

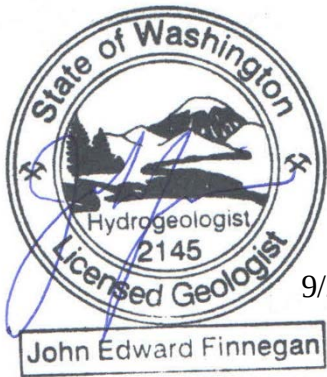
Geotechnical Conditions Report
Grandview 92-Lot Development
Spokane County, WA

Prepared for:

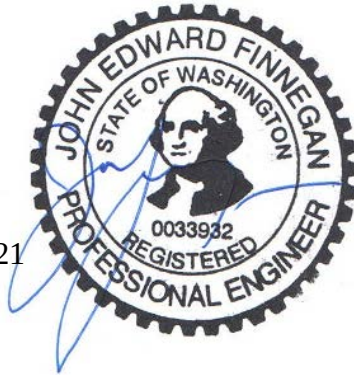
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9/20/2021



9/20/2021

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Budinger
& Associates

CONTENTS

CONTEXT	1
<i>Project Considerations</i>	<i>1</i>
<i>Location</i>	<i>1</i>
<i>Scope... ..</i>	<i>1</i>
<i>Conceptual Phase Evaluation</i>	<i>1</i>
<i>Design Phase Evaluation</i>	<i>2</i>
ENCOUNTERED CONDITIONS	2
<i>Physical Setting</i>	<i>2</i>
<i>Surface Conditions</i>	<i>3</i>
<i>Subsurface Conditions</i>	<i>3</i>
<i>Surface and Groundwater Hydrology.....</i>	<i>4</i>
PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS	4
<i>Seismic Considerations</i>	<i>5</i>
<i>Earthwork</i>	<i>5</i>
<i>Additional Services</i>	<i>6</i>
FIELD EXPLORATION.....	6
<i>Test Pits.....</i>	<i>6</i>
<i>Soil Samples.....</i>	<i>6</i>
<i>Soil and Rock Classification</i>	<i>6</i>
<i>Location</i>	<i>7</i>
LABORATORY ANALYSIS	7
<i>Index Paramters</i>	<i>7</i>
LIMITATIONS	7
REFERENCES	8

EMBEDDED TABLES

<i>Table 1: Seismic Design Parameters</i>	<i>5</i>
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ATTACHED FIGURES

Figure 1: Vicinity Map
Figures 2-1 to 2-2: Site Plan and Geo/LIDAR Overview Plan
Figure 3: Guide to Soil & Rock Descriptions
Figures 4-1 to 4-13: Test Pit Logs
Figure 5: Laboratory Summary
Figure 6: Grain Size Distributions
Appendix: Important Information about Your Geotechnical-Engineering Report

CONTEXT

This conceptual phase geotechnical conditions report (GCR) presents the results of limited geotechnical exploration and analysis for design of the proposed development. Our work was contracted and coordinated with Toll Brothers, Inc., represented by David Morse.

Project Considerations

A single-family residential housing development is planned in the Grandview Avenue-17th Avenue neighborhood in the City of Spokane, WA. It will consist of approximately 92 residential lots and 6 Tracts. The proposed site occupies approximately 22.4 acres. Preliminary plans for the lot layout were provided by Whipple Consulting Engineers, dated May 8, 2021.

This report addresses general geotechnical information needed to complete planning, layout, and conceptual design. Additional geotechnical services will be needed to complete a geotechnical engineering report (GER) appropriate for civil design, structural design, and construction.

Location

The site is approximately ½-mile south of Sunset Highway at Rustle Road and ½-mile east on Grandview at 17th. It is positioned on the south side of 17th between H and D Streets, to the west and east, respectively. The site occupies 15 Spokane County Parcels, numbered 25261.2606, .2607, .2710, .2812, .2901, .3001, .3002, .3003, .3004, .3005, .3101, .3203, .3204, .3301, and .3305. It is in the SW ¼ of the NE ¼ of Section 26, Township 25N, Range 42E WM, Washington, as illustrated in the *Vicinity Map* and *Site Plan*.

Scope

This geotechnical study involved interpretation of subsurface soil conditions to assess the suitability of the site for the overall conceptual design phase. We endeavored to conduct these services in accordance with generally accepted geotechnical engineering practices as outlined in proposal, S21702, dated August 19, 2021. The following scope was completed:

Conceptual Phase Evaluation

The first Task included exploring subsurface conditions with 13 test pits excavated to depths ranging from 1 to 17 feet deep. Test pits were excavated by your earthwork contractor and backfilled in compacted lifts upon completion.

Subsurface conditions were logged by a qualified geologist.

Limited laboratory testing was completed on representative soil samples. The testing included moisture content, Atterberg Limits, and gradation.

Characterization of subsurface conditions encountered included:

- Layering (stratification);
- Soil texture and classification;
- Risks from existing, undocumented fill soils;
- Soil moisture, capillarity, and groundwater; and,
- Seismic considerations.

This report presents conclusions and recommendations limited to engineering parameters for general site development including depth to bedrock, and potential infiltration areas. Parameters to complete design of individual lot foundations, earthwork, retaining walls, slabs, pavements, and stormwater infiltration rates are beyond the scope of this proposed phase. Recommendations for determining which individual lots should be scheduled for specific geotechnical engineering exploration and analysis, if any, are included.

Further subsurface exploration, not authorized at this time, includes: borings for exploration and analysis with additional soil testing for stormwater infiltration in accordance with *Spokane Regional Stormwater Manual* (SRSW), dynamic cone penetrometer soundings for soil density estimates, and pavement DCP for subgrade soil strength analysis and pavement section design. These results can be presented as addenda to this report.

Design Phase Evaluation

Information needed to complete design-level geotechnical services includes anticipated structural loads, anticipated pavement traffic loads, anticipated finish floor elevations, and locations and heights of retaining walls, if required.

ENCOUNTERED CONDITIONS

Physical Setting

The site is centered on a bluff of a remnant basalt lava plateau with steep sides eroded and undercut by glacial flood waters. Geologic mapping of this area shows Glacial Lake Missoula outburst flood deposits (*Qfg*) across but primarily along the lower reaches of middle Miocene Epoch Basalt lava (*Mwp*) belonging to the Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group. (WSDNR, 2004). An interflow of lacustrine sediments of the Latah Formation occurs between the Priest Rapids Basalt and underlying Grande Ronde Basalt.

