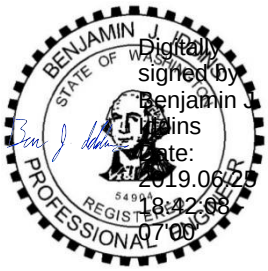
DRAINAGE MEMORANDUM

TO: City of Mercer Island

FROM: Ben Iddins, P.E.

DATE: June 25, 2019

RE: 7431 E Mercer Way, Mercer Island, WA
On-site Drainage System Design Summary



This memorandum summarizes the drainage system design in accordance with the 2012 edition of the Washington State Department of Ecology Stormwater Management Manual for Western Washington (as amended in 2014) and the City of Mercer Island Drainage Requirements (the combination of which is hereafter referred to as "the Manual").

1 PROJECT SUMMARY

The site at 7431 E Mercer Way on Mercer Island totals 9,848 square feet and will be developed with a single-family residence with an attached garage. The site is currently vacant as it contains no structures, but it does contain a large concrete surface that will be removed during construction. One tree will be removed on site for the construction of the driveway and five off site trees will be also be removed during construction. All other trees will be protected to remain (see Attachment G for the full arborist report). The site is accessed from E Mercer Way via an existing asphalt and concrete driveway which will be extended to provide access to the project site. The total new plus replaced impervious surfaces is 4,519 square feet, which includes 629 square feet of driveway which is technically offsite but is required to provide access to the project site. See TABLE 1 for a summary of land cover calculations and Attachment A for photos of the existing site. A summary of the onsite soils is included in the following sections. Since the project will add greater than 2,000 SF but less than 5,000 SF of new plus replaced impervious surfaces, it is subject to Minimum Requirements 1 through 5 as outlined in Section I-2.4, Figure 2.4.2 of the Manual.

TABLE 1 **Land Cover Summary**

		Area (SF)	Area (acres)
Existing Conditions	Impervious Surfaces (concrete surface)	5,169	.1186
Developed Conditions	House	2,352	.0540
	Driveway	975	.0224
	Patios/Steps/Walks	563	.0129
	Off-site Driveway	629	.0144
	Total New Plus Replaced Impervious surfaces	4,519	.1037
	Total Impervious Surface	4,519	.1037
	Total Pollution Generating Impervious Surface (PGIS)	1,604	.0368
	Pervious Surface (landscaping and trees)	5,329	.1223

The areas in TABLE 1 were determined by area measurements in AutoCAD from a topographic survey. As shown in TABLE 1, the developed site total impervious surfaces are 4,519 SF, all of which are new and replaced impervious surfaces. The project also proposes 1,604 SF of new plus replaced pollution generating impervious surfaces.

2 DRAINAGE SYSTEM

The onsite stormwater system is comprised of a Type 1 catch basin, a 12" area drain, trench drain, 60"Ø x 31' long detention pipe, Type 2 catch basin with flow restrictor tee, 4" and 6" SDR35 PVC pipe, and a perforated PVC D2729 footing drain pipe. Stormwater runoff from the driveway will be collected by a trench drains or a Type 1 catch basin located along the property line at the bottom of the driveway. Stormwater is then routed from the trench drain and Type 1 catch basin to a Type 2 catch basin associated with the detention facility, which is located beneath the driveway. Likewise, runoff from the proposed single-family residence will be captured in a gutter and downspout system and conveyed to the Type 1 catch basin and then to the detention facility. Any stormwater collected within the building footing drains will be routed to a 12" area drain which contains a 2' min sump for the settlement of fines. The 12" area drain will also collect stormwater from the concrete patio located on the east side of the proposed single-family residence. The outlet from this area drain connects to the onsite storm pipes which are routed to the detention facility. See the Drainage Plan in Attachment B for additional details on the proposed drainage system.

All collected stormwater on site will be routed to the detention facility before being conveyed to the public storm main along the west side of W Mercer Way (the storm main will be extended across the frontage as a part of this project). The detention facility was sized using Table 1 of the City of Mercer Island's Onsite Detention Design Requirements document, which can be seen in Attachment F, since the

project is proposing less than 9,500 SF of new plus replaced impervious surface. The total new plus replaced impervious surfaces are 4,519 SF which falls within the 4,000 to 5,000 SF new and replaced impervious surface area range in the detention sizing table. The detention facility will have a pipe diameter of 60" and a pipe length of 31 ft since the soils on site are classified as Type C soils (see Section 5 and Attachment C for additional soils information). The orifice elevations and dimensions were also determined from Table 1 of the City of Mercer Island's Onsite Detention Design Requirements document which is included in Attachment F.

3 LEVEL 1 DOWNSTREAM ANALYSIS

Per the Manual, development projects that discharge stormwater offsite shall submit an offsite analysis report that assesses the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and the appropriate mitigation of those impacts up to 1/4 miles downstream of the site. Since this development is discharging stormwater offsite, a downstream analysis has been provided. See Attachment D for additional details on the downstream analysis.

4 MINIMUM REQUIREMENTS

Since the project will add less than 5,000 SF of new plus replaced impervious surfaces, it is subject to Minimum Requirements #1 through 5 (MR#1-5) in the Manual. The Project meets MR#1-5 as follows:

4.1 MINIMUM REQUIREMENT #1 – STORMWATER SITE PLANS

The Stormwater Site Plan was prepared in accordance with Volume 1 Chapter 3 of the Manual and includes the minimum requirements applicable to the subject site based on thresholds of new and replaced site impervious coverage.

4.2 MINIMUM REQUIREMENT #2 – CONSTRUCTION STORMWATER POLLUTION PREVENTION

The Construction Stormwater Pollution Prevention Plan (SWPP) was prepared in accordance with Volume 1 Chapter 2 Section 2.5.2 of the Stormwater Manual and is described below in Section 6 of this report. The Temporary Erosion and Sediment Control Plan (TESC Plan) can be seen in in the Project Plans submitted under separate cover and serves as a guide for the contractor to implement a final TESC Plan. As the site disturbance is less than one acre, a Stormwater Permit is not required.

4.3 MINIMUM REQUIREMENT #3 – SOURCE CONTROL

The proposed catch basins, spill control elbows, detention facility, area drains with sumps, and cleanouts serve as source control of pollution on the project site. In order to control pollutants, proper maintenance and cleaning of debris, sediment, and oil from stormwater collection and conveyance systems is required per the operation and maintenance recommendations found in Volume 5 Section 4.6 of the Stormwater Manual in addition to the BMPs in Volume IV Section 2.2. See Attachment E for operation and maintenance requirements pertaining to the project.

4.4 MINIMUM REQUIREMENT #4 – PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

The proposed drainage system will emulate the natural pre-developed conditions of the site (i.e., forested conditions) as much as possible as a portion of the undisturbed natural vegetation on the site will remain undisturbed. Stormwater discharged from the site will connect to the public drainage system within E Mercer Way which eventually drains to Lake Washington, thus maintaining the natural drainage course from the site.

4.5 MINIMUM REQUIREMENT #5 – ON-SITE STORMWATER MANAGEMENT

The On-Site Stormwater Management requirements applicable to this project were determined using List #1. The project complies with List #1 as described below.

Lawn and landscaped areas:

All disturbed pervious surfaces will be amended in accordance with the Post-Construction Soil Quality and Depth requirements as listed under BMP T5.13 in Chapter 5 of Volume V.

Roof:

1. Full Dispersion is infeasible because the required vegetated flowpath is not available. Downspout Full Infiltration is infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
2. Bioretention or rain garden facilities are infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
3. Downspout Dispersion Systems is infeasible because the required vegetated flowpath is not available onsite.
4. Perforated Stub-out Connections is infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
5. On-site detention will be utilized for the stormwater management of all roof surfaces on site.

Other Hard Surfaces:

1. Full dispersion is infeasible because the required vegetated flowpath is not available onsite.
2. Permeable pavement, rain gardens, and bioretention are infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
3. Sheet flow dispersion and concentrated flow dispersion are infeasible because the required vegetated flowpath is not available onsite and may create issues with the neighboring house downgradient of the site.
4. On-site detention will be utilized for the stormwater management of all non-roof impervious surfaces on-site. A portion of the new driveway which is located on the adjacent site to the east (628 SF) will remain unmitigated as stormwater cannot be collected off-site and conveyed to the detention facility.

Therefore, the Post-Construction Soil Quality and Depth requirements as listed under BMP T5.13 and the detention facility utilized for the impervious surfaces on site satisfies MR#5.

5 SOILS

A soils investigation was completed by Cascade GeotechNW LLC, on December 5, 2018. Two test pits (B-1 and B-2) were excavated to exploration depth of approximately 26.5 and 16.5 feet below the existing ground surface. Boring locations and details are summarized in the Geotechnical Report attached as Attachment C.

Subsurface exploration generally encountered native stiff to very stiff, silt, and sandy silt extending to the bottom of the borings. Groundwater was not encountered within the drilling depths during drilling. However, very moist to wet soils were observed on the soil sample between 17½ and 19 feet in boring B-1 during drilling.

Additionally, the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on the City of Mercer Island's online map.

6 CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPP)

The SWPP was prepared in accordance with The Manual. An Erosion and Sediment Control Plan is required per The Manual. Erosion and sediment control (ESC) measures were designed for the project and shown on the TESC plan in Section Error! Reference source not found. of this report. Both the SWPP and TESC Plan serve as guides as the contractor is required to design a working TESC plan for the site. The TESC is submitted under separate cover.

Element 1: Preserve Vegetation/Mark Clearing Limits
BMPs used:

- BMP C233: Silt Fence

Silt fence will be placed around the low points of the perimeter of the site.
Element 2: Establish Construction Access
BMPs used:

- BMP C105: Stabilize Construction Entrance/Exit

The project site will have one construction access connecting to E Mercer Way. The contractor shall install a temporary construction entrance made from quarry spalls. E Mercer Way will be swept daily, or as needed, to remove sediment tracked from the project site.
Element 3: Control Flow Rates
BMPs used:

- BMP C235: Wattles

If necessary, the contractor will implement compost socks and/or straw wattles to control flow rates and disperse stormwater.
Element 4: Install Sediment Controls
BMPs used:

- BMP C233: Silt Fence
- BMP C235: Wattles

Silt fencing or straw wattles will be placed along the low points of the perimeter of the construction site to prevent sediment from escaping downstream of the site.
Element 5: Stabilize Soils

BMPs used:

- BMP C121: Mulching
- BMP C140: Dust Control

Mulch will be used by the contractor whenever soils will be left exposed for a significant amount of time or whenever a rainfall event is anticipated. During summer months water will be sprinkled on the site as needed to minimize the amount of dust coming off the site.

Element 6: Protect Slopes

BMPs used:

- BMP C121 Mulching

Mulch will be added to soils on significant slopes to provide temporary protection from erosion.

Element 7: Protect Drain Inlets

BMPs used:

- BMP C220: Storm Drain Inlet Protection

Temporary catch basin inlet protection on all existing catch basins adjacent to the site will be implemented to prevent sediment from entering the drainage system.

Element 8: Stabilize Channels and Outlets

N/A. There are no existing roadside ditches and channels which require stabilization

Element 9: Control Pollutants

BMPs used:

- BMP C153: Material Delivery, Storage and Containment
- BMP C154: Concrete Washout Area

A material delivery, storage and containment area shall be designated by the contractor and located away from traffic and near the construction entrance. An onsite concrete washout area for any concrete mixing shall be designated by the contractor as well.

Element 10: Control De-Watering

BMPs used:

- Water Bars

De-watering should not be an issue on this site as the groundwater table is not known to be near the surface. However, the contractor shall apply water bars during construction as needed.

Element 11: Maintain BMPs

BMPs used:

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead

The contractor shall keep erosion prevention and sediment control materials onsite for regular maintenance and emergency situations. The contractor will be the person in charge of erosion and sediment control for this project.

Element 12: Manage the Project

BMPs used:

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling

The contractor will be in control of erosion and sediment control and will keep erosion prevention and sediment control materials onsite for regular maintenance and emergency situations. The construction project will be sequenced in an orderly manner to minimize the duration of exposed soil to erosion.

Element 13: Protect Low-Impact Development BMPs

BMPs used:

- BMP C102: Buffer Zone
- BMP C103: High Visibility Fence
- BMP C233: Silt Fence

N/A since to LID BMPs are infeasible on the site besides Post-Construction Soil Quality and Depth for landscaped areas. See Section 4.5 of this report for more information on the infeasibility of LID BMPs.

7 ATTACHMENTS

ATTACHMENT A – SITE PHOTOS

ATTACHMENT B – DRAINAGE PLAN

ATTACHMENT C – GEOTECHNICAL MEMORANDUM

ATTACHMENT D – DOWNSTREAM ANALYSIS

ATTACHMENT E – OPERATION AND MAINTENANCE MANUAL

ATTACHMENT F – DETENTION FACILITY SIZING EXHIBIT

ATTACHMENT G – ARBORIST REPORT

ATTACHMENT A – SITE PHOTOS

Appendix A - Site Photos
Project: 7431 E Mercer Way, Parcel #2579500162

Access to the site is provided by this driveway along E Mercer Way (looking SW)

We were not able to take additional photos of our site, as we were not able to receive permission to enter private property. Our site is on the west side of the single-family home (looking SW).

ATTACHMENT B – DRAINAGE PLAN

KEY NOTES

KEY	DESCRIPTION	DETAIL/ SHEET
1	4" ROOF DOWNSPOUT (TYP)	-
2	4" ROOF DOWNSPOUT TIGHTLINE @ 2.00% MIN SLOPE AND 2' MIN COVER	-
3	4" SDCO RIM 119.05 4" IE 117.25	E/C06
4	47 LF 4" SD @ 2.00% MIN SLOPE	-
5	4" SDCO RIM 120.94 4" IE 118.50	E/C06
6	41 LF 4" SD @ 2.00% MIN SLOPE	-
7	4" SDCO RIM 119.75 4" IE 117.00	E/C06
8	54 LF 4" SD @ 2.00% MIN SLOPE. INSTALL VERTICAL BENDS AS NECESSARY TO ROUTE PIPE BELOW DRIVEWAY RETAINING WALL WHILE MAINTAINING 2% MIN SLOPE & 2' MIN COVER	-
9	4" SDCO RIM 113.83 4" IE 111.50	E/C06
10	4 LF 4" SD @ 2.00% MIN SLOPE	-
11	54"Ø TYPE 2 CATCH BASIN W/ FLOW CONTROL STRUCTURE RIM 114.55 4" IE (E) 111.15 36" IE (W) 109.70 6" IE (S) 109.70 (OUTLET) FLOW CONTROL STRUCTURE INFO: 6" OVERFLOW ELEV 114.20 ORIFICE #2: 1.3"Ø @ ELEV 113.20 ORIFICE #1: 0.5"Ø @ ELEV 107.70	G/C06 & H/C07
12	DETENTION FACILITY 5'Ø X 31'L PIPE LAID FLAT TOP OF 60" PIPE 114.20 36" IE (E) 109.70 60" IE 109.20	H/C07
13	88 LF 6" SD @ 2.00% MIN SLOPE	-
14	6" SDCO RIM 117.00 6" IE 107.94	E/C06
15	125 LF 6" SD @ 2.00% MIN SLOPE	-
16	9 LF 6" SD @ 2.00% MIN SLOPE	-
17	20 LF 6" SD @ 2.00% MIN SLOPE	-
18	TYPE 1 CATCH BASIN W/ SOLID LOCKING LID RIM 87.21 6" IE (W) 84.71 12" IE (N) 84.21 2' MIN SUMP CONTRACTOR TO DETERMINE LOCATION OF WATERMAIN PRIOR TO SETTING CB. PROTECT WATERMAIN DURING CONSTRUCTION AND INSTALL ETHAFOAM CUSHION BETWEEM WATERMAIN AND CB IF LESS THAN 1' SEPARATION	F/C06
19	88 LF 12" SD @ 1.00% MIN SLOPE	-
20	EX CB - TYPE 1 RIM 85.80 4" IE (W) 83.47 6" IE (S) 82.93 12" IE (S) 83.30 6" IE (N) 82.93	-
21	APPROX LOCATION OF EX WATER MAIN (NOT SURVEYED). CONTRACTOR TO POTHOLE WATERMAIN TO DETERMINE LOCATION AND DEPTH PRIOR TO INSTALLATION OF UTILITIES WITHIN ROW	-
22	ROOF OVERHANG (TYP)	-
23	PERIMETER FOOTING DRAIN - 4" PERFORATED PVC PIPE IN 6" WASHED GRAVEL WRAPPED IN NON-WOVEN FILTER FABRIC (TYP)	SEE GEOTECH REPORT
24	6" SDCO RIM 101.00 6" IE 98.50	E/C06
25	6" SDCO RIM 101.50 6" IE 98.30	E/C06
26	3 LF 4" SD @ 2.00% MIN SLOPE	-
27	TYPE 1 CATCH BASIN W/ OPEN GRATE LID & OIL/WATER SEPARATOR RIM 113.83 4" IE (S) 111.33 4" IE (W) 111.23 2' MIN SUMP	D&F/C06
28	2 LF 4" SD @ 2.00% MIN SLOPE	-
29	12" AREA DRAIN RIM 121.05 4" IE (W) 118.60 (FTG DRN) 4" IE (E) 118.50 2' MIN SUMP	-
30	12 LF 6" TRENCH DRAIN RIM VARIES (SEE SHEET C02) 4" IE (E) 117.50	-
31	11 LF 4" SD @ 2.00% MIN SLOPE	-
32	4" SOLID WALL PVC FOOTING DRAIN TIGHTLINE @ 2.00% MIN SLOPE	-
33	SAWCUT AND MATCH EG. REPLACE EX ASPHALT PAVEMENT SECTION IN-KIND	-
34	CONTRACTOR TO DETERMINE WHERE EXISTING INLET DRAINS FROM AND REMOVE PIPE IF IT HAS BEEN ABANDONED. IF PIPE CONVEYS DRAINAGE FROM AN UPSTREAM LOCATION, CONTACT ENGINEER OF RECORD WITH DETAILS	-
35	PROTECT EX SSS DURING CONSTRUCTION. CONTRACTOR TO POTHOLE SSS PRIOR TO INSTALLATION OF SD TO DETERMINE DEPTH. CONTACT ENGINEER OF RECORD IF CONFLICT OCCURS	-

