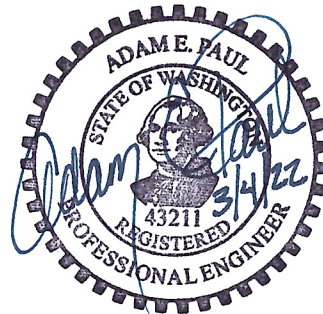


TECHNICAL INFORMATION REPORT

NOVEMBER 11, 2021
APCE PROJECT #2021056

PREPARED FOR:
FRONT PORCH HOLDINGS SUBDIVISION
19707 40TH PLACE SOUTH
PARCEL #0240000065
SEATAC, WA 98188

AT THE REQUEST OF:
PATRICK HUNSAKER
325 WASHINGTON AVENUE SOUTH, SUITE 5
KENT, WA 98188



I hereby state that these Drainage Calculations have been prepared by me or under my supervision and meet the standard of care and expertise which is usual and customary in the community for professional engineers. I understand that City of Seatac does not and will not assume liability or the sufficiency, suitability, or performance of drainage facilities prepared by me.

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FRONT PORCH HOLDINGS SUBDIVISION TECHNICAL INFORMATION REPORT

1.0 PROJECT OVERVIEW

This report accompanies the drainage review plan prepared for the Front Porch Holdings Subdivision project on parcel 0240000065 at 19707 40th Place South, Seattle, Washington. The site location is shown in Figure 1, below. The project has been designed to meet the requirements of the 2021 King County Surface Water Design Manual (KCSWDM).



FIGURE 1 - Vicinity Map

The existing 0.262-acre site is a developed single-family residential lot. The neighboring parcels are also developed single-family residential lots. The parcel is an internal lot which has a private road, 40th Place South, along the east property that provides accesses to Military Road South.

The project will consist of dividing the lot into two single-family residential lots, the construction of two new single-family residences, private driveways, and off-street parking. Stormwater runoff from the new residence will be conveyed to dispersion

trenches and the unconcentrated runoff will discharge northward Angle Lake. Predeveloped land cover characteristics are provided below in Table 1.

TABLE 1. PREDEVELOPED AREAS

	Description	Area (ft ²)	Total (ft ²)
Impervious	0	0	0
Pervious	Forest	11,410	11,410
	Total	11,410	

The total project area will be 11,410 square feet and each lot is designed to accommodate 3,332 square feet of new impervious area. The developed areas are tallied below in Table 2.

The soils present on the project site are identified in the King County Area Soil Survey as Arents, Alderwood material type of soil.

Stormwater runoff from the proposed project will be managed by basic dispersion BMPs. The runoff from the proposed roofs will be collected and conveyed into dispersion trenches. The runoff from the proposed driveway will be mitigated by sheet flow dispersion BMPs with 2-foot-wide rock strip and 10-foot-wide vegetated flowpath.

TABLE 2 - DEVELOPED AREAS

	Description	Area (ft ²)	Total (ft ²)
Impervious	Roof	5,009	6,664
	Driveway & Private Access	1,655	
Pervious	Landscaping	4,764	4,764
			11,410

2.0 CONDITIONS AND REQUIREMENTS SUMMARY

The pre-developed project area is assumed to have consisted of 11,410 square feet of forest. The developed site will contain 6,664 square feet of new impervious areas. The site is slope to the north, the drainage pattern will remain the same and no impact on the stormwater is anticipated in this development.

The general slope of the land is towards the north based on the topographic information per King County GIS. On-site soils were identified in the NRCS as being primarily Arents Alderwood material type of soil. A copy of the NRCS soil survey map in Appendix A.

The project will result in 6,664 square feet of total impervious surface added since January 8th, 2001 and has more than 7,000 square feet of disturbed area. Because this project does not qualify for Simplified Drainage Review, and it is not subject to Large Project Drainage Review (more than 50 acres of project area), Full Drainage Review will be required for the subdivision project. This report will show how the project complies with Core Requirements 1 through 9 and Special Requirements 1 through 5, as follows:

Core Requirement #1: Discharge at Natural Location

Under existing conditions, stormwater runoff will continue to disperse naturally toward the north edge of the property, into the existing driveway, and into Angle Lake, as it does under existing conditions.

Core Requirement #2: Off-site Analysis

The off-site system analysis is included in Section 3.0 of this report.

Core Requirement #3: Flow Control

A WWHM analysis of the historic and developed surfaces of this project's threshold discharge areas has been completed and included with this report. This analysis shows that the 15-minute, 100-year peak flow rate under historic conditions from the area that will be disturbed by this project will not be surpassed by the 15-minute, 100-year peak flow rate under developed conditions by more than 0.15 cfs. This project is, therefore, exempt from providing flow control facilities.

Core Requirement #4: Conveyance System

The conveyance system for this project includes pipes on the property that convey the stormwater to dispersion trenches. They are sized appropriately to handle the stormwater that is anticipated.

Core Requirement #5: Erosion and Sediment Control

Erosion and sediment control requirements have been designed per Appendix D of the KCSWDM.

Core Requirement #6: Maintenance and Operations

The on-site dispersion areas will be maintained privately by the property owner. Operations and Maintenance requirements are included in Appendix E of this report.

Core Requirement #7: Financial Guarantees and Liability

Financial guarantees will be provided as required by the City.

Core Requirement #8: Water Quality

The project will be exempt from water quality treatment because the proposed PGIS is less than 5,000 square feet in Section 1.2.8 of the KCSWDM.

Core Requirement #9: Flow Control BMPs

This site has an area of less than 22,000 square feet as defined in Section 1.2.9.2.1 of the KCSWDM. Each proposed lot is less than 11,000 square feet and, therefore, target impervious surfaces must be mitigated to the maximum extent feasible and a quantity of impervious surface equivalent at least 10% of the site must be mitigated.

Special Requirement #1: Other Adopted Area-Specific Requirements

There are no known area-specific special requirements that apply to this project site.

Special Requirement #2: Flood Hazard Area Delineations

There are no known flood hazard areas on or adjacent to this project.

Special Requirement #3: Flood Protection Facilities

Flood protection facility special requirements do not apply to this project. The project does not propose to construct a new or modify an existing flood protection facility.

Special Requirement #4: Source Controls

Since the proposed project is a single-family residence, source control measures are not anticipated to be required in conjunction with this project. There is no proposed outside-use or storage of pollutants.

Special Requirement #5: Oil Control

The proposed project does not require oil control measurements. The site is not considered high-use since it is a single-family residence.

3.0 OFF-SITE ANALYSIS

A Level 1 downstream analysis was completed in November of 2021. The highest point of the developed site is at the south of the property boundary and the elevation is about 410 feet. The runoff flows north along the existing driveway and passes the lot to the north, Parcel number 0240000066. The runoff continues to flow north until it reaches Angle Lake. See Appendix E for the off-site analysis map.

Downstream Basin of Threshold Discharge Area:

The overall slope of the project site is toward the north edge of the property. After exiting the project site, the runoff discharges north to the adjacent properties until it reaches Angle Lake.

No relevant complaints are known to have been reported within the last ten years that affect the properties adjacent to the downstream path of the runoff from the project site.

From a review of the information available relating to the downstream system, there did not appear to be any existing significant erosion or flooding problems and no significant problems are anticipated as a result of the improvements proposed as part of this project.

Upstream Tributary Basin:

The raised edge along Military Road South prevents stormwater from flowing onto the site.

4.0 FLOW CONTROL AND WATER QUALITY FACILITY ANALYSIS AND DESIGN

Performance Standard

The City has identified the project as a part of a Conservation Flow Control Area Level II and the entire site shall be analyzed as forest under pre-developed conditions. The result of WWHM shows that the 15-minute, 100-year peak flow rate under historic conditions (forest on type C soils) from the area that will be disturbed by this project will not be surpassed by the 100-year peak flow rate under developed conditions by more than 0.15 cfs. This project will, therefore, be exempt from providing flow control facilities. The dispersion facilities will be designed to mitigate the runoff from the target impervious areas.