Qfg is described as “thick-bedded to massive mixture of boulders, cobbles, pebbles, granules, and sand; contains beds and lenses of sand and silt; gray, yellowish gray, or light brown; poorly to moderately sorted; both matrix and clast supported; locally composed of boulders and cobbles in a matrix of mostly pebbles and coarse sand” (WSDNR, 2004).

The *Mwp* unit is described as “Dark gray to black, fine-grained, dense basalt. [It] lies directly on pre-Miocene rocks, Latah Formation, or Grande Ronde Basalt; contact with the underlying Grande Ronde Basalt occurs between 2,200 and 2,300 ft elevation” (WSDNR, 2004).

Soil types at the site, as mapped by the USDA Web Soil Survey, consist of *Rockly-Fourmound complex, 0 to 15 percent slopes* (unit 3114), *Northstar-Rock outcrop complex, 3 to 15 percent slopes* (Unit 3115), *Rock outcrop-Northstar complex, 15 to 30 percent slopes* (Unit 3126), and *Urban land-Northstar, disturbed complex, 3 to 8 percent slopes* (unit 7131) (NRCS, 2020).

Units 3114 and 3115 are rated by the NRCS as hydrologic soil groups D and C, respectively. The saturated hydraulic conductivity for units 3114 and 3115 is approximately 1.3 and 7.7 inches per hour, respectively (NRCS, 2020).

Surface Conditions

The site consisted of undeveloped land with abundant outcrop of rock and steep rock faces with accumulated talus. Site topography is best described as two relatively level benches above the overall plateau surface. Maximum total relief across the site was 78 feet from the top of the benches down to the plateau surface to the north at 17th. Elevations of the top of the benches were 2,270 feet (City Datum). Steep slopes ranging from 36 to 100 percent inclinations at heights of 20 to 40 feet were observed along the margins of the benches. Steeper slopes were generally observed along southern exposures.

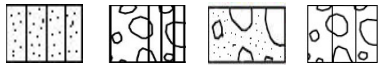
The benches are bisected by a northwest-southeast trending saddle between two small basins as illustrated in the *Geo-LIDAR Overview Plan*. Two meadows occupy the basins containing a wide assemblage of vegetation including shrubs and Ponderosa Pine trees. The basins sloped gently from the saddle at elevation of 2,264 feet down to elevation 2,240 feet at 15 percent inclinations. The remainder of the site sloped gently down to the plateau surface.

Subsurface Conditions

Conditions encountered in the test pits are described in the *Test Pit Logs* in accordance with methods described in *Field Exploration*. The following groups of subsurface materials were differentiated based on characteristics relevant to this project:

soil

Log symbols:



Silt with sand was the predominant soil encountered across the site. It was present between outcrop and directly overlying rock in 5 test pits. Where encountered, the silt with sand ranged from 2 to 6 feet thick beginning at the ground surface. It averaged 4.5 feet thick. Fines content (percent, by weight, passing the US #200 sieve) was 79 percent for one representative sample tested. Fines were non-plastic. At Test Pit 13 (TP-13), it overlaid two horizons consisting of silty gravel overlying sand with gravel, with rock beginning 6 feet below ground surface (BGS).

Silty sand with gravel varying to silty gravel with sand and cobbles was encountered in 4 test pits directly overlying rock. It ranged from 1.5 to 5.5 feet thick and averaged 3.5 feet thick. At TP-5 and TP-13, it was 2 feet thick. This stratum was likely coarse alluvium originally deposited on rock with fines washed into the open graded deposit as described in the following paragraph.

TP-5 encountered 2 feet of surficial colluvium consisting of angular gravel and cobbles in a matrix of silt and sand beginning at the ground surface. A thick deposit of gravel with silt, sand, and cobbles extended from 2 feet BGS to greater than 17 feet BGS, the maximum reach of the excavator. The characteristic differing this horizon from the surficial silty gravel was in the fines content of 7.7 percent.

An isolated deposit of sand with gravel and cobbles with 3.3 percent fines was encountered in TP-13. It was only 2 feet thick between 4 and 6 feet BGS laying directly on rock. This appears to be the only occurrence of permeable soil. However, it lacks sufficient thickness and lateral extent to qualify as an infiltration stratum as follows:

The primary relevant stormwater design documents are the *Spokane Regional Stormwater Manual* (SRSM, 2008) and *Stormwater Management Manual for Eastern Washington* (SMMEW, 2019). The SRSM includes Geotechnical Site Characterization (GSC) requirements for characterizing the suitability of soil units for receiving stormwater by infiltration structures. Use of infiltration structures requires a suitable target soil of adequate thickness, extent, and permeability. Extensive thick permeable soils for rapid infiltration appear to be lacking across this site.

basalt

Log symbol



Extrusive *basalt* lava rock was observed as outcrop across the site and in all but one test pit beginning at depths ranging from 0 to 6 feet BGS. TP-5 did not encounter rock to the depth of reach of the excavator at 17 feet BGS. Encountered *basalt* was moderately to highly weathered in the top 0.5 to 6 feet with an average weathered surface less than 2 feet thick. The exposed *basalt* comprises the upper, entablature, portion of the flow. Unlike columnar *basalt* found at lower elevations, it generally contains randomly oriented very close to closely spaced jointing in good condition. As such, it may require significant hoe-ram breaking to remove competent segments.

Surface and Groundwater Hydrology

Surface waters were not observed on site. A 12.98-acre Freshwater Emergent Wetland occurred in a topographic basin 100 feet to the southwest of the site. Although surface water was not observed during the dry summer, the area is classified as PEM1C (USFWS). The classification *PEM1C* includes, but is not limited to, the presence of *herbaceous hydrophytes for most of the growing season* and *visible surface water for extended periods*.

Groundwater was not encountered during explorations which were primarily up on the rock benches. Mottled textures in the soil that would indicate the presence of fluctuating groundwater over long periods of time were not observed. Local well reports obtained through the Washington State Department of Ecology website show ground water levels beginning at depths greater than 60 feet BGS in the within 0.75-mile of the site.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Soils are generally thin across the site with the exception of TP-5 which extended below the depth of reach of the excavator, 17 feet BGS. Predominant soil is silt with fine sand. Limited thickness and extent of gravel was encountered in 4 test pits.

The subgrade contains abundant *basalt* rock.

With the exception of TP-5, the depth to *basalt* ranged in depth from outcrop to 6 feet BGS. The condition of *basalt* varied throughout the site. Weathered rock segments were excavatable to depths of up to 8 feet with the 50 to 60-ton excavator used during the subsurface explorations. Excavation in the fresh rock was as little as 1 foot.

Some areas were fresh, competent, and contained randomly oriented very close to closely spaced

jointing in good condition. As such, it may require significant hoe-ram breaking to remove fresh rock segments.