DRAINAGE NOTES:

ROOF DRAINS:
1. NUMBER AND SIZE SHALL BE IN CONFORMANCE WITH THE UNIFORM PLUMBING CODE.
2. DOWNSPOUTS SHALL BE TIED INTO A NON-PERFORATED, RIGID, SMOOTH-BORE PIPE, WHICH DRAINS TO AN APPROVED STORM SYSTEM.
3. DRAINPIPE SHALL MEET MATERIAL STANDARDS FOR D2729 FOR P.V.C. PIPE, GR F-405 FOR SMOOTH-BORE H.D.P.E. PIPE.
4. PROVIDE CLEANOUTS AT THE UPPER END OF THE SYSTEM AND AT EACH CUMULATIVE CHANGE OF DIRECTION IN EXCESS OF 135 DEGREES.
5. ALL PIPE FITTINGS SHALL BE MADE OF THE SAME MATERIAL AS THE STRAIGHT PIPE. GLUED JOINTS SHALL USE A BONDING AGENT RECOMMENDED BY THE PIPE MANUFACTURER.

FOOTING DRAINS:
1. FOOTING DRAINS SHALL BE INSTALLED AROUND ALL FOUNDATIONS WHICH ENCLOSE A CRAWL SPACE, CELLAR, BASEMENT, GARAGE OR OTHER BUILDING SPACE.
2. DRAINS SHALL BE CONSTRUCTED OF PERFORATED PIPE INSTALLED AT THE BASE OF THE FOOTING.
3. DRAIN PIPE SHALL MEET MATERIAL STANDARDS FOR D2729 FOR P.V.C. PIPE, WITH THE PERFORATIONS DIRECTED DOWNWARD.
4. GRANULAR BACKFILL SHALL BE PLACED AROUND AND ABOVE THE FOOTING DRAIN TO A DEPTH OF 2/3 OF THE HEIGHT OF THE WALL.
5. A FILTER FABRIC SHALL BE USED TO PREVENT SOIL PARTICLES FROM ENTERING THE FOOTING DRAIN. IT IS PREFERABLE THAT THE FABRIC BE PLACED BETWEEN THE GRANULAR BACKFILL AND THE NATIVE SOILS.

DRIVEWAY/PARKING AREA DRAINS:
1. LARGE IMPERVIOUS AREAS USED FOR PARKING OR MANEUVERING OF VEHICLES SHALL BE SLOPED TO DRAIN TO ONE OR MORE CATCH BASINS.
2. THE BASINS SHALL BE TIED INTO THE ON-SITE STORM DRAINAGE SYSTEM USING NON-PERFORATED PIPE OF THE SAME MATERIALS.
3. AT LEAST ONE CATCH BASIN SHALL HAVE AN OIL SEPARATOR TO CLEAN THE WATER, OIL AND SILT PRIOR TO ENTERING THE APPROVED STORM SYSTEM.
4. IN AREAS WHERE THE OFF-SITE STORM SYSTEM IS INADEQUATE, ON-SITE DETENTION OF RUNOFF MAY BE REQUIRED. (CONTACT THE DEVELOPMENT ENGINEER FOR MORE INFORMATION).

GENERAL:
1. SLOPE ALL DRAIN LINES AT 2% MINIMUM TOWARD THE OUTLET.
2. PROVIDE CLEANOUTS OR CONTROL STRUCTURES AS APPROPRIATE.
3. ALL DRAINAGE PIPING AND STRUCTURES ARE SUBJECT TO INSPECTION PRIOR TO BACKFILLING.
4. ROOF AND FOOTING DRAINS MAY BE COMBINED BEYOND THE LOWEST POINT OF THE FOOTING DRAIN.
5. USE SAND COLLARS AT CB CONNECTIONS TO P.V.C. PIPE.
6. UNLESS OTHERWISE SPECIFIED, 6" STORM DRAIN PIPE FOR ROOF DRAINS AND SEWER PIPE SHALL BE SDR35 PVC PIPE.
7. ALL FOOTING DRAIN AND PERFORATED PIPE SHALL BE D2729 PVC PIPE WITH THE PERFORATIONS DIRECTED DOWNWARDS.
8. ALL PERF PIPE SHALL BE 4" DIAMETER UNLESS OTHERWISE SHOWN.
9. CONTRACTOR TO VERIFY INVERTS OF STORM DRAIN IN ROW AND ADJUST ONSITE STORM SYSTEM AS NECESSARY.
10. CONTRACTOR TO FIELD LOCATE AND REROUTE ANY POTENTIAL UTILITY CONFLICTS WITH DETENTION FACILITY PRIOR TO CONSTRUCTION

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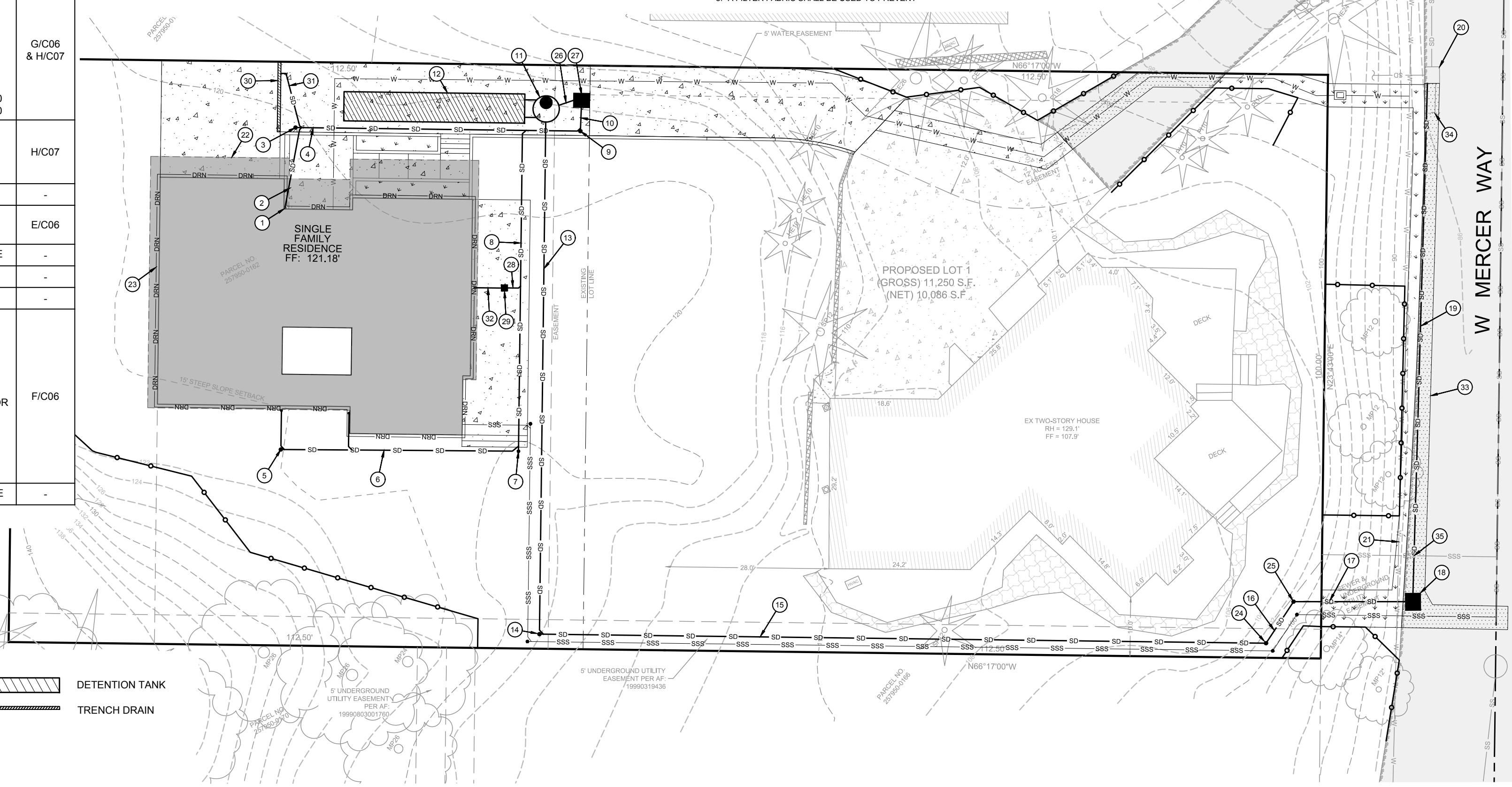

LEGEND:
- ASPHALT
- CONCRETE
- LANDSCAPE
- TREE PROTECTION FENCING
- DETENTION TANK
- TRENCH DRAIN

REVISION			
No.	DATE	BY	REVISION

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BENJAMIN J. IDDINS, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: YANG RESIDENCE
7431 E MERCER WAY
MERCER ISLAND, WA 98040

PROJECT: 7431 E MERCER WAY
MERCER ISLAND, WA 98040
DRAINAGE PLAN

PROJ. MANAGER:	BI
DESIGNED BY:	BI, LG
DRAWN BY:	GR
CHECKED BY:	BI, TG
SCALE:	SCALE
DATE: 6/27/2019	REV. A, SHEET 4 OF 7

SHEET NUMBER
C04

CAD FILE NUMBER: P:\CLIENTS\CIVIL\STUDIO 19\7431 E MERCER WAY MERCER ISLAND\DWG\DRAWING\7431 E MERCER WAY_18.DWG
LAST MODIFIED BY: BIDDINS · SAVE DATE: 6/27/2019 9:50 AM · SHEET SET: XXXX · ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
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ATTACHMENT C – GEOTECHNICAL MEMORANDUM

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
PROPOSED RESIDENCE
7431 EAST MERCER WAY
MERCER ISLAND, WASHINGTON

PREPARED FOR
MS. MELISSA YANG

PREPARED BY
CASCADE GEOTECHNW
4957 LAKEMONT BLVD SE, C-4, #325
BELLEVUE, WA 98006
(206) 491-0081

PROJECT NO. 2018-015
December 5, 2018

CASCADE GROUP INT. LLC
DBA CASCADE GEOTECHNW
4957 Lakemont Blvd SE, C-4, #325
Bellevue, WA 98006
(425) 649-0613

December 5, 2018
Project No. 2018-015

Ms. Melissa Yang
c/o Mr. Steve Long
Studio 19 Architects
207½ 1St Avenue S, Suite 300, Seattle, WA 98104

Subject: Preliminary Geotechnical Engineering Study
Proposed Residence
7431 East Mercer Way, Mercer Island, WA

Dear Ms. Yang,

As requested, Cascade GeotechNW LLC has performed a preliminary geotechnical engineering study for the above project. This report documents the subsurface conditions at the site and presents our preliminary geotechnical recommendations for the proposed development

Based on the borings drilled, the subsurface soils at the site consist of a layer of fill overlying stiff to very stiff silt, sandy silt, and clayey silt to at least 26½ feet below surface. Groundwater was not encountered within the drilling depth in the borings. However, very moist to wet soils were observed at about 17½ feet in boring B-1 during drilling.

In our opinion, the proposed project is feasible from a geotechnical standpoint. Based on the soil conditions and our understanding the design concept, in our opinion, the proposed residence may be supported by a mat foundation/structural slabs with thickened edge footings. It is our opinion that temporary excavations may be accomplished with unsupported, sloped open cuts.

Cascade GeotechNW appreciates the opportunity to be of service to you during the design phase of this project. Please contact us at if you have any questions or we can be of further assistance.

Respectfully submitted,

Michael Xue, P.E.
Principal Geotechnical Engineer

Encl.: Preliminary Geotechnical Engineering Study Report

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Figures

Appendix

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
PROPOSED RESIDENCE
7431 EAST MERCER WAY
MERCER ISLAND, WASHINGTON

1.0 INTRODUCTION

This report presents the results of our preliminary geotechnical engineering study for the proposed residence at the above-referenced site. The purpose of our work was to evaluate the subsurface conditions at the site and provide preliminary geotechnical recommendations regarding foundation design, site grading, and retaining walls for the proposed development. Authorization to conduct the geotechnical engineering study was provided by Ms. Yang on November 13, 2018.

2.0 SITE AND PROJECT DESCRIPTION

The subject property is an approximately 9,850 square foot lot located at 7431 East Mercer Way in the City of Mercer Island, Washington. The approximate location of the site is shown on the Vicinity Map, Figure 1. The subject property is a rectangular-shaped vacant lot, accessed through 7435 East Mercer Way (see Figure 2). It is bordered by vacant lots to the west and south, and by existing single-family residences to the north and east. Based on review of topographic map and our field observations, the majority of the property is a relatively level concrete pad that is currently used as a tennis court. However, steep slopes (40% or greater) exist along most of the property lines.

Based on the information provided to us, we understand that it is proposed to construct a new single-family residence at the subject property. Design plans are not available at the time this report was prepared. However, we envision the proposed SFR will be a two-story wood frame structure with concrete slabs on grade. We anticipate that a new driveway will need to be constructed along the north property line to provide access to the proposed residence from East Mercer Way through 7435 property. We anticipate that site grading for the proposed construction will likely involve cuts and fill on the order of 4 feet for the house foundation construction, and fills up to 6 to 7 feet for the driveway construction.

The conclusions and recommendations outlined in this report are based on our current understanding of the proposed development, which is in turn based on the project information provided to us. If the above project description is incorrect, or the project

information changes, we should be consulted to review the recommendations contained in this study and make modifications, if needed.

3.0 PROJECT SCOPE

The purpose of our geotechnical engineering study for the proposed development is to characterize subsurface conditions at the project site. The subsurface information obtained was used to develop preliminary geotechnical engineering recommendations pertinent to the design and construction of the subject project. The scope of our work for this project included the following tasks and work efforts:

1. Collect and review available geotechnical data in the site vicinity to form a basis for our field exploration.

2. Conduct a site reconnaissance to observe the existing site conditions, and to identify site conditions that may impact the proposed development from a geotechnical standpoint.

3. Drill two test borings at the site to explore the general subsurface conditions at the site.

4. Perform engineering analyses to develop preliminary engineering recommendations pertinent to the proposed development concept.

5. Preparation of a preliminary geotechnical report summarizing our work on the project and presenting our findings and preliminary geotechnical recommendations.

It should be noted that our proposed scope of work does not include an evaluation of chemical properties of soil and groundwater. Our scope also does not include evaluation of stormwater infiltration.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

The Geologic Map of Mercer Island (Troost and Wisher, 2006) mapped the surficial geologic unit at the subject site as Lawton Clay deposit (Qvlc). Lawton Clay deposits (Qvlc) are described by Troost, et al. as laminated to massive silt, clayey silt, and silty

clay with scattered dropstones deposited in lowland proglacial lakes that were glacially-overridden. Lawton Clay deposits are typically very stiff to hard, and are generally weathered to medium stiff to stiff near the surface.

