artificial edges with adjoining single-family residential areas.

5.2 IMPACTS TO WILDLIFE

Direct alteration (reduction) to the distribution, composition, and amount of native vegetation resulting from the proposed residential development would affect the distribution and composition of native wildlife on the property. In addition, indirect impacts to habitat retained on-site would make it less suitable for some species of wildlife currently inhabiting the site.

Upon completion, the proposed residential development would reduce the forest habitat available for native wildlife on the site. This would reduce the local populations of most native species on the property. Grading and construction activities associated with the proposed development, as well as increased levels of human activity on-site, would also result in increased short- and long-term disturbance to wildlife species using the retained habitat areas. This would further reduce the suitability of the on-site habitats to some wildlife species, particularly those vulnerable to predation by domestic cats and dogs (Penland 1984). Some species adapted to urban environments and fringes, including many non-native plant and animal species, would find suitable habitat on-site, and may become established and/or increase in numbers. Some species less adapted for urban environments, however, would be expected to decrease in numbers, and some wildlife species may be eliminated from the site entirely.

Impacts to Endangered, Threatened, Sensitive, or Other Priority Species or Habitats

Because endangered, threatened, and sensitive wildlife species are not known or likely to occur on or in the site or have a primary association with any impacted habitats, no impacts to these species are expected. The proposed subdivision would likely retain most snags on site, including those used by foraging pileated woodpeckers, a state candidate species. The proposed development is not expected to have a substantial adverse impact on pileated woodpeckers, however, as they do not appear to be foraging there currently, and none of the snags on site appear to be suitable for nesting or roosting. In addition, the Edgewood East property is small compared to the large home ranges (more than a square mile) typically occupied by pileated woodpeckers (Lewis and Azerrad 2004), and thus does not likely represent a significant portion

of the habitat areas used by pileated woodpeckers in the vicinity. No other terrestrial priority species, or species of local importance, are known or likely to inhabit the site. Thus, the proposed development would not adversely affect such species.

The proposed site plan would retain the Class II stream and buffers as native open space. The site contains no wetlands or other habitats designated as fish and wildlife conservation areas, so the proposed development would not affect such habitats. Consequently, no habitats or habitat features known or suspected to be used by other priority species or species of local importance would be affected by the proposed site plan.

5.3 IMPACTS TO THE STREAM CORRIDOR

The stream corridor and associated forested riparian corridor encompassing an averaged buffer would be retained in the eastern portion of the property. Thus, no direct impact to the stream would occur as a result of the proposed development.

The proposed site plan includes a minor amount of buffer averaging to the required stream buffers to accommodate lot clearing and grading (Figure 5). The proposed buffer encroachment totals 5,554 square feet along the northern portions of the stream corridor. As compensation, an additional 5,720 square feet of buffer would be provided along the southern portion of the corridor (Figure 5), for a net increase in buffer area of 166 square feet. This buffer averaging would retain the required 50-foot outer buffer. The 100-foot inner buffer would be reduced to a minimum of over 78 feet wide and in areas of buffer compensation range up to well over 100 feet wide.

In addition, a small portion of the outer buffer (less than 20%, totaling 8,035 square feet) would be cleared to accommodate lot grading and level spreaders to discharge roof runoff from selected lots (Figure 5). The area of temporary clearing is currently dominated by Himalayan and trailing blackberry, salmonberry, and reed canarygrass, along with a few small to medium deciduous trees (cottonwood and big-leaf maple) as overstory. The areas temporarily cleared to accommodate lot grading would be revegetated with a mixture of native plant species, including shrubs, trees, and ground cover, in order to stabilize soils and restore habitat for native wildlife.

The City of Redmond (2014) allows stream buffer averaging, subject to the following criteria:

> *Stream Buffer Width Averaging. The Administrator may allow the recommended stream buffer width to be reduced in accordance with best available science only if:*
>
> *a. The width reductions will not reduce stream or habitat functions, including those of non-fish habitat;*
>
> *b. The width reduction will not degrade the habitat, including habitat for salmonid fisheries;*
>
> *c. The proposal will provide additional habitat protection;*

d. The total area contained in the stream buffer area after averaging is no less than that which would be contained within the standard stream buffer area; and

e. The buffer width is not reduced to less than 25 percent of the standard stream buffer width or 25 feet, whichever is greater.

For Class II streams, buffer averaging may be applied to the inner buffer. The following provisions apply to the inner buffer:

f. The width of the inner buffer shall not be reduced below 75 percent of the required inner buffer width at any point;

g. Encroachment shall not occur into the buffer of an associated wetland;

h. The area of the inner buffer after averaging shall be equivalent to the area of the inner buffer prior to averaging;

i. There is a net improvement in overall buffer ecological functions; and

j. Averaging shall not preclude the opportunity for future recovery of structure and function.

For Class I and II streams, maximum clearing and grading within the outer 50-foot buffer is 35 percent of the outer buffer area. Nothing in this provision shall be construed to require remediation of existing situations where the current clearing and grading is in excess of 35 percent. No net effective impervious surface may be created within this area.

Specifically, the proposed buffer averaging plan meets the City of Redmond (2014) requirements listed above in the following ways:

a. The proposed averaging would not adversely affect stream functioning. The retained overall buffer would vary from a minimum of more than 122 feet to well over 150 feet. This would retain the riparian forest and shrub cover that provides potential recruitment of large woody debris, stream shading to maintain cool temperatures, and help maintain slope stability.
b. The proposed averaging will retain potential habitat for fish as under current conditions, and will retain an equal or greater amount of forested habitat compared with standard buffers.
c. The total area of stream buffer after averaging will exceed the area of standard buffers by 166 feet, and will be retained in a designated open space tract with covenants to protect it and restrict uses, thus providing protection not provided under current conditions as an abandoned site.
d. The total area within the averaged buffer exceeds the area contained in the standard buffer.
e. The minimum width of the overall buffer would be over 122 feet, or 82% of the overall standard buffer width of 150 feet.
f. The of the inner buffer would be at least 78 feet wide or 78% of the standard inner buffer of 100 feet.

g. No associated wetlands occur along the stream channel. Consequently, no buffer encroachments are proposed on any wetlands.
h. The area of the inner buffer after averaging would exceed the area of the standard inner buffer by 166 square feet.
i. With formal designation of the stream and associated buffers in an open space tract with covenants restricting allowed uses, we would expect an equivalent to incremental increase in ecological functioning, compared with standard buffers. The buffer compensation area consists of deciduous forest of comparable functioning as the encroachment area. Invasive species, including Himalayan blackberry and reed canarygrass, would be removed in areas temporarily cleared to accommodate lot grading, and these would be replaced with a mixture of native shrubs, trees, and ground cover.

The maximum clearing would be limited to less than 20% of the outer buffer, less than the allowed maximum of 35%. No effective impervious areas would be constructed within the outer 50-foot buffer.

6.0 MITIGATION

Mitigation has been defined by the State Environmental Policy Act (SEPA) (WAC 197-11-768; cf. Cooper 1987), and more recently in a Memorandum of Agreement between the Environmental Protection Agency and the U.S. Army Corps of Engineers (Anonymous 1989). In order of desirability, mitigation may include:

1. ***Avoidance*** - avoiding impacts by not taking action or parts of an action;

2. ***Minimization*** - minimizing impacts by limiting the degree or magnitude of the action and its implementation;

3. ***Compensation*** - which may involve:

    a) repairing, rehabilitating, or restoring the affected environment;

    b) replacing or creating substitute resources or environments;

    c) mitigation banking.

