SUBMITTED TO:
Municipality of Anchorage,
Department of Facility
Management
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AECC 125

GEOTECHNICAL ENGINEERING REPORT

Fire House 11 Warm Storage Building

EAGLE RIVER, ALASKA

August 2022

Shannon & Wilson No: 109464-001

SHANNON & WILSON

Submitted To: Municipality of Anchorage, Department of Facility Management
3640 East Tudor Road, Warehouse No.1
Anchorage, Alaska 99507
Attn: Contact Name

Subject: GEOTECHNICAL ENGINEERING REPORT, FIRE HOUSE 11 WARM STORAGE BUILDING, EAGLE RIVER, ALASKA

Shannon & Wilson prepared this report and participated in this project as a consultant to the Municipality of Anchorage (MOA) Department of Facility Management. Our scope of services was specified in our May 25, 2022, proposal and Purchase Order (PO) Number 2022001316 with MOA which was undated but was received on May 26, 2022. This report presents the results of geotechnical engineering studies conducted by Shannon & Wilson, Inc. for the proposed new Fire House 11 Warm Storage Facility in Eagle River, Alaska, that will replace the old building, which was damaged in the November 30, 2018 Anchorage Earthquake. This geotechnical engineering report was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

Thomas Keatts, PE
Senior Engineer

KLB:tmk

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1 INTRODUCTION

This report presents the results of subsurface explorations, laboratory testing, and geotechnical engineering studies conducted by Shannon & Wilson, Inc. for a proposed new Fire House 11 Warm Storage Building in Eagle River, Alaska. The proposed new building will replace the existing Fire House 11 which was damaged by the November 30, 2018 Anchorage Earthquake. The purpose of this geotechnical study was to explore subsurface conditions and provide geotechnical engineering recommendations needed to design and construct the proposed improvements. To accomplish this, three soil borings were advanced adjacent to the existing structure near the footprint of the proposed development. Soil samples recovered from the borings were tested in our geotechnical laboratory and engineering studies were performed to support foundation, pavement, and drainage design. Presented in this report are descriptions of the site and project, subsurface explorations and laboratory test procedures, an interpretation of subsurface conditions, and conclusions and recommendations from our engineering studies.

Authorization to proceed with this work was received in the form of a Purchase Order signed by Ms. Rachelle Alger, of the MOA and received on May 26, 2022. The work was performed in general accordance with our May 25, 2022 proposal.

2 SITE AND PROJECT DESCRIPTION

The project site is located at 16716 Fire House Lane in Eagle River, Alaska. The site is currently developed with the existing fire house storage building which was damaged during the earthquake, asphalt paved driveways and parking area, concrete walkways and landscaped grass areas. A portion of the parking area on the north side of the building was gravel at the time of our explorations. In general, the site was relatively flat with no more than several feet of relief from one end of the property to the other. A vicinity map showing the general project area is included as Figure 1. Figure 2 includes a site plan showing the boring locations and other prominent site features.

We understand that the project generally consists of designing and constructing a new warm storge building with a footprint similar to the existing building's footprint and generally in the same location as the existing building. We understand that the existing building and its foundation will be demolished and removed entirely.

The proposed new storage building will consist of relatively lightly loaded, one or two-story, wood- or steel-framed structure with slab-on-grade construction. Design drawings indicate that the proposed building will be located centrally on the property with a pull through driveway on the north side of the building and parking on the east side of the building and parcel. Drawings also show the existing driveway on the west side of the building will be widened with asphalt on the south side. Improvements will also include new buried utilities to provide services to the new building. We assume that the general site grade will be maintained at the approximate existing site grade and that the building will be heated continuously throughout the year.

3 SUBSURFACE EXPLORATIONS

Subsurface explorations at the site consisted of advancing and sampling three soil borings adjacent to the existing building. The borings, designated Borings B-1 through B-3 were drilled by Denali Drilling of Anchorage, Alaska on June 16 and 17, 2022 using a truck-mounted CME-85 drill rig. The approximate boring locations, shown on Figure 2, were selected by our onsite representative to provide reasonable coverage of the proposed new building and to avoid conflicts with onsite utilities. Boring locations were positioned using swing tie measurements from the existing structure. The surface elevations shown on the boring logs were estimated from topographic contours provided by the Municipality of Anchorage GIS department. The boring locations shown on the site plan and the elevations reported on the boring logs should be considered approximate. An experienced representative from Shannon & Wilson was present during drilling to locate the borings, observe drill action, collect samples, log subsurface conditions, and observe groundwater conditions.

The borings were advanced with 4 1/4-inch inner diameter (ID), continuous flight, hollow-stem augers to depths of approximately 40 feet below ground surface (bgs). As the borings were advanced, samples were generally recovered using Standard Penetration Test (SPT) methods at 2.5-foot intervals to 10 feet bgs and 5-foot intervals thereafter to the bottom of the boring. With the SPT method, samples are recovered by driving a 2-inch outer diameter (OD) split-spoon sampler into the bottom of the advancing hole with blows of a 140-pound hammer free falling 30 inches onto the drill rods. For each sample, the number of blows required to drive the sampler the final 12 inches of an 18-inch penetration into undisturbed soil is recorded. Where the sampler did not penetrate the full 18 inches, our log reports the blow count and corresponding penetration in inches. Blow counts are shown graphically on the boring log figures as “penetration resistance” and are displayed adjacent to sample depth. The penetration resistance values give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively.

The soils encountered were observed and described in the field in general accordance with the classification system described by ASTM International (ASTM) D2488. Selected samples recovered during drilling were tested in our laboratory to refine our soil descriptions in general accordance with the Unified Soil Classification System (USCS) described in Figure 3. Frost classifications were also estimated for samples based on laboratory testing (sieve analyses and hydrometer) and are shown on the boring logs. The frost classification system is presented in Figure 4. Summary logs of the borings are presented in Figures 5 through 7.

Boring B-2 was completed by installing a 1-inch, polyvinyl chloride (PVC) groundwater level observation well with slotted tip to facilitate observation of groundwater levels. The annular space between the borehole wall and casing was backfilled with auger cuttings produced during drilling activity. The PVC well casing was allowed to stick up out of the ground approximately 1 to 2 feet. The remaining borings were completed by backfilling the hole with auger cuttings produced during drilling. The installation details for each observation well are shown on the boring logs.

4 LABORATORY TESTING

Laboratory tests were performed on soil samples recovered from the borings to confirm our field classifications and to estimate the index properties of the typical materials encountered at the site. The laboratory testing was formulated with emphasis on determining gradation properties, natural water content, and frost characteristics.

Water content tests were performed on each sample recovered from the borings. The tests were generally conducted according to procedures described in ASTM D2216. The results of the water content measurements are presented graphically on the boring logs presented in Figures 5 through 7.

Grain size classification tests were conducted on selected samples to confirm the field classification of the soils encountered. The gradation testing generally followed the mechanical sieve procedures described in ASTM C117/136 and D422. The grain size testing results are presented as Figure 8, and summarized on the boring logs as percent gravel, percent sand, and percent fines. Note that hydrometer testing indicates particle size only and visual classification under USCS designates the entire fraction of soil finer than the No. 200 sieve as silt. Plasticity characteristics (Atterberg Limits results) are required to differentiate between silt and clay soils under USCS.

Atterberg limits were evaluated for one sample of fine-grained soil to estimate plasticity characteristics. The test generally followed procedures described in ASTM D4318. The results of this test are presented graphically on the boring logs and on Figure 9.

5 SUBSURFACE CONDITIONS

The subsurface conditions encountered in our explorations at the site are depicted graphically on the boring logs in Figures 5 through 7. In general, Boring B-1, which was advanced through the existing asphalt surface encountered approximately 2 inches of asphalt pavement underlain by 4.5 feet of granular fill consisting of gravel with silt and sand. Borings B-2 and B-3 were drilled through landscaped areas and encountered a surficial grass mat underlain by approximately 2.3 feet of organic silt with sand and gravel.

Soils at the site were generally variable in the upper 13 feet and consisted of alternating layers of sands and gravels with relatively low silt contents, and low plasticity clayey silt layers with significant sand and gravel. Beneath the fill (in Boring B-1) and organics (in Boring B-2) a layer of silt with sand was encountered to a depth of between 7 and 9.5 feet. A similar layer was encountered in Boring B-3 from 6.2 to 13 feet bgs. Below 13 feet the soils in each boring consisted of silty sands and gravels.

Near surface soils above approximately 10 feet bgs were generally loose to medium dense based on typical penetration resistance values ranging between 4 and 21 blows per foot (bpf). Penetration resistance values in the deeper granular soils below 10 feet bgs were typically greater than 26 bpf, and generally increased with depth to greater than 50 bpf. These deeper soils were generally dense to very dense. According to our laboratory tests, water contents in the granular soils ranged between approximately 4 and 21 percent with higher moisture contents typically associated with higher fines content or with soils located below the groundwater table. Fines contents varied between 7 and 54 percent.

Groundwater was encountered in each boring at a depth of approximately 15 feet bgs during drilling. The piezometer installed in Boring B-2 was obstructed at 10 feet bgs (we believe it may have been vandalized) and prevented measurement after drilling when attempted to read water levels on June 28, 2022. It should be noted that groundwater levels may fluctuate by several feet seasonally.

6 SEISMIC CONDITIONS

Based on our explorations and local experience, the site class according to the 2018 International Building Code (IBC) will be D for a stiff soil profile based on the blow count (N) method with typical blow counts ranging between 15 and 50 blows per foot. Assuming the site is prepared as described herein, slope failure, liquefaction, and surface rupture are unlikely at this site. Therefore, we believe that a Site Class D will be the most representative of the site. Based on Section 1613.5 of IBC 2018, Ss and S1 for the Maximum Considered

Earthquake were estimated at 1.5 and 0.686 times the force of gravity (g), respectively. The site specific modifying coefficients for the spectral response accelerations are FA = 1.0 and Fv = 1.5 for the short and long periods, respectively. The SMS and SM1 were calculated to be 1.5 and 1.029 g respectively. The computed SDS and SD1 are 1.0 and 0.686 g.

It should be noted that Site Class D requires a site-specific seismic analysis unless an exception applies as describes in ASCE 7-16 Section 11.4.8. We assume that Exception 2 applies and will be followed by the structural engineer.

7 ENGINEERING CONCLUSIONS

The design of the foundations for support of the proposed building must consider the bearing capacity of the soils, expected settlements, lateral earth pressures, frost conditions within the subsurface soils, and constructability issues. Other geotechnical considerations associated with this project consist of developing pavements and sidewalks, controlling trench excavations, developing pipe bedding, addressing potential settlements, and trench backfill and compaction. Our explorations at the site encountered up to 2.3 feet of soil containing organics underlain by loose clayey-silt soils to as deep as 9 feet bgs. These soils were underlain by granular soils with varying silt content to the bottom of our explorations. Soils were generally loose to medium dense in the upper 10 feet of our borings, but dense to very dense below 10 feet. Based on these soil conditions, conventional shallow foundations would, in our opinion, provide suitable support for the proposed new structure provided the site is prepared as outlined below in Section 7.1.