BMPs

Section 1.2.9.2.1 of the KCSWDM requires that a project that must comply with Core Requirement #9 and which is on a lot that has a less than 22,000 square feet. This project will implement Section 1.2.9.2.1 BMPs for site sizes up to 11,000 square feet to the maximum extent feasible, mitigating at least 10% of the impervious surfaces.

Water Quality

This project proposes less than 5,000 square feet of PGIS and is, therefore, exempt from providing water quality treatment.

Flow Control

A WWHM analysis of the historic and developed surfaces has been completed and included with this report. This analysis shows that the 15-minute, 100-year peak flow rate under historic conditions (flat-sloped forest on type C soils) from the area that will be disturbed by this project will not be surpassed by the 100-year peak flow rate under developed conditions by more than 0.15 cfs. This project is, therefore, exempt from providing flow control facilities. Basic dispersion flow control BMPs from Appendix C of the KCSWDM will be applied.

Land covers for developed conditions are summarized in the table below.

WWHM MODEL SUMMARY

	Developed	Modeled as			
		Impervious	Lawn	Pasture	Forest
Roof	0.115 acres	0.115 acres	0.000 acres	0.000 acres	0.000 acres
Driveway	0.038 acres	0.038 acres	0.000 acres	0.000 acres	0.000 acres
Landscaping	0.178 acres	0.000 acres	0.178 acres	0.000 acres	0.000 acres
Totals	0.331 acres	0.153 acres	0.178 acres	0.000 acres	0.000 acres

The WWHM model indicates that the developed site will have a 15-minute, 100-year peak flow of 0.172 cfs. This is less than a 0.15 cfs increase over the 15-minute, 100-year peak for 0.331 acres of forest on type C soils (0.026 cfs). This project is, therefore, exempt from providing additional flow control facilities.

Detailed calculations are included in Appendix D.

BMPs

Full Dispersion: It is not feasible for this project to implement full dispersion, because a flowpath of 100 feet in length does not fit on the property that would meet the requirement of native vegetative flowpath segment for any full dispersion devices.

Full Infiltration: It is infeasible to apply full infiltration BMPs as detailed in Section C.2.2 of the 2021 KCSWDM. On-site soils were identified in the NRCS as being primarily Ardens Alderwood material type of soil. A copy of the NRCS soil survey map in Appendix A. The soil type identified is gravelly sandy loam. Therefore, it is not feasible for full infiltration per Section C.2.2. of the KCSWM.

Limited Infiltration: It is feasible to apply limited infiltration BMPs as detailed in Section C.2.2 of the 2021 KCSWDM. On-site soils were identified in the NRCS as being primarily Ardens Alderwood material type of soil. A copy of the NRCS soil survey map in Appendix A. The soil type identified is gravelly sandy loam. Therefore, it is not feasible for full infiltration per Section C.2.3. of the KCSWM.

Basic Dispersion: It is feasible to implement basic dispersion BMPs because there is sufficient space on the north end of each of the new lots. A 42-foot long dispersion trench with with 25 feet of vegetated flowpath is proposed which will disperse the runoff collected from 2,500 square feet of roof. According to KCSWDM Section C.2.4.4, the required trench length for 2,500 square feet impervious area is:

Total Impervious Area/700 x 10 = 2,500/700 x 10 = 36 feet

This project proposes to install a 36-foot long and 2-foot wide gravel-filled trench with 25 feet of vegetated flow path on each lot.

For the new driveway and the parking area will use sheet flow dispersion BMPs in Section C.2.4.5 of the KCSWDM. A 2-foot wide rock strip will be placed along the north edge of the proposed private driveway with a 20-foot flowpath because the width of the driveway and sidewalk is approximately 29 feet and for each 20 feet of impervious area, 10 feet of vegetative flowpath is required by the KCSWDM.

All impervious area will be mitigated by basic dispersion BMPs which meets the minimum requirements of the Small Lot BMP requirement to mitigate an area of impervious surface equal to 10% of the total lot area.

Water Quality

The project will be exempt from water quality treatment because the proposed PGIS is less than 5,000 square feet per Section 1.2.8 of KCSWDM.

5.0 CONVEYANCE SYSTEM ANALYSIS AND DESIGN

Conveyance pipes for this project will consist of 6-inch pipes to the dispersion trenches and will have a minimum slope of 1%. These are adequately sized to handle the flows that are anticipated from this project.

6.0 SPECIAL REPORTS AND STUDIES

Geotech report prepared by Geotech Consultants, Inc. dated January 31, 2022 is included in this report.

7.0 OTHER PERMITS

A building permit for the proposed home will be required in conjunction with this project.

8.0 ESC ANALYSIS AND DESIGN

The Erosion and Sediment Control Plan will be provided at the time of final engineering.

9.0 BOND QUANTITIES, FACILITY SUMMARIES, AND DECLARATION OF COVENANT

A bond quantities worksheet will be provided at the time of final engineering.

10.0 OPERATIONS AND MAINTENANCE MANUAL

The operations and maintenance details for the private facilities will be provided at the time of final engineering.

APPENDIX A:
SOIL INFORMATION

January 31, 2022

JN 22009

Front Porch Holdings LLC
325 Washington Avenue South, Box #5
Kent, Washington 98032

Attention: Mike Hunsaker
via email: mike@shmrockln.com

Subject: **Transmittal Letter – Geotechnical Engineering Study**
Proposed Short-Plat
Vacant Lot South of 3782 – 40th Place South
Parcel #0240000065
SeaTac, Washington

Dear Mr. Hunsaker,

Attached to this transmittal letter is our geotechnical engineering report for the new short plat to be constructed in SeaTac. The scope of our services consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for general earthwork and design considerations for foundations, retaining walls, subsurface drainage, and temporary excavations. This work was authorized by your acceptance of our proposal, P-11065, dated January 3, 2022.

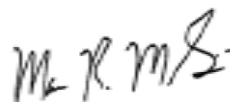
The attached report contains a discussion of the study and our recommendations. Please contact us if there are any questions regarding this report, or for further assistance during the design and construction phases of this project.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.



Matthew K. McGinnis
Geotechnical Engineer



Marc R. McGinnis, P.E.
Principal

cc: **Development Planning & Strategies LLC – Ross Woods**
via email: ross@dev-strat.com

MKM/MRM:kg

GEOTECHNICAL ENGINEERING STUDY
Proposed Short-Plat
Vacant Lot South of 3782 – 40th Place South
Parcel #0240000065
SeaTac, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed short plat to be located in SeaTac.

Development of the property is in the planning stage, and detailed plans were not available at the time of this study. We were provided with a topographic map prepared by 4 Site Surveying & Consulting, dated August 18, 2021, and a preliminary lot layout plan that was undated. Based on this information, we understand that the undeveloped yard area south of the existing residence is proposed to be short platted into two new lots. These new lots will comprise a total site area of approximately 0.17-acres per lot, with approximate dimensions of 120.1 feet in the north-south direction, and 60 feet in the east-west direction for each lot. No plans have been developed regarding the site development for each new lot, but they will likely each be developed with a new residence. The new residences will likely be two stories in height, and the northern residence may contain a daylight basement. Decks may extend off the north faces of the new residences. New driveways will extend off 40th Place South into the lots. No finish floor elevations have been provided at this time, but we anticipate that the main levels of the residence will sit close to the existing site grades. Preliminary property line setbacks of 15 feet from the north, 25 feet from the east, 20 feet from the south, and 5 feet from the west are shown on the preliminary lot layout plan. Excavation depths will range depending on the final siting and designs chosen.

If the scope of the project changes from what we have described above, we should be provided with revised plans in order to determine if modifications to the recommendations and conclusions of this report are warranted.

SITE CONDITIONS

SURFACE

The Vicinity Map, Plate 1, illustrates the general location of the site in SeaTac. The long, narrow property is located near the southern shore of Angle Lake. The site comprises an approximate site area of 0.4-acres and has approximate dimensions of 268.6 feet in the north-south direction, and 60 feet in the east-west direction. The site is bordered on all sides by residential parcels, and a narrow private driveway (40th Place South) runs along the eastern property line.