6.1 AVOIDANCE AND MINIMIZATION

Conversion of the Edgewood East property to a residential development would incorporate one or more mitigating measures that would avoid or reduce impacts to on-site habitat.

The proposed development plan for the Edgewood East property would establish an open space tract encompassing the Class II stream and associated forested riparian buffer (Figure 5). The proposed development plan incorporates a number of other design features that would avoid or minimize impacts to the retained areas and off-site habitats:

- Direct impacts to the on-site Class II stream would be avoided;
- The forested stream buffer would retain a substantial portion of the forested habitat on site; The limits of the buffer tract would be clearly marked with fencing and critical area signage per City of Redmond requirements;
- No residential structures, impervious surfaces, or trails would be located within the designated open space tract;
- The proposed development would route the majority of stormwater runoff to a detention vault to provide water quality treatment and discharge it at controlled rates via pipe down the slope to an energy dissipater near the stream course protect downstream resources;
- In addition, stormwater runoff from selected lots would be directed to separate level spreaders within the outer buffer to promote infiltration and limit potential for sediment transport from concentrated flows;

- Temporary erosion and sediment control (TESC) measures would be installed during construction and would utilize appropriate best management practices (BMPs) designed to prevent sediment deposition to on-site open space tracts and off-site areas;

6.2 COMPENSATORY MITIGATION

As outlined above, the proposed site plan includes buffer averaging on the Class II stream. The buffer averaging includes additional buffer area to compensate for proposed buffer encroachments. The buffer compensation is discussed more fully in Section 5 above (see Figure 5).

In addition, the areas of temporary buffer clearing within the outer buffer to accommodate lot grading would be revegetated with a mix of native trees, shrubs, and groundcovers that will restore buffer vegetation, provide habitat (cover and forage) for wildlife, and act to trap potential sediment and pollutants in surface water run-off from reaching the stream. The area of grading would remove invasive species currently growing in the forest, to be replaced with native plants. Prior to planting, a minimum of 12 inches of topsoil would be installed throughout the buffer enhancement area to provide favorable growing conditions for the tree and shrub plantings establishment and growth. Topsoils must be approved by the project biologist prior to installation. Soil amendments, such as compost that has been prior-approved by the project biologist, may be added to salvaged on-site soils in order to create favorable soil conditions for tree and shrub planting establishment and growth.

Plantings would consist of species well-adapted to site conditions and which would provide wildlife habitat value for foraging and cover. These may include western red cedar (*Thuja plicata*), big-leaf maple, salmon raspberry, vine maple, snowberry (*Symphoricarpos albus*), salal (*Gaultheria shallon*), Cascade Oregongrape (*Mahonia nervosa*), and sword fern. All plant materials would be locally grown and be of local origin. Tree stock would be two or five gallon container, 3- to 4-feet tall, and well-rooted and branched. Trees would be planted on 9-foot centers. Shrub stock would be one gallon, 18- to 24-inches tall, well-rooted and branched. Shrub plantings would be spaced on 5-foot centers.

Upon approval of this conceptual revegetation plan, a final planting plan and construction specifications would be prepared for review and approval by the City. The final planting plan would specify such items as: (1) plant species, quantities, and sizes, (2) planting locations, (3) general notes, (4) planting details, (5) construction timing, (6) protection of existing vegetation, (7) source of plant material, (8) soil amendments, (9) watering, and (10) maintenance. The final revegetation plans would include a systematic monitoring program to assess the success of the effort, as required by City of Redmond (2014) code. The monitoring program would include construction, compliance, and long-term monitoring. The duration of a long-term monitoring program would be established per City of Redmond requirements. Performance standards of success (for use in monitoring), as well as contingency plans as needed, would also be developed in coordination with the City.

7.0 LIMITATIONS

We have prepared this report for the exclusive use of Quadrant Homes and its consultants. No other person or agency may rely upon the information, analysis, or conclusions contained herein without permission from Quadrant Homes.

The determination of ecological system classifications, functions, values, and boundaries is an inexact science, and different individuals and agencies may reach different conclusions. With regard to wetlands, the final determination of their boundaries for regulatory purposes is the responsibility of the various agencies that regulate development activities in wetlands. We cannot guarantee the outcome of such determinations. Therefore, the conclusions of this report should be reviewed by the appropriate regulatory agencies.

We warrant that the work performed conforms to standards generally accepted in our field, and prepared substantially in accordance with then-current technical guidelines and criteria. The conclusions of this report represent the results of our analysis of the information provided by the project proponent and their consultants, together with information gathered in the course of the study. No other warranty, expressed or implied, is made.

8.0 LITERATURE CITED

Anonymous. 1989. Memorandum of Agreement between the U.S. Environmental Protection Agency and the Department of Army Concerning the Determination of Mitigation under the Clean Water Act, Section 404 B1 Guidelines. Effective 7 November 1989.

Azerrad, J.M., editor. 2004. Management recommendations for Washington's priority species, Volume V: mammals. Washington Department of Fish and Wildlife, Olympia, Washington.

Beam, Cathy. 2014. Personal telephone communication requesting background information on the project site. City of Redmond. July 15, 2014.

Beavers, Tom. 2014. Personal email communication by email regarding stream conditions in stream 0120. King County. July 22, 2014.

Brown, E.R. (tech. ed.). 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington. Publ. No. R6-F&WL--192-1985. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Portland. 332 pp.

Cooper, J.W. 1987. An overview of estuarine habitat mitigation projects in Washington State. Northwest Environmental Journal 3(1): 112-127.

Cowardin, L., F. Golet, V. Carter, and E. LaRoe. 1992. Classification of wetlands and deepwater habitats of the United States. U.S.D.I. Fish and Wildlife Service Publ. FWS/OBS-79/31. 103 pp.

Dane, Roger. 2014. Personal telephone communication requesting background information on the project site. City of Redmond. July 16, 2014.

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, US Army Engineers Waterways Experiment Station, Vicksburg, Mississippi. 100 pp.

Federal Register. 1986. 40 CFR Parts 320 through 330: Regulatory programs of the Corps of Engineers; final rule. Vol. 51. No. 219. pp. 41206-41260, U.S. Government Printing Office, Washington, D.C.

Federal Register. 1995. U.S. Department of Agriculture, Soil Conservation Service: Changes in Hydric Soils of the United States. Volume 59, No 133, July 13, 1994. Revised September 15, 1995.

Harris, L.D. 1984. The fragmented forest: island biogeographic theory and the preservation of biotic diversity. University of Chicago Press. Chicago, Illinois. 210 pp.

Hitchcock, C., and A. Cronquist. 1976. Flora of the Pacific Northwest. Univ. of Washington Press, Seattle, Washington. 730 pp.

Johnson, D.H., and T.A. O'Neil. 2001. Wildlife habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR. 736 pp.

Johnson, Thara. 2014 Personal telephone communication requesting background information on the project site. City of Redmond. July 17, 2014.

King County. 1987. Wildlife habitat profile. King County Open Space Program. Parks, Planning and Resources Development. Seattle, Washington. 111 pp.

King County. 1990. Proposed Bear Creek Basin Plan. Seattle, WA.

