Bull Ranch

Stormwater Site Plan Report

March 17, 2021

Prepared for

Genesis KC Development, LLC
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03/15/2021

Submitted by

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APPENDICES

1. PROJECT OVERVIEW

The proposed Bull Ranch project is located south and east of the intersection of Kittitas Highway & Gregory Place within Section 12, Township 17 North, Range 18 East (W.M.), at 298633 Kittitas Highway, Ellensburg, WA 98926. The site contains parcel 298633 zoned RS (Residential Suburban) for a total of 45.02 acres. The proposed project is a residential development with pedestrian access, utility services, and various infiltration facilities for stormwater flow control mitigation. Refer to Figure 1.1, 1.2, and 1.3 for a vicinity map, existing, and proposed conditions respectively.

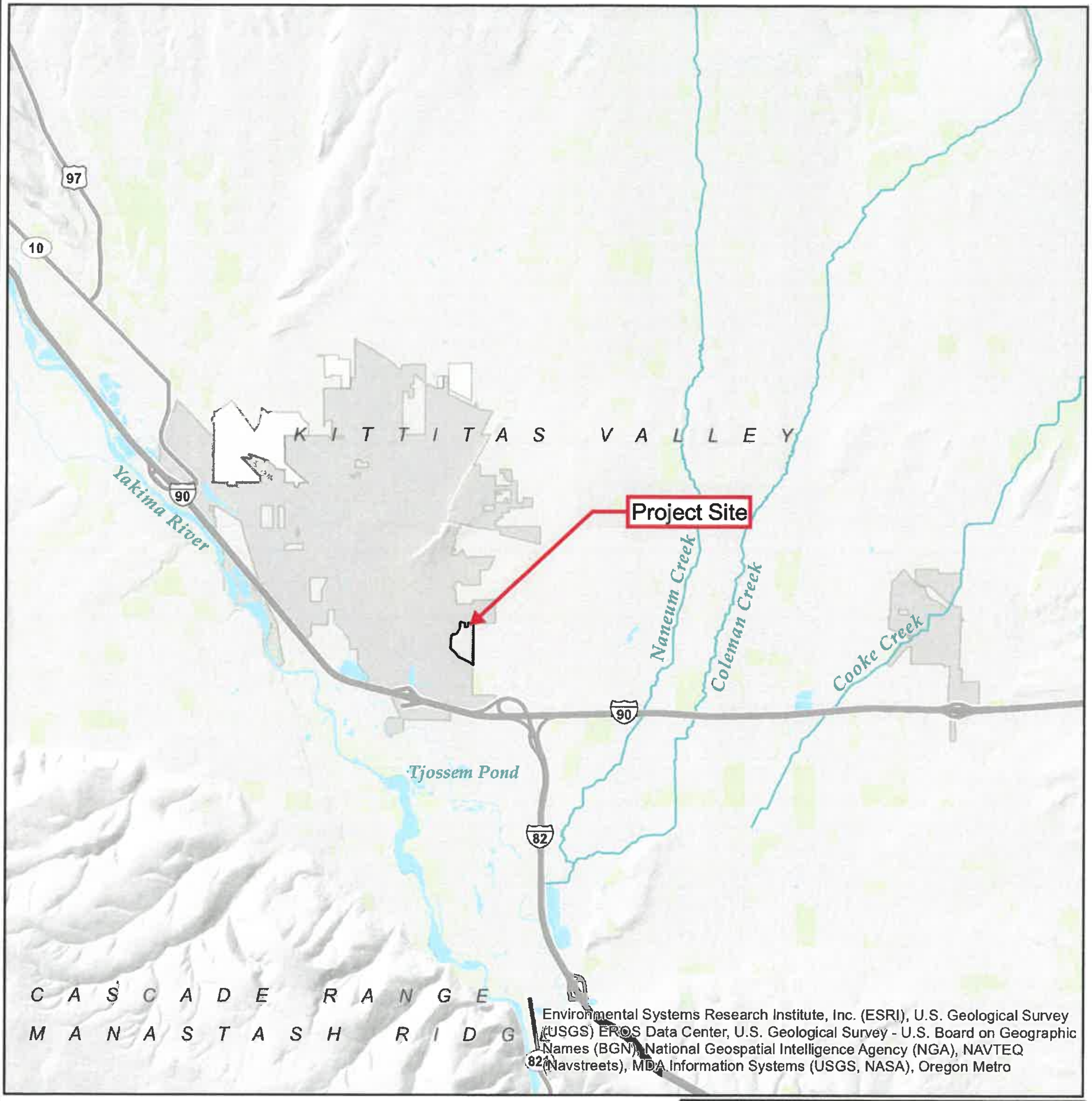
The 2019 Stormwater Management Manual for Eastern Washington and the 2019 City of Ellensburg Public Works Development Standards (hereafter collectively referred to as SWM) were used to construct this Stormwater Site Plan Report, with additional guidance from the pre-application conference summary for the proposed development. A Geotechnical Report has been prepared for this project and is included in the appendix of this report.

Any existing site improvements within the clearing limits are proposed to be demolished and the remainder of the area will be cleared and grubbed of any remaining vegetation.

Flow control mitigation will be achieved with Full Infiltration via lot infiltration trenches, bioswales, and infiltration ponds. Refer to Section 4 of this report for more information.

Water quality treatment required for this project will be provided in the bioswales. Refer to Sections 2 & 4 of this report for more information.

Figure 1.1 - Vicinity Map



Date: 3/11/2021

1 inch = 11,128 feet
Relative Scale 1:133,541

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N

0 0.5 1 2 3 4 mi

Figure 1.2 - Existing Site Conditions

Date: 3/11/2021

1 inch = 696 feet
Relative Scale 1:8,346

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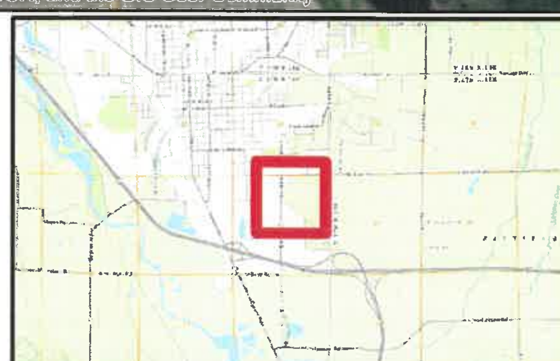
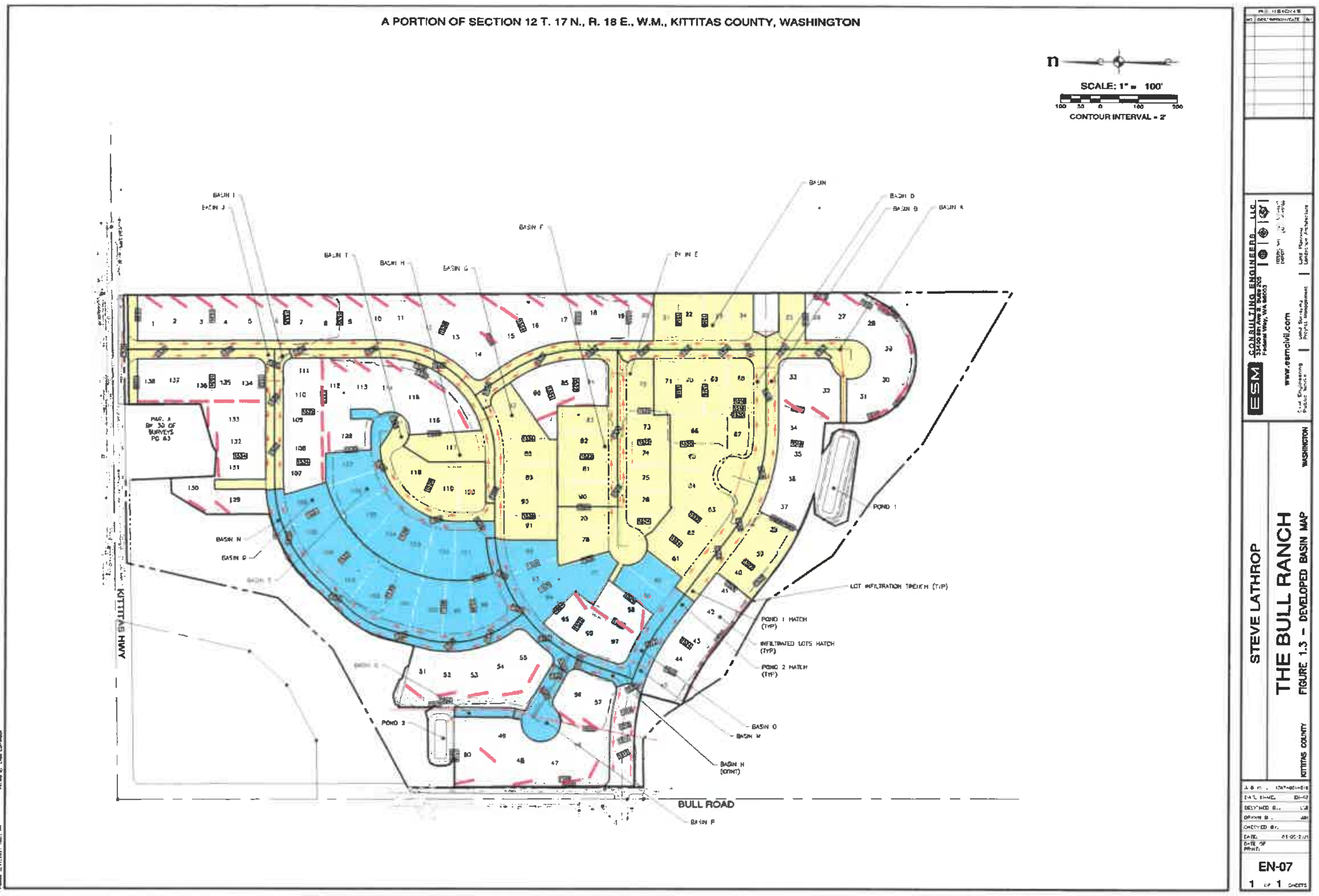
N

0 0.0375 0.075 0.15 0.225 0.3 mi





A PORTION OF SECTION 12 T. 17 N., R. 18 E., W.M., KITTITAS COUNTY, WASHINGTON
SCALE: 1" = 100'
CONTOUR INTERVAL = 2'
KITTITAS HWY
BULL ROAD
POND 1
POND 2
LOT INFILTRATION TRENCH (TYP)
POND 1 HATCH (TYP)
INFILTRATED LOTS HATCH (TYP)
POND 2 HATCH (TYP)
ESM CONSULTING ENGINEERS LLC
www.esmcivil.com
STEVE LATHROP
THE BULL RANCH
FIGURE 1.3 – DEVELOPED BASIN MAP
KITTITAS COUNTY
WASHINGTON
EN-07
1 of 1 SHEETS

Hydrologic Soil Group—Kittitas County Area, Washington
(Bull Road)

Map Scale: 1:4,130 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Kittitas County Area, Washington
Survey Area Data: Version 13, Jun 4, 2020

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

Date(s) aerial images were photographed: Jul 3, 2014—Sep 21, 2016

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
410	Tanaha ashy loam, 0 to 2 percent slopes	C	6.5	14.0%
494	Caliralls silt loam, 10 to 15 percent slopes	C	15.4	33.0%
587	Argixerolls, 15 to 30 percent slopes	C	0.2	0.4%
635	Opnish ashy loam, 0 to 2 percent slopes	C	2.1	4.6%
720	Nanum ashy sandy clay loam, 0 to 2 percent slopes	C/D	19.6	42.0%
838	Nosal ashy silt loam, 0 to 2 percent slopes	C/D	2.8	5.9%
Totals for Area of Interest			**46.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

2. EXISTING CONDITIONS

The existing project currently has little development and is generally flat because of its current agricultural usage. There is some amount stormwater drainage along the northerly parcel boundary from Kittitas Highway (as sheetflow) and possibly irrigation water as a result of the existing irrigation channel extending from the adjacent property to the east; however, due to the existing topography of the area being flat, it is not possible to determine the limits of the upstream area nor the source irrigation water (if applicable). The upstream runoff is conveyed around and through the middle of the project site in channels and subsequently discharged along the southerly parcel boundary, no other upstream runoff reaches the site. Stormwater in the irrigation channel that runs through the central portion of the project site and divides the growable agricultural area. The onsite drainage pattern follows the irrigation requirements for the current agricultural use and are therefore man-made. As a result, the soils onsite have capacity for in-place infiltration and likely generate very little runoff; however, there is a concrete drainage channel that surrounds the agricultural area of the project site to collect and convey runoff to the adjacent parcels for irrigation. The site does not contain the 100-year flood hazard zone. Refer to Figure 1.2 for existing conditions.

There are no superfund areas in the vicinity, or upstream, of the project.

The Geotechnical Report indicates that the site has soils suitable for infiltration in various locations across the project site. Refer to the Geotechnical Report for more information.

According to NRCS's Web Soil Survey, the onsite soils are as follows:

- Tanaha ashy loam, 0 to 2 percent slopes
- Caliralls silt loam, 10 to 15 percent slopes
- Argixerolls, 15 to 30 percent slopes
- Opnish ashy loam, 0 to 2 percent slopes
- Nanum ashy sandy clay loam, 0 to 2 percent slopes
- Nosal ashy silt loam, 0 to 2 percent slopes

Refer to Figure 1.4 for the Web Soil Survey.

The geotechnical report recommends infiltration onsite; therefore, stormwater infiltration is proposed via infiltration trenches, bioswales, and infiltration ponds.

3. OFFSITE ANALYSIS

The existing project site drains predominantly to the south and east; however, there is little (if any) runoff leaving the site due to the agricultural land use and latent infiltration capacity of the soils.

The runoff from Kittitas Highway collects in a concrete drainage channel along the south side of the roadway at the northern parcel boundary and is routed across the middle of the project site. Stormwater flows area then discharged to the draining ditch along the southern parcel boundary and flow southwest offsite. There were no other sources of upstream run-on to the project site.

A site visit was completed on March 3, 2021, at 12pm. The weather was sunny and approximately 40°F. The following are pictures and descriptions that document the existing stormwater conveyance system and stormwater movement from upstream, onsite, and relevant downstream flows. Refer to Figure 3.1 for the Point locations.

At Point #1 looking west

Runoff from Kittitas Highway is collected in the concrete channel shown in the picture (on the south side of the road).

This picture is taken at a low point of the channel.

At Point #1 looking west

The valve shown here controls the flow direction of the runoff in the channel. If opened, water would flow south along the site's easterly border and bypass irrigation for the site.

The pipe that is controlled by the valve shown is approximately an 8-inch diameter pipe.

At Point #2 looking northeast

This is a flow splitter that diverts some amount of flow around the irrigated area of the project site through a 15-inch diameter pipe into a swale. That swale runs along the toe of the slope that forms the growable area of the site and runs to the south.

At Point #2 looking south

The 15-inch pipe mentioned above is controlled by this valve. There is an additional 8-inch pipe (& valve) to the left of the 15-inch pipe in this picture.

At Point #3 looking north

Stormwater runoff flows south around in this grass-lined swale to Point #4.

At Point #4 looking west

There was an additional valve at this location that directed runoff into the vertical pipe protruding from the ground in the background of the photo. That vertical pipe acts as a catch basin to allow for an angled connection. Further downstream connections from the vertical pipe were not visible and are not known beyond the arrows shown to the left.

The bottom right arrow indicates the flow direction to Point #5.

At Point #5 looking north

There is a ditch that conveys runoff from the concrete channel in the center of the irrigated area to this point (arrows coming down the hill). The long arrow across the bottom of the picture is flow that came from Point #4 above.

At Point #5 looking southeast

The end of the swale around the west side of the irrigated area of the project site has a 15-inch diameter CMP that connects to a vertical pipe (in similar fashion to the pipe at Point #4) for irrigation control and flow diversion.

At Point #5 looking south

The vertical pipe shown is a junction that splits flows into the directions indicated by the arrows in the photo to the left.

The south arrow (straight through) flows in a concrete channel. The east arrow (pointing to the top-left of the picture) flows in a 10-inch PVC pipe to Point #7.

Inside view of the vertical pipe from the above picture.

The 10-inch PVC outlet pipe (on the top) appears to be an overflow pipe since its invert is above the crown of the inlet pipe (on the left) while the 8-inch pipe (on the right) has a control valve and is in-line with the inlet pipe.

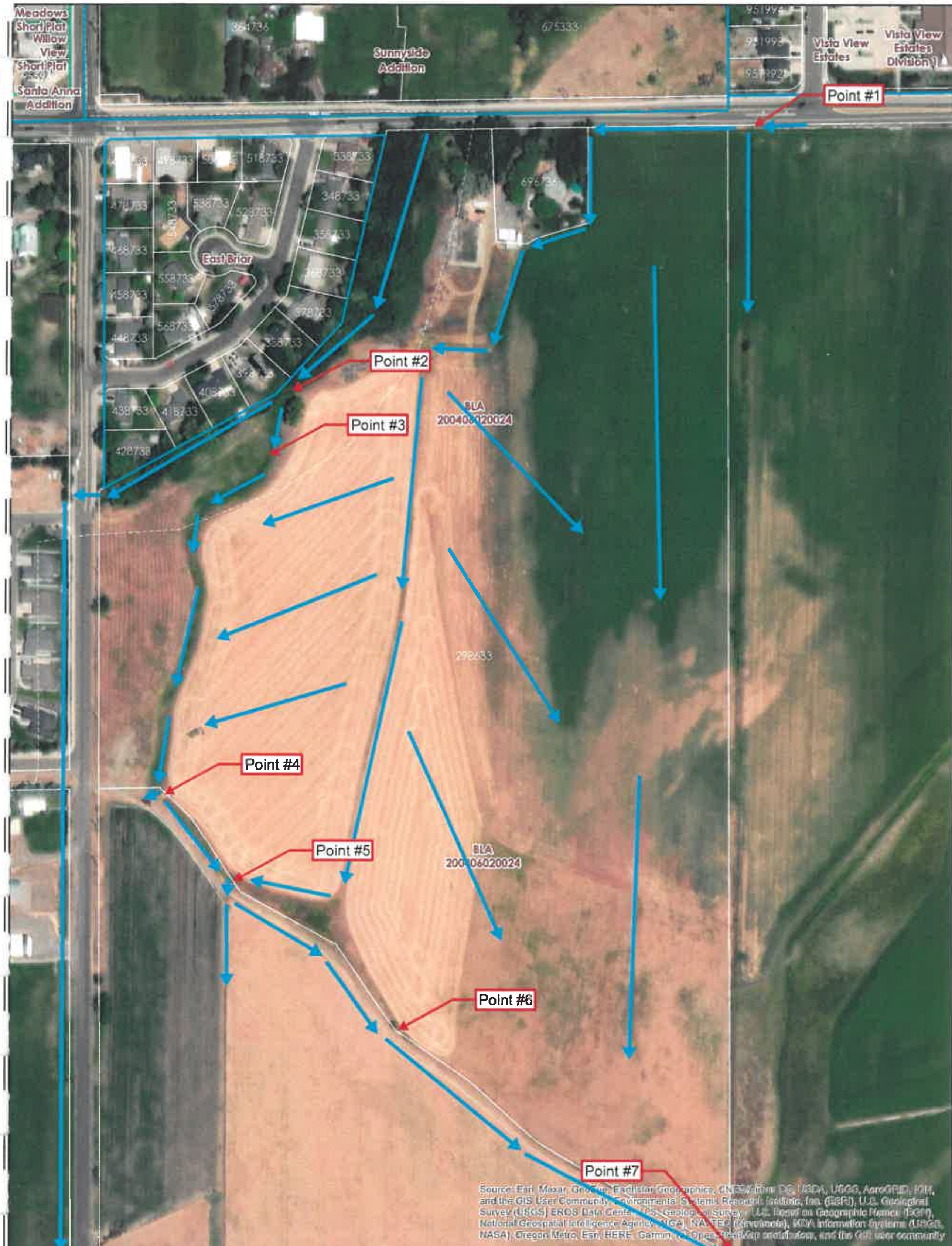
At Point #6 looking southeast

There was no drainage ditch or swale to collect runoff in this area of the project site.

