1st Review
PLPSP20220049
June 2022

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BRADLEY HEIGHTS APARTMENTS

Stormwater Site Plan
Preliminary Drainage Report

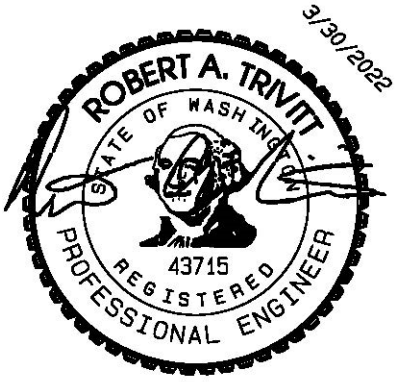
FOR: Timberlane Partners
1816 11th Ave Unit C
Seattle, WA 98122

BY: Azure Green Consultants
409 East Pioneer
Puyallup, WA 98372
253.770.3144

DATE: March 29, 2022

JOB NO: 3227

ENGINEER: Robert A. Trivitt, P.E.



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Section I - Project Overview

Overview:

The project site is located on the north side of 27th Ave SE, east of the intersection with S Meridian. The site address is 919 9th Ave NW. Tax parcel number is 041903-6-006. Parcel area is 7.78 acres. The project is an apartment project with 10 apartment buildings and a recreation building.

Improvements for the project will include the parking lot, storm drainage facilities, sanitary sewer main extension, water main extension, construction of multi-family and recreation buildings, and construction of curb, gutter, and sidewalk along the project frontage.

Project Requirements:

Determination of Applicable Minimum Requirements

Per PMC 21.10.040 the City of Puyallup has adopted the Washington State Department of Ecology Stormwater Management Manual for Western Washington (SMMWW), with the version in effect being "the most current version approved for city use by the council." The 2012 DOE Manual as amended in 2014 has been adopted by the City and is the controlling regulation and is referred to as "the Manual" or "SMMWW" hereinafter.

The project consists of over 270,000 sf of new plus replaced hard surfaces onsite. The existing hard surfaces are 135,105 sf or 40% of the project site and therefore, the project is considered redevelopment. Since the total new plus replaced hard surfaces for the project are greater than 5,000 square feet, and the value of improvements exceed 50% of the assessed value of the existing site improvments, all minimum requirements apply to the new and replaced hard surfaces and converted vegetation areas. Note that all of the existing vegetated areas are already lawn/landscaping so therefore there are no converted vegetation areas. Therefore, the minimum requirements only apply to the new and replaced hard surfaces.

Use correct address. [Storm Report; Pg 3 of 92]

south side. [Storm Report; Pg 3 of 92]

The City will adopt the 2019 Ecology Manual as of July 1, 2022. Since Preliminary Site Plan applications are not a vesting tool, the stormwater design shall adhere to the 2019 Ecology Manual. [Storm Report; Pg 3 of 92]

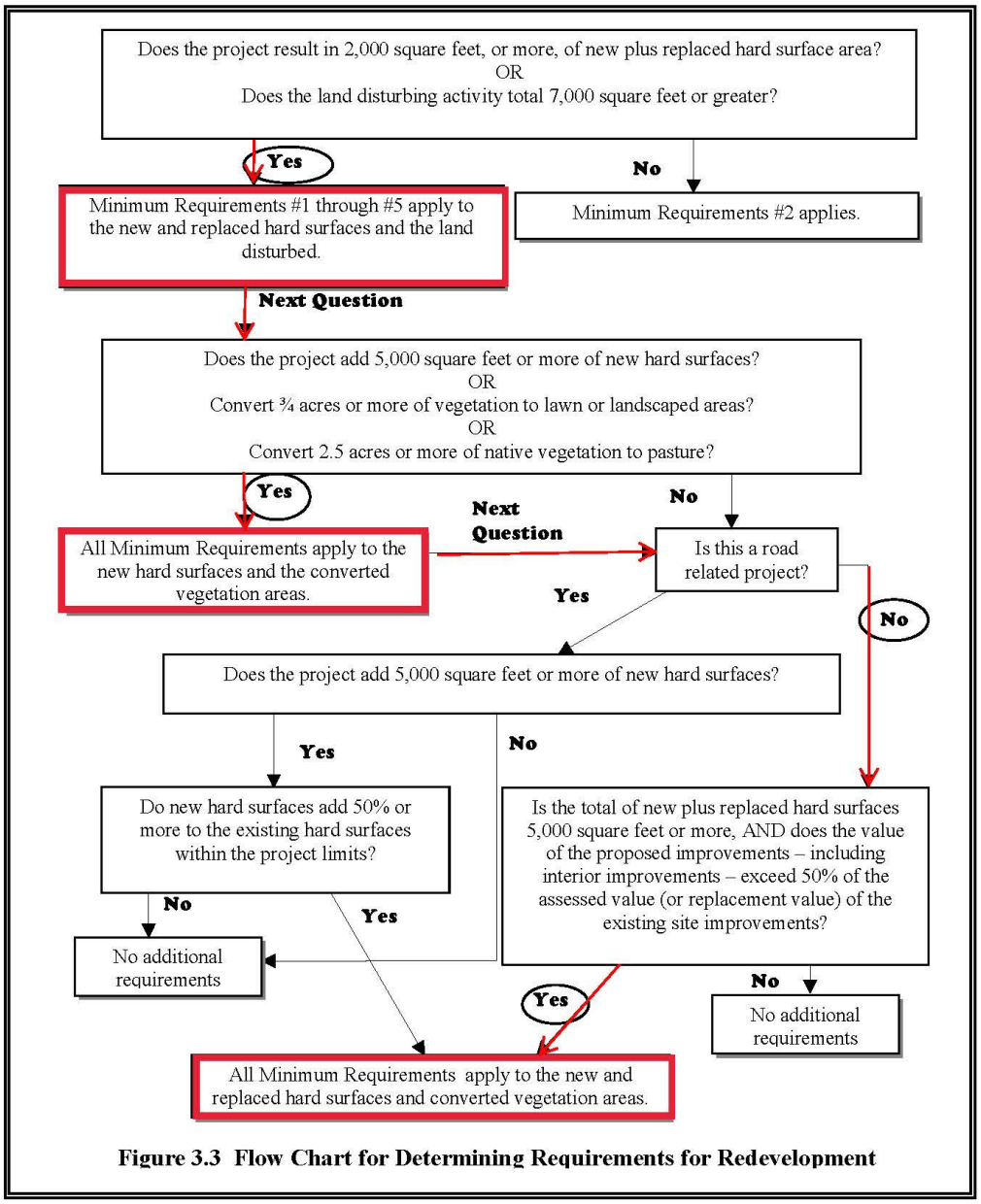


Figure 3.3 Flow Chart for Determining Requirements for Redevelopment

Discussion of Minimum Requirements

The Minimum Requirements per Section I-2.5 of the Manual:

Minimum Requirement #1: Preparation of Stormwater Site Plans

The Stormwater Site Plan consists of a report and construction plans. This report and the attached conceptual storm plan are preliminary versions of the Drainage Report and the site improvement plans that will be submitted for construction permits and will satisfy Minimum Requirement #1.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPPP)

The SWPPP consists of a narrative and drawings. The narrative will be addressed in Section V of the final version of the Drainage Report. The drawings will include a TESC plan, notes, and details as part of the site development construction plans. The narrative and drawings will be prepared and submitted at time of civil permit application.

Minimum Requirement #3: Source Control of Pollution

A Pollution Source Control Plan will be prepared in conformance with requirements of Section IV of the Manual and will be submitted as a separate document at time of civil permit application.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Currently, drainage from the site sheet flows to the north into 27th Ave SE, then west in the gutter and closed conveyance system. The proposed drainage improvements will connect to this same closed conveyance system to preserve existing drainage systems and outfalls.

Minimum Requirement #5: On-site Stormwater Management

Because the project triggers MR #1-9, and is inside the urban growth area, the project must either meet the Low Impact Development Performance Standard, or use List #2 to determine applicable On-Site Stormwater Management BMPs. This project will use List #2. For each surface the BMP's must be considered in the order listed for that type of surface and use the first BMP that is considered feasible.

Lawn and Landscaped Areas:

- All lawn and landscaped areas will meet the requirements of BMP T5.13, Post Construction Soil Quality and Depth with notes on the plans to this effect.

Roofs:

1. BMP T5.30: Full Dispersion – infeasible due to lack of native vegetation and flowpath length onsite; BMP T5.10A: Downspout Full Infiltration – infeasible based on field tested infiltration rates.
2. Bioretention – infeasible based on field tested infiltration rates
3. BMP T5.10B: Downspout dispersion system – not feasible based on required flowpath lengths
4. BMP T5.10C: Perforated Stub-out connections – will be used for all roof drains.

Other Hard Surfaces:

1. BMP T5.30: Full Dispersion – infeasible due to lack of native vegetation and flowpath length
2. BMP T5.15: Permeable pavement – infeasible based on field tested infiltration rates
3. Bioretention – infeasible based on field tested infiltration rates
4. BMP T5.12: Sheet Flow Dispersion & BMP T5.11: Concentrated Flow Dispersion – infeasible due to lack of flowpath length

Minimum Requirement #6: Runoff Treatment

New plus replaced pollution generating hard surfaces (PGHS) is the parking lot paving. The total area is well over 5,000 square feet and therefore runoff treatment is required. As a multi-family development, enhanced treatment is required. Two methods of enhanced treatment will be used. A Filterra or Biopod system will be used for some areas, and a treatment train of wet-vault followed by filter media (StormFilter with ZPG or equivalent) will be used in other areas.

Minimum Requirement #7: Flow Control

The total new plus replaced hard surface for the project is well over 10,000 sf and therefore flow control is required. Any existing pervious surface to be disturbed is already lawn, and therefore the converted vegetation thresholds are not exceeded, and the minimum requirements do not apply to the pervious areas. To meet this minimum requirement stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50 percent of the 2-year recurrence interval peak flow up to the full 50-year peak flow. Predeveloped condition to be matched shall be forested land cover. Note that the forested land cover only applies to the new and replaced impervious areas since the existing land cover is lawn. Therefore, for the onsite lawn in developed conditions, and offsite tributary areas, the land cover is modeled as in existing conditions, i.e. lawn. See below for hydrologic analysis.

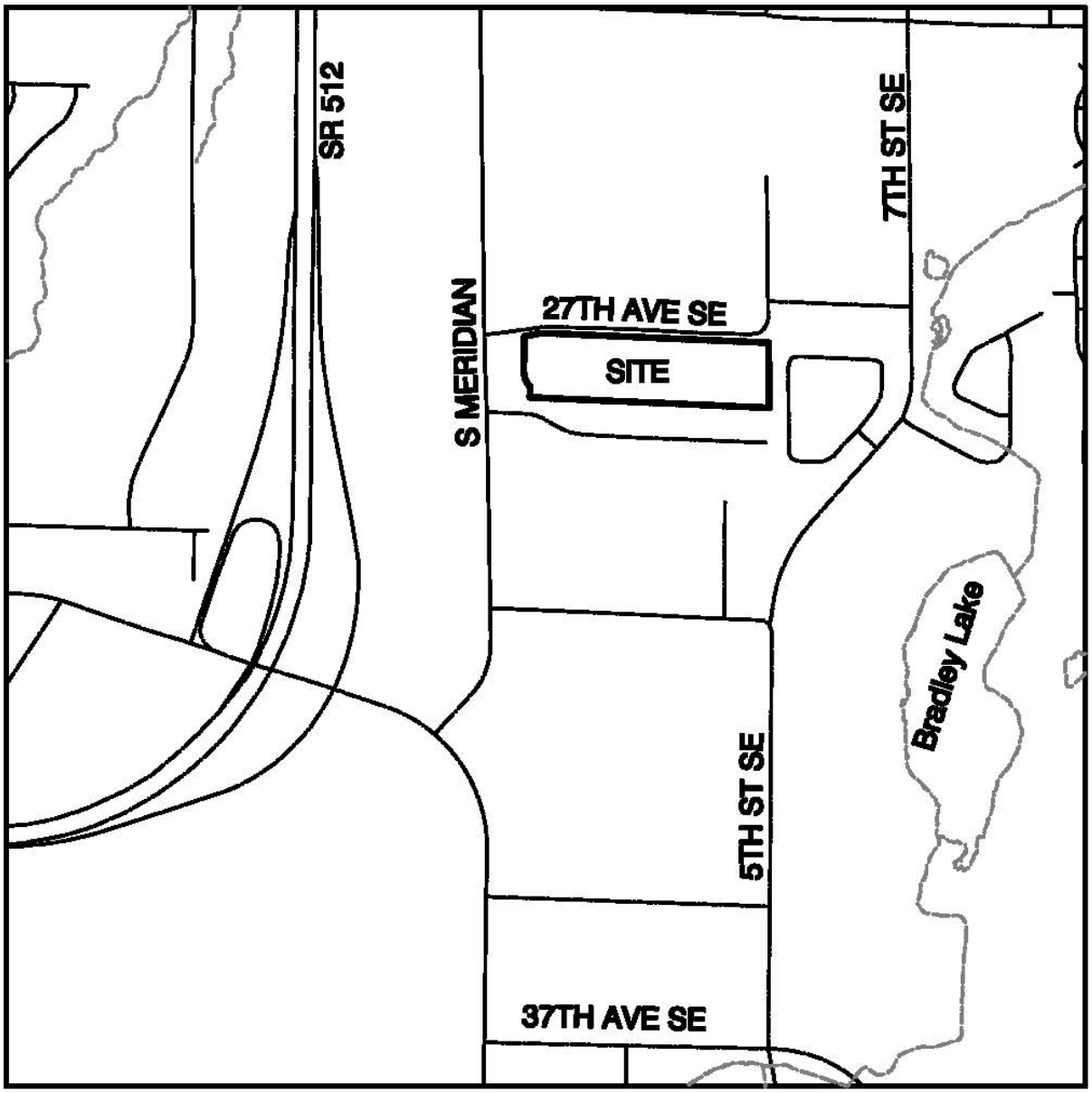
Minimum Requirement #8: Wetlands Protection

There are no wetlands on or near the site..

Minimum Requirement #9: Operation and Maintenance

The stormwater facilities required for this project that require a maintenance plan are: conveyance system, detention vault, flow restrictor, Filterra or Biopod, and Stormfilter manhole. All onsite stormwater facilities will be owned, operated, and maintained by the property owner. An O&M plan will be submitted with civil plan application in the future.

Figure 1. Site Location:



VICINITY MAP

Section II – Existing Conditions Summary

Topography:
In existing conditions the site slopes to the northwest, with slopes generally between 5 and 10%. The steepest portion of the site is 14%, with about 10 feet of fall in the west end of the property.

Ground Cover:
The site is developed as a mobile home park. A drive aisle runs through the site with parking areas for each unit. The non-hard surface areas are covered with lawn and landscaping.

Drainage:
There is no defined drainage course onsite. Any surface runoff that does not infiltrate sheet flows northwest into 27th Ave SE.

Soils:
The NRCS Soil Survey of Pierce County indicates the soils on the majority of the site are Everett gravelly sandy loam (13B & 13C). The soils in the northwest corner of the site are mapped as Kitsap silt loam (20B). Based on the soils exploration performed by GeoResources, the soils vary over site, consisting of recessional outwash, glacial till, and glaciolacustrine soils, generally matching the USDA mapping. Groundwater monitoring was performed during the winter of 2021 with peak groundwater reaching elevation 361.0 on the west end of the site and 383.0 on the east end of the site. The field tested infiltration rate was less than 0.1 inch per hour and therefore infiltration of runoff is deemed infeasible.

Floodplain
The project site does not include a floodplain based on latest FIRM and Pierce County flood data.

Section III – Off-Site Analysis

Upstream

Approximately 2.7 acres immediately south of the site drains onto the site. The drainage area is limited by 28th Ave SE and the drainage system that collects any other upstream runoff. The tributary area is similar in topography to the site and is developed with moderate density single-family lots.

Downstream

From the project site, runoff sheet flows north into 27th Ave SE and is collected in the public closed conveyance system consisting of 12-inch pipe along the project frontage. This system flows west, with pipe size increasing to 24-inch right before connecting in the Meridian conveyance system. The Meridian conveyance system is a 24-inch pipe flowing north for approximately 1150 feet to the ¼ mile downstream point. This point is approximately 400 feet north of 23rd Ave SW

Problems

There are no known drainage problems along this downstream route, the road grade is approximately 8% for several hundred feet of fall.

Section IV – Permanent Stormwater Control Plan

Existing Site Hydrology

In existing conditions, any runoff travels northwesterly across the site as sheet flow and is collected along the frontage in the storm system in 27th Ave SE. The areas that must be considered in the hydrologic analysis are the project site itself, the area within the frontage that will be disturbed, and the offsite tributary area.