The site is currently undeveloped and is covered with grass and scattered trees. The grade across the lot slopes downward gently from south to north, with a total elevation change of 28 feet. This sloped lot is generally inclined at 10 percent through the full footprint of the property. No steep slopes were observed on, or in the direct vicinity of the site. Angle Lake is situated to the north of the adjacent northern parcel.

The adjacent parcels are all developed with single family residences and the surrounding vicinity follows a similar south to north trending downgradient continuing to the elevation of Angle Lake. The northern parcel (#3782) is owned by the client and contains a one-story residence with a partial basement set greater than 10 feet from the property lines. A detached garage is set south of the

residence but is still set well away from the property lines. The adjacent eastern parcels also contain one and two-story residences located relatively close to the property lines and the 40th Place South right-of-way. The adjacent southern parcel contains a two-story residence set well away from the property lines and is separated from the subject site by a large yard area; a small stone retaining wall is set near the southern property line.

The adjacent western lots are also developed with single-family residences on similar, narrow lots. The southwestern and central-western lots both contain two story residences with no basements set approximately 5 feet from the property lines. A detached shed and covered porch are set up to the property line on the southwestern property, and a short retaining wall could be observed on the central-western parcel where the grade steps down approximately 3 feet into the adjacent parcel. The northwestern adjacent parcel also contains a two-story residence set 5 feet off the property line; however, this residence contains a partial lower level/basement space which mostly appeared to consist of the attached garage space. All of these residences appear to bear on shallow foundations located close to the ground surface.

SUBSURFACE

The subsurface conditions were explored by excavating four test pits at the approximate locations shown on the Site Exploration Plan, Plate 2. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

The test pits were excavated on January 18, 2022 with a small, tracked excavator provided by the client. A geotechnical engineer from our staff observed the excavation process, logged the test pits, and obtained representative samples of the soil encountered. "Grab" samples of selected subsurface soil were collected from the backhoe bucket. The Test Pit Logs are attached to this report as Plates 3 and 4.

Soil Conditions

The test pits generally encountered similar subsurface soil conditions. Beneath the ground surface, a layer of loose fill soil was revealed to depths of 2 to 2.5 feet. A layer of old topsoil was revealed beneath the fill in Test Pit 2, extending to a depth of 3 feet. Beneath the fill and topsoil, native, loose, weathered silty sand was revealed. This weathered layer contained some roots, exhibited rust staining and mottling, and was in an elevated moisture state. This weathered layer continued to depths of 4 to 4.5 feet, where the soils became cemented and dense. This native soil is glacially compressed and is geologically referred to as glacial till. The dense glacial till continued to the base of the excavations at depths of 5 feet.

Published geologic maps indicate that the near-surface geologic unit in this area consists of glacial drift, a glacially-compressed, silty, fine-grained sand. Glacial till is similar in composition and strength to glacial drift. Our firm has also completed previous projects in the site vicinity that found similar glacial till soils.

An old drainpipe was revealed within the fill soils in Test Pit 4 during excavation. Debris, buried utilities, and old foundation and slab elements are commonly encountered on sites that have had previous development.

Although our explorations did not encounter cobbles or boulders, they are often found in soils that have been deposited by glaciers or fast-moving water.

Groundwater Conditions

Perched groundwater seepage was observed at a depth of 2 to 3 to 3 feet in all but Test Pit 1, which was excavated near the southern property extent, near the highest point of the site. These test pits were excavated in the middle of the wet season, and this perched groundwater is typical for a near-surface water table that perches on top of the impervious glacial till soils.

It should be noted that groundwater levels vary seasonally with rainfall and other factors. We anticipate that groundwater could be found in more permeable soil layers, sand seams within the till, and between the looser near-surface soil and the underlying glacial till.

The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. The relative densities and moisture descriptions indicated on the test pit logs are interpretive descriptions based on the conditions observed during excavation.

The compaction of test pit backfill was not in the scope of our services. The test pits were backfilled with excavated soil that was lightly tamped into place. Loose soil will therefore be found in the area of the test pits. If this presents a problem, the backfill will need to be removed and replaced with structural fill during construction.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

THIS SECTION CONTAINS A SUMMARY OF OUR STUDY AND FINDINGS FOR THE PURPOSES OF A GENERAL OVERVIEW ONLY. MORE SPECIFIC RECOMMENDATIONS AND CONCLUSIONS ARE CONTAINED IN THE REMAINDER OF THIS REPORT. ANY PARTY RELYING ON THIS REPORT SHOULD READ THE ENTIRE DOCUMENT.

The test pits conducted for this study encountered dense to very dense, glacially-compressed glacial till soil at depths ranging from about 4 to 4.5 feet beneath the ground surface. These soils are suitable for supporting new structural loads, and a conventional foundation system can be used, provided they bear either directly atop the glacial till, or on structural fill placed atop the glacial till. It will be important for all fill, topsoil, and loose soil to be removed from beneath foundations. Depending on final site and foundation elevations, some overexcavations may be needed in areas to reach this suitable bearing soil. Excavations into glacially compressed soils are typically conducted using toothed buckets due to the soil's density. This creates several inches of loose, disturbed soils at the base of the excavations. It will be important that the base of the excavations be scraped clean of any loose debris or soil that may become disturbed during excavation. This can be accomplished by using a cleanout bucket, smooth grade bar, or flat blade shovel. In addition, it may be necessary to protect the soil subgrade in footing areas with a mat of imported, clean, granular fill if the native soils are wet at the time of foundation construction; this is because the soil is moisture sensitive and prone to being disturbed if wet or by foot and machine traffic. This will likely be the scenario in the winter and spring months. This rock layer would both help to protect the

prepared bearing surfaces from disturbance and would facilitate any pumping of standing water from the foundation excavations if needed. Additional recommendations can be found in the **Conventional Foundations** section of this report.

Existing fill and topsoil should be removed from beneath settlement floor slabs. The on-site soils are silty and fine grained. Reuse of the excavated soils as compacted fill beneath lightly-loaded elements, such as slabs, would be possible in hot, dry weather, but will not be possible in wet conditions, if the soils are overly moist when excavated, or if the excavated soils are allowed to become overly moist before they are placed and compacted. The on-site soils will not have good drainage properties, even when well compacted. Imported, clean, angular rock or gravel such as ballast rock or quarry spalls should be used beneath the foundations where structural fill is needed, and free-draining, granular fill should be placed behind backfilled walls.

The excavations for the proposed residences will range depending on the final design and siting locations. Based on the soils encountered in our test pits, a temporary excavation inclination of no steeper than a 1:1 (Horizontal:Vertical) is appropriate for this project. Vertical excavations should not be made on, or near the shared property lines, or near any settlement sensitive structure. Some caving was observed in the loose weathered soils, particularly in the zones of perched groundwater seepage. Based on the preliminary lot layout plan, sufficient setbacks from the north, east, and south property lines are being proposed to maintain the excavations within the property boundaries. However, a setback of only 5 feet is shown from the western property line, and the adjacent western residences and accessory site features are located close to the common property line. Depending on the final foundation elevations, excavations in this area may either require that temporary excavation easements be obtained from the adjacent property owners, or some form of excavation shoring be utilized to facilitate the excavations, especially if the excavation requires several feet of room for the concrete subcontractor to work on the perimeter forms, and if the outside edge of the footing extends past the building setback line. We can comment further on this once preliminary residence designs have been completed, however, it should be noted that excavations will likely need to extend at least 4 to 4.5 feet below the existing grade to reach the suitable bearing soils encountered in the test pits. Further recommendations can be found in the **Excavations and Slopes** section of this report.

A layer of perched groundwater was revealed in the test pits approximately 2 to 3 feet below the ground surface. A similar amount of onsite water is possible to exist within the site bounds in the winter and spring months in any year and could affect earthwork during these months. The earthwork and utility contractor(s) for the project should be aware of this. A sufficient subsurface drainage system and waterproofing should be included beneath the proposed structure locations, especially if below-grade spaces are included in the residence designs. This is true even for crawl spaces. More detailed recommendations can be found in the **Drainage Considerations** section of this report.

