DRAFT Drainage Control Plan Report

for

Heritage Restoration New Hawks Prairie Facility

8675 & 8695 Martin Way E.
Lacey, WA 98513
TPN 11812310402 & 11812310401

City of Lacey Project No. __-____
Olympic Engineering Project No. 22071

May 5, 2023

OLYMPIC ENGINEERING

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COVER SHEET

HERITAGE RESTORATION

Lacey, Washington
May 5, 2023

Owner/Applicant

Prepared for:	Godfrey Rentals 6, LLC
Contact:	Kevin Godfrey 1581 N. National Ave. Chehalis, WA 98532 (360) 345-1015 kevin@firewaterstorm.com

Reviewing Agency

Jurisdiction:	City of Lacey, Washington
Project Number:	__-____
Project Contact:	Sarah Schelling, AICP, Senior Planner (360) 491-5642 sschelli@ci.lacey.wa.us

Contractor

Contact:

References

City of Lacey Stormwater Design Manual (SDM)*, 2022 ed.*

Project Engineer

Prepared by:	Olympic Engineering, Inc. PO Box 12690 Olympia, WA 98508 (360) 705-2474 www.olyeng.com
Contact:	Chris Merritt, PE
Olympic Project:	22071
File Name:	Draft Drainage Report

5/5/2023

"I hereby certify that this DRAFT Drainage Control Plan Report for the **Heritage Restoration** project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Lacey does not and will not assume liability for the sufficiency, suitability, or performance of drainage BMPs prepared by me."

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APPENDICES

SECTION 1 – PROPOSED OVERVIEW

1.1 Site Information

Site Address
8675 & 8695 Martin Way E.
Lacey, WA 98513

Parcel Number
11812310402 & 11812310401

Zoning
MHDC, Mixed Use High Density Corridor

Owner
Godfrey Rentals 6, LLC
Kevin Godfrey
1581 N. National Ave.
Chehalis, WA 98532
(360) 345-1015
kevin@firewaterstorm.com

1.2 Project Description

The proposal is to construct two commercial buildings (office/retail/warehouse) with associated access, driveway, parking lot, utility, and storm drainage improvements.

All proposed site work improvements are anticipated to be constructed in one phase with substantial site work construction completion by Spring/Summer 2024. The completion timeframe of the buildings is currently unknown but is anticipated to be Fall 2024.

1.3 Proposed Stormwater Drainage Design

The existing private community storm drainage system was sized to provide treatment and detention/infiltration of stormwater runoff from full build-out of the subject parcels. However, this existing system was designed under old stormwater standards. In order to help meet treatment and LID standards, only stormwater runoff generated by the proposed roof areas will be conveyed to the existing stormwater system. See Section 3.4 for additional information. Additionally, due to a shallow restrictive soil horizon on the northern parcel, downspout infiltration is not feasible on this parcel as minimum vertical separation requirements cannot be met.

- All new drive aisle and parking lot areas will be constructed of Permeable Pavement (BMP T5.15) with an underlying sand filter for treatment, detention, and infiltration.
- Stormwater runoff from the sidewalks adjacent to permeable pavement will sheet flow onto the permeable pavement surface.
- Stormwater runoff from the sidewalks not adjacent to permeable pavement will be sheet flow dispersed on to adjacent lawn/landscape areas (BMP T5.12).
- Stormwater runoff from the roof areas will be tightlined to the existing community storm drainage system.

See Core Requirements in Section 2.5, along with Section 5, for additional

information regarding these proposed stormwater BMPs.

1.4 Subarea Data Tabulations

North Lot Parcel Area:	21,239 sf (0.488 ac)
South Lot Parcel Area:	28,980 sf (0.665 ac)
Off-Site Area:	2,172 sf (0.050) ac)
Total Project Area:	52,391 sf (1.203 ac)

Existing Surfaces	Surface Type	Area (sf)	Area (ac)
Pavement (Shared)	Impervious	2,284	0.052
Walkway (Off-Site)	Impervious	402	0.009
Forest (On-Site)	Pervious	8,415	0.193
Lawn/Landscape (On-Site)	Pervious	40,722	0.935
Lawn/Landscape (Off-Site)	Pervious	568	0.013
Total		**52,391**	**1.203**

Proposed New/Replaced Surfaces	Surface Type	PGIS?	Area (sf)	Area (ac)
Roof (1)	Impervious	No	11,606	0.266
Drive/Parking (On-Site)	Hard/Perm.	Yes	14,644	0.336
Drive/Parking (Off-Site)	Hard/Perm.	Yes	1,202	0.028
Sidewalk (On-Site) (2)	Impervious	No	938	0.022
Sidewalk (On-Site) (3)	Impervious	No	1,582	0.036
Sidewalk (Off-Site) (4)	Impervious	No	970	0.022
Sidewalk (On-Site) (1)	Impervious	No	333	0.008
Existing Pavement (Shared) (1)	Impervious	Yes	2,284	0.052
Lawn/Landscaping	Pervious	No	18,832	0.432
Total			**52,391**	**1.203**

(1) Contributing to Existing Drainage System
(2) Contributing to Permeable Pavement (BMP T5.13)
(3) Sheet Flow Dispersion (BMP T5.12)
(4) Contributing to Existing Drainage Swale & Off-Site Drainage System along Martin Way

Development (Impervious) Coverage (excludes off-site areas)

North Lot:	8,491 sf (40%)
South Lot:	8,815 sf (28.2%)

Development coverage on each both lot is less than the 75% maximum allowed per lot per zoning.

The total square-footage and acreage shown in the table above may not equal due to rounding.

SECTION 2 – DEVELOPMENT CONDITIONS AND REQUIREMENTS

2.1 Project Vesting

The 2022 SDM is applicable to this project.

2.2 Permits Required

At this time, it is anticipated that the following permits may be required for this project:

- City of Lacey – Right-of-Way Access Permit
- City of Lacey – Grading and Building Permits
- Washington State Department of Ecology – Construction Stormwater General Permit

2.3 Project Type and Size

This project is a new development project that will create more than 5,000 sf of new hard surface area; therefore, Core Requirements #1-9 are applicable.

2.4 Critical Areas

There are no known critical areas (e.g. wetlands, steep slopes, etc.) on-site or within the immediate vicinity of the site.

2.5 Core Requirements

The total proposed "new and/or replaced" hard surface area is greater than 5,000 sf; therefore, this project is required to address Core Requirements (CR) #1-9 per Chapter 2, Section 2.2, of the City of Lacey Stormwater Design Manual (SDM).

These Core Requirements have been addressed as follows:

Core Requirement #1 – Preparation of Stormwater Site Plans

A Drainage Plan has been prepared (see Appendix). After Site Plan approval, a final Drainage Control Plan Report and Plans meeting the requirements of Chapter 3, Section 3.3.3 of the SDM will be prepared and submitted to the city for review and approval.

Core Requirement #2 – Construction Stormwater Pollution Prevention (SWPP)

A Draft SWPP plan has been prepared (see Appendix).

Core Requirement #3 – Source Control of Pollution

A Stormwater Maintenance and Pollution Source Control Manual will be provided with the final Drainage Control Plan Report and will be recorded prior to final project approval. See Section 8 below for additional information on Source Control BMPs.

Core Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

There are no known natural drainage patterns or outfalls located on or adjacent to the parcel. If any are found, they will be maintained and will

remain undisturbed to the maximum extent practical. The existing drainage fronting the project along Martin Way will remain as-is but will be landscaped per city requirements.

Core Requirement #5 – On-Site Stormwater Management

The project is utilizing Best Management Practices (BMPs) from List #2 of the List Approach as follows:

Lawn and Landscape Areas:

- All disturbed and/or new lawn and landscape areas will contain soils meeting the Post-Construction Soil Quality and Depth (BMP T5.13) requirements.

Roof Areas:

- Stormwater runoff from the roof areas will be tightlined to the existing community drainage system.

Other Hard Surface Areas:

- All new drive aisle and parking lot areas will be constructed of Permeable Pavement (BMP T5.15) for treatment, detention, and infiltration.
- Stormwater runoff from the sidewalks adjacent to permeable pavement will sheet flow onto the permeable pavement surface.
- Stormwater runoff from the sidewalks not adjacent to permeable pavement will be sheet flow dispersed on to adjacent lawn/landscape areas (BMP T5.12).
- Stormwater runoff from the new sidewalk extension on the south parcel will sheet flow onto the existing pavement and then conveyed to the existing community stormwater system.
  - Full Dispersion of runoff is not feasible as a 65/10 of forested to impervious surface ratio cannot be met and minimum flow distances cannot be met.
  - Bioretention for sidewalk areas is not practical and is not feasible in most locations due to space constraints and minimum horizontal and vertical setback/separation requirements could not be met.

Stormwater Facility Drawdown Times

Facility	Max. Stage Height (ft)	Infiltration Rate (in/hr)	Drawdown Time (hours)
Permeable Pavement	0.05	1	0.60

Drawdown time = (stage height x 12”/1’) / (infiltration rate)

Modeling Narrative

- Stormwater runoff from the sidewalk areas being dispersed have been modeled as a “lawn” area in WWHM.

- All lawn/landscape areas will meet the Post-Construction Soil Quality and Depth (BMP T5.13) requirements and have been modeled as “pasture” in WWHM.

- The roof areas and the sidewalk area contributing runoff to the existing pavement have been discounted from the model as they will be fully infiltrated in the existing stormwater pond. See Section 3.4 for additional information.

- The permeable pavement was modeled with a 1”/hr design infiltration rate as that’s the lowest rate between the long-term rate recommended by QualityGeo and the assumed rate of a sand filter per Section 8.7.8 of the SDM. Additional evaluation of the exposed infiltration surface sub-grades will be conducted by a geotechnical engineer prior to facility construction to confirm the design rates are acceptable.

Core Requirement #6 – Runoff Treatment

This project will create and/or replace more than 5,000 square-feet of new pollution generating hard surface (PGHS) area; therefore, Runoff Treatment facilities are required per Section 2.2.6 of the SDM.

See Core Requirement #5 above for a description of the proposed stormwater BMPs. Additionally, see Sections 4.3 and 6.1 for additional information regarding soil suitability for infiltration treatment along with enhanced treatment requirements.

Core Requirement #7 – Flow Control

This project will have less than 10,000 square-feet of new “effective” hard surface area; will convert less than ¾-acre of vegetation to lawn/landscape; and will cause less than a 0.15-cfs increase in the 100-year recurrence interval flow frequency; therefore, Flow control is not applicable.

See Core Requirement #5 above for a description of the proposed stormwater BMPs.

Core Requirement #8 – Wetlands Protection

There are no known wetlands on-site or within the immediate vicinity; therefore, this Core Requirement is not applicable.

Core Requirement #9 – Operation and Maintenance

A Stormwater Maintenance and Pollution Source Control Manual will be recorded prior to final project approval. The owner will be responsible for all maintenance of the stormwater infrastructure.

Additional Requirements –Financial Guarantees

Maintenance and/or operational bonding or other financial guarantees will be provided prior to final project approval, if required.

SECTION 3 – SITE AND VICINITY DESCRIPTION

3.1 Existing Physiography

The north parcel is mostly forested with some lawn/landscape along the existing drive aisle and parking stalls. The south parcel contains mostly grass and brush with a few small scattered trees. Overall site topography slopes down from east to west with an overall relief of up to approximately 4'.

There are no creeks, lakes, ponds, springs, etc. on or near the subject parcel.

Per FEMA FIRM Panel #53067C0192E the project is located in Zone X (an area determined to be outside the 0.2% annual chance floodplain).

3.2 Existing Improvements

Both parcels contain portions of the existing drive aisle and parking stalls serving the existing adjacent developments, along with some associated landscaping improvements. The remainder of the parcels is undeveloped.

No known underground or leaking storage tanks are located on-site per a field visit and review of the Washington State Department of Ecology (DOE) UST/LUST map.

There are no known on-site wells or wells within 200-feet of the site per a site visit and DOE well log search.

There are no known on-site or nearby septic systems.

3.3 Drainage Patterns

There is no known off-site drainage affecting the subject parcels. Stormwater runoff from the existing drive aisles crossing the parcels sheet flows to the existing community drainage system. There is no other known runoff from the subject parcel affecting adjacent parcels. There are no known historical drainage problems such as flooding, erosion, etc. on or near the subject parcels.

See Section 4.1 below for the soil conditions.

This project is not located within any known adopted basin plan areas.

The project site is located within the Henderson Inlet and Nisqually River Watersheds.

3.4 Qualitative Analysis

Over 97% of the stormwater runoff generated by the new improvements will be collected, stored, and fully infiltrated on-site and/or within the existing community stormwater system. 970 sf off off-site sidewalk area along Martin Way will discharge into an existing downstream conveyance (only a 568 sf increase in surface area over what is currently discharging to this system).

The existing private community stormwater pond was designed using a 20"/hr infiltration rate (per the O. Bee Credit Union Drainage and Erosion Control Report prepared by Barghausen Consulting Engineers, dated 10/2/2008) and this design rate has recently been confirmed by QualityGeo (see Section 4.3 and the Soils Report in Appendix). This pond was sized to accommodate approximately 44,006 sf

of contributing impervious surface area from the subject parcels; however, only 11,606 sf of roof area, plus 333 sf of sidewalk area, is proposed to be directed to this pond. At the initial full build-out assumptions, the existing pond has approximately 2.7' of freeboard per the O. Bee Credit Union As-Builts prepared by Barghausen Consulting Engineers, dated 5/18/2009. The project surveyor surveyed the existing stormwater pond and the as-built volume is slightly greater than the design volume used in the Barghausen drainage report.

The proposed permeable pavement section has 1.78-feet of freeboard (see Section 2.5). Any emergency overflow from the permeable pavement would sheet flow and/or be conveyed into the existing community stormwater conveyance system and discharged into the existing community stormwater pond.

3.5 Quantitative Analysis

Based on the information in Section 3.4 above, a Quantitative Analysis is not warranted.

SECTION 4 – SOIL AND INFILTRATION ANALYSIS

4.1 Summary of Soils and Geotechnical Data

The Natural Resource Conservation Service (NRCS) classifies 80% of the on-site soils as Everett Very Gravelly Sandy Loam (HSG A) and 20% as Spanaway Gravelly Sandy Loam (HSG A). A Geotechnical Investigation report has been prepared by QualityGeo NW) (see Appendix). Five test pits were evaluated to depths of up to 10' below-grade and the soils generally consisted of a 4" to 27" depth of topsoil overlying sand with silt (GP-GM) or gravel with sand (GP).

A restrictive horizon (inferred as till) was encountered at depths of approximately 5.5' to 7.5' below-grade in the northern portion of the project area. It appears this restrictive horizon slopes down from north to south fairly quickly as it was not encountered in the other test pits to the south at depths of up to 10' below-grade nor was it encountered within the existing community stormwater pond at a depth of approximately 18' below-grade.

Any infiltration facilities in the northern portion of the site would not meet minimum separation requirements to the restrictive layer.

4.2 Subsurface Factors

Groundwater, nor any indications of groundwater, were encountered in any test pits and the stormwater pond was dry during an Olympic Engineering staff site visit in December 2022.

4.3 Infiltration Rates

Per the Geotechnical Investigation report, the initial Ksat at a depth of 2.5' was 50.33 in/hr and at a depth of 5' it was 21.3 in/hr. The bottom of the existing community stormwater pond had an initial Ksat of over 200 in/hr. The long-term rates were calculated to 5 in/hr, 5.33 in/hr, and over 20 in/hr, respectively. QualityGeo recommended a design long-term rate of 5 in/hr in the northern portion of the site and 5.3 in/hr in the southern portion of the site.

Per the Geotechnical Investigation Report, the soils beneath the topsoil have a Cation Exchange Capacity (CEC) of 4.2 to 5.6 meq/100g and an organic content of

1.1%-1.6%, both of which meet minimum infiltration treatment requirements.

SECTION 5 – ON-SITE STORMWATER MANAGEMENT AND LOW IMPACT DEVELOPMENT (CORE REQUIREMENT #5)

5.1 LID Site Design

The effective impervious surface area has been minimized to the maximum extent practical by utilizing permeable pavement (BMP T5.13) and fully infiltrating roof runoff. See Section 2.5 for additional information.

5.2 Methodology

See Sections 2.5, 5.1, and 5.5 for additional information. Over 97% of the stormwater runoff from the proposed improvements will be fully infiltrated.

5.3 LID Practices

Permeable pavement (BMP T5.13) is proposed for all new drive aisle and parking lot areas. Stormwater runoff from the roof areas will be fully infiltrated in the existing community stormwater pond. See Sections 2.5, 5.4, and 5.5 for additional information.

5.4 Post-Construction Soil Quality and Depth

See Section 2.5. All disturbed and proposed lawn/landscape areas will meet the Post-Construction Soil Quality and Depth requirements. It is anticipated that the bulk of this requirement will be met by stripping, stockpiling, and reusing existing topsoil. The soils will be amended as needed and any additional soil/compost needed to meet this requirement will be imported from approved off-site sources.

5.5 Retained Trees and Aesthetics

To provide for a reasonable development area, no existing trees can be retained. The City of Lacey has initially indicated that the project can pay a fee in-lieu-of providing a tree tract.

The proposed stormwater facility (permeable pavement) cannot be landscaped. A landscape and irrigation plan will be prepared meeting City of Lacey requirements.

SECTION 6 – RUNOFF TREATMENT AND FLOW CONTROL (CORE REQUIRMENTS #6 AND #7

6.1 Runoff Treatment Selections

Step 1: There are no receiving waters.
Step 2: Oil control is not applicable as this is not a high-use site.
Step 3: The native subgrade soil is not fully conducive for pollutant control due to the in-situ infiltration rate of the native soils exceeding 9 in/hr. However, the subgrade soils do meet the requirements for organic content and CEC. Based on a discussion with Doug Christensen at the City of Lacey, proposing a 6” sand filter beneath the permeable pavement section would satisfy the pollutant removal requirements.
Step 4: Phosphorus control is not applicable as there will be no discharges to fresh water bodies or wetlands.
Step 5: Enhanced treatment is required since this the project is located within a Category I critical aquifer recharge area. Per Table 8.2 in Section 8.3.4 of

the SDM, a sand filter provides Enhanced Treatment.

Per Section 8.3.4 of the SDM, the proposed Permeable Pavement (BMP T5.13) with a 6" sand filter will meet the Enhanced Treatment requirements and 100% of the runoff will be treated.

6.2 BMP Types & Descriptions

See Section 2.5 for the proposed stormwater BMPs.

6.3 Facility Selection and Design Data

See Section 2.5 for the proposed stormwater BMPs, Section 6.1 for the treatment selection, and Section 6.4 for the Design Data. All treatment and flow control BMPs were sized using WWHM.

6.4 Design Calculations

Over 97% of the stormwater runoff generated by this project will be fully infiltrated and 100% of the runoff from pollution generating hard surface areas will be treated. See Section 4.3 for the design infiltration rates uses. See WWHM report in the Appendix.

SECTION 7 – RUNOFF COLLECTION & CONVEYANCE SYSTEM

7.1 System Design & Layout

Stormwater runoff from the proposed roof areas will be tightlined through 6"-12" diam. pipes to the existing community stormwater pond. Any emergency overflow from the permeable pavement area west of Building 2 will be collected in a catch basin and tightlined with an 8" diam. pipe to the existing conveyance system and existing stormwater pond.