At Point #7 looking south

Stormwater runoff from Point #1 and Point #5 converge here and continue south in this swale (difficult to cleanly photograph due to the tall grass).

Figure 3.1 - Downstream Analysis Flowpath



Date: 3/11/2021

1 inch = 264 feet

Relative Scale 1:3,169

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N

0 0.0150.03 0.06 0.09 0.12 mi

Figure 3.1 - Downstream Analysis Flowpath

Date: 3/11/2021

1 inch = 264 feet

Relative Scale 1:3,169

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N

0 0.0150.03 0.06 0.09 0.12 mi

4. PERMANENT STORMWATER CONTROL PLAN

This project has one Threshold Discharge Area (TDA) which fully infiltrates in-place onsite. Bioswales in the right-of-way are proposed to meet water quality requirements and flow control via Full Infiltration where there is sufficient infiltration area. There are 2 infiltration ponds proposed which collect and infiltrate runoff that overflows from the bioswales. Lots that are located in the areas with good infiltration characteristics have infiltration trenches located within each lot and are not estimated to generate any runoff that is tributary to the bioswales or the infiltration ponds.

The SCS method was used with a Type 1A storm to size the onsite infiltration facilities with an infiltration rate of 2.1 inches per hour in accordance with the Geotechnical Report, after application of all appropriate correction and safety factors.

Predeveloped Site Hydrology

The total parcel area is 45.02 acres; however, the project disturbance limit area is 37.55 acres in total. Since the proposed mitigation mechanism is Full Infiltration, no predeveloped condition area was modeled to determine developed condition compliance for the majority of the site improvements.

The upstream stormwater that is currently conveyed through the site in a network of earthen and concrete channels flows from the northerly parcel boundary to either the southerly parcel boundary (to irrigate other agricultural fields to the south) or to the westerly parcel boundary into a large conveyance channel along Bull Road. From there, stormwater continues south toward I-90. Refer to Section 3 of this report for more information.

Developed Site Hydrology

In the developed condition, the site will have the upstream stormwater from the stream diversion piped through the site and discharged into the existing stormwater conveyance system at the southern portion of the project site. The final sizing of that conveyance pipe will be determined at a later date; however, the existing conveyance restriction is a 15-inch diameter pipe opening at the inlet and outlet of the channel. The proposed pipe will be at least 18-inch diameter to convey those existing flows.

Some of the lots within the project site infiltrate in-place with infiltration trenches located on each applicable lot. The remainder of the lots and the proposed roadway will generate runoff that is collected and infiltrated in the roadside swales (which provide runoff treatment). Most of the swales infiltrate the runoff in-place, but the excess runoff will continue to either Pond #1 or Pond #2 for full infiltration. Refer to Figure 1.3 and Table 4.1 for more information.

Table 4.1 - Developed Land Use Summary

Basin ID	Number of Lots without Infiltration*	Basin			Tributary Pond #
		Area	Impervious	Pervious	
A	1	0.53	0.39	0.14	1
B	3	1.13	0.67	0.46	1
C	4	1.70	0.99	0.71	1
D	11	3.21	1.48	1.73	1
E	7	1.86	0.89	0.97	1
F	4	1.21	0.61	0.60	1
G	5	1.28	0.49	0.79	1
H	1	0.74	0.40	0.34	1
I	0	0.20	0.16	0.04	1
J	0	0.53	0.39	0.14	1
M	0	0.20	0.16	0.04	2
N	0	0.67	0.53	0.14	2
O	6	1.60	0.78	0.82	2
P	0	0.31	0.31	0.00	2
Q	0	0.09	0.09	0.00	2
R	9	2.47	1.05	1.42	2
S	7	1.86	0.80	1.06	2
T	3	0.95	0.47	0.48	1
****Pond 1**	**39**	**13.34**	**6.94**	**6.40**	**N/A**
****Pond 2**	**22**	**7.20**	**3.72**	**3.48**	**N/A**

* Each lot is estimated to have 3000 sq-ft of impervious area with the remainder to be lawn.
** Input data shown in Appendix C of this report

Flow Control System

This project will infiltrate all stormwater runoff onsite with a combination of infiltration trenches, bioswales, and infiltration ponds.

Stormwater runoff from the lots located within the areas of the site that have good infiltration capacity will be routed to on-lot infiltration trenches. Each trench is sized to fully infiltrate the impervious area of each lot without discharge. The pervious areas of those lots are estimated to disperse and infiltrate in place.

Stormwater runoff from the lots located within the area of the site that has low infiltration capacity are routed to the stormwater conveyance system in the proposed roadway.

Stormwater runoff from the roadways throughout the site is collected in the proposed bioswales within the right-of-way prism for treatment, infiltration, and conveyance in the event of extreme runoff rates. Swales A, D, E, G, & T in the Pond 1 basin will receive more runoff than they have capacity to infiltrate and will thus flow into Pond 1 to fully infiltrate the remaining runoff. Swale S in the Pond 2 basin will receive more runoff than it has capacity to infiltrate and will thus flow into Pond 2 to infiltrate fully.

As an added factor of safety, both Ponds 1 & 2 are sized to fully infiltrate the runoff from their respective tributary basins in without bioswale infiltration. Pond 1 stages 2.96-feet, and Pond 2 stages 2.95-feet, off of the pond bottom surfaces during their respective 100-year storm events. Pond 1 requires 26,325 cubic-feet of storage and Pond 2 requires 13,973 cubic-feet of storage.

Refer to Appendix C for the hydrology model output.

Water Quality System

Runoff treatment is provided in the bioswales along the proposed roadway throughout the project site. All bioswales will be constructed per BMP T5.30 to provide adequate treatment capacity for the inflow.

Conveyance System Analysis and Design

Conveyance calculations will be provided with the final report.

5. DISCUSSION OF CORE ELEMENTS

All applicable Core Elements (as determined from Figure 2.1 of the SWM and included here) are discussed in this section of the report.

Core Element #1 - Preparation of Stormwater Site Plans

A Stormwater Site Plan Report (this document) and stormwater site plans are being provided with this submittal.

Core Element #2 - Construction Stormwater Pollution Prevention Plan

The Stormwater Pollution Prevention Plan (SWPPP) will be included with the final report.

Core Element #3 - Source Control of Pollution

Applicable source control BMPs are shown on the grading plans.

Core Element #4 - Preservation of Natural Drainage Systems and Outfalls

The project site will maintain the natural drainage pattern of the existing site by infiltrating collected stormwater onsite. In extreme events, overflow from infiltration facility will continue downstream in the existing stormwater conveyance system as documented in Section 3 of this report.

Core Element #5 - Runoff Treatment

Runoff treatment will be provided by the bioswales along the roadway within the project site.

Refer to Section 4: Water Quality System of this report for more information.

Core Element #6 - Flow Control

The Geotechnical Report indicates that there are soils with favorable infiltration rates located across the site and there are areas that contain mostly impermeable soils. In the areas that have capacity for infiltration, each proposed lot will have an infiltration trench to percolate the runoff. All proposed roadway within the site will be collected in bioswales for treatment and infiltration. Lots that don't have an infiltration trench will be collected in the bioswales.

Runoff that exceeds the capacity of the bioswales will continue downstream in the onsite conveyance system to the infiltration ponds. Each infiltration pond is sized to fully infiltrate the runoff generated by the area tributary to that pond without the infiltration capacity of the bioswales (as an added factor of safety).

Refer to Section 4: Flow Control System for more information.

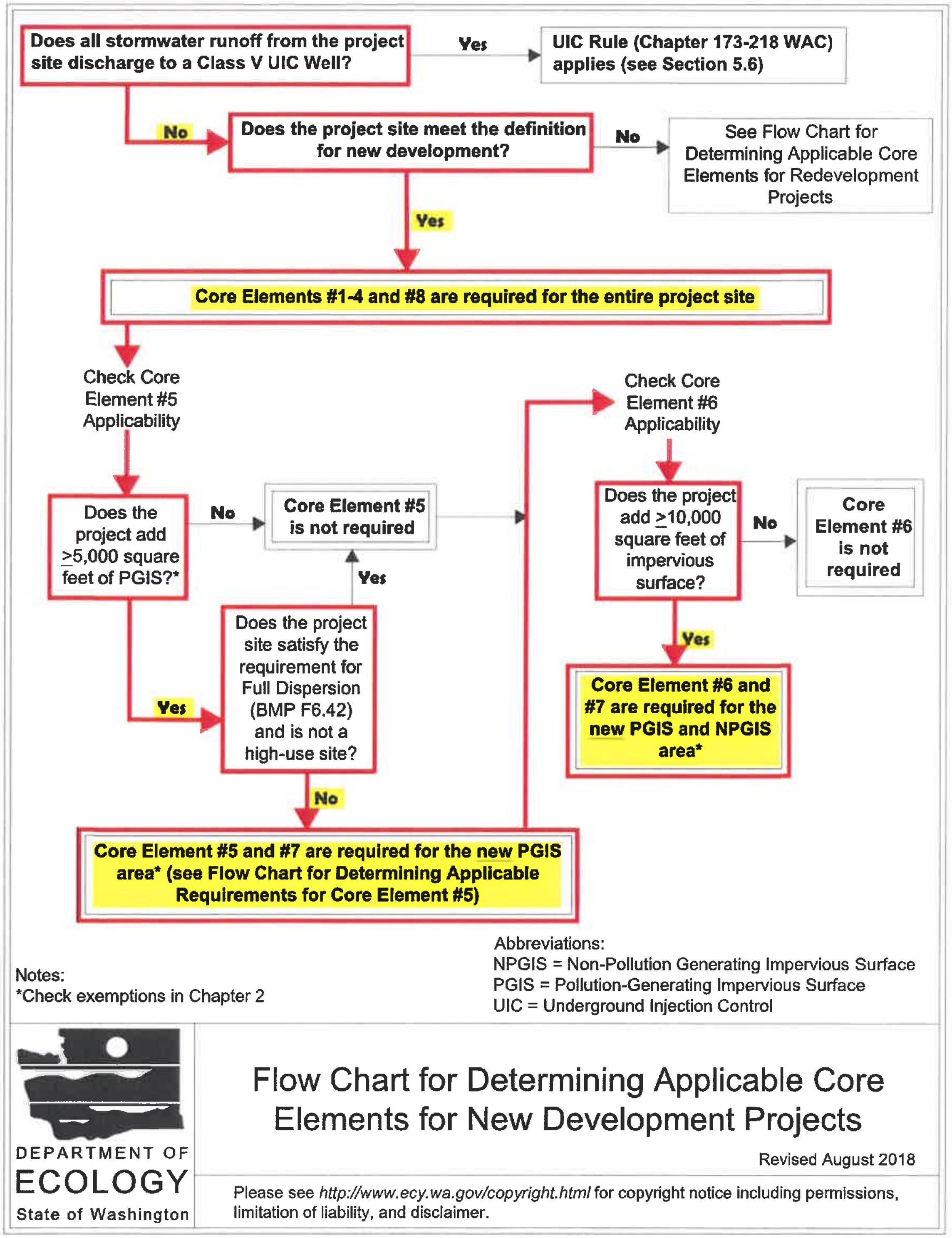
Core Element #7 - Operations and Maintenance

The Operations and Maintenance Manual is included in Appendix A.

Core Element #8 - Local Requirements

Local requirements are satisfied with the preparation of this report and site plan in accordance with the guidelines established in the SWM.

Figure 2.1: Flow Chart for Determining Applicable Core Elements for New Development Projects



APPENDIX A - OPERATIONS AND MAINTENANCE MANUAL

The proposed onsite storm system consists of infiltration trenches, bioswales, culverts, catch basins, pipes, and infiltration ponds.

The operations and maintenance manual will be provided with the final version of this report.

APPENDIX B - CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

This document will be provided with the final report.

APPENDIX C - HYDRAULIC / HYDROLOGIC ANALYSIS AND MODELING RESULTS

The project was modeled using the SCS method in StormSHED 3G, which is an approved hydrology model.

Relevant model input and output has been included in this appendix.

Appended on: Monday, March 15, 2021 4:12:36 PM

Layout Report: Bull Ranch Model - Issues

Event	Precip (in)
2 yr 24 hr	0.80
10 year	1.20
25 year	1.60
50 year	1.80
100 year	2.00

Node Records

Record Id: Pond-001

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	105.00 ft
Void Ratio	100.00		
Length	200.00 ft	Width	30.00 ft
Length ss1	4.00v:1h	Length ss2	4.00v:1h
Width ss1	4.00v:1h	Width ss2	4.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Pond-002

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	105.00 ft
Void Ratio	100.00		
Length	100.00 ft	Width	30.00 ft
Length ss1	4.00v:1h	Length ss2	4.00v:1h
Width ss1	4.00v:1h	Width ss2	4.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin A

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	101.50 ft
Void Ratio	100.00		
Length	188.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin B

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	802.00 ft	Width	1.00 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin C

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	1674.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin D

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	916.00 ft	Width	1.00 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin E

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	482.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin F

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	745.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin G

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	348.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin H

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	778.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin I

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	359.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin J

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	101.50 ft
Void Ratio	100.00		
Length	675.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin M

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	274.00 ft	Width	1.00 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin N

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	101.50 ft
Void Ratio	100.00		
Length	1176.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin O

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	739.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin P

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	192.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin R

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	1002.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin S

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	433.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Record Id: Swales - Basin T

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	108.00 ft
Void Ratio	100.00		
Length	341.00 ft	Width	0.50 ft
Length ss1	3.00v:1h	Length ss2	3.00v:1h
Width ss1	3.00v:1h	Width ss2	3.00v:1h
Consider surface area for infiltration			
Trap Type Node			

Contributing Drainage Areas

Record Id: Basin A

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.14 ac	**DCIA**	0.39 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscaped Area	0.14 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.39 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin B

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.46 ac	**DCIA**	0.67 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscape area for 5 lots and road	0.46 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.67 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin C

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.77 ac	**DCIA**	0.90 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscape area for 6 lots and road	0.71 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.99 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin D

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	2.52 ac	**DCIA**	1.42 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Lawn from road and lots	1.73 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	1.48 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin E

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.47 ac	**DCIA**	0.20 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Lawn and Landscape	0.97 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.89 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin F

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	2.51 ac	**DCIA**	1.74 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscaped Area	0.60 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.61 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin G

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.24 ac	**DCIA**	0.46 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscaped Area	0.79 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.49 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin H

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.64 ac	**DCIA**	0.36 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	**SubArea**	**Sub cn**
Landscape area from lots and road	0.34 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	**SubArea**	**Sub cn**
Impervious surfaces (pavements, roofs, etc)	0.40 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin I

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.06 ac	**DCIA**	0.14 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscape area from lots and road	0.04 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.16 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin J

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.36 ac	**DCIA**	0.26 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscape area for lots and road	0.14 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces road and 8 lots	0.39 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin M

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.30 ac	**DCIA**	0.29 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscape area for lots and road	0.04 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.16 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin N

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.23 ac	**DCIA**	0.43 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscape area for lots and road	0.14 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces Road and 1 Lot	0.53 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin O

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.65 ac	**DCIA**	0.70 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscaped Area	0.82 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.78 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin P

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.15 ac	**DCIA**	0.16 ac
Pervious CN	0.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.31 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin R

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	1.23 ac	**DCIA**	1.00 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	**SubArea**	**Sub cn**
Landscape on lots and road	1.42 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	**SubArea**	**Sub cn**
Impervious surfaces (pavements, roofs, etc)	1.05 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin S

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	1.87 ac	**DCIA**	0.67 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	5.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	**SubArea**	**Sub cn**
Landscaped area from lots and road	1.06 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet		350.00 ft	1.25%	0.05	0.80 in	0.05 min
Pervious TC						0.05 min

DCI - CN Calc

Description	**SubArea**	**Sub cn**
Impervious surfaces (pavements, roofs, etc)	0.80 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Basin T

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	0.48 ac	**DCIA**	0.47 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscape area for lots and road	0.48 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.47 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Pond 1 Basin

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	6.40 ac	**DCIA**	6.94 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscaped Area	6.40 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	6.94 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Record Id: Pond 2 Basin

Design Method	SCS	**Rainfall type**	TYPE1A.RAC
Hyd Intv	10.00 min	**Peaking Factor**	484.00
Storm Duration	24.00 hrs	**Abstraction Coeff**	0.20
Pervious Area	3.48 ac	**DCIA**	3.72 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	10.00 min	**DC TC**	10.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Landscaped Area	3.48 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Sheetflow	350.00 ft	1.25%	10.0	0.80 in	10.00 min
Pervious TC						10.00 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	3.72 ac	98.00
DC Composited CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet		0.00 ft	0.0%	10.0	0.00 in	10.00 min
Pervious TC						10.00 min

Appended on: Saturday, March 13, 2021 3:34:58 PM

LPOOLCOMPUTE [Pond 1 Outflow] SUMMARY using Puls, 24 hr Storm Event

Start of live storage:100 ft

Event	Match Q (cfs)	Peak Q (cfs)	Max El (ft)	Vol (cf)	Vol (acft)	Time to Empty (hr)
100 year	4.253	0.5832	102.9557	26325.4697	0.6043	16.8978

Appended on: Saturday, March 13, 2021 3:34:26 PM

LPOOLCOMPUTE [Pond 2 Outflow] SUMMARY using Puls, 24 hr Storm Event

Start of live storage:100 ft

Event	Match Q (cfs)	Peak Q (cfs)	Max El (ft)	Vol (cf)	Vol (acft)	Time to Empty (hr)
100 year	2.2888	0.3226	102.9573	13973.0143	0.3208	16.8033

APPENDIX D - DECLARATION OF COVENANT FOR PRIVATELY MAINTAINED FACILITIES

A Declaration of Covenant for privately maintained facilities will be provided following completion and acceptance of construction only.