4.2 SUBSURFACE CONDITIONS

Two test borings (B-1 and B-2) drilled at the site generally encountered about 4½ feet of fill overlying native stiff to very stiff, silt, clayey silt, and sandy silt extending to the bottom of the borings at about 26½ and 16½ feet in B-1 and B-2, respectively. Please refer to the summary boring logs Figures A-1 and A-2 in Appendix A for details.

Groundwater was not encountered within the drilling depths during drilling. However, very moist to wet soils were observed on the soil sample between 17½ and 19 feet in boring B-1 during drilling. It should be noted that groundwater elevations and seepage rates are likely to vary depending on the season, local subsurface conditions, tidal fluctuations, and other factors. Groundwater levels and seepage rates are normally highest during the winter and early spring.

5.0 GEOLOGY HAZARDS ASSESSMENT

5.1 LANDSLIDE HAZARDS AND STEEP SLOPES

The subject site is mapped within a potential landslide hazard area according to the City of Mercer Island's Geologic Hazards Map. The majority of the site is flat with concrete surface. However, steep slopes exist at the approximate southwestern corner of the site and on adjacent property to the west. Based on the review of topographic survey map and our site observations, the steep slopes at the subject and neighboring sites are about 18 to 20 feet in height.

A site reconnaissance of the subject property was conducted on November 27, 2018. During our site reconnaissance, we did not observe obvious evidence of recent slope instability or ground movement at the site. In our opinion, the soldier pile walls installed at the adjacent parcel north and northeast of the steep slope areas also improved the subject site stability. The concrete surface appears to be in relatively good condition with some cracks at the east end. Based on our field observations, the general topography at the site and vicinity, and the result of subsurface explorations, in our opinion, the subject site appears to be globally stable in its current

configuration. Based on the current development concept and the fact the proposed construction will be confined in the developed areas with minor grading, it is also our opinion that the proposed single-family development concept as currently planned is feasible from a geotechnical engineering standpoint and will not adversely affect the overall stability of the site or adjacent properties, provided the project is properly design and constructed.

5.2 SEISMIC HAZARDS

Based on our review of the City of Mercer Island's Geologic Hazards Maps, the project site is mapped within a seismic hazard area. The City of Mercer Island Code defines seismic hazard areas as those areas subject to risk of damage as a result of earthquake-induced ground shaking, slope failure, and soil liquefaction or surface faulting. Based on the fine-grained soils and lack of static groundwater table, it is our opinion that the potential for soil liquefaction during an IBC-code level earthquake at the site is considered negligible. As such, in our opinion, special design consideration associated with soil liquefaction at the site is not necessary.

5.3 EROSION HAZARDS

The site is mapped within a potential erosion hazard area according to the City of Mercer Island's Geologic Hazards Map. Based on the soils encountered in the borings, the near-surface site soils are likely to exhibit low to moderate erosion potential if exposed to long periods of rains in the wet season. However, in our opinion, the erosion hazards at the site can be effectively mitigated with the best management practice during construction and with properly designed and implemented landscaping for permanent erosion control, based on the current design concept with anticipated minor grading.

During construction, the temporary erosion hazard can be effectively managed with an appropriate erosion and sediment control plan, including but not limited to installing silt fence at the construction perimeter, limiting removal of vegetation to the construction area, placing rocks or hay bales at the disturbed/traffic areas and on the downhill side of the project, covering stockpile soil or cut slopes with plastic sheets, constructing a temporary drainage pond to control surface runoff and sediment trap, placing quarry spalls at the construction entrance, etc. Permanent erosion control measures should

include establishing vegetation, landscape plants, and hardscape established at the end of project, and reducing surface runoff to the minimum extent possible.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 GENERAL

Based on the subsurface conditions at the site, it is our opinion that the proposed development concept as currently planned is feasible from a geotechnical standpoint. In our opinion, the proposed residence may be supported by a mat foundation/structural slabs. Our recommendations for the seismic design, site grading, foundations, and retaining wall are presented in the following sections.

6.2 SEISMIC DESIGN PARAMETERS

The following table provides seismic design parameters for the site that are in conformance with the 2015 edition of the International Building Code (IBC), which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps:

Table 1 – Summary Seismic Design Parameters per 2015 IBC

Site Class	Spectral Acceleration at 0.2 sec. (g) S_S	Spectral Acceleration at 1.0 sec. (g) S_1	Site Coefficients		Design Spectral Response Parameters	
			F_a	F_v	S_{DS}	S_{D1}
D	1.451	0.553	1.0	1.50	0.968	0.553

6.3 GENERAL EARTHWORK RECOMMENDATIONS

Based on the current design concept, we anticipate that site grading for the proposed project will likely consist of cuts and fill up to 4 to 5 feet feet for the building construction and about 6 to 7 feet for the driveway construction. The site grading should be observed by a qualified geotechnical engineer. It is important that the earthwork be observed to evaluate whether any undesirable/unsuitable materials are encountered during the excavation and scarification process, and whether the exposed soil/rock

conditions are similar to those encountered in our exploration. The following subsections provide general guidelines for design of site grading and earthwork.

6.3.1 Site Preparation

Site preparation for the proposed project mainly includes removal of the existing concrete, site clearing, and excavations to the design subgrade. All debris resulted from demolition should be hauled away from the site. The stripped surface materials should be properly disposed off-site or be "wasted" on site in non-structural landscaping areas.

Following site clearing and excavations, the adequacy of the subgrade where structural fill, foundations, slabs, or pavements are to be placed should be verified by a representative of Cascade GeotechNW. The subgrade soil in the improvement areas, if recompacted and still yielding, should also be over-excavated and replaced with compacted structural fill or lean-mix concrete.

6.3.4 Material Reuse and Structural Fill Materials

In the context of this report, structural fill is defined as compacted fill placed under footings, concrete stairs and landings, and slabs, or other load-bearing areas. In our opinion, the on-site fill and fine-grained soils are not suitable to be used as structural fill. Structural fill should consist of imported, well-grade, granular material, such as WSDOT Gravel Borrow (WSDOT 9-03.14(1)) or approved equivalent. Well-graded recycled concrete may also be considered as a source of structural fill. Use of recycled concrete as structural fill should be approved by the geotechnical engineer. The on-site fill may be used as general fill in the non-structural and landscaping areas. If use of the on-site soil is planned, the excavated soil should be stockpiled and protected with plastic sheeting to prevent softening from rainfall in the wet season.

6.3.5 Structural Fill Placement and Compaction Requirements

Structural fills should be placed in thin horizontal lifts not exceeding 10 inches in loose thickness, moisture conditioned to within about 3 percent of optimum moisture content, and systematically compacted to meet the following minimum relative densities based on the maximal dry density as determined using test method ASTM D 1557.

Table 2 – Structural Fill Compaction Requirements

Application	Percentage
Beneath conventional strip & column footings, patios, porches, and slab-on-grade floors	95%
Beneath roadways, driveways, pavement areas, sidewalks and backfill behind retaining & basement walls (required for backfill next to vertical drain mats).	95% for the top 12 inches and 90-95% below 12 inches

Observations and soil density tests should be performed during grading operations to assist the contractor in obtaining the required degree of compaction and the proper moisture content on each fill lift. Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content as necessary, to obtain the specified compaction.

6.3.6 Permanent Cut and Fill Slopes

Permanent cut and fill slopes should be graded no steeper than 2H:1V. Erosion control measures such as erosion-control mats and/or vegetation should be applied to the permanent slopes as soon as feasible.

6.4 BUILDING FOUNDATIONS

Based on the subsurface conditions at the site and our understanding of the design concept, we recommend that a mat foundation/structural slab with thickened edge bearing on 12-inch of structural fill be used to support the proposed building. The mat foundation/structural slab with thickened edge will provide a better foundation support and improve the long-term foundation performance. The following sections present our recommendations for designing the mat foundation/structural slab with thickened edge.

The mat foundation/structural slabs should bear on 12 inches of structural fill compacted to a dense condition. The native foundation subgrade soil at the bottom of 12 inches of structural fill should be in a firm condition or be re-compacted to a firm and unyielding condition prior to placement of structural fill. Any soft/loose and pumping native subgrade soil detected during compaction should be removed and replaced with structural

fill or CDF. The foundation should be thickened a minimum depth of 18 inches below the adjacent finish grade around the perimeter of the mat. The thickened edge of the structural slabs should have a minimum width of 18 inches. For design of the mat foundation/structural slab with thickened edge bearing on the prepared subgrade as discussed above, a modulus of subgrade reaction, k_s, of 100 pounds per cubic inch (pci) may be used. With the mat foundation/structural slab foundation, we anticipate the average bearing pressure to be less than 2,000 psf.

Provided the mat slab subgrade is prepared as described above, mat foundation/structural slab settlement is estimated to be approximately one inch with differential settlement on the order of ½ inch.

Lateral Resistance

Lateral loads acting on the foundations may be resisted by passive earth pressure developed against the embedded portion of the foundation system and by frictional resistance at the bottom of the footings. For footings bearing on the competent native soil or compacted structural fill, a frictional coefficient of 0.35 may be used to evaluate sliding resistance. Passive soil resistance may be calculated using an equivalent fluid unit weight of 300 pcf, assuming properly re-compacted native soil or compacted structural fill will be placed against the footings. The above values include a factor of safety of 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

Perimeter Footing Drain

Footing drains should be installed around the perimeter of the building, at or just below the invert of the footings. However, if clean sand is present at and below the footing bottom during construction, footing drains may be omitted. Under no circumstances should roof downspout drain lines be connected to the footing drain systems. Roof downspouts must be separately tightlined to a suitable discharge point. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

Foundation Subgrade Preparation

All foundation subgrades should be carefully prepared. The foundation subgrade should be in a dense condition or be compacted to a dense condition prior to concrete pour. If the on-site soil cannot be compacted to a dense condition, they should be over-excavated 12 inches and replaced with compacted structural fill. Foundation excavations should be observed by Cascade GeotechNW to confirm that the exposed footing subgrade is consistent with the expected conditions and adequate to support the design bearing pressure.

6.5 RETAINING AND BASEMENT WALL DESIGN PARAMETERS

Retaining and basement walls should be properly designed to resist the lateral earth pressures exerted by the soils behind the wall. Proper drainage provisions should also be provided behind the walls to intercept and remove groundwater that may be present behind the wall. Our geotechnical recommendations for the design and construction of the retaining/basement walls are presented below.

6.5.1 Lateral Earth Pressures

Concrete cantilever walls should be designed for an equivalent fluid pressure of 35 pcf for level backfills behind the walls assuming the walls are free to rotate. If walls are to be restrained at the top from free movement, such as basement walls, equivalent fluid pressures of 45 pcf should be used for level backfills behind the walls. Walls with a maximum 2H:1V backslope should be designed for an active and at rest earth pressure of 45 and 55 pcf, respectively.

Permanent walls should be designed for an additional uniform lateral pressure of 8H psf for seismic loading, where H corresponds to the buried depth of the wall. The recommended lateral pressures assume that the backfill behind the wall consists of a free draining and properly compacted fill with adequate drainage provisions.

6.5.2 Surcharge

Surcharge loads, where present, should also be included in the design of retaining walls. We recommend that a lateral load coefficient of 0.3 be used to compute the lateral

pressure on the wall face resulting from surcharge loads located within a horizontal distance of one-half wall height.

6.5.3 Lateral Resistance

Lateral forces from seismic loading and unbalanced lateral earth pressures may be resisted by a combination of passive earth pressures acting against the embedded portions of the foundations and by friction acting on the base of the foundations. Passive resistance values may be determined using an equivalent fluid weight of 300 pcf. This value includes a factor of safety of 1.5, assuming the footing is poured against dense native sand, re-compacted on-site sandy soil or properly compacted structural fill adjacent to the sides of footing. A friction coefficient of 0.35 may be used to determine the frictional resistance at the base of the footings. The coefficient includes a factor safety of 1.5.

6.5.4 Wall Drainage

Provisions for wall drainage should consist of a 4-inch diameter perforated drainpipe behind and at the base of the wall footings, embedded in 12 to 18 inches of clean crushed rock and pea gravel wrapped with a layer of filter fabric. Where applicable, in-lieu of conventional footing drains, weep holes (2" diameter of 10 feet on center) may be used for site retaining walls. A minimum 18-inch wide zone of free draining granular soils (i.e. pea gravel or washed rock) is recommended to be placed adjacent to the wall for the full height of the wall. Alternatively, a composite drainage material, such as Miradrain 6000, may be used in lieu of the clean crushed rock or pea gravel. The drainpipe at the base of the wall should be graded to direct water to a suitable outlet.

6.5.5 Wall Backfill

Based on the field exploration, the on-site soil would not be suitable for wall backfill due to its high fines content. Where wall backfill is needed, we recommend using free draining granular soils, such as WSDOT gravel barrow or clean crushed gravel. In areas where the space is limited between the wall and the face of excavation, 5/8" clean crushed rock or pea gravel may be used as backfill without compaction.

Wall backfill should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and

systematically compacted to a dense and relatively unyielding condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557. Within 5 feet of the wall, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

6.6 TEMPORARY EXCAVATIONS AND SHORING

6.6.1 Unsupported Open Cuts

In general, we anticipate site excavations to encounter a few feet of fill over very stiff to very stiff silt. All temporary excavations should be performed in accordance with Part N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring. Excavations more than a total of 4 feet deep should be properly shored or sloped. For planning purposes, it is our opinion that temporary excavations may be sloped as steep as 1H:1V in the dry season, and should be sloped 1½H:1V in the wet season. Where space may be limited, the use of L-shaped footings may be required to conserve space for the temporary cuts.

The temporary excavations and cut slopes should be re-evaluated by a qualified geotechnical engineer in the field during construction based on actual observed soil conditions, and may need to be modified in the wet reasons. The cut slopes should be covered with plastic sheets in the raining season. We also recommend that heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a distance equal to 1/3 the slope height from the top of any excavation.

6.6.2 Temporary Shoring

The detailed project design plans have not been developed yet. In our opinion, temporary shoring is not needed for the building foundation construction. However, temporary shoring may potentially be needed for the driveway construction. If needed, Cascade GeotechNW can provide shoring design recommendations if requested.

6.7 BUILDING SETBACK DISTANCE

Based on review of site topographic survey map and our field observations, the slope in the western portion of the site ranges about 18 to 20 feet in height. Based on the slope

inclination, the total slope height, and the soil conditions encountered in our borings, it is our opinion that the proposed building should have a setback distance of 10 feet from the steep slopes. Additionally, the need for a catchment wall at the southwest corner of the site should be evaluated during design once the project design plans are finalized.

6.8 WET WEATHER CONSTRUCTION

In our opinion, the proposed site construction may be accomplished during wet weather (such as in winter) without adversely affecting the site stability. However, earthwork construction performed during the drier summer months likely will be more economical. Winter construction will require the implementation of best management erosion and sedimentation control practices to reduce the chance of off-site sediment transport. Some of the site soils contain a high percentage of fines and are moisture sensitive. Any footing subgrade soils that become softened either by disturbance or rainfall should be removed and replaced with structural fill, CDF, or lean-mix concrete. General recommendations relative to earthwork performed in wet conditions are presented below:

- Site stripping, excavation and subgrade preparation should be followed promptly by the placement and compaction of clean structural fill or CDF;
- The size and type of construction equipment used may have to be limited to prevent soil disturbance;
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Geotextile silt fences should be strategically located to control erosion and the movement of soil;
- Structural fill should consist of less than 5% fines; and
- Excavation slopes should be covered with plastic sheets.

All permanent cut and fill slopes should be protected so that erosion will not occur. Vegetation should be established as soon after construction as possible to provide long-term erosion protection of the slopes. Prior to establishing vegetation, silt fences and straw bales staked along contours and slopes are recommended to reduce erosion. The slopes should be periodically monitored until vegetation has become fully established.

6.9 SURFACE DRAINAGE AND EROSION CONTROL

Surface runoff can be controlled during construction by careful grading practices. Typically, this includes the construction of shallow, upgrade perimeter ditches or low earthen berms in conjunction with silt fences to collect runoff and prevent water from entering excavations or to prevent runoff from the construction area from leaving the immediate work site. Temporary erosion control may require the use of hay bales on the downhill side of the project to prevent water from leaving the site and potential storm water detention to trap sand and silt before the water is discharged to a suitable outlet. All collected water should be directed under control to a positive and permanent discharge system.