Does this capture the road widening also? [Storm Report; Pg 11 of 92]

At time of civil application, document compliance with 2019 Ecology Manual, Vol III, Sec III-2.4 (2014 Manual, Vol. III, Appendix III-B, Section 6) for the Offsite Basin inflow. [Storm Report; Pg 11 of 92]

Drainage Analysis	sf	ac
Project Onsite Area	339103	7.7847
Frontage Area	22426	0.5148
Upstream Trib Area	170871	3.9227
Total	532400	12.2222

Because the offsite tributary runoff will not be bypassed, that area is modeled as in existing conditions. The offsite tributary area is delineated as:

At time of civil application, document compliance with 2019 Ecology Manual, Vol III, Sec III-2.4 (2014 Manual, Vol. III, Appendix III-B, Section 6) for the non-converted lawn areas inflow. [Storm Report; Pg 11 of 92]

Upstream Area	sf	ac
Total Area	170871	3.9227
Driveway	20665	0.4744
Shoulder	2181	0.0501
Roof	27737	0.6368
Patio	4128	0.0948
Total Impervious	54711	1.2560
Lawn	116160	2.6667

Verify-seems small considering the replaced road surface area? [Storm Report; Pg 11 of 92]

Because the existing site is developed, the existing lawn area that will remain as lawn does not need to address the minimum requirements, so that only the new and replaced impervious areas are modeled as forest in pre-developed conditions. This will consist of 9,818 sf of new sidewalk in 27th Ave SE and 268,873 sf of new impervious onsite, for a total of 278,691 sf to be modeled as forest. The resulting breakdown of areas for pre-developed conditions are:

Verify-per Developed conditions only 1.61ac remains unconverted for Onsite, vs. the 1.90 ac indicated here. [Storm Report; Pg 11 of 92]

At time of civil application, provide pre-dev and post-dev basin exhibits with land type areas delineated. [Storm Report; Pg 11 of 92]

PREDEVELOPED	sf	ac
Total Area	532400	12.2222
Pervious		
C, Forest, Mod	278691	6.3979
C, Lawn, Mod	198998	4.5684
Total Pervious	477689	10.9662
Impervious		
Roof	27737	0.6368
Driveways, Flat	20665	0.4744
Sidewalks, Flat	4128	0.0948
Parking, Flat	2181	0.0501
Total Impervious	54711	1.2560

Confirm gage being used with WWHM.
[Storm Report; Pg 12 of 92]

Based on the USDA soil mapping of the site, the soils are a mix of hydrologic group A and C. However, because the tested infiltration rate shows that infiltration is infeasible, the soils are modeled as hydrologic group C. The slopes are moderate. The project site is within the 42-inch, East rainfall zone and WWHM is run with 15-minute intervals. See Appendix A for WWHM analysis.

The peak runoff rates calculated by WWHM2012 for predeveloped conditions are:

```
Flow Frequency     Flow(cfs)  0501 15m
    2 Year   =     0.8161
    5 Year   =     1.2842
    10 Year  =     1.6603
    25 Year  =     2.2177
    50 Year  =     2.6968
    100 Year =     3.2344
```

See comments on Pg 11 of 92 regarding area inflow. [Storm Report; Pg 13 of 92]

Developed Site Hydrology

Drainage Basins

For developed conditions, three basins are used in the WWHM model: onsite, offsite, and frontage. The onsite and offsite basins will be routed through a detention facility for flow control. The onsite basin is delineated for the proposed improvements, the offsite basin is delineated as per existing conditions. The frontage improvements will bypass the detention system and the basin is delineated for proposed improvements. The areas are delineated as follows:

DEVELOPED - TO DETENTION		
Offsite	sf	ac
Pervious		
C, Lawn, Mod	116160	2.6667
Total Pervious	116160	2.6667
Impervious		
Roof	27737	0.6368
Driveways, Flat	20665	0.4744
Sidewalks, Flat	4128	0.0948
Parking, Flat	2181	0.0501
Total Impervious	54711	1.2560
Total Offsite	170871	3.9227
Onsite	sf	ac
Pervious		
C, Lawn, Mod	70230	1.6123
Total Pervious	70230	1.6123
Impervious		
Roof	147873	3.3947
Sidewalks, Flat	15000	0.3444
Parking, Flat	106000	2.4334
Total Impervious	268873	6.1725
Total Onsite	339103	7.7847
Total Onsite+Offsite	509974	11.7074

Does this capture the road widening also? [Storm Report; Pg 14 of 92]

DEVELOPED - BYPASS		
Frontage	sf	ac
Impervious		
Driveways, Flat	909	0.0209
Sidewalks, Flat	9818	0.2254
Total Impervious	10727	0.2463
Pervious		
C, Lawn, Mod	11699	0.2686
Total	22426	0.5148

The peak runoff rates calculated by WWHM2012 for developed conditions (prior to detention) are:

```
Flow Frequency    Flow(cfs)   0701 15m
   2 Year    =     2.9623
   5 Year    =     4.0752
   10 Year   =     4.8996
   25 Year   =     6.0453
   50 Year   =     6.9772
   100 Year  =     7.9789
```

Flow Control

Detention vaults and/or underground lattice structures such as StormTank will be used to meet flow control requirements. To simplify the analysis for this preliminary design, a single vault is used the WWHM model with multiple vaults shown in the preliminary plan meeting the total storage volume required. The final design will model each vault separately to show the project in total meets the flow control requirement. The requirement is that stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50 percent of the 2-year recurrence interval peak flow up to the full 50-year peak flow. The vault is sized with 3 feet of live storage depth with no overflow through the standpipe for flows through the 50-year event. A single orifice, and notched standpipe is used for outlet control. The WWHM analysis shows that a vault with 37,636 sf of area is adequate to provide the required detention volume. Following are the developed flows with data set 801 being total developed flows (vault release plus bypass) and data set 1000 being release from the vault.

```
  Flow Frequency      Flow(cfs)
                   0801 15m    1000 15m
2 Year    =        0.4060      0.3487
5 Year    =        0.5648      0.4908
10 Year   =        0.6959      0.6115
25 Year   =        0.8949      0.7992
50 Year   =        1.0702      0.9682
100 Year  =        1.2711      1.1653
```

The stage of detention in the vault:

```
Frequency         Stage (feet)      1001 15m
   2 Year    =     1.2535
   5 Year    =     1.7276
   10 Year   =     2.0430
   25 Year   =     2.4430
   50 Year   =     2.7422
   100 Year  =     3.0425
```

Runoff Treatment

Because the project is multi-family, enhanced treatment of runoff is required. Multiple types of runoff treatment will be used. Where minimal depth is available, a Filterra, Biopod, or other GULD enhanced treatment device will be used precedent to detention. Where depth is available, a treatment train consisting of combined wetvault/detention vault, followed by StormFilter cartridges with ZPG media will be used.

Conclusions

As explained above, the Minimum Requirements only apply to new and replaced hard surfaces. Drainage from all new and replaced hard surfaces will be routed to detention structures and treatment devices. The analysis shows that the flow control standard can be met.

Section V – Construction Stormwater Pollution Prevention Plan

An SWPPP will be prepared and submitted for this project with the final engineering.

Section VI – Special Reports and Studies

See Geotech report in Appendix B.

Section VII – Other Permits

Building permits will be required for construction of the future buildings.

Section VIII – Operation and Maintenance Manual

An Operations and Maintenance Manual is required for all storm drainage improvements. The O&M Manual will be prepared and submitted with the final engineering.

Section IX – Bond Quantities Worksheet

Any required bond amounts will be calculated when required for permit issuance.

APPENDIX A

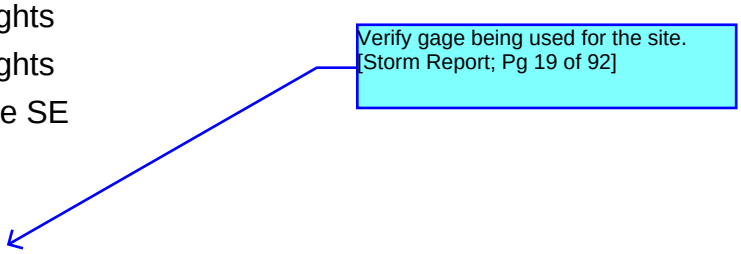
WWHM Analysis

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Bradley Heights
Site Name:	Bradley Heights
Site Address:	202 27th Ave SE
City:	Puyallup
Report Date:	3/30/2022
Gage:	42 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/13
Version:	4.2.17



POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Forest, Mod	6.3979
C, Lawn, Mod	4.5684
Pervious Total	10.9663

Impervious Land Use	acre
ROOF TOPS FLAT	0.6368
DRIVEWAYS FLAT	0.4744
SIDEWALKS FLAT	0.0948
PARKING FLAT	0.0501
Impervious Total	1.2561
Basin Total	12.2224

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Onsite

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Mod	1.6123
Pervious Total	1.6123

Impervious Land Use	acre
ROOF TOPS FLAT	3.3947
SIDEWALKS FLAT	0.3444
PARKING FLAT	2.4334
Impervious Total	6.1725
Basin Total	7.7848

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Offsite

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Mod	2.6667
Pervious Total	2.6667

Impervious Land Use	acre
ROOF TOPS FLAT	0.6368
DRIVEWAYS FLAT	0.4744
SIDEWALKS FLAT	0.0948
PARKING FLAT	0.0501
Impervious Total	1.2561
Basin Total	3.9228

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Frontage

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Mod	0.5148
Pervious Total	0.5148

Impervious Land Use	acre
DRIVEWAYS FLAT	0.0209
SIDEWALKS FLAT	0.2254
Impervious Total	0.2463
Basin Total	0.7611

At time of civil application, verify-Basin total w Pg 11. [Storm Report; Pg 23 of 92]

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

Width: 194 ft.
Length: 194 ft.
Depth: 4 ft.
Discharge Structure
Riser Height: 3 ft.
Riser Diameter: 12 in.
Notch Type: Rectangular
Notch Width: 0.500 ft.
Notch Height: 1.000 ft.
Orifice 1 Diameter: 3.375 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

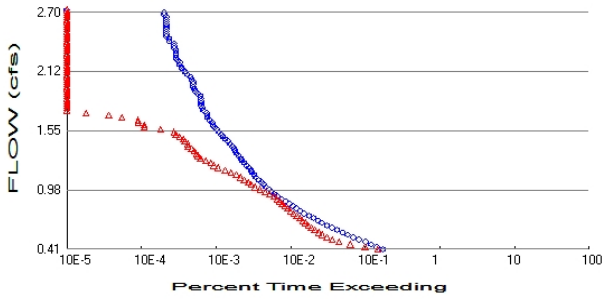
Vault Hydraulic Table

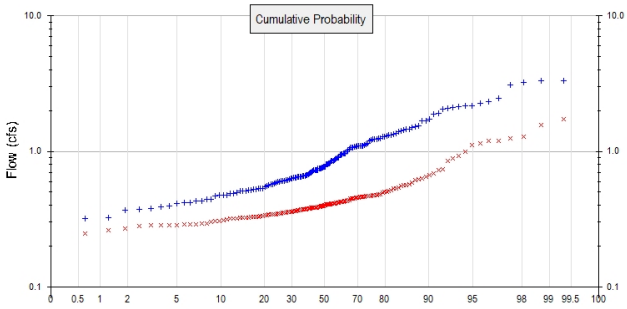
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.864	0.000	0.000	0.000
0.0444	0.864	0.038	0.065	0.000
0.0889	0.864	0.076	0.092	0.000
0.1333	0.864	0.115	0.112	0.000
0.1778	0.864	0.153	0.130	0.000
0.2222	0.864	0.192	0.145	0.000
0.2667	0.864	0.230	0.159	0.000
0.3111	0.864	0.268	0.172	0.000
0.3556	0.864	0.307	0.184	0.000
0.4000	0.864	0.345	0.195	0.000
0.4444	0.864	0.384	0.206	0.000
0.4889	0.864	0.422	0.216	0.000
0.5333	0.864	0.460	0.225	0.000
0.5778	0.864	0.499	0.235	0.000
0.6222	0.864	0.537	0.243	0.000
0.6667	0.864	0.576	0.252	0.000
0.7111	0.864	0.614	0.260	0.000
0.7556	0.864	0.652	0.268	0.000
0.8000	0.864	0.691	0.276	0.000
0.8444	0.864	0.729	0.284	0.000
0.8889	0.864	0.768	0.291	0.000
0.9333	0.864	0.806	0.298	0.000
0.9778	0.864	0.844	0.305	0.000
1.0222	0.864	0.883	0.312	0.000
1.0667	0.864	0.921	0.319	0.000
1.1111	0.864	0.960	0.325	0.000
1.1556	0.864	0.998	0.332	0.000
1.2000	0.864	1.036	0.338	0.000
1.2444	0.864	1.075	0.344	0.000
1.2889	0.864	1.113	0.350	0.000
1.3333	0.864	1.152	0.356	0.000
1.3778	0.864	1.190	0.362	0.000
1.4222	0.864	1.228	0.368	0.000
1.4667	0.864	1.267	0.374	0.000
1.5111	0.864	1.305	0.380	0.000
1.5556	0.864	1.344	0.385	0.000
1.6000	0.864	1.382	0.391	0.000

1.6444	0.864	1.420	0.396	0.000
1.6889	0.864	1.459	0.401	0.000
1.7333	0.864	1.497	0.407	0.000
1.7778	0.864	1.536	0.412	0.000
1.8222	0.864	1.574	0.417	0.000
1.8667	0.864	1.612	0.422	0.000
1.9111	0.864	1.651	0.427	0.000
1.9556	0.864	1.689	0.432	0.000
2.0000	0.864	1.728	0.437	0.000
2.0444	0.864	1.766	0.457	0.000
2.0889	0.864	1.804	0.490	0.000
2.1333	0.864	1.843	0.532	0.000
2.1778	0.864	1.881	0.581	0.000
2.2222	0.864	1.920	0.635	0.000
2.2667	0.864	1.958	0.694	0.000
2.3111	0.864	1.996	0.758	0.000
2.3556	0.864	2.035	0.827	0.000
2.4000	0.864	2.073	0.900	0.000
2.4444	0.864	2.112	0.976	0.000
2.4889	0.864	2.150	1.056	0.000
2.5333	0.864	2.188	1.140	0.000
2.5778	0.864	2.227	1.227	0.000
2.6222	0.864	2.265	1.317	0.000
2.6667	0.864	2.304	1.411	0.000
2.7111	0.864	2.342	1.507	0.000
2.7556	0.864	2.380	1.606	0.000
2.8000	0.864	2.419	1.708	0.000
2.8444	0.864	2.457	1.813	0.000
2.8889	0.864	2.496	1.920	0.000
2.9333	0.864	2.534	2.030	0.000
2.9778	0.864	2.572	2.143	0.000
3.0222	0.864	2.611	2.237	0.000
3.0667	0.864	2.649	2.388	0.000
3.1111	0.864	2.688	2.600	0.000
3.1556	0.864	2.726	2.851	0.000
3.2000	0.864	2.764	3.125	0.000
3.2444	0.864	2.803	3.405	0.000
3.2889	0.864	2.841	3.673	0.000
3.3333	0.864	2.880	3.912	0.000
3.3778	0.864	2.918	4.112	0.000
3.4222	0.864	2.956	4.266	0.000
3.4667	0.864	2.995	4.378	0.000
3.5111	0.864	3.033	4.495	0.000
3.5556	0.864	3.072	4.595	0.000
3.6000	0.864	3.110	4.691	0.000
3.6444	0.864	3.148	4.783	0.000
3.6889	0.864	3.187	4.872	0.000
3.7333	0.864	3.225	4.959	0.000
3.7778	0.864	3.264	5.043	0.000
3.8222	0.864	3.302	5.125	0.000
3.8667	0.864	3.340	5.205	0.000
3.9111	0.864	3.379	5.282	0.000
3.9556	0.864	3.417	5.358	0.000
4.0000	0.864	3.456	5.432	0.000
4.0444	0.864	3.494	5.505	0.000
4.0889	0.000	0.000	5.576	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 10.9663
Total Impervious Area: 1.2561

Mitigated Landuse Totals for POC #1
Total Pervious Area: 4.7938
Total Impervious Area: 7.6749

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.816099
5 year	1.284175
10 year	1.660335
25 year	2.217657
50 year	2.696761
100 year	3.234421

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.406026
5 year	0.564786
10 year	0.695897
25 year	0.894915
50 year	1.070176
100 year	1.271139

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.615	0.416
1903	0.657	0.325
1904	1.907	0.465
1905	0.498	0.415
1906	0.370	0.268
1907	1.205	0.485
1908	0.672	0.344
1909	0.770	0.409
1910	1.227	0.461
1911	0.961	0.368