APPENDIX E - GEOTECHNICAL REPORT

The following is the geotechnical engineering report for this project by Icicle Creek Engineers, Inc., dated March 3, 2021.

Report
Geotechnical Engineering Services
Proposed Residential Development
New Bull Road Site – Kittitas County Parcel ID 298633
Kittitas County, Washington

March 3, 2021
ICE File No. 1390-001

Report
Geotechnical Engineering Services
Proposed Residential Development
New Bull Road Site – Kittitas County Parcel ID 298633
Kittitas County, Washington

March 3, 2021
ICE File No. 1390-001

Prepared For:
Lathrop Development Company, Inc.

Prepared By:
Icicle Creek Engineers, Inc.

March 3, 2021

F. Steven Lathrop
Lathrop Development Company, Inc.
1572 Robinson Canyon Road
Ellensburg, Washington 98926

Icicle Creek Engineers (ICE) is pleased to submit one original copy and an electronic copy (pdf) of our *Report, Geotechnical Engineering Services, Proposed Residential Development, New Bull Road Site – Kittitas County Parcel ID 298633, Kittitas County, Washington*. ICE's services were completed in general accordance with our Proposal dated October 30, 2020; these services were authorized in writing by F. Steven Lathrop of Lathrop Development Company, Inc., on November 2, 2020.

The draft report was submitted to Mr. Lathrop for review and comment on January 22, 2021.

It has been our pleasure to be of service to Lathrop Development Company, Inc. on this project. If you have any questions regarding the contents of this report or if we can be of further service, please contact us.

Yours very truly,

Icicle Creek Engineers, Inc.

Brian R. Beaman, PE, LEG, LHG
Principal Engineer/Geologist/Hydrogeologist

Document ID: 1390001.cvl
Attachment

cc (email): Laura Bartenhagen, ESM Consulting Engineers

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Page/Figure Number

REPORT
GEOTECHNICAL ENGINEERING SERVICES
PROPOSED RESIDENTIAL DEVELOPMENT
NEW BULL ROAD SITE – KITTITAS COUNTY PARCEL ID 298633
KITTITAS COUNTY, WASHINGTON
FOR
LATHROP DEVELOPMENT COMPANY, INC.

1.0 INTRODUCTION

This report presents the results of Icicle Creek Engineers' (ICE's) geotechnical engineering services regarding a proposed residential development referred to as the New Bull Road Site within an approximately 45-acre property (Kittitas County Parcel ID 298633) located southeast of Ellensburg, in unincorporated Kittitas County, Washington. The New Bull Road Site is shown relative to nearby physical features on the Vicinity Map, Figure 1.

2.0 PROJECT DESCRIPTION

Our understanding of the project and property area is based on discussions with and information provided by Laura Bartenhagen of ESM Consulting Engineers, LLC (ESM). This information is referenced as follows:

- ESM Consulting Engineers, LLC, September 8, 2020, *New Bull Road, Preliminary Site Plan, Kittitas County, Washington,* sheet PL-01, scale 1" = 100'.

We understand that the preliminary plan for the proposed residential development at the New Bull Road Site includes approximately 140 residential lots, along with paved access roads, as conceptually shown on the Site Plan, Figure 2. It is likely that the number of lots will increase or decrease as the design develops. We understand that conventional two-story wood-framed residential houses will be built on the lots. The grading plan is not known at this time, but we generally expect cuts and fills to be limited to about 5 feet in height/thickness.

Underground water, storm and sewerlines will be installed within the access roads. We expect that water force mains and storm will be less than 4-feet deep. The sewerlines may be gravity or forcemain; details regarding the depth of sewerline are not known at this time. Power and/or gas utilities may also be installed, likely paralleling the shoulder area of the access roads within the access road right-of-way.

We expect that stormwater from roof downspouts and driveways will be contained within individual lots. We understand that the preliminary plan for stormwater disposal from new road areas includes collection in catch basins and conveyance through underground stormwater lines to infiltration facilities that have yet to be sited (in part, subject to this report).

3.0 SCOPE OF SERVICES

The purpose of our services was to explore subsurface soil and groundwater conditions at the New Bull Road Site as a basis for developing geotechnical recommendations for site development. Specifically, our services included the following:

Information Review, Reconnaissance, Utility Locate and Test Pits

- Review readily available geologic maps, and hydrogeologic and geotechnical information regarding the project site area.
- Complete a geologic reconnaissance of the New Bull Road Site and accessible adjacent areas to evaluate surface conditions.

- Explore subsurface soil and groundwater conditions by excavating 16 test pits to depths of about 4 to 15 feet with a trackhoe.

Laboratory Testing

- Complete laboratory tests on soil samples obtained from the test pits. The laboratory testing program included moisture content determination, laboratory compaction tests (proctors) and grain-size analysis (particle size distribution).
- Evaluate pertinent physical and engineering characteristics of the soils based on our observations and site knowledge, and on the results of laboratory tests completed on samples obtained from the test pits.

Geotechnical Considerations

- Describe and characterize soil and groundwater conditions across the site.
- Evaluate the stability of Steep Slopes (slopes steeper than 33.3-percent grade) and provide recommendations for structure (foundation) setback from Steep Slopes, as appropriate.
- Provide recommendations for site preparation and earthwork including suitability of on-site soils for use as structural fill and bedding, constraints for wet weather construction and placement and compaction of structural fill and bedding materials.
- Evaluate dewatering and shoring requirements and provide recommendations for excavation and trench side slopes.
- Provide recommendations for foundation support, uplift, friction, lateral soil pressures, and estimated postconstruction settlement performance of manhole structures.
- Provide recommendations for support of the underground utility lines including criteria for overexcavation.
- Provide recommendations for roadway subgrade preparation and pavement section.
- Provide recommendations for the structures (residential buildings) for foundation support including allowable bearing capacities, settlement estimates for shallow spread footings and preparation of subgrade for slab-on-grade floors.
- Provide recommendations for lateral earth pressures including active pressures for subgrade walls and passive earth pressures on footings. Provide recommendations for the coefficient of base friction against sliding.

Field and Design Infiltration Rate

- Evaluate soil infiltration characteristics using methods (Soil Grain Size Method) described in Washington State Department of Ecology's (Ecology's) Stormwater Management Manual for Eastern Washington (SMMEW, February 2019, Section 6.B.4, Recommended Laboratory Test Procedures), supplemented by Ecology's 2014 Stormwater Management Manual for Western Washington (SMMWW) empirical relationship (Section 3.3.6, *Method 3: Soil Grain Size Analysis Method*).
- Provide recommendations for short-term (field) and long-term (design) infiltration rate(s).

4.0 GEOLOGIC AND GEOMORPHIC SETTING

Regional geologic mapping of this area by the Washington State Department of Natural Resources (DNR, 1983, *Geologic Map of the Ellensburg Quadrangle, Washington,* Geologic Map GM-28) shows that the New Bull Road Site is underlain by Quaternary-age Alluvium deposited by tributary streams to the Yakima River. Alluvium typically consists of loose to medium dense stratified (layered) sand and gravel with variable amounts of silt and cobbles. Quaternary-age eolian (wind-blown) deposits, referred to as Loess in this report, are mapped immediately east of the New Bull Road Site. Loess typically consists of silt and fine sand in a soft/loose to stiff/medium dense condition.

Based on our review of Digital Terrain Model (DTM) derived hillshade image and topographic contours (DNR Washington LiDAR Portal, Yakima 2014 acquisition), the New Bull Road Site is generally located on a wide, gently-sloping inactive alluvial fan that has been subsequently dissected by tributary streams (Naneum Creek and Wilson Creek) to the Yakima River, creating smooth, rolling topography typical of the lower Kittitas Valley.

5.0 SITE CONDITIONS

5.1 GENERAL

Shane Markus, EIT of ICE completed site visits on November 23, 2020 to complete a geologic reconnaissance of the site, and December 3, 2020 to observe the excavation of test pit explorations at the site. During the site visits, the weather was partly to mostly sunny, with temperatures in the 30s and 40s. There was no snow on the ground during the site visits.

Our understanding of the New Bull Road Site is based on our review of readily available geologic and geotechnical information, historical aerial photograph review (from Google Earth and USGS EarthExplorer), surface reconnaissance of the site, and observations of subsurface conditions in 16 test pit explorations completed for this study.

5.2 SURFACE CONDITIONS

5.2.1 General

The approximately 45-acre New Bull Road Site is bordered to the west by Bull Road (a two-lane County road), to the north by residential properties and Kittitas Highway (a two-lane County road), and to the east and south by similar farmland. The New Bull Road Site varies from about Elevation 1,510 feet and Elevation 1,536 feet.

5.2.2 Lots 1 through 41 and Lots 51 through 140

Most of the proposed lots (Lots 1 through 41, and 51 through 140) and access roads occupy a wide, gently sloping (about 1- to 2-percent grade down to the south) somewhat elevated crop field. The field is surfaced with silt and fine sand, with occasional round gravel and cobbles, and had been recently planted with a winter crop at the time of our site visits. An "irrigation trough" crosses the New Bull Road Site from north to south as shown on Figure 2. The irrigation trough is constructed of concrete, is raised above the adjacent ground by about 1- to 2-feet and is about 1-foot deep and 2-feet wide. The perimeter of the crop field is vegetated with tall, thick grass. An approximately 150-feet long, 25-feet wide and up to 6-feet high concrete rubble pile was observed along the northwest edge of the crop field as shown on Figure 2.

Adjacent to the northwest side of the crop field (vicinity of Lots 101 through 106, 131 and 132), the ground surface descends abruptly at about a 40- to 70-percent grade for about 10 to 12 feet of vertical relief to a stream as shown on Figure 2. The stream was flowing at about 10 gallons per minute at the time of our site visit. The slope bordering the development area and the stream is generally planar and smooth, and vegetated with mature deciduous trees and medium dense brush. We did not observe evidence of recent stream undercutting and/or erosion, or slope instability within the stream channel or adjacent slope.

5.2.3 Lots 42 through 50

The south and west edges of the crop field descend moderately at about a 20- to 35-percent grade for 6 to 8 feet of vertical relief to a neighboring crop field (owned by others) and to the area of Lots 42 through 50. Lots 42 through 50 are located within a lower, nearly-level area along the west edge of the New Bull Road Site as shown on Figure 2. This area is surfaced with grass and patches of bare soil (silt and fine sand).

5.3 SUBSURFACE CONDITIONS

5.3.1 Subsurface Exploration Program

Subsurface conditions at the New Bull Road Site were explored by excavating 16 test pits (Test Pits TP-1 through TP-16) at the approximate locations shown on Figure 2. A description of the field exploration program and the test pit logs are presented in Appendix A. The laboratory testing program and test results are presented in Appendix B.

5.3.2 Soil Conditions

Based on our reconnaissance and observation of the test pits explorations, the shallow subsurface soil conditions are generally consistent with the previously described regional mapping by the DNR (1983). The following is a description of the soil types encountered in the test pit explorations.

Sod and Topsoil – All test pits encountered a surficial layer of about 4 to 6 inches of Sod and Topsoil. The Sod and Topsoil contained fine roots.

Loess – Loess, ranging from about 1- to 7.7-feet thick (typically about 2- to 4-feet thick), underlies the Sod and Topsoil in all test pits. The Loess generally consisted of loose to medium dense silty fine sand, or medium stiff to stiff sandy silt, with up to a trace of gravel.

Alluvium – Alluvium underlies the Loess in all test pits. Alluvium ranged from about 1-foot to at least 13½-feet thick. Alluvium was encountered to the completion depth in Test Pits TP-1, TP-4, TP-7, TP-8, TP-9, TP-12, TP-13, TP-14, and TP-15. Alluvium generally consisted of loose to medium dense sand and gravel with variable amounts of silt and cobbles, and stiff silt with sand.

Caliche, a mineral cement, was encountered within the Alluvium in Test Pits TP-2, TP-5, TP-6, TP-9, TP-10, TP-11 and TP-15. The Caliche ranged from about 6 inches to at least 2-feet thick (encountered to the completion depth of 4 feet in Test Pit TP-2 due to digging refusal). Caliche is formed when infiltrating rain or irrigation water precipitates calcium carbonate within the pore space between soil grains, effectively cementing the grains together and changing (hardening) the character of the soil. With regard to digging action, Alluvium where cemented by Caliche was considered to be in a moderately to heavily cemented (dense to very dense) condition.

Older Alluvium – Older Alluvium underlies the Alluvium at depths ranging from about 4½ to 8 feet in Test Pits TP-3, TP-5, TP-6, TP-10, TP-11, and TP-16. The Older Alluvium generally consisted of gravel with sand and variable amounts of silt and cobbles. Older Alluvium was also cemented (hardened) to varying degrees due to mineral precipitates (likely silica sourced from volcanic ash) from groundwater and/or rainwater. With regard to digging action, Older Alluvium was considered to be in a lightly to heavily cemented (dense to very dense) condition. Older Alluvium was encountered to the completion depth of the test pits, where encountered.

5.3.3 Groundwater Conditions

Groundwater was encountered at depths of about 6 to 14 feet in Test Pits TP-1, TP-4, TP-7, TP-8, TP-12, TP-13, TP-14, TP-15, and TP-16; groundwater was not encountered in the remaining test pits. Groundwater was generally observed to be higher along the east and south edges of the New Bull Road Site. We expect groundwater levels to be strongly influenced by irrigation, with the highest levels during the summer months. Where observed, groundwater was typically observed to flow rapidly into the test pit excavations.

5.3.4 Other Observations

Excavatability of the site soil using a John Deere 120 trackhoe (with a toothed bucket) was typically easy in the Loess and Alluvium, although locally difficult to impossible where Caliche cement was encountered within the Alluvium, and difficult to very difficult in the Older Alluvium.

6.0 PRELIMINARY INFILTRATION ANALYSIS

We completed a preliminary evaluation of infiltration rates in general accordance with Ecology's February 2019 SMMEW (Recommended Laboratory Test Procedures, page 744). As indicated in the table below, Ecology's 2014 Stormwater Management Manual for Western Washington (SMMWW) empirical relationship (Section 3.3.6, *Method 3: Soil Grain Size Analysis Method*) was more applicable to the soil types encountered at some locations and produced more realistic infiltration rate results; the 2014 SMMWW was used when appropriate.

Grain size analyses were completed on selected soil samples obtained from the test pits; the particle size distribution reports are presented in Appendix B. The empirical relationships described in Ecology's 2019 SMMEW and 2014 SMMWW used to relate particle size distribution to saturated hydraulic conductivity were originally derived from soils with a maximum particle size of about D = 40 mm (about 1.6 inches, where D is the particle diameter) (University of Washington, Massman, Joel, 2008, Infiltration Pond Research Extension Final Report). Therefore, our analysis considered only the material passing a 1.5-inch sieve (1.5-inch-minus material) in order to evaluate the infiltration rate of the matrix material.

The following is a summary of our infiltration analysis results (field/short-term and design/long-term rates):

Test Pit Number/Sample Number	Sample Depth (feet)	Geologic Unit	Soil Type	Soil Infiltration Rate (short-term / long-term(1)) (inches per hour - iph)
TP-1 / S-2	8	Alluvium	Gravel with silt, sand and occasional cobbles	12.7 / 3.0(2)
TP-3 / S-3	8	Older Alluvium	Gravel with silt, sand and cobbles	< 0.5 / < 0.5(3)
TP-5 / S-3	5	Alluvium	Gravel with sand and a trace of silt	119.3 / 34.9
TP-5 / S-4	9	Older Alluvium	Silty gravel with sand and cobbles	< 0.5 / < 0.5(3)
TP-7 / S-1	2	Loess	Silty fine sand	2.4 / 0.49
TP-8 / S-2	6	Alluvium	Silty gravel with sand and cobbles	8.2 / 1.9(2)
TP-12 / S-2	4	Alluvium	Silty gravel with sand and occasional cobbles	5.7 / 1.3(2)
TP-13 / S-1	1	Loess	Sandy silt	2.3 / 0.46
TP-15 / S-1	5	Alluvium	Silty gravel with sand and cobbles	7.0 / 1.6
TP-16 / S-1	4	Alluvium	Silty gravel with sand and cobbles	11.0 / 2.6

(1) The long-term (design) infiltration rate includes correction factors to account for in-situ density test method, maintenance and biofouling. The long-term infiltration rate should be used for design (sizing) infiltration facilities.

(2) Empirical relationships given in Ecology's 2014 SMMWW were considered more appropriate in calculating this infiltration rate.

(3) Cemented soils (locally encountered in Alluvium and Older Alluvium) may inhibit or prevent vertical infiltration of water (long-term soil infiltration rate = < 0.5 iph).

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 GENERAL

Based on our field reconnaissance, test pit explorations, laboratory testing and analyses, we conclude that residential structures may be supported on conventional reinforced concrete spread footings extending to stiff/medium dense or denser soils (Loess, Alluvium and Older Alluvium), or on a pad of Structural Fill that extends to the competent soils. We expect that pavements and slab-on-grades may also be supported by stiff/medium dense or denser soils, or Structural Fill. We expect that underground utilities and associated manhole and vault structures will be deep enough that they will be founded on firm bearing soils.

7.2 STEEP SLOPE STRUCTURE SETBACK

Kittitas County (Kittitas County Community Development Services (KCCDS) Detail D-002, "Setback from Slopes") requires foundations for new construction to be set back from Steep Slopes (considered slopes greater than 1H:1V (horizontal to vertical), or 33.3-percent-grade) a distance equal to 1/3 of the slope height. Detail D-002 indicates that alternate setbacks and clearances may be permitted subject to an investigation and recommendation by a geotechnical engineer.

Based on review of the LiDAR-derived topographic contours (DNR Washington LiDAR Portal, Yakima 2014 acquisition, processed by ICE using Esri ArcGIS 10.6) in the vicinity of Lots 103, 104 and 105 and a proposed access road, the slope is inclined at about a 40- to 70-percent grade for about 10 to 12 feet of vertical relief. We recommend a structure setback consistent with KCCDS Detail D-002 (equal to 1/3 of the slope height) in this area. This area is shown as a Regulated Steep Slope on Figure 2.