7.1 Site Preparation

The current ground surface of the site is near the grade of adjacent lots and roadways. November 2021 design drawings indicate that the finished grade of the site will be at or near the existing grade. In order to prepare the site for building, the existing building should be demolished, and all foundation elements should be removed from the footprint. The foundation elements should be removed in their entirety and not broken off below grade and abandoned in place. Removal of the foundation elements will likely loosen the near surface site soils and leave voids that will require filling. Voids at the site created by the removal of the foundation should not be graded over or bulk filled. Fill placed to level the site after demolition should consist of Municipality of Anchorage Standard Specifications (MASS) Type II structural fill and should be placed and compacted with moisture and density control as described in Section 7.9.

Vegetation should be cleared and organic material and soils containing organics should be grubbed within the footprint of the proposed building and under areas to be paved. The grubbed areas should extend a minimum of 5 feet from the outer edges of the buildings and edge of asphalt. According to our borings, organic soils and soils containing organics were generally encountered in the upper 2 to 3 feet of the ground surface. Note our borings were conducted adjacent to the existing structure and not within the footprint of the building. It is possible that organic soils have already been removed from most of the footprint. Organic material should not be re-used as fill beneath pavement or building areas at the site and should be removed from the site or used as topsoil in landscaping.

Loose clayey-silt soils were encountered in our borings to approximately 9 feet bgs. These soils may exhibit low shear strength, be moisture sensitive, and difficult to compact. To bridge these weak soils and to create a firm and unyielding surface for casting footings and floor slabs, we recommend the soil beneath footings and floor slabs be over-excavated 2 feet below the base of the footing. The over excavation should extend 2 feet horizontally from the edge of footings and under the entire floor slab at the base of the over-ex. The base of the excavation should be probed for loose unsuitable soils. The base of the excavation should be covered with a non-woven geotextile separation fabric, and then MASS Type IIA structural fill should be placed and compacted up to the base of footing or floor slab grade. Structural fill should be placed and compacted as described in Section 7.9. Note that some of the soils exposed at the bottom of sub-cut excavations may have elevated fines contents and may be sensitive to moisture and disturbance. If moisture sensitive materials are encountered, flat-nosed excavator buckets should be used. Additionally, equipment should not be operated on the exposed subgrade if the area is wet and moisture sensitive prior to fill placement.

Once the above site preparation is completed, the exposed ground surface should be proof rolled and then observed by an experienced geotechnical engineer to look for soft or loose zones. If loose or soft zones are discovered, they should be locally compacted or excavated and replaced with compacted, structural fill material. The resultant grade should be smooth, consistent, and unyielding.

7.2 Building Foundations

We recommend that the proposed new buildings be supported on spread or continuous strip footings bearing on firm Type IIA structural fill. The recommended minimum footing width is 16 inches for continuous strip footings and 24 inches for spread footings. The base of exterior footings and unheated interior footings should be buried sufficiently to prevent structural damage resulting from frost action. We recommend that perimeter footings in heated buildings be placed a minimum of 42 inches below the ground surface. If portions of the proposed buildings are to be unheated, the minimum burial depth for footings should be increased to 60 inches bgs for frost protection.

Based on the expected footing dimensions, depths, and site preparation recommendations, we recommend that foundations for the proposed buildings be designed with an allowable soil bearing pressure of 2,500 pounds per square foot (psf). Localized loose or soft areas, whether resulting from existing conditions or disturbance during construction must be corrected prior to casting footings, or damaging differential settlements could occur. The above bearing value may be increased by one-third for short-term wind or seismic loading. A typical footing detail is included in Figure 10.

7.3 Floor Slab Support

Slab on grade construction is anticipated for this project. To provide an even, firm, unyielding base, we recommend that floor slabs be founded on 2-feet of MASS TypeIIA structural fill. A non-woven geotextile separation fabric is recommended between native soils and structural fill. The structural fill placed beneath the floor slab should be placed and compacted in accordance with the recommendations included in Section 7.9. Provided the recommendations discussed above are adhered to by the contractor, a subgrade reaction modulus of at least 150 pounds per square inch per inch (psi/in) should be attainable on the recommended support soils. In areas to receive floor coverings, we recommend installing a vapor retarder directly beneath the concrete slab.

7.4 Estimated Building Settlements

The magnitude of the settlements that will develop at the building site is dependent upon the applied loads and density of the support material. Assuming the site is prepared as recommended and the subgrade beneath footings is protected from moisture while exposed, we estimate that total maximum settlements will be about 1 inch or less with differential settlements being about 1/2 of the total settlements over the length of the structure. The greatest amount of settlement should occur during construction, essentially as fast as the building loads are applied, such that long term differential settlements of the building will be relatively small and well within tolerable limits. The relatively loose to medium dense soils at the site may be sensitive to strength loss during a seismic event. Seismically induced settlements during a design event may be on the order of approximately 2 inches of additional settlement.

7.5 Lateral Earth Pressures and Lateral Resistance

Building walls below ground that support earth fills and floor slabs should be designed to resist horizontal earth pressures. The magnitude of the pressure is dependent on the method of backfill placement, the type of backfill material, drainage provisions, and whether the wall is permitted to deflect after or during placement of backfill.

If the walls are allowed to deflect laterally or rotate an amount equal to about 0.001 times the height of the wall, an active earth pressure condition under static loading would prevail and an equivalent fluid weight of 36 pounds per cubic foot (pcf) is recommended for design of the walls. For rigid walls that are restrained from deflecting at the top, an at-rest earth pressure condition would prevail and an equivalent fluid weight of 57 pcf is recommended. To simulate seismic loading (from soils adjacent to the foundation) a rectangular pressure prism with a magnitude of 17 psf per foot of wall height should be applied to the below-grade walls. Note that these values reflect free-draining, compact, granular backfill with no hydrostatic forces acting on the wall, and also assume that the soils within the zone of frost penetration behind the wall (about 6 to 8 feet horizontal) are non-frost-susceptible. These values do not include a factor of safety.

Lateral forces from wind or seismic loading may be resisted by passive earth pressures against the sides of footings. These resisting pressures can be estimated using an equivalent fluid weight of 240 pcf. This value includes a factor of safety of 2 on the full passive earth pressure and assumes that backfill around the footings is densely compacted.

Lateral resistance may also be developed in friction against sliding along the base of foundations placed on grade such as footings or floor slabs. These forces may be computed using a coefficient of 0.4 between concrete and soil.

7.6 Drainage

Site drainage should be considered during design and construction. Groundwater was encountered in each boring at approximately 15 feet bgs during drilling. Therefore, it is unlikely that groundwater will be encountered during construction. In general, excavation and backfill work should be closely coordinated such that seepage and surface runoff is not allowed to collect and stand in open excavations. Likewise, the ground surface around excavations should be contoured to drain away from the excavation and the excavation bottoms should be graded to drain to a sump or topographic low. If excavations remain open for an extended duration or during periods of high rainfall or rapid snow melting, shoring and/or dewatering with sumps and pumps in the excavation bottom may be necessary to maintain stable slope and bottom conditions.

We recommend that the site be carefully graded such that surface water and roof run-off are directed away from the proposed structure, so that it cannot pond against or infiltrate the soils near the building walls. Positive drainage should be maintained for driveways and paved parking areas such that surface water is directed off the pavement surface away from the pavement structural section.

7.7 Excavation Slopes and Utility Trenches

Buried pipes and cables will be needed to tie the new developments into existing nearby utilities. Trenches excavated for installation of these new utilities should be generally constructed as presented in Figure 11. The bedding and structural fill material around the buried utility should be densely compacted to support and hold the pipe firmly in place.

The native soils in this area range from predominantly fine-grained to granular and moist with variable fines contents. Excavation slopes will tend to stand steeply at first, and then ravel over time to flatter slopes (i.e., to about 1.5 H to 1 V or shallower). The actual slope and excavation bottom conditions should be made the responsibility of the contractor, who will be present on a day-to-day basis and can adjust efforts to obtain the needed stability. The contractor should be prepared to use shoring or a trench box as necessary to protect their workers in accordance with state and federal safety regulations (including OSHA) which require slope protection for trenches deeper than 4 feet bgs.

Below areas that are receiving pavements or floor slabs, trench backfill should be placed in maximum 8-inch loose lifts and compacted to at least 95 percent of maximum density, as discussed in Section 7.9. The lift thickness may be increased to up to 12 inches if it can be shown that the lift is adequately compacted at depth. In areas where no paving is planned, less compaction is required and material may be placed in thicker lifts (12 inches) and moderately compacted to achieve at least 90 percent compaction. The bedding and fill material around buried pipes should also be compacted to at least 95 percent of maximum density or per manufacturer recommendations to support and hold the pipe firmly in place. Utility trenches should be backfilled with existing inorganic soils as much as practicable between the top of the pipe bedding and the bottom of the pavement structural section or the original ground surface. This procedure limits the contrast between trench backfill and the surrounding soil conditions that can lead to adverse settlement or frost heave behavior. Bulking of backfill into trenches should be discouraged as this can cause voids and lead to large future surface settlements.

7.8 Asphalt Pavements

We understand that new asphalt driving surfaces and asphalt repairs will be constructed for driveways and a parking area. Pavement design in southcentral Alaska is typically based on estimated frost penetration and the frost classification of the subgrade materials rather than anticipated loading. Our borings indicate that site generally contains a 2 to 3 foot layer of soil containing organics at the ground surface. These soils should be removed from areas to be paved. Soils below the organics are generally clayey silt soils with a frost classification of F4. In our opinion, the soils beneath the organic containing soils are generally competent to support the perceived traffic loads if careful attention is given to control of surface water and to frost design of the pavement section.

To prepare the subgrade to receive the pavement structural section fill, the area to receive fill should be excavated, as required, to the design elevation of the bottom of the structural section. The base of the excavation should then be proof rolled to identify loose subgrade materials. These spots should be re-compacted or removed and replaced with structural fill that is placed and compacted as described in Section 7.9. The goal of this process is to attain a relatively uniform, firm and unyielding subgrade upon which to construct the pavement system.

The performance of the pavement is controlled by the quality (gradation characteristics) of the materials imported to the site, placed, and compacted to develop the needed structural section, and the quality of the subgrade supporting the pavement structural section. We assume that the parking area pavement section will typically be lightly loaded and that traffic will generally consist of personal vehicles. We understand that the building is a fire house storage building and heavier equipment such as fire trucks and water tankers will also contribute to pavement loading. Therefore, we recommend that the asphalt pavement structural section consist of (in ascending order) non-woven geotextile separation fabric, 28 inches of compacted Type II/IIA structural fill, 4 inches of leveling course and 4 inches of asphalt. Our recommended structural section for asphalt pavements can also be applied to concrete sidewalks. Note that these recommendations provide an asphalt pavement that may exhibit seasonal deflections. It is our opinion that seasonal frost will penetrate deeper than our recommended pavement structural section at the site; however, we believe that the seasonal surface deflections that may be associated with these materials will be small and gradual such that they can be reasonably tolerated.

