PRELIMINARY TECHNICAL INFORMATION REPORT

Larsen Drive Subdivision
La Center, Washington

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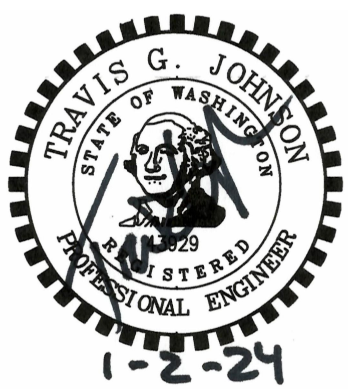
Technical Appendix:

CERTIFICATE OF ENGINEER

Larsen Drive Subdivision
Preliminary Drainage Report

The technical information and data contained in this report were prepared by the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.



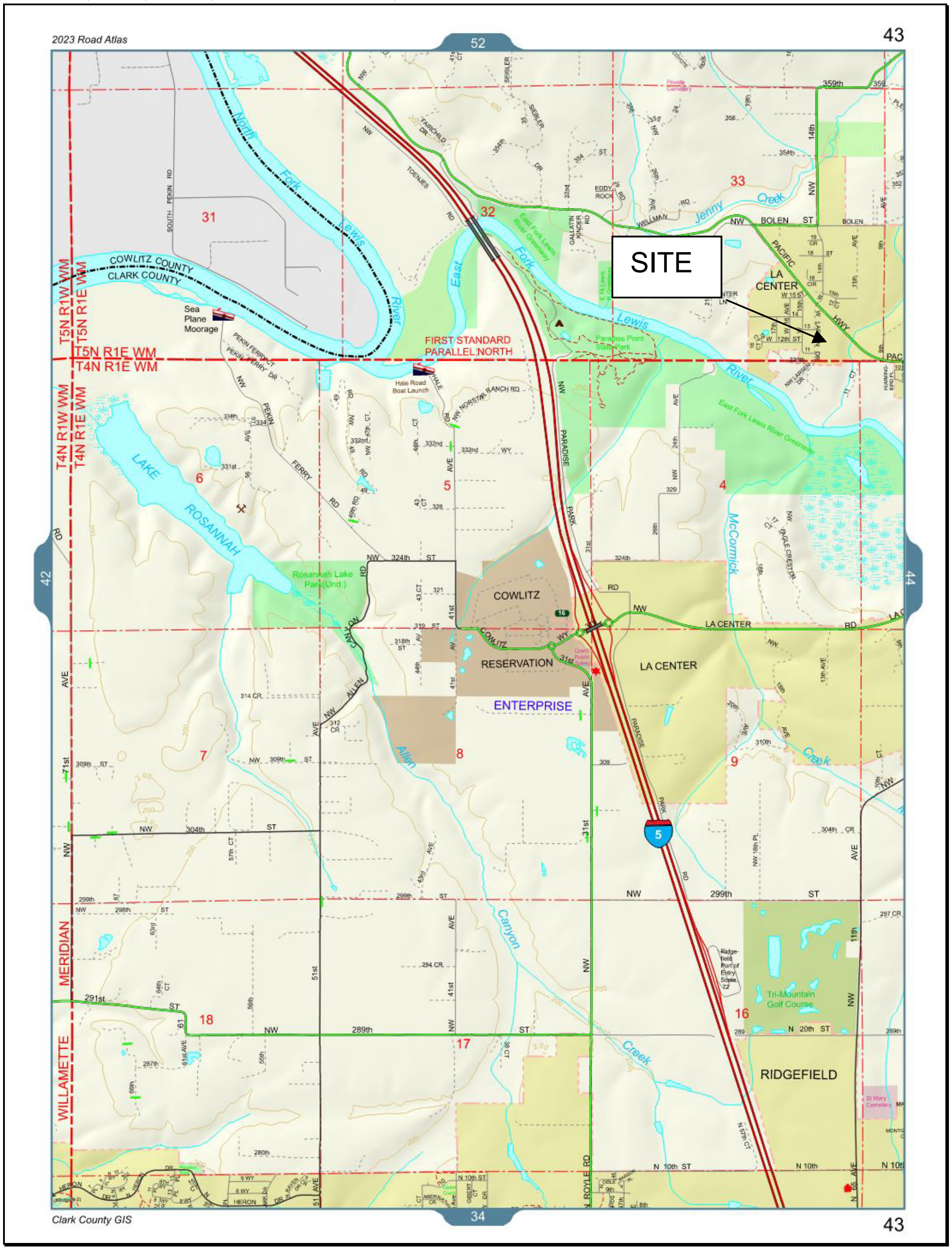
This document was:
Prepared by:

Mitchell A Geisler, EIT

VICINITY MAPS

(a) Site Location Map

Clark County Atlas
SE 1/4, S33, T5N, R1E La Center, WA



(b). Soils Map

USDA SCS Map 1" = 2130'

**Outlined Area of Interest (AOI) is an estimate of property boundary

Map Unit Legend:

GeB (Gee silt loam, 0-8% slopes):	93.8% of site
GeE (Gee silt loam, 20-30% slopes):	1.5% of site
OdB (Odne silt loam, 0-5%% slopes):	4.6% of site

SECTION A – PROJECT OVERVIEW

Larsen Drive Subdivision is a 6.40-acre site located in La Center, WA. The site currently has no identifiable address per Clark County GIS but it located directly south of 34214 NW Pacific Hwy La Center, Washington. It is identified by the Clark County Assessor's office as parcel 258631000 and further identified within the SE ¼ of section 33, T5N, R1E of the Willamette Meridian in Clark County, Washington. NW Larsen Drive borders the site to the west. The north and east sides of the site are bordered by private residential lots. The south side of the site is bordered by parcel 986051587 owned and maintained by the Riverside Estates HOA which contains the subdivisions sanitary sewer pump. A boundary line adjustment will be made between the project site, PN: 258631000 and the property to the north PN: 258766000. The project site is currently only 3.96 acres. The adjusted boundary lines will add 2.44 acres to the project site totaling 6.40 acres.

The site's existing topography is generally flat with slopes ranging from 0-8% sloping from the north to the southeast corner. Along the east boundary line, the site begins to increase in grade with steep slopes from 20-30%.

Larsen Drive Subdivision proposes to subdivide one parcel, after a BLA into 41 lots. The site will be accessed by NW Larsen Drive from the west. All roads installed onsite will be public and provide access to the lots. One private shared driveway will provide access to 3 lots. Individual driveway construction will be completed at the time of home construction.

The combined impervious area generated by the project includes approximately 105,487 ft^2 or roof area, 21,562 ft^2 of private driveway, 41,168 ft^2 of public road, 10,605 ft^2 public sidewalk, 2,313 ft^2 of private shared driveway, 3,041 ft^2 of open space trail through Tracts A and B, totaling 184,176 ft^2. The roof areas were calculated to be 60% of each lot's total area and the driveway areas were calculated to be 25ft x 20ft driveways for a total of 500 ft^2 per individual lot. These areas were modelled to ensure that enough detention is provided for the maximum impervious surface areas. The remaining area in each lot will be converted to lawn or landscaping totaling 50,958 ft^2 of pervious area. Landscaping in public right of way as well as within Tracts A and B have a total of 51,081 ft^2.

Due to negligible infiltration rates onsite, the project will utilize a detention pond with a flow control structure to store and release stormwater runoff to a flow spreader located at the southeast corner of the site, being the natural discharge location. Stormwater runoff will be piped to a treatment vault for treatment before being routed to the detention pond.

Existing storm water functions include surface runoff discharging off site to existing facilities. A ridge currently runs north south along roughly the center of the subject site. Flows on the east side of the ridge runoff to the southeast corner of the site and discharge off site into a ravine where an unnamed stream is located that flows south to the East Fork Lewis River. Runoff on the western side of the ridge discharges to a conveyance ditch along the east side of the existing NW Larsen Drive and drains to the southwest corner of the property. All runoff from the west side of the property gets captured by an 8" ductile iron culvert that conveys runoff to an existing stormwater pond located at the intersection of NW 339th Street and NW Larsen Drive on parcel 986030203. Due to existing topography runoff from parcel 258766000 to the north will continue to drain onto the project site. Runoff from the neighboring parcel will be considered as an offsite basin in the stormwater model for the design of the detention pond. Runoff generated due to construction within Basin 1 as well as existing runoff from offsite properties will be captured and conveyed to a treatment vault prior to being discharged to the stormwater detention pond where runoff will be flow controlled to discharge at rates that are equal to or less than the 2, 10, 25 and 100-year storm events. Runoff from within Basin 2 will be captured by a treatment catch basin prior to being discharged to its existing discharge location, however these flows will be considered in the design of the detention pond model.

SECTION B – QUANTITY CONTROL ANALYSIS AND DESIGN

Per Chapter 18.320 of the La Center Municipal Code (LCMC), the subdivision will be required to mitigate for stormwater runoff impacts generated as a result of the proposed improvements. The hydrologic analysis of this site was performed in accordance with the guidelines contained in LCMC and Chapters III-1 and III-2 of the Puget Sound Manual. The storm events were assumed to have a 24-hour duration and follow a Type II storm distribution. Rainfall depth for the 2, 10, 25, and 100-year 24-hour storm events are 2.3, 3.25, 3.75, and 4.4 inches respectively, as obtained from the Isopluvial maps for Clark County included in Appendix A. The detention facility has been designed to release runoff at rates equal to or less than the predevelopment peak runoff rates for the 2, 10, 25 and 100-year, 24-hour storm events as stated in LCMC Code Section 18.320.220 (3)(d)(i). In addition, the facility has been designed utilizing Figure III-1.1 Volume Correction Factor from the Puget Sound Manual. This resulted in a correction factor of 1.36 for the detention facilities or a storage multiplier of 0.72.

The live storage area of the stormwater facilities was assumed to be empty at the beginning of the design storm event. The hydrological analysis was completed using HydroCAD v 10.0, which allows the SCS TR-20 method of hydrograph routing to be utilized and the TR-55 method to determine the times of concentration. The soil characteristics were obtained from USDA NRCS website. As can be seen on the soils map located in the appendix of this report, there are multiple soil types covering this site. These soil types consist of hydrologic soil groups (HSG) C. The Runoff Curve Numbers (RCNs) that were used in the design of the project were taken from Table III-1.3 of the Puget Sound Manual. An RCN value of 85 was used for the HSG C soil in meadow or pasture area across the site for predeveloped conditions. An RCN value of 69 was used for post-development landscaping and an RCN value of 98 was used for pavement and roofs. The offsite basin for post-development flows was modeled with an RCN value of 98 for the existing roof areas and driveways, and 89 for the existing yard.

Table 1 below shows a tabulation of the project site areas for pre- and post-developed conditions.

Table 1- Summary of Pre-Developed Areas

	Basin	Pervious (sq-ft)	Total (acres)
Pre-Developed Area			
	Onsite	286,216	6.57
	Offsite	14,636	0.34

Table 2- Summary of Post-Developed Areas

Existing hard surface to remain	0 ft^2
New hard surface	184,176 ft^2 (4.23 acre)
Replaced hard surface	0 ft^2
Native vegetation converted to lawn or landscaping	102,040 ft^2 (2.34 acre)
Native vegetation converted to pasture	0 ft^2
Total land-disturbing activity	286,216 ft^2 (6.57 acre)
Pollution-generating hard surface	78,689 ft^2 (1.80 acre)
Pollution-generating pervious surface	0 ft^2
Total pollution-generating surfaces	78,689 ft^2 (1.79 acre)
Total non-pollution-generating surfaces	207,527 ft^2 (4.76 acre)

For the post-development prelim analysis two basins were modeled with all runoffs draining to the designed detention facility located at the southeast corner of the property.

The HydroCAD model basin DEV includes areas within both Basins 1 & 2 from the Post-Development Basin Map found in Appendix C of this report. Areas within Basin 2 will not be draining to the designed detention pond in the final design of the conveyance system. This is because the surface elevation of the catch basin positioned within Basin 2 is too low to convey stormwater back to the proposed pond. Instead, runoff will be treated and conveyed to the existing stormwater facility across NW Larsen Drive, where stormwater from the western half of the existing site is being drained too under the site's existing conditions. Additionally, areas along the frontage of NW Larsen Drive have been included out to the Center line of the roadway as contributing to the design ponds drainage area. NW Larsen Drive, after development, will remain to be a shed section roadway as it is currently, except for the newly constructed east 8.5' of roadway measured from the proposed face of curb. This last 8.5' will be crowned to drain runoff back to the proposed curb line, where it will be captured and mitigated with the development of Larsen Drive Subdivision. The preliminary pond has been designed to over-detain 0.17 acres of area that will not be draining to the pond post-development and will remain to drain to its existing discharge locations.

RCN values of 98 were used for asphalt and concrete impervious areas and 69 was used for landscaping areas that will be amended post construction.

Please refer to the HydroCAD stormwater model located in Appendix B, for tabulated acreage, imperviousness, curve numbers, length and grade of overland flow, and other hydrological parameters used in completing the analysis. Basin Maps are included in Appendix C.

Water quantity control for the development will be accomplished utilizing a detention facility. The detention pond will be constructed in the southeast corner of the site and will be accessed by a gravel road extending from the private shared driveway accessing lots 7-9. A flow control structure with 3 offices has been designed to release detained stormwater at rates equal to or less than the predeveloped discharge rates for the 2, 10, 25 and 100 year design storm events. See Appendix B for the HydroCAD report.

SECTION C – CONVEYANCE SYSTEMS ANALYSIS AND DESIGN

The pipes for the conveyance system will be designed for the 100-year storm event per LCMC 18.320.220 and will be sized to carry flows from the contributing drainage areas upon full buildout while operating in an open flow regime. The conveyance calculations for the stormwater pipes will be included with the Final TIR.

SECTION D – RUNOFF WATER QUALITY TREATMENT

Runoff from pollution generating surfaces will be treated using a Peak Diversion Stormfilter vault. Stormfilter Media cartridge systems supplied by Contech Engineered Solutions will be used to treat stormwater runoff from the site’s new roadways, driveways and sidewalk. Runoff will be treated through the vault before being piped to the detention facility. The number of required Stormfilter cartridges in the system will be based on the water quality treatment flow rate calculated for pollution generating and non-pollution generating surfaces and the treatment capacity of the filters supplied by Contech Engineered Solutions. Stormfilters have gained Washington Department of Ecology approval and have been allowed to be sized as offline systems because peak storms bypass the Stormfilter treatment chamber via an inlet/bypass assembly. See Appendix B for water quality flow rates calculated with the use of the Western Washington Hydrology Model (WWHM).

SECTION E – SOILS EVALUATION

There are three identified soil types located on this site. A soils map, obtained from USDA NRCS website is located before the narrative of this report. The soil types onsite consist of Gee silt loam, 0 to 8% slopes (GeB) and 20 to 30% slopes (GeE), and Odne silt loam, 0 to 5% slopes. These soils are in hydrologic soil group (HSG) C, except Odne silt loam is in hydrologic soil group D, and is mapped as a hydric soil.

SECTION F – SPECIAL REPORTS AND STUDIES

A geotechnical report, traffic analysis report, archeological report and critical areas report were all completed for this site. All reports have been included as part of the subdivision application. The Geotechnical Report is provided in Appendix D.

SECTION G – OTHER PERMITS

No other permits to be submitted for this site at this time.

SECTION H – MAINTENANCE AND OPERATIONS MANUAL

All of the stormwater facilities associated with this development are to be owned & maintained by the Larsen Drive Subdivision Homeowner's Association. A maintenance and operations manual is provided in Appendix E.

APPENDIX A

Design Criteria

Curve Numbers
Manning's "n" Values
Isopluvial Maps (2-, 10-, 25- and 100-Year)

Table III-1.3 SCS Western Washington Runoff Curve Numbers
(Published by SCS in 1982) Runoff curve numbers for selected agricultural, suburban and urban land use for Type 1A rainfall distribution, 24-hour storm duration.

LAND USE DESCRIPTION		CURVE NUMBERS BY HYDROLOGIC SOIL GROUP A	B	C	D
Cultivated land(1):	winter condition	86	91	94	95
Mountain open areas:	low growing brush & grasslands	74	82	89	92
Meadow or pasture:		65	78	85	89
Wood or forest land:	undisturbed	42	64	76	81
Wood or forest land:	young second growth or brush	55	72	81	86
Orchard:	with cover crop	81	88	92	94
Open spaces, lawns, parks, golf courses, cemeteries, landscaping.					
Good condition:	grass cover on ≥75% of the area	68	80	86	90
Fair condition:	grass cover on 50-75% of the area	77	85	90	92
Gravel roads & parking lots:		76	85	89	91
Dirt roads & parking lots:		72	82	87	89
Impervious surfaces, pavement, roofs etc.		98	98	98	98
Open water bodies:	lakes, wetlands, ponds etc.	100	100	100	100
Single family residential(2):		Separate curve number shall be selected for pervious & impervious portions of the site or basin			
Dwelling Unit/Gross Acre	%Impervious(3)				
1.0 DU/GA	15				
1.5 DU/GA	20				
2.0 DU/GA	25				
2.5 DU/GA	30				
3.0 DU/GA	34				
3.5 DU/GA	38				
4.0 DU/GA	42				
4.5 DU/GA	46				
5.0 DU/GA	48				
5.5 DU/GA	50				
6.0 DU/GA	52				
6.5 DU/GA	54				
7.0 DU/GA	56				
PUD's, condos, apartments, commercial businesses & industrial areas	%impervious must be computed				

(1) For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Sec. 4, Hydrology, Chapter 9, August 1972.
(2) Assumes roof and driveway runoff is directed into street/storm system.
(3) The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

Table III-1.5 Values of the Roughness Coefficient, "n"

Type of Channel and Description	Manning's "n"* (Normal)
A. Constructed Channels	
a. Earth, straight and uniform	
1. Clean, recently completed	0.018
2. Gravel, uniform section, clean	0.025
3. With short grass, few weeds	0.027
b. Earth, winding and sluggish	0.025
1. No vegetation	0.025
2. Grass, some weeds	0.030
3. Dense weeds or aquatic plants in deep channels	0.035
4. Earth bottom and rubble sides	0.030
5. Stony bottom and weedy banks	0.035
6. Cobble bottom and clean sides	0.040
c. Rock lined	
1. Smooth and uniform	0.035
2. Jagged and irregular	0.040
d. Channels not maintained, weeds and brush uncut	
1. Dense weeds, high as flow depth	0.080
2. Clean bottom, brush on sides	0.050
3. Same, highest stage of flow	0.070
4. Dense brush, high stage	0.100
B. Natural Streams	
B-1 Minor streams (top width at flood stage < 100 ft.)	
a. Streams on plain	
1. Clean, straight, full stage no rifts or deep pools	0.030
2. Same as above, but more stones and weeds	0.035
3. Clean, winding, some pools and shoals	0.040
4. Same as above, but some weeds	0.040
5. Same as 4, but more stones	0.050
6. Sluggish reaches, weedy deep pools	0.070
7. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.100
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages	
1. Bottom: gravel, cobbles, and few boulders	0.040
2. Bottom: cobbles with large boulders	0.050
B-2 Flood plains	
a. Pasture, no brush	
1. Short grass	0.030
2. High grass	0.035
b. Cultivated areas	
1. No crop	0.030
2. Mature row crops	0.035
3. Mature field crops	0.040
c. Brush	
1. Scattered brush, heavy weeds	0.050
2. Light brush and trees	0.060
3. Medium to dense brush	0.070
4. Heavy, dense brush	0.100
d. Trees	
1. Dense willows, straight	0.150
2. Cleared land with tree stumps, no sprouts	0.040
3. Same as above, but with heavy growth of sprouts	0.060
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.100
5. Same as above, but with flood stage reaching branches	0.120

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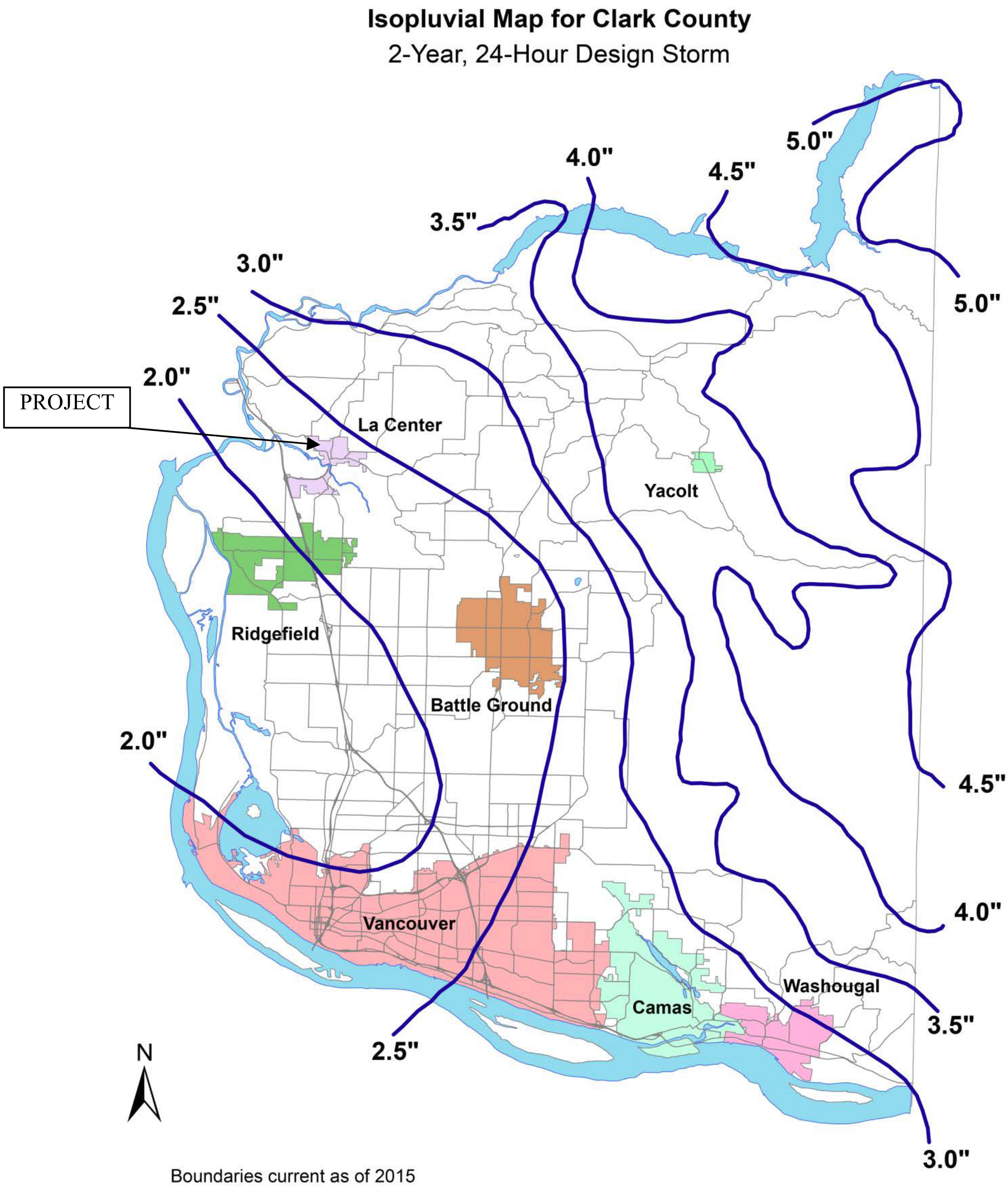

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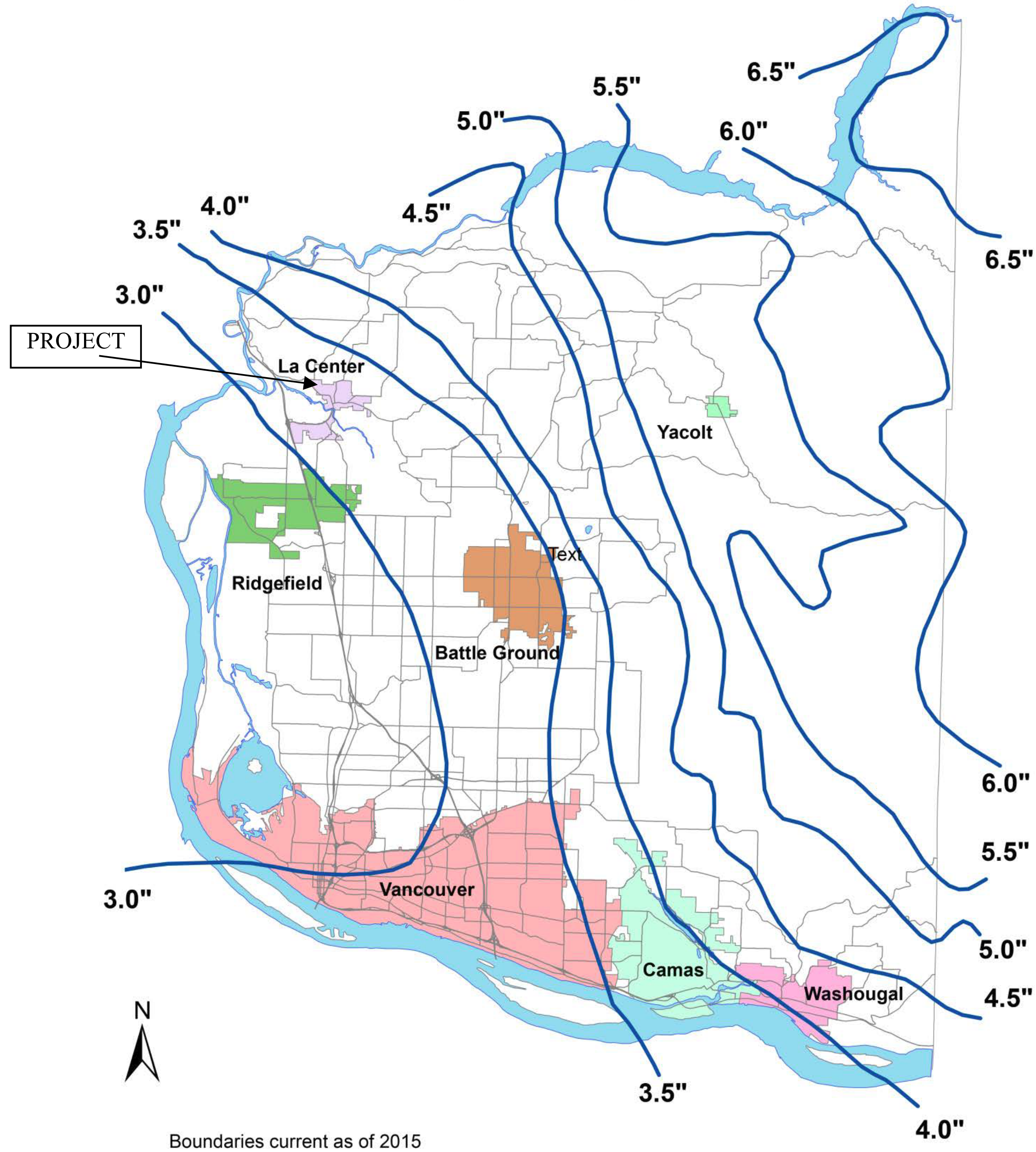
Isopluvial Map for Clark County