The underlying Glacial Till is essentially impervious and will stop downward percolation of large volumes of water infiltrated above it. A 1997 study published by U.S. Geologic Survey (USGS) in cooperation with the Washington Department of Ecology (WDOE) determined the infiltration capacity of Glacial Till soils to vary between 0.0005 and 0.005 inches/hour. We have found similar extremely low infiltration rates in Pilot Infiltration Tests our firm has conducted in glacial till soils. This is because Glacial Till is very dense, cemented, is often comprised of fine-grained sand, and can have high silt (fines) content. As a result, there are no large or continuous pore spaces in the soil that can transmit water. Often, the impermeable nature of the Glacial Till causes a shallow seasonal perched water table to form where the ground surface is not covered by an impervious layer. This is a common problem in the wet season throughout the Puget Sound area and was

observed in the shallow perched groundwater layers during our field work. Considering all this, and that perched groundwater was encountered, it is our professional opinion that onsite infiltration or dispersion of stormwater is not feasible for the subject site. Attempting on-site infiltration or dispersion would likely increase the potential for surface and subsurface drainage problems in both the proposed homes, and on the adjacent properties. All collected stormwater runoff should be tightlined offsite to the appropriate facilities.

The erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered. We anticipate that a silt fence will be needed around the downslope sides of any cleared areas. Existing pavements, ground cover, and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Rocked staging areas and construction access roads should be provided to reduce the amount of soil or mud carried off the property by trucks and equipment. Trucks should not be allowed to drive off of the rock-covered areas. Cut slopes and soil stockpiles should be covered with plastic during wet weather. It will be important that no silty runoff is allowed to travel downhill to the north, and reach Angle Lake. Currently, another residential parcel exists between the development area and the lake, which should provide sufficient runoff to prevent any runoff from reaching the lake's edge. However, if uncapped drainage lines or ditches exist within the influence of the development area, it will be important that any silty water be diverted from these conveyance locations, as these lines typically directly discharge into Angle Lake. Following clearing or rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface. On most construction projects, it is necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

The drainage and/or waterproofing recommendations presented in this report are intended only to prevent active seepage from flowing through concrete walls or slabs. Even in the absence of active seepage into and beneath structures, water vapor can migrate through walls, slabs, and floors from the surrounding soil, and can even be transmitted from slabs and foundation walls due to the concrete curing process. Water vapor also results from occupant uses, such as cooking, cleaning, and bathing. Excessive water vapor trapped within structures can result in a variety of undesirable conditions, including, but not limited to, moisture problems with flooring systems, excessively moist air within occupied areas, and the growth of molds, fungi, and other biological organisms that may be harmful to the health of the occupants. The designer or architect must consider the potential vapor sources and likely occupant uses, and provide sufficient ventilation, either passive or mechanical, to prevent a buildup of excessive water vapor within the planned structure.

Geotech Consultants, Inc. should be allowed to review the final development plans to verify that the recommendations presented in this report are adequately addressed in the design. Such a plan review would be additional work beyond the current scope of work for this study, and it may include revisions to our recommendations to accommodate site, development, and geotechnical constraints that become more evident during the review process.

We recommend including this report, in its entirety, in the project contract documents. This report should also be provided to any future property owners so they will be aware of our findings and recommendations.

SEISMIC CONSIDERATIONS

In accordance with the International Building Code (IBC), the site class within 100 feet of the ground surface is best represented by Site Class Type D (Stiff Soil). As noted in the USGS website, the

mapped spectral acceleration value for a 0.2 second (S_s) and 1.0 second period (S_1) equals 1.43g and 0.48g, respectively.

The IBC and ASCE 7 require that the potential for liquefaction (soil strength loss) during an earthquake be evaluated for the peak ground acceleration of the Maximum Considered Earthquake (MCE), which has a probability of occurring once in 2,475 years (2 percent probability of occurring in a 50-year period). The MCE peak ground acceleration adjusted for site class effects (F_{PGA}) equals 0.66g. The glacial till soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of their dense, glacially-compressed nature.

CONVENTIONAL FOUNDATIONS

The proposed structures can be supported on conventional continuous and spread footings bearing on undisturbed, dense glacial till, or on imported crushed rock structural fill placed above this competent native soil. See the section entitled **General Earthwork and Structural Fill** for recommendations regarding the placement and compaction of structural fill beneath structures. Prior to placing structural fill beneath foundations, the excavation should be observed by the geotechnical engineer to document that adequate bearing soils have been exposed.

We recommend that continuous and individual spread footings have minimum widths of 16 and 24 inches, respectively. Exterior footings should also be bottomed at least 18 inches below the lowest adjacent finish ground surface for protection against frost and erosion. The local building codes should be reviewed to determine if different footing widths or embedment depths are required. Footing subgrades must be cleaned of loose or disturbed soil prior to pouring concrete. Depending upon site and equipment constraints, this may require removing the disturbed soil by hand.

Depending on the final site grades, overexcavation may be required below the footings to expose competent native soil. Unless lean concrete is used to fill an overexcavated hole, the overexcavation must be at least as wide at the bottom as the sum of the depth of the overexcavation and the footing width. For example, an overexcavation extending 2 feet below the bottom of a 2-foot-wide footing must be at least 4 feet wide at the base of the excavation. If lean concrete is used, the overexcavation need only extend 6 inches beyond the edges of the footing.

An allowable bearing pressure of 2,500 pounds per square foot (psf) is appropriate for footings supported on competent, dense native soil, or on adequately compacted structural fill placed atop the competent native soils. A one-third increase in this design bearing pressure may be used when considering short-term wind or seismic loads. For the above design criteria, it is anticipated that the total post-construction settlement of footings founded on competent, dense native soil, or on structural fill up to 5 feet in thickness, will be about one-half-inch, with differential settlements on the order of one-half-inch in a distance of 30 feet along a continuous footing with a uniform load.

Lateral loads due to wind or seismic forces may be resisted by friction between the foundation and the bearing soil, or by passive earth pressure acting on the vertical, embedded portions of the foundation. For the latter condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level, well-compacted fill.

We recommend using the following ultimate values for the foundation's resistance to lateral loading:

PARAMETER	ULTIMATE VALUE
Coefficient of Friction	0.40
Passive Earth Pressure	300 pcf

Where: pcf is Pounds per Cubic Foot, and Passive Earth Pressure is computed using the Equivalent Fluid Density.

If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. The above ultimate values for passive earth pressure and coefficient of friction do not include a safety factor.

FOUNDATION AND RETAINING WALLS

Retaining walls backfilled on only one side should be designed to resist the lateral earth pressures imposed by the soil they retain. The following recommended parameters are for walls that restrain level backfill:

PARAMETER	VALUE
Active Earth Pressure *	40 pcf
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.40
Soil Unit Weight	135 pcf

Where: pcf is Pounds per Cubic Foot, and Active and Passive Earth Pressures are computed using the Equivalent Fluid Pressures.

* For a restrained wall that cannot deflect at least 0.002 times its height, a uniform lateral pressure equal to 10 psf times the height of the wall should be added to the above active equivalent fluid pressure. This applies only to walls with level backfill.

The design values given above do not include the effects of any hydrostatic pressures behind the walls and assume that no surcharges, such as those caused by slopes, vehicles, or adjacent foundations will be exerted on the walls. If these conditions exist, those pressures should be added to the above lateral soil pressures. Where sloping backfill is desired behind the walls, we will need to be given the wall dimensions and the slope of the backfill in order to provide the appropriate design earth pressures. The surcharge due to traffic loads behind a wall can typically be accounted for by adding a uniform pressure equal to 2 feet multiplied by the above active fluid density. Heavy construction equipment should not be operated behind retaining and foundation walls within a distance equal to the height of a wall, unless the walls are designed for the additional lateral pressures resulting from the equipment.

The values given above are to be used to design only permanent foundation and retaining walls that are to be backfilled, such as conventional walls constructed of reinforced concrete or masonry. It is not appropriate to use the above earth pressures and soil unit weight to back-calculate soil strength parameters for design of other types of retaining walls, such as soldier pile, reinforced earth, modular or soil nail walls. We can assist with design of these types of walls, if desired.