If frost heaving of the pavement cannot be tolerated for operations at this facility, a significantly thicker structural section, or a section including a layer of insulation should be considered. Typical "Limited Subgrade Frost Penetration" sections in this area require non-frost susceptible soils to extend approximately 8-10 feet below ground surface, insulated sections typically contain 2 inches of "blueboard" insulation and require non-frost susceptible soils to extend approximately 4-5 feet bgs.

7.9 Structural Fill and Compaction

Backfill will be required behind the foundation walls and under pavements, foundations and floor slabs. Structural fill that is placed should be clean, well-graded, granular soil to provide drainage and frost protection. Type II/IIA structural fill as defined by the MASS meets these requirements and may be placed in both wet and dry conditions. Gradation requirements for Type II/IIA structural fill are provided in Figure 12.

The existing site soils encountered by our borings do not meet the requirements of Type II/IIA structural fill. Our borings were not advanced through the existing building. Organic soils at the site should not be reused except as topsoil in landscaping applications. Mineral soils at the site may be reused as unclassified fill beneath pavement structural sections, as utility trench backfill, and in nonstructural areas. The existing fine-grained soils at the site will likely be moisture sensitive and special handling techniques (i.e. moisture control/protection, reduced traffic, etc.) may need to be implemented if they are to be re-used. Re-use will be dictated by the contractor's ability to place and compact the material with proper moisture density control.

Moisture sensitive materials (soils with elevated fines content) that are exposed at the bottom of excavations during site preparation activities should be protected from excess moisture prior to construction. These soils may be difficult to compact and will likely be sensitive to vibrations. Care should be taken to prevent excess moisture in the soils and compaction of these soils should be done with a moisture content dry of the optimum moisture content. Compaction effort should consist of static rolling to reduce the risk of developing excess pore pressures in these soils and to reduce the likelihood of pumping. If compaction of the soils is not possible then the soils should be excavated and replaced with Type II structural fill placed and compacted with moisture and density control.

Structural fills below pavements should be placed in lifts not to exceed 12 inches loose thickness and compacted to at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557). Non-structural fills should be placed in similar lifts and compacted to at least 90 percent of ASTM D1557. We recommend that our services be retained to inspect the quality of fill compaction during construction.

When backfilling within 18 inches of building walls where the wall is not supported on both sides, material shall be placed in layers not to exceed 6 inches loose thickness and densely compacted with hand operated equipment. Heavy equipment shall not be used as it could cause increased lateral pressures and damage walls.

7.10 Geotextile Fabric

We have included recommendations for incorporating a geotextile fabric at the base of foundation excavation and at the base of the pavement structural section. This geofabric layer will increase the stability or strength of the subgrade and should prevent intermixing of the subgrade soils with structural fill thereby maintaining the fill quality and improving fill placement/compaction efficiency. The geofabric will also provide additional support during springtime thaw weakening. After the area to be treated with geofabric has been prepared within the fill limits as described previously, the geofabric should be placed over the subgrade material before the first lifts of structural section fill are placed. Geofabric used for this project should consist of a non-woven geotextile material such as Mirafi® 180N, or equivalent. This geofabric layer will increase the stability and should provide separation between the subgrade materials and the new structural section fills. We recommend the minimum material properties in the following exhibit when selecting an equivalent geofabric for this application in the project based on Minimum Average Roll Values (MARV):

Exhibit 7-1: Non-woven Geotextile Properties (Mirafi® 180N)

Mechanical Properties	Minimum Average Roll Value
Grab Tensile Strength by ASTM D4632	205 lbs.
Trapezoidal Tear by ASTM D4533	80 lbs.
CBR Puncture Strength by ASTM D6241	500 lbs.
Grab Tensile Elongation by ASTM D4632	50 percent
Apparent Opening Size by ASTM D4751B-5	US Sieve 80
Permittivity by ASTM D4491B-6	1.4 sec-1
Flow Rate by ASTM D4491	95 gal/min/ft2

Joining of the geofabric should be in accordance with manufacturers recommendations or the Municipality of Anchorage Standard Specifications (MASS). A minimum of 12 inches of overlap is required. Additional guidelines and specifications are provided in the MASS Section 20.25.

8 CLOSURES AND LIMITATIONS

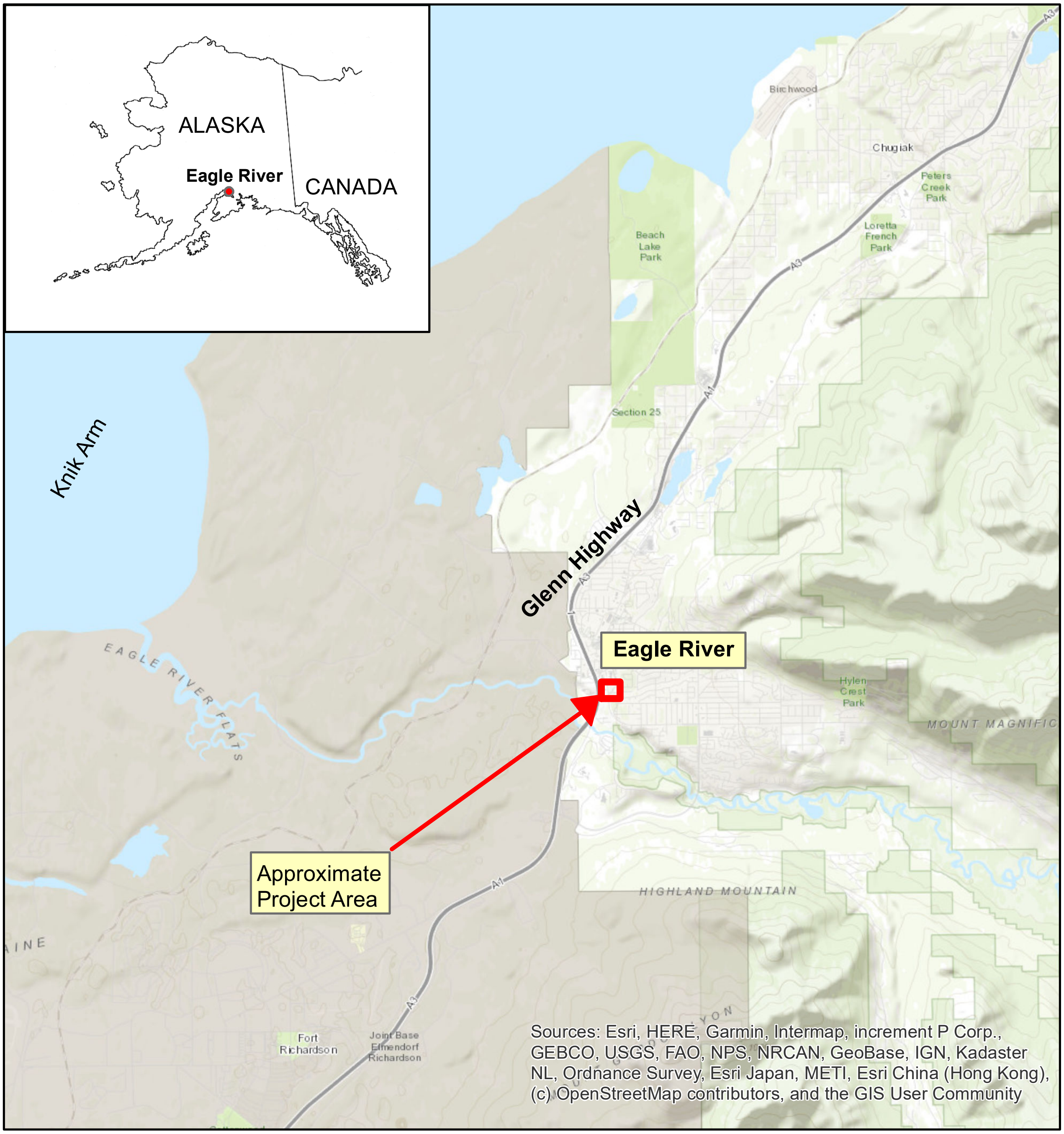
This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein. The analyses and conclusions contained in this report are based on site conditions as they presently exist. It is assumed that the exploratory borings are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

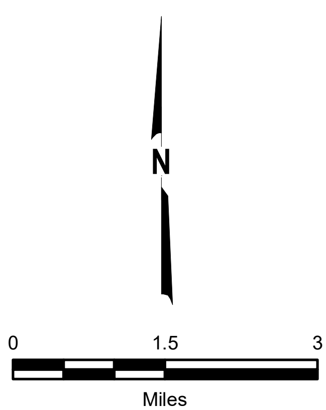
If, during construction, subsurface conditions different from those encountered in these explorations are observed or appear to be present, Shannon & Wilson, Inc. should be advised at once so that these conditions can be reviewed, and recommendations can be reconsidered where necessary. If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse.

We recommend that we be retained to review those portions of the plans and specifications pertaining to earthwork and foundations to determine if they are consistent with our recommendations. In addition, we should be retained to review design/build contractor's design and submittals, and to observe construction, particularly the site excavations, compaction of structural fill, preparation of foundations, and such other field observations as may be necessary.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs. Shannon & Wilson has prepared the attachment, Important Information About Your Geotechnical/Environmental Report, to assist you and others in understanding the use and limitations of the reports.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information obtained or derived from such electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact Shannon & Wilson.