10-Year, 24-Hour Design Storm



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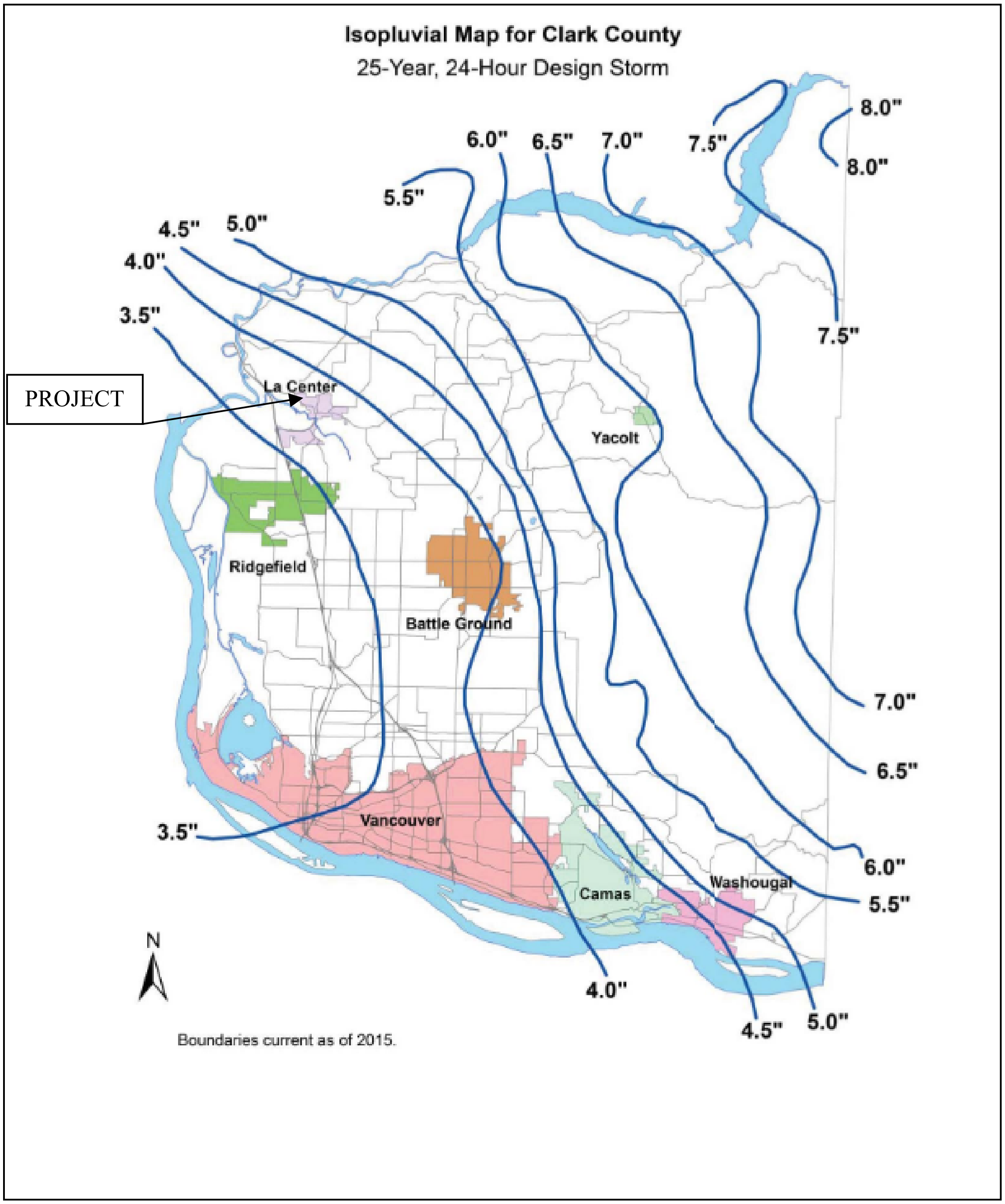

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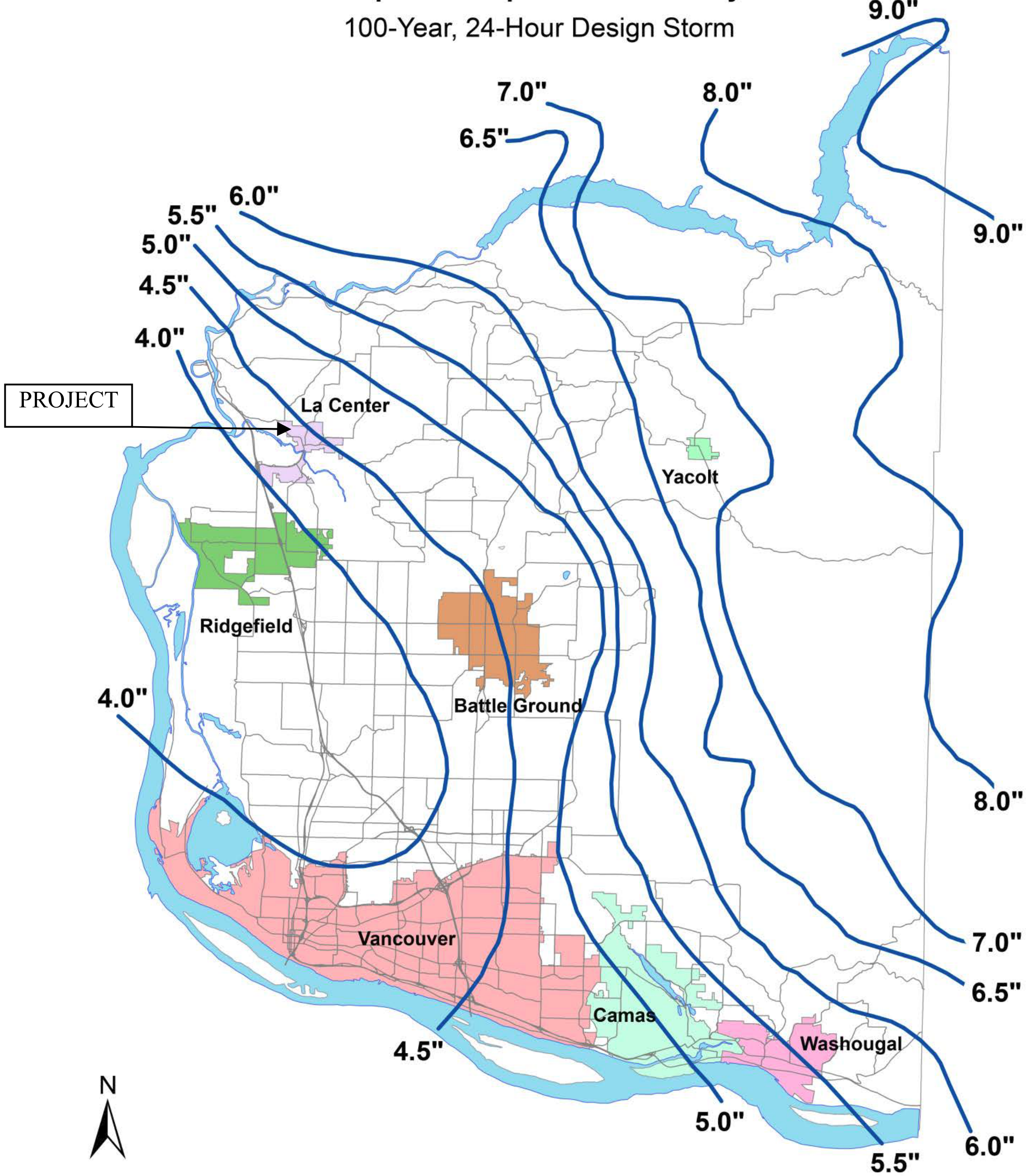
Isopluvial Map for Clark County

100-Year, 24-Hour Design Storm



Boundaries current as of 2015.

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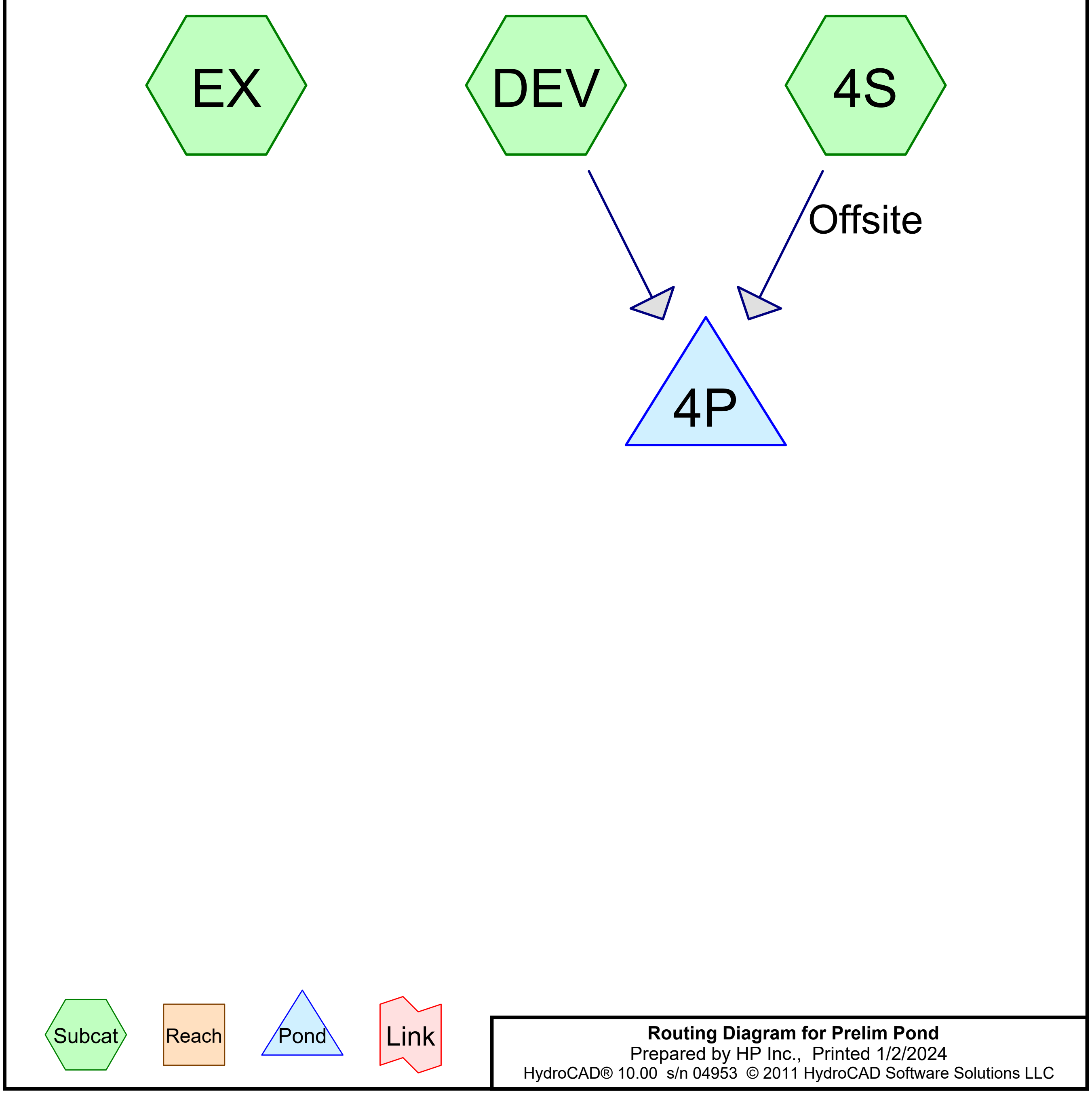
APPENDIX B

Stormwater Models



Routing Diagram for Prelim Pond
Prepared by HP Inc., Printed 1/2/2024
HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.170	69	Lot Landscape (DEV)
0.225	69	Planter Strips (DEV)
0.930	69	Tract A Landscape (DEV)
0.017	69	Tract B Landscape (DEV)
0.336	85	Offsite Pre-developed SG C (EX)
6.571	85	Onsite Pre-developed SG C (EX)
0.293	89	Existing Yard (4S)
0.495	98	Driveways (DEV)
0.998	98	Roads (DEV)
2.422	98	Roof (DEV)
0.043	98	Roof & D/W (4S)
0.313	98	S/W (DEV)
13.813	**86**	**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4S: Offsite Runoff Area=14,636 sf 12.84% Impervious Runoff Depth>1.26"
Tc=6.0 min CN=90 Runoff=0.77 cfs 0.035 af

Subcatchment DEV: Runoff Area=286,216 sf 64.35% Impervious Runoff Depth>1.12"
Tc=6.0 min CN=88 Runoff=13.68 cfs 0.612 af

Subcatchment EX: Runoff Area=300,852 sf 0.00% Impervious Runoff Depth>0.93"
Flow Length=704' Tc=22.0 min CN=85 Runoff=7.32 cfs 0.535 af

Pond 4P: Peak Elev=137.14' Storage=5,222 cf Inflow=14.45 cfs 0.648 af
Outflow=7.27 cfs 0.646 af

Total Runoff Area = 13.813 ac Runoff Volume = 1.182 af Average Runoff Depth = 1.03"
69.08% Pervious = 9.542 ac 30.92% Impervious = 4.271 ac

Summary for Subcatchment 4S: Offsite

Runoff = 0.77 cfs @ 11.97 hrs, Volume= 0.035 af, Depth> 1.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Year Rainfall=2.30"

	Area (sf)	CN	Description
*	1,879	98	Roof & D/W
*	12,757	89	Existing Yard
	14,636	90	Weighted Average
	12,757		87.16% Pervious Area
	1,879		12.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment DEV:

Runoff = 13.68 cfs @ 11.97 hrs, Volume= 0.612 af, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Year Rainfall=2.30"

	Area (sf)	CN	Description
*	105,487	98	Roof
*	21,562	98	Driveways
*	50,959	69	Lot Landscape
*	43,481	98	Roads
*	13,646	98	S/W
*	9,819	69	Planter Strips
*	40,522	69	Tract A Landscape
*	740	69	Tract B Landscape
	286,216	88	Weighted Average
	102,040		35.65% Pervious Area
	184,176		64.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX:

Runoff = 7.32 cfs @ 12.16 hrs, Volume= 0.535 af, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Year Rainfall=2.30"

	Area (sf)	CN	Description
*	286,216	85	Onsite Pre-developed SG C
*	14,636	85	Offsite Pre-developed SG C
	300,852	85	Weighted Average
	300,852		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	300	0.0567	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.30"
3.7	404	0.0668	1.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.0	704	Total			

Summary for Pond 4P:

Inflow Area = 6.907 ac, 61.84% Impervious, Inflow Depth > 1.13" for 2 Year event
Inflow = 14.45 cfs @ 11.97 hrs, Volume= 0.648 af
Outflow = 7.27 cfs @ 12.07 hrs, Volume= 0.646 af, Atten= 50%, Lag= 5.9 min
Primary = 7.27 cfs @ 12.07 hrs, Volume= 0.646 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 137.14' @ 12.07 hrs Surf.Area= 2,703 sf Storage= 5,222 cf

Plug-Flow detention time= 5.8 min calculated for 0.646 af (100% of inflow)
Center-of-Mass det. time= 5.1 min (789.6 - 784.5)

Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	21,789 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.00	1,078	0	0
135.00	1,786	1,432	1,432
136.00	2,613	2,200	3,632
137.00	3,604	3,109	6,740
138.00	4,681	4,143	10,883
139.00	5,831	5,256	16,139
140.00	7,046	6,439	22,577
141.00	8,325	7,686	30,263

Device	Routing	Invert	Outlet Devices
#1	Primary	134.00'	**12.5" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	137.20'	**13.1" Vert. Orifice/Grate** C= 0.600
#3	Primary	139.63'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.22 cfs @ 12.07 hrs HW=137.10' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 7.22 cfs @ 8.48 fps)
├—**2=Orifice/Grate** (Controls 0.00 cfs)
└—**3=Orifice/Grate** (Controls 0.00 cfs)

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4S: Offsite Runoff Area=14,636 sf 12.84% Impervious Runoff Depth>2.07"
Tc=6.0 min CN=90 Runoff=1.24 cfs 0.058 af

Subcatchment DEV: Runoff Area=286,216 sf 64.35% Impervious Runoff Depth>1.90"
Tc=6.0 min CN=88 Runoff=22.67 cfs 1.040 af

Subcatchment EX: Runoff Area=300,852 sf 0.00% Impervious Runoff Depth>1.66"
Flow Length=704' Tc=22.0 min CN=85 Runoff=13.04 cfs 0.953 af

Pond 4P: Peak Elev=138.61' Storage=10,047 cf Inflow=23.91 cfs 1.098 af
Outflow=13.01 cfs 1.096 af

Total Runoff Area = 13.813 ac Runoff Volume = 2.051 af Average Runoff Depth = 1.78"
69.08% Pervious = 9.542 ac 30.92% Impervious = 4.271 ac

Summary for Subcatchment 4S: Offsite

Runoff = 1.24 cfs @ 11.97 hrs, Volume= 0.058 af, Depth> 2.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.25"

	Area (sf)	CN	Description
*	1,879	98	Roof & D/W
*	12,757	89	Existing Yard
	14,636	90	Weighted Average
	12,757		87.16% Pervious Area
	1,879		12.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment DEV:

Runoff = 22.67 cfs @ 11.97 hrs, Volume= 1.040 af, Depth> 1.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.25"

	Area (sf)	CN	Description
*	105,487	98	Roof
*	21,562	98	Driveways
*	50,959	69	Lot Landscape
*	43,481	98	Roads
*	13,646	98	S/W
*	9,819	69	Planter Strips
*	40,522	69	Tract A Landscape
*	740	69	Tract B Landscape
	286,216	88	Weighted Average
	102,040		35.65% Pervious Area
	184,176		64.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX:

Runoff = 13.04 cfs @ 12.15 hrs, Volume= 0.953 af, Depth> 1.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.25"

	Area (sf)	CN	Description
*	286,216	85	Onsite Pre-developed SG C
*	14,636	85	Offsite Pre-developed SG C
	300,852	85	Weighted Average
	300,852		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	300	0.0567	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.30"
3.7	404	0.0668	1.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.0	704	Total			

Summary for Pond 4P:

Inflow Area = 6.907 ac, 61.84% Impervious, Inflow Depth > 1.91" for 10 Year event
Inflow = 23.91 cfs @ 11.97 hrs, Volume= 1.098 af
Outflow = 13.01 cfs @ 12.06 hrs, Volume= 1.096 af, Atten= 46%, Lag= 5.7 min
Primary = 13.01 cfs @ 12.06 hrs, Volume= 1.096 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 138.61' @ 12.06 hrs Surf.Area= 3,876 sf Storage= 10,047 cf

Plug-Flow detention time= 7.2 min calculated for 1.093 af (100% of inflow)
Center-of-Mass det. time= 6.6 min (779.4 - 772.8)

Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	21,789 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.00	1,078	0	0
135.00	1,786	1,432	1,432
136.00	2,613	2,200	3,632
137.00	3,604	3,109	6,740
138.00	4,681	4,143	10,883
139.00	5,831	5,256	16,139
140.00	7,046	6,439	22,577
141.00	8,325	7,686	30,263

Device	Routing	Invert	Outlet Devices
#1	Primary	134.00'	**12.5" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	137.20'	**13.1" Vert. Orifice/Grate** C= 0.600
#3	Primary	139.63'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=12.87 cfs @ 12.06 hrs HW=138.57' (Free Discharge)
├─**1=Orifice/Grate** (Orifice Controls 8.78 cfs @ 10.30 fps)
├─**2=Orifice/Grate** (Orifice Controls 4.10 cfs @ 4.38 fps)
└─**3=Orifice/Grate** (Controls 0.00 cfs)

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4S: Offsite Runoff Area=14,636 sf 12.84% Impervious Runoff Depth>2.51"
Tc=6.0 min CN=90 Runoff=1.49 cfs 0.070 af

Subcatchment DEV: Runoff Area=286,216 sf 64.35% Impervious Runoff Depth>2.33"
Tc=6.0 min CN=88 Runoff=27.48 cfs 1.276 af

Subcatchment EX: Runoff Area=300,852 sf 0.00% Impervious Runoff Depth>2.06"
Flow Length=704' Tc=22.0 min CN=85 Runoff=16.19 cfs 1.188 af

Pond 4P: Peak Elev=139.27' Storage=12,799 cf Inflow=28.97 cfs 1.346 af
Outflow=15.00 cfs 1.344 af

Total Runoff Area = 13.813 ac Runoff Volume = 2.534 af Average Runoff Depth = 2.20"
69.08% Pervious = 9.542 ac 30.92% Impervious = 4.271 ac

Summary for Subcatchment 4S: Offsite

Runoff = 1.49 cfs @ 11.97 hrs, Volume= 0.070 af, Depth> 2.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=3.75"

	Area (sf)	CN	Description
*	1,879	98	Roof & D/W
*	12,757	89	Existing Yard
	14,636	90	Weighted Average
	12,757		87.16% Pervious Area
	1,879		12.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment DEV:

Runoff = 27.48 cfs @ 11.97 hrs, Volume= 1.276 af, Depth> 2.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=3.75"

	Area (sf)	CN	Description
*	105,487	98	Roof
*	21,562	98	Driveways
*	50,959	69	Lot Landscape
*	43,481	98	Roads
*	13,646	98	S/W
*	9,819	69	Planter Strips
*	40,522	69	Tract A Landscape
*	740	69	Tract B Landscape
	286,216	88	Weighted Average
	102,040		35.65% Pervious Area
	184,176		64.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX:

Runoff = 16.19 cfs @ 12.15 hrs, Volume= 1.188 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=3.75"

	Area (sf)	CN	Description
*	286,216	85	Onsite Pre-developed SG C
*	14,636	85	Offsite Pre-developed SG C
	300,852	85	Weighted Average
	300,852		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	300	0.0567	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.30"
3.7	404	0.0668	1.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.0	704	Total			

Summary for Pond 4P:

Inflow Area = 6.907 ac, 61.84% Impervious, Inflow Depth > 2.34" for 25 Year event
Inflow = 28.97 cfs @ 11.97 hrs, Volume= 1.346 af
Outflow = 15.00 cfs @ 12.07 hrs, Volume= 1.344 af, Atten= 48%, Lag= 5.9 min
Primary = 15.00 cfs @ 12.07 hrs, Volume= 1.344 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 139.27' @ 12.07 hrs Surf.Area= 4,437 sf Storage= 12,799 cf

Plug-Flow detention time= 7.7 min calculated for 1.344 af (100% of inflow)
Center-of-Mass det. time= 7.2 min (775.3 - 768.1)

Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	21,789 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.00	1,078	0	0
135.00	1,786	1,432	1,432
136.00	2,613	2,200	3,632
137.00	3,604	3,109	6,740
138.00	4,681	4,143	10,883
139.00	5,831	5,256	16,139
140.00	7,046	6,439	22,577
141.00	8,325	7,686	30,263

Device	Routing	Invert	Outlet Devices
#1	Primary	134.00'	**12.5" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	137.20'	**13.1" Vert. Orifice/Grate** C= 0.600
#3	Primary	139.63'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=14.87 cfs @ 12.07 hrs HW=139.23' (Free Discharge)
├─**1=Orifice/Grate** (Orifice Controls 9.38 cfs @ 11.01 fps)
├─**2=Orifice/Grate** (Orifice Controls 5.49 cfs @ 5.87 fps)
└─**3=Orifice/Grate** (Controls 0.00 cfs)

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4S: Offsite Runoff Area=14,636 sf 12.84% Impervious Runoff Depth>3.09"
Tc=6.0 min CN=90 Runoff=1.81 cfs 0.087 af

Subcatchment DEV: Runoff Area=286,216 sf 64.35% Impervious Runoff Depth>2.90"
Tc=6.0 min CN=88 Runoff=33.76 cfs 1.588 af

Subcatchment EX: Runoff Area=300,852 sf 0.00% Impervious Runoff Depth>2.61"
Flow Length=704' Tc=22.0 min CN=85 Runoff=20.34 cfs 1.502 af

Pond 4P: Peak Elev=140.01' Storage=16,298 cf Inflow=35.56 cfs 1.675 af
Outflow=20.34 cfs 1.673 af

Total Runoff Area = 13.813 ac Runoff Volume = 3.177 af Average Runoff Depth = 2.76"
69.08% Pervious = 9.542 ac 30.92% Impervious = 4.271 ac

Summary for Subcatchment 4S: Offsite

Runoff = 1.81 cfs @ 11.96 hrs, Volume= 0.087 af, Depth> 3.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.40"

	Area (sf)	CN	Description
*	1,879	98	Roof & D/W
*	12,757	89	Existing Yard
	14,636	90	Weighted Average
	12,757		87.16% Pervious Area
	1,879		12.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment DEV:

Runoff = 33.76 cfs @ 11.97 hrs, Volume= 1.588 af, Depth> 2.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.40"

	Area (sf)	CN	Description
*	105,487	98	Roof
*	21,562	98	Driveways
*	50,959	69	Lot Landscape
*	43,481	98	Roads
*	13,646	98	S/W
*	9,819	69	Planter Strips
*	40,522	69	Tract A Landscape
*	740	69	Tract B Landscape
	286,216	88	Weighted Average
	102,040		35.65% Pervious Area
	184,176		64.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment EX:

Runoff = 20.34 cfs @ 12.15 hrs, Volume= 1.502 af, Depth> 2.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.40"

	Area (sf)	CN	Description
*	286,216	85	Onsite Pre-developed SG C
*	14,636	85	Offsite Pre-developed SG C
	300,852	85	Weighted Average
	300,852		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	300	0.0567	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.30"
3.7	404	0.0668	1.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.0	704	Total			

Summary for Pond 4P:

Inflow Area = 6.907 ac, 61.84% Impervious, Inflow Depth > 2.91" for 100 Year event
Inflow = 35.56 cfs @ 11.97 hrs, Volume= 1.675 af
Outflow = 20.34 cfs @ 12.06 hrs, Volume= 1.673 af, Atten= 43%, Lag= 5.6 min
Primary = 20.34 cfs @ 12.06 hrs, Volume= 1.673 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 140.01' @ 12.06 hrs Surf.Area= 5,081 sf Storage= 16,298 cf

Plug-Flow detention time= 8.2 min calculated for 1.668 af (100% of inflow)
Center-of-Mass det. time= 7.7 min (770.7 - 763.0)

Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	21,789 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.00	1,078	0	0
135.00	1,786	1,432	1,432
136.00	2,613	2,200	3,632
137.00	3,604	3,109	6,740
138.00	4,681	4,143	10,883
139.00	5,831	5,256	16,139
140.00	7,046	6,439	22,577
141.00	8,325	7,686	30,263

Device	Routing	Invert	Outlet Devices
#1	Primary	134.00'	**12.5" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	137.20'	**13.1" Vert. Orifice/Grate** C= 0.600
#3	Primary	139.63'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=19.87 cfs @ 12.06 hrs HW=139.97' (Free Discharge)
├─**1=Orifice/Grate** (Orifice Controls 10.03 cfs @ 11.77 fps)
├─**2=Orifice/Grate** (Orifice Controls 6.73 cfs @ 7.19 fps)
└─**3=Orifice/Grate** (Weir Controls 3.11 cfs @ 1.92 fps)

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 3681 Prelim WQ

Site Name:	
Site Address:	
City:	
Report Date:	1/2/2024
Gage:	Ridgefield
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.110
Version Date:	2023/01/27
Version:	4.2.19

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
SG2, Lawn, Mod	2.635
Pervious Total	2.635
Impervious Land Use	acre
ROADS MOD	0.998
ROOF TOPS FLAT	2.46
DRIVEWAYS FLAT	0.495
SIDEWALKS MOD	0.313
Impervious Total	4.266
Basin Total	6.901

Mitigated Land Use

Basin 1

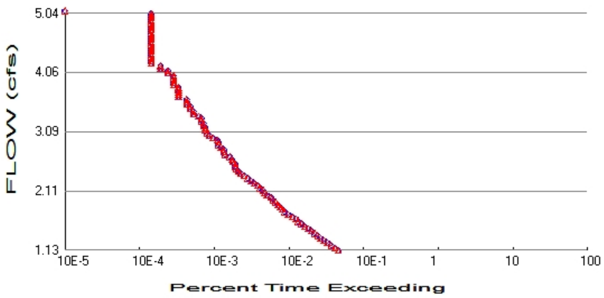
Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SG2, Lawn, Mod	2.635
Pervious Total	2.635
Impervious Land Use	acre
ROADS MOD	0.998
ROOF TOPS FLAT	2.46
DRIVEWAYS FLAT	0.495
SIDEWALKS MOD	0.313
Impervious Total	4.266
Basin Total	6.901

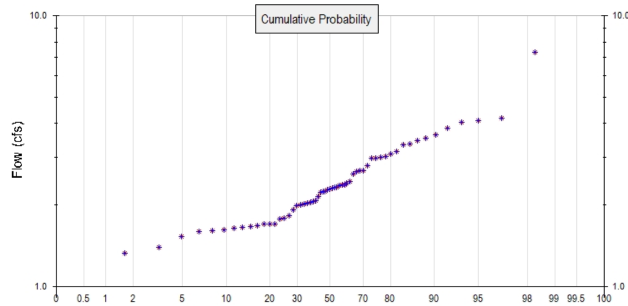
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 2.635
Total Impervious Area: 4.266

Mitigated Landuse Totals for POC #1
Total Pervious Area: 2.635
Total Impervious Area: 4.266

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	2.267343
5 year	3.052452
10 year	3.624367
25 year	4.408539
50 year	5.038902
100 year	5.710156

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	2.267343
5 year	3.052452
10 year	3.624367
25 year	4.408539
50 year	5.038902
100 year	5.710156

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	3.838	3.838
1950	1.706	1.706
1951	2.662	2.662
1952	2.378	2.378
1953	1.593	1.593
1954	2.249	2.249
1955	1.681	1.681
1956	3.031	3.031
1957	1.664	1.664
1958	2.446	2.446

1959	1.616	1.616
1960	2.043	2.043
1961	2.684	2.684
1962	1.922	1.922
1963	2.276	2.276
1964	1.780	1.780
1965	2.016	2.016
1966	3.087	3.087
1967	2.036	2.036
1968	3.621	3.621
1969	3.003	3.003
1970	7.307	7.307
1971	2.977	2.977
1972	2.296	2.296
1973	2.325	2.325
1974	4.047	4.047
1975	1.700	1.700
1976	2.327	2.327
1977	1.391	1.391
1978	2.980	2.980
1979	2.685	2.685
1980	1.700	1.700
1981	3.457	3.457
1982	2.057	2.057
1983	4.108	4.108
1984	1.644	1.644
1985	2.240	2.240
1986	2.605	2.605
1987	1.819	1.819
1988	3.530	3.530
1989	1.530	1.530
1990	2.234	2.234
1991	1.649	1.649
1992	1.790	1.790
1993	1.994	1.994
1994	1.611	1.611
1995	2.144	2.144
1996	3.341	3.341
1997	3.355	3.355
1998	2.306	2.306
1999	2.369	2.369
2000	1.232	1.232
2001	1.331	1.331
2002	3.163	3.163
2003	2.409	2.409
2004	2.353	2.353
2005	2.796	2.796
2006	2.077	2.077
2007	2.001	2.001
2008	4.192	4.192

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	7.3069	7.3069
2	4.1918	4.1918
3	4.1083	4.1083
4	4.0471	4.0471

5	3.8383	3.8383
6	3.6210	3.6210
7	3.5297	3.5297
8	3.4566	3.4566
9	3.3546	3.3546
10	3.3410	3.3410
11	3.1629	3.1629
12	3.0865	3.0865
13	3.0308	3.0308
14	3.0033	3.0033
15	2.9799	2.9799
16	2.9773	2.9773
17	2.7963	2.7963
18	2.6847	2.6847
19	2.6837	2.6837
20	2.6621	2.6621
21	2.6051	2.6051
22	2.4461	2.4461
23	2.4092	2.4092
24	2.3783	2.3783
25	2.3687	2.3687
26	2.3529	2.3529
27	2.3267	2.3267
28	2.3249	2.3249
29	2.3063	2.3063
30	2.2962	2.2962
31	2.2758	2.2758
32	2.2487	2.2487
33	2.2404	2.2404
34	2.2338	2.2338
35	2.1435	2.1435
36	2.0771	2.0771
37	2.0571	2.0571
38	2.0430	2.0430
39	2.0356	2.0356
40	2.0164	2.0164
41	2.0014	2.0014
42	1.9939	1.9939
43	1.9222	1.9222
44	1.8192	1.8192
45	1.7905	1.7905
46	1.7801	1.7801
47	1.7061	1.7061
48	1.7001	1.7001
49	1.6996	1.6996
50	1.6807	1.6807
51	1.6643	1.6643
52	1.6494	1.6494
53	1.6442	1.6442
54	1.6159	1.6159
55	1.6111	1.6111
56	1.5933	1.5933
57	1.5296	1.5296
58	1.3907	1.3907
59	1.3312	1.3312
60	1.2318	1.2318

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
1.1337	965	965	100	Pass
1.1731	868	868	100	Pass
1.2126	774	774	100	Pass
1.2520	688	688	100	Pass
1.2915	619	619	100	Pass
1.3309	563	563	100	Pass
1.3704	509	509	100	Pass
1.4098	463	463	100	Pass
1.4492	419	419	100	Pass
1.4887	383	383	100	Pass
1.5281	340	340	100	Pass
1.5676	310	310	100	Pass
1.6070	282	282	100	Pass
1.6465	261	261	100	Pass
1.6859	233	233	100	Pass
1.7254	205	205	100	Pass
1.7648	186	186	100	Pass
1.8043	171	171	100	Pass
1.8437	160	160	100	Pass
1.8832	149	149	100	Pass
1.9226	139	139	100	Pass
1.9621	128	128	100	Pass
2.0015	120	120	100	Pass
2.0409	107	107	100	Pass
2.0804	98	98	100	Pass
2.1198	95	95	100	Pass
2.1593	87	87	100	Pass
2.1987	80	80	100	Pass
2.2382	72	72	100	Pass
2.2776	66	66	100	Pass
2.3171	59	59	100	Pass
2.3565	52	52	100	Pass
2.3960	47	47	100	Pass
2.4354	44	44	100	Pass
2.4749	41	41	100	Pass
2.5143	40	40	100	Pass
2.5538	40	40	100	Pass
2.5932	37	37	100	Pass
2.6326	36	36	100	Pass
2.6721	34	34	100	Pass
2.7115	29	29	100	Pass
2.7510	28	28	100	Pass
2.7904	28	28	100	Pass
2.8299	26	26	100	Pass
2.8693	24	24	100	Pass
2.9088	24	24	100	Pass
2.9482	23	23	100	Pass
2.9877	20	20	100	Pass
3.0271	18	18	100	Pass
3.0666	17	17	100	Pass
3.1060	16	16	100	Pass
3.1455	16	16	100	Pass
3.1849	15	15	100	Pass

3.2244	15	15	100	Pass
3.2638	14	14	100	Pass
3.3032	14	14	100	Pass
3.3427	13	13	100	Pass
3.3821	11	11	100	Pass
3.4216	11	11	100	Pass
3.4610	10	10	100	Pass
3.5005	10	10	100	Pass
3.5399	9	9	100	Pass
3.5794	9	9	100	Pass
3.6188	9	9	100	Pass
3.6583	7	7	100	Pass
3.6977	7	7	100	Pass
3.7372	7	7	100	Pass
3.7766	7	7	100	Pass
3.8161	7	7	100	Pass
3.8555	6	6	100	Pass
3.8949	6	6	100	Pass
3.9344	6	6	100	Pass
3.9738	6	6	100	Pass
4.0133	6	6	100	Pass
4.0527	5	5	100	Pass
4.0922	5	5	100	Pass
4.1316	4	4	100	Pass
4.1711	4	4	100	Pass
4.2105	3	3	100	Pass
4.2500	3	3	100	Pass
4.2894	3	3	100	Pass
4.3289	3	3	100	Pass
4.3683	3	3	100	Pass
4.4078	3	3	100	Pass
4.4472	3	3	100	Pass
4.4866	3	3	100	Pass
4.5261	3	3	100	Pass
4.5655	3	3	100	Pass
4.6050	3	3	100	Pass
4.6444	3	3	100	Pass
4.6839	3	3	100	Pass
4.7233	3	3	100	Pass
4.7628	3	3	100	Pass
4.8022	3	3	100	Pass
4.8417	3	3	100	Pass
4.8811	3	3	100	Pass
4.9206	3	3	100	Pass
4.9600	3	3	100	Pass
4.9995	3	3	100	Pass
5.0389	3	3	100	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.5737 acre-feet
On-line facility target flow:	0.7978 cfs.
Adjusted for 15 min:	0.7978 cfs.
Off-line facility target flow:	0.4471 cfs.
Adjusted for 15 min:	0.4471 cfs.

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
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

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

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   3681 Prelim WQ.wdm
MESSU      25   Pre3681 Prelim WQ.MES
           27   Pre3681 Prelim WQ.L61
           28   Pre3681 Prelim WQ.L62
           30   POC3681 Prelim WQ1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      17
      IMPLND       2
      IMPLND       4
      IMPLND       5
      IMPLND       9
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                         in  out           ***
   17      SG2, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   17              0        11       0.1       400       0.1         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                   ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   17            0.1       1.2      0.25         1       0.4      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   17              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->   Unit-systems   Printer ***
    # -  #                      User  t-series Engl Metr ***
                                        in  out           ***
    2      ROADS/MOD               1    1    1   27    0
    4      ROOF TOPS/FLAT          1    1    1   27    0
    5      DRIVEWAYS/FLAT          1    1    1   27    0
    9      SIDEWALKS/MOD           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    9         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    9         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
```

```
    4         0    0    0    0    0
    5         0    0    0    0    0
    9         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            400      0.05       0.1      0.08
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    9            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2              0         0
    4              0         0
    5              0         0
    9              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2              0         0
    4              0         0
    5              0         0
    9              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  17                       2.635     COPY   501     12
PERLND  17                       2.635     COPY   501     13
IMPLND   2                       0.998     COPY   501     15
IMPLND   4                        2.46     COPY   501     15
IMPLND   5                       0.495     COPY   501     15
IMPLND   9                       0.313     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                                in  out                      ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                       ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.11           PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.11           IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.8            IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   3681 Prelim WQ.wdm
MESSU      25   Mit3681 Prelim WQ.MES
           27   Mit3681 Prelim WQ.L61
           28   Mit3681 Prelim WQ.L62
           30   POC3681 Prelim WQ1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      17
      IMPLND       2
      IMPLND       4
      IMPLND       5
      IMPLND       9
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out         ***
   17      SG2, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   17              0        11       0.1       400       0.1         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   17            0.1       1.2      0.25         1       0.4      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   17              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    2      ROADS/MOD             1    1    1   27    0
    4      ROOF TOPS/FLAT        1    1    1   27    0
    5      DRIVEWAYS/FLAT        1    1    1   27    0
    9      SIDEWALKS/MOD         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    9         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   *********
    2         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    9         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***
    2         0    0    0    0    0
```

```
    4         0    0    0    0    0
    5         0    0    0    0    0
    9         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            400      0.05       0.1      0.08
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    9            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2              0         0
    4              0         0
    5              0         0
    9              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2              0         0
    4              0         0
    5              0         0
    9              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  17                       2.635     COPY   501     12
PERLND  17                       2.635     COPY   501     13
IMPLND   2                       0.998     COPY   501     15
IMPLND   4                        2.46     COPY   501     15
IMPLND   5                       0.495     COPY   501     15
IMPLND   9                       0.313     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *     *  *  *  *  *        *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.11           PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.11           IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.8            IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>      <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>               <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY          INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY          INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY          INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Local (360)943-0304

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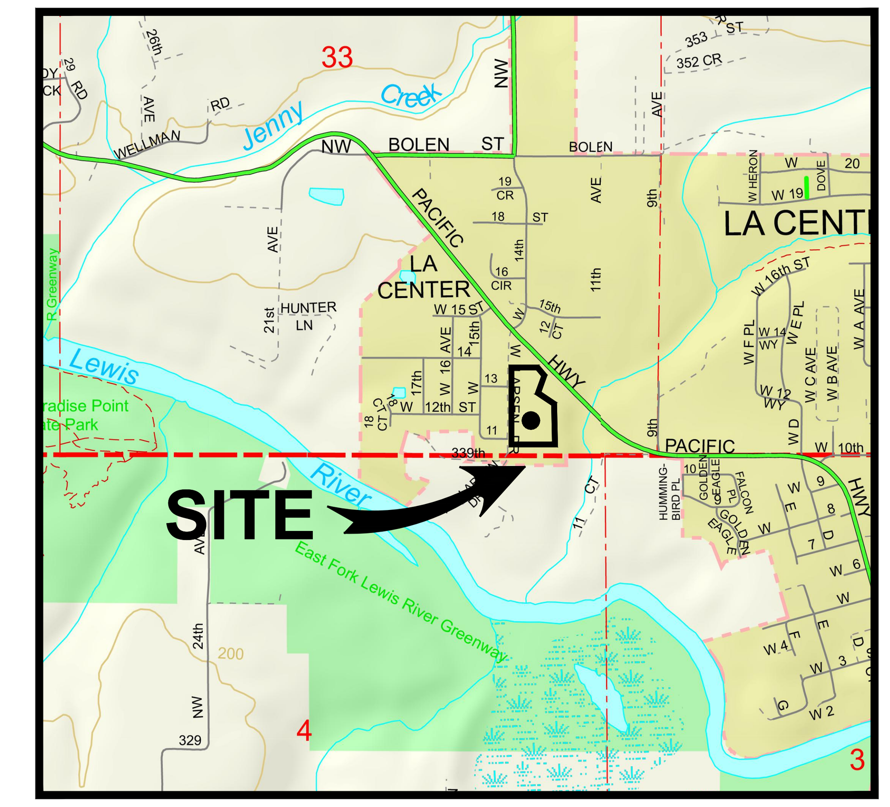
APPENDIX C

Basin Maps

Pre-Developed
Post-Developed

Larsen Drive Subdivision

Located in the SE ¼ of Section 33, T5N, R1E, W.M.
La Center, Washington



VICINITY MAP
NOT TO SCALE

APPLICANT:
MJS Investors
Contact: Rob Risinger
11201 SE 8th St Suite 116
Bellevue, WA 98004
robr@mjsinvenstors.com

OWNER:
Rodney Peterson
PO Box 176
La Center, WA 98629

PROJECT CONTACT:
PLS Engineering
Contact: Travis Johnson, PE
604 W Evergreen Blvd
Vancouver, WA 98660
(360) 944-6519
pm@plsengineering.com

Ground Cover	Onsite	Offsite	Total
Undisturbed Forest HSG C	6.57 AC	0.36 AC	6.91 AC

Basin Summary Table

PLS ENGINEERING

Pre-Developed Basin Map For:
Larsen Drive Subdivision
A Subdivision Located In The City Of La Center, WA

Engineering - Surveying - Planning | 604 W. Evergreen Blvd., Vancouver, WA 98660 | PH (360) 944-6519 | Fax (360) 944-6539

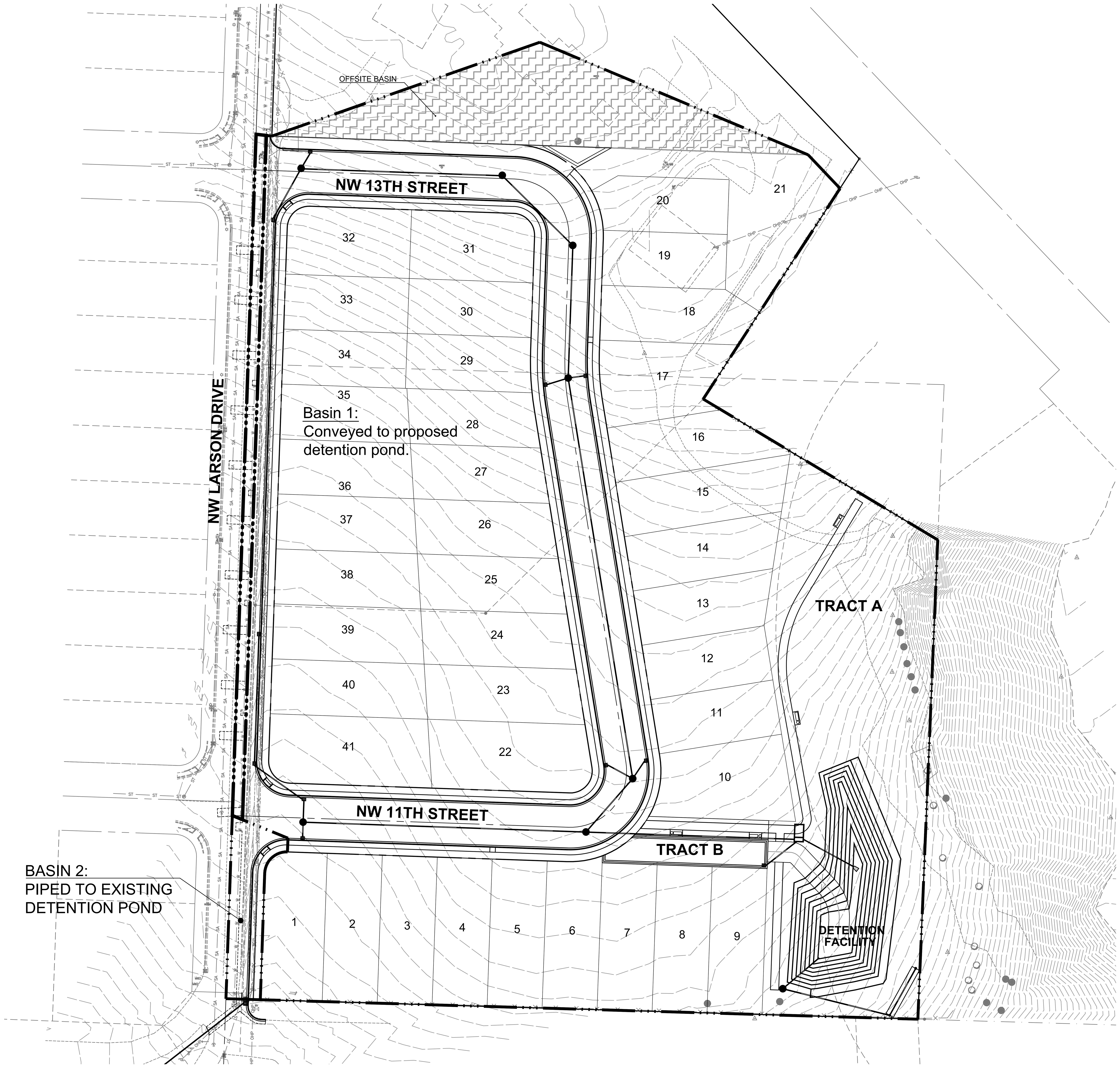
Revisions

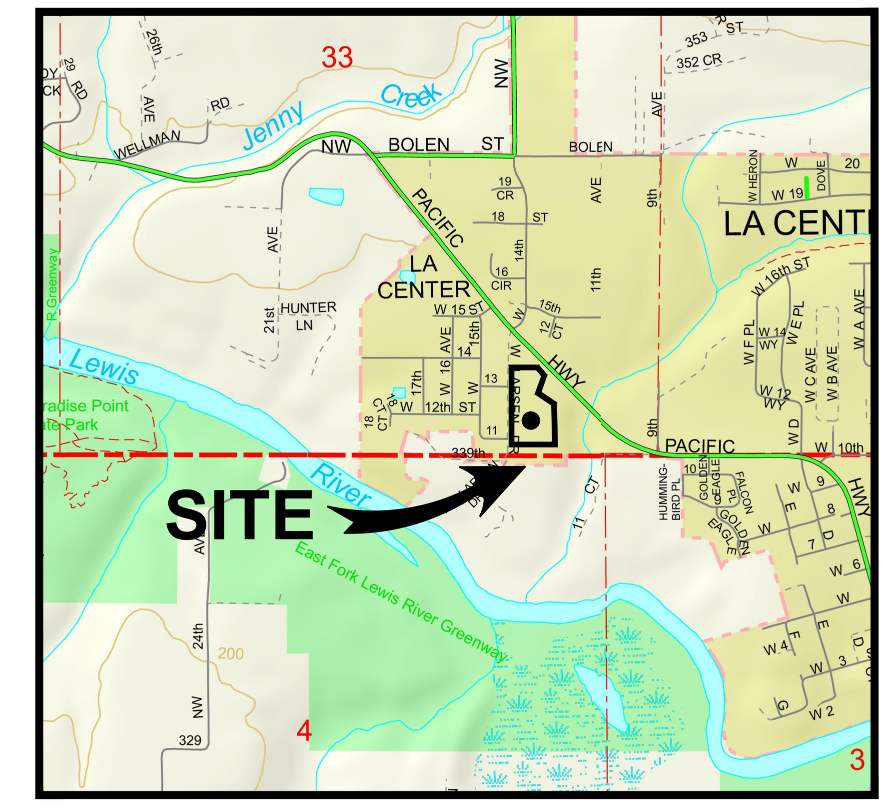
Project No. 3681	
SCALE:	H: 1" = 40' V: N/A
DESIGNED BY:	MAG
DRAFTED BY:	MAG
REVIEWED BY:	TGJ

1 / 2

Larsen Drive Subdivision

Located in the SE ¼ of Section 33, T5N, R1E, W.M.
La Center, Washington





VICINITY MAP
NOT TO SCALE

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Basin Summary Table

Ground Cover	Basin 1	Basin 2	Offsite
Roof (Impervious)	105,487 SF	0 SF	1,356 SF
Driveways (Impervious)	21,562 SF	0 SF	523 SF
Landscaping (Pervious)	92,221 SF	0 SF	12,757 SF
Roads (Impervious)	41,057 SF	2,424 SF	0 SF
S/W (Impervious)	13,040 SF	606 SF	0 SF
Planters (Impervious)	9,371 SF	448 SF	0 SF

Scale 1" = 40'
40 20 0 40

PLS ENGINEERING

Post-Developed Basin Map For:
Larsen Drive Subdivision
A Subdivision Located In The City Of La Center, WA

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Revisions
1 2 3 4 5 6

Project No. 3681

SCALE:	H: 1" = 40' V: N/A
DESIGNED BY:	MAG
DRAFTED BY:	MAG
REVIEWED BY:	TGJ

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2

APPENDIX D

Geotechnical Report

Geotechnical Engineering Report

Peterson Subdivision

La Center, Washington

July 31, 2023

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

11917 NE 95th Street
Vancouver, Washington
98682
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Phone: 971-384-1666

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West
Engineering, Inc

GEOTECHNICAL ENGINEERING REPORT
PETERSON SUBDIVISION
LA CENTER, WASHINGTON

Prepared For:

MJS Investors
Attn: Rob Risinger
11201 SE 8th Street, Suite 116
Bellevue, Washington 98004

Site Location:

34214 NW Pacific Highway
Parcel Nos. 258766000 & 258631000
La Center, Washington

Prepared By:

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11917 NE 95th Street
Vancouver, Washington 98682
Phone: 360-823-2900

Date Prepared:

July 31, 2023

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GEOTECHNICAL ENGINEERING REPORT
PETERSON SUBDIVISION
LA CENTER, WASHINGTON

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering evaluation for the proposed Peterson Subdivision project located in La Center, Washington. The purpose of the evaluation is to provide geotechnical engineering recommendations for use in design and construction of the proposed development.