Permanent control of surface water should be incorporated in the final grading design. Adequate surface gradients and drainage systems should be incorporated into the design such that surface runoff is directed away from structures. We suggest that the ground surface be sloped at a gradient of 3 percent for a distance of at least 10 feet feet away from the building, except in paved areas, which can be sloped at a gradient of 1 percent. Potential problems associated with erosion may also be reduced by establishing vegetation within disturbed areas immediately following grading operations.

Roof downspouts should be tightlined to discharge into the storm-water collection system separately from any footing drain system. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the downspout tightline system.

7.0 STATEMENT OF RISK

We understand that the site contains geologic hazard areas, specifically as steep slopes and potential landslide, erosion, and seismic hazard areas. Per Mercer Island City Code Section 19.07.060.D.2, development within geologic hazard areas and critical slopes may occur if the geotechnical engineer provides a statement of risk with supporting documentation indicating that one of the following conditions can be met:

a. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe; or

b. An evaluation of site specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area; or

c. Development practices are proposed for the alteration that would render the development as safe as if it were not located in a geologic hazard area; or

d. The alteration is so minor as not to pose a threat to the public health, safety, and welfare.

Based on the results of our geotechnical evaluation, it is our opinion that the site is stable in its existing condition. It is also our opinion that the proposed development meets the criteria (c) above, as the foundation elements designed and constructed per our recommendations should adequately mitigate potential geologic hazards from impacting the subject and surrounding properties. The adequacy of the temporary erosion and sediment control measures should be monitored during construction, especially in the wet season, by Cascade GeotechNW and may be modified as necessary according to the site and weather conditions. Permanent erosion control measures including landscape and hardscape installations will effectively mitigate the risk of erosion in the long term.

8.0 ADDITIONAL GEOTECHNICAL SERVICES

It should be noted that the preliminary geotechnical recommendations contained in this report are based on the subsurface conditions encountered at the site and the future design concept we envisioned based on the limited information provided to us. Additional geotechnical study including additional field exploration, if warranted, and engineering analysis may likely be required to update our recommendations contained in this report once the development plans are developed and finalized.

To confirm that our recommendations are properly incorporated into the design and construction of the proposed development, Cascade GeotechNW should also be retained to conduct a review of the final project plans and specifications. It is recommended that Cascade GeotechNW be retained to provide monitoring and testing services for geotechnical-related work during construction. This is to observe compliance with the intent of the design concepts, specifications, and/or recommendations, and to allow design changes in the event when subsurface conditions differ from those anticipated during design. The recommendations presented in this report are contingent upon the above observations.

Modifications to our recommendations presented in this report may be necessary, based on the actual conditions encountered during construction.

9.0 LIMITATIONS

This report has been prepared for the exclusive use of Ms. Melissa Yang and the project team for specific application to the proposed development. This report is intended to provide geotechnical recommendations based on a site reconnaissance, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

The scope of our work does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be

relied upon after 24 months from its issuance. Cascade GeotechNW should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify Cascade GeotechNW of such intended use and for permission to copy this report. Based on the intended use of the report, Cascade GeotechNW may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release Cascade GeotechNW from any liability resulting from the use this report.

We appreciate the opportunity to be of service.

Sincerely,

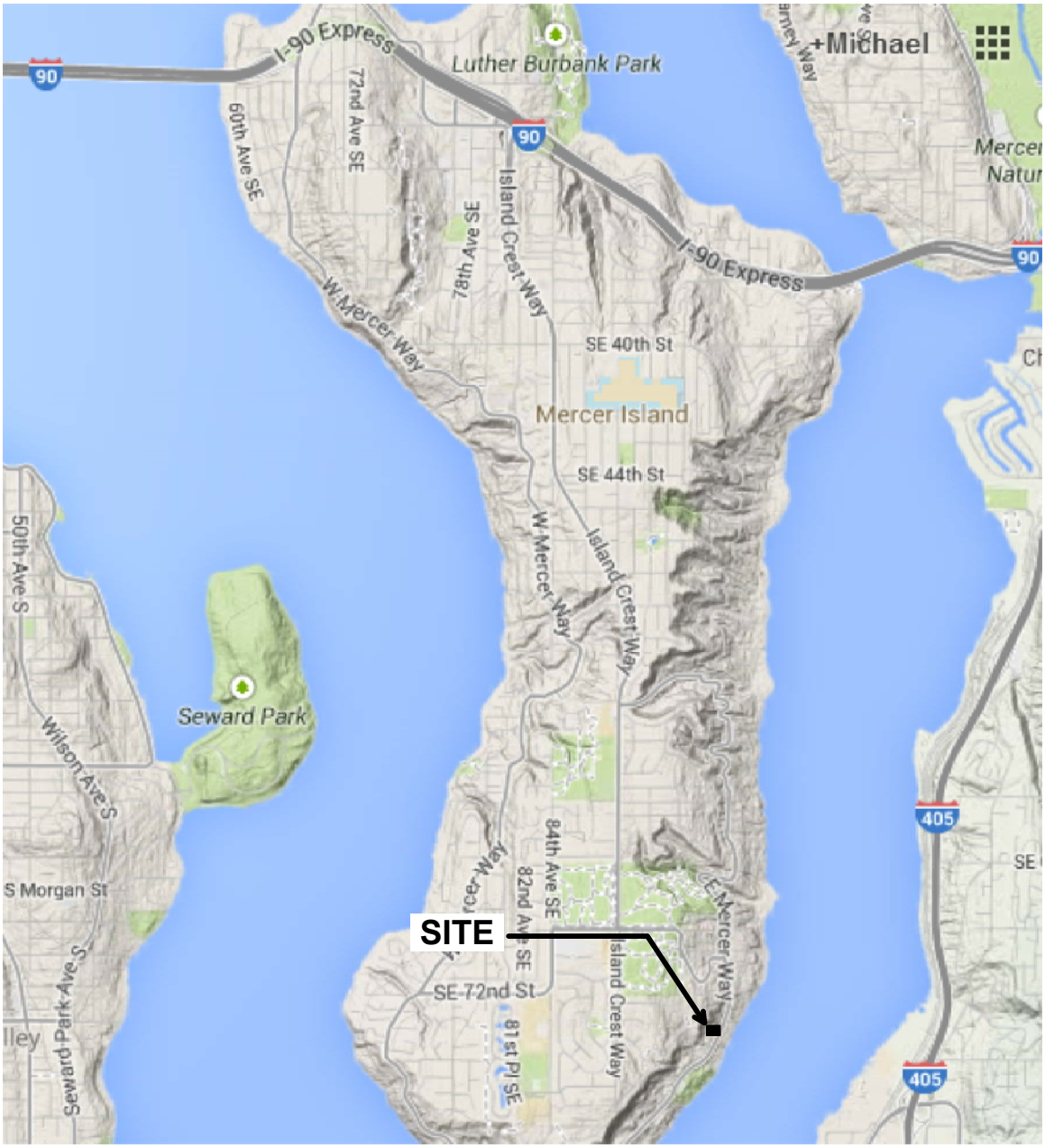
H. Michael Xue, P.E.
Principal Geotechnical Engineer

10.0 REFERENCES

Booth, D. B., Troost, K. A., and Wisher, A. P., 2007, *The Geologic Map of King County, Washington: scale 1:100,000*.

International Code Council, 2015, *International Building Code (IBC)*.

WSDOT, 2018, *Standard Specifications for Road, Bridges, and Municipal Construction.*



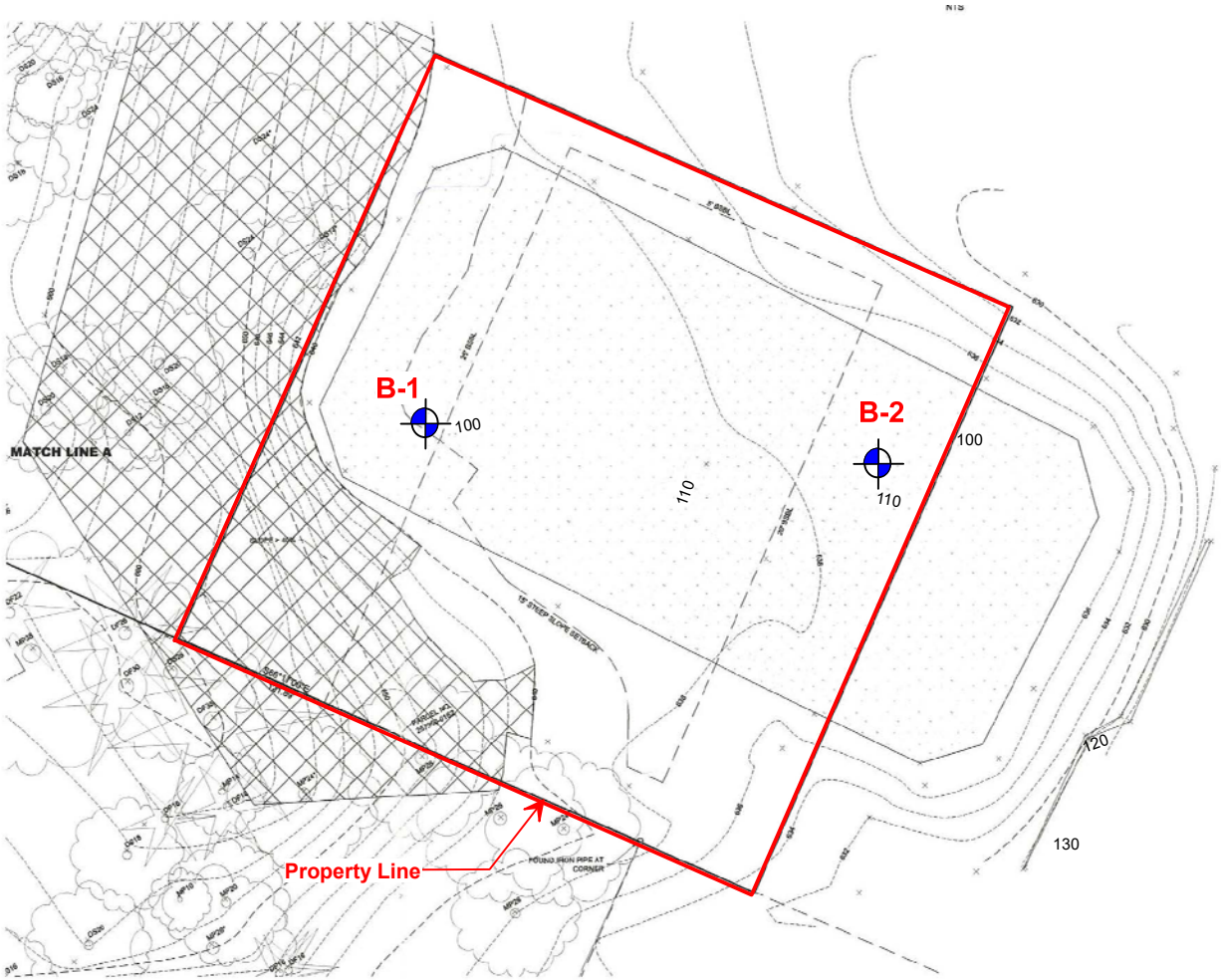
Not to Scale

Base Map: Google Maps

Cascade GeotechNW	**Proposed Residence 9431 E Mercer Way Mercer Island, WA**	**VICINITY MAP**	
		Project No. **2018-015**	Figure No. **1**

file.grf w/ file.dat 12/4/18 (08:13) SDD

Site PlanL.grf w/ [file.jpg] 12/4/18 (08:43) HMX



Approx. Scale
1" = 30'

Note: Basemap modified from Topographic Survey Map prepared by Site Surveying Inc.

Legend:

B-1 Approx. Test Boring Location

Cascade GeotechNW	**Proposed Residence 7431 E Mercer Way Mercer Island, Washington**	**SITE AND EXPLORATION PLAN**	
		Project No. **2018-015**	Figure No. **2**

APPENDIX A

FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling two test borings (B-1 and B-2) to depths of 26.5 and 16.5 feet in B-1 and B-2, respectively on November 27, 2018. The approximate locations of the test boring are shown on the Site Exploration Plan, Figure 2. The borings were drilled with a hand-operated portable drill rig owned and operated by CN Drilling of Seattle, Washington.

The drill rig was equipped with 4-inch outside diameter hollow stem augers. Soil samples were obtained from the borings at 2½- and 5-foot depth intervals in general accordance with Standard Penetration Test (SPT) sampling methods (ASTM test method D-1586) in which the samples are obtained using a 2-inch outside diameter split-spoon sampler. The sampler was driven into the soil a distance of 18 inches using a 140-pound weight freely falling a distance of 30 inches. The number of blows required for each 6-inch increment of sampler penetration was recorded. The number of blows required to achieve the last 12 inches of sample penetration is defined as the SPT N-value. The N-value provides an empirical measure of the relative density of cohesionless soil, or the relative consistency of fine-grained soils.

An engineer from Cascade GeotechNW was present during the field exploration to observe the drilling, assist in sampling, and to describe and document the soil samples obtained from the borings. The soil samples were described and field classified in general accordance with the symbols and terms outlined in Figures A-3 and A-4, and the summary boring logs are included as Figures A-1 and A-2.

Date Started:	11/27/2018	Drill Rig:	Acker Portable Rig
Date Completed:	11/27/2018	Drilling Method:	4" Hollow Stem Auger
Logged by:	MX	Driving Energy:	140 lb. wt., 30 in. drop
total Depth:	26.5 feet		

Approx. Surface Elevation (ft): N/A

Depth, ft	Field: Sample	Field: Blows / inch	Laboratory: Dry Density, pcf	Laboratory: Moisture Content, %	Laboratory: Compression Strength, psf	Recovery (%)	Pocket Pen, tsf	Symbol	DESCRIPTION
		1 2 2				100			Approx. 5 inches of concrete Brown, SILT to sandy SILT **(ML)**, race organics, Medium stiff, very moist **(Fill)**
		1 2 4				100			Becomces brown-gray SILT to clayey SILT **(ML)**, medium stiff, moist
5									Gray, sandy SILT **(ML)**/slightly silty SAND **(SM)**, stiff, moist
		3 6 8				100			
		1 5 7				100			Becomes brown SILT **(ML)**, stiff, moist
10									
		3 6 10				67			Gray, SILT/sandy SILT **(ML)**, very stiff, moist
		5 9 14				100			Gray, SILT/sandy SILT **(ML)**, very stiff, damp to moist, massive
15									
		6 10 17				100			
		4 5 6				89			Gray, SILT/clayey SILT **(ML)**, stiff, very moist to wet
20									

CASCADE GROUP INT LLC
dba **CASCADE GEOTECHNW**

PROJECT # 2018-015 **11/27/2018**

LOG OF BORING B-1
7431 E MERCER WAY
MERCER ISLAND, WASHINGTON

FIGURE
A-1.1

Date Started:	11/27/2018	Drill Rig:	Acker Portable Rig
Date Completed:	11/27/2018	Drilling Method:	4" Hollow Stem Auger
Logged by:	MX	Driving Energy:	140 lb. wt., 30 in. drop
total Depth:	26.5 feet		

Approx. Surface Elevation (ft): N/A

Depth, ft	Field: Sample	Field: Blows / inch	Laboratory: Dry Density, pcf	Laboratory: Moisture Content, %	Laboratory: Compression Strength, psf	Recovery (%)	Pocket Pen, tsf	Symbol	DESCRIPTION
20		2 6 10				100			Gray-brown, SILT/clayey SILT **(ML)**, very stiff, moist
25		9 12 16				100			Gray, SILT **(ML)**, very stiff, moist
30									Boring terminated at about 26.5 feet. No groundwater encountered during drilling. Very moist to wet soil was observed from 17.5 to 20 feet.
35									
20									

CASCADE GROUP INT LLC
dba **CASCADE GEOTECHNW**

PROJECT # 2018-015 **11/27/2018**

LOG OF BORING B-1
7431 E MERCER WAY
MERCER ISLAND, WASHINGTON

FIGURE
A-1.2

Date Started:	11/27/2017	Drill Rig:	Acker Portable Rig
Date Completed:	11/27/2017	Drilling Method:	4" Hollow Stem Auger
Logged by:	MX	Driving Energy:	140 lb. wt., 30 in. drop
total Depth:	16.5 feet		

Approx. Surface Elevation (ft): N/A

Depth, ft	Field: Sample	Field: Blows / inch	Laboratory: Dry Density, pcf	Laboratory: Moisture Content, %	Laboratory: Compression Strength, psf	Recovery (%)	Pocket Pen, tsf	Symbol	DESCRIPTION
		2 4 4				61			Approx. 4 inches of concrete Brown-gary, SILT **(ML)** with sand, trace gravel, medium stiff ti stiff, very moist **(Fill)**
		1 2 5				100			Becomes gray, SILT to clayey SILT **(ML)**, trace wood fragments, medium stiff, very moist
5									Brown, clayey SILT **(ML)**, minor oxide stains, stiff, moist
		1 4 5				100			
		2 4 5				100			Brown, SILTY/clayey SILT **(ML)**, stiff, moist
10									
		1 3 6				100			Gray, SILT **(ML)**, stiff, moist
15									
		4 7 10				100			Becomes gray, SILT **(ML)**, very stiff, moist
20									Boring terminated at about 16.5 feet. No groundwater encountered during drilling.