The fine-grained silty soils are not suitable for re-use as structural fill. These soils are also susceptible to frost heave and capable of wicking moisture throughout the soil profile.

Suitable stormwater infiltration areas require a suitable target soil of adequate thickness, extent, and permeability. Such soil was not found on the site during this task. Alternative systems (infiltration galleries, under-drain systems, etc) may be required. Test pit infiltration test methods in accordance with the *SRS*M can be used for alternative design.

The site includes topography that exhibits slopes of 30 percent or greater. The Spokane County Critical Areas Ordinance, Chapter 11.20, defines such slopes as *geologically hazardous areas* and further delineation and characterization will apply.

Seismic Considerations

The recommended seismic site class designation is Site Class C, “*very dense soil and soft rock*.” Spectral response acceleration parameters, adjusted for Site Class C, were calculated using USGS, U.S. Seismic Design Web Services through the Applied Technology Council website (ATC, 2019). The values of predicted earthquake ground motion for short period structural elements (0.2 second spectral response acceleration, S_s) and for long period structural elements (1.0 second spectral response acceleration, S_1) are provided in the table below. The design parameters (S_{DS} and S_{D1}) are equal to $\frac{2}{3}$ of the maximum earthquake spectral response accelerations (S_{MS} and S_{M1}).

Table 1. Seismic Design Parameters

Site Class	Latitude	Longitude	PGA	S_s	S_1	S_{DS}	S_{D1}
C	47.64 N	-117.46 W	0.142g	0.329g	0.115g	0.264g	0.129g

Due to the presence of relatively shallow rock, the low probability of high ground acceleration, and absence of shallow groundwater, estimated liquefaction potential is very low.

Earthwork

Development in the northeast and southwest portions of the site will involve the most *basalt* excavation but settlement risks will be minimized in this area. Rock will be difficult to excavate and may require breaking hammers and blasting. The remainder of the site will offer the least amount of *basalt* excavation, but there may be settlement risks associated with loose soil conditions. Foundations that span both *soil* and *basalt* should be over-excavated to avoid differential settlement risks.

The overburden soils are generally granular in nature, consistent with Type C materials per WISHA excavation criteria. WISHA specifies a maximum inclination of 1-½ horizontal to 1 vertical (1-½ H:1V) in the temporary condition for Type C.

Fill material. The encountered coarse-grained soils may be suitable for re-use as structural fill provided that deleterious items (anthropogenic debris, organics, and over-sized materials, etc.) are removed prior to their re-use. However, these soils are comprised of fine sands and silts, are moisture-sensitive and may be difficult to compact. If imported fill is used a material such as Common Borrow in WSDOT Standard Specifications for Road, Bridge, and Municipal

Construction Section 9-03.14(3) is recommended.

Additional Services

Effective geotechnical services involve cooperation with the owner, designer, and constructor as follows:

1. Preliminary study to assist in planning and to economically adapt the project to its geologic environment.
2. Soil exploration and analysis to characterize subsurface conditions and recommend design criteria.
3. Consultation with the designer to adapt the specific design to the site in accordance with the recommendations.
4. Construction observation to verify the conditions encountered and to make recommendations for modifications as necessary.
5. Construction material testing, quality control, and special inspection.

This GCR satisfies Item 1 of the 5-phase endeavor. Additional geotechnical services will be needed to complete a GER when design-level information is available. We are eager to provide assistance with design and construction as appropriate to assist in completing a safe and economical project.

FIELD EXPLORATION

The fieldwork was conducted by lead geologist Jason Pritzl, GIT, and supervised by geotechnical engineer John Finnegan, PE, on August 9, 2021. The field activities generally consisted of the following:

- Reconnaissance of the site and surrounding area;
- Logging subsurface conditions for 13 test pits; and
- Obtaining bulk samples of the soils.

Results are presented in *Figures*.

Test Pits

Test pits were excavated with a Volvo EC480 excavator with a 48-inch bucket by Selland's Construction, Inc. Criteria governing the depth to which test pits were excavated included limits of equipment reach and digging refusal with a 50-ton, 373hp excavator on competent *basalt*.

Soil Samples

Samples were obtained by capturing representative material from the bucket of the excavator or from within the excavation while less than 4 feet below grade.

Soil and Rock Classification

WSDOT Soil and Rock Classification and Logging. Field descriptions of soils and rock were completed in accordance with the current version of the Washington State Department of Transportation, *Geotechnical Design Manual* (GDM), M 46-03.11, except that fines (silt and clay) were described in accordance with ASTM D 2487. Whereas, the GDM uses the terms 'silty' and

‘clayey’ to describe a very broad range of fines from 10 to 49 percent; ASTM D 2487 uses those terms for percentages greater than 12 and the term ‘with’ for fines ranging from 5 to 12 percent, which is typically necessary to describe variations relevant to soil permeability per the SRSM. A key to the descriptions is provided in *Guide to Soil and Rock Descriptions*.

Location

Horizontal & vertical control. Plans were provided by the client. The *Site Plan* is based on measured offsets from existing site features at the time of exploration.

Elevations presented on the *Test Pit Logs* were correlated from topographical data illustrated on the provided plans. Horizontal and vertical locations can be considered accurate to within 5-foot and 1-foot, respectively, relative to the information provided.

LABORATORY ANALYSIS

Laboratory testing was performed on representative samples of the soils encountered to provide data used in our assessment of soil characteristics.

Tests were conducted, where practical, in accordance with nationally recognized standards (ASTM, AASHTO, etc.), which are intended to model in-situ soil conditions and behavior. The results are presented in *Figures*.

Index Parameters

Moisture content – ASTM D2216. Moisture contents were determined by direct weight proportion (weight of water/weight of dry soil) determined by drying soil samples in an oven until reaching constant weight.

Gradation – ASTM D6913. Gradation analysis was performed by the mechanical sieve method. The mechanical sieve method is utilized to determine particle size distribution based upon the dry weight of sample passing through sieves of varying mesh sizes. The results of gradation are provided in *Grain Size Distribution Results*.

Atterberg Limits – ASTM D4318. Atterberg limits describe the properties of a soil’s fine-grained constituents by relating the water content to the soil’s limits of engineering behavior. As the water content increases, the state of the soil changes from a brittle solid to a plastic solid and then to a viscous liquid.

The liquid limit (LL) is the water content above which the soil tends to behave as a viscous liquid. Similarly, the plastic limit (PL) is defined as the water content below which the soil tends to behave as a brittle solid. The plasticity index describes the range of water content over which a soil is plastic and is derived by subtracting the PL from the LL. The soil is classified as “non-plastic” if rolling a 1/8-inch bead is not possible at any water content.