The passive pressure given is appropriate only for a shear key poured directly against undisturbed native soil, or for the depth of level, well-compacted fill placed in front of a retaining or foundation wall. The values for friction and passive resistance are ultimate values and do not include a safety factor. Restrained wall soil parameters should be utilized the wall and reinforcing design for a distance of 1.5 times the wall height from corners or bends in the walls, or from other points of restraint. This is intended to reduce the amount of cracking that can occur where a wall is restrained by a corner.

Wall Pressures Due to Seismic Forces

Per IBC Section 1803.5.12, a seismic surcharge load need only be considered in the design of walls over 6 feet in height. A seismic surcharge load would be imposed by adding a uniform lateral pressure to the above-recommended active pressure. The recommended seismic surcharge pressure for this project is $9H$ pounds per square foot (psf), where H is the design retention height of the wall. Using this increased pressure, the safety factor against sliding and overturning can be reduced to 1.2 for the seismic analysis.

Retaining Wall Backfill and Waterproofing

Backfill placed behind retaining or foundation walls should be coarse, free-draining structural fill containing no organics. This backfill should contain no more than 5 percent silt or clay particles and have no gravel greater than 4 inches in diameter. The percentage of particles passing the No. 4 sieve should be between 25 and 70 percent. If the on-site soils can be properly compacted, and are used as wall backfill, a minimum 12-inch width of free-draining gravel should be placed against the backfilled retaining walls. The gravel should be hydraulically connected to the foundation drain system. Free draining backfill should be used for the entire width of the backfill where seepage is encountered. The later section entitled ***Drainage Considerations*** should also be reviewed for recommendations related to subsurface drainage behind foundation and retaining walls.

The purpose of these backfill requirements is to ensure that the design criteria for a retaining wall are not exceeded because of a build-up of hydrostatic pressure behind the wall. Also, subsurface drainage systems are not intended to handle large volumes of water from surface runoff. The top 12 to 18 inches of the backfill should consist of a compacted, relatively impermeable soil or topsoil, or the surface should be paved. The ground surface must also slope away from backfilled walls at one to 2 percent to reduce the potential for surface water to percolate into the backfill.

Water percolating through pervious surfaces (pavers, gravel, permeable pavement, etc.) must also be prevented from flowing toward walls or into the backfill zone. Foundation drainage and waterproofing systems are not intended to handle large volumes of infiltrated water. The compacted subgrade below pervious surfaces and any associated drainage layer should therefore be sloped away. Alternatively, a membrane and subsurface collection system could be provided below a pervious surface.

It is critical that the wall backfill be placed in lifts and be properly compacted, in order for the above-recommended design earth pressures to be appropriate. The recommended wall design criteria assume that the backfill will be well-compacted in lifts no thicker than 12 inches. The compaction of backfill near the walls should be accomplished with hand-operated equipment to prevent the walls from being overloaded by the higher soil forces that occur during compaction. The section entitled ***General Earthwork and Structural Fill***

contains additional recommendations regarding the placement and compaction of structural fill behind retaining and foundation walls.

The above recommendations are not intended to waterproof below-grade walls, or to prevent the formation of mold, mildew, or fungi in interior spaces. Over time, the performance of subsurface drainage systems can degrade, subsurface groundwater flow patterns can change, and utilities can break or develop leaks. Therefore, waterproofing should be provided where future seepage through the walls is not acceptable. This typically includes limiting cold-joints and wall penetrations and using bentonite panels or membranes on the outside of the walls. There are a variety of different waterproofing materials and systems, which should be installed by an experienced contractor familiar with the anticipated construction and subsurface conditions. Applying a thin coat of asphalt emulsion to the outside face of a wall is not considered waterproofing and will only help to reduce moisture generated from water vapor or capillary action from seeping through the concrete. As with any project, adequate ventilation of basement and crawl space areas is important to prevent a buildup of water vapor that is commonly transmitted through concrete walls from the surrounding soil, even when seepage is not present. This is appropriate even when waterproofing is applied to the outside of foundation and retaining walls. We recommend that you contact an experienced envelope consultant if detailed recommendations or specifications related to waterproofing design or minimizing the potential for infestations of mold and mildew are desired.

SLABS-ON-GRADE

The building floors can be constructed as slabs-on-grade atop competent native soil, or on structural fill placed following removal of the existing fill and topsoil. The subgrade soil must be in a firm, non-yielding condition at the time of slab construction or underslab fill placement. Any soft areas encountered should be excavated and replaced with select, imported structural fill. Alternately, the floors could be constructed as framed floors atop a crawlspace if the client desires.

Even where the exposed soils appear dry, water vapor will tend to naturally migrate upward through the soil to the new constructed space above it. This can affect moisture-sensitive flooring, cause imperfections or damage to the slab, or simply allow excessive water vapor into the space above the slab. All interior slabs-on-grade should be underlain by a capillary break drainage layer consisting of a minimum 4-inch thickness of clean gravel or crushed rock that has a fines content (percent passing the No. 200 sieve) of less than 3 percent and a sand content (percent passing the No. 4 sieve) of no more than 10 percent. Pea gravel or crushed rock are typically used for this layer.

As noted by the American Concrete Institute (ACI) in the *Guides for Concrete Floor and Slab Structures*, proper moisture protection is desirable immediately below any on-grade slab that will be covered by tile, wood, carpet, impermeable floor coverings, or any moisture-sensitive equipment or products. ACI recommends a minimum 10-mil thickness vapor retarder for better durability and long-term performance than is provided by 6-mil plastic sheeting that has historically been used. A vapor retarder is defined as a material with a permeance of less than 0.3 perms, as determined by ASTM E 96. It is possible that concrete admixtures may meet this specification, although the manufacturers of the admixtures should be consulted. Where vapor retarders are used under slabs, their edges should overlap by at least 6 inches and be sealed with adhesive tape. The sheeting should extend to the foundation walls for maximum vapor protection.

If no potential for vapor passage through the slab is desired, a vapor *barrier* should be used. A vapor barrier, as defined by ACI, is a product with a water transmission rate of 0.01 perms when tested in accordance with ASTM E 96. Reinforced membranes having sealed overlaps can meet this requirement.

We recommend that the contractor, the project materials engineer, and the owner discuss these issues and review recent ACI literature and ASTM E-1643 for installation guidelines and guidance on the use of the protection/blotter material.

DRAINAGE CONSIDERATIONS

Footing drains should be used where: (1) crawl spaces or basements will be below a structure; (2) a slab is below the outside grade; or (3) the outside grade does not slope downward from a building. Drains should also be placed at the base of all earth-retaining walls. These drains should be surrounded by at least 6 inches of 1-inch-minus, washed rock that is encircled with non-woven, geotextile filter fabric (Mirafi 140N, Supac 4NP, or similar material). At its highest point, a perforated pipe invert should be at least 6 inches below the bottom of a slab floor or the level of a crawl space. The discharge pipe for subsurface drains should be sloped for flow to the outlet point. Roof and surface water drains must not discharge into the foundation drain system. A typical footing drain detail is attached to this report as Plate 5. For the best long-term performance, perforated PVC pipe is recommended for all subsurface drains. Clean-outs should be provided for potential future flushing or cleaning of footing drains.

Drainage inside the building's footprint should also be provided where (1) a crawl space or slab will slope or be lower than the surrounding ground surface, (2) an excavation encounters significant seepage, or (3) an excavation for a building will be close to the expected high groundwater elevations. It is common for crawl spaces that extend close to, or into, glacial till soils to develop standing water from groundwater that bypasses the perimeter footing drains. As a minimum, a vapor retarder, as defined in the **Slabs-On-Grade** section, should be provided in any crawl space area to limit the transmission of water vapor from the underlying soils. Crawl space grades are sometimes left near the elevation of the bottom of the footings. As a result, an outlet drain is recommended for all crawl spaces to prevent an accumulation of any water that may bypass the footing drains. Providing several inches of free draining gravel underneath the vapor retarder is also prudent to limit the potential for seepage to build up on top of the vapor retarder.

Perched groundwater was observed during our field work. If seepage is encountered in an excavation, it should be drained from the site by directing it through drainage ditches, perforated pipe, or French drains, or by pumping it from sumps interconnected by shallow connector trenches at the bottom of the excavation.