CASCADE GROUP INT LLC
dba **CASCADE GEOTECHNW**

PROJECT # 2018-015 **11/27/2018**

LOG OF BORING B-2
7431 E MERCER WAY
MERCER ISLAND, WASHINGTON

FIGURE A-2

KEY:

■ Indicates 3-inch OD Dames & Moore Sample.

◪ Indicates 2-inch OD Split Spoon Sample (SPT).

☒ Indicates Disturbed Sample.

⊥ Indicates No Recovery.

□ Indicates Bag Sample.

▨ Indicates Shelby Tube Sample.

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace or little	1 - 5%
Some	6 - 12%
Clayey, silty, sandy, gravelly	13 - 30%
And	31 - 50%

MOISTURE CONTENT

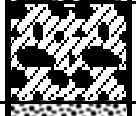
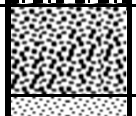
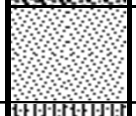
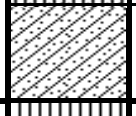
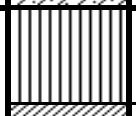
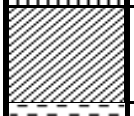
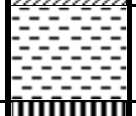
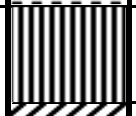
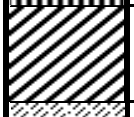
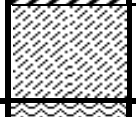
DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

ATD: At Time of Drilling

BGS: Below Ground Surface

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density (%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	< 250
Loose	5 to 10	16 - 35	Soft	3 to 4	250 - 500
Medium Dense	11 to 30	36 - 65	Medium Stiff	5 to 8	501 - 1000
Dense	31 to 50	66 - 85	Stiff	9 to 15	1001 - 2000
Very Dense	over 50	86 - 100	Very Stiff	16 to 30	2001 - 4000
			Hard	over 30	> 4000

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

ATTACHMENT D – DOWNSTREAM ANALYSIS

Photos
Project: 7431 E Mercer Way Mercer Island, Parcel#2579500162

Aerial Photo w/ Corresponding Photo Locations

North

Photos
Project: 7431 E Mercer Way Mercer Island, Parcel#2579500162

Photo 1 (looking N): Type 1 CB (#1). Not shown in Mercer Island GIS. All drainage on site will be routed to a new proposed catch basin in the ROW which will outlet to CB (#1).

Photo 2 (looking into CB #1): Type 1 CB (#1). Two inlets from south and east side. Outlet flowing north.

Photo 3 (looking N): Type 2 Catch basin (#2).

Photo 4 (looking into CB #2): Type 2 CB (#2). Two inlets from south and east side. Outlet flowing north.

Photo 5 (looking into CB #2): Type 2 CB (#2). South inlet from 12” concrete pipe.

Photo 6 (looking into CB #2): Type 2 CB (#2). East inlet from 12” concrete pipe.

Photo 7 (looking into CB #2): Type 2 CB (#2). North outlet from 12” concrete pipe.

Photo 8 (Looking N): Type 2 Manhole (#3). Inlets from the West, South, and East side of MH.

Photo 9 (looking into MH #3): Type 2 Manhole (#3). 12” concrete pipe inlet flowing north.

Photo 10 (looking N): Type 2 CB (#4). Inlet from 12” concrete pipe.

Photo 11 (looking into Type 2 CB #4): Type 2 CB (#4). 12” concrete pipe flowing east.

Photo 12 (looking W): Outlet from CB #4 cross E Mercer Way and goes onto private property before outflowing into Lake Washington.

DOWNSTREAM DRAINAGE SYSTEM ANALYSIS

Date: 6/13/2019

Project: 7431 E Mercer Way
Owner:
Parcels: 002579500162

Basin: Lake Washington
Subbasin: N/A
Subbasin #: N/A

Date of Inspection: 4/26/2019
Weather: Sunny

Symbol see map	Drainage Component Type, Name, and Size Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	Drainage Component Description drainage basin, vegetation, cover, depth, type of sensitive area, volume	Slope %	Length ft	Distance from site discharge ¼ ml = 1,320 ft.	Existing Problems constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion	Potential Problems	Observations of field inspector, resource reviewer, or resident tributary area, likelihood of problem, overflow pathways, potential impacts
1 to 3	From catch basin #1 through concrete pipe to catch basin #2 in E Mercer Way.	Pavement	2.0%	68	0 to 68	No Problems	No Problems	None
3 to 8	From catch basin #2 through 12" concrete pipe to manhole #3 in E Mercer Way.	Pavement	2.0%	24	68 to 92	No Problems	No Problems	None
8 to 10	From manhole #3 through 12" concrete pipe to catch basin #4 in E Mercer Way.	Pavement	2.0%	200	92 to 292	No Problems	No Problems	None
10 to 12	From catch basin #4 through 12" concrete pipe and it outlets to Lake Washington.	Pavement	2.0%	300	292 to 592	No Problems	No Problems	None

ATTACHMENT E – OPERATION AND MAINTENANCE MANUAL

7431 E Mercer Way SFR
Operation and Maintenance Manual

Person or Organization Responsible for Maintenance of the On-Site Storm System:

Melissa Yang
7431 E Mercer Way
Mercer Island, WA 98040

The Location Where the Operation and Maintenance Manual is to be Kept:

7431 E Mercer Way
Mercer Island, WA 98040

*Note: The manual and maintenance activity log must be made available to the City of Mercer Island for inspection purposes.

Description of On-Site Storm System

The on-site storm system for 7431 E Mercer Way consists of 4-36" conveyance pipe, 60" detention facility, 12" area drain, Type 1 catch basin and a Type 2 catch basin.

Stormwater runoff from the driveway will be collected by a Type 1 catch basin located along the property line at the bottom of the driveway. Stormwater is then routed from the Type 1 catch basin to a Type 2 catch basin associated with the detention facility. Likewise, runoff from the proposed single-family residence will be captured in a gutter and downspout system and conveyed to the Type 1 catch basin and then the detention facility. Any stormwater collected within the building footing drains will also be routed to the Type 1 catch basin which contains a 2' min sump for the settlement of fines. A 12" area drain will collect stormwater from the impervious surface on the east side of the proposed single-family residence and routed it to the Type 1 catch basin. All collected stormwater on site will be routed to the detention facility before being conveyed to the public storm main.

The Type I catch basin, Type 2 catch basin, 60" detention facility, 12" area drain, and storm drain cleanouts serve as source control of pollution for the project site. In order to control pollutants, proper maintenance and cleaning of debris, sediments, and oil from stormwater collection and conveyance systems is required per the operation and maintenance recommendations found in Volume 5 Section 4.6 of the Stormwater Manual in addition to the BMPs in Volume IV Section 2.2. See the attached sheets for operation and maintenance requirements pertaining to the project.

Contact Information for Stormwater Facility Manufacturers and Installers:

Contractor (Installer of On-Site Stormwater Facilities)
TBD

Civil Engineer (Designer of On-Site Stormwater Facilities)
Ben Iddins, P.E.
Davido Consulting Group, Inc
9706 4th Ave NE, Suite 300
Seattle, WA 98115
Phone – 206.523.0024 Ext. 115
ben@dcgengr.com

Attachments

- Maintenance Standards for Closed Detention Systems (2014 DOE Manual)
- Maintenance Standards for Control Structure/Flow Restrictor (2014 DOE Manual)
- Maintenance Standards for Catch Basins (2014 DOE Manual)

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

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

No. 4 – Control Structure/Flow Restrictor

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

No. 5 – Catch Basins

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

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

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

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

ATTACHMENT F – DETENTION FACILITY SIZING EXHIBIT

CITY OF MERCER ISLAND

DEVELOPMENT SERVICES GROUP
9611 SE 36TH STREET | MERCER ISLAND, WA 98040
PHONE: 206.275.7605 | www.mercergov.org
Inspection Requests: Online: www.MyBuildingPermits.com VM: 206.275.7730

ON-SITE DETENTION DESIGN REQUIREMENTS

General Requirements

This guidance applies only to projects that meet the thresholds specified below in "Is On-site Detention Required for My Project?" if all of the on-site stormwater BMPs included on List #1 and List #2 are determined to be infeasible for roofs and/or other hard surfaces.

Is On-site Detention Required For My Project?

YES, if my project:

1) Results in 2,000 square feet, or greater, of new plus replaced hard surface area, or
2) Has a land disturbing activity or 7,000 square feet or greater, or
3) Results in a ***net increase*** of impervious surface of 500 square feet or greater.

AND

1) All of the on-site stormwater BMPs included on List #1 and List #2 are determined to be infeasible for roofs and/or other hard surfaces, and
2) Drainage from the site will be discharged to a storm and surface water system that includes a watercourse or there is a capacity constraint in the system.

NO, if my project:

1) Results in less than 2,000 square feet of new plus replaced hard surface area, and
2) Has a land disturbing activity less than 7,000 square feet, and
3) Results in a **net increase of less than 500 square feet** of impervious surface area.
4) The project discharges ***directly*** to Lake Washington, or findings from a ¼-mile downstream analysis confirm that the downstream system is free of capacity constraints.

Designing Your On-Site Detention System

All on-site detention system designs must be prepared by a professional engineer registered in the State of Washington. The Standard On-site Detention System worksheet (Attachment 1) must be submitted on 18" x 24" (minimum) size sheets.

Construction that results in 500 to 9,500 square feet of new plus replaced impervious surfaces: Size system according to Table 1. The configuration of the on-site detention system shall be as shown on Attachment 1 (Standard On-Site Detention Systems Worksheet) or as specifically designed by the engineer for the site.

Note:

- The applicant may pay a fee-in-lieu-of constructing an on-site detention system when allowed by the City Engineer. The fee will not be an option when in the opinion of the City Engineer, undetained runoff from the development may adversely exacerbate an existing problem (MICC 15.11) or if flow control is required by Minimum Requirement #7.
- **Construction that results in more than 9,500 square feet of new plus replaced impervious surfaces and/or exceeds a 100-year flow frequency of 0.15 cubic feet per second (for moderate and steep sloped sites greater than a 5% slope):** Size system according to Minimum Requirement #7 (Flow Control) in the Stormwater Management Manual for Western Washington (Ecology 2014).

Table 1

ON-SITE DETENTION DESIGN FOR PROJECTS BETWEEN 500 SF AND 9,500 SF NEW PLUS REPLACED IMPERVIOUS SURFACE AREA

New and Replaced Impervious Surface Area (sf)	Detention Pipe Diameter (in)	Detention Pipe Length (ft)		Lowest Orifice Diameter (in)[3]		Distance from Outlet Invert to Second Orifice (ft)		Second Orifice Diameter (in)	
		B soils	C soils	B soils	C soils	B soils	C soils	B soils	C soils
500 to 1,000 sf	36"	30	22	0.5	0.5	2.2	2.0	0.5	0.8
	48"	18	11	0.5	0.5	3.3	3.2	0.9	0.8
	60"	11	7	0.5	0.5	4.2	3.4	0.5	0.6
1,001 to 2,000 sf	36"	66	43	0.5	0.5	2.2	2.3	0.9	1.4
	48"	34	23	0.5	0.5	3.2	3.3	0.9	1.2
	60"	22	14	0.5	0.5	4.3	3.6	0.9	0.9
2,001 to 3,000 sf	36"	90	66	0.5	0.5	2.2	2.4	0.9	1.9
	48"	48	36	0.5	0.5	3.1	2.8	0.9	1.5
	60"	30	20	0.5	0.5	4.2	3.7	0.9	1.1
3,001 to 4,000 sf	36"	120	78	0.5	0.5	2.4	2.2	1.4	1.6
	48"	62	42	0.5	0.5	2.8	2.9	0.8	1.3
	60"	42	26	0.5	0.5	3.8	3.9	0.9	1.3
4,001 to 5,000 sf	36"	134	91	0.5	0.5	2.8	2.2	1.7	1.5
	48"	73	49	0.5	0.5	3.6	2.9	1.6	1.5
	60"	46	31	0.5	0.5	4.6	3.5	1.6	1.3
5,001 to 6,000 sf	36"	162	109	0.5	0.5	2.7	2.2	1.8	1.6
	48"	90	59	0.5	0.5	3.5	2.9	1.7	1.5
	60"	54	37	0.5	0.5	4.6	3.6	1.6	1.4
6,001 to 7,000 sf	36"	192	128	0.5	0.5	2.7	2.2	1.9	1.8
	48"	102	68	0.5	0.5	3.7	2.9	1.9	1.6
	60"	64	43	0.5	0.5	4.6	3.6	1.8	1.5
7,001 to 8,000 sf	36"	216	146	0.5	0.5	2.8	2.2	2.0	1.9
	48"	119	79	0.5	0.5	3.8	2.9	2.2	1.7
	60"	73	49	0.5	0.5	4.5	3.6	2.0	1.6
8,001 to 8,500 sf[1]	36"	228	155	0.5	0.5	2.8	2.2	2.1	1.9
	48"	124	84	0.5	0.5	3.7	2.9	1.9	1.8
	60"	77	53	0.5	0.5	4.6	3.6	2.0	1.6
8,501 to 9,000 sf	36"	NA [1]	164	0.5	0.5	NA [1]	2.2	NA [1]	1.9
	48"	NA [1]	89	0.5	0.5	NA [1]	2.9	NA [1]	1.9
	60"	NA [1]	55	0.5	0.5	NA [1]	3.6	NA [1]	1.7
9,001 to 9,500 sf[2]	36"	NA [1]	174	0.5	0.5	NA [1]	2.2	NA [1]	2.1
	48"	NA [1]	94	0.5	0.5	NA [1]	2.9	NA [1]	2.0
	60"	NA [1]	58	0.5	0.5	NA [1]	3.7	NA [1]	1.7

Notes:

▪ Minimum Requirement #7 (Flow Control) is required when the 100-year flow frequency causes a 0.15 cubic feet per second increase (when modeled in WWHM with a 15-minute timestep). Breakpoints shown in this table are based on a flat slope (0-5%). The 100-year flow frequency will need to be evaluated on a site-specific basis for projects on moderate (5-15%) or steep (> 15%) slopes.

▪ Soil type to be determined by geotechnical analysis or soil map.

▪ Sizing includes a Volume Correction Factor of 120%.

▪ Upper bound contributing area used for sizing.

