Geotechnical Evaluation Report

VOA Young Adult Shelter Addition
3104 East August Avenue
Spokane, Washington

Prepared for:

Architecture All Forms
Spokane, WA

Professional Certification:
This report was prepared by me or under my direct supervision, and I am a duly registered engineer under the laws of the State of Washington.

GREGORY J. VOIGT
STATE OF WASHINGTON
54336
REGISTERED
PROFESSIONAL ENGINEER

8-26-21

Gregory J. Voigt, P.E.
Geotechnical Engineer

Intermountain Materials Testing & Geotechnical
Project No. S21697
August 26, 2021

INTERMOUNTAIN MATERIALS TESTING & GEOTECHNICAL
9401 E. Appleway Blvd.
Spokane Valley, WA 99206
(509) 474-9764

August 26, 2021
Project No. S21697

Robert Vralsted
Architecture All Forms
827 W 1st Ave
Spokane, WA 99201

Re: **Geotechnical Evaluation**
VOA Young Adult Shelter Addition
3104 East August Avenue
Spokane, WA

Dear Mr. Vralsted:

We have completed the geotechnical evaluation for the proposed project located at the above-referenced site in Spokane, Washington. The purpose of the evaluation was to assess the subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and construction of foundations, slabs, underground utilities, and stormwater management facilities and in preparation of plans and specifications for construction.

We appreciate the opportunity to provide our services to you on this project. If you have any questions or need additional information, please do not hesitate to call us at (509) 474-9764 at your convenience.

Sincerely,
INTERMOUNTAIN MATERIALS TESTING & GEOTECHNICAL

Gregory J. Voigt, P.E.
Geotechnical Engineer

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3104 East Augusta Avenue
Spokane, Washington

1.0 INTRODUCTION

1.1 Project Description
We understand the project will consist of the construction of a 1,133 square-foot building addition along with new stormwater management facilities at the site. We understand the addition will be a single-story, wood-framed structure with a slab-on-grade.

1.2 Purpose
The purpose of the evaluation was to assess the subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and construction of foundations, slabs, underground utilities, and stormwater management facilities and in preparation of plans and specifications for construction.

1.3 Scope
Our services were requested by Mr. Robert Vralsted of Architecture All Forms. Mr. Vralsted authorized us to proceed on July 5, 2021. The scope of work agreed upon consisted of the following:

- Review of existing geotechnical data and reports, if available
- Observe the excavation of 2 test pits at the site to depths ranging from 5 to 15 feet
- Perform laboratory tests on samples obtained from the test pits, if necessary
- Classify the soils and prepare test pit logs
- Submit a geotechnical report containing logs of the test pits, results of our field investigation, our analyses and our recommendations for design and construction

1.4 Available Information
We were provided preliminary architectural plans for the project. The plans consisted of a site plan and a floor plan. The plans were prepared by Architecture All Forms and dated April 15, 2021.

1.5 Locations and Elevations
The test pits were excavated at or near locations selected by us. The approximate test pit locations are shown on the Exploration Location Map in Appendix A. The test pits were excavated by an excavator working under subcontract Intermountain Materials Testing & Geotechnical (IMT). Surface elevations at the test pit locations were estimated using Google Earth™.

2.0 RESULTS

2.1 Logs
Log of Test Pit sheets indicating the vertical sequence of soils and materials encountered and groundwater observations are included in Appendix B. The strata changes were measured during

excavation of the test pits. Please note that the depths shown as changes between the strata are only approximate. The changes are likely transitions, and the depths of changes vary between the test pits. Geologic origins for each stratum are based on the soil type, available geologic maps, previous geotechnical reports for this and adjacent sites, and available common knowledge of the depositional history of the site.

2.2 Site Conditions

The site is located at 3104 East Augusta Avenue in Spokane, Washington. The property is currently developed and consists of a building along with associated asphalt pavement areas and landscaped areas. The location of the proposed building addition is in an existing pavement area and is relatively level.