Fire House 11 Warm Storage Building
16716 Fire House Lane
Eagle River, Alaska

VICINITY MAP

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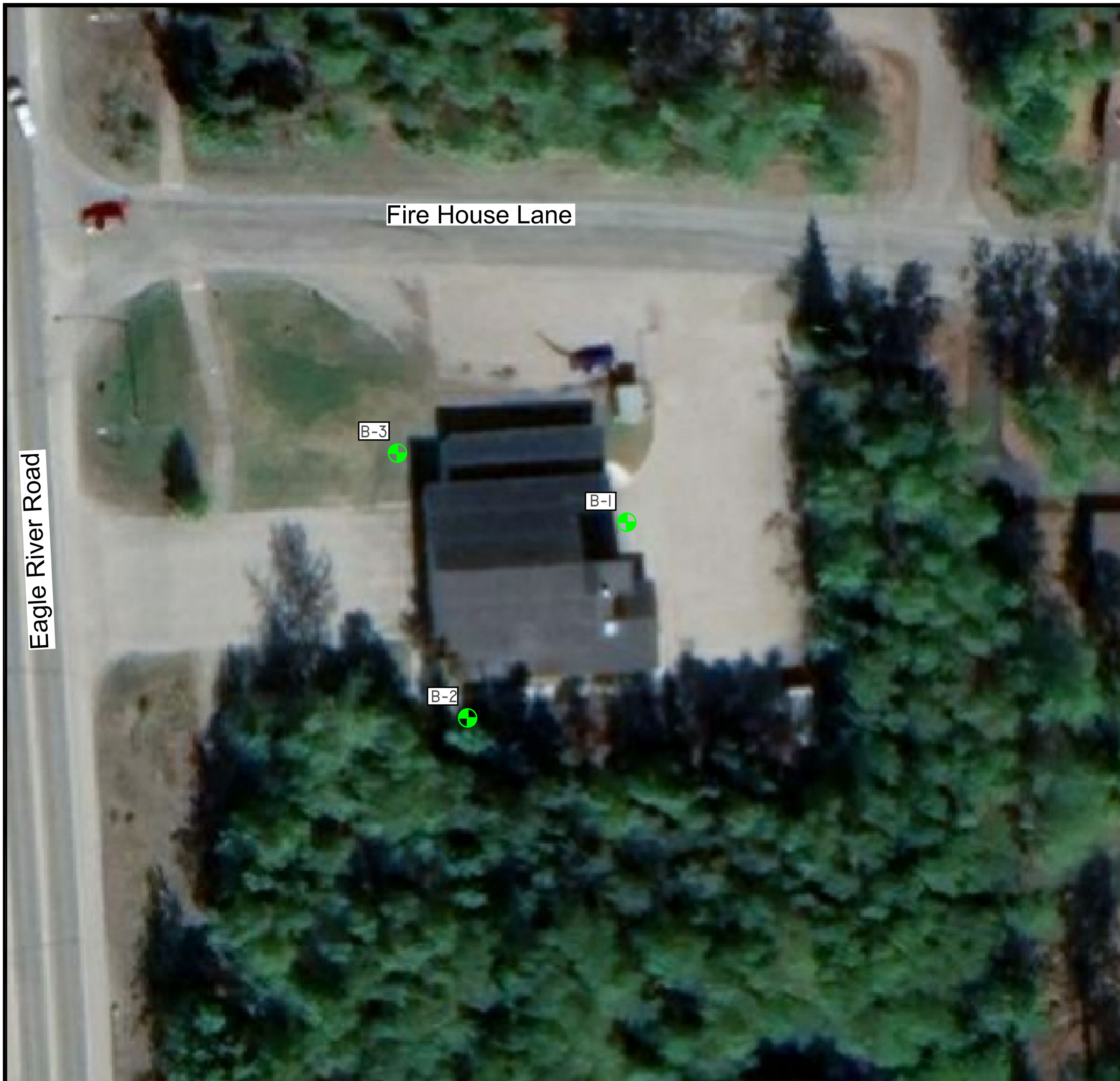
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1



Map adapted from aerial imagery provided by GoogleEarth® , Image date: May 2021

LEGEND

B-I Approximate location of Boring B-1, advanced by Shannon & Wilson, June 2022.

0 50 100
APPROXIMATE SCALE IN FEET

N

Fire House 11 Warm Storage Building
16716 Fire House Lane
Eagle River, Alaska

SITE PLAN

August 2022 109464-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 2

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

Bentonite Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Inclinometer or Non-perforated Casing
Perforated or Screened Casing	Vibrating Wire Piezometer

PERCENTAGES TERMS[1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Fire House 11 Warm Storage Building
16716 Fire House Lane
Eagle River, Alaska

SOIL DESCRIPTION AND LOG KEY

August 2022 109464-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 3
Sheet 1 of 3

2013 BORING CLASS1 109464 GINT .GPJ SWNEW.GDT 8/13/22

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL	TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW	Well-Graded Gravel; Well-Graded Gravel with Sand
			GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM	Silty Gravel; Silty Gravel with Sand
			GC	Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW	Well-Graded Sand; Well-Graded Sand with Gravel
			SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM	Silty Sand; Silty Sand with Gravel
			SC	Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

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SOIL DESCRIPTION AND LOG KEY

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FIG. 3
Sheet 2 of 3

2013 BORING CLASS2 109464 GINT .GPJ SWNEW.GDT 8/13/22

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

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ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

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SOIL DESCRIPTION AND LOG KEY

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FIG. 3
Sheet 3 of 3

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FROST CLASSIFICATION

(after Municipality of Anchorage, 2007)

GROUP		0.02 Mil.	P-200*	USC SYSTEM (based on P-200 results)
NFS	Sandy Soils	0 to 3	0 to 6	SW, SP, SW-SM, SP-SM
	Gravelly Soils	0 to 3	0 to 6	GW, GP, GW-GM, GP-GM
F1	Gravelly Soils	3 to 10	6 to 13	GM, GW-GM, GP-GM
F2	Sandy Soils	3 to 15	6 to 19	SP-SM, SW-SM, SM
	Gravelly Soils	10 to 20	13 to 25	GM
F3	Sands, except very fine silty sands**	Over 15	Over 19	SM, SC
	Gravelly Soils	Over 20	Over 25	GM, GC
	Clays, PI>12			CL, CH
F4	All Silts	Over 15	Over 19	ML, MH
	Very fine silty sands**			SM, SC
	Clays, PI<12			CL, CL-ML
	Varved clays and other fined grained, banded sediments			CL and ML CL, ML, and SM; SL, SH, and ML; CL, CH, ML, and SM

PI = Plasticity index
P-200 = Percent passing the number 200 sieve
0.02 Mil. = Percent material below 0.02 millimeter grain size

*Approximate P-200 value equivalent for frost classification.
Value range based on typical, well-graded soil curves.

** Very fine sand : greater than 50% of sand fraction passing the number 100 sieve

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FROST CLASSIFICATION LEGEND

August 2022 109464-001

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FIG. 4

MATERIAL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water
Approx. Elevation: 327 Ft.				
Asphalt	0.1			
S1: 53% Gravel, 39% Sand, 8% Fines (F1 (0.02mm))			S1	
Loose, brown, *Well-Graded Gravel with Silt and Sand (GW-GM)*; moist [Fill]			S2	
Loose to medium dense, brown, *Sandy Silt (ML)*; moist	4.5		S3	
S3: 11% Gravel, 36% Sand, 54% Fines (F4 (P200))			S4	
Dense, brown, *Well-Graded Sand with Silt and Gravel (SW-SM)*; moist	9.5		S5	
S5: 36% Gravel, 56% Sand, 8% Fines (F2 (P200))				
Medium dense to dense, brown, *Silty Gravel with Sand (GP-GM)*; moist to wet	13.0		S6	6/16/22
			S7	
Medium dense to dense, brown, *Silty Sand with Gravel (SM)*; wet	23.0		S8	
			S9	
	33.0			

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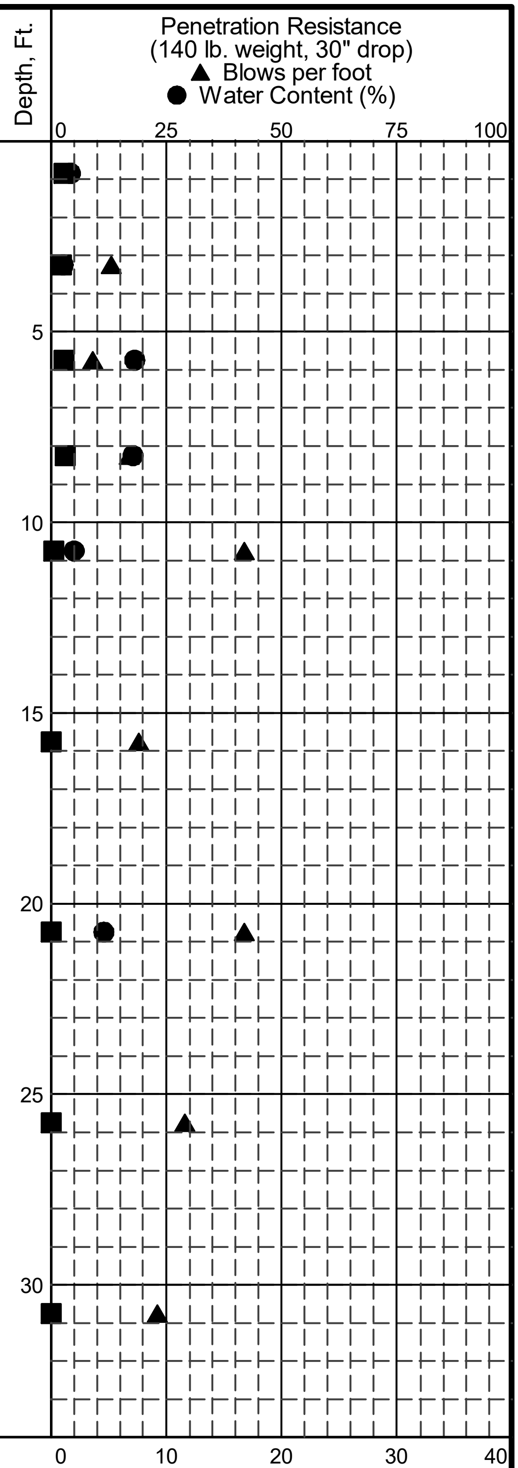

■ PID Reading (ppm)

Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

LEGEND

* Sample Not Recovered

⌶ 2" O.D. Split Spoon Sample

∇ Ground Water Level At Time Of Drilling

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-1

August 2022 109464-001

SHANNON & WILSON, INC.
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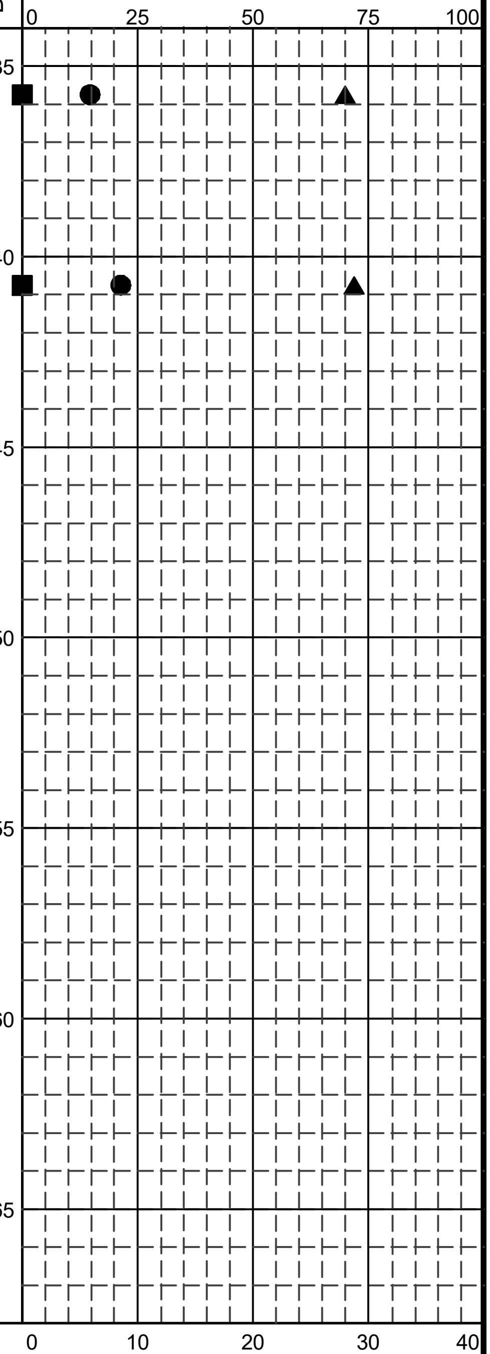
FIG. 5
Sheet 1 of 2