The excavation and site should be graded so that surface water is directed off the site and away from the tops of slopes. Water should not be allowed to stand in any area where foundations, slabs, or pavements are to be constructed. Final site grading in areas adjacent to the buildings should slope away at least one to 2 percent, except where the area is paved. Surface drains should be provided where necessary to prevent ponding of water behind foundation or retaining walls. A discussion of grading and drainage related to pervious surfaces near walls and structures is contained in the **Foundation and Retaining Walls** section.

GENERAL EARTHWORK AND STRUCTURAL FILL

All building and pavement areas should be stripped of surface vegetation, topsoil, organic soil, and other deleterious material. The stripped or removed materials should not be mixed with any materials to be used as structural fill, but they could be used in non-structural areas, such as landscape beds.

Structural fill is defined as any fill, including utility backfill, placed under, or close to, a building, or in other areas where the underlying soil needs to support loads. All structural fills should be placed in horizontal lifts with a moisture content at, or near, the optimum moisture content. The optimum moisture content is that moisture content that results in the greatest compacted dry density. The moisture content of fill is very important and must be closely controlled during the filling and compaction process. As discussed in the **General** section, the on-site soils are generally unsuitable for not suitable for reuse as structural fill, especially underneath foundations, due to their fine-grained, silty nature, elevated moisture content, and poor drainage qualities.

The allowable thickness of the fill lift will depend on the material type selected, the compaction equipment used, and the number of passes made to compact the lift. The loose lift thickness should not exceed 12 inches, but should be thinner if small, hand-operated compactors are used. We recommend testing structural fill as it is placed. If the fill is not sufficiently compacted, it should be recompacted before another lift is placed. This eliminates the need to remove the fill to achieve the required compaction. The following table presents recommended levels of relative compaction for compacted fill:

LOCATION OF FILL PLACEMENT	MINIMUM RELATIVE COMPACTION
Beneath slabs or walkways	95%
Filled slopes and behind retaining walls	90%
Beneath pavements	95% for upper 12 inches of subgrade; 90% below that level

Where: Minimum Relative Compaction is the ratio, expressed in percentages, of the compacted dry density to the maximum dry density, as determined in accordance with ASTM Test Designation D 1557-91 (Modified Proctor).

LIMITATIONS

The conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our exploration and assume that the soil and groundwater conditions encountered in the test pits are representative of subsurface conditions on the site. If the subsurface conditions encountered during construction are significantly different from those observed in our explorations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unanticipated conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking samples in test pits. Subsurface conditions can also vary between exploration locations. Such unexpected conditions frequently require making additional expenditures to attain a properly constructed project. It is recommended that the owner consider providing a contingency fund to accommodate such potential extra costs and risks. This is a standard recommendation for all projects.

This report has been prepared for the exclusive use of Front Porch Holdings LLC and its representatives, for specific application to this project and site. Our conclusions and recommendations are professional opinions derived in accordance with our understanding of current local standards of practice, and within the scope of our services. No warranty is expressed or implied. The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. Our services also do not include assessing or minimizing the potential for biological hazards, such as mold, bacteria, mildew, and fungi in either the existing or proposed site development.

ADDITIONAL SERVICES

In addition to reviewing the final plans, Geotech Consultants, Inc. should be retained to provide geotechnical consultation, testing, and observation services during construction. This is to confirm that subsurface conditions are consistent with those indicated by our exploration, to evaluate whether earthwork and foundation construction activities comply with the general intent of the recommendations presented in this report, and to provide suggestions for design changes in the event subsurface conditions differ from those anticipated prior to the start of construction. However, our work would not include the supervision or direction of the actual work of the contractor and its employees or agents. Also, job and site safety, and dimensional measurements, will be the responsibility of the contractor.

During the construction phase, we will provide geotechnical observation and testing services when requested by you or your representatives. Please be aware that we can only document site work we actually observe. It is still the responsibility of your contractor or on-site construction team to verify that our recommendations are being followed, whether we are present at the site or not.

The following plates are attached to complete this report:

Plate 1	Vicinity Map
Plate 2	Site Exploration Plan
Plates 3 - 4	Test Pit Logs
Plate 5	Typical Footing Drain Detail

We appreciate the opportunity to be of service on this project. Please contact us if you have any questions, or if we can be of further assistance.

Respectfully submitted,

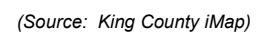
GEOTECH CONSULTANTS, INC.



1/31/2022

Marc R. McGinnis, P.E.
Principal

MKM/MRM:kg



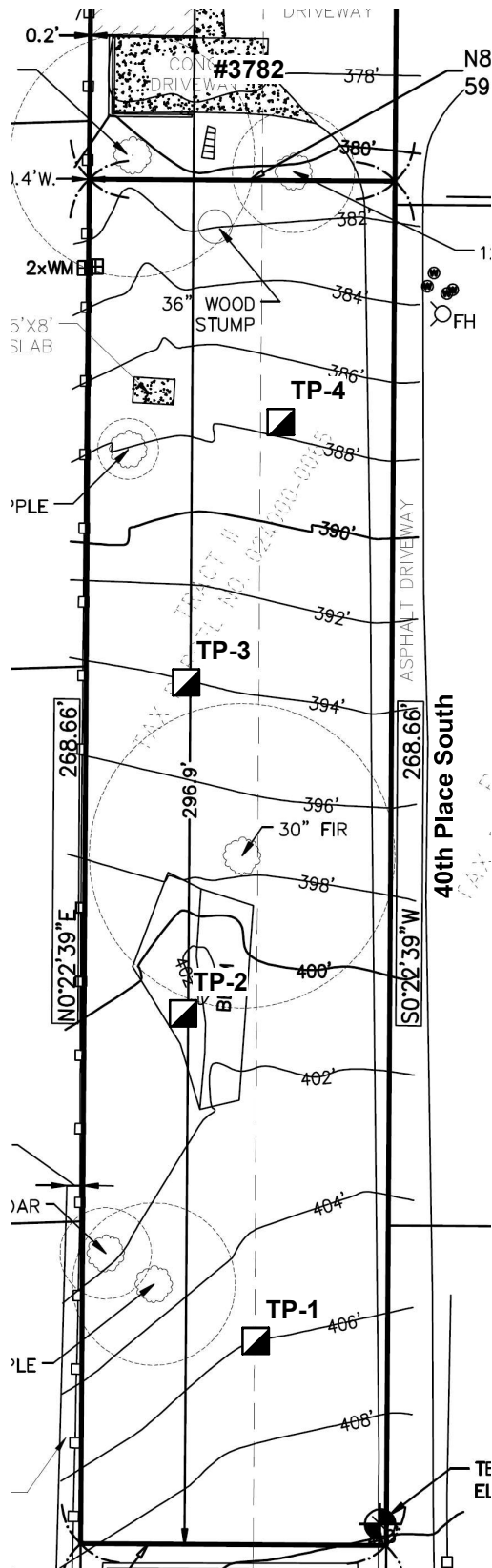
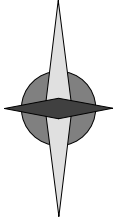
Vacant Lot South of 3782 - 40th Place South
Parcel #0240000065
SeaTac, Washington

22009

Jan. 2022

1

NORTH



Legend:

■ Test Pit Location



GEOTECH
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SITE EXPLORATION PLAN

Vacant Lot South of 3782 - 40th Place South
Parcel #0240000065
SeaTac, Washington

Job No:	Date:	No Scale	Plate:
22009	Jan. 2022	No Scale	2

TEST PIT 1

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
			FILL	Brown silty SAND with roots, fine-grained, moist, loose (FILL)
				Topsoil
5			SM	Gray mottled brown and orange, silty SAND with rusting and trace roots, fine-grained, moist, loose to medium-dense -becomes gray mottled orange, cemented, dense (Glacial Till)
10				<ul style="list-style-type: none"> * Test Pit terminated at 5 feet on January 18, 2022. * No groundwater seepage was observed during excavation. * No caving observed during excavation.