[1] On Type B soils, new plus replaced impervious surface areas exceeding 8,500 sf trigger Minimum Requirement #7 (Flow Control)

[2] On Type C soils, new plus replaced impervious surface areas exceeding 9,500 sf trigger Minimum Requirement #7 (Flow Control)

[3] Minimum orifice diameter = 0.5 inches

in = inch

ft = feet

sf = square feet

Basis of Sizing Assumptions:

Sized per MR#5 in the Stormwater Management Manual for Puget Sound Basin (1992 Ecology Manual)

SBUH, Type 1A, 24-hour hydrograph

2-year, 24-hour storm = 2 in; 10-year, 24-hour storm = 3 in; 100-year, 24-hour storm = 4 in

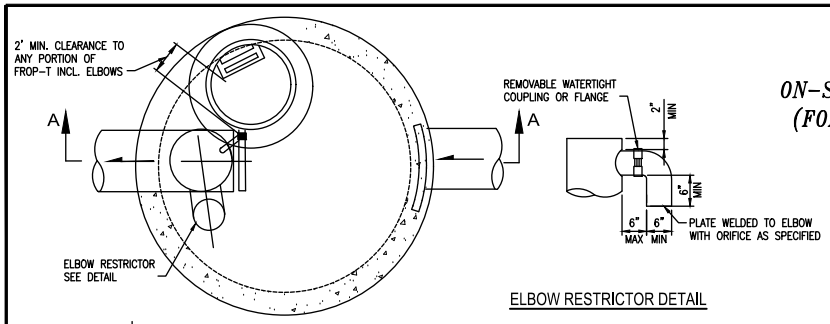
Predeveloped = second growth forest (CN = 72 for Type B soils, CN = 81 for Type C soils)

Developed = impervious (CN = 98)

0.5 foot of sediment storage in detention pipe

Overland slope = 5%

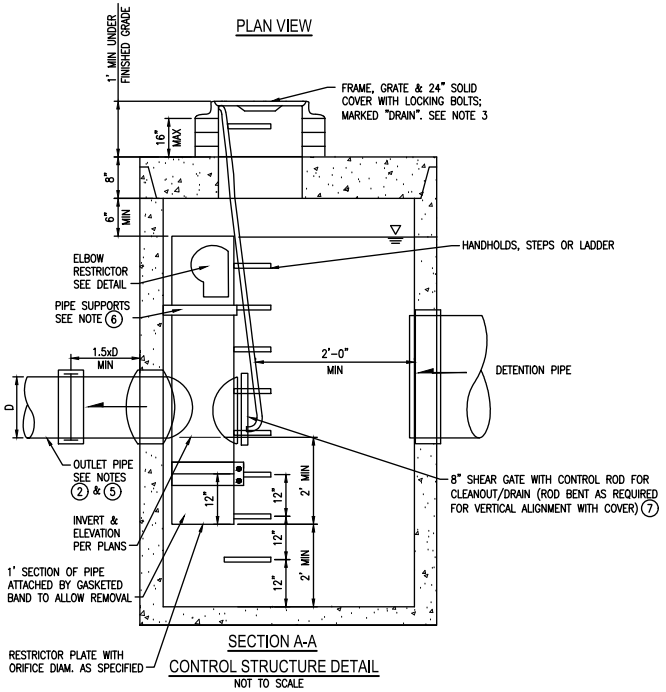
ATTACHMENT 1
CITY OF MERCER ISLAND
ON-SITE DETENTION SYSTEM WORKSHEET
(FOR NEW PLUS REPLACED IMPERVIOUS AREA OF 9,500 SF OR LESS)



ELBOW RESTRICTOR DETAIL

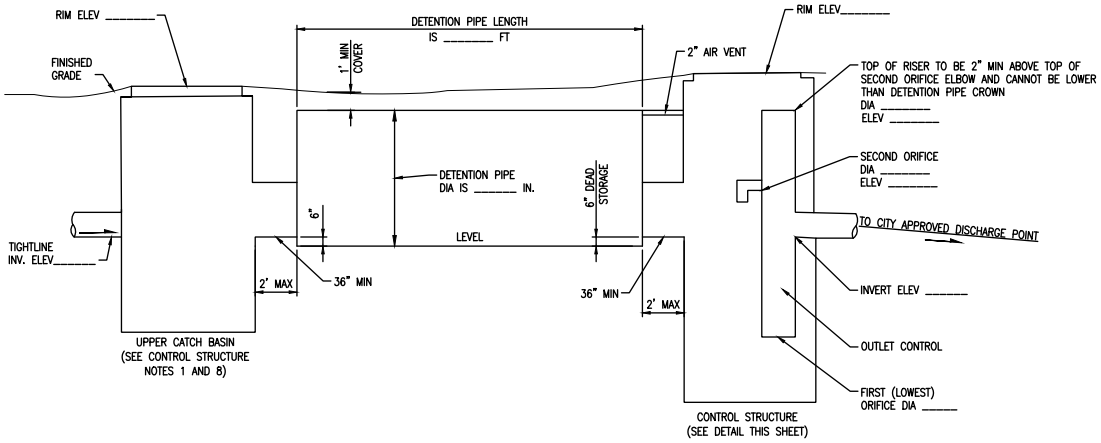
PLAN VIEW

OWNER: _____	ADDRESS: _____	PREPARED BY: _____
PERMIT #: _____	_____	PHONE: _____
		DATE: _____
NEW PLUS REPLACED IMPERVIOUS SURFACE AREA (SF): _____	DETENTION PIPE DIA (INCH): _____	DETENTION PIPE LENGTH (FT): _____
SOIL TYPE: _____	PIPE MATERIAL: _____	ORIFICE #1 DIA ___ INCH, ELEV _____
		ORIFICE #2 DIA ___ INCH, ELEV _____



SECTION A-A

CONTROL STRUCTURE DETAIL
NOT TO SCALE



ON-SITE DETENTION SYSTEM
NOT TO SCALE (ENGINEER TO FILL IN BLANKS)

CONTROL STRUCTURE NOTES:

1. USE A MINIMUM OF A 54 IN. DIAM. TYPE 2 CATCH BASIN. THE ACTUAL SIZE IS DEPENDENT ON CONNECTING PIPE MATERIAL AND DIAMETER.
2. OUTLET PIPE: MIN. 6 INCH.
3. METAL PARTS: CORROSION RESISTANT. NON-GALVANIZED PARTS PREFERRED. GALVANIZED PIPE PARTS TO HAVE ASPHALT TREATMENT 1.
4. FRAME AND LADDER OR STEPS OFFSET SO:
   A. CLEANOUT GATE IS VISIBLE FROM TOP;
   B. CLIMB-DOWN SPACE IS CLEAR OF RISER AND CLEANOUT GATE;
   C. FRAME IS CLEAR OF CURB.
5. IF METAL OUTLET PIPE CONNECTS TO CEMENT CONCRETE PIPE, OUTLET PIPE TO HAVE SMOOTH O.D. EQUAL TO CONCRETE PIPE I.D. LESS 1/4 IN.
6. PROVIDE AT LEAST ONE 3 X 0.090 GAUGE SUPPORT BRACKET ANCHORED TO CONCRETE WALL WITH 5/8 IN. STAINLESS STEEL EXPANSION BOLTS OR EMBEDDED SUPPORTS 2 IN. INTO CATCH BASIN WALL (MAXIMUM 3'-0" VERTICAL SPACING).
7. THE SHEAR GATE SHALL BE MADE OF ALUMINUM ALLOY IN ACCORDANCE WITH ASTM B 26M AND ASTM B 275, DESIGNATION ZG32A; OR CAST IRON IN ACCORDANCE WITH ASTM A 48, CLASS 30B.
   THE LIFT HANDLE SHALL BE MADE OF A SIMILAR METAL TO THE GATE (TO PREVENT GALVANIC CORROSION), IT MAY BE OF SOLID ROD OR HOLLOW TUBING, WITH ADJUSTABLE HOOK AS REQUIRED.
   A NEOPRENE RUBBER GASKET IS REQUIRED BETWEEN THE RISER MOUNTING FLANGE AND THE GATE FLANGE.
   INSTALL THE GATE SO THAT THE LEVEL-LINE MARK IS LEVEL WHEN THE GATE IS CLOSED.
   THE MATING SURFACES OF THE LID AND THE BODY SHALL BE MACHINED FOR PROPER FIT.
   ALL SHEAR GATE BOLTS SHALL BE STAINLESS STEEL.
8. THE UPPER CATCH BASIN IS REQUIRED IF THE LENGTH OF THE DETENTION PIPE IS GREATER THAN 50 FT.

ON-SITE DETENTION SYSTEM NOTES:

1. CALL DEVELOPMENT SERVICES (206-275-7605) 24 HOURS IN ADVANCE FOR A DETENTION SYSTEM INSPECTION BEFORE BACKFILLING AND FOR FINAL INSPECTIONS.
2. RESPONSIBILITY FOR OPERATION AND MAINTANANCE OF DRAINAGE SYSTEMS ON PRIVATE PROPERTY IS RESPONSIBILITY OF THE PROPERTY OWNER. MATERIAL ACCUMULATED IN THE STORAGE PIPE MUST BE REMOVED FROM CATCH BASINS TO ALLOW PROPER OPERATION. THE OUTLET CONTROL ORIFICE MUST BE KEPT OPEN AT ALL TIMES.
3. PIPE MATERIAL, JOINT, AND PROTECTIVE TREATMENT SHALL BE IN ACCORDANCE WITH SECTION 7.04 AND 9.05 OF THE WSDOT STANDARD SPECIFICATION FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION, LATEST VERSION. SUCH MATERIALS INCLUDE THE FOLLOWING, LINED CORRUGATED POLYETHYLENE PIPE (LCPE), ALUMINIZED TYPE 2 CORRUGATED STEEL PIPE AND PIPE ARCH (MEETS AASHTO DESIGNATIONS M274 AND M36), CORRUGATED OR SPIRAL RIB ALUMINUM PIPE, OR REINFORCED CONCRETE PIPE. CORRUGATED STEEL PIPE IS NOT ALLOWED.
4. FOOTING DRAINS SHALL NOT BE CONNECTED TO THE DETENTION SYSTEM.

ATTACHMENT G – ARBORIST REPORT

A.B.C Consulting Arborists LLC

Accurate *Balanced* *Certified*

Yang Residence
7431 E Mercer Way
Tree Protection Plan

March 1, 2019

PREPARED FOR:

Melissa Yang
C/O Steven M. Long, Studio 19 Architects
RE: 7435/7431 E Mercer Way
Mercer Island, WA

PREPARED BY:
A.B.C. Consulting Arborists LLC

Daniel Maple,

Registered Consulting Arborist #627
ISA Municipal Specialist # PN-7970AM
ISA Tree Risk Assessment Qualified (TRAQ)
ISA Board Certified Master Arborist #PN-7970BM

TABLE OF CONTENTS

CONSULTING ARBORIST

Daniel J. Maple / A.B.C. Consulting Arborists, LLC
Email: Daniel@AbcArborist.Com Cell Phone: (509) 953-0293

Certifications

ASCA Registered Consulting Arborist (RCA)	# 627
ISA Board Certified Master Arborist (BCMA)	PN-7970BM
ISA Certified Arborist Municipal Specialist	PN-7970AM
ISA Tree Risk Assessment Qualified (TRAQ)	June 30, 2020
SAF Qualified Tree Farm Inspector	# 169449
Commercial Applicator	# 92432
Commercial UAV Airman Pilot (Drone)	# 4135495

ASSIGNMENT

Provide a tree inventory and protection plan for a new residence.

- Assess the trees for pre-& post construction viability.
- General health and condition of the trees.
- Provide Tree Protection Zones (TPZ)
- Provide Critical Root Zones (CRZ)
- Provide TPZ, CRZ fencing requirements and instructions.
- Provide observations, facts, findings and recommendations in a professionally written report.

LIMITATIONS OF ASSIGNMENT

This report is a limited to a Visual Assessment (VA) of the site and the trees. It is not a comprehensive risk assessment, structural assessment or health assessment. The report is limited to the scope of the assignment.

METHODOLOGY

To evaluate the trees, as well as to prepare this report, I drew upon my 30+ years of experience in the field of arboriculture and my formal education. I followed the protocol of the International Society of Arboriculture (ISA) and I performed my assessment using and/or considering the following Best Management Practices:

ANSI A300 Part 2 – *Soil Management a.) Modification b.) Fertilization & c.) Drainage.*
ANSI A300 Part 5 – *Managing Trees During Site Planning, Site Development, and Construction.*
ANSI A300 Part 9 – *Tree Risk Assessment* (Second Edition).
ISA BMP's – *Tree Inventories* (Second Edition 2013)

Best Management Practices were developed to aid in the interpretation of professional standards and guide work practices based upon current science and technology. Using this process, I performed my assessment, which included looking at the overall health of the trees as well as the site conditions. This is a scientifically based process to look at the entire site, surrounding land and soil, as well as a general look at the trees themselves.

SITE

Parcel 257950-0162 is a 9,850 sq. ft. (.23-acre) site, **Zoned** R-9.6, proposed for a new residence. Access to the site will be via a driveway extension from parcel 2579500160. Potential erosion conditions were found using King County iMap. Soils are generally native, moderate in depth and well drained. No other relevant site conditions were noted.

TREE LOCATION AND ID

There are 45 trees included in this report, they were geo-tagged and are referenced as 1-45. Please refer to *Attachment 1, Tree Plotter Image* for an orientation to the site and the approximate location of the trees.

TREES

There was a total of 45 trees inventoried. 6 are in the ROW, 22 are on 2579500160, 4 are on 2579500151, 4 are on 2579500156, 3 are on 2579500170, and 6 were on the subject site parcel 2579500162. *See Attachment 1 Tree Plotter Image & Attachment 2 Tree Summary*.

Non-viable or Hazard Trees

There was 1 non-viable or hazard tree (18) on the site,
There were 6 offsite trees (17 and 22-26) that visual evidence suggests they may pose a hazard. They should have a thorough assessment by a qualified arborist.

Trees to be Removed for Improvements

There was 1 tree (14) that conflicts with the proposed site improvements and will be removed.
There were 4 trees (10-13), on parcel 2579500160, that need to be removed to provide access to the site.

Trees to be Retained

4 healthy viable trees in good to excellent condition will be retained on the site.

Offsite Trees

There are were 10 offsite trees with driplines near to or that extended over the property line, none of the driplines extended over proposed construction areas.

Impacts

With the installation of the tree protection fencing prior to development activity and by following the outlined tree protection instructions impacts to the on and offsite trees will be minimal.

Supplemental Trees/Replanting

Per city code 30% of the trees are to be retained. We are retaining 4 of the 6 trees (66%) more than the minimum 30% required by city code. **No supplemental trees or replanting is required**.

TREE PROTECTION ZONES (TPZ)

In order for trees to survive the stresses placed upon them in the construction process, tree protection must be planned in advance of equipment arrival on site. If tree protection is not planned integral with the design and layout of the project, the trees will suffer needlessly and possibly die. With proper preparation, often costing little or nothing extra to the project budget, trees can survive and thrive after construction. This is critical for tree survival because damage prevention is the single most effective treatment for trees on construction sites. Once trees are damaged, the treatment options available are limited.

General

The TPZ is the optimal protection zone set to preserve trees during construction. The TPZ radius generally is 8-Inches to 18-Inches of protection for every 1-Inch of DBH, based on the trees size, vigor and construction tolerances (*ANSI A300 Part 5 BMP, Matheny, Clark, 1998*).

The TPZ can usually safely be reduced by 20% as long as it does not impact the CRZ. Greater than 20% reductions may be possible, pending review, written permission, and direct over site of the work, by the Consulting Arborist.

The trees to be saved, must be protected during construction by temporary 6' tall chain-link, or like fencing, located 10' beyond the edge of the trees farthest extending limbs on all sides (dripline). The individual tree protection zones (TPZ) are 10' past the driplines of the tree(s), unless otherwise delineated by A.B.C. Consulting Arborist LLC. See **Attachment 2** for tree specific TPZ and CRZ.

No irrigation lines, trenches, or other utilities shall be installed within the TPZ, without detailed written instructions and the oversite of the Consulting Arborist, to reduce the impacts to the tree roots, and construction related stressors. Cuts or fills should impact no more than 20% of a tree's root system. If topsoil is added to the root zone of a protected tree, the depth should not exceed 2 inches of a sandy loam or loamy fine sand topsoil and should not cover more than 20% of the root system.

If roots are encountered outside the TPZ during construction, they shall be cut cleanly with a saw (not ripped or torn) and covered immediately with moist soil. Noxious vegetation within the critical root zone should be removed by hand. If a proposed save tree must be impacting by grading or fills, then the tree should be re-evaluated by A.B.C. Consulting Arborist LLC to determine if the tree can be saved with mitigating measures, or if the tree should be removed.
See **Attachment 3** for complete tree protection instructions.

CRITICAL ROOT ZONES (CRZ)

The CRZ is the area where the roots vital for the trees survival are located, the CRZ is generally ½ of the TPZ. At no time or for any reason shall the roots within the CRZ be impacted. See **Attachment 2** for tree specific TPZ and CRZ.