The approximately 5.5-acre site is located southeast of the intersection of NW Pacific Highway and NW Larson Drive. The site is shown relative to surrounding physical features on Figure 1. Exploration locations are shown on Figure 2. Subsurface exploration logs are presented in Appendix A. Laboratory test results are presented in Appendix B. Soil classification information is presented in Appendix C. A photo log is presented in Appendix D. This report is subject to the limitations expressed in Section 10.0, *Limitations*, and Appendix E.

2.0 PROJECT UNDERSTANDING

We understand that the site is planned for residential development with single-family building lots, paved public roadways, underground utilities, and stormwater management facilities. Foundation loads were not available at the time this report was prepared; however, we have assumed maximum column and wall loads of 50 kips and 3 kips per foot, respectively. We expect that floor loads will be less than 100 psf. Cuts and fills are expected to be up to 10 feet each. We should be contacted to revise our recommendations if the assumptions stated above are incorrect.

3.0 PURPOSE AND SCOPE

The purpose of our services was to provide geotechnical engineering recommendations for use in design and construction of the proposed development. Specifically, we have completed the following tasks:

- Reviewed information available in our files from previous geological and geotechnical studies conducted at and in the vicinity of the site.
- Excavate nine test pits at the site to a maximum depth of 14 feet BGS.
- Collected disturbed soil samples from the borings and hand-auger explorations for laboratory analysis.
- Classified and logged observed soil and groundwater conditions.
- Prepared this geotechnical engineering report that provides our findings, conclusions, and recommendations with regard to:
    - Subsurface soil and groundwater conditions.

- Assessment and mitigation of geologically-hazardous areas in accordance with *La Center Municipal Code, Section 18.300*, *Critical Areas*.
- Settlement considerations.
- Site preparation, grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork.
- Foundation support for proposed residential structures.
- Slab subgrade preparation and modulus of subgrade reaction.
- Recommendations for use in design of conventional retaining walls, including backfill and drainage requirements and lateral earth pressures
- Management of groundwater conditions that may affect the performance of structures or pavement.
- Pavement and public roadway construction.
- Seismic design parameters in accordance with *ASCE 7-16.*

4.0 REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Willamette Valley/Puget Sound Lowland, a wide physiographic depression flanked by the mountainous Coast Range on the west and the Cascade Range on the east. Inclined or uplifted structural zones within the Willamette Valley/Puget Sound Lowland constitute highland areas and depressed structural zones form sediment-filled basins. The site is located in the northern portion of the Portland/Vancouver Basin, an open, somewhat elliptical, northwest-trending syncline approximately 60 miles wide.

Geologic mapping shows that the site is underlain by Missoula Flood Deposits (Ma et al, 2012). From about 21,000 to 12,000 years ago, dozens of gigantic floods swept down the Columbia River and through the Portland/Vancouver area as a huge lake in Montana broke through the glacier that dammed it. The floodwaters reached an elevation of about 400 feet above sea level and scoured many areas down to bedrock, while burying other areas under thick layers of gravel, sand, and silt.

Fine-grained flood deposits consist of sand and silt that were deposited in a series of distinct layers, a few inches to a few feet thick, each of which represents a single flood. These deposits fill most of the northern Willamette Valley, the entire Tualatin Valley, and large areas of Portland and Vancouver. Coarse-grained flood deposits consist mainly of huge overlapping sheets of loose gravel that extend from the mouth of the Columbia River Gorge at Troutdale all the way to the Willamette River.

Underlying the flood deposits is the Pliocene- to Pleistocene-aged Troutdale Formation, which consists of poorly- to moderately-consolidated, semi-cemented, subrounded to rounded sand and gravel conglomerate. The Troutdale Formation is underlain by the Miocene- to Pliocene-aged Sandy River Mudstone and the Miocene-aged Columbia River

Basalt Group (CRBG), which is a series of basalt flows that originated from southeastern Washington and northeastern Oregon.

5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION

Subsurface conditions were explored by excavating nine test pits (TP-1 through TP-9) using a track-mounted excavator at the approximate locations shown on Figure 2. The test pits were excavated on June 30, 2023 to a maximum depth of 14 feet BGS. Subsurface conditions were logged in accordance with the Unified Soil Classification System (USCS). Disturbed soil samples were collected at representative depth intervals. Test pit logs are presented in Appendix A. Analytical laboratory test results are presented in Appendix B. Soil descriptions and classification information are provided in Appendix C.

5.1 Surface Investigation and Site Description

The site is located at 34214 NW Pacific Highway in La Center, Washington and consists of tax parcel 258631000 and the southern portion of parcel 258766000 which totals approximately 5.5 acres. The site is bound by NW Pacific Highway to the north, NW Larson Drive to the west, a forested drainage ravine to the east, and a utility easement to the south. The site is currently undeveloped and utilized for agricultural purposes. No buildings were observed in the proposed development area which is primarily vegetated with grass. Most site terrain is relatively flat to gently rolling and characterized by grades of 5 to 10 percent. Steeper, densely-forested ravine slopes were observed along the eastern site boundary, discussion of which is presented later in Section 6.2, *Slope and Landslide Hazard Areas*.

5.2 Subsurface Conditions

The test pits were excavated through grass surface and a 3- to 4-inch-thick root zone. A low-organic till zone extended to approximately 18 inches. Underlying the surface vegetation, fine-grained alluvial deposits and sedimentary conglomerate were encountered to the maximum explored depth of 14 feet BGS. Subsurface lithology may generally be described by the soil units identified in the following text.

5.2.1 Fine-Grained Alluvium

Underlying the surface vegetation, stiff to very stiff clay and silt with varying proportions of fine sand was observed to depths of 9 to 14 feet BGS. Moisture content of the alluvium ranged from 20 to 27 percent at the time of exploration. Atterberg limits analysis indicates that the alluvium exhibits low to medium plasticity behavior.

5.2.2 Sedimentary Conglomerate

Underlying the fine-grained alluvium, sedimentary conglomerate of dense to very dense sand and gravel with varying proportions of silt and clay was observed to the maximum explored depth of 14 feet BGS. Moisture content of the conglomerate was approximately 22 percent at the time of exploration. Atterberg limits analysis indicates that the fine-textured constituents exhibit medium plasticity behavior.

5.2.3 Groundwater

Perched groundwater was observed at a depth of 13 feet BGS in test pits TP-5 and TP-8. Note that groundwater levels are subject to seasonal variance and may rise during extended periods of increased precipitation. Perched groundwater is typical in the La Center area, generally present near the surface during the wet season and dropping below depths of 10 to 15 feet in the dry season.

6.0 GEOLOGIC HAZARDS

City of La Center Municipal Code, Section 18.300 defines geologic hazard requirements for proposed development in areas subject to City of La Center jurisdiction. Three potential geologic hazards are identified: (1) erosion hazard areas, (2) slope and landslide hazard areas, and (3) seismic hazard areas. According to *Clark County Maps Online*, ravine slopes located along the eastern site boundary are mapped as potential erosion, slope, and landslide hazard areas.

Columbia West conducted geologic hazard review to assess whether these hazards are present at the subject property proposed for development, and if so, to provide appropriate development recommendations. The geologic hazard review was based upon physical and visual reconnaissance, subsurface exploration, laboratory analysis of collected soil samples, and review of maps and other published technical literature. The results of the geologic hazard review are discussed in the following sections.

6.1 Erosion Hazard Areas

According to *Clark County Maps Online*, the *Soil Survey of Clark County, Washington,* and field observations, the erosion hazard for site soils ranges from slight to severe depending upon slope grade. Therefore, according to the *City of La Center Municipal Code,* a soil erosion hazard area is present at the site. However, the soil erosion hazard can be successfully mitigated by preparation and adherence to a site-specific erosion control plan that identifies BMPs to reduce potential impacts on site soils during construction. Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Erosion control measures are discussed further in Section 8.7, *Erosion Control Measures*.

6.2 Slope and Landslide Hazard Areas

According to *City of La Center Municipal Code,* critical areas associated with slopes and landslide hazards are defined respectively as slopes with gradients meeting or exceeding 25 percent and areas subject to risk of mass movement due to a combination of geologic, topographic, and hydrologic factors.

Columbia West conducted review of available mapping, *Clark County GIS* data, and site reconnaissance to evaluate the potential presence of critical areas associated with slopes and landslide hazards on or near the subject site.

6.2.1 Geologic Literature Review

Columbia West reviewed *Slope Stability of Clark County* (Washington Department of Natural Resources, Division of Geology and Earth Resources, Fiksdal, 1975) to assess site slope characteristics. The Fiksdal report identifies four levels of potential slope instability within Clark County: (1) stable areas – no slides or unstable slopes, (2) areas of potential instability because of underlying geologic conditions and physical characteristics associated with steepness, (3) areas of historical or still active landslides, and (4) older landslide debris. The site is largely mapped as (1) stable areas – no slides or unstable slopes. The drainage ravine located along the eastern site boundary is mapped as (2) areas of potential instability because of underlying geologic conditions and physical characteristics associated with steepness.

Columbia West also reviewed the *Geologic Map of the Ridgefield Quadrangle, Clark County, Washington* (R.C. Evarts, Washington Division of Geology and Earth Resources, Scientific Investigations Map 2844, 2004), which indicates that no landslide deposits are mapped at the subject site or in the surrounding vicinity.

6.2.2 Slope Reconnaissance

To observe geomorphic conditions, Columbia West conducted visual and physical reconnaissance of the drainage ravine slopes located along the eastern property boundary. As previously described, test pit explorations conducted near the slopes indicated the presence of stiff to very stiff clay underlain by dense sedimentary conglomerate. No landslide debris was observed within subsurface soils explored near the slopes.

Review of topographic mapping indicates that vertical slope heights for the eastern drainage ravine slopes (east facing), as measured from toe to top-of-slope break, vary from approximately 40 to 50 feet. Slope grades generally range from 25 to 65 percent with localized steeper areas. Slopes currently support dense vegetation consisting of deciduous and conifer trees, blackberry vines, grasses, and shrubs. Slopes are generally planar with no observed evidence of instability. There was no observed direct evidence of large-scale, mass slope movements or historic landslides.

6.2.3 Slope Stability Assessment

Based upon the results of literature review, subsurface exploration, and field reconnaissance, Columbia West did not observe a combination of geologic, topographic, or hydrologic features suggesting significant risk of mass slope movement. However, slope grades along the eastern drainage ravine meet or exceed 25 percent in several locations and therefore meet the definition of a critical area according to *City of La Center Municipal Code*. The location of the critical area is indicated on Figure 2. Site development near the critical area may be successfully achieved by following the engineering and planning recommendations presented in this report and by maintaining an appropriate geotechnical buffer from the top-of-slope as presented in the following text sections.

6.2.4 Geotechnical Buffer

To reduce the risk of adverse impacts to slope stability within and near the critical area, residential structures, structural fill placement, and stormwater facility construction should be avoided within the geotechnical buffer identified on Figure 2, unless a case-by-case assessment as described in Section 6.2.6 is conducted. The buffer recommendations are intended to reduce potential for slope instability by limiting locations for large dynamic and static loads derived from earthwork, residential structures, retaining walls, roadways, and other significant developments. The geotechnical buffer line is based upon the slope reconnaissance and slope stability assessment described above and may be measured as 30 feet from the eastern ravine's existing top-of-slope.

Note that areas within the geotechnical buffer are not intended to be do-not-disturb conservation areas. Small disturbances such as minor landscaping, fence building, or pedestrian path construction are acceptable provided that the increased risk of soil sloughing and settlement within the buffer is understood. Deep-rooted vegetation generally results in reduced slope erosion and increased near-surface soil shear strength. The risk of slope instability increases with disturbance or alteration of existing slope vegetation. Removal of established slope vegetation within the buffer should be minimized. The text herein pertains only to the geotechnical aspect of construction within the recommended geotechnical buffer.

6.2.5 Grading Recommendations within the Geotechnical Buffer

The geotechnical buffer is intended to minimize adverse impacts to slope stability due to dynamic and static loading. Placement of engineered structural fill or stockpiles of disturbed soil should be avoided inside the geotechnical buffer without case-by-case evaluation per Section 6.2.6, *Potential Encroachment within the Geotechnical Buffer*. Soil excavation may be acceptable within the buffer, as driving forces may be reduced by removing soil mass. Columbia West should review mass grading plans as they relate to the geotechnical buffer.

6.2.6 Potential Encroachment within the Geotechnical Buffer

Encroachment of some site improvements or structural facilities inside the geotechnical buffer may be possible if evaluated in detail on a case-by-case basis. Feasibility of such encroachment will depend upon dimensions, locations, and specific design features of the proposed improvement. Often these data are not available until later in the design process. Encroachment within the geotechnical buffer area should be contingent upon a supplemental geotechnical investigation. The investigation should include additional exploratory activities and data analysis to develop appropriate design recommendations. Quantification of risk of slope instability and specialized design recommendations, if applicable or necessary, should be included.

6.3 Seismic Hazard Areas

Seismic hazards include areas subject to severe risk of earthquake-induced damage. Damage may occur due to soil liquefaction, dynamic settlement, lateral spreading, ground shaking amplification, or surface faulting rupture. These seismic hazards are discussed below.

6.3.1 Liquefaction

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand with low silt and clay content is the most susceptible to liquefaction. Low plasticity silty sand and silt may also be susceptible to seismic settlement during a seismic event under relatively higher levels of ground shaking; however, the magnitude of settlement at the ground surface is less than liquefaction settlement. Based on laboratory testing, liquefiable materials were not observed at the site to the depth explored. Accordingly, liquefaction is not a design consideration.

6.3.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard that occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement. Since the site is not susceptible liquefaction, lateral spreading at the site is not a design consideration.

6.3.3 Ground Shaking Amplification

Review of the *Site Class Map of Clark County, Washington* (Washington State Department of Natural Resources, 2004), indicates that site soils may be represented by Site Class C as defined by *ASCE 7-16, Chapter 20, Table 20.3-1*. A designation of Site Class C indicates that minor amplification of seismic energy may occur during a seismic event due to subsurface conditions. However, this is typical for many areas within Clark County, does not constitute a geologic hazard in our opinion, and will not prohibit development if properly accounted for during the design process.

6.3.4 Fault Rupture

Because there are no known geologic seismic faults within the site boundaries, fault rupture is unlikely.

7.0 DESIGN RECOMMENDATIONS

The geotechnical site investigation suggests the proposed development is generally compatible with surface and subsurface soils, provided the recommendations presented in this report are incorporated in design and implemented during construction. Design and construction recommendations are presented in the following sections.

7.1 Shallow Foundation Support

Proposed residential structures may be supported by conventional spread footings bearing on firm native soil or engineered structural fill.

Any loose or disturbed soil should be improved or removed and replaced with structural fill. If footing subgrade soils are above their optimum moisture content, we recommend that a minimum of 6 inches of compacted aggregate be placed over exposed subgrade soils. The aggregate pad should extend 6 inches beyond the edge of the foundations and consist of imported granular material as described in Section 8.6.1, *Structural Fill*. Columbia West should observe exposed subgrade conditions prior to placement of crushed aggregate to verify adequate subgrade support.

7.1.1 Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum width dimensions of 18 and 24 inches, respectively. The base of exterior footings should bear at least 18 inches below the lowest adjacent exterior grade. The base of interior footings should bear at least 12 inches below the base of the floor.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,000 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

7.1.2 Shallow Foundation Settlement

Foundation settlement is a significant structural design consideration. Provided subgrade soils are prepared as described above and in Section 8.1, *Site Preparation and Grading*, we anticipate that post-construction static foundation settlement will be less than approximately 1 inch. Differential settlement between comparably-loaded foundations is not expected to exceed approximately 0.5 inch over a distance of 50 feet.

7.1.3 Resistance to Sliding

Lateral foundation loads can be resisted by passive earth pressure on the sides of the footing and by friction at the base of the footings. Recommended passive earth pressure for footings confined by native soil or engineered structural fill is 350 pcf. The upper 12 inches of soil should be neglected when calculating passive pressure resistance. Adjacent floor slabs and pavement, if present, should also be neglected from the analysis. The recommended passive pressure resistance assumes that a minimum horizontal clearance of 10 feet is maintained between the footing face and adjacent downgradient slopes.

The estimated coefficient of friction between in situ native soil or engineered structural fill and in-place poured concrete is 0.35. The estimated coefficient of friction between compacted crushed aggregate and in-place poured concrete is 0.45.

7.1.4 Subgrade Observation

Subgrade should be evaluated by Columbia West prior to placing forms or reinforcing steel to verify subgrade support conditions are as described in this report. Subgrade observation should confirm that all undocumented fill, disturbed material, organic debris, remnant topsoil zones, and softened subgrades (if present) have been removed. Over-excavation of footing subgrade soils may be required to remove deleterious material, particularly if footings are constructed during wet-weather conditions.

7.1.5 Floor Slabs

Floor slabs can be supported on firm, competent, native soil or engineered structural fill prepared as described in this report. Disturbed soils and unsuitable fills in proposed slab locations, if encountered, should be removed and replaced with structural fill.

To provide a capillary break, slabs should be underlain by at least 6 inches of compacted crushed aggregate that contains less than 5 percent by weight passing the No. 200 Sieve. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab base aggregate and subgrade geotextile are discussed in Section 8.6, *Materials*.

Floor slabs with maximum floor load of 100 psf may be designed assuming a modulus of subgrade reaction, k, of 125 pci.

7.2 Seismic Design Considerations

Seismic design for proposed structures is prescribed by *ASCE 7-16.* Based on literature review and results of subsurface exploration conducted by Columbia West, site soils meet the criteria for Site Class C. Seismic design parameters for Site Class C are presented in Table 1.

Table 1. ASCE 7-16 Seismic Design Parameters[1]

	Short Period	1 Second Period
MCE Spectral Acceleration	0.805	0.380
Site Class	C	
Site Coefficient	Fa = 1.2	Fv = 1.5
Adjusted Spectral Response Acceleration	S_{MS} = 0.966	S_{M1} = 0.570
Design Spectral Response Acceleration	S_{DS} = 0.644	S_{D1} = 0.380

1. The structural engineer should evaluate *ASCE 7-16* code requirements and exceptions to determine if these parameters are valid for design.

As discussed in Section 6.3, *Seismic Hazards*, liquefaction and lateral spreading are not design considerations for the site.

7.3 Retaining Structures

Lateral earth pressures should be considered during design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Wall foundation construction and bearing capacity should adhere to specifications provided previously in Section 7.1, *Shallow Foundation Support*.

Permanent retaining walls that are not restrained from rotation should be designed for active earth pressures using an equivalent fluid pressure of 35 pcf. Walls that are restrained from rotation should be designed for an at-rest, equivalent fluid pressure of 55 pcf. The recommended earth pressures assume a maximum wall height of 10 feet with well-drained, level backfill. These values also assume that adequate drainage is provided behind retaining walls to prevent hydrostatic pressures from developing. Lateral earth pressures induced by surcharge loads may be estimated using the criteria presented on Figure 3.

Seismic forces may be calculated by superimposing a uniform lateral force of $7H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. The force should be applied as a distributed load with the resultant located at 0.6H from the base of the wall.

7.3.1 Wall Drainage and Backfill

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of retaining walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of finished grade. The drain rock and geotextile drainage fabric should meet the specifications provided in Section 8.6, *Materials*. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drainage systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill material placed behind the walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of select granular material placed and compacted as described in Section 8.6.1, *Structural Fill.*

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be delayed at least four weeks after placement of wall backfill, unless survey data indicates that settlement is complete prior to that time.

7.4 Pavement Recommendations

We understand that public roadways for the subdivision will be constructed in accordance with City of La Center standards. For dry weather construction, pavement surface sections should bear upon competent subgrade consisting of scarified and compacted native soil or engineered structural fill. Wet weather construction may require an increased thickness of base aggregate as discussed later in Section 8.2, *Construction Traffic and Staging*.

In general, AC paving is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress. Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix, as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Oregon, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thicknesses greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thicknesses between 2 and 2.5 inches.

If AC paving must take place during cold-weather construction as defined in this section, the contractor and design team should discuss options for minimizing risk to pavement serviceability.

7.5 Drainage

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. Drainage design in general should conform to City of La Center regulations. Finished site grading should be conducted with positive drainage away from structures at a minimum 2 percent slope for a distance of at least 10 feet. Depressions or shallow areas that may retain ponding water should be avoided.

Recommendations for foundation drains and subdrains are presented in the following sections. Drain rock and geotextile drainage fabric should meet the requirements presented in Section 8.6, *Materials*. Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. We should be consulted to provide appropriate recommendations.

7.5.1 Foundation Drains

Roof drains are recommended for all structures. Perimeter building foundation drains should be considered for shallow foundations constructed below existing site grades, but are not necessary for the functionality of the buildings.

Foundation and roof drains, where installed, should consist of separate systems that gravity flow away from foundations to an approved discharge location. Perimeter foundation drains should consist of 4-inch perforated PVC pipe surrounded by a minimum 2-foot-wide zone of clean, washed drain rock wrapped with geotextile drainage fabric. The wrapped drain rock zone should extend up the sides of embedded walls to within 12 inches of proposed finished grade. Foundation drains should be constructed with a minimum slope of ½ percent. The drainpipe’s invert elevation should be at least 18 inches below the elevation of the floor slab. Figure 4 presents a typical foundation drain detail.

7.5.2 Subdrains

Subdrains should be considered if groundwater seepage is observed during construction. Shallow groundwater or seeps should be conveyed via drainage channel or perforated pipe to an approved discharge. Recommendations for design and installation of perforated drainage pipe should be made on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail is presented in Figure 5.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Site Preparation and Grading

Site vegetation primarily consisted of grass and a 3- to 4-inch-thick root zone at the time of our exploration. Thicker root zones may be present in areas of mature trees and shrub growth. Pavement, vegetation, organic material, unsuitable fill, and deleterious material should be cleared from areas identified for structures and site grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed, or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot. Actual stripping depths should be determined based upon visual observations made during construction when soil conditions are exposed.

8.1.1 Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully-loaded dump truck or similar heavy, rubber tire construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over-excavated and backfilled with compacted imported granular fill.

8.2 Construction Traffic and Staging

Near-surface clay will be easily disturbed during construction. If not carefully executed, site preparation, excavation, and grading can create extensive soft areas resulting in significant repair costs. Earthwork planning should include considerations for minimizing subgrade disturbance, particularly during wet-weather conditions.

If construction occurs during wet-weather conditions, or if the moisture content of the surficial soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Under these conditions, granular haul roads and staging areas will also be necessary provide a firm support base and sustain construction equipment.

Base aggregate for pavement sections is intended to support post-construction design traffic loads and will not provide adequate support for construction traffic. Staging areas and haul roads will require an increased base thickness during wet weather conditions. The configuration of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor’s means and methods. Therefore, design and construction of staging areas and haul roads should be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul road areas. In areas of heavy construction traffic, geotextile separation fabric may be placed between the subgrade soil and imported granular material to increase subgrade support and minimize fines migration into the base aggregate layer.

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

8.3 Cut and Fill Slopes

Fill slopes should consist of structural fill material as discussed in Section 8.6.1*, Structural Fill*. Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than six feet in height should be vertically keyed into existing subsurface soil. A typical fill slope cross-section is shown in Figure 6. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. Extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 10 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from top of cut or fill slope face or overall slope height divided by three (H/3), whichever is greater. A minimum slope setback detail for structures is presented in Figure 7. Slope buffer recommendations for the eastern drainage ravine slopes were provided previously in Section 6.2.4, *Geotechnical Buffer*.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least two feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

8.4 Excavation

The site was explored to a maximum depth of 14 feet BGS with an excavator. Conventional earthmoving equipment in proper working condition should be capable of making necessary site excavations.

Perched groundwater was observed at a depth of 13 feet BGS in test pits TP-5 and TP-8. Recommendations as described in Section 8.5, Dewatering, should be considered where subsurface construction activities intersect the shallow groundwater table.

Temporary excavation sidewalls should maintain a vertical cut to a depth of approximately 4 feet in the near-surface clay, provided groundwater seepage is not present in the sidewalls. In sandy soil, excavations will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1H:1V and groundwater seepage is not present. Excavation slopes should be reduced to 1.5H:1V or 2H:1V if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are infeasible or if excavations are proposed adjacent to existing infrastructure. Typical methods for stabilizing excavations consist of solider piles and timber lagging, sheet pile walls, tiebacks and shotcrete, or pre fabricated hydraulic shoring. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

The contractor should be held responsible for site safety, sloping, and shoring. All excavation activity should be conducted in accordance with applicable OSHA requirements. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of applicable local, state, and federal laws.

8.5 Dewatering

Perched groundwater was observed as shallow as 13 feet BGS at the time of our field exploration. Based on this observation, groundwater may be encountered in utility trench excavations and in areas of cut. Generalized recommendations for temporary construction dewatering are presented in the following section.

8.5.1 Construction Dewatering

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of exposed site soils. During rough and finished grading of building pad areas, the contractor should keep all footing excavations and slab subgrade soils free of standing water.

The contractor’s proposed dewatering plan should be capable of maintaining groundwater levels at least two feet below the base of proposed trench excavations. Without adequate trench dewatering, running soil, caving, and sloughing will increase backfill volumes and may result in damage to adjacent structures or utilities. Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to the recommended depth. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches. Depending on proposed utility depths, a site-specific dewatering plan may be necessary.

If groundwater is present at the base of utility excavations, we recommend placing 18 to 24 inches of stabilization material at the base of the excavation. Subgrade geotextile placed directly over trench subgrade soils may reduce the required thickness of the stabilization material. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. Trench stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements presented in Section 8.6, *Materials*.

8.6 Materials

8.6.1 Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in Section 8.1, *Site Preparation and Grading*. Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with *ASTM D6938*. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by Columbia West prior to placement.