LIMITATIONS

The conclusions and recommendations presented herein are based upon the results of field

explorations and laboratory testing results. They are predicated upon our understanding of the project, its design, and its location as defined in by the client. We endeavored to conduct this study in accordance with generally accepted geotechnical engineering practices in this area.

This GCR - presents our professional interpretation of exploration data developed, which we believe meets the standards of the geotechnical profession in this area; we make no other warranties, express or implied. Attached is a document titled “*Important Information About Your Geotechnical Engineering Report*,” which we recommend you review carefully to better understand the context within which these services were completed.

Unless test locations are specified by others or limited by accessibility, the scope of analysis is intended to develop data from a representative portion of the site. However, the areas tested are discreet. Interpolation between these discreet locations is made for illustrative purposes only but should be expected to vary. If a greater level of detail is desired, the client should request an increased scope of exploration.

REFERENCES

Applied Technology Council (ATC), Hazards by Location, Seismic Loads Application. Available online at <https://hazards.atcouncil.org/#/>.

ASTM International, 2011, Standard Practice for Classification of Soils for Engineering Purposes, D 2487-11.

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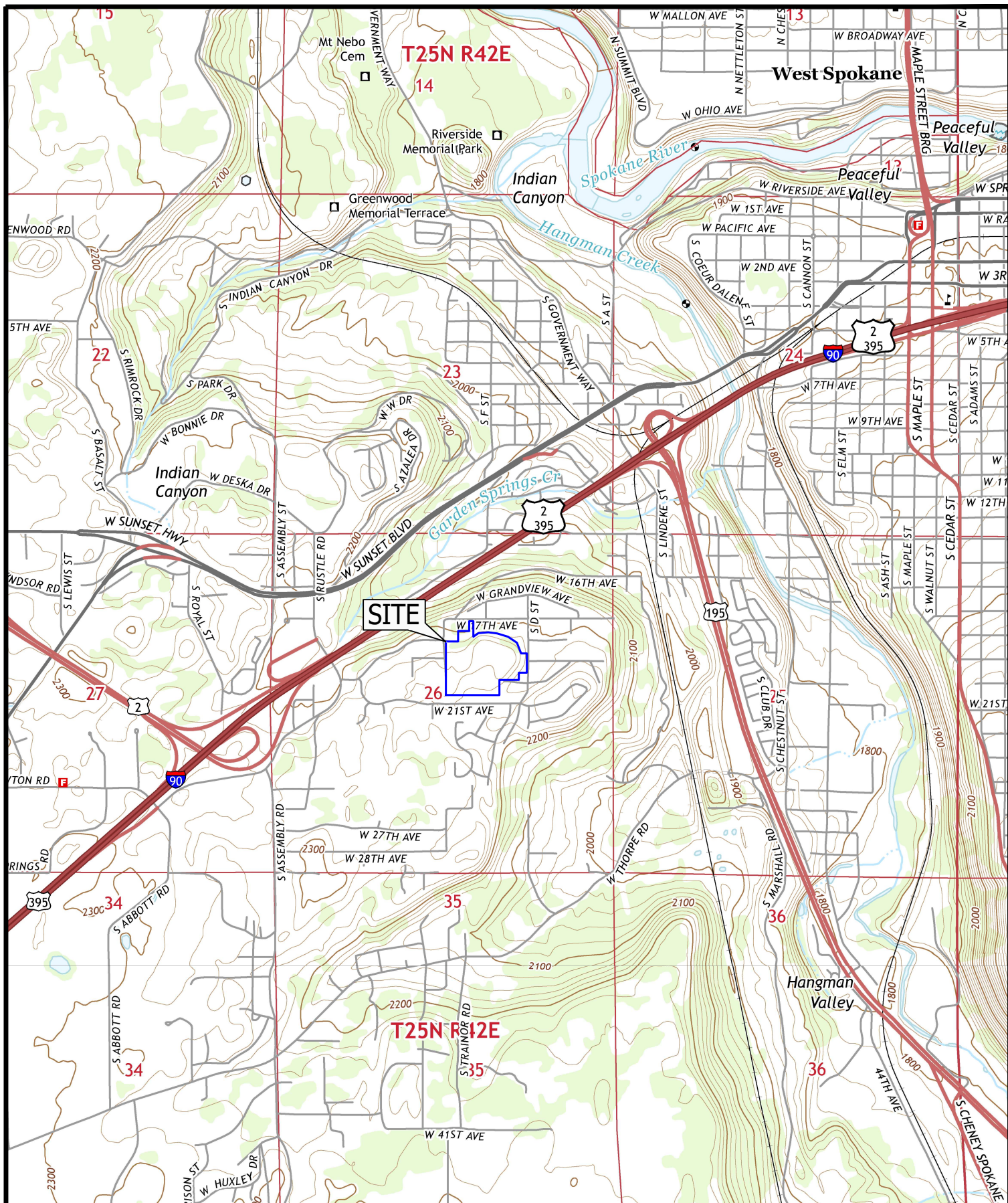
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Washington State Department of Natural Resources (WSDNR), 2004, Geologic Map of the Spokane Northwest 7.5-minute Quadrangle, Spokane County, Washington, OFR 2004-3.

Washington State Department of Transportation, 2019, Geotechnical Design Manual (WSDOT GDM).

Washington State Department of Transportation, 2020, Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT SS).



