ATTACHMENT O

PRELIMINARY
STORM DRAINAGE REPORT

FOR

PENNY LANE II
REDMOND, WASHINGTON

11/19/2019

Prepared By:	Gina R. Brooks, P.E.
Date:	May 1, 2019
Revised:	August 29, 2019, November 19, 2019
Core No.:	17051

CORE DESIGN
12100 NE 195th Street, Suite 300
Bothell, Washington 98011
Ph 425.885.7877
www.coredesigninc.com

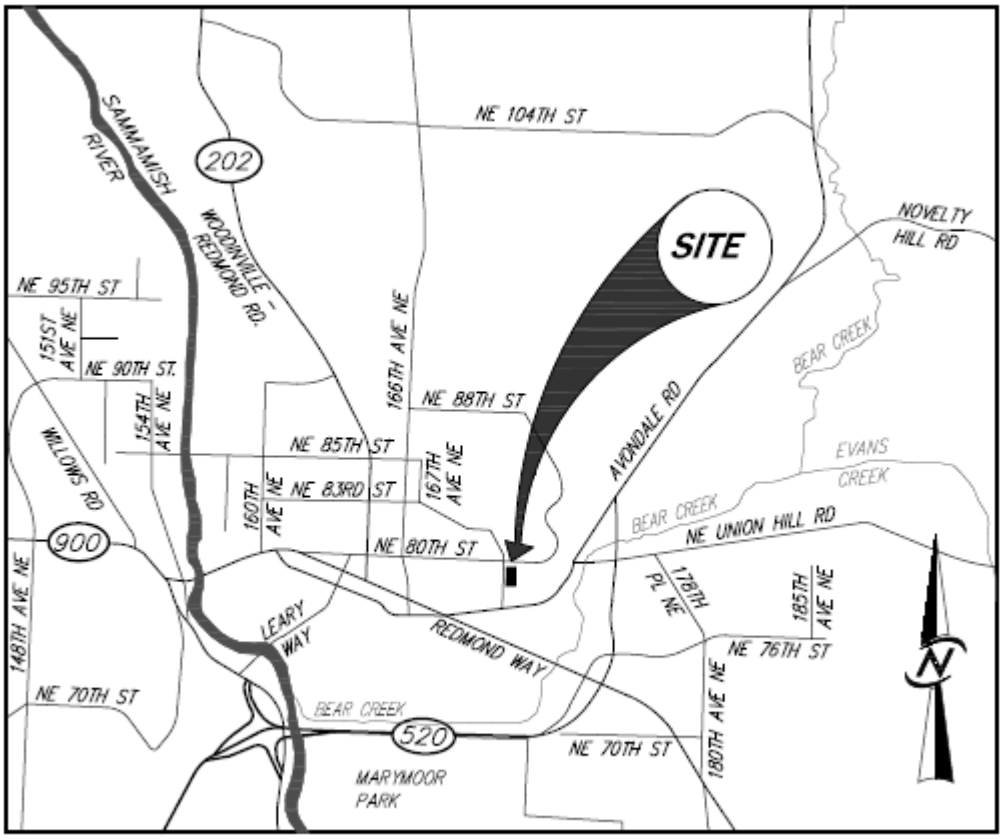
Penny Lane II

Table of Contents

SECTION 1. PROJECT OVERVIEW 1-1
SECTION 2. EXISTING CONDITIONS AND REQUIREMENTS SUMMARY 2-1
A. Existing Conditions 2-1
B. Requirements 2-5
SECTION 3. OFFSITE ANALYSIS REPORT 3-1
A. Upstream 3-1
B. Downstream 3-1
C. Sensitive Areas Research 3-3
SECTION 4. PERMANENT STORMWATER CONTROL PLAN 4-1
A. Performance Standards and Goals 4-1
B. Developed Conditions 4-1
C. Full Infiltration Design 4-3
D. Conveyance System Analysis and Design 4-10
E. Downtown Sub-Basin Stormwater Capital Facilities Charge Calculation 4-10
SECTION 5. CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN 5-1
SECTION 6. OTHER PERMITS 6-1
SECTION 7. OPERATIONS AND MAINTENANCE MANUAL 7-1
SECTION 8. BOND QUANTITIES WORKSHEET 8-1
SECTION 9. LID SITE ASSESSMENT 9-1
SECTION 10. SPECIAL REPORT AND STUDIES 10-1

SECTION 1. PROJECT OVERVIEW

Penny Lane II is a proposed 14 unit townhome project located at 7960, 7970, and 7980 - 170th Avenue NE in Redmond, Washington. See the Vicinity Map below. The site consists of three parcels (779290-0125, 779290-0130, 779290-0140) which in total have an approximate gross area of 0.56 acre. Adjacent land uses include multifamily and single family.



SITE VICINITY MAP

Each underlying parcel contains one single family residence. The majority of the site is relatively flat with the steepest slope being 3%. Ground cover consists of impervious surfaces associates with the existing residences along with vegetation including ornamental trees, shrubs, and lawn. The subject site is partially located within a Seismic Hazard Area. The site is also located within Wellhead Protection Zone 1. Site soils are Everett very gravelly sandy loam (EvB). See Existing Conditions exhibit and Soils Map in Section 2 of this Report.

Existing drainage pattern from the site is sheetflow to 170th Avenue NE and 170th Court NE. Drainage is then captured within the street's tight-lined conveyance systems and conveyed south. Drainage ultimately discharges into the City's Downtown regional facility.

Upstream drainage is received from the existing pavement within the existing surrounding roads upon installation of the frontage improvements. This upstream drainage will be collected and routed to the existing downstream conveyance systems.

The project proposal is for the construction of 14 townhome units within a single building. Frontage improvements will also be completed as part of the development.

The subject project is located within the Downtown Regional Facility Surcharge Area and will be contributing to the regional improvements through payment via the Downtown Sub-basin Stormwater Capital Facilities Charge. In the Downtown Surcharge Area, the City has constructed or is constructing stormwater trunk lines that convey 50-year flows to the Sammamish River. Regional runoff treatment facilities have been built or will be built downstream as well.

The subject project is exempt from Flow Control as the project drains to the Sammamish River via manmade conveyance. Roof drainage though, will be infiltrated to take advantage of the 80 percent credit towards the Downtown Sub-basin Stormwater Capital Facilities Charge. The subject project is not required to install a runoff treatment facility as treatment is provided via the regional facility.

The proposed infiltration facilities will be designed per the Washington State Department of Ecology's Stormwater Management Manual for Western Washington, 2014 (2014 DOE Manual) and the City of Redmond 2019 Technical Notebook Issue 8 (City Technical Notebook).

SECTION 2. EXISTING CONDITIONS AND REQUIREMENTS SUMMARY

A. Existing Conditions

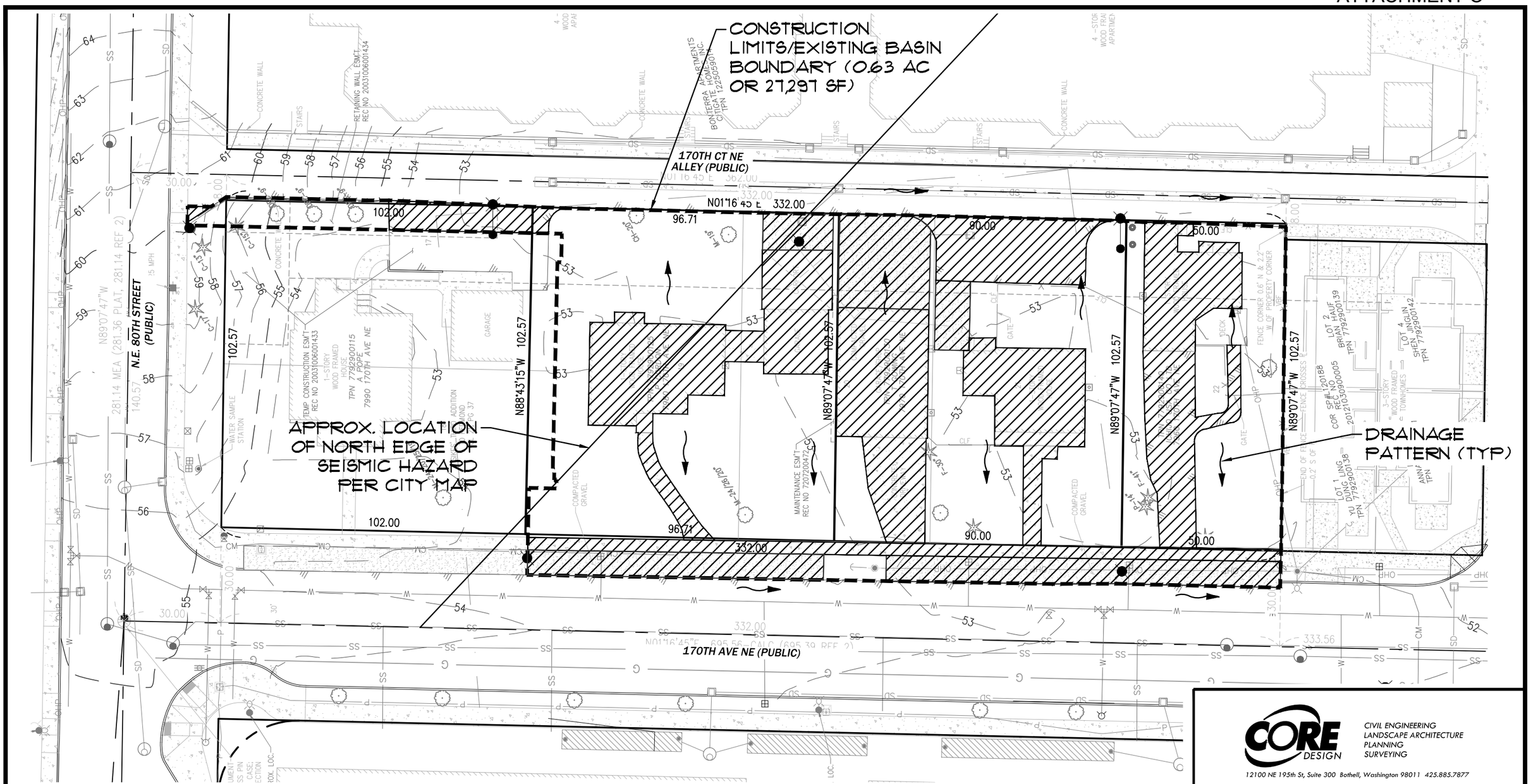
The site consists of three parcels (779290-0125, 779290-0130, 779290-0140) which in total have an approximate gross area of 0.56 acre. Each underlying parcel contains one single family residence. The majority of the site is relatively flat with the steepest slope being 3%. Ground cover consists of impervious surfaces associates with the existing residences along with vegetation including ornamental trees, shrubs, and lawn. The subject site is partially located within a Seismic Hazard Area. The site is also located within CARA 1. Site soils are Everett very gravelly sandy loam (EvB). See Existing Conditions exhibit and Soils Map on the following pages.

Existing drainage pattern from the site is sheetflow to 170th Avenue NE and 170th Court NE. Drainage is then captured within the street's tight-lined conveyance systems and conveyed south. Drainage ultimately discharges into the City's regional facility.

Upstream drainage is received from the existing pavement within the existing surrounding roads upon installation of the frontage improvements. This upstream drainage will be collected and routed to the existing downstream conveyance systems.

The Existing Basin Boundary or Limits of Construction is 0.63 acre (27,297 square feet). The subject site is currently covered with 0.29 acre (12,693 square feet) of impervious surfaces consisting of roofs, pavement, concrete, and compacted gravel.

ATTACHMENT O



EXISTING IMPERVIOUS AREA (0.29 AC OR 12,693 SF)

TOPOGRAPHY: FLAT (≤5%)

SCALE: 1" = 30'

0 7.5 15 30

CORE DESIGN

CIVIL ENGINEERING
LANDSCAPE ARCHITECTURE
PLANNING
SURVEYING

12100 NE 195th St, Suite 300 Bothell, Washington 98011 425.885.7877

EXISTING CONDITIONS

PENNY LANE II

DATE	FEB 2019	SHEET	OF
DESIGNED	GRB		
DRAWN	DSV	PROJECT NUMBER 17051	

J:\2017\17051\Engineering\Exhibits\17051 PL2 EX. CONDITIONS EXHIBIT.dwg, SITE PLAN, 4/30/2019 2:15:41 PM, DSV, DWG To PDF.pc3, 1:1

Custom Soil Resource Report
Soil Map
170th Ave Ne
EvB
Soil Map may not be valid at this scale.
Map Scale: 1:420 if printed on A portrait (8.5" x 11") sheet.
Meters
Feet
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

TABLE 3.2.2.B EQUIVALENCE BETWEEN SCS SOIL TYPES AND KCRTS SOIL TYPES

SCS Soil Type	SCS Hydrologic Soil Group	KCRTS Soil Group	Notes
Alderwood (AgB, AgC, AgD)	C	Till	
Arents, Alderwood Material (AmB, AmC)	C	Till	
Arents, Everett Material (An)	B	Outwash	1
Beausite (BeC, BeD, BeF)	C	Till	2
Bellingham (Bh)	D	Till	3
Briscot (Br)	D	Till	3
Buckley (Bu)	D	Till	4
Earlmont (Ea)	D	Till	3
Edgewick (Ed)	C	Till	3
Everett (EvB, EvC, EvD, EwC)	A/B	Outwash	1
Indianola (InC, InA, InD)	A	Outwash	1
Kitsap (KpB, KpC, KpD)	C	Till	
Klaus (KsC)	C	Outwash	1
Neilton (NeC)	A	Outwash	1
Newberg (Ng)	B	Till	3
Nooksack (Nk)	C	Till	3
Norma (No)	D	Till	3
Orcas (Or)	D	Wetland	
Oridia (Os)	D	Till	3
Ovall (OvC, OvD, OvF)	C	Till	2
Pilchuck (Pc)	C	Till	3
Puget (Pu)	D	Till	3
Puyallup (Py)	B	Till	3
Ragnar (RaC, RaD, RaC, RaE)	B	Outwash	1
Renton (Re)	D	Till	3
Salal (Sa)	C	Till	3
Sammamish (Sh)	D	Till	3
Seattle (Sk)	D	Wetland	
Shalcar (Sm)	D	Till	3
Si (Sn)	C	Till	3
Snohomish (So, Sr)	D	Till	3
Sultan (Su)	C	Till	3
Tukwila (Tu)	D	Till	3
Woodinville (Wo)	D	Till	3

Notes:

1. Where outwash soils are saturated or underlain at shallow depth (<5 feet) by glacial till, they should be treated as till soils.
2. These are bedrock soils, but calibration of HSPF by King County DNRP shows bedrock soils to have similar hydrologic response to till soils.
3. These are alluvial soils, some of which are underlain by glacial till or have a seasonally high water table. In the absence of detailed study, these soils should be treated as till soils.
4. Buckley soils are formed on the low-permeability Osceola mudflow. Hydrologic response is assumed to be similar to that of till soils.

B. Requirements

The proposed project is classified as a "Large Project" per Chapter 3 of the City Technical Notebook. Therefore, minimum requirements #1 - #9 will be addressed per Section 6.2 and as detailed in Chapter 2 of the City Technical Notebook. The 9 minimum requirements and how each requirement is addressed are listed on the following pages.

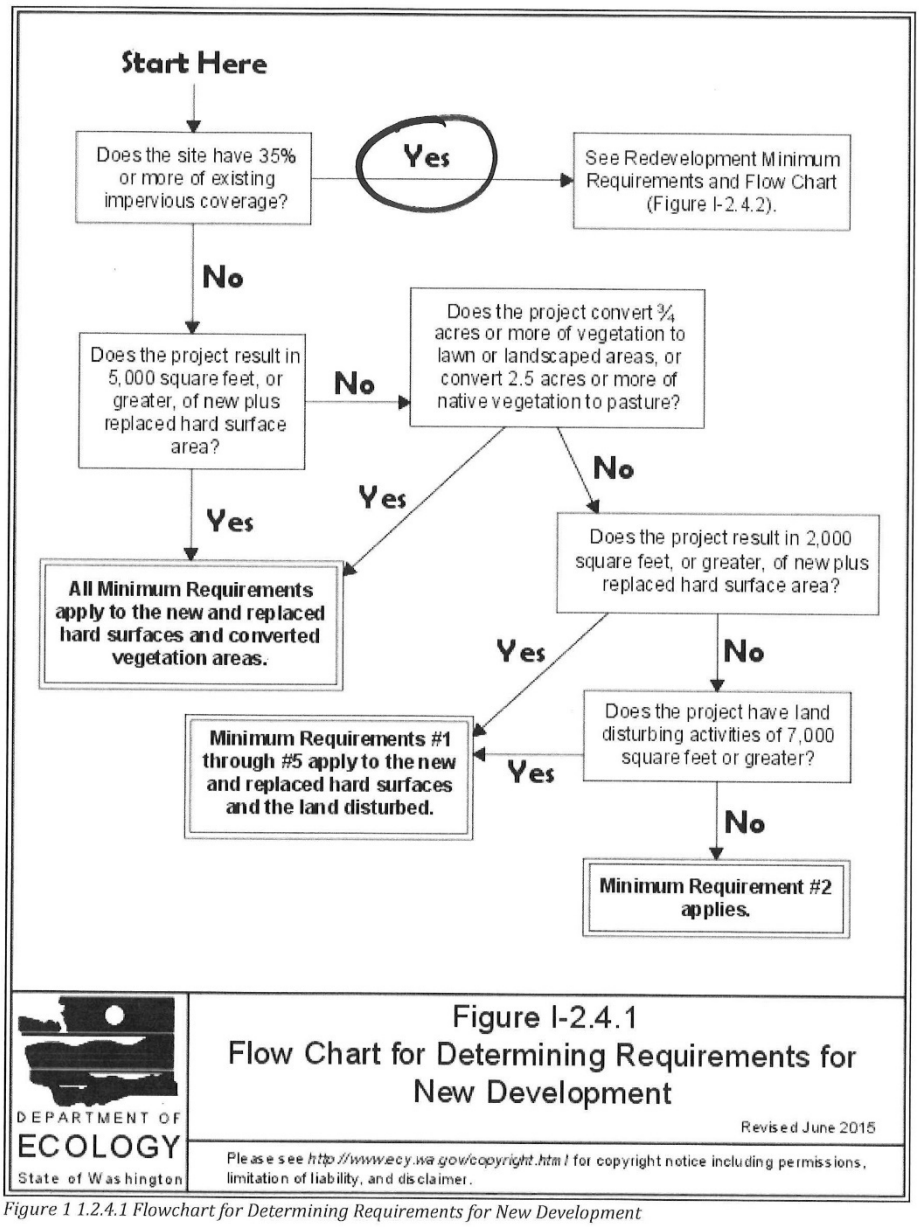


Figure 1 1.2.4.1 Flowchart for Determining Requirements for New Development

8

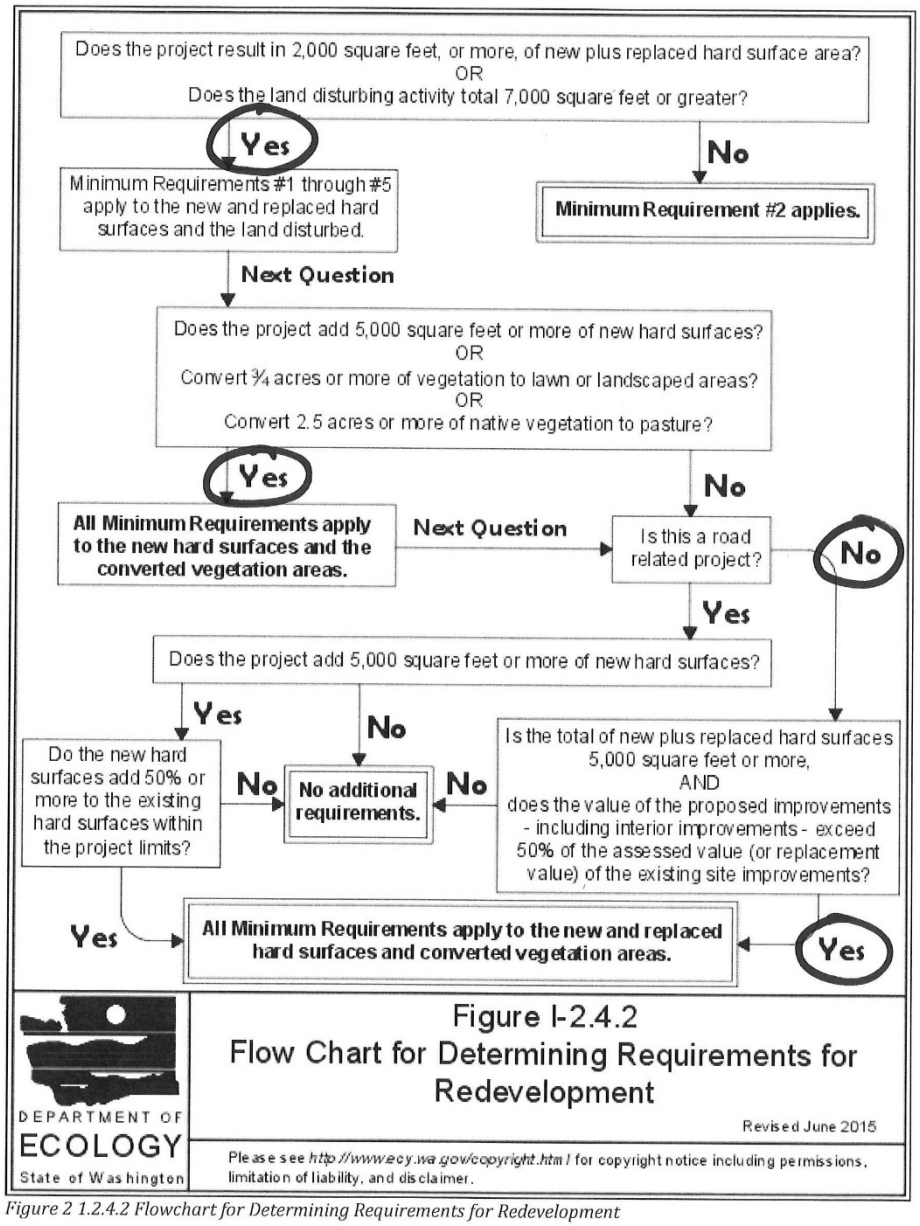


Figure 2 1.2.4.2 Flowchart for Determining Requirements for Redevelopment

Minimum Requirement #1: Preparation of Stormwater Site Plans: Preliminary Civil Plans under separate cover and Preliminary Storm Drainage Report herein have been prepared for the subject project.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPPP): This minimum requirement will be addressed during final engineering design.

Minimum Requirement #3: Source Control Pollution: The subject single-family development does not fall under the category of urban stormwater pollutant sources as defined at the beginning of Chapter 2 of Volume IV within the 2014 DOE Manual therefore, no source control is required for the developed site. Minimum Requirement #2 addresses BMPs for construction sites.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: Developed drainage will either be routed to the natural discharge location and/or infiltrated.

The City's Draft Downtown Basin map indicates areas of inadequate pipe capacity. See copy of map on the following pages. Upon review of this map, inadequate pipe capacity is identified along the downstream route along 170th Place NE south of Avondale Way. Since the subject project will be infiltrating all the roof area generated from the proposed building's roof and the resultant impervious coverage tributary to the conveyance system is less than what was existing, the subject development will be helping to alleviate the current capacity conditions. Per the City Technical Notebook, page 23, Section 2.5.4, if the downstream analysis required in Section 2.6 identifies conveyance deficiencies that may be caused or exacerbated by the proposed project, then offsite improvements may be required to avoid significant adverse impact to down gradient properties. Since the subject project is not causing or exacerbating the existing condition and in fact, is helping alleviate some of the deficiencies with the development itself, offsite improvements are not required.

It is not clear if the City's Downtown Stormwater Infrastructure map located within Appendix P of the 2019 Redmond Technical Notebook replaces the City's Draft Downtown Basin Map as described above. The downstream system is tributary to one of the City's direct discharge pipes (50-year capacity storm trunk) which begins at the intersection of Avondale Way NE and 170th Place NE. See Downtown Stormwater Infrastructure map attached on the following pages. Per Section 8.8.1 within the City Technical Notebook, "The City's Downtown Facility Map, shown in Appendix P, identified pies that have been confirmed by City modeling to provide direct discharge". Based on this statement, it is assumed the deficiencies noted per the City's Draft Downtown Basin map are no longer applicable.

ATTACHMENT O

Project Site

Legend

- Catch Basins
- Inadequate Pipe Capacity
- Adequate Pipe Capacity
- Pipes Not Studied
- Surcharge Area

N

CityofRedmond WASHINGTON

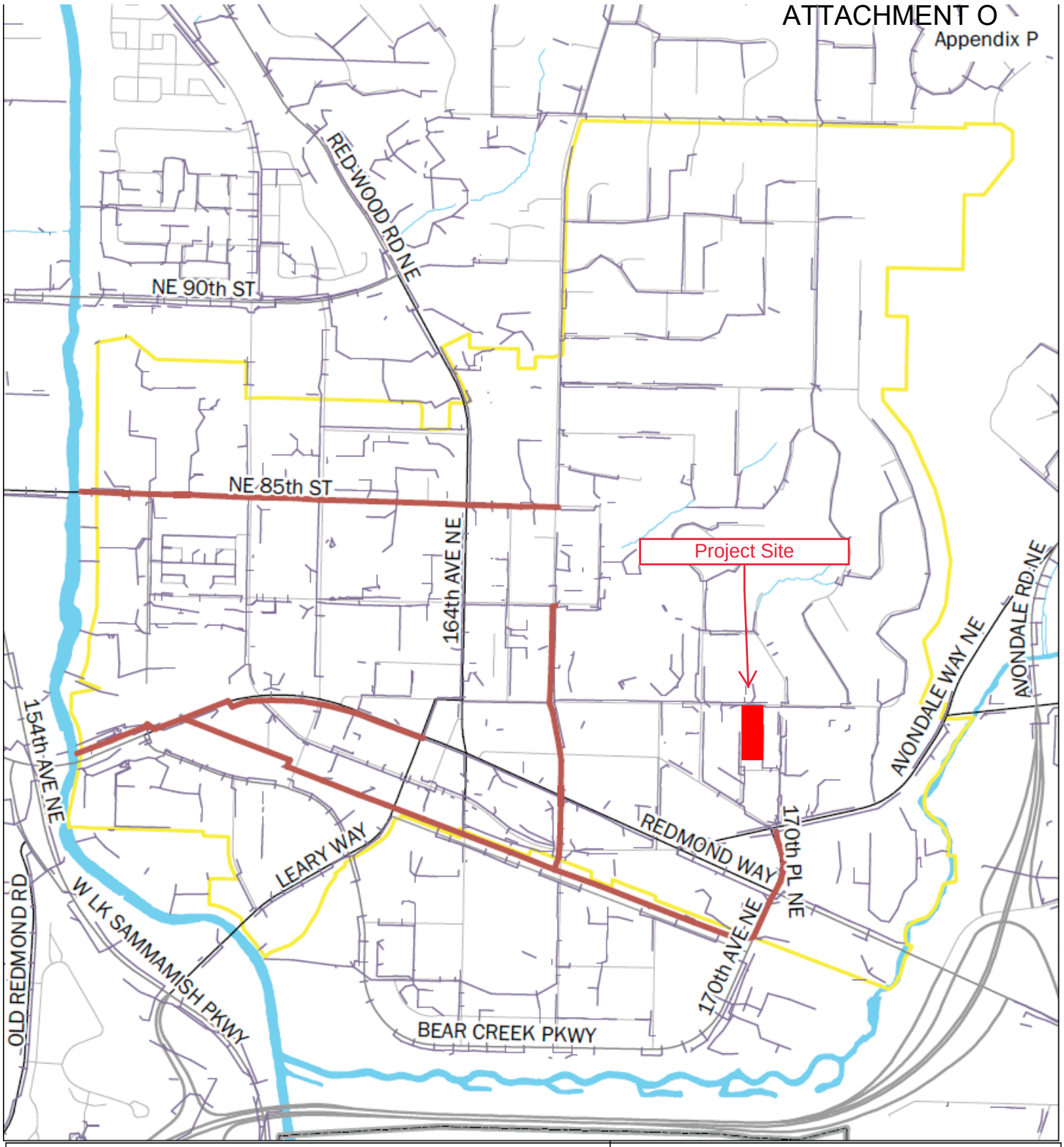
0 250 500 750

Scale: 1" = 600'

Disclaimer: This map is created and maintained by the City of Redmond, for reference purposes only. The City makes no guarantee as to the accuracy or completeness of the features shown on this map.

Draft Downtown Basin

NHCStormDowntown.mxd *Draft Date 02/22/2012*



Downtown Stormwater Infrastructure

City of Redmond, Washington

4/1/2019

Disclaimer: This map is created and maintained by Public Works Department, for reference purposes only. The City makes no guarantee as to the accuracy of the features shown on this map.