1912	3.325	0.650
1913	0.658	0.477
1914	3.300	0.685
1915	0.514	0.364
1916	0.849	0.379
1917	0.302	0.291
1918	0.570	0.408
1919	0.526	0.392
1920	0.857	0.352
1921	0.752	0.409
1922	1.335	0.467
1923	0.760	0.405
1924	0.708	0.317
1925	0.441	0.329
1926	0.717	0.389
1927	0.486	0.330
1928	0.627	0.332
1929	1.249	0.470
1930	0.817	0.346
1931	0.603	0.357
1932	0.643	0.360
1933	0.724	0.432
1934	1.669	0.562
1935	0.523	0.375
1936	0.726	0.375
1937	1.309	0.502
1938	0.584	0.385
1939	0.427	0.293
1940	0.874	0.384
1941	0.754	0.294
1942	1.286	0.853
1943	0.808	0.381
1944	1.726	1.115
1945	0.768	0.419
1946	0.956	0.319
1947	0.419	0.355
1948	1.091	0.573
1949	1.094	0.884
1950	0.418	0.314
1951	0.618	0.322
1952	2.456	1.286
1953	2.107	1.194
1954	0.686	0.361
1955	0.394	0.324
1956	0.326	0.244
1957	0.582	0.414
1958	1.513	1.254
1959	1.320	0.587
1960	0.476	0.345
1961	2.154	0.552
1962	0.701	0.383
1963	0.376	0.321
1964	2.180	0.471
1965	1.076	0.537
1966	0.560	0.349
1967	1.221	0.372
1968	0.650	0.426
1969	0.699	0.368

1970	1.085	0.437
1971	1.145	0.740
1972	3.087	0.671
1973	1.197	0.731
1974	1.100	0.408
1975	2.079	0.610
1976	1.668	0.424
1977	0.390	0.281
1978	1.466	0.510
1979	0.911	0.374
1980	1.235	0.379
1981	0.731	0.387
1982	0.533	0.325
1983	1.117	0.534
1984	1.020	0.380
1985	1.465	0.430
1986	0.630	0.396
1987	1.411	0.999
1988	0.597	0.396
1989	0.602	0.388
1990	0.831	0.425
1991	1.034	0.390
1992	0.992	0.403
1993	0.731	0.419
1994	1.062	0.505
1995	0.506	0.312
1996	1.249	0.929
1997	0.647	0.341
1998	1.091	0.436
1999	0.554	0.262
2000	0.771	0.380
2001	0.514	0.304
2002	2.058	0.519
2003	0.798	0.466
2004	0.946	0.414
2005	2.331	0.530
2006	0.593	0.303
2007	0.963	0.457
2008	0.849	0.383
2009	0.551	0.327
2010	0.608	0.464
2011	0.443	0.283
2012	0.724	0.457
2013	0.849	0.329
2014	0.657	0.289
2015	1.894	0.425
2016	0.477	0.285
2017	0.897	0.624
2018	1.446	1.571
2019	2.135	1.732
2020	1.134	0.352
2021	0.903	0.447
2022	1.093	0.348
2023	0.970	0.407
2024	3.203	0.627
2025	0.530	0.430
2026	1.066	0.477
2027	0.666	0.355

2028	0.318	0.289
2029	0.752	0.372
2030	1.289	0.496
2031	0.373	0.306
2032	0.411	0.247
2033	0.474	0.287
2034	0.491	0.399
2035	1.367	1.150
2036	0.752	0.411
2037	0.508	0.331
2038	1.318	0.472
2039	1.061	0.384
2040	0.644	0.340
2041	0.748	0.342
2042	1.387	1.191
2043	0.935	0.484
2044	0.884	0.455
2045	0.645	0.370
2046	0.648	0.446
2047	0.530	0.356
2048	0.508	0.393
2049	0.816	0.416
2050	0.802	0.338
2051	1.538	0.562
2052	0.469	0.410
2053	0.617	0.449
2054	2.250	0.464
2055	0.639	0.285
2056	0.678	0.343
2057	0.433	0.383
2058	0.573	0.365
2059	1.494	0.452

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	3.3249	1.7324
2	3.3003	1.5706
3	3.2026	1.2863
4	3.0868	1.2542
5	2.4565	1.1940
6	2.3311	1.1909
7	2.2505	1.1500
8	2.1799	1.1155
9	2.1543	0.9995
10	2.1351	0.9295
11	2.1071	0.8841
12	2.0787	0.8534
13	2.0576	0.7402
14	1.9073	0.7310
15	1.8944	0.6851
16	1.7259	0.6713
17	1.6685	0.6500
18	1.6682	0.6266
19	1.5376	0.6244
20	1.5126	0.6097
21	1.4935	0.5871
22	1.4659	0.5725

23	1.4647	0.5617
24	1.4462	0.5616
25	1.4114	0.5517
26	1.3874	0.5367
27	1.3666	0.5340
28	1.3351	0.5304
29	1.3201	0.5193
30	1.3178	0.5105
31	1.3089	0.5045
32	1.2895	0.5019
33	1.2864	0.4960
34	1.2490	0.4847
35	1.2489	0.4840
36	1.2345	0.4770
37	1.2269	0.4769
38	1.2214	0.4724
39	1.2054	0.4713
40	1.1973	0.4696
41	1.1455	0.4673
42	1.1336	0.4658
43	1.1170	0.4650
44	1.1000	0.4643
45	1.0937	0.4636
46	1.0927	0.4613
47	1.0911	0.4572
48	1.0909	0.4568
49	1.0855	0.4555
50	1.0762	0.4517
51	1.0655	0.4489
52	1.0622	0.4469
53	1.0607	0.4458
54	1.0341	0.4365
55	1.0196	0.4356
56	0.9919	0.4316
57	0.9696	0.4304
58	0.9633	0.4298
59	0.9610	0.4263
60	0.9558	0.4252
61	0.9463	0.4246
62	0.9353	0.4241
63	0.9113	0.4190
64	0.9033	0.4190
65	0.8969	0.4163
66	0.8836	0.4158
67	0.8743	0.4149
68	0.8571	0.4141
69	0.8493	0.4138
70	0.8488	0.4108
71	0.8486	0.4100
72	0.8306	0.4088
73	0.8167	0.4086
74	0.8163	0.4079
75	0.8080	0.4078
76	0.8017	0.4067
77	0.7980	0.4049
78	0.7710	0.4027
79	0.7701	0.3993
80	0.7678	0.3962

81	0.7596	0.3956
82	0.7540	0.3935
83	0.7524	0.3924
84	0.7519	0.3899
85	0.7517	0.3894
86	0.7478	0.3880
87	0.7312	0.3867
88	0.7310	0.3851
89	0.7260	0.3842
90	0.7243	0.3840
91	0.7242	0.3831
92	0.7172	0.3828
93	0.7085	0.3827
94	0.7008	0.3815
95	0.6986	0.3800
96	0.6859	0.3797
97	0.6775	0.3787
98	0.6721	0.3786
99	0.6659	0.3753
100	0.6580	0.3746
101	0.6573	0.3736
102	0.6567	0.3725
103	0.6504	0.3722
104	0.6478	0.3701
105	0.6469	0.3683
106	0.6446	0.3676
107	0.6438	0.3650
108	0.6435	0.3635
109	0.6391	0.3609
110	0.6304	0.3599
111	0.6270	0.3572
112	0.6177	0.3557
113	0.6165	0.3553
114	0.6155	0.3547
115	0.6075	0.3522
116	0.6027	0.3516
117	0.6018	0.3492
118	0.5969	0.3476
119	0.5927	0.3462
120	0.5841	0.3450
121	0.5817	0.3436
122	0.5733	0.3432
123	0.5697	0.3420
124	0.5602	0.3411
125	0.5538	0.3398
126	0.5505	0.3382
127	0.5330	0.3316
128	0.5302	0.3310
129	0.5297	0.3295
130	0.5260	0.3291
131	0.5231	0.3289
132	0.5137	0.3268
133	0.5135	0.3255
134	0.5082	0.3247
135	0.5077	0.3244
136	0.5064	0.3217
137	0.4979	0.3212
138	0.4915	0.3193

139	0.4861	0.3172
140	0.4768	0.3144
141	0.4760	0.3123
142	0.4743	0.3057
143	0.4693	0.3042
144	0.4426	0.3035
145	0.4411	0.2935
146	0.4326	0.2935
147	0.4271	0.2911
148	0.4190	0.2888
149	0.4181	0.2886
150	0.4109	0.2867
151	0.3935	0.2850
152	0.3898	0.2846
153	0.3764	0.2834
154	0.3725	0.2812
155	0.3701	0.2681
156	0.3257	0.2622
157	0.3178	0.2474
158	0.3017	0.2438

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.4080	9474	8088	85	Pass
0.4312	7911	5456	68	Pass
0.4543	6587	3482	52	Pass
0.4774	5512	2445	44	Pass
0.5005	4578	1993	43	Pass
0.5236	3831	1698	44	Pass
0.5468	3235	1462	45	Pass
0.5699	2751	1321	48	Pass
0.5930	2302	1161	50	Pass
0.6161	1958	1045	53	Pass
0.6392	1684	949	56	Pass
0.6624	1462	866	59	Pass
0.6855	1281	800	62	Pass
0.7086	1120	730	65	Pass
0.7317	970	665	68	Pass
0.7548	835	608	72	Pass
0.7779	740	550	74	Pass
0.8011	651	497	76	Pass
0.8242	584	462	79	Pass
0.8473	528	425	80	Pass
0.8704	474	396	83	Pass
0.8935	420	361	85	Pass
0.9167	368	330	89	Pass
0.9398	333	288	86	Pass
0.9629	302	250	82	Pass
0.9860	285	216	75	Pass
1.0091	259	184	71	Pass
1.0322	238	164	68	Pass
1.0554	222	149	67	Pass
1.0785	205	131	63	Pass
1.1016	190	117	61	Pass
1.1247	180	103	57	Pass
1.1478	168	88	52	Pass
1.1710	162	73	45	Pass
1.1941	152	59	38	Pass
1.2172	141	52	36	Pass
1.2403	131	47	35	Pass
1.2634	123	40	32	Pass
1.2865	119	34	28	Pass
1.3097	111	32	28	Pass
1.3328	106	30	28	Pass
1.3559	100	28	28	Pass
1.3790	96	26	27	Pass
1.4021	91	23	25	Pass
1.4253	85	23	27	Pass
1.4484	79	21	26	Pass
1.4715	73	20	27	Pass
1.4946	68	18	26	Pass
1.5177	65	16	24	Pass
1.5408	60	15	25	Pass
1.5640	56	10	17	Pass
1.5871	53	6	11	Pass
1.6102	50	6	12	Pass

1.6333	49	5	10	Pass
1.6564	45	5	11	Pass
1.6796	42	3	7	Pass
1.7027	42	2	4	Pass
1.7258	41	1	2	Pass
1.7489	37	0	0	Pass
1.7720	36	0	0	Pass
1.7951	35	0	0	Pass
1.8183	35	0	0	Pass
1.8414	35	0	0	Pass
1.8645	35	0	0	Pass
1.8876	34	0	0	Pass
1.9107	31	0	0	Pass
1.9339	29	0	0	Pass
1.9570	28	0	0	Pass
1.9801	27	0	0	Pass
2.0032	27	0	0	Pass
2.0263	27	0	0	Pass
2.0494	26	0	0	Pass
2.0726	25	0	0	Pass
2.0957	23	0	0	Pass
2.1188	21	0	0	Pass
2.1419	20	0	0	Pass
2.1650	19	0	0	Pass
2.1882	18	0	0	Pass
2.2113	18	0	0	Pass
2.2344	17	0	0	Pass
2.2575	16	0	0	Pass
2.2806	16	0	0	Pass
2.3037	16	0	0	Pass
2.3269	16	0	0	Pass
2.3500	15	0	0	Pass
2.3731	15	0	0	Pass
2.3962	15	0	0	Pass
2.4193	13	0	0	Pass
2.4425	13	0	0	Pass
2.4656	12	0	0	Pass
2.4887	12	0	0	Pass
2.5118	12	0	0	Pass
2.5349	12	0	0	Pass
2.5581	12	0	0	Pass
2.5812	12	0	0	Pass
2.6043	12	0	0	Pass
2.6274	12	0	0	Pass
2.6505	12	0	0	Pass
2.6736	11	0	0	Pass
2.6968	11	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.9456 acre-feet
On-line facility target flow:	1.1501 cfs.
Adjusted for 15 min:	1.1501 cfs.
Off-line facility target flow:	0.6622 cfs.
Adjusted for 15 min:	0.6622 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault 1 POC	☐	3866.31			☐	0.00			
Total Volume Infiltrated		3866.31	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

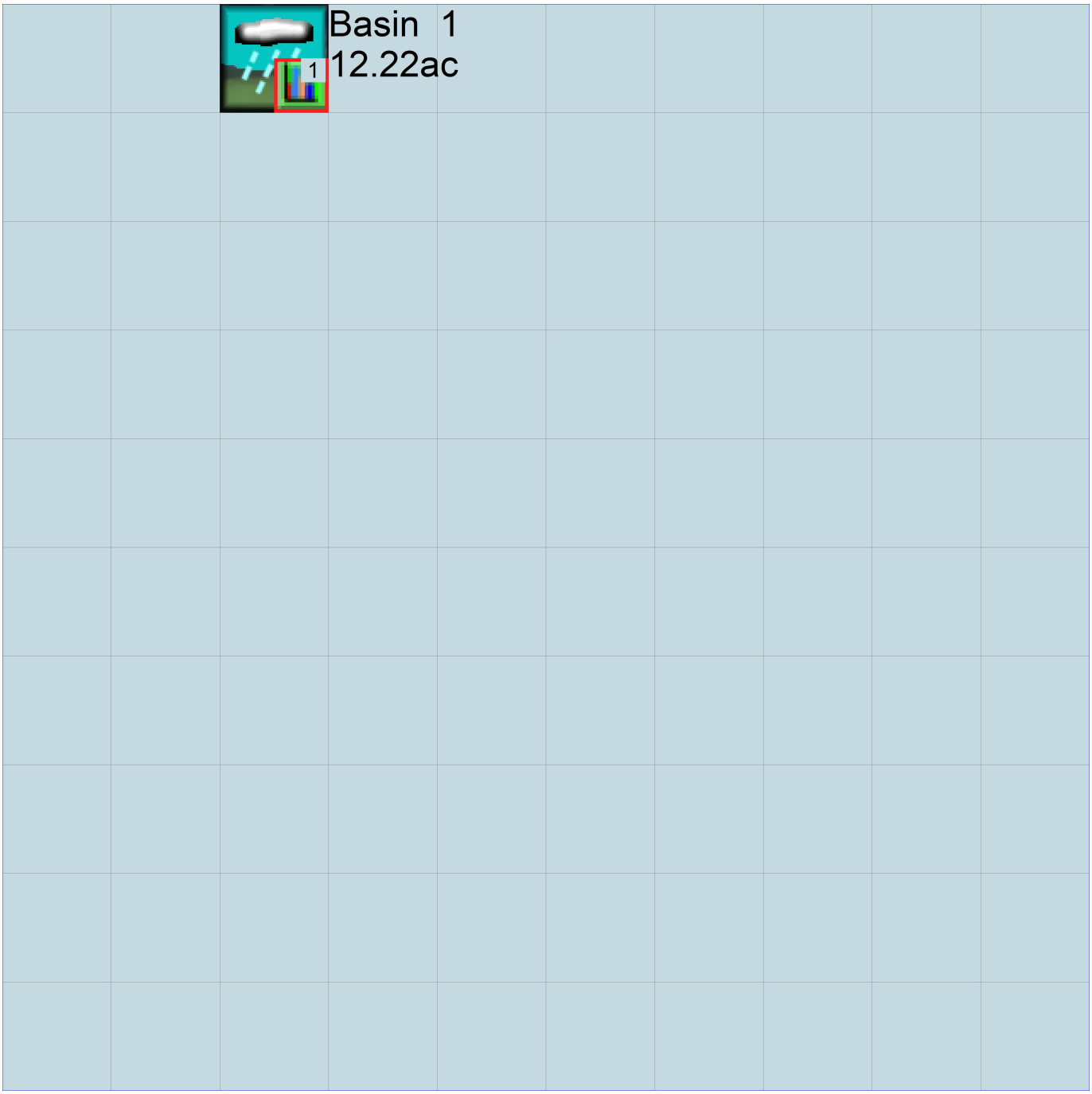
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Bradley Heights.wdm
MESSU       25   PreBradley Heights.MES
            27   PreBradley Heights.L61
            28   PreBradley Heights.L62
            30   POCBradley Heights1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      17
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
   17     C, Lawn, Mod            1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11         0    0    0    0    0    0    0    0    0    0    0
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11              0       4.5      0.08       400       0.1       0.5     0.996
   17              0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11              0         0         2         2         0         0         0
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                          ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11          0.2       0.5      0.35         6       0.5       0.7
   17          0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   11              0         0         0         0       2.5         1         0
   17              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
  END ACTIVITY

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

```
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  11                     6.3979     COPY   501     12
PERLND  11                     6.3979     COPY   501     13
PERLND  17                     4.5684     COPY   501     12
PERLND  17                     4.5684     COPY   501     13
IMPLND   4                     0.6368     COPY   501     15
IMPLND   5                     0.4744     COPY   501     15
IMPLND   8                     0.0948     COPY   501     15
IMPLND  11                     0.0501     COPY   501     15

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

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

END EXT SOURCES

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

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

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

  MASS-LINK       15
```

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

END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Bradley Heights.wdm
MESSU       25   MitBradley Heights.MES
            27   MitBradley Heights.L61
            28   MitBradley Heights.L62
            30   POCBradley Heights1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      17
      IMPLND       4
      IMPLND       8
      IMPLND      11
      IMPLND       5
      RCHRES       1
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  1                    MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   17     C, Lawn, Mod            1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