Other local slopes within or around the New Bull Road Site are inclined up to about 40-percent grade for up to about 5 feet of vertical relief. Based on our evaluation, we recommend exempting slopes less than 10 feet of vertical relief from the Kittitas County Steep Slopes regulation (KCCDS Detail D-002).

7.3 SITE PREPARATION

Sod and Topsoil and Loess containing abundant roots should be stripped and removed from access road and building areas. Stripping should be minimized to the extent that only the footprint of these areas is affected. We expect the stripping depth will be up to about 1 foot during dry weather conditions.

Following stripping, the exposed pavement, slab-on-grade and footing subgrade areas should be thoroughly proofrolled in dry weather and probed in wet weather to evaluate areas of soft, loose, or otherwise unsuitable subgrade areas.

In slab-on-grade and pavement areas, soft or loose soils identified during proofrolling or probing should be moisture-conditioned and compacted as Structural Fill (see section **7.4** of this report) or removed and replaced with Structural Fill up to about 3 feet below final subgrade elevation, and a woven geotextile fabric (such as Tencate Mirafi® RS380i or equal) placed in the bottom of the excavation prior to backfilling with Structural Fill.

In building footing areas, soft or loose soils identified during proofrolling or probing should be moisture-conditioned and compacted as Structural Fill (see section **7.4** of this report) or removed and replaced with Structural Fill to a firm and unyielding subgrade, regardless of depth.

7.4 STRUCTURAL FILL

Structural Fill should be free of organic material or debris and have a maximum particle size of 9 inches. The material should contain less than five percent fines (soil particles passing the US Standard No. 200

sieve) by weight relative to the portion finer than the ¾-inch sieve. If earthwork is done during generally dry weather conditions, the fines content may be increased.

As a guideline, Structural Fill should be placed in horizontal lifts which are 12 inches or less for Loess soils or 18 inches or less for the Alluvium soils. The actual lift thickness depends on the quality of the fill material and the size of the compaction equipment. Based on our experience, a "sheepsfoot" type compaction equipment is best suited for the Loess soil type.

We recommend that Structural Fill placed in the building and pavement areas be uniformly compacted to at least 95 percent of the maximum dry density (MDD) obtained in general accordance with ASTM Test Method D 1557. Nonstructural fill placed in landscape areas need only be compacted to the degree required for trafficability of construction equipment and effective surface drainage.

We expect that the Loess, Alluvium and Older Alluvium (including cemented soils if they can be effectively broken up) that are excavated may be reused for Structural Fill during periods of extended dry weather. During wet weather, it may be necessary to import soil containing less than five percent fines (soil particles passing the US Standard No. 200 sieve). Moisture conditioning (wetting or drying) may be required, especially where silt contents are higher (such as within the Loess).

Based on our experience at other sites with surface or near surface Loess, attention to moisture content and careful monitoring of Loess compaction methods (contractor responsibility) will be important to provide uniform support for roads, utilities and structures. We expect that experimentation with compaction methods and occasional recompactive efforts when using Loess as Structural Fill may be needed, potentially causing delays.

7.5 FOUNDATION SUPPORT

Proposed buildings (wood frame, two-story residential structures) may be satisfactorily supported on conventional reinforced concrete spread footings provided that they are constructed in accordance with the recommendations outlined in this section.

We recommend that spread footings be founded on stiff/medium dense or denser native undisturbed soils including the Loess (if firm and unyielding), Alluvium and Older Alluvium, or on a pad of Structural Fill that extends to the competent soils. In areas where Structural Fill is placed under footings, the zone of Structural Fill below footings should extend laterally beyond the footing edges a horizontal distance at least equal to the thickness of the Structural Fill placed. The Loess can be in a loose or medium stiff condition and may require moisture conditioning and compaction as Structural Fill (see section **7.4** of this report) to provide firm and uniform support for foundations.

Continuous and isolated spread footings should have minimum widths of 16 and 24 inches, respectively. The footings should be a minimum of 24 inches below the adjacent grade for frost protection. Footings may be designed using an allowable soil bearing value of 2,500 pounds per square foot (psf). This value applies to the sum of all dead and long-term live loads, exclusive of the weight of the footing and the backfill above the footing. For transient loads, including wind or seismic, a one-third increase in the recommended value may be used.

Care should be taken to avoid loosening or softening the bearing surface soils when preparing footing subgrades, particularly during wet weather. During wet weather, foundations should be excavated, formed and poured the same day or be protected by a layer of crushed rock or lean concrete. We estimate that settlement of footings founded as described above will be less than ½ inch and will occur rapidly as loads are applied.

Resistance to lateral loads can be developed by friction between the base of the foundation and by passive pressures acting on the sides of foundations. We recommend that resistance to lateral loads be estimated using a coefficient of friction of 0.3 and an equivalent fluid density of 200 pounds per cubic foot (pcf). These values include a safety factor of 1.5.

7.6 SLAB-ON-GRADE SUPPORT

Slab-on-grade subgrades should be prepared as previously described in sections **7.3** and **7.4** of this report. We recommend that the subgrade surface be compacted such that a minimum compaction of 95 percent of the MDD (ATSM Test Method D 1557) is achieved before placing Structural Fill or capillary break material.

We recommend that a layer of medium to coarse sand and gravel at least 4-inches thick containing less than three percent fines (material passing the US Standard No. 200 sieve) by weight based on the fraction of the material passing the ¾-inch sieve be placed below the bottom elevation of the floor slab to provide uniform support and a capillary break. A vapor retarder and/or waterproofing should be provided if there is a potential for surface or shallow groundwater to occur or migrate under the slab.

7.7 SUBGRADE (BASEMENT) WALLS

Subgrade (basement) walls may be required for house construction. As a generality, full basement construction is not recommended because of the unpredictable occurrence of groundwater in the area. However, daylight basement construction is acceptable provided adequate wall drainage is installed that can drain by gravity to maintain dry basement conditions.

The lateral soil pressures acting on subgrade walls depend on the type, density, and geometry of the soil behind the wall and the amount of lateral wall movement which can occur as backfill is placed. For walls that are free to yield at the top at least one one-thousandth of the height of the wall, an active pressure obtained using equivalent fluid densities of 35, 45, and 60 pcf should be used for level backslopes, 4H:1V backslopes and 2H:1V backslopes, respectively. These values assume that the soil behind the wall is free draining. For "at rest" conditions where the wall is restrained against movement, a lateral pressure based on equivalent fluid densities of 50, 55, and 75 pcf should be used for level backslopes, 4H:1V backslopes and 2H:1V backslopes, respectively. These values assume that the soil behind the wall is free draining. Surcharge effects should be considered as appropriate.

In settlement-sensitive areas, the backfill for subgrade walls should be compacted to at least 95 percent of the MDD (ASTM Test Method D 1557). At other locations, wall backfill should be compacted to between 90 and 92 percent of the MDD. Measures should be taken to prevent the buildup of excess lateral soil pressures due to overcompaction of the backfill behind the wall. Care must be exercised by the contractor to avoid overcompaction.

A drainage zone consisting of clean, free-draining granular material containing less than five percent fines at least 18-inches wide should be placed against the back face of the wall for its full height. Positive drainage behind subgrade walls should also include installing a footing drain at the base of the wall as described in section **7.11** of this report.

7.8 UNDERGROUND UTILITY CONSIDERATIONS

7.8.1 Trench Excavation

Based on our test pit excavations, the Loess and Alluvium (except Caliche) can be excavated using conventional heavy construction equipment such as a Komatsu PC200 track-mounted excavator. The Caliche in the upper part of the Alluvium (encountered at depths ranging from about 1½ to 4 feet in Test Pits TP-2, TP-5, TP-6, TP-9, TP-10, TP-11 and TP-15) was locally very difficult to impossible to excavate using the John Deere 120 trackhoe with a standard toothed bucket. The Older Alluvium (encountered at depths ranging from about 5- to 8-feet in Test Pits TP-3, TP-5, TP-6, TP-10, TP-11 and TP-16) was difficult to very difficult to excavate using the John Deere 120 trackhoe. Alternative methods, such as excavators with tiger-toothed buckets, or hydraulic breakers, may increase efficiency of the excavation work in local areas.

7.8.2 Temporary Excavations

Temporary excavations greater than 4 feet in depth in the Loess, Alluvium and Older Alluvium may be made at an inclination of 1H:1V or flatter. Flatter slopes may be necessary if instability is observed.

Some sloughing and raveling of the excavation walls should be expected. Temporary covering, such as heavy plastic sheeting, should be used to protect these slopes during periods of wet weather. Surface water runoff from above excavations should be prevented from flowing over the slope face by using berms, drainage ditches, swales, or other appropriate methods.

If the walls of temporary excavations experience excessive sloughing or raveling during construction, it may become necessary to modify the slope inclinations to maintain safe working conditions and protect adjacent facilities or structures. Excavation walls experiencing problems can be flattened or regraded to add intermediate slope benches if poor slope performance is encountered. Alternatively, underground utility trenches can be completed using temporary trench shoring (shored excavations) in lieu of open excavations.

All temporary excavations must comply with the provisions of Title 296 Washington Administrative Code (WAC), Part N, *Excavation, Trenching and Shoring*. We recommend that cut slopes for temporary excavations be made the responsibility of the contractor. The contractor is present at the site continuously and is best able to observe changes in site and soil conditions and to monitor the performance of excavations.

7.8.3 Shored Excavations

To construct the underground utilities, it may be necessary to support the temporary excavations to maintain the integrity of the surrounding undisturbed soils, reduce disruption of adjacent areas, and to protect the personnel working within the excavations.

Because of the diversity of available shoring systems and construction techniques, the design of temporary shoring is most appropriately left up to the contractor proposing to complete the installation. We recommend that the shoring be designed by a licensed professional engineer in Washington, and that the PE-stamped shoring plans and calculations be submitted to the project engineer for review and comment prior to construction. The following paragraphs present recommendations for the types of shoring systems and design parameters that we conclude are appropriate for the subsurface conditions at the New Bull Road Site.

The majority of the materials within the New Bull Road Site can be retained using conventional trench shoring systems such as trench shields with lateral restraint. The design of temporary shoring should

allow for lateral pressures exerted by the adjacent soil, and surcharge loads due to traffic, construction equipment, and temporary stockpiles adjacent to the excavation, etc. Lateral load resistance can be mobilized through the use of braces, tiebacks, anchor blocks and passive pressures on members that extend below the bottoms of excavations. Temporary trench shoring utilized to support excavation walls typically uses internal bracing such as aluminum hydraulic shoring or trench shield bracing.
Temporary trench shoring with internal bracing can be designed using active soil pressures. We recommend that temporary shoring be designed using a lateral pressure equal to an equivalent fluid density of 40 pcf for conditions with a level ground surface adjacent to the excavation. If the ground within 5 feet of the excavation rises at an inclination of 1H:1V or steeper, the shoring should be designed using an equivalent fluid density of 75 pcf. For adjacent slopes flatter than 1H:1V, soil pressures can be interpolated between this range of values. Other conditions should be evaluated on a case-by-case basis.

These lateral soil pressures do not include traffic or construction surcharges that should be added separately, if appropriate. It is typical for shoring to be designed for a traffic influence equal to a uniform lateral pressure of 100 psf acting over a depth of 10 feet below the ground surface. More conservative pressure values should be used if the designer deems them appropriate. These soil pressure recommendations are based on the excavation being essentially dewatered, therefore, hydrostatic water pressures are not included.

Shoring must comply with the provisions of Title 296 WAC, Part N, *Excavation, Trenching and Shoring.* As previously described, we recommend that the design of shoring be made the responsibility of the contractor. The contractor is present at the site continuously and is best able to observe changes in site and soil conditions and to monitor the performance of excavations.

7.8.4 Trench Backfill

Trench backfill should consist of Structural Fill quality material. Structural Fill material should be free of debris, organic material and rock fragments larger than 9 inches. Unless specified otherwise in this report, the following general requirements shall apply to fill placement, including pipe bedding, and trench backfilling.

- Underground utilities should be bedded in crushed, processed or naturally occurring granular material as specified in the 2020 Washington State Department of Transportation (WSDOT) Standard Specifications, Section 9-03.12(3) for *Gravel Backfill for Pipe Zone Bedding*.
- Pipe zone bedding should extend at least 4 inches below and 6 inches above the utility line. Bedding should be worked under the pipe haunches using hand tools as required. Bedding material should be tamped or vibrated (compacted) into place.
- Pipe zone bedding for non-water underground utilities should be compacted to at least 90 percent of the MDD (ASTM Test Method D 1557). Pipe zone bedding for all water mains should be compacted to at least 95 percent of the MDD.
- Backfill placed above the bedding material should consist of Structural Fill quality on-site material, or *Common Borrow* as specified in 2020 WSDOT Standard Specifications, Section 9-03.14(3). During wet weather periods, backfill material should have less than five percent fines content.
- As a guideline, backfill should be placed in lifts of 12 inches or less for the Loess soils, and 18 inches or less for the Alluvium soils (loose thickness). The actual lift thickness will depend on the quality of the fill and the type of compaction equipment used. Each lift should be compacted prior to placing the subsequent lift. Prior to compaction, the backfill should be moisture conditioned to near optimum moisture content. The loose lift thickness should be a field decision by a representative from ICE.
- Trench backfill should be compacted in lifts to at least 95 percent of the MDD (ASTM Test Method D 1557). Backfill compaction should be achieved by mechanical means. No jetting, ponding, or flooding will be allowed for compaction.

- During trench backfill placement, in-place density tests should be completed at approximately 50-foot intervals along the trench alignment to evaluate if the required compaction is being achieved.

7.8.5 Manhole Support

Any loosened subgrade soil at the base of manhole excavations should be recompacted, if possible, or removed and replaced with fill compacted to at least 95 percent of the MDD (ASTM Test Method D 1557). We recommend that a layer of *Top Course Crushed Surfacing* as specified in 2020 WSDOT Standard Specifications, Section 9-03.9(3) at least 12-inches thick be placed and compacted beneath manholes to provide uniform support. Manhole structures may be designed using an allowable bearing pressure of 3,000 psf (assuming a burial depth of at least 5 feet).

Resistance to uplift can be developed by the dead weight of the structure and friction along the sides of the structure. Frictional resistance can be computed using a coefficient of friction of 0.4 applied to the lateral soil pressures. This coefficient of friction value includes a safety factor of about 1.5. We recommend that lateral soil pressures for uplift resistance be computed using an equivalent fluid density of 55 pcf where groundwater is absent, and 30 pcf where groundwater is present. These equivalent fluid density values assume that the backfill will be compacted to at least 95 percent of the MDD (ASTM Test Method D 1557).

7.8.6 Settlement Considerations

We expect that the underground utilities will generally be deep enough (more than 4-feet deep) so that the manhole structures and utility pipes will be founded on firm bearing soils. Nominal settlements will occur under these circumstances with good construction practices.

Localized exceptions will be in the areas where the pipe invert is underlain with very loose or soft soils. However, based on our test pit explorations and general knowledge of the site conditions, we do not expect that these very loose or soft soil conditions will be a persistent problem. Should these conditions be encountered, long-term settlement could occur from the pipe and bedding material in these areas, and construction difficulties during installation with the very loose or soft ground could result in additional settlement. Under these circumstances, we recommend the very loose or soft soils be removed to a depth equal to the diameter of the pipe plus 12 inches to each side. We recommend that a woven geotextile fabric such as Tencate Mirafi® RS280i/RS580i or equal be placed in the base of the overexcavation to reduce the potential for contamination of the pipe bedding. The overexcavation should be backfilled with bedding soils as discussed in the previous section. Settlements are expected to be nominal using this procedure.

7.8.7 Construction Dewatering

Excavation dewatering may be necessary, depending on the time of year (more likely if trenching is completed in the late Summer or Fall) and the depth of excavation. If pockets of groundwater seepage are encountered, we expect that pumping from a sump within the trench may be used for small to moderate amounts of groundwater seepage. Well points or pumped wells will be necessary if large amounts of groundwater seepage are encountered. We recommend that the contractor be required to submit the proposed dewatering system design and plan layout to the project engineer for review and comment prior to beginning construction.

7.9 ACCESS ROAD CONSIDERATIONS

7.9.1 Structural Fill

New fill for the access roads should be placed as Structural Fill as described in section **7.4** of this report. We recommend that a representative from ICE observe the preparation for, placement, and compaction of Structural Fill. A representative from ICE should complete an adequate number of in-place density tests in the Structural Fill to evaluate if the desired degree of compaction is being achieved.

7.9.2 Road Subgrade Preparation

We expect that the access roads will initially experience repeated traffic from heavy construction equipment and trucks. The heavy equipment loads require that the subgrade preparation be effective. Lack of adequate subgrade preparation and protection of the subgrade might result in severe damage to the access road subgrade and surfacing due to construction traffic.

Prior to placing the base course materials, we recommend that the exposed subgrade be thoroughly prepared and evaluated as recommended in section **7.3** of this report. A representative from ICE should be present to observe pavement subgrade preparation and advise on the extent of any remedial action needed.

7.9.3 Pavement Drainage Considerations

Paved areas that are underlain by Loess, Alluvium and Older Alluvium may be susceptible to frost heaving, especially in pavement areas where the snow is typically removed (plowed) and the subgrade is more exposed to colder temperatures rather than being "insulated" by snow cover. Where these conditions occur, frost heaving can only be avoided by a pavement section that contains free-draining aggregate (Top Course and Base Course).

7.9.4 Pavement Section

Construction Material	Light-Duty Pavement Section Passenger Vehicle Parking and Low Traffic Areas (inches)
Asphalt Concrete Pavement (ACP)	3
Crushed-Surfacing Top Course (CSTC)	2
Crushed-Surfacing Base Course (CSBC)*	7

* Alternatively, CSBC can be used for the full crushed surfacing section (9 inches - eliminate the CSTC).

7.10 STORMWATER DISPOSAL

7.10.1 Stormwater Infiltration

The following is a summary of infiltration rates (short-term/field and long-term/design) from section **6.0** of this report based on the results of our grain size analysis of samples obtained from the test pit explorations.