Miles
0 0.125 0.25

N

Provide downstream analysis from project site, to storm trunk, assuming full buildout

- Storm Trunk (50 Year Capacity)
- Storm Pipe >= 12"
- Regional Facility Surcharge Area (May Require Modification)

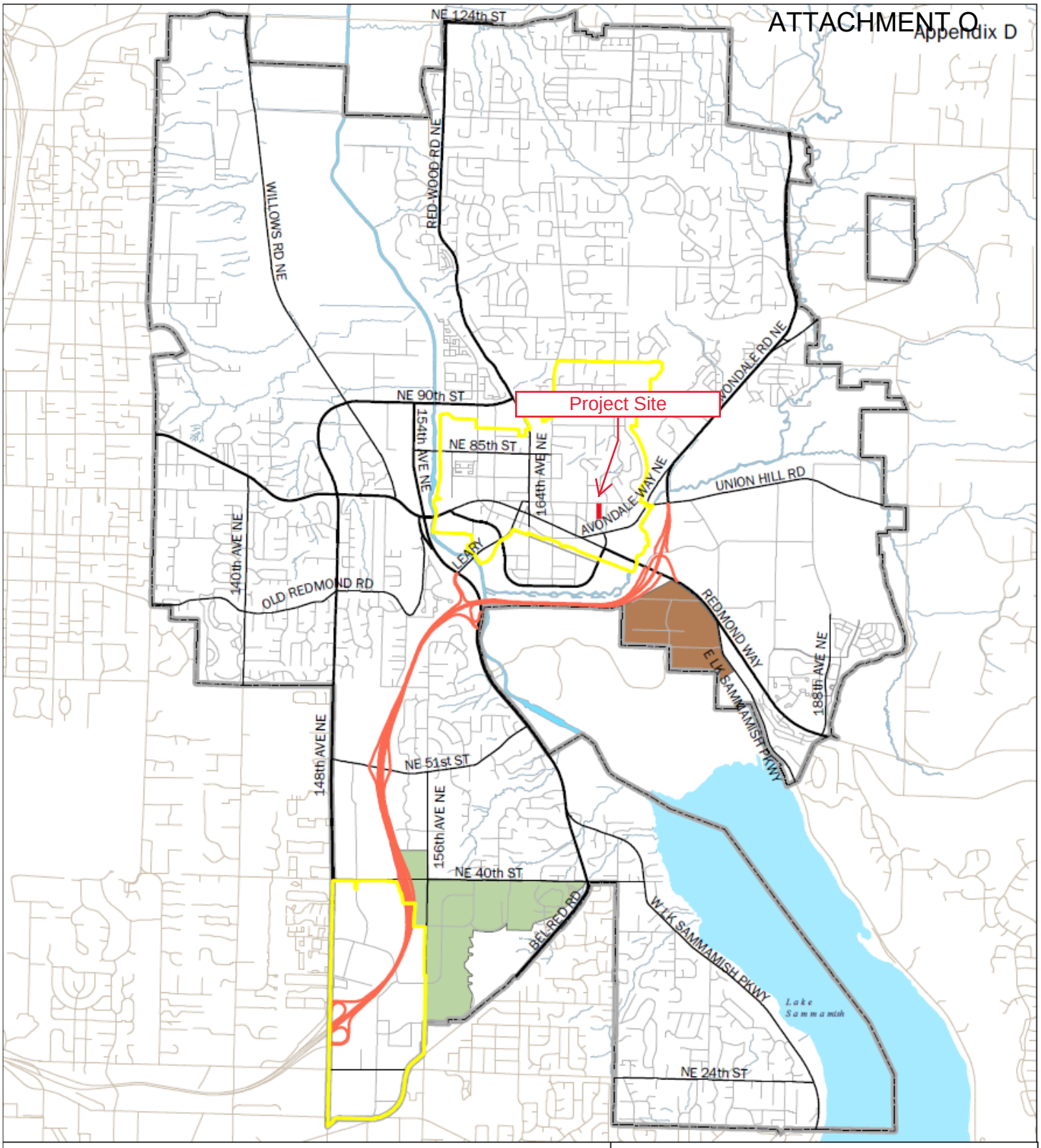
Minimum Requirement #5: On-Site Stormwater Management: Per the MR5: Onsite Stormwater Management Custom Areas map located within Appendix D of the City Technical Notebook, the project is located within the Regional Facility Surcharge Area. Specifically, the project is located within the Downtown Regional Facilities Surcharge Area per the City's Regional Facilities Map located within Appendix O of the City Technical Notebook. Aside from the subject project's locations within the Downtown Regional Facilities Surcharge Area, the project is exempt from Flow Control as the project drains to the Sammamish River via manmade conveyance.

As this project is flow control exempt, the following Section 2.5.5.1 applies.

Per Section 2.5.5.1 within the City Technical Notebook, projects qualifying as flow control exempt in accordance with 2.5.7 Minimum Requirement #7: Flow Control do not have to achieve the LID performance standard, nor consider bioretention, rain gardens, permeable pavement, or full dispersion if using List #1 or List #2. However, those projects must implement the following:

- BMP T5.13: Post-Construction Soil Quality and Depth;
- BMP T5.10A: Downspout Full Infiltration, or BMP T5.10B: Downspout Dispersion Systems, or BMP T5.10C: Perforated Stub-out Connections; and
- BMP T5.11: Concentrated Flow Dispersion or BMP T5.12: Sheet Flow Dispersion, if feasible.

For this project, landscape areas will incorporate soil amendment per BMP T5.13. All roof drainage will be fully infiltrated per Section III-3.3 within the 2014 DOE Manual versus sizing per BMP T5.10A. Drainage from the front porches will sheetflow to the drainage system within 170th Avenue NE.



Document Path: Q:\NRDivision\NRFunctions\04MappingGISDatabase\PROJECTS\StormwaterTechNotebook\Maps\MR5_OnsiteManagement.mxd

MR 5: Onsite Stormwater Management Custom Areas

City of Redmond, Washington

4/1/2019

CityofRedmond

N

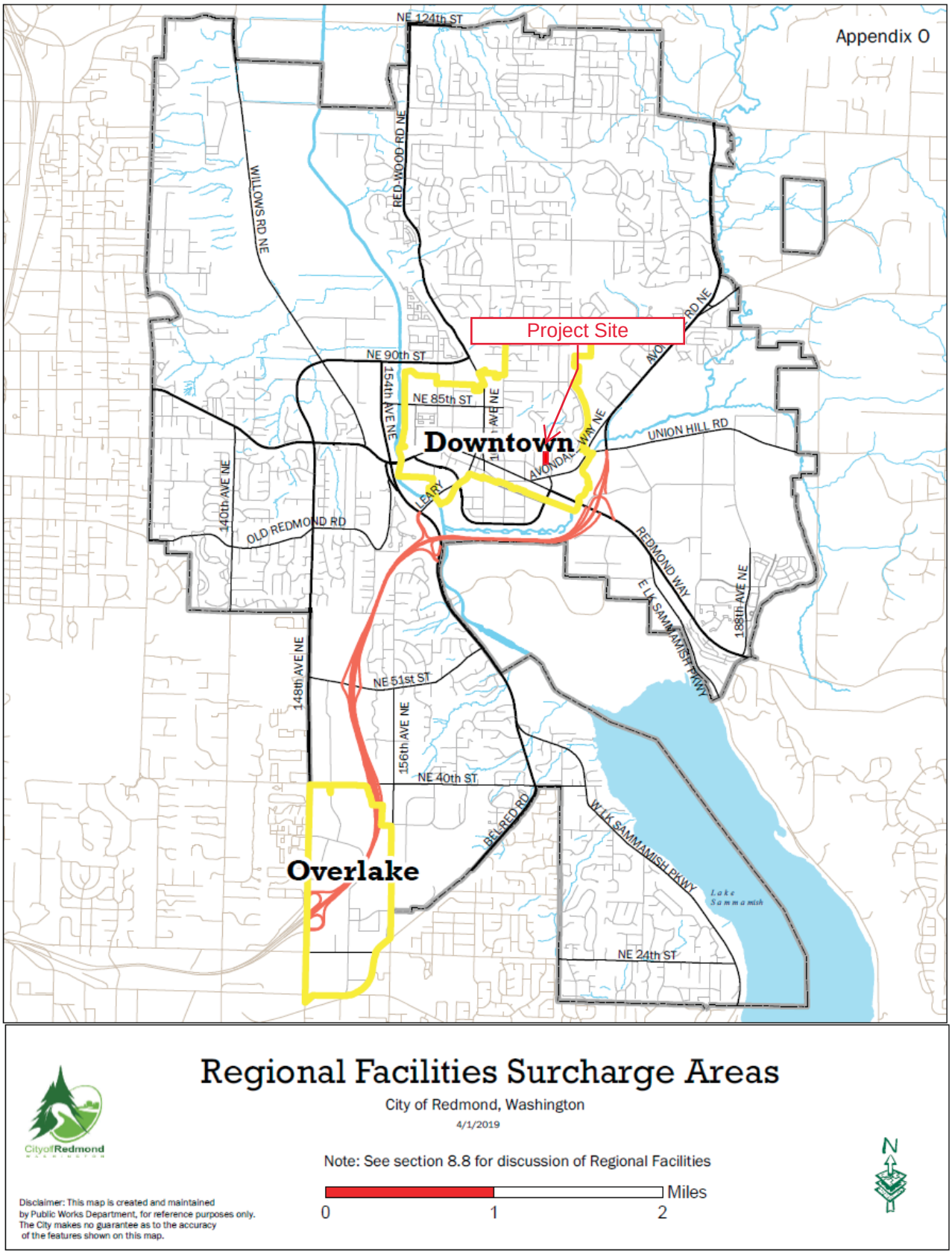
0 0.5 1 Miles

Disclaimer: This map is created and maintained by Public Works Department, for reference purposes only. The City makes no guarantee as to the accuracy of the features shown on this map.

- Regional Facility Surcharge Areas
- 40th Street Basin
- Marymoor - 100% Infiltration

Note: See section 2.5.5 for explanation of custom areas

Appendix O - Regional Facilities Map



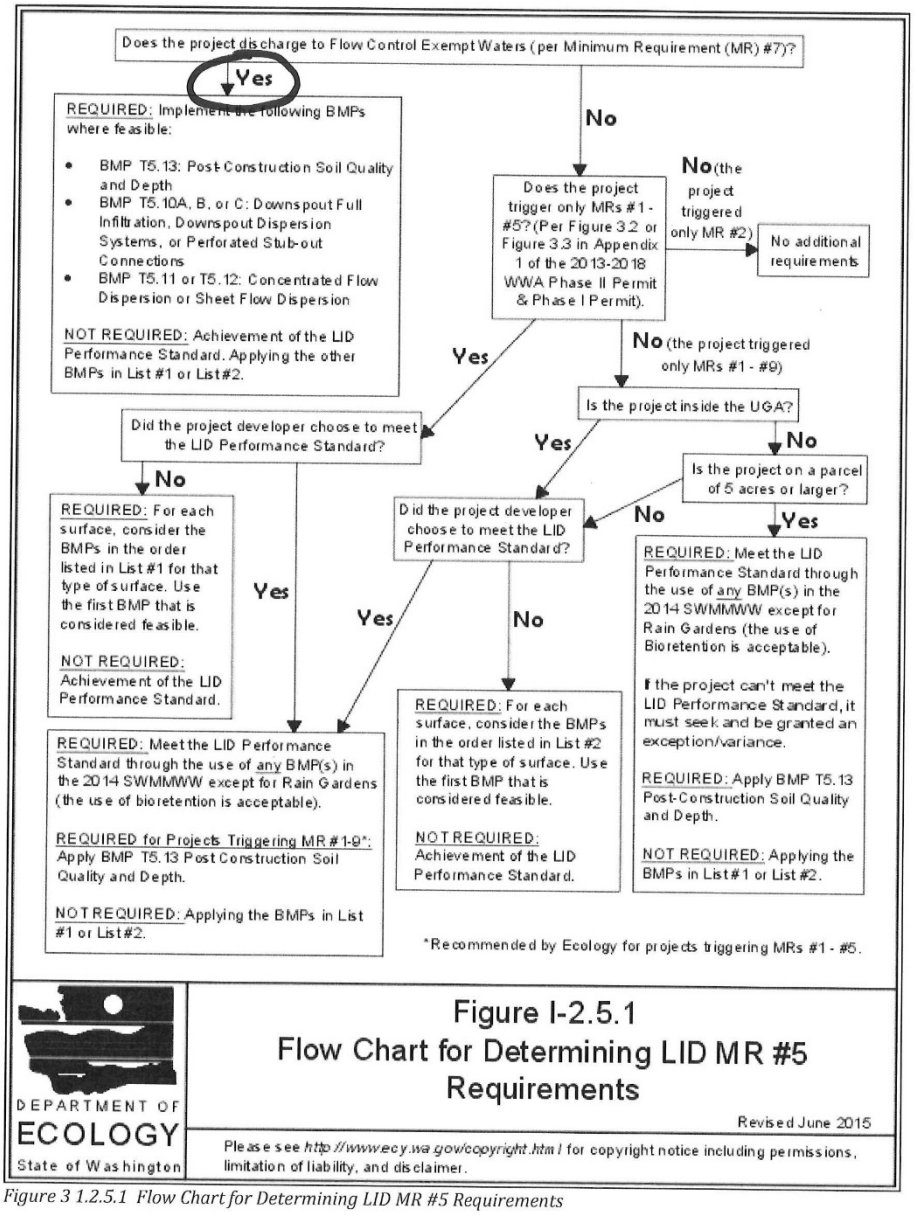


Figure 3 1.2.5.1 Flow Chart for Determining LID MR #5 Requirements

Minimum Requirement #6: Runoff Treatment: Per the MR6: Runoff Treatment Custom Areas map located within Appendix E of the City Technical Notebook, the project is located within the Downtown Regional Facility Surcharge Area with Basic Treatment provided by the Regional Facility.

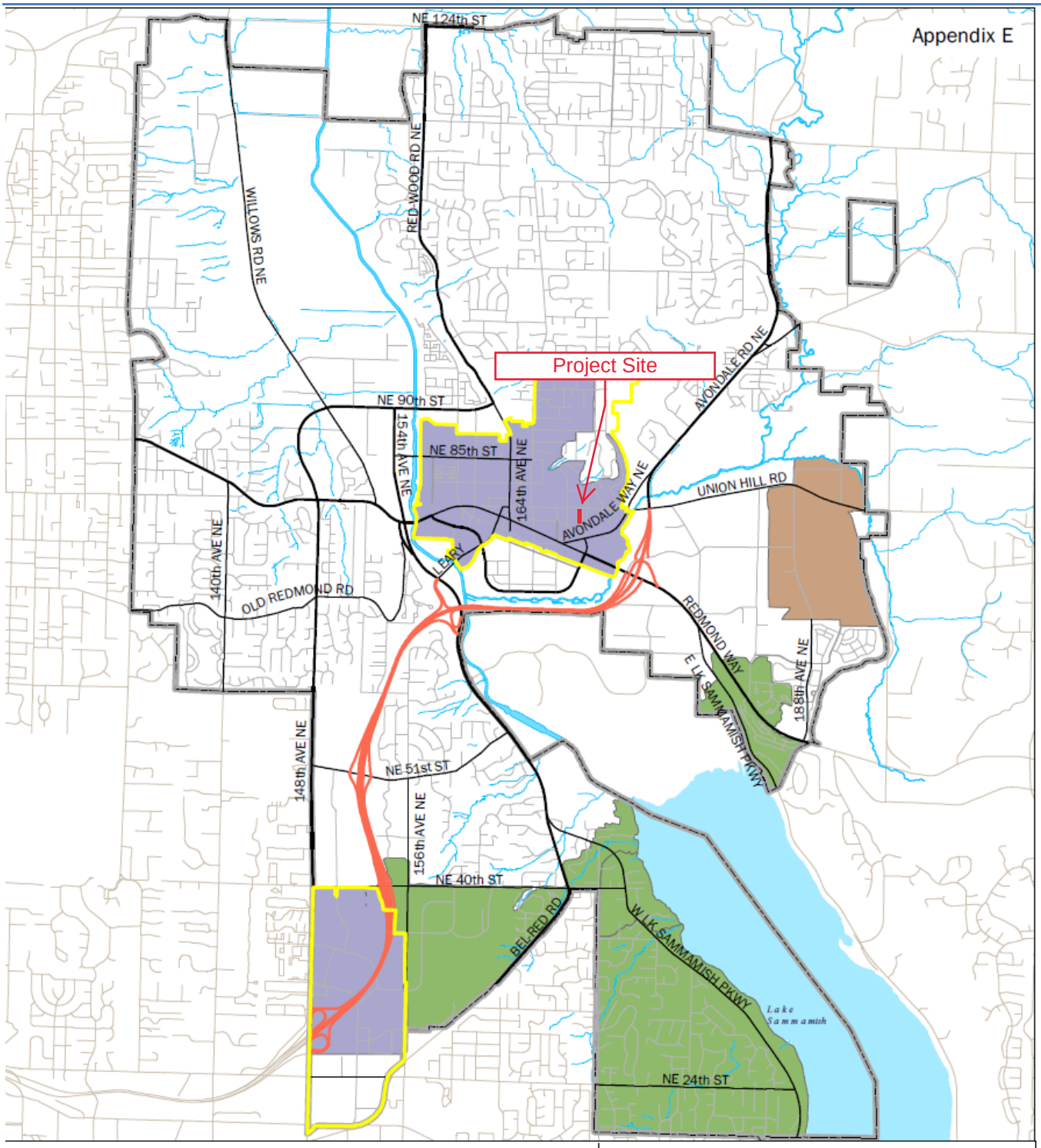
Per Section 2.5.6 within the City Technical Notebook, projects located within the Overlake and Downtown Regional Facility Surcharge Areas are not required to build basic or enhanced runoff treatment facilities as those are provided in a regional facility.

Minimum Requirement #7: Flow Control: Per the MR7: Flow Control Requirements Custom Areas map located within Appendix F of the City Technical Notebook, the project is located within the Regional Facility Surcharge Area. Aside from the subject project's locations within the Downtown Regional Facilities Surcharge Area, the project is exempt from Flow Control as the project drains to the Sammamish River via manmade conveyance.

Minimum Requirement #8: Wetlands Protection: This requirement is not applicable since drainage does not discharge to a wetland. See City Wetlands Critical Areas Map in Section 3.C. of this Report.

Minimum Requirement #9: Operation and Maintenance: This minimum requirement will be addressed during final engineering design.

Appendix E - Minimum Requirement Map 6



MR 6: Runoff Treatment Custom Areas

City of Redmond, Washington

4/1/2019

CityofRedmond

N

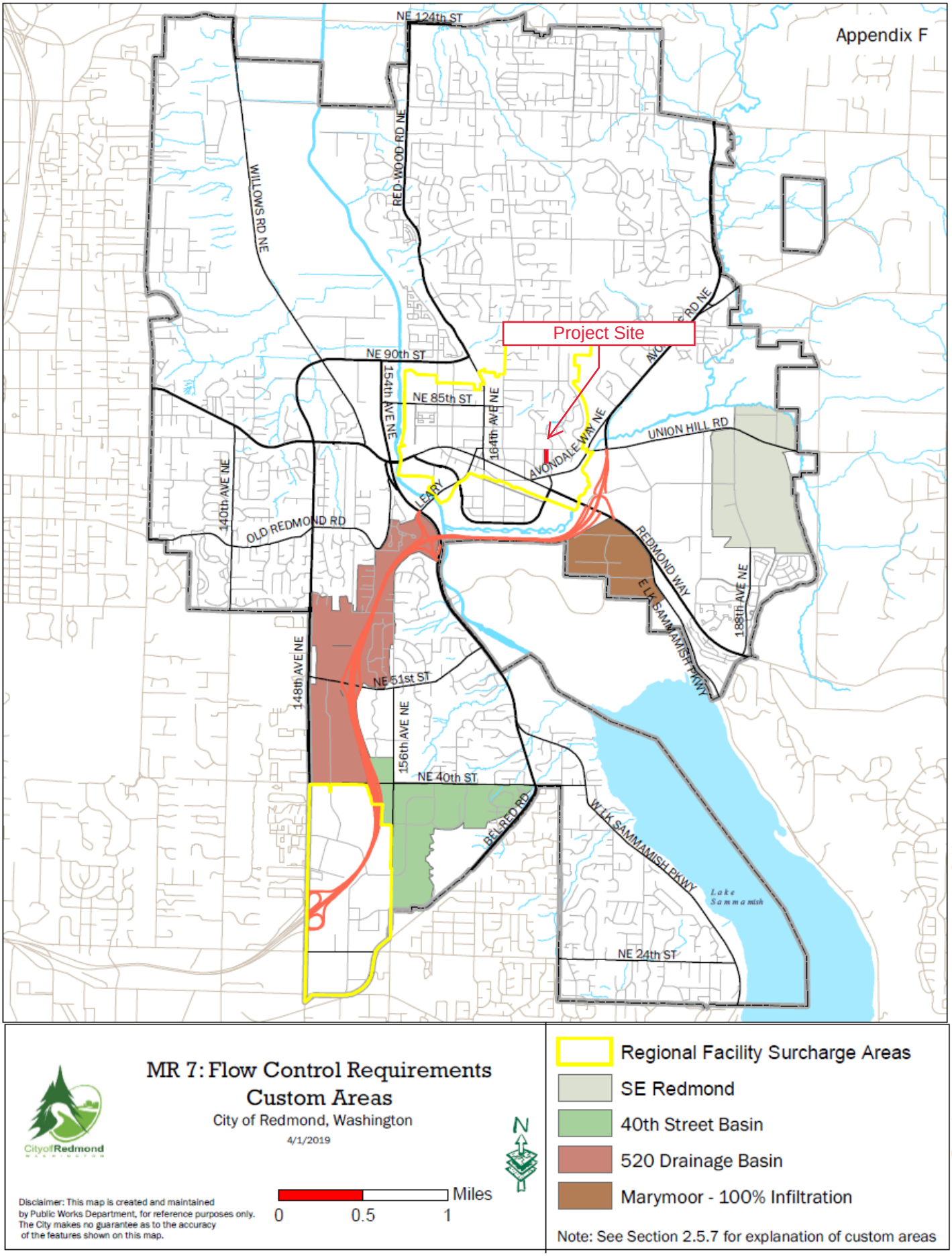
Miles

0 0.5 1

Disclaimer: This map is created and maintained by Public Works Department, for reference purposes only. The City makes no guarantee as to the accuracy of the features shown on this map.

- Regional Facility Surcharge Areas
- Basic Treatment Provided by Regional Facility
- Phosphorous Control
- SE Redmond

Note: See section 2.5.6 for explanation of custom areas. Oil/water separator applies where required city wide.



CityofRedmond

MR 7: Flow Control Requirements Custom Areas

City of Redmond, Washington

4/1/2019

N

Miles

0 0.5 1

Disclaimer: This map is created and maintained by Public Works Department, for reference purposes only. The City makes no guarantee as to the accuracy of the features shown on this map.

- Regional Facility Surcharge Areas
- SE Redmond
- 40th Street Basin
- 520 Drainage Basin
- Marymoor - 100% Infiltration

Note: See Section 2.5.7 for explanation of custom areas

SECTION 3. OFFSITE ANALYSIS REPORT

A. Upstream

There is no upstream drainage flowing onto the site.

B. Downstream

Date of Field Inspection: Thursday, September 20, 2018
Weather Conditions: Partly Sunny, approximately 70 degrees Fahrenheit

A second field investigation was conducted on December 13, 2018. The weather was rainy and approximately 45 degrees.

Existing Downstream

The downstream map included at the end of this section will assist in this discussion.

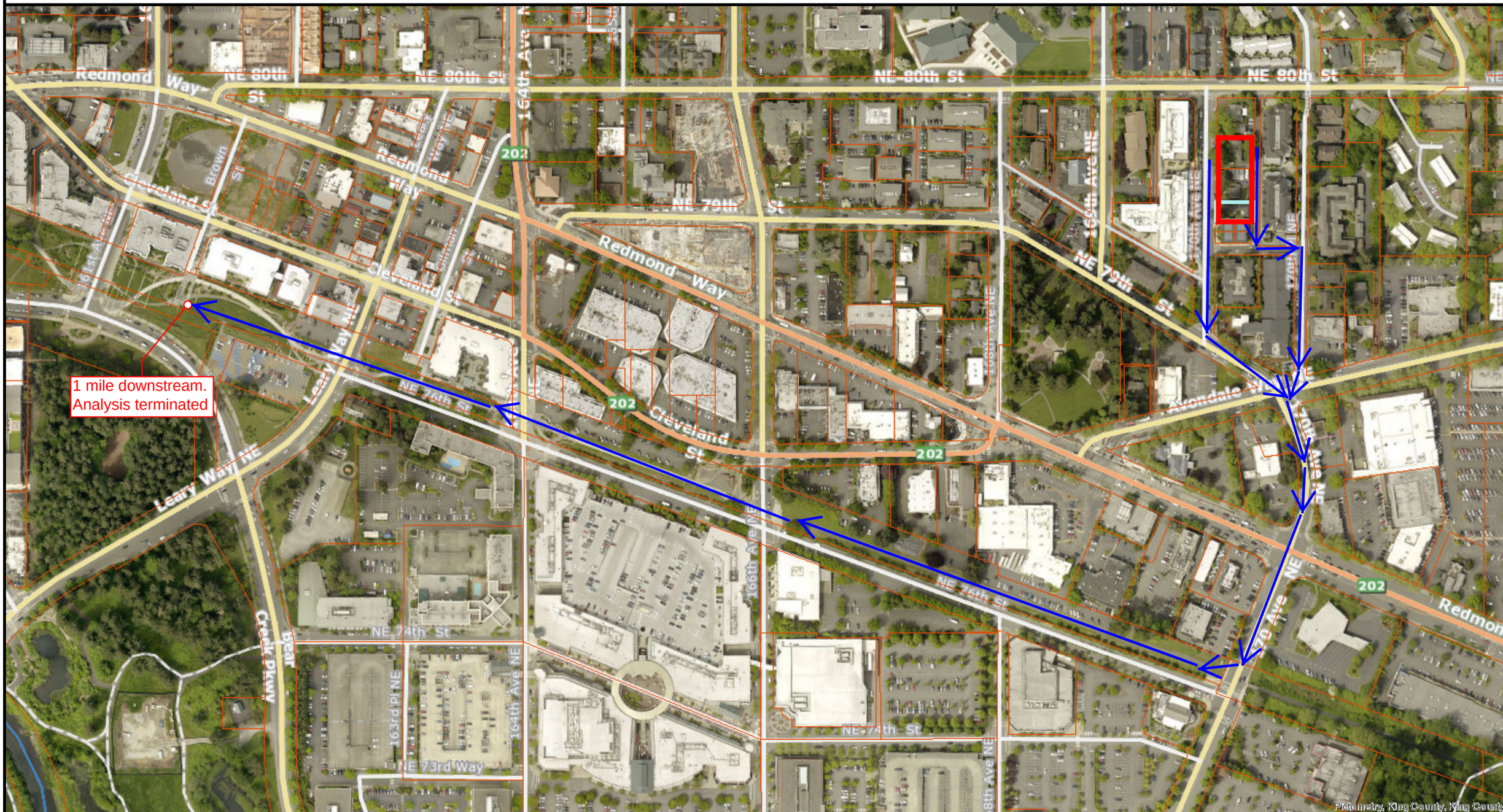
The site currently consists of three lots with single family residences and associated garage structures. Several trees are scattered throughout the site with landscaped yards and paved driveways. The site is generally flat, with slight slopes from the center of the property to the east and west.

Stormwater runoff leaves the site in two different directions. Runoff on the west half of the site flows west to 170th Avenue NE. Runoff on the east half of the site flows east to 170th Court NE. These two drainage paths are described below up to one mile downstream, as required by the City of Redmond. Note that the two separate drainage paths meet up prior to reaching one mile downstream of the site.

West Drainage: Runoff from the west side of the project site sheetflows west into the tight-lined storm system within 170th Avenue NE. Flow enters a series of catch basins with 12-inch pipe and continues south approximately 350 feet until reaching NE 79th Street, redirecting flows in a southeast direction. The catch basins up to this point appear to be in good condition with minimal sedimentation, however the catch basin at the northeast corner of the intersection between 170th Avenue NE and NE 79th Street contains significant debris and the pipe out is completely covered. Flow continues for about 250 feet through the conveyance system in NE 79th Street and across Avondale Way where it enters a regional facility (36-inch to 48-inch pipe system). The regional facility conveys flows south and southwest along 170th Place NE for approximately 900 feet until reaching NE 76th Street. At this point, the regional facility continues to the northwest along a pedestrian path north of NE 76th Street. Flows continue through the regional facility through 36-inch pipe in a northwest direction for approximately ½-mile until reaching a point one mile downstream of the project site where the analysis was terminated.

East Drainage: Runoff from the east side of the project site sheetflows east into the tight-lined storm system within 170th Court NE and flows south for approximately 300 feet towards Penny Lane through 12-inch pipe. Flows are redirected east at Penny Lane through a series of catch basins for about 100 feet, then directed south once reaching 170th Place NE. The conveyance system continues south for about 300 feet until reaching the corner of Avondale Way and NE 79th Street, where the system crosses Avondale Way and enters the regional facility described for the west drainage above. The catch basins, prior to reaching the regional facility, are in good condition and minimal sedimentation is observed. Flows from the east half of the site have now met up with flows from the west half of the site and the drainage continues in the same manner as described for the west drainage.

Penny Lane II



The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a survey product. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.