7.2 Conveyance System Calculations Summary

Conveyance systems are designed to convey the 25-year 24-hour storm event, at a minimum. Detailed calculations will be provided with the final Drainage Control Plan Report, if required.

SECTION 8 – SOURCE CONTROL

8.1 Potential Sources of Pollution

Based on the proposed commercial use, it is expected that the most common sources of pollution will be from fertilizers and pesticides associated with mostly lawn and landscaping maintenance. Other sources may come from vehicles leaking oils, greases, and suspended solids in the drive aisle and parking lot areas.

8.2 Source Control BMPs

Based on the proposed commercial use, it is anticipated that the following Source Control BMPs are applicable to this project:

S410 Correcting Illicit Discharges to Storm Drains
S411 Landscaping and Lawn/Vegetation Management
S417 Maintenance of Stormwater Drainage and Treatment Systems
S421 Parking and Storage of Vehicles and Equipment

S424 Roof / Building Drains at Manufacturing and Commercial Buildings
S435 Pesticides and an Integrated Pest Management Program
S442 Labeling Storm Drain Inlets On Your Property
S443 Fertilizer Application
S450 Irrigation
S453 Formation of a Pollution Prevention Team
S454 Preventive Maintenance / Good Housekeeping
S455 Spill Prevention and Cleanup
S456 Employee Training
S457 Inspections
S458 Record Keeping

8.3 Source Control Checklist and Worksheet

A Source Control Checklist and Source Control Worksheets will be provided with the final Drainage Control Plan Report.

SECTION 9 – COVENANTS, DEDICATIONS, EASEMENTS, AGREEMENTS, AND GUARANTEES

9.1 Covenants, Dedications, and Easements

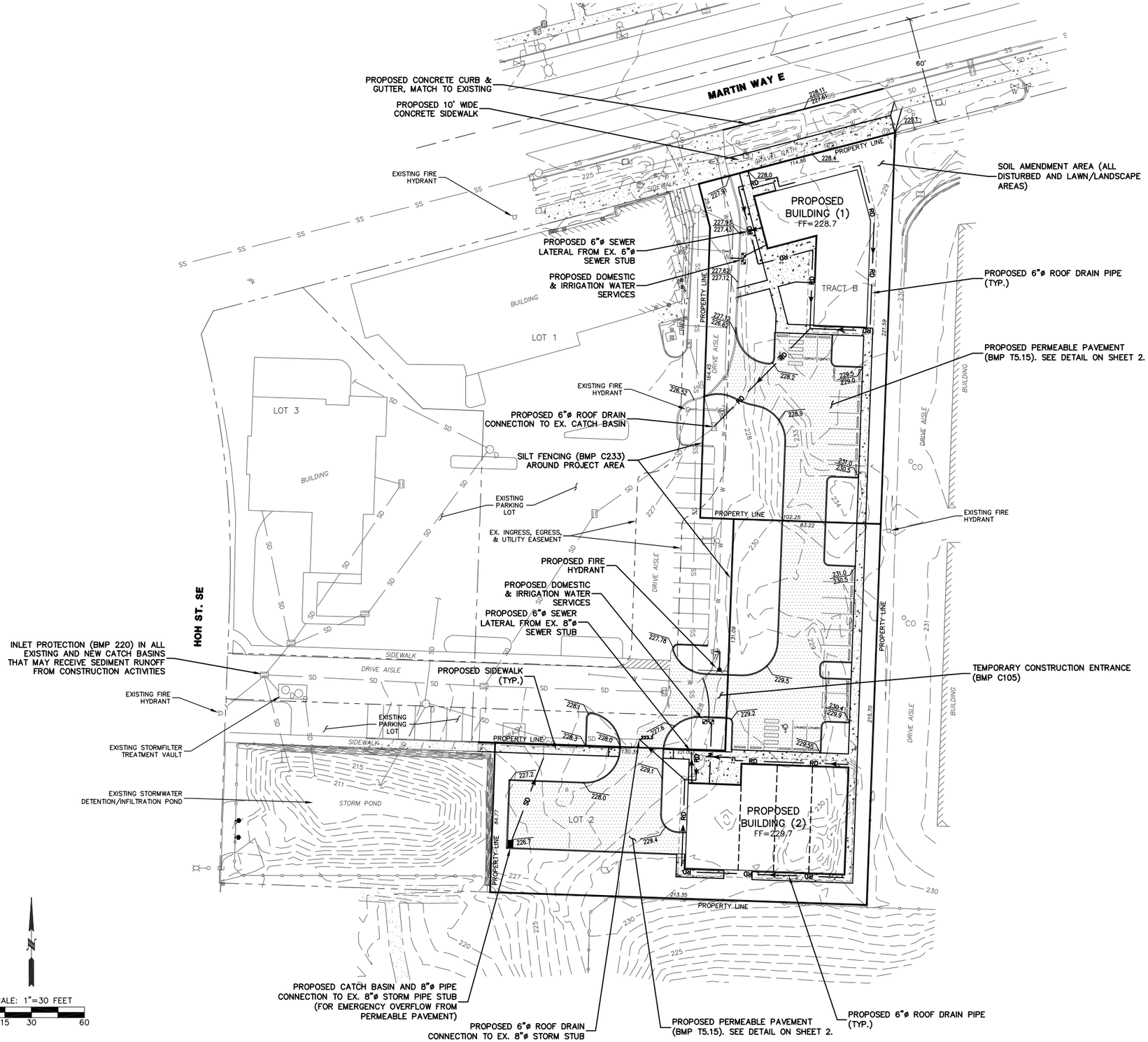
No covenants, dedications, or easements are proposed or required for the stormwater facilities.

9.2 Agreements and Guarantees

The owner will be responsible for maintenance of the on-site storm drainage systems and shared maintenance of the off-site systems. A Maintenance and Source Control Manual will be recorded prior to final project approval.

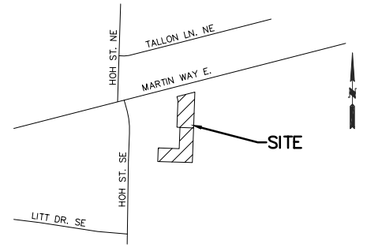
Maintenance and/or operational bonding or other financial guarantees will be provided prior to final project approval, if required.

Appendix 1
Drainage Plans



VICINITY MAP

N.T.S.



PROJECT INFORMATION

OWNER/APPLICANT:	GODFREY RENTALS 6, LLC 1581 N. NATIONAL AVE. CHEHALIS, WA 98532
PARCEL NO:	11812310402 & 11812310401
SITE ADDRESS:	8675 & 8695 MARTIN WAY E. LACEY, WA 98513
ZONING:	MHDC
PARCEL AREA:	21,239 SF, 0.488 AC (TRACT B) 28,980 SF, 0.665 AC (LOT 2)
WATER/SEWER:	CITY OF LACEY
TELECOMMUNICATIONS:	COMCAST & LUMEN
POWER/GAS:	PUGET SOUND ENERGY
FIRE DISTRICT:	LACEY
REFUSE/RECYCLING:	PACIFIC DISPOSAL
SOIL TYPE:	EVERETT VERY GRAVELLY SANDY LOAM (HSG A) & SPANAWAY GRAVELLY SANDY LOAM (HSG A) PER NRCS
FEMA FIRM DESIGNATION:	ZONE X (PANEL #53067C0192E), OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN
GRADING:	±5,400 CY CUT/FILL (FOR APPLICATION PURPOSES ONLY)

HARD SURFACE COVERAGES:

NORTH LOT:		
	ROOF:	5,029 SF
	DRIVES/PARKING:	4,816 SF (PERMEABLE)
	DRIVE (SHARED):	1,905 SF
	SIDEWALK:	1,277 SF
	TOTAL:	13,027 SF
SOUTH LOT:		
	ROOF:	6,577 SF
	DRIVES/PARKING:	9,828 SF (PERMEABLE)
	SIDEWALK:	1,608 SF
	TOTAL:	18,013 SF

SURVEY NOTE

THE BOUNDARY AND TOPOGRAPHIC SURVEY INFORMATION DEPICTED HEREON WAS PROVIDED BY MTN 2 COAST PROFESSIONAL LAND SURVEYORS AND OBTAINED FROM CITY RECORDS. THIS SURVEY INFORMATION WAS NOT FIELD VERIFIED BY OLYMPIC ENGINEERING AND OLYMPIC ENGINEERING ASSUMES NO LIABILITY IN THE ACCURACY OF THIS INFORMATION OR FOR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO THESE DRAWINGS AS A RESULT.

SITE PLAN

SEE SITE PLAN PREPARED BY MEYARCHITECTURE FOR ADDITIONAL INFORMATION.

LEGEND

EXISTING	PROPOSED	
SS	SS	SANITARY SEWER
W	W	WATER
SD		STORM
RD	RD	ROOF DRAIN

NO.	DATE	REVISION

HERITAGE RESTORATION
NEW HAWKS PRAIRIE FACILITY

CITY OF LACEY, WASHINGTON

PRELIMINARY
EROSION CONTROL, DRAINAGE, AND GRADING PLAN

DESIGNED BY:	CMM	DRAWN BY:	CMM	CHECKED BY:	
SCALE:	1" = 30'	DATE:	4/21/2023		

4/21/2023
CHRISTOPHER M. MERRITT
STATE OF WASHINGTON
27401
REGISTERED PROFESSIONAL ENGINEER

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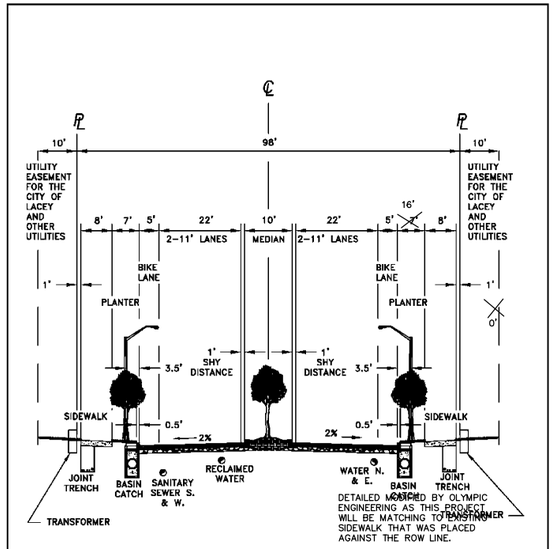
Civil Engineering • Land Planning • Project Management

JOB NUMBER: 22071
DRAWING NAME: 22071_DRPL

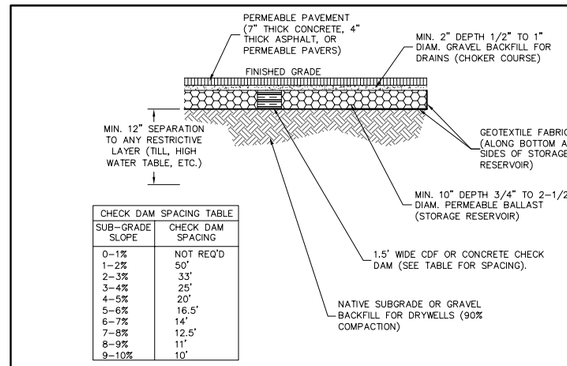


GENERAL NOTES:

1. ON-STREET PARKING PROHIBITED.
2. SEE DETAIL 4-6.1 FOR PAVEMENT STRUCTURE.
3. MANHOLE LIDS AND WATER VALVE BOXES SHALL BE LOCATED IN THE IN THE MIDDLE OF THE OUTSIDE VEHICLE TRAVEL LANES.
4. STREET TREES IN MEDIAN SHALL BE CENTERED. STREET TREES IN PLANTERS SHALL BE 2.5' FROM EDGE OF SIDEWALK TO CENTERLINE OF TREE.
5. APPLY RECLAIMED WATER WHERE APPLICABLE.
6. SEE PIPING SEPARATION DETAIL FOR PIPE VERTICAL AND HORIZONTAL SEPARATION.

DG4-2.2.DWG

CITY OF LACEY, WASHINGTON DEPT. OF PUBLIC WORKS			
STREET DESIGN ARTERIAL			
APPROVED Roger A Schaum CITY ENGINEER			DWG. NO. 4-2.2
DES. MAH	DWN. WHO	CKD. PDM	DATE 12/15/2014



CHECK DAM SPACING TABLE	
SUB-GRADE SLOPE	CHECK DAM SPACING
0-1%	NOT REQ'D
1-2%	50'
2-3%	33'
3-4%	25'
4-5%	20'
5-6%	16.5'
6-7%	14'
7-8%	12.5'
8-9%	11'
9-10%	10'

NOTES:

1. ALL THICKNESSES ARE COMPACTED DEPTHS (90%).
2. MAXIMUM PAVING SLOPES SHALL BE 5% FOR PERMEABLE ASPHALT, 6% FOR PERMEABLE CONCRETE, 10% FOR INTERLOCKING PAVERS, AND 6% FOR GRID/LATTICE SYSTEMS.
3. EXCAVATE TO GRADE WITH LIGHT EQUIPMENT WITH RUBBER TIRES. MINIMIZE DISTURBANCE OF THE SUBGRADE SOILS TO THE EXTENT PRACTICAL.
4. WASHED AGGREGATES SHALL MEET THE WSDOT SPECIFICATIONS FOR GRAVEL BACKFILL FOR DRAINS 9-03.12(4) AND PERMEABLE BALLAST 9-03.9(2).
5. GEOTEXTILE FABRIC SHALL BE MIRAFI 160N OR EQUAL.
6. PROVIDE CONTROLLED DENSITY FILL (CDF) OR CONCRETE CHECK DAMS PERPENDICULAR TO THE PAVEMENT SLOPE TO PREVENT WATER FROM FLOWING LATERALLY WITHIN THE STORAGE RESERVOIR SECTION.
7. ANY FILL NEEDED TO BRING THE PERMEABLE PAVEMENT SECTION UP TO GRADE SHALL CONSIST OF "PERMEABLE BALLAST PER WSDOT 9-03.9(2)".

PERMEABLE PAVEMENT (BMP T5.15) SECTION

N.T.S.

TEMPORARY CONSTRUCTION BMP'S

THE FOLLOWING BEST MANAGEMENT PRACTICES (BMP'S) ARE PROPOSED DURING THE CONSTRUCTION PHASE OF THE PROJECT TO PREVENT SEDIMENTATION, EROSION, AND RELEASE OF POLLUTANTS TO WATERS OF WASHINGTON STATE, ADJACENT PROPERTIES, AND DRAINAGE FACILITIES:

- C101 PRESERVING NATURAL VEGETATION
- C105 STABILIZED CONSTRUCTION ENTRANCE/EXIT
- C121 MULCHING
- C123 PLASTIC COVERING
- C125 TOPSOILING/COMPOSTING
- C140 DUST CONTROL
- C150 MATERIALS ON HAND
- C151 CONCRETE HANDLING
- C152 SAWCUTTING AND SURFACING POLLUTION PREVENTION
- C154 CONCRETE WASHOUT AREA
- C160 CERTIFIED EROSION AND SEDIMENT CONTROL LEAD
- C233 SILT FENCING

PERMANENT STORMWATER BMP'S

THE FOLLOWING PERMANENT STORMWATER BEST MANAGEMENT PRACTICES (BMP'S) ARE PROPOSED:

- T5.13 POST-CONSTRUCTION SOIL QUALITY AND DEPTH (LAWN/LANDSCAPE AND DISTURBED AREAS)
- T5.15 PERMEABLE PAVING (DRIVE/PARKING AREA)

NO. | DATE | REVISION

HERITAGE RESTORATION
NEW HAWKS PRAIRIE FACILITY

CITY OF LACEY, WASHINGTON

DETAILS AND NOTES

DESIGNED BY: CMM
DRAWN BY: CMM
CHECKED BY:
SCALE: N.T.S.
DATE: 4/21/2023

4/21/2023
CHRISTOPHER M. ANDERSON
STATE OF WASHINGTON
37401
REGISTERED
PROFESSIONAL ENGINEER

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OLYMPIC ENGINEERING
Civil Engineering • Land Planning • Project Management

JOB NUMBER: 22071
DRAWING NAME: 22071_DETL

Appendix 2
Drainage Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	22071_050523
Site Name:	Heritage Restoration
Site Address:	8675 Martin Way E
City:	Lacey
Report Date:	5/5/2023
Gage:	Fairgrounds (Kaiser)
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Flat	1.142
Pervious Total	1.142

Impervious Land Use	acre
SIDEWALKS FLAT	0.009
PARKING FLAT	0.052
Impervious Total	0.061
Basin Total	1.203

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Permeable Pavement

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
SIDEWALKS FLAT	0.022
PARKING FLAT	0.364
Impervious Total	0.386
Basin Total	0.386

Element Flows To:

Surface	Interflow	Groundwater
Permeable Pavement	Permeable Pavement	

Basin 2

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.036
A B, Pasture, Flat	0.432
Pervious Total	0.468

Impervious Land Use	acre
SIDEWALKS FLAT	0.022
PARKING FLAT	0.052
Impervious Total	0.074
Basin Total	0.542

Dispersed sidewalk area

Excludes infiltrated roof and sidewalk areas, see drainage report

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Routing

Permeable Pavement

Bottom Length:	125.80 ft.
Bottom Width:	125.90 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	1.5
Pour Space of material for first layer:	0.4
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	78.084
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	78.084
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	1.333 ft.
Riser Diameter:	6 in.
Element Flows To:	
Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

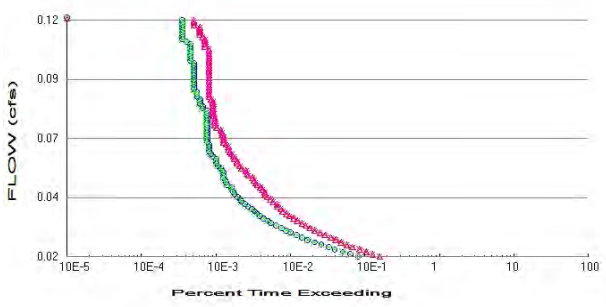
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.363	0.000	0.000	0.000
0.0204	0.363	0.003	0.000	0.366
0.0407	0.363	0.005	0.000	0.366
0.0611	0.363	0.008	0.000	0.366
0.0815	0.363	0.011	0.000	0.366
0.1018	0.363	0.014	0.000	0.366
0.1222	0.363	0.017	0.000	0.366
0.1426	0.363	0.020	0.000	0.366
0.1629	0.363	0.023	0.000	0.366
0.1833	0.363	0.026	0.000	0.366
0.2037	0.363	0.029	0.000	0.366
0.2240	0.363	0.032	0.000	0.366
0.2444	0.363	0.035	0.000	0.366
0.2648	0.363	0.038	0.000	0.366
0.2851	0.363	0.041	0.000	0.366
0.3055	0.363	0.044	0.000	0.366
0.3259	0.363	0.047	0.000	0.366
0.3462	0.363	0.050	0.000	0.366
0.3666	0.363	0.053	0.000	0.366
0.3870	0.363	0.056	0.000	0.366
0.4073	0.363	0.059	0.000	0.366
0.4277	0.363	0.062	0.000	0.366
0.4481	0.363	0.065	0.000	0.366
0.4684	0.363	0.068	0.000	0.366