2.3 Soils

Geologic maps indicate the soils in this area consist primarily of glacial flood deposits. According to the Natural Resources Conservation Service (NRCS) Soil Survey of Spokane County, the site soils are classified as Urban land-Opportunity, disturbed complex (7110). The native soils encountered in the test pits were generally consistent with the geologic and NRCS data.

At the surface, Test Pit TP-2 encountered about 2½ inches of asphalt. Below the asphalt or beginning at the surface, the test pits encountered existing fill to depths of 2½ and 4 feet. Below the fill, the test pits encountered glacial flood deposits to their termination depths. The glacial flood deposits consisted of silty to poorly graded gravel.

2.4 Groundwater

Groundwater was not encountered in the test pits during or immediately after excavation. Seasonal and annual fluctuations of groundwater should be anticipated.

2.5 Laboratory Testing

A moisture content test and a percent passing the #200 sieve test (P200) were performed on a sample obtained from Test Pit TP-1. The tests were performed in accordance with ASTM D2216 and ASTM D1140, respectively. The results of the tests are on the test pit logs in Appendix B.

3.0 BASIS FOR RECOMMENDATIONS

3.1 Design Details

We have assumed that wall loads for the addition will be on the order of 1 to 2 kips per lineal foot and column loads, if any, will be less than 50 kips. We have also assumed that grades within the building addition area will remain within 2 feet of existing grades.

We recommend our firm review the geotechnical aspects of the final design and specifications to evaluate whether the design is as expected and whether our recommendations have been incorporated into the construction documents.

3.2 Design and Construction Considerations

The test pits indicate that existing fill is present at the site. Some of the existing fill appears to be undocumented. Because of the potential for variability in the relative density of undocumented fill, it is our opinion that it is not suitable for support of the proposed building addition. We recommend that undocumented fill be excavated from below the proposed addition and replaced with compacted structural fill. Based on the test pits, some of the existing fill may be suitable for reuse as structural fill provided it meets the requirements below in Section 4.2.

Based on the data obtained from the test pits, it is our opinion the proposed addition can be supported on conventional spread footings bearing on the native soils or on compacted structural fill placed over the native soils. The floor slab can also be placed over the native soils or on compacted structural fill placed over the native soils. Furthermore, based on the data obtained from the test pits and the laboratory testing performed, it is our opinion that swales with drywells would be suitable for the infiltration of stormwater.

4.0 ANALYSIS AND RECOMMENDATIONS

4.1 Site Preparation and Grading

We recommend that all undocumented fill and any topsoil, if present, be excavated and removed from below the proposed building addition area. We also recommend that any materials associated with previous structures (foundations, slabs, pavements, etc.) and utilities be removed. After these soils and materials have been removed, we recommend surface compacting the exposed soils prior to placing structural fill or forms for footings.

We recommend that the foundation system associated with the existing building not be undermined. It is our opinion that excavations made adjacent to existing footings not extend below a line drawn outward from the bottom outside edge of existing footings at a gradient of 2:1 (H:V). If this is not possible, we recommend that excavations made adjacent to existing footings be performed in sections in order to not undermine entire lengths at once.

4.2 Engineered Fill

Structural fill should be defined as soils placed as fill below foundations and slabs. We recommend that structural fill be specified to meet the following requirements:

- Free of organic or foreign materials
- Soils have an ASTM or USCS soil designation with a prefix letter of S or G (e.g. SM, SP, GP, etc.)
- 100% passing the 3-inch sieve

- Less than 30% passing the #200 sieve
- Able to be placed and compacted by standard equipment per the requirements of this report

Granular soils with less than 5% passing the #200 sieve may be needed to accommodate work occurring during periods of wet or freezing weather.

Structural fill should be placed in 6 to 8-inch-thick loose lifts at or near optimum moisture content and compacted to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D 1557 (modified Proctor).

Non-structural fill should be placed in 12-inch-thick, loose lifts and compacted to at least 85 percent of the modified Proctor maximum dry density.