King County. 2014. iMAP GIS Interactive map center, King County, Washington. http://www.metrokc.gov/gis/iMAP_main.htm#. Accessed July 11, 2014.

Larsen, E.M., editor. 1997. Management recommendations for Washington's priority species, Volume III: amphibians and reptiles. Washington Department of Fish and Wildlife, Olympia, Washington. 122 pp.

Larsen, E.M., J.M. Azerrad, and N. Nordstrom, editors. 2004. Management recommendations for Washington's priority species, Volume IV: Birds. Washington Department of Fish and Wildlife, Olympia, Washington. 268 pp.

Leu, M., S.E. Hanser, and S.T. Knick. 2008. The human footprint in the West: a large-scale analysis of anthropogenic impacts. Ecological Applications 18:1119-1139.

Levenson, J.B. 1981. Woodlots as biogeographic islands in southeastern Wisconsin. In: Burgess, R.L., and D.M. Sharpe, eds. Forest island dynamics in man-dominated landscapes. New York, New York: Springer-Verlag.

Lewis, J.C., and J.M. Azerrad. 2004. Pileated woodpecker (*Dryocopus pileatus*). Pages 29-1 to 29-9 *in* E.M. Larsen, J.M. Azerrad, and N. Nordstrom, editors. Management Recommendations for Washington's Priority Species, Volume IV: Birds. Available at http://wdfw.wa.gov/publications/00026/wdfw00026.pdf

Lichvar, Robert W.and John T. Kartesz. 2009. North American Digital Flora: National Wetland Plant List, version 2.4.0 (https://wetland_plants.usace.army.mil). U.S. Army Corps of Engineers, Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH, and BONAP, Chapel Hill, NC.

Maestas, J.D., R.L. Knight, and W.C. Gilgert. 2003. Biodiversity across a rural land-use gradient. Conservation Biology 17:1425-1434.

Munsell Color. 2009. Munsell soil color charts. Munsell Color, Grand Rapids, MI.

Noss, R.F., and L.D. Harris. 1986. Nodes, networks, and MUMs: preserving diversity at all scales. Environmental Management 10:299-309.

Odell, E.A., and R.L. Knight. 2001. Songbird and medium-sized mammal communities associated with exurban development in Pitkin County, Colorado. Conservation Biology 15:1143-1150.

Penland, S. 1984. Avian response to a gradient of urbanization. PhD. Dissertation, University of Washington, Seattle, Washington. 407 pp.

Redmond, City of. 2012. Stream Classification map Redmond, WA.

Redmond, City of. 2013. City of Redmond, WA Citywide Watershed Management Plan. Prepared by Herrera Environmental Consultants. Redmond,WA.

Redmond, City of. 2014. Redmond Zoning Code, Chapter 21.64. Critical Areas Regulations. Current through Ordinance 2749, passed September 16, 2014.

Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: Northwest (Region 9). U.S.D.I. Fish and Wildlife Service. Biological Report 88 (26.9). 89 pp.

Rodrick, E.A. and R.L. Milner, editors. 1991. Management recommendations for Washington's priority habitats and species. Washington Department of Fish and Wildlife, Fish Management and Habitat Management Divisions. Olympia, Washington.

Simberloff, D., and J. Cox. 1987. Consequences and costs of conservation corridors. Conservation Biology 1:63-71.

Thomas, J.W., and J. Verner. 1986. Forests. Pages 73-91 *in* A. Cooperrider, R. Boyd, and H. Stuart, eds. Inventory and monitoring of wildlife habitat. U.S. Department of the Interior, Bureau of Land Management Service Center, Denver, Colorado.

U.S. Army Corps of Engineers. 1991a. Special notice. Subject: Use of the 1987 wetland delineation manual. U.S. Army Corps of Engineers, Seattle District. August 30, 1991.

U.S. Army Corps of Engineers. 1991b. Memorandum. Subject: Questions and answers on the 1987 manual. U.S. Army Corps of Engineers, Washington D.C. October 7, 1991. 7 pp. including cover letter by John P. Studt, Chief, Regulatory Branch.

U.S. Army Corps of Engineers. 1992. Memorandum. Subject: Clarification and interpretation of the 1987 methodology. U.S. Army Corps of Engineers, Washington D.C., March 26, 1992. 4 pp. Arthur E. Williams, Major General, U.S.A. Directorate of Civil Works.

U.S. Army Corps of Engineers. 1994. Public Notice. Subject: Washington regional guidance on the 1987 wetland delineation manual. May 23, 1994, Seattle District. 8 pp.

U.S. Army Corps of Engineers. 2010. Regional supplement to the Corps of Engineers wetland delineation manual: western mountains, valleys, and coast region (Version 2.0). Wakeley, J.S., R.W. Lichvar, and C.V. Noble, eds. May 2010. ERDC/EL TR-10-3. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

U.S. Army Corps of Engineers. 2012. Special Public Notice. Final Regional Conditions, 401 Water Quality Conditions, Coastal Zone Management Consistency Responses, for Nationwide Permits for the Seattle District Corps of Engineers for the State of Washington. U.S. Army Corps of Engineers, Seattle District. March 19, 2012.

U.S.D.A. Natural Resources Conservation Service. 2014. On-line Web Soil Survey. http://websoilsurvey.nrcs.usda.gov . Accessed June 23, 2014.

U.S.D.A. Soil Conservation Service. 1991. Hydric soils of the United States: In cooperation with the National Technical Committee for Hydric Soils. U.S.D.A. Miscellaneous Publication Number 1491.

Washington Department of Fish and Wildlife. 2008. Priority habitats and species list. August 2008. Olympia, Washington. 174 pp. http://wdfw.wa.gov/publications/pub.php?id=00165.

Washington Department of Fish and Wildlife. 2014a. PHS on the web. Available at: http://wdfw.wa.gov/mapping/phs/. Last accessed October 31, 2014.

Washington Department of Fish and Wildlife. 2014b. Salmonscape web site. http://apps.wdfw.wa.gov/salmonscape/map.html#. Accessed July 15, 2014.

Washington Department of Fisheries. 1975. A catalog of Washington streams and salmon utilization. Olympia, WA.

Washington State Department of Natural Resources. 2014. Forest Practices Application Review System Activity Map. http://wa.gov/dnr/app1/fpars/viewer.htm. Accessed July 15, 2014.