8.6.1.1 Onsite Soil

Most onsite soil will be suitable for use as structural fill if adequately dried or moisture-conditioned to achieve recommended compaction specifications. Native clay soil with a plasticity index greater than 25, if encountered, should be evaluated and approved by Columbia West prior to use as structural fill. Laboratory analysis indicated that the moisture content of the near-surface clay was above optimum at the time of exploration. Moisture conditioning will likely be necessary to dry the soil prior to applying compaction effort. In addition, the near-surface clay will be moisture sensitive and difficult, if not impossible, to compact during wet weather conditions. Therefore, structural fill placement using onsite soil should be performed during dry summer months if possible. Onsite soil may also require addition of moisture during extended periods of dry weather.

Onsite soil used as structural fill should be placed in loose lifts not exceeding 8 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* Compacted onsite fill soils should be covered shortly after placement.

8.6.1.2 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand. The imported granular material should also be durable, angular, and fairly well graded between coarse and fine material; should have less than 5 percent fines (material passing the U.S. Standard No. 200 sieve) by dry weight; and should have at least two mechanically fractured faces. Imported granular material should be placed in loose lifts not exceeding 12 inches in depth and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* During wet-weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

8.6.1.3 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organics and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically-fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and be compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-textured soils. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and the stabilization material.

8.6.1.4 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting *WSDOT 9-03.12(3)* specifications for *Gravel Backfill for Pipe Zone Bedding.* Pipe zone backfill should be compacted to at least 90 percent of maximum dry density, as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of *WSDOT 9-03.19 Bank Run Gravel for Trench Backfill* or *WSDOT 9-03.14(2) Select Borrow* with a maximum particle size of 2 ½-inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

8.6.1.5 Floor Slab Base Aggregate

Base aggregate for building floor slabs should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Slab base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.2 Pavement Base Aggregate

Base aggregate for pavement should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Pavement base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.2.1 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of free-draining granular material meeting *WSDOT 9-03.12(2)* specifications for *Gravel Backfill for Walls*. The wall backfill should be separated from structural fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

Wall backfill located within a horizontal distance of 3 feet from the face of a retaining wall should be compacted to 90 percent of the maximum dry density, as determined by *ASTM D1557*. Backfill placed within 3 feet of the wall should be compacted in loose lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). Remaining wall backfill should be compacted to at least 95 percent of the maximum dry density, as determined by *ASTM D1557*.

8.6.2.2 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. The leveling pad material should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.2.3 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and less than 2 percent by weight passing the No. 200 sieve. Drain rock should be free of roots, organic debris, and other unsuitable material and should have at least two mechanically-fractured faces. Drain rock should be compacted to a firm, unyielding condition. Drain rock should be completely wrapped in a geotextile drainage fabric meeting the requirements presented below.

8.6.3 Geotextile Fabric

8.6.3.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization*. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

8.6.3.2 Drainage Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties*. The AOS should be between the No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

8.7 Erosion Control Measures

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed before construction begins. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

9.0 OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and foundation performance depends to a large degree on the quality of construction. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated. In addition, sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications.

10.0 LIMITATIONS

We have prepared this report for use by the client and members of the design and construction team for the proposed development. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Soil explorations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were not finalized at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction, the conclusions and recommendations presented may not be applicable. If design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in this report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

COLUMBIA WEST ENGINEERING, Inc.

Greg L. Williamson, P.E.
Senior Geotechnical Engineer

Brett A. Shipton, P.E., G.E.
Principal

07-31-23

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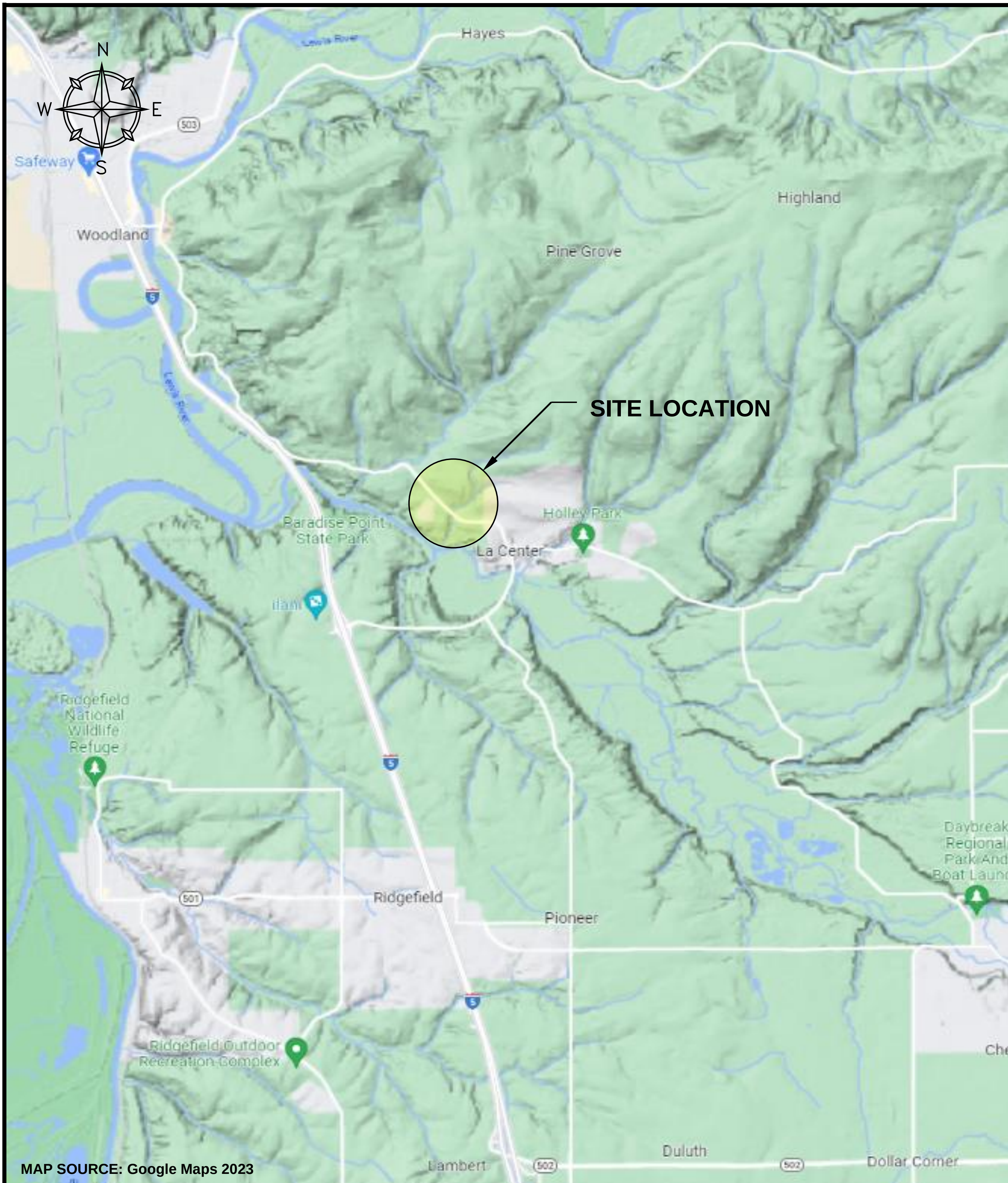
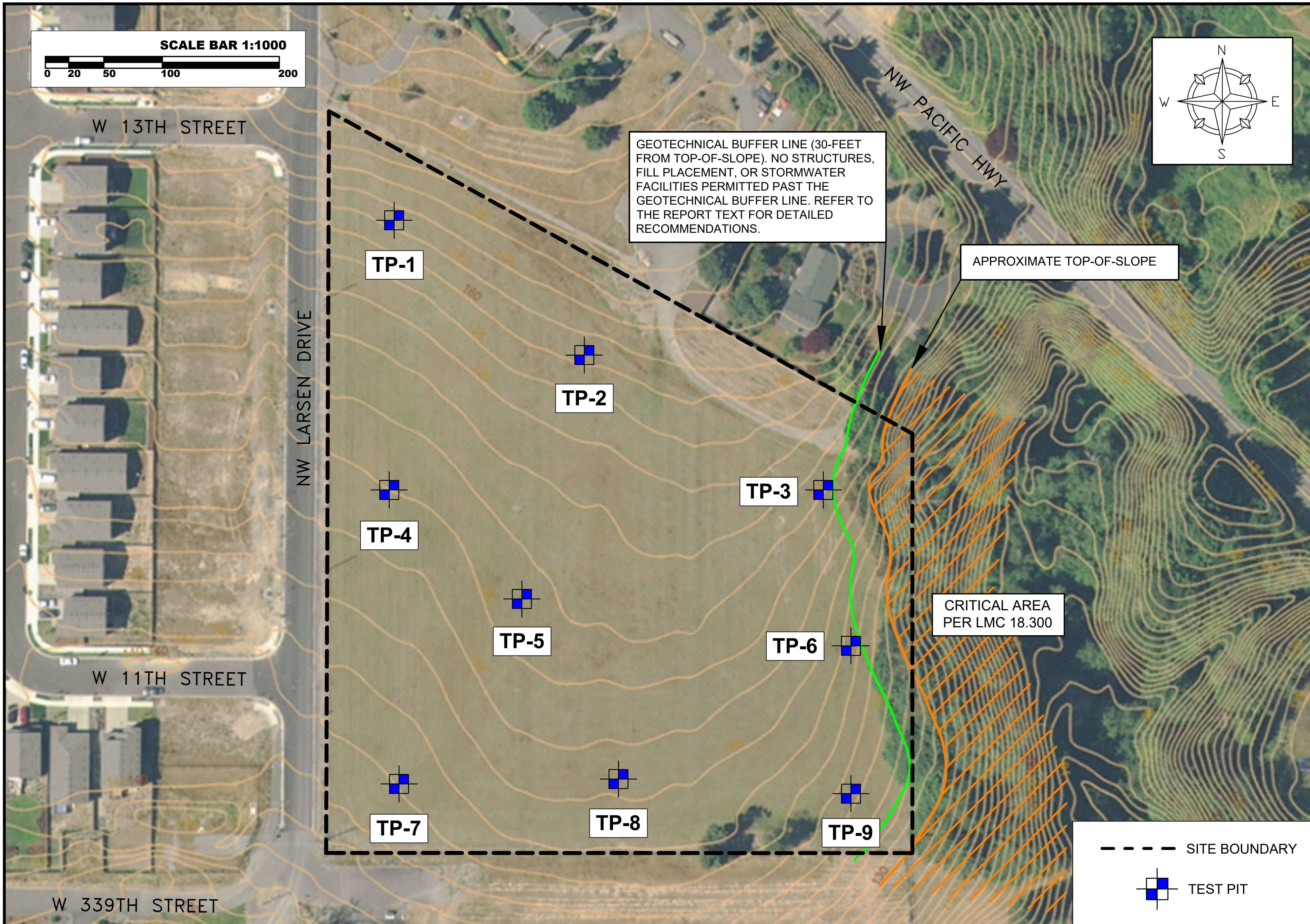
FIGURES



Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	Job No: 23264 Date: 06/26/23 Drawn: GLW Checked: BAS	SITE LOCATION MAP PETERSON SUBDIVISION LA CENTER, WASHINGTON	FIGURE 1



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Columbia West

Engineering, Inc

Project: 23264
Date: 06/20/23
Drawn: GLW
Checked: BAS

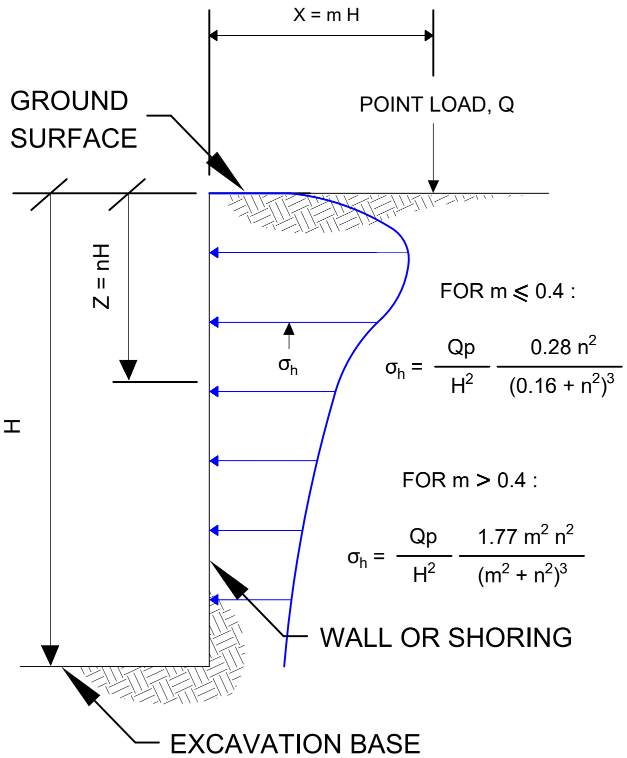
EXPLORATION LOCATION MAP

PETERSON SUBDIVISION

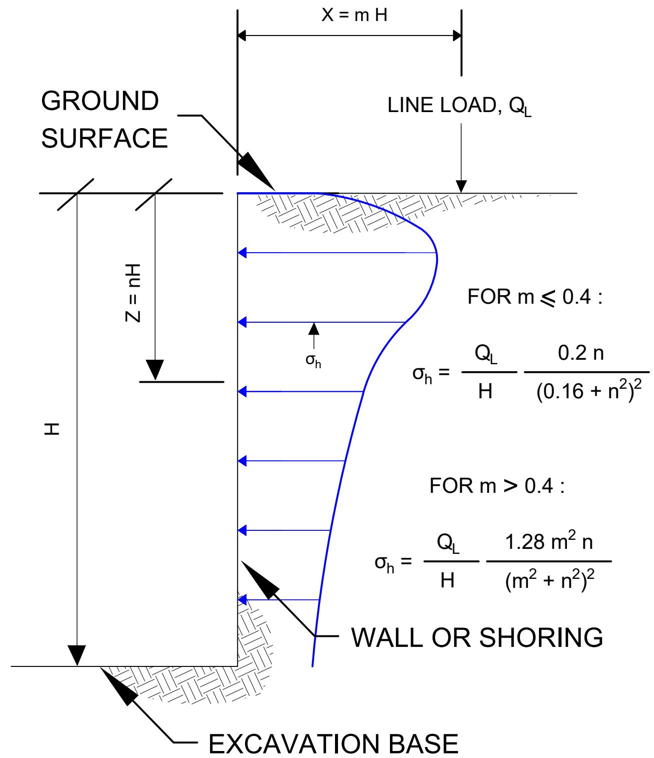
NOTES:
1. SITE LOCATION: 34214 NW PACIFIC HWY, LA CENTER, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 258766000 AND 258631000 TOTALING APPROXIMATELY 5.5 ACRES.
3. BASE MAP OBTAINED FROM CLARK COUNTY MAPS ONLINE, 2023.
4. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.

FIGURE
2

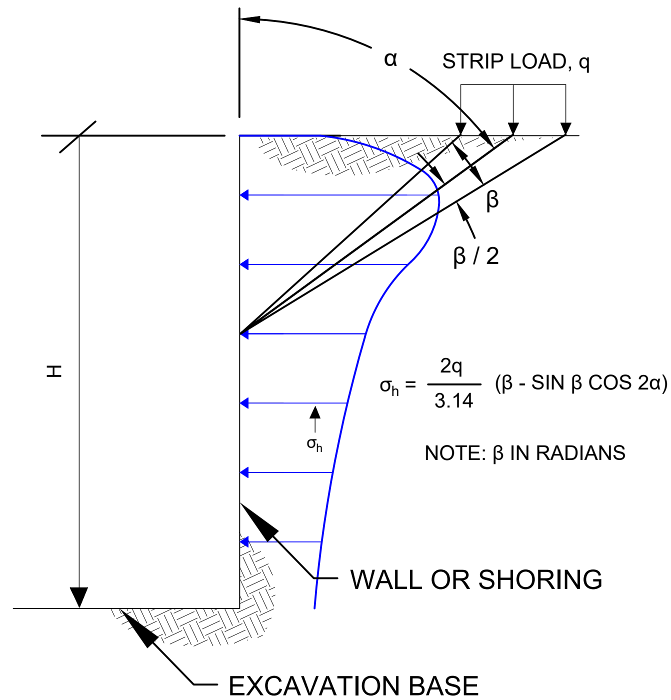
VERTICAL POINT LOAD



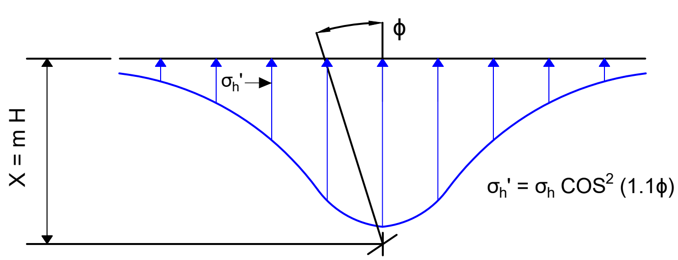
LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL



VERTICAL POINT LOAD
HORIZONTAL PRESSURE DISTRIBUTION



NOTES:
1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

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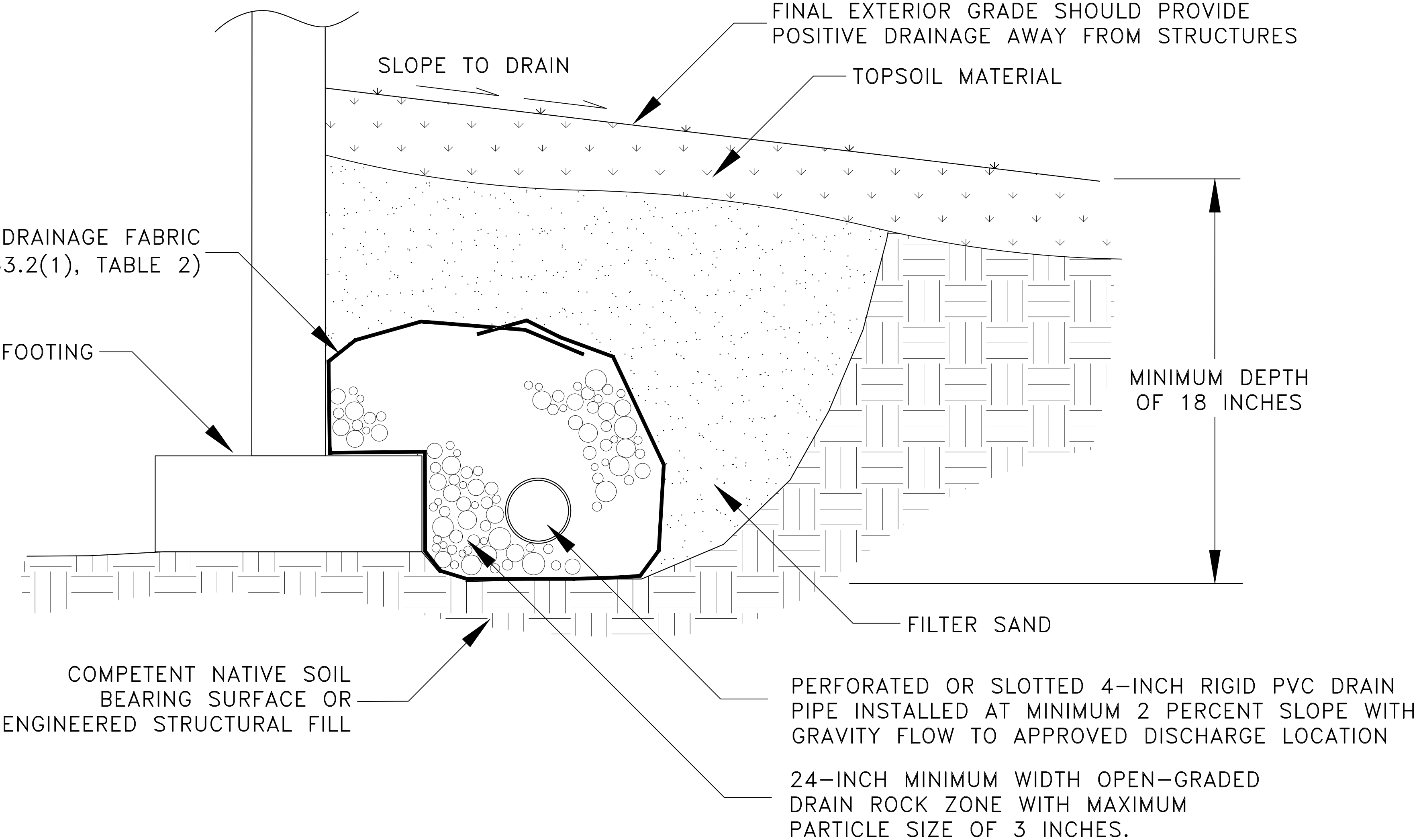
SURCHARGE–INDUCED LATERAL EARTH PRESSURES

FIGURE
3



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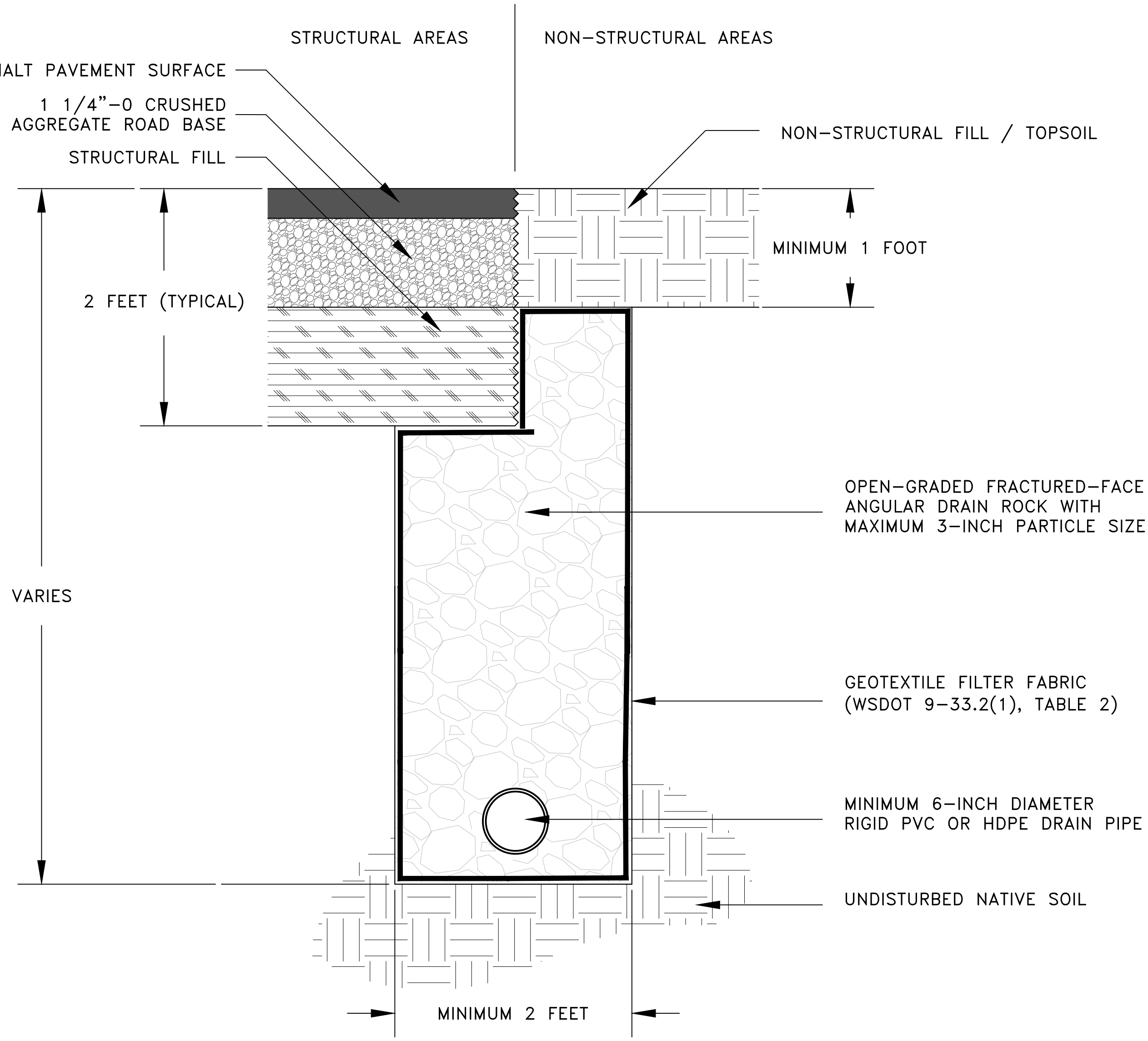
TYPICAL PERIMETER FOOTING DRAIN DETAIL

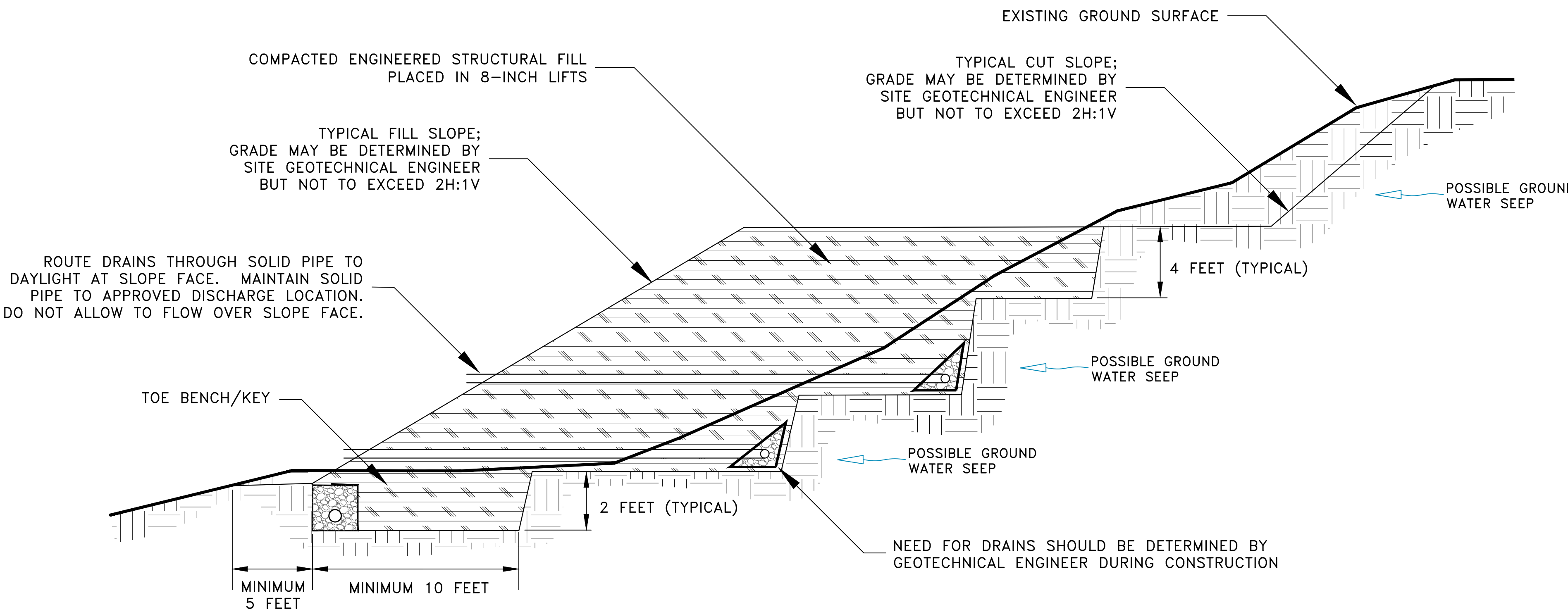
NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL PERIMETER FOOTING DRAIN DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE 4

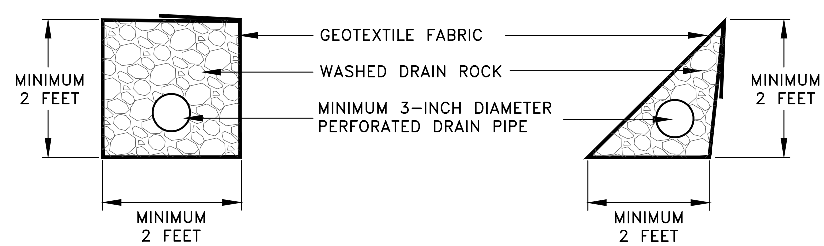


NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE–SPECIFIC SOIL CONDITIONS.