4.3 Foundations

We recommend that continuous foundations be placed at least 24 inches below the exposed ground surface for frost protection or as required by local building codes. Interior footings can be placed immediately below the slab. For unheated footings, we recommend that they be placed a minimum of 36 inches below the exposed ground surface. We recommend dowelling new footings into adjacent existing footings to reduce the potential for abrupt differential settlement.

We recommend that all subgrades be evaluated by a geotechnical engineer for support of the proposed construction. Soils judged to be unsuitable should be sub-excavated and replaced with compacted structural fill. All foundation bearing surfaces should be free of loose soil and debris. If the foundation bearing soils are disturbed by excavation, the exposed soil should be re-compacted to a minimum of 95 percent of the modified Proctor maximum dry density.

We recommend that any sub-excavations be oversized (widened) 1 foot horizontally from the edges of the footings for each foot of excavation below bottom-of-footing grade (1:1 excavation oversizing). Attached in Appendix A is a cross section that illustrates 1:1 excavation oversizing.

If the foundation subgrades have been prepared as recommended above, it is our opinion that spread footings may be designed for a net allowable bearing pressure of up to 2,500 pounds per square foot (psf). This recommended bearing capacity includes a safety factor of at least 3.0 against shear failure. The maximum net allowable bearing pressure value may be increased up to 30 percent to account for transient loads such as wind and seismic.

If the previous recommendations are implemented, it is our opinion that total settlement will be less than 1 inch. It is also our opinion that differential settlement will be less than ½ inch across 40 feet.

We recommend that all backfill placed on the exterior sides of foundation walls be compacted to a minimum of 90 percent of the modified Proctor maximum dry density. Beneath slabs, steps, and pavements, it should be compacted to a minimum of 95 percent. Backfill should be brought up uniformly on both sides of the foundation walls to minimize displacement of the foundation walls.

4.4 Lateral Resistance
Passive earth pressures and friction between the bottom of footings and the soil can be used to resist lateral foundation loads. For passive pressures, we recommend using an equivalent fluid pressure of 345 pounds per cubic foot (pcf). For mass concrete placed over the native gravel or granular structural fill, we recommend using a coefficient of friction against sliding of 0.45.

These values assume that foundation subgrades will be prepared as recommended above. They also assume the on-site soils will be used as foundation wall backfill and will be placed and compacted in accordance with this report. The values are un-factored.

4.5 Friction Coefficients
For mass concrete placed over the native gravel or granular structural fill, we recommend using a coefficient of friction against sliding of 0.45. It should be reduced to 0.35 if mass concrete is placed on a vapor retarder over the granular soils.

4.6 Floor Slab
After the construction of the building pad has been completed, we anticipate slab subgrades will consist of silty gravel or structural fill. Interior footing subgrades and mechanical trench backfill should be compacted to a minimum of 95 percent of the modified Proctor maximum dry density.

We recommend placing a minimum of 6 inches of crushed aggregate having less than 5 percent by weight passing a 200 sieve immediately below the slab. This aggregate cushion will reduce moisture transmission to the floor slabs from the subgrade soils by creating a capillary break. The aggregate cushion should be compacted to a minimum of 95 percent of the modified Proctor maximum dry density.

We recommend using a subgrade modulus of 200 pounds per square inch per inch of deflection (pci) to design the slab. If a minimum of 6 inches of crushed aggregate road base is placed above the subgrade and below the aggregate cushion, a modulus of 250 pci could be used for design.

If floor coverings or coatings will be used, a vapor retarder or barrier should be placed immediately beneath the slab. We also recommend consulting with the designer of the buildings and floor covering manufacturers regarding the appropriate type, use, and installation of the vapor retarder or barrier.

4.7 Exterior Slabs
The near surface gravel at the site is considered to be low to moderately frost-susceptible. If these soils become saturated and freeze, heave may occur. This heave may become a nuisance

for slabs or steps in front of doors or at other critical grade areas adjacent to buildings and could affect design drainage patterns.