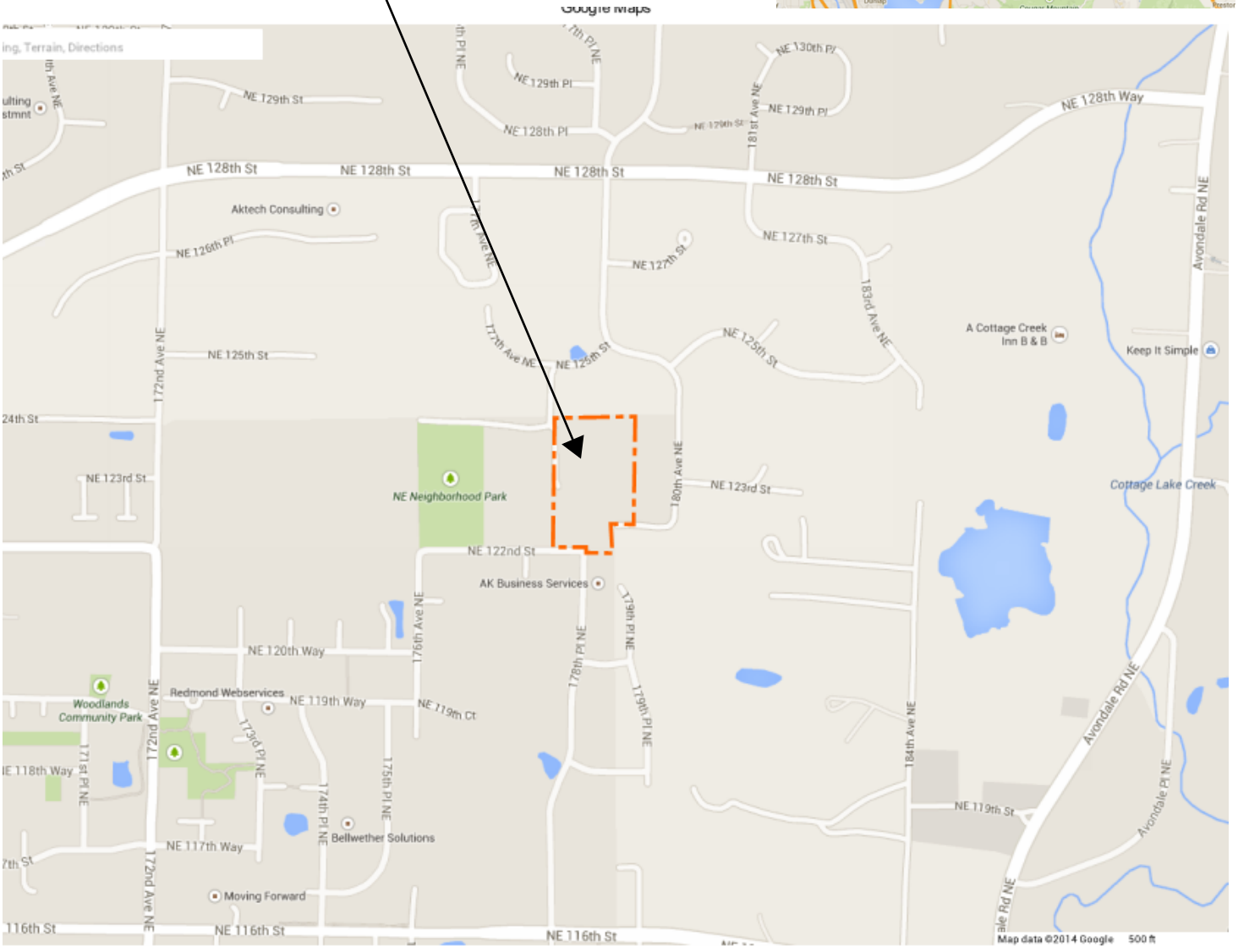
Washington Natural Heritage Program. 2014. Sections that contain Natural Heritage Features. Data current as of September 24, 2014. Washington Department of Natural Resources, Natural Heritage Program, Olympia, Washington. http://www.dnr.wa.gov/Publications/amp_nh_trs.pdf.

Zapata, Cameron. 2014. Personal telephone communication requesting previous critical areas reports on the project site. City of Redmond. July 22, 2014.

FIGURES

Attachment 21

EDGEWOOD EAST



Source: Google Maps. Available at https://www.google.com/maps. Accessed July 2, 2014.

N

FIGURE 1

REGIONAL & VICINITY MAP

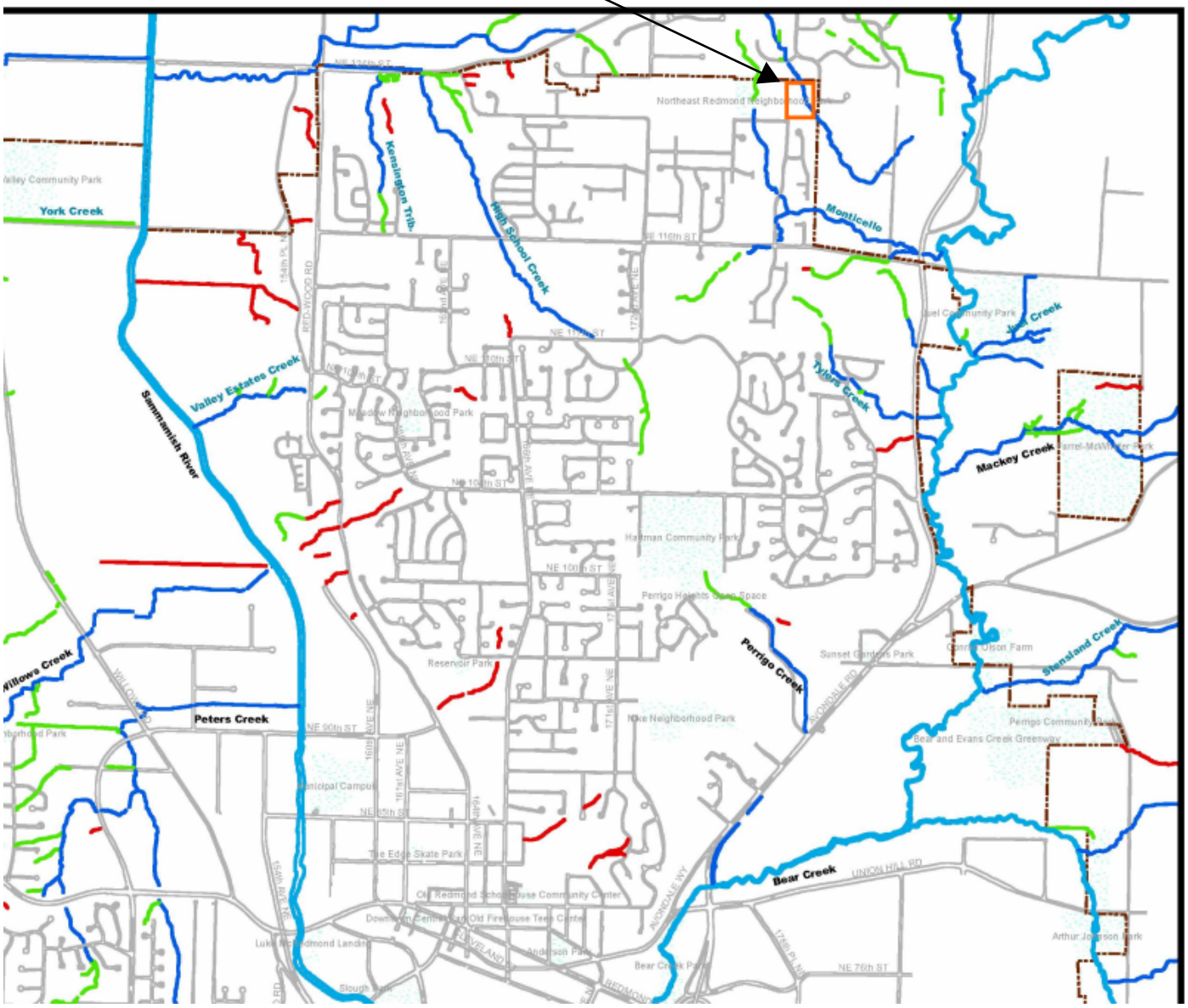
EDGEWOOD EAST PROPERTY

REDMOND, WA

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI # 2014-009

EDGEWOOD EAST



City of Redmond

Critical Areas Map
Effective: September 1, 2012

Map 64.3 Streams Classification

Legend:

- Class I
- Class II
- Class III
- Class IV

Stream Official USGS Stream Name
Stream Informal Stream Name

Sources:
City of Redmond Public Works, Natural Resources Division
City of Redmond GIS Services
Washington Trout / Wild Fish Conservancy
King County GIS

Note: This map shall be used as a general guide representing the approximate location of streams, per RZC 21.64.010(E)(2). The map does not necessarily ensure the presence or absence of streams. In the event of a conflict between the map and the criteria of the Critical Areas Ordinance (CAO), the criteria shall prevail. Consult the CAO (RZC 21.64) for reporting requirements

Note: Gaps in illustrated streams may indicate culverts, pipes, ponds, etc.