Date: 9/21/2018

Notes:

N

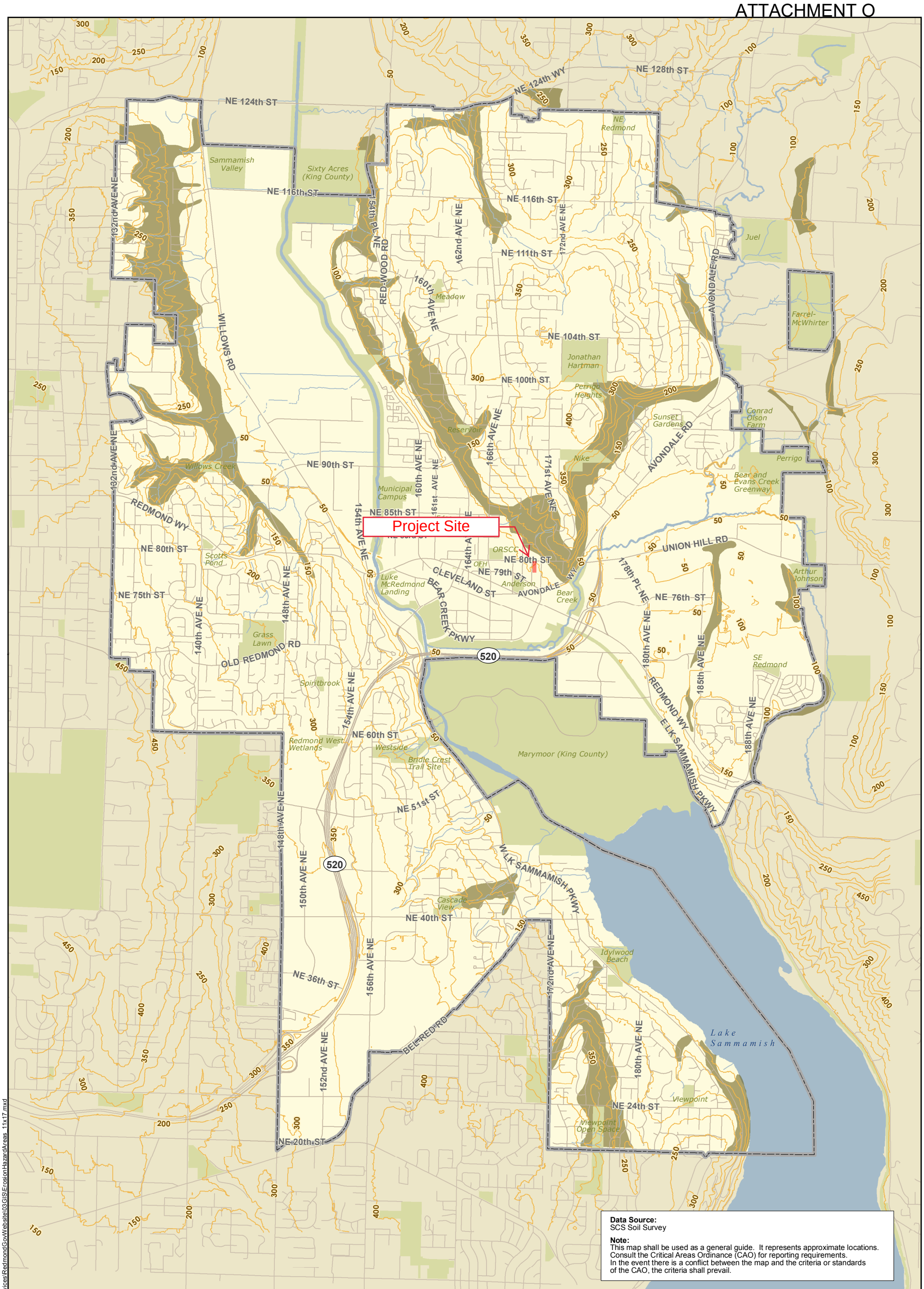
King County GIS Center

C. Sensitive Areas Research

Based on the City's critical areas maps, the subject site is partially located within a Seismic Hazard Area. The subject site is not located within an Erosion Hazard Area, a Landslide Hazard Area, or a Frequently Flooded Area. The subject site does not have wetlands or streams. The subject site is located within CARA 1. See maps on the following pages.

The proposed development is a single family residential project that does not fall within the prohibited land uses as delineated in the RZC 21.64.050.C for required wellhead protection.

ATTACHMENT O



Data Source:
SCS Soil Survey

Note:
This map shall be used as a general guide. It represents approximate locations. Consult the Critical Areas Ordinance (CAO) for reporting requirements. In the event there is a conflict between the map and the criteria or standards of the CAO, the criteria shall prevail.

Erosion Hazard Areas

Critical Areas Map

City of Redmond, Washington

Effective: 05/28/2005

0 0.5 1
Miles

N

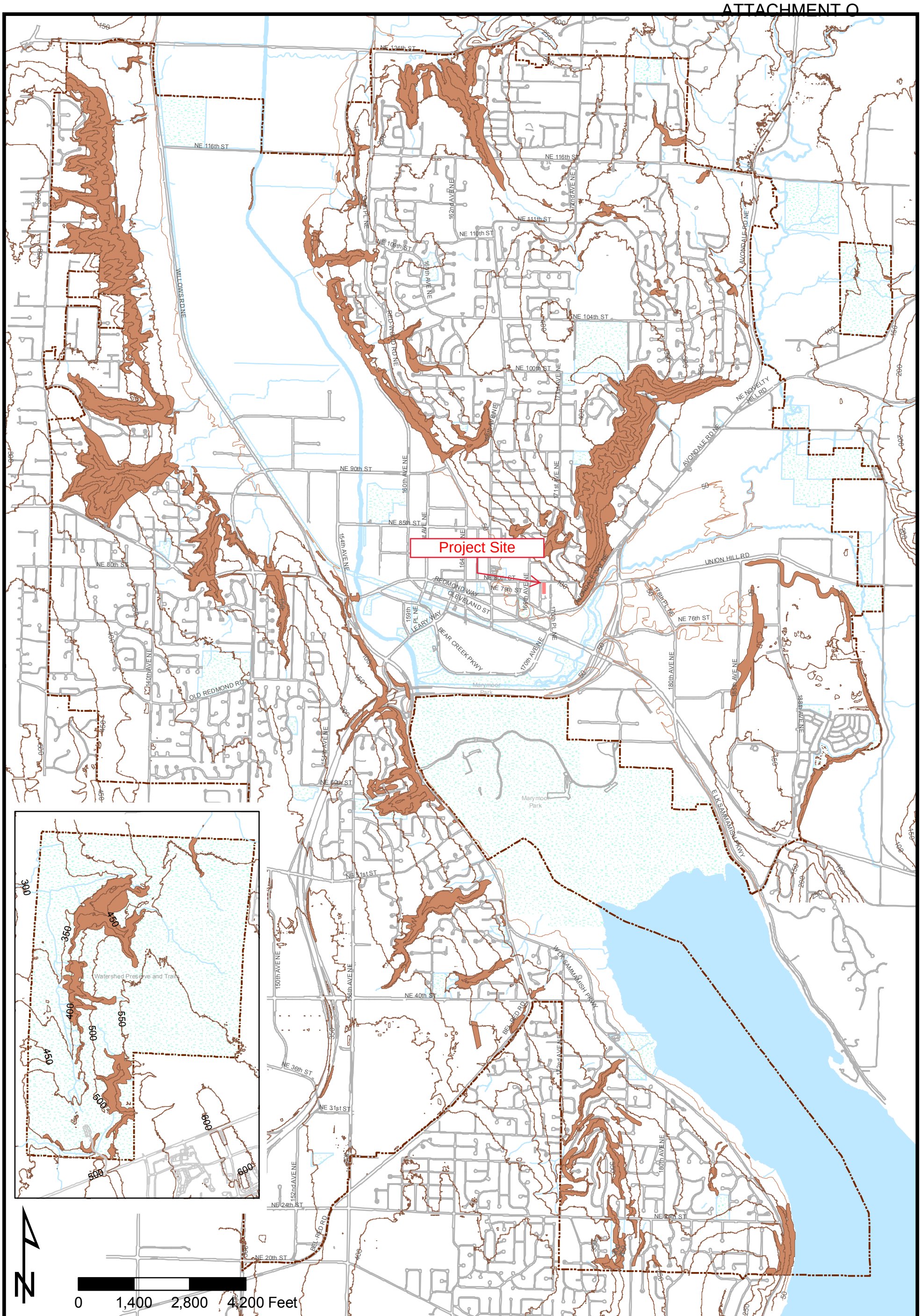
Contour
Erosion Hazard Area
City Limit
Park and Open Space
Water

Disclaimer: This map is created and maintained by GIS Services Group,Finance and Information Services, City of Redmond, Washington, for reference purposes only.

The City makes no guarantee as to the accuracy of the features shown on this map.

File Name:\\redmond.man\ts\GISUser\GIS\GISServicesProject\GISServices\RedmondGovWebsite\03GIS\ErosionHazardAreas_11x17.mxd

ATTACHMENT O



City of Redmond

Critical Areas Map
Effective: 03/12/2016

Map 64.7 Landslide Hazards

Legend

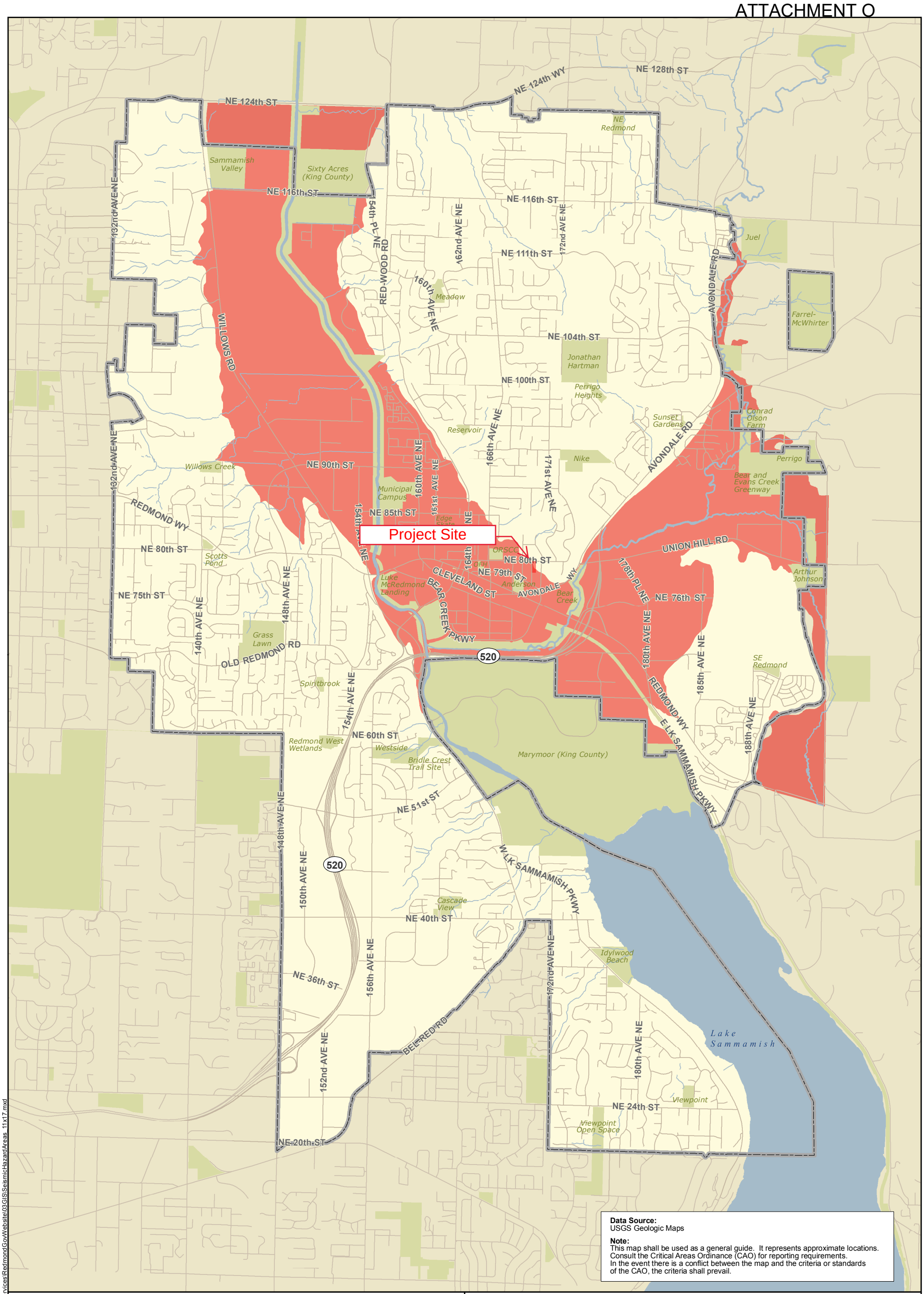
- Landslide Hazards Areas
- Contours
- Park

Sources:
City of Redmond GIS Services
King County GIS

Note: This map shall be used as a general guide representing the approximate location of steep slopes, per RZC 21.64.060(A)(1)b.vii. The map does not necessarily ensure the presence or absence of landslide hazards. 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.

G:\Planning\COMPLAN & DEV GUIDE GRAPHICS\ArcGISMaps\RCDG Rewrite\GIS\FinalDrafts\Map64_7_RZC.mxd

ATTACHMENT O



Seismic Hazard Areas

Critical Areas Map

City of Redmond, Washington

Effective: 05/28/2005

0 0.5 1
Miles

N

Seismic Hazard Area

City Limit

Park and Open Space

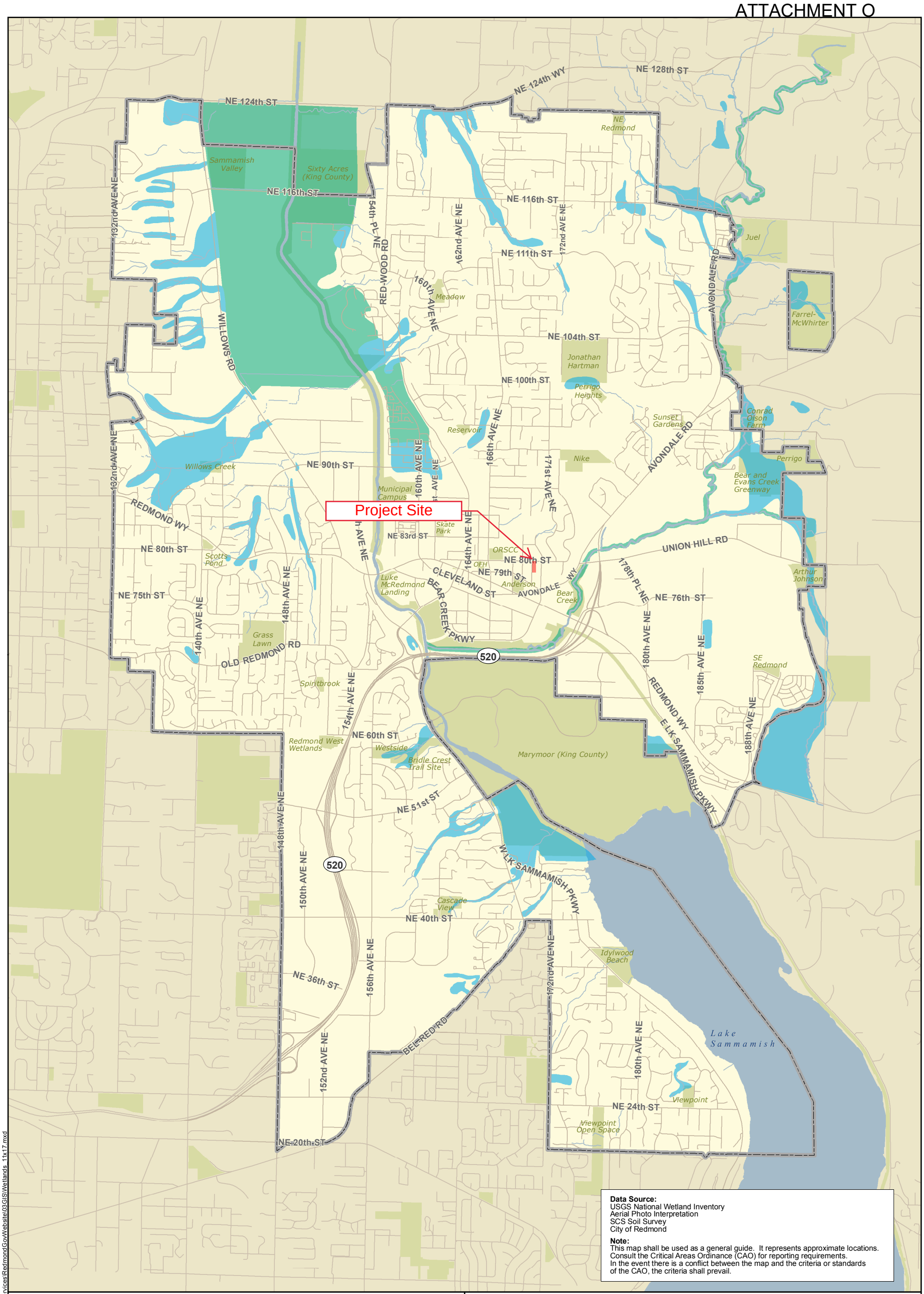
Water

Disclaimer: This map is created and maintained by GIS Services Group,Finance and Information Services, City of Redmond, Washington, for reference purposes only.

The City makes no guarantee as to the accuracy of the features shown on this map.

File Name:\\redmond.man\fs\GISUser\GIS\GISServicesProject\GISServices\RedmondGovWebsite\03GIS\SeismicHazardAreas_11x17.mxd

ATTACHMENT O



Data Source:
USGS National Wetland Inventory
Aerial Photo Interpretation
SCS Soil Survey
City of Redmond

Note:
This map shall be used as a general guide. It represents approximate locations.
Consult the Critical Areas Ordinance (CAO) for reporting requirements.
In the event there is a conflict between the map and the criteria or standards of the CAO, the criteria shall prevail.

Wetlands

Critical Areas Map

City of Redmond, Washington

Effective: 05/28/2005

0 0.5 1
Miles

N

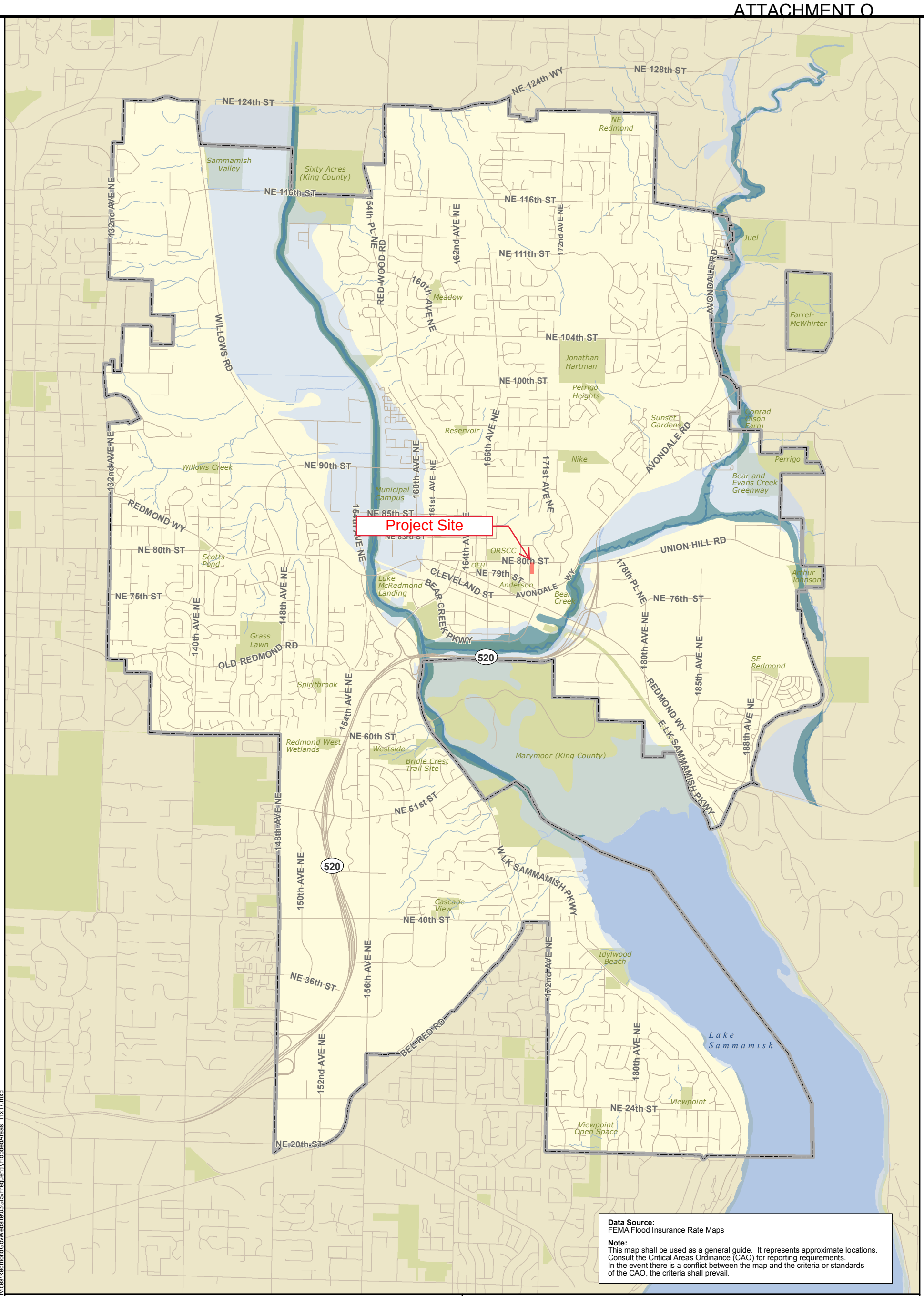
Mixed Wetland/Upland
Wetland
City Limit
Park and Open Space
Water

Disclaimer: This map is created and maintained by GIS Services Group,Finance and Information Services, City of Redmond, Washington, for reference purposes only.

The City makes no guarantee as to the accuracy of the features shown on this map.

File Name:\\redmond.man\fs\GISUser\GIS\GISServicesProject\GISServices\RedmondGovWebsite\03GIS\Wetlands_11x17.mxd

ATTACHMENT O



Frequently Flooded Areas

Critical Areas Map

City of Redmond, Washington

Effective: 05/28/2005

0 0.5 1
Miles

N

100 Year Floodplain

FEMA Floodway

City Limit

Park and Open Space

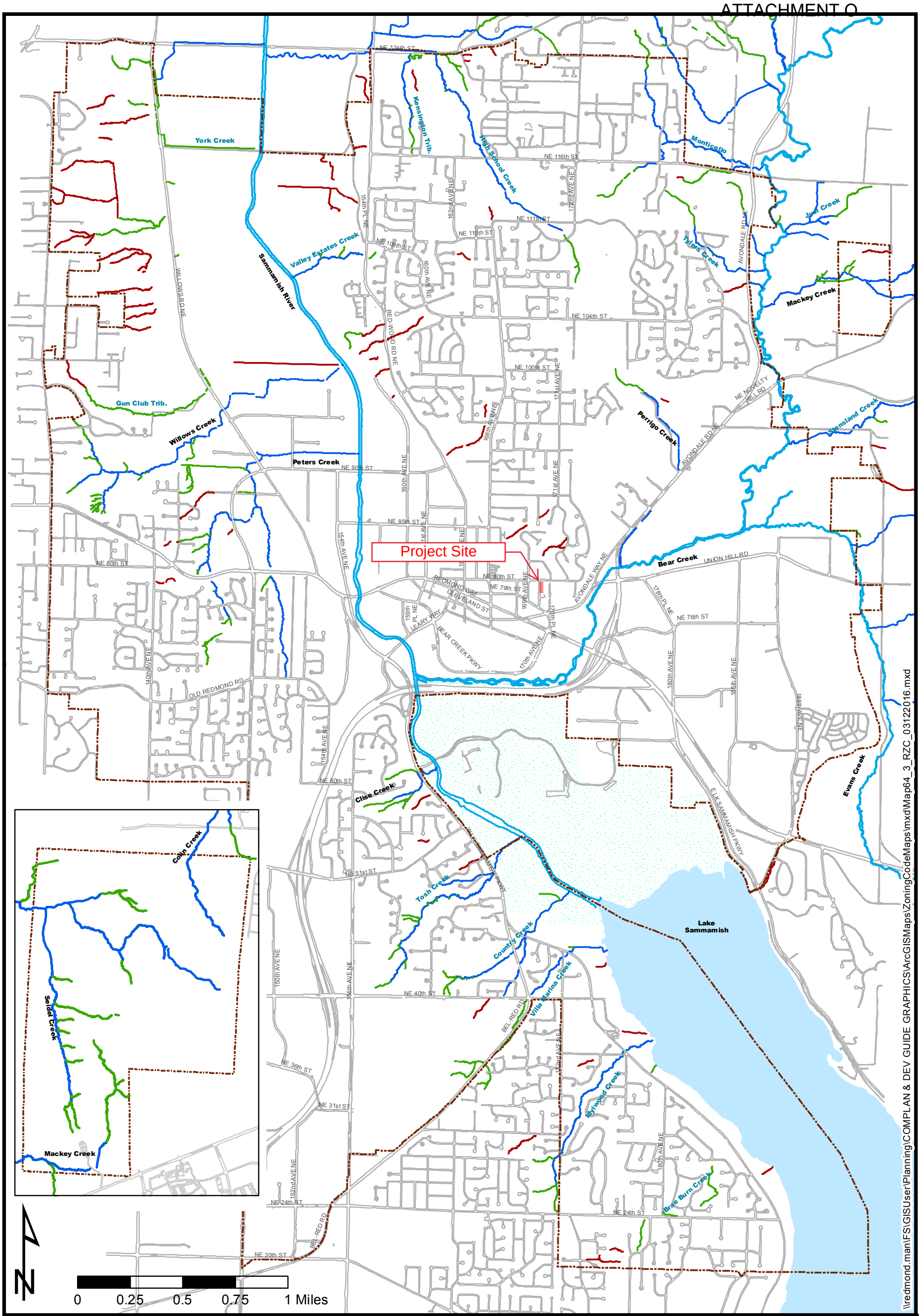
Water

Disclaimer: This map is created and maintained by GIS Services Group,Finance and Information Services, City of Redmond, Washington, for reference purposes only.

The City makes no guarantee as to the accuracy of the features shown on this map.

File Name:\\redmond.man\fs\GISUser\GIS\GISServicesProject\GISServices\RedmondGovWebsite\03GIS\FrequentlyFloodedAreas_11x17.mxd

ATTACHMENT O



City of Redmond

Critical Areas Map
***Effective:* 3/12/2016**

Stream Official USGS Stream Name
Stream Informal Stream Name

Class I Stream
Class II Stream
Class III Stream
Class IV Stream

Map 64.3 Streams Classification

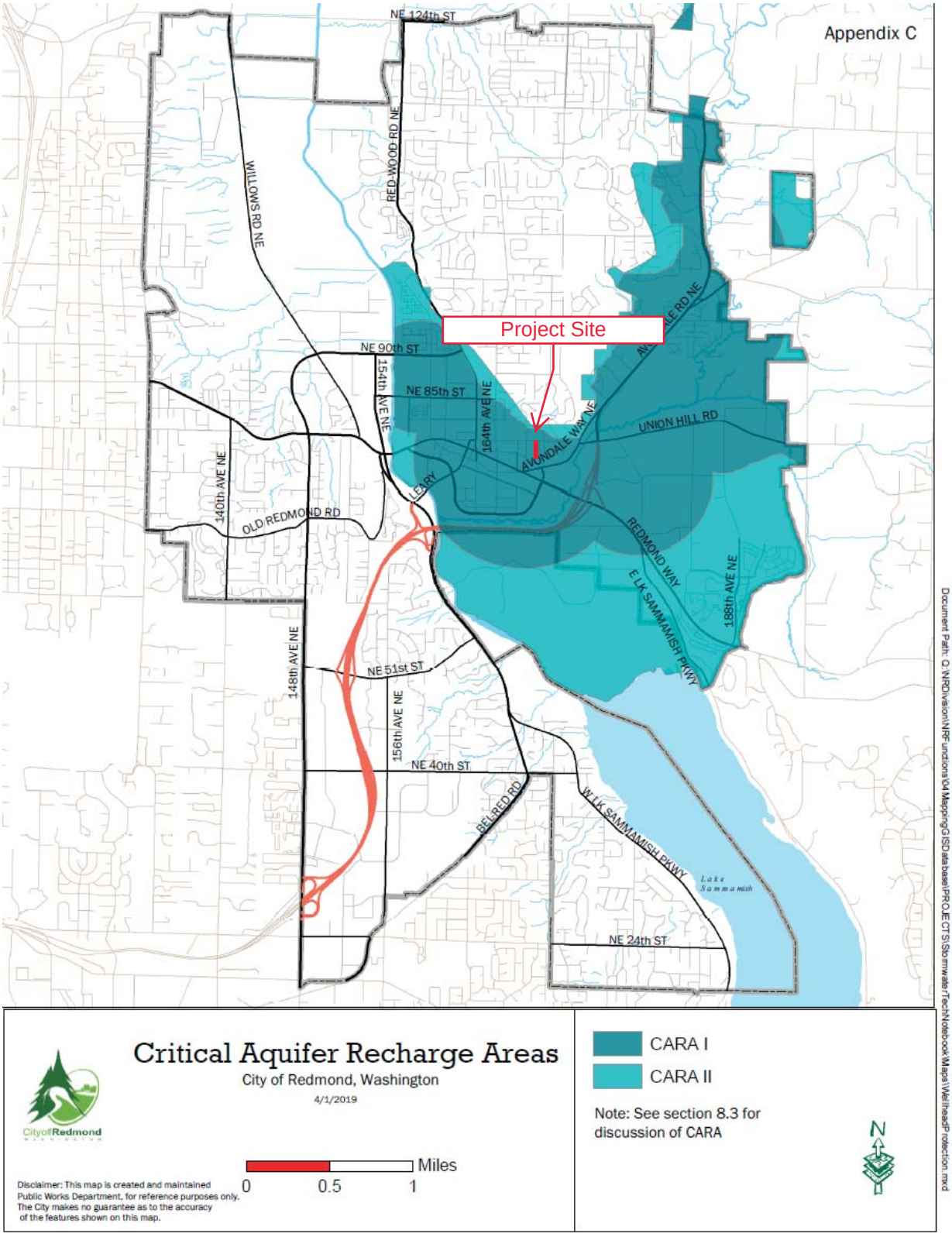
Sources:
City of Redmond Public Works, Natural Resources Division
City of Redmond GIS Services
Washington Trout / Wild Fish Conservancy
King County GIS

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, etc.

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

Appendix C - Critical Aquifer Recharge Areas



SECTION 4. PERMANENT STORMWATER CONTROL PLAN

A. Performance Standards and Goals

The subject project is not required to provide formal Runoff Treatment with the project's location within the Downtown Regional Facility Surcharge Area. The subject project is exempt from Flow Control as the project drains to the Sammamish River via manmade conveyance.

Per Section 2.5.5.1 within the City Technical Notebook, projects qualifying as flow control exempt must implement the following:

- BMP T5.13: Post-Construction Soil Quality and Depth;
- BMP T5.10A: Downspout Full Infiltration, or BMP T5.10B: Downspout Dispersion Systems, or BMP T5.10C: Perforated Stub-out Connections; and
- BMP T5.11: Concentrated Flow Dispersion or BMP T5.12: Sheet Flow Dispersion, if feasible.

For this project, landscape areas will incorporate soil amendment per BMP T5.13. All roof drainage will be fully infiltrated per Section III-3.3 within the 2014 DOE Manual versus sizing per BMP T5.10A. Drainage from the front porches will sheetflow to the drainage system within 170th Avenue NE.

B. Developed Conditions

See Developed Conditions exhibit on the following pages.