One of the more conservative ways to reduce the potential for this heave is to remove the frost-susceptible soils down to bottom-of-footing grade or a maximum depth of 3 feet. The resulting excavation should then be replaced with non-frost-susceptible sand or sandy gravel. Sand or sandy gravel having less than 5 percent of the particles by weight passing a 200 sieve is considered to be non-frost-susceptible. We also recommend sloping the bottom of the excavation toward one or more collection points to remove any water entering the engineered fill. This approach will not be effective in controlling frost heave without removing the water. We would be available to discuss alternative approaches.

4.8 Seismic Conditions

An S_S coefficient of 0.335g should be used for the project site per Figure 1613.3.1(1) in the 2015 edition of the International Building Code. An S_1 coefficient of 0.115g should be used for the project site per Figure 1613.3.1(2). The seismic coefficients should be modified for a soil site Class D per Table 1613.3.5(1) of the International Building Code.

4.9 Utilities

We anticipate support soils for utilities will consist primarily of silty to poorly graded gravel. It is anticipated that utilities can be installed per manufacturer bedding requirements. Unsuitable soils (e.g., loose, soft, organic, etc.), if encountered, should be removed and replaced with structural fill. For trench sidewall support, the site soils are considered to be Type C soils according to Occupational Safety and Health Administration (OSHA) guidelines.

Backfill placed over the utilities should consist of a debris-free mineral soil. Soils from the trench excavation can be used as backfill above the pipe provided particles larger than 3 inches, organics, and all debris is removed. Backfill should be placed and compacted to a minimum of 95 percent of the modified Proctor maximum dry density. It will be critical to achieve adequate compaction in the utility trenches to limit the potential for post-construction settlements occurring in pavement areas. Compaction to 85 percent would be suitable in landscape areas.

4.10 Site Grading and Drainage

We recommend that the site be graded to provide positive runoff away from structures. We recommend that landscape areas be sloped a minimum of 6 inches within 10 feet of structures and that slabs be sloped a minimum of 2 percent.

4.11 Stormwater Recommendations

Based on the data obtained from the test pits and the laboratory testing performed, it is our opinion that swales with drywells would be suitable for the infiltration of stormwater. We estimated design outflow rates for drywells using the results of the laboratory testing and the procedures described in the Spokane Regional Stormwater Manual (SRSM), Appendix 4A (Spokane 200 Method). The following table summarizes the results of the analysis.

Test Pit	Depth (feet)	USCS Classification	Percent Fines	Normalized Outflow Rate (cfs/ft)	Recommended Design Drywell Outflow Rate (cfs)	
					Single-Depth	Double-Depth
TP-1	6	GP	4.5	0.093	0.3	0.7

These recommended design outflow rates include a safety factor of 1.3 as required by the SRSM.

5.0 CONSTRUCTION

5.1 Excavation

Based on the test pits, it is our opinion the on-site soils can be excavated with standard soil excavation equipment. For footing excavations, we recommend a backhoe with a smooth-lipped bucket to minimize disturbance. The native gravel and the existing fill are considered to be Type C soils under OSHA guidelines. Unsupported excavations in Type C soils should be maintained at a gradient no steeper than 1½:1 (H:V). Deeper excavations should be shored or braced in accordance with OSHA specifications and local codes. The contractor is responsible for providing appropriate trench wall support and/or slopes.

5.2 Excavation Dewatering

If groundwater is encountered or if stormwater accumulates in excavations, we recommend dewatering. When final plans are available, we should be contacted to discuss dewatering options.

5.3 Observations

We recommend that a geotechnical engineer from IMT observe all subgrades prior to placing fill or forms for footings to evaluate if the soils are suitable for support of the proposed construction and to evaluate whether the subsurface conditions are consistent with the test pits.

5.4 Backfills and Fills

Backfills and fills should be moisture conditioned to near optimum moisture content to achieve adequate compaction and placed in thin lifts not exceeding 6 to 8 inches. It is our opinion that engineered fill should meet the requirements provided in Section 4.2 of this report. Based on the test pits, the native, inorganic gravel at the site would be suitable for reuse as structural fill provided large particles and debris are removed.