SCALE: 1"=2000'
0 1000 2000

SECTION 26
T 25 N R 42 E
USGS 2014



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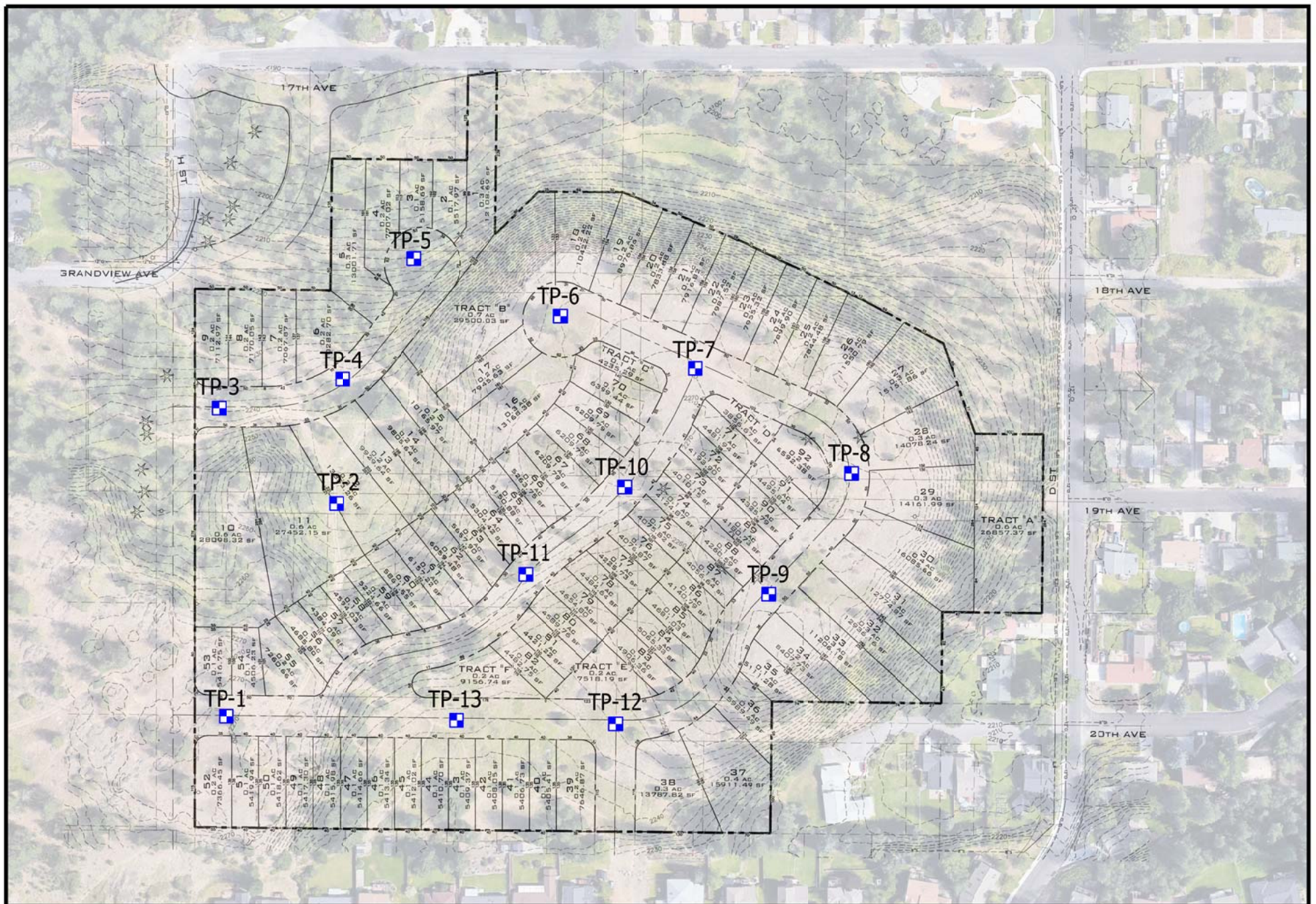
VICINITY MAP

GRANDVIEW 92-LOT HOUSING DEVELOPMENT
SPOKANE, WASHINGTON

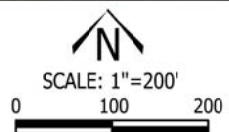
FIGURE 1

PROJECT NUMBER S21702

DATE: 8/2021



■ TEST PIT LOCATION (TP-1)



BASE PLAN FROM
WCE



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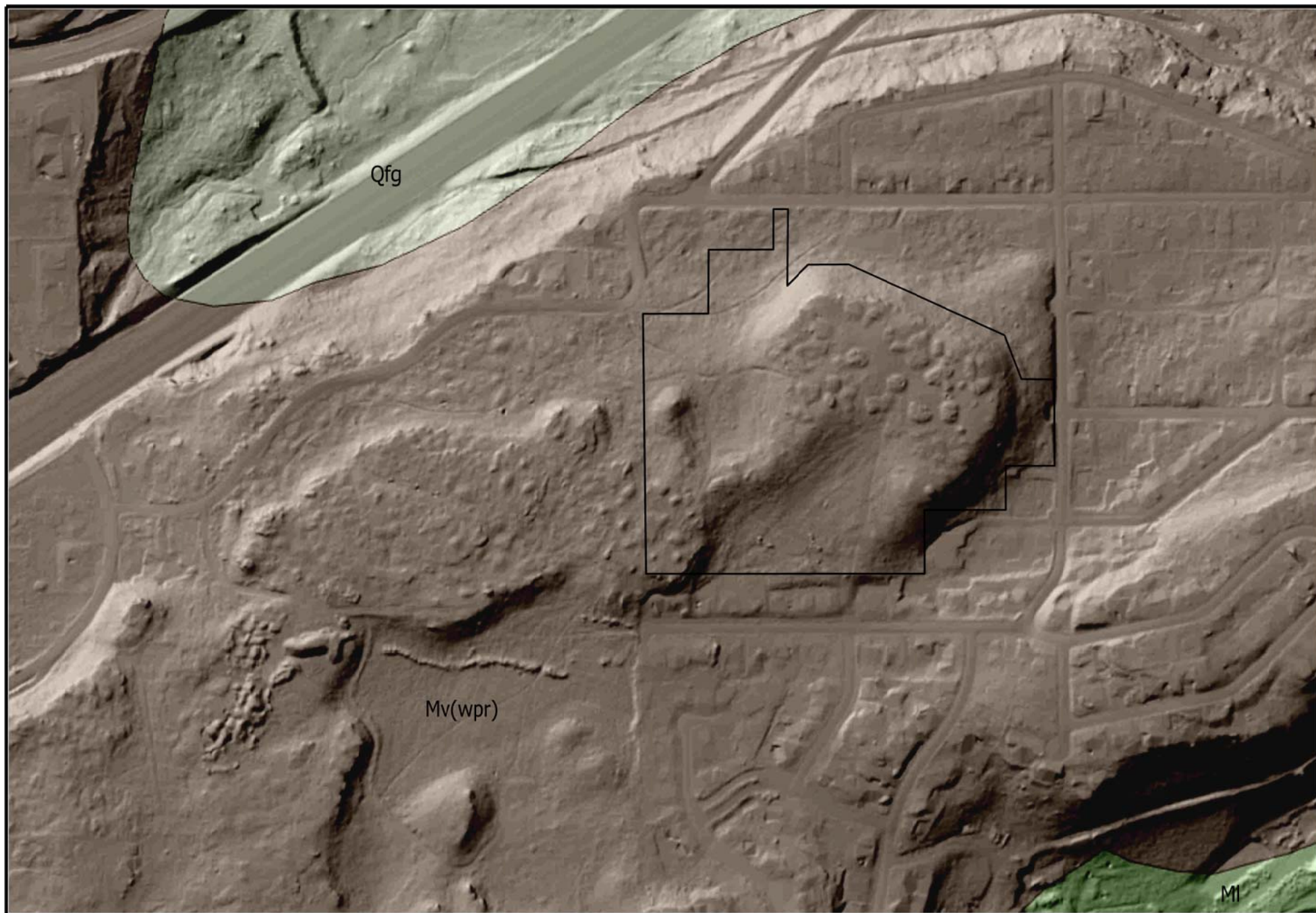
SITE PLAN