Note: Informal stream names may not conform to USGS policies and may change in the future.

N

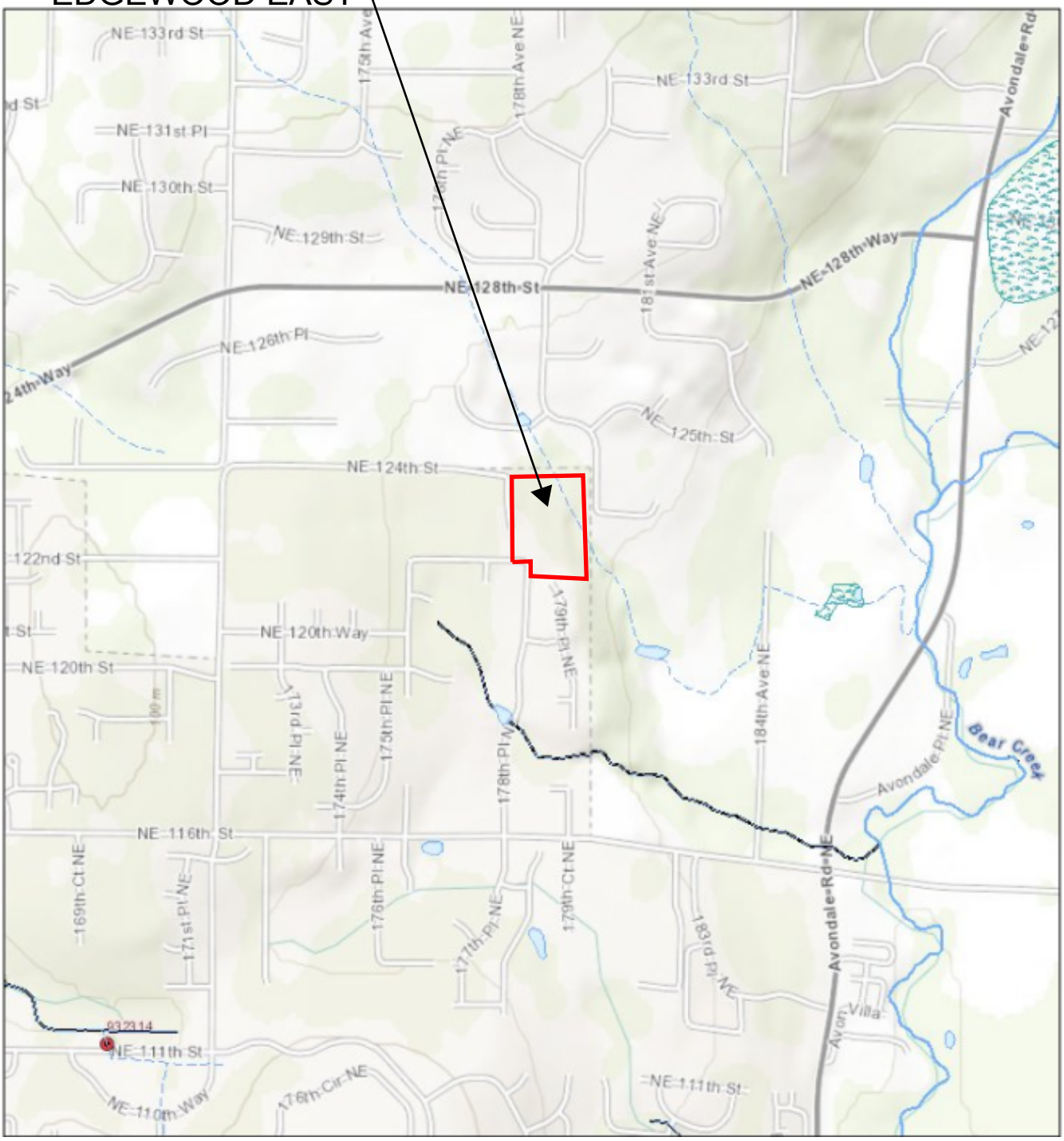
FIGURE 2
REDMOND STREAMS CLASSIFICATION
EDGEWOOD EAST PROPERTY
REDMOND, WA

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI # 2014-009

EDGEWOOD EAST

Attachment 21



July 16, 2014

- All SalmonScape Species
- Total Blockage
- Total Blockage, Fishway Present
- Partial Blockage
- Partial Blockage, Fishway Present
- Unknown Blockage
- Unknown Blockage, Fishway Present
- Total Blockage
- Total Blockage, Fishway Present
- Partial Blockage
- Partial Blockage, Fishway Present
- Unknown Blockage
- Unknown Blockage, Fishway Present

N

FIGURE 3

WDFW SALMONSCAPE

EDGEWOOD EAST PROPERTY

REDMOND, WA

Source: Washigton Department of Fish and Wildlife. Accessed at http://apps.wdfw.wa.gov/salmonscape/. Accessed on July 16, 2014