The project proposal is for the construction of 14 townhome units within a single building. Frontage improvements will also be completed as part of the development. The subject project is exempt from Runoff Treatment and Flow Control though, storm mitigation will be provided onsite for the roof drainage. Roof drainage will be infiltrated.

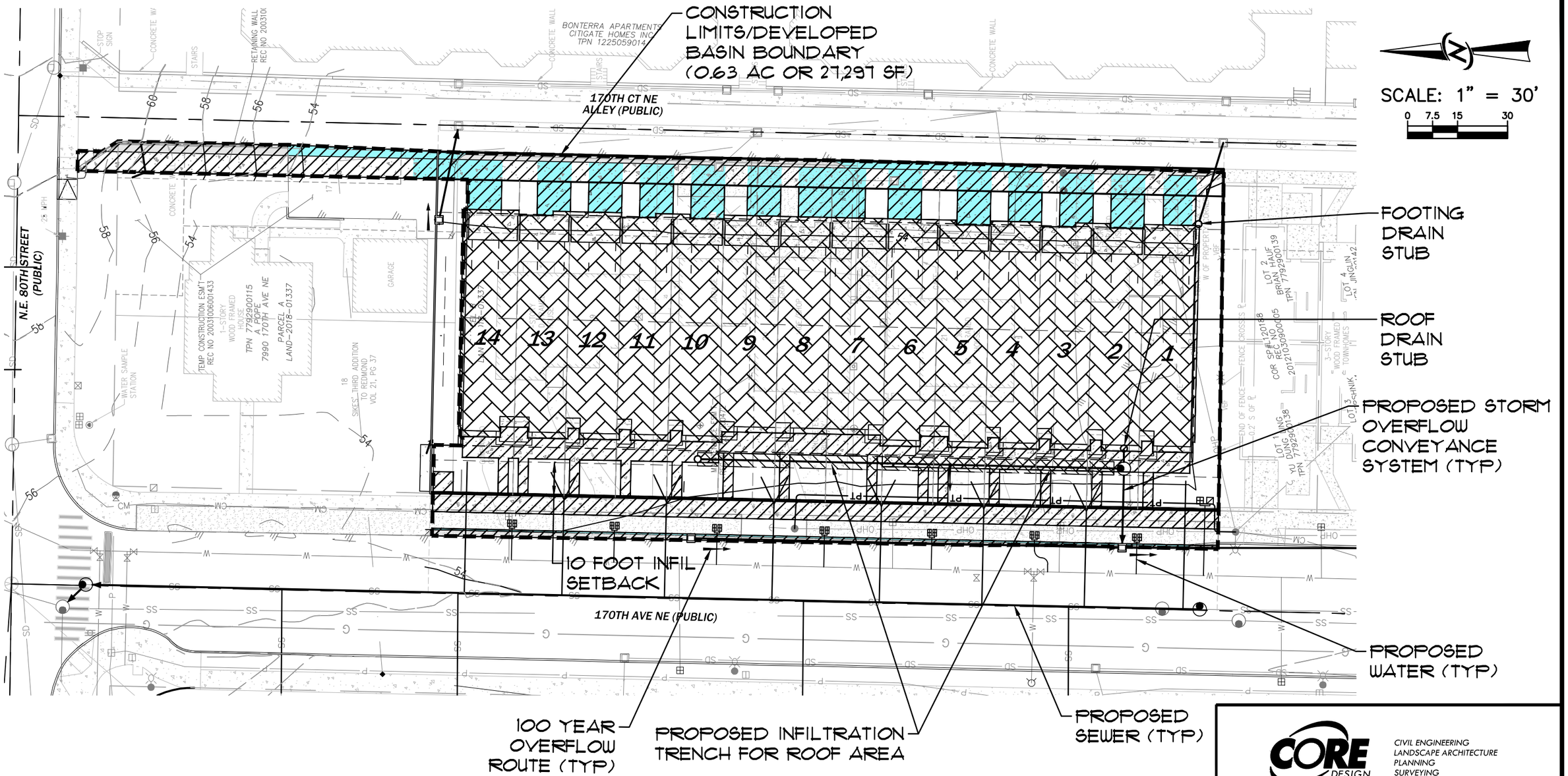
The Developed Basin Boundary or Limits of Construction is 0.63 acre (27,297 square feet). Proposed development will result in 0.52 acre (22,604 square feet) of impervious surfaces consisting of roofs, pavement, and concrete. The remaining area will be landscaping.

DEVELOPED CONDITION	Total Area = 27,297 square feet
GROUND COVER	AREA(square feet)
Landscaping	4,620
Impervious (PGIS)	3,346
Impervious (NPGIS)	19,331

The roof area, which will be infiltrated, covers 0.34 acre (14,712 square feet). The resultant developed impervious coverage is therefore, reduced to 0.18 acre (7,892 square feet). This resultant impervious coverage will discharge to the City's conveyance system.

As a result of the development, the resultant impervious coverage, 0.18 acre, is reduced below existing conditions, 0.29 acre. As mentioned in this Report in Section 2.B, Core Requirement #4, inadequate pipe capacity was identified along the downstream route along 170th Place NE south of Avondale Way. Since the subject project is not causing or exacerbating the existing condition and in fact, is helping alleviate some of the deficiencies with the development itself and the reduction of impervious surface tributary to the conveyance system, offsite improvements are not required.

ATTACHMENT O



ROOF AREA
(0.34 AC OR 14,712 SF)

PROPOSED IMPERVIOUS AREA
(EXCLUDING ROOF)
(0.18 AC OR 7,892 SF)

PGIS/NPGIS AREA BREAKDOWN

PGIS (3,365 SF)

NPGIS (19,239 SF)

CORE DESIGN
CIVIL ENGINEERING
LANDSCAPE ARCHITECTURE
PLANNING
SURVEYING
12100 NE 195th St, Suite 300 Bothell, Washington 98011 425.885.7877

DEVELOPED CONDITIONS

PENNY LANE II

DATE	FEB 2019	SHEET	OF
DESIGNED	GRB		
DRAWN	DSV	PROJECT NUMBER 17051	

J:\2017\17051\Engineering\Exhibits\17051 PL2 DEV. CONDITIONS EXHIBIT.dwg, 8/21/2019 12:36:29 PM, DWG To PDF.pc3

C. Full Infiltration Design

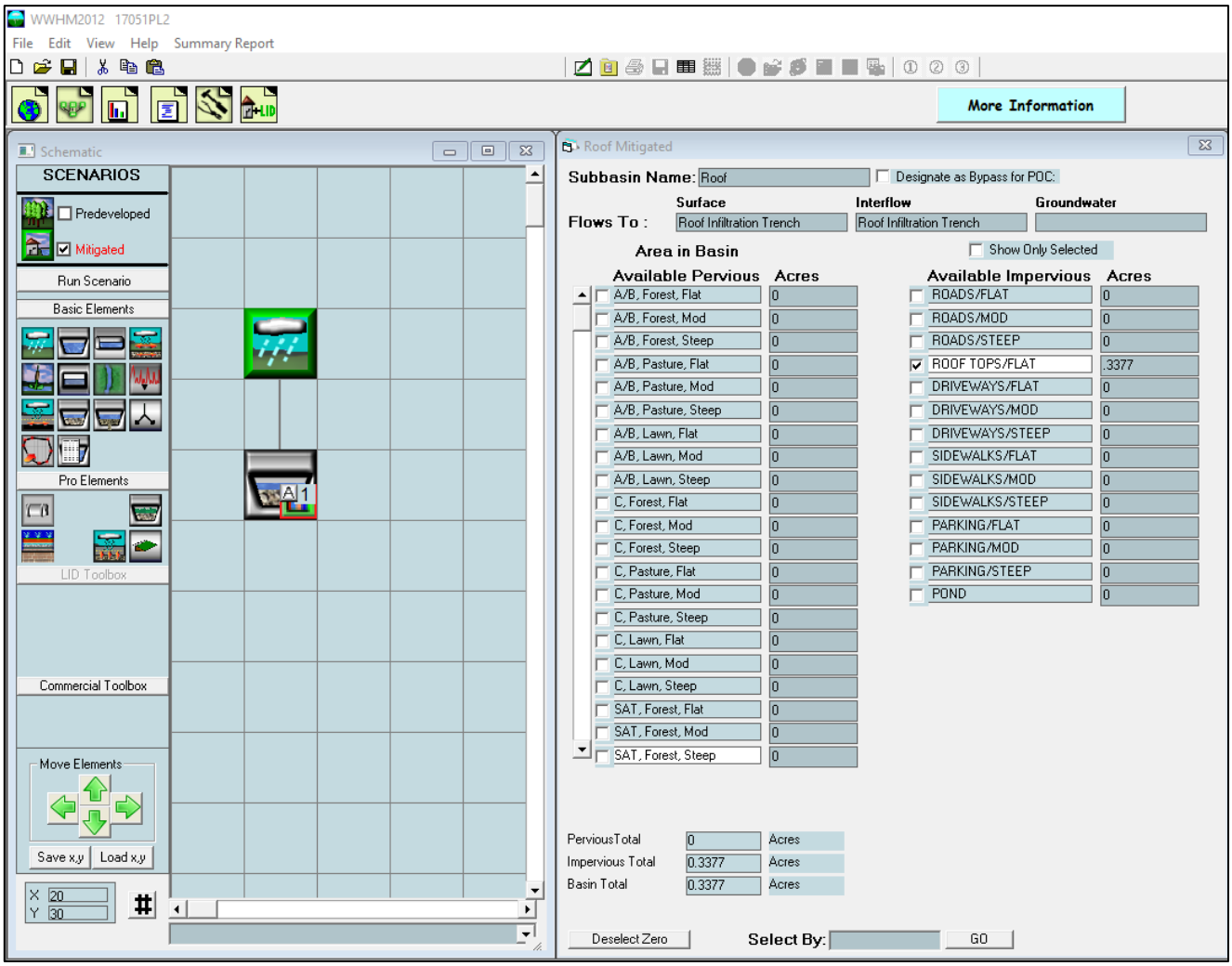
Full infiltration will be installed to mitigate for the roof area per Section III-3.3.11 (Infiltration Trenches) within the 2014 DOE Manual.

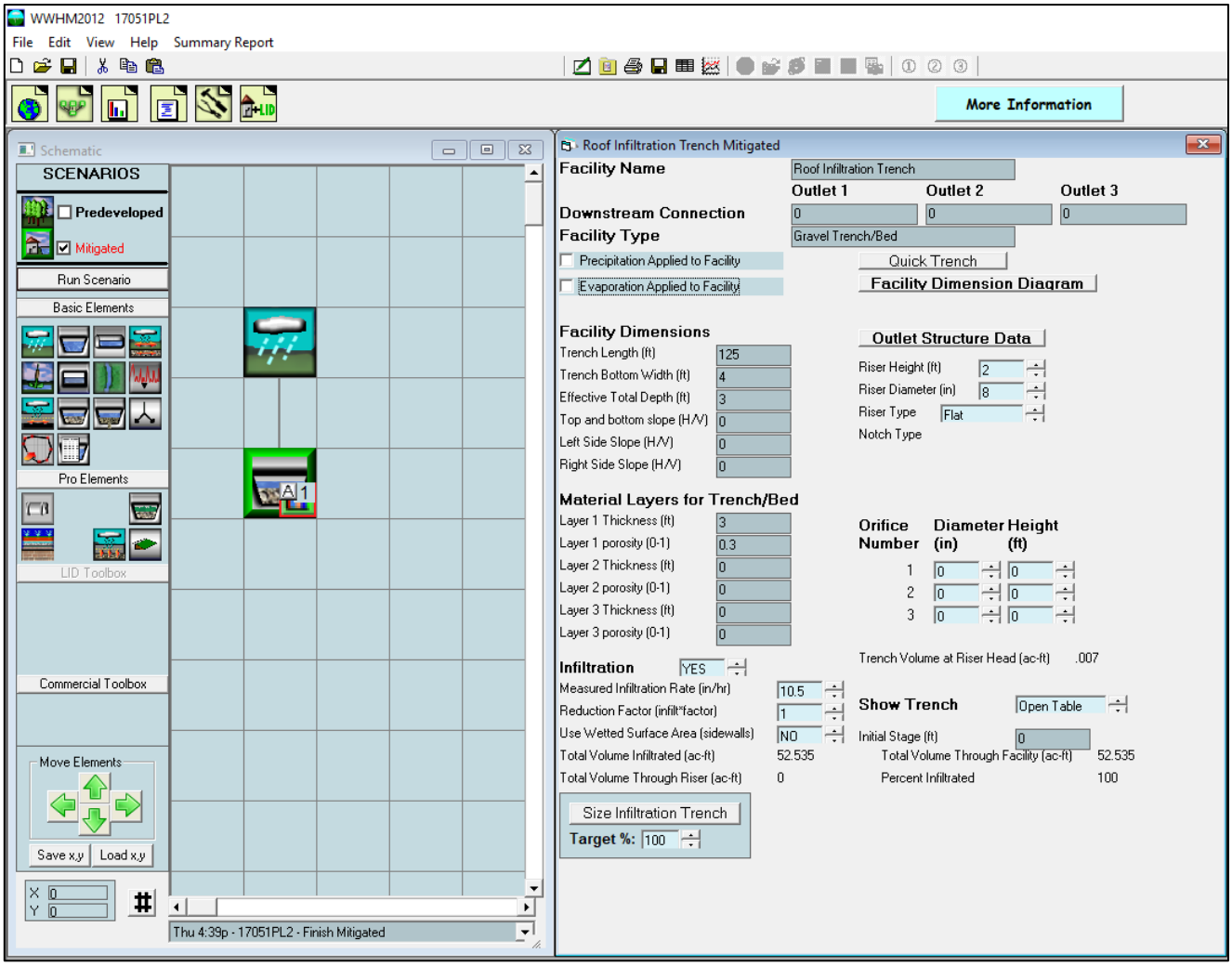
The total roof area is 0.3377 acre (14,712 square feet).

Per the WWHM2012 screenshots below, for 100% infiltration, the required trench dimensions are as follows.

- Trench Depth (water storage): 2 feet
- Trench Width: 4 feet
- Trench Length: 125 feet long

The proposed infiltration trench will match the dimensions of the minimum required and is therefore, adequately sized. The design of the infiltration trench meets the City Checklist Criteria as delineated below.





CITY CHECKLIST CRITERA

Soil permeability tests or gradation per the 2014 Department of Ecology Manual. At least two tests must be conducted or one test for every 5,000 square feet of infiltration system bottom area.

Two soil logs were completed for the infiltration trench. See Figure 3 within the geotechnical report, copy of which is located within Section 10 of this Report. As well, see soil logs near the end of the geotechnical report.

Soil test must be taken at the proposed bottom of infiltrations system

Exploration pits extend a minimum of four feet below the bottom of trench as required below.

Excavation or boring is required in the trench area to a minimum depth of 4 feet below the bottom of the trench. Infiltration is not feasible if there is evidence of groundwater or bedrock/hard pan.

See Figure 3 and exploration logs within the geotechnical report, copy of which is located within Section 10 of this Report, for depth of excavation. The bottom of the trench is located at elevation 48.51. The shallowest bottom of excavation for the two exploration pits is elevation 43.5 which is more than four feet below the bottom of the trench.

Infiltration facilities design based on infiltration rates provided in the Geotechnical Report.

See Section 15.1 of the geotechnical report which provides the design infiltration rate of 10.5 inches per hour utilized in the design of the infiltration trench.

Setbacks
o Minimum ~~500~~ 100 feet from drinking water wells and springs, septic tanks and drain fields
o Minimum 10 feet from NGPE and property line.
o Minimum 10 feet from rockeries and retaining walls.

Per consultation with Aaron Moldver at the City, the setback from drinking water wells should be 100 feet rather than 500 feet as quoted in the City's checklist. The project is meeting the required setbacks.

Infiltration systems may not be located in an area previously used as a sediment trap

Noted. No sediment traps will be proposed within the vicinity of the infiltration system.

CITY TECHNICAL NOTEBOOK SECTION 8.3.4

Per Section 8.3.4 within the City Technical Notebook, additional criteria separation from groundwater or bedrock is specified. In general, the bottom of any infiltrating stormwater facility shall be 5 feet from the seasonal high water table. Though, there are exceptions including Single Family roof infiltration – Any type of infiltration facility for the sole purpose of infiltrating runoff from single family roofs is not regulated as a UIC (WAC 173-218) and requires a minimum of 1 foot of separation from the bottom of the facility to the high water table.

See Section 4.4 of the geotechnical report which provides the estimated groundwater elevation of 33. This elevation is well over 5 feet below the bottom of the infiltration trench.

CITY TECHNICAL NOTEBOOK SECTION 8.6.11

Per Section 8.6.11 within the City Technical Notebook, additional criteria for building setback is as follows, "Setback to building of zero feet requires the building design be based upon this location. Provide confirmation from geotechnical and structural engineer of knowledge of proximity of infiltration to building."

Email correspondence is attached on the following pages from the project's architect and geotechnical engineering supporting this design.

From: dan@umbacharchitect.com
To: Gina Brooks; Stan Thompson; Tony Romanick
Subject: Re: Penny Lane II & III - Downspout Infiltration System Zero Setback to Building
Date: Monday, August 19, 2019 2:50:43 PM

I am out of town now. Structural has not really looked at the plans yet, but I expect they will just design to whatever limitations the geotech places in the foundation system..

Dan

Get Outlook for Android

On Mon, Aug 19, 2019 at 2:50 PM -0400, "Tony Romanick" <tromanick@aesgeo.com> wrote:

Thanks Gina, I will review and get back to you on this.

Tony Romanick, P.E. | Senior Project Engineer

associated earth sciences incorporated

tromanick@aesgeo.com | www.aesgeo.com
Associated Earth Sciences, Inc.
911 5th Avenue | Kirkland, Washington 98033
O| 425-827-7701 C| 425-766-2298

This email and any files transmitted with it are confidential and intended solely for the use of the individual or entity to whom they are addressed. Please notify the sender immediately by e-mail if you have received this e-mail by mistake and delete this e-mail from your system. If you are not the intended recipient you are notified that disclosing, copying, distributing or taking any action in reliance on the contents of this information is strictly prohibited.

From: Gina Brooks <GRB@coredesigninc.com>
Sent: Sunday, August 18, 2019 10:36 AM
To: Tony Romanick <tromanick@aesgeo.com>; Trevor Louviere <tlouviere@aesgeo.com>; Stan Thompson <sthompson@aesgeo.com>; dan@umbacharchitect.com
Subject: Penny Lane II & III - Downspout Infiltration System Zero Setback to Building

All,

Per the City's Technical Notebook Section 8.6.11, I need approval and consideration from the geotechnical engineer and the structural engineer for the location of the downspout infiltration facilities adjacent to the building. I am assuming the architect can act on the behalf of the structural engineer and convey this information to the structural engineer. The City requirement is listed below.

CITY REQUIREMENT
Setback to building of zero feet requires the building design be based upon this location.
Provide confirmation from geotechnical and structural engineer of knowledge of
proximity of infiltration to building.

-
The proposed trenches are not located against the building but, the City does not quote a standard setback distance from building for waiving the above condition. I want to ensure the current infiltration designs, quoted below, consider and incorporate any additional design measures as required to ensure functionality and structural stability.

The trench designs are as follows.

Penny Lane II Trench

Bottom Elevation 48.51
Adjacent Bldg Finish Floor Elevation 55.30
Closest Distance to Bldg = 5 feet

Penny Lane III Trench
Bottom Elevation 47.12
Adjacent Bldg Garage Floor Elevation 55.25
Closest Distance to Bldg Wing Wall = 1.6 feet
Closest Distance to Bldg (face of garage) = 6.1 feet

Please respond and let me know if any special design requirements are necessary including deepening foundations, etc or if the proposed design is acceptable as designed.

-

Thanks so much,

Gina R. Brooks, P.E.
Associate, Sr. Project Engineer
Core Design Inc.

O 425.885.7877

www.coredesigninc.com
We've moved! Please visit our website for the new locations.

From: Tony Romanick
To: Gina Brooks; Stan Thompson; dan@umbacharchitect.com
Subject: RE: Penny Lane II & III - Downspout Infiltration System Zero Setback to Building
Date: Wednesday, August 28, 2019 8:11:54 AM

Hi Gina,

The trench for Penny lane II is set back far enough from the building and is suitable as designed.

For Penny Lane III, due to the close proximity of the wing walls to the trench, we recommend the bottom of wing wall foundation be located within a foot (vertically) of the bottom of infiltration trench.

Thanks,

Tony Romanick, P.E. | Senior Project Engineer

associated earth sciences incorporated

tromanick@aesgeo.com | www.aesgeo.com
Associated Earth Sciences, Inc.
911 5th Avenue | Kirkland, Washington 98033
O| 425-827-7701 C| 425-766-2298
This email and any files transmitted with it are confidential and intended solely for the use of the individual or entity to whom they are addressed. Please notify the sender immediately by e-mail if you have received this e-mail by mistake and delete this e-mail from your system. If you are not the intended recipient you are notified that disclosing, copying, distributing or taking any action in reliance on the contents of this information is strictly prohibited.

From: Gina Brooks <GRB@coredesigninc.com>
Sent: Sunday, August 18, 2019 10:36 AM
To: Tony Romanick <tromanick@aesgeo.com>; Trevor Louviere <tlouviere@aesgeo.com>; Stan Thompson <sthompson@aesgeo.com>; dan@umbacharchitect.com
Subject: Penny Lane II & III - Downspout Infiltration System Zero Setback to Building

All,

Per the City's Technical Notebook Section 8.6.11, I need approval and consideration from the geotechnical engineer and the structural engineer for the location of the downspout infiltration facilities adjacent to the building. I am assuming the architect can act on the behalf of the structural engineer and convey this information to the structural engineer. The City requirement is listed below.

CITY REQUIREMENT
Setback to building of zero feet requires the building design be based upon this location.
Provide confirmation from geotechnical and structural engineer of knowledge of
proximity of infiltration to building.

-
The proposed trenches are not located against the building but, the City does not quote a standard setback distance from building for waiving the above condition. I want to ensure the current infiltration designs, quoted below, consider and incorporate any additional design measures as required to ensure functionality and structural stability.

The trench designs are as follows.

Penny Lane II Trench
Bottom Elevation 48.51

Adjacent Bldg Finish Floor Elevation 55.30
Closest Distance to Bldg = 5 feet

Penny Lane III Trench
Bottom Elevation 47.12
Adjacent Bldg Garage Floor Elevation 55.25
Closest Distance to Bldg Wing Wall = 1.6 feet
Closest Distance to Bldg (face of garage) = 6.1 feet

Please respond and let me know if any special design requirements are necessary including deepening foundations, etc or if the proposed design is acceptable as designed.

-

Thanks so much,

Gina R. Brooks, P.E.
Associate, Sr. Project Engineer
Core Design Inc.

O 425.885.7877

www.coredesigninc.com
We've moved! Please visit our website for the new locations.

D. Conveyance System Analysis and Design

The conveyance system analysis and design will be completed at final design.

E. Downtown Sub-Basin Stormwater Capital Facilities Charge Calculation

See calculation for the Downtown Sub-basin Stormwater Capital Facilities Charge per RMC 13.20.045 on the following page.

CITY OF REDMOND STORMWATER
ASSESSMENT PER ORDINANCES 2041, 2320, 2435
CAPITAL FACILITIES CHARGES

Post to Transcode 1786

Date	8/15/2019
PROJECT NAME:	Penny Lane II
TAX LOT #:	779290-0125, -0130, -0140
ADDRESS:	7960, 7970, 7980 170th Ave NE
PERMIT #:	LAND 2019-00399

This form calculates fees based upon the fees current on April 18, 2019. Fees may change in the future.

Step One - Impervious Surfaces Calculation

	Parcel*	ROW**
Impervious Surfaces (sq ft) A	20,805	1,799
Impervious Units B = A\2000	10.4	0.8

Step Two - City Wide Fee Calculation

	Previously Paid Impervious Units*** C	Net IU D = B - C	Rate E	Fee F = D * E
City Wide Fee (Parcel Only)		10.4	$1,342.00	$13,957

***** If project outside of Downtown or Overlake, skip to Step 5 *****

Step Three - Credit for Infiltrated Impervious (Applies to Downtown and Overlake Fees Only)

	Parcel**	ROW***
Fully Infiltrated Impervious Surfaces (sq ft) G	14,712	
Infiltrated Impervious Units H = G\2000	7.3	0.0
Credited Impervious Units I = H * 80%	5.8	0.0

Step Four - Regional Fee Calculation (if applicable)

Regional Fees (Include ROW)	Previously Paid Impervious Units*** J	Net IU K = B - I - J	Rate L	Fee M = L * K
☑ Downtown		5.4	$5,979.00	$32,287
☐ Overlake		0.0	$10,929.00	$0

Step Five - Total Project Fee

Project Fee N = M + F	**$46,243.40**

Notes

Impervious units are truncated to the tenth

Net IU may not be less than zero

***Parcel area after ROW dedication**

**** ROW after ROW dedication. Includes any impervious surfaces created by project**

***** Requires documentation of previous payment**

SECTION 5. CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

The SWPPP will be completed at final design and submitted under separate cover. The SWPPP will include consideration of the 12 Elements listed below.

- Mark Clearing Limits
- Establish Construction Access
- Control Flow Rates
- Install Sediment Controls
- Stabilize Soils
- Protect Slopes
- Protect Drain Inlets
- Stabilize Channels And Outlets
- Control Pollutants
- Control De-Watering
- Maintain BMPs
- Manage the Project

SECTION 6. OTHER PERMITS

No other permits with relation to this Storm Drainage Report are known to be required at this time.

SECTION 7. OPERATIONS AND MAINTENANCE MANUAL

The Operations and Maintenance Manual will be completed at final design and submitted under separate cover.

SECTION 8. BOND QUANTITIES WORKSHEET

The bond quantities worksheet will be completed at final design and submitted under separate cover.

SECTION 9. LID SITE ASSESSMENT

Per Chapter 8.7.2 of the City Technical Notebook, all projects that trigger Minimum Requirement #1 are required to submit a site assessment. See completed LID Site Assessment and Planning Packet taken from Appendix N of the City Technical Notebook on the following pages.

ATTACHMENT O

LID Site Assessment and Planning Packet

Instructions for completing this packet:

- This packet is to be completed as part of a preliminary site assessment by the applicant per RZC 21.17.10E and as specified in the Stormwater Technical Notebook (STN).
- For documentation purposes, all projects that result in 2,000 square feet or greater of new, replaced, or new plus replaced hard surface area or have land disturbing activity of 7,000 square feet or greater must complete an LID assessment and include this packet as an appendix to the project drainage report submitted as part of the site plan entitlement process.
- This packet is to be completed early in the site development process. Please complete all sections of this packet to the best of your ability. Some sections may not apply. You may state "Not Applicable" only when you can explain why it does not apply and not when the answer is unknown. Consulting with a qualified consultant may be necessary to determine ascertain certain features of the property (i.e. depth to groundwater/ infiltration rates). Please consult with a geotechnical engineer or civil engineer if your project meets the thresholds identified above.
- This is a fillable PDF form. The forms will expand and allow you to enter more text than the space indicates. If you should run out of space, attach a separate sheet and write "continued from" and include the section and number (i.e. D.1).

The goal of this assessment is to:

- Document how projects propose to minimize:
  - Impervious areas
  - Loss of native vegetation
  - Stormwater runoff
- Demonstrate how the project proposes to comply with Minimum Requirement #5: On-site Stormwater Management.
- Some of the below requirements are modified based on whether the project is located within an urban center or an area draining to a flow control exempt water body. To determine how your site's location in the City influences On-site Stormwater Requirements (Minimum Requirement #5) refer to Map 1- MR 5: Stormwater Management Custom Areas at end of this packet and then look for the corresponding symbol for where requirements are modified. (This map is also found as Appendix F in the Redmond Stormwater Technical notebook). The custom flow control areas in Redmond include:
  - Downtown
  - Overlake
  - SR520 Drainage Basin
  - 40th Street Basin
  - SE Redmond (some properties)

APPLICANT INFORMATION

Company/Agency/Owner: Core Design, Inc.

Contact Person: Gina Brooks

Address: 12100 NE 195th St, Suite 300
Bothell, WA 98011

Phone: 425-885-7877

Email: grb@coredesigninc.com

Signature: Gina R Brooks

Date: 8-29-2019

A PROJECT INFORMATION

Project Number: LAND-2019-00399 and LAND2019-00400 Penny Lane II

Project Address or Boundaries: 7960, 7970 & 7980 170th Ave NE

Parcel Number: 779290-0125, -0130, -0140

Is the site in a Flow Control Exempt area? (Refer to Section 2.5.7 of the STN): ☑ Yes ☐ No

If yes, note the items that are footnoted in the tables in Section F "F. Potential LID BMP Matrix" and refer to that footnote at the bottom of each table.

Is the site located within the Marymoor Subarea as depicted on Map 1? (Refer to Map 1at the end of this packet): ☐ Yes ☑ No

If yes, Sections B, C, D and E do not need to be completed as the intent of this packet will be exceeded through the infiltration of 100% of site runoff.

Is the site located within a Critical Aquifer Recharge Area? (Refer to Map 2: Critical Aquifer Recharge Areas at the end of this packet): ☑ Yes ☐ No

If yes, refer to Section 8.3.2 of the STN. Single-family residential projects in Critical Aquifer Recharge Area I may infiltrate runoff from pollution generating hard surfaces only after enhanced treatment using a BMP that is exposed to the surface (such as bioretention visible from public sidewalks or roads). In the Marymoor Subarea there is no stormwater conveyance available, so development is required to infiltrate stormwater, even if it lies within CARA I. Stormwater must receive enhanced treatment prior to infiltration. Infiltration of runoff from non-pollution generating surfaces is encouraged where feasible.