Test Pit Number /Sample Number	Geologic Unit	Soil Infiltration Rate (short-term / long-term) (inches per hour – iph[1])
TP-1 / S-2	Alluvium	12.7 / 3.0
TP-3 / S-3	Older Alluvium	< 0.5 / < 0.5
TP-5 / S-3	Alluvium	119.3 / 34.9
TP-5 / S-4	Older Alluvium	< 0.5 / < 0.5
TP-7 / S-1	Loess	2.4 / 0.49
TP-8 / S-2	Alluvium	8.2 / 1.9
TP-12 / S-2	Alluvium	5.7 / 1.3
TP-13 / S-1	Loess	2.3 / 0.46
TP-15 / S-1	Alluvium	7.0 / 1.6
TP-16 / S-1	Alluvium	11.0 / 2.6

(1) The long-term (design) infiltration rate includes correction factors to account for in-situ density, test method, maintenance and biofouling. The long-term infiltration rate should be used for design (sizing) infiltration facilities.

It is possible that these infiltration rates could be increased (or decreased) depending on the results of large-scale field infiltration testing. Assuming the infiltration facility is stripped to the level of Alluvium (Loess and Caliche cement within Alluvium removed, if encountered), **we recommend a design infiltration rate of 2.1 iph). The 2.1 iph is based on using the average design rate for Alluvium soils.**

The Loess and Caliche Expected Depth Map, Figure 3, shows the locations of test pits in which Loess, or Caliche within Alluvium (low-permeability materials) were encountered to depths of 4 feet or less, and test pits in which Loess or Caliche were encountered to depths of greater than 4 feet. In addition, general areas are shaded showing where Loess or Caliche is expected to be 4-feet deep or less, or greater than 4-feet deep. This map should be used as a guideline for locating infiltration facilities in order to minimize overexcavation (removal of Loess or Caliche).

7.10.2 Stormwater Dispersion

In our opinion, stormwater runoff from the access roads can also be accomplished by using "engineered dispersion" or "natural dispersion" in general accordance with methods developed by WSDOT (April 2019, *Highway Runoff Manual, M31-16.05, Stormwater Best Management Practices*, Chapter 5-4.2.2, FC-01 and FC-02).

7.11 EROSION CONTROL AND DRAINAGE CONSIDERATIONS

The native surficial soils at the New Bull Road Site have a moderate to high potential for erosion. Erosion control measures during earthwork should include proper control of surface water runoff, use of straw bales or appropriate geotextile filters and temporary sedimentation basins. Wind-blown dust can also be a problem during the Summer and early Fall months and may require frequent use of a water truck for dust suppression during site earthwork. Erosion control measures should comply with local requirements and guidelines.

We recommend sloping the ground surface away from buildings. We recommend that perimeter footing drains be installed adjacent to the outside footings of the buildings. These drains should consist of 4-inch diameter, perforated, smooth-walled pipe bedded in at least 6 inches of 1¼-inch uniform washed rock, with the base of the pipe at the base of the adjacent footings. The bedding should be enclosed within a non-woven geotextile fabric such as Tencate Mirafi® 160N or equal to reduce the potential for infiltration of fines into the drainage material from the native soils. The pipe should be placed with the perforations down. The perforated pipe should be connected to a tightline collection system that discharges away from structures.

We expect that daylight basement construction will be feasible if footing and curtain drains that flow by gravity to an appropriate discharge point are installed.

The ground surface below the drip line of the roofs should be protected with an erosion resistant material such as sod, pea gravel or crushed rock. Water runoff from the roofs should be monitored during storm events or snow melt and erosion control measures installed and/or modified should concentrated water runoff occur. Depending on the site conditions, drywells may be used for water disposal.

8.0 USE OF THIS REPORT

We have prepared this report for use by Lathrop Development Company, Inc. The data and report should be provided to prospective contractors for their bidding or estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

If there are changes in the grades, locations, configurations, or types of the facilities planned, the conclusions and recommendations presented in this report may not be applicable. If design changes are made, we request that we be given the opportunity to review our conclusions and recommendations and to provide a written modification if needed. When the design has been finalized, we recommend that the final design and specifications be reviewed by our firm to see that our recommendations have been interpreted and implemented as intended.

There are possible variations in subsurface conditions between the explorations and also with time. A contingency for unexpected conditions should be included in the project budget and schedule. Sufficient observation, testing and consultation by our firm should be provided during construction to evaluate that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions encountered during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

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

****

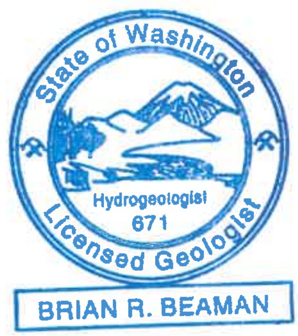
We trust this report meets your present needs. Please call if you have any questions.

Yours very truly,
Icicle Creek Engineers, Inc.

Shane J. Markus, EIT
Senior Staff Engineer

Kathy S. Killman, LEG
Principal Engineering Geologist

Brian R. Beaman, PE, LEG, LHG
Principal Engineer/Geologist/Hydrogeologist



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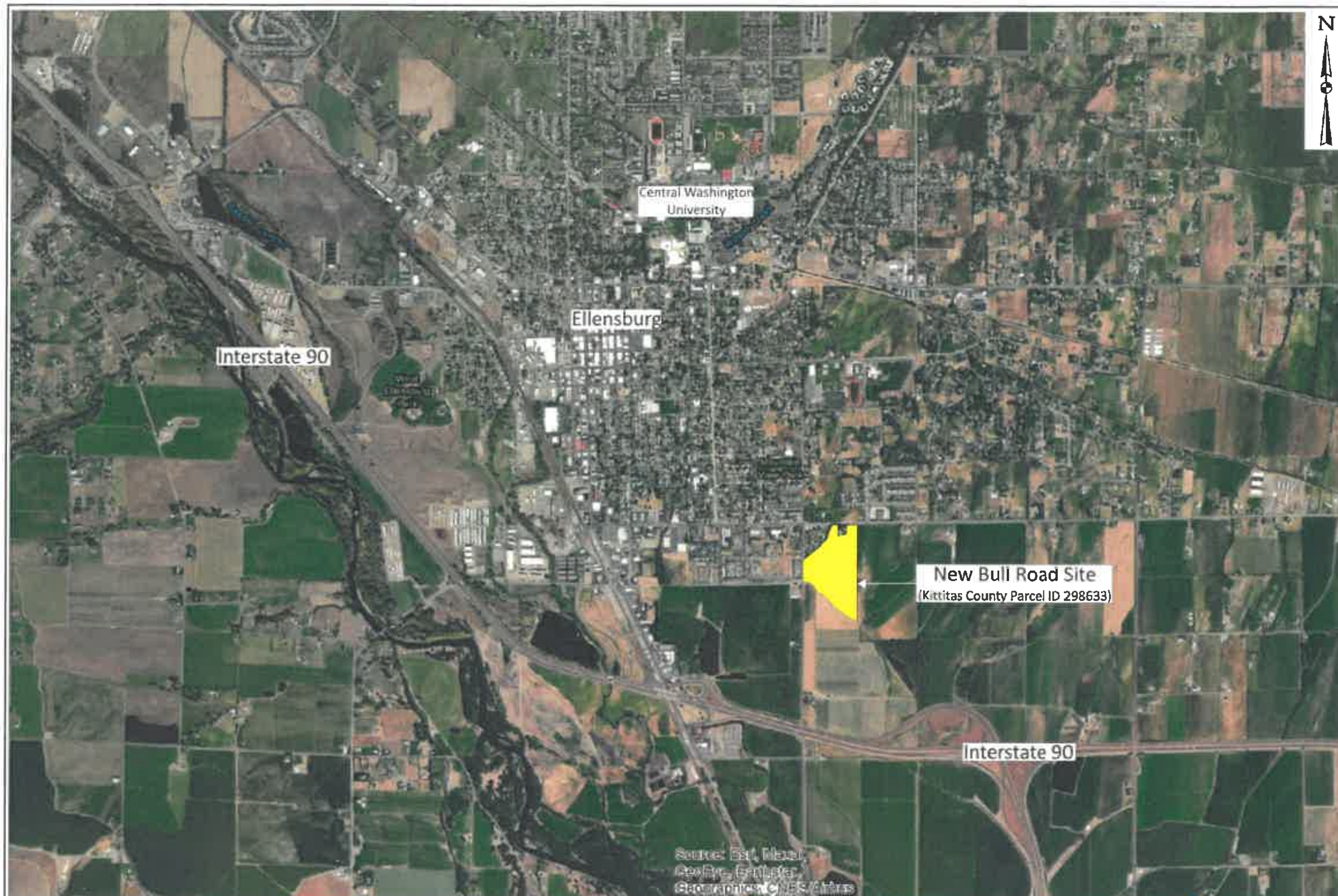
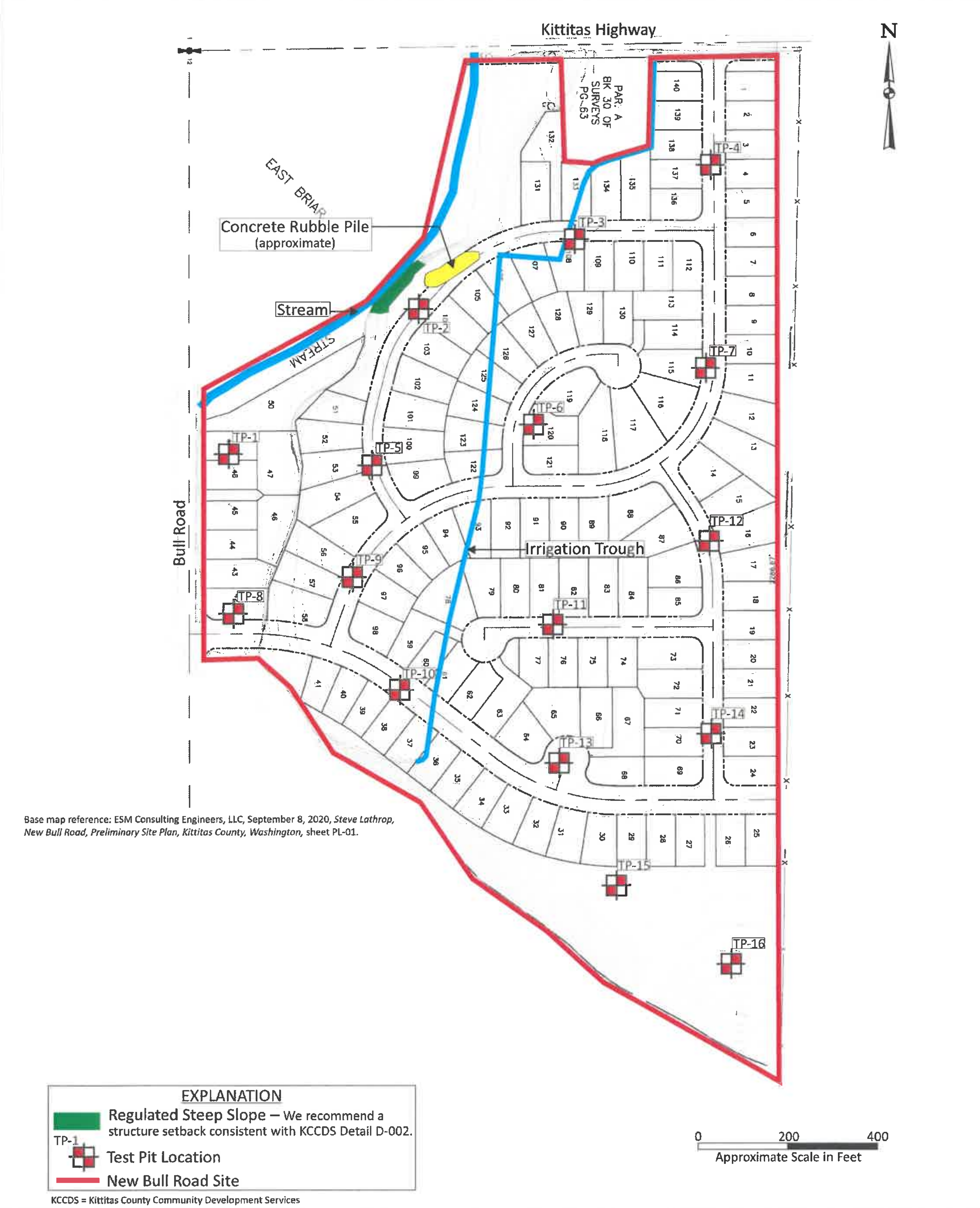
FIGURES



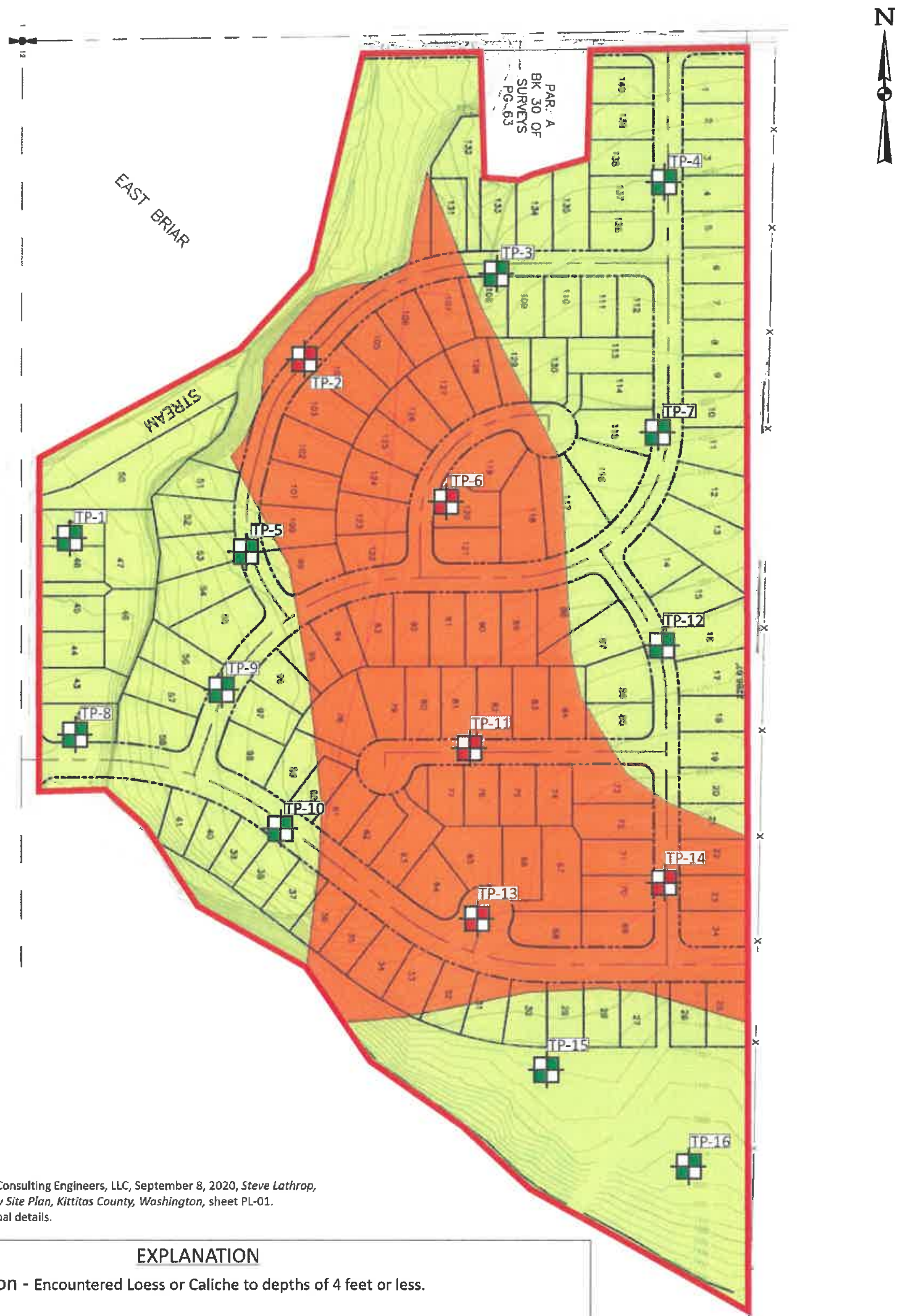
Aerial photograph dated October 13, 2018 obtained from the Washington State Department of Natural Resources Geologic Information Portal (http://www.dnr.wa.gov/geologyportal).

0 ½ 1
Approximate Scale in Miles

VICINITY MAP	ICICLECREEK ENGINEERS	SCALE: As Shown	ICE FILE NO.
PROPOSED RESIDENTIAL DEVELOPMENT NEW BULL ROAD SITE - KITTITAS COUNTY PARCEL ID 298633	29335 NE 20th Street Carnation, Washington 98014 (425) 333-0093	CHECKED: BRB/KSK	1390-001
		DATE: 03/03/2021	Figure 1



SITE PLAN	ICICLECREEK ENGINEERS	SCALE: As Shown	ICE FILE NO.
		DESIGNED: ---	1390-001
PROPOSED RESIDENTIAL DEVELOPMENT	29335 NE 20th Street	DRAWN: SJM	
NEW BULL ROAD SITE - KITTITAS COUNTY PARCEL ID 298633	Carnation, Washington 98014	CHECKED: BRB/KSK	Figure
	(425) 333-0093	DATE: 03/03/2021	2



Notes: 1) Base map reference: ESM Consulting Engineers, LLC, September 8, 2020, *Steve Lathrop, New Bull Road, Preliminary Site Plan, Kittitas County, Washington*, sheet PL-01.
2) See report text for additional details.

EXPLANATION

TP-1 Test Pit Location - Encountered Loess or Caliche to depths of 4 feet or less.

TP-2 Test Pit Location - Encountered Loess or Caliche to depths greater than 4 feet.

Loess/Caliche 4-Feet Deep or Less - Up to 4 feet of low-permeability Loess or Caliche was encountered in the test pits in this area.

Loess/Caliche Greater Than 4-feet Deep - More than 4 feet of low-permeability Loess or Caliche was encountered in the test pits in this area.

New Bull Road Site

LOESS AND CALICHE EXPECTED DEPTH MAP	ICICLECREEK ENGINEERS	SCALE: As Shown DESIGNED: — DRAWN: SJM	ICE FILE NO. 1390-001
PROPOSED RESIDENTIAL DEVELOPMENT **NEW BULL ROAD SITE - KITTITAS COUNTY PARCEL ID 298633**	29335 NE 20th Street Carnation, Washington 98014 (425) 333-0093	CHECKED: BRB/KSK DATE: 03/03/2021	Figure 3

APPENDIX A

SUBSURFACE EXPLORATION PROGRAM

APPENDIX A
SUBSURFACE EXPLORATION PROGRAM

Subsurface conditions at the site were explored by excavating sixteen test pits (Test Pits TP-1 through TP-16) to depths of about 4 to 15 feet on December 3, 2020 using a John Deere 120 trackhoe operated by McCormick Excavating, LLC of Cle Elum, Washington. Locations of the test pits were obtained in the field by measuring distances from existing site features and using a geo-referenced exploration plan. The approximate locations of the test pits are shown on the Site Plan, Figure 2.