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

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

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

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   17              0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   17            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   17              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    8              0         0
   11              0         0
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    8              0         0
   11              0         0
    5              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Onsite***
PERLND  17                     1.6123     RCHRES   1      2
PERLND  17                     1.6123     RCHRES   1      3
IMPLND   4                     3.3947     RCHRES   1      5
IMPLND   8                     0.3444     RCHRES   1      5
IMPLND  11                     2.4334     RCHRES   1      5
Offsite***
PERLND  17                     2.6667     RCHRES   1      2
PERLND  17                     2.6667     RCHRES   1      3
IMPLND   4                     0.6368     RCHRES   1      5
IMPLND   5                     0.4744     RCHRES   1      5
IMPLND   8                     0.0948     RCHRES   1      5
IMPLND  11                     0.0501     RCHRES   1      5
Frontage***
PERLND  17                     0.5148     COPY   501     12
PERLND  17                     0.5148     COPY   601     12
PERLND  17                     0.5148     COPY   501     13
PERLND  17                     0.5148     COPY   601     13
IMPLND   5                     0.0209     COPY   501     15
IMPLND   5                     0.0209     COPY   601     15
IMPLND   8                     0.2254     COPY   501     15
IMPLND   8                     0.2254     COPY   601     15

******Routing******
PERLND  17                     1.6123     COPY     1     12
IMPLND   4                     3.3947     COPY     1     15
IMPLND   8                     0.3444     COPY     1     15
IMPLND  11                     2.4334     COPY     1     15
PERLND  17                     1.6123     COPY     1     13
```

```
PERLND  17                      2.6667     COPY     1     12
IMPLND   4                     0.6368     COPY     1     15
IMPLND   5                     0.4744     COPY     1     15
IMPLND   8                     0.0948     COPY     1     15
IMPLND  11                     0.0501     COPY     1     15
PERLND  17                     2.6667     COPY     1     13
RCHRES   1                          1     COPY   501     16
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                       in  out                               ***
    1     Vault  1               1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *      *  *  *  *  *         ***
    1       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
    1             1      0.04       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
```

0.000000	0.864004	0.000000	0.000000
0.044444	0.864004	0.038400	0.065165
0.088889	0.864004	0.076800	0.092157
0.133333	0.864004	0.115200	0.112869
0.177778	0.864004	0.153601	0.130330
0.222222	0.864004	0.192001	0.145714
0.266667	0.864004	0.230401	0.159621
0.311111	0.864004	0.268801	0.172411
0.355556	0.864004	0.307201	0.184315
0.400000	0.864004	0.345601	0.195495
0.444444	0.864004	0.384002	0.206070
0.488889	0.864004	0.422402	0.216128
0.533333	0.864004	0.460802	0.225739
0.577778	0.864004	0.499202	0.234956
0.622222	0.864004	0.537602	0.243825
0.666667	0.864004	0.576002	0.252383
0.711111	0.864004	0.614403	0.260660
0.755556	0.864004	0.652803	0.268683
0.800000	0.864004	0.691203	0.276472
0.844444	0.864004	0.729603	0.284048
0.888889	0.864004	0.768003	0.291427
0.933333	0.864004	0.806403	0.298624
0.977778	0.864004	0.844804	0.305651
1.022222	0.864004	0.883204	0.312521
1.066667	0.864004	0.921604	0.319242
1.111111	0.864004	0.960004	0.325825
1.155556	0.864004	0.998404	0.332278
1.200000	0.864004	1.036804	0.338608
1.244444	0.864004	1.075205	0.344821
1.288889	0.864004	1.113605	0.350925
1.333333	0.864004	1.152005	0.356924
1.377778	0.864004	1.190405	0.362824
1.422222	0.864004	1.228805	0.368629
1.466667	0.864004	1.267205	0.374345
1.511111	0.864004	1.305606	0.379975
1.555556	0.864004	1.344006	0.385522
1.600000	0.864004	1.382406	0.390991
1.644444	0.864004	1.420806	0.396384
1.688889	0.864004	1.459206	0.401705
1.733333	0.864004	1.497606	0.406956
1.777778	0.864004	1.536007	0.412140
1.822222	0.864004	1.574407	0.417260
1.866667	0.864004	1.612807	0.422318
1.911111	0.864004	1.651207	0.427316
1.955556	0.864004	1.689607	0.432256
2.000000	0.864004	1.728007	0.437141
2.044444	0.864004	1.766408	0.457572
2.088889	0.864004	1.804808	0.490874
2.133333	0.864004	1.843208	0.532540
2.177778	0.864004	1.881608	0.580960
2.222222	0.864004	1.920008	0.635206
2.266667	0.864004	1.958408	0.694652
2.311111	0.864004	1.996808	0.758839
2.355556	0.864004	2.035209	0.827410
2.400000	0.864004	2.073609	0.900079
2.444444	0.864004	2.112009	0.976611
2.488889	0.864004	2.150409	1.056805
2.533333	0.864004	2.188809	1.140489
2.577778	0.864004	2.227209	1.227515
2.622222	0.864004	2.265610	1.317750
2.666667	0.864004	2.304010	1.411078
2.711111	0.864004	2.342410	1.507392
2.755556	0.864004	2.380810	1.606598
2.800000	0.864004	2.419210	1.708609
2.844444	0.864004	2.457610	1.813346
2.888889	0.864004	2.496011	1.920735
2.933333	0.864004	2.534411	2.030710
2.977778	0.864004	2.572811	2.143209
3.022222	0.864004	2.611211	2.237512
3.066667	0.864004	2.649611	2.388536

```
  3.111111  0.864004  2.688011  2.600049
  3.155556  0.864004  2.726412  2.851412
  3.200000  0.864004  2.764812  3.125620
  3.244444  0.864004  2.803212  3.405330
  3.288889  0.864004  2.841612  3.673066
  3.333333  0.864004  2.880012  3.912814
  3.377778  0.864004  2.918412  4.112366
  3.422222  0.864004  2.956813  4.266210
  3.466667  0.864004  2.995213  4.378849
  3.511111  0.864004  3.033613  4.495935
  3.555556  0.864004  3.072013  4.595450
  3.600000  0.864004  3.110413  4.691179
  3.644444  0.864004  3.148813  4.783533
  3.688889  0.864004  3.187214  4.872854
  3.733333  0.864004  3.225614  4.959430
  3.777778  0.864004  3.264014  5.043505
  3.822222  0.864004  3.302414  5.125290
  3.866667  0.864004  3.340814  5.204966
  3.911111  0.864004  3.379214  5.282692
  3.955556  0.864004  3.417615  5.358609
  4.000000  0.864004  3.456015  5.432840
  4.044444  0.864004  3.494415  5.505496
  END FTABLE  1
END FTABLES

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

END EXT SOURCES

EXT TARGETS
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<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
END EXT TARGETS

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  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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