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI # 2014-009

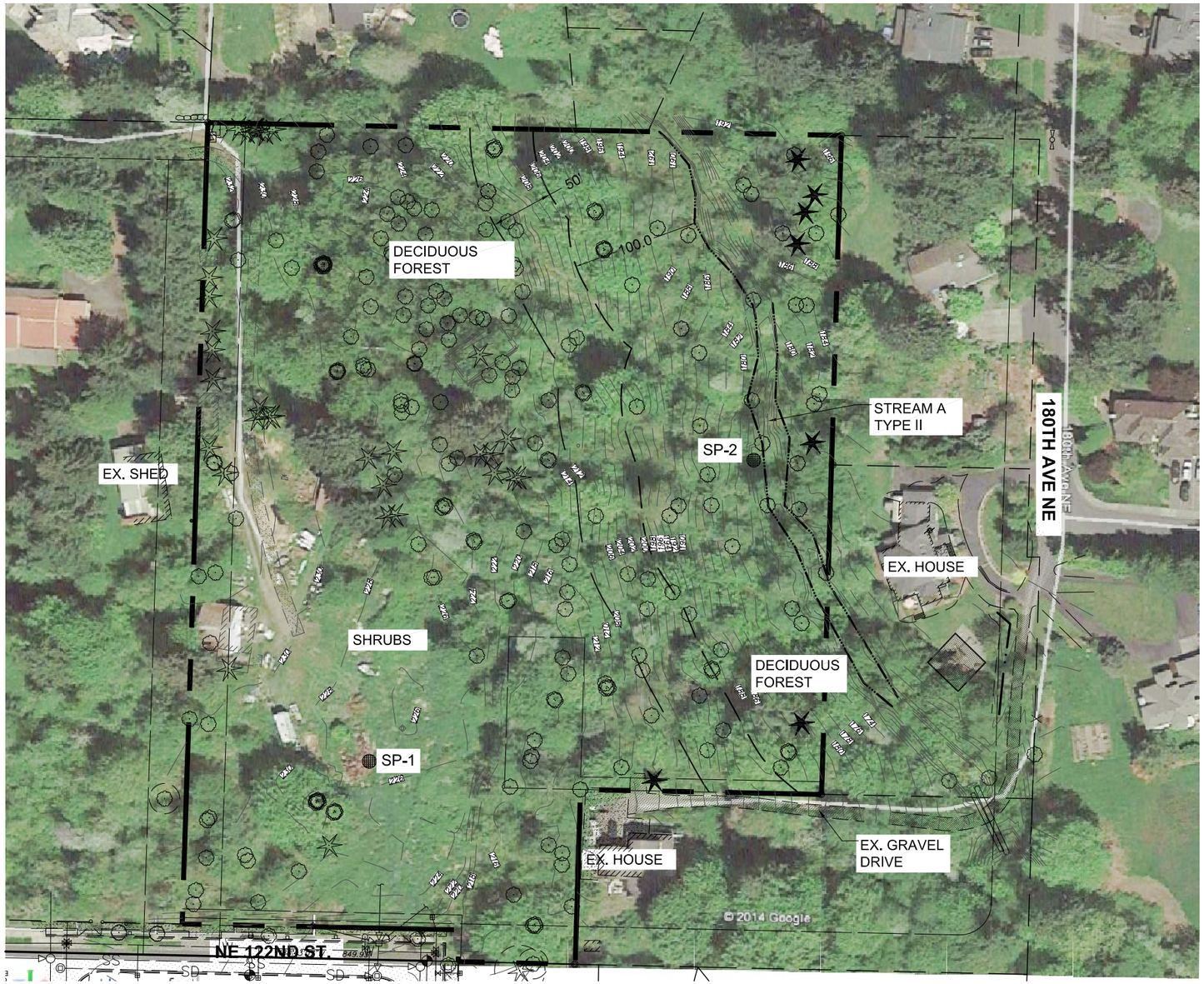
FIGURE 4

QUADRANT HOMES

EDGEWOOD EAST

CRITICAL AREAS ASSESSMENT

EXISTING CONDITIONS



LEGEND

- PROPERTY LINE
- EX. 2 FOOT CONTOURS
- ORDINARY HIGH WATER MARK (OHWM)
- STREAM INNER BUFFER
- STREAM OUTER BUFFER
- SP-# SAMPLE PLOT LOCATIONS
- EXISTING TREES

NORTH

0 50' 100' 200'

SCALE: 1" = 100'

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI PROJECT: 2014-009	
DATE: NOVEMBER 3, 2014	
DRAWN BY:AC	PM:CW

BASE INFORMATION: Survey & Site Plan
BLUELINE 25 Central Way, Suite 400
Kirkland, WA 98033 Ph: 425.216.4051

Attachment 21

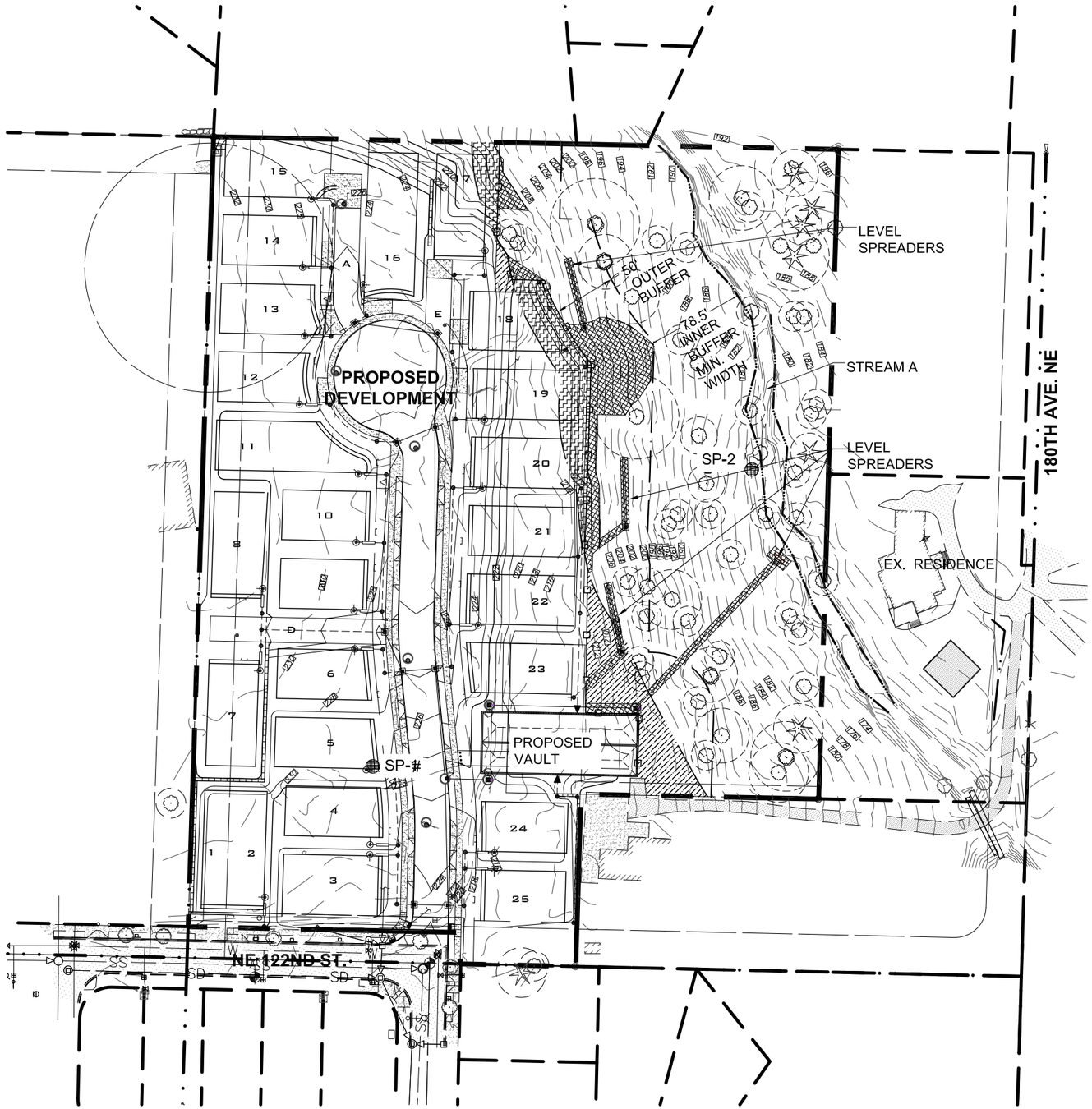
FIGURE 5

QUADRANT HOMES

EDGEWOOD EAST

CRITICAL AREAS ASSESSMENT

SITE PLAN



LEGEND

- PROJECT BOUNDARY
- ORDINARY HIGH WATER MARK (OHWM)
- EXISTING 2' CONTOURS
- PROPOSED CONTOURS
- STREAM OUTER BUFFER
- PROPOSED INNER BUFFER
- NGPA FENCE/ PROPOSED BUFFER LINE
- BUFFER ENCROACHMENT APPROX. 5,554 SF
- BUFFER ADDITION APPROX. 5,720 SF
- TEMPORARY BUFFER IMPACT APPROX. 8,035 SF

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI PROJECT: 2014-009	
DATE: NOVEMBER 3, 2014	
DRAWN BY:AC	PM:CW

BASE INFORMATION: SITE PLAN:
BLUELINE 25 Central Way, Suite 400
Kirkland, WA 98033 Ph: 425.216.4051

File: T:\2014\2014-009-Hussey\11x17 2014-009 Hussey.dwg

PHOTO PLATES

Photo 1. View of deeply incised channel in Stream A. February 4, 2014.