5.5 Testing

We recommend in-place density tests be performed on all fill placed. Density testing should be performed at the frequencies recommended as follows:

Fill Location	Recommended Testing Frequency
Building Area and Mass Grading	2,500 square feet, each 1-foot lift
Foundation Subgrade and Wall Backfill	50 linear feet, each 1-foot lift
Utility Trench Backfill	100 linear feet, each 2-foot lift

5.6 Cold Weather

If site grading and construction are anticipated during cold weather, we recommend that good winter construction practices be observed. All snow and ice should be removed from excavated and fill areas prior to additional earthwork or construction. No fill, footings, or slabs should be placed on soils which have frozen or contain frozen material. Frozen soils should not be used as backfill or fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed upon frozen soils or soils which contain frozen material. Concrete should be protected from freezing until the necessary strength is achieved. Frost should not be permitted to penetrate below footings bearing on frost-susceptible soils since such freezing could heave and crack the footings and/or foundation walls.

5.7 Wet Weather

The gravel encountered at the site is low to moderately sensitive to disturbance when wet. If these soils become wet and unstable, we recommend that construction traffic be minimized where these soils are exposed. Low ground pressure (tracked) equipment should be used to minimize disturbance. For high traffic areas, such as access or haul roads, we recommend placing a woven, water-permeable geotextile fabric and 12 to 18 inches of crushed gravel to reduce disturbance. Specific options should be evaluated during construction in order to select the most cost-effective option.

6.0 PROCEDURES

6.1 Excavation and Sampling

The test pits were excavated on August 12, 2021 using a rubber-tire backhoe operated by an independent firm working under subcontract to IMT. A geotechnical engineer from our firm continuously observed the test pit excavations and logged the surface and subsurface conditions. The test pits were backfilled after excavation.

6.2 Soil Classification

The soils encountered in the test pits were visually and manually classified in the field by our field personnel in accordance with ASTM D 2488 “Description and Identification of Soils (Visual-Manual Procedures)”.

7.0 GENERAL RECOMMENDATIONS

7.1 Basis of Recommendations

The analyses and recommendations submitted in this report are based on the data obtained from the test pits excavated at the approximate locations indicated on the Exploration Location Map in Appendix A. It should be recognized that the explorations performed for this evaluation reveal subsurface conditions only at discreet locations across the project site and that actual conditions in other areas could vary. Furthermore, the nature and extent of any such variations would not become evident until additional explorations are performed or until construction activities have begun. If significant variations are observed at that time, we may need to modify our conclusions and recommendations contained in this report to reflect the actual site conditions.

7.2 Groundwater Fluctuations

We made water level observations in the test pits at the times and conditions stated on the test pit logs. This data was interpreted in the text of this report. The period of observation was relatively short and fluctuation in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw and other seasonal and annual factors not evident at the time the observations were made. Design drawings and specifications and construction planning should recognize the possibility of fluctuations.

7.3 Use of Report

This report is for the exclusive use of the addressed parties. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other parties or projects.