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

```
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX B

Geotechnical Report

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February 10, 2022

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Geotechnical Engineering Report
Proposed Multi-Family Development
202 – 27th Avenue Southeast
Puyallup, Washington
PN: 0419036006
Doc ID: Timberlane.BradleyHeights.RG

INTRODUCTION

This *geotechnical engineering report* summarizes our site observations, subsurface explorations, laboratory testing and engineering analyses, and provides geotechnical recommendations and design criteria for the proposed multi-story, multi-family residential development to be located at 202 – 27th Avenue Southeast in the City of Puyallup within Pierce County, Washington. The development is proposed to be on one Pierce County tax parcel, numbered 0419036006. The site is currently in use as a trailer park with multiple single-family trailers and access road. The general location of the site is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our discussions with you, a review of the *Conceptual Site Plan* provided to us by Azure Green Consultants (attached as our Figure 2), our subsurface explorations, including those completed during our most recent December 22, 2021 site visit, and our experience in the general area.

We understand that the proposed development will include the construction of 12 multi-family residential structures and one clubhouse building. We anticipate the structures will range from one to three stories and will be supported by conventional spread footings. Additional development will include paved drive lanes and parking areas, a below-grade stormwater facility, and associated typical below grade utilities.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and design criteria for the proposed development. Specifically, the scope of services for this project will include the following:

1. Reviewed available geological, hydrogeological, and geotechnical literature for the site area;

2. Monitoring the drilling of three hollow-stem auger borings to depths of about 21 feet below existing grades and completed as groundwater observation wells;
3. Describing surface and subsurface conditions, including soil type, and depth to groundwater;
4. Performing one Small Scale (PIT) at a location and elevation determined and approved by the project civil engineer;
5. Providing seismic design parameters, including 2018 IBC site class;
6. Providing geotechnical conclusions and recommendations regarding site grading activities, including site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut slopes and drainage and erosion control measures;
7. Providing recommendations for the design and construction of shallow foundations and slabs-on-grade including bearing capacity and subgrade modulus as appropriate;
8. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2012 (with 2014 updates) Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW);
9. Providing recommendations for erosion and sediment control during wet weather grading and construction;
10. Preparing this written *Geotechnical Engineering Report* summarizing our site observations and conclusions, and our geotechnical recommendations and design criteria, along with the supporting data; and,
11. Monitoring groundwater levels on a monthly basis during the prescribed wet season and prepare a written report addendum summarizing the collected data.
12. Provided a design infiltration rate based on in-situ testing, as applicable; and,
13. Updated our preliminary *Geotechnical Engineering Report*, summarized our site observations and conclusions, our geotechnical recommendations and design criteria, along with supporting data.

The above scope of work was summarized in our Proposal for Geotechnical Engineering Services dated December 3, 2021. We received authorization from Mr. David R. Enslow the same day.

SITE CONDITIONS

Surface Conditions

The site is located at 202 – 27th Avenue Southeast in Puyallup, Washington (PN: 0419036006), within an area of existing residential development. The site is generally rectangular in shape, measures approximately 1,115 to 1,130 feet wide (east to west) by 300 feet long (north to south), and encompasses about 7.78 acres. The site is bounded by residential development to the south, east, and west, and by 27th Avenue Southeast to the north.

The site generally slopes gently down from southeast to northwest towards the intersection of 27th Avenue Southeast and South Meridian. The southeastern and south-central portions of the site slope down at approximately 3 to 5 percent, while the north-central and southwestern portions of the site slope down to the northwest at approximately 7 to 10 percent, with localized slopes of approximately 20 to 22 percent located in the southwestern corner of the site. The northwestern corner of the site slopes down to 27th Avenue Southeast at approximately 2 to 4 percent. The total topographic

relief across the site is on the order of 48 to 50 feet.

Vegetation across the site generally consists of typical residential landscaping and grass lawn areas with occasional coniferous and deciduous trees along the site perimeter and scattered within the existing lots. No areas of erosion or slope instability were noted at the site at the time of our reconnaissance.

Site Soils

The USDA Natural Resource Conservation Survey (NRCS) Web Soil Survey maps most of the site, including the areas of proposed development, as being underlain by Everett gravelly sandy loam (13B and 13C). An area in the northwestern portion of the site is mapped as being underlain by Kitsap silt loam (20B). An excerpt from the NRCS soils map for the site area is included as Figure 3. These soils are described below.

- Everett very gravelly sandy loam (13B, 13C): The Everett soils are typically derived from sandy and gravelly glacial outwash and form on slopes of 0 to 8 (13B) and 8 to 15 (13C) percent. These soils are listed as having a "slight" (13B) and "moderate," (13C) erosion hazard when exposed, and are included in hydrologic soils group A.

- Kitsap Silt Loam (20B): The Kitsap soils are derived from glaciolacustrine deposits, form on slopes of 2 to 8 percent, are listed as having a "slight to moderate" erosion hazard, and are included in hydrologic soils group C/D.

Site Geology

The draft *Geologic Map of the Puyallup 7.5-minute Quadrangle, Washington* by K. W. Troost (in review) maps the site as being underlain by recessional outwash ($Qvsb_4$) and adjacent to areas mapped as underlain by recessional lacustrine deposits (Qvrl). These glacial soils were deposited during near the end of the Vashon Stade of the Fraser Glaciation, approximately 12,000 to 15,000 years ago. An excerpt of the above reference geologic map is attached as Figure 3. Description of the geologic units is provided below.

- Recessional Outwash ($Qvsb_4$): Recessional outwash deposits typically consist of a poorly sorted, lightly to moderately stratified mixture of sand and gravel that may locally contain silt or clay. Recessional outwash was deposited by meltwater streams issuing from the receding continental ice mass. Accordingly, they are considered normally consolidated and offer moderate strength properties where undisturbed. The potential for stormwater infiltration is generally favorable, depending on grain size.

- Recessional-Lacustrine (Qvrl): Recessional-lacustrine or glaciolacustrine deposits typically consist of a stratified to varved deposit of clay, silt, and sand that was deposited within glacial lakes or other low energy fluvial environments. These deposits are considered normally consolidated and exhibit low to moderate strength and moderate compressibility characteristics where undisturbed. Because of the silty nature of recessional lacustrine soils, the potential for stormwater infiltration is low.

Subsurface Explorations

As part of the scope of work for this study, on January 24, 2020 a GeoResources representative was on site and monitored the drilling of three hollow-stem auger borings to depths of 21 to 21½ feet

below existing grades. After termination of drilling, each boring was completed as a groundwater monitoring well in accordance with Washington Department of Ecology Regulations. On December 22, 2021, a GeoResources representative returned to the site and monitored the excavation of two test pits (TP-101 and TP-102) and performed a small-scale pilot infiltration test (PIT) in general accordance with the 2019 Department of Ecology Stormwater Management Manual of Western Washington (2019 SWMMWW) to determine the initial saturated hydraulic conductivity ($K_{sat,\ initial}$) of the subsurface soils at 4 feet below existing grades. The PIT was completed at the location of TP-102. The test pits were excavated by a licensed contractor operating a track mounted excavator working for us.

On March 21, 2018, we monitored the excavation of five test pits to depths of 7½ to 8½ feet below existing grades under a separate scope of work. The work was completed for a different client as a portion of their feasibility period to purchase the property. The test pits are labeled as TP-1 through TP-5 and their locations are approximately shown on the Site and Exploration Plan, Figure 2.

The specific number, locations, and depths of our explorations were selected by GeoResources personnel based on the configuration of the proposed development and were adjusted in the field based on site access limitations. Given the existing development, access limitations were significant. A field representative from our office continuously monitored the test pit explorations, maintained logs of the subsurface conditions encountered, obtained representative soil samples, and observed pertinent site features. The soil densities presented on the test pit logs were based on the difficulty of excavation and our experience. Each test pit was then backfilled with the excavated material and abandoned.

The subsurface explorations excavated as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun. Based on our experience in the area and extent of prior explorations in the area, it is our opinion that the soils encountered in the explorations are generally representative of the soils at the site. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The USCS is included in Appendix A as Figure A-1. The approximate locations of our explorations are indicated on the attached Site and Exploration Map, Figure 2, while the descriptive logs of our explorations and are included in Appendix A.

Subsurface Conditions

In our opinion, the soils we encountered generally confirmed the mapped stratigraphy at the site and typical conditions for the general site area. In the western portion of the site, we generally encountered tan to light brown massive to laminated silt that was in a soft wet condition which we interpret as glaciolacustrine recessional outwash. In the central portions of the site, we encountered variable surficial conditions ranging from silt, silty sand, and sandy gravel that was in a loose/soft to medium dense/medium stiff, moist to wet condition. We interpret these soils as glaciolacustrine recessional outwash and uncontrolled fill. In the eastern portion of the site, we encountered dense silty sand with gravel that we interpret as glacial till. It appears the surficial soils in the central and western portions of the site were underlain by glacial till at depth.

Given the limitations of our subsurface exploration program because of the developed conditions, we anticipate that additional areas of uncontrolled fill may be present on the site.

Additional subsurface explorations would be required to determine the depths, extents, and composi of uncontrolled fill at the site.

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the borings and test pits to estimate index engineering properties of the soils encountered. Laboratory testing included visual soil classification per ASTM D: 2488 and ASTM D: 2487, moisture content determinations per ASTM D: 2216, and grain size analyses per ASTM D: 6913 standard procedures. The results of the laboratory tests are included in Appendix B, and summarized below in Table 1.

TABLE 1:
LABORATORY TEST RESULTS FOR ON-SITE SOILS

Soil Type	Sample	Lab ID Number	Gravel Content (percent)	Sand Content (percent)	Silt/Clay Content (percent)
Poorly graded GRAVEL with silt and sand (GP-GM)	B-1/S-5/12½ft	099117	53.0	36.9	10.1
Well-graded GRAVEL with silt and sand (GW-GM)	B-2/S-4/10ft	099123	55.4	38.5	6.1
SILT (ML)	B-3/S-4/10ft	099129	NA	NA	97.0
NA = Not Applicable					

Groundwater Conditions

Groundwater monitoring was completed during the wet season between October 2020 to April 2021 in each of the three monitoring wells installed at the site. Monitoring was completed using downhole pressure transducers that collected daily measurements of water levels in each monitoring well. Additionally, one pressure transducer was installed at the site to provide daily measurements of barometric pressure. Measurements of barometric pressure were used to correct water level measurements for the effects of atmospheric pressure fluctuations.

Our observations indicate a seasonal perched groundwater table develops during the wet season in the western and central portions of the site. A perched groundwater table typically develops when the vertical infiltration of precipitation through a more permeable soil is slowed at depth by a deeper, less permeable soil type, such as glacial till. The groundwater table appears to have a limited thickness and fluctuates relatively rapidly. Total seasonal variation was on the order of 2 to 4 feet. Below, Table 2 summarizes the depths and elevations of groundwater observations for the site. Graphical outputs of wet season groundwater level measurements are included in Appendix C.

TABLE 2:
APPROXIMATE DEPTHS AND ELEVATIONS OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Well ID	Depth to Seasonal High Groundwater (feet)	Seasonal High Elevation of Groundwater (feet)	Date Observed
MW-1	17	361	February 23, 21
MW-2	17	383	January 13, 21
MW-3	NE	NE	NA

Notes: NE = Not encountered NA = Not applicable

ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our data review, site reconnaissance, subsurface explorations and our experience in the area, it is our opinion that the site is suitable for the proposed multi-family development. Pertinent conclusions and geotechnical recommendations regarding the design and construction of the proposed multi-family development are presented below.

Seismic Design

The site is located in the Puget Sound region of western Washington, which is seismically active. Seismicity in this region is attributed primarily to the interaction between the Pacific, Juan de Fuca and North American plates. The Juan de Fuca plate is subducting beneath the North American plate at the Cascadia Subduction Zone (CSZ). This produces both intercrustal (between plates) and intracrustal (within a plate) earthquakes. In the following sections we discuss the design criteria and potential hazards associated with the regional seismicity.

Seismic Site Class

Based on our observations and the subsurface units mapped at the site, we interpret the structural site conditions to correspond to a seismic Site Class "C" in accordance with the 2018 IBC documents and American Society of Civil Engineers (ASCE) standard 7-16 Chapter 20 Table 20.3-1. This is based on the reviewed range of SPT (Standard Penetration Test) blow counts for the soil types in the site area. These conditions were assumed to be representative for the subsurface conditions for the site.

Design parameters

The U.S. Geological Survey (USGS) completed probabilistic seismic hazard analyses (PSHA) for the entire country in November 1996, which were updated and republished in 2002 and 2008. We used the *ATC Hazard by Location* website to estimate seismic design parameters at the site. Table 4, below, summarizes the recommended design parameters.

TABLE 3:
2018 IBC Parameters for Design of Seismic Structures

Spectral Response Acceleration (SRA) and Site Coefficients	Short Period	1 Second Period
Mapped SRA	S_s = 1.263	S_1 = 0.435
Site Coefficients (Site Class C)	F_a = 1.2	F_v = 1.5
Maximum Considered Earthquake SRA	S_{MS} = 1.516	S_{M1} = 0.653
Design SRA	S_{DS} = 1.010	S_{D1} = 0.435

Peak Ground Acceleration

The mapped peak ground acceleration (PGA) for this site is 0.5g. To account for site class, the PGA is multiplied by a site amplification factor (F_{PGA}) of 1.2. The resulting site modified peak ground acceleration (PGA_M) is 0.6g. In general, estimating seismic earth pressures (k_h) by the Mononobe-Okabe method or seismic inputs for slope stability analysis are taken as 1/3 to 1/2 of the PGA_M, or 0.2g to 0.3g.

Seismic Hazards

Earthquake-induced geologic hazards may include liquefaction, lateral spreading, slope instability, and ground surface fault rupture. Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in pore water pressure in soils. The increase in pore water pressure is induced by seismic vibrations. Liquefaction primarily affects geologically recent deposits of loose, uniformly graded, fine-grained sands and granular silts that are below the groundwater table. The site is mapped as having a "very low" liquefaction susceptibility by the *Liquefaction Susceptibility Map of Pierce County, Washington* (2004); an excerpt of this map is included as Figure 5. The soils encountered in our explorations consisted of a relatively limited thickness of loose to medium dense silty sand and medium stiff to stiff sandy silt underlain by dense to very dense glacial till. Give the limited perched groundwater table, we anticipate that settlements caused by liquefaction would be limited to less than estimated static settlements.

The ground surface at the project site is gently sloping. Accordingly, it is our opinion the potential for earthquake-induced slope instability on the site is low. No evidence of ground fault rupture was observed in the subsurface explorations or out site reconnaissance. Therefore, in our opinion, the proposed structures should have no greater risk for ground fault rupture than other structures located in the area.

Foundation Support

Based on the encountered subsurface conditions at the locations explored and the preliminary building plans, we recommend that spread footings be founded on the medium dense to very dense native glacial soils, or on structural fill that extends to suitable native soils. Based on our understanding of the proposed locations of the structures, it is our opinion that shallow foundations may be used to support the buildings; however, considerations for uncontrolled fill and loose to medium stiff native soils should be made. We have not been provided with the design loads and have assumed the structures will be lightly loaded based on our experience with similar projects.

Complete Fill Removal

Uncontrolled fill soils and soft silt deposits encountered in the lower, western portion of the site are not a suitable bearing soil for the proposed footings. Any known locations of uncontrolled fill or uncontrolled filled encountered during grading should be removed from the building envelopes of the proposed structures. Soft silt soils in the western portion of the site can likely be mitigated through grading and placement of structural fill.

We recommend that all footing elements be supported by a minimum of 2 feet of properly placed structural fill. In areas where deeper fill removal is required the foundation elements may be deepened to extend to the base of the excavation, or the excavation may be backfilled with structural fill. After removal of the fill materials, the exposed surface should be evaluated prior to placing structural fill.

Spread Footing design

Footings should bear on properly placed and compacted structural fill as discussed in the "Complete Fill Removal" section, above. Removal of unsuitable soils below the footings should extend beyond the foundation edges 1-foot horizontally for every 1-foot of vertical excavation. Loose, soft, or other unsuitable material present at the base of the excavation should be removed prior to placement of structural fill. The soil at the base of the excavations should be protected against disturbance from weather, traffic, or other adverse conditions. The excavation should be backfilled with suitable materials as described in the **"Structural Fill"** section of this report. If Control Density Fill (CDF) is used as backfill, the horizontal extent of the excavation can be limited to 1H:2V on each side of the footing.

We recommend a minimum width of 24 inches for isolated footings and at least 18 inches for continuous wall footings. All footing elements should be embedded at least 18 inches below grade for frost protection. For footing bearing surfaces prepared as described in the "Complete Fill Removal" we recommend using an allowable soil bearing capacity of 2,000 psf (pounds per square foot) for design.nnThese values are for combined dead and long-term live loads. The weight of the footing and any overlying backfill may be neglected. The allowable bearing value may be increased by one-third for transient loads such as those induced by seismic events or wind loads.

Lateral loads may be resisted by friction on the base of footings and floor slabs and as passive pressure on the sides of footings. We recommend that an allowable coefficient of friction of 0.35 be used to calculate friction between the concrete and the underlying structural fill. Passive pressure may be determined using an allowable equivalent fluid density of 300 pcf (pounds per cubic foot). Factors of safety have been applied to these values.

We estimate that settlements of footings designed and constructed as recommended will be less than 1 inch, for the anticipated load conditions, with differential settlements between comparably loaded footings of ½ inch or less. Most of the settlements should occur essentially as loads are being applied; however, disturbance of the foundation subgrade during construction could result in larger settlements than estimated.

Floor Slab Support

We anticipate that the lower level of the structures will consist of a slab-on-grade floor. Slab-on-grade floors should be supported on medium dense native soils or on structural fill prepared as

described above. Areas of uncontrolled fill material should be evaluated during grading activity for suitability of structural support. Areas of significant organic debris should be removed.

We recommend that floor slabs be directly underlain by a minimum 4-inch thick pea gravel or washed 5/8-inch crushed rock and should contain less than 5 percent fines. This layer should be placed and compacted to an unyielding condition.

A synthetic vapor retarder is recommended to control moisture migration through the slabs. This is of particular importance where moisture migration through the slab is an issue, such as where adhesives are used to anchor carpet or tile to the slab.

A subgrade modulus of 350 kcf (kips per cubic foot) may be used for floor slab design. We estimate that settlement of the floor slabs designed and constructed as recommended, will be 1/2 inch or less over a span of 50 feet.

Subgrade/Basement Walls

The lateral pressures acting on retaining walls (such as basement or grade separation walls) will depend upon the nature and density of the soil behind the wall as well as the presence or absence of hydrostatic pressure. Below we provide recommended design values and drainage recommendations for retaining walls.

Design Values

For walls backfilled with granular well-drained soil and a level backslope, the design active pressure may be taken as 35 pcf (equivalent fluid density). For walls that are braced or otherwise restrained, the design at-rest pressure may be taken as 55 pcf. For the condition of an inclined back slope, higher lateral pressures would act on the walls. For a 3H:1V (Horizontal to Vertical) slope above the wall, the pressure may be taken as 35 pcf (equivalent fluid density). For walls that are braced or otherwise active pressure may be taken as 48 pcf; for a 2H:1V back slope condition, a wall design pressures of 55 pcf may be assumed If basement walls taller than 6 feet are required, as seismic surcharge of 12H should be included where required by the code. If walls will be constructed with a backslope and will be braced or otherwise restrained against movement, we should be notified so that we can evaluate the anticipated conditions and recommend an appropriate at-rest earth pressure.

Lateral loads may be resisted by friction on the base of footings and as passive pressure on the sides of footings and the buried portion of the wall, as described in the "**Foundation Support**" section of this report.

Wall Drainage

Adequate drainage behind retaining structures is imperative. Positive drainage which controls the development of hydrostatic pressure can be accomplished by placing a zone of drainage behind the walls. Granular drainage material should contain less than 2 percent fines and at least 30 percent retained on the US No. 4 sieve.

A minimum 4 inch diameter perforated or slotted PVC pipe should be placed in the drainage zone along the base and behind the wall to provide an outlet for accumulated water and direct accumulated water to an appropriate discharge location. We recommend that a nonwoven geotextile filter fabric be placed between the soil drainage material and the remaining wall backfill to reduce silt migration into the drainage zone. The infiltration of silt into the drainage zone can, with time, reduce the permeability of the granular material. The filter fabric should be placed such that it fully separates the drainage material and the backfill, and should be extended over the top of the drainage zone.

A soil drainage zone should extend horizontally at least 18 inches from the back of the wall. The drainage zone should also extend from the base of the wall to within 1 foot of the top of the wall. The soil drainage zone should be compacted to approximately 90 percent of the maximum dry density (MDD), as determined in accordance with ASTM D: 1557. Over-compaction should be avoided as this can lead to excessive lateral pressures on the wall. A geocomposite drain mat may also be used instead of free draining soils, provided it is installed in accordance with the manufacturer's instructions.

Below Grade Vaults

The proposed below grade vault should be designed to resist the static and dynamic lateral earth pressures presented in the **"Subgrade/Basement Walls"** section of this report. We recommend the proposed vault be completely waterproofed (exterior of foundation walls and underside of slab) to prevent water intrusion. The walls and floor slabs associated with these structures should be designed to resist the lateral and uplift forces associated with maximum estimated seasonal high groundwater levels. We recommend using a soil unit weight of 130 pcf to calculate vertical forces acting on the vault lid, base extensions, or anti-flotation slabs.

Temporary Excavations

All job site safety issues and precautions are the responsibility of the contractor providing services/work. The following cut/fill slope guidelines are provided for planning purposes only. Temporary cut slopes will likely be necessary during grading operations or utility installation. All excavations at the site associated with confined spaces, such as utility trenches and retaining walls, must be completed in accordance with local, state, or federal requirements including Washington Administrative Code (WAC) and Washington Industrial Safety and Health Administration (WISHA). Excavation, trenching, and shoring is covered under WAC 296-155 Part N.