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	TYPICAL PERFORATED DRAINPIPE TRENCH DETAIL	NOTES: 1. DRAWING IS NOT TO SCALE. 2. DRAWING REPRESENTS TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL AND MAY NOT BE SITE–SPECIFIC.	FIGURE 5



TYPICAL DRAIN SECTION DETAIL



DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL MEET WSDOT 9-33.2(1), TABLE 2, GEOTEXTILE FOR UNDERGROUND DRAINAGE FILTRATION PROPERTIES WITH AOS BETWEEN No. 70 AND No. 100 SIEVE. WATER PERMITIVITY SHOULD BE GREATER THAN 1.5/SEC.

WASHED DRAIN ROCK SHALL BE OPEN-GRADED ANGULAR DRAIN ROCK WITH LESS THAN 2 PERCENT PASSING THE No. 200 SIEVE AND A MAXIMUM PARTICLE SIZE OF 2 INCHES.

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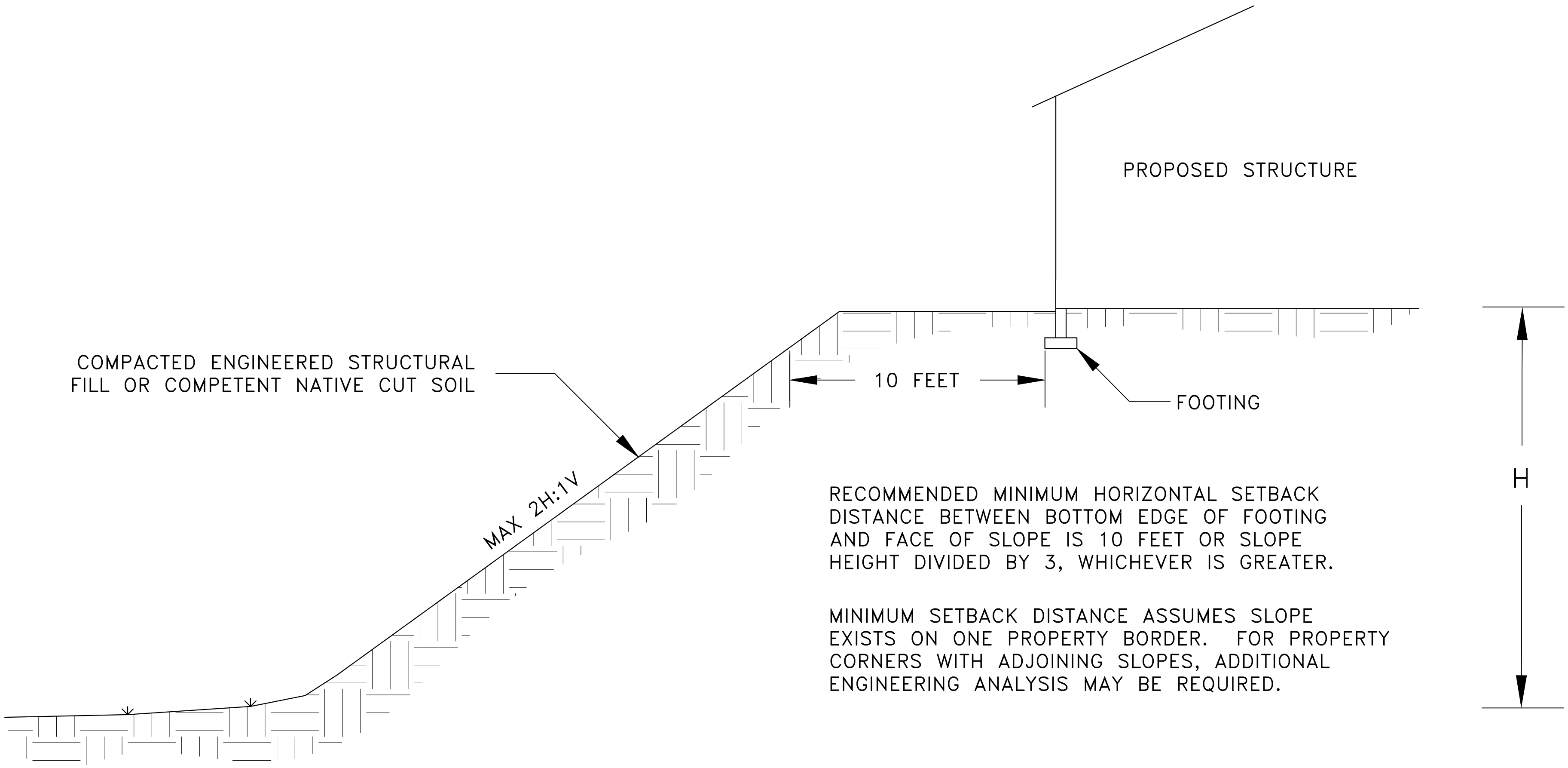
TYPICAL CUT AND FILL SLOPE CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL CUT AND FILL SLOPE CROSS SECTION AND MAY NOT BE SITE-SPECIFIC.

FIGURE 6



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TYPICAL MINIMUM FOUNDATION
SLOPE SETBACK DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FOUNDATION SETBACK DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE
7

APPENDIX A
SUBSURFACE EXPLORATION PROGRAM
FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by excavating nine test pits (TP-1 through TP-9) to a maximum depth of 14 feet BGS using a track-mounted excavator. Excavation services were provided by L&S Contractors, Inc. of Battle Ground, Washington on June 30, 2023. The test pit locations are shown on Figure 2. Exploration logs are presented in this appendix.

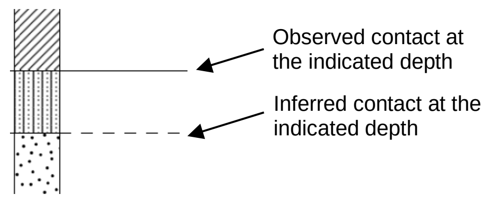
SOIL SAMPLING

Representative grab samples of soil from the test pit explorations were obtained from the walls and/or base of the test pits using the excavator bucket. Sampling intervals are shown on the exploration logs.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the Unified Soil Classification System presented in Appendix C. The exploration log indicates the depths at which the soils or their characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration log.

EXPLORATION LEGEND

<table>
<tr><th>Symbol</th><th colspan="2">Description</th></tr>
<tr><td>SPT</td><td colspan="2">Sample obtained from the indicated depth in general accordance with ASTM D1586, Standard Penetration Test and Split-Barrel Sampling of Soils</td></tr>
<tr><td>SHELBY</td><td colspan="2">Sample obtained from the indicated depth using thin-wall Shelby tube in general accordance with ASTM D1587, Thin-Walled Tube Sampling of Fine-Grained Soils</td></tr>
<tr><td>D&M 300</td><td colspan="2">Sample obtained from the indicated depth using Dames & Moore sampler and 300-pound hammer or pushed</td></tr>
<tr><td>D&M 140</td><td colspan="2">Sample obtained from the indicated depth using Dames & Moore sampler and 140-pound hammer or pushed</td></tr>
<tr><td>CSS</td><td colspan="2">Sample obtained from the indicated depth using 3-inch-outer-diameter California split-spoon sampler and 140-pound hammer</td></tr>
<tr><td>GRAB</td><td>Grab sample obtained from the indicated depth</td><td rowspan="3"><u>Graphical Log of Subsurface Lithology</u>

</td></tr>
<tr><td>CORE</td><td>Rock core interval at the indicated depth</td></tr>
<tr><td></td><td>Water level observed during exploration</td></tr>
</table>

Geotechnical Acronyms			
AASHTO	American Association of State Highway and Transportation Officials	P	Push Sample
ASTM	American Society for Testing and Materials	PP	Pocket Penetrometer
ATT	Atterberg Limits	PSF	Pounds Per Square Foot
BGS	Below Ground Surface	P200	Percent Passing No. 200 Sieve
CBR	California Bearing Ratio	RES	Resilient Modulus
CON	Consolidation Test	SIEV	Sieve Analysis
DCPT	Dynamic Cone Penetration Test	SPT	Standard Penetration Test
DD	Dry Density	TS	Torvane Shear
DS	Direct Shear	UC	Unconfined Compressive Strength
HYD	Hydrometer	UU	Unconsolidated Undrained Triaxial Test
IR	Infiltration Rate	USCS	United Soil Classification System
MC	Moisture Content	VS	Vane Shear
MD	Moisture-Density Relationship	WD	Wet Density
OC	Organic Content		

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-1
PROJECT LOCATION: La Center, Washington	CONTRACTOR: L&S Excavating	EQUIPMENT: Excavator	ENGINEER: MAC	DATE: 6/30/23
TEST PIT LOCATION: See Figure 2	APPROX. SURFACE ELEVATION: Not Surveyed	GROUNDWATER DEPTH: See Page Notes	START TIME: 1245	FINISH TIME: 1330

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		CL		Brown to brown/orange/gray lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
5											
						Increased fine sand and decreased plasticity with depth.					
10											
						Bottom of test pit at 14.0 feet. No groundwater observed on 6/30/23.					
15											
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-2
PROJECT LOCATION	CONTRACTOR	EQUIPMENT	ENGINEER	DATE
La Center, Washington	L&S Excavating	Excavator	MAC	6/30/23
TEST PIT LOCATION	APPROX. SURFACE ELEVATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure 2	Not Surveyed	See Page Notes	0800	0845

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		CL		Brown to brown/gray, mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
	TP-2.1		A-6(7)				27.0	71.7	35	11	
5											
						Increased fine sand and decreased plasticity with depth.					
	TP-2.2						27.0	56			
10											
				GC		Weathered brown to black sedimentary CONGLOMERATE of semi-consolidated clayey gravel with sand, moist, dense to very dense, medium plasticity fines.					
	TP-2.3										
						Bottom of test pit at 14.0 feet. No groundwater observed on 6/30/23.					
15											
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-3
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Excavating	EQUIPMENT Excavator	ENGINEER MAC	DATE 6/30/23
TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION Not Surveyed	GROUNDWATER DEPTH See Page Notes	START TIME 1115	FINISH TIME 1150

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		CL		Brown to brown/gray, mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
5											
						Increased fine sand and decreased plasticity with depth.					
10				GC		Weathered brown to black sedimentary CONGLOMERATE of semi-consolidated clayey gravel with sand, moist, dense to very dense, medium plasticity fines.					
						Bottom of test pit at 13.0 feet. No groundwater observed on 6/30/23.					
15											
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-4
PROJECT LOCATION: La Center, Washington	CONTRACTOR: L&S Excavating	EQUIPMENT: Excavator	ENGINEER: MAC	DATE: 6/30/23
TEST PIT LOCATION: See Figure 2	APPROX. SURFACE ELEVATION: Not Surveyed	GROUNDWATER DEPTH: See Page Notes	START TIME: 1220	FINISH TIME: 1245

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		CL		Brown to brown/orange/gray mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
5											
10											
	TP-13.1						27.0	74			
						Bottom of test pit at 14.0 feet. No groundwater observed on 6/30/23.					
15											
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-5
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
La Center, Washington	L&S Excavating	Excavator	MAC	6/30/23
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	See Page Notes	0845	0930

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		CL		Brown to brown/gray mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
5											
	TP-5.1										
10				SC		Weathered brown to black sedimentary CONGLOMERATE of semi-consolidated clayey sand with trace gravel, moist to wet, dense to very dense, medium plasticity fines.					
▼											
	TP-5.2										
						Bottom of test pit at 14.0 feet. Groundwater seep observed at 13.0 feet bgs.					
15											
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-6
PROJECT LOCATION	CONTRACTOR	EQUIPMENT	ENGINEER	DATE
La Center, Washington	L&S Excavating	Excavator	MAC	6/30/23
TEST PIT LOCATION	APPROX. SURFACE ELEVATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure 2	Not Surveyed	See Page Notes	1040	1115

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		CL		Brown to brown/gray mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
5											
				GC		Weathered brown to black sedimentary CONGLOMERATE of semi-consolidated clayey gravel with sand, moist, dense to very dense, medium plasticity fines.					
10											
	TP-6.1		A-2-7(1)				22.0	24.1	48	21	
						Bottom of test pit at 13.0 feet. No groundwater observed on 6/30/23.					
15											
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-7
PROJECT LOCATION: La Center, Washington	CONTRACTOR: L&S Excavating	EQUIPMENT: Excavator	ENGINEER: MAC	DATE: 6/30/23
TEST PIT LOCATION: See Figure 2	APPROX. SURFACE ELEVATION: Not Surveyed	GROUNDWATER DEPTH: See Page Notes	START TIME: 1155	FINISH TIME: 1220

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		CL		Brown to brown/orange/gray mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
5											
10											
						Bottom of test pit at 14.0 feet. No groundwater observed on 6/30/23.					
15											
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-8
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Excavating	EQUIPMENT Excavator	ENGINEER MAC	DATE 6/30/23
TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION Not Surveyed	GROUNDWATER DEPTH See Page Notes	START TIME 0930	FINISH TIME 1010

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
	TP-8.1	Gee silt loam		CL		Brown to brown/gray mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity. Increased fine sand and decreased plasticity with depth.	20.0	66			
5											
10											
▼	TP-8.2			SC		Weathered brown to black sedimentary CONGLOMERATE of semi-consolidated clayey sand with trace gravel, moist to wet, dense to very dense, medium plasticity fines.					
15						Bottom of test pit at 14.0 feet. Groundwater seep observed at 13.0 feet bgs.					
20											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Peterson Subdivision	MJS Investors		23264	TP-9
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Excavating	EQUIPMENT Excavator	ENGINEER MAC	DATE 6/30/23
TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION Not Surveyed	GROUNDWATER DEPTH See Page Notes	START TIME 1010	FINISH TIME 1040

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Grass and 3- to 4-inch-thick root zone. Fine rootlets and low-organic till zone extends to approximately 18 inches.					
		Gee silt loam		SM		Brown to brown/gray mottled lean CLAY with sand, moist, stiff to very stiff, low to medium plasticity.					
5											
10				GC		Weathered brown to black sedimentary CONGLOMERATE of semi-consolidated clayey gravel with sand, moist, dense to very dense, medium plasticity fines.					
						Bottom of test pit at 14.0 feet. No groundwater observed on 6/30/23.					
15											
20											

APPENDIX B
LABORATORY TESTING

CLASSIFICATION

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications.

MOISTURE CONTENT

We determined the natural moisture content of select soil samples in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

PARTICLE-SIZE ANALYSIS

We completed particle-size analysis on select soil samples in general accordance with ASTM D6913. This test is a quantitative determination of the soil particle size distribution expressed as a percentage of dry soil weight.

ATTERBERG LIMITS

The plastic and liquid limits (Atterberg limits) of select soil samples were determined in accordance with ASTM D4318. The testing was conducted to classify fine-grained soil in accordance with United Soil Classification System (USCS) specifications. Results of the Atterberg limits analysis are presented in this appendix.

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Peterson Subdivision La Center, Washington	MJS Investors 11201 SE 8th Street, Suite 116 Bellevue, Washington 98004	23264	S23-0835
		REPORT DATE: 07/19/23	FIELD ID: TP2.1
		DATE SAMPLED: 06/30/23	SAMPLED BY: MAC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
brown Lean CLAY with Sand	Test Pit TP-02 depth = 3 feet	CL, Lean Clay with Sand

SPECIFICATIONS	AASHTO CLASSIFICATION
none	A-6(7)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter, moist prep, hand washed, 12" single sieve-set	ASTM D6913, Method A

ADDITIONAL DATA

initial dry mass (g) =	151.78		
as-received moisture content =	27%	coefficient of curvature, C_C =	n/a
liquid limit =	35	coefficient of uniformity, C_U =	n/a
plastic limit =	24	effective size, $D_{(10)}$ =	n/a
plasticity index =	11	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	n/a

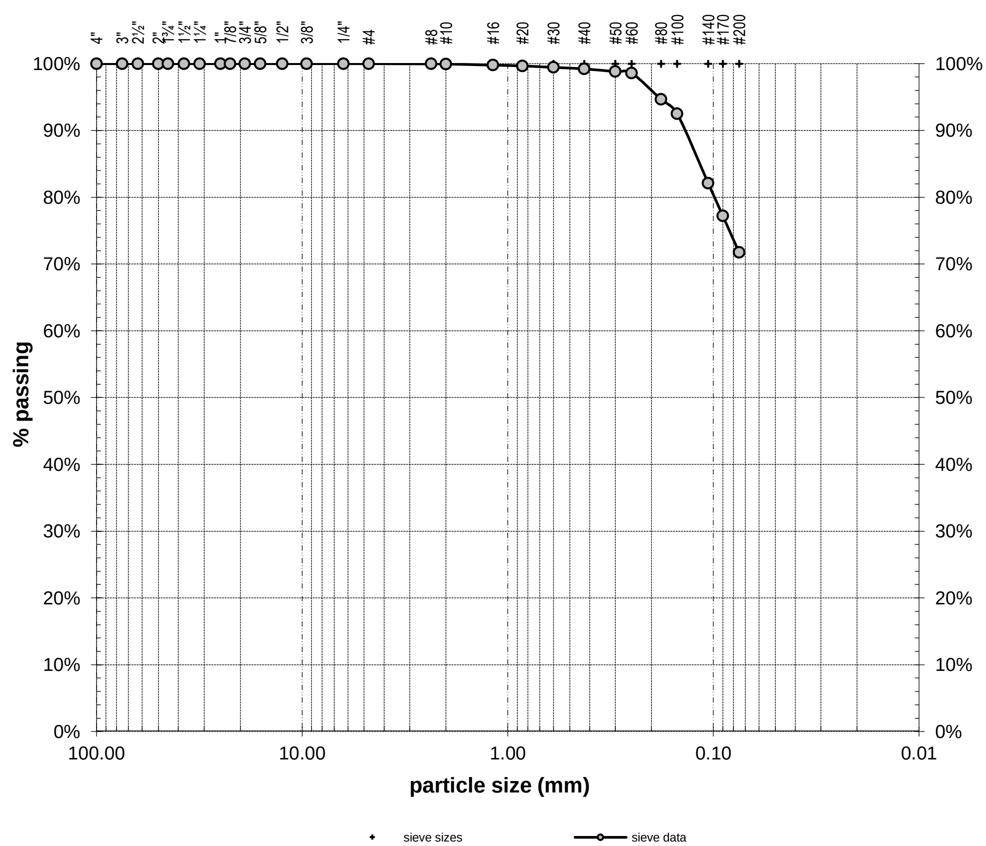
SIEVE DATA

% gravel = 0.0%
% sand = 28.3%
% silt and clay = 71.7%

	SIEVE SIZE US	SIEVE SIZE mm	PERCENT PASSING SIEVE act.	SIEVE interp.	SPECS max	SPECS min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		99%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		95%		
	#100	0.150	92%			
	#140	0.106		82%		
	#170	0.090		77%		
	#200	0.075	72%			

DATE TESTED	TESTED BY
07/14/23	MRS

GRAIN SIZE DISTRIBUTION



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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Peterson Subdivision La Center, Washington	MJS Investors 11201 SE 8th Street, Suite 116 Bellevue, Washington 98004	23264	S23-0835
		REPORT DATE: 07/19/23	FIELD ID: TP2.1
		DATE SAMPLED: 06/30/23	SAMPLED BY: MAC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
brown Lean CLAY with Sand	Test Pit TP-02 depth = 3 feet	CL, Lean Clay with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

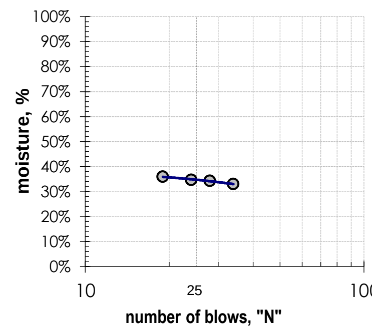
ATTERBERG LIMITS

liquid limit = 35
plastic limit = 24
plasticity index = 11

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	35.08	33.71	34.91	33.89
dry soil + pan weight, g =	31.58	30.46	31.33	30.43
pan weight, g =	20.98	20.97	21.02	20.82
N (blows) =	34	28	24	19
moisture, % =	33.0 %	34.3 %	34.7 %	36.0 %

LIQUID LIMIT



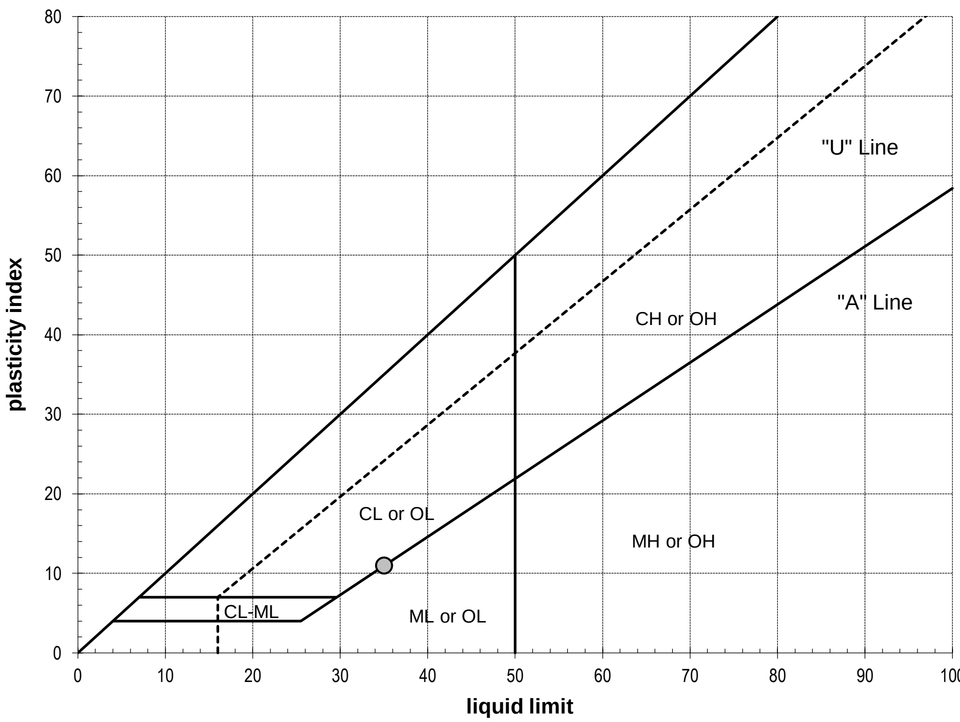
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.37	28.12		
dry soil + pan weight, g =	26.94	26.76		
pan weight, g =	20.87	21.02		
moisture, % =	23.6 %	23.7 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 28.3%
% silt and clay = 71.7%
% silt = n/a
% clay = n/a
moisture content = 27%

DATE TESTED	TESTED BY
07/17/23	MRS

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Peterson Subdivision La Center, Washington	MJS Investors 11201 SE 8th Street, Suite 116 Bellevue, Washington 98004	23264	S23-0838
		REPORT DATE: 07/19/23	FIELD ID: TP6.1
		DATE SAMPLED: 06/30/23	SAMPLED BY: MAC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
orange/brown/black Clayey GRAVEL with Sand	Test Pit TP-06 depth = 12 feet	GC, Clayey Gravel with Sand

SPECIFICATIONS	AASHTO CLASSIFICATION
none	A-2-7(1)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter, air-dried prep, hand washed, composite sieve - #4 split	ASTM D6913, Method A

ADDITIONAL DATA

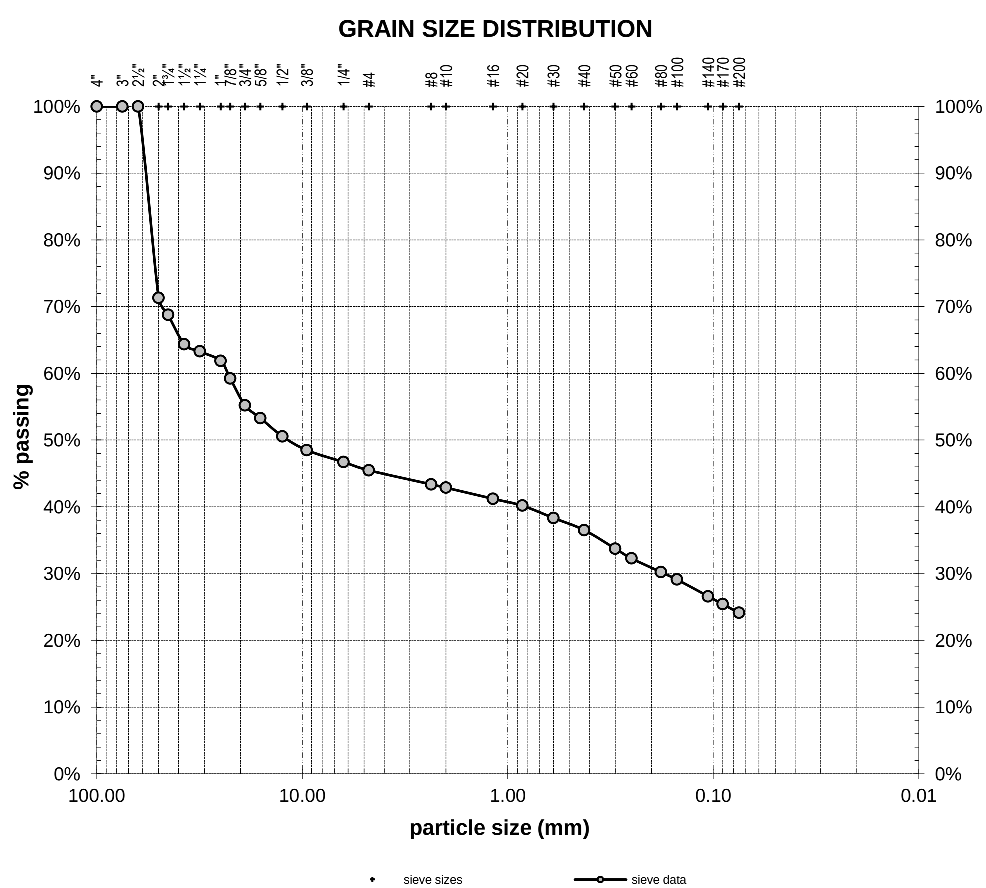
initial dry mass (g) =	1915.97		
as-received moisture content =	22%	coefficient of curvature, C_C =	n/a
liquid limit =	48	coefficient of uniformity, C_U =	n/a
plastic limit =	27	effective size, $D_{(10)}$ =	n/a
plasticity index =	21	$D_{(30)}$ =	0.173 mm
fineness modulus =	n/a	$D_{(60)}$ =	23.149 mm

NOTE: Entire sample used for analysis; did not meet minimum size required.