7.4 Level of Care

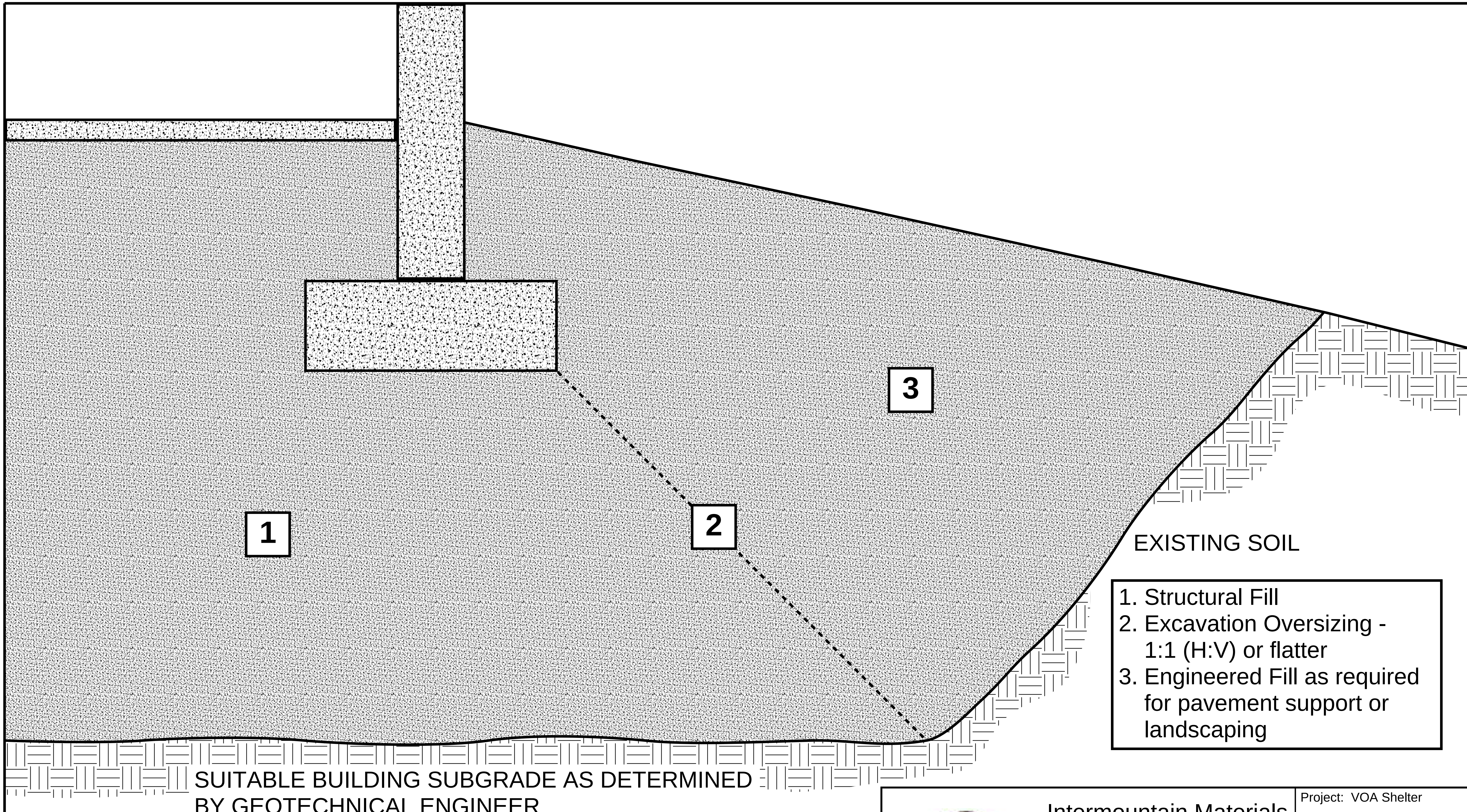
Services performed for this project have been conducted in a manner consistent with that level of care ordinarily exercised by reputable members of the profession currently practicing in this area under similar circumstances. No warranty, expressed or implied, is intended or made.

APPENDIX A

EXPLORATION LOCATION MAP,
EXCAVATION OVERSIZING ILLUSTRATION

Intermountain Materials Testing & Geotechnical
9401 E Appleway Blvd
Spokane Valley, WA 99206
(509) 474-9764

Project: VOA Shelter	
Project No.: S21697	
Figure 1	
Exploration Location Map	
Date: August 26, 2021	
Scale: NTS	



Intermountain Materials Testing & Geotechnical
9401 E Appleway Blvd
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(509) 474-9764

Project: VOA Shelter

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Figure 2: Excavation Oversizing Illustration

Date: August 26, 2021

Scale: NTS

APPENDIX B

LOGS OF TEST PITS AND DESCRIPTIVE TERMINOLOGY

Intermountain Materials Testing & Geotechnical

Log of Test Pit

TP-1

Project:	VOA Youth Shelter Addition	Project No:	S21697
Location:	Spokane, WA	Date:	8/12/2021
Client:	Architecture All Forms	Logged By:	GV
Test Pit Loc.:	See attached map.	Elevation:	1924

Depth (Ft.)	Graphic Log	USCS Classification	SOIL DESCRIPTION	Sample	WL	Tests or Notes
0		SM	FILL: Silty Sand with Gravel, fine to medium-grained, dark brown to black, moist.			
2.5		GM	SILTY GRAVEL with SAND, fine to coarse-grained, with Cobbles and Boulders*, moist. (Glacial Flood Deposit)			*Boulders up to 3 feet in diameter.
5		GP	POORLY GRADED GRAVEL with SAND, fine to coarse-grained, with Cobbles, brown, moist. (Glacial Flood Deposit)	6–7		MC=4.5%, P200=4.5%
7			End of test pit (due to caving). Groundwater not encountered. Test pit backfilled.			

Depth scale (Ft.): 0, 2, 4, 6, 8, 10, 12, 14

Intermountain Materials Testing & Geotechnical

Log of Test Pit

TP-2

Project:	VOA Youth Shelter Addition	Project No:	S21697
Location:	Spokane, WA	Date:	8/12/2021
Client:	Architecture All Forms	Logged By:	GV
Test Pit Loc.:	See attached map.	Elevation:	1925

Depth (Ft.)	Graphic Log	USCS Classification	SOIL DESCRIPTION	Sample	WL	Tests or Notes
0			Asphalt.			
		GM	FILL: Silty Gravel with Sand, fine-grained, dark gray, damp.			
		SM	FILL: Silty Sand with Gravel, fine to medium-grained, with Cobbles, dark brown, moist.			
2						
4		GM	SILTY GRAVEL with SAND, fine to medium-grained, with Cobbles, brown, moist. (Glacial Flood Deposit)			
6			End of test pit (due to caving). Groundwater not encountered. Test pit backfilled.			
8						
10						
12						
14						

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D2488

MAJOR DIVISION			GROUP SYMBOL	LETTER SYMBOL	GROUP NAME
COARSE GRAINED SOILS CONTAINS MORE THAN 50% FINES	**GRAVEL AND GRAVELLY SOILS** MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVEL WITH * 5% FINES		GW	Well-graded GRAVEL
				GP	Poorly graded GRAVEL
		GRAVEL WITH BETWEEN 5% AND 12% FINES		GW-GM	Well-graded GRAVEL with silt
				GW-GC	Well-graded GRAVEL with clay
				GP-GM	Poorly graded GRAVEL with silt
				GP-GC	Poorly graded GRAVEL with clay
		GRAVEL WITH ≥ 12% FINES		GM	Silty GRAVEL
				GC	Clayey GRAVEL
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SAND WITH * 5% FINES		SW	Well-graded SAND
				SP	Poorly graded SAND
		SAND WITH BETWEEN 5% AND 12% FINES		SW-SM	Well-graded SAND with silt
				SW-SC	Well-graded SAND with clay
				SP-SM	Poorly graded SAND with silt
				SP-SC	Poorly graded SAND with clay
		SAND WITH ≥ 12% FINES		SM	Silty SAND
				SC	Clayey SAND
FINE GRAINED SOILS CONTAINS MORE THAN 50% FINES	SILT AND CLAY	LIQUID LIMIT LESS THAN 50		ML	Inorganic SILT with low plasticity
				CL	Lean inorganic CLAY with low plasticity
				OL	Organic SILT with low plasticity
		LIQUID LIMIT GREATER THAN 50		MH	Elastic inorganic SILT with moderate to high plasticity
				CH	Fat inorganic CLAY with moderate to high plasticity
				OH	Organic SILT or CLAY with moderate to high plasticity
HIGHLY ORGANIC SOILS				PT	PEAT soils with high organic contents

NOTES:

1) Sample descriptions are based on visual field and laboratory observations using classification methods of ASTM D2488. Where laboratory data are available, classifications are in accordance with ASTM D2487.

2) Solid lines between soil descriptions indicate change in interpreted geologic unit. Dashed lines indicate stratigraphic change within the unit.

3) Fines are material passing the U.S. Std. #200 Sieve.