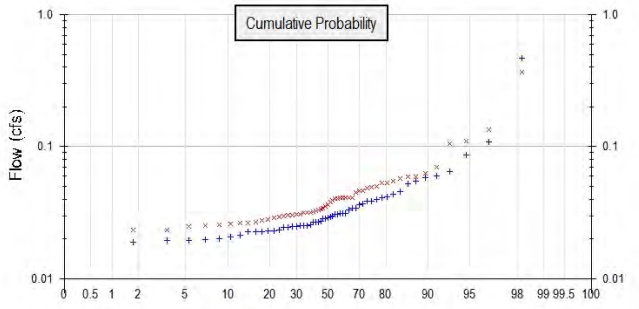
0.4888	0.363	0.071	0.000	0.366
0.5092	0.363	0.074	0.000	0.366
0.5295	0.363	0.077	0.000	0.366
0.5499	0.363	0.080	0.000	0.366
0.5703	0.363	0.082	0.000	0.366
0.5906	0.363	0.085	0.000	0.366
0.6110	0.363	0.088	0.000	0.366
0.6314	0.363	0.091	0.000	0.366
0.6517	0.363	0.094	0.000	0.366
0.6721	0.363	0.097	0.000	0.366
0.6925	0.363	0.100	0.000	0.366
0.7128	0.363	0.103	0.000	0.366
0.7332	0.363	0.106	0.000	0.366
0.7536	0.363	0.109	0.000	0.366
0.7739	0.363	0.112	0.000	0.366
0.7943	0.363	0.115	0.000	0.366
0.8147	0.363	0.118	0.000	0.366
0.8350	0.363	0.121	0.000	0.366
0.8554	0.363	0.124	0.000	0.366
0.8758	0.363	0.127	0.000	0.366
0.8961	0.363	0.130	0.000	0.366
0.9165	0.363	0.133	0.000	0.366
0.9369	0.363	0.136	0.000	0.366
0.9572	0.363	0.139	0.000	0.366
0.9776	0.363	0.142	0.000	0.366
0.9980	0.363	0.145	0.000	0.366
1.0183	0.363	0.148	0.000	0.366
1.0387	0.363	0.151	0.000	0.366
1.0591	0.363	0.154	0.000	0.366
1.0794	0.363	0.157	0.000	0.366
1.0998	0.363	0.160	0.000	0.366
1.1202	0.363	0.162	0.000	0.366
1.1405	0.363	0.165	0.000	0.366
1.1609	0.363	0.168	0.000	0.366
1.1813	0.363	0.171	0.000	0.366
1.2016	0.363	0.174	0.000	0.366
1.2220	0.363	0.177	0.000	0.366
1.2424	0.363	0.180	0.000	0.366
1.2627	0.363	0.183	0.000	0.366
1.2831	0.363	0.186	0.000	0.366
1.3035	0.363	0.189	0.000	0.366
1.3238	0.363	0.192	0.000	0.366
1.3442	0.363	0.195	0.006	0.366
1.3646	0.363	0.198	0.029	0.366
1.3849	0.363	0.201	0.062	0.366
1.4053	0.363	0.204	0.101	0.366
1.4257	0.363	0.207	0.144	0.366
1.4460	0.363	0.210	0.189	0.366
1.4664	0.363	0.213	0.233	0.366
1.4868	0.363	0.216	0.274	0.366
1.5071	0.363	0.223	0.310	0.366
1.5275	0.363	0.231	0.339	0.366
1.5479	0.363	0.238	0.362	0.366
1.5682	0.363	0.245	0.379	0.366
1.5886	0.363	0.253	0.398	0.366
1.6090	0.363	0.260	0.413	0.366
1.6293	0.363	0.268	0.428	0.366
1.6497	0.363	0.275	0.443	0.366

1.6701	0.363	0.282	0.457	0.366
1.6904	0.363	0.290	0.470	0.366
1.7108	0.363	0.297	0.484	0.366
1.7312	0.363	0.305	0.496	0.366
1.7515	0.363	0.312	0.509	0.366
1.7719	0.363	0.319	0.521	0.366
1.7923	0.363	0.327	0.533	0.366
1.8126	0.363	0.334	0.545	0.366
1.8330	0.363	0.342	0.556	0.366

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.142
Total Impervious Area: 0.061

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.468
Total Impervious Area: 0.46

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.030372
5 year	0.049027
10 year	0.065669
25 year	0.092711
50 year	0.118034
100 year	0.148561

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.037724
5 year	0.058968
10 year	0.077451
25 year	0.106843
50 year	0.13384
100 year	0.165875

Less than 0.15 cfs

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.031	0.041
1957	0.037	0.059
1958	0.023	0.032
1959	0.029	0.035
1960	0.031	0.040
1961	0.021	0.025
1962	0.023	0.027
1963	0.087	0.111
1964	0.029	0.034
1965	0.030	0.045

1966	0.019	0.024
1967	0.023	0.028
1968	0.020	0.026
1969	0.020	0.025
1970	0.019	0.026
1971	0.034	0.037
1972	0.039	0.046
1973	0.025	0.030
1974	0.033	0.041
1975	0.026	0.032
1976	0.025	0.032
1977	0.040	0.049
1978	0.041	0.050
1979	0.034	0.041
1980	0.037	0.049
1981	0.044	0.053
1982	0.055	0.055
1983	0.052	0.063
1984	0.027	0.032
1985	0.023	0.028
1986	0.028	0.041
1987	0.031	0.038
1988	0.019	0.023
1989	0.020	0.023
1990	0.030	0.039
1991	0.109	0.135
1992	0.467	0.365
1993	0.060	0.053
1994	0.058	0.070
1995	0.039	0.046
1996	0.031	0.041
1997	0.064	0.106
1998	0.045	0.059
1999	0.027	0.033
2000	0.025	0.031
2001	0.021	0.026
2002	0.024	0.029
2003	0.024	0.030
2004	0.031	0.041
2005	0.025	0.031
2006	0.027	0.034
2007	0.025	0.030
2008	0.023	0.027
2009	0.027	0.033
2010	0.042	0.058
2011	0.024	0.029

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.4671	0.3653
2	0.1093	0.1354
3	0.0871	0.1107
4	0.0645	0.1063
5	0.0601	0.0704
6	0.0582	0.0633
7	0.0546	0.0589
8	0.0522	0.0587

9	0.0454	0.0575
10	0.0438	0.0549
11	0.0418	0.0534
12	0.0413	0.0530
13	0.0400	0.0501
14	0.0389	0.0495
15	0.0386	0.0485
16	0.0368	0.0463
17	0.0366	0.0462
18	0.0341	0.0447
19	0.0340	0.0414
20	0.0334	0.0413
21	0.0314	0.0411
22	0.0314	0.0411
23	0.0313	0.0408
24	0.0308	0.0406
25	0.0306	0.0402
26	0.0298	0.0390
27	0.0295	0.0381
28	0.0288	0.0366
29	0.0287	0.0351
30	0.0283	0.0341
31	0.0274	0.0337
32	0.0270	0.0330
33	0.0269	0.0329
34	0.0268	0.0324
35	0.0256	0.0319
36	0.0252	0.0318
37	0.0251	0.0317
38	0.0251	0.0306
39	0.0250	0.0306
40	0.0247	0.0304
41	0.0243	0.0303
42	0.0243	0.0299
43	0.0235	0.0295
44	0.0232	0.0290
45	0.0230	0.0281
46	0.0228	0.0276
47	0.0226	0.0269
48	0.0226	0.0265
49	0.0213	0.0262
50	0.0208	0.0259
51	0.0201	0.0256
52	0.0198	0.0254
53	0.0196	0.0248
54	0.0194	0.0235
55	0.0189	0.0234
56	0.0187	0.0227

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0152	1603	3124	194	Fail
0.0162	1248	2509	201	Fail
0.0173	991	2042	206	Fail
0.0183	772	1664	215	Fail
0.0193	640	1342	209	Fail
0.0204	511	1126	220	Fail
0.0214	413	942	228	Fail
0.0225	335	796	237	Fail
0.0235	280	692	247	Fail
0.0245	239	571	238	Fail
0.0256	197	491	249	Fail
0.0266	173	417	241	Fail
0.0277	149	360	241	Fail
0.0287	126	314	249	Fail
0.0297	107	282	263	Fail
0.0308	98	244	248	Fail
0.0318	86	218	253	Fail
0.0328	77	192	249	Fail
0.0339	70	175	250	Fail
0.0349	65	155	238	Fail
0.0360	60	146	243	Fail
0.0370	53	133	250	Fail
0.0380	48	130	270	Fail
0.0391	43	115	267	Fail
0.0401	42	106	252	Fail
0.0412	39	96	246	Fail
0.0422	35	90	257	Fail
0.0432	34	89	261	Fail
0.0443	32	83	259	Fail
0.0453	32	78	243	Fail
0.0464	28	71	253	Fail
0.0474	27	67	248	Fail
0.0484	26	64	246	Fail
0.0495	25	61	244	Fail
0.0505	25	54	216	Fail
0.0515	25	52	208	Fail
0.0526	24	50	208	Fail
0.0536	23	43	186	Fail
0.0547	21	41	195	Fail
0.0557	20	38	190	Fail
0.0567	20	38	190	Fail
0.0578	20	35	175	Fail
0.0588	18	34	188	Fail
0.0599	17	32	188	Fail
0.0609	16	30	187	Fail
0.0619	16	29	181	Fail
0.0630	16	29	181	Fail
0.0640	16	27	168	Fail
0.0651	15	25	166	Fail
0.0661	15	25	166	Fail
0.0671	15	25	166	Fail
0.0682	15	24	160	Fail
0.0692	15	24	160	Fail
0.0702	15	23	153	Fail

Not applicable

0.0713	15	20	133	Fail
0.0723	15	19	126	Fail
0.0734	15	19	126	Fail
0.0744	15	19	126	Fail
0.0754	15	19	126	Fail
0.0765	15	18	120	Fail
0.0775	15	18	120	Fail
0.0786	15	18	120	Fail
0.0796	13	18	138	Fail
0.0806	13	18	138	Fail
0.0817	12	18	150	Fail
0.0827	12	18	150	Fail
0.0838	12	17	141	Fail
0.0848	11	16	145	Fail
0.0858	11	16	145	Fail
0.0869	11	16	145	Fail
0.0879	10	16	160	Fail
0.0889	10	16	160	Fail
0.0900	10	16	160	Fail
0.0910	10	16	160	Fail
0.0921	10	16	160	Fail
0.0931	10	16	160	Fail
0.0941	10	16	160	Fail
0.0952	10	16	160	Fail
0.0962	10	16	160	Fail
0.0973	10	16	160	Fail
0.0983	10	16	160	Fail
0.0993	10	16	160	Fail
0.1004	9	16	177	Fail
0.1014	9	16	177	Fail
0.1025	9	16	177	Fail
0.1035	9	16	177	Fail
0.1045	9	16	177	Fail
0.1056	9	16	177	Fail
0.1066	9	14	155	Fail
0.1076	9	14	155	Fail
0.1087	8	14	175	Fail
0.1097	7	14	200	Fail
0.1108	7	13	185	Fail
0.1118	7	12	171	Fail
0.1128	7	12	171	Fail
0.1139	7	12	171	Fail
0.1149	7	12	171	Fail
0.1160	7	10	142	Fail
0.1170	7	10	142	Fail
0.1180	7	10	142	Fail

Not applicable

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

Not applicable

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Permeable Pavement POC	☑	71.06	78.08	78.08	☑	100.00	78.08	100.00	Treat. Credit
Total Volume Infiltrated		71.06	78.08	78.08		100.00	78.08	78 / 78 = 100%	Treat. Credit = 100%
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

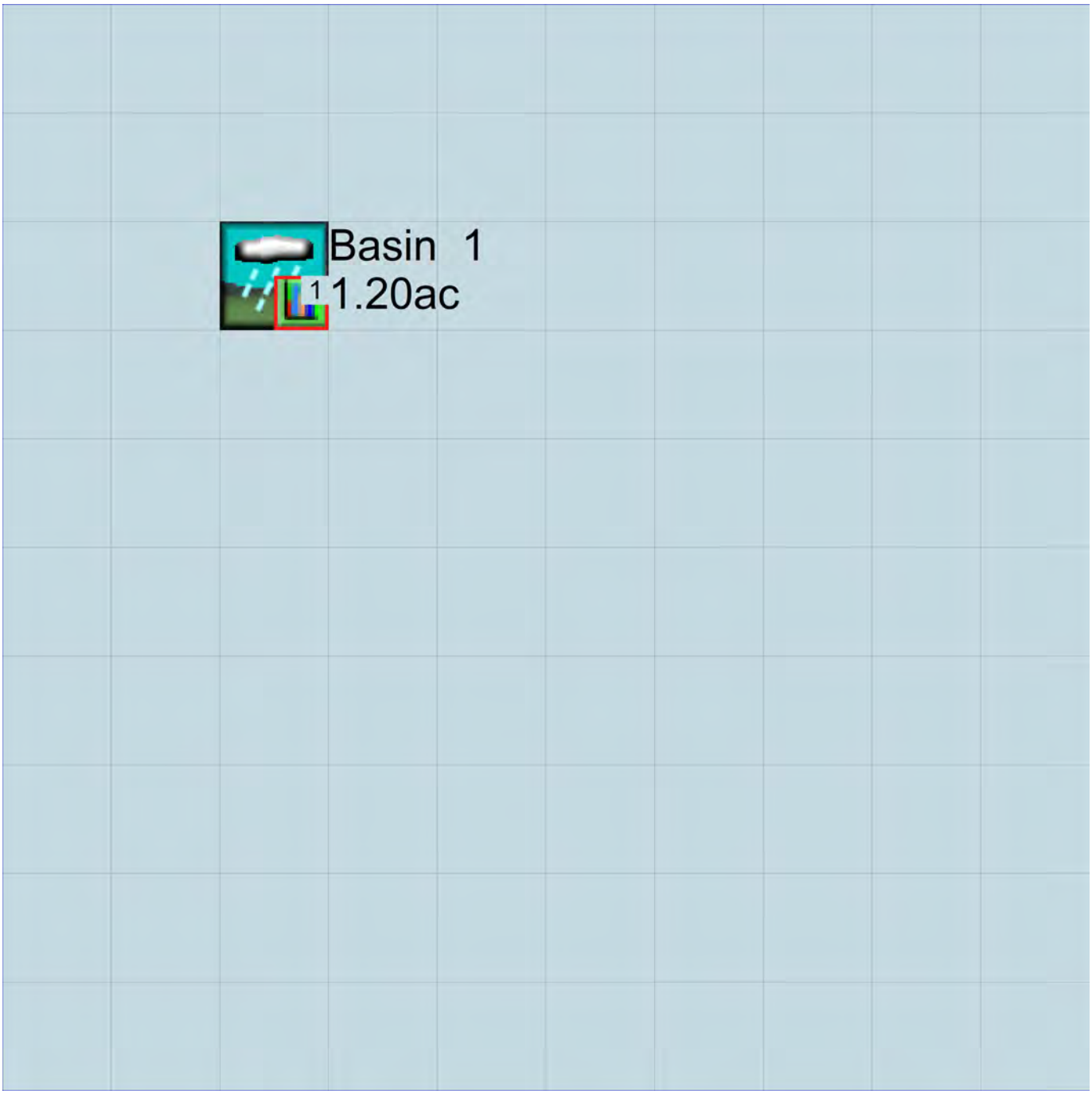
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Appendix 3
Soils Reports

SOILS REPORT

HERITAGE RESTORATION
8695 MARTIN WAY EAST
LACEY, WA

Heritage Restoration, Inc
Attn: Kevin K Godfrey

Prepared by:

Audrey White
Staff Geologist

Approved by:

1/27/2023

LUKE PRESTON MCCANN

Luke Preston McCann, L.E.G.
Principal Licensed Engineering Geologist

Quality Geo NW, PLLC
Geotechnical Investigation & Engineering Consultation
Phone: 360-878-9750 | Web: qualitygeonw.com
Mail: 4631 Whitman Ln SE, Ste D, Lacey, WA 98513

01/27/2023

QG Project # QG22-229

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the findings and recommendations of Quality Geo NW's (QG) soil investigation conducted in support of new site surface improvements.

1.1 PROJECT DESCRIPTION

QG understands the project entails new commercial development within two currently undeveloped parcels. QG has been contracted to perform a soils investigation of the proposed site to provide stormwater and earthwork recommendations.

1.2 FIELD WORK

Site exploration activities were performed on 12/16/2022. Exploration locations were marked in the field by a QG Staff Geologist with respect to the provided map and cleared for public conductible utilities. Our exploration locations were selected by an QG Staff Geologist prior to field work to provide safest access to relevant soil conditions. The geologist directed the advancement of 5 excavated test pits (TP). The test pits were advanced within the vicinity of the anticipated development footprint areas, to maximum depths of 10.0 feet below present grade (BPG) in general accordance with the specified contract depth.

During explorations QG logged each soil horizon we encountered, and field classified them in accordance with the Unified Soil Classification System (USCS). Representative soil samples were collected from each unit, identified according to boring location and depth, placed in plastic bags to protect against moisture loss, and were transported to the soil laboratory for supplemental classification and other tests.

QG advanced 1 Wildcat Dynamic Cone Penetrometer (DCP) test at a representative location within the vicinity of a proposed structure location and as slope conditions permitted. The penetrometer test was terminated upon reaching the equipment's maximum practical extent. During penetrometer advancement, blow counts were recorded in 10-centimeter increments as a thirty-five-pound weight was dropped a distance of 15 inches. Blow counts were then converted to resistance (kg/cm^2), standard penetration blow counts (N-values), and corresponding soil consistency, with complete results shown on the attached logs.

An aerial site plan with relevant features is presented in Appendix B.

2.0 EXISTING SITE CONDITIONS

2.1 AREA GEOLOGY

QG reviewed available map publications to assess known geologic conditions and hazards present at the site location. The Washington Geologic Information Portal (WGIP), maintained by the Department of Natural Resources Division of Geology and Earth Resources, provides 1:24,000-scale geologic mapping of the region. Geology of the site location and vicinity consists of continental glacial drift (Qgo). The sediment deposits on site are described as "Recessional and proglacial stratified, moderately to well-rounded, poorly to moderately sorted outwash sand and gravel."

The WGIP Map also offers layers of mapped geohazard conditions within the state. According to the regional-scale interactive map, no known geohazards are mapped for the site. Furthermore, the site is listed as very low for liquefaction susceptibility.

The United States Department of Agriculture portal (USDA) provides a soil mapping of the region. The soils making up the majority of the site are mapped as Everett very gravelly sandy loam (33 and 34). Everett very gravelly sandy loam is formed from sandy and gravelly glacial outwash in the form of moraines, eskers, and kames. These soils are described as slightly decomposed plant material from 0 to 1 inch, very gravelly sandy loam from 1 to 24 inches, very gravelly loamy sand from 24 to 35 inches, and extremely cobbly coarse sand from 35 to 60+ inches. Depth to restrictive features is more than 80 inches. Capacity of the most limiting layer to transmit water (Ksat) is high (1.98 to 5.95 inches/hour). Depth to the water table is more than 80 inches.