Project Type: ☑ Residential ☐ Commercial ☐ Industrial ☐ Public ☐ New Development ☑ Redevelopment ☐ Remodel ☐ Retrofit

☐ Combination (explain)

Project Description: Fourteen unit townhome project

B LOW IMPACT DEVELOPMENT GOALS

In the spaces below, please document project efforts to:

Minimize Impervious Surface Coverage: _____

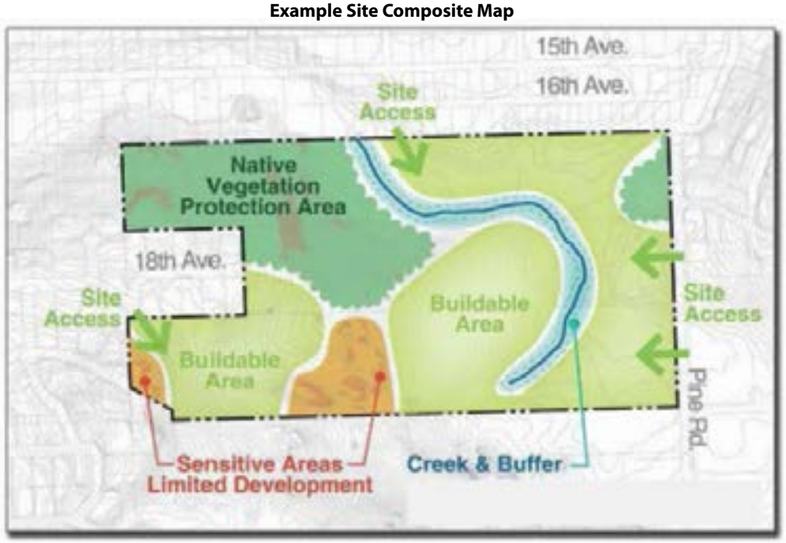
Minimize Loss of Native Vegetation: _____

Minimize Stormwater Runoff: All roof drainage will be infiltrated.

C CREATE SITE COMPOSITE MAP

Develop a composite site map as you collect site information in Section D. See the example below. This map must be submitted as part of the completed packet, and will be used as the basis for the site design.

Example Site Composite Map



D EXISTING SITE INVENTORY AND ANALYSIS CHECKLIST

Use this portion of the packet to document the site inventory and analysis. For additional information on each portion of the analysis, refer to Chapter 2 of the City of Redmond Stormwater Technical Notebook 8.

1. PROJECT BOUNDARIES AND STRUCTURES

See Existing and Developed Conditions exhibits on the following pages.

- ❑ Identify/delineate on map:
  - ❑ Project Site boundaries (limits of disturbance)
  - ❑ Existing and proposed buildings
  - ❑ Required Infiltration setbacks (please describe) Property line: 10 feet; Bldg: 0 feet.
  - ❑ Location and extent of proposed foundations and footing drains

ATTACHMENT O

2. SOILS

- ❑ Characterize existing soil type(s) (Refer to Section 10.5.3 of the Stormwater Technical Notebook): Group A/B
- ❑ What is the depth to seasonal average high groundwater (feet) as determined by a geotechnical investigation? (Refer to Section 2.9.3.9 of the Stormwater Technical Notebook) Elev. 33
- ❑ Is bedrock present? ☐ Yes ☑ No If yes, depth (feet) _____
- ❑ What is the measured long-term native soil infiltration rate (inch/hour) 10.5
- ❑ Identify source(s) of information used: Geotechnical Report by AESI

3. CRITICAL AREAS

- ❑ Identify and map any Critical Areas and associated buffers located on the project site and within the project vicinity
  - ❑ Erosion Hazard Areas None
  - ❑ Fish and Habitat Conservation Areas None
  - ❑ Floodplains None
  - ❑ Frequently Flooded Area/Special Flood Hazard Area None
  - ❑ Critical Aquifer Recharge Areas CARA 1
  - ❑ Landslide hazard Areas None
  - ❑ Seismic Hazard Areas See Existing Conditions exhibit for approx. location.
  - ❑ Shoreline Environments None
  - ❑ Streams None
  - ❑ Wetlands None
  - ❑ Other _____

4. TOPOGRAPHY

- ❑ Describe site topography and slopes: Site is flat with steepest slope of 3%
- ❑ Identify/Delineate on map:
  - ❑ Areas of flat(≤5%), moderate (5%-20%), moderate-steep (20%-40%) and steep(≥40%)slopes
  - ❑ Closed depressions

5. HYDROLOGIC PATTERNS & FEATURES

- ❑ Identify/Delineate on map:
  - ❑ Sub-basin(s) None
  - ❑ Existing drainage swales and ditches (please describe) None
  - ❑ Location(s) if any natural seeps or springs (please describe) None
  - ❑ Existing discharge location(s) from each sub-basin and overall project site: (please describe) See Existing Conditions exhibit for drainage pattern.
  - ❑ Signs of existing erosion (please describe) None
  - ❑ Existing flooding or drainage complaints on site or vicinity None
  - ❑ Other _____

6. VEGETATION

- ❑ Native vegetation type(s): Douglas Fir, Western Red Cedar, Cascara, Big Leaf Maple
- ❑ Approximate tree canopy coverage (acres): 0.14
- ❑ Number of trees (greater than 6-inch diameter at breast height) 14
- ❑ Identify source(s) of information used: Arborist Report, Site Photos

7. LAND USE CONTROLS

- ❑ What is the project site zoning? EH
- ❑ Describe landscaping requirements: 2,800 sf private open space required. 3,789 sf provided
- ❑ Describe parking requirements: 14 private and 4 public required. 28 private and greater than 4 public provided.
- ❑ Describe any applicable comprehensive plan designation, zoning classification, and/or overlay districts that apply to the site:
- ❑ Does a Shoreline Master Plan apply to the site? ☐ Yes ☑ No
  - ❑ If yes, describe

8. ACCESS

- ❑ Identify/Delineate on map:
  - ❑ Roads, driveways, and other points of ingress and egress within 50 feet of the project site: See Existing Conditions exhibit
  - ❑ Identify frontage improvement requirements: Public Local Access Type III (170th Ave NE) and Public Local Access Type VII (170th Court NE)

9. UTILITY AVAILABILITY AND CONFLICTS

A complete understanding of existing and proposed buried utilities is necessary to properly plan for infiltration.

- ❑ Identify/Delineate on map:
  - ❑ Existing utilities and easements present on and adjacent to the project site, including utility owner. Also note any utility or easement setback requirements that affect site planning: See Existing Conditions exhibit. All existing utilities located within ROWs
  - ❑ Existing utilities that may need to be moved and new utilities that may need to be extended to the site: See Developed Conditions Exhibit.

EXISTING SITE CONDITIONS

	EXISTING CONDITIONS	PROPOSED CONDITIONS
Vegetated Areas		
Tree Canopy (acres)	0.19	0.14
Landscape (acres)	0.34	0.10
Total project vegetated area	0.53	0.24
Impervious Area		
Total roof impervious area (sq. feet)	NA	14,712
Total site impervious area (acres)	0.29	0.52
Change		
% Increase/decrease in vegetated area		-37%
% Increase/decrease in impervious area		+37% (-17% with roof infiltration)

POTENTIAL LID BMP MATRIX

ATTACHMENT O

For each of the following surfaces proposed, complete the following matrices evaluating the BMPs in the order as specified in Lists #1 and #2 contained within the Stormwater Technical Notebook*:*

- ❑ Lawn and landscaped areas
- ❑ Roofs
- ❑ Other hard surfaces

SURFACE TYPE: Roofs

For each LID BMP being evaluated, use the infeasibility criteria for each BMP in the SWMMWW to determine whether the LID BMP is infeasible for your project. You must use the first BMP that is feasible in accordance with Lists #1 and List#2 of the STN.

	FEASIBILITY/INFEASIBILITY EVALUATION			
	FEASIBLE	INFEASIBLE	NOT APPLICABLE/ NOT KNOWN	If infeasible provide justification as stated by the Infeasibility Criteria in the SWMMWW
Post Construction Soil Quality and Depth	○	○	◉	
Full Dispersion[1]	○	○	◉	See footnote 1
Downspout Full Infiltration (Roofs, only)	◉	○	○	
Rain Gardens/Bioretention[1]	○	○	◉	See footnote 1
Permeable Pavement or Functional Equivalent[1]	○	○	◉	See footnote 1
Downspout Dispersion	○	◉	○	Insufficient flow path
Perforated Stubout Connection (Roofs, only)	○	○	◉	Full infiltration is utilized instead for roof.
Sheet Flow Dispersion	○	○	◉	
Concentrated Flow Dispersion	○	◉	○	Insufficient flow path

[1]Not Required in Flow Control Exempt Areas

SURFACE TYPE: Other Hard Surfaces

For each LID BMP being evaluated, use the infeasibility criteria for each BMP in the SWMMWW to determine whether the LID BMP is infeasible for your project. You must use the first BMP that is feasible in accordance with Lists #1 and List#2 of the STN.

	FEASIBILITY/INFEASIBILITY EVALUATION			
	FEASIBLE	INFEASIBLE	NOT APPLICABLE/ NOT KNOWN	If infeasible provide justification as stated by the Infeasibility Criteria in the SWMMWW
Post Construction Soil Quality and Depth	○	○	●	
Full Dispersion[1]	○	○	●	See Footnote 1
Downspout Full Infiltration (Roofs, only)	○	○	●	
Rain Gardens/Bioretention[1]	○	○	●	See Footnote 1
Permeable Pavement or Functional Equivalent[1]	○	○	●	See Footnote 1
Downspout Dispersion	○	○	●	
Perforated Stubout Connection (Roofs, only)	○	○	●	
Sheet Flow Dispersion	●	○	○	
Concentrated Flow Dispersion	○	○	●	Insufficient flowpath

[1]Not Required in Flow Control Exempt Areas

SURFACE TYPE: Lawn and landscape

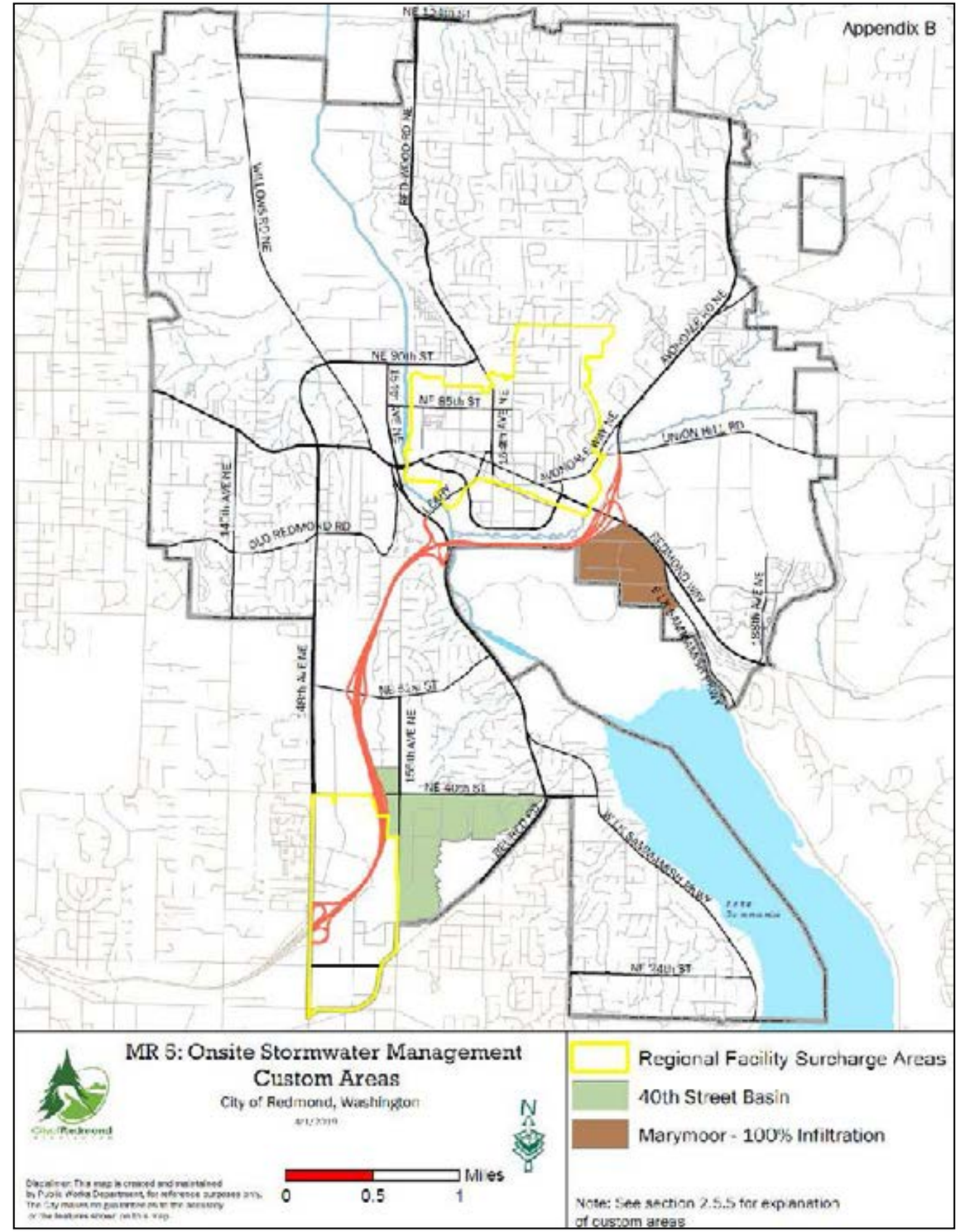
For each LID BMP being evaluated, use the infeasibility criteria for each BMP in the SWMMWW to determine whether the LID BMP is infeasible for your project. You must use the first BMP that is feasible in accordance with Lists #1 and List#2 of the STN.

	FEASIBILITY/INFEASIBILITY EVALUATION			
	FEASIBLE	INFEASIBLE	NOT APPLICABLE/ NOT KNOWN	If infeasible provide justification as stated by the Infeasibility Criteria in the SWMMWW
Post Construction Soil Quality and Depth	●	○	○	
Full Dispersion[1]	○	○	●	See Footnote 1
Downspout Full Infiltration (Roofs, only)	○	○	●	
Rain Gardens/Bioretention[1]	○	○	●	See Footnote 1
Permeable Pavement or Functional Equivalent[1]	○	○	●	
Downspout Dispersion	○	○	●	
Perforated Stubout Connection (Roofs, only)	○	○	●	
Sheet Flow Dispersion	○	○	●	
Concentrated Flow Dispersion	○	○	●	

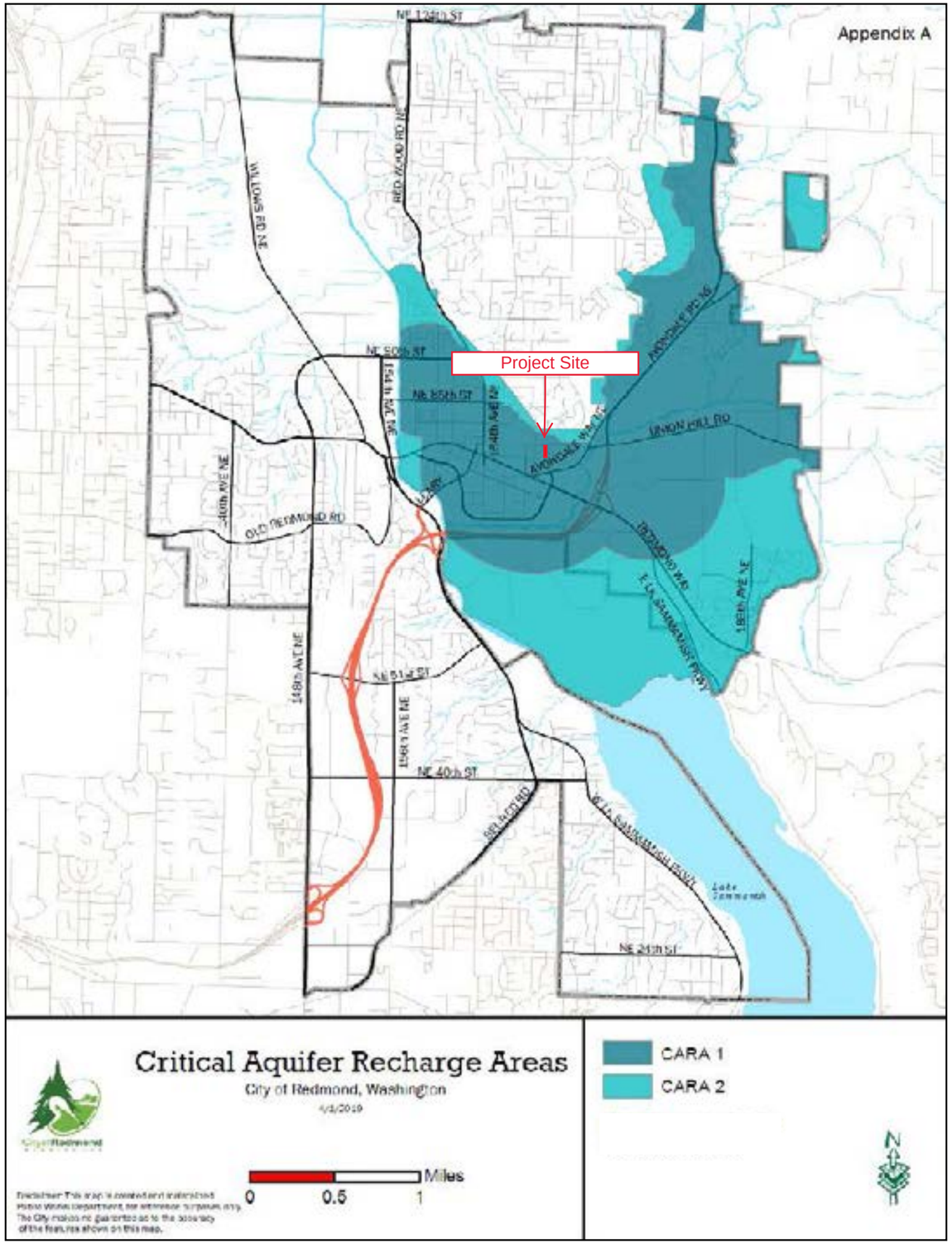
[1]Not Required in Flow Control Exempt Areas

Map 1: Onsite Stormwater Management Custom Areas

ATTACHMENT O

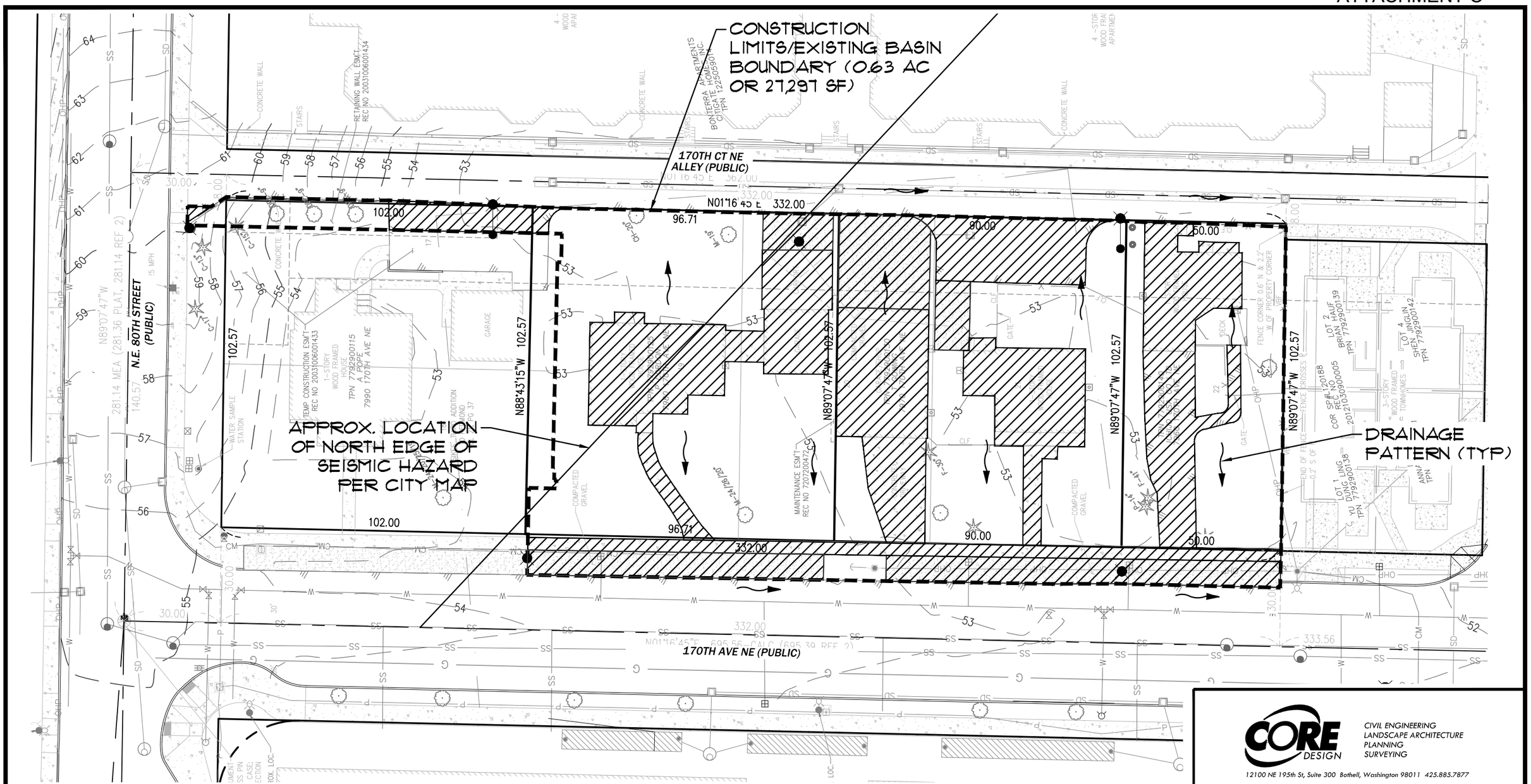


Map 2: Critical Aquifer Recharge Areas



ATTACH COMPLETED SITE COMPOSITE MAP HERE.

ATTACHMENT O



EXISTING IMPERVIOUS AREA (0.29 AC OR 12,693 SF)

TOPOGRAPHY: FLAT (≤5%)

SCALE: 1" = 30'

0 7.5 15 30

CORE DESIGN

CIVIL ENGINEERING
LANDSCAPE ARCHITECTURE
PLANNING
SURVEYING

12100 NE 195th St, Suite 300 Bothell, Washington 98011 425.885.7877

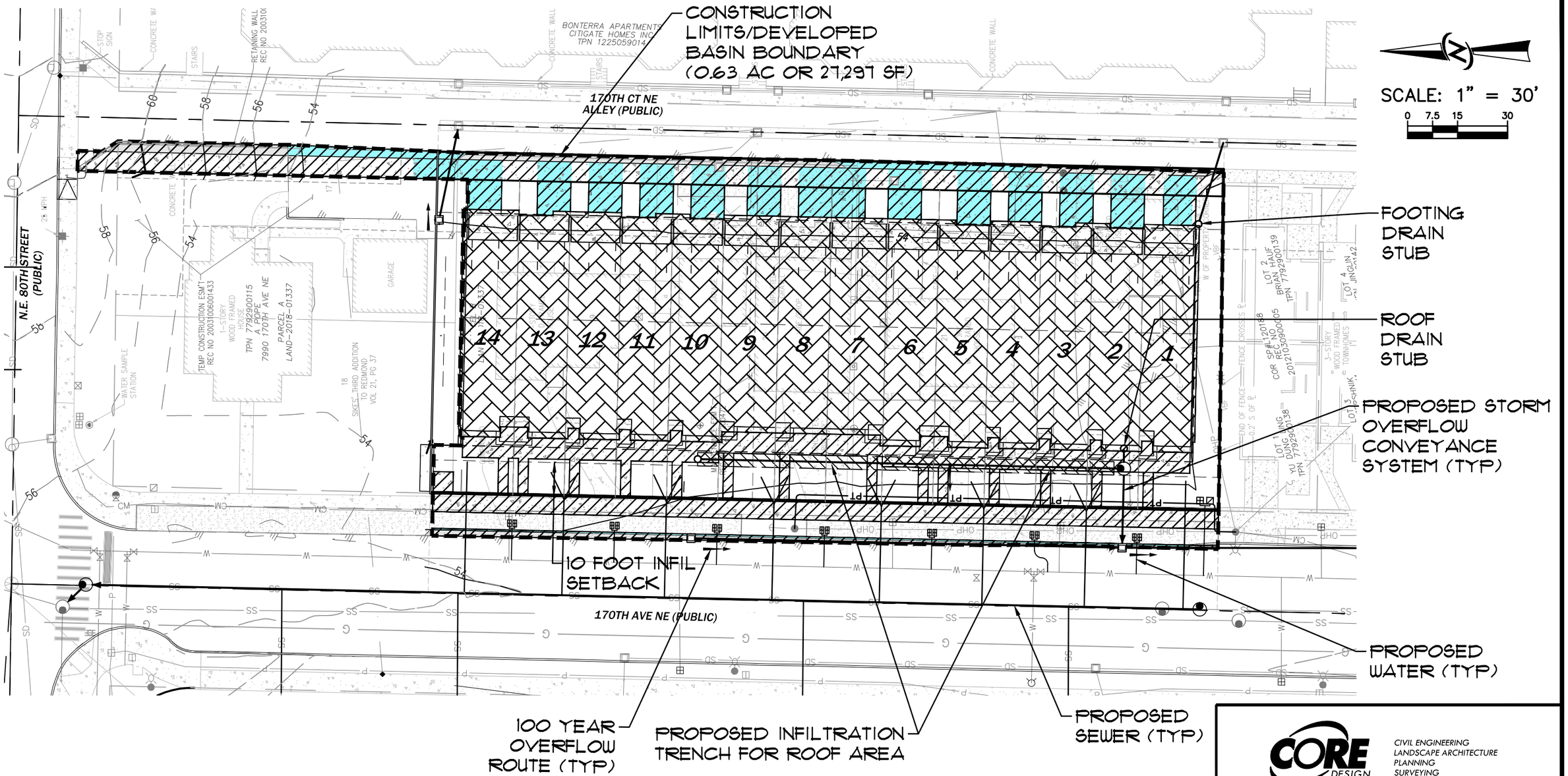
EXISTING CONDITIONS

PENNY LANE II

DATE	FEB 2019	SHEET	OF
DESIGNED	GRB		
DRAWN	DSV	PROJECT NUMBER 17051	

J:\2017\17051\Engineering\Exhibits\17051 PL2 EX. CONDITIONS EXHIBIT.dwg, SITE PLAN, 4/30/2019 2:15:41 PM, DSV, DWG To PDF.pc3, 1:1

ATTACHMENT O



ROOF AREA
(0.34 AC OR 14,712 SF)

PROPOSED IMPERVIOUS AREA
(EXCLUDING ROOF)
(0.18 AC OR 7,892 SF)

PGIS/NPGIS AREA BREAKDOWN

PGIS (3,365 SF)

NPGIS (19,239 SF)

CORE DESIGN
CIVIL ENGINEERING
LANDSCAPE ARCHITECTURE
PLANNING
SURVEYING
12100 NE 195th St, Suite 300 Bothell, Washington 98011 425.885.7877

DEVELOPED CONDITIONS

PENNY LANE II

DATE	FEB 2019	SHEET	OF
DESIGNED	GRB		
DRAWN	DSV	PROJECT NUMBER 17051	

J:\2017\17051\Engineering\Exhibits\17051 PL2 DEV. CONDITIONS EXHIBIT.dwg, 8/21/2019 12:36:29 PM, DWG To PDF.pc3

SECTION 10. SPECIAL REPORT AND STUDIES

The following reports and assessments are provided for reference and informational purposes only. Core Design takes no responsibility or liability for these reports, assessments or designs as they were not completed under the direct supervision of Core Design.

The following report is included in this section:

- Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report, dated November 19, 2019, by Associated Earth Sciences, Inc.

ATTACHMENT O

associated
earth sciences
incorporated

Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report

PENNY LANE II & III

Redmond, Washington

Prepared For:

ICHIJO USA CO., LTD.

Project No. 20180106E001
April 16, 2019
Revised November 19, 2019

Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, WA 98033
P (425) 827 7701

ATTACHMENT O

associated earth sciences incorporated

April 16, 2019
Revised November 19, 2019
Project No. 20180106E001

Ichijo USA Co., Ltd.
15135 NE 90th Street, Suite 200
Redmond, Washington 98052

Attention: Mr. Randy Barnett

Subject: Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report
Penny Lane II & III
Redmond, Washington

Dear Mr. Barnett:

Associated Earth Sciences, Inc. (AESI) is pleased to present this report providing the results of our Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report for the above-referenced site. This report has been prepared for the exclusive use of Ichijo USA Co., Ltd. and their agents, for specific application to this project.

We have enjoyed working on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions, or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Bruce L. Blyton, P.E.
Senior Principal Engineer

BLB/ms - 20180106E001-13

ATTACHMENT O

SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND GEOTECHNICAL ENGINEERING REPORT

PENNY LANE II & III

Redmond, Washington

Prepared for:
Ichijo USA Co., Ltd.
15135 NE 90th Street, Suite 200
Redmond, Washington 98052

Prepared by:
Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, Washington 98033
425-827-7701

April 16, 2019
Revised November 19, 2019
Project No. 20180106E001

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of Associated Earth Sciences, Inc's. (AESI) subsurface exploration, geologic hazard, and geotechnical engineering study for the proposed new multi-family residential development. The location of the site is shown on the "Vicinity Map," Figure 1. The approximate locations of explorations completed for this study, along with existing site features, are shown on the "Existing Site and Exploration Plan," Figure 2. The approximate locations of explorations, along with proposed site features, are shown on the "Proposed Site and Exploration Plan," Figure 3. Interpretive exploration logs are included in the Appendix A. The conclusions and recommendations contained in this report should be reviewed and modified, or verified, if project plans change substantially. For preparation of this report we were provided with plan sets for "Penny Lane II" and "Penny Lane III," prepared by CORE Design, dated August 29, 2019. AESI has also prepared a "Critical Aquifer Recharge Areas Report," dated April 17, 2019, (AESI, 2019) to address City of Redmond requirements for critical areas.

1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the design of the project. Our study included a review of selected geologic literature, completion of four exploration borings with a track-mounted hollow-stem auger drill rig, completion of ten exploration pits with a track-mounted excavator, and performance of geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater. Geotechnical engineering and hydrogeologic studies were completed to formulate our recommendations for site preparation, site grading, construction, stormwater infiltration, and drainage. This report summarizes our current fieldwork and offers recommendations for development based on our present understanding of the project. We recommend that we be allowed to review any revisions to project plans to verify that our geotechnical engineering and hydrogeologic recommendations have been correctly interpreted and incorporated into the design.