The test pit explorations were continuously observed by an engineer from ICE who visually classified the soils, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each exploration. The test pit logs are based on our interpretation of the field and laboratory data and indicate the various types of soil encountered. The densities noted on the test pit logs are based on the difficulty of digging, probing with a ½-inch-diameter steel rod, and our observations, experience and judgment. The logs also indicate the depths at which the soil characteristics change, although the change might be gradual. Soils encountered were classified in general accordance with the classification system described in Figure A-1. The test pit logs completed for this study are presented in Figures A-2 through A-6.

Approximate ground surface elevations shown on the test pit logs are based on LiDAR-based data obtained from the Washington State Department of Natural Resources, Washington LiDAR Portal and processed by ICE for 2-foot contour intervals using Esri ArcGIS 10.6.

The weather at the time of our site visit was mostly sunny with the temperature in the 30s and 40s. There was no snow on the ground at the time of the site visit. The test pits were backfilled upon completion by placing the excavated soil into the test pit in multiple loose lifts; each lift was compacted by tamping with the trackhoe bucket.

Unified Soil Classification System

MAJOR DIVISIONS			Soil Classification and Generalized Group Description	
Coarse-Grained Soils More than 50% retained on the No. 200 sieve	GRAVEL More than 50% of coarse fraction retained on the No. 4 sieve	CLEAN GRAVEL	GW	Well-graded gravels
			GP	Poorly-graded gravels
		GRAVEL WITH FINES	GM	Gravel and silt mixtures
			GC	Gravel and clay mixtures
	SAND More than 50% of coarse fraction passes the No. 4 sieve	CLEAN SAND	SW	Well-graded sand
			SP	Poorly-graded sand
		SAND WITH FINES	SM	Sand and silt mixtures
			SC	Sand and clay mixtures
Fine-Grained Soils More than 50% passing the No. 200 sieve	SILT AND CLAY Liquid Limit less than 50	INORGANIC	ML	Low-plasticity silts
			CL	Low-plasticity clays
		ORGANIC	OL	Low plasicity organic silts and organic clays
	SILT AND CLAY Liquid Limit greater than 50	INORGANIC	MH	High-plasticity silts
			CH	High-plasticity clays
		ORGANIC	OH	High-plasticity organic silts and organic clays
Highly Organic Soils	Primarily organic material with organic odor		PT	Peat

Notes: 1) Soil classification based on visual classification of soil in general accordance with ASTM Test Method D 2488.
2) Soil classification using laboratory tests is based on ASTM Test Method D 2487.
3) Description of soil density or consistency is based on interpretation of digging action and probing with a 1/2-inch-diameter steel rod.

Soil Particle Size Definitions

Component	Size Range
Boulders	Greater than 12 inch
Cobbles	3 inch to 12 inch
Gravel	3 inch to No. 4 (4.78 mm)
Coarse	3 inch to 3/4 inch
Fine	3/4 inch to No. 4 (4.78 mm)
Sand	No. 4 (4.78 mm) to No. 200 (0.074 mm)
Coarse	No. 4 (4.78 mm) to No. 10 (2.0 mm)
Medium	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Less than No. 200 (0.074 mm)

Soil Moisture Modifiers

Soil Moisture	Description
Dry	Absence of moisture
Moist	Damp, but no visible water
Wet	Visible water

SOIL CLASSIFICATION SYSTEM	ICICLECREEK ENGINEERS 29335 NE 20th Street Carnation, Washington 98014 (425) 333-0093	SCALE: No Scale DESIGNED: -- DRAWN: SJM CHECKED: BRB/KSK DATE: 03/03/2021	ICE FILE NO. 1390-001 Figure A-1
PROPOSED RESIDENTIAL DEVELOPMENT NEW BULL ROAD SITE - KITTITAS COUNTY PARCEL ID 298633			

Depth [1] (feet)	Soil Group Symbol [2]	Test Pit Description [3]
Test Pit TP-1	Approximate Ground Surface Elevation: 1,515 feet	Latitude 46.98217, Longitude -120.52836
0.0 - 0.5		Sod and Topsoil with fine roots
0.5 - 3.0	SM	Light brown silty fine SAND (loose, moist) (Loess) grades to medium dense at about 2.0 feet
3.0 - 11.0	GP-GM	Grayish-brown fine to coarse GRAVEL with silt, sand and occasional cobbles (medium dense, moist) (Alluvium) grades to wet at about 10.0 feet
		Test pit completed at about 11.0 feet on 12/03/2020 Light caving of the test pit wall sobserved between about 3.0 and 6.0 feet Groundwater seepage observed below about 10.0 feet Disturbed soil samples obtained at about 2.0 and 8.0 feet
Test Pit TP-2	Approximate Ground Surface Elevation: 1,532 feet	Latitude 46.98306, Longitude -120.52665
0.0 - 0.5		Sod and Topsoil with fine roots
0.5 - 2.0	SM	Light brown silty fine SAND (loose, moist) (Loess)
2.0 - 4.0	GM	Light gray and brown silty fine to coarse GRAVEL with sand and occasional cobbles (very dense/heavily cemented, dry) (Alluvium/Caliche)
		Test pit completed at about 4.0 feet on 12/03/2020 due to digging refusal No caving of the test pit walls observed No groundwater seepage observed Disturbed soil sample obtained at about 3.0 feet
Test Pit TP-3	Approximate Ground Surface Elevation: 1,532 feet	Latitude 46.98347, Longitude -120.52525
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 4.0	ML	Light brown sandy SILT (medium stiff, moist) (Loess) grades to stiff at about 2.0 feet
4.0 - 5.0	SM	Light brown silty fine to medium SAND with gravel (meidum dense, moist) (Alluvium)
5.0 - 12.0	GP-GM	Brown fine to coarse GRAVEL with silt, sand and cobbles (dense/lightly cemented, moist) (Older Alluvium)
		Test pit completed at about 12.0 feet on 12/03/2020 No caving of the test pit walls observed No groundwater seepage observed Disturbed soil samples obtained at about 2.0, 4.5 and 8.0 feet
Test Pit TP-4	Approximate Ground Surface Elevation: 1,533 feet	Latitude 46.98393, Longitude -120.52401
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 3.0	ML	Brown sandy SILT (medium stiff, moist) (Loess)
3.0 - 6.0	GP	Grayish-brown fine to coarse GRAVEL with sand and occasional cobbles (medium dense, moist) (Alluvium)
6.0 - 10.0	GP-GM	Grayish-brown fine to coarse GRAVEL with silt, sand and cobbles (medium dense, moist) (Alluvium) grades to wet at about 9.0 feet
		Test pit completed at about 10.0 feet on 12/03/2020 Light caving of the test pit walls observed between about 3.0 and 6.0 feet Groundwater seepage observed below about 9.0 feet Disturbed soil samples obtained at about 2.0 and 5.0 feet

See Notes on Figure A-6

Depth [1] (feet)	Soil Group Symbol [2]	Test Pit Description [3]
Test Pit TP-5	Approximate Ground Surface Elevation: 1,524 feet	Latitude 46.98210, Longitude -120.52709
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 2.5	SM	Brown silty fine SAND (loose, moist) (Loess)
2.5 - 4.0	GM	Light grayish-brown silty fine to coarse GRAVEL with sand (very dense/heavily cemented, moist) (Alluvium/Caliche)
4.0 - 6.0	GP	Grayish-brown fine to coarse GRAVEL with sand and a trace of silt (medium dense, moist) (Alluvium)
6.0 - 8.0	GP-GM	Grayish-brown fine to coarse GRAVEL with silt and sand (medium dense, moist) (Alluvium)
8.0 - 14.0	GM	Brown silty fine to coarse GRAVEL with sand and cobbles (very dense/heavily cemented, moist) (Older Alluvium)
		Test pit completed at about 14.0 feet on 12/03/2020 Moderate caving of the test pit walls observed between about 4.0 and 6.0 feet No groundwater seepage observed Disturbed soil samples obtained at about 2.0, 3.0, 5.0 and 9.0 feet
Test Pit TP-6	Approximate Ground Surface Elevation: 1,527 feet	Latitude 46.98234, Longitude -120.52562
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 3.0	ML	Brown sandy SILT (medium stiff, moist) (Loess)
3.0 - 4.5	GM	Brown silty fine to coarse GRAVEL with sand and occasional cobbles (very dense/heavily cemented, moist) (Alluvium/Caliche)
4.5 - 8.0	GP-GM	Grayish-brown fine to coarse GRAVEL with silt, sand and cobbles (medium dense, moist) (Alluvium)
8.0 - 10.0	GP-GM	Brown fine to coarse GRAVEL with silt, sand and cobbles (dense/lightly cemented, moist) (Older Alluvium)
		Test pit completed at about 10.0 feet on 12/03/2020 No caving of the test pit walls observed No groundwater seepage observed Disturbed soil sample obtained at about 2.0 and 9.0 feet
Test Pit TP-7	Approximate Ground Surface Elevation: 1,528 feet	Latitude 46.98269, Longitude -120.52407
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 3.0	SM	Brown silty fine SAND (loose, moist) (Loess) grades to medium dense at about 1.5 feet
3.0 - 5.0	GP-GM	Brown fine to coarse GRAVEL with silt, sand and occasional cobbles (loose, moist) (Alluvium)
5.0 - 9.0	GM	Brown silty fine to coarse GRAVEL with sand and cobbles (medium dense, moist) (Alluvium) grades to wet at about 7.0 feet
		Test pit completed at about 9.0 feet on 12/03/2020 Moderate caving of the test pit walls observed between about 3.0 and 5.0 feet Groundwater seepage observed below about 7.0 feet Disturbed soil samples obtained at about 2.0 and 6.0 feet

See Notes on Figure A-6

Depth [1] (feet)	Soil Group Symbol [2]	Test Pit Description [3]
Test Pit TP-8		Approximate Ground Surface Elevation: 1,510 feet — Latitude 46.98120, Longitude -120.52833
0.0 - 0.5		Sod and Topsoil with fine roots
0.5 - 1.5	SM	Brown silty fine SAND with fine roots (loose, moist) (Loess)
1.5 - 5.0	GP-GM	Grayish-brown fine to coarse GRAVEL with silt, sand and occasional cobbles (medium dense, moist) (Alluvium)
5.0 - 10.0	GM	Light brown silty fine to coarse GRAVEL with sand and cobbles (medium dense, moist) (Alluvium)
10.0 - 12.0	ML	Light gray SILT with sand (stiff, moist) (Alluvium)
12.0 - 15.0	SM	Light brown silty fine to medium SAND (medium dense, moist) (Alluvium) grades to with gravel, wet at about 14.0 feet
		Test pit completed at about 15.0 feet on 12/03/2020 Moderate caving of the test pit walls observed between about 1.5 and 5.0 feet Groundwater seepage observed below about 14.0 feet Disturbed soil samples obtained at about 1.0, 6.0 and 11.0 feet
Test Pit TP-9		Approximate Ground Surface Elevation: 1,522 feet — Latitude 46.98141, Longitude -120.52729
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 2.0	ML	Light brown sandy SILT (stiff, dry) (Loess)
2.0 - 3.0	GM	Light gray silty fine to coarse GRAVEL with sand (very dense/heavily cemented, moist) (Alluvium/Caliche)
3.0 - 6.0	GP	Light grayish-brown coarse GRAVEL with sand, cobbles and a trace of silt (medium dense, moist) (Alluvium)
6.0 - 10.0	GP-GM	Brown fine to coarse GRAVEL with silt, sand and cobbles (medium dense, moist) (Alluvium)
		Test pit completed at about 10.0 feet on 12/03/2020 No caving of the test pit walls observed No groundwater seepage observed Disturbed soil sample obtained at about 4.0 feet
Test Pit TP-10		Approximate Ground Surface Elevation: 1,523 feet — Latitude 46.98069, Longitude -120.52686
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 2.0	ML	Light brown sandy SILT (stiff, dry) (Loess)
2.0 - 4.0	SM	Light gray silty fine to medium SAND with gravel and cobbles (very dense/heavily cemented, dry) (Alluvium/Caliche)
4.0 - 7.0	GP	Light grayish-brown fine to coarse GRAVEL with sand, cobbles and a trace of silt (medium dense, moist) (Alluvium)
7.0 - 10.0	GP-GM	Light grayish-brown fine to coarse GRAVEL with silt, sand and cobbles (dense/lightly cemented, moist) (Older Alluvium)
		Test pit completed at about 10.0 feet on 12/03/2020 No caving of the test pit walls observed No groundwater seepage observed Disturbed soil samples obtained at about 3.0 and 8.0 feet

See Notes on Figure A-6

1390001/030321

Depth [1] (feet)	Soil Group Symbol [2]	Test Pit Description [3]
Test Pit TP-11	Approximate Ground Surface Elevation: 1,522 feet	Latitude 46.98111, Longitude -120.52546
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 4.0	SM	Light brown silty fine SAND (loose, moist) (Loess) grades to medium dense at about 2.5 feet
4.0 - 5.0	GM	Light grayish-brown silty fine to coarse GRAVEL with sand (very dense/heavily cemented, moist) (Alluvium/Caliche)
5.0 - 8.0	GP	Brown fine to coarse GRAVEL with sand, occasional cobbles and a trace of silt (medium dense, moist) (Alluvium)
8.0 - 9.0	GM	Brown silty fine to coarse GRAVEL with sand and cobbles (dense/lightly cemented, moist) (Older Alluvium)
		Test pit completed at about 9.0 feet on 12/03/2020 Light caving of the test pit walls was observed between about 5.0 and 8.0 feet No groundwater seepage observed Disturbed soil samples obtained at about 2.0 and 6.0 feet
Test Pit TP-12	Approximate Ground Surface Elevation: 1,522 feet	Latitude 46.98160, Longitude -121.52407
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 2.5	ML	Dark brown sandy SILT (medium stiff, moist) (Loess)
2.5 - 9.0	GM	Brown silty fine to coarse GRAVEL with sand and occasional cobbles (loose, moist) (Alluvium) grades to medium dense, wet at about 6.0 feet
		Test pit completed at about 9.0 feet on 12/03/2020 Severe caving of the test pit walls was observed between about 2.5 and 6.0 feet Groundwater seepage was observed below about 6.0 feet Disturbed soil samples obtained at about 2.0 and 4.0 feet
Test Pit TP-13	Approximate Ground Surface Elevation: 1,518 feet	Latitude 46.98023, Longitude -120.52542
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 8.0	ML	Light brown sandy SILT (medium stiff, moist) (Loess) grades to stiff at about 3.0 feet
8.0 - 10.0	SM	Brown silty fine to medium SAND with gravel and occasional cobbles (medium dense, moist) (Alluvium) grades to wet at about 9.0 feet
		Test pit completed at about 10.0 feet on 12/03/2020 No caving of the test pit walls observed Groundwater seepage was observed below about 9.0 feet Disturbed soil samples obtained at about 1.0 and 8.5 feet

See Notes on Figure A-6

1390001/030321

Depth [1] (feet)	Soil Group Symbol [2]	Test Pit Description [3]
Test Pit TP-14	Approximate Ground Surface Elevation: 1,516 feet	Latitude 46.98039, Longitude -120.52406
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 4.5	SM	Brown silty fine SAND with a trace of gravel (loose, moist) (Loess) grades to medium dense at about 2.0 feet
4.5 - 9.0	GM	Brown silty fine to coarse GRAVEL with sand and cobbles (medium dense, moist) (Alluvium) grades to wet at about 6.0 feet
		Test pit completed at about 9.0 feet on 12/03/2020 Light caving of the test pit walls observed between about 4.5 and 9.0 feet Groundwater seepage observed below about 6.0 feet Disturbed soil samples obtained at about 2.0 and 5.0 feet
Test Pit TP-15	Approximate Ground Surface Elevation: 1,511 feet	Latitude 46.97947 Longitude -120.52495
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 1.5	SM	Light brown silty fine SAND (loose, moist) (Loess)
1.5 - 2.0	GM	Light gray silty fine to coarse GRAVEL with sand (dense/moderately cemented, dry) (Alluvium/Caliche)
2.0 - 4.0	GP-GM	Light grayish-brown fine to coarse GRAVEL with silt, sand and occasional cobbles (medium dense, moist) (Alluvium)
4.0 - 10.0	GM	Brown silty fine to coarse GRAVEL with sand and cobbles (medium dense, moist) (Alluvium) grades to wet at about 7.0 feet
		Test pit completed at about 10.0 feet on 12/03/2020 Light caving of the test pit walls observed between about 4.0 and 10.0 feet Groundwater seepage observed below about 7.0 feet Disturbed soil sample obtained at about 5.0 feet
Test Pit TP-16	Approximate Ground Surface Elevation: 1,506 feet	Latitude 46.97901, Longitude -120.52390
0.0 - 0.3		Sod and Topsoil with fine roots
0.3 - 2.0	SM	Light brown silty fine SAND (medium dense, dry) (Loess)
2.0 - 8.0	GM	Brown silty fine to coarse GRAVEL with sand and cobbles (medium dense, moist) (Alluvium) grades to wet at about 6.0 feet
8.0 - 13.0	GM	Brown silty fine to coarse GRAVEL with sand and occasional cobbles (dense/lightly cemented, moist) (Older Alluvium)
		Test pit completed at about 13.0 feet on 12/03/2020 Light caving of the test pit walls observed between about 2.0 and 8.0 feet Groundwater seepage observed below about 6.0 feet Disturbed soil sample obtained at about 4.0 feet

Notes:

(1) The depths on the test pit logs are shown in 0.5 foot increments, however these depths are based on approximate measurements across the length of the test pit and should be considered accurate to 1.0 foot. The depths are relative to the adjacent ground surface.

(2) The soil group symbols are based on the Soil Classification System, Figure A-1.

(3) The approximate test pit locations are shown on the Site Plan, Figure 2.

APPENDIX B

LABORATORY TESTING PROGRAM

APPENDIX B
LABORATORY TESTING PROGRAM

The soil samples obtained from the test pits were visually examined in our soils laboratory and selected samples were tested to evaluate pertinent physical characteristics. The testing program included moisture content by ASTM Test Method D 2216 and grain size analysis (particle size distribution) by ASTM Test Methods C 117 (modified) and C 136 (modified). The test results are presented on Figure B-1 (moisture content) and Figures B-2 through B-11 (particle size distribution reports).