TEST PIT 2

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
			FILL	Brown silty SAND with roots, fine-grained, moist, loose (FILL)
5			SM	Brown mottled orange, silty SAND with roots and gravel, fine-grained, wet, loose -becomes gray-brown mottled orange and rust, very moist, loose to medium-dense -becomes gray, cemented, dense (Glacial Till)
10				<ul style="list-style-type: none"> * Test Pit terminated at 5 feet on January 18, 2022. * Perched groundwater seepage was observed at 3 feet during excavation. * No caving was observed during excavation.



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TEST PIT LOG

Vacant Lot South of 3782 - 40th Place South
Parcel #0240000065
SeaTac, Washington

Job	Date:	Logged by:	Plate:
22009	Jan. 2022	MKM	3

TEST PIT 3

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
			FILL	Brown silty SAND with roots, fine-grained, very moist, loose (FILL)
				Brown mottled orange, silty SAND with roots, fine-grained, wet, loose
			SM	-becomes gray-brown mottled orange, very moist, medium-dense -becomes gray with rusting, cemented, dense (Glacial Till)
5				<ul style="list-style-type: none"> * Test Pit terminated at 5 feet on January 18, 2022. * Perched groundwater seepage was observed from 2 to 3 feet during excavation. * No caving observed during excavation.
10				

TEST PIT 4

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
			FILL	Brown silty SAND with roots, fine-grained, moist to very moist, loose (FILL)
				Old AC drainpipe
				Brown mottled orange, gravelly, silty SAND with roots, fine-grained, wet, loose
			SM	-becomes gray with rusting, cemented, dense (Glacial Till)
5				<ul style="list-style-type: none"> * Test Pit terminated at 5 feet on January 18, 2022. * Perched groundwater seepage was observed from 2.5 to 3 feet during excavation. * Slight caving was observed from 2 to 3 feet during excavation.
10				

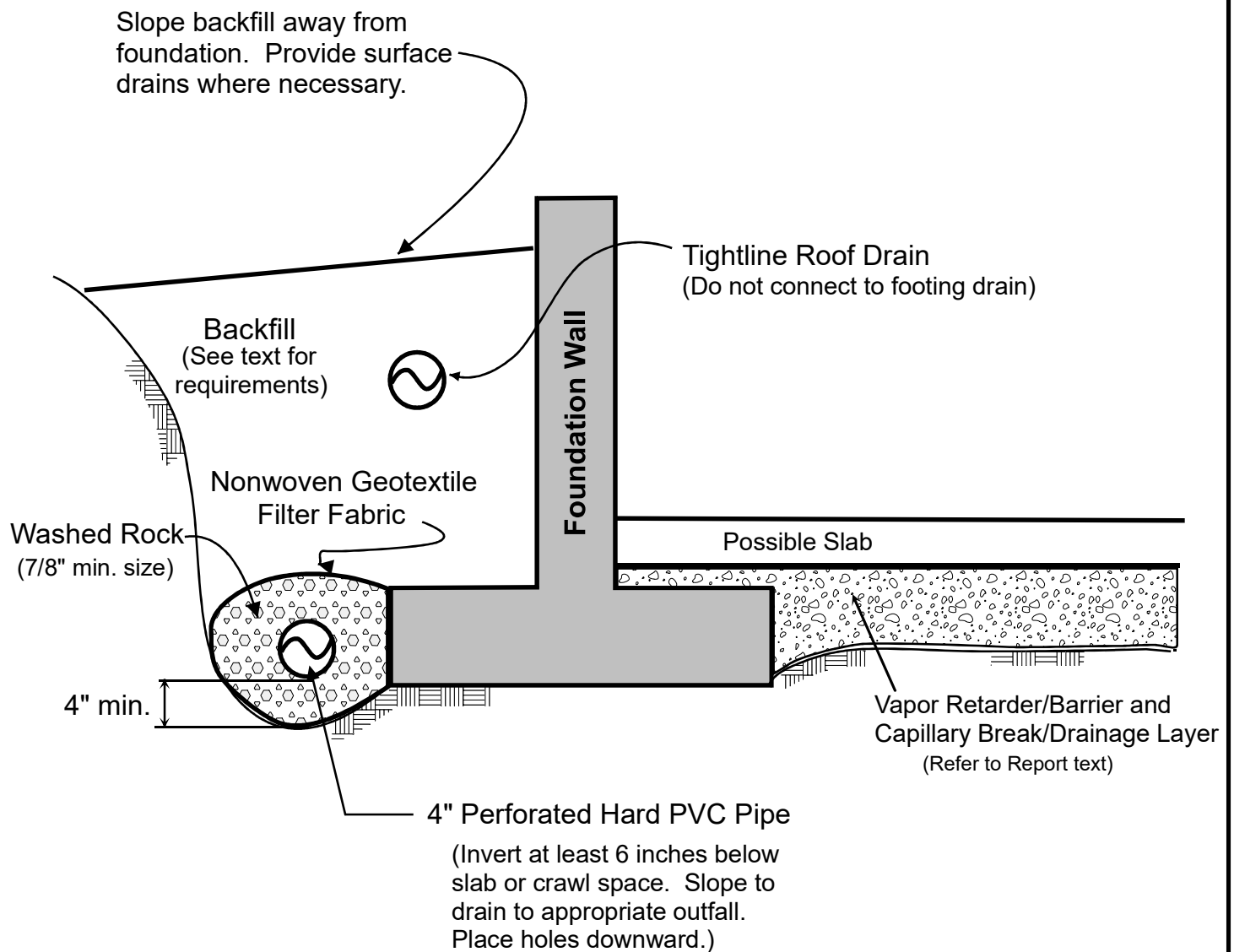


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TEST PIT LOG

Vacant Lot South of 3782 - 40th Place South
Parcel #0240000065
SeaTac, Washington

Job	Date:	Logged by:	Plate:
22009	Jan. 2022	MKM	4



NOTES:

- (1) In crawl spaces, provide an outlet drain to prevent buildup of water that bypasses the perimeter footing drains.
- (2) Refer to report text for additional drainage, waterproofing, and slab considerations.



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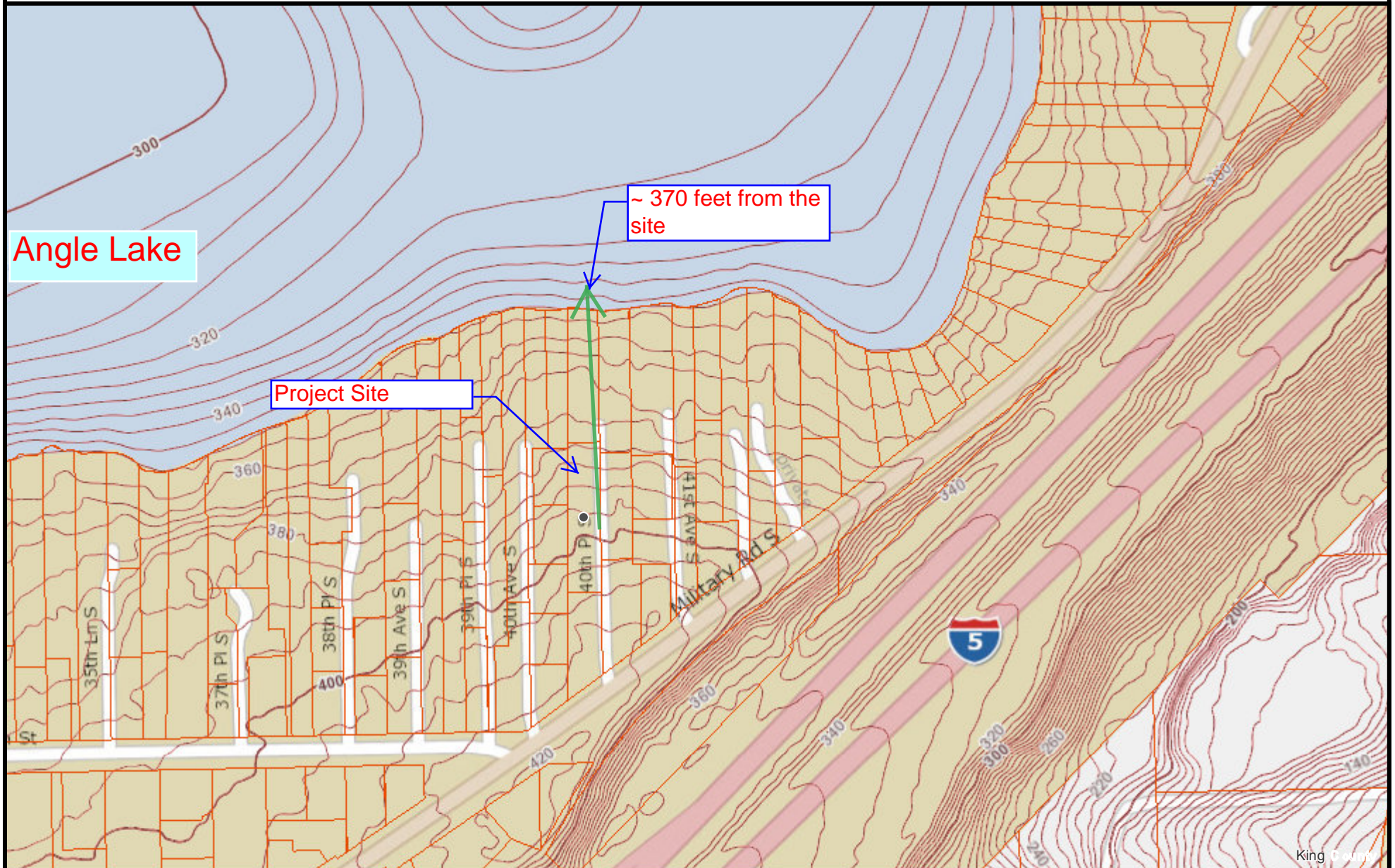
FOOTING DRAIN DETAIL