Photo 2. Less incised channel in Stream A as the stream passes through the site. February 4, 2014.

Photo Plate 1

Photo 3. Typical stream bed substrate and flow observed at southern end of project site. July 14, 2014.

Photo 4. Typical canopy coverage on the west bank riparian corridor of stream A. July 14, 2014.

Photo Plate 2

APPENDIX A:

Sample Plot Data Sheets

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Hussey Redmond City/County: Redmond/King County Sampling Date: 2/4/14

Applicant/Owner: Quadrant Homes State: WA Sampling Point: SP 1

Investigator(s): Chris Wright, Bryce Vanderkolk Section, Township, Range: S25, T26N, R5E

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): Concave Slope (%): <3%

Subregion (LRR): Northwest forest & coast (LRR-A) Lat: 47 42 34.66 N Long: 122 06 05.75 W Datum: Unknown

Soil Map Unit Name: Alderwood gravelly sand loam, 6 to 15 percent slopes. NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Sample plot 1 is located in the southwest portion of the site

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. Rubus armeniancus (Himalayan blackberry)	50	Y	FACU
2.			
3.			
4.			
5.			
	50 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Phalaris arundinacea (reed canarygrass)	50	Y	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	50 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 50	x 2 = 100
FAC species _____	x 3 = _____
FACU species 50	x 4 = 200
UPL species _____	x 5 = _____
Column Totals: 100 (A)	300 (B)

Prevalence Index = B/A = 3.0

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☒ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: Prevalence Index is 3.0, lack of hydric soil or hydrology indicates that plant community is not hydrophytic.

SOIL

Sampling Point: SP 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-14+	10YR 4/2	100					Sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: Soils at sample plot resemble the mapped Alderwood series.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No evidence of hydrology within 14 inches of ground surface

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Hussey Redmond City/County: Redmond/King County Sampling Date: 2/4/14

Applicant/Owner: Quadrant Homes State: WA Sampling Point: SP 2

Investigator(s): Chris Wright, Bryce Vanderkolk Section, Township, Range: S25, T26N, R5E

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): Concave Slope (%): 8%

Subregion (LRR): Northwest forest & coast (LRR-A) Lat: 47 42 34.66 N Long: 122 06 05.75 W Datum: Unknown

Soil Map Unit Name: Alderwood gravelly sand loam, 6 to 15 percent slopes. NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Sample plot 2 is located along west side of stream

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0	= Total Cover	
Sapling/Shrub Stratum (Plot size: ____)			
1. Rubus armeniancus (Himalayan blackberry)	30	Y	FACU
2. Rubus spectabilis (salmon rasberry)	20	Y	FAC
3. Acer circinatum (vine maple)	20	Y	FAC
4.			
5.			
	70	= Total Cover	
Herb Stratum (Plot size: _____)			
1. Polystichum munitum (sword fern)	30	Y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	30	= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species 40	x 3 = 120
FACU species 60	x 4 = 240
UPL species _____	x 5 = _____
Column Totals: 100 (A)	360 (B)

Prevalence Index = B/A = 3.6

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks:

SOIL

Sampling Point: SP 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16+	10YR 4/2 & 4/3	100					Sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: Soils at sample plot resemble the mapped Alderwood series.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No evidence of hydrology within 16 inches of ground surface

APPENDIX B:

Stream Summary Sheet and Habitat Assessment Form

STREAM SUMMARY SHEET

Stream Summary			Buffer Summary			Riparian Corridor Summary		
Label[1]	Type[2]	Linear Feet[3]	Required[4]	Proposed[5]	Averaging[6]	Disturbed Area[7]	Filled Area[8]	Mitigation Area[9]
A	II	425	150	varies 125 to 205	83,914 standard	8,035	5,554	5,720
					84,080 averaged			

[1] Stream A, B, C, etc.
[2] Stream type per City stream classification system.
[3] Length of stream on the property.
[4] Required buffer width in feet per RCDG.
[5] Proposed buffer width in feet.
[6] Note if buffer averaging is used. If so, identify minimum and maximum buffer widths in feet as well as area in square feet contained within the buffer prior to and after averaging.
[7] Area of buffer that is disturbed in square feet.
[8] Area of buffer to be filled in square feet, such as for a road crossing.
[9] Location and size in square feet of riparian corridor mitigation.

Attachment 21

CITY OF REDMOND
HABITAT UNIT ASSESSMENT FORM

HABITAT UNIT: Edgewood East Short Plat
LOCATION: Section 25, T26N, R5E, W.M.
TOTAL SCORE: 16

Habitat Parameter	Scoring Criteria	Habitat Unit Score
Size	• >50 acres = 3 points • 10-50 acres = 2 points • 0-10 acres = 1 point	1
Vegetation Community Types	≥ 4 types = 3 points • 2-3 types = 2 points • 1 type = 1 point • None = 0 points	2
Community Interspersion	• High = 3 points • Medium = 2 points • Low = 1 point • None = 0 points	1
Priority Species Presence	• Threatened & Endangered Species = 3 points • Candidate Species = 2 points • Monitor Species = 1 point • None = 0 points	2
Priority Species Habitat Use	• Breeding = 3 points • Roosting = 2 points • Foraging = 1 point • None = 0 points	1
Habitat Continuity	• Links protected habitats = 3 points • Links unprotected habitats = 2 points • Extends habitat corridor = 1 point • None = 0 points	3
Forest Vegetation Layers	• 3 layers = 3 points • 2 layers = 2 points • 1 layers = 1 point • None = 0 points	3
Forest Age	• Mature = 3 points • Pole = 2 points • Seedling/Shrub = 1 point • None = 0 points	2
Invasive Species Presence	• 0-25% = 3 points • 26-50% = 2 points • 51-75% = 1 point • 75-100% = 0 points	1

CITY OF REDMOND
HABITAT UNIT ASSESSMENT FORM

VEGETATION COMMUNITY TYPES:

Deciduous forest, open shrub

INVASIVE PLANTS:

Himalayan and cutleaf blackberry, reed canarygrass

HABITAT FEATURES (snags, perches, downed logs, etc):

Few small snags (less than 10 inches dbh). Downed logs widely scattered, mostly less than 10 inches diameter, with one 15 inches diameter noted over stream channel.

WILDLIFE OBSERVATIONS (direct or indirect):

Foraging excavations by pileated woodpecker in one snag. Otherwise, a few species of breeding and resident small birds typical of lowland forests were observed. Deer were observed within the riparian corridor. No reptiles or amphibians were observed.

THREATS TO HABITAT INTEGRITY:

Invasive species, particularly Himalayan blackberry and reed canarygrass.
Human and domestic pet activity from surrounding residences.