FENCING

6' tall chain link (or like fencing) shall be installed the TPZs prior to commencement of site clearing and shall remain in place for the duration of the project. When possible it is preferred that trees be fenced as a group, rather than individuals. At no time shall any vehicle or equipment be allowed inside TPZ/Fencing. No placing or stock-piling of any material of any kind shall be allowed inside the TPZ/Fencing.
Removal of any vegetation within the TPZ shall be done by hand. Should any disturbance be required inside the TPZ to install utilities or any other needs during the construction period, they will require project specific instructions by the Consulting Arborist and approval by the city prior to undertaking any said activity in the TPZ.

ROOT PROTECTION

Any roots encountered of 1” in diameter or greater, shall be cut with loppers, pruners, reciprocal saw or like device to provide a clean smooth cut. At no time, shall 1” or greater diameter roots be ripped or torn. Exposed roots shall be covered with wet burlap, or like item, to keep roots from drying out and shall be covered with soil as soon as reasonably possible.

Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations. Protect root systems from damage due to removal of adjacent trees.

SEE ATTACHMENT 3 For Complete Tree Protection Instructions.

CERTIFICATION

I, Daniel Maple, Certify to the best of my knowledge and belief:

1. That the statements of fact contained in this report are true and correct.
2. That the analysis, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and that they are my personal, unbiased professional analysis, opinions, and conclusions.
3. That I have no present or prospective interest in the property or plants that are the subject of this report, and that I had no personal interest or bias with respect to the parties involved.
4. That my compensation is not contingent upon a predetermined value or direction and that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated results, or the occurrence of any subsequent event.
5. That my analysis, opinions, and conclusions were developed to reflect reasonable conformity with current ANSI A300 Best Management Practices and Industry Standards.
6. The report is based on the information known to me at the time of my assessment. If more information is disclosed, I may have further opinions.
7. The report is based on my analysis at the time of the assessment and covers that time frame only; any additional limitations are addressed in the body of the report and/or in the attachments.
8. That statements of fact in the report are correct to the best of my knowledge and belief, and that they are made in good faith.

Thank you for contacting A.B.C. Consulting Arborists LLC for your arboricultural needs.

Sincerely,

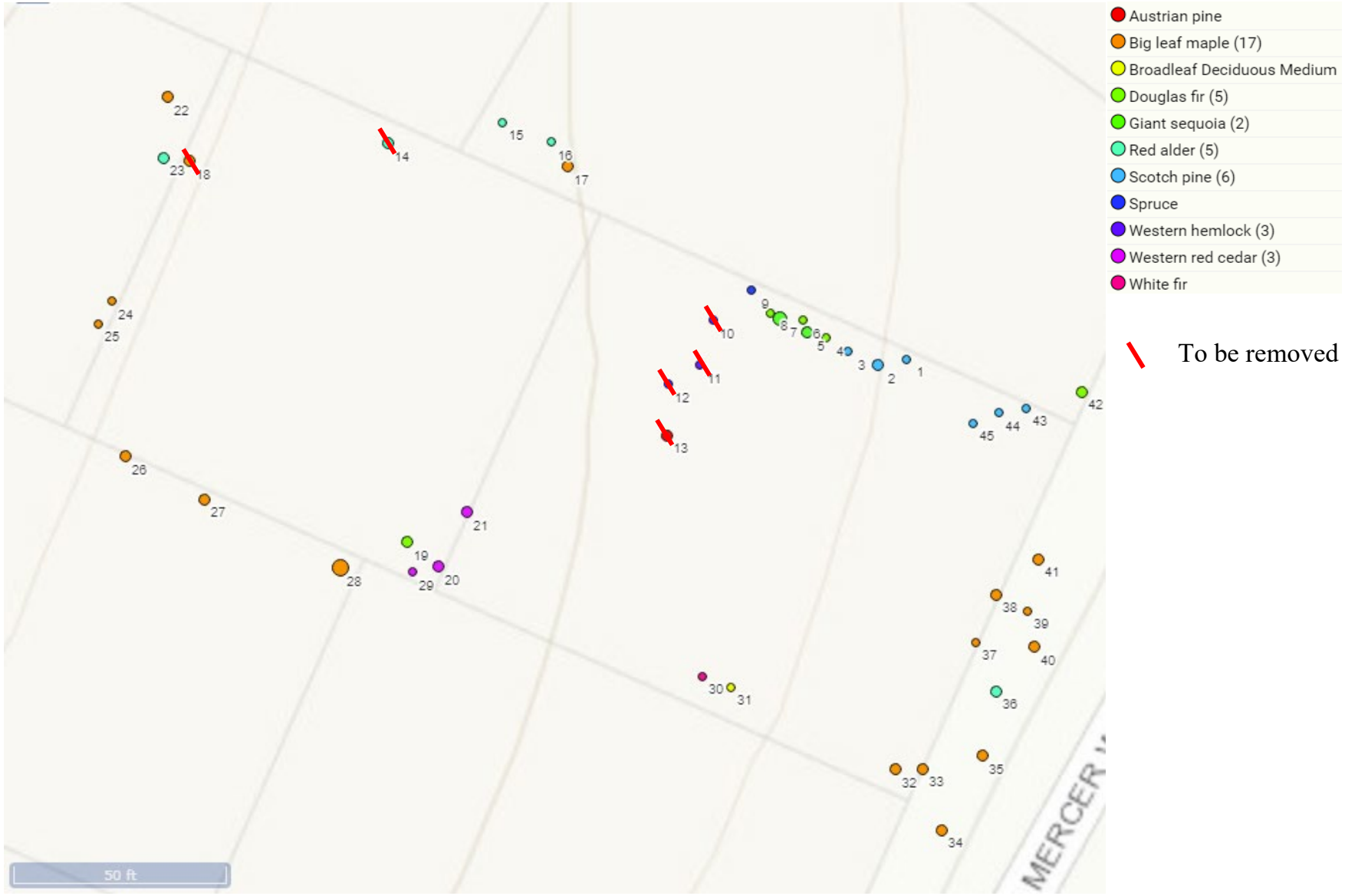
Daniel Maple, Consulting Arborist

Registered Consulting Arborist #627
ISA Municipal Specialist #PN-7970AM
ISA Tree Risk Assessment Qualified (TRAQ)
ISA Board Certified Master Arborist #PN-7970BM

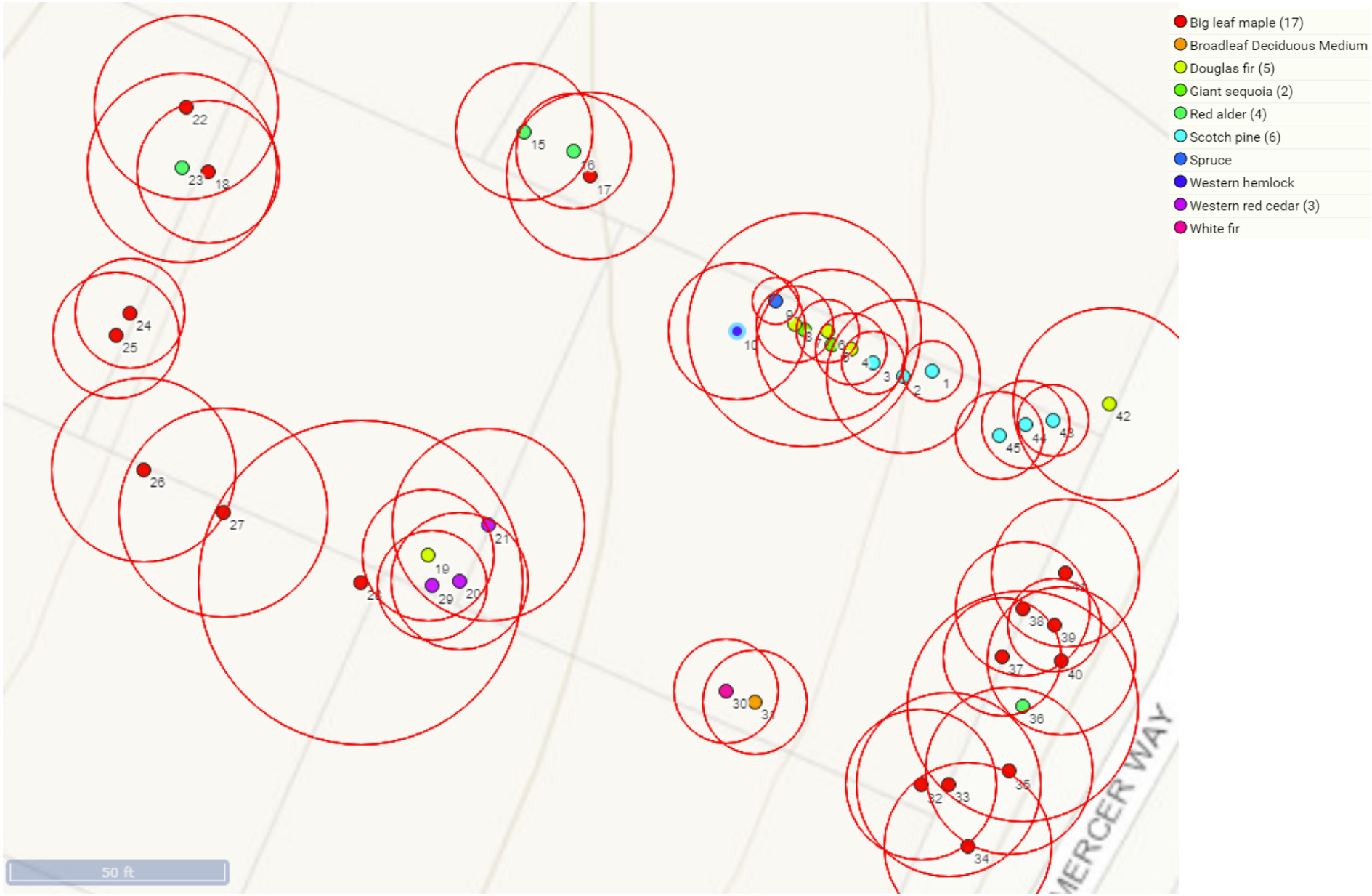
ATTACHMENTS

ATTACHMENT 1 - TREE PLOTTER IMAGE

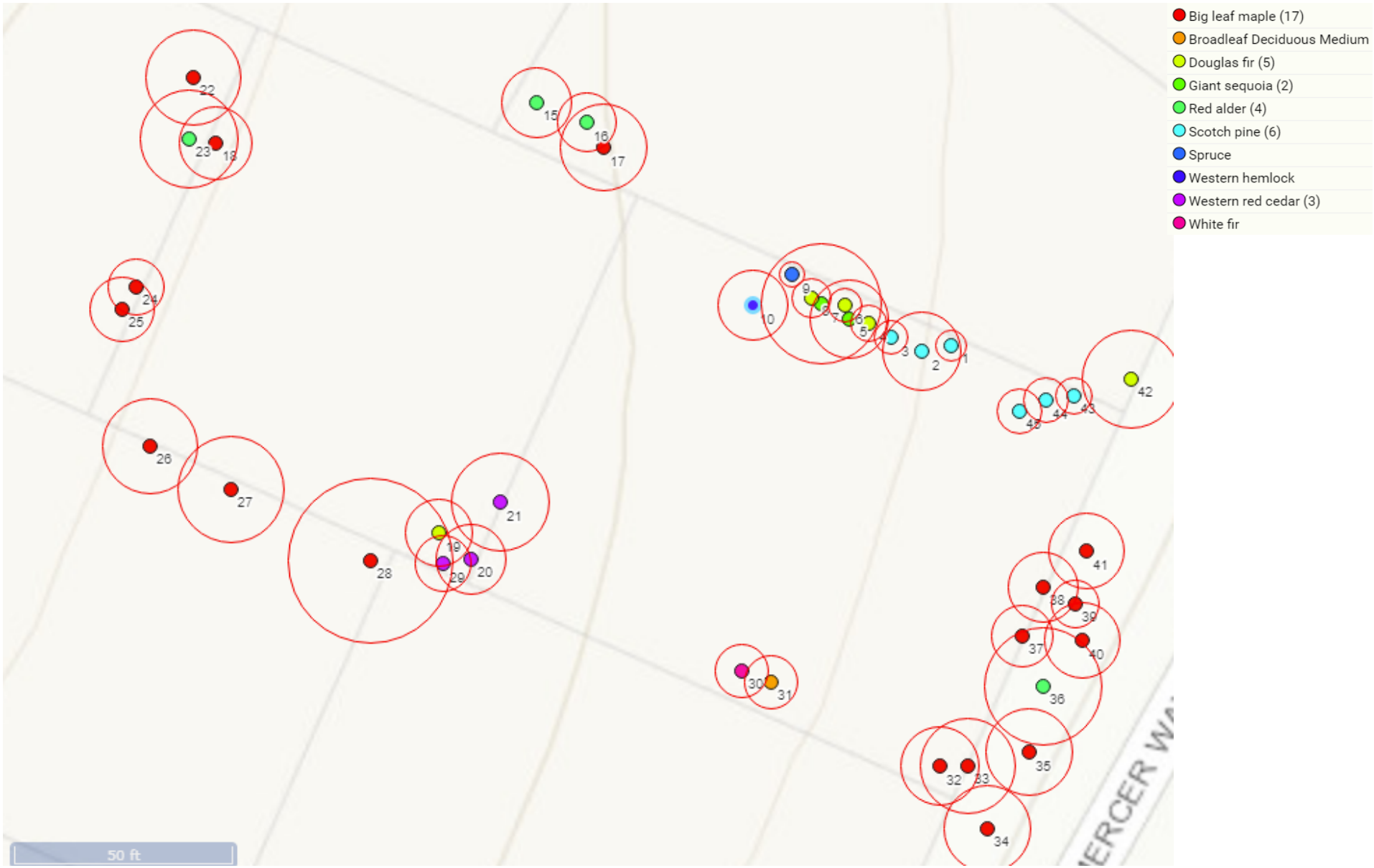
North



Trees to be Retained and TPZ



Trees to be Retained and CRZ



ATTACHMENT 2 - TREE SUMMARY, TPZ, CRZ

ID	Common Name	*Latin Name*	DBH	Height	Spread	Condition	Management	TPZ-Radius [ft]	CRZ-Radius [ft]
1	Scotch pine	*Pinus sylvestris*	7	20	9	Fair (70+)	Retain-Viable	Edge of Driveway	3.5
2	Scotch pine	*Pinus sylvestris*	18.5	50	22	Good (80+)	Retain-Viable	Edge of Driveway	9.25
3	Scotch pine	*Pinus sylvestris*	7.5	28	9	Fair (70+)	Retain-Viable	Edge of Driveway	3.75
4	Douglas fir	*Pseudotsuga menziesii*	8.5	36	21	Good (80+)	Retain-Viable	Edge of Driveway	4.25
5	Giant sequoia	*Sequoiadendron giganteum*	18	55	21	Good (80+)	Retain-Viable	Edge of Driveway	9
6	Douglas fir	*Pseudotsuga menziesii*	7.5	36	21	Good (80+)	Retain-Viable	Edge of Driveway	3.75
7	Giant sequoia	*Sequoiadendron giganteum*	28	77	29	Good (80+)	Retain-Viable	Edge of Driveway	14
8	Douglas fir	*Pseudotsuga menziesii*	9	36	21	Good (80+)	Retain-Viable	Edge of Driveway	4.5
9	Spruce	*Picea species*	5.5	25	14	Fair (70+)	Retain-Viable	Edge of Driveway	2.75
10	Western hemlock	*Tsuga heterophylla*	13	42	18	Fair (70+)	Remove for Construction	16.25	8.125
11	Western hemlock	*Tsuga heterophylla*	14.5	53	25	Good (80+)	Remove for Construction	18.125	9.0625
12	Western hemlock	*Tsuga heterophylla*	14.5	53	25	Good (80+)	Remove for Construction	18.125	9.0625
13	Austrian pine	*Pinus nigra*	22	57	33	Fair (70+)	Remove for Construction	22	11
14	Red alder	*Alnus rubra*	18.5	65	30	Fair (70+)	Remove for Construction	23.125	11.5625
15	Red alder	*Alnus rubra*	13	65	12	Fair (70+)	Offsite-Viable	16.25	8.125
16	Red alder	*Alnus rubra*	11	55	15	Poor (50+)	Offsite-Viable	13.75	6.875
17	Big leaf maple	*Acer macrophyllum*	20	65	40	Poor (50+)	Offsite-Needs Assessment	20	10
18	Big leaf maple	*Acer macrophyllum*	17	75	25	Fair (70+)	Remove not Viable	17	8.5
19	Douglas fir	*Pseudotsuga menziesii*	15.6	57	15	Fair (70+)	Retain-Viable	15.6	7.8
20	Western red cedar	*Thuja plicata*	16.5	30	23	Fair (70+)	Retain-Viable	16.5	8.25
21	Western red cedar	*Thuja plicata*	23	50	30	Good (80+)	Retain-Viable	23	11.5
22	Big leaf maple	*Acer macrophyllum*	22	67	25	Poor (50+)	Offsite-Needs Assessment	22	11
23	Red alder	*Alnus rubra*	18	67	25	Fair (70+)	Offsite-Needs Assessment	22.5	11.25
24	Big leaf maple	*Acer macrophyllum*	13	67	25	Poor (50+)	Offsite-Needs Assessment	13	6.5
25	Big leaf maple	*Acer macrophyllum*	15	67	25	Poor (50+)	Offsite-Needs Assessment	15	7.5
26	Big leaf maple	*Acer macrophyllum*	22	67	29	Poor (50+)	Offsite-Needs Assessment	22	11
27	Big leaf maple	*Acer macrophyllum*	25	67	37	Good (80+)	Offsite-Viable	25	12.5
28	Big leaf maple	*Acer macrophyllum*	38.74	67	37	Fair (70+)	Offsite-Viable	38.74	19.37
29	Western red cedar	*Thuja plicata*	13	37	24	Good (80+)	Offsite-Viable	13	6.5
30	White fir	*Abies concolor*	12.5	18	18	Fair (70+)	Retain-Viable	12.5	6.25
31	Deciduous Medium	*Deciduous Medium*	14	30	14	Good (80+)	Retain-Viable	12.5	6.25
32	Big leaf maple	*Acer macrophyllum*	18	65	23	Fair (70+)	Retain-Viable	18	9
33	Big leaf maple	*Acer macrophyllum*	22	65	23	Fair (70+)	Retain-Viable	22	11