GEOTECHNICAL LOG 109464 GINT .GPJ S&W GEO1.GDT 8/16/22

MATERIAL DESCRIPTION Approx. Elevation: 327 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Very dense, brown, *Silty Sand with Gravel (SM)*; wet			S10		
			S11		
	41.5				
Bottom of Boring Boring Completed 6/16/2022					

Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



LEGEND

* Sample Not Recovered
⌶ 2" O.D. Split Spoon Sample
∇ Ground Water Level At Time Of Drilling

■ PID Reading (ppm)
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-1

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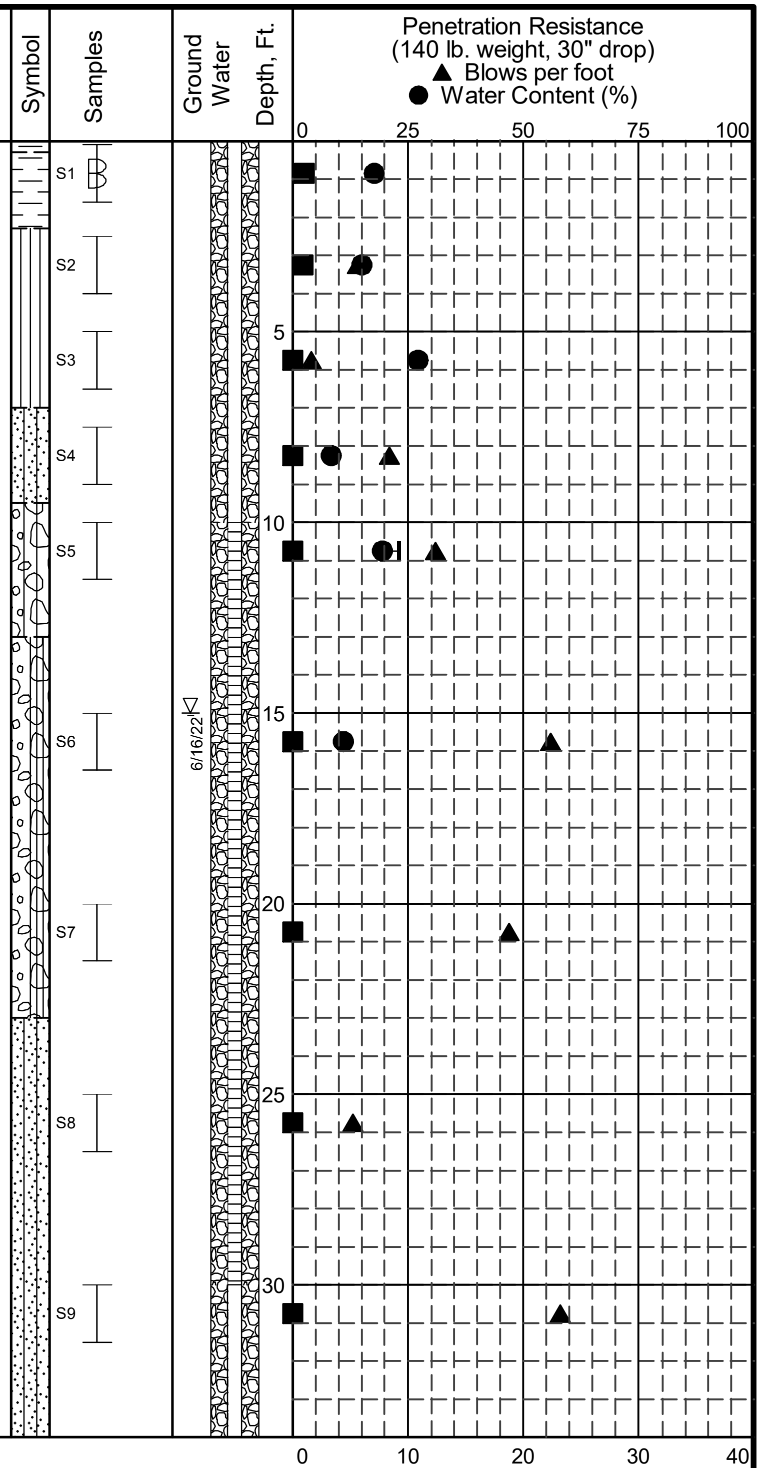
FIG. 5
Sheet 2 of 2

MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 327 Ft.	
Loose, dark brown, *Grass Mat (OL)*; moist	0.3
Loose, dark brown to black, *Organic Silt with Sand and Gravel (OL)*; moist	2.3
Medium dense to loose, brown to light brown, *Sandy Silt (ML)*; moist S3: 10% Gravel, 35% Sand, 54% Fines (F4 (P200))	7.0
Medium dense, brown, *Silty Sand with Gravel (SM)*; moist S4: 32% Gravel, 55% Sand, 13% Fines (F2 (P200))	9.5
Dense, brown, *Silty Gravel with Sand (GM)*; moist Piezometer obstructed at 10 feet bgs after drilling preventing reading on 6/28/22	13.0
Dense to medium dense, brown, *Well-Graded Gravel with Silt and Sand (GW-GM)*; moist to wet S6: 47% Gravel, 46% Sand, 7% Fines (F1 (P200))	23.0
Medium dense to very dense, brown, *Silty Sand with Gravel (SM)*; wet	



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LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-2

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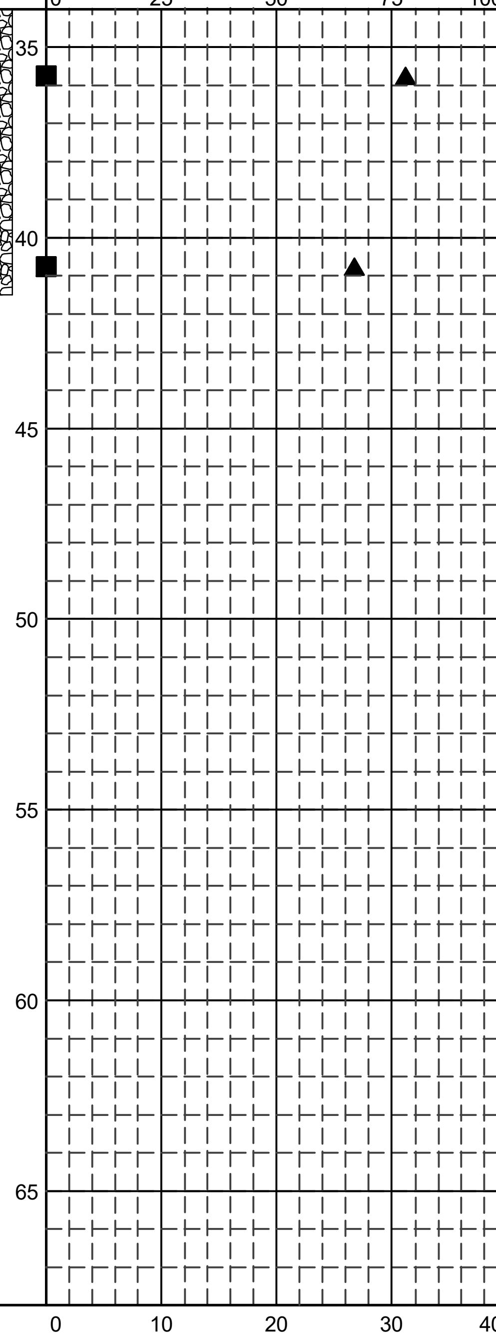
FIG. 6
Sheet 1 of 2

Version 1.0 - FINAL

MATERIAL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Approx. Elevation: 327 Ft.					
Very dense, brown, *Silty Sand with Gravel (SM)*; wet			S10		35
			S11		40
Bottom of Boring Boring Completed 6/16/2022	41.5				

Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



■ PID Reading (ppm)
Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-2

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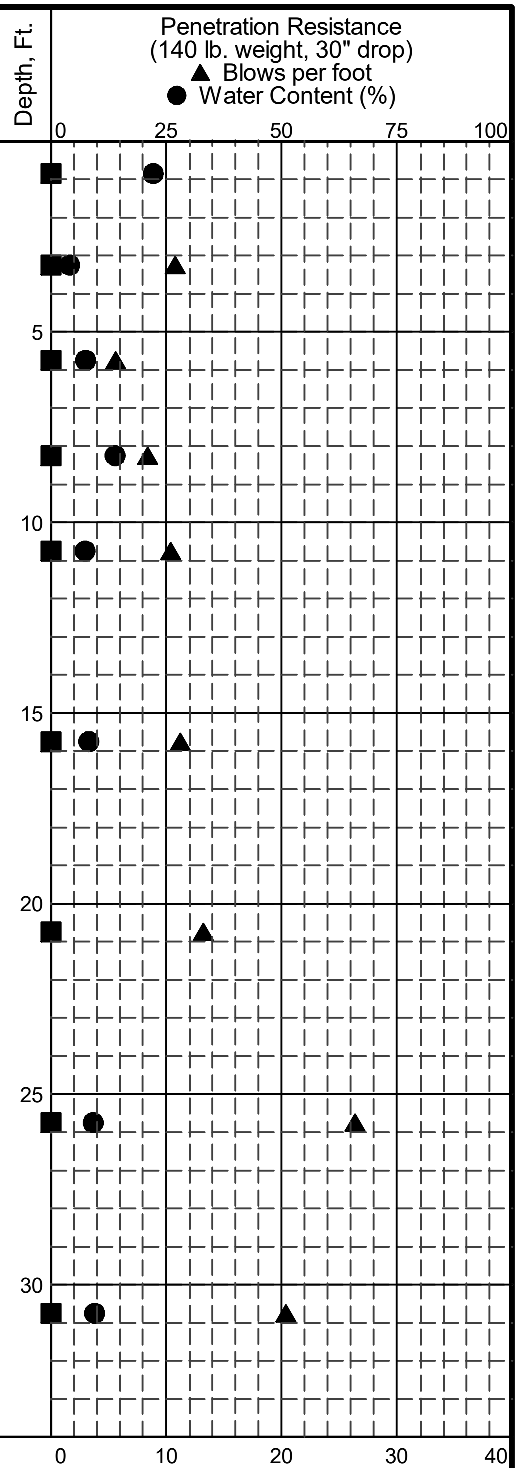
FIG. 6
Sheet 2 of 2