SIEVE DATA

% gravel = 54.5%
% sand = 21.4%
% silt and clay = 24.1%

	SIEVE SIZE US	mm	PERCENT PASSING SIEVE act.	interp.	SPECS max	min
	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
GRAVEL	2.50"	63.0	100%			
GRAVEL	2.00"	50.0	71%			
GRAVEL	1.75"	45.0		69%		
GRAVEL	1.50"	37.5	64%			
GRAVEL	1.25"	31.5		63%		
GRAVEL	1.00"	25.0	62%			
GRAVEL	7/8"	22.4		59%		
GRAVEL	3/4"	19.0	55%			
GRAVEL	5/8"	16.0		53%		
GRAVEL	1/2"	12.5	51%			
GRAVEL	3/8"	9.50	48%			
GRAVEL	1/4"	6.30		47%		
GRAVEL	#4	4.75	45%			
SAND	#8	2.36		43%		
SAND	#10	2.00	43%			
SAND	#16	1.18		41%		
SAND	#20	0.850	40%			
SAND	#30	0.600		38%		
SAND	#40	0.425	37%			
SAND	#50	0.300		34%		
SAND	#60	0.250	32%			
SAND	#80	0.180		30%		
SAND	#100	0.150	29%			
SAND	#140	0.106		27%		
SAND	#170	0.090		25%		
SAND	#200	0.075	24%			



DATE TESTED	TESTED BY
07/18/23	KMS

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Peterson Subdivision La Center, Washington	MJS Investors 11201 SE 8th Street, Suite 116 Bellevue, Washington 98004	23264	S23-0838
		REPORT DATE: 07/19/23	FIELD ID: TP6.1
		DATE SAMPLED: 06/30/23	SAMPLED BY: MAC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
orange/brown/black Clayey GRAVEL with Sand	Test Pit TP-06 depth = 12 feet	GC, Clayey Gravel with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

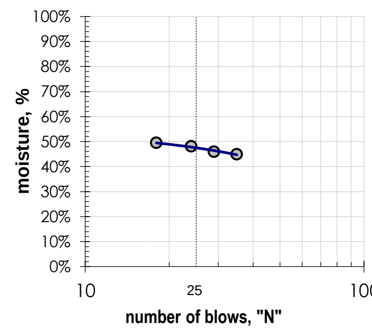
ATTERBERG LIMITS

liquid limit = 48
plastic limit = 27
plasticity index = 21

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	32.28	31.36	32.91	31.26
dry soil + pan weight, g =	28.61	27.92	29.03	27.72
pan weight, g =	20.44	20.43	20.96	20.56
N (blows) =	35	29	24	18
moisture, % =	44.9 %	45.9 %	48.1 %	49.4 %

LIQUID LIMIT



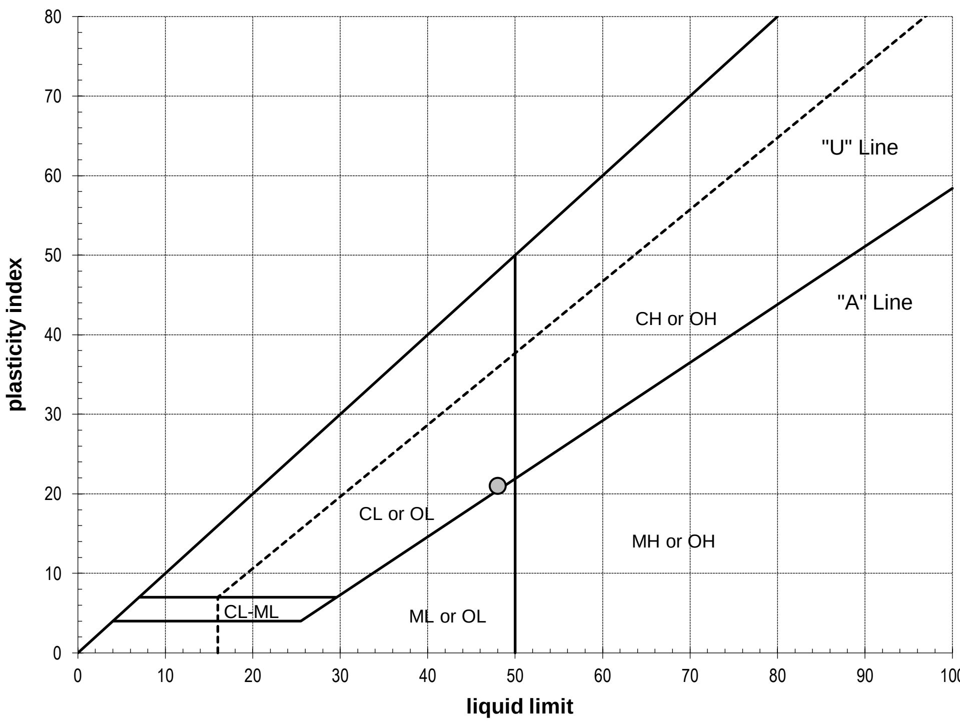
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.68	28.07		
dry soil + pan weight, g =	26.23	26.43		
pan weight, g =	20.93	20.42		
moisture, % =	27.4 %	27.3 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 54.5%
% sand = 21.4%
% silt and clay = 24.1%
% silt = n/a
% clay = n/a
moisture content = 22%

DATE TESTED	TESTED BY
07/17/23	MRS

COLUMBIA WEST ENGINEERING, INC. authorized signature

Vancouver, Washington • Phone: 360-823-2900
Beaverton, Oregon • Phone: 971-384-1666
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

MOISTURE CONTENT, PERCENT PASSING NO. 200 SIEVE BY WASHING

PROJECT	CLIENT	PROJECT NO.	REPORT DATE
Peterson Subdivision La Center, Washington	MJS Investors 11201 SE 8th Street, Suite 116 Bellevue, Washington 98004	23264	07/19/23
		DATE SAMPLED: 06/30/23	
		SAMPLED BY: MAC	

LABORATORY TEST DATA

TEST PROCEDURE
ASTM D2216 - Method A, ASTM D1140

LAB ID	CONTAINER MASS	MOIST MASS + PAN	DRY MASS + PAN	AFTER WASH DRY MASS + PAN	MATERIAL DESCRIPTION	FIELD ID	SAMPLE DEPTH	MOISTURE CONTENT	PASSING NO. 200 SIEVE
S23-0835	87.20	322.23	272.63	sieved sample	brown Lean CLAY with Sand	TP2.1	3 feet	27%	72%
S23-0836	542.64	832.70	770.44	642.42	brown/gray Sandy SILT	TP2.2	9 feet	27%	56%
S23-0837	541.95	828.20	767.88	599.66	brown/orange/gray CLAY with Sand	TP4.1	13 feet	27%	74%
S23-0838	548.11	2,878.49	2,464.08	sieved sample	brown/orange/black Clayey GRAVEL with Sand	TP6.1	12 feet	22%	24%
S23-0839	556.51	855.50	804.93	640.38	brown Sandy SILT	TP8.1	2 feet	20%	66%

NOTES:	DATE TESTED	TESTED BY
Sample weight received for Lab ID: S23-0838 did not meet the minimum size requirement; entire sample used for analysis.	07/18/23	MRS/BTT

COLUMBIA WEST ENGINEERING, INC. authorized signature

APPENDIX C
SOIL AND ROCK CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION

Particle-Size Classification

COMPONENT	ASTM / USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Boulders	Greater than 300 mm	Greater than 12 inches	-	-
Cobbles	75 mm to 300 mm	3 inches to 12 inches	Greater than 75 mm	Greater than 3 inches
Gravel	75 mm to 4.75 mm	3 inches to No. 4 sieve	75 mm to 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm to 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm to 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm to 0.075 mm	No. 4 to No. 200 sieve	2.00 mm to 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm to 2.00 mm	No. 4 to No. 10 sieve	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	Less than 0.075 mm	Passing No. 200 sieve	Less than 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	Less than 2	Less than 3	Less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.50
Medium Stiff	4 to 8	6 to 12	0.50 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very Stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	30 to 60	65 to 145	Greater than 4.0
Very Hard	Greater than 60	Greater than 145	-

Relative Density for Granular Soil

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium Dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very Dense	Greater than 50	Greater than 120

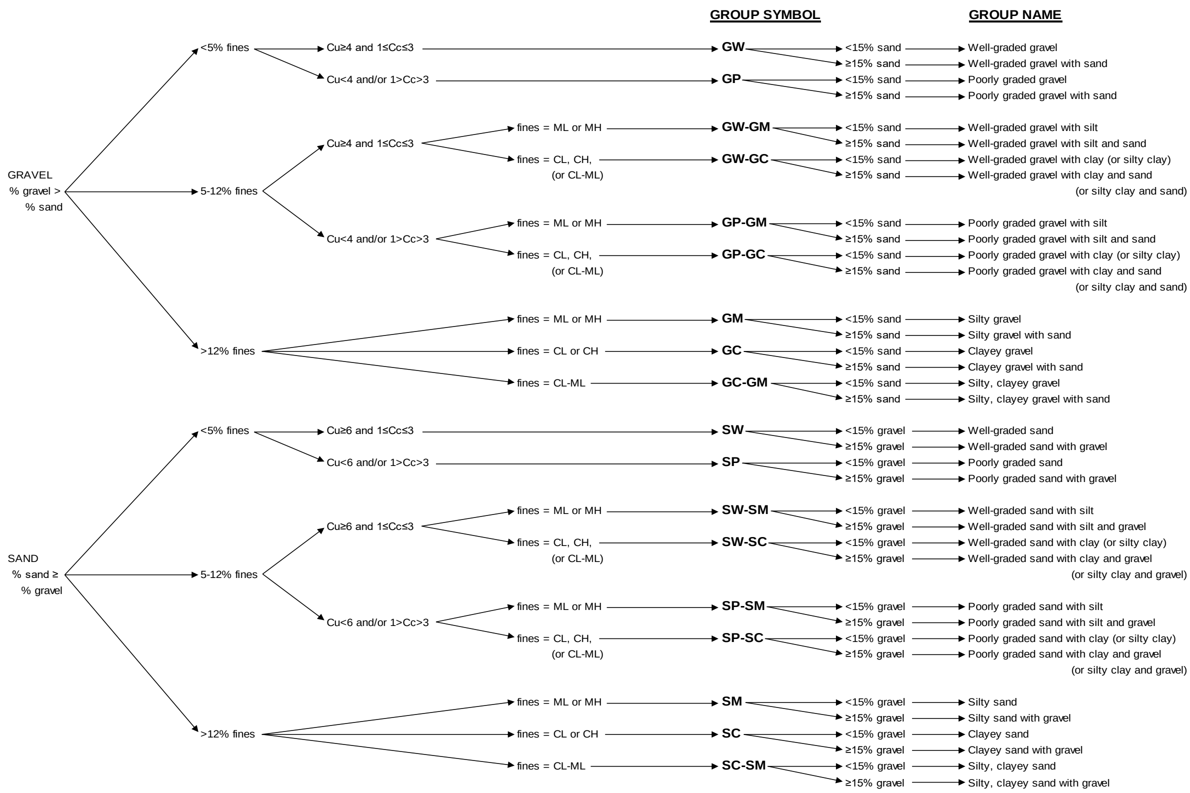
Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

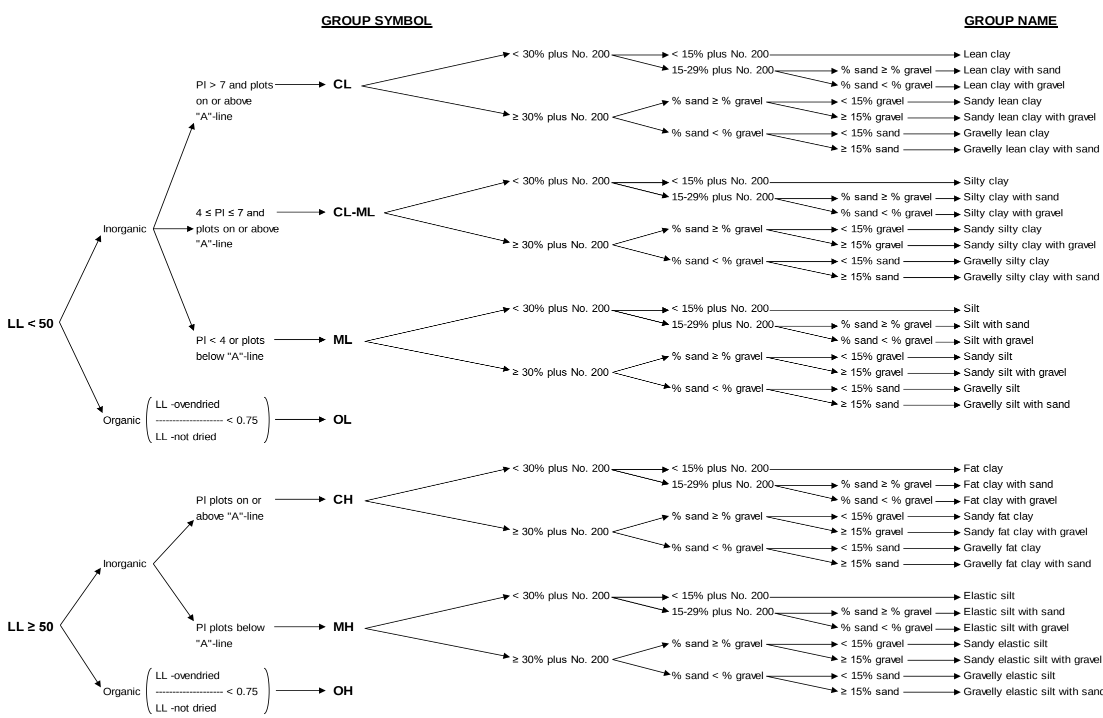
Additional Constituents

Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	with (approx. percentage)

UNIFIED SOIL CLASSIFICATION SYSTEM



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)



Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

ROCK CLASSIFICATION SYSTEM

STRENGTH	DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH (PSI)
Extremely Weak (R0)	Easily indented by thumbnail	35 to 150
Very Weak (R1)	Scratched with fingernail, peeled by knife, indented by rock pick	150 to 275
Weak (R2)	Peeled by knife, indented by rock pick	725 to 3,500
Medium Strong (R3)	Cannot be peeled or scraped with a knife	3,500 to 7,250
Strong (R4)	Requires more than one blow with a rock hammer to fracture it	7,250 to 14,500
Very Strong (R5)	Requires many blows with a rock hammer to fracture it	14,500 to 36,250
Extremely Strong (R6)	Can only be chipped with a rock hammer	Greater than 36,250

WEATHERING	DESCRIPTION
Decomposed	A soil formed in place with original texture of rock destroyed
Completely Weathered	Rock wholly weathered but rock texture preserved
Highly Weathered	Rock weakened so that large pieces can be broken by hand
Moderately Weathered	Rock mass is decomposed locally
Slightly Weathered	Discoloration along discontinuities
Fresh	No visible signs of weathering or discoloring

JOINT SPACING	DESCRIPTION
Very Close	Less than 0.2 foot
Close	0.2 foot to 1 foot
Moderately Close	1 foot to 3 feet
Wide	3 feet to 10 feet
Very Wide	Greater than 10 feet

FRACTURING	FRACTURE SPACING
Very Intensely Fractured	Chips, fragments, with scattered short core lengths
Intensely Fractured	0.1 foot to 0.3 foot with scattered fragments
Moderately Fractured	0.3 foot to 1 foot
Slightly Fractured	1 foot to 3 feet
Very Slightly Fractured	Greater than 3 feet
Unfractured	No fractures observed

HEALING	DESCRIPTION
Not Healed	Discontinued surface, fractured zone, sheared material, filling is not cemented
Partly Healed	Less than 50% of fractures or sheared zone bonding
Moderately Healed	Greater than 50% fractures or sheared zone bonding
Totally Healed	All fragments are bonded

QUALITY	RQD (%)
Very poor	Less than 25%
Poor	25 to 50%
Fair	51 to 75%
Good	76 to 90%
Excellent	91 to 100%

Rock Quality Designation (RQD) is a measure of quality of rock core taken from a borehole. The length of core pieces is measured along center line of the pieces. All pieces of intact rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run to obtain RQD value

APPENDIX D
PHOTO LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

Peterson Subdivision

June, 2023

La Center, Washington

Test Pit, TP-1

Typical Soil Mottling, Test Pit, TP-1

Peterson Subdivision

June, 2023

La Center, Washington

Test Pit, TP-2

Test Pit, TP-3

Peterson Subdivision

June, 2023

La Center, Washington

Test Pit, TP-4

Test Pit, TP-5

Peterson Subdivision

June, 2023

La Center, Washington

Test Pit, TP-6

Test Pit, TP-7

Peterson Subdivision

June, 2023

La Center, Washington

Test Pit, TP-8

Test Pit, TP-9

Peterson Subdivision

June, 2023

La Center, Washington

Facing North From South End of Site

East Slope, Facing South

Peterson Subdivision

June, 2023

La Center, Washington

From East Side of Site, Facing West

From North Side of Site, Facing South

Peterson Subdivision

June, 2023

La Center, Washington

West Side of Site, Facing South

East Side of Site, From North Central Area of Site

Peterson Subdivision

June, 2023

La Center, Washington

Southwest Corner of Site

APPENDIX E
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Date: July 31, 2023
Project: Peterson Subdivision
La Center, Washington

Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.

APPENDIX E

Operations and Maintenance Manual

Catch Basin

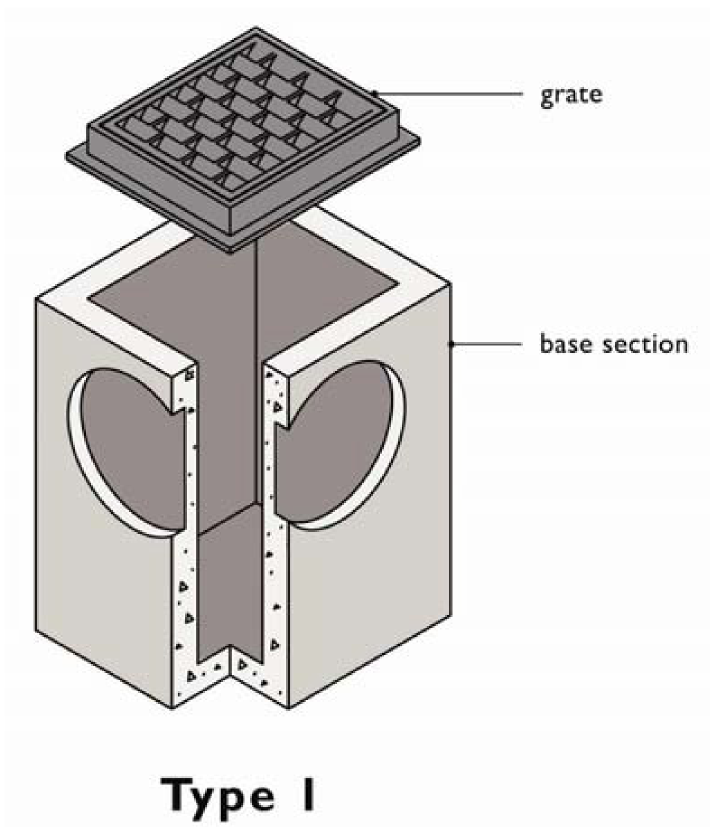
A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

A Type 1 catch basin is a rectangular box with approximate dimensions of 3’x2’x5’. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

A Type 2 catch basin, also commonly referred to as a storm manhole, is listed separately under “Manhole” in this book.

Catch basins typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or debris.

Catch basins are frequently associated with all stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning catch basins is an industrial vacuum truck with a tank and vacuum hose (e.g. Vactor® truck) to remove sediment and debris from the sump.
- A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch Basin			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

	Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Oil/Debris Trap (If Applicable)	Dislodged	Oil or debris trap is misaligned with or dislodged from the outlet pipe.	Trap is connected to and aligned with outlet pipe.

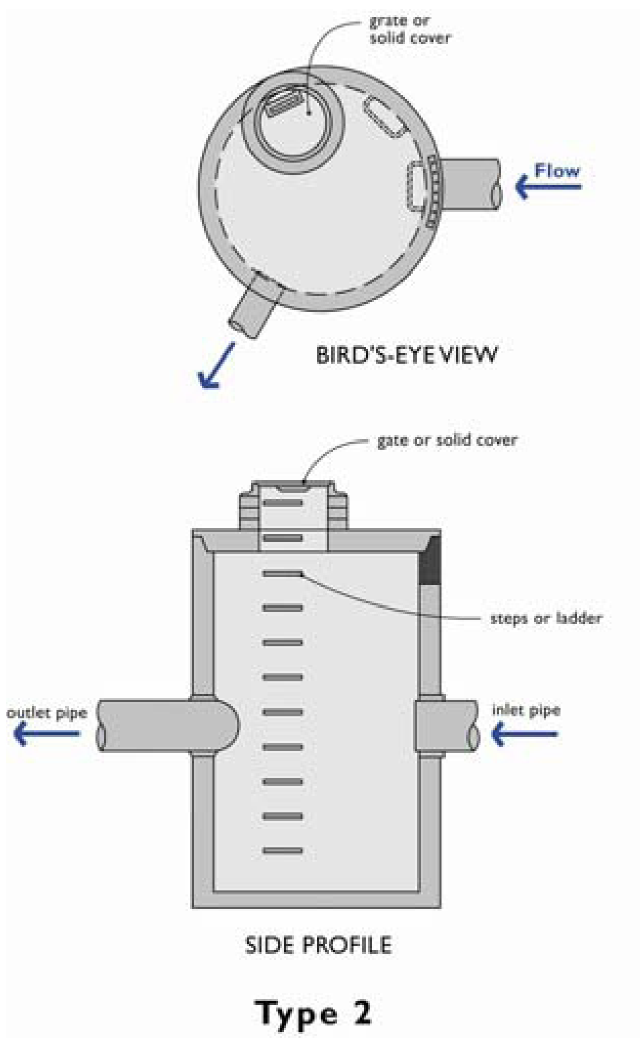
Manhole

A manhole is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Manholes can also be used as a junction in a pipe system and may have a solid lid. A manhole is also known as a Type 2 catch basin.

Manholes are round concrete structures ranging in diameter from 4 feet to 8 feet. They are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Manholes typically have steps mounted on the side of the structure to allow access.