34	Big leaf maple	*Acer macrophyllum*	20	65	23		Retain-Viable	20	10
35	Big leaf maple	*Acer macrophyllum*	20	38	25	Fair (70+)	Retain-Viable	20	10
36	Red alder	*Alnus rubra*	22	65	23	Fair (70+)	Retain-Viable	27.5	13.75
37	Big leaf maple	*Acer macrophyllum*	14	60	20	Good (80+)	Retain-Viable	14	7
38	Big leaf maple	*Acer macrophyllum*	16	60	20	Good (80+)	Retain-Viable	16	8
39	Big leaf maple	*Acer macrophyllum*	11	47	15	Fair (70+)	Retain-Viable	11	5.5
40	Big leaf maple	*Acer macrophyllum*	17.8	47	22	Fair (70+)	Retain-Viable	17.8	8.9
41	Big leaf maple	*Acer macrophyllum*	17.8	55	30	Fair (70+)	Retain-Viable	17.8	8.9
42	Douglas fir	*Pseudotsuga menziesii*	23	58	38	Excellent (90+)	Retain-Viable	Edge of Driveway	11.5
43	Scotch pine	*Pinus sylvestris*	8.5	30	19	Fair (70+)	Retain-Viable	Edge of Driveway	4.25
44	Scotch pine	*Pinus sylvestris*	10.5	30	23	Excellent (90+)	Retain-Viable	Edge of Driveway	5.25
45	Scotch pine	*Pinus sylvestris*	10.5	30	23	Excellent (90+)	Retain-Viable	Edge of Driveway	5.25

The Dripline TPZ is sometimes used as a default TPZ. The above listed TPZ's shall be the TPZ that is used. When possible fence trees as a group instead of individually.

The TPZ can be reduced to the CRZ, unless noted otherwise, as long as the TPZ is not reduced by more than 20%. This may be further reduced on a case by case basis, upon review, approval, and under the direct over site of A.B.C. Consulting Arborists LLC.

ATTACHMENT 3 - TREE PROTECTION

The following minimum Tree Protection Measures can be copied and introduced into all relevant documents such as site plans, permit applications and conditions of approval, and bid documents so that everyone involved is aware of the requirements.

1. Tree Protection Fencing:

   a. Tree Protection Fences will need to be placed around each tree or group of trees to be retained.

      i. Tree Protection Fences are to be placed according to the attached drawing (bottom of attachment) at a distance of not less than 10' feet outside the dripline of the tree or group of trees to be saved, **or at the designated TPZ See Attachment 2 for TPZ/CRZ**

      ii. Tree Protection Fences must be inspected prior to the beginning of any demolition or construction work activities.

      iii. Nothing must be parked or stored within the Tree Protection Fences—no equipment, vehicles, soil, debris, or construction supplies of any sorts.

   b. Signs:

      i. The Tree Protection Fences need to be clearly marked with the following or similar text in four inch or larger letters every 20'

      TREE PROTECTION FENCE, DO NOT ENTER!
      DO NOT PARK OR STORE MATERIALS WITHIN THE PROTECTION AREA

      Questions contact Daniel Maple of A.B.C. Consulting Arborists LLC.
      Cell: (509) 953-0293 **Email:** Daniel@AbcArborist.Com

Signs along the TPZ may be waived at the discretion of the City and/or its officials.

2. Cement Trucks/Washout:

   a. Cement trucks must not be allowed to deposit waste or wash out materials from their trucks within the Tree Protection Fences.
   b. No waste, wash out, or contaminated water shall be allowed to flow into the Tree Protection Area.

3. Canopy Pruning:

   a. The canopies of some of the trees may need to be properly pruned to allow Sight lines (vehicular), access of equipment, materials, or building and construction clearance.
   b. If so, the pruning must be done by an International Society of Arboriculture, (ISA) Certified Arborist using current industry standard pruning techniques. (ANSI A300 Pruning Standards and ANSI Z131.1 Safety Standards as well as all OSHA, WISHA, and local standards must be followed.)
   c. Plant debris can be chipped and utilized on site for the mulch under the trees.

5. When excavation occurs near trees that are scheduled for retention, the following procedure must be followed to protect the long-term survivability of the tree:

    a. An International Society of Arboriculture, (ISA) Certified Arborist must be working with all equipment operators.
        i. The Certified Arborist should be outfitted with an Airspade™, shovel, hand pruners, a pair of loppers, a handsaw, and a power saw (a "saws all" type reciprocating saw is recommended).
    b. The hoe must be placed to "comb" the material directly away from the trunk as opposed to cutting across the roots.
        i. Combing is the gradual excavation of the ground cover plants and soil in depths that only extend as deep as the tines of the hoe.
    c. When any roots of one-inch diameter or greater, of the tree to be retained, is struck by the equipment, the Certified Arborist should stop the equipment operator.
    d. The Certified Arborist should then excavate around the tree root by Airspade™ (recommended) or by hand/shovel and cleanly cut the tree root.
        i. The Certified Arborist should then instruct the equipment operator to continue.

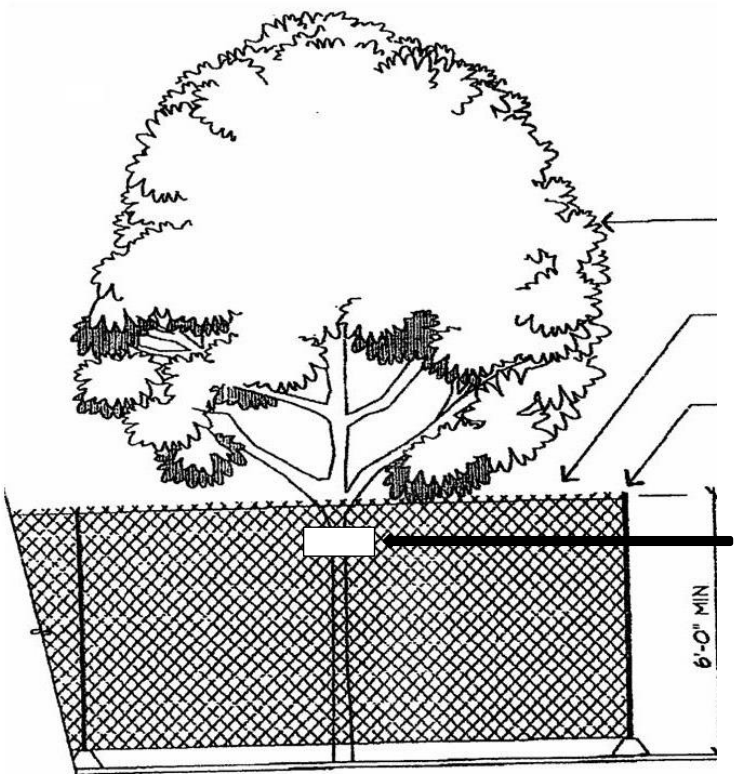
6. Putting Utilities Under the Root Zone:

    a. Boring under the root systems of trees (and other vegetation) shall be done under the supervision of an ISA Certified Arborist. This is to be accomplished by excavating a limited trench or pit on each side of the critical root zone of the tree and then hand digging or pushing the pipe through the soil under the tree. The closest pit walls shall be a minimum of 7 feet from the center of the tree and shall be sufficient depth to lay the pipe at the grade as shown on the plan and profile.
    b. Tunneling under the roots of trees shall be done under the supervision of an ISA Certified Arborist in an open trench by carefully excavating and hand digging around areas where large roots are exposed. No roots 1 inch in diameter or larger shall be cut.
    c. The contractor shall verify the vertical and horizontal location of existing utilities to avoid conflicts and maintain minimum clearances; adjustment shall be made to the grade of the new utility as required.

7. Watering:

The trees will require significant watering throughout the summer and early fall in order to survive long-term. An easy and economical watering can be done using soaker hoses placed three feet from the trunk of the tree and spiraled around the tree. One 75-foot soaker hose per tree is adequate. It is best to place the soakers using landscape staples, (available from HD Fowler in Bellevue for pennies apiece) then cover the area with three to six inches of mulch. The mulch will minimize evaporation and will also stimulate the microbial activity of the soil which is another benefit to the health of the tree.

    a. Water the tree to a depth of 18 to 20 inches. I recommended leaving the water on the soaker hoses for six to eight hours and then digging down to determine how deep your water is penetrating. Then adjust accordingly. It may take a good two days of watering to reach the proper depth.
    b. Once the water reaches the proper depth, turn off the hoses for four weeks and then water again. Water more often when temperatures increase— every three weeks when temperatures exceed 80 degrees and every two weeks when temperatures exceed 90 degrees. This drying out of the soil in between watering is important to prevent soil pathogens from attacking the trees.



Existing Significant Tree

Continuous 6' min. chain link or like fencing. Fence post @ 10' Max O.C.

Install as shown on plans 5' min past Dripline, or per specific TPZ/CRZ instructions.

Signs installed every 20'
TREE PROTECTION FENCE, DO NOT ENTER!
DO NOT PARK OR STORE MATERIALS WITHIN THE PROTECTION AREA

Include Arborist Contact Info.

Six-foot high temporary chain link (or like material) fencing shall be installed as shown on plans. Fencing shall be installed prior to construction activity and remain in place until construction is completed. Fencing panels are recommended. Fencing shall completely encircle the tree(s). Install fence posts using pier blocks. Avoid driving posts or stakes into major roots.

Make a clean straight cut, using loppers, reciprocal saw, or like tool, to remove damaged portion of root(s) over 1" inch diameter that are damaged during construction. **ALL** exposed roots shall be temporarily covered with damp burlap and covered with soil the same day, if possible, to prevent drying out. If not possible, the burlap must be kept moist at all times.

Work within the protection fencing shall be done manually. No stockpiling of materials, soil, debris, vehicular traffic, or storage of machinery or equipment shall be allowed within the limits of the fencing.

Cement trucks must not be allowed to deposit waste or wash out materials from their trucks within the tree protection fences, or in a manner that would allow the waste or wash out material to enter the TPZ.

The area within the tree protection fencing she'd be covered with wood chips, hog fuel, or similar materials, to a depth of 3 to 6 inches. The materials should be placed prior to beginning construction and remain until the tree protection fencing was taken down.

Should the tree protection fencing need to be installed inside the TPZ to allow for construction activity, then the following shall be done.
For construction equipment, cover the area from the tree protection fencing to the outer edge of the TPZ with 8 to 10 inches of wood chips, hog fuel, or similar materials, to reduce compaction cover area with steel plates.
For foot traffic' cover the area from the tree protection fencing to the outer edge of the TPZ with 6 inches of wood chips, hog fuel, or similar materials, to reduce compaction, cover with ¾ inch to 1-inch plywood.

The steel plates, plywood and wood chips are to remain in place until all construction activity is completed. The steel plates, plywood and woodchips shall then be removed and the tree protection fencing installed along the outer edge of the tree protection zone.

ATTACHMENT 4 - ASSUMPTIONS & LIMITING CONDITIONS

ASSUMPTIONS & LIMITING CONDITIONS

1. A field examination of the site was made for this report (date referenced in report). Reasonable care has been taken to obtain information from reliable sources, however, the certified/consulting arborist cannot guarantee the accuracy or validity of information provided by any outside sources.

2. Information provided in this report covers only tree's that were indicated for examination in the assignment and reflects the apparent condition of those tree(s) at the time of inspection. This inspection is limited to a visual method of the trees in question, excluding any core sampling, probing, dissection, aerial inspection, or excavation unless noted in writing and is contingent upon the appropriate fee for such services having been authorized in writing. There is no guarantee nor warranty, expressed or implied that any problems with any trees may not arise in the future.

3. All drawings, sketches, and photographs submitted with this report, are intended as visual aids only, and are not exact to scale. They should not be construed as engineering or architectural report or surveys unless noted and specified.

4. The certified/consulting arborist is not required to give any testimony or to attend meetings or dispute resolution proceedings relating this report unless subsequent contractual arrangements and fee agreements are made.

5. Any alterations made to this report automatically invalidates this report.

7. The report and values/opinions expressed, represent the work of the certified/consulting arborist, and the arborist's fees are in no way contingent upon the reporting of any specified values, stipulated results, or occurrence of a subsequent event.

ATTACHMENT 5 - GLOSSARY

Air excavation device, Air-Spade: Device that directs a jet of highly compressed air to excavate soil. Used within the root zone of trees to avoid or minimize damage to tree roots or near underground structures such as pipes and wires. May also reduce hazards associated with excavation near pipes or wires.

Alternate: Pertaining to bud or leaf arrangement, one leaf or bud at each node, situated at alternating positions along the stem. In this arrangement, the leaves are not directly across from each other

Drip line: Imaginary line defined by the branch spread (farthest extending limb in all directions) of a single plant or group of plants.

Defoliation: Loss of leaves from a tree or other plant by biological or mechanical means.

Foliage: The live leaves or needles of the tree; the plant part primarily responsible for photosynthesis.

Hypsometer: A device that measures vertical angles, and provides direct height measurements of objects by triangulation.

Included-bark: Bark that becomes embedded in a crotch (union) between branch and trunk or between codominant stems. Causes a weak structure.

Mulch: Any material such as wood chips, straw, sawdust, leaves, and stone that is spread on the surface of the soil to protect the soil and plant roots from the effects of raindrops, soil crusting, freezing, and evaporation.

Opposite: Pertaining to leaf or branch arrangement, leaves or branches situated two at each node, across from each other on the stem.

PH: Unit of measure that describes the alkalinity or acidity of a solution. Negative log of the hydrogen ion concentration. Measured on a scale from 0 to 14. Greater than 7 is alkaline, less than 7 is acid, and 7 is neutral (pure water).

Resistograph®: Brand name of a device consisting of a specialized micro drill bit that drills into trees and graphs density differences that are used to detect decay.

Soil compaction: Compression of the soil, often because of vehicle or heavy-equipment traffic, that breaks down soil aggregates and reduces soil volume and total pore space, especially macro-pore space.

Soil probe: Any one of many instruments used to take soil cores or samples. Usually some variation of a metal tube with a sharpened or serrated point and a T-shaped handle

Target: Any person or object within reach of a falling tree or part of a tree, that may be injured or damaged.

Tree protection zone (TPZ): Defined area within which certain activities are prohibited or restricted to prevent or minimize potential injury to designated trees, especially during construction or development.

Tree growth regulator (TGR): Chemical that can be applied to trees that slows terminal growth by reducing cell elongation.

Vigor: Overall health; the capacity to grow and resist physiological stress

Visual tree assessment (VTA): Method of assessing the structural integrity of trees using external symptoms of mechanical stress (such as bulges, reactive growth, etc) and defects (cracks, cavities, etc).

ATTACHMENT 6 - REFERENCES

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