OTHER NOTES:

Section 7 Other Permits

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

Section 8 Temporary Erosion and Sedimentation Control

The temporary erosion and sedimentation control plan was designed to reduce the discharge of sediment-laden runoff from the site. The plan is comprised of temporary measures (construction entrance, filter fence, straw mulch, catch basin inserts, sediment pond, etc.) as well as permanent measures (hydroseeding and landscaping).

The surface area of the sediment pond is determined by calculating the runoff rate of the 2-year, 24-hour developed storm event (1.04 cfs). The developed area and resulting WWHM2012 flow rate are shown at the end of this section.

Sediment Pond

$$\text{Surface Area} = \frac{2 \times Q_{10}}{V_{sed}}$$

where: Q_2 = design inflow for the developed site (1.04 cfs)

V_{sed} = settling velocity of the design soil particle (0.00096 ft/sec)

$$\text{Surface Area} = \frac{2(1.04)}{0.00096} = 2{,}173 \text{ ft}^2$$

The required surface area for sediment pond is 2,173 ft^2. The detention vault will be utilized as the sediment pond; the actual surface area provided within the water quality portion of the vault will be 5,640 ft^2 (both of the vault's two cells: 120' x 47'). Please see the Grading & TESC Plan for further details.

Dewatering Orifice

$$A_o = \frac{A_s (2h)^{0.5}}{0.6 \times 3600 T g^{0.5}}$$

where: A_o = orifice area (sf)

A_s = vault/sediment pond surface area (sf) → 5,640 sf provided

h = head of water above orifice (height of riser in feet) → 2.0

T = dewatering time (24 hours)

g = acceleration due to gravity (32.2 ft/sec)

$$A_o = \frac{5{,}640(2 \times 2.0)^{0.5}}{0.6 \times 3600 \times 24 \times 32.2^{0.5}} = 0.0383 \text{ sf}$$

$$D = 24\sqrt{\frac{A_o}{\pi}}$$

where: D = orifice diameter (inches)

A_o = orifice area (sf)

$$D = 24\sqrt{\frac{0.0383}{\pi}} = 2.65 \text{ in} \rightarrow \textbf{Use 2.67-inch diameter dewatering orifice}$$

Temporary Swale

The temporary swales are designed according to the City of Redmond Standard Detail 504 and not to exceed a flow velocity of 4.0 fps. To be conservative, the 10-year developed flow rate (1.58 cfs, 15-minute time steps) is used when modeling the flow velocity. This is a conservative assumption since the total site flow will divided amongst all temporary swales and different entry points to the detention vault (temporary sediment pond). The following variables were used in Manning's equations for ditch flow to determine the flow velocity.

Q_{10} = 1.58

n = 0.025 (earth lined ditch)

bottom width = 4 feet

side slope = 2 (X:1)

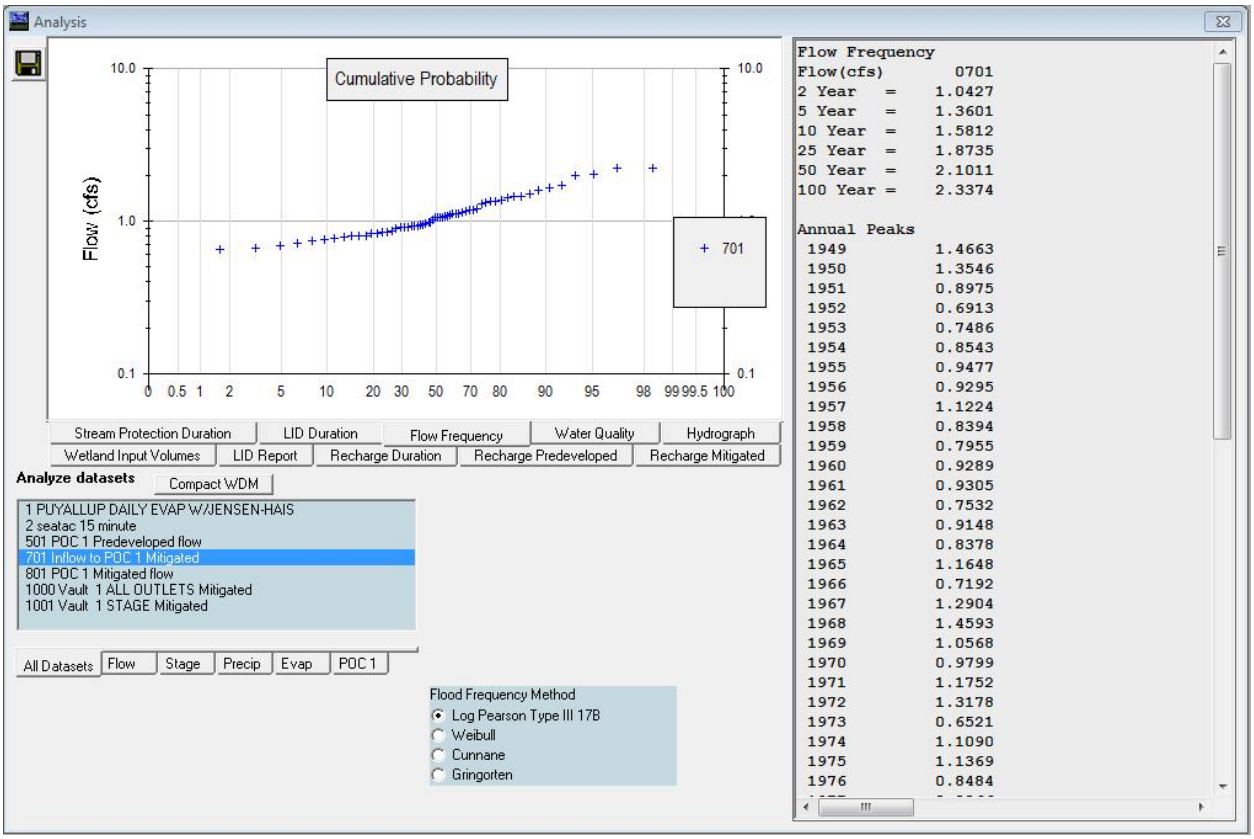
slope = 4%

flow depth = 0.25 feet

Using the above parameters, the resulting flow velocity is 3.88 ft/s. The flow velocity will remain under 4.0 feet per second as long as the longitudinal slope of the swale is less than 4.0%.

WWHM2012 Developed Flow Rates (unmitigated):

The unmitigated inflow to the vault used for pond area and dewatering orifice calculation is shown in the following WWHM screen shot.



Section 9 Operation and Maintenance

Maintenance standards from the 2005 DOE Manual for stormwater features of the proposed Edgewood East project are provided on the following pages within this section.

No. 3 – Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See “Catch Basins” (No. 5)	See “Catch Basins” (No. 5).	See “Catch Basins” (No. 5).

No. 4 – Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See “Closed Detention Systems” (No. 3).	See “Closed Detention Systems” (No. 3).	See “Closed Detention Systems” (No. 3).
Catch Basin	See “Catch Basins” (No. 5).	See “Catch Basins” (No. 5).	See “Catch Basins” (No. 5).

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

No. 7 – Energy Dissipaters

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 12 – Wetvaults

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
	Sediment Accumulation in Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	Remove sediment from vault.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Pipe repaired or replaced to proper working specifications.
	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Baffles repaired or replaced to specifications.
	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.

No. 18 – Catchbasin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Normal Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.