Manholes typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some manholes are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

Manholes are often associated with other stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning manholes is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the sump.
- A manhole may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a manhole, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Manhole

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

	Settlement/ Misalignment	If failure of manhole has created a safety, function, or design problem.	Manhole replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the opening.	No vegetation blocking opening to manhole.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Manhole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open manhole is a safety hazard and requires immediate maintenance.	Manhole cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to manhole wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

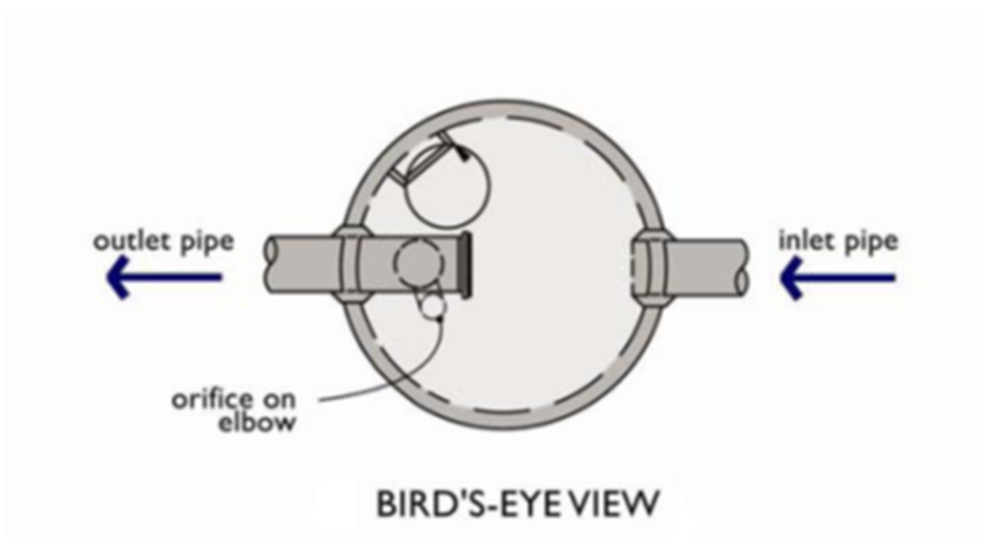
Control Structure/Flow Restrictor

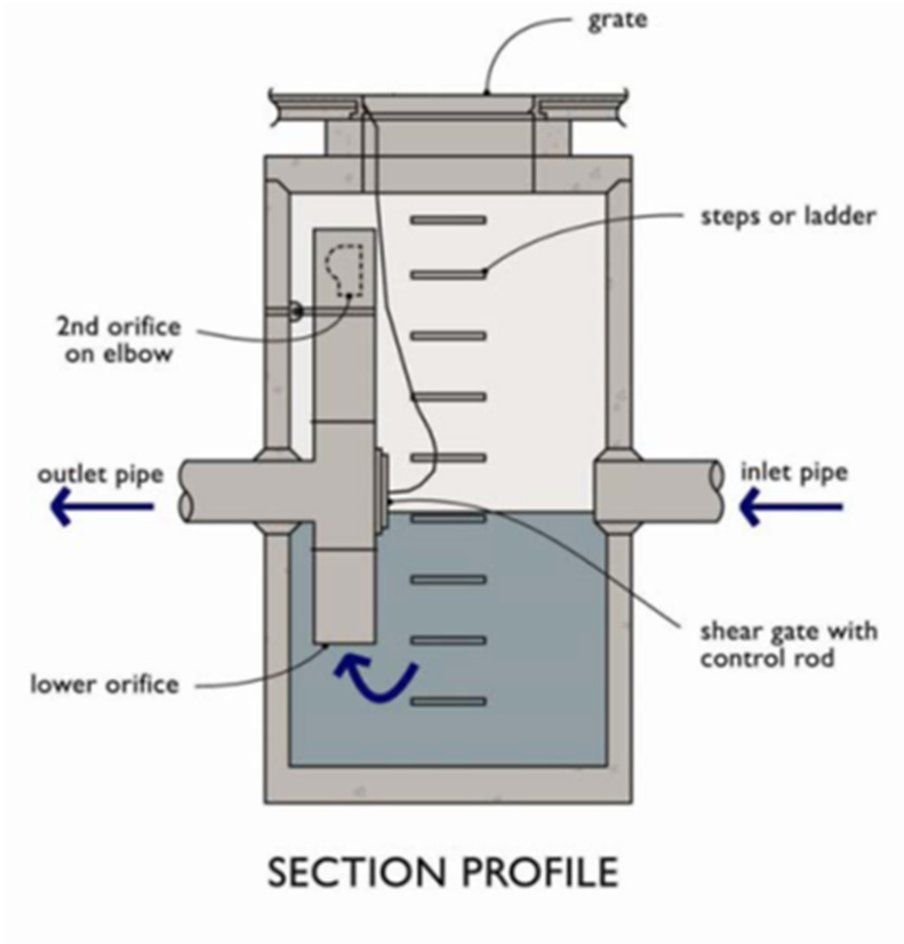
Flow control structures and flow restrictors direct or restrict flow in or out of facility components. Outflow controls on detention facilities are a common example where flow control structures slowly release stormwater at a specific rate. The flow is regulated by a combination of orifices (holes with specifically sized diameters) and weirs (plates with rectangular or "V" shaped notch). Lack of maintenance of the control structure can result in the plugging of an orifice. If these flow controls are damaged, plugged, bypassed, or not working properly, the facility could overtop or release water too quickly.

Control structures have a history of maintenance-related problems and it is imperative to establish a good maintenance program for them to function properly. Sediment typically builds up inside the structure, which blocks or restricts flow to the outlet. To prevent this problem, routinely clean out these structures and conduct regular inspections to detect the need for non-routine cleanout.

Facility objects that are typically associated with a control structure/flow restrictor include:

- detention ponds
- media cartridge filters
- closed detention system
- conveyance stormwater pipe





Key Operations and Maintenance Considerations

- Conduct regular inspections of control structures to detect the need for non-routine cleanout, especially if construction or land-disturbing activities occur in the contributing drainage area.
- The most common tool for cleaning control structures/flow restrictors is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the sump.
- A control structure is an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a control structure, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

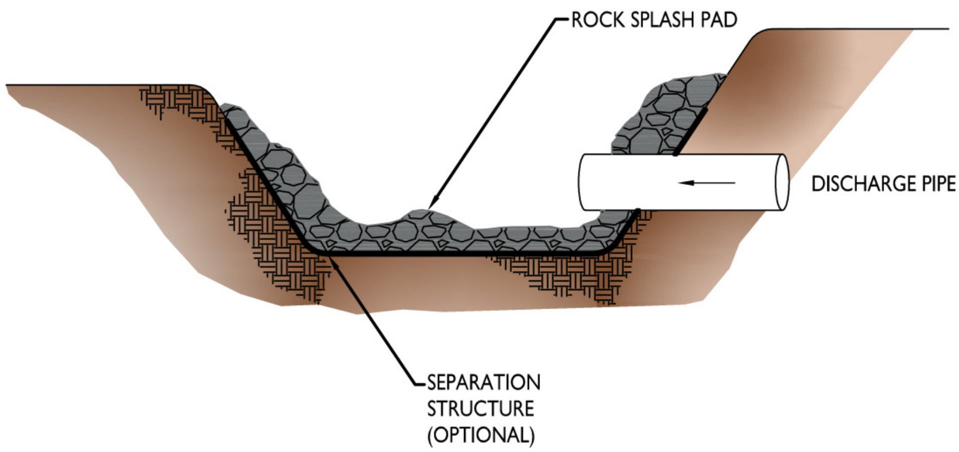
Control Structure/Flow Restrictor			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris has been removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design specifications. Allows maintenance person safe access.
Catch Basins	**See "Catch Basins"**		

Energy Dissipater / Outfall Protection

An energy dissipater is installed on or near the inlet or outlet to a closed pipe system to prevent erosion at these locations. There are a variety of designs, including wire gabion baskets, rock splash pads, trenches, and specially designed pools or manholes. The rock splash pad is typically constructed of 4- to 12-inch diameter rocks a minimum of 12 inches thick and is often lined with filter fabric. The rock pad should extend above the top of the pipe a minimum of 1 foot.

Facility features that are typically associated with energy dissipaters include:

- detention ponds
- infiltration basin
- wetponds
- treatment wetlands



Key Operations and Maintenance Considerations

- The most common tools for maintenance are hand tools such as rakes to redistribute rocks as necessary.
- Periodic removal of sediment or debris may be necessary.

Energy Dissipaters			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad has been replaced to design function.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad has been replaced to design function.
	Sediment	Sediment on top of rock pad exceeds 10% of the surface.	Rock pad has been cleared of sediment.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Coordinate with Clark County Environmental Services Department, Vegetation Management Program.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of Class B weeds designated by Clark County Weed Board. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Other Weeds	Other weeds (not listed on County/State noxious weed lists) are present on the rock pad.	Weeds have been removed per the routine maintenance schedule, following IPM protocols.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe is free of sediment and meets design specifications.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench has been repaired or modified such that it does not discharge at concentrated points and meets design function.
	Perforations Plugged	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe has been cleaned or replaced and <25% of perforations are plugged.
	Water Flows Out Top of "Distributor" Catch Basin	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt per design specifications or redesigned to meet approved County standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/ Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
Catch Basins	**See "Catch Basins"**		

Stormwater Conveyance Pipe

Storm sewer pipes convey stormwater. Inlet and outlet stormwater pipes convey stormwater in, through, and out of stormwater facilities.

Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.

Key Operations and Maintenance Considerations

- The most common tool for cleaning stormwater conveyance pipes is a truck with a tank, vacuum hose, and a jet hose (Vactor® truck) to flush sediment and debris from the pipes.

Stormwater Conveyance Pipe			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
	Drainage Slow	Decreased capacity that indicates slow drainage. Does not meet facility design infiltration rate. The Water Quality Design Storm Volume does not infiltrate within 48 hours (if perforated pipe). Water remains in the pipe for greater than 24 hours after the end of most moderate rainfall events.	Perforated drain pipe has been cleaned and drainage rates are per design specifications. (Do not allow removed sediment and water to discharge back into the storm sewer.)
	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced per design standards.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced per design standards.
	Sediment & Debris	Sediment depth is greater than 20% of pipe diameter.	Pipe has been cleaned and is free of sediment/ debris. (Upstream debris traps installed where applicable.)
	Debris Barrier or Trash Rack Missing	Stormwater pipes > than 18 inches need debris barrier.	Debris barrier present on all stormwater pipes 18 inches and greater.

Stormwater Facility Discharge Points / Pipe Outlets

Stormwater facility discharge points may convey stormwater from the stormwater facility into open channels, ditches, ponds, streams, and wetlands. Stormwater facility discharge points need to be assessed to make sure stormwater is not causing any negative impacts to these drainage areas.

Key Operations and Maintenance Considerations

- The most common tools are hand tools to remove debris or to redistribute outfall protection rock.

(Source: USDA - Natural Resources Conservation Service - Illinois)

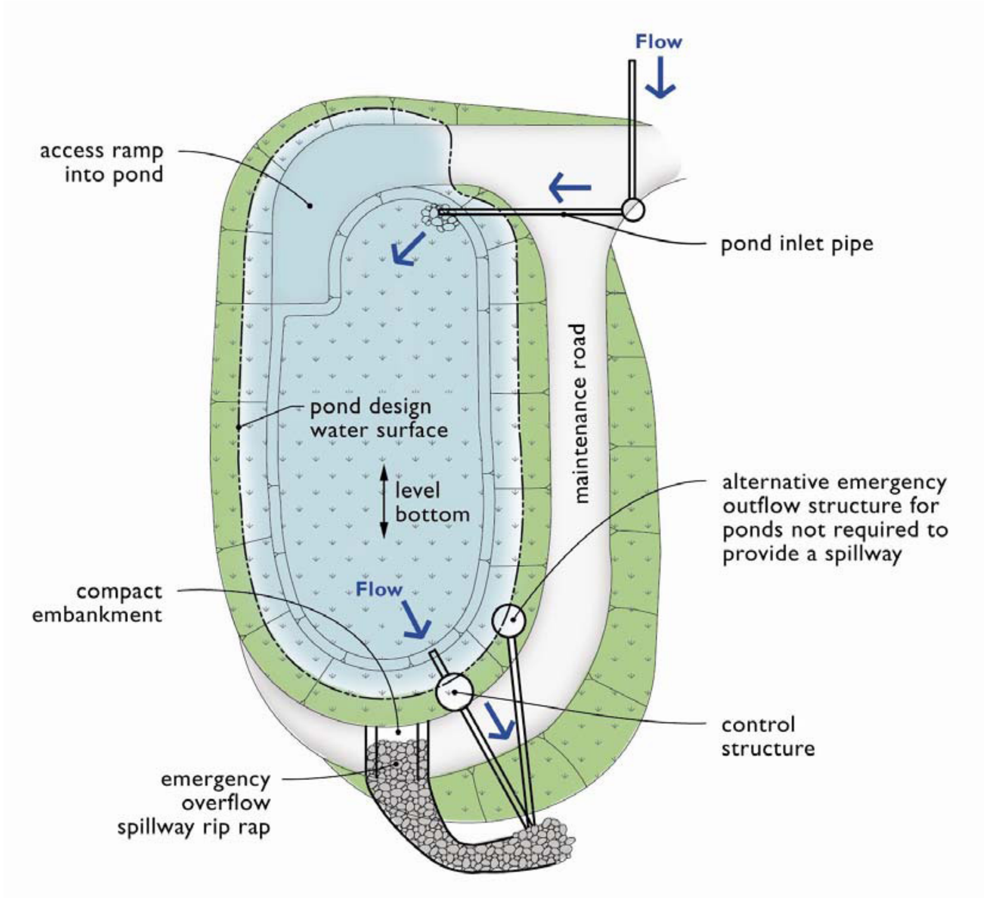
Facility Discharge Point			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Monitoring	Contaminants in Discharge Water	Any evidence of oil, gasoline, contaminants or other pollutants. Sheen, obvious oil or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	Effluent discharge from facility is clear.
	Receiving Area Saturated	Water in receiving area is causing substrate to become saturated and unstable. • Report to Clark County Clean Water Program for Engineer Evaluation.	Receiving area is sound and not saturated.
	Ditch or Stream Banks Eroding (via Off Site Assessment)	Erosion, scouring, or headcuts in ditch or stream banks downstream of facility discharge point due to flow channelization or higher flows. • Report to Clark County Clean Water Program for Engineer Evaluation.	Ditch or stream banks are stable.
General	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design function.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design function.
	Obstructions, Including Roots	Roots or debris enters pipe or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Pipe Rusted or Deteriorated	Any part of the pipe that is broken, crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced to design standards.
Internal (If Applicable)			
Energy Dissipater	**See "Energy Dissipater"**		

Detention Pond

A stormwater detention pond is an open basin built by excavating below existing ground or by constructing above-ground berms (embankments). The detention pond temporarily stores stormwater runoff during rain events and slowly releases it through an outlet (control structure). Detention ponds are typically designed to completely drain within 24 hours after the completion of a storm event. Styles vary greatly from well-manicured to natural appearing. Generally, more natural-appearing vegetation is preferred for reduced maintenance and enhanced wildlife habitat.

Facility objects that are typically associated with a detention pond include:

- access road or easement
- fence, gate, and water quality sign
- typical bioswale
- wet bioswale
- media filter cartridge
- control structure/flow restrictor
- energy dissipaters
- conveyance stormwater pipe



Example of a Manicured Detention Pond

Key Operations and Maintenance Considerations

- Maintenance is of primary importance if detention ponds are to continue to function well.
- Sediment should be removed when the standards in the defect table are exceeded. Sediments must be disposed in accordance with current local health department requirements and the Minimum Functional Standards for Solid Waste Handling. For additional guidance see Book 3, Appendix 3-E, Recommendations for Management of Street Waste.
- Handle sediments removed during the maintenance operation in a manner consistent with Book 3, Appendix 3-E, Recommendations for Management of Street Waste.
- If a shallow marsh has established, then contact Clark County Department of Environmental Services for advice.
- Maintenance of sediment forebays and attention to sediment accumulation within the pond is extremely important. Continually monitor sediment deposition in the basin. Owners, operators, and maintenance authorities should be aware that significant concentrations of metals (e.g., lead, zinc, and cadmium) as well as some organics such as pesticides, may be expected to accumulate at the bottom of these types of facilities. Regularly conduct testing sediment, especially near points of inflow, to determine the leaching potential and level of accumulation of potentially hazardous material before disposal.
- Slope areas that have become bare should be revegetated and eroded areas should be regraded prior to being revegetated.
- A common tool for cleaning detention ponds is a small bulldozer or excavator to remove built-up sediment and debris from the bottom of the pond during the dry season.

Plant Material

Table 1: Stormwater Tract "Low Grow" Seed Mix* for Detention Pond

Stormwater Tract "Low Grow" Seed Mix*		
Botanical Name	Common Name	% By Weight
Festuca arundinacea var.	Dwarf tall fescue	40%
Lolium perenne var. barclay	Dwarf perennial rye** 'Barclay'	30%
Festuca rubra	Red fescue	25%
Agrostis tenius	Colonial bentgrass	5%
Selected plants shall not include any plants from the State of Washington Noxious Weed List. Refer to clark.wa.gov/weed/ for a current list of noxious weeds.		
*Adapted from Ecology 2012, v.III, Ch 3.2.		
** If wildflowers are used and sowing is done before Labor Day, the amount of dwarf perennial rye can be reduced proportionately to the amount of wildflower seed used.		

Detention Pond			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
Note: table spans multiple pages.			
General	Trash and Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Site is free of trash and debris.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Coordinate with Clark County Environmental Services Department, Vegetation Management Program.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of Class B weeds designated by Clark County Weed Board. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vaccuming, or equipment movements). If trees are not interfering with access or maintenance, do not remove. Dead, diseased, or dying trees are identified. (Use a certified Arborist to determine health of tree or removal requirements.)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard trees.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. (Coordinate removal/cleanup with local water quality response agency.)	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with Clark County Maintenance and Operations department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies.)

Detention Pond			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted Clark County Operations and Maintenance policies.
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Pond Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation.	Dike is built back to the design elevation.
		If settlement is apparent, measure berm to determine amount of settlement.	
		Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	
	Piping	Discernible water flow through pond berm. Ongoing erosion with potential for erosion to continue.	Piping eliminated. Erosion potential resolved.
		(Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	
Emergency Overflow/ Spillway and Berms Over 4 Feet in Height	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.

Detention Pond			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
	Piping	Discernible water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.

Media Cartridge Filters

Media cartridge filters are passive, flow-through, stormwater treatment systems. They are comprised of one or more vaults that house rechargeable, media-filled filter cartridges. Stormwater passes through a filtering medium, which traps particulates and/or adsorb pollutants such as dissolved metals and hydrocarbons. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged into an open channel drainage way.

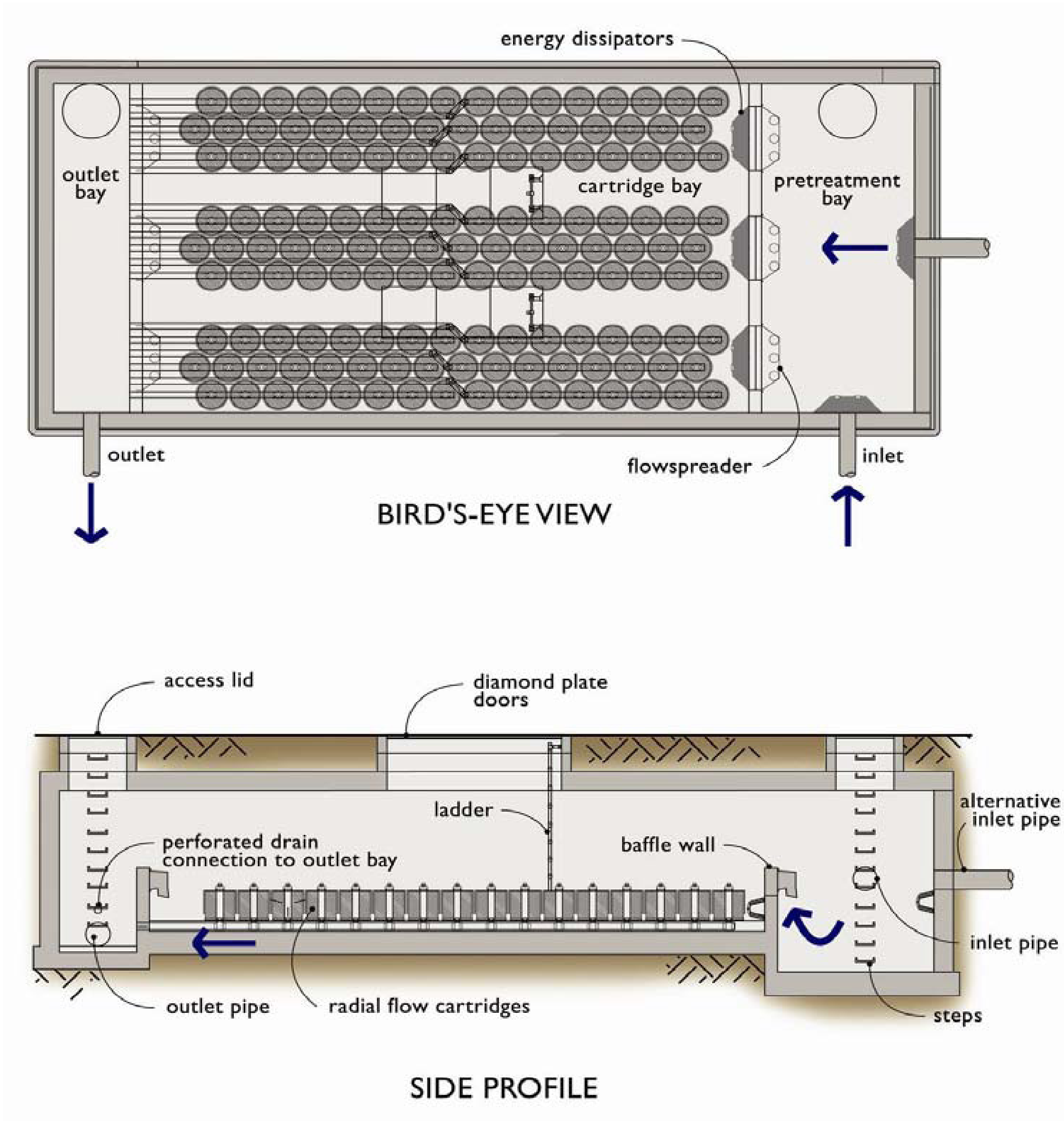
The filter media can be housed in cartridge filters enclosed in concrete vaults or catch basins. Structures will have vault doors or manhole lids (older designs) for maintenance access. Various types of filter media are available from system manufacturers.

StormFilter® units are an example of a proprietary manufactured media cartridge filter system that is common in Clark County. See manufacturer's publications for additional maintenance information.

Facility objects that are typically associated with a manufactured media filter system include:

- access road or easement
- control structure/flow restrictor
- conveyance stormwater pipe

Media Cartridge Filter Vault with Accumulated Sediment



Key Operations and Maintenance Considerations

- The most common tool for cleaning media cartridge filters is a truck with a tank and vacuum hose (e.g.Vactor® truck) to remove sediment and debris from the vault.
- Media cartridge filters are enclosed spaces where harmful chemicals and vapors can accumulate. Therefore, the inspection and maintenance of these facilities should be conducted by an individual trained and certified to work in hazardous confined spaces.
- Cartridges require replacement when the individual cartridges no longer meet the specifications for pollutant removal.

Media Cartridge Filters			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
			Note: table spans multiple pages.
Forebay	Sediment Accumulation	Sediment accumulation exceeds 6 inches or 1/3 of available sump.	Sediment accumulation less than 6 inches.
Media Filter Vault	Sediment Accumulation on Top Media Filters (Cartridges)	Sediment depth exceeds 0.25-inches (on top of filter cartridges).	No sediment deposits which would impede permeability of the compost media. No sediment deposits on top of cartridges. (Sediment on cartridges likely indicates that cartridges are plugged and require maintenance.)
	Sediment Accumulation in Vault	Sediment depth exceeds 4 inches in chamber. Look for other indicators of clogged cartridges or overflow.	No sediment deposits in vault bottom of first chamber. Cartridges have been checked and replaced or serviced as needed.
	Trash and Debris Accumulation	Trash and debris accumulated in vault.	No trash or debris in vault.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris has been removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced to design specifications.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure; corrosion/deformation of cover.	Cover repaired or replaced to design specifications.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles Damaged	Baffles corroding, cracking, warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to design specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets design specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Compost Media Clogging	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges have been replaced and drawdown time and overflow frequency are per design standards.

Media Cartridge Filters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
	Short Circuiting	Flows do not properly enter filter cartridges.	Flows are properly entering filter cartridges. Cartridges have been replaced if necessary.
	Filter Cartridges Submerged	Filter vault does not drain within 24 hours following storm. Look for evidence of submergence due to backwater or excessive hydrocarbon loading.	Filter media have been checked and replaced if needed and vault drains down within 24 of a storm event. (If cartridges are plugged with oil, additional treatment or source control BMP may be needed.)

Compost-Amended Soil

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition.

Compaction from construction can reduce the soil's natural ability to provide these functions. Compost-amended soils are intended to replace these lost functions by establishing a minimum soil quality and depth in the post-development landscape.

Sufficient organic content is a key to soil quality. Soil organic matter can be attained through numerous amendments such as compost, composted woody material, biosolids, and forest product residuals. The full benefits of compost-amended soils are realized when desired soil media depths are maintained and soil compaction is minimized.

Key Operations and Maintenance Considerations

- Replenish soil media as needed (as a result of erosion) and address compacted, poorly draining soils.
- Site uses should protect vegetation and avoid soil compaction. Care should be taken to prevent compaction of soils via vehicular loads and/or excessive foot traffic, especially during wet conditions.
- The table below provides the recommended maintenance frequencies, standards, and procedures for compost-amended soils. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities prone to erosion due to site conditions such as steep slopes or topography tending to concentrate flows.

Compost-Amended Soil			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Minimum Performance Standard**
Soil Media	Soils Waterlogged or Not Infiltrating	Soils become waterlogged, or otherwise do not appear to be infiltrating.	Soils have been aerated or amended such that infiltration occurs and soils to not remain completely saturated, per design specifications.
	Erosion/Scouring	Areas of potential erosion are visible, such as gullies or scouring.	Any eroded areas have been repaired, and sources of erosion addressed to prevent further soil erosion.
Vegetation	Vegetation in Poor Health	Less than 75% of planted vegetation is healthy with a generally good appearance.	At least 75% of planted vegetation is healthy with generally good appearance. Any conditions found that were deleterious to plant health have been corrected where possible. Routine maintenance schedule has been updated as necessary to ensure continued plant health and satisfactory appearance.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Coordinate with Clark County Environmental Services Department, Vegetation Management Program.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of Class B weeds designated by Clark County Weed Board. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Other Weeds Present	Other weeds (not listed on County/State noxious weed lists) are present on site.	Weeds have been removed per the routine maintenance schedule, following IPM protocols.