1.2 Authorization

This report has been prepared for the exclusive use of Ichijo USA Co., Ltd. and their agents for specific application to this project. Our work was performed in accordance with our scope of work and cost proposal dated March 7, 2018. We were authorized to proceed by means of a consultant agreement.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The subject site consists of King County Tax Parcel Nos. 7792900-115, -125, -130, and -140, located along 170th Avenue NE immediately south of NE 80th Street, in Redmond, Washington. The parcels are rectangular shaped in plan view and have a total approximate area of 0.8 acres combined. Each parcel is occupied by a single-family residence, garage, paved parking and driveway, lawn areas, and landscaping. Site topography across the parcels is relatively flat with overall vertical relief estimated at 10 feet. The project area lies within the City of Redmond's Wellhead Protection Zone 1. AESI has completed a Critical Areas report (AESI, 2019), which addresses the City of Redmond Requirements for a Critical Aquifer Recharge Area (CARA) report.

We understand the project will consist of, at-grade, row-house-style townhomes across the four adjacent lots and arranged into two separate structures, referred to as Penny Lane II and Penny Lane III. The townhomes will be supported by conventional spread footings. Two infiltration trenches are proposed at the project site—one along each new townhome building. Other site improvements will include sidewalks, landscaping, at-grade parking and utilities.

3.0 SUBSURFACE EXPLORATION

AESI conducted several rounds of explorations at the project site. Exploration borings EB-1 through EB-4 were completed at the site on March 28, 2018 and March 29, 2018 and were completed with a track-mounted hollow-stem auger drill rig. Exploration Pits EP-1 through EP-10 were completed at the project site on April 22, 2018, and February 28, 2019, and were completed with a track-mounted excavator. The locations of the exploration borings shown on the "Existing Site and Exploration Plan" (Figure 2) and "Proposed Site and Exploration Plan" (Figure 3) were estimated based on approximate distances from existing site features. Interpretive exploration logs are presented in the Appendix A.

The conclusions and recommendations presented in this report are based on the explorations completed for this study. The number, locations, and depths of our explorations were completed within site and budgetary constraints.

3.1 Exploratory Borings

The exploration borings were completed by advancing hollow-stem auger tools with a track-mounted or trailer-mounted drill rig. During the drilling process, samples were obtained at generally 2½-foot and 5-foot-depth intervals. The exploration borings were continuously observed and logged by a representative from our firm. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed, but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM) D-1586. This test and sampling method consists of driving a standard 2-inch, outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing, as summarized in this report.

3.2 Exploration Pits

The exploration pits were excavated with a track-mounted excavator. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by a geotechnical engineer from our firm. All exploration pits were backfilled immediately after examination and logging. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. Because of the nature of exploratory work below ground, interpolation of subsurface conditions between field 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 between the field explorations may not become fully evident until construction. The general distribution of geologic units is shown on the exploration logs.

The explorations typically encountered surficial alluvial native materials consisting of medium dense sand and gravel sediments. In one of our exploration borings, we encountered pre-Fraser silts underlying the alluvial sands and gravels at a depth of 23 feet below the surface. Three exploration borings and six exploration pits encountered surficial existing fill soils, ranging from 2 feet to greater than 9 feet in thickness.

4.1 Stratigraphy

Fill

Fill soils (those not naturally placed) were encountered in exploration borings EB-1, EB-2, and EB-4, and in exploration pits EP-4 through EP-8 and EP-10. The fill ranged in thickness from 2 feet to greater than 9 feet where encountered. The fill soils generally consisted of sandy silt with trace gravel, and fine to medium sands with varying amounts of silt and gravel. The fill encountered varies in thickness over relatively short horizontal distances. For example, EP-3 encountered no fill soils and EB-4—located less than 20 feet to the east—encountered fill thickness greater than 9 feet. This amount of variability over relatively short distances may be from past excavations, utility trench backfill, demolition of former buildings, or other past construction or grading episodes.

The fines content of fill was highly variable and, where containing relatively high fines, would be considered moisture-sensitive. The existing fill should not be used for infiltration of site stormwater or for support of foundations.

Alluvium

Explorations borings EB-1 and EB-3, as well as all of the exploration pits, encountered native sediments generally consisting of medium dense grading to dense, sandy gravels/gravelly sands with varying amounts of silt. Zones of sand with some silt and some gravel were also encountered, but were less common. The alluvial sediments extended beyond the depths explored except for exploration boring EB-1 where the alluvium was underlain at a depth of 23 feet below the surface by pre-Fraser silts. Holocene alluvium was deposited in streambeds and alluvial fans subsequent to the full recession (melting) of the Vashon-age glacier in the area of the site approximately 12,500 years ago.

Medium dense alluvium is generally suitable for support of light to moderately loaded foundations when properly prepared. Where permeable and unsaturated, the alluvial

sediments are a potentially suitable stormwater infiltration receptor. Excavated Holocene alluvium is suitable for reuse in structural fill applications provided all particles over 6 inches in diameter and other deleterious materials are removed. We anticipate that the native alluvial sediments were at or near optimum moisture content for structural fill applications at the time or our explorations.

Pre-Fraser Fine-Grained Sediments

Underlying the alluvium in exploration boring EB-1, we encountered sediments consisting of hard silt with trace sand and gravel. These sediments were encountered at a depth of 23 feet below the surface and extended beyond a depth of 31.5 feet below the surface. These sediments were deposited prior to the Fraser Glaciation of the region. The high relative density characteristic of these sediments is due to their consolidation by the massive weight of the glacial ice that overrode them subsequent to their deposition. Pre-Fraser fine-grained sediments are not expected to provide direct support for structures or hardscapes onsite.

Review of Selected Available Geologic and Soil Data

Review of the regional geologic map titled *Geologic Map of the Redmond Quadrangle* (Derek B. Booth and J.P. Minard, 1988) indicates that the site is underlain by Holocene-age alluvium. This is consistent with our interpretation of the sediments encountered in the explorations completed at the project site.

Review of regional soils mapping (D.E. Snyder, P.S. Gale, and R.F. Pringle, 1973, *Soil Survey of King County Area, Washington*, U.S. Department of Agriculture [USDA], Soils Conservation Service [SCS] now referred to as Natural Resources Conservation Service [NRCS]) indicates that the subject site is underlain by Everett very gravelly sandy loam. Everett soils are formed from the weathering of sandy and gravelly outwash. The native shallow sediments onsite are consistent with the published soils map.

4.2 Hydrology

The site and surrounding vicinity are underlain by a regional unconfined aquifer located within the Holocene alluvium and Vashon recessional outwash deposits found throughout the Sammamish Valley. We encountered groundwater seepage in exploration boring EB-1 at a depth of 22 feet below the surface and is representative of the regional unconfined aquifer.

It should be noted that fluctuations in the level of the groundwater can occur due to the time of the year, variations in rainfall, on- and off-site land uses, and other factors. Locally perched groundwater can sometimes be present above finer-grained (silt, fine sand) interbeds within the alluvium during and following extended periods of precipitation.

Seasonal High Groundwater Elevation

As stated in our CARA report (AESI, 2019), based on our analysis of long-term water level data from the City monitoring wells, AESI extrapolates a seasonal high groundwater level of up to 32 feet elevation (21 feet bgs) with short-term peaks up to 33 feet elevation at the project site. Further detail on this approach can be found in the referenced report.

We then compared our estimate with the procedure provided in Section 2.9.3.9 of the City of Redmond's *Stormwater Technical Notebook 2019* - Issue 8 (2019 SWTN). The SWTN procedure determines a groundwater high elevation by averaging the highest individual peak groundwater elevations each year for a 5-year period from water level data measured in nearby City wells with data provided by the City of Redmond. AESI obtained continuous water level data dating back to January 2014 for monitoring well MW009 located approximately 650 feet southwest of the project site. We also received biyearly water level data for MW052 located approximately 250 feet to the southwest. Tables 1 and 2 below present the yearly seasonal high groundwater elevations for the last 5 years and the average of those values for MW009 and MW052, respectively.

Table 1
MW009 Yearly Peak Groundwater Elevation

Month/Year	Elevation (feet)
1/2014	31.62
12/2015	32.36
1/2016	31.74
2/2017	30.11
1/2018	28.61
Average	**30.88**

Table 2
MW052 Yearly Peak Groundwater Elevation

Month/Year	Elevation (feet)
1/2014	28.84
1/2015	30.84
1/2016	31.83
2/2017	29.05
1/2018	28.47
Average	**29.81**

The high groundwater elevation provided in our CARA report of 33 feet is more conservative when compared to the averages obtained from wells MW009 and MW052 following the SWTN. Therefore, we recommend that the project uses a groundwater high elevation of 33 feet for infiltration facility design.

4.3 Laboratory Grain-Size Analysis

Three laboratory grain-size (sieve) analyses were performed by AESI's in-house laboratory on representative selected samples collected from AESI's subsurface exploration pits. The grain-size analysis test results are presented in Appendix B and are summarized in Table 3. Based on the ASTM D-2487 Unified Soil Classification System (USCS), the grain-size analysis test results indicate that the alluvial sediments generally correlate to a "Gravel" with a variable fines content generally ranging from 2.4 to 3.9 percent. The gravel content ranged as high as 73 percent, the fines content ranged from 0.6 percent to 4.8 percent.

Table 3
Summary of Grain Size Analyses

Exploration	Depth (feet)	USCS Description	Silt Content by Weight (Measured on #200 Sieve)
EP-1	10	Sandy GRAVEL, trace silt	2.4
EP-4	9	Very sandy GRAVEL, trace silt	3.7
EP-5	4	Sandy GRAVEL, trace silt	3.9
EP-6	6.5	Sandy GRAVEL, trace silt	4.8
EP-7	8	Sandy GRAVEL, trace silt	4.8
EP-8	8	Sandy GRAVEL, trace silt	0.6
EP-9	6	Sandy GRAVEL, trace silt	4.2
EP-10	6	Very sandy GRAVEL, trace silt	3.9

USCS = Unified Soil Classification System

The grain-size distribution data were also transformed to describe the USDA soil texture. The grain-size distributions were normalized to the No. 10 sieve—i.e., the coarse sand and gravel fraction of the sample is discounted and the remainder is taken as 100 percent of the sample. The fines were assessed relative to the No. 270 sieve. For soils with a significant proportion of gravel and coarse sand, the USDA soil texture can overstate the fine-grained texture. The sediments tested were about 68 to 83 percent coarse sand and gravel. The USDA soil texture for the 16 to 26 percent passing the No. 10 sieve primarily correlates to a sandy clay loam to sand. No hydrometers were performed. Soil texture represents the range assuming the fines range from silt to clay.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and shallow groundwater conditions as observed and discussed herein.

5.0 LANDSLIDE HAZARDS AND MITIGATIONS

It is our opinion that the risk of damage to the proposed structures by landsliding is low due to lack of steep slopes at the project site and vicinity. No detailed slope stability analyses were completed as part of this study, and none are warranted, in our opinion. Based on our review of the City of Redmond Municipal Code, the site vicinity does not contain areas that are considered to be governed by regulations associated with Landslide Hazard Areas.

6.0 SEISMIC HAZARDS AND MITIGATIONS

Earthquakes occur regularly in the Puget Lowland. Most of these events are small and are not felt by people. However, large earthquakes do occur, as evidenced by the 2001, 6.8-magnitude event; the 1965, 6.5-magnitude event; and the 1949, 7.2-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

Generally, the largest earthquakes that have occurred in the Puget Sound area are sub-crustal events with epicenters ranging from 50 to 70 kilometers in depth. Earthquakes that are generated at such depths usually do not result in fault rupture at the ground surface. Current research indicates that surficial ground rupture is possible in areas close to the Seattle and South Whidbey Island Fault Zones. Although our current understanding of these fault zones is limited and it is an active area of research, the site lies north of the currently mapped limits of the Seattle Fault Zone and south of the mapped limits of the South Whidbey Island Fault Zone. Therefore, based on current information, the risk of damage to planned improvements as a result of surface rupture due to faulting is low, in our opinion.

6.2 Seismically Induced Landslides

It is our opinion that the risk of damage to the proposed structures by seismically induced landsliding is low due to the lack of significant slopes at the subject site and vicinity.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

Our explorations suggest that the potential risk of damage to the proposed development by liquefaction is low, due to the large grain-size and depth to groundwater within the alluvial sediments and the high relative densities of the underlying pre-Fraser fine-grained sediments.

6.4 Seismic Site Class (2015 *International Building Code*)

In our opinion, the subsurface conditions at the site are consistent with seismic Site Class "D" in accordance with the 2015 *International Building Code* (IBC), and the publication *American Society of Civil Engineers* (ASCE) 7 referenced therein, the most recent version of which is ASCE 7-10.

7.0 EROSION HAZARDS AND MITIGATION

Based on review of the City of Redmond's map titled "Erosion Hazard Areas Critical Areas Map," the site does not lie within an erosion hazard area. However, the sediments underlying the site generally contain silt and sand that can be sensitive to erosion. In order to reduce the amount of sediment transport off the site during construction, the following recommendations should be followed:

1. Silt fencing should be placed around the lower perimeter of all disturbed area(s). The fencing should be periodically inspected and maintained as necessary to ensure proper function.

2. To the extent possible, earthwork-related construction should proceed during the drier periods of the year and disturbed areas should be revegetated as soon as possible. Temporary erosion control measures should be maintained until permanent erosion control measures are established.

3. Areas stripped of vegetation during construction should be mulched and hydroseeded, replanted as soon as possible, or otherwise protected. During winter construction, hydroseeded areas should be covered with clear plastic to facilitate grass growth.

4. If excavated soils are to be stockpiled on the site for reuse, measures should be taken to reduce the potential for erosion from the stockpile. These could include, but are not limited to, covering the pile with plastic sheeting, the use of low stockpiles in flat areas, and the use of straw bales/silt fences around pile perimeters.

5. Interceptor swales with rock check dams should be constructed to divert stormwater from construction areas and to route collected stormwater to an appropriate discharge location.

6. A rock construction entrance should be provided to reduce the amount of sediment transported off-site on truck tires.

7. All stormwater from impermeable surfaces, including driveways and roofs, should be tightlined into approved facilities and not be directed onto or above steeply sloping areas.

III. DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Our explorations indicate that from a geotechnical engineering standpoint, the proposed project is feasible provided the recommendations contained herein are properly followed. With the exception of EB-4, the bearing stratum was generally shallow and conventional shallow foundations should be suitable with proper subgrade preparation. Existing fill encountered in our explorations ranges in thickness from 2 feet to greater than 9 feet in EB-4, and will require removal where present under areas of new foundations. Fill soils are also likely to be present around existing structures and buried utilities may require removal and recompaction at the time of construction.

9.0 SITE PREPARATION

Site preparation of building and paving areas should include removal of all grass, trees, brush, debris, and any other deleterious materials. Additionally, the upper, organic topsoil should be removed and the remaining roots grubbed. All existing fill beneath planned foundation areas should be removed. We recommend that we are able to observe the removal of existing fill soils from under areas of new foundation due to the high variability of fill thicknesses, and the difficulty of distinguishing the fill soils from suitable native bearing soils. Buried utilities should be removed from planned foundation areas, and should be abandoned in place or removed from below planned new paving. Any depressions below planned final grades caused by demolition activities should be backfilled with structural fill, as discussed under the “Structural Fill” section of this report. Where existing loose fill or natural sediments are relatively free of organics and near their optimum moisture content for compaction, they can be segregated for reuse as structural fill.

9.1 Temporary and Permanent Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, we recommend that temporary, unsupported cut slopes in the existing fill or alluvial soils can be planned at an inclination of 1.5H:1V (Horizontal:Vertical) or flatter. As is typical with earthwork operations, some sloughing and raveling may occur and cut slopes may have to be adjusted in the field. If groundwater seepage is encountered in cut slopes or if surface water is not routed away from temporary cut slope faces, flatter slopes or shoring may be required. In addition, WISHA/OSHA regulations should be followed at all times.

Permanent cut and structural fill slopes should be graded no steeper than 2H:1V. Slopes should be hydroseeded, landscaped, or otherwise protected as soon as possible after grading. Cut slopes in natural soils that must be steeper than 2H:1V should be protected by retaining walls or rockeries. Unreinforced rockeries should not be used to retain fill greater than 3 feet thick.

9.2 Site Drainage and Surface Water Control

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth drum-rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Portions of the near-surface, weathered, on-site soils contain a moderate to high percentage of fine-grained material, which 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. Equipment access may be limited, and the amount of soil rendered unfit for use as structural fill may be greatly increased if drainage efforts are not accomplished in a timely sequence.

Final exterior grades should promote free and positive drainage away from planned new buildings at all times. Water must not be allowed to pond or to collect adjacent to foundations or within the immediate building area. We recommend that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeters be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided, unless provisions are included for collection and disposal of surface water adjacent to the buildings.

9.3 Wet Weather Conditions

Portions of the near-surface site soils encountered in our explorations are considered moisture-sensitive. To help mitigate the erosion potential of the site soils, we recommend that construction occur during the dry season. Also, if construction does proceed during an extended wet weather construction period, it is possible the site soils may become disturbed and too wet to use for structural fill.

9.4 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw, and then be recompacted prior to placing subsequent lifts of structural fill. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

10.0 STRUCTURAL FILL

Structural fill will be necessary to establish desired grades and for utility trench backfill. All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials, as discussed in this section. In those areas where existing, uncontrolled fill is present, we recommend that it be removed and, where suitable, set aside for reuse. Our recommendations for the placement of structural fill are presented in the following sections.

10.1 Fill Placement

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer or their representative, the upper 12 inches of exposed ground should be compacted to a firm and unyielding condition, as determined by the geotechnical engineer or their representative. If the subgrade contains too much moisture, adequate compaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of compaction, the area to receive fill should be blanketed with washed rock, quarry spalls, or crushed recycled concrete to act as a capillary break between the new fill and the wet subgrade. Structural fill should be placed and compacted within 2 percent of the optimum moisture content.

After compaction of the exposed ground is approved, or a free-draining rock course is laid, possibly in conjunction with engineering stabilization fabric, structural fill may be placed 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 at least 95 percent of the modified Proctor maximum density using ASTM D-1557 as the standard.

The contractor should note that any proposed fill soils should be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 72 hours in advance to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the U.S. No. 200 sieve) is greater than approximately 5 percent (measured on the minus U.S. No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soils in structural fills should be limited to favorable dry weather and near-optimum subgrade moisture conditions.

The on-site soils are generally suitable for use as structural fill, although the siltier fill soils observed in our explorations contained significant amounts of silt and clay, were observed to be above their optimum moisture content for compaction, and are considered moisture-sensitive. Construction equipment traversing the site when the soils are wet can cause considerable disturbance. If fill is placed during wet weather or if proper compaction

cannot be obtained due to wet subgrade or soil conditions, an imported, 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 U.S. No. 4 sieve fraction and at least 25 percent greater than the No. 4 sieve.

11.0 FOUNDATIONS

Spread footings that are supported on the native alluvial sediments, or a combination of these sediments and structural fill, may be designed with an allowable foundation soil bearing pressure of 3,000 pounds per square foot (psf), including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing stratum, and no footing should be founded in or above organic or existing fill soils.

It should be noted that the area bound 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 edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded as described above should be on the order of ¾ inch or less. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be observed by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. Such inspections may be required by the City of Redmond. Perimeter footing drains should be provided, as discussed under the “Drainage Considerations” section of this report.

12.0 DRAINAGE CONSIDERATIONS

Perimeter footing walls should be provided with a drain at the base of the footing elevation. Drains should consist of rigid, perforated, polyvinyl chloride (PVC) pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set at or slightly below the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the buildings. In addition, all retaining walls should be lined with a minimum, 12-inch-thick, washed gravel blanket, or synthetic drainage mat, which extends to within 1 foot of the surface and is continuous with the footing drain. Roof and surface runoff

should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain. In planning, exterior grades should be sloped downward away from the structures to achieve surface drainage.

13.0 FLOOR SUPPORT

Slab-on-grade floors may be constructed on undisturbed native soils or structural fill prepared as described in the "Site Preparation" section of this report. The floor should be cast atop a minimum of 4 inches of washed pea gravel or clean, uniformly graded crushed rock to act as a capillary break. The capillary break should be covered by a minimum, 10-mil-thick, vapor barrier to mitigate passage of moisture vapor through the floor.

14.0 FOUNDATION WALLS

All backfill behind foundation walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed using an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid of 50 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

As required by the 2015 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the recommended wall backfill materials, we recommend a seismic surcharge pressure of 8H and 11H psf, where H is the wall height in feet for the "active" and "at-rest" loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the walls.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of excavated on-site soils, or imported structural fill compacted to 90 percent of ASTM D-1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in settlement of the slab-on-grade or other structures supported above the walls. Thus, the compaction level is critical and must be tested by our firm during placement. Surcharges from adjacent footings or heavy construction equipment must be added to the above values. Footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

Proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum 1-foot-wide blanket drain to within 1 foot of finish grade for the full wall height using imported, washed gravel against the walls.

14.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the natural soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance provided below. We recommend the following allowable design parameters:

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.35

15.0 INFILTRATION ASSESSMENT

Based on our review of the above-referenced plans, infiltration of site-derived surface water will include two infiltration trenches to manage runoff from non-pollution-generating surfaces. The infiltration trenches will target the permeable alluvial sediments encountered near the surface or underlying existing fill in our explorations. Infiltration locations where existing fill is present should follow excavation recommendations provided in Section 15.3. Based on our site-specific exploration and laboratory testing, it is AESI's opinion that infiltration is feasible at the project site.

The project will manage stormwater in accordance with the 2019 SWTN and the Washington State Department of Ecology's (Ecology's) 2014 *Stormwater Management Manual for Western Washington* (Ecology Manual). To manage stormwater from non-pollution-generating sources, the project will use Best Management Practices (BMPs) from the Ecology Manual as required by the City's 2019 SWTN.

15.1 Infiltration Design Rate

Using the ASTM D-422 soil grain-size data, with the "Soil Grain-Size Analysis Method" for determining infiltration rates in the 2014 Ecology Manual (also referred to as the Massmann method), the estimated initial short-term infiltration rate for the alluvial deposits is on the order of 57 to over 200 inches per hour. These rates assume depth to groundwater is moderate and the soil layer being characterized has not been compacted.

In our experience, the soil grain-size analysis method in the 2014 Ecology Manual can overestimate the initial short-term (uncorrected) infiltration rate for certain unconsolidated sediments. We estimated infiltration rates using in-house, empirical correlations between grain-size data and previous pilot infiltration tests. This in-house method correlates the grain-size distribution with AESI's library of pilot infiltration tests paired with grain-size distribution data to estimate initial short term infiltration rates. For this site, we recommend using an uncorrected infiltration rate of 45 inches per hour.

Per Table III-3.3.1 of the 2014 Ecology Manual, the short-term infiltration rate must have correction factors applied. The short-term rate must be reduced to account for site variability and number of tests conducted, type of test method, and the potential for long-term clogging due to siltation and bio-buildup.

As described in the 2014 Ecology Manual, the correction factor is applied as follows:

Ksat, design = Ksat, initial * CFv * CFt * CFm

Where: Ksat, initial, represents short-term rate determined from the Grain-Size Method.

CFv: site variability correction factor = **0.65** for general uniformity of on-site alluvial sediments, and the number of tests conducted in the vicinity of the proposed infiltration facility (based upon AESI interpretation of the site conditions encountered).

CFt: test method uncertainty correction factor = **0.4** for Grain-Size Method (prescriptive value from the 2014 Ecology Manual).

CFm: correction factor for degree of influent control to prevent siltation and bio-buildup = **0.9** for typically maintained facilities (prescriptive value from the 2014 Ecology Manual).

The design infiltration rate based on these factors is **10.5 inches per hour (in/hr).**

Ksat, design = 45 in/hr * 0.65 * 0.4 * 0.9 = 10.5 in /hr

15.2 Infiltration Facility Setback

Infiltration facility layout for Penny Lane II propose an infiltration trench no closer than 5 feet from the new building. In our opinion, the horizontal setback distance from the new building to the infiltration trench is suitable.

Infiltration facility layout for Penny Lane III proposes an infiltration trench that is no closer than 6 feet from the main building wall of the new building, but within 2 feet of the ends of two wing walls that will extend from the main building toward the facility. We understand that project sequencing proposes that the wing walls will be constructed before the infiltration trench is installed. To avoid undermining of the wing walls adjacent to the infiltration trench, we recommend that the wing wall foundations are deepened to be within 1 foot vertically from the bottom of infiltration trench subgrade. Excavation of infiltration facilities should follow the temporary excavation recommendations provided in Section 9.1.

15.3 Stripping and Subgrade Overexcavation

Existing fill soils 2 to 9 feet in thickness were encountered in areas of the project site. The fill thicknesses varied over small horizontal distances based on our explorations. We recommend that the infiltration facility base be stripped of topsoil and excavated through the upper topsoil/fill to expose a minimum of 1 foot of the underlying coarse-grained alluvial sediments. We recommend that AESI observe the construction of all infiltration trenches to confirm that they are properly situated in permeable native soils.

Stripping and overexcavation should be performed in a manner that does not disturb the underlying receptor horizon. In addition, the subsequent placement of washed import free-draining aggregate on the areas proposed for infiltration should be completed in a manner which minimizes impacts to the framework and density of the native soil. Use of heavy equipment in the areas proposed for infiltration has the potential to compact the subgrade and reduce infiltration potential. As such, we recommend using an excavator with a toothed-edge bucket to strip and scarify the subgrade without tracking over it. An excavator should also be used to initially place the aggregate material over the stripped subgrade to reduce the potential for disturbance. Construction activity on the surface that results in compaction of the native soil will have a detrimental effect on the infiltration rate.

15.4 Imported Fill

Imported fill for infiltration trench will include washed 1½- to 3-inch washed rounded gravel per the referenced civil plans. The infiltration trench gravel backfill is also recommended as backfill below the facility design depth in areas where overexcavation is required due to existing fill that extends below the facility design subgrade. The specified gravel backfill is recommended in Volume III, Section 3.3.11 “Infiltration Trenches,” of the Ecology Manual for use as a permeable backfill within infiltration trenches and has a significantly higher infiltration rate than the native sediments. The infiltration rate for the gravel backfill can be conservatively assumed to be equal to the native soil design infiltration rate of 10.5 in/hr as calculated within Section 15.1 of this report. Use of the specified gravel backfill in places where existing fill is present will not

impact a facility design that is sized based on the infiltration rate of the native sediments. The contractor should note that any proposed fill soils must be provided to AESI a minimum of 72 hours prior to placement for conformance with project specifications. The washed aggregate will need to be protected from siltation and sand by proper temporary erosion and sediment control (TESC) practices and management of the imported materials stockpile.

15.5 Protection of Infiltration Facilities During Construction

The infiltration system must remain off-line during construction to avoid siltation. Stormwater runoff must not be routed to the infiltration facility until the site is stabilized and runoff is clear. Imported fill for the underground infiltration facilities will likely include washed aggregate or equivalent.

15.6 Facility Overflow

We recommend an overflow path be specified such that runoff above the facility's design capacity does not cause flooding of a building or emergency access, erosion, downstream sedimentation, or slope failure.

16.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

This report is preliminary in that all of the geotechnical and hydrogeologic engineering aspects of the project have not been fully determined and designed. The City of Redmond will require infiltration testing to confirm the infiltration rate provided in this report. We are available to provide additional geotechnical and hydrogeologic consultation as the project design develops and possibly changes from that upon which this report is based. If significant changes in grading are made, we recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design.