MATERIAL DESCRIPTION	Depth, Ft.	Samples
Approx. Elevation: 327 Ft.		
Loose, dark brown, *Grass Mat (OL)*; moist	0.3	S1
Loose, dark brown to black, *Organic Silt with Sand and Gravel (OL)*; moist	2.3	
S2: 45% Gravel, 46% Sand, 8% Fines (F2 (0.02mm))		S2
Medium dense, light brown to brown, *Sand with Silt and Gravel (SP-SM)*; moist	6.2	S3
Medium dense, brown, *Silty Sand (SM)*; moist		
S4: 5% Gravel, 51% Sand, 43% Fines (F3 (P200))		S4
	13.0	S5
Medium dense to very dense, brown, *Silty Sand with Gravel (SP-SM)*; moist to wet		S6, S7, S8, S9

Ground Water: 6/17/22 (approx. 14.5 ft)



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LEGEND

* Sample Not Recovered

2" O.D. Split Spoon Sample

Ground Water Level At Time Of Drilling

■ PID Reading (ppm)

Plastic Limit —●— Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Fire House 11 Warm Storage Building
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LOG OF BORING B-3

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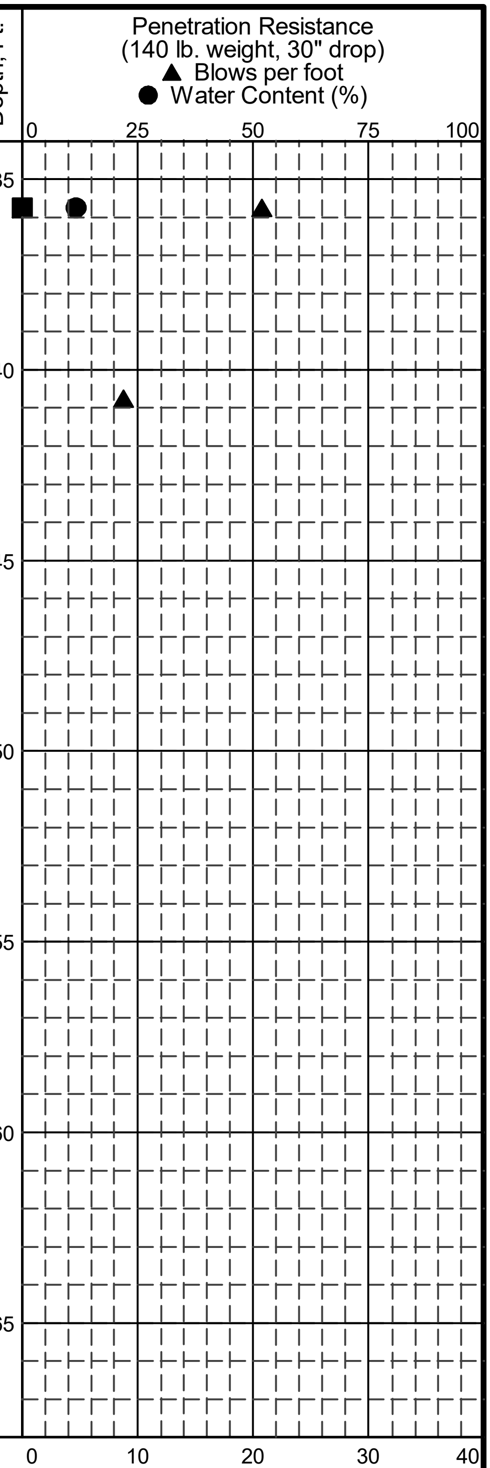
FIG. 7
Sheet 1 of 2

MATERIAL DESCRIPTION Approx. Elevation: 327 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
			S10		35
Medium dense, brown, *Silty Gravel with Sandl (GP-GM)*; wet S11: No Recovery	37.0		S11 *		40
Bottom of Boring Boring Completed 6/17/2022	41.5				45, 50, 55, 60, 65



LEGEND

* Sample Not Recovered
⌶ 2" O.D. Split Spoon Sample
∇ Ground Water Level At Time Of Drilling

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Fire House 11 Warm Storage Building
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LOG OF BORING B-3

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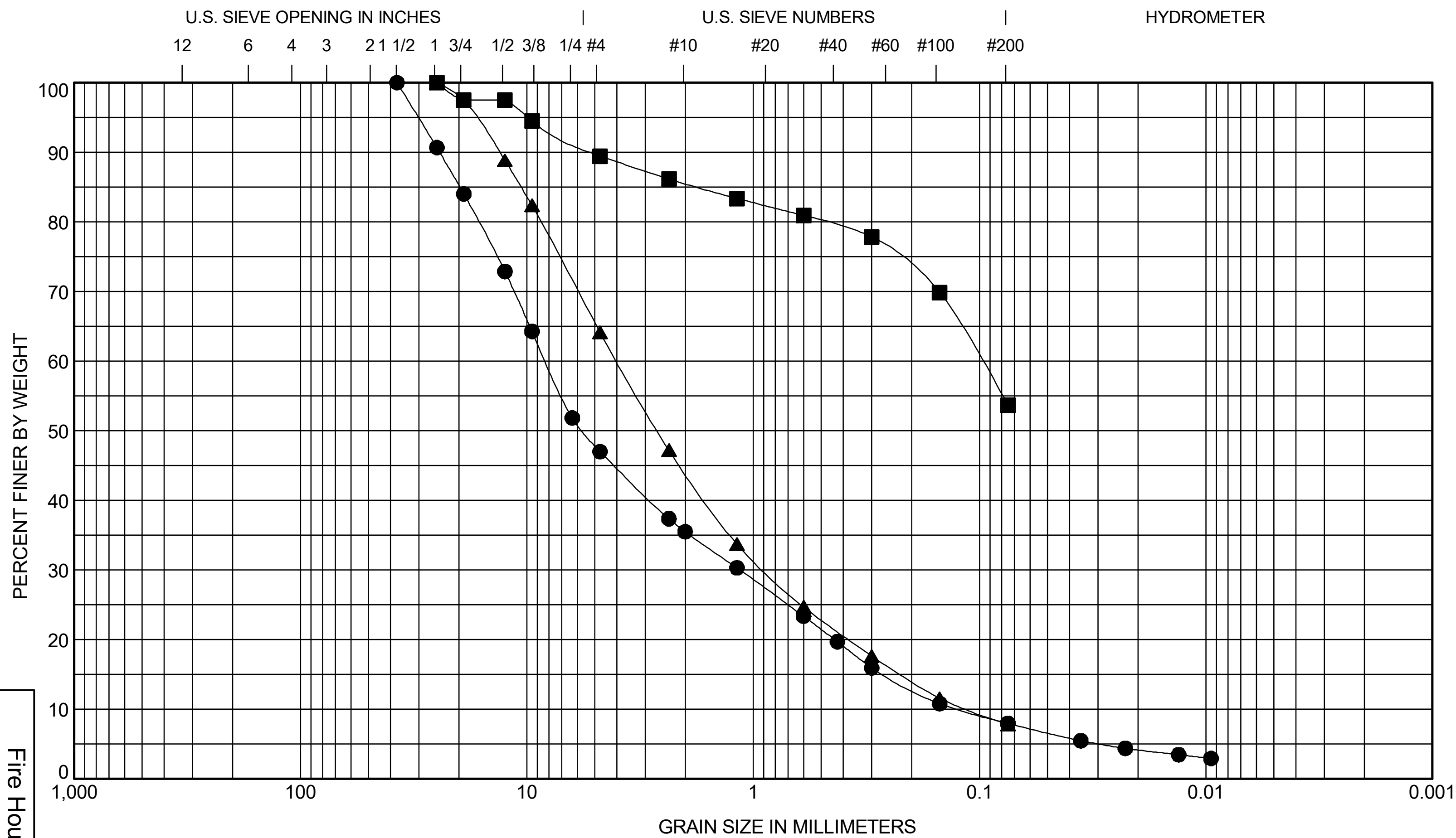
FIG. 7
Sheet 2 of 2

Version 1.0 - FINAL



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	USCS Classification	LL	PL	PI	Cc	Cu
●	**B-1 S1**	**0.1 - 1.6**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.3**	**66.7**
■	**B-1 S3**	**5.0 - 6.5**	**Sandy Silt (ML)**					
▲	**B-1 S5**	**10.0 - 11.5**	**Well-Graded Sand with Silt and Gravel (SW-SM)**				**1.8**	**35.7**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1 S1**	**0.1 - 1.6**	**37.5**	**8.25**	**1.15**	**0.12**	**53**	**39**	**8**	
■	**B-1 S3**	**5.0 - 6.5**	**25**	**0.1**			**11**	**36**	**54**	
▲	**B-1 S5**	**10.0 - 11.5**	**25**	**4.01**	**0.89**	**0.11**	**36**	**56**	**8**	