GRANDVIEW 92-LOT HOUSING DEVELOPMENT
SPOKANE, WASHINGTON

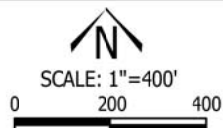
FIGURE 2-1

PROJECT NUMBER S21702

DATE: 8/2021



Qfg - Pleistocene outburst flood deposits
Mv(wpr) - Priest Rapids Basalt
MI - Latah Formation



BASE PLAN FROM
WSDNR GEOLOGY PORTAL



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GEO-LIDAR OVERVIEW PLAN

GRANDVIEW 92-LOT HOUSING DEVELOPMENT
SPOKANE, WASHINGTON

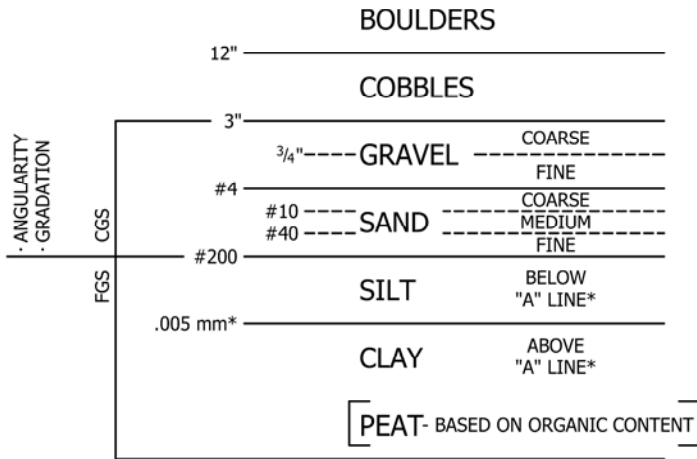
FIGURE 2-2

PROJECT NUMBER S21702

DATE: 8/2021

GUIDE TO SOIL & ROCK DESCRIPTIONS

SOIL CLASSIFICATION



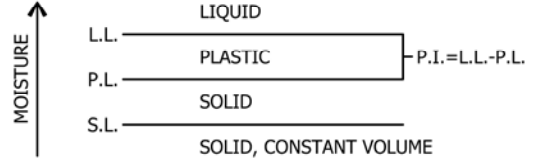
* SEE PLASTICITY CHART

CGS - COARSE GRAINED SOIL - MORE THAN 50% RETAINED ON A #200 SIEVE

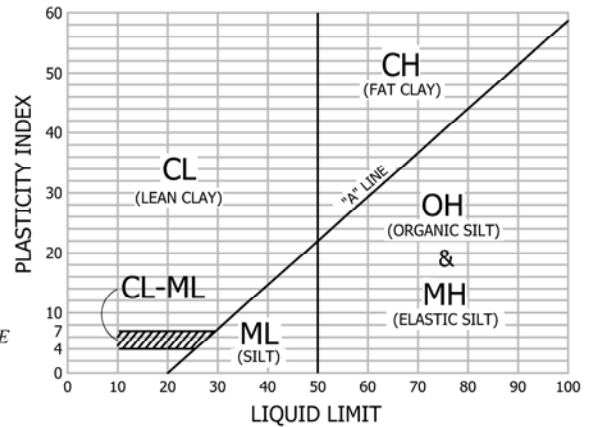
FGS - FINE GRAINED SOIL - 50% MORE PASSES, #200 SIEVE

FINES - PORTION FINER THAN #200 SIEVE

ATTERBERG LIMITS



PLASTICITY CHART



NOTE - CHART APPLIES TO FGS AND MINUS #40 SIEVE FRACTION OF CGS

GUIDE TO SOIL DESCRIPTION MODIFIERS, MOISTURE, AND CONDITION PRESENTED ON LOGS

MODIFIER	ESTIMATED PERCENTAGE OF MATERIAL	MOISTURE	SOIL CONDITION
SUFFIX "LY" OR "Y"	30% OR MORE FOR COARSE PARTS IN FGS GREATER THAN 12% FOR FINES IN CGS	DRY	CGS: VERY LOOSE
WITH	15% - 29% FOR COARSE PARTS IN FGS 6% - 14% FOR FINES IN CGS	MOIST	LOOSE
		SATURATED OR WET	MEDIUM DENSE DENSE VERY DENSE

NOTE - VISUAL ESTIMATES OF MATERIAL PERCENTAGES TYPICALLY VARY 0 TO 10% FROM THOSE DETERMINED BY LABORATORY TESTING.

SAMPLES

	STANDARD 2" PENETRATION TEST SAMPLER WITH BLOWS PER FOOT
	3" SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
	DRILL CUTTING SAMPLE
	BULK SAMPLE
	THIN-WALLED TUBE SAMPLE
	DIAMOND CORE RUN WITH % RECOVERY & ROCK QUALITY DESIGNATION
	2.5" SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
	CONTINUOUS SOIL SAMPLE
R	REFUSAL OF SAMPLE (50+ BLOWS PER 6")

ROCK WEATHERING

FRESH
SLIGHTLY WEATHERED
MODERATELY WEATHERED
HIGHLY WEATHERED
COMPLETELY WEATHERED
RESIDUAL SOIL

ROCK CONDITION

EXTREMELY WEAK
VERY WEAK
MODERATELY WEAK
MODERATELY STRONG
STRONG
VERY STRONG



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FIGURE 3

TEST PIT 1

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; north of proposed Lot 52
Surface: grass and weeds

Elevation: 2270 ft
Logged by: J. Pritzl
Size of hole: 6 X 10 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, light brown	SILT with fine Sand, occasional angular to subangular Gravel and Cobbles, moderate amount of small roots to 0.5 feet.											
			Basalt Fresh											
5		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 4.5 ft											
10														
15														
20														



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TEST PIT LOGS

FIGURE 4-1

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 2

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Center property line between proposed Lots 11 & 12
Surface: grass and weeds

Elevation: 2242 ft
Logged by: J. Pritzl
Size of hole: 6 X 11 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, light brown	SILT with fine Sand, occasional angular to subangular Gravel and Cobbles, moderate amount of small roots to 0.5 feet.											
5														
		dark brownish gray	BASALT, moderately weathered											
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 6 ft											
10														
15														
20														