We are also available to provide geotechnical engineering, monitoring services and infiltration testing during construction. The integrity of the infiltration trenches and foundations depend on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know, and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

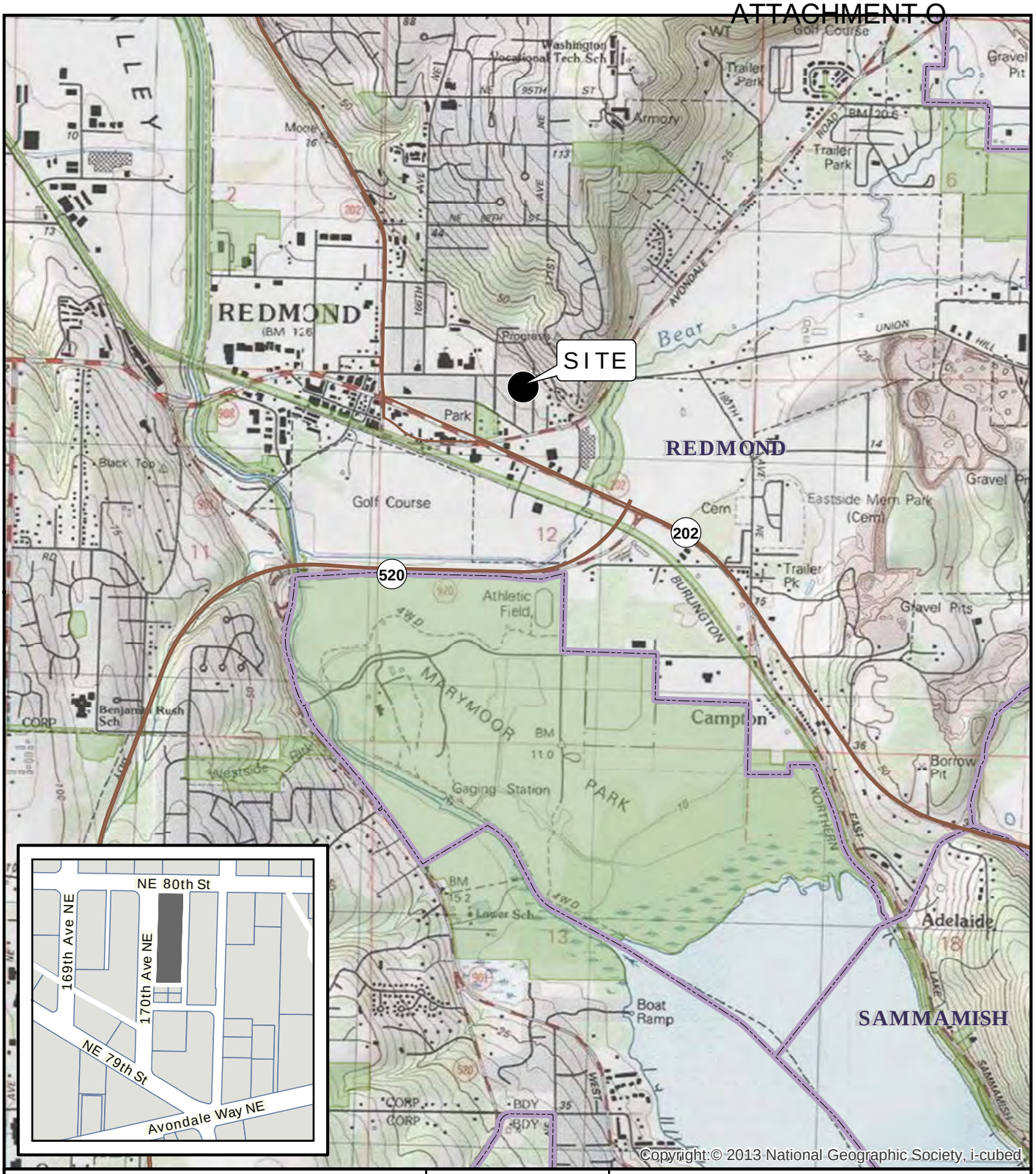
ANTHONY W. ROMANICK
STATE OF WASHINGTON
51606
REGISTERED
PROFESSIONAL ENGINEER
11-19-19

Bruce L. Blyton, P.E.
Senior Principal Engineer

Anthony W. Romanick, P.E.
Senior Project Engineer

Attachments:
- Figure 1. Vicinity Map
- Figure 2. Existing Site and Exploration Plan
- Figure 3. Proposed Site and Exploration Plan
- Appendix A. Exploration Logs
- Appendix B. Laboratory Testing Data

ATTACHMENT O



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
KING CO: STREETS, PARCELS, CITY LIMITS 1/18

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 1000 2000
FEET

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

associated earth sciences incorporated

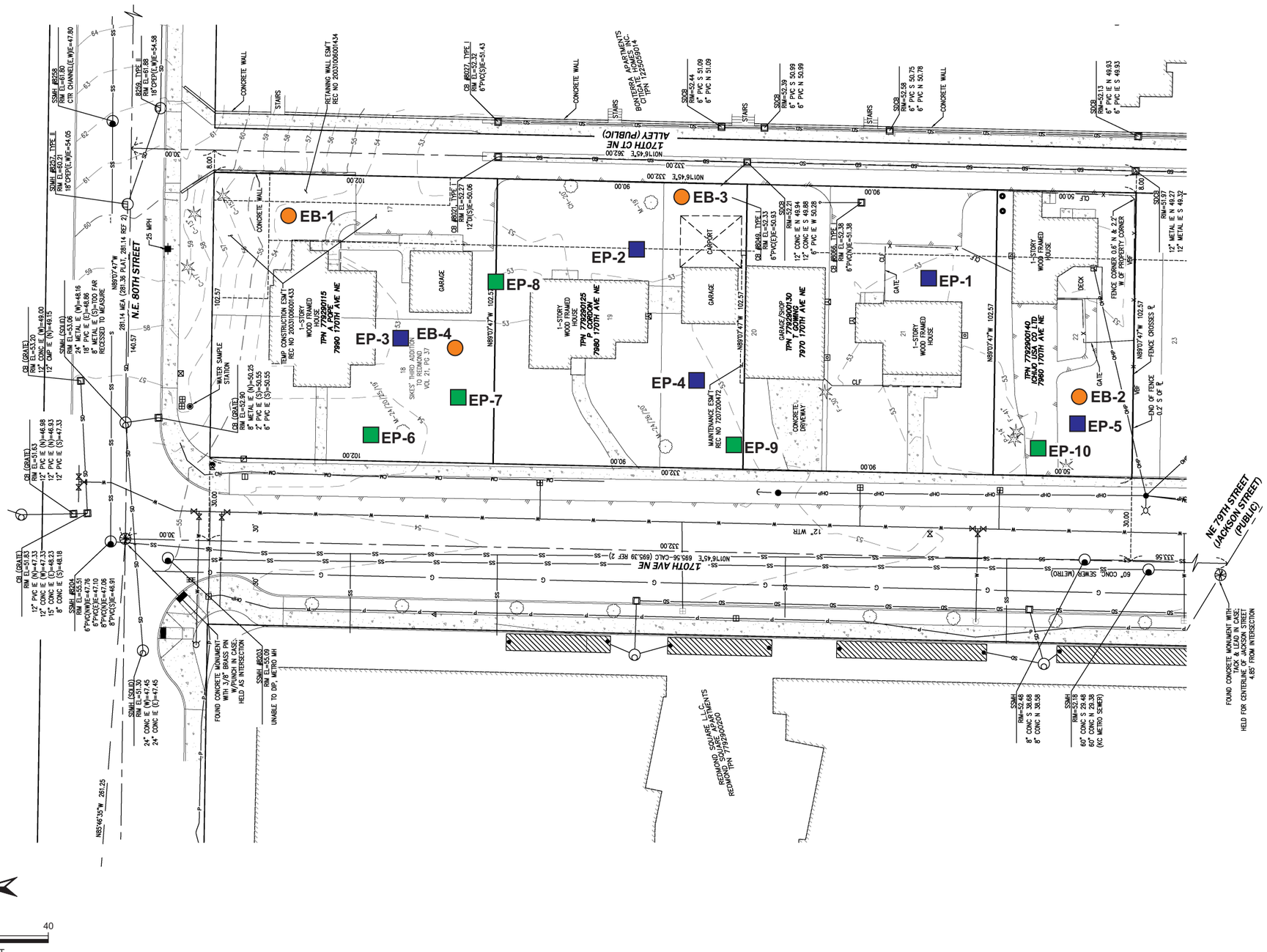
VICINITY MAP

PENNY LANE II
REDMOND, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180106E001	4/18	1

Document Path: G:\GIS_Projects\aaY2018\180106 Penny Lane II\mxd\180106E001 F1 VM_Penny.mxd

ATTACHMENT O



LEGEND:

- EB — EXPLORATION BORING - AESI 3/28/18
- EP — EXPLORATION PIT - AESI 4/21/18
- EP — EXPLORATION PIT - AESI 2/28/19

CONTOUR INTERVAL = 1'

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

NOTES:
1. BASE MAP REFERENCE: CORE DESIGN, ICHIJO USA CO, BOUNDARY AND TOPOGRAPHIC SURVEY GOWING PROPERTY, SHEET 1 OF 1, 10/3/17

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

associated earth sciences incorporated

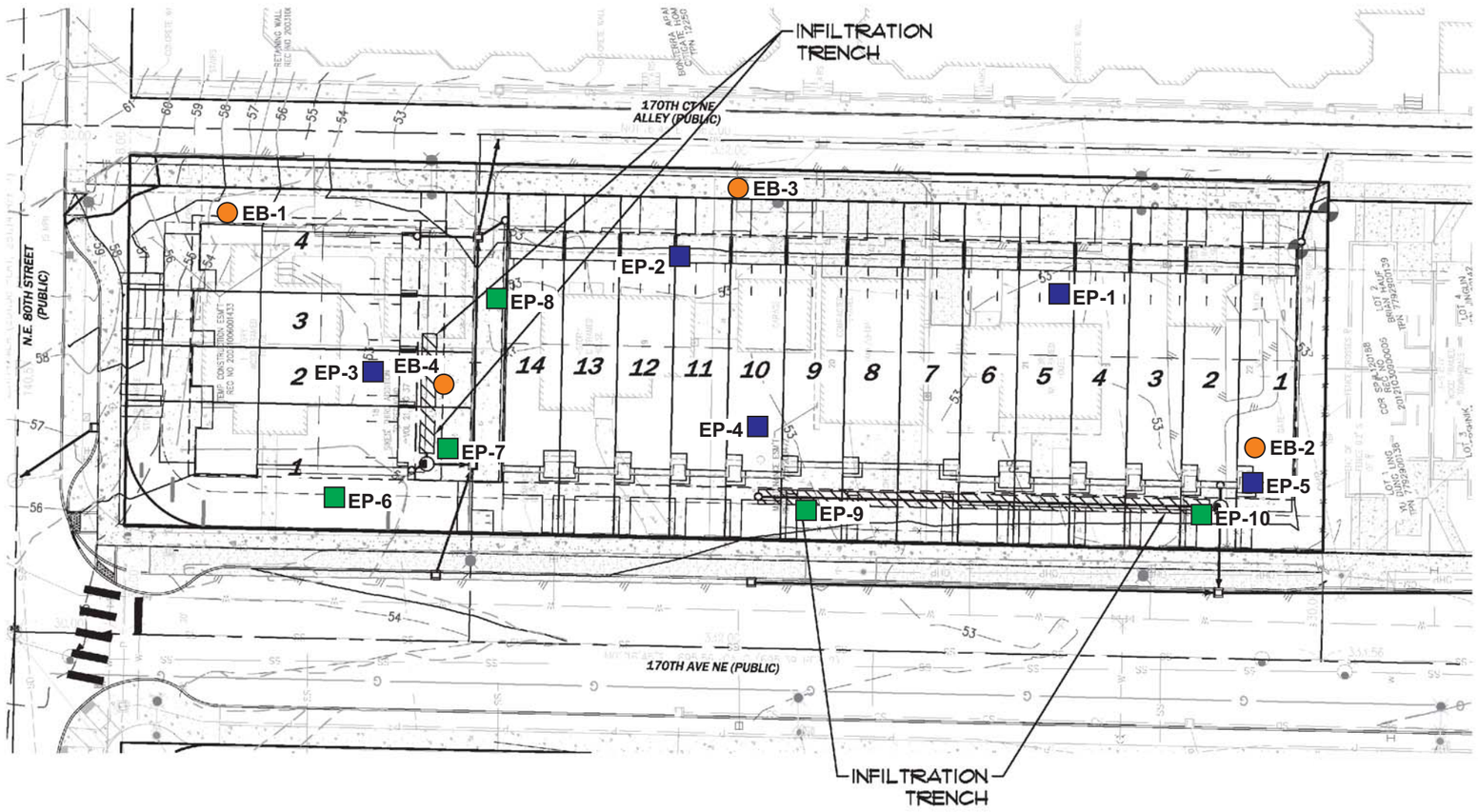
EXISTING SITE AND EXPLORATION PLAN

PENNY LANE II & III
REDMOND, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180106E001	4/19	2

180106 Penny Lane \ 180106E001 F2 S-E 4-19.cdr

ATTACHMENT O



N

0 20 40
FEET

LEGEND:

- EB — EXPLORATION BORING - AESI 3/28/18
- EP — EXPLORATION PIT - AESI 4/21/18
- EP — EXPLORATION PIT - AESI 2/28/19

CONTOUR INTERVAL = 1'

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

NOTES:
1. BASE MAP REFERENCE: CORE DESIGN, PENNY LANE II &III, SITE PLAN, 8/19.

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

associated earth sciences incorporated

PROPOSED SITE AND EXPLORATION PLAN
PENNY LANE II & III
REDMOND, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180106E001	8/19	3

180106 Penny Lane \ 180106E001 F2 S-E-P 8-19.cdr

APPENDIX A

Exploration 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
		≥12% 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
		≥12% 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

Coarse-Grained Soils

Density	SPT(2) blows/foot
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	>50

Fine-Grained Soils

Consistency	SPT(2) blows/foot
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)

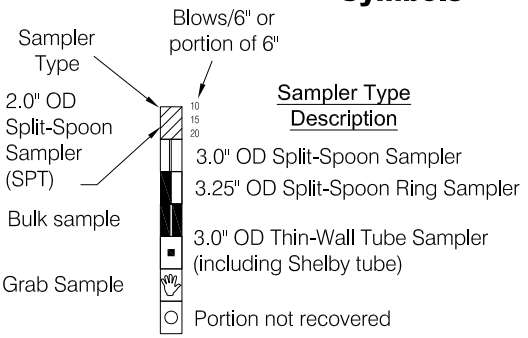
(3) Estimated Percentage

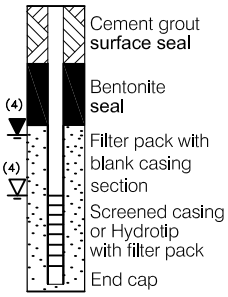
Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

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 12%

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.

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 simplification of actual conditions encountered.

DESCRIPTION

Elev: 53 ft

Grass - 4 inches

Alluvium

1 Medium dense, moist, light brown to brown, gravelly, fine to medium SAND, trace silt; weathered horizon; Cobbles (2 to 8 inches in diameter); stratified (SP).

2

3

4 Moderate caving.

5

6

7

8 Increased moisture in excavated soils.

9

10 Medium dense, moist to very moist, light brown to gray, medium to coarse sandy, GRAVEL, trace silt (GW).

11

12 Very moist.

13

14 Medium dense, very moist to wet, light brown, gravelly, fine to medium SAND, trace to some silt (SP-SM).

15

Bottom of exploration pit at depth 15 feet
No seepage. Moderate caving.

16

17

18

Penny Lane II & III
Redmond, WA

Logged by: TG

Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

4/21/18

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 simplification of actual conditions encountered.

DESCRIPTION

Elev: 53 ft

Grass Turf - 4 inches

Topsoil - 9 inches

1 Root zone 1 to 2.5 feet

Alluvium

2 Medium dense, moist, light brown and gray, fine SAND, some gravel, trace silt; minor cobbles (2 to 4 inches in diameter) (SP).

3

4 Some stratification of fine and coarse gravel.

5

6

7

8 Increased moisture.

9 Medium dense, very moist, gray to brown, gravelly, fine to medium SAND, some silt; silt coated gravel; some stratification (SP-SM).

10

11

12

13

14

Bottom of exploration pit at depth 14 feet
No seepage. Moderate to heavy caving.

15

16

17

18

Penny Lane II & III
Redmond, WA

Logged by: TG

Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

4/21/18

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 simplification of actual conditions encountered.

DESCRIPTION

Elev: 53 ft

Grass Turf - 4 inches

Topsoil - 6 inches

1

Alluvium

Loose, moist, light brown to brown, fine to medium SAND, some gravel, trace silt; some stratification apparent (SP).

2

3

4

5

Denser material at 5 feet, increase in cobbles.

6

Layers of silt.

7

8

9

Medium dense, moist, dark brown to gray, fine to medium sandy, GRAVEL, some to trace silt (GP).

10

Heavy caving below 10 feet.

11

Increase in moisture.

12

13

14

Larger cobbles (3 to 6 inches in diameter)

15

Medium dense, very moist, dark brown to dark gray, gravelly, fine to medium SAND, some to trace silt (SP-SM).

16

Bottom of exploration pit at depth 15.5 feet
No seepage. Moderate caving 0 to 10 feet, heavy caving below 10 feet.

17

18

Penny Lane II & III
Redmond, WA

Logged by: TG

Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

4/21/18

LOG OF EXPLORATION PIT NO. EP-4

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 simplification of actual conditions encountered.

Elev: 53 ft

Depth (ft)	DESCRIPTION
	Crushed Rock - 9 inches
1	**Fill** Silty sand with gravel.
2	**Alluvium** Weathered horizon with roots 2 to 4 feet.
3	Loose, moist, brown to reddish brow, silty, fine SAND, some gravel (SM).
4	
5	Obvious stratification.
6	
7	
8	Denser material at 8 feet, larger cobbles (3 to 6 inches in diameter).
9	Medium dense, moist, dark brown to gray, very sandy, GRAVEL, trace silt; predominantly medium to coarse sand (GW).
10	Heavy caving below 9 feet.
11	
12	Increased moisture.
13	
14	
15	Medium dense, very moist, light brown, to gray, gravelly, fine to medium SAND, trace to some silt (SP-SM).
16	Bottom of exploration pit at depth 15 feet No seepage. Moderate caving 0 to 9 feet, heavy caving below 9 feet.
17	
18	

Penny Lane II & III
Redmond, WA

Logged by: TG
Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

4/21/18

LOG OF EXPLORATION PIT NO. EP-5

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 simplification of actual conditions encountered.

Elev: 53 ft

Depth (ft)	DESCRIPTION
	Grass Turf - 4 inches
	Fill
1	Crushed rock material
2	**Alluvium**
	Black plastic at 2 feet.
3	
4	Medium dense, moist, brown to gray, sandy, GRAVEL, trace silt; large cobbles (3 to 9 inches in diameter) (GP).
5	Medium dense, moist, light brown to brown, medium to coarse sandy, GRAVEL, trace silt; obvious stratification (GP).
6	
7	Tough digging conditions.
8	
9	
10	
11	
12	Increased moisture at 12 feet.
13	
14	Pockets of angular silt blocks encased in alluvium ("rip up clasts").
15	Medium dense, very moist, light brown to gray, gravelly, fine to coarse SAND, trace to some silt (SP-SM).
16	
17	Bottom of exploration pit at depth 16 feet No seepage. Moderate caving 2 to 8 feet, heavy caving below 8 feet.
18	

Penny Lane II & III
Redmond, WA

Logged by: TG
Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

4/21/18

LOG OF EXPLORATION PIT NO. EP-6

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 simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION — Elev: 53 ft
	Fill
1	Loose, dry, dark brown, silty, fine to medium SAND, some gravel; abundant organics including large roots and smaller rootlets (SM).
2	
3	Loose, dry to slightly moist, dark brownish red, silty, fine to medium SAND, some gravel; scattered organics (rootlets) (SM).
4	As above.
	Alluvium
5	Medium dense, slightly moist, brown, gravelly, fine to medium SAND, trace silt; minimal organics (rootlets) (SP).
6	
7	Medium dense, moist, brown, fine to coarse sandy, GRAVEL, trace silt (GP).
8	
9	Medium dense, moist, tan to brown, GRAVEL, some medium to coarse sand, trace silt; abundant scattered cobbles (≥ 6 inches) (GP).
10	
11	As above (GP).
12	Bottom of exploration pit at depth 11 feet No seepage. No caving.
13	
14	
15	
16	
17	
18	

Penny Lane II & III
Redmond, WA

Logged by: BCY
Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001
2/28/19

LOG OF EXPLORATION PIT NO. EP-7

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 simplification of actual conditions encountered.

Elev: 53 ft

Depth (ft)	DESCRIPTION
	Fill
1	Loose, slightly moist, dark brown, silty, fine to medium SAND, trace to some gravel; abundant organics (SM).
2	Loose, slightly moist, brown to reddish brown, silty, fine to medium SAND, some gravel; scattered organics (rootlets) (SM).
3	**Alluvium**
4	Loose, slightly moist, brown, medium SAND, some gravel, trace silt (SP).
5	Loose, slightly moist, fine to medium SAND, trace to some gravel, trace silt (SP).
6	
7	
8	Loose to medium dense, slightly moist, brown, fine to medium sandy, GRAVEL, trace silt; minor scattered organics (GW).
9	Medium dense, slightly moist to moist, GRAVEL, some fine to coarse sand, trace silt; scattered cobbles (up to 7 inches); scattered organics (rootlets) (GW).
10	
11	Medium dense, moist, tan to brown, medium to coarse sandy, GRAVEL, trace silt; scattered cobbles (GW).
12	
13	Bottom of exploration pit at depth 12 feet No seepage. No caving.
14	
15	
16	
17	
18	

Penny Lane II & III
Redmond, WA

Logged by: BCY
Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

2/28/19

LOG OF EXPLORATION PIT NO. EP-8

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 simplification of actual conditions encountered.

Elev: 53 ft

Depth (ft)	DESCRIPTION
	Fill
1	Loose, dry, dark brown, silty, fine to medium SAND, some gravel; scattered organics and construction debris (SM).
	Alluvium
2	
3	Loose, slightly moist, tan, fine to medium SAND, trace to some gravel, trace silt (SP-SW).
4	Loose to medium dense, slightly moist, tan, fine to coarse SAND, trace to some gravel, trace silt (SP-SW).
5	
6	Medium dense, slightly moist to moist, tan, medium to coarse sandy, GRAVEL, trace silt; scattered cobbles (≥6 inches) (GW).
7	
8	Medium dense, moist, tan, medium to coarse sandy, GRAVEL, trace silt; scattered cobbles (4 to 6 inches); scattered rootlets (GW).
9	
10	As above; sand content coarsening (GW).
11	
12	Medium dense to dense, moist, tannish brown, GRAVEL, some medium to coarse sand, trace silt, trace cobbles; minor scattered organics (GW).
13	Bottom of exploration pit at depth 12.5 feet No seepage. Minor caving at 6 and 11 feet.
14	
15	
16	
17	
18	

Penny Lane II & III
Redmond, WA

Logged by: BCY
Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

2/28/19

LOG OF EXPLORATION PIT NO. EP-9

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 simplification of actual conditions encountered.

Elev: 54 ft

Depth (ft)	DESCRIPTION
	Alluvium
1	Medium dense, dry, tannish brown, silty, fine SAND, some gravel; scattered organics (rootlets) (SM).
2	
3	Medium dense, dry, tan, gravelly, fine to medium SAND, trace silt; scattered organics (rootlets) (SP).
4	
5	
6	Medium dense, dry, tan, medium to coarse sandy, GRAVEL, trace silt; scattered organics (rootlets) (GW).
7	
8	As above; cobbles (up to 6 inches) (GW).
9	
10	As above; cobbles (up to 4.5 inches) (GW).
11	Bottom of exploration pit at depth 10.5 feet No seepage. Minor caving at 4 feet, moderate caving at 9 feet.
12	
13	
14	
15	
16	
17	
18	

Penny Lane II & III
Redmond, WA

Logged by: BCY
Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

2/28/19

LOG OF EXPLORATION PIT NO. EP-10

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

Elev: 54 ft

Fill

Loose, moist, gray, GRAVEL (~3/8 inch) (GP).

1

Topsoil / Fill

Loose, dry, reddish brown, silty, fine SAND, trace to some gravel; scattered organics (rootlets) (SM).

2

3

Alluvium

Loose to medium dense, slightly moist, tannish brown, medium sandy, GRAVEL, trace silt; scattered cobbles (GW).

4

5

6

Medium dense to dense, moist, gray, medium to coarse very sandy, GRAVEL, some cobbles (up to 6 inches), trace silt (GW).

7

8

Dense to medium dense, moist, gray, medium to coarse sandy, GRAVEL, some cobbles (up to 7 inches), trace silt (GW).

9

10

11

Dense, moist, gray to tan, medium to coarse sandy, GRAVEL, trace cobbles (up to 5 inches), trace silt; discontinuous silt interbed (5 inches thick) at 11 feet, transitions back to sandy gravel (GW).

12

Bottom of exploration pit at depth 12 feet
No seepage. Caving 5 to 12 feet.

13

14

15

16

17

18

KCTP3 180106.GPJ March 26, 2019

Penny Lane II & III
Redmond, WA

Logged by: BCY

Approved by: JHS

associated earth sciences incorporated

Project No. 180106E001

2/28/19

ATTACHMENT O

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180106E001	EB-1	1 of 1

Project Name	Penny Lane	Ground Surface Elevation (ft)	54
Location	Redmond, WA	Datum	NAVD 88
Driller/Equipment	Geologic Drill / Walk-behind or XL Trailer Rig	Date Start/Finish	3/28/18,3/28/18
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	6 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Topsoil - 6 inches					
				Fill					
		S-1		Moist, brown to reddish brown, fine to medium SAND, some silt, some gravel; occasional organics (SP-SM).			2 2 2	4	
				Alluvium					
5		S-2		Moist, light brown to light brownish gray, fine to medium SAND, some gravel, trace silt; massive (SP).			2 5 4	9	
		S-3		Moist, light brown, fine SAND, trace gravel, trace silt' massive (SP).			1 2 10	12	
10		S-4		Moist, brown and gray, gravelly, fine to coarse SAND, trace silt; massive (SP).			6 12 17	29	
				Cobbles in drill cuttings, erratic drill action observed at 13 feet.					
15		S-5		Moist, brown and brownish gray, gravelly, fine to medium SAND, trace silt; broken rock in sampler (SP).			10 21 18	39	
				Very gravelly drilling observed at 17 feet.					
20		S-6		Very moist, brownish gray, gravelly, fine to medium SAND, trace silt; sampler tip is wet; broken rock in sampler (SP).		▼	14 17 21	38	
				Pre-Fraser Fine Grained Sediments					
				"Sticky" drilling observed at 23 feet.					
25		S-7		Very moist, gray to dark gray, SILT, trace sand, trace gravel; trace gravel present as dropstones; minor mica flakes (ML).			6 14 30	44	
				Very hard drilling at 27 feet.					
30		S-8		Very moist, gray to dark gray, SILT, trace gravel; trace gravel present as dropstones (ML).			22 25 32	57	
				Bottom of exploration boring at 31.5 feet					
35									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

▽ Water Level ()

▼ Water Level at time of drilling (ATD)

Logged by: TG

Approved by: JHS

ATTACHMENT O

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180106E001	EB-2	1 of 1

Project Name	Penny Lane	Ground Surface Elevation (ft)	53
Location	Redmond, WA	Datum	NAVD 88
Driller/Equipment	Geologic Drill / Walk-behind or XL Trailer Rig	Date Start/Finish	3/28/18,3/28/18
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	6 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Topsoil - 6 inches					
				Fill					
		S-1		Moist, light to dark brown, fine to medium SAND, some gravel, some silt; broken rock in sampler; occasional organics (SP-SM). Very cobbly drilling observed 3 to 4 feet; plastic in drill cuttings. Driller repositioned.			12 20 17	▲47	
5		S-2		As above. Very cobbly drilling observed 5 to 7.5 feet.			11 17 30	▲47	
				Bottom of exploration boring at 7 feet. Refusal due to cobbles.					
10									
15									
20									
25									
30									
35									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

Logged by: TG

Approved by: JHS

ATTACHMENT O

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180106E001	EB-3	1 of 1

Project Name	Penny Lane	Ground Surface Elevation (ft)	53
Location	Redmond, WA	Datum	NAVD 88
Driller/Equipment	Geologic Drill / Walk-behind or XL Trailer Rig	Date Start/Finish	3/29/18,3/29/18
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	6 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Topsoil - 4 inches					
				Alluvium					
		S-1		Moist, light brown to dark brown, fine to medium SAND, some silt, some gravel, ranging to silty, SAND; occasional organics (SP-SM/SM).			3 5 5	▲10	
5		S-2		Moist, light brown, gravelly, fine to medium SAND, some silt; large rock in sampler tip, pushing rock; low recovery (SP-SM). Very rough drilling observed 5 to 7.5 feet; large gravel and cobbles present in drill cuttings.			9 15 15	▲30	
		S-3		As above, sample may not be representative; large rock in sampler tip, pushing rock, low recovery. Very cobbly drilling observed 7.5 to 11 feet.			7 19 12	▲31	
10		S-4		Moist, light brown, gravelly, fine to medium SAND, trace silt (SP).			14 19 18	▲37	
				Driller used rock spike to break up cobbles.					
				Bottom of exploration boring at 13 feet					
15									
20									
25									
30									
35									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

Logged by: TG

Approved by: JHS

ATTACHMENT O

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180106E001	EB-4	1 of 1

Project Name	Penny Lane	Ground Surface Elevation (ft)	53
Location	Redmond, WA	Datum	NAVD 88
Driller/Equipment	Geologic Drill / Walk-behind or XL Trailer Rig	Date Start/Finish	3/29/18,3/29/18
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	6 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Grass Turf / Topsoil - 4 inches					
				Fill					
		S-1		Very moist, gray to dark brown, very silty, fine SAND, trace gravel, trace organics (SM).			2 6 4	▲10	
5		S-2		Broken rock in sampler, sample not representative.			16 30 9	▲39	
				Cobbly drilling observed at 6 feet; driller noted pounding on rock, pushing rock, low recovery.					
		S-3		Moist, light brownish gray, sandy, SILT, trace gravel, ranges to silty, SAND; broken rock in sampler; contains pockets of dark brown, silty, sand (SM-ML). Driller used rock spike to break up cobbles, driller could not advance drill.			10 20 14	▲34	
10				Bottom of exploration boring at 9 feet					
15									
20									
25									
30									
35									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

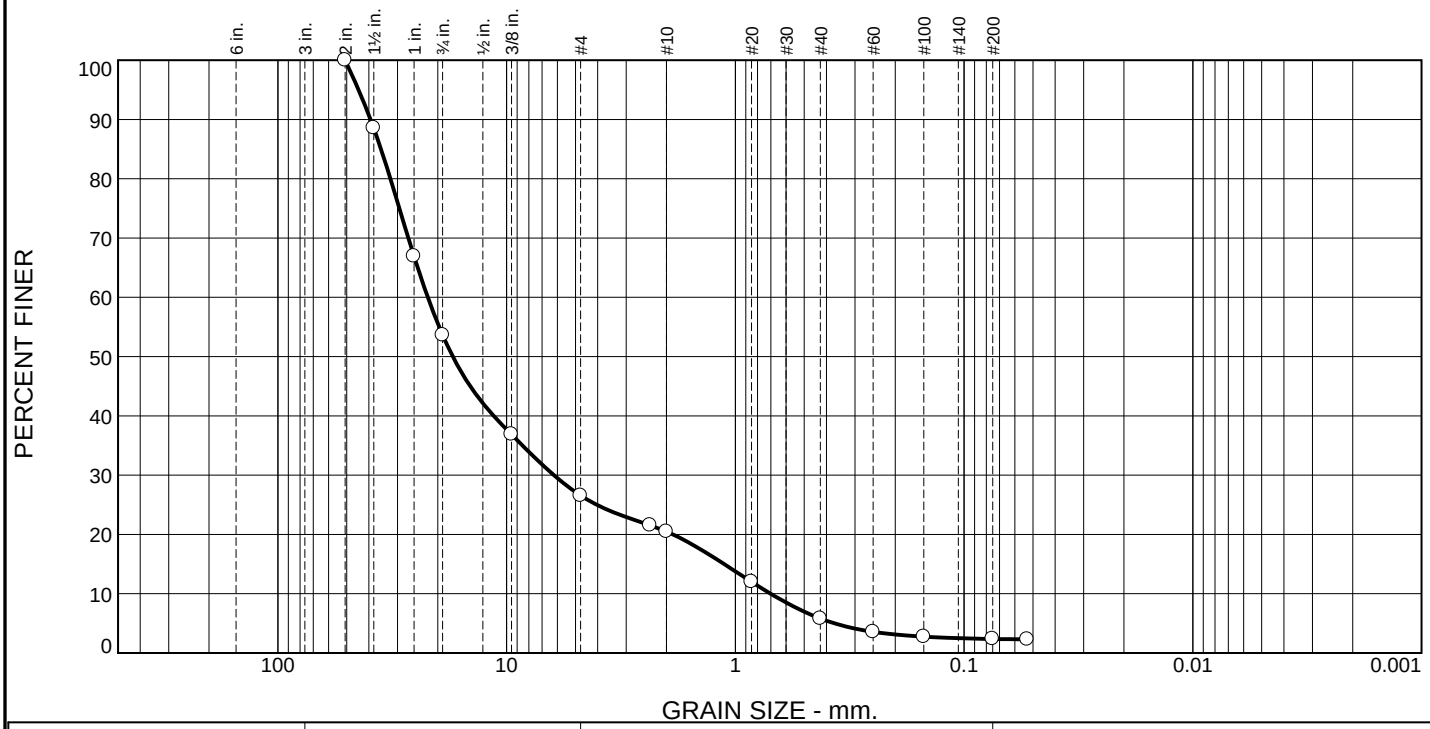
Logged by: TG

Approved by: JHS

APPENDIX B

Laboratory Testing Data

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	46.4	27.0	6.1	14.7	3.4	2.4	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2	100.0		
1.5	88.6		
1	66.9		
.75	53.6		
.375	36.9		
#4	26.6		
#8	21.5		
#10	20.5		
#20	12.0		
#40	5.8		
#60	3.6		
#100	2.8		
#200	2.4		
#270	2.3		