Vacant Lot South of 3782 - 40th Place South
Parcel #0240000065
SeaTac, Washington

Job No: 22009	Date: Jan. 2022	Plate: 5
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APPENDIX B:
OFF-SITE ANALYSIS

Hunsaker Subdivision Downstream Map



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

Date: 11/10/2021

Notes:



APPENDIX C:
SPECIAL REPORTS

FRONT PORCH HOLDINGS SUBDIVISION STORM DRAINAGE FACILITIES OPERATION AND MAINTENANCE MANUAL

This Operation and Maintenance Manual is for the dispersion trenches serving the new subdivision located on parcel number 0240000065. The purpose of the stormwater facilities is to provide management of stormwater runoff generated by the residence and driveway on this property.

The storm drainage facilities include a tightline connection from the roof downspouts, to dispersion facilities. A catch basin will be installed between the surfaces to provide a point for some trash and any other substances that could clog the systems to be removed from the runoff. Sediment and trash should be prevented from entering the dispersion trenches and to keep the rock and native soils from clogging.

The following pages identify and describe the maintenance tasks associated with the storm drainage facilities.

This Operation and Maintenance Manual shall be kept on the premises of the home on parcel number 0240000065 and must be made available for inspection by the City of SeaTac.

The operation and maintenance of the storm drainage facilities will be the responsibility of the homeowner.

Long-term maintenance shall be performed as described hereinafter. All conveyance systems shall be inspected for sediment and blockages on an annual basis or after large storm events. Catch basin sumps shall be removed of sediment and debris on an annual basis or if a blockage occurs. The main contributors of sediment to the storm system are total suspended solids (TSS) and detritus from trees. The debris collected shall be placed in the trash, not the roadway catch basins. Long-term maintenance of the storm drainage system shall be completed in accordance with the following checklists.

Instructions for Use of Maintenance Checklists

The following pages contain maintenance needs for most of the components that are part of your drainage system, as well as for some components that you may not have. Ignore requirements that do not apply to your system. You should plan to complete a checklist for all system components on the following schedule:

1. Monthly from November through April.
2. Once in late summer (preferably in September).
3. After any major storm (use 1-inch in 24-hours as a guideline), for items marked "S" only.

Using photocopies of the checklist pages, check off the problems that you looked for each time you conducted an inspection. Add comments on problems found and remedy actions taken. Keep these "checked" sheets in your records. Some items do not need to be looked at every time an inspection is done. Use the suggested frequency at the left of each item as a guideline for your inspection.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds ⅓ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		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 catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.
		Cracks wider than ½ 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.	No cracks more than ¼ inch wide at the joint of inlet/outlet pipe.
	Settlement/misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $\frac{7}{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris.
	Damaged or missing	Grate missing or broken member(s) of the grate. Any open structure requires urgent maintenance.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. Any open structure requires urgent maintenance.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 27 – GRAVEL FILLED DISPERSION TRENCH BMP			
Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Preventative	Blocking, obstructions	Debris or trash limiting flow to dispersion trench or preventing spreader function.	Dispersion trench able to receive full flow prior to and during wet season.
Site	Trash and debris	Trash or debris that could end up in the dispersion trench is evident.	No trash or debris that could get into the dispersion trench can be found.
Pipes	Inlet is plugged	The entrance to the pipe is restricted due to sediment, trash, or debris.	The entrance to the pipe is not restricted.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Plugged	Sediment or other material prevents free flow of water through the pipe.	Water flows freely through pipes.
	Broken joint or joint leaks.	Damage to the pipe or pipe joints allowing water to seep out.	Pipe does not allow water to exit other than at the outlet to the trench.
	Cleanout caps	Cleanout caps are broken, missing, or buried.	Cleanout caps are accessible and intact.
Structure	Flow not reaching trench	Flows are not getting into the trench as designed.	Water enters and exits trench as designed.
	Perforated pipe plugged	Flow not able to enter or properly exit from perforated pipe.	Water freely enters and exits perforated pipe.
	Flow not spreading evenly at outlet of trench	Outlet flows channelizing or not spreading evenly from trench.	Sheet flow occurs at the outlet of the trench.
	Cleanout/inspection access does not allow cleaning or inspection of perforated pipe	The cleanout/inspection access is not available.	Cleanout/inspection access is available.
Filter Media	Filter media plugged	Filter media plugged.	Flow through filter media is normal.
Inspection	Frequency	Annually and prior to and following significant storms.	Inspect dispersion trench system for any defects or deficiencies.

NO. 32 – RAINWATER HARVESTING BMP

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Preventative	Storage volume	No rain water in storage unit at the beginning of the rain season.	Maximum storage available at the beginning of the rain season (Oct. 1 st).
Collection Area	Trash and debris	Trash of debris on collection area may plug filter system	Collection area clear of trash and debris.
Filter	Restricted or plugged	Filter is partially or fully plugged preventing water from getting in to the storage unit.	Filter is allowing collection water into storage unit.
Inspection	Frequency	Annually and after large storms	Rain harvesting equipment is functioning normally.
	Maintenance log	A Maintenance log must be kept and available for review by KC staff.	Maintenance log is kept and is available to KC staff.

NO. 33 – ROCK PAD BMP

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris accumulated on rock pad site.	Rock pad site free of any trash or debris.
Rock Pad Area	Rock pad size	Rock pad is not 2 feet by 3 feet by 6 inches thick or as designed.	Rock pad is 2 feet by 3 feet by 6 inches thick or as designed.
	Vegetation	Vegetation is seen growing in or through rock pad.	No vegetation within rock pad area.
Rock	Exposed soil	Soil can be seen through the rock pad.	Full thickness of the rock pad is in place, no soil visible through rock pad.
Inspection	Frequency	Annually and after large storms	Rock pad is functioning normally.

NO. 34 – SHEET FLOW BMP

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris accumulated on the sheet flow site.	Sheet flow site free of any trash or debris.
Sheet flow area	Erosion	Soil erosion occurring in sheet flow zone.	Soil erosion is not occurring and rills and channels have been repaired.
	Concentrated flow	Sheet flow is not occurring in the sheet flow zone.	Sheet flow area is regraded to provide sheet flow.
Inspection	Frequency	Annually and after large storms	Rain harvesting equipment is functioning normally.

APPENDIX H:
BOND QUANTITIES WORKSHEET