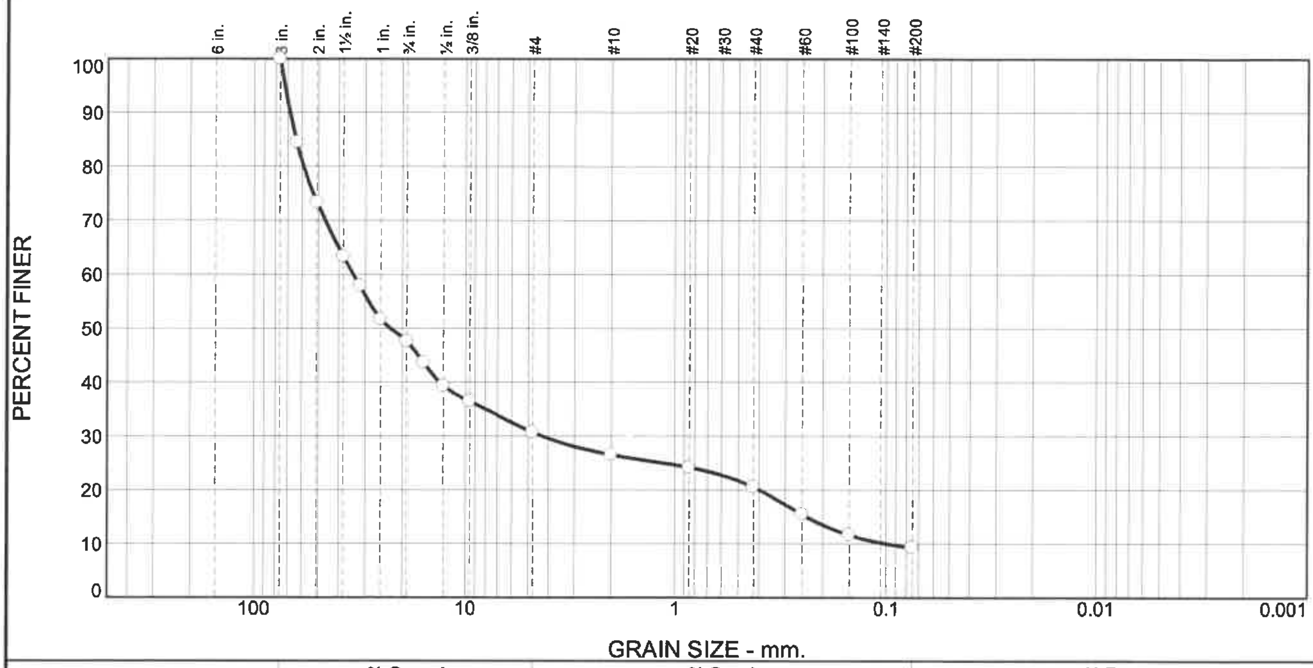
Test Pit Number	Sample Number	Sample Depth (feet)	Moisture Content (percent)
TP-1	S-1	2	20
TP-1	S-2	8	6
TP-2	S-1	3	9
TP-3	S-1	2	23
TP-3	S-2	4.5	16
TP-3	S-3	8	9
TP-4	S-1	2	20
TP-4	S-2	5	6
TP-5	S-1	2	12
TP-5	S-2	3	12
TP-5	S-3	5	4
TP-5	S-4	9	8
TP-6	S-1	2	17
TP-6	S-2	9	7
TP-7	S-1	2	18
TP-7	S-2	6	7
TP-8	S-1	1	13
TP-8	S-2	6	11
TP-8	S-3	11	47
TP-9	S-1	4	4
TP-10	S-1	3	15
TP-10	S-2	8	5
TP-11	S-1	2	9
TP-11	S-2	6	4
TP-12	S-1	2	18
TP-12	S-2	4	11
TP-13	S-1	1	14
TP-13	S-2	8.5	25
TP-14	S-1	2	25
TP-14	S-2	5	16
TP-15	S-1	5	6
TP-16	S-1	4	6

1390001/030321

Icicle Creek Engineers

Moisture Content Results - Figure B-1

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	52.4	16.9	4.2	6.0	11.2	9.3	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2.5	84.5		
2	73.3		
1.5	63.3		
1.25	57.8		
1	51.6		
3/4	47.6		
5/8	43.6		
1/2	39.3		
3/8	36.5		
#4	30.7		
#10	26.5		
#20	24.1		
#40	20.5		
#60	15.4		
#100	11.6		
#200	9.3		

* (no specification provided)

Material Description

Grayish-brown fine to coarse GRAVEL with silt, sand and occasional cobbles (medium dense, moist) (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 68.1722 D_{85}= 63.9538 D_{60}= 34.1242
D_{50}= 22.9953 D_{30}= 4.2808 D_{15}= 0.2384
D_{10}= 0.0996 C_u= 342.69 C_c= 5.39

Remarks

Moisture Content 6 Percent

Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

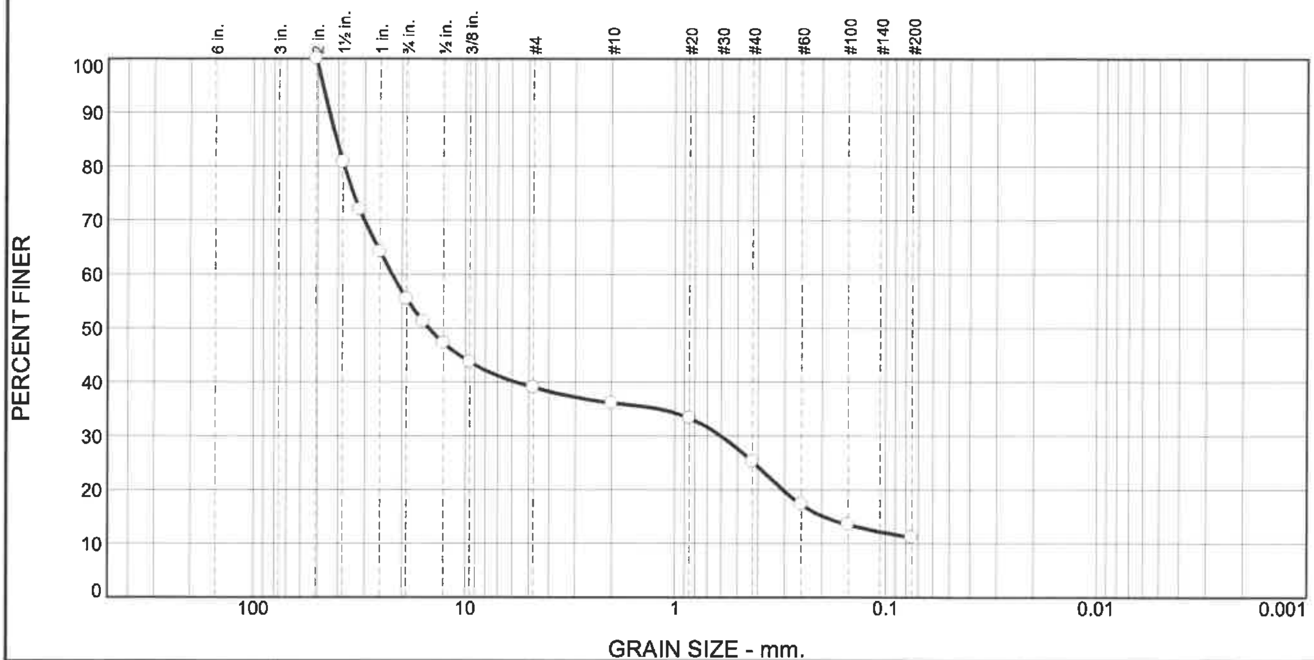
Source of Sample: Test Pit Explorations **Depth:** 8 feet **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-1, S-2

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-2

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	44.6	16.4	2.9	10.9	14.1	11.1	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2	100.0		
1.5	80.8		
1.25	72.0		
1	64.1		
3/4	55.4		
5/8	51.2		
1/2	47.2		
3/8	43.7		
#4	39.0		
#10	36.1		
#20	33.3		
#40	25.2		
#60	17.3		
#100	13.5		
#200	11.1		

* (no specification provided)

Material Description

Brown fine to coarse GRAVEL with silt, sand and cobbles (dense, moist) (Older Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 44.0803 D_{85}= 40.8533 D_{60}= 22.3175
D_{50}= 14.9407 D_{30}= 0.6027 D_{15}= 0.1958
D_{10}= C_u= C_c=

Remarks

Moisture Content 9 Percent
*Moderate cementation of soil grains observed
*Cemented soil slaked (broke apart) in water

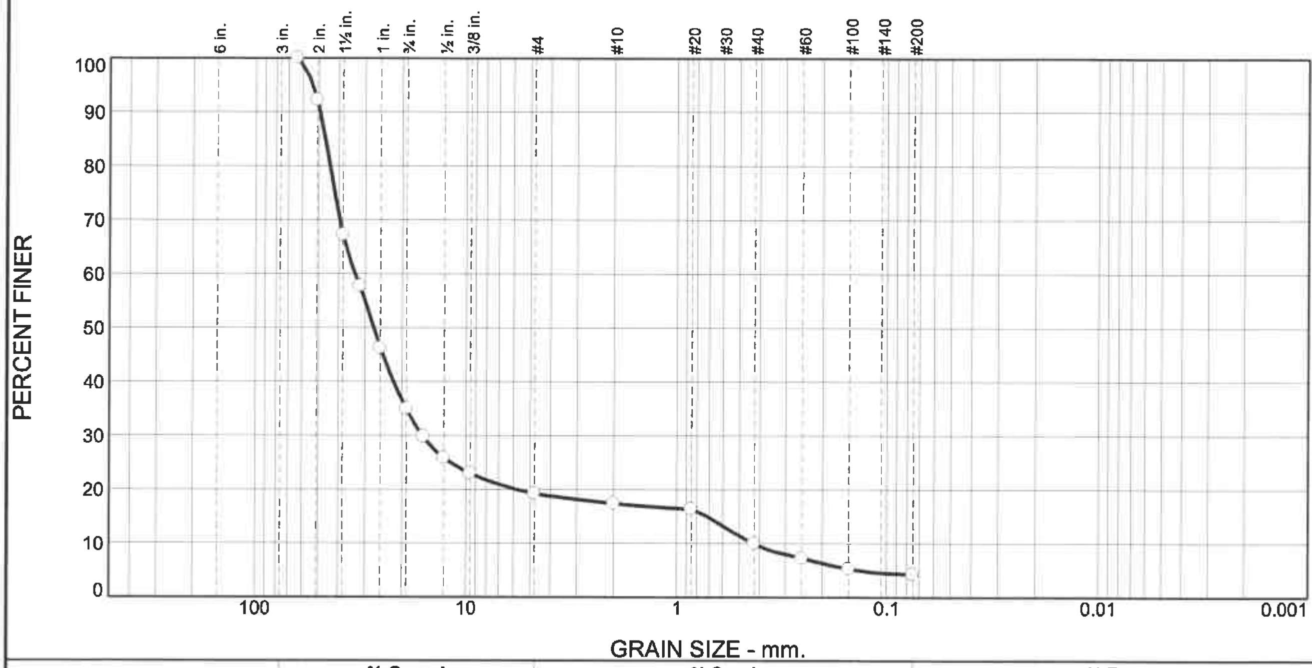
Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

Source of Sample: Test Pit Explorations **Depth:** 8 feet **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-3, S-3

ICICLE CREEK ENGINEERS, INC.
Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	65.1	15.7	1.8	7.5	5.6	4.3	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2.5	100.0		
2	92.2		
1.5	67.2		
1.25	57.7		
1	46.2		
3/4	34.9		
5/8	29.8		
1/2	25.8		
3/8	23.0		
#4	19.2		
#10	17.4		
#20	16.4		
#40	9.9		
#60	7.3		
#100	5.3		
#200	4.3		

* (no specification provided)

Material Description

Grayish-brown coarse GRAVEL with sand and a trace of silt (medium dense, moist) (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 49.2369 D_{85}= 46.4181 D_{60}= 33.3788
D_{50}= 27.3507 D_{30}= 16.0404 D_{15}= 0.7152
D_{10}= 0.4289 C_u= 77.83 C_c= 17.97

Remarks

Moisture Content 4 Percent

Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

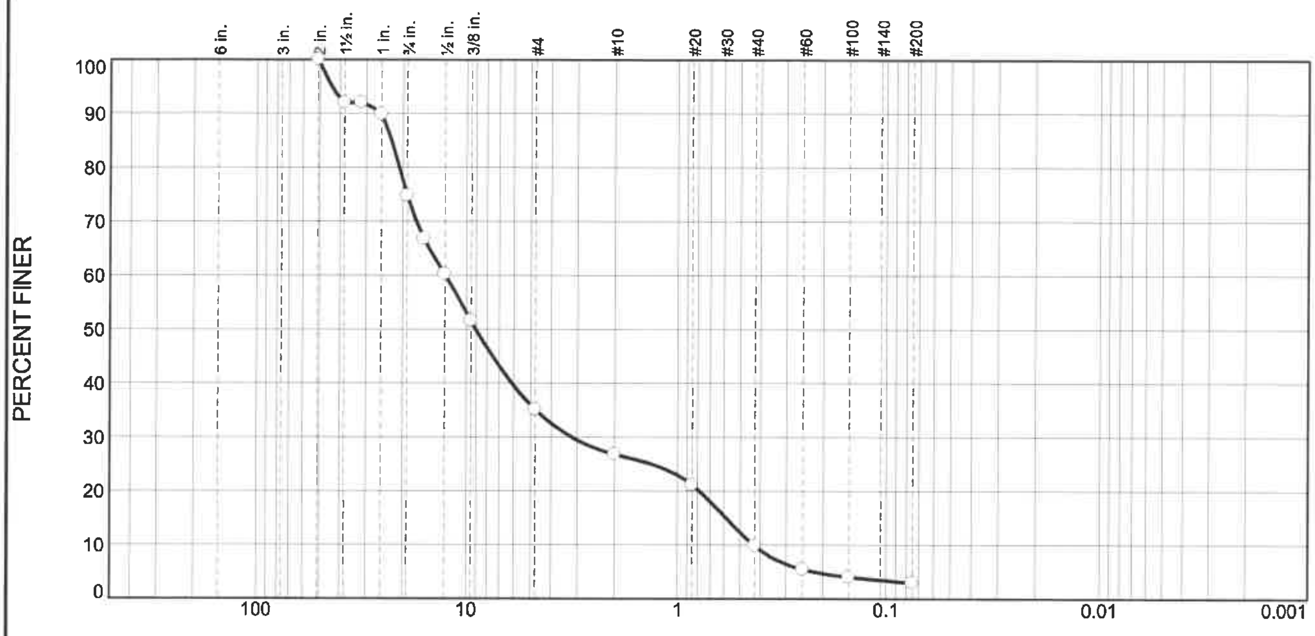
Source of Sample: Test Pit Explorations **Depth:** 5 feet **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-5, S-3

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-4

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	25.2	39.7	8.3	17.0	6.8	3.0	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2	100.0		
1.5	92.0		
1.25	92.0		
1	89.8		
3/4	74.8		
5/8	66.8		
1/2	60.2		
3/8	51.6		
#4	35.1		
#10	26.8		
#20	21.1		
#40	9.8		
#60	5.4		
#100	4.0		
#200	3.0		

* (no specification provided)

Material Description

Brown silty fine to coarse GRAVEL with sand and cobbles (very dense, moist) (Older Alluvium)*

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 25.7009 D_{85}= 22.7687 D_{60}= 12.6006
D_{50}= 9.0332 D_{30}= 3.1982 D_{15}= 0.5848
D_{10}= 0.4311 C_u= 29.23 C_c= 1.88

Remarks

Moisture Content 8 Percent
*Heavy cementation of soil grains observed
*Cemented soil remained intact in water

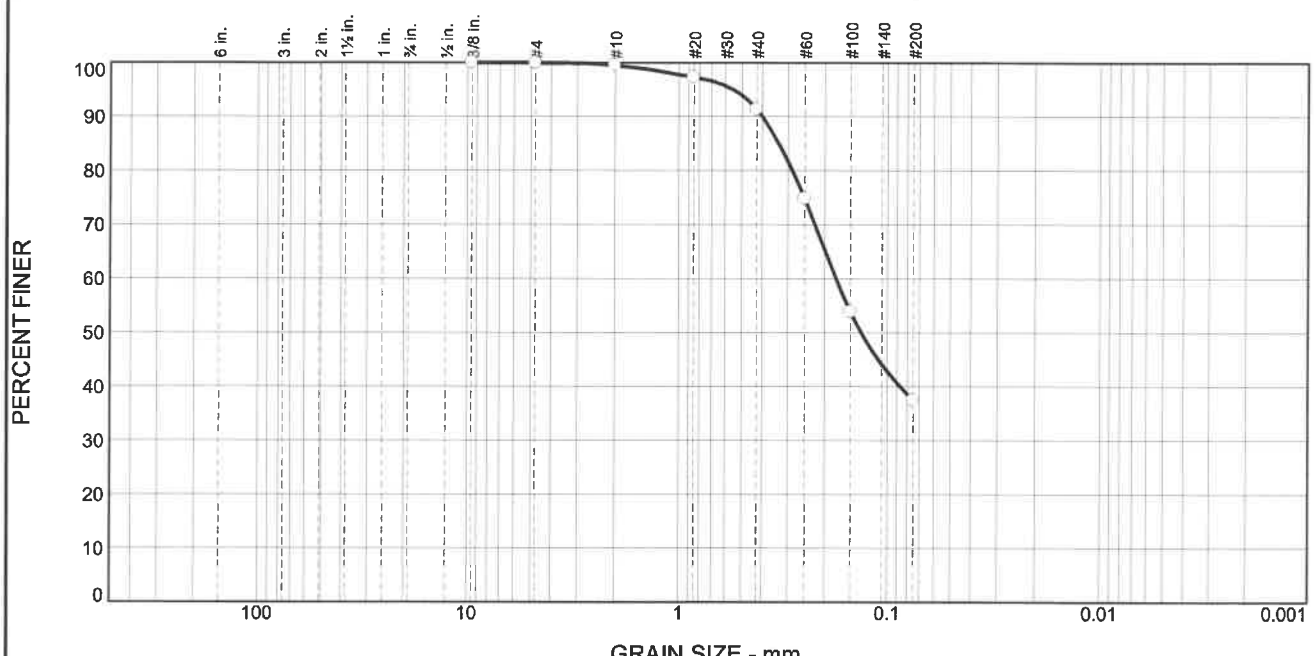
Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

Source of Sample: Test Pit Explorations **Depth:** 9 feet
Sample Number: Test Pit TP-5, S-4 **Date Sampled:** 12/03/2020

ICICLE CREEK ENGINEERS, INC.
Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-5