Soils in the southwest and northeast corners of the site are mapped as Spanaway gravelly sandy loam (110). Spanaway gravelly sandy loam is formed from volcanic ash deposited over gravelly outwash in the form of terraces and outwash plains. These soils are describes as gravelly sandy loam from 0 to 15 inches, very gravelly loam from 15 to 20 inches, and extremely gravelly sand from 20 to 60 inches. Depth to restrictive feature is more than 80 inches. Capacity of the most limiting layer to transmit water (Ksat) is high (1.98 to 5.95 inches/hour). Depth to the water table is more than 80 inches.

2.2 SITE & SURFACE CONDITIONS

The project area is relatively flat, near the same elevation as the adjacent road and parking lot. The site is currently undeveloped and is vegetated with mostly grasses and shrubs in the southern portion, and trees in the northern portion. The western-most parcel contains a large, fenced-in infiltration pond surrounded by trees.

2.3 SOIL LOG

Site soil conditions varied across the 5 test pits. Representative lab samples were taken from TP-3 and TP-5 (Infiltration), which was located within the infiltration pond in the southwest corner of the site. Soil conditions from TP-3 are described below:

- **0’ to 2’ – Topsoil:**

  An overriding 2-foot layer of topsoil was present over the site. Topsoil was brown, loosely packed, and moist, with a heavy organic content, no mottling, and no cobbles.

- **2’ to 7.5’ – Poorly Graded Gravel with Sand (GP)**

  Beneath topsoil was approximately a 5.5-foot layer of grey, moist soil with a minor organic content and cobbles measuring up to 8 inches in length. The soil was medium dense and is interpreted to be a slightly weathered glacial till. Test pits 2, 3, and 4 exhibited this layer.

- **7.5’– Inferred to be Glacial Till**
  Below the grey gravel layer is a layer of grey, hard-packed material inferred to be glacial till. This layer was encountered in test pits 2 and 3.

2.4 SURFACE WATER AND GROUNDWATER CONDITIONS

No active surface water features are present on site. The Billy Frank Jr. Nisqually National Wildlife Refuge, which is a wetland, is located 1.5 miles to the northeast of the site, the Medicine Creek Resevoir is approximately 1.21. mils to the east, and Longs Lake is located 2.2 miles to the southwest. During our test pit explorations, no groundwater was encountered, and there was no water present in the infiltration pond in the southwest corner of the site. No groundwater table has been documented in the vicinity of the site, based on well logs made publicly available by the WA Department of Ecology.

QG’s scope of work did not include determination or monitoring of seasonal groundwater elevation variations, formal documentation of wet season site conditions, or conclusive measurement of groundwater elevations at depths past the extent feasible for explorations at the time of the field explorations.

3.0 GEOTECHNICAL RECOMMENDATIONS

3.1 SHALLOW FOUNDATION RECOMMENDATIONS

- **Subgrade Preparation**

  QG recommends excavating and clearing any loose or organic cover soils, including the thin overriding layer of topsoil where necessary, from areas of proposed pavement construction, down to firm bearing conditions and benching the final bottom of subgrade elevation flat. Excavations should be performed with a smooth blade bucket to limit disturbance of subgrade soils. Vibratory compaction methods are suitable for densification of the non-organic native soils.

  After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade should be evaluated under the periodic guidance of a QG representative. Any areas that are identified as being soft or yielding during subgrade evaluation should be brought to the attention of the geotechnical engineer. Where over excavation is performed below a structure, the over excavation area should extend beyond the outside of the footing a distance equal to the depth of the over excavation below the footing. The over excavated areas should be backfilled with properly compacted structural fill.

  The proposed buildings may utilize either stepped or continuous footings with slab-on-grade elements. For continuous footing elements, upon reaching bearing, we recommend benching foundation lines flat. Continuous perimeter and strip foundations may be stepped as needed to accommodate variations in final subgrade level. We also recommend maximum steps of 18 inches with spacing of at least 5 feet be constructed unless specified otherwise by the design engineer. Structural fill may then be placed as needed to reestablish final foundation grade.

- **Allowable Bearing Capacity:**

  Up to 1,500 pounds per square foot (psf) for foundations placed on compacted native soil or on approved structural fill soils placed in accordance with the recommendations of *Section 4.2*. Bearing capacities, at or below 1,500 psf may eliminate the need for additional inspection requirements if approved by the county. The allowable bearing capacity may be increased by 1/3 for transient loading due to wind and seismic events.

- **Minimum Footing Depth:**

  For a shallow perimeter and spread footing system, all exterior footings shall be embedded a minimum of 18 inches and all interior footings shall be embedded a minimum of 12 inches below the lowest adjacent finished grade, but not less than the depth required by design. However, all footings must also penetrate to the prescribed bearing stratum cited above.

Minimum depths are referenced per IBC requirements for frost protection; other design concerns may dictate greater values be applied.

- **Minimum Footing Width:**

  Footings should be proportioned to meet the stated bearing capacity and/or the IBC 2018 (or current) minimum requirements. For a shallow perimeter and spread footing system, continuous strip footings should be a minimum of 16 inches wide and interior or isolated column footings should be a minimum of 24 inches wide.

- **Estimated Settlements:**

  All concrete settles after placement. We estimate that the maximum settlements will be on the order of 0.5 inch, or less, with a differential settlement of ½ inch, or less, over 50 linear feet. Settlement is anticipated to occur soon after the load is applied during construction.

  The following recommendations pertain to the design and construction of laterally loaded bulkhead retaining wall structures. These recommendations are not applicable to: exceedingly sloping backfills, backfills composed of non-granular soil materials, braced or tied-back walls, or basement retaining wall foundations.

- **Active and At-Rest Pressures:**

  Yielding grade beams should be designed to withstand an appropriate active lateral earth pressure, whereas non-yielding (restrained) grade beams should be designed to withstand an appropriate at-rest lateral earth pressure. The at-rest case is applicable where grade beams movement is confined to less than 0.005 H, where H is the wall height. If greater movement is possible, the active case applies. A movement of about 0.02 H will be required to develop the full passive pressure. These pressures act over the entire grade beam and can vary with the backslope inclination. For lateral pressures relative to seismic loading conditions, we recommend applying a uniform blanket seismic surcharge of 10 H psf for a generalized design situation based on our limited subsurface testing at the project site.

For lateral support of structures, the following soil parameters should be considered regarding any structural fill against these features (ignoring the upper 18 inches, due to freeze/thaw softening, unless covered in concrete or asphalt).

Table 1. Lateral Earth Pressures for Seismic Site Class D-Default

Soil Type	Active Pressure (PSF*H)	At-Rest Pressure (PSF*H)	Seismic Surcharge (PSF*H)	Passive Lateral Equivalent Fluid Weight (PCF)	Grade Beam Coefficient of Friction
Existing Soils	40	60	10	220	0.38
New Structural Fill	35	55	10	200	0.38

- **Excavations:**

  The duration of time that excavations behind grade beams remain open should be limited to only as necessary to prepare the base pad and placement of the wall features, backfilling with drain rock and approved fill immediately. Temporary worker protections such as trench boxes or temporary shoring may be required for entering excavations deeper than 4 feet, and all OSHA safety regulations should be observed. Extended open cut periods or work proceeding in wet weather may require surface coverings, lesser cut angles, and/or temporary bracing be applied. We suggest a minimum 5-foot horizontal buffer be maintained from the temporary cut to the upslope property lines (to allow for some near-surface disturbance during excavation).

3.1.1 BUILDING SLAB ON GRADE FLOOR

QG anticipates that slab-on-grade floors are planned for the interior of the proposed building. Based on typical construction practices, we assume finished slab grade will be similar to or marginally above present grade for the below recommendations. If floor grades are planned to be substantially raised or lowered from existing grade, QG should be contacted to provide revised or alternative recommendations.

- **Capillary Break:**

  A capillary break will be helpful to maintain a dry slab floor and reduce the potential for floor damage resulting from shallow perched water inundation. To provide a capillary moisture break, a 6-inch thick, properly compacted granular mat consisting of open-graded, free-draining angular aggregate is recommended below floor slabs. To provide additional slab structural support, or to substitute for a structural fill base pad where specified, QG recommends the capillary break should consist of crushed rock all passing the 1-inch sieve and no more than 3 percent (by weight) passing the U.S. No. #4 sieve, compacted in accordance with *Section 5.2.2* of this report.

- **Vapor Barrier:**

  A vapor retarding membrane such as 10 mil polyethylene film should be placed beneath all floor slabs to prevent transmission of moisture where floor coverings may be affected. Care

should be taken during construction not to puncture or damage the membrane. To protect the membrane, a layer of sand no more than 2 inches thick may be placed over the membrane if desired. If excessive relict organic fill material is discovered at any location, additional sealant or more industrial gas barriers may be required to prevent off-gassing of decaying material from infiltrating the new structure. These measures shall be determined by the structural engineer to meet local code requirements as necessary.

- **Structural Design Considerations:**

  QG assumes design and specifications of slabs will be assessed by the project design engineer. We suggest a minimum unreinforced concrete structural section of 4.0 inches be considered to help protect against cracking and localized settlement, especially where larger equipment or localized loads are anticipated. It is generally recommended that any floor slabs and annular exterior concrete paving subject to vehicular loading be designed to incorporate reinforcing. Additionally, some level of reinforcing, such as a wire mesh may be desirable to prolong slab life due to the overwhelming presence of such poor underlying soils. It should be noted that QG does not express any guarantee or warranty for proposed slab sections.

3.2 INFILTRATION RATE DETERMINATION

QG understands design of on-site stormwater controls are pending the results of this study to confirm design parameters and interpreted depths to perched seasonal groundwater and restrictive soil features.

3.2.1 GRADATION ANALYSIS METHODS & RESULTS

During test pit excavations for general site investigation, QG additionally collected representative samples of native soil deposits among potential infiltration strata and depths. Representative soil samples were selected from the southwest and east portions of the site (TP-1, TP-3 and TP-5) to characterize the local infiltration conditions.

We understand the project will be subject to infiltration design based on the Washington Department of Ecology Stormwater Management Manual for Western Washington (DoE SMMWW). For initial site infiltration characterization within the scope of this study, laboratory gradation analyses were completed including sieve and hydrometer tests for stormwater design characterization and rate determination to supplement field observations. Results of laboratory testing in terms of rate calculation are summarized below.

Laboratory results were interpreted to recommended design inputs in accordance with methods of the 2019 DoE SMMWW. Gradation results were applied to the Massmann (2003) equation (1) to calculate Ksat representing the initial saturated hydraulic conductivity.

(1) log10(Ksat) = -1.57 + 1.90*D10 + 0.015*D60 - 0.013*D90 - 2.08*ff

Corrected Ksat values presented below are a product of the initial Ksat and correction factor CFT. For a generalized site-wide design situation, we have applied a site variability factor of CFv = 0.7 along with typical values of CFt = 0.4 (for the Grain Size Method) and CFm = 0.9 (assuming standard influent control).

(2) CFT = CFv x CFt x CFm = 0.7 x 0.4 x 0.9 = 0.25

Results were cross-referenced with test pit logs to determine the validity and suitability of unique materials as an infiltration receptor. Additional reduction factors were applied for practical rate determination based on our professional judgement.

Table 2. Results Of Massmann Analysis

TP #	Sample Depth *(BPG)*	Unit Extent *(ft)*	Soil Type	D10	D60	D90	Fines (%)	Ksat *(in/hr)*	Corrected Ksat *(in/hr)*	LT Design Infiltration Rate*(in/hr)*	Cation Exchange Capacity (meq/100g)	Organic Content %
3	2.5	2 to 7.5’	GP	0.165	01.13	12.16	2.5	50.33	12.58	**5.0**	5.6	1.6
1	5.0	2 to 10’	GP-GM	0.060	9.81	21.16	11.5	21.3	5.33	**5.33**	NA	NA
5	16	16 to 17.5’	SP	3.642	12.24	23.26	0	200+	50	**20**	4.2	1.1

In-ground infiltration structures are required to maintain a minimum 5-feet separation from restrictive soil & perched water features. Available well logs did not indicate the potential for shallow ground water. The required separation **does not** appear achievable in the northern portions of the site (TP-2, TP-3) due to the impermeable nature of the hardpan layer. Beneath topsoil, the upper brown, grey soils were observed to generally exhibit minimal fines content and no oxidation patterns. **QG recommends any infiltration within proximity to TP-2 & TP-3 utilize shallow infiltration structures, such as bio swales, rain gardens, pervious pavements, etc. For shallow infiltration features utilizing treatment media, we recommend a maximum design rate of up to 5.0 inches/hour be considered**, which is typically suitable for most shallow infiltration features, and considers light compaction of the soil during construction. The above rate includes any areas that are being considered for pervious/permeable asphalt/concrete. These rates are considered applicable to all areas of the subject site at the specified depths.

In the southern portion of the site at TP-1 and TP-4, QG did not encounter an impermeable layer within 10-feet of depth. Because of this, the required separation **does** appear to be achievable in these portions of the site. Beneath topsoil, GP and GP-GM soils were observed to generally exhibit minimal oxidation patterns and moderate fines content. **QG recommends any infiltration within**

proximity to TP-1 & TP-4 utilize in-ground infiltration galleries, we recommend a maximum design rate of up to 5.3 inches/hour be considered.

Alternatively, facility designer could divert all stormwater from site to retention pond adjacent to the site with owner's permission.

At this time, QG does not recommend mounding analysis due to the generally suitable site conditions.

QG recommends the facility designer review these results and stated assumptions per reference literature to ensure applicability with the proposed development, level of anticipated controls, and long- term maintenance plan. The designer may make reasonable adjustments to correction factors and the resulting design values based on these criteria to ensure design and operational intent is met. We recommend that we be contacted if substantial changes to rate determination are considered.

3.2.2 TREATMENT POTENTIAL

Depending on stormwater and runoff sources, some stormwater features, such as rain gardens or pervious pavements may require treatment. Stormwater facilities utilizing native soils as treatment media typically require Cation Exchange Capacities (CEC) of greater than 5 milliequivalents per 100grams (meq/100g) and organic contents greater than 1% (this may vary depending on local code). The soils directly beneath the topsoil **did** meet the minimum treatment standards.

3.2.3 DRAINAGE RECOMMENDATIONS

QG recommends proper drainage controls for stormwater runoff during and after site development to protect the site. The ground surface adjacent to structures should be sloped to drain away at a 5% minimum to prevent ponding of water adjacent to them.

QG recommends all stormwater catchments (new or existing) be tightlined (piped) away from structures to an existing catch basin, stormwater system, established channel, or approved outfall to be released using appropriate energy-dissipating features at the outfall to minimize point erosion. Roof and footing drains should be tightlined separately or should be gathered in an appropriately sized catch basin structure and redistributed collectively. If storm drains are incorporated for impervious flatworks (driveways, sidewalks, etc.) collected waters should also be discharged according to the above recommendations.

3.3 IMPERVIOUS PAVEMENT CONSIDERATIONS

QG anticipates most pavements will be constructed of flexible Hot Mix Asphalt surfacing, with thickened sections for anticipated heavy load areas. The main entrance/exit drive will likely

experience different traffic volumes than the far end of the pavement areas. As a result, consideration could be given to increasing the pavement section in the main entrance/exit drive.

The following table summarizes the proposed new minimum pavement sections.

Table 3. Summary of Minimum Flexible Pavement Sections

Scenario	Pavement	CSTC	Gravel Base	Geogrid*
Heavy Pavement Section	4 inches	2 inches	10 inches	No
Car Access and Parking	3 inches	2 inches	8 inches	No

*Tensar Technology – TriAx TX160 geogrid placed directly above subgrade per the manufacturer's specifications, or an approved alternative.

Existing soils at the new bottom subgrade level should be graded level with minimal disturbance, in an effort to prevent degradation. Smooth bladed equipment should be used for final grading. For any saturated, organic rich, or deteriorated soils encountered, unsuitable soils shall be removed and replaced with approved compacted imported structural fill. This will provide an even surface for paving application that will also serve as additional support to the flexible pavement sections that can increase design life and reduce repair regularity in the long term.

Pavement sections presented in the above table should not be used for areas which experience repeated truck traffic/parking, equipment or truck parking areas, entrances and exit aprons, or contain trash dumpster loading zones. In these areas, a Portland Cement Concrete (PCC) pavement should be used, as opposed to HMA.

One of the important considerations in designing a high quality and durable pavement is providing adequate drainage. Design of drainage for the proposed pavement section is outside of QG 's scope of work at this time. It is important that bird baths (leeching basins) and surface waves are not created during construction of the HMA layer. A proper slope should also be allowed, and drainage should be provided along the edges of pavements and around catch basins to prevent accumulation of free water within the base course, which otherwise may result in subgrade softening and pavement deterioration under exposure and repeated traffic conditions.

All pavements require regular maintenance and repair in order to maintain the serviceability of the pavement. These repairs and maintenance are due to normal wear and tear of the pavement surface and are required in order to extend the serviceability life of the pavement. However, after 10 years of service, a normal pavement structure is likely to deteriorate to a point where pavement rehabilitation may be required to maintain the serviceability. The deterioration is more likely if the pavement is constructed over poor subgrade soils or in area of higher traffic volumes.

Rigid pavement components are commonly utilized for portions of accesses and ancillary exterior improvements. The project civil designer may re-evaluate the below general recommendations for pavement thicknesses and base sections, if necessary, to ensure proper application to a given structure and use. QG recommends that we be contacted for further consultation if the below sections are proposed to be reduced.

Concrete driveway aprons and curb alignments, if utilized, should consist of a minimum 6-inch thickness of unreinforced concrete pavement over structural base fill. Base thickness should correspond to related location and anticipated traffic loading. For light traffic areas, a 6-inch minimum base thickness (total 12-inch section) can be applied. For heavy traffic zones, we recommend allotting a 12- inch minimum base section beneath the pavement, or the incorporation of reinforcing steel in the concrete.

Concrete sidewalks, walkways and patios if present may consist of a minimum 4-inch section of plain concrete (unreinforced) installed over a 6-inch minimum compacted base of crushed rock. At locations where grade has been raised with structural fill, a 4-inch minimum crushed rock section may be used. Flatworks should employ frequent joint controls to limit cracking potential.

3.4 PERVIOUS/PERMEABLE PAVEMENT CONSIDERATIONS

Site soil conditions appear generally amenable for pervious pavement surfaces, if necessary, to meet local stormwater code. Based on our infiltration and laboratory analysis, both rigid and flexible pervious pavement sections appear feasible.

The following recommendations are not given to serve as an engineering design, but are given to assure that minimum adequate drainage is maintained for site features in relation to the present soil types, and do not reflect assumed ESALs, anticipated traffic loads, or rutting. These should be considered by the project civil site designer prior to finalizing their engineering design, as well as considering the local municipal code requirements, or material manufacturer/supplier specifications. Alternatives may be utilized at the civil engineer's discretion.

Table 4: Preliminary Pervious Pavement Considerations

Scenario	Pavement Type	Pavement Thickness (in)	Choker Course (in)	Drainage Course (in)	Non-woven Fabric? (Y/N)
Car Access/Parking (Flexible)	Pervious Asphalt	4.0	2.0	10.0	Yes
Truck Access/Parking (rigid)	Pervious Concrete	7.0	2.0	12.0	Yes

Organic topsoils shall be removed from proposed pavement areas, exposing the grey sandy gravel below. Construction traffic over subgrades intended for pervious pavements should be limited as

much as possible to prevent over-compaction and degradation of infiltration characteristics within these areas. Prior to placement of pavement sections, native subgrade should be adequately compacted to prevent settlement, but not so excessively that infiltration becomes infeasible.

Pervious pavement sections should consist of an unreinforced layer of pervious asphaltic concrete (PAC) for car access, or pervious cementitious concrete (PCC) for heavy truck access, overlaying a leveling course of crushed permable ballast over a basal drainage course separated from in place native subgrade soils by a non-woven geotextile fabric. The drainage and leveling courses shall be gently compacted to allow for the maximum settlement of grains within the section. Excessive compaction of the pavement during placement should be avoided.

Geotextile fabric shall meet section 9-33.2(1), tables 1 and 2: Geotextile for Underground Drainage, from the WSDOT Standard Specifications. Aggregate within the leveling course shall be crushed, angular, relatively clean, and conform to the most recent WSDOT standard specification for Permeable Ballast (WSDOT section 9-03.9(2)), or an approved free draining alternative. The aggregate within the underlying drainage course shall conform to WSDOT Standard Specification *9-03.12(5) - Gravel Backfill for Drywells, or specification 9-03.12(4) Gravel Backfill for Drains* (or an approved alternative). Alternatively, the entire drainage course and leveling course may jointly be composed of WSDOT Permeable Ballast. Pervious pavement materials shall conform to those specified by the project civil designer and the supplying manufacturer and yield a minimum infiltration rate of 100 inches-per-hour when tested at any location per the procedures outlined in *ASTM C 1701-09, Infiltration Rate of In-Place Pervious Concrete*.

We recommend that the placement of material be monitored by a representative of QG to ensure proper placement and thickness.

4.0 CONSTRUCTION RECOMMENDATIONS

4.1 EARTHWORK

4.1.1 GRADING & EXCAVATION

A grading plan was not available to QG at the time of this report. However, based on provided conceptual plans, this study assumes finished site grade will approximate current grade. Therefore, depths referred to in this report are considered roughly equivalent to final depths. Excavations can generally be performed with conventional earthmoving equipment such as bulldozers, scrapers, and excavators.

4.1.2 SUBGRADE EVALUATION & PREPARATION

After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade should be evaluated under the part-time observation and guidance of an QG representative.

The special inspection firm should continuously evaluate all backfilling. Any areas that are identified as being soft or yielding during subgrade evaluation should be over excavated to a firm and unyielding condition or to the depth determined by the geotechnical engineer. Where over excavation is performed below a structure, the over excavation area should extend beyond the outside of the footing a distance equal to the depth of the over excavation below the footing. The over excavated areas should be backfilled with properly compacted structural fill.

4.1.3 SITE PREPARATION, EROSION CONTROLL, WET WEATHER

Any silty or organic rich native soils may be moisture-sensitive and become soft and difficult to traverse with construction equipment when wet. During wet weather, the contractor should take measures to protect any exposed soil subgrades, limit construction traffic during earthwork activities, and limit machine use only to areas undergoing active preparation.

Once the geotechnical engineer has approved subgrade, further measures should be implemented to prevent degradation or disturbance of the subgrade. These measures could include, but are not limited to, placing a layer of crushed rock or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tarp and keeping construction traffic off the subgrade. Once subgrade has been approved, any disturbance because the subgrade was not protected should be repaired by the contractor at no cost to the owner.

During wet weather, earthen berms or other methods should be used to prevent runoff from draining into excavations. All runoffs should be collected and disposed of properly. Measures may

also be required to reduce the moisture content of on-site soils in the event of wet weather. These measures can include, but are not limited to, air drying and soil amendment, etc.

QG recommends earthwork activities take place during the summer dry season.

4.2 STRUCTURAL FILL MATERIALS AND COMPACTION

4.2.1 MATERIALS

All material placed below structures or pavement areas should be considered structural fill. Excavated native soils may be considered suitable for reuse as structural fill on a case-by-case basis. Imported material can also be used as structural fill. Care should be taken by the earthwork contractor during grading to avoid contaminating stockpiled soils that are planned for reuse as structural fill with native organic materials. Frozen soil is not suitable for use as structural fill. Fill material may not be placed on frozen soil.

Structural fill material shall be free of deleterious materials, have a maximum particle size of 4 inches, and be compactable to the required compaction level. Imported structural fill material should conform to the WSDOT manual Section 9-03.14(1) Gravel Borrow, or an approved alternative import material. Controlled-density fill (CDF) or lean mix concrete can be used as an alternative to structural fill materials, except in areas where free-draining materials are required or specified.

Imported materials utilized for trench back fill shall conform to Section 9-03.19, Trench Backfill, of the most recent edition (at the time of construction) of the State of Washington Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications)*. Imported materials utilize as grade fill beneath roads shall conform to WSDOT Section 9-03.10, Gravel Base.

Pipe bedding material should conform to the manufacturer's recommendations and be worked around the pipe to provide uniform support. Cobbles exposed in the bottom of utility excavations should be covered with pipe bedding or removed to avoid inducing concentrated stresses on the pipe.

Soils with fines content near or greater than 10% fines content may likely be moisture sensitive and become difficult to use during wet weather. Care should be taken by the earthwork contractor during grading to avoid contaminating stockpiled soils that are planned for reuse as structural fill with native organic materials.

The contractor should submit samples of each of the required earthwork materials to the materials testing lab for evaluation and approval prior to delivery to the site. The samples should be

submitted **at least 5 days prior to their delivery** and sufficiently in advance of the work to allow the contractor to identify alternative sources if the material proves unsatisfactory.

4.2.2 FILL PLACEMENT AND COMPACTION

For lateral and bearing support, structural fill placement below footings shall extend at minimum a distance past each edge of the base of the footing equal to the depth of structural fill placed below the footing [i.e. extending at least a 1H:1V past both the interior and the exterior of the concrete footing].

Prior to placement and compaction, structural fill should be moisture conditioned to within 3 percent of its optimum moisture content. Loose lifts of structural fill shall not exceed 12 inches in thickness. All structural fill shall be compacted to a firm and unyielding condition and to a minimum percent compaction based on its modified Proctor maximum dry density as determined per ASTM D1557. Structural fill placed beneath each of the following shall be compacted to the indicated percent compaction:

- Foundation and Floor Slab Subgrades: 95 Percent
- Pavement Subgrades & wall backfill (upper 2 feet): 95 Percent
- Pavement Subgrades & wall backfill (below 2 feet): 90 Percent
- Utility Trenches (upper 4 feet): 95 Percent
- Utility Trenches (below 4 feet): 90 Percent

A sufficient number of tests should be performed to verify compaction of each lift. The number of tests required will vary depending on the fill material, its moisture condition and the equipment being used. Initially, more frequent tests will be required while the contractor establishes the means and methods required to achieve proper compaction.

Jetting or flooding is not a substitute for mechanical compaction and should not be allowed.

4.3 TEMPORARY EXCAVATIONS AND TRENCHES

All excavations and trenches must comply with applicable local, state, and federal safety regulations. Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing soil type information solely as a service to our client for planning purposes. Under no circumstances should the information be interpreted to mean that QG is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred. The contractor shall be responsible for the safety of personnel working in utility trenches. Given that steep excavations in native soils may be prone to caving, we recommend all utility trenches, but particularly those greater than 4 feet in depth, be supported in

accordance with state and federal safety regulations. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed near the top of any excavation.

Temporary excavations and trenches should be protected from the elements by covering with plastic sheeting or some other similar impermeable material. Sheeting sections should overlap by at least 12 inches and be tightly secured with sandbags, tires, staking, or other means to prevent wind from exposing the soils under the sheeting.

5.0 SPECIAL INSPECTION

The recommendations made in this report assume that an adequate program of tests and observations will be made throughout construction to verify compliance with these recommendations. Testing and observations performed during construction should include, but not necessarily be limited to, the following:

- Geotechnical plan review and engineering consultation as needed prior to construction phase,
- Observations and testing during site preparation, earthwork, structural fill, and pavement section placement,
- Consultation on temporary excavation cutslopes and shoring if needed,
- Consultation as necessary during construction.

QG recommends that a local and reputable materials testing & inspection firm be retained for construction phase testing and observation in accordance with the local code requirements. We also strongly recommend that QG be retained as the project Geotechnical Engineering Firm of Record (GER) during the construction of this project to perform periodic supplementary geotechnical observations and review the special inspectors reports during construction.

Our knowledge of the project site and the design recommendations contained herein will be of great benefit in the event that difficulties arise and either modifications or additional geotechnical engineering recommendations are required or desired. We can also, in a timely fashion observe the actual soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

We would be pleased to meet with you at your convenience to discuss the *Time & Materials* scope and cost for these services.

6.0 LIMITATIONS

Upon acceptance and use of this report, and its interpretations and recommendations, the user shall agree to indemnify and hold harmless QG, including its owners, employees and subcontractors, from any adverse effects resulting from development and occupation of the subject site. Ultimately, it is the owner's choice to develop and live in such an area of possible geohazards (which exist in perpetuity across the earth in one form or another), and therefore the future consequences, both anticipated and unknown, are solely the responsibility of the owner. By using this report for development of the subject property, the owner must accept and understand that it is not possible to fully anticipate all inherent risks of development. The recommendations provided above are intended to reduce (but may not eliminate) such risks.

This report does not represent a construction specification or engineered plan and shall not be used or referenced as such. The information included in this report should be considered supplemental to the requirements contained in the project plans & specifications and should be read in conjunction with the above referenced information. The selected recommendations presented in this report are intended to inform only the specific corresponding subjects. All other requirements of the above-mentioned items remain valid, unless otherwise specified.

Recommendations contained in this report are based on our understanding of the proposed development and construction activities, field observations and explorations, and laboratory test results. It is possible that soil and groundwater conditions could vary and differ between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, or if the scope of the proposed construction changes from that described in this report, QG should be notified immediately in order to review and provide supplemental recommendations.

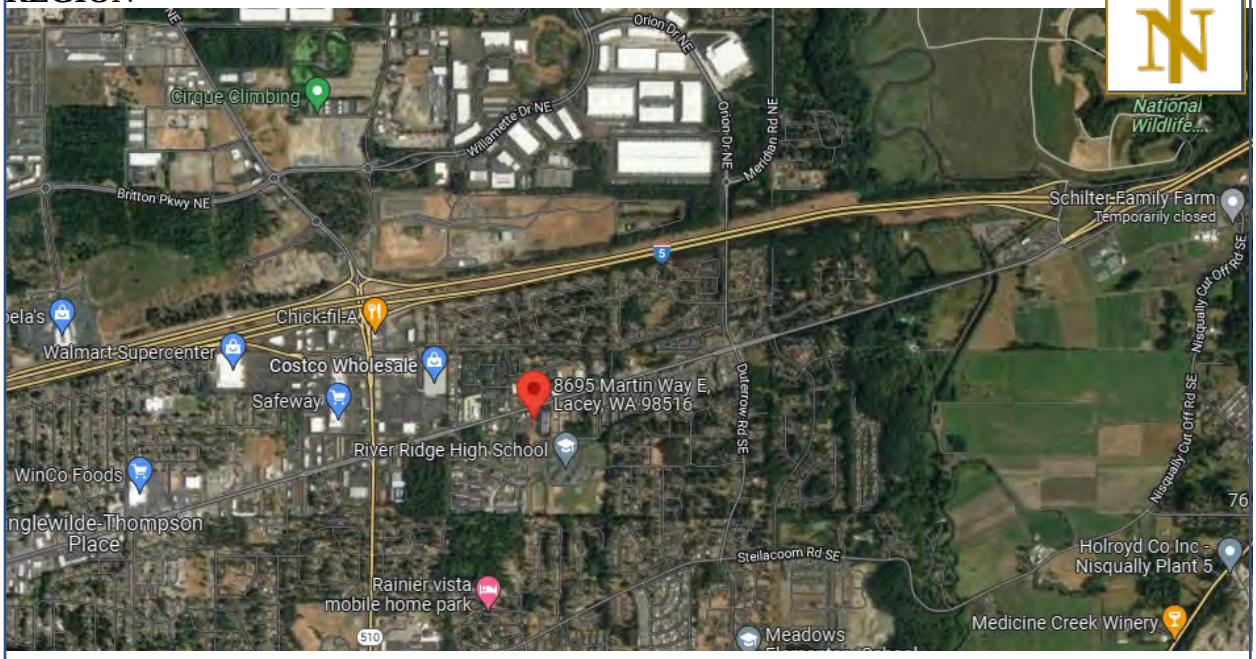
The findings of this study are limited by the level of scope applied. We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the subject region. No warranty, expressed or implied, is made. The recommendations provided in this report assume that an adequate program of tests and observations will be conducted by a WABO approved special inspection firm during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the Client and their design consultants and only for the purposes stated within a reasonable time from its issuance, but in no event later than 18 months from the date of the report. It is the Client's responsibility to ensure that the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. Note that if another firm assumes Geotechnical Engineer of Record responsibilities, they need to review this report and either concur with the findings, conclusions, and recommendations or provide alternate findings, conclusions and recommendation.

Land or facility use, on- and off-site conditions, regulations, or other factors may change over time, and additional work may be required. Based on the intended use of the report, QG may recommend that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release QG from any liability resulting from the use of this report. The Client, the design consultants, and any unauthorized party, agree to defend, indemnify, and hold harmless QG from any claim or liability associated with such unauthorized use or non-compliance. We recommend that QG be given the opportunity to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted. We assume no responsibility for misinterpretation of our recommendations.

Appendix A. Region & Vicinity Maps

REGION



VICINITY

Quality Geo NW, PLLC	**Site Region** 8695 Martin Way E, Lacey	Source: Google Imagery, 2023 **Scale & Locations are approx.** **Not for Construction**	**Figure 1**

Appendix B. Exploration Map

Quality Geo NW, PLLC	**Site Map** 8695 Martin Way E, Lacey	Source: Lewis Co. GIS, 2023 **Scale & Locations are approx.** **Not for Construction**	**Figure 2**

Appendix C. Exploration Logs

TEST PIT LOG TP-1

PROJECT NUMBER QG22-229
PROJECT NAME Heritage Restoration Geo
PROJECT LOCATION Lacey, WA

FIELD WORK DATE 12/19/2022
DRILLING METHOD Excavated Test Pits

BORING LOCATION South edge of parcel
SURFACE ELEVATION Existing
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
0				TS	TOPSOIL Brown, loose, moist, heavy organics, no mottling, no cobbles
1				GP	POORLY GRADED GRAVEL with SAND Gray color, moist, few organics, no mottling, cobbles to 4 inches diameter, medium dense.
2				GP-GM	Gravel = 85% Sand = 15% Fines = 5%
3					WELL GRADED SAND with SILT and GRAVEL Dark brown color, moist, few organics, no mottling, cobbles to 8 inches diameter.
4					Gravel = 62% Sand = 27% Fines = 11%
5					
6					
7					
8					
9					
10					Terminated at Contracted Depth No Groundwater Encountered
11					
12					
13					
14					
15					
16					
17					
18					
19					

Quality Geo NW, PLLC - Ph: 360-878-9705, qualitygeonw.com, 4631 Whitman Lane SE, Ste D, Lacey, WA
produced by ESlog.ESdat.net on 27 Jan 2023

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TEST PIT LOG TP-2

PROJECT NUMBER QG22-229
PROJECT NAME Heritage Restoration Geo
PROJECT LOCATION Lacey, WA

FIELD WORK DATE 12/19/2022
DRILLING METHOD Excavated Test Pits

BORING LOCATION Northeast corner of parcel
SURFACE ELEVATION Existing
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
1				TS	TOPSOIL Brown, loose, moist, heavy organics, no mottling, no cobbles
2					
3				GP	POORLY GRADED GRAVEL with SAND Gray color, moist, few organics, no mottling, cobbles to 10 inches diameter, medium dense. Gravel = 85% Sand = 15% Fines = 5%
4					
5					
6					Inferred to be GLACIAL TILL
7					Terminated at Contracted Depth No Groundwater Encountered
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					

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TEST PIT LOG TP-3

PROJECT NUMBER QG22-229
PROJECT NAME Heritage Restoration Geo
PROJECT LOCATION Lacey, WA

FIELD WORK DATE 12/19/2022
DRILLING METHOD Excavated Test Pits

BORING LOCATION East edge of parcel
SURFACE ELEVATION Existing
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
1				TS	TOPSOIL Brown, loose, moist, heavy organics, no mottling, no cobbles
2				GP	POORLY GRADED GRAVEL with SAND Grey color, moist, few organics, no mottling, cobbles to 8 inches diameter. Gravel = 85% Sand = 15% Fines = 5%
3					
4					
5					
6					
7					
8					Inferred to be GLACIAL TILL
9					Terminated at Contracted Depth No Groundwater Encountered
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					

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TEST PIT LOG TP-4

PROJECT NUMBER QG22-229
PROJECT NAME Heritage Restoration Geo
PROJECT LOCATION Lacey, WA

FIELD WORK DATE 12/19/2022
DRILLING METHOD Excavated Test Pits

BORING LOCATION Southeast corner of parcel
SURFACE ELEVATION Existing
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
0				TS	TOPSOIL Brown, loose, moist, heavy organics, no mottling, few cobbles
1				GP	POORLY GRADED GRAVEL with SAND Gray color, moist, few organics, no mottling, cobbles to 10 inches diameter, medium dense. Gravel = 85% Sand = 15% Fines = 5%
2					
3					
4					
5					
6					
7					
8					
9					Terminated at Contracted Depth No Groundwater Encountered
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					

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TEST PIT LOG INFILTRATION POND (TP-5)

PROJECT NUMBER QG22-229
PROJECT NAME Heritage Restoration Geo
PROJECT LOCATION Lacey, WA

FIELD WORK DATE 12/19/2022
DRILLING METHOD Hand trowel

BORING LOCATION West side infiltration pond
SURFACE ELEVATION 16 ft below grade
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
0.5 – 15.5					INFILTRATION POND- empty/void space
16 – 17.5				SP	POORLY GRADED SAND with GRAVEL Brown, medium dense, moist, heavy organics, no mottling, few cobbles Gravel: 23% Sand= 74% Fines= 3%
17.5 – 19.5					Terminated at Contracted Depth No Groundwater Encountered

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WILDCAT DYNAMIC CONE LOG

Quality Geo NW, PLLC
Geotechnical Consultants
Lacey, WA

PROJECT NUMBER: QG22-229
DATE STARTED: 12-16-2022
DATE COMPLETED: 12-16-2022

HOLE #: DCP-1
CREW: AW
PROJECT: Heritage Restoration Geo
ADDRESS: 8695 Martin Way E, Lacey WA
LOCATION:

SURFACE ELEVATION: Existing
WATER ON COMPLETION: No
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