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TEST PIT LOGS

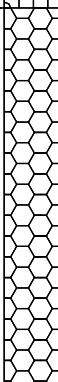
FIGURE 4-2

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 3

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; north of proposed Lot 10
Surface: grass and weeds

Elevation: 2240 ft
Logged by: J. Pritzl
Size of hole: 6 X 13 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, light brown	SILT with Sand, Gravel, and Cobbles (colluvium)											
		dark brownish gray	BASALT, highly weathered with zones of saprolite											
5														
10		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 8 ft											
15														
20														



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TEST PIT LOGS

FIGURE 4-3

Project: Grandview 92-Lot Housing Development

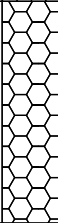
Location: Spokane, WA

Number: S21702

TEST PIT 4

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; south of proposed Lot 6
Surface: grass and weeds

Elevation: 2238 ft
Logged by: J. Pritzl
Size of hole: 6 X 12 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, light brown	SILT with Sand, Gravel and Cobbles (colluvium)											
		dark brownish gray	BASALT, highly weathered with zones of saprolite											
5														
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 5 ft											
10														
15														
20														



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TEST PIT LOGS

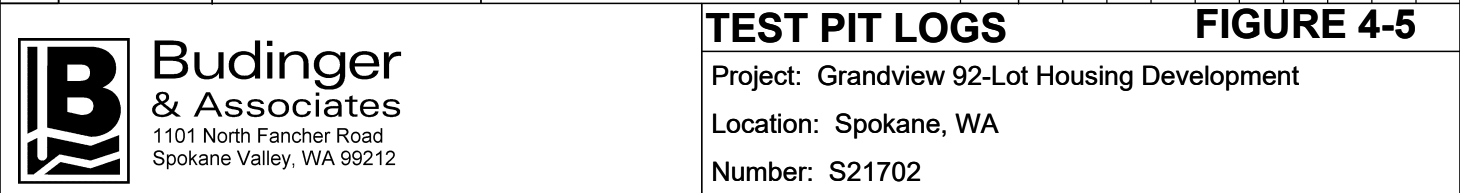
FIGURE 4-4

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 5

Date: 8-9-21 Excavator: Selland's Construction Equipment: Volvo EC480 Location: Center of proposed cul-de-sac south of proposed Lot 3 Surface: grass and weeds	Elevation: 2210 ft Logged by: J. Pritzl Size of hole: 6 X 14 feet
---	--

Date: 8-9-21 Excavator: Selland's Construction Equipment: Volvo EC480 Location: Center of proposed cul-de-sac south of proposed Lot 3 Surface: grass and weeds	Elevation: 2210 ft Logged by: J. Pritzl Size of hole: 6 X 14 feet
---	--

[illegible]

TEST PIT 6

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Center of proposed cul-de-sac south of proposed Lot 18
Surface: grass and weeds

Elevation: 2266 ft
Logged by: J. Pritzl
Size of hole: 6 X 12 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, light brown	SILT with fine Sand											
5		dark brownish gray	BASALT, moderately weathered											
10		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 6.5 ft											
15														
20														



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TEST PIT LOGS FIGURE 4-6

Project: Grandview 92-Lot Housing Development
 Location: Spokane, WA
 Number: S21702

TEST PIT 7

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; south of proposed Lot 22
Surface: grass and weeds

Elevation: 2270 ft
Logged by: J. Pritzl
Size of hole: 5 X 8 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0		dark brownish gray	BASALT, moderately weathered		10	20	30	40	50	60	70	80	90	
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 1.5 ft											
5														
10														
15														
20														



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TEST PIT LOGS

FIGURE 4-7

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 8

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; west of proposed Lot 29
Surface: grass and weeds

Elevation: 2271 ft
Logged by: J. Pritzl
Size of hole: 5 X 8 feet

					TEST RESULTS									
DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	ATTERBERG LIMITS									
					PL LL									
0					WATER CONTENT									
		dark brownish gray	BASALT, moderately weathered		10	20	30	40	50	60	70	80	90	
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 1 ft											
5														
10														
15														
20														



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TEST PIT LOGS

FIGURE 4-8

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 9

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; west of proposed Lot 33
Surface: grass and weeds

Elevation: 2269 ft
Logged by: J. Pritzl
Size of hole: 6 X 12 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, dark orangish brown	SILT with fine Sand											
5														
			Basalt, fresh											
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 6 ft											
10														
15														
20														



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TEST PIT LOGS

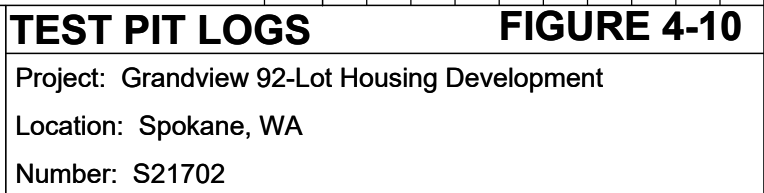
FIGURE 4-9

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 10

Date: 8-9-21 Excavator: Selland's Construction Equipment: Volvo EC480 Location: Proposed road alignment CL; west of proposed Lot 75 Surface: grass and weeds	Elevation: 2268 ft Logged by: J. Pritzl Size of hole: 6 X 10 feet
---	--

Date: 8-9-21 Excavator: Selland's Construction Equipment: Volvo EC480 Location: Proposed road alignment CL; west of proposed Lot 75 Surface: grass and weeds	Elevation: 2268 ft Logged by: J. Pritzl Size of hole: 6 X 10 feet
---	--

[illegible]

TEST PIT 11

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; west of proposed Lot 80
Surface: grass and weeds

Elevation: 2263 ft
Logged by: J. Pritzl
Size of hole: 6 X 9 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS									
0					PL ——— LL									
					WATER CONTENT ○									
					10	20	30	40	50	60	70	80	90	
		dry, grayish brown	SILTY GRAVEL with Sand, Cobbles and Boulders, coarse, angular (colluvium)											
5			Basalt, fresh											
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 6 ft											
10														
15														
20														



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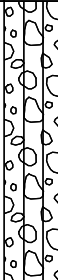
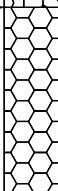
TEST PIT LOGS **FIGURE 4-11**

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 12

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; south of proposed Tract E
Surface: grass and weeds

Elevation: 2246 ft
Logged by: J. Pritzl
Size of hole: 6 X 13 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, grayish brown	SILTY GRAVEL with Sand and Cobbles, coarse, angular (colluvium)											
5		dark grayish brown	BASALT, moderately to highly weathered											
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 7.5 ft											
10														
15														
20														