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.5	8.2	53.9	37.4	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8	100.0		
#4	100.0		
#10	99.5		
#20	97.3		
#40	91.3		
#60	74.8		
#100	53.8		
#200	37.4		

* (no specification provided)

Material Description

Brown silty fine SAND (loose, moist) (Loess)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.4000 D_{85}= 0.3323 D_{60}= 0.1762
D_{50}= 0.1333 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Moisture Content 18 Percent

Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

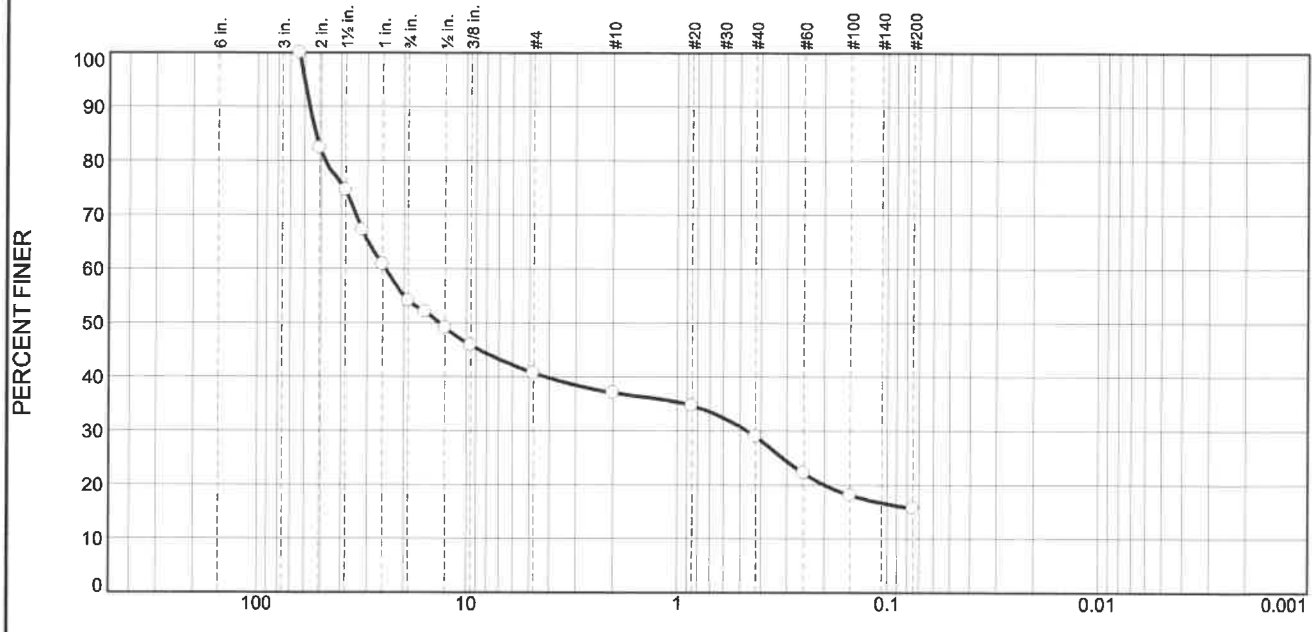
Source of Sample: Test Pit Explorations **Depth:** 2 feet
Sample Number: Test Pit TP-7, S-1 **Date Sampled:** 12/03/2020

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-6

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	46.0	13.3	3.7	8.0	13.4	15.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2.5	100.0		
2	82.4		
1.5	74.6		
1.25	67.1		
1	60.8		
3/4	54.0		
5/8	52.0		
1/2	49.0		
3/8	45.8		
#4	40.7		
#10	37.0		
#20	34.7		
#40	29.0		
#60	22.1		
#100	18.1		
#200	15.6		

* (no specification provided)

Material Description

Light brown silty fine to coarse GRAVEL with sand and cobbles (medium dense, moist) (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 56.7770 D_{85}= 53.1164 D_{60}= 24.5981
D_{50}= 13.6325 D_{30}= 0.4652 D_{15}=
D_{10}= C_u= C_c=

Remarks

Moisture Content 11 Percent

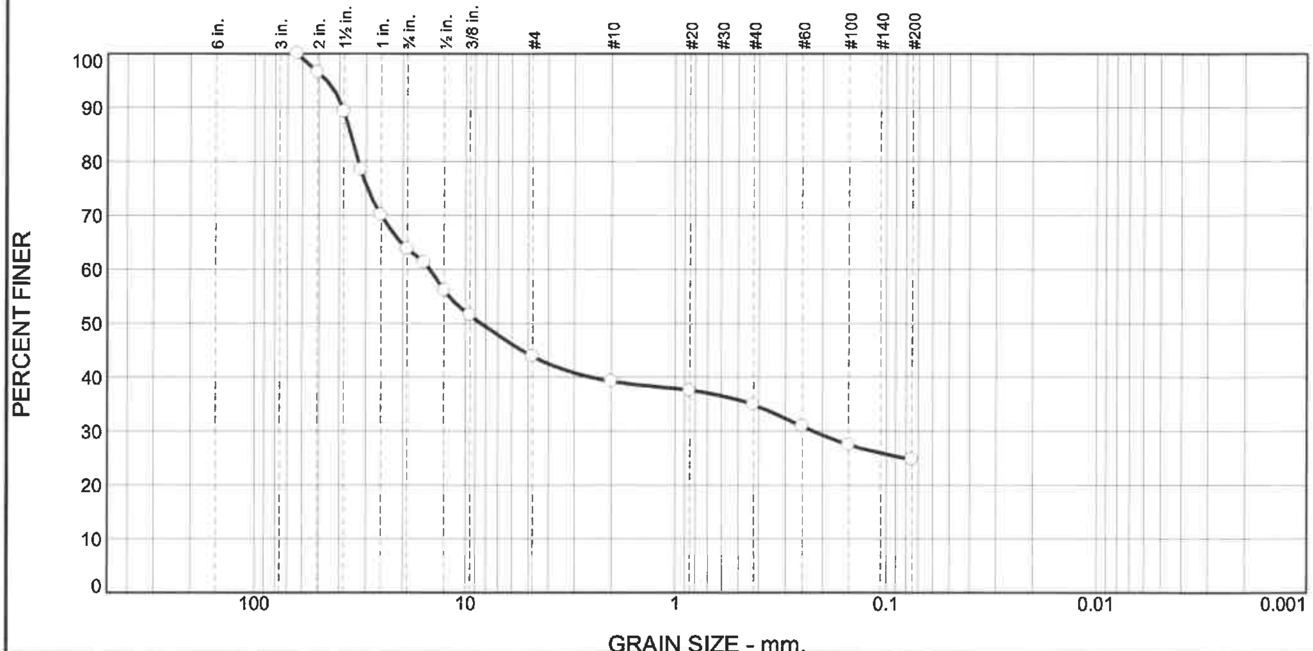
Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

Source of Sample: Test Pit Explorations **Depth:** 6 feet **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-8, S-2

ICICLE CREEK ENGINEERS, INC.
Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-7

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	36.2	19.9	4.7	4.3	10.2	24.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2.5	100.0		
2	96.5		
1.5	89.2		
1.25	78.5		
1	70.1		
3/4	63.8		
5/8	61.3		
1/2	56.1		
3/8	51.5		
#4	43.9		
#10	39.2		
#20	37.6		
#40	34.9		
#60	30.9		
#100	27.5		
#200	24.7		

* (no specification provided)

Material Description

Brown silty fine to coarse GRAVEL with sand and occasional cobbles (loose, moist) (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 38.7462 D_{85}= 35.3728 D_{60}= 14.9345
D_{50}= 8.4360 D_{30}= 0.2217 D_{15}=
D_{10}= C_u= C_c=

Remarks

Moisture Content 11 Percent

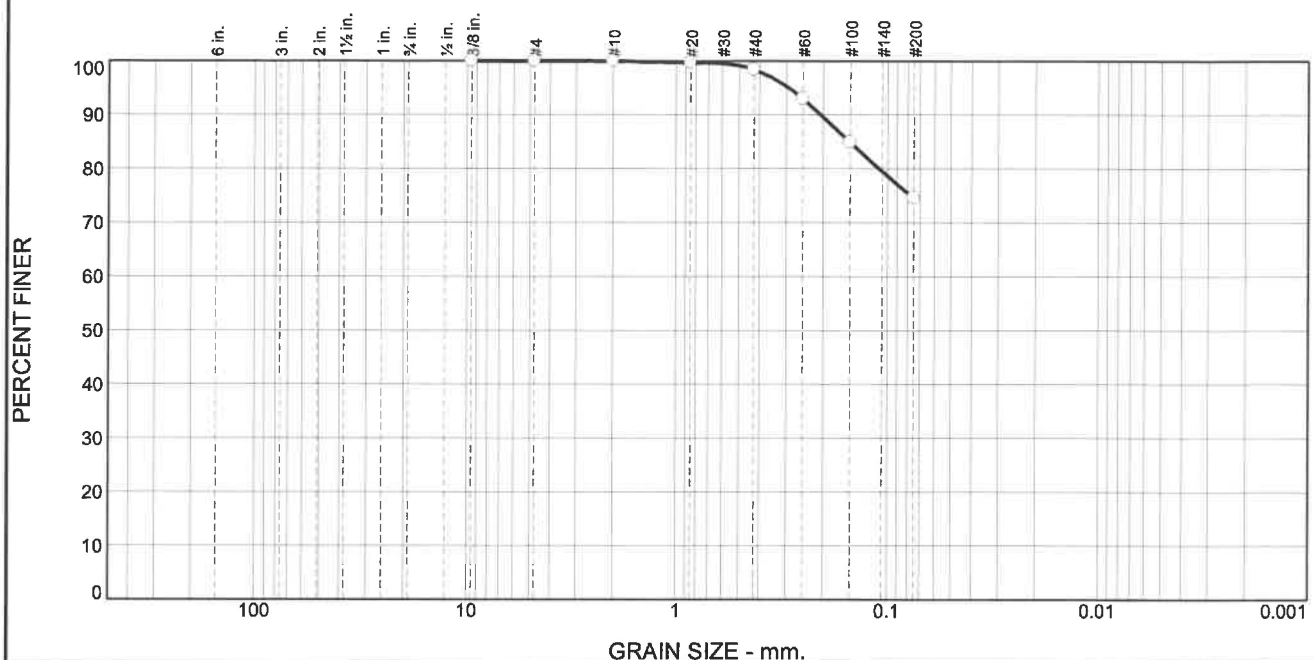
Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

Source of Sample: Test Pit Explorations **Depth:** 4 feet **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-12, S-2

ICICLE CREEK ENGINEERS, INC.
Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-8

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.5	23.8	74.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8	100.0		
#4	100.0		
#10	99.9		
#20	99.7		
#40	98.4		
#60	92.9		
#100	84.9		
#200	74.6		

* (no specification provided)

Material Description

Light brown sandy SILT (medium stiff, moist) (Loess)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.2058 D_{85}= 0.1512 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Moisture Content 14 Percent

Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

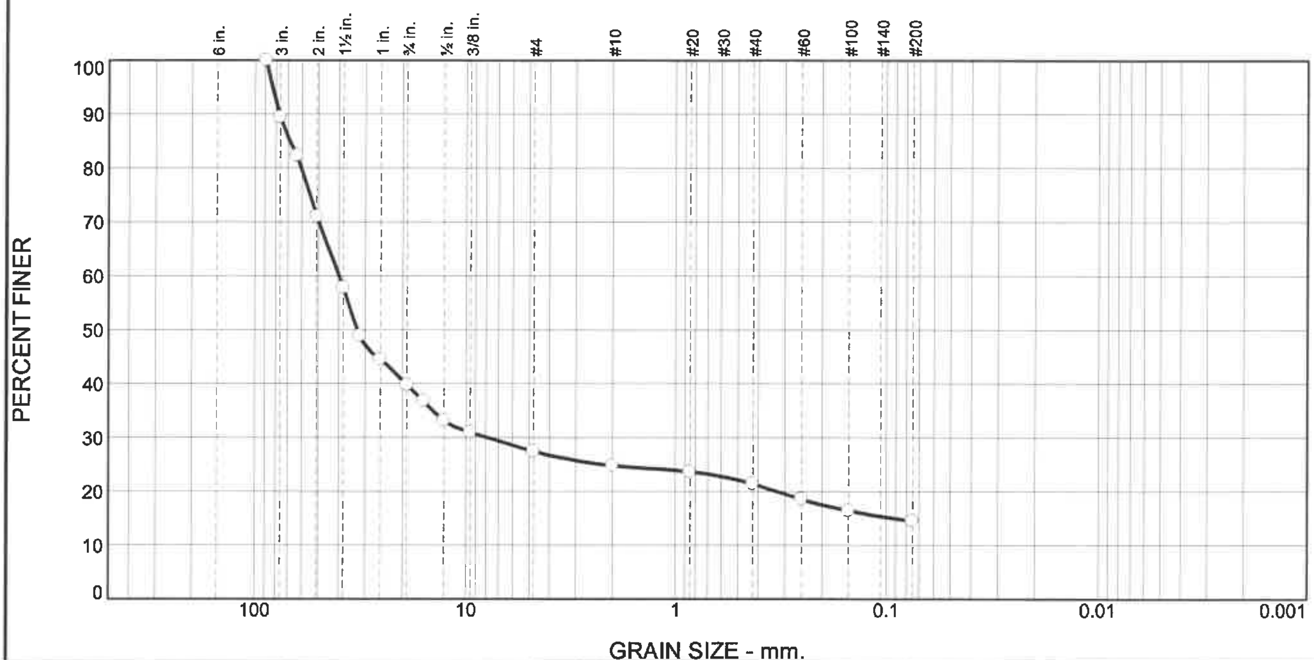
Source of Sample: Test Pit Explorations **Depth:** 1 foot **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-13, S-1

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-9

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
10.6	49.7	12.3	2.6	3.4	6.9	14.5	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.5	100.0		
3	89.4		
2.5	82.3		
2	71.0		
1.5	57.8		
1.25	48.9		
1	44.5		
3/4	39.7		
5/8	36.8		
1/2	33.1		
3/8	31.0		
#4	27.4		
#10	24.8		
#20	23.6		
#40	21.4		
#60	18.6		
#100	16.4		
#200	14.5		

* (no specification provided)

Material Description

Brown silty fine to coarse GRAVEl with sand and cobbles (medium dense, moist) (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 77.0115 D_{85}= 68.4172 D_{60}= 39.8564
D_{50}= 32.6710 D_{30}= 7.8477 D_{15}= 0.0931
D_{10}= C_u= C_c=

Remarks

Moisture Content 6 Percent

Date Received: 12/04/2020 **Date Tested:** 12/04/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

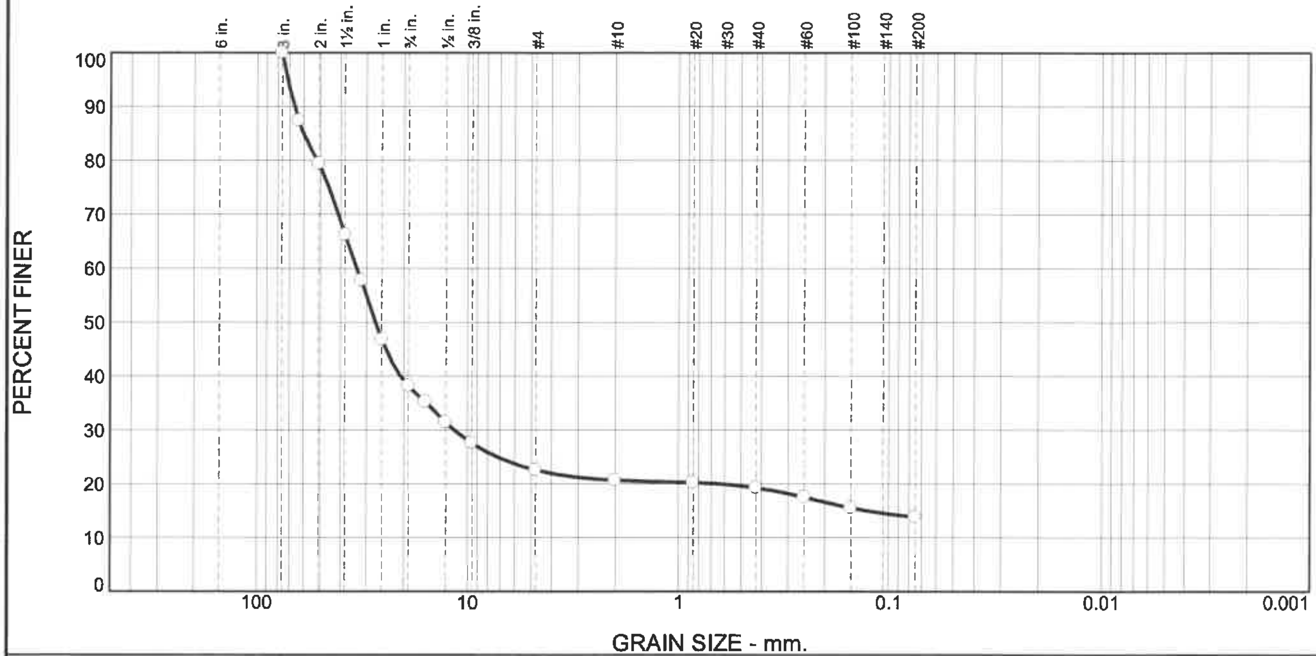
Source of Sample: Test Pit Explorations **Depth:** 5 feet **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-15, S-1

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-10

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	61.8	15.6	2.0	1.4	5.4	13.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2.5	87.4		
2	79.4		
1.5	66.2		
1.25	57.8		
1	46.7		
3/4	38.2		
5/8	35.2		
1/2	31.4		
3/8	27.6		
#4	22.6		
#10	20.6		
#20	20.2		
#40	19.2		
#60	17.5		
#100	15.5		
#200	13.8		

* (no specification provided)

Material Description

Brown silty fine to coarse GRAVEL with sand and cobbles (medium dense, moist) (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 66.4331 D_{85}= 60.2319 D_{60}= 33.2875
D_{50}= 27.2454 D_{30}= 11.5859 D_{15}= 0.1269
D_{10}= C_u= C_c=

Remarks

Moisture Content 6 Percent

Date Received: 12/04/2020 **Date Tested:** 12/14/2020
Tested By: SJM
Checked By: JMS
Title: Project Eng. Geologist

Source of Sample: Test Pit Explorations **Depth:** 4 feet **Date Sampled:** 12/03/2020
Sample Number: Test Pit TP-16, S-1

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Lathrop Development Company
Project: Proposed Residential Development, New Bull Road Site
Project No: 1390-001 **Figure** B-11