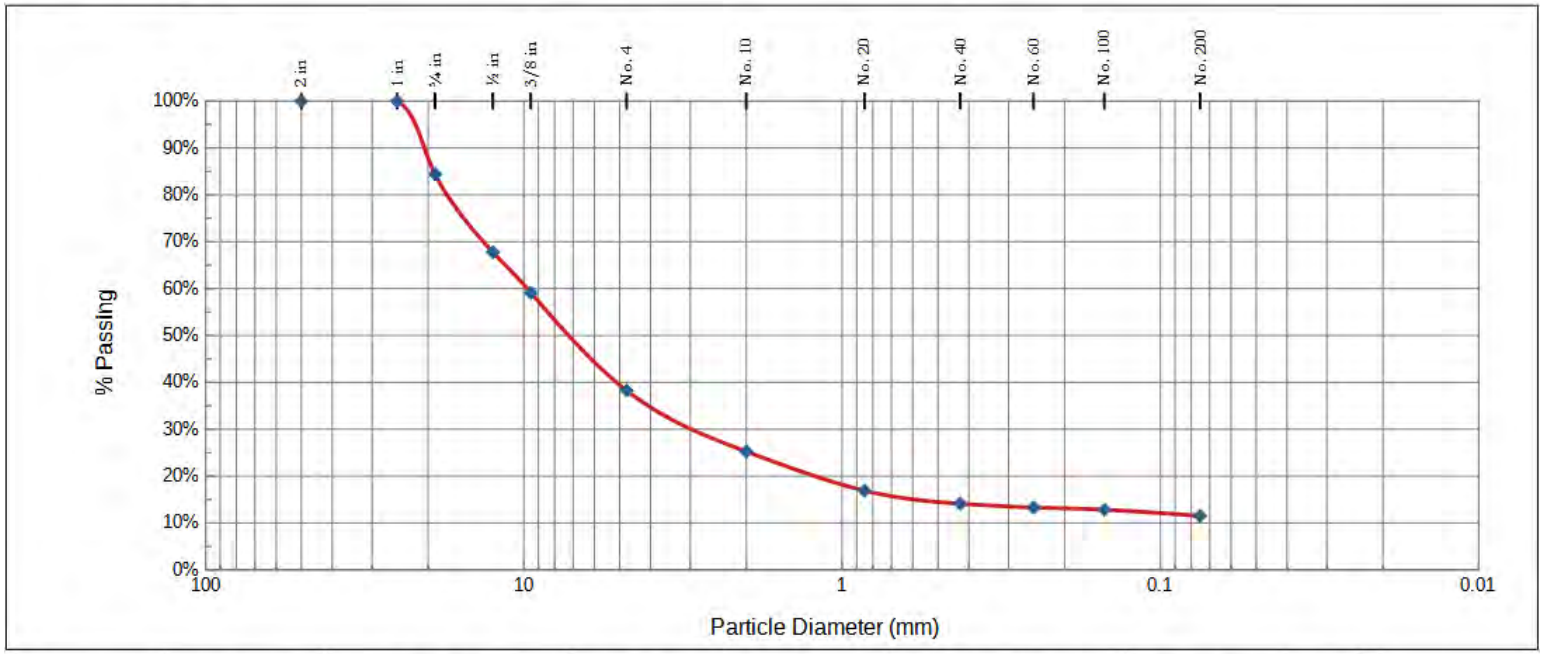
	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm²	0 50 100 150	N'	NON-COHESIVE	COHESIVE
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	18	79.9	••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
- 1 ft	40	177.6	•••	25+	DENSE	HARD
-	47	208.7	•••	25+	VERY DENSE	HARD
-	50	222.0	•••	25+	VERY DENSE	HARD
- 2 ft						
-						
-						
- 3 ft						
- 1 m						
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

Appendix D. Laboratory Results

Project Name:	Heritage Restoration Ge
Project Number:	QG22-229
Date Collected:	12/16/22
Date Reported:	01/27/23
Boring ID:	TP-1
Boring Depth:	5ft

SAMPLE ID: TP-1@5ft

☑ Sieve Analysis | ☑ Wet Wash | ☐ Hydrometer | ☐ Atterberg Limits



USCS Scale	Coarse Gravel		Fine Gravel			Coarse Sand		Medium Sand		Fine Sand			(% of Fines Passing #200 Sieve) Hydrometer Method			Sand Total	Gravel Total
Sieve #	2"	1"	¾"	½"	3/8"	4	10	20	40	60	100	200	0.060	0.050	0.002		
Diameter, mm	50	25	19	12.5	9.5	4.75	2	0.85	0.425	0.25	0.15	0.075					
Retained	0.0%	0.0%	15.6%	32.3%	40.9%	61.8%	74.8%	83.1%	85.9%	86.7%	87.2%	88.5%	NA	NA	NA	**26.7%**	**61.8%**
Passing	100.0%	100.0%	84.4%	67.7%	59.1%	38.2%	25.2%	16.9%	14.1%	13.3%	12.8%	**11.5%**					

Graph Values

D90	21.16				
D60	9.81	**Coefficient of Uniformity:**	3.26	**CEC:**	NA meq/100g
D30	3.008	**Coefficient of Gradation:**	15.40	**OM (LOI 360):**	NA %
D10	0.060				

Unified Soil Classification System (USCS) Description	
GP-GM	POORLY-GRADED GRAVEL with SILT and SAND

Staff Initials: AB

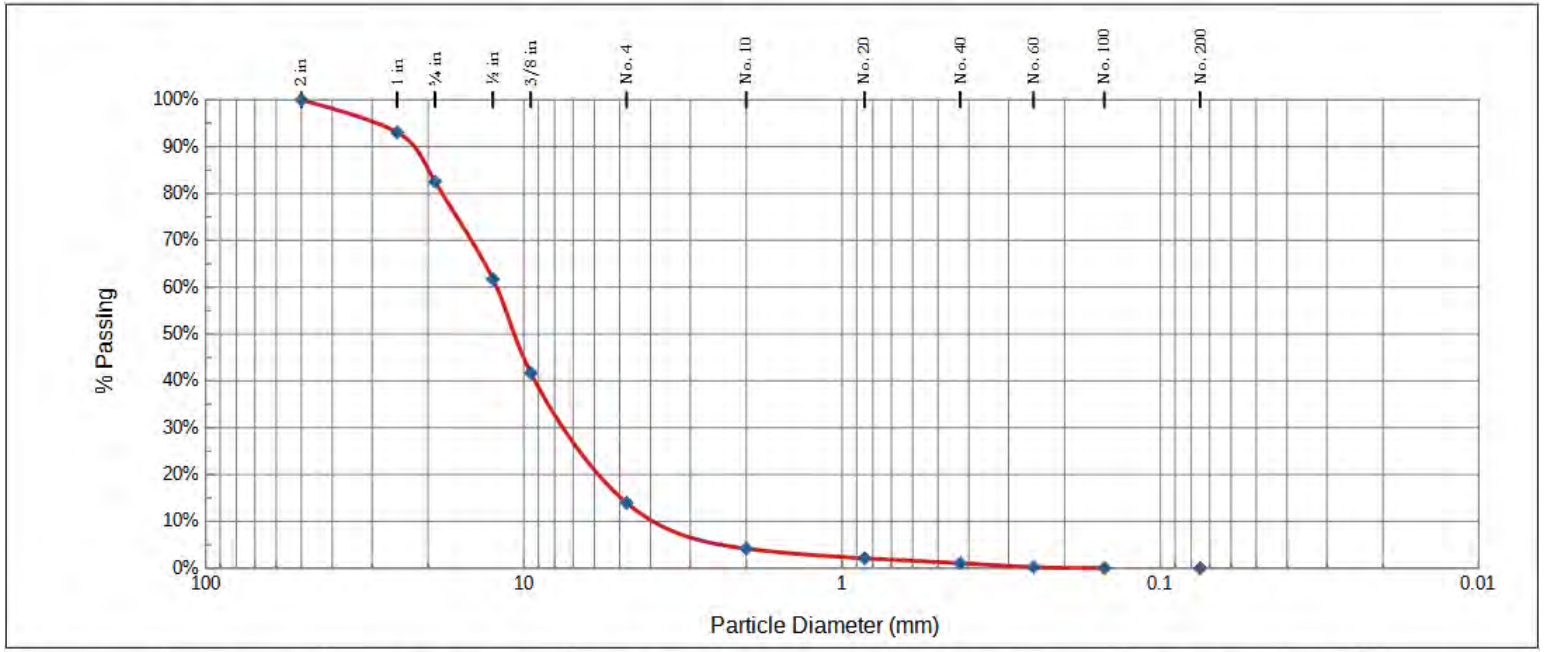
Test Methods: ASTM D6913

January 27, 2023

Project Name:	Heritage Restoration Ge
Project Number:	QG22-229
Date Collected:	12/16/22
Date Reported:	01/03/23
Boring ID:	TP-3
Boring Depth:	2.5 ft

SAMPLE ID: TP-3 @ 2.5 ft

☑ Sieve Analysis | ☐ Wet Wash | ☐ Hydrometer | ☐ Atterberg Limits



USCS Scale	Coarse Gravel		Fine Gravel			Coarse Sand		Medium Sand		Fine Sand			(% of Fines Passing #200 Sieve) Hydrometer Method			Sand Total	Gravel Total
Sieve #	2"	1"	¾"	½"	3/8"	4	10	20	40	60	100	200	0.060	0.050	0.002		
Diameter, mm	50	25	19	12.5	9.5	4.75	2	0.85	0.425	0.25	0.15	0.075					
Retained	0.0%	7.0%	17.5%	38.3%	58.3%	86.1%	95.8%	97.9%	98.9%	99.8%	101.4%	102.3%	NA	NA	NA	**16.2%**	**86.1%**
Passing	100.0%	93.0%	82.5%	61.7%	41.7%	13.9%	4.2%	2.1%	1.1%	0.2%	0.0%	**0.0%**					

Graph Values

D90	23.26				
D60	12.24	Coefficient of Uniformity:	1.63	CEC:	4.2 meq/100g
D30	7.501	Coefficient of Gradation:	1.26	OM (LOI 360):	1.1 %
D10	3.642				

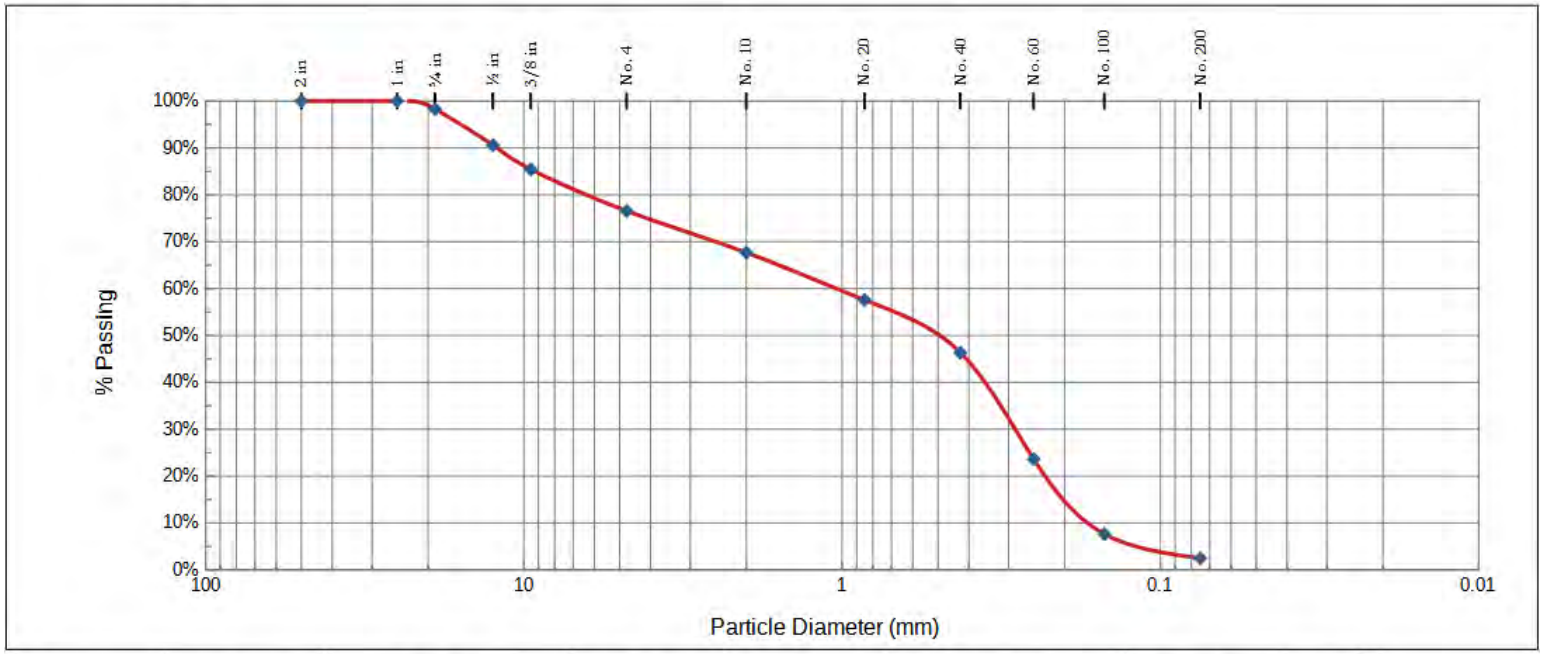
Unified Soil Classification System (USCS) Description	
GP	POORLY GRADED GRAVEL with SAND

Staff Initials: AB, AW Test Methods: ASTM D6913 January 3, 2023

Project Name:	Heritage Restoration Ge
Project Number:	QG22-229
Date Collected:	12/16/22
Date Reported:	01/03/23
Boring ID:	Infiltration Pond
Boring Depth:	17 ft

SAMPLE ID: Infiltration Pond @ 17 ft

☑ Sieve Analysis | ☐ Wet Wash | ☐ Hydrometer | ☐ Atterberg Limits



USCS Scale	Coarse Gravel		Fine Gravel			Coarse Sand		Medium Sand		Fine Sand			(% of Fines Passing #200 Sieve) Hydrometer Method			Sand Total	Gravel Total
Sieve #	2"	1"	¾"	½"	3/8"	4	10	20	40	60	100	200					
Diameter, mm	50	25	19	12.5	9.5	4.75	2	0.85	0.425	0.25	0.15	0.075	0.060	0.050	0.002		
Retained	0.0%	0.0%	1.7%	9.4%	14.6%	23.4%	32.3%	42.4%	53.7%	76.4%	92.3%	97.5%	NA	NA	NA	**74.1%**	**23.4%**
Passing	100.0%	100.0%	98.3%	90.6%	85.4%	76.6%	67.7%	57.6%	46.3%	23.6%	7.7%	**2.5%**					

Graph Values

D90	12.16				
D60	1.13	**Coefficient of Uniformity:**	3.77	**CEC:**	5.6 meq/100g
D30	0.299	**Coefficient of Gradation:**	0.48	**OM (LOI 360):**	1.6 %
D10	0.165				

Unified Soil Classification System (USCS) Description	
SP	POORLY GRADED SAND with GRAVEL

Staff Initials: AB, AW Test Methods: ASTM D6913

January 3, 2023

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Thurston County Area, Washington

Heritage Restoration

April 19, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:797 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Thurston County Area, Washington
Survey Area Data: Version 16, Sep 8, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 31, 2022—Aug 8, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
33	Everett very gravelly sandy loam, 8 to 15 percent slopes	1.0	78.0%
34	Everett very gravelly sandy loam, 15 to 30 percent slopes	0.0	2.4%
110	Spanaway gravelly sandy loam, 0 to 3 percent slopes	0.3	19.7%
Totals for Area of Interest		**1.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Thurston County Area, Washington

33—Everett very gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t62b
Elevation: 30 to 900 feet
Mean annual precipitation: 35 to 91 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Moraines, eskers, kames
Landform position (two-dimensional): Shoulder, footslope
Landform position (three-dimensional): Crest, base slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: very gravelly sandy loam
Bw - 3 to 24 inches: very gravelly sandy loam
C1 - 24 to 35 inches: very gravelly loamy sand
C2 - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XN402WA), Droughty Soils (G002XS401WA), Droughty Soils (G002XF403WA)
Other vegetative classification: Droughty Soils (G002XN402WA), Droughty Soils (G002XS401WA), Droughty Soils (G002XF403WA)
Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 10 percent
Landform: Hills, ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope, talf
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Indianola

Percent of map unit: 10 percent
Landform: Terraces, kames, eskers
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

34—Everett very gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t62c
Elevation: 30 to 900 feet
Mean annual precipitation: 35 to 91 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Moraines, eskers, kames
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: very gravelly sandy loam
Bw - 3 to 24 inches: very gravelly sandy loam
C1 - 24 to 35 inches: very gravelly loamy sand
C2 - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XN402WA), Droughty Soils (G002XS401WA)
Other vegetative classification: Droughty Soils (G002XN402WA), Droughty Soils (G002XS401WA)
Hydric soil rating: No

Minor Components

Indianola

Percent of map unit: 10 percent
Landform: Terraces, kames, eskers
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Alderwood

Percent of map unit: 10 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope, talf
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

110—Spanaway gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2ndb6
Elevation: 330 to 1,310 feet
Mean annual precipitation: 35 to 65 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Spanaway and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Spanaway

Setting

Landform: Terraces, outwash plains
Parent material: Volcanic ash over gravelly outwash

Typical profile

H1 - 0 to 15 inches: gravelly sandy loam
H2 - 15 to 20 inches: very gravelly loam
H3 - 20 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: R002XA006WA - Puget Lowlands Prairie
Forage suitability group: Droughty Soils (G002XS401WA)
Other vegetative classification: Droughty Soils (G002XS401WA)
Hydric soil rating: No

Appendix 4
SWPPP

DRAFT
Construction Stormwater Pollution Prevention Plan (SWPPP)

for

Heritage Restoration
New Hawks Prairie Facility

8675 & 8695 Martin Way E.
Lacey, WA 98513
TPN 11812310402 & 11812310401

City of Lacey Project No. __-____
Olympic Engineering Project No. 22071

May 5, 2023

Prepared by:

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Certified Erosion and Sediment Control Lead (CESCL)

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Contractor

_____
_____
_____
_____

This SWPPP has been prepared by Olympic Engineering based on our estimate of anticipated site conditions throughout construction along with anticipated construction methods and sequencing used by the contractor. The BMP's suggested in this SWPPP are simply suggestions and the contractor and/or owner is responsible for implementing all BMPs necessary to minimize and prevent erosion and sedimentation throughout construction and through final site stabilization.

<u>The owner retains the ultimate responsibility for environmental protection at the site and for ensuring the project is in compliance at all times.</u>

5/5/2023

*"I hereby state that this DRAFT Construction SWPPP for the **Heritage Restoration** project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Lacey does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."*

Project Overview

The proposal is to construct two commercial buildings (office/retail/warehouse) with associated access, driveway, parking lot, utility, and storm drainage improvements.

All proposed site work improvements are anticipated to be constructed in one phase with substantial site work construction completion by Spring/Summer 2024. The completion timeframe of the buildings is currently unknown but is anticipated to be Fall 2024.

Proposed Stormwater BMP's:

- All new drive aisle and parking lot areas will be constructed of Permeable Pavement (BMP T5.15) with an underlying sand filter for treatment, detention, and infiltration.
- Stormwater runoff from the sidewalks adjacent to permeable pavement will sheet flow onto the permeable pavement surface.
- Stormwater runoff from the sidewalks not adjacent to permeable pavement will be sheet flow dispersed on to adjacent lawn/landscape areas (BMP T5.12).
- Stormwater runoff from the roof areas will be tightlined to the existing community storm drainage system.

The north parcel is mostly forested with some lawn/landscape along the existing drive aisle and parking stalls. The south parcel contains mostly grass and brush with a few small scattered trees. Overall site topography slopes down from east to west with an overall relief of up to approximately 4'.

There are no creeks, lakes, ponds, springs, etc. on or near the subject parcel.

Per FEMA FIRM Panel #53067C0192E the project is located in Zone X (an area determined to be outside the 0.2% annual chance floodplain).

There is no known off-site drainage affecting the subject parcels. Stormwater runoff from the existing drive aisles crossing the parcels sheet flows to the existing community drainage system. There is no other known runoff from the subject parcel affecting adjacent parcels. There are no known historical drainage problems such as flooding, erosion, etc. on or near the subject parcels.

The Natural Resource Conservation Service (NRCS) classifies 80% of the on-site soils as Everett Very Gravelly Sandy Loam (HSG A) and 20% as Spanaway Gravelly Sandy Loam (HSG A). A Geotechnical Investigation report has been prepared by QualityGeo NW. Five test pits were evaluated to depths of up to 10' below-grade and the soils generally consisted of a 4" to 27" depth of topsoil overlying sand with silt (GP-GM) or gravel with sand (GP). A restrictive horizon (inferred as till) was encountered at depths of approximately 5.5' to 7.5' below-grade in the northern portion of the project area. It appears this restrictive horizon slopes down from north to south fairly quickly as it was not encountered in the other test pits to the south at depths of up to 10' below-grade nor was it encountered within the existing community stormwater pond at a depth of approximately 18' below-grade.

Objective

To control erosion and prevent sediment and other pollutants from leaving the site during the construction phase of a project. To have fully functional stormwater facilities and BMPs for the developed site upon completion of construction.

Supplemental Guidelines

If a Construction SWPPP is found to be inadequate (with respect to erosion and sediment control requirements), then the Plan Approval Authority within the City shall require that other BMPs be implemented, as appropriate.

The Plan Approval Authority may allow development of generic Construction SWPPP's that apply to commonly conducted public road activities, such as road surface replacement, that trigger this core requirement. They may also develop an abbreviated SWPPP format for project sites that will disturb less than 1 acre.

Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance. The local permitting authority shall take enforcement action - such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:

- If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
- If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

General Requirements

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas shall be delineated on the site plans and the development site.

The SWPPP shall be implemented beginning with initial land disturbance through final stabilization. Sediment and Erosion control BMPs shall be consistent with the BMPs contained in Chapter 5 of the City of Lacey Stormwater Design Manual (SDM)*, 2022 ed.*

Seasonal Work Limitations - From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site. See Element #12 below for additional information.

Project Requirements - Construction SWPPP Elements

In most cases, all of the following elements shall apply and be implemented throughout construction. Self-contained sites (discharges only to groundwater) must comply with all elements with the exception of Element 3: Control Flow Rates.

The suggested BMPs underlined and in **bold** are proposed for use in all phases of construction. Additional BMP's shall be implemented as necessary to minimize and prevent erosion and sedimentation throughout construction. See Chapter 5 of the SDM for reference. All BMP's shall be maintained until final site stabilization.

Element #1: Preserve Vegetation/Mark Clearing Limits

- Prior to beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Clearly visible plastic, metal, or stake wire fence may be used to mark the clearing limits.
- The duff layer, native topsoil, and natural vegetation shall be retained in an undisturbed state to the maximum degree practicable. If it is not practicable to retain the duff layer in place, stockpile it on-site, cover it to prevent erosion, and replace it immediately upon completion of the ground disturbing activities.

Suggested BMPs:

- **BMP C100: Preservation of Native Topsoil (On-site)**
- **BMP C101: Preserving Natural Vegetation (On-site)**
- BMP C102: Buffer Zones
- BMP C103: High Visibility Plastic Fence.
- **BMP C233: Silt Fence**

Element #2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible, or two for linear projects such as roadways where more than one access is necessary for large equipment maneuvering.
- Stabilize access points with a pad of quarry spalls or crushed rock, or equivalent BMP prior to traffic leaving the construction site to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on site, if the stabilized construction entrance is not effective in preventing sediment from being tracked on public roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example during wet weather) to prevent sediment from entering waters of the state. Remove sediment from roads by shoveling or pickup sweeping and transport to a controlled sediment disposal area. Street washing is allowed only after sediment is removed in this manner.
- Control street wash wastewater by pumping back on site to an approved infiltration facility, or otherwise preventing it from discharging into systems tributary to the city municipal separated storm sewer system, wetlands, or waters of the State. Other options include discharge to the sanitary sewer, or discharge to an approved offsite treatment system. For discharges to the sanitary sewer, permits must be obtained from the local jurisdiction providing the sewer.

Element #3: Control Flow Rates

- Protect properties and waterways downstream from development sites from erosion and the associated discharge of turbid waters due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.

- Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, stream banks, bed sediment, or aquatic habitat. See Volume I, Chapter 2, for potential offsite analysis requirements and guidelines (Core Requirement #11).
- Where necessary to comply with Core Requirement #7, construct stormwater retention/detention facilities as one of the first steps in grading. Ensure that detention facilities are functional prior to construction of site improvements (e.g., impervious surfaces).
- Outlet structures designed for permanent detention ponds are not appropriate for use during construction without modification. If used during construction, install an outlet structure that will allow for long-term storage of runoff and enable sediment to settle. Verify that the pond is sized appropriately for this purpose. Restore ponds to their original design dimensions, remove sediment, and install a final outlet structure at completion of the project.
- Sites that must implement flow control (Core Requirement #7) for the developed site condition must also control stormwater release rates during construction. Construction site stormwater discharges shall not exceed the discharge durations of the pre-developed condition for the range of pre-developed discharge rates from ½ of the 2-year flow through the 10-year flow as predicted by an approved continuous runoff model. Match the pre-developed condition to the land cover condition immediately prior to the development project.
- The City may require pond designs that provide additional or different stormwater flow control if necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- If permanent infiltration ponds are used for flow control during construction, protect them from siltation during the construction phase.

Suggested BMPs:

- BMP C203: Water Bars
- BMP C207: Check Dams
- BMP C209: Outlet Protection
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- Refer to Volumes III and V for site suitability and sizing for infiltration facilities and for design of Detention and Infiltration Facilities for flow control.

Element #4: Install Sediment Controls

- Prior to leaving a construction site or prior to discharge to an infiltration facility, pass stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP.
- Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, the first bullet. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The City shall inspect and approve areas fully stabilized by means other than pavement or quarry spalls.
- Construct sediment ponds, vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on site as one of the first steps in grading. Ensure that these BMPs are functional before other land disturbing activities take place.
- Where feasible, design outlet structures that withdraw impounded water from the surface to avoid discharging sediment that is still suspended lower in the water column.
- Seed and mulch earthen structures such as dams, dikes, and diversions according to the timing indicated in Element #5.

- Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during non-storm events, in response to rain event changes in stream elevation or wetted area.
- If installing a floating pump structure, include a stopper to prevent the pump basket from hitting the bottom of the pond.

Suggested BMPs:

- BMP C231: Brush Barrier
- BMP C232: Gravel Filter Berm
- **BMP C233: Silt Fence**
- BMP C234: Vegetated Strip
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration.

Element #5: Stabilize Soils

- Stabilize all exposed and un-worked soils by application of effective BMPs that prevent erosion; protect the soil from the erosive forces of raindrop impact, flowing water, and wind.
- Control stormwater volume and velocity within the site to minimize erosion; and control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- From October 1 through April 30, no soils shall remain exposed and un-worked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and un-worked for more than 7 days. This condition applies to all soils on site, whether at final grade or not. These time limits may be adjusted by the City if it can be shown that the average time between storm events justifies a different standard.
- Stabilize soils at the end of the shift before a holiday or weekend if the weather forecast calls for precipitation. Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.
- Soil stabilization measures should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures, and when possible, be located away from storm drain inlets, waterways and drainage channels.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.
- Ensure that gravel base used for stabilization is clean and does not contain fines or sediment.
- Linear construction activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirements and time periods set forth above.

Suggested BMPs:

- o **BMP C120: Temporary and Permanent Seeding**
- o **BMP C121: Mulching**
- o BMP C122: Nets and Blankets
- o **BMP C123: Plastic Covering**
- o BMP C124: Sodding
- o **BMP C125: Topsoiling/Composting**
- o BMP C126: Polyacrylamide for Soil Erosion Protection
- o BMP C130: Surface Roughening
- o BMP C131: Gradient Terraces
- o **BMP C140: Dust Control**

Element #6: Protect Slopes

- Design and construct cut and fill slopes in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing the length of continuous slope with terracing and diversions, reducing slope steepness, and roughening slope surface.
- Divert offsite stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes, and/or swales. Manage offsite stormwater separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.
- Design temporary pipe slope drains to handle the peak 10-minute velocity of flow from a 10-year, 24-hour event assuming a Type 1A rainfall distribution. Alternatively, the 10-year, 1 hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. If a 15-minute (or less) time step is used, no correction factor is required. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas shall be modeled as “landscaped” area.
- Permanent pipe slope drains shall be sized for the 100-year, 24-hour event.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within channels that are cut down a slope.
- Stabilize soils on slopes, as specified in Element #5.
- BMP combinations are the most effective method of protecting slopes with disturbed soils. For example, using both mulching and straw erosion control blankets in combination.

Suggested BMPs:

- o **BMP C120: Temporary and Permanent Seeding**
- o **BMP C121: Mulching**
- o BMP C122: Nets and Blankets
- o **BMP C123: Plastic Covering**
- o BMP C124: Sodding
- o BMP C130: Surface Roughening
- o BMP C131: Gradient Terraces
- o BMP C200: Interceptor Dike and Swale
- o BMP C201: Grass-Lined Channels

- o BMP C203: Water Bars
- o BMP C204: Pipe Slope Drains
- o BMP C205: Subsurface Drains
- o BMP C206: Level Spreader
- o BMP C207: Check Dams
- o BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam).

Element #7: Protect Drain Inlets

- Protect all storm drain inlets made operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- Keep all approach roads clean. Do not allow sediment and street wash water to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the state.
- Inspect inlets weekly at a minimum and daily during storm events. Clean inlet protection devices, or remove and replace when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

Suggested BMPs:

- o **BMP C220: Storm Drain Inlet Protection**

Element #8: Stabilize Channels and Outlets

- Design, construct, and stabilize all temporary on-site conveyance channels to prevent erosion from the expected peak 10 minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm. Alternatively, the 10-year, 1-hour time step flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. If a 15-minute (or less) time step is used, no correction factor is required. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas shall be modeled as “landscaped” area.
- Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches at the outlets of all conveyance systems.
- The best method for stabilizing channels is to completely line the channel with a blanket product first, then add check dams as necessary to function as an anchor and to slow the flow of water.

Suggested BMPs:

- o BMP C122: Nets and Blankets
- o BMP C202: Channel Lining
- o BMP C207: Check Dams
- o BMP C209: Outlet Protection

Element #9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.
- Handle and dispose all pollutants, including waste materials and demolition debris that occur on-site, in a manner that does not cause contamination of stormwater. Woody debris may be chipped, ground, or chopped and spread on site.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks shall include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure. Double- walled tanks do not require additional secondary containment.
- Use spill prevention and control measures when conducting fueling, maintenance and repair of heavy equipment and vehicles including oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff. Clean contaminated surfaces immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as a closed-loop recirculation or upland land application, or to the sanitary sewer, with local sewer district approval.
- Apply agricultural chemicals, including fertilizers and pesticides, in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' recommendations for application rates and procedures shall be followed.
- Use BMPs to prevent or treat contamination of stormwater runoff by pH modifying sources. These acidic or basic sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of the water quality standards. Projects must obtain written approval from the Department of Ecology prior to using chemical treatment other than CO2 or dry ice to adjust pH.
- Washout of concrete trucks shall be performed off-site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State if prohibited. Do not use upland land applications for discharging wastewater from concrete washout areas.
- Wheel wash or tire bath wastewater shall not be mixed with wastewater from concrete washout areas.

Suggested BMPs:

- **BMP C151: Concrete Handling**
- **BMP C152: Sawcutting and Surfacing Pollution Prevention**
- **BMP C153: Material Delivery, Storage and Containment**
- **BMP C154: Concrete Washout Area**
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration
- BMP C252: High pH Neutralization Using CO2

- BMP C253: pH Control for High pH Water.
- See Volume IV – Source Control BMPs.

Element #10: Control De-Watering

- Discharge foundation, vault, and trench de-watering water, which have similar characteristics to stormwater runoff at the site, into a controlled conveyance system prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.
- Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters or interfere with operation of the system. Do not route these clean waters through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, separately from stormwater.
- Discharging sediment-laden (muddy) water into waters of the State likely constitutes violation of water quality standards for turbidity. The easiest way to avoid discharging muddy water is through infiltration and preserving vegetation.
- Other treatment or disposal options, depending on site constraints, may include:

    - Infiltration
    - Transport offsite in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters
    - Ecology-approved on-site chemical treatment or other suitable treatment technologies
    - Sanitary sewer discharge with local sewer district approval, if there is no other option
    - Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Suggested BMPs:

- BMP C203: Water Bars
- BMP C236: Vegetative Filtration

Element #11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function. Conduct maintenance and repair in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs not designed to remain in place following construction (e.g. compost socks), within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Remove or stabilize trapped sediment on site. Permanently stabilize disturbed soil resulting from removal of BMPs or vegetation.
- Protect all BMPs installed for the permanent control of stormwater from sediment and compaction. All BMPs that are to remain in place following completion of construction shall be examined and placed in full operating condition. If sediment enters the BMPs during construction, it shall be removed and the facility shall be returned to the conditions specified in the construction documents.

Suggested BMPs

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

Element #12: Manage the Project

Phasing of Construction:

- Phase development projects to the maximum extent practicable and take into account seasonal work limits in order to prevent soil erosion and, to reduce to the maximum extent practicable, the transport of sediment from the site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.
- Clearing and grading activities for developments are permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, minimize the removal of existing trees and the disturbance/compaction of native soils except as needed for building purposes. Delineate the permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by the City, on the site plans and the development site.

Seasonal Work Limitations:

- From October 1 through April 30, clearing, grading, and other soil disturbing activities will not be permitted unless it is shown to the satisfaction of the City that silt-laden runoff will be prevented from leaving the site through a combination of the following:

    - Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters; and
    - Limitations on activities and the extent of disturbed areas; and
    - Proposed erosion and sediment control measures.

- Based on the information provided and/or local weather conditions, the City may expand or restrict the seasonal limitation on site disturbance. The City shall take enforcement action – such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:

    - If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
    - If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

- The following activities are exempt from the seasonal clearing and grading limitations:

    - Routine maintenance and necessary repair of erosion and sediment control BMPs;
    - Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
    - Activities where there is 100 percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Coordination with Utilities and Other Contractors:

The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

Inspection and Monitoring:

- For construction sites that will disturb 1 acre or more a Certified Erosion and Sediment Control Lead (CESCL) shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification must be obtained through an approved training program that meets the erosion and sediment control training standards established by Ecology.
- Project sites less than one acre (not part of a larger common plan of development or sale) may have a person without CESCL certification conduct inspections. The person shall be identified in the Construction SWPPP and shall be on-site or on-call at all times.
- All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted at least weekly and immediately following any substantial rainfall event by a person who is knowledgeable in the principles and practices of erosion and sediment control. The CESCL or inspector (project sites less than one acre) must have the skills to:

    1) Assess the site conditions and construction activities that could impact the quality of stormwater, and
    2) Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.
- Implement appropriate BMPs or design changes as soon as possible whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant.
- Based on the results of the inspection, construction site operators must correct the problems identified by:

    - Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
    - Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, the construction site operator may request and extension from the City within the initial 10-day response period.
    - Documenting BMP implementation and maintenance in the site log book (sites larger than 1-acre).
    - The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week). The CESCL or inspector may reduce the

inspection frequency for temporarily stabilized, inactive sites to once every calendar month.

Maintaining an Updated Construction SWPPP:

- The Construction SWPPP shall be retained on-site or within reasonable access to the site.
- The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
- The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, City or a state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

Suggested BMPs

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

Element #13: Protect Low Impact Development BMPs

- Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs.
- Restore Bioretention and Rain Garden BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP includes removal of sediment and any sediment-laden Bioretention/Rain Garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compaction of Bioretention, Rain Garden, and other infiltration BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- Protect surrounding land uses from erosion and manage to avoid introducing sediment onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-lade runoff onto permeable pavements.
- Clean pavements fouled with sediments or no longer passing an initial infiltration test using procedures acceptable to the City or in accordance with manufacturer's procedures.
- Keep heavy equipment off of existing soils under LID facilities (Bioretention, Rain Gardens, Infiltration Ponds, Permeable Pavements, etc.) that have been excavated to final grade to retain the infiltration rate of the soils.

Suggested BMPs

- BMP C102: Buffer Zone
- BMP C103: High Visibility Fence
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C207: Check Dams

- BMP C208: Triangular Silt Dike (TSD) (Geotextile-Encased Check Dam).
- BMP C231: Brush Barrier
- **BMP C233: Silt Fence**
- BMP C234: Vegetated Strip
- Additional Guidance: See Chapter 5: Precision Site Preparation and Construction in the LID Technical Guidance Manual for Puget Sound for more detail on protecting LID integrated management practices.

Appendix 4
Existing Drainage System Records

GRADING AND STORM DRAINAGE PLAN

PORTIONS OF NW 1/4 OF SW 1/4 and NE 1/4 OF SW 1/4 SECTION 12, TOWNSHIP 18 NORTH, RANGE 1 WEST, W.M.

PIPE CONVEYANCE BASIN MAP

CALL BEFORE YOU DIG:
1-800-424-5555

CATCH BASIN SCHEDULE

CB 1
STA: 10+50.68, 100.30' RT
TYPE 1 W/ GRATE
RIM=227.1
IE OUT=224.3 (8" S)

CB 2
STA: 11+69.54, 97.24' RT
TYPE 2-48" W/ GRATE
RIM=227.0
IE IN=223.71 (6" NE, 8" N&E)
IE OUT=223.71 (12" SW)

CB 3
STA: 12+21.88, 161.84' RT
TYPE 1 W/ GRATE
RIM=226.5
IE IN=223.29 (12" NE)
IE OUT=223.29 (12" SW)

CB 4
STA: 13+20.43, 118.42' RT
TYPE 1 W/ GRATE
RIM=227.0
IE IN=223.44 (8" S)
IE OUT=223.44 (8" W)

CB 5
STA: 13+20.57, 220.09' RT
TYPE 1 W/ GRATE
RIM=226.0
IE IN=222.44 (8" E, 12" NE)
IE OUT=222.44 (12" W)

CB 6
STA: 13+20.74, 341.86' RT
TYPE 2-60" W/ SOLID LOCKING LID
RIM=220.0
IE IN=215.05 (12" W & E)
IE IN=216.05 (12" NE)
IE OUT=215.05 (12" SE)
IE OUT=216.0 (12" S)

SF 1
STA. 13+22.94, 327.11' RT TO CENTER OF VAULT
W/ 32 CARTRIDGES
RIM=220.75±
IE IN=215.0 (12" NW)
IE OUT=212.7 (12" S)

CB 7
STA: 12+00.18, 222.61' RT
TYPE 1 W/ SOLID LOCKING LID
RIM=224.5
IE IN=220.5 (8" N)
IE OUT=220.5 (8" S)

CB 8
STA: 13+31.66, 252.81' RT
TYPE 2-48", W/ SOLID LOCKING LID
RIM=224.75
IE IN=219.00 (8" N & E)
IE OUT=219.0 (12" W)

CB 9
STA: 12+08.85, 271.31' RT
TYPE 1 W/ GRATE
RIM=223.4
IE IN=218.47 (12" N)
IE OUT=218.47(12" SE)
IE IN=219.50(8" NW)

CB #10
STA: 13+00.60, 331.05' RT
TYPE 1 W/ GRATE
RIM=221.0
IE IN=217.17 (12" NE)
IE OUT=217.17 (12" SW)

CB #11
STA: 12+82.26, 290.29' RT
TYPE 1 W/ GRATE
RIM=223.11
IE IN=218.17 (12" NE)
IE OUT=218.17 (12" SW)

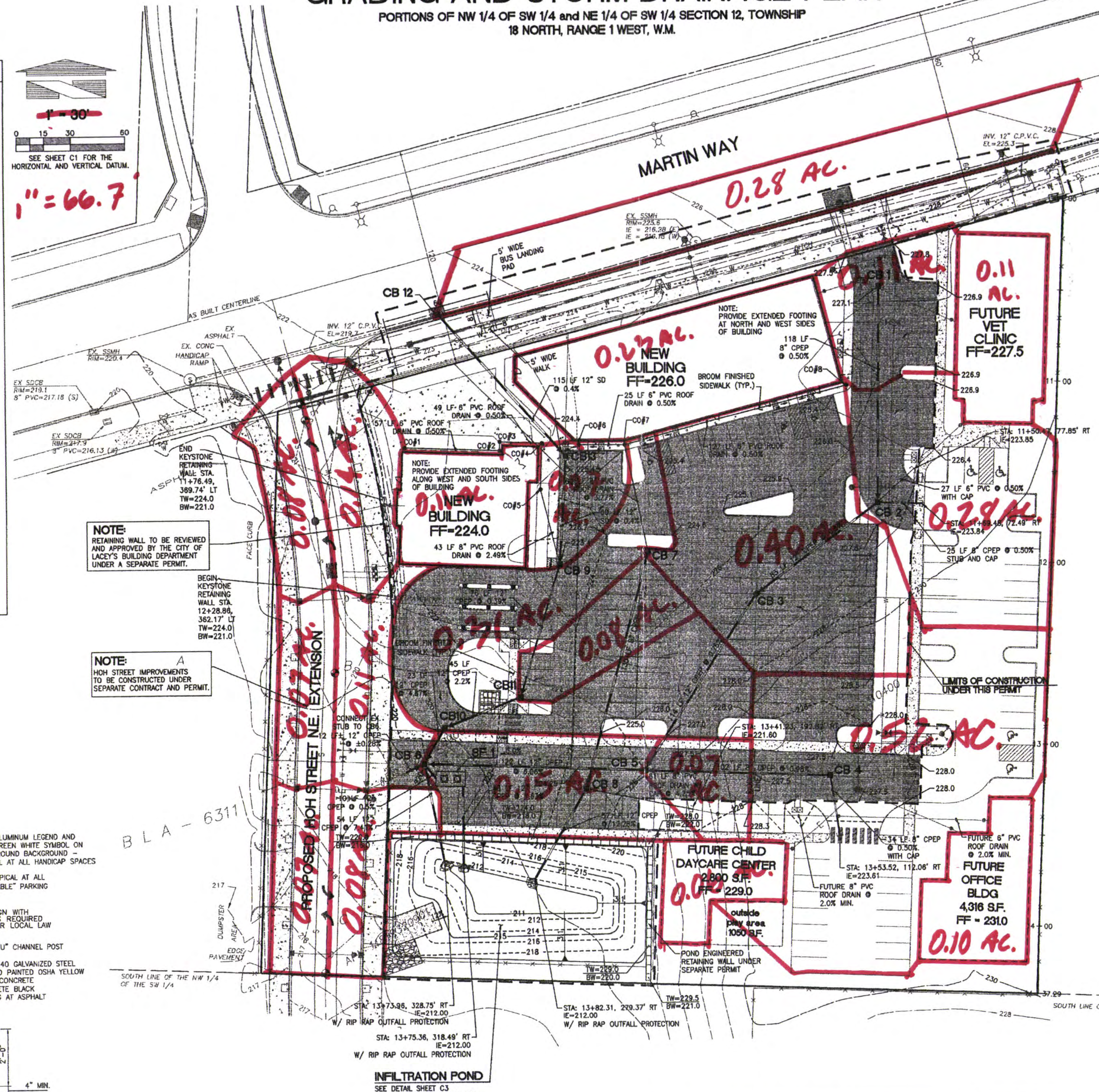
CB #12
STA: 10+85.16, 341.98' RT
TYPE 1 W/ GRATE
RIM=223.00
IE OUT=219.17 (12" SE)

CB #13
STA: 11+49.16, 270.00'RT.
TYPE 1 W/ GRATE
RIM=224.40
IE IN=218.71(12" NW)
IE OUT=218.71(12" S)

NOTE:
ALL CATCH BASINS FRAME AND GRATES ARE WSDOT STD. PLAN B-2A AND B-2B, UNLESS OTHERWISE NOTED

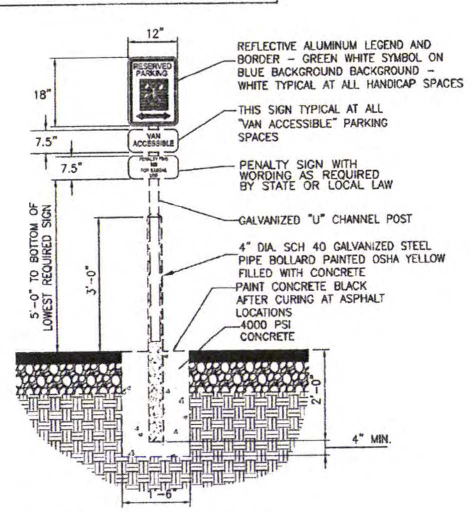
CLEANOUT SCHEDULE

CO#1 STA. 11+47.33, 358.55' LT. RIM=224.00 IE=221.50	CO#4 STA. 11+41.11, 283.04' LT. RIM=224.0 IE=	CO#7 STA. 11+42.92, 237.55' LT. RIM=225.90 IE=222.89
CO#2 STA. 11+47.32, 306.20' LT. RIM=224.00 IE=221.22	CO#5 STA. 11+66.54, 282.0' LT. RIM=224.0 IE=	CO#8 STA.11+05.32, 116.38' LT. RIM=225.90 IE=222.76
CO#3 STA. 11+42.46, 306.20' LT. RIM=224.20 IE=220.97	CO#6 STA. 11+42.65, 262.91' LT. RIM=225.90 IE=223.40	



1" = 30'
SEE SHEET C1 FOR THE HORIZONTAL AND VERTICAL DATUM.
1" = 66.7'
MARTIN WAY
0.28 AC.
0.11 AC.
FUTURE VET CLINIC
FF=227.5
NEW BUILDING
FF=226.0
NEW BUILDING
FF=224.0
0.40 AC.
0.29 AC.
0.52 AC.
0.15 AC.
0.07 AC.
0.10 AC.
FUTURE CHILD DAYCARE CENTER
FUTURE OFFICE BLDG
4,316 S.F.
FF = 231.0
PROPOSED HOH STREET NE EXTENSION
NOTE: RETAINING WALL TO BE REVIEWED AND APPROVED BY THE CITY OF LACEY'S BUILDING DEPARTMENT UNDER A SEPARATE PERMIT.
NOTE: HOH STREET IMPROVEMENTS TO BE CONSTRUCTED UNDER SEPARATE CONTRACT AND PERMIT.
LIMITS OF CONSTRUCTION UNDER THIS PERMIT
INFILTRATION POND
SEE DETAIL SHEET C3
MAXIMUM W.S. EL. = 215.06
B L A - 6311

Approximately 44,006 sf of impervious surface area assumed for the subject project.



REFLECTIVE ALUMINUM LEGEND AND BORDER - GREEN WHITE SYMBOL ON BLUE BACKGROUND BACKGROUND - WHITE TYPICAL AT ALL HANDICAP SPACES
THIS SIGN TYPICAL AT ALL "VAN ACCESSIBLE" PARKING SPACES
PENALTY SIGN WITH WORDING AS REQUIRED BY STATE OR LOCAL LAW
GALVANIZED "U" CHANNEL POST
4" DIA. SCH 40 GALVANIZED STEEL PIPE BOLLARD PAINTED OSHA YELLOW FILLED WITH CONCRETE
PAINT CONCRETE BLACK AFTER CURING AT ASPHALT LOCATIONS
4000 PSI CONCRETE
4" MIN.

HANDICAP PARKING SIGN

ONE AT EACH HANDICAP SPACE. WHERE HANDICAP SPACES FACE EACH OTHER WITHOUT WALKWAY, THERE SHALL BE ONE POST WITH SIGNS MOUNTED BOTH SIDES

GENERAL NOTES (STORM DRAIN CONSTRUCTION)

1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY OF LACEY STANDARDS AND THE MOST CURRENT COPY OF THE WSDOT/APWA STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION. IN CASES OF CONFLICT, THE MOST STRINGENT STANDARD SHALL APPLY.
2. THE CONTRACTOR SHALL BE IN COMPLIANCE WITH ALL SAFETY STANDARDS AND REQUIREMENTS AS SET FORTH BY OSHA, WISHA AND THE STATE OF WASHINGTON, DEPARTMENT OF LABOR AND INDUSTRIES.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TRAFFIC CONTROL IN ACCORDANCE WITH THE WSDOT/APWA STANDARD PLANS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION (ALL APPLICABLE "K" PLANS) AND/OR THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD). PRIOR TO DISRUPTION OF ANY TRAFFIC, A TRAFFIC CONTROL PLAN SHALL BE PREPARED AND SUBMITTED TO THE CITY FOR APPROVAL. NO WORK SHALL COMMENCE UNTIL ALL APPROVED TRAFFIC CONTROL IS IN PLACE.
4. ALL APPROVALS AND PERMITS REQUIRED BY THE CITY OF LACEY SHALL BE OBTAINED BY THE CONTRACTOR PRIOR TO THE START OF CONSTRUCTION. A GRADING PERMIT FOR STORM POND CONSTRUCTION MAY BE REQUIRED.
5. IF CONSTRUCTION IS TO TAKE PLACE IN THE COUNTY RIGHT-OF-WAY, THE CONTRACTOR SHALL NOTIFY THE COUNTY AND OBTAIN ALL THE REQUIRED APPROVALS AND PERMITS.
6. A PRECONSTRUCTION MEETING SHALL BE HELD WITH THE CITY OF LACEY CONSTRUCTION INSPECTOR PRIOR TO THE START OF CONSTRUCTION.
7. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT 1-800-424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.
8. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO HAVE A COPY OF AN APPROVED SET OF PLANS ON THE CONSTRUCTION SITE AT ALL TIMES.
9. ALL SURVEYING AND STAKING SHALL BE PERFORMED PER THE ... LACEY DEVELOPMENT ...

... MEASURES SHALL BE ... 1-07.15 OF THE ... E DRAINAGE DESIGN ... NO TIME, WILL SILTS ... XISTING OR NEWLY ... ONS HAVE BEEN ...

... UALIFIED PRODUCTS LIST FOR THE SPECIFICATION LISTED BELOW:

   A. PLAIN CONCRETE STORM SEWER PIPE OR REINFORCED CONCRETE STORM SEWER PIPE PER WSDOT STANDARD SPECIFICATION 9-05.7.
   B. SOLID WALL PVC STORM SEWER PIPE PER WSDOT STANDARD SPECIFICATION 9-05.12(1).
   C. DUCTILE IRON SEWER PIPE PER WSDOT STANDARD SPECIFICATION 9-05.13.
   D. HANCOR BLUE SEAL AND ADVANCED DRAINAGE SYSTEMS (ADS) N-12 HDPE UP TO 36" IN DIAMETER PER WSDOT STANDARD SPECIFICATION 9-05.20.

12. ALL STORM DRAINAGE SYSTEMS SHALL BE AIR TESTED AT 4 PSI EXCEPT CONCRETE PIPE WHICH SHALL BE TESTED PER WSDOT/APWA STANDARD FOR CONCRETE STORM PIPE. ALL FLEXIBLE PIPE SHALL BE MANDREL TESTED PER WSDOT/APWA STANDARDS. TESTING SHALL BE DONE BY THE CONTRACTOR.
13. TESTING OF THE STORM SEWER SHALL INCLUDE VIDEO TAPING OF THE MAIN BY THE CONTRACTOR. IMMEDIATELY PRIOR TO VIDEO TAPING, ENOUGH WATER SHALL BE RUN DOWN THE LINE SO IT COMES OUT THE LOWER CATCHBASIN. A COPY OF THE VIDEO TAPE SHALL BE SUBMITTED TO THE CITY OF LACEY. ACCEPTANCE OF THE LINE WILL NOT BE MADE UNTIL AFTER THE TAPE HAS BEEN REVIEWED AND APPROVED BY THE CITY. TESTING SHALL TAKE PLACE AFTER ALL UNDERGROUND UTILITIES ARE INSTALLED AND COMPACTION OF THE ROADWAY SUBGRADE IS COMPLETE.
14. SPECIAL STRUCTURES, OIL/WATER SEPARATORS AND OUTLET CONTROLS SHALL BE INSTALLED PER PLANS AND MANUFACTURERS' RECOMMENDATIONS.
15. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED IN ACCORDANCE WITH THE DRAINAGE DESIGN AND EROSION CONTROL MANUAL FOR LACEY, SECTION 9.4, WET SEASON, DRY SEASON REQUIREMENTS FOR SITE STABILIZATION AND SECTION 9.14.16, EROSION CONTROL SEEDING. FOR SITES WHERE VEGETATION HAS BEEN PLANTED THROUGH HYDROSEEDING, THE FINANCIAL GUARANTEE WILL NOT BE RELEASED UNTIL THE VEGETATION HAS BEEN THOROUGHLY ESTABLISHED.
16. WHERE CONNECTIONS REQUIRE "FIELD VERIFICATIONS", CONNECTION POINTS WILL BE EXPOSED BY CONTRACTOR AND FITTINGS VERIFIED 48 HOURS PRIOR TO DISTRIBUTING SHUT-DOWN NOTICES.
17. ALL CATCH BASINS/MANHOLES, SHALL HAVE PADS PER LACEY DETAIL 5-5.
18. ANY CHANGES TO THE DESIGN SHALL FIRST BE REVIEWED AND APPROVED BY THE PROJECT ENGINEER AND THE CITY OF LACEY.
19. "DUMP NO WASTE PROTECT YOUR GROUND WATER" SHALL BE STENCILED BY EACH CATCH BASIN. USE WHITE TRAFFIC PAINT FOR STENCILING.

REVISED: 07/2005

PARCEL NUMBERS:
LOT 1 (310401)
LOT 2 (310402)
LOT 3 (320902)
LOT 4 (321001)

APPROVED FOR CONSTRUCTION FOR THE CITY OF LACEY

BY: ______________
DIRECTOR OF PUBLIC WORKS

DATE: ______________

Approval Expires Two Years from Above Date

UTILITY CONFLICT NOTE:

CAUTION:
THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION, DIMENSION, AND DEPTH OF ALL EXISTING UTILITIES WHETHER SHOWN ON THESE PLANS OR NOT BY POTHOLING THE UTILITIES AND SURVEYING THE HORIZONTAL AND VERTICAL LOCATION PRIOR TO CONSTRUCTION. THIS SHALL INCLUDE CALLING UTILITY LOCATE @ 1-800-424-5555 AND THEN POTHOLING ALL OF THE EXISTING UTILITIES AT LOCATIONS OF NEW UTILITY CROSSINGS TO PHYSICALLY VERIFY WHETHER OR NOT CONFLICTS EXIST. LOCATIONS OF SAID UTILITIES AS SHOWN ON THESE PLANS ARE BASED UPON THE UNVERIFIED PUBLIC INFORMATION AND ARE SUBJECT TO VARIATION. IF CONFLICTS SHOULD OCCUR, THE CONTRACTOR SHALL CONSULT BARGHAUSEN CONSULTING ENGINEERS, INC. TO RESOLVE ALL PROBLEMS PRIOR TO PROCEEDING WITH CONSTRUCTION.

ALI SADR — STATE OF WASHINGTON — 24661 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 6/11/

No.	Date	By	Ckd.	Appr.	Revision
7	7/29/08	DMH	AS	AS	REVISED PER CITY REVIEW
6	6/11/08	DMH	AS	AS	REVISED PER CITY REVIEW
5	1/28/08	DMH	AS	AS	UPDATED CURB RAMP DETAILS
4	1/14/08	DMH	AS	AS	REVISED PER CITY REVIEW
3	11/29/07	DMH	AS	AS	REVISED PER CITY REVIEW
2	5/24/06	MDY	JJ	AS	REVISED PER CITY REVIEW
1	4/11/06	MDY	JJ	AS	REVISED PER CITY REVIEW

Title: GRADING AND STORM DRAINAGE PLAN
O.B. CENTER
LACEY, WASHINGTON

For: UNITED BUILDERS, LLC
2905 BLACK LAKE BLVD. SW
TUMWATER, WASHINGTON 98512
CONTACT: BRENT RAKESTRAW (360) 753-0513

Designed JJ
Drawn RB
Checked AS
Approved AS
Date 2/7/06

Scale: Horizontal 1"=30'
Vertical N/A

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
KENT, WA 98032
(425)251-6222
(425)251-8782 FAX
CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES

Job Number 10938
Sheet C2 of 15

File:P:\10000s\10938\engineering\2-7-08\10938-gm1.dwg Date/Time:7/29/2008 12:50 PM Scale:1:30_XREF BWOLLASTON Xref: , z10938-b.DWG, z10938-s3.dwg, z10938-t.dwg, 205271-c.dwg

9.0 FACILITY SIZING AND DOWNSTREAM ANALYSIS

Retention Sizing Criteria

Total Site Area = 3.55 acres*
Martin Way Contributing: = 0.28 acres

Total = 3.83 acres**

Total area contributing to the infiltration pond = 3.83 acres
of which 0.68 acres are landscaping CN = 86
and 3.15 acres are impervious CN = 98

Required Storage Volume: 11,182 CF
Provided Storage Volume: 12,320 CF

Water Quality Sizing Criteria:

Impervious = 3.15 acres
- 0.06 ac. (future daycare)
- 0.23 ac. (building along Martin Way)
- 0.10 ac. (future office)

2.76 ac.

Pervious = 0.68 acre
- 0.25 ac. (pond)
- 0.23 ac. (pervious areas that bypass water quality)

0.20 ac.

6-Month Flow Rate = 1.05 cfs = 471.27 gpm
Storm Filter Flow Rate Per Cartridge = 15 gpm

Total Number of Cartridges = 471.27 gpm
÷ 15 gpm

31.42 = 32 total cartridges

* Includes Hoh Street S.E. road improvements.
* Includes the pond itself as well.

The infiltration pond size for this development was based on an infiltration rate of 20 inches per hour and infiltrating a 100-year 24-hour storm event, which utilized a precipitation rate of 6.15 inches over the 3.83 acres. A time of concentration of 10 minutes was used, which was conservative. The conveyance system was sized based on a 25-year storm utilizing Thurston County's Rational Method sizing program for conveyance elements. Please see the Appendix of this report for the Exhibit D infiltration sizing calculations, Exhibit E, the pipe conveyance sizing calculations, and Exhibit F, the water quality sizing calculations.