* (no specification provided)

Material Description

sandy, GRAVEL, trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 39.3254 D_{85}= 35.4198 D_{60}= 22.1124
D_{50}= 17.1943 D_{30}= 6.2155 D_{15}= 1.1201
D_{10}= 0.7012 C_u= 31.53 C_c= 2.49

Remarks

Collected by: TG

Date Received: 04/23/2018 **Date Tested:** 04/24/2018

Tested By: BN

Checked By: BLB

Title:

Location: Onsite
Sample Number: EP-1 **Depth:** 10'

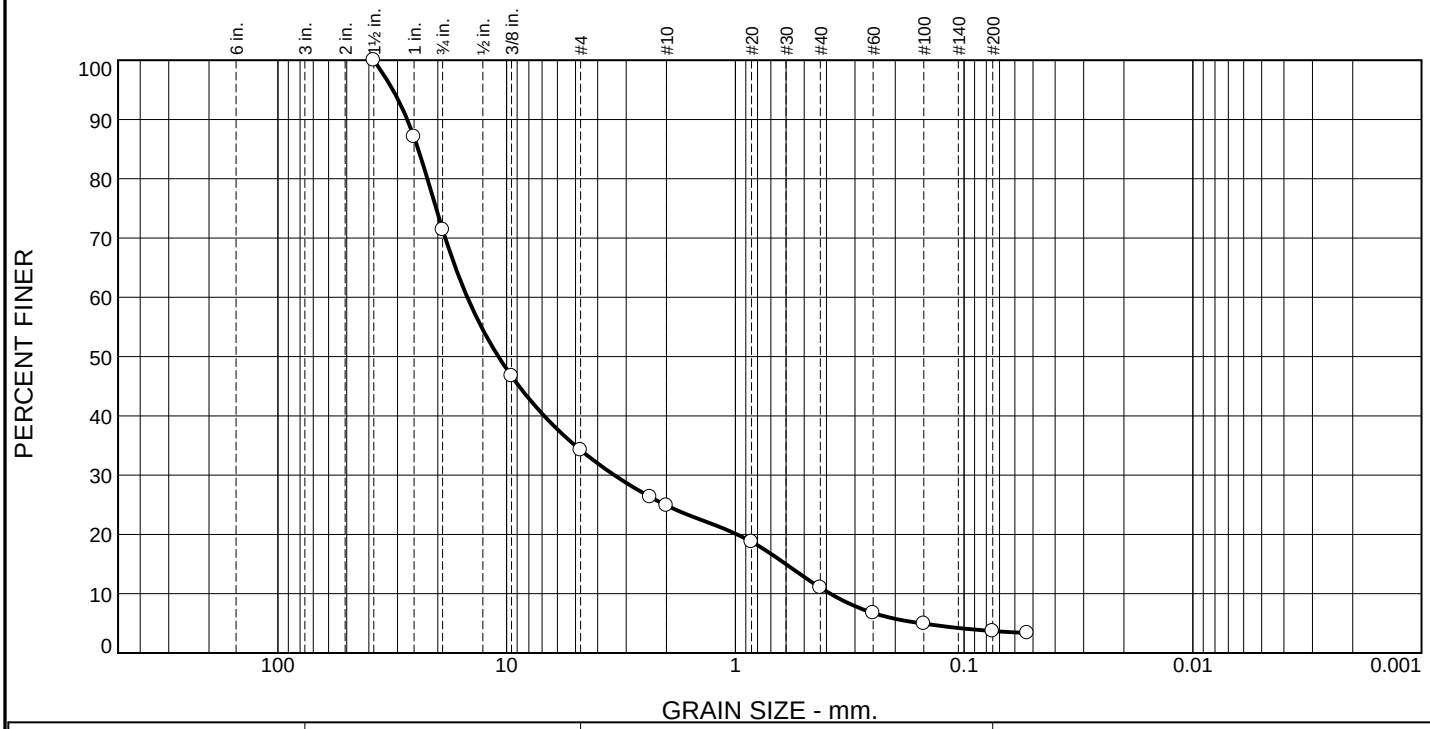
Date Sampled: 04/21/2018

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	28.6	37.2	9.3	13.9	7.3	3.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	87.1		
.75	71.4		
.375	46.7		
#4	34.2		
#8	26.3		
#10	24.9		
#20	18.8		
#40	11.0		
#60	6.7		
#100	4.9		
#200	3.7		
#270	3.4		

* (no specification provided)

Material Description

very sandy, GRAVEL, trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 27.1612 D_{85}= 24.3455 D_{60}= 14.8443
D_{50}= 10.8623 D_{30}= 3.3800 D_{15}= 0.6015
D_{10}= 0.3847 C_u= 38.59 C_c= 2.00

Remarks

Collected by: TG

Date Received: 04/23/2018 **Date Tested:** 04/24/2018

Tested By: BN

Checked By: BLB

Title:

Location: Onsite
Sample Number: EP-4 **Depth:** 9'

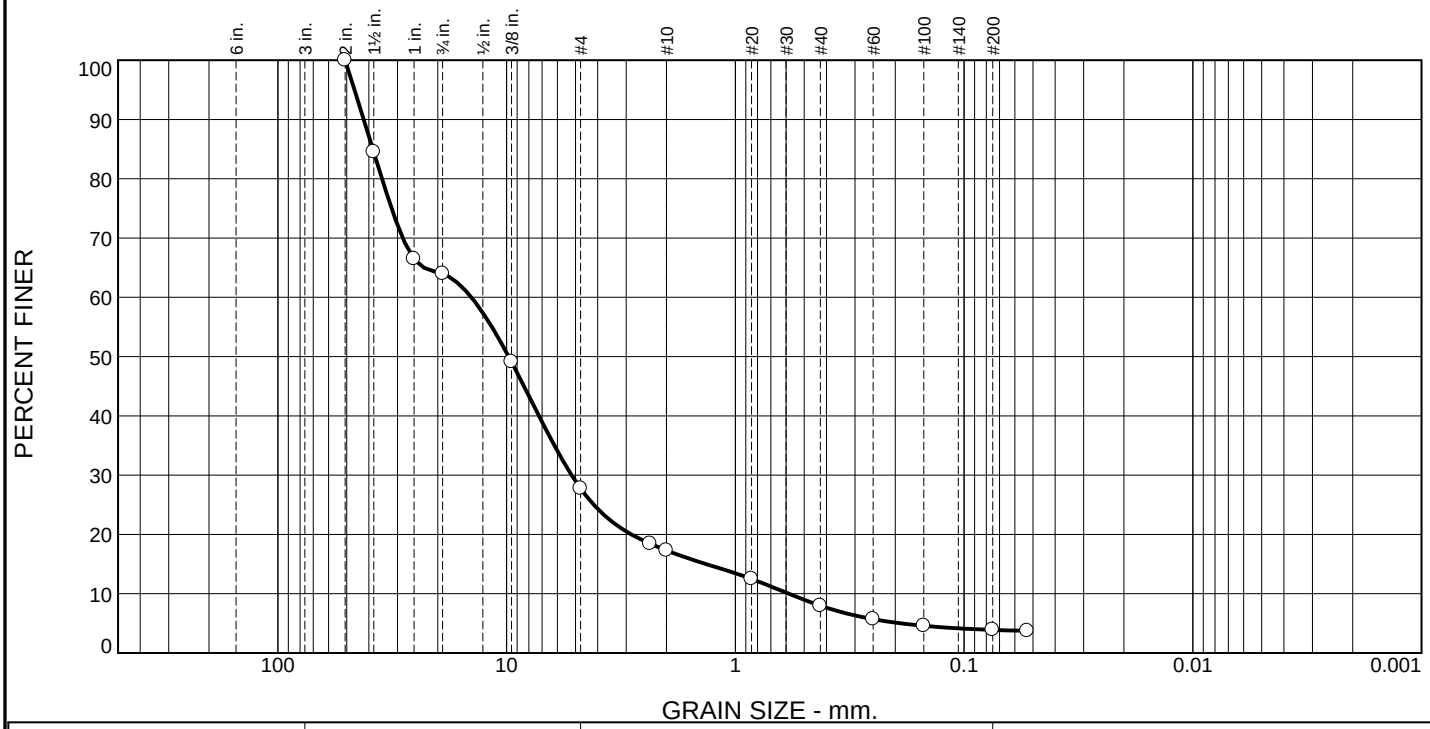
Date Sampled: 04/21/2018

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	36.0	36.3	10.4	9.3	4.1	3.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2	100.0		
1.5	84.5		
1	66.5		
.75	64.0		
.375	49.1		
#4	27.7		
#8	18.5		
#10	17.3		
#20	12.5		
#40	8.0		
#60	5.7		
#100	4.6		
#200	3.9		
#270	3.7		

* (no specification provided)

Material Description

sandy, GRAVEL, trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 42.1473 D_{85}= 38.4367 D_{60}= 14.2579
D_{50}= 9.7984 D_{30}= 5.2005 D_{15}= 1.3426
D_{10}= 0.5842 C_u= 24.41 C_c= 3.25

Remarks

Collected by: TG

Date Received: 04/23/2018 **Date Tested:** 04/24/2018

Tested By: BN

Checked By: BLB

Title:

Location: Onsite
Sample Number: EP-5 **Depth:** 4'

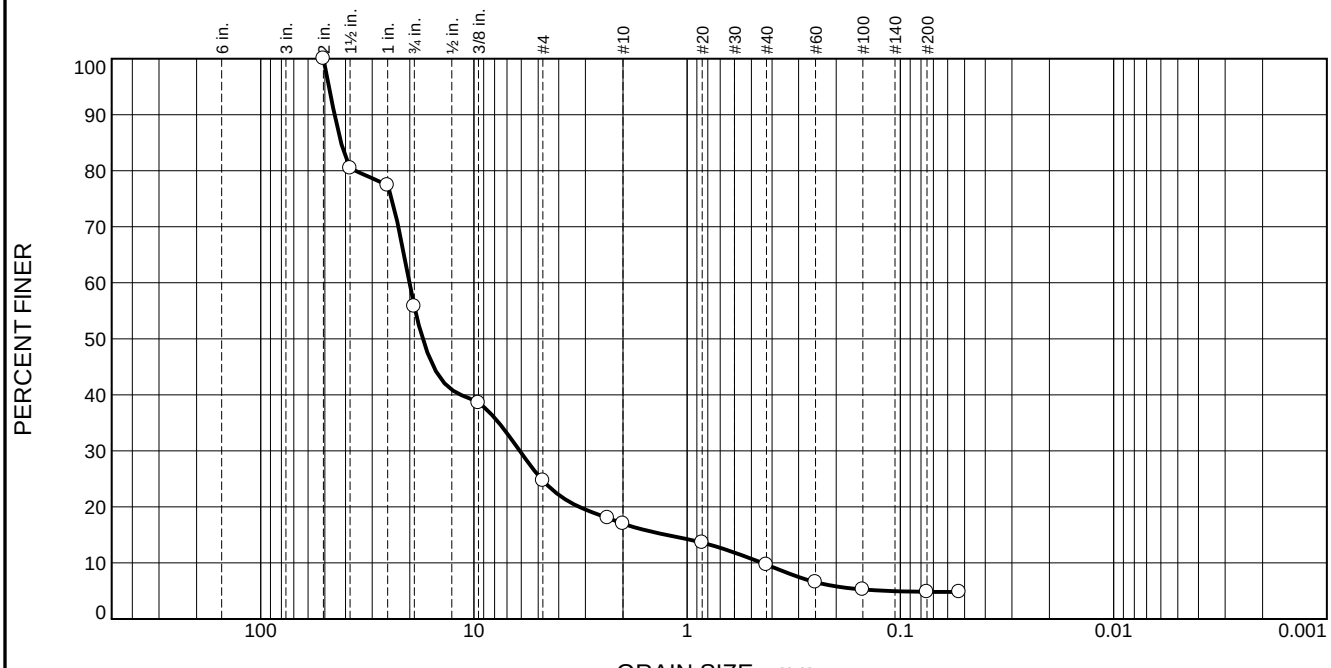
Date Sampled: 04/21/2018

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	44.2	31.1	7.7	7.3	4.9	4.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2	100.0		
1.5	80.4		
1	77.4		
.75	55.8		
.375	38.6		
#4	24.7		
#8	18.0		
#10	17.0		
#20	13.6		
#40	9.7		
#60	6.6		
#100	5.3		
#200	4.8		
#270	4.8		

* (no specification provided)

Material Description

Sandy GRAVEL Trace Silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** NV **PI=**

Classification

USCS (D 2487)= GP **AASHTO (M 145)=**

Coefficients

D_{90}= 45.0819 D_{85}= 41.9814 D_{60}= 20.0854
D_{50}= 17.3819 D_{30}= 6.0998 D_{15}= 1.2481
D_{10}= 0.4454 C_u= 45.10 C_c= 4.16

Remarks

Date Received: 3-6-19 **Date Tested:** 3-6-19

Tested By: BP

Checked By: AWR

Title:

Location: Onsite
Sample Number: EP-6 **Depth:** 6.5'

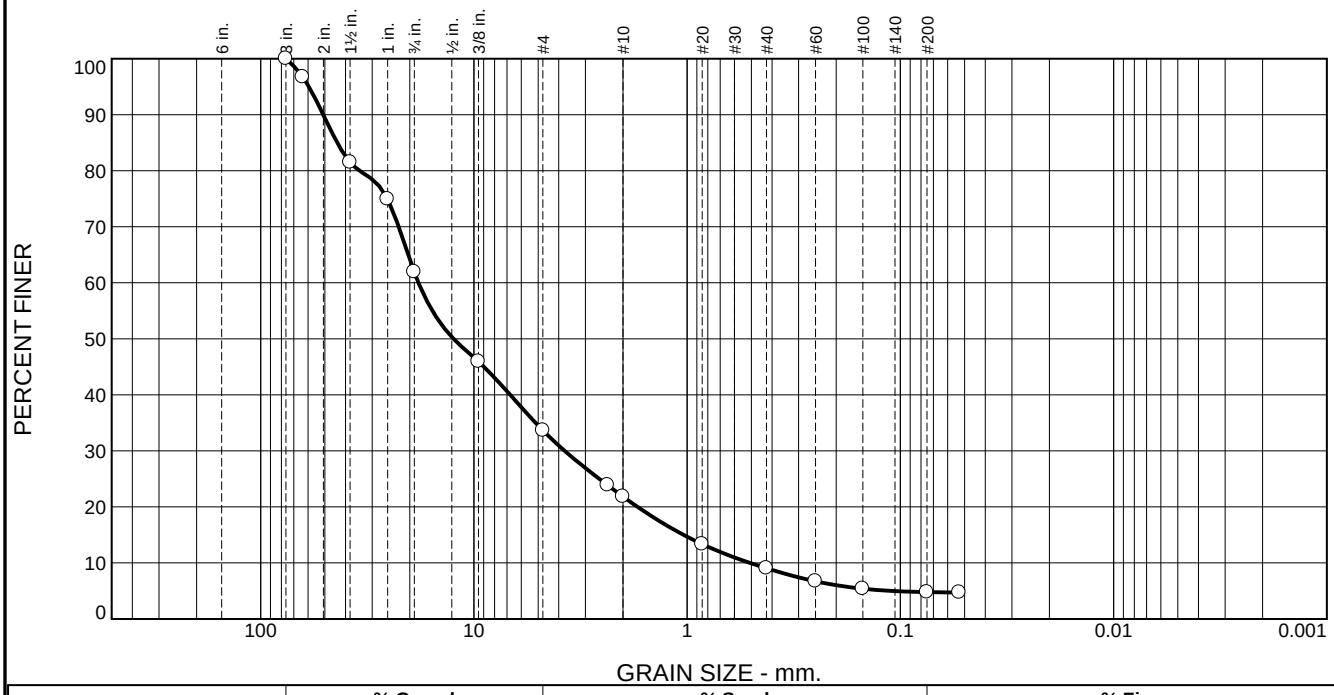
Date Sampled: 3-6-19

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	38.1	28.3	11.8	12.7	4.3	4.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2.5	96.7		
1.5	81.5		
1	74.9		
.75	61.9		
.375	45.9		
#4	33.6		
#8	23.9		
#10	21.8		
#20	13.4		
#40	9.1		
#60	6.7		
#100	5.4		
#200	4.8		
#270	4.7		

* (no specification provided)

Material Description

Sandy GRAVEL Trace Silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** NV **PI=**

Classification

USCS (D 2487)= GW **AASHTO (M 145)=**

Coefficients

D_{90}= 50.9176 D_{85}= 43.7764 D_{60}= 18.1938
D_{50}= 12.4574 D_{30}= 3.7558 D_{15}= 1.0388
D_{10}= 0.5077 C_u= 35.84 C_c= 1.53

Remarks

Date Received: 3-6-19 **Date Tested:** 3-6-19

Tested By: BP

Checked By: AWR

Title:

Location: Onsite
Sample Number: EP-7 **Depth:** 8'

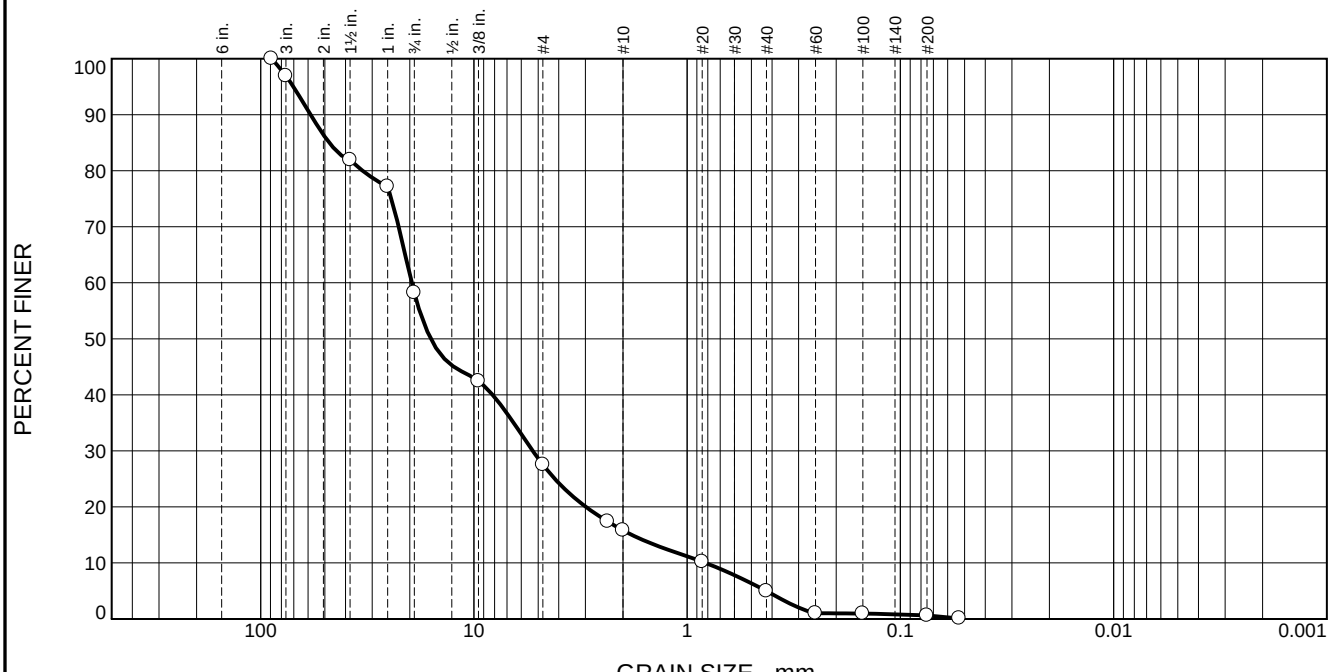
Date Sampled: 3-6-19

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
3.1	38.7	30.7	11.7	10.8	4.4	0.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.5	100.0		
3	96.9		
1.5	81.9		
1	77.2		
.75	58.2		
.375	42.4		
#4	27.5		
#8	17.4		
#10	15.8		
#20	10.2		
#40	5.0		
#60	1.0		
#100	1.0		
#200	0.6		
#270	0.1		

* (no specification provided)

Material Description

Sandy GRAVEL Trace Silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** NV **PI=**

Classification

USCS (D 2487)= GW **AASHTO (M 145)=**

Coefficients

D_{90}= 58.3543 D_{85}= 47.7219 D_{60}= 19.5810
D_{50}= 15.9397 D_{30}= 5.2990 D_{15}= 1.8196
D_{10}= 0.8222 C_u= 23.82 C_c= 1.74

Remarks

Date Received: 3-6-19 **Date Tested:** 3-6-19

Tested By: BP

Checked By: AWR

Title:

Location: Onsite
Sample Number: EP-8 **Depth:** 8'

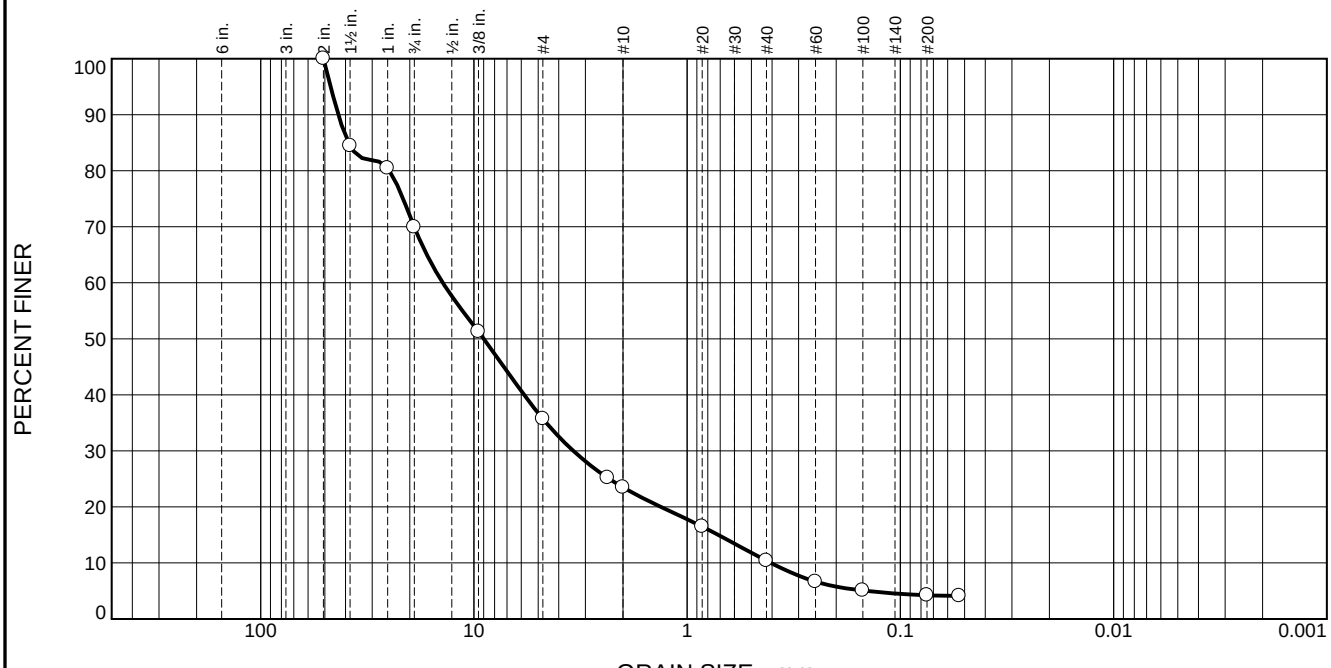
Date Sampled: 3-6-19

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	30.1	34.2	12.2	13.1	6.2	4.2	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2	100.0		
1.5	84.5		
1	80.5		
.75	69.9		
.375	51.3		
#4	35.7		
#8	25.2		
#10	23.5		
#20	16.5		
#40	10.4		
#60	6.7		
#100	5.1		
#200	4.2		
#270	4.1		

* (no specification provided)

Material Description

Sandy GRAVEL Trace Silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** NV **PI=**

Classification

USCS (D 2487)= GW **AASHTO (M 145)=**

Coefficients

D_{90}= 43.2645 D_{85}= 38.7489 D_{60}= 13.9997
D_{50}= 9.0011 D_{30}= 3.4194 D_{15}= 0.7146
D_{10}= 0.4054 C_u= 34.53 C_c= 2.06

Remarks

Date Received: 3-6-19 **Date Tested:** 3-6-19

Tested By: BP

Checked By: AWR

Title:

Location: Onsite
Sample Number: EP-9 **Depth:** 6'

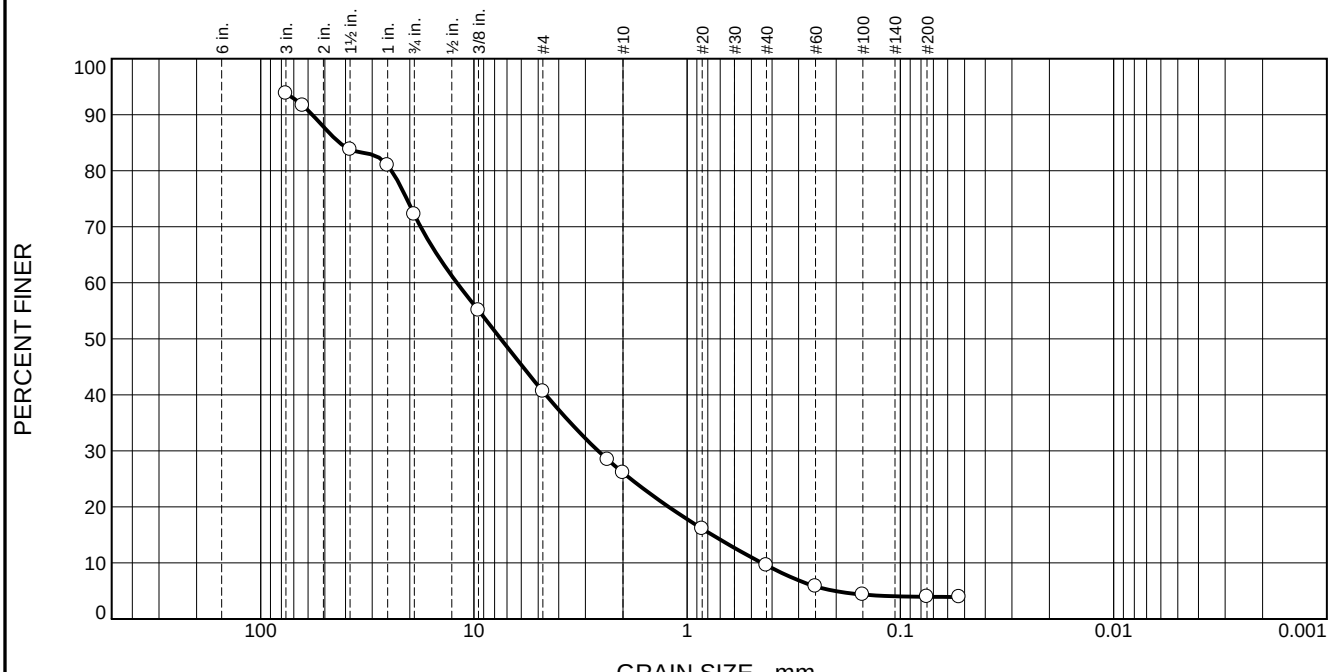
Date Sampled: 3-6-19

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	21.6	31.6	14.5	16.5	5.7	3.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	93.8		
2.5	91.6		
1.5	83.8		
1	81.0		
.75	72.2		
.375	55.1		
#4	40.6		
#8	28.5		
#10	26.1		
#20	16.1		
#40	9.6		
#60	5.8		
#100	4.4		
#200	3.9		
#270	3.9		

* (no specification provided)

Material Description

Very SAndy GRAVEL Trace Silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** NV **PI=**

Classification

USCS (D 2487)= GW **AASHTO (M 145)=**

Coefficients

D_{90}= 57.2829 D_{85}= 42.6874 D_{60}= 12.0207
D_{50}= 7.4856 D_{30}= 2.6140 D_{15}= 0.7624
D_{10}= 0.4463 C_u= 26.93 C_c= 1.27

Remarks

Date Received: 3-6-19 **Date Tested:** 3-6-19

Tested By: BP

Checked By: AWR

Title:

Location: Onsite
Sample Number: EP-10 **Depth:** 6'

Date Sampled: 3-6-19

associated earth sciences incorporated

Client: Ichijo USA Co. LTD
Project: Penny Lane II

Project No: 180106 E001 **Figure**