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GRAIN SIZE CLASSIFICATION

August 2022

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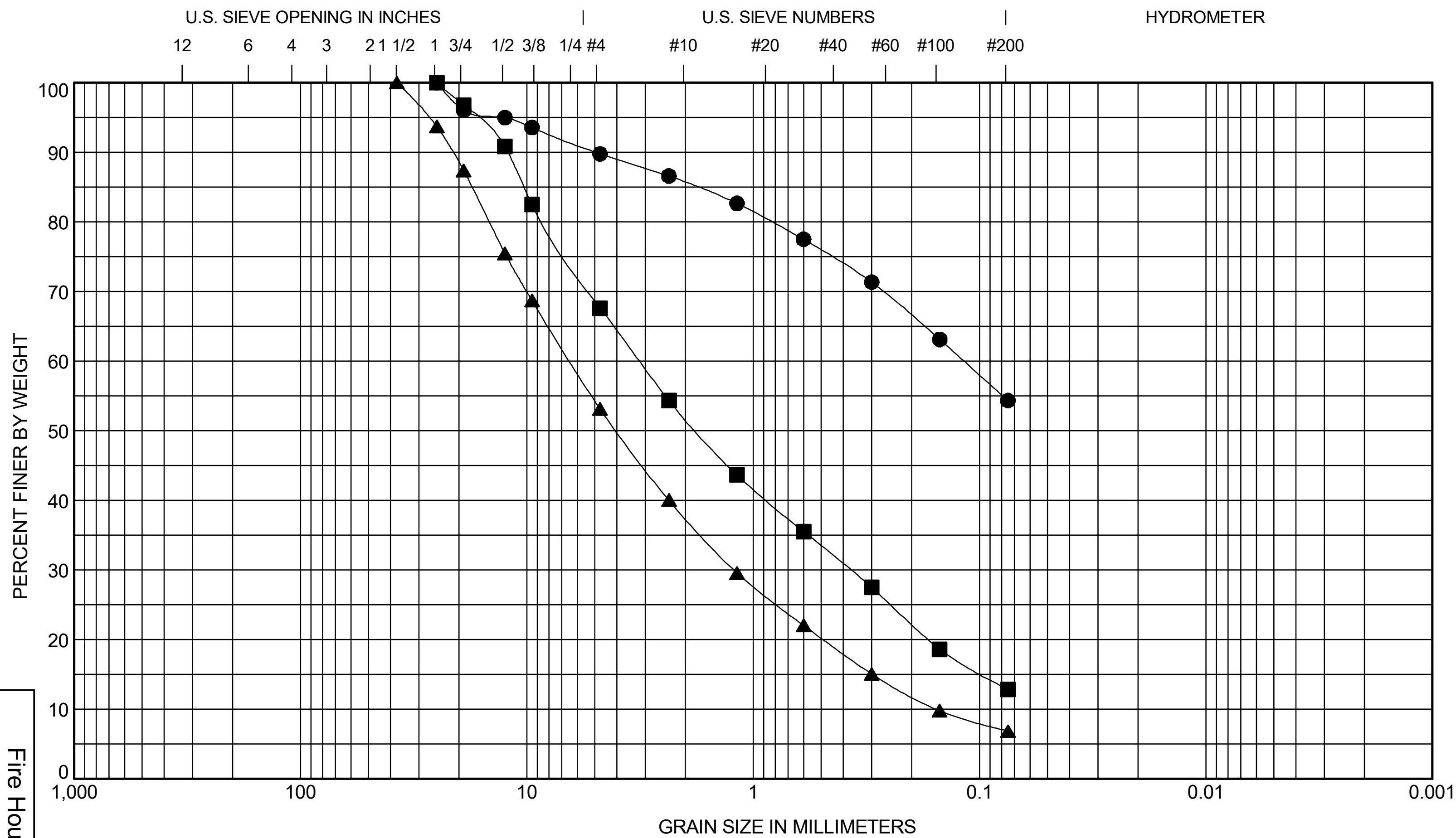
FIG. 8
Sheet 1 of 3



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	USCS Classification	LL	PL	PI	Cc	Cu
●	**B-2 S3**	**5.0 - 6.5**	**Sandy Silt (ML)**					
■	**B-2 S4**	**7.5 - 9.0**	**Silty Sand with Gravel (SM)**					
▲	**B-2 S6**	**15.0 - 16.5**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.5**	**41.7**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2 S3**	**5.0 - 6.5**	**25**	**0.12**			**10**	**35**	**54**	
■	**B-2 S4**	**7.5 - 9.0**	**25**	**3.18**	**0.37**		**32**	**55**	**13**	
▲	**B-2 S6**	**15.0 - 16.5**	**37.5**	**6.45**	**1.21**	**0.15**	**47**	**46**	**7**	

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GRAIN SIZE CLASSIFICATION

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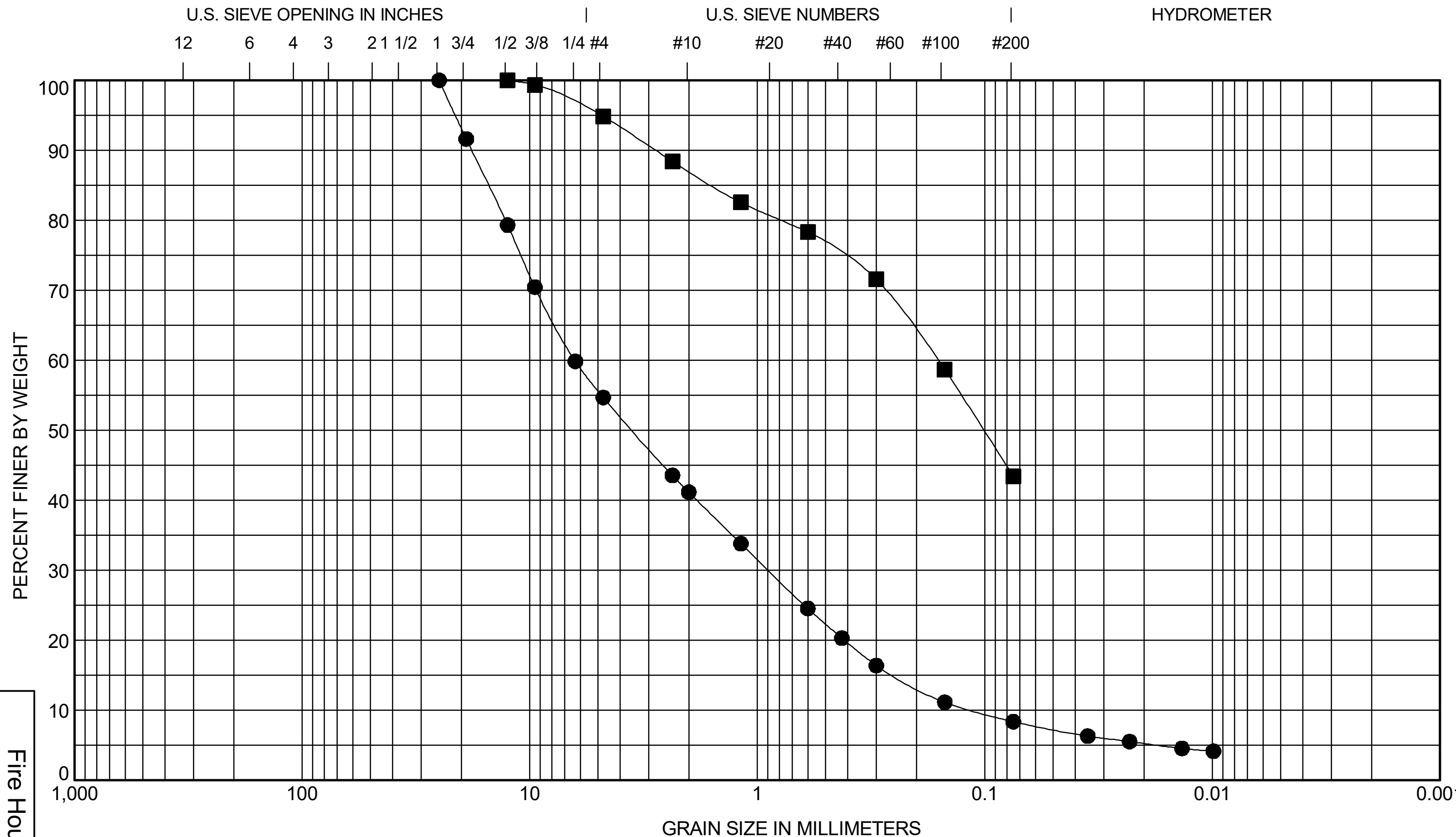
FIG. 8
Sheet 2 of 3



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	USCS Classification	LL	PL	PI	Cc	Cu
●	**B-3 S2**	**2.5 - 4.0**	**Well-Graded Sand with Silt and Gravel (SW-SM)**				**1.1**	**56.1**
■	**B-3 S4**	**7.5 - 9.0**	**Silty Sand (SM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-3 S2**	**2.5 - 4.0**	**25**	**6.34**	**0.89**	**0.11**	**45**	**46**	**8**	
■	**B-3 S4**	**7.5 - 9.0**	**12.5**	**0.16**			**5**	**51**	**43**	

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FIG. 8
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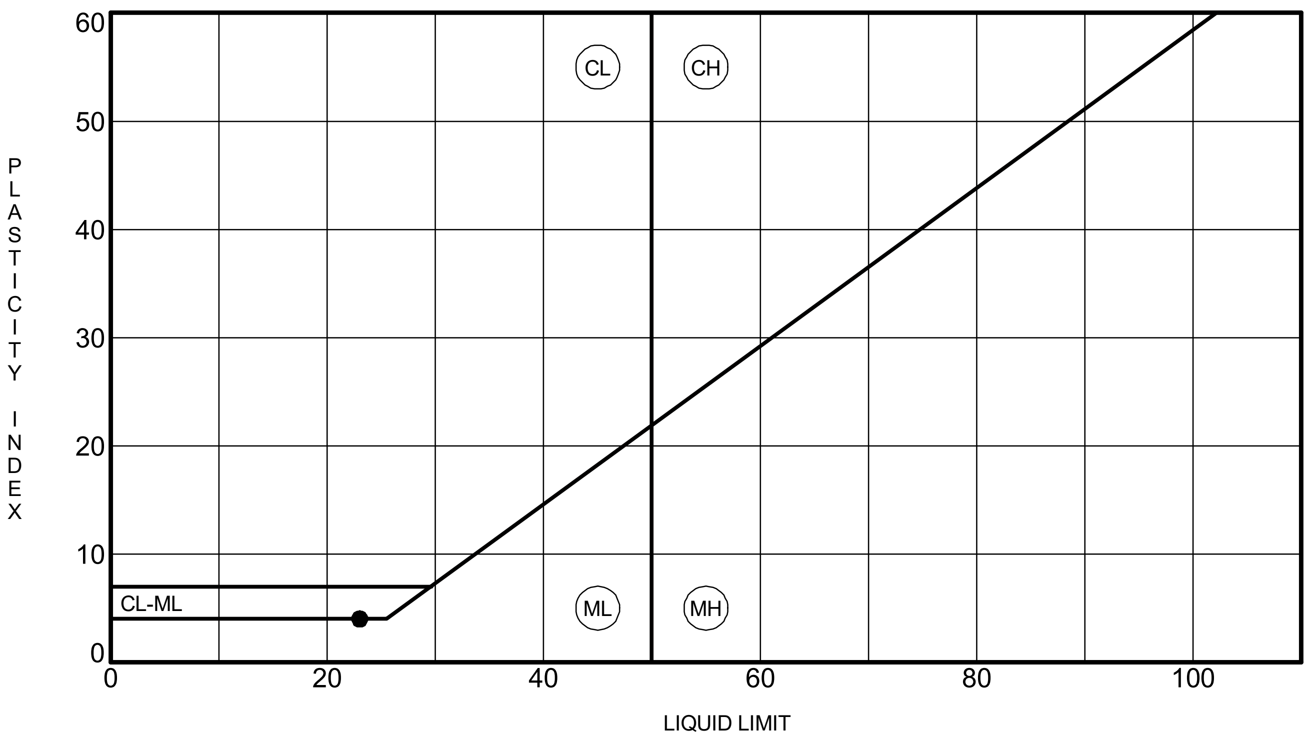

	Boring	Depth, Ft	LL	PL	PI	Fines	Classification
●	**B-2**	**10.0 - 11.5**	**23**	**19**	**4**		**CL-ML**