Based on WAC 296-155-66401, it is our opinion that the glaciolacustrine recessional outwash soils on the site would be classified as Type C soils, while the underlying glacial till would be classified as Type A soils. For temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be sloped at a maximum inclination of 1½ H:1V or flatter from the toe to top of the slope; while side slopes in Type A soils should be sloped at a maximum inclination of ¾H:1V or flatter from the toe to top of the slope. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume that all surface loads are kept at a minimum distance of at least one half the depth of the cut away from the top of the slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant raveling or seepage occurs, if construction materials will be stockpiled along the slope crest, or if construction traffic will be routed along the slope crest.

Where it is not feasible to slope the site soils back at these inclinations, shoring will be required. All shoring for the project should incorporate applicable criteria presented in the **"Subgrade/Basement Walls"** section of this report into the design. Settlement of the ground surface can occur behind shoring during excavation. The amount of settlement depends heavily on the type of shoring system, the contractor's workmanship, and soil conditions. Accordingly, we recommend that structures in the vicinity of the planned shoring installation be reviewed with regard to foundation support and tolerance to settlement.

This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that GeoResources, LLC assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor..

Permanent Cut and Fill Slopes

We do not anticipate that permanent cut and fill slopes will be utilized for this project. However, if cut and fill slopes are required, we recommend a maximum slope of 2H:1V (Horizontal:Vertical) for permanent cut and fill slopes. Where 2H:1V slopes are not feasible, retaining structures should be considered. Where retaining structures are greater than 4 feet in height (bottom of footing to top of structure) or have slopes of greater than 15 percent above them, they should be designed by a qualified engineer.

Fill slopes constructed on grades that are steeper than 5H:1V (20 percent) should be "keyed" into the undisturbed native soils by cutting a series of horizontal benches and should be constructed in accordance with Appendix J of the 2018 IBC. The benches should be 1½ times the width of the equipment used for grading and be a maximum of 3 feet in height. Subsurface drainage may be required in areas where significant seepage is encountered during grading. Collected drainage should be directed to an appropriate discharge point.

Site Drainage

All ground surfaces, pavements and sidewalks at the site should be sloped to direct surface water away from the structures and property lines. Surface water runoff should be controlled by a system of curbs, berms, drainage swales, and or catch basins, and conveyed to an appropriate discharge point.

We recommend that footing drains are installed for the residence in accordance with IBC 1805.4.2, and basement walls (if utilized) have a wall drain as describe above. The roof drain should not be connected to the footing drain.

Stormwater Infiltration

In the following sections we provide an opinion regarding the feasibility of infiltration, and construction considerations.

Infiltration Feasibility

Based on our observations, laboratory testing, in-situ infiltration testing, and experience, it is our opinion that the soils at the site will not support on-site infiltration. On December 22, 2021, we completed a small-scale pilot infiltration test (PIT) in the lower, western portion of the site in accordance with method outlined by the current Stormwater Management Manual for Western Washington. The results of our PIT indicated the saturated hydraulic conductivity of the soils was less than 0.1 inches per hour, below the infeasibility threshold for infiltration facilities. Accordingly, we recommend that alternative stormwater management methods are used.

Construction Considerations

To reduce potential clogging of stormwater facilities, they should not be connected to the stormwater runoff system until after construction is complete and the site area is landscaped, paved or otherwise protected. Additional measures may also be taken during construction to minimize the potential of fines contamination of the proposed stormwater facility, such as utilizing an alternative

storm water management location during construction. All contractors working on the site (builders and subcontractors) should divert sediment laden stormwater away from proposed infiltration facilities during construction and landscaping activities. No concrete trucks should be washed or cleaned, and washout areas should not be within the vicinity of the proposed infiltration facilities. After construction activities have been completed, periodic sweeping of the paved areas will help extend the life of the stormwater facility.

Pavement Section Design

We understand that several pavement sections may be used for the onsite portion of the development, including hot mix asphalt (HMA) pavement sections in the passenger car parking stalls, passenger car drive lanes, and either HMA or Portland cement concrete (PCC) pavement in emergency vehicle or truck areas.

Pavement Subgrades

Pavement subgrade areas should be prepared by removing any soft or deleterious material down to firm and unyielding soils in accordance with the "**Site Preparation**" section of this report. The prepared subgrade should be evaluated by proof-rolling with a fully-loaded dump truck or equivalent point load equipment. Soft, loose, or wet areas that are identified should be recompacted or removed, as appropriate. Over-excavated areas should be backfilled with compacted structural fill. Where fill is placed, the upper 2 feet of roadway subgrade should have a maximum dry density of at least 95 percent, as determined in accordance with the ASTM D: 1557.

Pavement Sections

Pavement section thicknesses should conform to appropriate minimum sections provided in the most current City of Puyallup *Public Works Engineering & Construction Standards*, Section 100 for roadway design.

Pavement Frost Conditions

Frost-susceptible soil is generally regarded as having greater than 3 percent finer than 0.02 millimeter (mm). Soil with a fines content not exceeding 7 percent passing the No. 200 sieve, based on the minus ¾-inch fraction, can normally be expected to have 3 percent or less finer than 0.02 mm. Based on the soils observed during our construction monitoring, most of the near-surface soils could be considered frost-susceptible. Based on information provided in the WSDOT Pavement Policy, we recommend assuming the frost depth would be about 18 inches. For both rigid and flexible pavements, WSDOT recommends that the total depth of the pavement section be at least 50 percent of the frost depth.

Pavement Materials and Construction

In general, the aggregate base course, HMA, and PCC should be constructed in accordance with the most current City of Puyallup *Public Works Engineering & Construction Standards*, Section 100 for roadway design. Where not covered by Section 100, we recommend defaulting to WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications, 2016). HMA should conform to Section 5-04 in the WSDOT Standard Specifications and the PCC should conform to Section 5-05 of the WSDOT Standard Specifications. We recommend that crushed rock used as CSBC in pavement sections consist of material of approximately the same quality as "crushed

surfacing (base course)" (or better) described in Section 9-03.9(3) of the WSDOT Standard Specifications. We further recommend that CSBC material be compacted to at least 95 percent of the MDD based on the modified Proctor procedure (ASTM D;1577).

EARTHWORK RECOMMENDATIONS

Site Preparation

All structural areas on the site to be graded should be stripped of vegetation, organic surface soils, and other deleterious materials including existing structures, foundations or abandoned utility lines. Organic topsoil is not suitable for use as structural fill, but may be used for limited depths in non-structural areas. Stripping depths ranging from 4 to 12 inches should be expected to remove these unsuitable soils. Areas of thicker topsoil or organic debris may be encountered in areas of heavy vegetation or depressions.

Where placement of fill material is required, the stripped/exposed subgrade areas should be compacted to a firm and unyielding surface prior to placement of any fill. Excavations for debris removal should be backfilled with structural fill compacted to the densities described in the "**Structural Fill**" section of this report.

We recommend that a member of our staff evaluate the exposed subgrade conditions after removal of vegetation and topsoil stripping is completed and prior to placement of structural fill. The exposed subgrade soil should be proof-rolled with heavy rubber-tired equipment during dry weather or probed with a 1/2-inch-diameter steel rod during wet weather conditions.

Soft, loose, or otherwise unsuitable areas delineated during proofrolling or probing should be recompacted, if practical, or over-excavated and replaced with structural fill. The depth and extent of overexcavation should be evaluated by our field representative at the time of construction. The areas of old fill material should be evaluated during grading operations to determine if they need mitigation; recompaction or removal.

Structural Fill

All material placed as fill associated with mass grading, as utility trench backfill, under building areas, or under roadways should be placed as structural fill. The structural fill should be placed in horizontal lifts of appropriate thickness to allow adequate and uniform compaction of each lift. Structural fill should be compacted to at least 95 percent of MDD (maximum dry density as determined in accordance with ASTM D: 1557).

The appropriate lift thickness will depend on the structural fill characteristics and compaction equipment used. We recommend that the appropriate lift thickness be evaluated by our field representative during construction. We recommend that our representative be present during site grading activities to observe the work and perform field density tests.

The suitability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines (material passing US No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. During wet weather, we recommend use of well-graded sand and gravel with less than 5 percent (by weight) passing the US No. 200 sieve based on that fraction passing the 3/4-inch sieve, such as *Gravel Backfill for Walls* (WSDOT 9-03.12(2)). If prolonged dry weather prevails during

the earthwork and foundation installation phase of construction, higher fines content (up to 10 to 12 percent) may be acceptable.

Material placed for structural fill should be free of debris, organic matter, trash and cobbles greater than 6-inches in diameter. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Suitability of On-Site Materials as Fill

During dry weather construction, the non-organic, granular on-site soil may be considered for use as structural fill; provided it meets the criteria described above in the "**Structural Fill"** section and can be compacted as recommended. If the soil material is over-optimum in moisture content when excavated, it will be necessary to aerate or dry the soil prior to placement as structural fill. We generally did not observe the site soils to be excessively moist at the time of our subsurface exploration program.

The uncontroleld fill encountered at shallow depths consist of a mixture of sand, silt, and gravel with debris. We do not anticipate that these soils will be suitable for use as structural fill because of their fines content and the presence of debris. The deeper glacial till is generally comparable to "common borrow" material and will be suitable for use as structural fill provided the moisture content is maintained within 2 percent of the optimum moisture level.

We recommend that completed graded-areas be restricted from traffic or protected prior to wet weather conditions. The graded areas may be protected by paving, placing asphalt-treated base, a layer of free-draining material such as pit run sand and gravel or clean crushed rock material containing less than 5 percent fines, or some combination of the above.

Erosion Control

Weathering, erosion and the resulting surficial sloughing and shallow land sliding are natural processes. As noted, no evidence of surficial raveling or sloughing was observed at the site. To manage and reduce the potential for these natural processes, we recommend erosion protection measures will need to be in place prior to grading activity on the site. Erosion hazards can be mitigated by applying Best Management Practices (BMP's) outlined in the current Stormware *Management Manual for Western Washington.* These may include, but are not limited to silt fence per BMP C233, straw wattles per BMP C235, temporary and permanent seeding per BMP C120, and mulch per BMP C121.

Wet Weather and Wet Condition Considerations

In the Puget Sound area, wet weather generally begins about mid-October and continues through about May, although rainy periods could occur at any time of year. Therefore, it is strongly encouraged that earthwork be scheduled during the dry weather months of June through September. Most of the soil at the site contains sufficient fines to produce an unstable mixture when wet. Such soil is highly susceptible to changes in water content and tends to become unstable and impossible to proof-roll and compact if the moisture content exceeds the optimum.

In addition, during wet weather months, the groundwater levels could increase, resulting in seepage into site excavations. Performing earthwork during dry weather would reduce these problems and costs associated with rainwater, construction traffic, and handling of wet soil. However, should wet weather/wet condition earthwork be unavoidable, the following recommendations are provided:

- The ground surface in and surrounding the construction area should be sloped as much as possible to promote runoff of precipitation away from work areas and to prevent ponding of water.
- Work areas or slopes should be covered with plastic when not being worked. The use of sloping, ditching, sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work.
- Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soils and placement and compaction of clean structural fill could be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. It may be necessary to excavate soils with a backhoe, or equivalent, and locate them so that equipment does not pass over the excavated area. Thus, subgrade disturbance caused by equipment traffic would be minimized.
- Fill material should consist of clean, well-graded, sand and gravel, of which not more than 5 percent fines by dry weight passes the No. 200 mesh sieve, based on wet-sieving the fraction passing the ¾-inch mesh sieve. The gravel content should range from between 20 and 50 percent retained on a No. 4 mesh sieve. The fines should be non-plastic.
- No exposed soil should be left uncompacted and exposed to moisture. A smooth-drum vibratory roller, or equivalent, should roll the surface to seal out as much water as possible.
- In-place soil or fill soil that becomes wet and unstable and/or too wet to suitably compact should be removed and replaced with clean, granular soil (see gradation requirements above).
- Excavation and placement of structural fill material should be observed on a full-time basis by a geotechnical engineer (or representative) experienced in wet weather/wet condition earthwork to determine that all work is being accomplished in accordance with the project specifications and our recommendations.
- Grading and earthwork should not be accomplished during periods of heavy, continuous rainfall.

We recommend that the above requirements for wet weather/wet condition earthwork be incorporated into the contract specifications.

LIMITATIONS

We have prepared this report for use by Bradley Heights SS, LLC and other members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during

the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

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

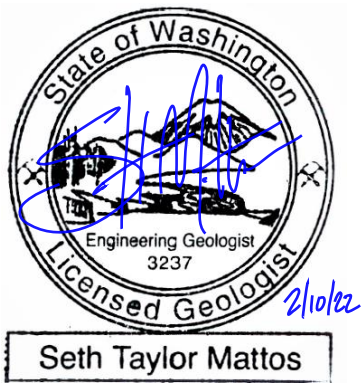
If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

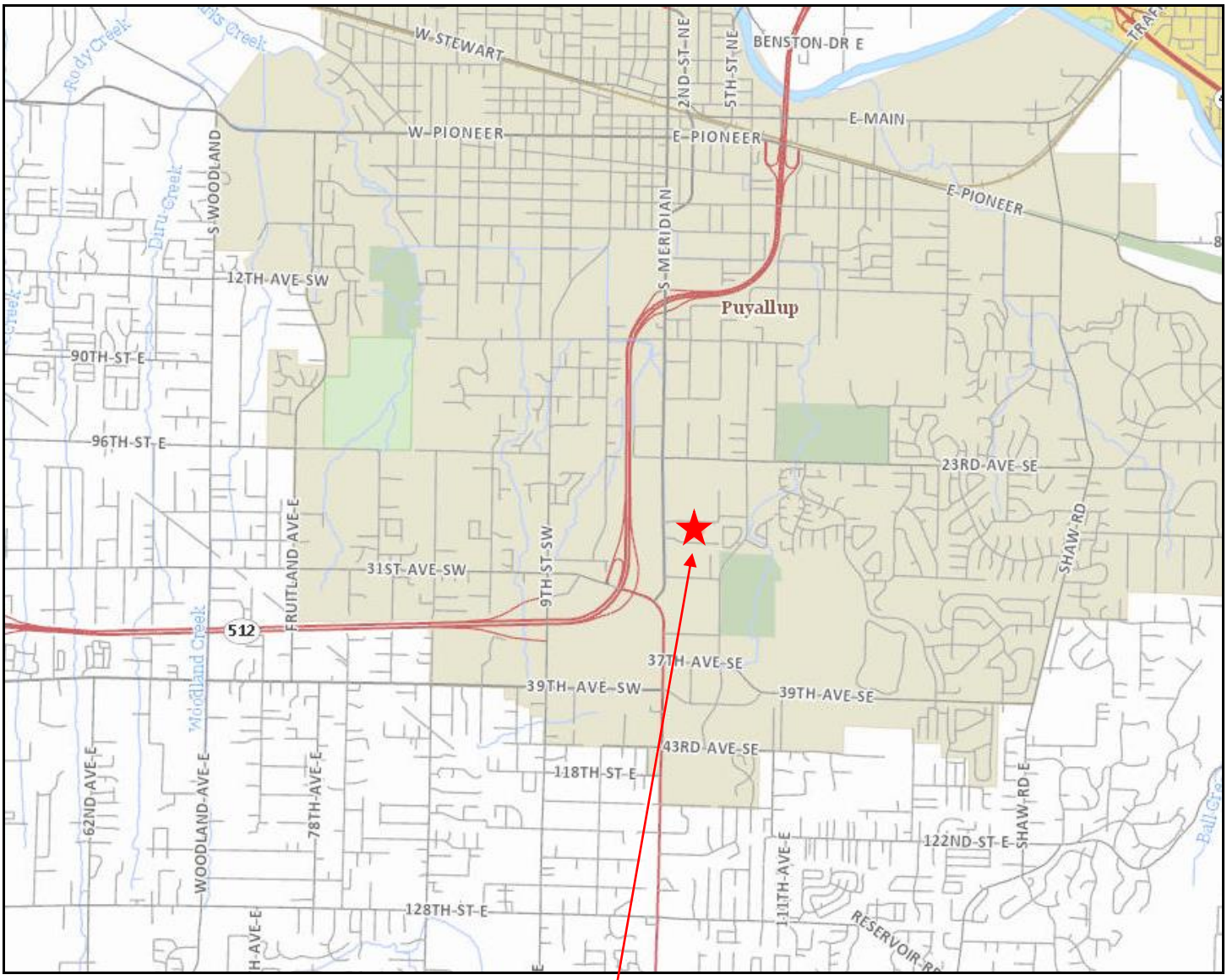
Tyler S. Slothower, EIT
Staff Engineer



Seth Taylor Mattos
Associate

Eric W. Heller, PE, LG
Senior Geotechnical Engineer

TSS:STM/EWH/tss
DocID: Timberlane.BradleyHeights.RG
Attachments: Figure 1: Site Location Map
Figure 2: Site & Exploration Plan
Figure 3: NRCS Soils Map
Figure 4: Geologic Map
Figure 5: Liquefaction Hazard Map
Appendix "A" - Subsurface Explorations
Appendix "B" - Laboratory Test results
Appendix "C" – Groundwater Monitoring Data



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

N
W E
S

Not to Scale

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Site Location Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure 1

Conceptual site plan provided by Azure Green Consultants

Number and approximate location of borings (1/24/20)

Number and approximate location of test pits (excavated 3/21/2018 & 12/22/21)

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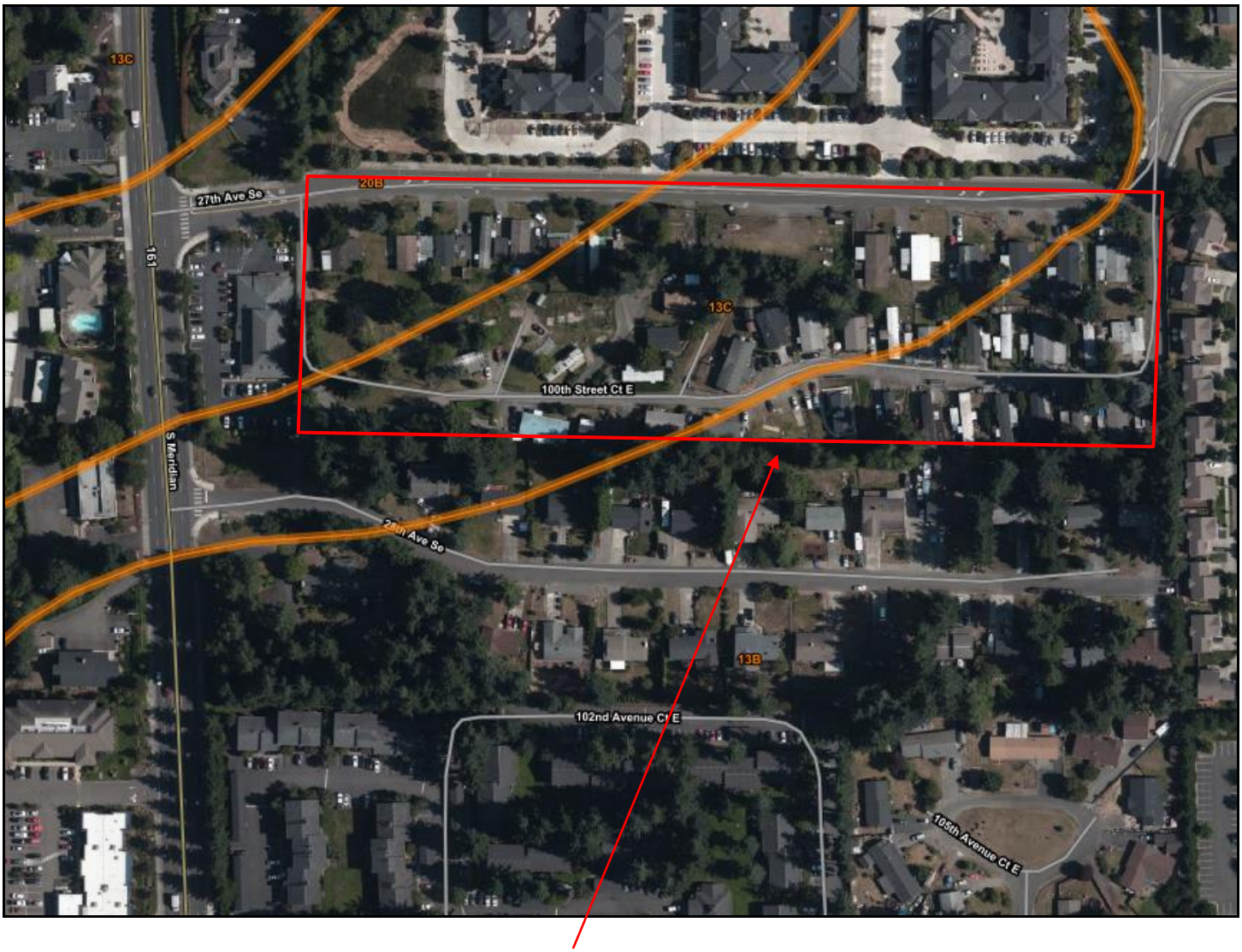
Site and Exploration Plan

Proposed Multifamily Redevelopment
202 – 27th Ave SE
Puyallup, Washington

Doc:ID: Timberlane.BradleyHeights.F2.1	February 2022	Figure 2



Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
13B	Everett very gravelly sandy loam	Sandy and gravelly glacial outwash	0 to 8	Slight	A
13C			8 to 15	Moderate	
20B	Kitsap silt loam	Glaciolacustrine deposits	2 to 8	Slight to moderate	C/D

Not to Scale

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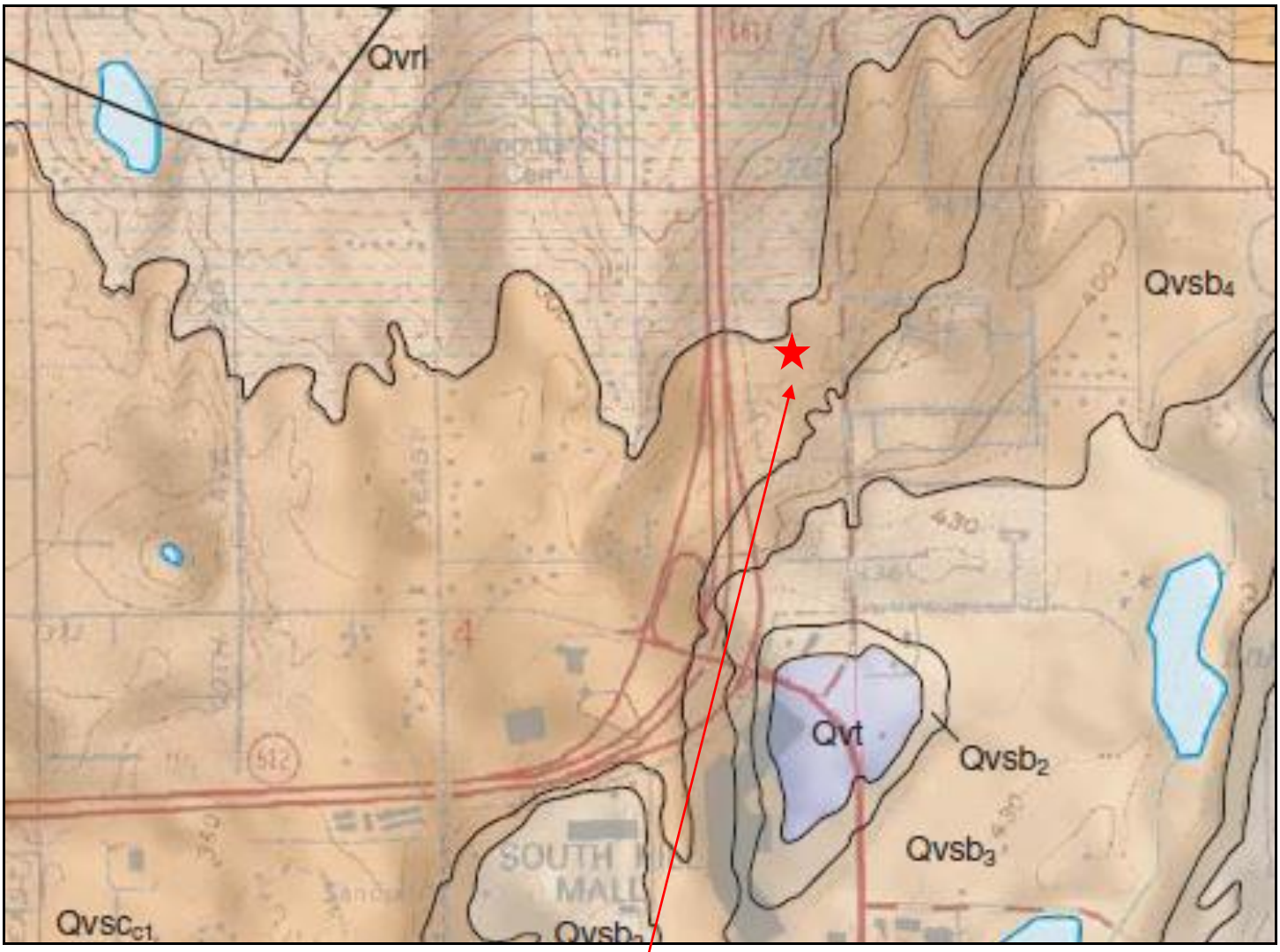
NRCS Soils Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006



Approximate Site Location

An excerpt from *the draft Geologic Map of the Puyallup 7.5-minute Quadrangle, Washington*, by Troost, K.G.

Qvrl	Recessional Lacustrine Deposits
$Qvsc_{C1}$	Steilacoom gravel-Clover Creek Channel
$Qvsb_4$	Vashon recessional outwash-Bradley Channel

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Geologic Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure 4

Approximate Site Location

An excerpt from *the Liquefaction Susceptibility Map of Pierce County, Washington* by Palmer et Al. (2004)

- Liquefaction susceptibility: HIGH
- Liquefaction susceptibility: MODERATE to HIGH
- Liquefaction susceptibility: MODERATE
- Liquefaction susceptibility: LOW to MODERATE
- Liquefaction susceptibility: LOW
- Liquefaction susceptibility: VERY LOW to LOW
- Liquefaction susceptibility: VERY LOW
- Bedrock

N W E S

Not to Scale

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Geologic Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure 4

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D6913.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

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LOG OF BORING

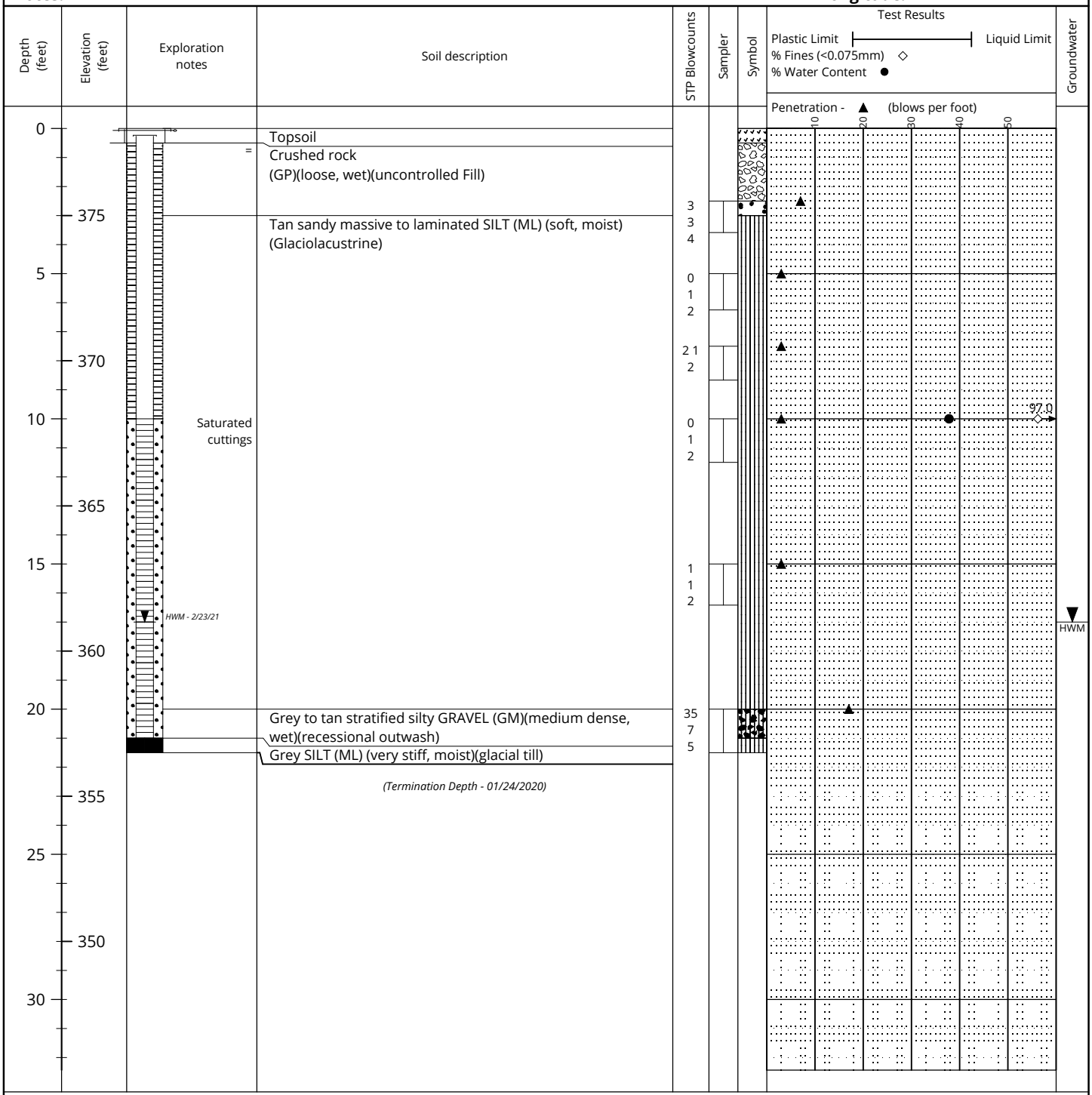
MW-1

Proposed Multi-Family Development
202 - 27th Avenue Southwest
Puyallup, WA

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Notes:

Drilling Company:	Holocene	**Logged By:**	EJF
Drilling Method:	HSA	**Drilling Date:**	01/24/2020
Drilling Rig:	D-50	**Datum:**	NAVD 88
Sampler Type:	2-inch OD Split spoon	**Elevation:**	378 feet
Hammer Type:	Auto	**Termination Depth:**	21.5
Hammer Weight:	140 lbs	**Latitude:**	
		Longitude:	



Paving | Gravel frac | Silty sand | Poorly graded GRAVEL with silt | Silty gravel | Topsoil

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FIG. A-2

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LOG OF BORING

MW-2

Proposed Multi-Family Development
202 - 27th Avenue Southwest
Puyallup, WA

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Notes:

Drilling Company:	Holocene	**Logged By:**	EJF
Drilling Method:	HSA	**Drilling Date:**	01/24/2020
Drilling Rig:	Track	**Datum:**	NAVD 88
Sampler Type:	Cathead?	**Elevation:**	400 feet
Hammer Type:		**Termination Depth:**	21
Hammer Weight:	140 lbs	**Latitude:**	
		Longitude:	

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol	Test Results: Plastic Limit — Liquid Limit; % Fines (<0.075mm) ◇; % Water Content ●; Penetration - ▲ (blows per foot) 10 20 30 40 50	Groundwater
0	400		Topsoil					
			Tan well-graded GRAVEL with silt and sand (GW-GM) (moist to wet, medium dense) (Recessional Outwash)	8 9 6				
5	395			12 12 8				
				13 8 8				
10	390		Tan well-graded sandy GRAVEL with silt (GW-GM), lightly stratified (moist, medium dense)	12 5 10				
15	385		Tan SAND (SP) (medium dense, moist)(recessional outwash)	11 11 6				
20	380		Grey, mottled SILT (ML)(very stiff, moist)(Glacial till)	4 7 10				
			(Termination Depth - 01/24/2020)					
25	375							
30	370							

Paving | Gravel frac | Silty sand | Poorly graded GRAVEL with silt | Silty gravel | Topsoil

JOB: Timberlane.BradleyHts

FIG. A-3

GEORESOURCES
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LOG OF BORING

MW-3

Proposed Multi-Family Development
202 - 27th Avenue Southwest
Puyallup, WA

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Notes:

Drilling Company:	Holocene	**Logged By:**	EJF
Drilling Method:	HSA	**Drilling Date:**	01/24/2020
Drilling Rig:	Track	**Datum:**	NAVD 88
Sampler Type:	Cathead?	**Elevation:**	426 feet
Hammer Type:		**Termination Depth:**	21
Hammer Weight:	140 lbs	**Latitude:**	
		Longitude:	

Depth (feet)	Elevation (feet)	Exploration notes	Soil description	STP Blowcounts	Sampler	Symbol	Test Results	Groundwater
0	425		Asphalt CSTC/CSBC crushed rock (road Fill)				Plastic Limit — Liquid Limit % Fines (<0.075mm) ◇ % Water Content ●	
5	420		Reddish brown silty SAND, reworked (SM)(medium dense, moist to wet)(uncontrolled fill)	2 4 6			Penetration - ▲ (blows per foot) 10 20 30 40 50	
		Chatter	Grey silty SAND with gravel (SM) (wet, medium dense) (Weathered Glacial Till)	19 17 20				
10	415		Grey to light grey sandy gravel with silt (GP-GM) (moist to wet, very dense) (Glacial Till)	24 34 31 20 31 50/4"			65 105	
15	410	Chatter		26 50/5" 28 50/5"			120 120	
20	405		*(Termination Depth - 01/24/2020)*	36 50/5"			120	
25	400							
30	395							

Paving | Gravel frac | Silty sand | Poorly graded GRAVEL with silt | Silty gravel

JOB: Timberlane.BradleyHts

FIG. A-4

Test Pit TP-101

Location: central-western portion of property
Approximate Elevation: 388 feet (NAVD 88)

Depth (ft)			Soil Type	Soil Description
0	-	¼	-	Topsoil
¼	-	1½	SM	Brown silty sand (medium dense, moist) (weathered till)
1½	-	9½	SM	Grey silty sand (dense to very dense, moist) (glacial till)

Terminated at 9½ feet below ground surface.
No caving was observed at time of excavation.
Mottling was observed at 1½ feet below ground surface.

Test Pit TP-102/PIT-1

Location: Northwestern portion of property
Approximate Elevation: 378 feet (NAVD 88)

Depth (ft)			Soil Type	Soil Description
0	-	¼	-	Topsoil
¼	-	6½	ML	Tan to grey silt (medium stiff, moist) (weathered till)

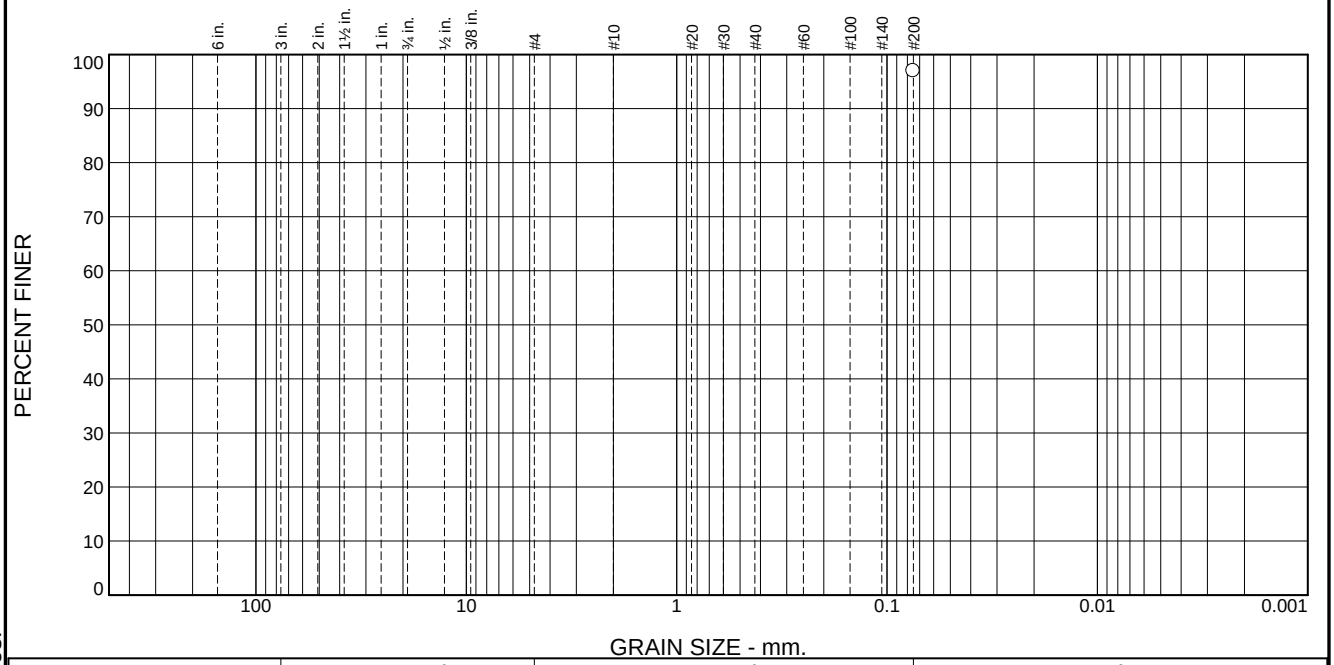
Terminated at 6½ feet below ground surface.
Caving observed from 2 to 6 feet below ground surface.
No mottling or groundwater seepage observed.
Small-scale PIT completed at 4 feet below ground surface.

Logged by: TSS **Excavated on: December 22, 2021**

Appendix B

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						97.0	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	97.0		

* (no specification provided)

Material Description

Tan, mottled, SILT (ML), laminated (wet, soft)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-2-4(0)

Coefficients

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

Remarks

Moisture = 37.8%

Date Received: 01/24/2020 **Date Tested:** 02/18/2020

Tested By: EJF

Checked By: _____

Title: _____

Source of Sample: MW-1 **Depth:** 10
Sample Number: S-4

Date Sampled: 01/24/2020

GeoResources, LLC

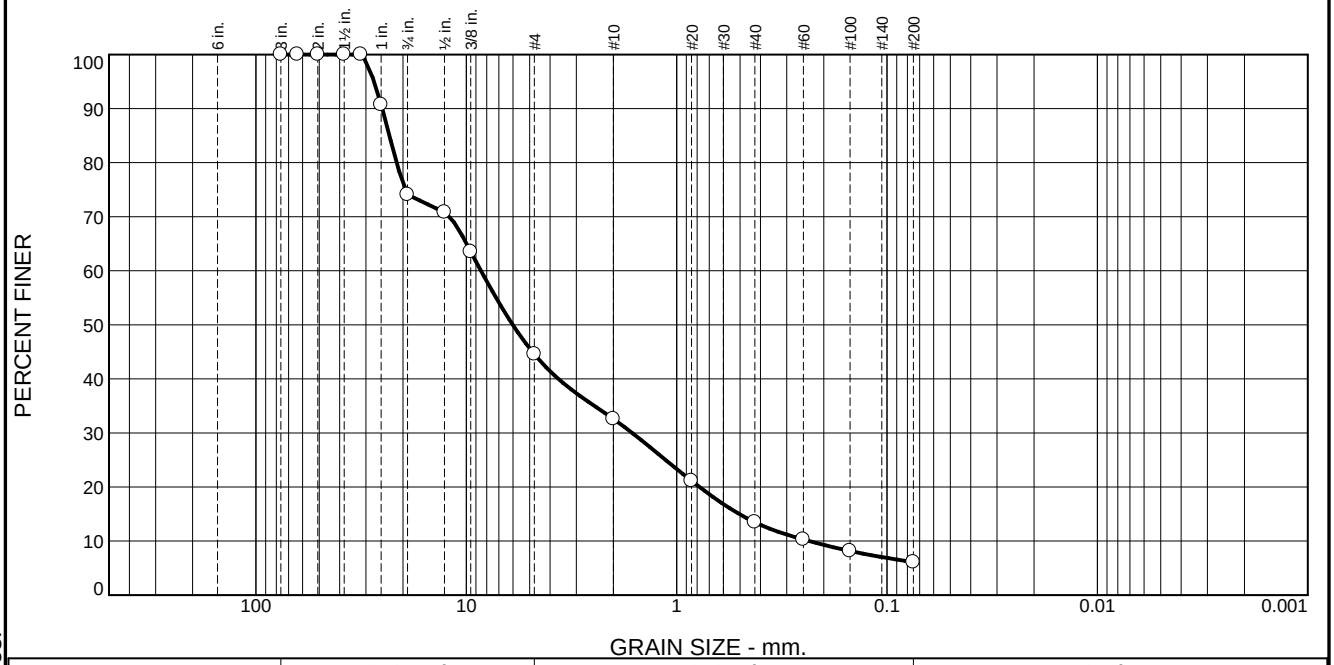
Fife, WA

Client: Bradley Heights SS, LLC
Project: Proposed Multi-Family Development

Project No: Timberlane.BradleyHts **Figure** B-3

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	25.9	29.5	12.0	19.1	7.4	6.1	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	90.7		
.75	74.1		
.5	70.8		
0.375	63.5		
#4	44.6		
#10	32.6		
#20	21.1		
#40	13.5		
#60	10.3		
#100	8.2		
#200	6.1		

* (no specification provided)

Material Description

Tan well-graded sandy gravel with silt (GW-GM), lightly stratified (wet, medium dense)

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 25.1048 D_{85}= 23.2261 D_{60}= 8.5264
D_{50}= 6.0116 D_{30}= 1.6294 D_{15}= 0.5038
D_{10}= 0.2347 C_u= 36.33 C_c= 1.33

Remarks

Moisture = 6.3%

Date Received: 01/24/2020 **Date Tested:** 02/19/2020

Tested By: EJF

Checked By:

Title:

Source of Sample: MW-2 **Depth:** 10 **Date Sampled:** 01/24/2020

Sample Number: S-4

GeoResources, LLC

Fife, WA

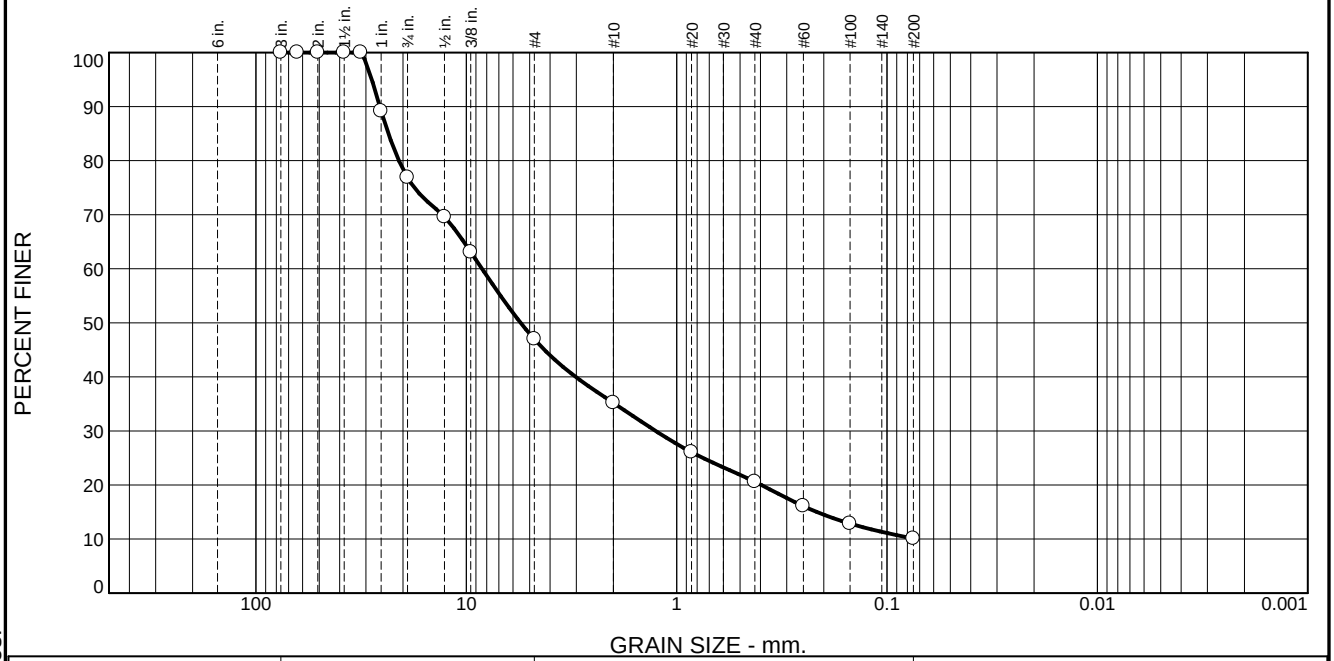
Client: Bradley Heights SS, LLC

Project: Proposed Multi-Family Development

Project No: Timberlane.BradleyHts **Figure** B-2

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	23.1	29.9	11.8	14.6	10.5	10.1	

Test Results (ASTM D 6913 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	89.2		
.75	76.9		
.5	69.6		
0.375	63.1		
#4	47.0		
#10	35.2		
#20	26.1		
#40	20.6		
#60	16.1		
#100	12.9		
#200	10.1		

* (no specification provided)

Material Description

Tan, poorly graded sandy gravel with silt (GP-GM) (moist to wet, dense)

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}= 25.7745 D_{85}= 23.4789 D_{60}= 8.4277
D_{50}= 5.5158 D_{30}= 1.2593 D_{15}= 0.2156
D_{10}= C_u= C_c=

Remarks

Moisture = 6.0%

Date Received: 01/24/2020 **Date Tested:** 02/18/2020

Tested By: EJF

Checked By: _____

Title: _____

Source of Sample: MW-3 **Depth:** 12.5
Sample Number: S-5

Date Sampled: 01/24/2020

GeoResources, LLC

Fife, WA

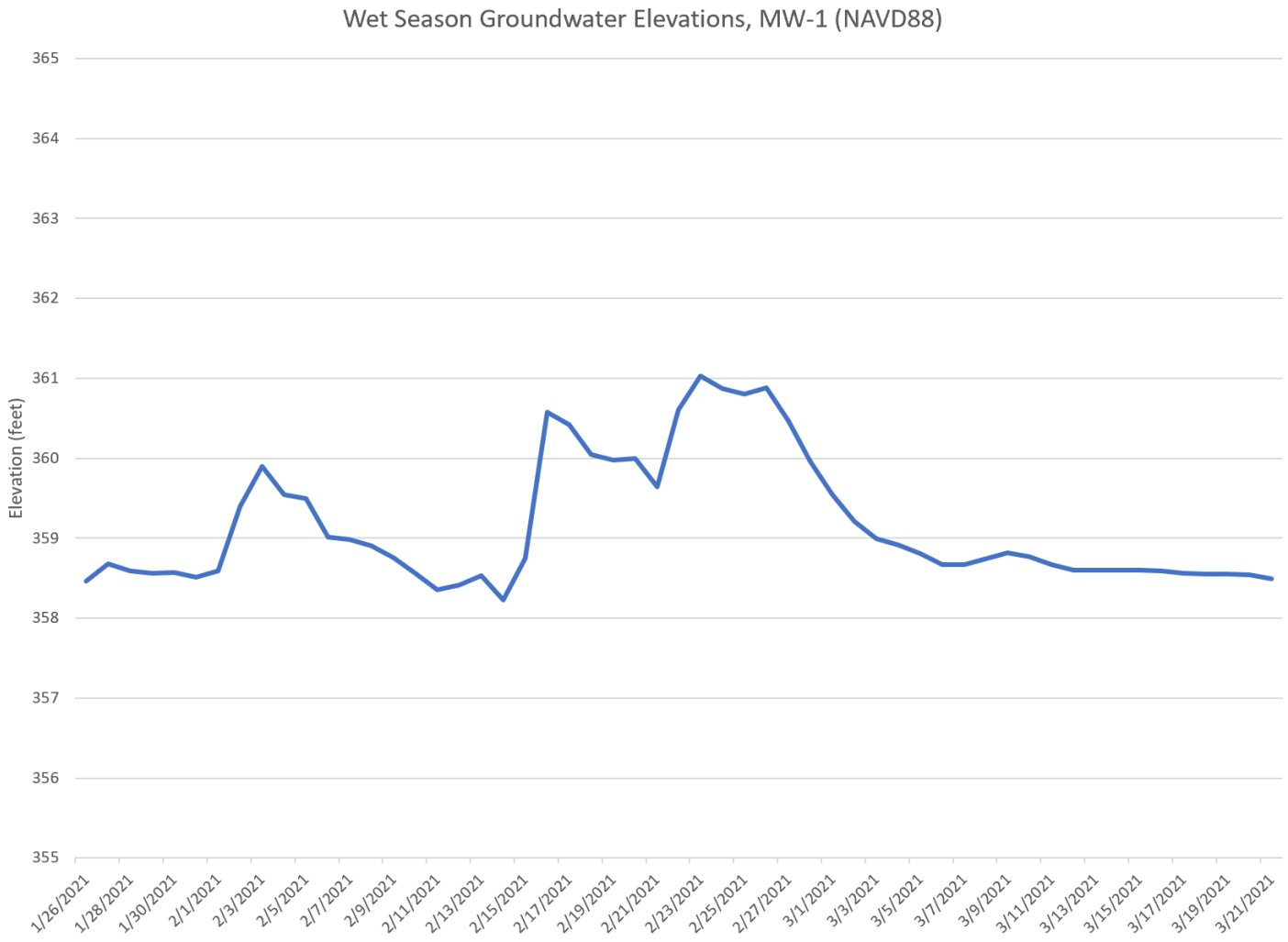
Client: Bradley Heights SS, LLC
Project: Proposed Multi-Family Development

Project No: Timberlane.BradleyHts **Figure** B-1

Tested By: _____ **Checked By:** _____

Appendix C

Groundwater Monitoring Data

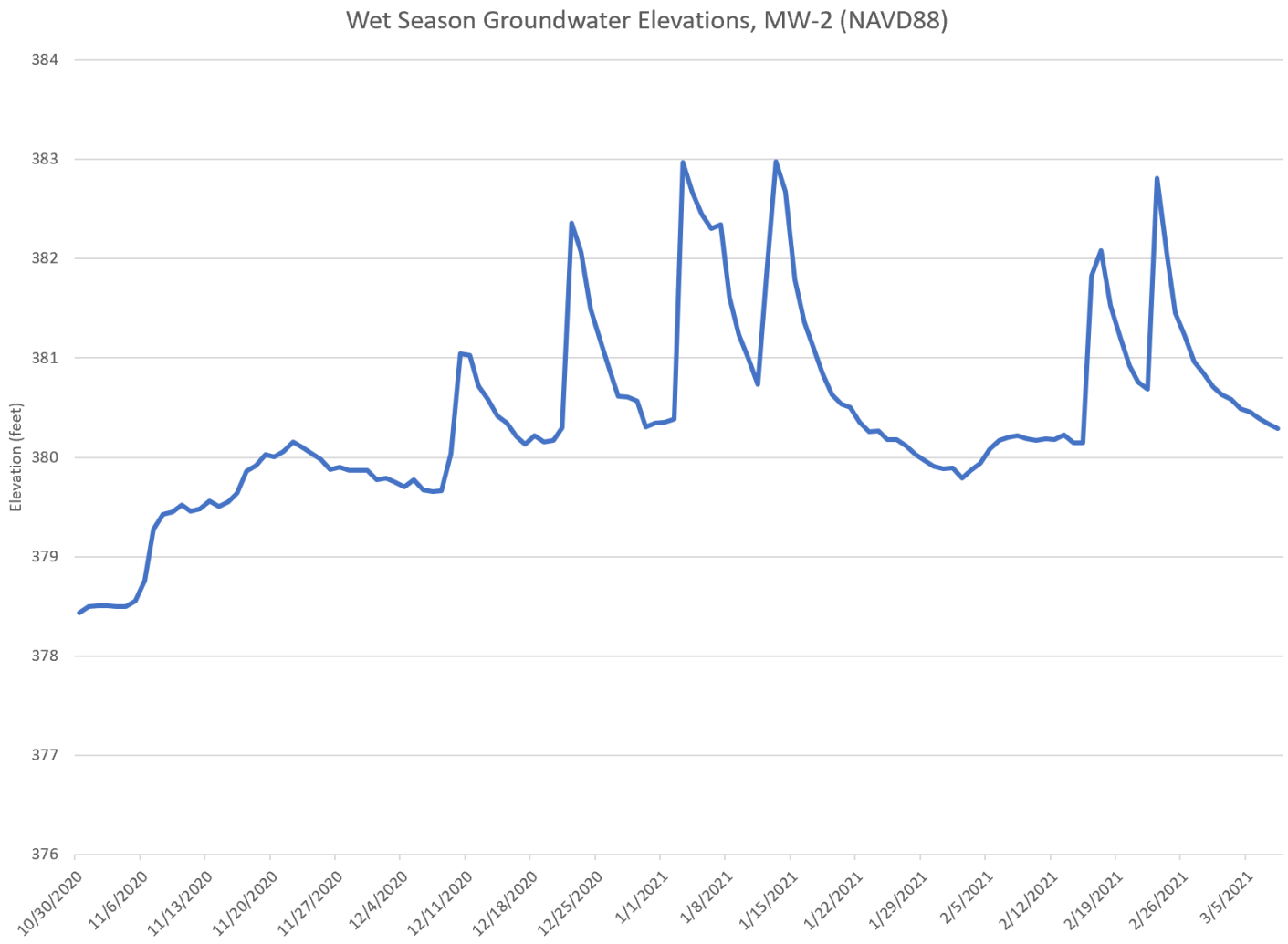


GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

Seasonal Groundwater Levels

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure C-1



GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www. georesources.rocks

Seasonal Groundwater Levels

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure C-2

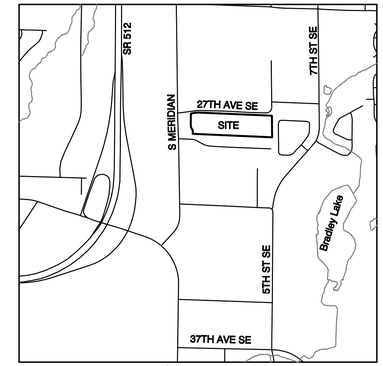
Bradley Heights

Section 3, Township 19 N, Range 4 E, Willamette Meridian, Pierce County, Washington

N
W E
S

GRAPHIC SCALE 1"=40'

0 40 80 120



VICINITY MAP

CONNECT TO EX. STORM
BIOPOD OR FILTERRA
27TH AVE SE
CONNECT TO EX. STORM
5TH ST SE
STORMTANK #1
VAULT #2 COMBINED DET/WETVAULT
BIOPOD OR FILTERRA
STORMFILTER MANHOLE
VAULT #3
BIOPOD OR FILTERRA
VAULT #4 COMBINATION DET/WETVAULT
STORMFILTER MANHOLE
DRAINAGE BASIN LIMITS (TYP.)
28TH AVE SE

FF=378.5' FF=387.5' FF=380.5' FF=389.5' FF=391' FF=394' FF=403' FF=389.75' FF=398.75' FF=388' FF=404.97 FF=407.20' FF=395.8' FF=404.8' FF=397.8' FF=406.8' FF=415.41' FF=418.28' FF=420.78' FF=419.67'

J K A C B D E F G H

Project Desc.: Bradley Heights Path: F:\Jobs\3227 - Bradley Heights\Tmain\bradley heights 2022 0328.pro Plot Date/Time: 3/30/2022 3:26:42PM

ROBERT A. TRIVITT 3/30/2022 EXPIRES 9/29 STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER

REVISION	DATE
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

JOB NO: 3227
DATE: March 28, 2022
DESIGNED BY: Rob Trivitt
DRAWN BY: Rob
CHECKED BY: Paul Green
APPROVED BY: Paul Green

AZURE GREEN CONSULTANTS
+feasibility +planning +engineering +surveying
409 East Pioneer, Suite A · Puyallup, WA 98372 phone: 253.770.3144 fax: 253.770.3142

Preliminary Drainage Plan

Bradley Heights

Timberlane Partners
1816 11th Ave Unit C
Seattle, WA, 98122
Phone
Fax

DRAWING
PRE-1
SHEET 1
OF 2