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TEST PIT LOGS

FIGURE 4-12

Project: Grandview 92-Lot Housing Development
Location: Spokane, WA
Number: S21702

TEST PIT 13

Date: 8-9-21
Excavator: Selland's Construction
Equipment: Volvo EC480
Location: Proposed road alignment CL; north of proposed Lot 43
Surface: grass and weeds

Elevation: 2243 ft
Logged by: J. Pritzl
Size of hole: 6 X 12 feet

DEPTH	SAMPLES	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG	TEST RESULTS									
					ATTERBERG LIMITS PL ——— LL WATER CONTENT ○									
0					10	20	30	40	50	60	70	80	90	
		dry, light brown	SILT with fine Sand											
		dry, grayish brown	SILTY GRAVEL with Sand and Cobbles, coarse, angular (colluvium)											
5		dry, gray	SAND with Gravel and Cobbles, coarse, angular to subangular, micaceous											
		dark grayish brown	BASALT, moderately weathered											
		no free groundwater observed	(digging refusal on fresh Basalt) End of Excavation @ 7.5 ft											
10														
15														
20														



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TEST PIT LOGS

FIGURE 4-13

Project: Grandview 92-Lot Housing Development
 Location: Spokane, WA
 Number: S21702

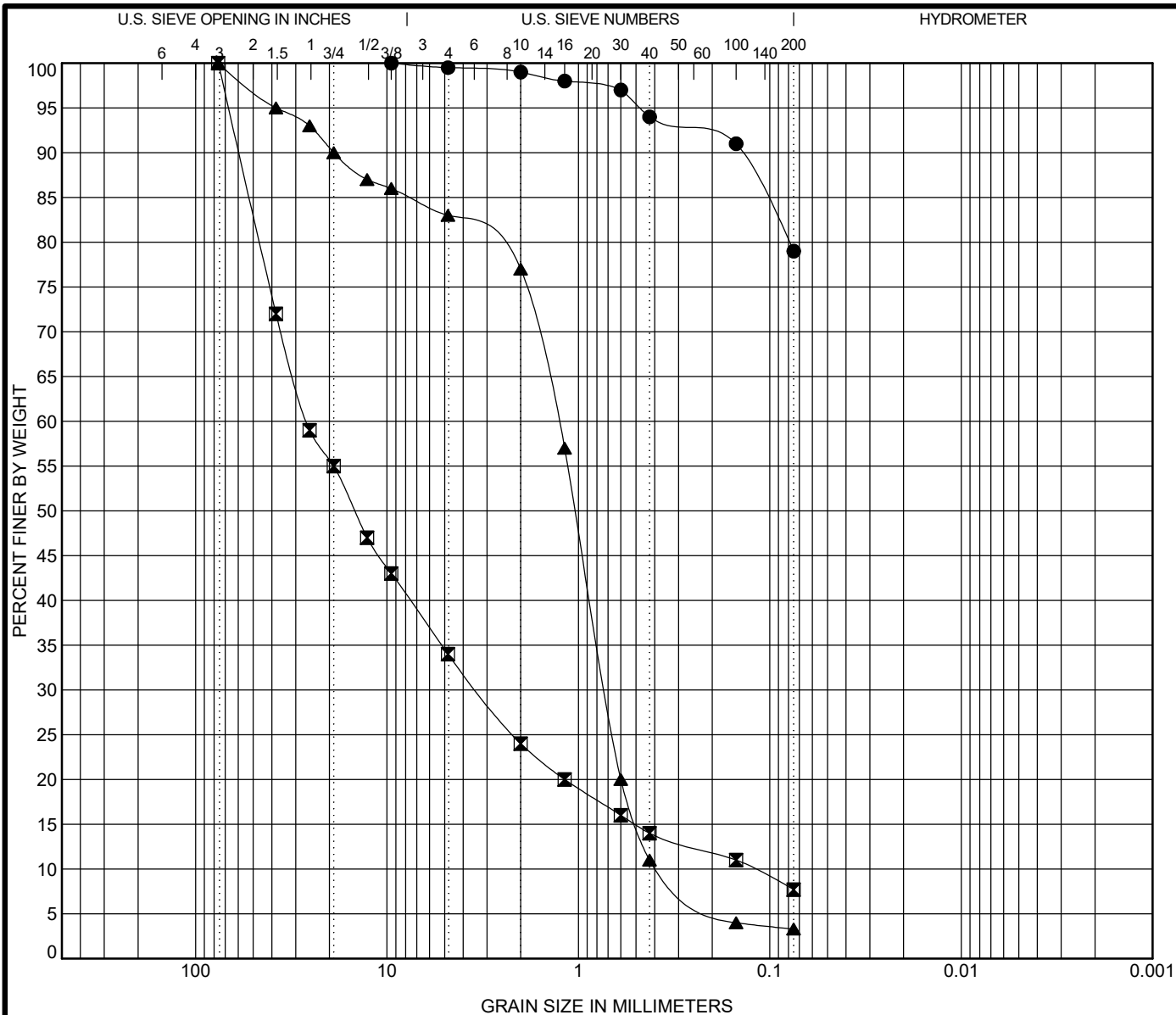
**SOIL MECHANICS
LABORATORY SUMMARY**

LABORATORY NUMBER		Units	Test Methods	21-5581	21-5582	21-5583
TEST PIT NUMBER				TP-2	TP-5	TP-13
DEPTH	TOP	feet		3	10	4.5
	BOTTOM	feet		4	12	5.5
MOISTURE CONTENT		%	ASTM D2216	4.8	8.8	3
PLASTICITY INDEX		%	ASTM D4318	NP	NP	NP
UNIFIED CLASSIFICATION			ASTM D2487	ML	GP-GM	SP
SIEVE ANALYSIS			ASTM D6913			
	3"				100	100
	1 1/2"				72	95
S	1"	%			59	93
I	3/4"				55	90
E	1/2"	P			47	87
V	3/8"	A			43	86
E	#4	S		100	34	83
	#10	S		99	24	77
S	#16	I		98	20	57
I	#30	N		97	16	20
Z	#40	G		94	14	11
E	#100			91	11	4
	#200			79	7.7	3.3

*NP= Non Plastic

+7% Cobbles +6% Cobbles

FIGURE 5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

[illegible][illegible]

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GRAIN SIZE DISTRIBUTION RESULTS

Project: Grandview 92-Lot Housing Development

Location: Spokane, WA

Number: S21702

FIGURE 6

Appendix A: *GBC - Important Information About Your Geotechnical Report*

Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study.* Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



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