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ATTERBERG LIMITS RESULTS

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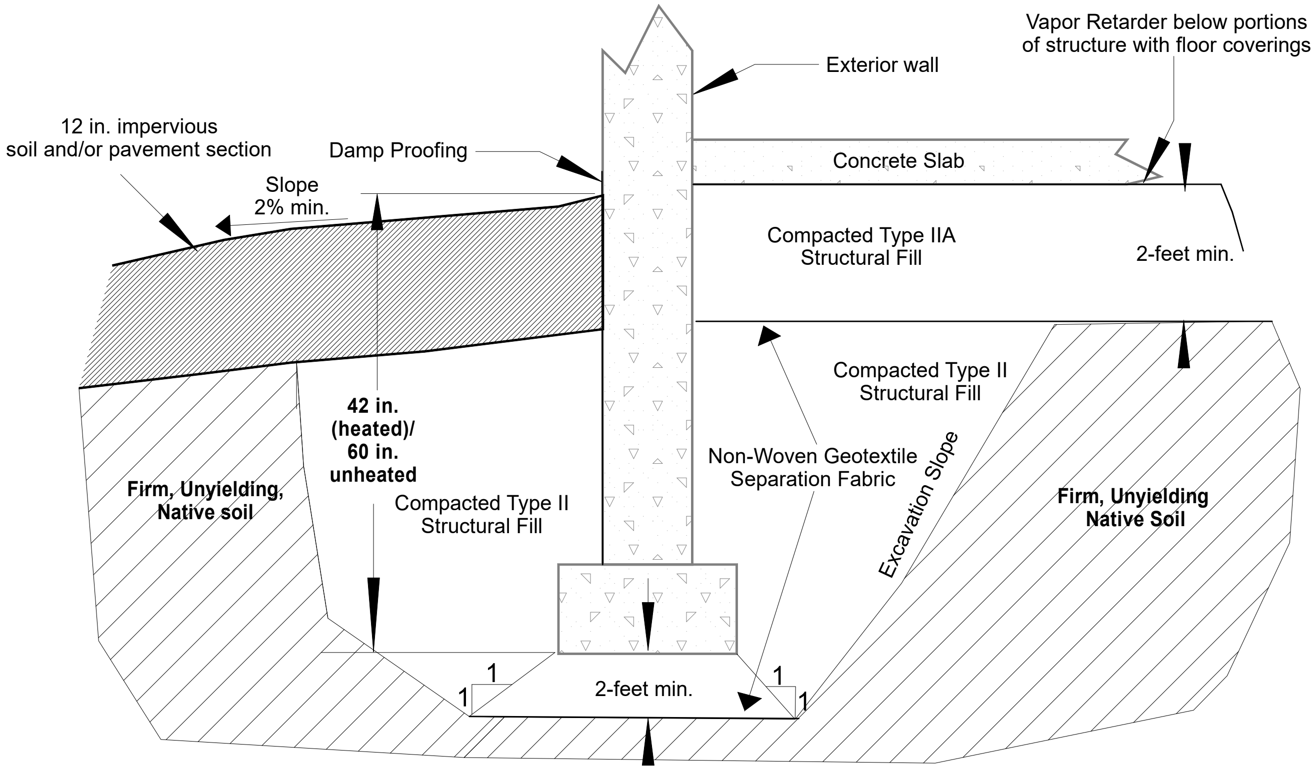
FIG. 9



NOTES:

1. Fill soils placed below footings and floor slabs and adjacent to footing walls should consist of free-draining granular fill that conforms to the gradation specifications of MASS Type II/IIA Structural Fill.
2. All backfill should be placed in layers not exceeding 10 to 12 inches loose thickness and densely compacted. Structural fill should be compacted to 95% minimum of ASTM D-1557.
3. Backfill within 18 inches of the wall should be placed in layers not exceeding 6 inches and densely compacted with hand-operated equipment. Heavy equipment should not be used for backfill, as such equipment operated near the wall could increase lateral earth pressures and possibly damage the wall.
4. OSHA requires slope protection and support for all trenches greater than 4 feet deep. Side slope requirements are variable depending upon soil type and the duration of time in which the trench remains open. The contractor should be made responsible or compliance to these regulations as he/she is at the project on a day to day basis and is aware of changing conditions.

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FLOOR SLAB AND FOOTING DETAIL

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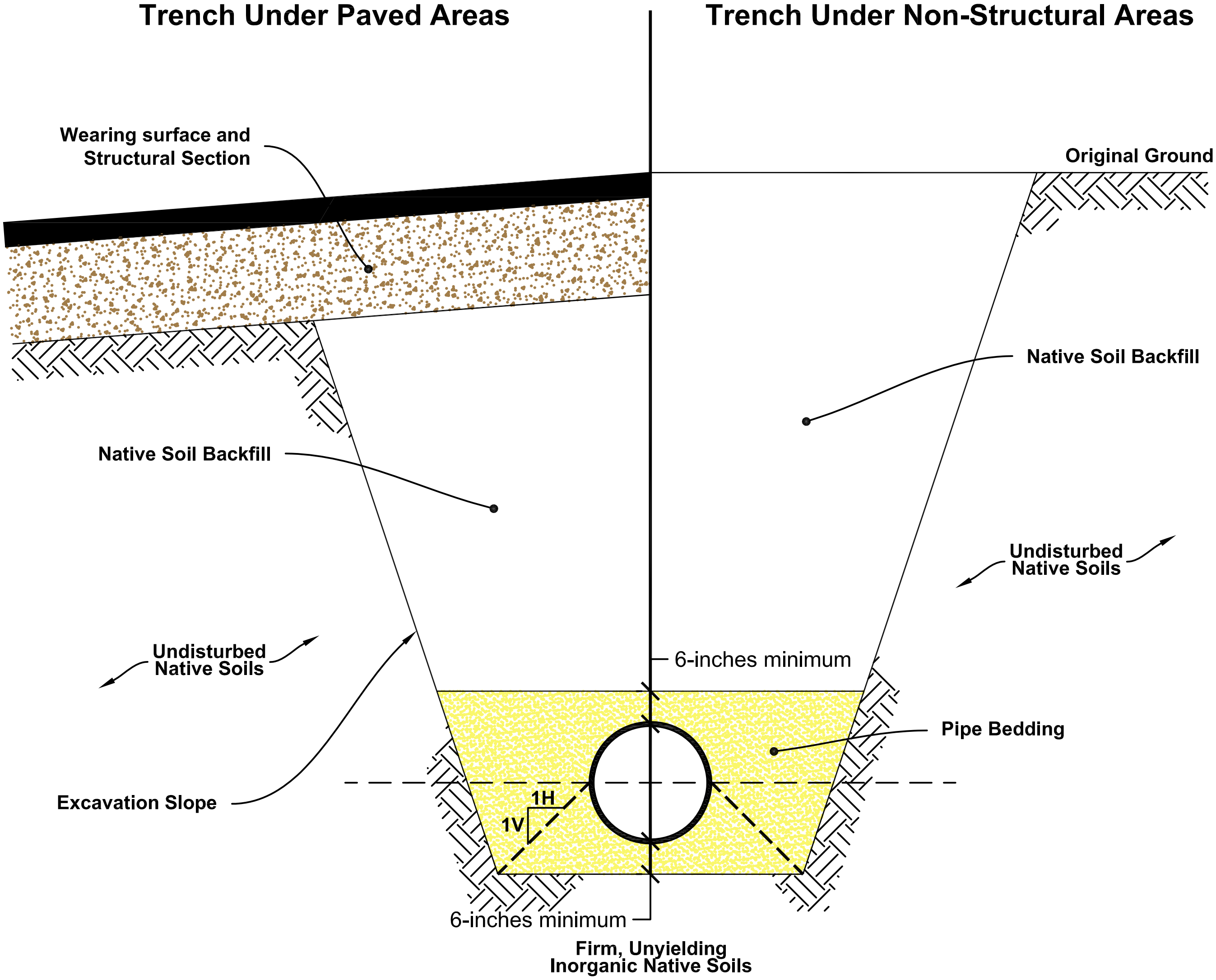
FIG. 10



NOTES

1. Trench backfill under paved areas should be placed in loose lifts not to exceed 12 inches and compacted to at least 95 percent of its maximum dry density as determined by AASHTO T-180-D.

2. Trench backfill under non-structural areas should be placed in loose lifts not to exceed 18 inches and compacted to at least 90 percent of its maximum dry density as determined by AASHTO T-180-D.

3. Pipe bedding should conform to MOA Class E bedding material or as recommended by pipe manufacturer.

4. Pipe bedding and cover thickness shown above should be used absent pipe manufacturer requirements.

5. OSHA requires slope protection and support for all trenches greater than 4 feet deep. Side slope requirements are variable depending upon soil type and the duration of time in which the trench remains open. The contractor should be made responsible for compliance to these regulations as he/she is at the project on a day to day basis, is aware of the changing conditions, and has authority to direct work.

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UTILITY TRENCH DETAIL

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FIG. 11

GRADATION REQUIREMENTS

(Adapted from Municipality of Anchorage Standard Specifications, 2015)

LEVELING COURSE

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
1 in.	25.0 mm	100
3/4 in.	19.0 mm	70 - 100
3/8 in.	9.5 mm	50 - 80
No. 4	4.75 mm	35 - 65
No. 8	2.36 mm	20 - 50
No. 50	0.30 mm	8 - 28
No. 200	0.075 mm	0 - 6*

TYPE II-A CLASSIFIED FILL

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
3 in.	75 mm	100
3/4 in.	19.0 mm	50 - 100
No. 4	4.75 mm	25 - 60
No. 10	2.00 mm	15 - 50
No. 40	0.425 mm	4 - 30
No. 200	0.075 mm	2 - 6***

TYPE II CLASSIFIED FILL

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
8 in.	-	100
3 in.	75 mm	70 - 100
1-1/2 in.	37.5 mm	55 - 100
3/4 in.	19.0 mm	45 - 85
No. 4	4.75 mm	20 - 60
No. 10	2.00 mm	12 - 50
No. 40	0.425 mm	4 - 30
No. 200	0.075 mm	2 - 6**

CLASS E BEDDING

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
1/2 in.	12.5 mm	100
3/8 in.	9.5 mm	100-80
No. 4	4.75 mm	20 - 75
No. 10	2.00 mm	12 - 60
No. 40	0.425 mm	2 - 30
No. 200	0.075 mm	0 - 6

* The fraction passing the No. 200 sieve shall not exceed 75 percent of the fraction passing the No. 50 sieve.

** The fraction passing the No. 200 sieve shall not exceed 15 percent of the fraction passing the No. 4 sieve.

*** The fraction passing the No. 200 sieve shall not exceed 20 percent of the fraction passing the No. 4 sieve.

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GRADATION REQUIREMENTS

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FIG. 12

IMPORTANT INFORMATION

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining

IMPORTANT INFORMATION

your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland