



GEOTECHNICAL ENGINEERING ASSESSMENT
For the Proposed
CIHA PH I & II HOUSING DEVELOPMENT
ANCHORAGE, ALASKA

Prepared for:
Triad Engineering, LLC
P.O. Box 111989
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Prepared by:
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JANUARY 2025



January 8, 2025

NGE-TFT Project # 7252-24

Triad Engineering, LLC
P.O. Box 111989
Anchorage, Alaska 99511

Attn: Brandon Marcott, PE – Principal

**RE: GEOTECHNICAL ENGINEERING ASSESSMENT OF THE SITE FOR THE
PROPOSED CIHA PH I & II HOUSING DEVELOPMENT LOCATED AT 4220
BAXTER ROAD, ANCHORAGE, ALASKA**

Brandon,

We (Northern Geotechnical Engineering, Inc. *d.b.a.* Terra Firma Testing) have completed our Geotechnical Engineering Assessment of the site for the proposed CIHA PH I & II Housing Development located at 4220 Baxter Road, Anchorage, Alaska.

Our engineering assessment of the project site suggests that the native soils at the project site are generally suitable to support the proposed housing development with conventional shallow and slab on grade foundations as long as our engineering recommendations are used in the design and construction processes. The existing fill stockpiles are not suitable to support the proposed site improvements and will likely be difficult to use as structural backfill.

In the following report, we provide a breakdown of the subsurface conditions and our laboratory findings from the samples collected, engineering conclusions and design recommendations based on the laboratory findings are provided to support our assessment of the project site.

Subsurface conditions can vary across a project site. As such, we recommend that The Observational Method (described in more detail in Appendix B of this report) be followed.

We greatly appreciate the opportunity to provide you with our professional service. Please contact us directly with any questions or comments you may have regarding the information that we present in this report, or if you have any other questions, comments, and/or requests.

Sincerely,

Northern Geotechnical Engineering, Inc. *d.b.a.* Terra Firma Testing

Jacob Stephens
Project Engineer

Clinton J. Banzhaf, P.E.
Senior Project Engineer

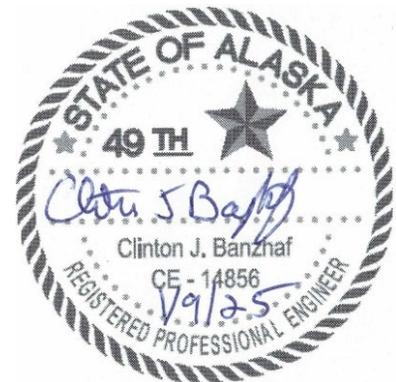


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1.0 INTRODUCTION

Project site: 4220 Baxter Road, Anchorage, Alaska 99504

Our client: Triad Engineering, LLC

NGE-TFT service fee proposal: #24-141(R1)

Authorization of services: via signed fee proposal #24-14(R1) by Brandon Marcott on November 13, 2024.

Scope of services:

- Characterize the subsurface conditions across the project site;
- provide pavement design recommendations;
- provide general foundation and earthworks engineering and construction recommendations.

2.0 PROJECT OVERVIEW

Project site location: 4220 Baxter Road, Anchorage, Alaska 99504 (See Figure 1 of this report)

Legal description of project site: Tract B of the Valetskaya Addition #1 Subdivision

Project site size: Approximately 2.75 acres

Previous site conditions:

- Site was developed with several residential structures that have been demolished as shown in previous aerial imagery.
- It appears that previous foundation areas were backfilled without compaction.

Current site conditions: (See Figure 2 of this report)

- The south side of the site is relatively clear and level;
- three (3) fill stockpiles approximately eight (8) to ten (10) ft high with light vegetation exist on the site;
 - northern fill stockpiles are approximately 11,900 sqft and 11,200 sqft
 - southern fill stockpile is approximately 19,000 sqft
- some trees exist along the south and east (along Baxter Road) sides of the site as well as in the northeast corner; and
- there is an asphalt walking trail throughout the site.

Proposed improvements to site: (See figure 3 of this report)

- Housing development to be constructed in two separate phases (configuration to be finalized):
 - Phase I (PH I) will be constructed along the southern half of the project site and consist of two or three multi-unit residential structures and associated paved driveways and parking areas.

- Phase II (PH II) will be constructed along the northern half of the project site and will likely consist of several additional multi-unit residential structures and additional paved driveways and parking areas.

3.0 SITE CHARACTERIZATION ACTIVITIES

Subsurface exploration contractor: Discovery Drilling, Inc. (DDI)

Number and type of soil explorations: Eight (8) hollow-stem auger soil borings

Exploration locations: Figure 2 of this report

Exploration depths: Approximately 11.5 to 26.5 feet below the ground surface (bgs)

Sampling method: Modified Penetration Test (MPT) split-spoon sampler

Drop-hammer type & correction factor: 340-lb automatic drop-hammer, CF=1.1

Field Blow Count Correction: Figure 4 of this report

Graphical Borehole Logs: Appendix A of this report

For more details regarding field activities refer to Appendix B (Section 1.0) of this report.

3.1 Infiltration Testing

Number and locations: Three (3) adjacent to boreholes B2, B4, and B5 (Figure 2)

Procedures followed:

- Falling head percolation test procedure outlined in Table 3.9 of the EPA On-site Water Treatment & Disposal Systems Manual
- EPA falling head test method as outlined in the Municipality of Anchorage Drainage Design Guidelines, Section 9.2.1.

Results: See Infiltration Test Results, Appendix C

For more details regarding infiltration testing refer to Appendix B (Section 1.3) of this report.

4.0 LABORATORY TESTING

We tested select soil samples in general accordance with the respective ASTM standard test methods including:

- moisture content analysis (ASTM D-2216);
- determination of fines content (a.k.a. P200 – ASTM D-1140);
- organic content (ASTM D2974); and
- grain size sieve and hydrometer analysis (ASTM D-6913 & D-7928) (*See Appendix B (Section 2.0) for an important note about these test methods*).

Laboratory Test Results: Appendices A (graphical exploration logs) and D (laboratory data sheets)

5.0 DESCRIPTION OF SUBSURFACE CONDITIONS

We compiled our field observations with the results from our laboratory analyses to produce graphical logs of each subsurface exploration (Appendix A). The graphical exploration logs depict the subsurface conditions that we identified at each exploration location and help us to interpret/extrapolate the subsurface conditions for areas adjacent to, and immediately surrounding, each exploration location across the project site.

5.1 General Subsurface Profile

The generalized subsurface conditions at the project site consisted of an approximate 0.5 ft top layer of organics or silt with organics across the site. The underlying subsurface conditions are split into two main sections:

Fill Stockpiles (See Figure 2)

Exploration locations located at fill stockpiles (B1, B3, B6, and B7) showed a loose silty gravel with some sand layer of approximately 5.0 to 8.0 ft bgs. Below this layer, the subsurface conditions reflected more native soils. Trace organics were found throughout the fill stockpiles.

Native Soils

The subsurface conditions between 0.5 ft bgs and 20.5 ft bgs at all non-fill stockpile locations (B2, B4, B5 and B8), and below fill stockpile locations, generally consist of native medium dense to dense silty gravel and medium dense to dense poorly graded gravel with some sand present.

Some cobbles were encountered, indicated by drilling (See Appendix A).

5.2 Groundwater

Groundwater was encountered at the time of drilling at borehole 1 (B1) at approximately 24 ft bgs. Groundwater was monitored at boreholes B1-B6, with groundwater encountered at B1, B5, and B6 (see Appendix A).

5.3 Frozen Soils

We observed seasonally frozen soil during our subsurface exploration program to a depth of 1.5 ft bgs. We do not expect permafrost to occur across the project site.

6.0 ENGINEERING CONCLUSIONS

Based on the findings of our field, laboratory testing, and engineering analysis efforts, it is our conclusion that:

General:

1. The native subgrade soils are generally suitable to support the proposed improvements provided that our concerns and recommendations are addressed by the design and construction processes.
2. Fill stockpiles are not suitable for the proposed improvements but can be reused as structural fill provided that our concerns and recommendations are addressed by the design and construction processes.

Earthworks:

3. Any organic rich material and/or fill should be excavated out to its horizontal and vertical extent within the footprint of the proposed improvements.
4. Coarse-grained material may be re-used on-site as structural fill assuming that the material is free of any organic material (or other deleterious debris) and that the material is compactible.
5. Excavations below the groundwater table will necessitate dewatering efforts for structural fill placement.

Foundations:

6. A conventional shallow foundation and slab on grade foundation are suitable for the project site.
7. There is a low potential for soil liquefaction and earthquake-induced lateral spreading and pressure ridges are unlikely.
 - a. Low liquefaction potential can be maintained by properly placing structural fill as discussed in Section 7.1 and 8.1 of this report.

Underground Utilities:

8. Underground utilities can be founded directly onto the existing native subgrade soils.
9. Underground utilities which can tolerate slight to moderate amounts of differential movements without effect on their overall performance (e.g., electrical and communication cables/wiring) can be founded directly in the existing fill and/or native subgrade soils.
10. Flexible utility-building connections and excess utility lengths may be necessary to accommodate some of the anticipated differential movements.
11. Gravity-fed utilities or utilities that are susceptible to damage from settlements will need to either be:
 - a. Founded onto properly placed structural fill bearing onto the relatively dense native mineral soils;
 - b. properly designed to accommodate potential differential and total settlements.

Pavement:

12. The pavement section design needs to consider the slightly to highly frost susceptible (F1 to F3) Municipality of Anchorage (MOA) frost classification of the near surface subgrade soils.

Settlements:

13. Total settlement for shallow concrete foundations placed on recommended bearing materials (defined in Section 7.1) is anticipated to be less than three-quarters (3/4) of an inch, with differential settlements comprising about one-half (1/2) of the total anticipated settlement.
 - a. Settlement amounts could increase substantially if the structural fill material used to bring any foundation pads to grade is not properly compacted.
 - b. Most of the settlements should occur as the building loads are applied, such that additional long-term settlements should be relatively small and within tolerable limits.
14. Settlements under driveways and parking areas are expected to vary more than under any buildings, especially where utility trenches are located.
 - a. The settlement potential can be reduced by performing all utility excavation and backfill efforts as early in the construction schedule as possible and placing any pavement as last in the construction schedule as possible.

7.0 DESIGN RECOMMENDATIONS

We have presented our design recommendations in the general order that the project site will most likely be developed. Our design recommendations can be used in parts (as needed) for the final design configuration.

7.1 Earthworks

Our general recommendations for earthworks are:

- Foundations should be placed on recommended bearing materials.
 - Recommended bearing materials: undisturbed native silty gravel and gravel or properly compacted structural fill above undisturbed native silty gravel and gravel.
- Structural fill materials should be compacted to a minimum of 95 percent of the modified Proctor density.
- To reuse excavated coarse-grained material as structural fill it:
 - should have less than approximately 15 percent passing the #200 sieve; and
 - must not contain any organic/deleterious material.
- Fill stockpile material:
 - will likely be difficult to reach required minimum compaction level for structural fill;

- is slightly organic, see Appendix E for additional details of our organic classification and impact on structural fill strengths; and
- we recommend using for non-structural fill applications.

Slopes at the project site should:

- not exceed a 2:1 slope (if constructed);
- have properly keyed in fill; and
- have erosion control.

We recommend the following quality control inspections:

- bottom-of-hole inspections;
- fill gradation classification; and
- in-situ compaction testing.

A bottom-of-hole inspection should be conducted (by a qualified geotechnical engineer, geologist, or special inspector) before any foundation construction begins.

7.2 Seismic Design Parameters

Assumptions: ASCE/SEI 7-22 and Seismic Risk Category 2

Seismic Site Classification: *D*

ASCE 7 Hazards Report: Appendix E

7.3 Shallow Foundations

For the purposes of this report, we consider a shallow foundation to be any foundation which will require over-excavation of the existing fill material prior to structural fill placement and/or foundation construction or is shallower than ten (10) feet bgs. We have separated our recommendations for warm (i.e., heated) and cold (i.e., unheated) shallow foundations into Sections 7.3.1 and 7.3.2 of this report.

7.3.1 Warm Shallow Foundations

For the purposes of this report, we consider a warm shallow foundation to be any shallow foundation located within or along the direct perimeter of an enclosed, climate-controlled space that maintains an internal ambient air temperature above 40°F.

7.3.1.1 Soil Bearing Capacity

Concrete foundations placed on recommended bearing materials (defined in Section 7.1) and at the burial depths of a perimeter footing as described in Section 7.1.1.3 may be designed with a:

- 3100 pounds per square foot (psf) soil bearing capacity; and
- one-third (1/3) increase to accommodate short-term wind and/or seismic loads.

Larger footings (smallest dimension greater than two feet in plan dimension) may be designed for greater bearing capacities at a rate of 200 psf for every additional horizontal linear foot of footing up to a maximum value of 3900 psf.

7.3.1.2 Continuous Strip Footings and Spread Footings

The minimum horizontal dimensions for continuous strip footings and/or spread footings founded directly onto recommended bearing materials (defined in Section 7.1) are:

- 16 inches for continuous strip footings
- 24 inches for individual spread footings

7.3.1.3 Footing Burial Depths

For the project site, the minimum burial depth for any uninsulated shallow foundation footings should be as follows (measured from the bottom of the foundation footing):

1. 12 inches (D_1 in Figure 6) for interior footings located entirely within an enclosed, continuously heated space* (measured from the bottom of the footing to the top of the floor slab) and
2. 42 inches (D_2 in Figure 6) for foundation footings located along the perimeter of an enclosed, continuously heated space* (measured from the bottom of the footing to the exterior finished grade).

**The temperature of an enclosed, continuously heated space must be maintained above 40 °F and allow for adequate heat transfer to foundation soils in order for our recommendations to apply.*

We have provided our recommended insulation configurations in Figure 5 of this report. We should be consulted if alternative foundation insulation configurations are to be utilized for this project so that we can evaluate their suitability as it pertains to the existing site conditions and proposed foundation design.

If foundation burial depths are reduced through the use of insulation, then the allowable bearing capacity of the foundation may also be reduced. As such, we should be consulted to re-evaluate our minimum allowable bearing capacities if foundation depths are to be shallower than those which we recommend above.

We provide more details about frost development and protection in Appendix B (Section 3.1) of this report.

7.3.1.4 Thickened Edge Slab Foundations and Floor Slabs

Thickened slab edges (i.e., perimeter slab footings) should extend a minimum of 16 inches below the finished exterior grade to achieve the recommended allowable soil bearing capacity and help resist any lateral forces. Warm thickened edge slab foundations and/or floor slabs can be founded

directly onto the recommended bearing materials (defined in Section 7.1) with a pad that consists of:

- adequate amounts of insulation (Figure 5);
- relatively free draining sands and gravels with less than about 15% of the fill material passing through a #200 sieve for the upper structural fill material (at or above the footing grade); and
- free draining material with less than 3% passing the #200 sieve for the top four to six inches beneath the slabs.

Concrete slabs constructed directly on the recommended bearing materials (defined in Section 7.1, may be designed using a modulus of subgrade reaction of $k_I=210$ pci (k_I is the value for a 1-ft \times 1-ft rigid plate) and the equations presented in Appendix B (Section 3.2) for modulus of subgrade reaction for load footprints.

7.3.2 Cold Shallow Foundations

For the purposes of this report, we consider a cold shallow foundation to be any shallow foundation whose subgrade is subjected to freezing temperatures for any amount of time.

It is difficult to predict the depth of ground frost penetration and extent of ice lens formation at any given site. Therefore, we do not recommend the construction of cold shallow foundations. The formation of ice lenses in the foundation subgrade can damage overlying foundations due to differential movements in the foundation subgrade as a result of soil ice growth and/or subsequent thaw-related losses of soil bearing capacity (due to increased soil moisture contents). However, in the event that cold shallow foundations cannot be avoided, we provide cold shallow foundations recommendations in the following Subsections of this report.

7.3.2.1 Soil Bearing Capacity

The bearing capacity of cold shallow foundations will be a function of both the configuration (i.e., dimensions) and burial depth of the foundation. We can provide allowable bearing capacities for various footing burial depths once a foundation configuration has been determined.

The warm shallow foundation bearing capacity may be used for a cold shallow foundation of the same burial depths; however, it is expected that a cold shallow foundation will be buried deeper which could increase the soil bearing capacity.

7.3.2.2 Footing Burial Depths

If the subgrade soils of shallow foundations are allowed to freeze (for any amount of time), then soil ice can form in the subgrade and result in a phenomena known as “frost heaving”. Frost heaving forces can generate significant footing uplift loads which can damage shallow foundations. As such, cold shallow foundations need to be buried sufficiently deep and/or be adequately

insulated so as to reduce the potential for freezing of the foundation subgrade and any associated frost heaving forces.

For the project site, the minimum burial depth for any uninsulated cold shallow foundation footings should be 96 inches (D_3 in Figure 6), measured from the bottom of the footing to the lowest elevation of either the interior or exterior finished grade – including any floor slabs).

The minimum footing burial depth for any cold shallow foundation may be reduced, if the foundation is placed onto a granular structural pad constructed of NFS fill material. NFS material should have less than 3% of the material finer than 0.02 mm in diameter. The minimum foundation burial for a cold shallow foundation bearing onto a structural NFS fill pad should be the same as our minimum recommended burial depth for a warm shallow foundation (D_2 in Figure 6). However, the NFS fill subgrade must extend a minimum of 96 inches below the planned finished grade (interior or exterior - whichever is lower) in order to adequately protect the foundation from potential frost heaving forces.

Insulation may be incorporated into the design of a cold shallow foundation to help protect the foundation subgrade from freezing. Artificial insulation may be used in lieu of some of the NFS backfill. In terms of insulating properties, one inch of rigid foam board insulation can be considered equivalent to one foot of NFS fill. A minimum of 18 inches of NFS fill must be present between the bottom of any shallow foundation footing and the top of any insulation to help protect the insulation from damage. We detail our recommended insulation configurations for cold shallow foundations in Figure 5 of this report (configurations E and F). We do not recommend the construction of a cold thickened edge slab foundation unless it is supported by an appropriately constructed NFS and/or insulated subgrade (as we discuss above).

Other cold shallow foundation insulation configurations do exist other than those which we detail in Figure 5 of this report, and we should be consulted if alternative shallow foundation insulation configurations are to be utilized for this project so that we can evaluate their suitability as it pertains to the existing site conditions and proposed foundation design.

7.3.2.3 Grade-level Design Elements

Any cold shallow foundation design elements which are to exist at (or very close to) grade level (e.g., grade beams, connecting structural members, exterior siding, etc.) should be designed to accommodate a minimum of 6 inches of vertical ground movement due to potential frost heave. If planned grade-level design elements cannot withstand any vertical movements, then they should not be used with a cold shallow foundation system, as frost heaving forces can damage these elements and/or result in failures at foundation connections. We recommend that a minimum air gap of 6 inches be maintained between the ground surface and any structural members that span between cold shallow foundations. We should be consulted in the event that the design cannot accommodate our recommended air gap so that we can evaluate the frost heaving pressures that may develop, so that they can be accounted for by the structural design.

7.3.3 Shallow Foundation Uplift Resistance

The uplift capacity of a foundation is a function of its weight, configuration, and depth and can be determined using:

- 80 percent of the weight of the foundation plus 80 percent of the weight of the effective soil mass (Figure 8) located above the footing;
- an effective unit weight of 130 pcf for granular structural backfill material; and
- no increase in uplift capacity for short-term loading, as the ultimate uplift load includes any short-term load factors.

Shallow foundation footings should extend laterally a minimum of one-eighth (1/8) of the footing width beyond any foundation walls to help resist any anticipated uplift/overturning forces (Figure 8).

We can calculate the uplift capacity for other foundation configurations upon request and once we have been provided with a general foundation design.

7.3.4 Lateral Loads for Foundation and Retaining Walls

Retaining walls (such as perimeter foundation stem walls for buildings with basements or crawl spaces) must be designed to resist lateral earth pressures. The magnitude of the pressure exerted on a retaining wall is dependent upon several factors, including:

- 1) whether the top of the wall is allowed to deflect after placement of backfill;
- 2) the type of backfill used;
- 3) compaction effort; and
- 4) wall drainage provisions.

Any foundation stem walls that are not designed to carry lateral loads should be backfilled on both sides simultaneously to prevent differential lateral loading of the foundation stem wall.

The lateral soil pressures can be represented by equivalent fluid pressures. The pressure distribution is a function of wall restraint, seismic loading, and drainage conditions. In Table 1 of this report, we provide the unit weights to be used with the pressure distribution diagrams for various loading conditions provided in Figure 9 of this report. We assumed that structural fill (containing less than ten percent fines) is used as backfill, and that the fill is compacted to at least 90 percent of the modified Proctor density.

Table 1: Equivalent Fluid Specific Weight for Lateral Loading Design

LOADING CONDITION	DRAINED EQUIVALENT FLUID SPECIFIC WEIGHT		UN-DRAINED EQUIVALENT FLUID SPECIFIC WEIGHT	
	SPECIFIC WEIGHT (pcf)	SYMBOL	SPECIFIC WEIGHT (pcf)	SYMBOL
ACTIVE	40	t_1	24	t_2
AT-REST	62	t_3	37	t_4
PASSIVE	495	t_5	300	t_6
SEISMIC	18 (UNRESTRAINED)	t_7	11 (RESTRAINED)*	t_8

* For wall heights less than 8 ft

Lateral forces may also be resisted by friction between the concrete foundations and the underlying soil. The frictional resistance may be calculated using a coefficient of friction of 0.4 between the concrete and soil.

We provide more details about lateral earth pressure in Appendix B (Section 3.3) of this report.

7.4 Insulation

Any subgrade insulation used should:

- consist of extruded polystyrene such as DOW Styrofoam™ Highload or UC Industries Foamular;
- not absorb more than 2% water per ASTM Test Method C-272;
- not have a thermal conductivity (k) that exceeds 0.25 BTU-in/hr-ft²-°F when tested at 75°F;
- be installed with proper bedding material that provides a flat, smooth surface; and
- be closed cell, board stock with a minimum compressive strength of:
 - 60 psi (at 5% deflection) for use under structural slabs.
 - 25 psi (at 5% deflection) for use around the exterior of any foundations.

7.5 Underground Utilities

In general, the soils in which deep utility trenches (6-10 feet bgs) are to be constructed are composed of native silty gravel and gravel. Any gravity-fed utility trenches extending into the native silty gravel and gravel should be a minimum of three feet wide at the bottom with the utility piping located in the center of the trenches. Structural fill should be used to bring the gravity-fed utilities to the proper installation grade. Utilities that are not sensitive to settlement may be placed in the existing fill.

Underground utilities which are susceptible to damage from freezing:

- Need to be frost-protected by sufficient amounts of backfill, insulation, and/or active freeze protection systems (e.g., heat tape, thaw wire, etc.); or some combination of the above.
- Need to contain some level of additional frost-protection (e.g., insulation, active freeze protection systems, or a combination of both) if they are planned to be constructed less than eight feet below the planned finished grade.

- Should not be constructed within four feet of the planned finished grade (regardless of insulation measures or active freeze-protection systems).

Any insulation used should:

- conform to the specifications detailed in Section 7. 4 of this report; and
- extend a minimum of two feet (and a maximum of four feet) perpendicular to either side of the proposed utility alignment.

The thickness of the insulation used will be a function of the burial depth. In general, one inch of insulation is equal to approximately 12 inches of compacted NFS backfill.

7.6 Pavement Sections

Design Considerations:

- There are cut and fill activities planned at the project site.
- The near surface subgrade soils classify as F1 to F3 on the MOA frost classification scale.

We provide more details about frost development in pavement sections in Appendix B (Section 3.4) of this report.

We detail our recommended pavement section for construction above the F2 soils in Table 2 and Table 3 of this report.

Table 2: Uninsulated Pavement Section for F2 subgrade

SECTION THICKNESS	MATERIAL
2 INCHES MIN.	ASPHALT CONCRETE (AC) PAVEMENT
2 INCHES MAX.	NFS LEVELING COURSE (A.K.A. “D-1”)
12 INCHES	TYPE II-A
N/A	GEOTEXTILE FABRIC (OPTIONAL)
N/A	F2 SUBGRADE (NATIVE OR FILL)

Table 3: Uninsulated Pavement Section for F3/F4 subgrade

SECTION THICKNESS	MATERIAL
2 INCHES MIN.	ASPHALT CONCRETE (AC) PAVEMENT
2 INCHES MAX.	NFS LEVELING COURSE (A.K.A. "D-1")
12 INCHES	TYPE II-A
12 INCHES	TYPE II or II-A
N/A	GEOTEXTILE FABRIC (RECOMMENDED)
N/A	F3/F4 SUBGRADE (NATIVE OR FILL)

Rigid, closed-cell foam board insulation (as we specify in Section 7.4 of this report) can be used to reduce the amount of Type II material that we specify in our recommended F2 and F3/F4 pavement section (Tables 2 and 3) at a rate of one inch of insulation for 12 inches of Type II/II-A fill. However, given the relatively thin overall section of our recommended pavement section it is likely that insulation will not be a cost-effective option for this project.

7.6.1 Confirmation Testing

NFS and F1 subgrades will only require a leveling course layer, as there is little to no potential for ice lens development in the subgrade soils at the project site. Confirmation frost classification testing of the subgrade soils located along the proposed street alignment should be conducted after the completion of all overburden removal and any utility installation activities at a frequency of:

- one test per 100 lineal feet along the exposed subgrade surface, and
- one test per 200 lineal feet at a depth of approximately 12 inches below the exposed subgrade surface.

The results of the confirmation frost classification testing can be used to ensure that the proper pavement section is used for the soil conditions exposed. If the confirmation testing indicates that the subgrade soils are NFS, then an alternative (thinner) pavement section can be used (as we discuss above). However, if the conformation testing indicates that the frost classification of the subgrade soils is higher than MOA NFS, then alternative pavement section designs, including thicker structural sections and/or the use of artificial insulation may be required as shown in Tables above.

7.6.1 Material Specifications

A permeable geotextile fabric is optional, but not required for this project. Any geotextile fabric used should meet the specifications in the 2015 Municipality of Anchorage Standard Specifications (MASS), Section 20.25. For the project site, we recommend a Type A, Class 2 (i.e., separation) geotextile fabric. The geotextile fabric may be either: 1) woven, or 2) non-woven with

perforations. We have provided the various strengths for both a woven and non-woven Type A, Class 2 geotextile fabric in Table 4 of this report.

Table 4: Type A, Class 2 Geotextile Fabric Strengths

FABRIC PROPERTY	ASTM STANDARD USED TO DETERMINE STRENGTH	WOVEN FABRIC STRENGTH	NON-WOVEN FABRIC STRENGTH
GRAB STRENGTH	D4632	250	160
SEWN SEAM STRENGTH	D4632	225	140
TEAR STRENGTH	D4533	90	56
PUNCTURE STRENGTH	D6241	495	310

Note: Units in lbs per foot.

The leveling course, Type II, and Type II-A materials used should conform to the specifications we provide in Figure 7 of this report and be placed in thin lifts compacted to a minimum of 95 % of the modified Proctor density.

Any leveling course used should be NFS; however, it is our experience that the “D-1” leveling course material currently available in Anchorage area may not be NFS following compaction, and as such we recommend:

- using two inches of recycled asphalt pavement (RAP) for the leveling course; or
- keeping the leveling course thickness to two inches or less.

We provide more details about pavement material specifications in Appendix B (Section 3.4) of this report.

7.7 Surface Drainage

After the property is brought to grade it should be relatively flat, such that storm water will tend to accumulate and flow off the site slowly.

Water accumulation will have a detrimental effect on foundations, retaining structures, and pavement sections and as such we recommend:

- 1) grading the ground surface around the proposed developments such that surface runoff is channel away from foundations/retaining structures/pavement sections;
- 2) tightly compacting the surface soils;
- 3) diverting roof, parking lot and driveway drainage away from foundation; and
- 4) making tight-line connections from roof drain collectors to storm sewer (if available).

8.0 CONSTRUCTION RECOMMENDATIONS

We have presented our construction recommendations in the general order that the project site will most likely be developed. Our construction recommendations are intended to aid the construction contractor(s) during the construction process.

8.1 Earthwork

Structural fill should be:

- compacted to a minimum of 95 percent of the modified Proctor density as determined by ASTM D-1557 (unless specifically stated otherwise in other sections of this report); and
- placed in individual lifts of less than one-foot in thickness (typical);
 - thickness will be determined based on the equipment used, the soil type, and existing soil moisture content.

All earthworks should be completed with quality control inspection.

Excavated coarse-grained material should:

- have less than approximately 10 to 15 percent passing the #200 sieve and not contain any organic/deleterious material to be used as structural fill; and
- be protected from additional moisture inputs (precipitation, etc.) through the use of plastic tarps, etc. if stockpiled on-site.

Soils with higher silt contents can be used within the foundation footprint. However, the effort required to achieve proper compaction of silt-rich soils may be more costly than purchasing better grade materials. The time of year, existing moisture content, rainfall, air temperature, and fill temperature can all have an impact on the effort required to adequately compact silt-rich material.

8.1.1 Winter Construction

To ensure proper placement and compaction of structural fill during winter months the following additional guidelines should be followed:

- ambient soil temperatures need to be above 37 °F;
- fill material needs to be completely thawed before placement; and
- subgrade soils (fill or native) need to be completely thawed prior to the placement and compaction of additional lifts of thawed fill material.

8.2 Shallow Foundations

Care should be taken during foundation excavation activities to limit the disturbance of the bottom of any foundation excavations. The bottom of any foundation excavation should be moisture conditioned and proof-rolled as necessary to return the exposed soils to their original in-situ density.

In general, the soils in which the proposed foundation pads are to be constructed consist primarily native silty gravel and gravel. As such, any surface water (*e.g.*, from precipitation, snowmelt, etc.) that enters into foundation excavations may tend to dissipate slowly. Excess water will have a negative impact on any backfill and compaction efforts. Therefore, if surface water does accumulate in any open foundation excavations it can be controlled by excavating a shallow drainage trench around the perimeter of the excavation. The drainage trench will collect surface water and direct it to a sump area, which should be located outside of the foundation footprint. The excess water can then be pumped from the sump area and be discharged at an appropriate location away from the excavation and any other existing foundations.

8.2.1 Warm Shallow Foundations

Warm shallow building foundation must remain thawed continuously through construction;

- if construction occurs during the winter months tenting (temporary enclosures) and heat should be applied to keep the foundation bearing material thawed.
- Consequences of freezing are described in Section 4.1 of Appendix B.

8.3 Pavement

The following are our construction recommendations for pavement sections:

- Confirmation frost classification testing of the exposed subgrade should be completed.
- All of the earthwork within any areas to be paved should be completed as early in the construction schedule as possible, and the pavement placed as late in the construction schedule as possible.
 - Underground utility piping should be installed prior to construction of any pavement sections such that trenching is done through the subgrade soils only.
 - This will give the subgrade soils time to settle, compress, and stabilize prior to placement of the pavement.
- Any structural fill used should be placed in thin lifts (less than one foot in thickness) and each lift should be compacted to a minimum of 95 percent of the modified Proctor density.
- Prior to paving, any surface fill material should be re-leveled and re-compacted.
- All backfill and paving materials should be inspected and tested for material specification compliance and compaction.

The minimum thickness for any asphalt concrete (AC) pavement surfaces is two inches. The minimum thickness of any Portland cement concrete (PCC) pavement surfaces will be a function of the reinforcement required. All applicable ACI and IBC standards should be followed.

9.0 CLOSURE

We (Northern Geotechnical Engineering, Inc. d.b.a. Terra Firma Testing) prepared this report exclusively for the use of Triad Engineering, LLC and their consultants/contractors/etc. for use in the design and construction of the proposed improvements. We should be notified if significant changes are to occur in the nature, design, or location of the proposed improvements in order that we may review our conclusions and recommendations that we present in this report and, if necessary, modify them to satisfy the proposed changes.

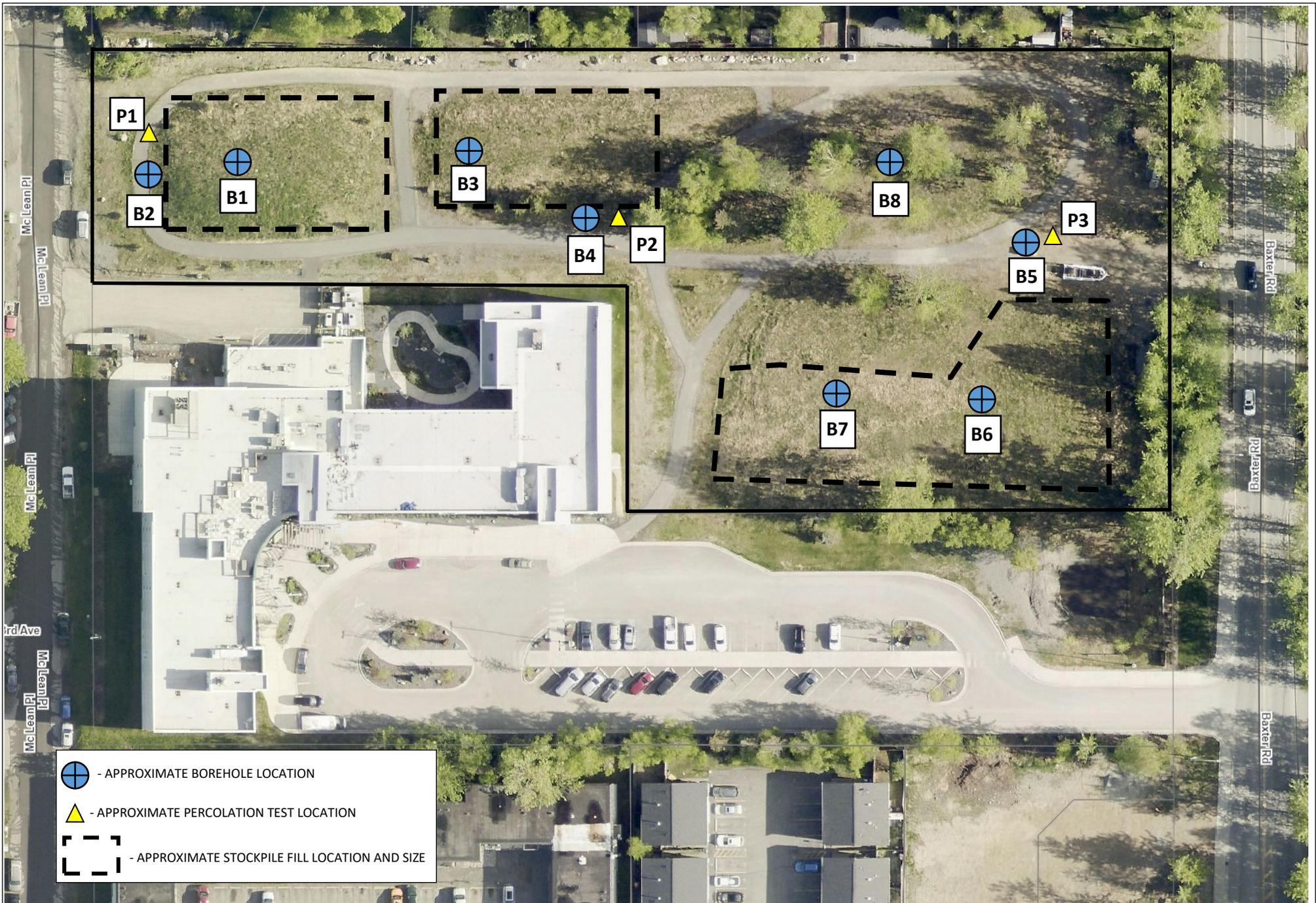
This report should always be read and/or distributed in its entirety (including all figures, exploration logs, appendices, etc.) so that all of the pertinent information contained within is effectively disseminated. Otherwise, an incomplete or misinterpreted understanding of the site conditions and/or our engineering recommendations may occur. Our recommended best practice is to make this report accessible, in its entirety, to any design professional and/or contractor working on the project. Any part of this report (e.g., exploration logs, calculations, material values, etc.) which is presented in the design/construction plans and/or specifications for the project should have an adequate reference which clearly identifies where the report can be obtained for further review.

Due to the natural variability of earth materials, variations in the subsurface conditions across the project site may exist other than those we identified during the course of our geotechnical assessment. Therefore, a qualified geotechnical engineer, geologist, and/or special inspector be on-site during construction activities to provide corrective recommendations for any unexpected conditions revealed during construction (see our discussion of the Observational Method in Section 6.0 of Appendix B of this report for more detail). Furthermore, the construction budget should allow for any unanticipated conditions that may be encountered during construction activities.

We conducted this evaluation following the standard of care expected of professionals undertaking similar work in the State of Alaska under similar conditions. No warranty, expressed or implied, is made.



REPORT FIGURES



NORTHERN GEOTECHNICAL ENGINEERING, INC.
TERRA FIRMA TESTING

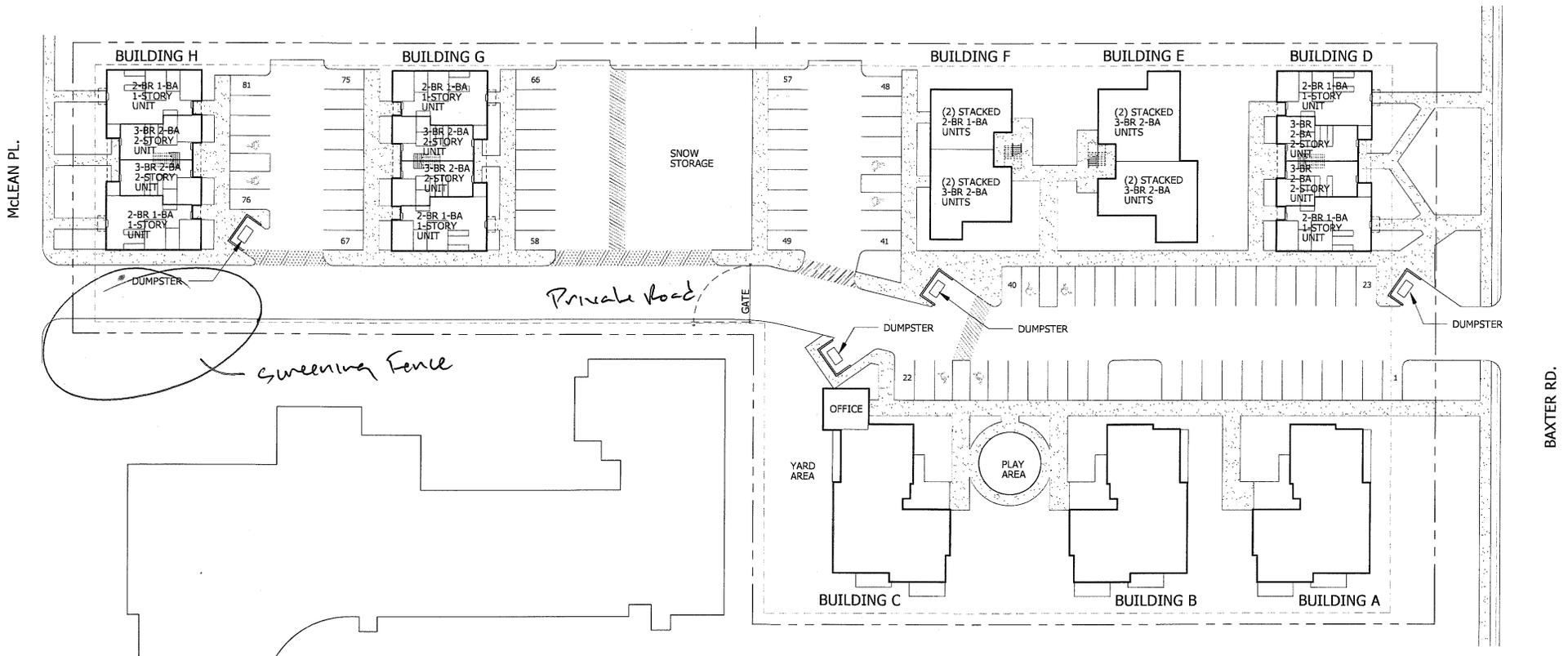
FIGURE TITLE:
CURRENT SITE LAYOUT AND APPROXIMATE EXPLORATION LOCATIONS

PROJECT NAME:
4220 BAXTER RD - CIHA HOUSING PH I&II

PROJECT LOCATION:
ANCHORAGE, ALASKA

PROJECT ID:
7252-24

FIGURE NUMBER:
2



Common Development Agreement

44 TOTAL UNITS
 PHASE ONE -- 24 UNITS
 BUILDINGS A, B AND C
 (16) 2-BR 1-BA
 (8) 3-BR 2-BA
 PHASE TWO -- 20 UNITS
 BUILDINGS D, E, F, G AND H
 (8) 2-BR 1-BA
 (12) 3-BR 2-BA
 81 PARKING SPACES
 INCLUDING (8) ACCESSIBLE

DRAWING PROVIDED BY TRIAD ENGINEERING, LLC



NORTHERN GEOTECHNICAL ENGINEERING, INC.
TERRA FIRMA TESTING

FIGURE TITLE:
CURRENT SITE LAYOUT AND APPROXIMATE EXPLORATION LOCATIONS

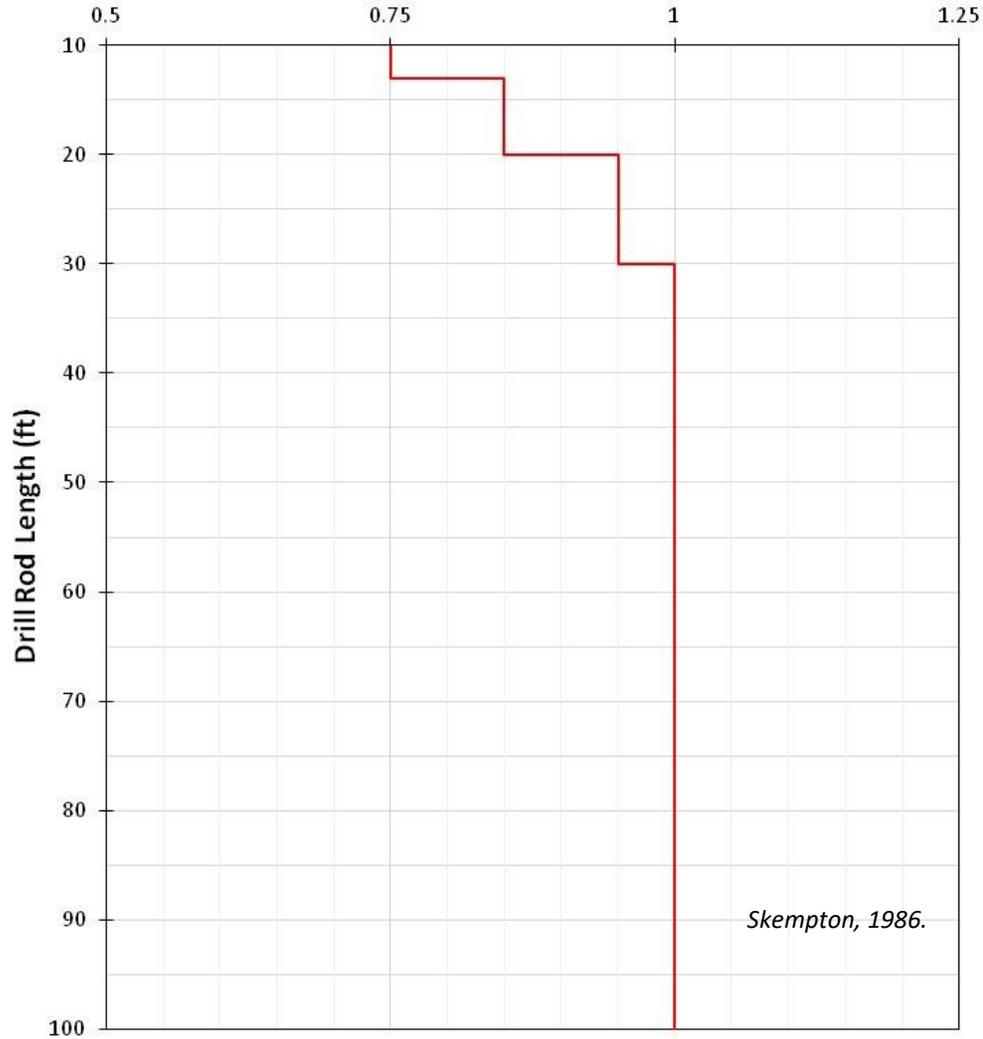
PROJECT NAME:
4220 BAXTER RD - CIHA HOUSING PH I&II

PROJECT LOCATION:
ANCHORAGE, ALASKA

PROJECT ID:
7252-24

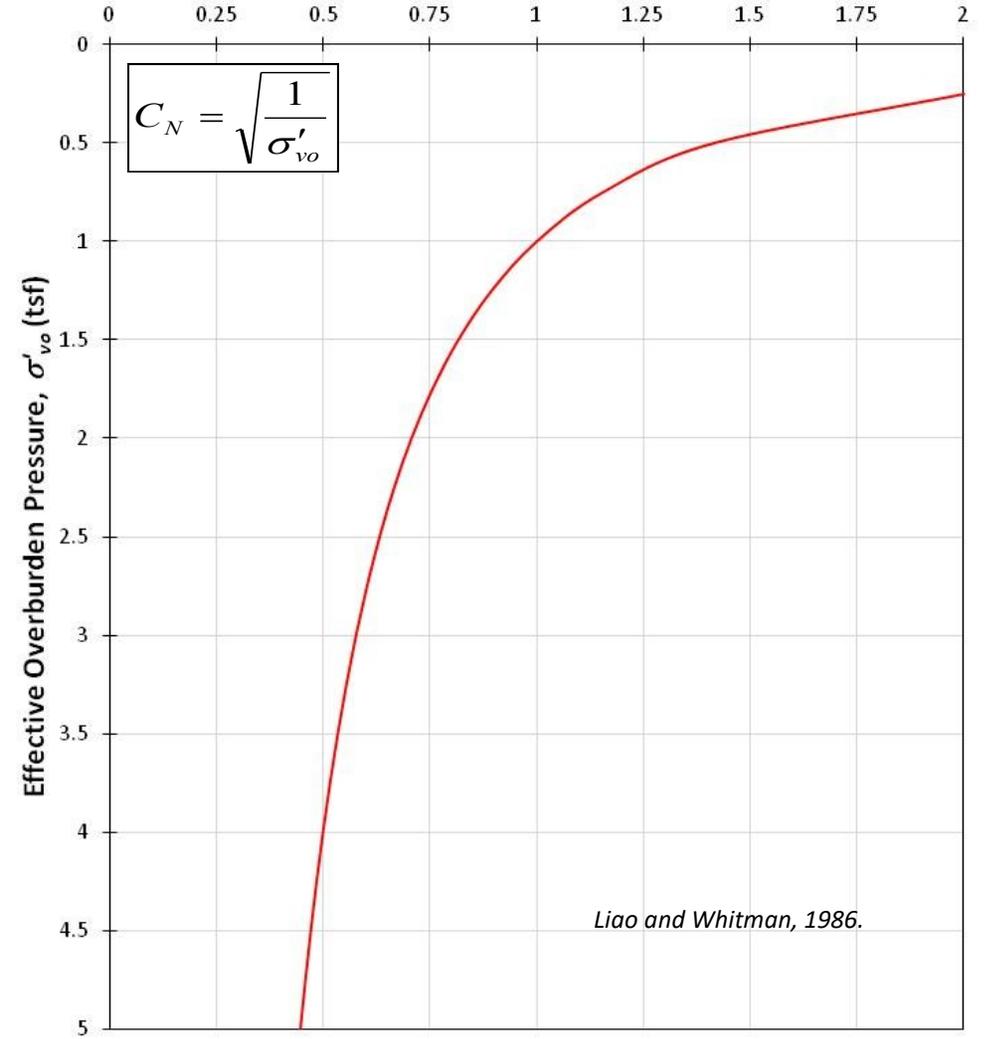
FIGURE NUMBER:
3

Rod Length Correction Factor, C_R



Skempton, 1986.

Overburden Correction Factor, C_N

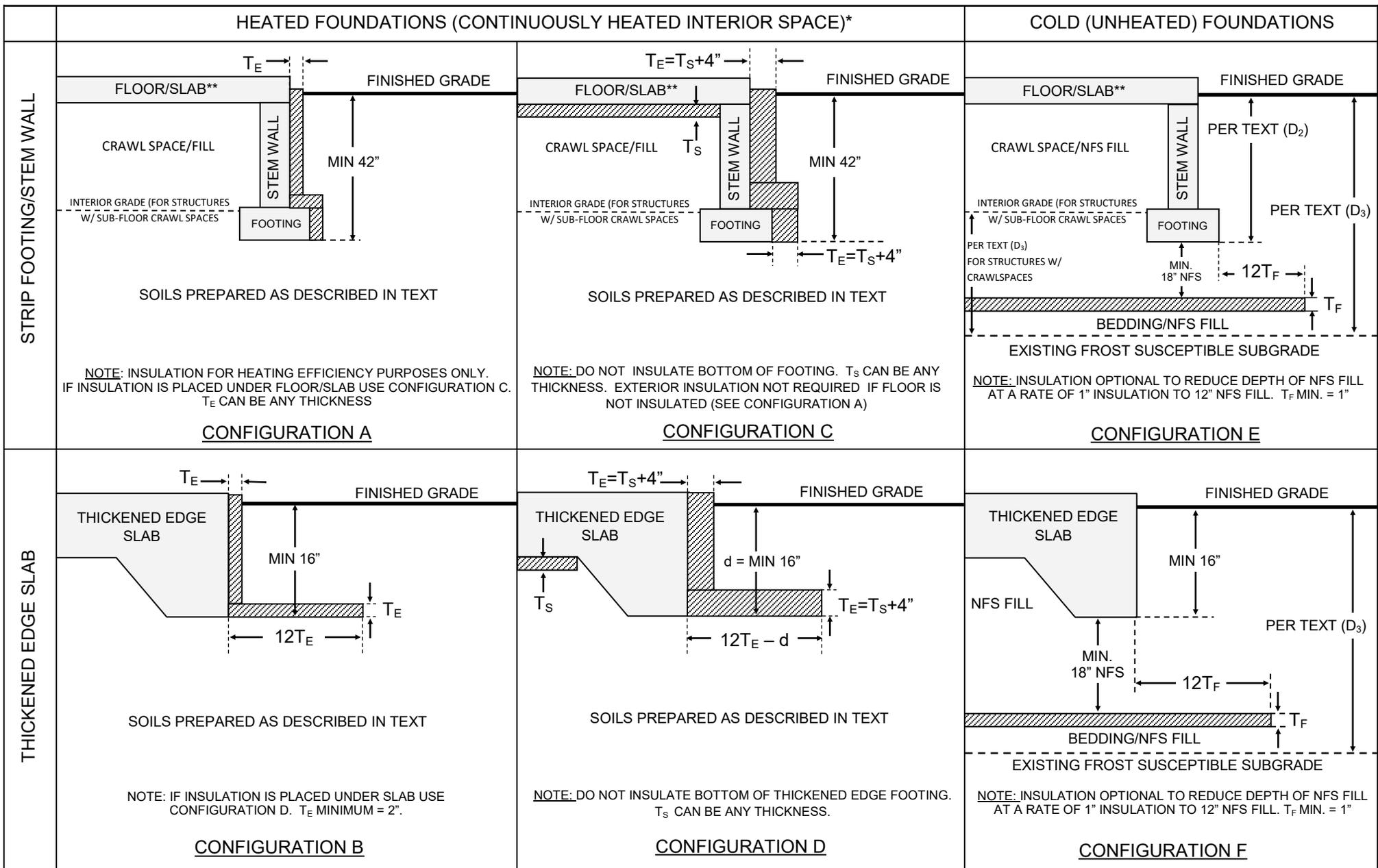


Liao and Whitman, 1986.

Notes:

- Overburden correction factor is used only for cohesionless soils
- C_N is the ratio of the measured blow count to what the blow count would be at an overburden pressure of 1 ton/ft²
- σ'_{vo} is the effective overburden pressure at the point of measurement (ton/ft²)





T_F = INSULATION THICKNESS UNDER ENTIRE FOUNDATION (INCHES)
 T_S = INSULATION THICKNESS UNDER FLOOR/SLAB ONLY (INCHES)
 T_E = INSULATION ALONG EXTERIOR OF FOUNDATION (INCHES)

*HEATED FOUNDATION TEMPERATURE MUST BE CONTINUOUSLY MAINTAINED AT/ABOVE 40°F
 **FLOOR SYSTEM CAN BE STRUCTURAL (W/ CRAWLSPACE) OR SLAB-ON-GRADE
 [Hatched Box] = RIGID BOARD INSULATION

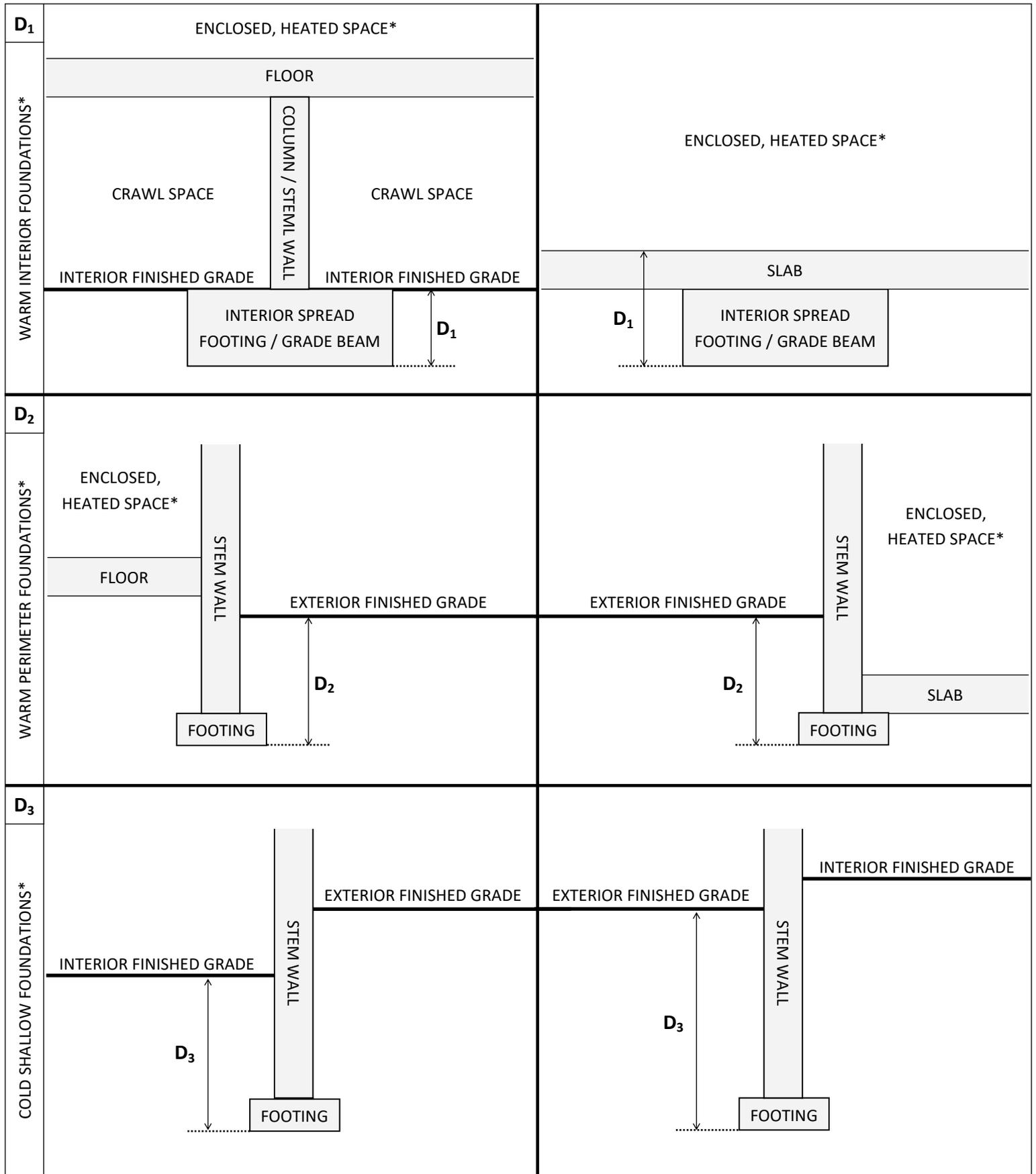
DRAWING NOT TO SCALE



NORTHERN GEOTECHNICAL ENGINEERING, INC.
TERRA FIRMA TESTING

FIGURE TITLE:
INSULATED SHALLOW FOUNDATION CONFIGURATIONS
 PROJECT NAME:
 4220 BAXTER RD - CIHA HOUSING PH I&II
 PROJECT LOCATION:
 ANCHORAGE, ALASKA

PROJECT ID:
7252-24
 FIGURE NUMBER:
5



NOTES:
 DRAWINGS NOT TO SCALE
 MINIMUM DEPTHS PROVIDED IN REPORT

* ENCLOSED HEATED SPACES MUST BE CONTINUOUSLY MAINTAINED AT/ABOVE 40°F

LEVELING COURSE

SIEVE SIZE	% BY MASS PASSING
1"	100
3/4"	70-100
3/8"	50-80
#4	35-65
#8	20-50
#50	8-28
#200	2-6
0.02	0-3

TYPE II

SIEVE SIZE	% BY MASS PASSING
8"	100
3"	70-100
1-1/2"	55-100
3/4"	45-85
#4	20-60
#10	12-50
#40	4-30
#200	*2-6
0.02	0-3

*IN ADDITION TO THE GRADING LIMITS LISTED ABOVE, THE FRACTION OF MATERIAL PASSING THE #200 SIEVE SHALL NOT BE GREATER THAN FIFTEEN PERCENT (15 %) OF THAT FRACTION PASSING THE #4 SIEVE.

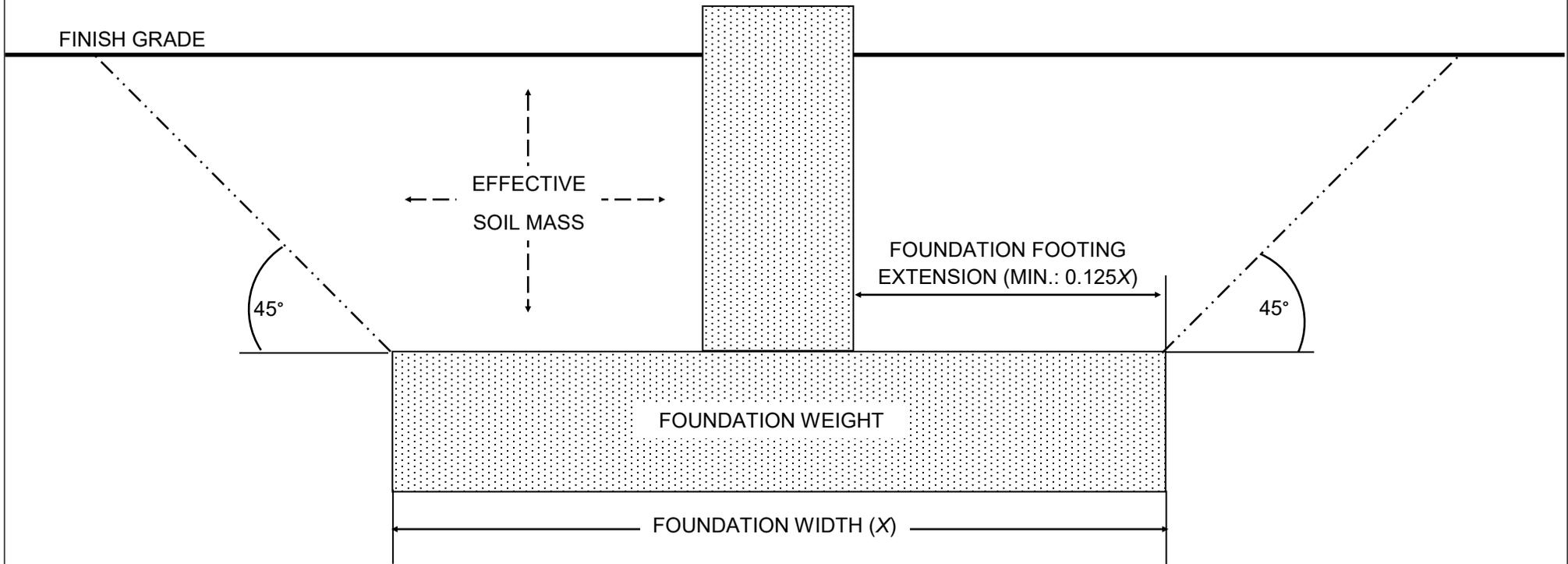
TYPE II - A

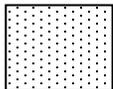
SIEVE SIZE	% BY MASS PASSING
3"	100
3/4"	50-100
#4	25-60
#10	15-50
#40	4-30
#200	*2-6
0.02	0-3

*IN ADDITION TO THE GRADING LIMITS LISTED ABOVE, THE FRACTION OF MATERIAL PASSING THE #200 SIEVE SHALL NOT BE GREATER THAN TWENTY PERCENT (20 %) OF THAT FRACTION PASSING THE #4 SIEVE.



$$\text{UPLIFT CAPACITY} = 0.8 \times (\text{EFFECTIVE SOIL MASS} + \text{WEIGHT OF FOUNDATION})$$



 = FOOTING / STEM WALL

DRAWING NOT TO SCALE



NORTHERN GEOTECHNICAL ENGINEERING, INC.
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FIGURE TITLE:
FOOTING UPLIFT CAPACITY DIAGRAM

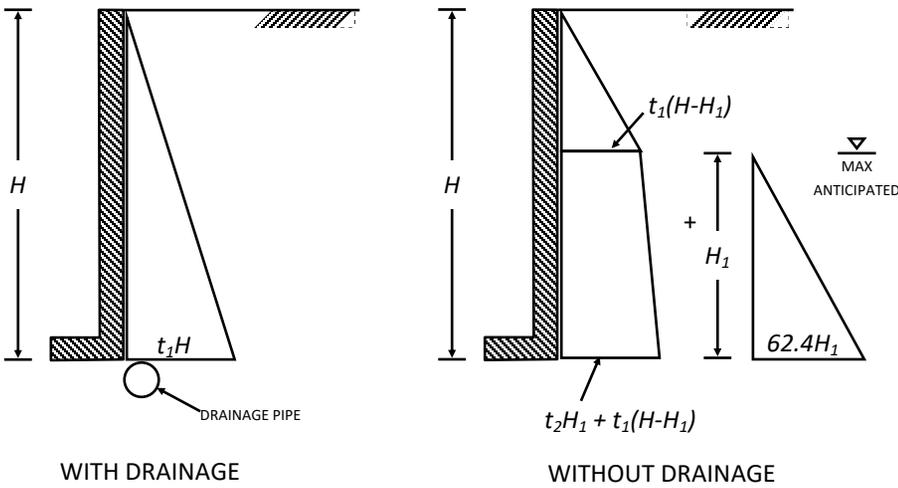
PROJECT NAME:
4220 BAXTER RD - CIHA HOUSING PH I&II

PROJECT LOCATION:
ANCHORAGE, ALASKA

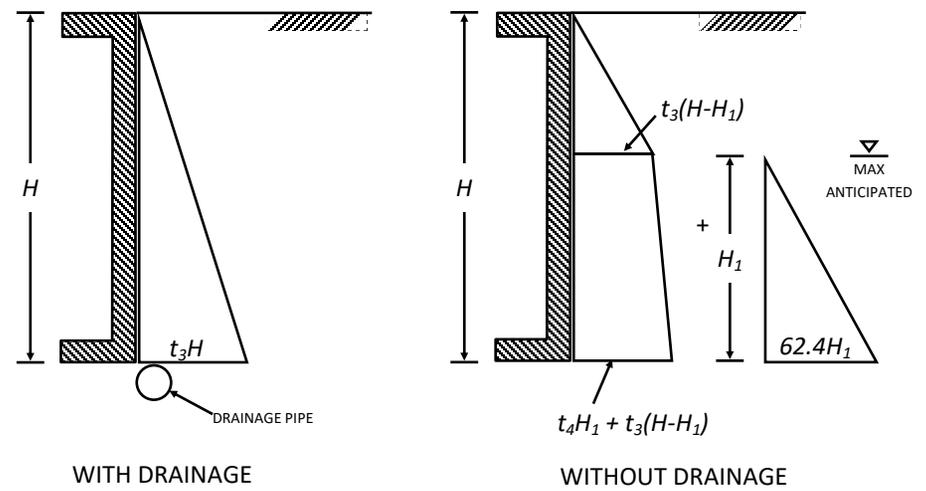
PROJECT ID:
7252-24

FIGURE NUMBER:
8

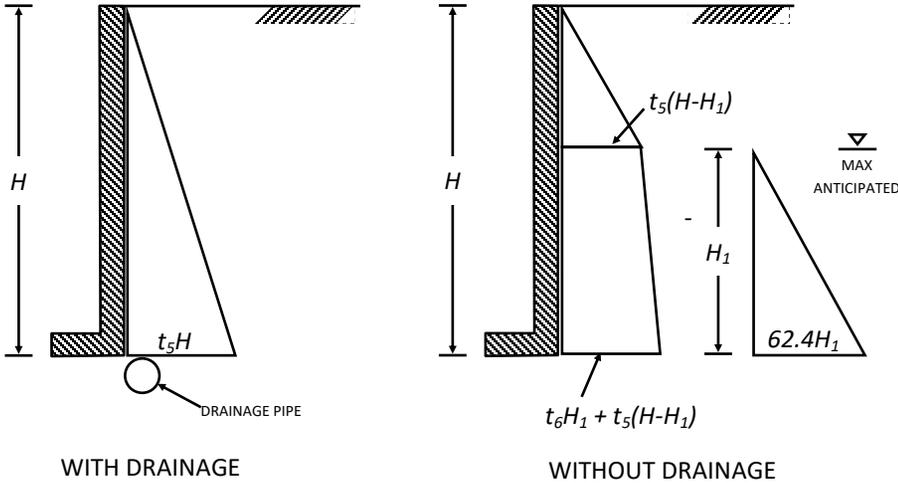
ACTIVE PRESSURE CONDITION



AT-REST PRESSURE CONDITION

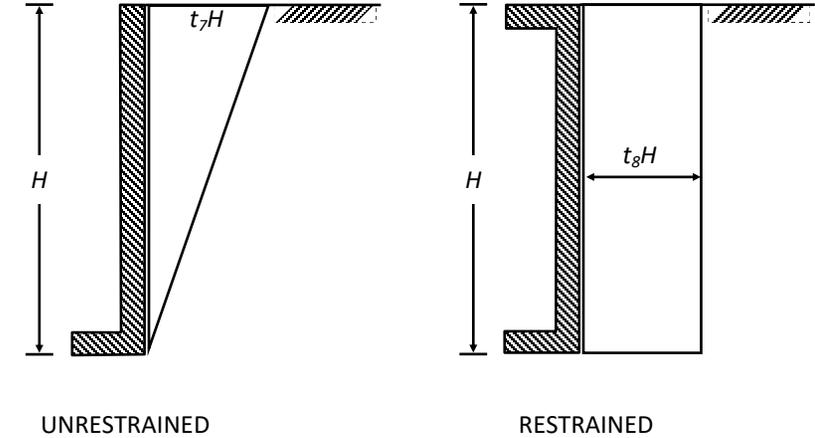


PASSIVE PRESSURE CONDITION



NOTE: WALLS CAN BE EITHER FREE OR RESTRAINED AT THE TOP FOR THE PASSIVE PRESSURE CONDITION. EQUATIONS ARE ONLY VALID FOR UNITS OF t_{1-8} (PCF) AND $H-H_1$ (FT).

SEISMIC



NOTE: SEISMIC LOADS ARE VALID FOR WALLS RETAINING LESS THAN 8 FEET VERTICAL OF EARTH. THE SEISMIC LOAD IS ADDED TO ACTIVE OR AT-REST CONDITIONS AND IS SUBTRACTED FROM PASSIVE CONDITIONS.





APPENDIX A

GRAPHICAL EXPLORATION LOGS



Northern Geotechnical Engineering, Inc.
and Terra Firma Testing
11301 Olive Lane
Anchorage, AK 99515

EXPLORATION B1

NGE-TFT PROJECT NAME: CIHA Housing PH I & II NGE-TFT PROJECT NUMBER: 7252-24
 PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK EXPLORATION CONTRACTOR: Discovery Drilling, Inc.
 EXPLORATION EQUIPMENT: Geoprobe 6712DT EXPLORATION METHOD: Hollow Stem Auger
 SAMPLING METHOD: MPT w/ 340lb autohammer LOGGED BY: C. Banzhaf
 DATE/TIME STARTED: 12/4/2024 @ 10:55:00 AM DATE/TIME COMPLETED: 12/4/2024 @ 1:30:00 PM
 EXPLORATION LOCATION: See report Figure 2 GROUND ELEVATION: Not Known
 ▽ GROUNDWATER (ATD): Approx. 24.0 ft bgs ▼ GROUNDWATER (12/12/2024): Approx. 21.0 ft bgs
 EXPLORATION COMPLETION: See completion comments at end of log WEATHER CONDITIONS: Cloudy, 37°F

DEPTH (ft bgs)	GRAPHIC LOG	FROZEN SOILS	MATERIAL DESCRIPTION	SAMPLE TYPE	FIELD SAMPLE ID	RECOVERY (in)	FIELD BLOWS	(N _{1,60})	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	REMARKS/NOTES	WELL DIAGRAM	
0			SILT WITH ORGANICS (ML) , brown <i>FILL, SILTY GRAVEL (GM)</i> , loose, brown, moist	X	S1	16	3 7 4	N/R		S1	S1 MC = 9.9% P200 = 15.0%	No recovery.		
				X	S2	0	1 3 2	N/R		S2				
5				X	S3	6	1 2 2	5		S3	S3 MC = 18.7% OC = 2.5%			
			WELL GRADED GRAVEL WITH SAND (GW) , medium dense, brown, moist	X	S4	12	10 8 8	17		S4	S4 MC = 9.3% 53.7% gravel, 41.5% sand, 4.8% silt			Fractured rock.
10				X	S5	12	11 12 14	24		S5	S5 MC = 2.1%			
15			POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM) , medium dense, brown, moist	X	S6	12	11 18 18	30		S6	S6 MC = 4.9% 52.9% gravel, 38.3% sand, 8.8% silt			Drilling indicated cobbles from approx. 16-18 ft bgs.
20			▼ POORLY GRADED GRAVEL (GP) , medium dense to dense, brown, moist to wet	X	S7	14	10 22 17	33		S7	S7 MC = 5.5%			Drilling resistance decreased.
25				X	S8	8	2 10 15	21		S8	S8 MC = 6.8%			

Bottom of borehole at 26.5 ft bgs.
Set 1-in PVC to BOH. Hand slotted bottom 5 ft of casing.
Backfilled with cuttings.



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Anchorage, AK 99515

EXPLORATION B2

NGE-TFT PROJECT NAME: CIHA Housing PH I & II NGE-TFT PROJECT NUMBER: 7252-24
 PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK EXPLORATION CONTRACTOR: Discovery Drilling, Inc.
 EXPLORATION EQUIPMENT: Geoprobe 6712DT EXPLORATION METHOD: Hollow Stem Auger
 SAMPLING METHOD: MPT w/ 340lb autohammer LOGGED BY: C. Banzhaf
 DATE STARTED: 12/4/2024 DATE COMPLETED: 12/4/2024
 EXPLORATION LOCATION: See report Figure 2 GROUND ELEVATION: Not Known
 ▽ GROUNDWATER (ATD): N/E ▼ GROUNDWATER (12/12/2024): N/E
 EXPLORATION COMPLETION: See completion comments at end of log WEATHER CONDITIONS: Sunny, 39°F

DEPTH (ft bgs)	GRAPHIC LOG	FROZEN SOILS	MATERIAL DESCRIPTION	SAMPLE TYPE	FIELD SAMPLE ID	RECOVERY (in)	FIELD BLOWS	(N _{1,60})	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	REMARKS/NOTES	WELL DIAGRAM
0			ORGANICS FILL, POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), loose, brown, moist	X	S1	12	7 7 7	N/R		S1	S1 MC = 9.8%	Fractured rocks.	
				X	S2	6	4 2 1	5		S2	S2 MC = 5.8% 52.9% gravel, 36.4% sand, 10.7% silt		
5			POORLY GRADED GRAVEL WITH SAND (GP) , medium dense to dense, brown, moist	X	S3	6	3 6 13	25		S3	S3 P0.02 = 6.6% FC = F1		
				X	S4	14	7 19 23	45		S4	S4 MC = 2.5% 69.2% gravel, 26.3% sand, 4.5% silt		
10				X	S5	16	6 20 26	46		S5	S5 MC = 3.5% MC = 5.6%		

Bottom of borehole at 13.8 ft bgs.
Set 1-in PVC to BOH. Hand slotted bottom 5 ft of casing.
Backfilled with cuttings.
Moved 5 ft north, installed 3-in PVC casing to 3.8 ft bgs.



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Anchorage, AK 99515

EXPLORATION B3

NGE-TFT PROJECT NAME: CIHA Housing PH I & II NGE-TFT PROJECT NUMBER: 7252-24
 PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK EXPLORATION CONTRACTOR: Discovery Drilling, Inc.
 EXPLORATION EQUIPMENT: Geoprobe 6712DT EXPLORATION METHOD: Hollow Stem Auger
 SAMPLING METHOD: MPT w/ 340lb autohammer LOGGED BY: C. Banzhaf
 DATE/TIME STARTED: 12/5/2024 @ 11:00:00 AM DATE/TIME COMPLETED: 12/5/2024 @ 12:30:00 PM
 EXPLORATION LOCATION: See report Figure 2 GROUND ELEVATION: Not Known
 ▽ GROUNDWATER (ATD): N/E ▼ GROUNDWATER (12/12/2024): N/E
 EXPLORATION COMPLETION: See completion comments at end of log WEATHER CONDITIONS: Rain, 34°F

DEPTH (ft bgs) GRAPHIC LOG FROZEN SOILS	MATERIAL DESCRIPTION	SAMPLE TYPE	FIELD SAMPLE ID	RECOVERY (in)	FIELD BLOWS	(N _{1,60})	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	REMARKS/NOTES	WELL DIAGRAM
0	ORGANICS (OH) FILL, SILTY GRAVEL (GM), trace organics, loose, brown, moist	X	S1	18	3 4 4	N/R		S1	S1 MC = 12.3%	Fractured rocks.	
		X	S2	12	1 2 2			S2	S2 MC = 12.6% OC = 3.7%		
5		X	S3	0	2 3 3			S3			
	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), medium dense to dense, brown, moist	X	S4	14	4 3 7	11		S4	S4 MC = 3.4%		
10		X	S5	14	5 11 13	24		S5	S5 MC = 3.9% 57.6% gravel, 35.6% sand, 6.8% silt		
15		X	S6	16	22 29 17	43		S6	S6 MC = 2.7% P200 = 5.4%		
20		X	S7	16	17 23 38	51		S7	S7 MC = 4.4%		

Bottom of borehole at 20.5 ft bgs.
Set 1-in PVC to BOH. Hand slotted bottom 5 ft of casing.
Backfilled with cuttings.



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Anchorage, AK 99515

EXPLORATION B4

PAGE 1 OF 1

NGE-TFT PROJECT NAME: CIHA Housing PH I & II **NGE-TFT PROJECT NUMBER:** 7252-24
PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK **EXPLORATION CONTRACTOR:** Discovery Drilling, Inc.
EXPLORATION EQUIPMENT: Geoprobe 6712DT **EXPLORATION METHOD:** Hollow Stem Auger
SAMPLING METHOD: MPT w/ 340lb autohammer **LOGGED BY:** C. Banzhaf
DATE/TIME STARTED: 12/5/2024 @ 12:45:00 PM **DATE/TIME COMPLETED:** 12/5/2024 @ 3:00:00 PM
EXPLORATION LOCATION: See report Figure 2 **GROUND ELEVATION:** Not Known
▽ GROUNDWATER (ATD): N/E **▼ GROUNDWATER ():** N/E
EXPLORATION COMPLETION: See completion comments at end of log **WEATHER CONDITIONS:** Cloudy, 36°F

DEPTH (ft bgs) GRAPHIC LOG	FROZEN SOILS	MATERIAL DESCRIPTION	SAMPLE TYPE	FIELD SAMPLE ID	RECOVERY (in)	FIELD BLOWS	(N _{1,60})	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	REMARKS/NOTES	WELL DIAGRAM
0		ORGANICS (OH) FILL, SILTY GRAVEL (GM), loose, brown, moist	X	S1	18	4 3 3	N/R		S1	S1 MC = 12.2% P200 = 26.4%	Fractured rocks.	
		POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), medium dense, brown, moist	X	S2	14	8 12 11			S2	S2 MC = 4.7% 66.4% gravel, 23.1% sand, 10.5% silt		
5		SILTY GRAVEL (GM) , medium dense, brown, moist	X	S3	14	18 15 14			S3	S3 MC = 8.9% P200 = 24.2%		
		POORLY GRADED GRAVEL (GP) , medium dense, brown, moist	X	S4	14	7 7 19			S4	S4 MC = 2.1%		
10			X	S5	14	8 10 10			S5	S5 MC = 3.1%		

Bottom of borehole at 11.5 ft bgs.
 Set 1-in PVC to BOH. Hand slotted bottom 5 ft of casing.
 Backfilled with cuttings.
 Moved 5ft east, installed 3-in PVC casing to 3.9 ft bgs.



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11301 Olive Lane
Anchorage, AK 99515

EXPLORATION B5

PAGE 1 OF 1

NGE-TFT PROJECT NAME: CIHA Housing PH I & II NGE-TFT PROJECT NUMBER: 7252-24
 PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK EXPLORATION CONTRACTOR: Discovery Drilling, Inc.
 EXPLORATION EQUIPMENT: Geoprobe 6712DT EXPLORATION METHOD: Hollow Stem Auger
 SAMPLING METHOD: MPT w/ 340lb autohammer LOGGED BY: C. Banzhaf
 DATE/TIME STARTED: 12/5/2024 @ 3:15:00 PM DATE/TIME COMPLETED: 12/5/2024 @ 5:00:00 PM
 EXPLORATION LOCATION: See report Figure 2 GROUND ELEVATION: Not Known
 ▽ GROUNDWATER (ATD): Approx. ▼ GROUNDWATER (12/12/2024): Approx. 13.0 ft bgs
 EXPLORATION COMPLETION: See completion comments at end of log WEATHER CONDITIONS: Cloudy, 36°F

DEPTH (ft bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	FIELD SAMPLE ID	RECOVERY (in)	FIELD BLOWS	(N ₁) ₆₀	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	WELL DIAGRAM
0		ORGANICS (OH) FILL, SILTY GRAVEL (GM), loose, brown, moist									
		WELL GRADED GRAVEL WITH SAND (GW) , medium dense, brown, moist		S1	10	7 4 3	12		S1	S1 MC = 4.2% P200 = 7.1%	
5				S2	10	3 5 8	16		S2	S2 MC = 3.0% 71.3% gravel, 25.4% sand, 3.3% silt	
		SILTY SAND WITH GRAVEL (SM) , medium dense to dense, brown, moist		S3	14	11 14 15	24		S3	S3 MC = 7.8% 30.1% gravel, 32.5% sand, 37.4% silt P0.02 = 26.5% FC = F3	
10				S4	6	5 10 14	20		S4	S4 MC = 7.5%	
15				S5		20 0.5"	N/A		S5		

Bottom of borehole at 15.5 ft bgs.
Set 1-in PVC to BOH. Hand slotted bottom 5 ft of casing. Backfilled with cuttings.
Moved 5ft east, installed 3-in PVC casing to 4.7 ft bgs.



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Anchorage, AK 99515

EXPLORATION B6

PAGE 1 OF 1

NGE-TFT PROJECT NAME: CIHA Housing PH I & II NGE-TFT PROJECT NUMBER: 7252-24
 PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK EXPLORATION CONTRACTOR: Discovery Drilling, Inc.
 EXPLORATION EQUIPMENT: Geoprobe 6712DT EXPLORATION METHOD: Hollow Stem Auger
 SAMPLING METHOD: MPT w/ 340lb autohammer LOGGED BY: C. Banzhaf
 DATE/TIME STARTED: 12/6/2024 @ 9:30:00 AM DATE/TIME COMPLETED: 12/6/2024 @ 12:25:00 PM
 EXPLORATION LOCATION: See report Figure 2 GROUND ELEVATION: Not Known
 ▽ GROUNDWATER (ATD): Approx. ▼ GROUNDWATER (12/12/2024): Approx. 19.4 ft bgs
 EXPLORATION COMPLETION: See completion comments at end of log WEATHER CONDITIONS: Cloudy, 31°F

DEPTH (ft bgs)	GRAPHIC LOG	FROZEN SOILS	MATERIAL DESCRIPTION	SAMPLE TYPE	FIELD SAMPLE ID	RECOVERY (in)	FIELD BLOWS	(N _{1,60})	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	REMARKS/NOTES	WELL DIAGRAM
0			ORGANICS (OH) FILL, SILTY SAND WITH GRAVEL (SM), loose, brown, moist										
5				X	S1	10	4 11 9			S1	S1 MC = 11.6% 34.1% gravel, 44.6% sand, 21.3% silt	No recovery.	
				X	S2	0	5 5 4	N/R		S2		No recovery.	
				X	S3	0	7 11 8	N/R		S3		No recovery.	
10				X	S4	12	2 3 5	7		S4	S4 MC = 8.4% P200 = 15.3%		
15			POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), medium dense, light brown, moist										
				X	S5	6	3 6 9	14		S5	S5 MC = 9.7%		
20			▼ POORLY GRADED GRAVEL (GP) , medium dense, brown, moist to wet										
				X	S6	14	5 16 18	32		S6	S6 MC = 9.5%		
25			SILT (ML) , stiff to very stiff, light brown, moist										
				X	S7	6	6 7 14	22		S7	S7 MC = 20.8% P200 = 72.7%		
Bottom of borehole at 26.5 ft bgs. Set 1-in PVC to BOH. Hand slotted bottom 5 ft of casing. Backfilled with cuttings.													

Always refer to our complete geotechnical report for this project for a more detailed explanation of the subsurface conditions at the project site and how they may affect any existing and/or prospective project site development.



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EXPLORATION B7

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NGE-TFT PROJECT NAME: CIHA Housing PH I & II **NGE-TFT PROJECT NUMBER:** 7252-24
PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK **EXPLORATION CONTRACTOR:** Discovery Drilling, Inc.
EXPLORATION EQUIPMENT: Geoprobe 7822DT **EXPLORATION METHOD:** Hollow Stem Auger
SAMPLING METHOD: MPT w/ 340lb autohammer **LOGGED BY:** C. Banzhaf
DATE/TIME STARTED: 12/6/2024 @ 12:40:00 PM **DATE/TIME COMPLETED:** 12/6/2024 @ 2:30:00 PM
EXPLORATION LOCATION: See report Figure 2 **GROUND ELEVATION:** Not Known
▽ GROUNDWATER (ATD): N/E **▽ GROUNDWATER (I):** N/E
EXPLORATION COMPLETION: Backfilled with cuttings. **WEATHER CONDITIONS:** Cloudy, 30°F

DEPTH (ft bgs)	GRAPHIC LOG	FROZEN SOILS	MATERIAL DESCRIPTION	SAMPLE TYPE		RECOVERY (in)	FIELD BLOWS	(N ₁) ₆₀	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	REMARKS/NOTES
				FIELD SAMPLE ID	LAB SAMPLE ID							
0			ORGANICS (OH) FILL, SILTY GRAVEL (GM), loose, brown, moist									Material description based on drill cuttings. No recovery.
				S1	S1	0	2 2 1	N/R				
5				S2	S2	0	1 3 3	N/R				No recovery.
			WELL GRADED GRAVEL WITH SAND (GW) , medium dense, brown, moist	S3	S3	12	6 7 9	16		S3	S3 MC = 4.1% 65.8% gravel, 29.9% sand, 4.3% silt	
10				S4	S4	12	8 12 11	19		S4	S4 MC = 5.0% P200 = 10.1%	
15			SILTY GRAVEL (GM) , medium dense, light brown, moist	S5	S5	12	6 10 6	12		S5	S5 MC = 9.3% P200 = 34.4%	
20			POORLY GRADED GRAVEL (GP) , medium dense to dense, brown, moist	S6	S6	8	14 12 50 4"	N/A		S6	S6 MC = 5.2%	Fractured rock.
25				S7	S7	0	50 5"	N/A		S7		
Bottom of borehole at 25.5 ft bgs.												

Always refer to our complete geotechnical report for this project for a more detailed explanation of the subsurface conditions at the project site and how they may affect any existing and/or prospective project site development.



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EXPLORATION B8

PAGE 1 OF 1

NGE-TFT PROJECT NAME: CIHA Housing PH I & II **NGE-TFT PROJECT NUMBER:** 7252-24
PROJECT LOCATION: 4220 Baxter Road, Anchorage, AK **EXPLORATION CONTRACTOR:** Discovery Drilling, Inc.
EXPLORATION EQUIPMENT: Geoprobe 7822DT **EXPLORATION METHOD:** Hollow Stem Auger
SAMPLING METHOD: MPT w/ 340lb autohammer **LOGGED BY:** C. Banzhaf
DATE/TIME STARTED: 12/6/2024 @ 2:40:00 PM **DATE/TIME COMPLETED:** 12/6/2024 @ 3:40:00 PM
EXPLORATION LOCATION: See report Figure 2 **GROUND ELEVATION:** Not Known
▽ GROUNDWATER (ATD): N/E **▽ GROUNDWATER (I):** N/E
EXPLORATION COMPLETION: Backfilled with cuttings. **WEATHER CONDITIONS:** Cloudy, 35°F

DEPTH (ft bgs)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	FIELD SAMPLE ID	RECOVERY (in)	FIELD BLOWS	(N ₁) ₆₀	SAMPLE INT. COLLECT	LAB SAMPLE ID	LAB RESULTS	REMARKS/NOTES
0		ORGANICS (OH) SILTY GRAVEL (GM) , loose to medium dense, brown, moist									Material description based on drill cuttings. No recovery.
			X	S1	0	6 13 8	35		S1		
5		POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM) , medium dense, brown, moist	X	S2	12	11 14 13	36		S2	S2 MC = 3.4% 68.1% gravel, 22.7% sand, 9.2% silt P0.02 = 8.3% FC = F1	
		SILTY GRAVEL TO SILTY SAND (GM) , medium dense, brown, moist	X	S3	16	11 15 9	26		S3	S3 MC = 8.7% P200 = 42.2%	
			X	S4	16	7 8 10	18		S4	S4 MC = 8.6%	
15		POORLY GRADED SAND (SP) , medium dense, brown, wet	X	S5	18	12 20 13	31		S5	S5 MC = 17.4%	

Bottom of borehole at 16.5 ft bgs.



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EXPLORATION LEGEND

CLIENT Triad Engineering, LLC

NGE-TFT PROJECT NAME CIHA Housing PH I & II

NGE-TFT PROJECT NUMBER 7252-24

PROJECT LOCATION 4220 Baxter Road, Anchorage, AK

LITHOLOGIC SYMBOLS (Unified Soil Classification System)



GM: USCS Silty Gravel



GP: USCS Poorly-graded Gravel



GP-GM: USCS Poorly-graded Gravel
with Silt



GPS: Sandy Gravel



GWS: USCS Well-graded Sandy Gravel



ML: USCS Silt



OH: USCS High Plasticity Organic silt or
clay



SM: USCS Silty Sand



SP: USCS Poorly-graded Sand

SAMPLER SYMBOLS



Modified Penetration Test

WELL CONSTRUCTION SYMBOLS



Slough Backfill



Slotted Pipe
Backfilled with
Slough

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
MC - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
P200 - PERCENT PASSING NO. 200 SIEVE
P0.02- PERCENT PASSING 0.02mm SIEVE
PP - POCKET PENETROMETER (tons/ft²)
S/U - CASING STICK-UP

▽ Water Level at Time
Drilling, or as Shown

▼ Water Level After 24
Hours, or as Shown

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
N/E - NOT ENCOUNTERED
N/R - NOT REPRESENTATIVE
N/A - NOT APPLICABLE
I_{s(50)} - POINT LOAD INDEX
S_c - UNCONFINED COMPRESSIVE STRENGTH



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SOIL CLASSIFICATION CHART

CLIENT Triad Engineering, LLC

PROJECT NAME CIHA Housing PH I & II

NGE-TFT PROJECT NUMBER 7252-24

PROJECT LOCATION 4220 Baxter Road, Anchorage, AK

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES	
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES	
		SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES	
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES	
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
					CH	INORGANIC CLAYS OF HIGH PLASTICITY
					OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS. DIAGONAL LINES INDICATE UNKNOWN DEPTH OF SOIL TRANSITION.



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EXPLORATION LOG KEY

CLIENT Triad Engineering, LLC

PROJECT NAME CIHA Housing PH I & II

NGE-TFT PROJECT NUMBER 7252-24

PROJECT LOCATION 4220 Baxter Road, Anchorage, AK

SAMPLER SYMBOLS

-  SPT w/ 140# Hammer
30" Drop and 2.0" O.D. Sampler
-  Modified SPT w/ 340# Hammer
30" Drop and 3.0 O.D. Sampler
-  Grab Sample
-  Shelby Tube Sample
-  Rock Core Sample
-  Direct Push Sample
-  No Recovery
- N/E** Not Encountered

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No. 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No. 4 (4.5 mm)
Sand	No. 4 (4.5 mm) to No. 200
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1-5%
Few	5-10%
Little	10-20%
Some	20-35%
And	35-50%

WELL SYMBOLS

-  1" Slotted Pipe
Backfilled with Silica Sand
-  1" PVC Pipe
Backfilled with Auger Cuttings
-  1" PVC Pipe
with Bentonite Seal
-  Capped Riser

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
DENSITY	N (BLOWS/FT)	APPROXIMATE RELATIVE DENSITY (%)	CONSISTENCY	N (BLOWS/FT)	APPROXIMATE UNDRAINED SHEAR STRENGTH (PSF)
VERY LOOSE	0-4	0-15	VERY SOFT	0-1	< 250
LOOSE	5-10	15-35	SOFT	2-4	250-500
MEDIUM DENSE	11-25	35-65	MEDIUM STIFF	5-8	500-1000
DENSE	26-50	65-85	STIFF	9-15	1000-2000
VERY DENSE	> 50	85-100	VERY STIFF	16-30	2000-4000
			HARD	> 30	> 4000



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EXPLORATION LOG KEY

CLIENT Triad Engineering, LLC

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NGE-TFT PROJECT NUMBER 7252-24

PROJECT LOCATION 4220 Baxter Road, Anchorage, AK

FROST DESIGN SOIL CLASSIFICATION

FROST GROUP (USACOE)	FROST GROUP (M.O.A.)	SOIL TYPE	% FINER THAN 0.02mm BY MASS	TYPICAL SOIL TYPES UNDER UNIFIED SOIL CLASSIFICATION SYSTEM
NFS*	NFS*	(A) GRAVELS CRUSHED STONE CRUSHED ROCK	0 - 1.5	GW, GP
		(B) SANDS	0 - 3	SW, SP
PFS*	NFS*	(A) GRAVELS CRUSHED STONE CRUSHED ROCK	1.5 - 3	GW, GP
	F2	(B) SANDS	3 - 10	SW, SP
S1	F1	GRAVELLY SOILS	3 - 6	GW, GP, GW-GM, GP-GM
S2	F2	SANDY SOILS	3 - 6	SW, SP, SW-SM, SP-SM
F1	F1	GRAVELLY SOILS	6 - 10	GM, GW-GM, GP-GM
F2	F2	(A) GRAVELLY SOILS	10 - 20	GM, GW-GM, GP-GM
		(B) SANDS	6 - 15	SM, SW-SM, SP-SM
F3	F3	(A) GRAVELLY SOILS	Over 20	GM, GC
		(B) SANDS, EXCEPT VERY FINE SILTY SANDS	Over 15	SM, SC
		(C) CLAYS, PI>12	-----	CL, CH
F4	F4	(A) ALL SILTS	-----	ML, MH
		(B) VERY FINE SILTY SANDS	Over 15	SM
		(C) CLAYS, PI<12	-----	CL, CL-ML
		(D) VARVED CLAYS AND OTHER FINE GRAINED, BANDED SEDIMENTS	-----	CL & ML; CL, ML, & SM; CL, CH, & ML; CL, CH, ML, & SM

*Non-frost susceptible

*Possibly frost susceptible, but requires lab testing to determine frost design soils classification.

ICE CLASSIFICATION SYSTEM

GROUP	ICE VISIBILITY	DESCRIPTION	SYMBOL
N	SEGREGATED ICE NOT VISIBLE BY EYE	POORLY BONDED OR FRIABLE	Nf
		WELL BONDED	Nb
		NO EXCESS ICE	Nbn
		EXCESS MICROSCOPIC ICE	Nbe
V	SEGREGATED ICE IS VISIBLE BY EYE AND IS ONE INCH OR LESS IN THICKNESS	INDIVIDUAL ICE CRYSTALS OR INCLUSIONS	Vx
		ICE COATINGS ON PARTICLES	Vc
		RANDOM OR IRREGULARLY ORIENTED ICE	Vr
		STRATIFIED OR DISTINCTLY ORIENTED ICE	Vs
		UNIFORMLY DISTRIBUTED ICE	Vu
ICE	ICE IS GREATER THAN ONE INCH IN THICKNESS	ICE WITH SOILS INCLUSIONS	ICE + Soil Type
		ICE WITHOUT SOILS INCLUSIONS	ICE



APPENDIX B

ADDITIONAL REPORT DETAILS



APPENDIX B –

Additional Report Details & Considerations

1.0 SITE CHARACTERIZATION ACTIVITIES

1.1 Subsurface Exploration

We conceived, coordinated, and directed a subsurface exploration program at the project site in an effort to characterize the subsurface conditions of the project site as they currently exist. We subcontracted Discovery Drilling, Inc. (DDI) to provide the necessary geotechnical exploration services. A qualified representative from our office was present on-site during the entire exploration program to select the exploration locations, direct the exploration activities, log the geology of each exploration, and collect representative samples for further identification and laboratory analysis. Under our direction DDI advanced a total of eight (8) soil borings at the project site on December 04, 2024 to December 05, 2024 to depths ranging from approximately 11.5 to 26.5 feet below the existing ground surface (bgs) using conventional hollow-stem auger drilling and split-spoon sampling methods.

Under our direction, DDI performed a Modified Penetration Test (MPT) at regular intervals during the drilling of each borehole. A MPT can be used to assess the consistency of a soil interval and to collect representative soil samples. A MPT is performed by driving a 3.0-inch O.D. (2.4-inch I.D.) split-spoon sampler at least 18 inches past the bottom of the advancing augers with blows from a 340-lb drop-hammer, free-falling 30 inches onto an anvil attached to the top of the drill rod stem. Our field representative recorded the hammer blows required to drive the modified split-spoon sampler the entire length of each sample interval, or until sampler refusal was encountered. We have provided the field blow count data for each sample interval (in six-inch increments) on the graphical borehole logs contained in Appendix A of this report.

We corrected the field blow count data for all eight (8) boreholes for standard confining pressure, drill rod length, and drop-hammer operation procedure to estimate a standard $(N_1)_{60}$ value for each sample interval. $(N_1)_{60}$ values are a measure of the relative density (compactness) and consistency (stiffness) of cohesionless or cohesive soils, respectively. Our estimate of the $(N_1)_{60}$ values is based on the drop-hammer blows required to drive the split-spoon sampler the final 12-inches of an 18-inch MPT. We have provided our estimated $(N_1)_{60}$ values for each sample interval on the graphical borehole logs contained in Appendix A of this report. The automatic drop-hammer that DDI used for this project is not standard, so we applied a correction factor of 1.1 to the $(N_1)_{60}$ values to account for the efficiency of the automatic drop-hammer used. The cathead-operated drop-hammer

(w/ two rope wraps) that DDI used for this project is standard, so no drop-hammer corrections were necessary to estimate the $(N_1)_{60}$ values. We have provided a graphical plot of the field blow count corrections that we used to correct for confining pressure and drill rod length in Figure 4 of this report.

Our field representative sealed each sample that they collected during our subsurface exploration program inside of an air-tight bag and/or container, to help preserve the moisture content of each sample, and then submitted each sample to our laboratory for further identification and analysis.

Once the exploration activities were complete, we directed DDI to backfill the annulus of each exploration with its respective drill cuttings.

We directed DDI to install three-inch diameter, open-ended PVC pipes from the ground surface down to approximately 3.7 ft bgs to 4.7 ft bgs at test well boreholes adjacent to boreholes B2, B4, and B5 to provide conduits (i.e., test wells) for future infiltration testing. DDI then placed approximately two inches of washed 3/8-inch gravel (a.k.a. pea gravel) at the bottom of each test well to protect the bottom from water scour during infiltration testing. We then directed the DDI to backfill the annulus of each test well borehole with drill cuttings. We have included construction diagrams for each infiltration test well on the graphical borehole logs contained in Appendix A of this report.

We directed DDI to install one-inch diameter, open-ended PVC pipe from the ground surface down to the bottom of boreholes B1 through B6 to provide a conduit (i.e., monitoring wells) for future groundwater level monitoring. As per our instruction, DDI hand-slotted the bottom five (5) feet of the monitoring well casing prior to installation and then backfilled the annulus of each monitoring well borehole with drill cutting.

1.2 Groundwater Level Monitoring

We conducted groundwater level monitoring efforts at the project site on December 12, 2024 to help determine what the static groundwater level is and/or to help chart seasonal changes in the groundwater level across the project site, etc.. We used an electronic water level meter (with 0.01-foot increments) to measure the relative depth of the groundwater surface (below the existing ground surface) at each monitoring well location. A summary of the groundwater level measurements that we collected at the project site are presented on the graphical borehole logs contained in Appendix A of this report.

1.3 Infiltration Testing

We conducted infiltration testing at test well locations P1, P2, and P3 on December 12, 2024 (See Figure 2 of this report). We conducted our infiltration testing in general conformance with the falling head percolation test procedure outlined in Table 3.9 of the EPA On-site Water Treatment & Disposal Systems Manual (as specified in Paragraph 9 of Section 9.2.1 of the 2009 Municipality of Anchorage Drainage Design Guidelines). Complete infiltration test data for each test well is contained in Appendix C of this report.

2.0 LABORATORY TESTING

It is important to note that ASTM test method D-6913 requires that any soil sample specimen which is to be submitted for gradational analysis (by ASTM D-7928 or other methods) must satisfy a minimum mass requirement based on the maximum particle size of the sample specimen. Split-spoon sampling techniques (standard or modified), as well as other small-diameter soil sampling techniques (e.g., macro-core, etc.), typically recover anywhere from approximately 1 to 10 pounds of sample specimen. The amount of sample specimen recovered can be influenced by (amongst other variables) the soil gradation, soil density, sample interval, sampler tooling, and soil moisture content. As a result, samples of coarse-grained soils (with individual soil particles greater than approximately 0.75 inches in diameter) collected with small-diameter sampling methods (e.g., split-spoons, macro-core, etc.) may not meet the minimum mass requirement specified by Table 2 of ASTM D-6913. This may result in gradational and frost classification results which are not representative of the actual (i.e., in-situ) soil gradation and/or frost classification. The use of small-diameter sampling devices in coarse-grained soils (e.g., sand and gravel) can result in the collection of unrepresentative samples due to: the exclusion of oversized particles (larger than the opening of the sampler) from the sample; and the mechanical breakdown/degradation of coarse-grained particles by the sampling process (producing an unrepresentative increase in smaller-diameter particles in the sample). Both of these sampling biases can skew laboratory test results towards the fine-grained end of the gradational spectrum.

3.0 DESIGN RECOMMENDATIONS

3.1 Frost Development and Protection

Frost Heave:

If the subgrade soils are allowed to freeze (for any amount of time), then soil ice can form in the subgrade and result in a phenomena known as “frost heaving”. Frost heaving forces can generate significant uplift loads which can damage foundations or connecting members.

Burial Depths:

Perimeter and exterior shallow foundation footing burial depths will vary, based on whether or not the foundation subgrade will be allowed to freeze during winter months. Additionally, shallow foundations need to be buried sufficiently deep so as to resist any anticipated uplift/overturning forces (e.g. wind, seismic, frost jacking, etc.).

Frost heaving forces can damage shallow foundations. As such, footings need to be buried sufficiently deep and/or be adequately insulated so as to reduce the potential for freezing of the foundation subgrade and any associated frost heaving forces.

Insulation:

Artificial insulation can be used to decrease minimum burial depths for both heated and unheated foundations by helping to reduce the potential for freezing of foundation soils, as well as help increase heating efficiency.

Insulation may be placed beneath of interior floors/slabs. However, no insulation should be placed directly underneath of any perimeter footings, as this can promote freezing of the foundation soils by preventing adequate heat transfer from the interior of the structure to the foundation soils. Alternatively, insulation should be placed along the exterior of the footing/stem wall to prevent freezing (and associated frost heaving) of the foundation soils along the perimeter of the foundation.

In terms of insulating properties, one inch of rigid board insulation can be considered equivalent to one foot of NFS fill.

Cold Shallow Foundations

It is difficult to predict the depth of ground frost penetration and extent of ice lens formation at any given site. Therefore, we do not recommend the construction of cold shallow foundations. The formation of ice lenses in the foundation subgrade can damage overlying foundations due to differential movements in the foundation subgrade as a result of soil ice growth and/or subsequent thaw-related losses of soil bearing capacity (due to increased soil moisture contents).

3.2 Modulus of Subgrade Reaction Calculations

For this project, the following equations can be used (with standard English units) to calculate the appropriate modulus of subgrade reaction for load footprints bearing onto recommended bearing materials (defined in the report):

$$k_{(B \times B)} = k_1 \left(\frac{B+1}{2B} \right)^2 \quad (1)$$

Where:

B = the load footprint width of a square load in feet

k_1 = the modulus of subgrade reaction for a 1-ft \times 1-ft rigid plate in pci

$k_{(B \times B)}$ = the modulus of subgrade reaction for a square load footprint of width B in pci

The following equation (2) can be used for a rectangular load having the dimensions $B \times L$ (in feet) with similar bearing soils as the square footprint loading equation above (1).

$$k_{(B \times L)} = \frac{k_{(B \times B)} \left(1 + 0.5 \frac{B}{L} \right)}{1.5} \quad (2)$$

Where:

$k_{(B \times B)}$ = the modulus of subgrade reaction for a $B \times B$ square load footprint

$k_{(B \times L)}$ = the modulus of subgrade reaction for $B \times L$ rectangular load footprint

B = the least horizontal dimension of a rectangular load footprint

L = the larger horizontal dimension of a rectangular load footprint

3.3 Lateral Earth Pressures

An active-earth pressure condition will prevail (under static loading) if a retaining wall is allowed to deflect or rotate a minimum of 0.001 times by the wall height. An at-rest pressure condition will prevail if a retaining wall is restrained at the top and cannot move at least 0.002 times the wall height. Lateral forces exerted by wind or seismic activity may be resisted by passive-earth pressures against the sides of the foundation footings, exterior walls (below grade), and grade beams. Therefore, interior footings should extend a minimum of 12 inches below the finished floor grade (assuming a continuously heated building is maintained during winter months) to help resist any lateral forces.

In order to prevent water accumulation against the outside of any foundation or retaining wall, the wall must have a perimeter drainage system connected to an outlet that will not freeze closed at any time of the year. The top of the drainage piping must be located below the top of the footing for the foundation and/or retaining wall. Backfill used against the wall (and extending a minimum

of one foot beyond the wall) must be free-draining with less than three percent fines. The top one-foot of backfill against the outside of a foundation and/or retaining wall should consist of relatively impermeable (fine-grained) material and be tightly compacted such that surface water is directed away from the foundation and/or retaining wall. A permeable geotextile fabric may be useful to prevent mixing of the impermeable (fine-grained) overburden and underlying free-draining (coarse-grained) backfill. Furthermore, the finished surface should slope away from any foundation and/or retaining wall with a grade between 1 to 2 percent, such that surface water is directed away from the foundation and/or retaining wall.

Seismic loading on foundation and/or retaining walls generally increases the lateral pressures on the wall and decreases the passive resistance. For foundation systems where the building foundation is continuous, the differential lateral movement between the soil and foundation is very small, and as such, essentially no excess lateral loading on the foundation wall is experienced. Foundation walls with a differential in backfill heights of over six feet (basements, crawl spaces, etc.) will experience seismic lateral loading from the inertial effects of seismic waves passing through the foundation.

3.4 Pavement Sections

Construction of the pavement section for the proposed roads and parking areas will be guided (in part) by the amount of cut/fill needed to achieve the final grade. The composition, structure, and thickness of the pavement section will be further controlled by the frost susceptibility of, and overall potential for ice lens development within, the subgrade soils.

There are three primary factors that influence the potential for ice lens formation at a given site:

1. soil gradation (i.e., ability to draw up moisture through capillary tension);
2. the presence of sufficient volumes of water (surface water, pore water, or groundwater) near the freeze front to foster ice lens development; and
3. the rate and duration of freeze-front advancement due to air temperature and wind variations.

All three factors need to occur simultaneously in order for ice lenses to develop in the subgrade.

Materials:

As we discuss in the report, it is our experience that the “D-1” leveling course material currently available in Anchorage area may not be NFS following compaction, because the compaction with a vibratory compactor further increases the frost susceptibility of the leveling course by increasing the percentage of fine-grained material (due to degradation of the soil particles from the impact of the compaction equipment).

RAP has a low frost susceptibility, making it a suitable alternative for D-1 as the leveling course material.

Type II-A materials can be used as a substitute for Type II materials, as Type II materials are becoming difficult to procure in the Anchorage area. However, no Type II materials should be placed within 12 inches of any pavement surfaces to help reduce the risk of pavement dimpling (from oversized particles contained within the Type II material).

4.0 CONSTRUCTION RECOMMENDATIONS

4.1 Warm Shallow Foundations

It is imperative that shallow building foundations for heated structures remain in a thawed state for the entire construction period; even when dealing with soils that have little to no frost susceptibility. Foundation soils that are allowed to freeze during the initial construction (before the building is enclosed and heated) may be compromised by the development of ice lenses. Upon thawing, which may take several weeks or months, potential differential settlements could distort the structure resulting in damaged foundations, cracked sheetrock, skewed door frames, and broken windows.

If construction extends into the winter months, temporary enclosures should be constructed which completely enclose warm foundations and heat should be applied to the enclosure to prevent freezing of the soils located beneath any warm foundation and/or floor slab.

5.0 THE OBSERVATIONAL METHOD

A comprehensive geoprofessional service (e.g., geotechnical, geological, civil, and/or environmental engineering, etc.) should consist of an interdependent, two-part process comprised of:

Part I - pre-construction site assessment, engineering, and design; and

Part II - continuous construction oversight and design support.

This process, commonly referred to in the geoprofessional industry as “The Observational Method”, was developed to reduce the costs required to complete a construction project, while simultaneously reducing the overall risk associated with the design and construction of the project.

In geotechnical engineering, Part I of the Observational Method (OM) begins with a geotechnical assessment of the site, which typically consists of some combination of literature research, site reconnaissance, subsurface exploration, laboratory testing, and geotechnical engineering. These efforts are usually documented in a formal report (e.g., such as this report) that summarizes the findings of the geotechnical assessment, and presents provisional geotechnical engineering recommendations for design and construction. Geotechnical assessment reports (and the findings and recommendations contained within) are considered provisional due to the fact that their

contents are typically based primarily on limited subsurface information for a site. Most conventional geotechnical exploration programs only physically characterize a very small percentage of a given site, as it is typically cost prohibitive to conduct extensive (i.e. high density/frequency) exploration programs. As an alternative, geoprosessionals use the subsurface information available for a site to extrapolate subsurface conditions between exploration locations and develop appropriate provisional recommendations based on the inferred site conditions. As a result, the geoprofessionals of record cannot be certain that the provisional recommendations will be wholly applicable to the site, as subsurface conditions other than those identified during the geotechnical assessment may exist at the site which could present obstacles and/or increased risk to the proposed design and construction.

Part II of the OM is employed by geoprofessionals to help reduce the risk associated with unidentified and/or unexpected subsurface conditions. Geoprofessionals accomplish Part II of the OM by providing construction oversight (e.g., construction observation, inspection, and testing). Part II of the OM is a valuable service, as the geoprofessionals of record is available if unexpected conditions are encountered during the construction process (e.g., during excavation, fill placement, etc.) to make timely assessments of the unexpected conditions and modify their design and construction recommendations accordingly; thus reducing considerable cost resulting from potential construction delays and reducing the risk of future problems resulting from inappropriate design and construction practices.

Oftentimes, a client may be persuaded to use an alternative geoprofessionals firm to conduct Part II of the OM for a given project; as some geoprofessionals firms offer the same services at discounted prices in order to help them obtain the overall construction materials engineering and testing (CoMET) commission. The geoprofessionals industry as a whole recommends against this practice. An alternative geoprofessionals firm cannot provide the same level of service as the geoprofessionals of record. The geoprofessionals of record has (amongst other things) a unique familiarity with the project including; an intimate understanding of the subsurface conditions, the proposed design, and the client's unique concerns and needs, as well as other factors that could impact the successful completion of a construction project. An alternative geoprofessionals firm is not aware of the inferences made and the judgment applied by the geoprofessionals of record in developing the provisional recommendations, and may overlook opportunities to provide extra value during Part II of the geoprofessionals service.

Clients that prevent the geoprofessionals of record from performing a complete service can be held solely liable for any complications stemming from engineering omissions as a result of unidentified conditions. The geoprofessionals of record may not be liable for any resulting complications that occur, as the geoprofessionals of record was not able to complete their services. Furthermore, the replacement geoprofessionals firm may also be found to have no liability for the same reasons.

We are available at any time to discuss the OM in more detail, or to provide you with an estimate for any additional construction observation and testing services required.



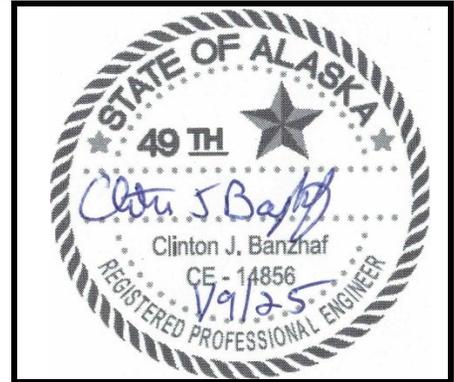
APPENDIX C

INFILTRATION TEST RESULTS



Infiltration/Percolation Test Form

Project Name/No.: 4220 Baxter - CIHA Housing / 7252-24
 Legal Description: Tract B of the Valetskaya Addition #1 Subdivision
 Date Test Performed: 12/12/2024
 Test Performed For: Triad Engineering, LLC
 Date of Excavation: 12/4/24
 Exploration I.D.: B2



Site Plan



Depth (feet) (USCS)
 1 (GP-GM) Gravel
 2 w/ Silt & Sand
 3
 4
 5
 6 (GW) Gravel
 7
 8
 9
 10
 11
 12
 13
 14 BOH @ 13.8 ft bgs

See Test Pit Log for more details.

Was GW Observed ATD? No GW Monitoring Depth N/E bgs
 If yes, at what depth? N/A bgs Date of Measurement 12/4/24

Reading No.	Date	Gross Time Start/Stop (HH:MM)	Net Time (Minutes)	Depth to Water Start/Stop (feet BTOC)		Net Drop (inches)
Test	12/12/24	1220/1231	11	4.23	5.23	12
Test	12/12/24	1235/1312	12	4.23	5.23	12
1	12/12/24	1313/1322	9	4.73	5.23	6
2	12/12/24	1323/1331	8	4.73	5.23	6
3	12/12/24	1332/1340	8	4.73	5.23	6

Final Percolation Rate: 1.3 (minutes/inch) Perc Hole/Casing Diam: 3 in
 Test Run between: 3.8 ft and 3.3 ft BGS Casing S/U: 1.0 ft

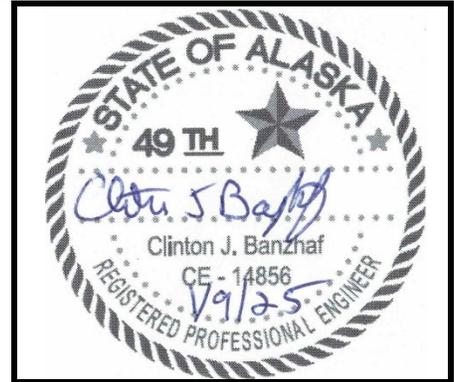
Comments:

Performed By: Clinton J. Banzhaf, P.E. I, Clinton J. Banzhaf, P.E. certify that this test was performed in accordance with all state and municipal guidelines in effect on this date. Date: 12/18/2024

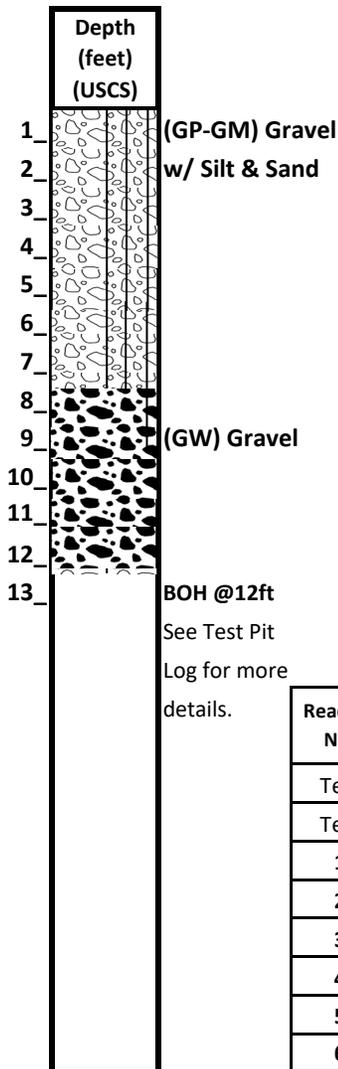


Infiltration/Percolation Test Form

Project Name/No.: 4220 Baxter - CIHA Housing / 7252-24
 Legal Description: Tract B of the Valetskaya Addition #1 Subdivision
 Date Test Performed: 12/12/2024
 Test Performed For: Triad Engineering, LLC
 Date of Excavation: 12/5/24
 Exploration I.D.: B4/P2



Site Plan



Was GW Observed ATD? No GW Monitoring Depth N/E bgs
 If yes, at what depth? N/A bgs Date of Measurement 12/4/24

Reading No.	Date	Gross Time Start/Stop (HH:MM)	Net Time (Minutes)	Depth to Water Start/Stop (feet BTOC)	Net Drop (inches)
Test	12/12/24	1353/1405	12	4.4 5.4	12
Test	12/12/24	1406/1428	22	4.4 5.4	12
1	12/12/24	1429/1439	10	5.2 5.4	2.2
2	12/12/24	1439/1449	10	5.3 5.4	1.8
3	12/12/24	1449/1459	10	5.2 5.4	2.4
4	12/12/24	1459/1509	10	5.2 5.4	3.0
5	12/12/24	1509/1519	10	5.2 5.4	3.0
6	12/12/24	1519/1529	10	5.2 5.4	3.0

Final Percolation Rate: 3.3 (minutes/inch) Perc Hole/Casing Diam: 3 in
 Test Run between: 3.9 ft and 3.4 ft BGS Casing S/U: 1.3 ft

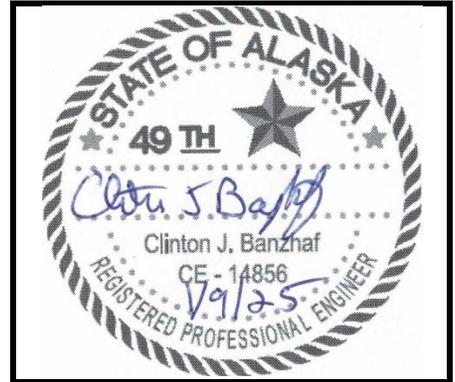
Comments:

Performed By: Clinton J. Banzhaf, P.E. I, Clinton J. Banzhaf, P.E. certify that this test was performed in accordance with all state and municipal guidelines in effect on this date. Date: 12/18/2024

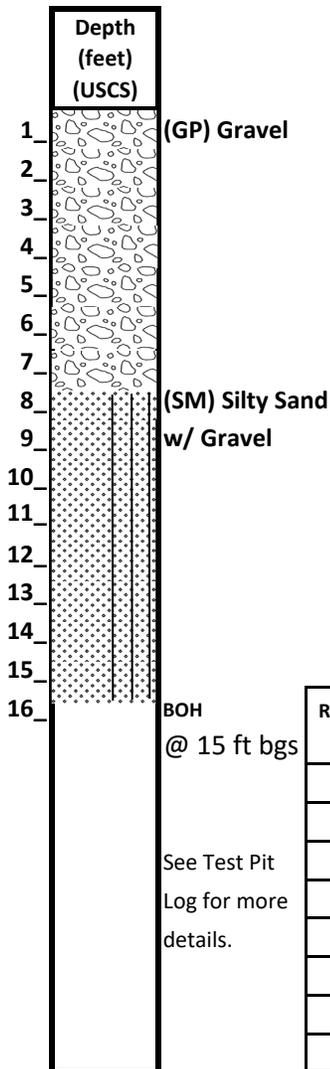


Infiltration/Percolation Test Form

Project Name/No.: 4220 Baxter - CIHA Housing / 7252-24
 Legal Description: Tract B of the Valetskaia Addition #1 Subdivision
 Date Test Performed: 12/12/2024
 Test Performed For: Triad Engineering, LLC
 Date of Excavation: 12/4/24
 Exploration I.D.: B5/P3



Site Plan



Was GW Observed ATD? No GW Monitoring Depth 13' bgs
 If yes, at what depth? N/A bgs Date of Measurement 12/12/24

Reading No.	Date	Gross Time Start/Stop (HH:MM)	Net Time (Minutes)	Depth to Water Start/Stop (feet BTOC)		Net Drop (inches)
Test	12/12/24	1400/1401	<1	7.22	8.22	12
Test	12/12/24	1403/1404	<1	7.22	8.22	12
1	12/12/24	1410/1411	0.12	7.72	8.22	6
2	12/12/24	1412/1413	0.12	7.72	8.22	6

Final Percolation Rate: <1 (minutes/inch) Perc Hole/Casing Diam: 3 in
 Test Run between: 4.7 ft and 4.2 ft BGS Casing S/U: 3.0 ft

Comments:

Performed By: Jacob F. Stephens I, Clinton J. Banzhaf, P.E. certify that this test was performed in accordance with all state and municipal guidelines in effect on this date. Date: 12/19/2024



APPENDIX D

LABORATORY DATA SHEETS



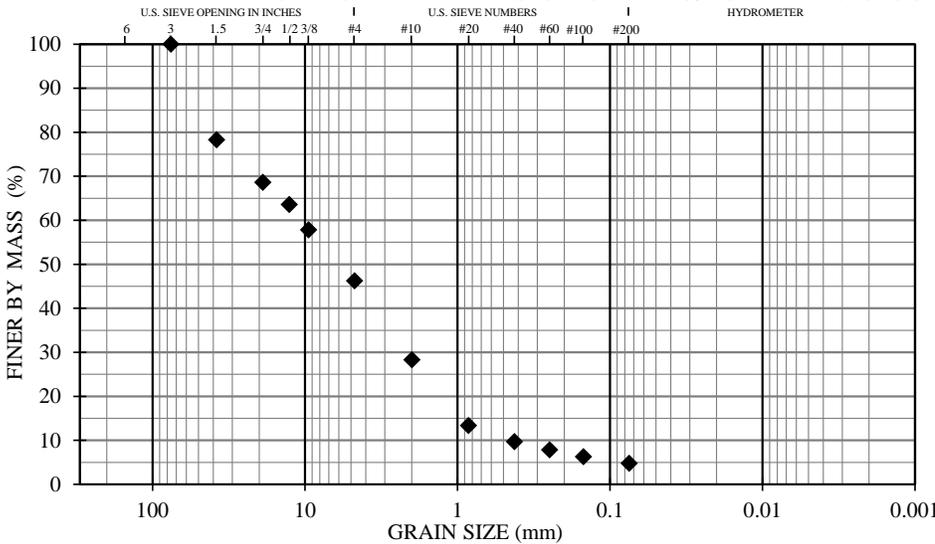
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B1
NUMBER/ DEPTH:	S4 / 7.5 - 9'
DESCRIPTION:	Well-graded gravel w/ sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Issac Logo
REVIEWED BY:	CJB

% GRAVEL	53.7	USCS	GW
% SAND	41.5	USACOE FC	N/A
% SILT/CLAY	4.8	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	9.3	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		23.3	
COEFFICIENT OF GRADATION (C _c)		1.0	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

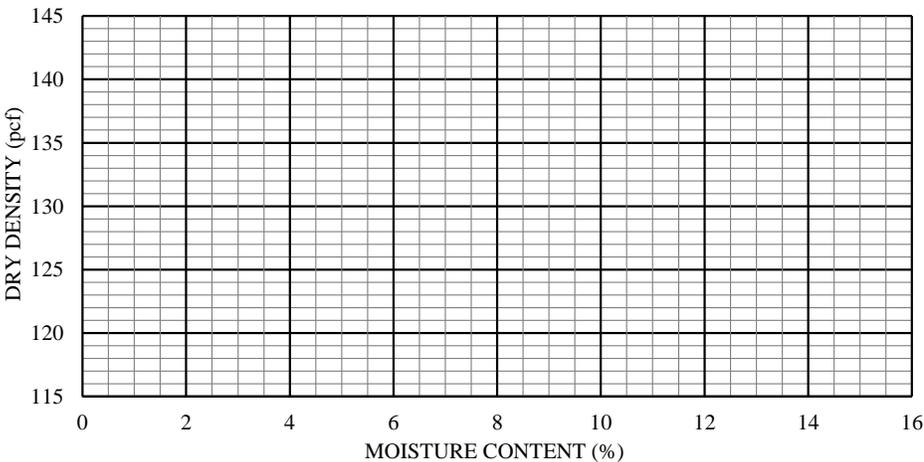
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	100	
38.10	1.5"	78	
19.00	3/4"	69	
12.70	1/2"	64	
9.50	3/8"	58	
4.75	#4	46	
2.00	#10	28	
0.85	#20	13	
0.43	#40	10	
0.25	#60	8	
0.15	#100	6	
0.075	#200	4.8	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

The testing services reported herein have been performed to recognized industry standards, unless otherwise noted. No other warranty is made. Should engineering interpretation or opinion be required, NGE-TFT will provide upon written request.

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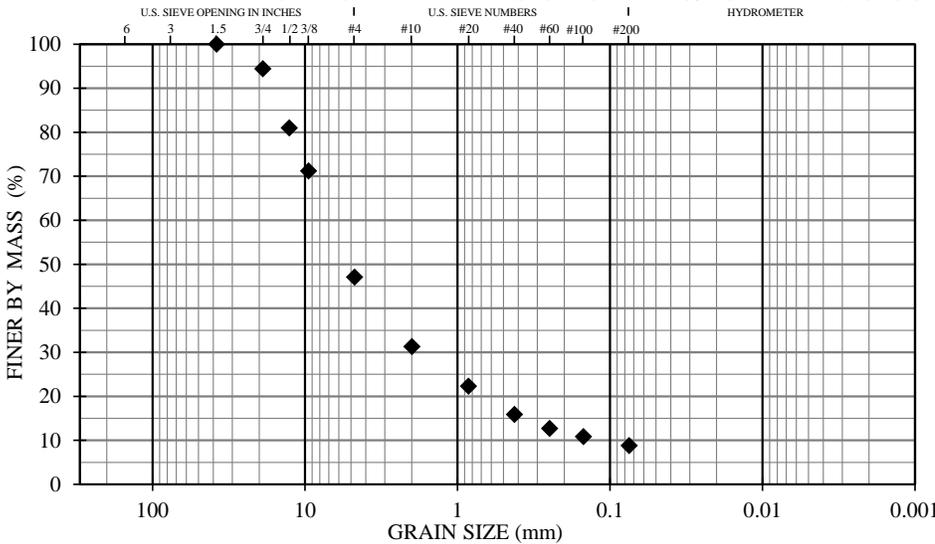
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B1
NUMBER/ DEPTH:	S6 / 15 - 16.5'
DESCRIPTION:	Poorly-graded gravel w/ silt and sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Isaac Logo
REVIEWED BY:	CJB

% GRAVEL	52.9	USCS	GP-GM
% SAND	38.3	USACOE FC	N/A
% SILT/CLAY	8.8	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	4.9	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		61.6	
COEFFICIENT OF GRADATION (C _c)		3.9	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

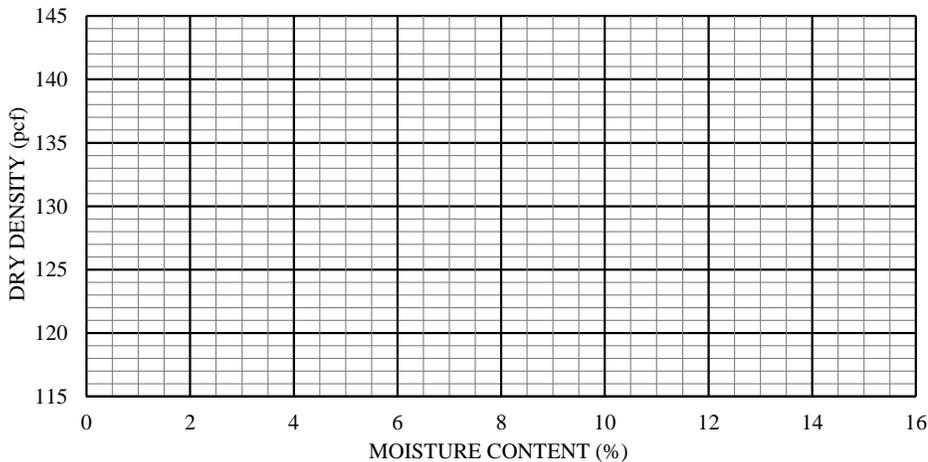
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	100	
19.00	3/4"	94	
12.70	1/2"	81	
9.50	3/8"	71	
4.75	#4	47	
2.00	#10	31	
0.85	#20	22	
0.43	#40	16	
0.25	#60	13	
0.15	#100	11	
0.075	#200	8.8	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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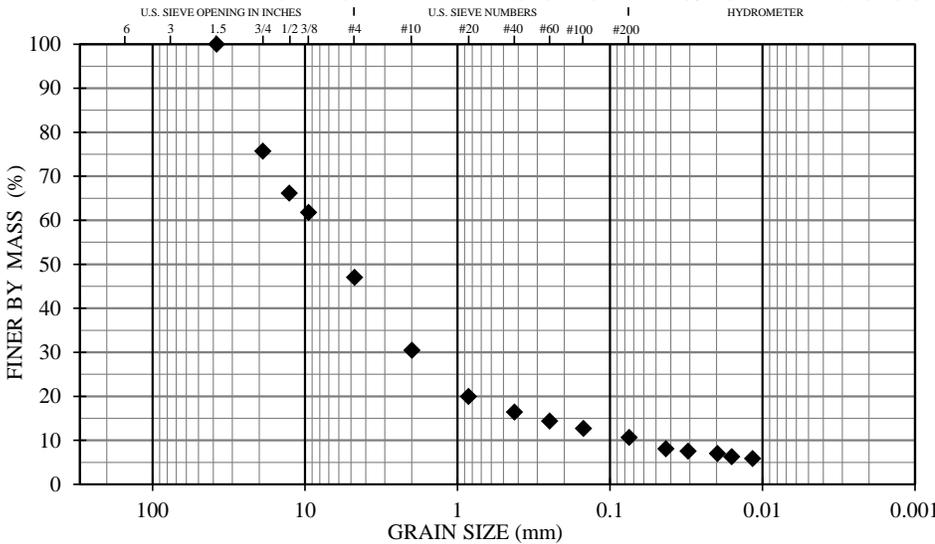
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B2
NUMBER/ DEPTH:	S2 / 2.5 - 4'
DESCRIPTION:	Poorly-graded gravel w/ silt and sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Chris Gerboth
REVIEWED BY:	CJB

% GRAVEL	52.9	USCS	GP-GM
% SAND	36.4	USACOE FC	F1
% SILT/CLAY	10.7	% PASS. 0.02 mm	6.6
% MOIST. CONTENT	5.8	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		133.4	
COEFFICIENT OF GRADATION (C _c)		6.4	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

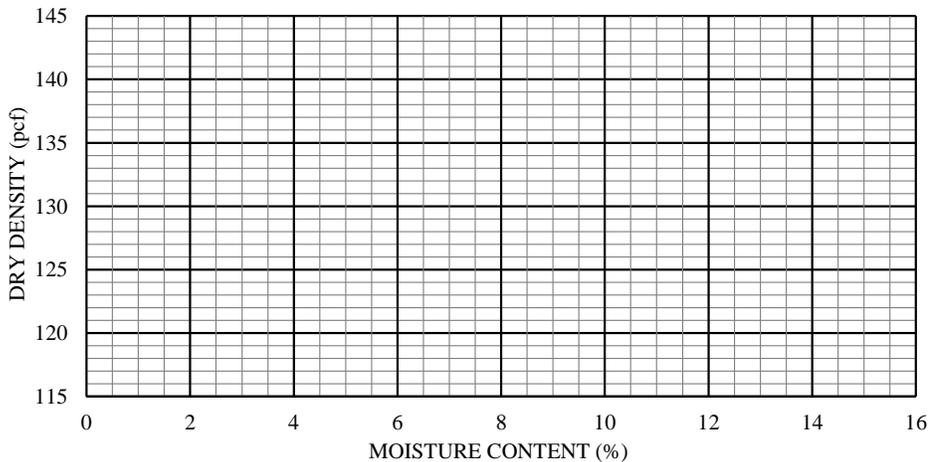
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	100	
19.00	3/4"	76	
12.70	1/2"	66	
9.50	3/8"	62	
4.75	#4	47	
2.00	#10	30	
0.85	#20	20	
0.43	#40	16	
0.25	#60	14	
0.15	#100	13	
0.075	#200	10.7	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1	0.0431	8.1
2	0.0309	7.5
5	0.0198	7.0
8	0.0160	6.3
15	0.0117	5.9
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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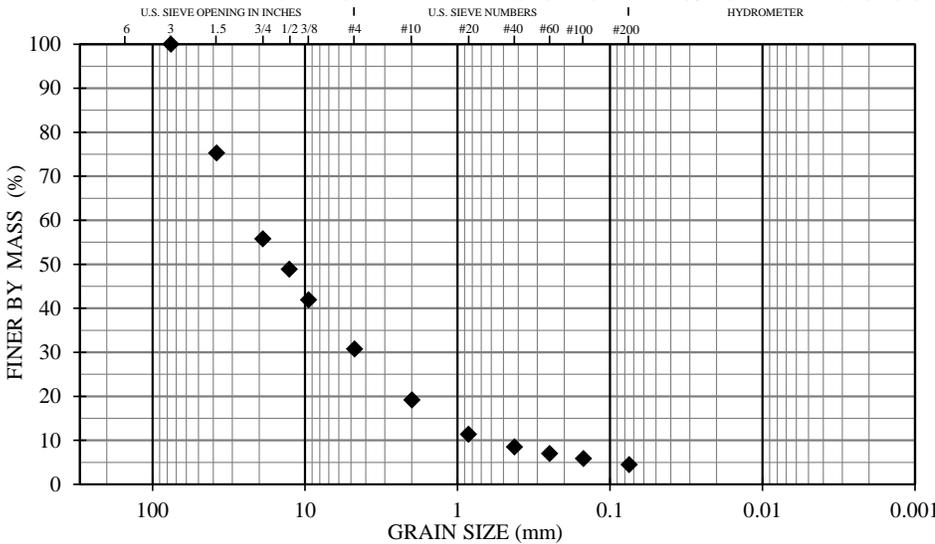
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B2
NUMBER/ DEPTH:	S3 / 5 - 6.5'
DESCRIPTION:	Well-graded gravel w/ sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Chris Gerboth
REVIEWED BY:	CJB

% GRAVEL	69.2	USCS	GW
% SAND	26.3	USACOE FC	N/A
% SILT/CLAY	4.5	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	2.5	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		36.1	
COEFFICIENT OF GRADATION (C _c)		1.4	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

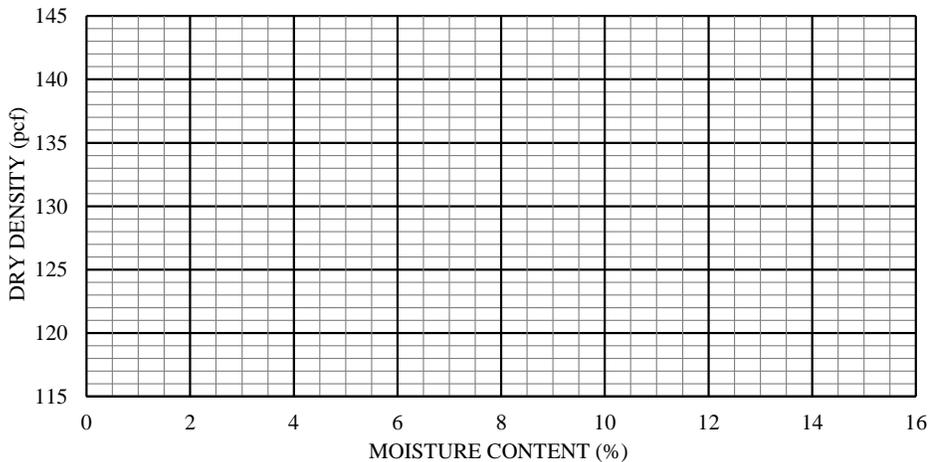
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	100	
38.10	1.5"	75	
19.00	3/4"	56	
12.70	1/2"	49	
9.50	3/8"	42	
4.75	#4	31	
2.00	#10	19	
0.85	#20	11	
0.43	#40	9	
0.25	#60	7	
0.15	#100	6	
0.075	#200	4.5	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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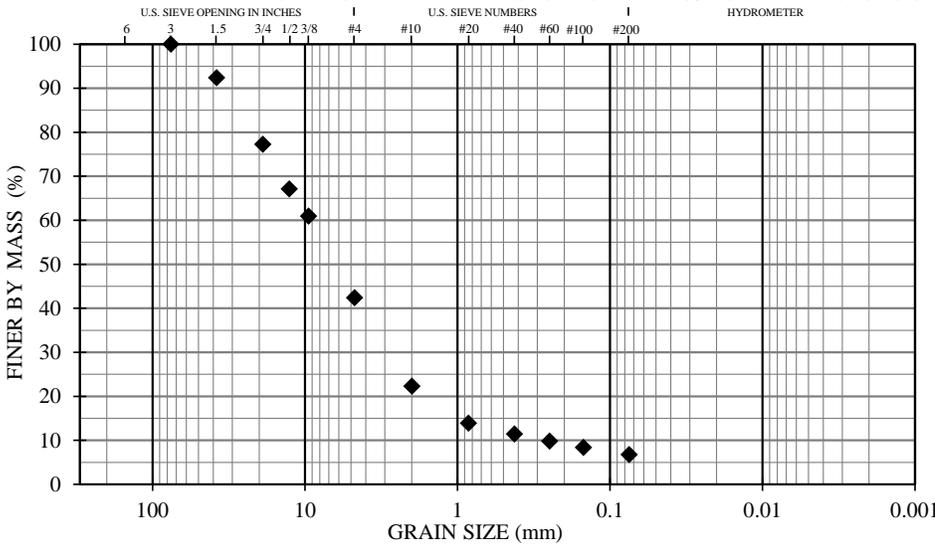
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B3
NUMBER/ DEPTH:	S5 / 10 - 11.5'
DESCRIPTION:	Poorly-graded gravel w/ silt and sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Isaac Logo
REVIEWED BY:	CJB

% GRAVEL	57.6	USCS	GP-GM
% SAND	35.6	USACOE FC	N/A
% SILT/CLAY	6.8	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	3.9	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C_u)		34.6	
COEFFICIENT OF GRADATION (C_g)		3.8	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

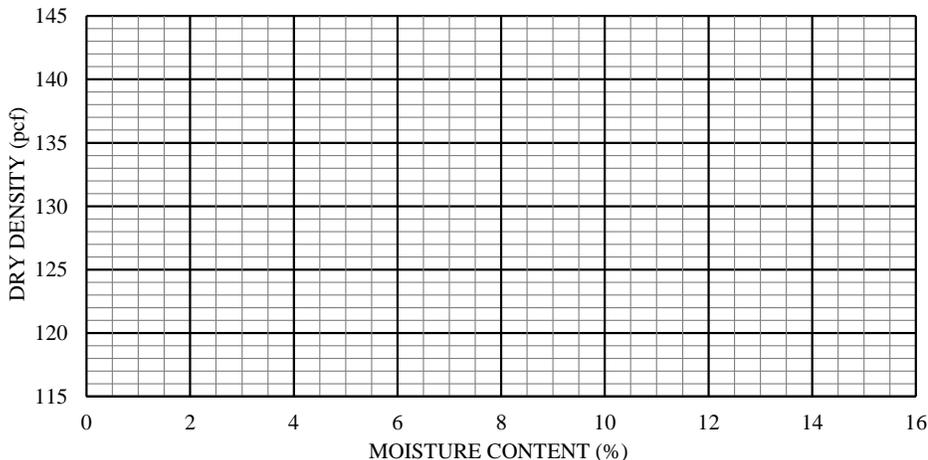
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	100	
38.10	1.5"	92	
19.00	3/4"	77	
12.70	1/2"	67	
9.50	3/8"	61	
4.75	#4	42	
2.00	#10	22	
0.85	#20	14	
0.43	#40	11	
0.25	#60	10	
0.15	#100	8	
0.075	#200	6.8	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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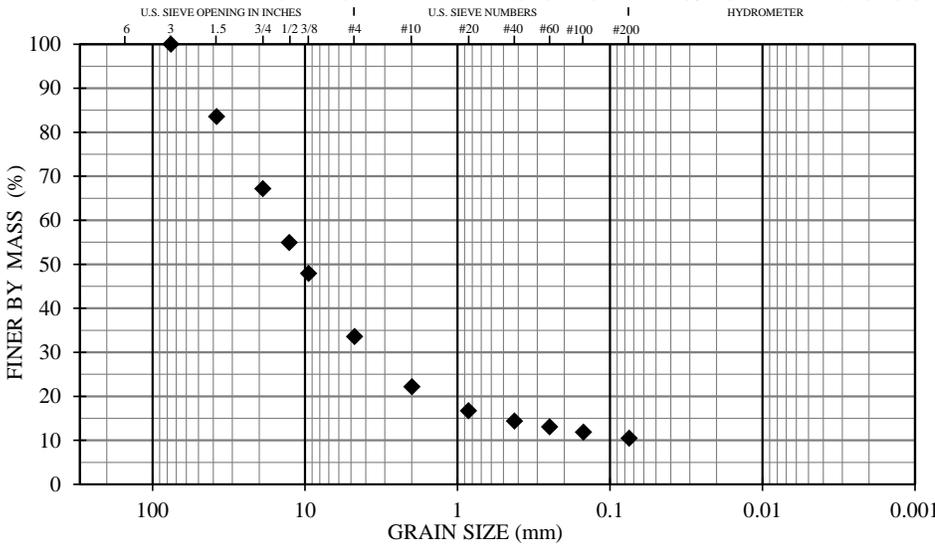
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B4
NUMBER/ DEPTH:	S2 / 5 - 6.5'
DESCRIPTION:	Poorly-graded gravel w/ silt and sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Chris Gerboth
REVIEWED BY:	CJB

% GRAVEL	66.4	USCS	GP-GM
% SAND	23.1	USACOE FC	N/A
% SILT/CLAY	10.5	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	4.7	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		UNKNOWN	
COEFFICIENT OF GRADATION (C _c)		UNKNOWN	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

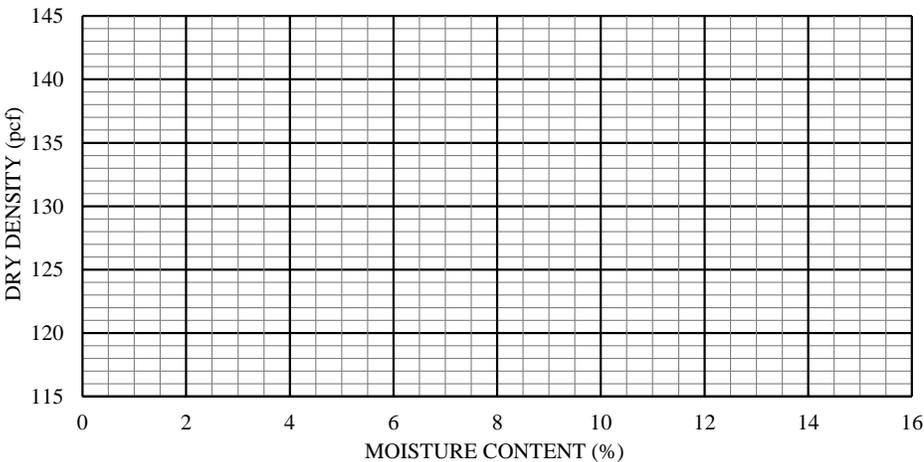
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	100	
38.10	1.5"	84	
19.00	3/4"	67	
12.70	1/2"	55	
9.50	3/8"	48	
4.75	#4	34	
2.00	#10	22	
0.85	#20	17	
0.43	#40	14	
0.25	#60	13	
0.15	#100	12	
0.075	#200	10.5	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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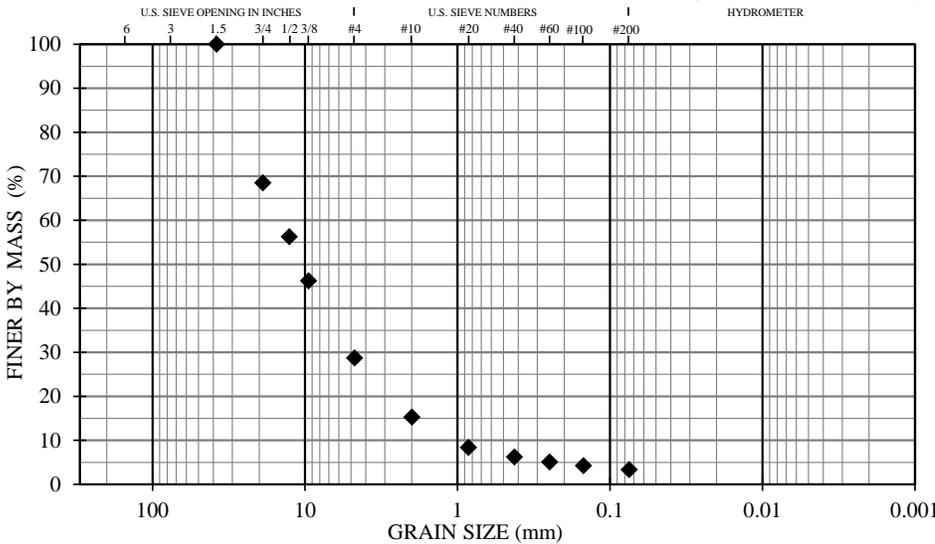
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B5
NUMBER/ DEPTH:	S2 / 5 - 6.5'
DESCRIPTION:	Well-graded gravel w/ sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Isaac Logo
REVIEWED BY:	CJB

% GRAVEL	71.3	USCS	GW
% SAND	25.4	USACOE FC	N/A
% SILT/CLAY	3.3	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	3.0	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		13.1	
COEFFICIENT OF GRADATION (C _c)		1.6	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

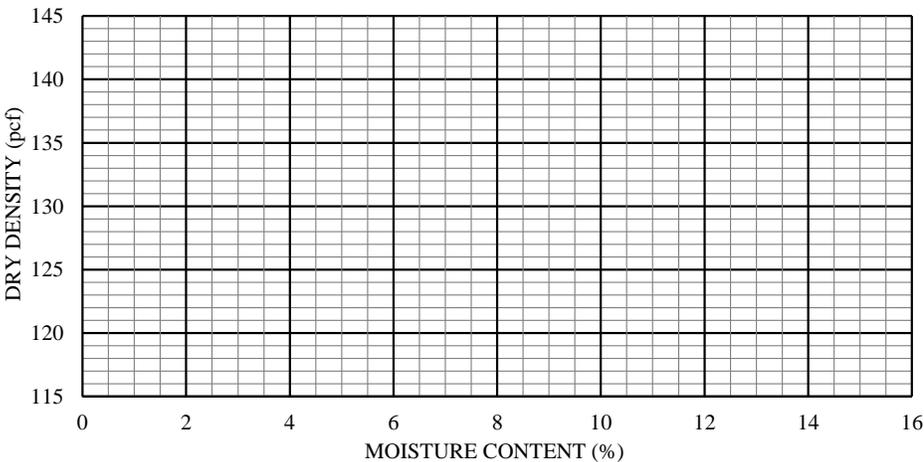
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	100	
19.00	3/4"	69	
12.70	1/2"	56	
9.50	3/8"	46	
4.75	#4	29	
2.00	#10	15	
0.85	#20	8	
0.43	#40	6	
0.25	#60	5	
0.15	#100	4	
0.075	#200	3.3	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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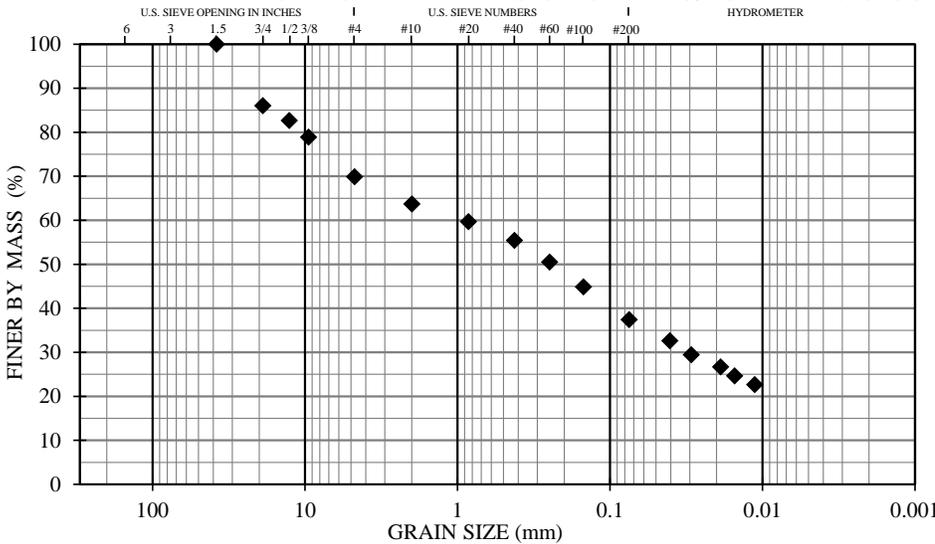
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B5
NUMBER/ DEPTH:	S3 / 7.5 - 9'
DESCRIPTION:	Silty sand w/ gravel
DATE RECEIVED:	12/9/2024
TESTED BY:	Chris Gerboth
REVIEWED BY:	CJB

% GRAVEL	30.1	USCS	SM
% SAND	32.5	USACOE FC	F3
% SILT/CLAY	37.4	% PASS. 0.02 mm	26.5
% MOIST. CONTENT	7.8	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		UNKNOWN	
COEFFICIENT OF GRADATION (C _c)		UNKNOWN	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

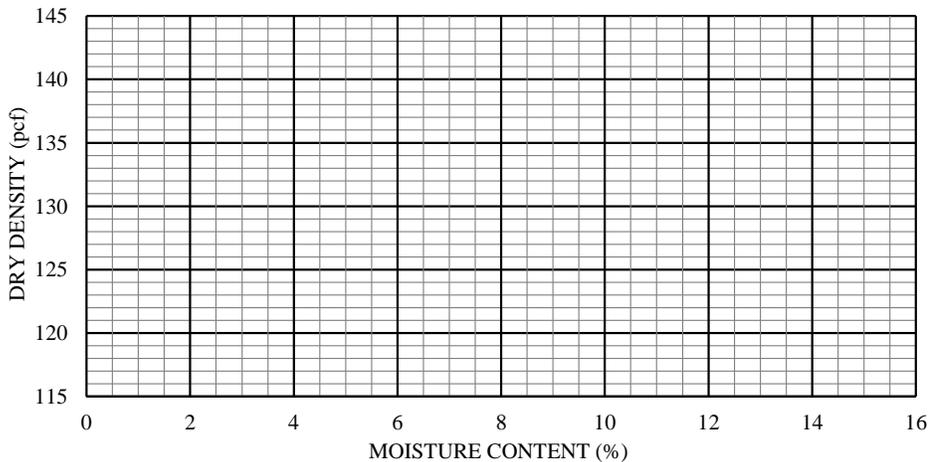
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	100	
19.00	3/4"	86	
12.70	1/2"	83	
9.50	3/8"	79	
4.75	#4	70	
2.00	#10	64	
0.85	#20	60	
0.43	#40	55	
0.25	#60	51	
0.15	#100	45	
0.075	#200	37.4	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1	0.0406	32.7
2	0.0294	29.5
5	0.0189	26.7
8	0.0153	24.7
15	0.0113	22.7
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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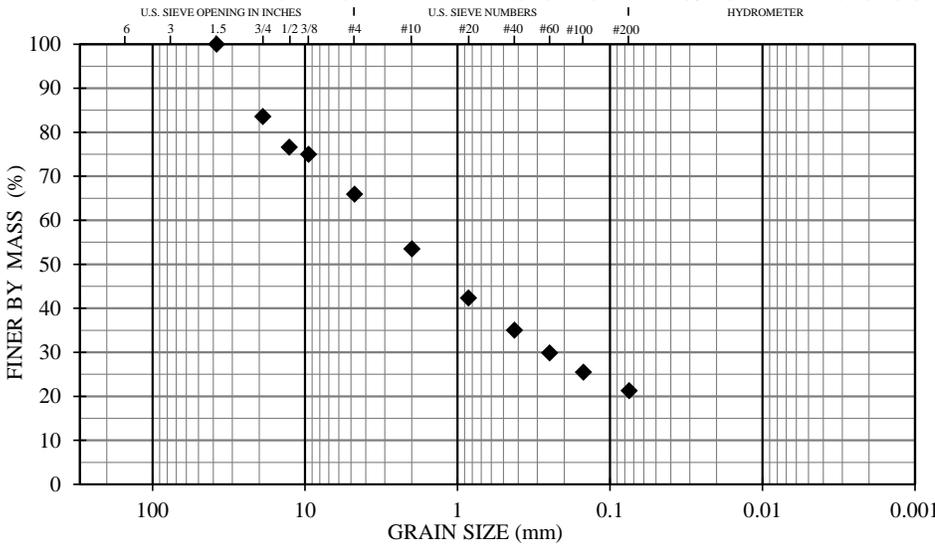
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B6
NUMBER/ DEPTH:	S1 / 2.5 - 4'
DESCRIPTION:	Silty sand w/ gravel
DATE RECEIVED:	12/9/2024
TESTED BY:	Issac Logo
REVIEWED BY:	CJB

% GRAVEL	34.1	USCS	SM
% SAND	44.6	USACOE FC	N/A
% SILT/CLAY	21.3	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	11.6	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		UNKNOWN	
COEFFICIENT OF GRADATION (C _c)		UNKNOWN	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

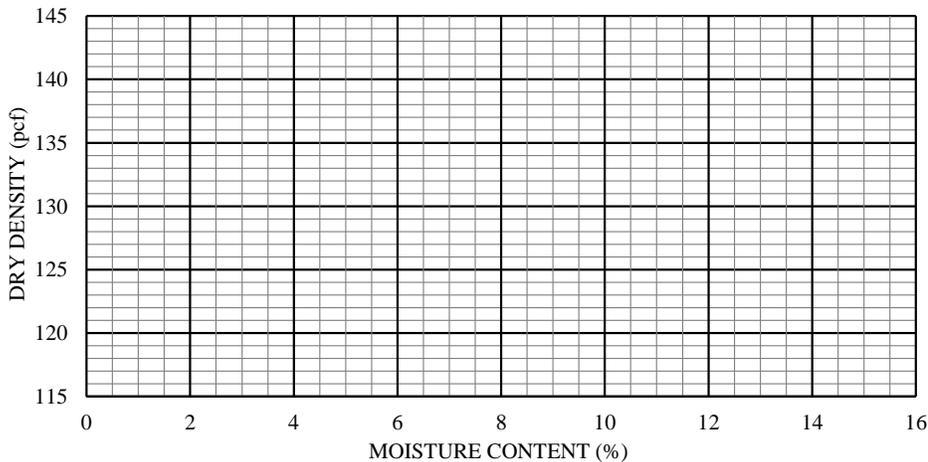
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	100	
19.00	3/4"	84	
12.70	1/2"	77	
9.50	3/8"	75	
4.75	#4	66	
2.00	#10	54	
0.85	#20	42	
0.43	#40	35	
0.25	#60	30	
0.15	#100	25	
0.075	#200	21.3	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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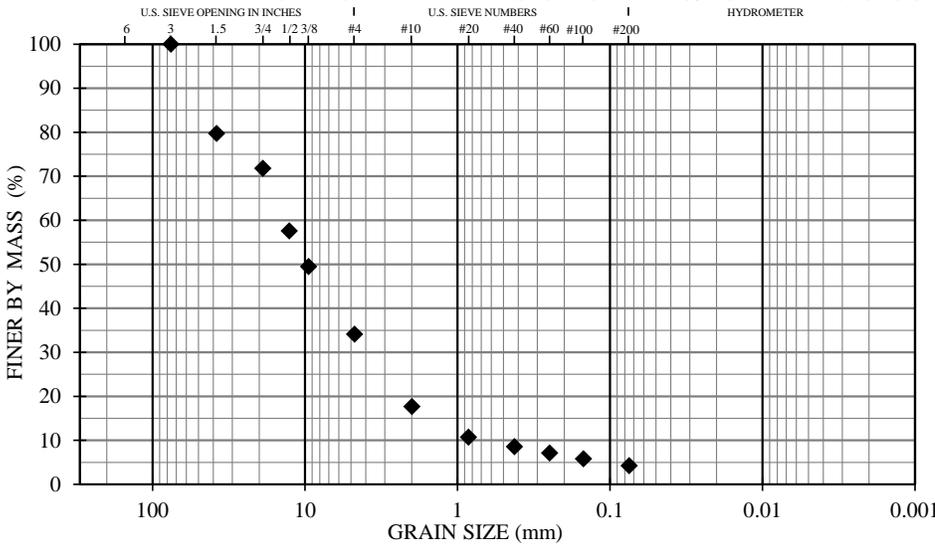
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B7
NUMBER/ DEPTH:	S3 / 7.5 - 9'
DESCRIPTION:	Well-graded gravel w/ sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Isaac Logo
REVIEWED BY:	CJB

% GRAVEL	65.8	USCS	GW
% SAND	29.9	USACOE FC	N/A
% SILT/CLAY	4.3	% PASS. 0.02 mm	N/A
% MOIST. CONTENT	4.1	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		19.6	
COEFFICIENT OF GRADATION (C _c)		1.7	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

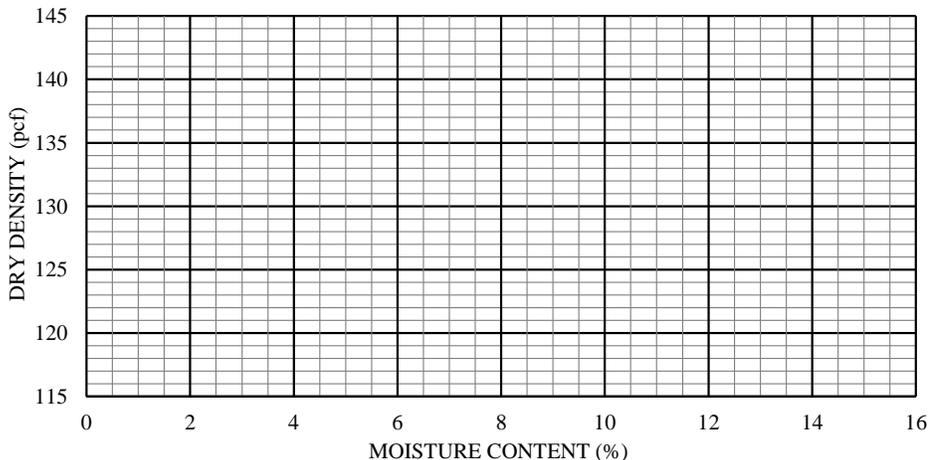
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	100	
38.10	1.5"	80	
19.00	3/4"	72	
12.70	1/2"	58	
9.50	3/8"	50	
4.75	#4	34	
2.00	#10	18	
0.85	#20	11	
0.43	#40	9	
0.25	#60	7	
0.15	#100	6	
0.075	#200	4.3	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1		
2		
5		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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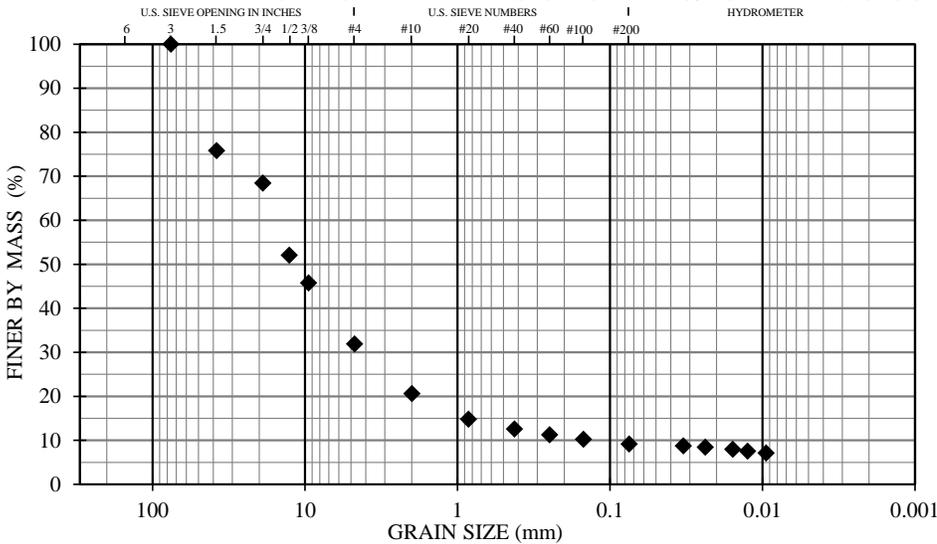
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	Triad
PROJECT NAME:	4220 Baxter
PROJECT NO.:	7252-24
SAMPLE LOC.:	B8
NUMBER/ DEPTH:	S2 / 5 - 6.5'
DESCRIPTION:	Poorly-graded gravel w/ silt and sand
DATE RECEIVED:	12/9/2024
TESTED BY:	Chris Gerboth
REVIEWED BY:	CJB

% GRAVEL	68.1	USCS	GP-GM
% SAND	22.7	USACOE FC	F1
% SILT/CLAY	9.2	% PASS. 0.02 mm	8.3
% MOIST. CONTENT	3.4	% PASS. 0.002 mm	N/A
UNIFORMITY COEFFICIENT (C _u)		119.6	
COEFFICIENT OF GRADATION (C _c)		8.9	
ASTM D1557 (uncorrected)		N/A	
ASTM D4718 (corrected)		N/A	
OPTIMUM MOIST. CONTENT. (corrected)		N/A	

PARTICLE SIZE ANALYSIS ASTM D6913 / D422 / C136



SIEVE ANALYSIS RESULT

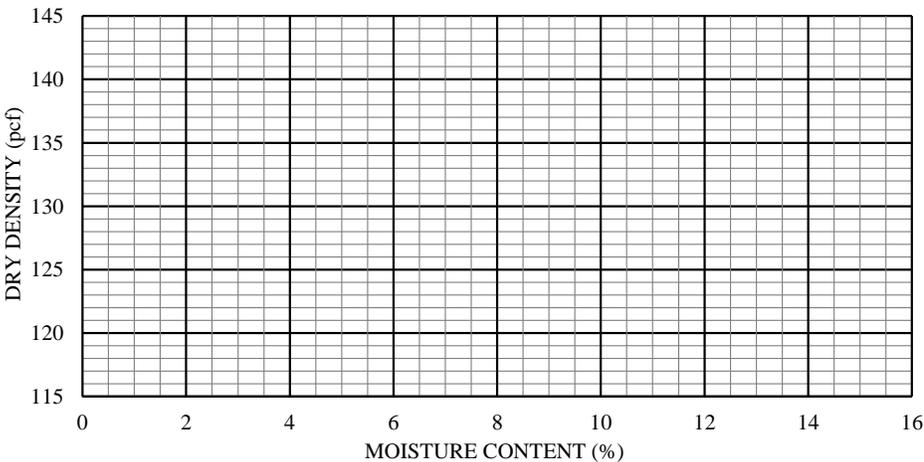
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	100	
38.10	1.5"	76	
19.00	3/4"	68	
12.70	1/2"	52	
9.50	3/8"	46	
4.75	#4	32	
2.00	#10	21	
0.85	#20	15	
0.43	#40	13	
0.25	#60	11	
0.15	#100	10	
0.075	#200	9.2	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
1	0.0332	8.8
2	0.0238	8.4
5	0.0157	8.0
8	0.0126	7.6
15	0.0095	7.1
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	N/A
DEGRADATION (ATM T-313)	N/A
PLASTICITY INDEX ASTM 4318	N/A

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APPENDIX E

CLASSIFICATION OF ORGANIC SOILS



APPENDIX E - CLASSIFICATION OF ORGANIC SOILS

1.0 Introduction

In order to develop relevant geotechnical engineering recommendations for a given site, it is first necessary to properly identify the three primary soil types which can occur at a given site. These soil types are:

1. Inorganic soils – contain no organic matter, only mineral soil particles.
2. Organic soils – contain a mixture of organic matter and mineral soil particles with $\leq 50\%$ organic matter (by mass).
3. Peat soils – contain a mixture of organic matter and mineral soil particles with $\geq 50\%$ organic matter (by mass).

According to the Unified Soil Classification System (USCS), there is no specified classification for coarse-grained soils (i.e., sand & gravel) which contain some percentage of organic matter; only for fine-grained soils (i.e., silt & clay) which contain some percentage of organic matter. There is a USCS classification for peat soils (which are also referred to as highly organic soils), however, within the USCS there are no established boundaries between peat soils and fine-grained organic soils.

There have been several studies conducted on the nature of organic soils and other soil classification systems have been suggested to better classify organic soils. The Alaska Department of Transportation and Public Facilities (AKDOT&PF), and several other state, federal, and academic organizations, have all proposed different classifications for organic soils. However, the majority of engineering professionals agree that there are four or five general classifications for organic soils. The classifications are as follows:

1. Inorganic soils
2. Soils with some organic content
3. Organic soils
4. Highly organic soils
5. Peat soils

The organic matter content of a soil may be determined by:

- visual estimation based on the volumetric percentage of organic matter present in a given soil, or
- direct measurement (by laboratory testing) based on the mass percentage of organic matter present in a given soil sample.

Due to the variable specific gravity of organic matter, the only reliable determination of the organic content of a given soil is by mass, which can be determined utilizing ASTM D-2974. It should be noted, however, that the organic content calculated using ASTM D-2974 does not include any organic particles retained on the #10 sieve or greater than approximately 0.08 inches in diameter. In the event that there are particles of coarse organic matter retained on the #10 sieve, then modifications to ASTM D-2974 must be made to account for the additional coarse organic matter (which we discuss in greater detail later in Section 2.0 of this Appendix).

There is not yet an accepted standard for delineating the percentages of organic matter in any given soil classification system, there are only recommendations derived from the proposed classifications. The AKDOT&PF classification specification states that soils with less than 2% organic matter by mass, or greater than 98% ash/mineral content (after lab testing), are deemed as inorganic soils. Ash content refers to the product of a Loss on Ignition (LOI) test (as per ASTM D-2974), where a soil sample is burned in an oven to determine its organic content. The organic matter in the test sample combusts under the high temperatures, leaving only inorganic minerals and the ash of the incinerated organic matter behind (which has a negligible mass).

The organic content of a soil can be approximated in the field by visually estimating the volume of organic matter present as part of the soil volume as a whole. These estimates tend to be highly unreliable (due to the variable density of organic soils), often resulting in erroneous organic content determinations. We therefore recommended that the organic content of a soil be determined solely through laboratory testing using the Loss on Ignition test (ASTM D-2974), which yields the mass percentage of organic material present in a given soil sample.

As we previously mention, a key to understanding the results of the ASTM D-2974 test procedure is that the test procedure first calls for the soil sample to be sieved over the #10 sieve. This procedure excludes pieces of coarse organic matter such as sticks, roots, and other fibrous organic matter which cannot pass the #10 sieve. This excluded coarse organic matter can have a significant impact on the structural performance of a given soil. To better assess the impact of all organic matter contained within a given soil sample (both coarse and fine organic matter), we have developed a modified procedure for ASTM D-2974, which includes the coarse organic matter retained on the #10 sieve. We have included a detailed explanation of our modified test procedure for ASTM D-2974 in Section 2.0 of this Appendix. Only by evaluating the total organic content of a soil can one properly evaluate the potential settlements risks associated with a given organic soil.

2.0 Modified Organic Content Test Method

The modified organic content test method that we have developed, which we have termed ASTM D2974m, considers the organic content of the entire soil sample as opposed to only the fine (i.e., smaller diameter) organic matter passing the #10 screen (as specified by ASTM D2974).

The coarse fraction of organic matter (that which is retained on the #10 sieve) in a sample is not considered by ASTM D2974 and can pose significant settlement potential in soils. Therefore, we feel that it is critical to properly evaluate the total organic content of any sample (both coarse and fine organic matter) in an effort to thoroughly evaluate the settlement potential of organic soils. We have detailed our procedure for determining the modified organic content of a soil below.

Step 1: Moisture Content – We determine the initial moisture content (mass fraction), W , of the as-received test specimen by measuring the mass of the sample both before and after drying. The moisture content of the test specimen can then be calculated from the relationship:

$$W = (A-B) / B \quad (1)$$

Where A is the mass of the wet (as-received) sample and B is the mass of the dry sample. Drying may take several days, dependent upon the particle sizes of any organic matter contained within the sample. We perform the sample drying as per ASTM D422.

Step 2: Split Sample – We sieve the dried sample over the #10 screen (as per ASTM D422). We then calculate the fraction (by mass) of material passing the #10 screen, F , using the equation:

$$F = E / B \quad (2)$$

Where E is the dry mass of material passing the #10 screen and B is defined in Step 1 of this procedure.

Step 3: Coarse Organic Matter Content – We calculate the fraction of organic matter retained on the #10 sieve by submerging and agitating the entire portion of the retained sample in water. The agitation process is as follows:

1. Submerge sample in water and agitate for one minute.
2. Collect floating fraction of sample (organic matter).
3. Agitate remaining sample for an additional 30 seconds.
4. Collect any additional floating material.
5. Repeat steps 3 & 4 until there is no floating material.

We then dry and measure the mass of all of the floating organic matter that we collect during the water immersion/agitation stage. The plus #10 organic fraction, O_{coarse} , is given by the equation:

$$O_{coarse} = C / B \quad (3)$$

Where C is the dry mass of the floating organic matter, dried per ASTM D422.

Step 4: Fine Organic Matter Content - The procedure we use to obtain the organic content of the material passing the #10 sieve is described by ASTM standard D2974, where the organic fraction, O_{fines} , is calculated from:

$$O_{fines} = (G-H) / (H-D) \quad (4)$$

Where G is the mass of the split sample (entire as-received sample passing #10 sieve) and crucible, H is the mass of the burnt residue (mineral plus ash content) and crucible and D is the mass of the crucible.

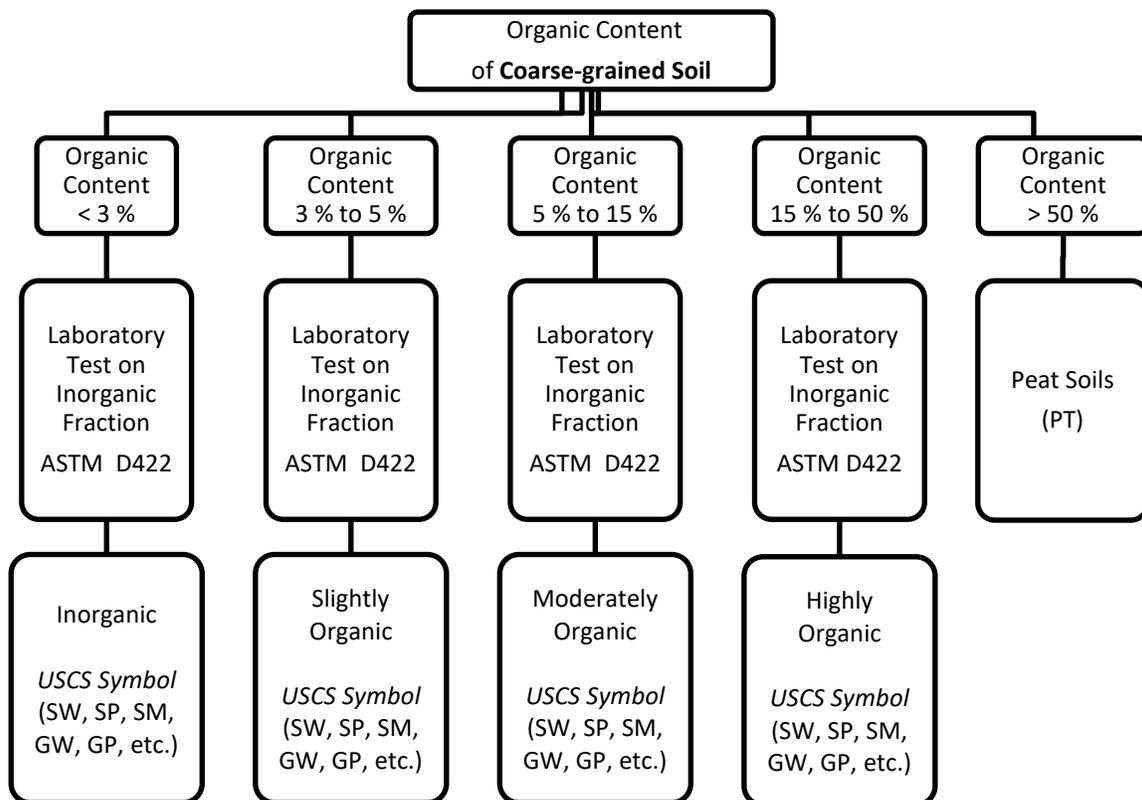
The total organic content by mass fraction, O_{total} , is finally given by:

$$O_{total} = (F \times O_{fines}) + O_{coarse} \quad (5)$$

3.0 Organic Soil Classification

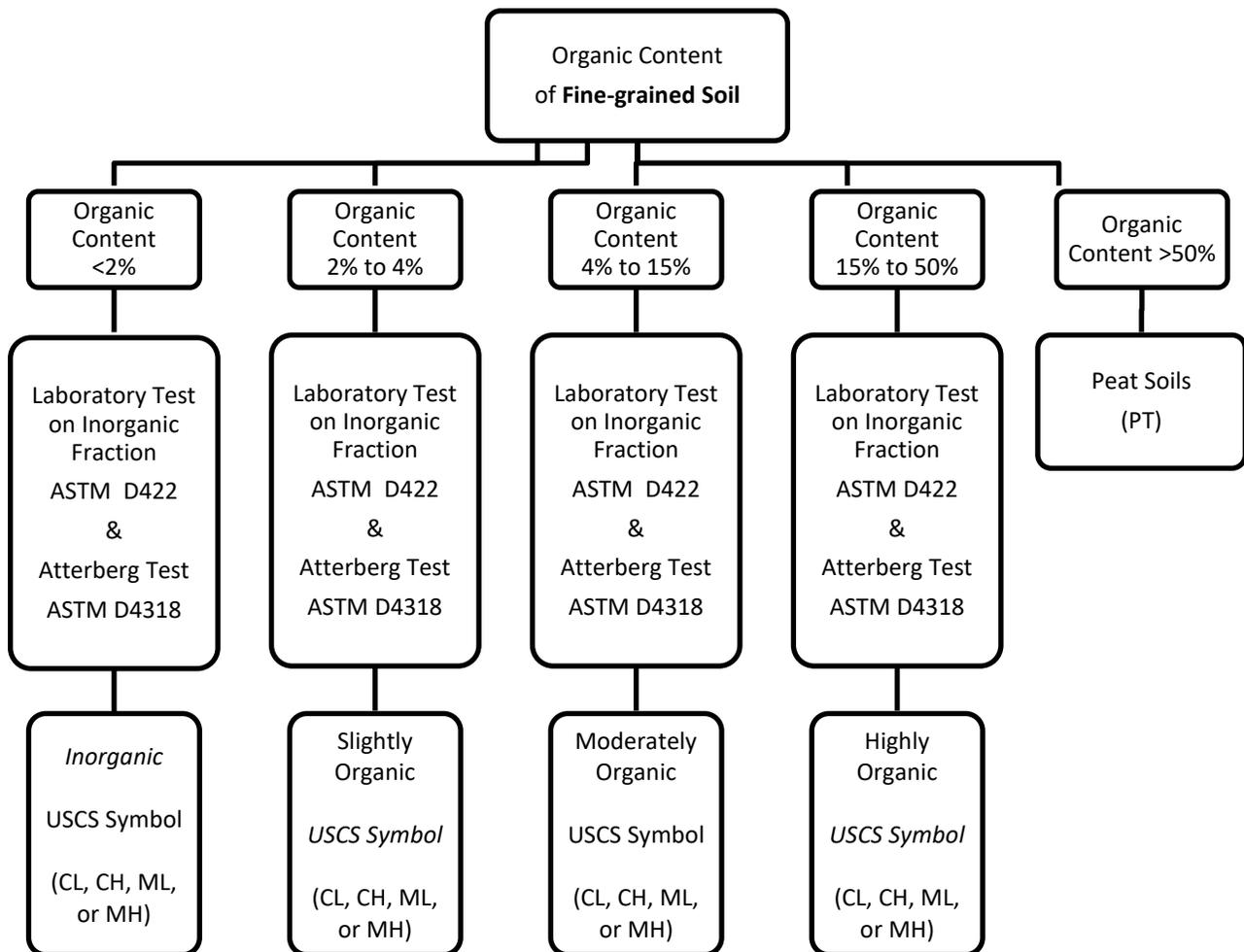
Our classification for the organic content of coarse-grained soils is based on the AKDOT&PF classification for coarse-grained soils. We detail our recommended coarse-grained soil classification in Figure 1 of this appendix.

Figure 1: Organic Soil Classification for Coarse-grained Soils (using ASTM D2974m)



The AKDOT&PF classification for the organic content of fine-grained soils is based on either visual-manual description of the soil or testing of the Atterberg limits of the soil as determined by ASTM D2487. However, the only quantifiable way to ascertain an organic soil based on the AKDOT&PF classification is to conduct an Atterberg limit test. If the liquid limit after oven drying is less than 75 percent of the liquid limit before oven drying, then the soil is classified as an organic silt/clay. This classification method does not determine the organic fraction of the soil by mass, and only describes the presence of organic matter. Therefore, we do not use the AKDOT&PF classification system for fine-grained organic soils. For stability considerations, we recommend that the organic content of fine-grained soils be defined by the chart that we present in Figure 2 of this appendix.

Figure 2: Organic Soil Classification for Fine-grained Soils (by ASTM D2974m)



For both coarse-grained and fine-grained classifications, we first begin by sieving the sample as per test method ASTM D422 with the fine organic fraction retained in the portion of the sample passing the #10 sieve and with the coarse organic fraction removed for the portion of the sample retained on the #10 sieve.

4.0 Peat Soil Classifications

Peat is defined as a naturally occurring, highly organic substance composed primarily of vegetative matter in various stages of decomposition. It is fibrous to amorphous in texture, is usually dark brown to black, and usually has an organic odor. The organic mat commonly found at the ground surface (comprised of grass, roots, and decaying leaves) is not included in the peat classification.

Peat has been classified into subcategories based on the structure of the peat. There is no generalized classification system, as the necessity of classification changes according to the purpose for which the soil is to be classified. Two of the most common methods for classification of peats include the Von Post system and the Radforth system. From these two systems, other more simplistic methods have been developed.

The Von Post classification system is dependent on the degree of humification (i.e., decomposition) of the peat and is the basis for ASTM D-5715; which is a visual/manual classification of peat. The AKDOT&PF further simplified the Von Post and Radforth systems into three categories of peat:

1. fibric;
2. hemic; and
3. sapric.

The peat is classified based on the results of a humification test for fiber content. Where humification or other peat classification is not required, the material is simply classified as peat. For engineering purposes, the specific classification of peat type (i.e, fibric, hemic, etc.) provides minimal distinction and therefore further classification is typically unnecessary.

The AKDOT&PF *Alaska Guide to Description and Classification of Peat and Organic Soil* classifies a peat soil as any soil with at least 75% organic matter or 25% mineral content (post-LOI testing as per ATSM D2974). However, for sake of simplicity and to be consistent with general USCS gradation breaks, we define peat soils as any soil (coarse or fine-grained) with more than 50 percent organic matter (or less than 50 percent ash/mineral content).

5.0 Engineering Properties of Organic and Peat Soils

The geotechnical properties of an organic/peat soil are a function of a number of factors, including:

1. organic content of the soil;
2. type of organic matter;
3. the degree of humification of the organic matter;
4. the soil void ratio;
5. mineral particle size distribution within the soil; and
6. soil moisture content.

As the organic content of an organic soil increases, so does its ability to retain water, and soil moisture contents of organic soils are typically much higher than inorganic soils. The Atterberg limits of fine-grained organic soils also typically increase, although the effects of the organic matter on Atterburg limits are not constant or predictable. However, as the organic content of a soil increases, the density of the soil decreases, as well as its ability to be mechanically compacted. The type of organic matter and the degree of humification has some effect on the strength and permeability of an organic/peat soil. The void ratio of a soil increases with organic content, and can affect the compressibility of the soil, which is an important factor in construction activities.

Peat soils are typically highly compressible and usually contain significantly higher natural moisture contents than mineral soils. Due to their compressibility, peat soils generally have a low bearing capacity, making them unsuitable for foundation, gravity-fed utility, and/or pavement support. Peat soils also have low lateral bearing capacities, and provide little lateral resistance to foundations (e.g., piles, grade beams, etc.) or other lateral load bearing features.

Organic soils are moderately compressible, and have a low to moderate bearing capacity. These types of soils are also unsuitable for supporting foundations, but may be suitable for gravity-fed utility and/or pavement section support (assuming proper engineering controls are implemented into the utility/pavement section design). Organic soils have a moderate lateral capacity, and can typically support moderate lateral loading with minimal compression.

In order to further classify the suitability of a soil for engineering purposes (based solely upon the ash/mineral content of the soil as determined by ASTM D-2974(m)), we have created a classification system of soils containing organic matter. Our classification system, which we detail in Section 10.0 of this appendix is based upon previous work by AKDOT&PF and others and does not reflect the suitability of a specific soil with respect to its USCS classification or its in-situ density, only the ash/mineral content.

6.0 Void Ratio and Degree of Saturation

The void ratio and degree of saturation for organic/peat soils involves an additional step to the void ratio determination typically used. We detail this procedure in Figure 3 of this appendix.

Figure 3: Void Ratio and Degree of Saturation Equations

$V_T=1$	Air	$V_a = 1 - V_w - V_o - V_s$
	Water	$V_w = \frac{W_w}{(1)\gamma_w}$ $\gamma_w =$ unit weight of water
	Organics	$V_o = \frac{W_o}{(1.35)\gamma_w}$ where 1.35 is the specific gravity of cellulose
	Soil	$V_s = \frac{W_s}{(G_s)\gamma_w}$ $G_s =$ specific gravity of the mineral soil of the sample

The degree of saturation: $S = \frac{V_w}{V_a + V_w}$

The void ratio: $e = \frac{V_a + V_w}{V_o + V_s}$

The cellular structure of organic matter inherently produces a significant portion of air voids. This inherently high void ratio is the reason why cellular organic matter (when dry) will float on water and contributes to the very high moisture contents and low bulk densities typically associated with organic/peat soils. The high void ratio of organic matter and organic/peat soils is also why organic/peat soils have a significant settlement potential associated with them.

7.0 Bearing Capacity Properties of Soil

The bearing capacity properties of a soil depend upon their intended application. We have separated the general geotechnical bearing capacity properties of a soil into two primary applications:

1. building foundation support; and
2. pavement section support.

For inorganic and slightly organic soils the same bearing capacity properties can be used for both applications. The bearing capacity properties can be calculated using the standard USCS, coupled with strength testing and/or correlations between soil densities. The low amount of organic matter present in these soils will not add any additional settlement potential outside of the normal settlement limits that we detail in our report and can therefore be ignored.

For organic and highly organic soils, the bearing capacity should be appropriately reduced for building foundation applications, as there can be low to moderate risks of settlement associated with these soils.

Peat soils are not suitable for building foundation support as there is a significant risk of settlement once foundation loads are applied. Pavement sections can be effectively constructed above organic/peat soils, but will require proper engineering assessments to evaluate any potential settlement risks based on the intended pavement use. Typically, an engineered structural pavement section consisting of varying amounts of coarse-grained fill and a geo-fabric layer(s) is required to help distribute pavement loads and reduce the potential for differential settlements within the organic/peat soil subgrade.

We have provided a summary of the settlement risks associated with the various organic/peat soils in the tables contained in Section 10.0 of this appendix.

8.0 Lateral Strength Properties of Soil

For inorganic and slightly organic soils, the lateral bearing properties can be calculated assuming normal USCS classification; effectively ignoring any organic content. The low amount of organic material in these soils will not reduce the lateral capacity as we describe in our report.

For organic and highly organic soils, the lateral capacity will be reduced in proportion to the organic content. Lateral pile testing is recommended for pile foundations in organic soil and is required in highly organic soils.

Peat soils are not suitable for lateral pile foundation support, and lateral pile bracing will most likely be required for pile foundations installed in areas of excessively thick peat soils.

We have provided a summary of the decreases in lateral capacity associated with the various organic/peat soils in the tables contained in Section 10.0 of this appendix.

9.0 Embankment Properties of Soils

The embankment properties for road and parking sections are the same for both coarse-grained and fine-grained soils.

The embankment properties for inorganic and slightly organic soils can be taken as the normal USCS density. The low amount of organic material in these soils will not reduce the stability of embankments as described in the report.

For organic soils, the stability of embankments will be reduced to marginal and a slope stability analysis is recommended. Highly organic soils and peat are not suitable for the construction of earthen embankments. We have provided a summary of the decreases in embankment strength associated with the various organic/peat soils in the tables contained in Section 10.0 of this appendix.

10.0 NGE-TFT Classifications for Organic Soils

As we discuss in Section 5.0 of this appendix, we have proposed a classification and suitability system of soils that contain organic matter as a part of determining suitability of a soil for its proposed engineering purpose. Our classification system, which we outline in Tables 1-4 of this appendix, does not reflect the suitability of a specific soil with respect to its USCS classification or its in-situ density. Our classification is based solely on the ash/mineral content of the soil as determined by ASTM D-2974 (or ASTM D-2974m).

Table 1: Classification for Coarse-grained Organic Soils and their Impact on Foundations

COARSE GRAINED – BUILDINGS & GRAVITY-FED UTILITIES					
	CATEGORY	ORGANIC CONTENT	ASH/MINERAL CONTENT	BASIS FOR BEARING PROPERTIES	BASIS FOR LATERAL CAPACITY
1.	INORGANIC	< 3 %	> 97 %	USCS / DENSITY	USCS / DENSITY
2.	SLIGHTLY ORGANIC	3 % - 5 %	97 % - 95 %	USCS / DENSITY	USCS / DENSITY
3.	ORGANIC	5 % - 17 %	95 % - 83 %	LOW TO MODERATE	MODERATE ¹
4.	HIGHLY ORGANIC	17 % - 50 %	83 % - 50 %	LOW	LOW ²
5.	PEAT	> 50 %	< 50 %	NONE	NONE

Table 2: Classification for Coarse-grained Organic Soils and their Impact on Pavement

COARSE GRAINED – PAVEMENT					
	CATEGORY	ORGANIC CONTENT	ASH/MINERAL CONTENT	BASIS FOR BEARING PROPERTIES	BASIS FOR LATERAL CAPACITY
1.	INORGANIC	< 3 %	> 97 %	USCS / DENSITY	USCS / DENSITY
2.	SLIGHTLY ORGANIC	3 % - 5 %	97 % - 95 %	USCS / DENSITY	USCS / DENSITY
3.	ORGANIC	5 % - 17 %	95% - 83%	ENGINEERING ³	MARGINAL ³
4.	HIGHLY ORGANIC	17 % - 50 %	83 % - 50 %	ENGINEERING ³	UNSUITABLE
5.	PEAT	> 50 %	< 50 %	ENGINEERING ³	UNSUITABLE

Table 3: Classification for Fine-grained Organic Soils and their Impact on Foundations

FINE GRAINED – BUILDINGS & GRAVITY-FED UTILITIES					
	CATEGORY	ORGANIC CONTENT	ASH/MINERAL CONTENT	BASIS FOR BEARING PROPERTIES	BASIS FOR LATERAL CAPACITY
1.	INORGANIC	< 2 %	> 98 %	USCS / DENSITY	USCS / DENSITY
2.	SLIGHTLY ORGANIC	2 % - 4 %	98 % - 96 %	USCS / DENSITY	USCS / DENSITY
3.	ORGANIC	4 % - 15 %	96 % - 85 %	LOW TO MODERATE	MODERATE ¹
4.	HIGHLY ORGANIC	15 % - 50 %	85 % - 50 %	LOW	LOW ²
5.	PEAT	> 50 %	< 50 %	NONE	NONE

Table 4: Classification for Fine-grained Organic Soils and their Impact on Pavement

FINE GRAINED – PAVEMENT					
	CATEGORY	ORGANIC CONTENT	ASH/MINERAL CONTENT	BASIS FOR BEARING PROPERTIES	BASIS FOR LATERAL CAPACITY
1.	INORGANIC	< 2 %	> 98 %	USCS / DENSITY	USCS / DENSITY
2.	SLIGHTLY ORGANIC	2 % - 4 %	98 % - 96 %	USCS / DENSITY	USCS / DENSITY
3.	ORGANIC	4 % - 15 %	96 % - 85 %	ENGINEERING ³	MARGINAL ³
4.	HIGHLY ORGANIC	15 % - 50 %	85 % - 50 %	ENGINEERING ³	UNSUITABLE
5.	PEAT	> 50 %	< 50 %	ENGINEERING ³	UNSUITABLE

Notes: ¹Lateral pile load testing recommended. ²Lateral pile load testing required. ³Compressibility and geo-fabric engineering studies needed. ⁴Slope stability evaluation recommended.

11.0 Closure

We (*Northern Geotechnical Engineering, Inc. d.b.a. Terra Firma Testing*) prepared this Appendix using a combination of published literature and our own professional experiences and engineering judgements. Information contained within this appendix that is based on our engineering judgments is our intellectual property and cannot be used without our express written consent. We prepared this appendix following the standard of care expected of professionals undertaking similar work in the State of Alaska under similar conditions. No warranty expressed or implied is made.

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APPENDIX F

ASCE 7 SEISMIC HAZARD REPORT

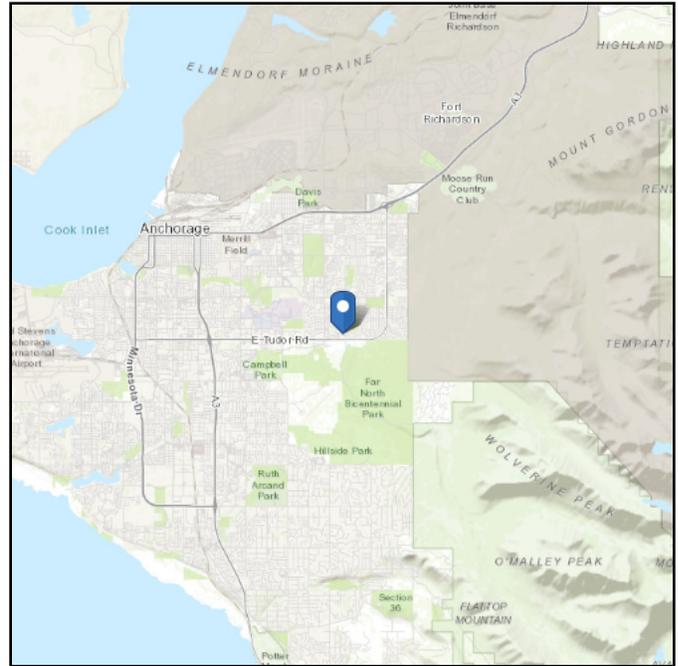
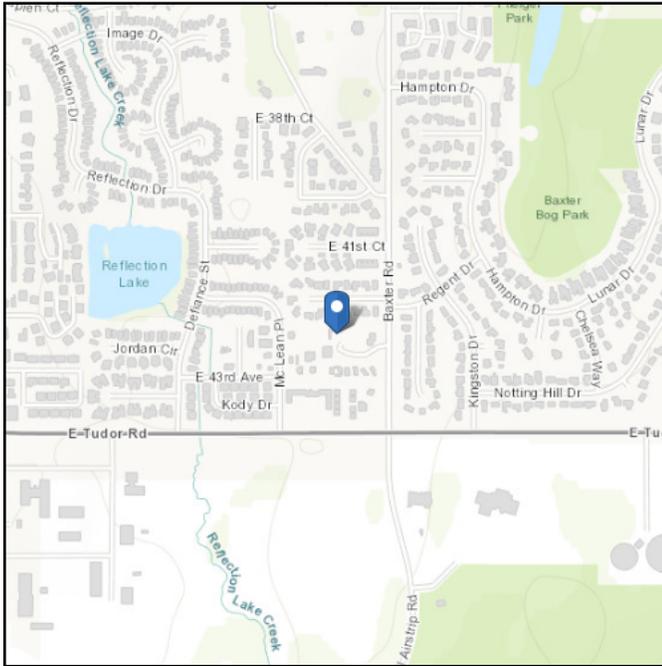


ASCE Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-22
Risk Category: II
Soil Class: D - Stiff Soil

Latitude: 61.182467
Longitude: -149.765289
Elevation: 249.37663037834588 ft (NAVD 88)

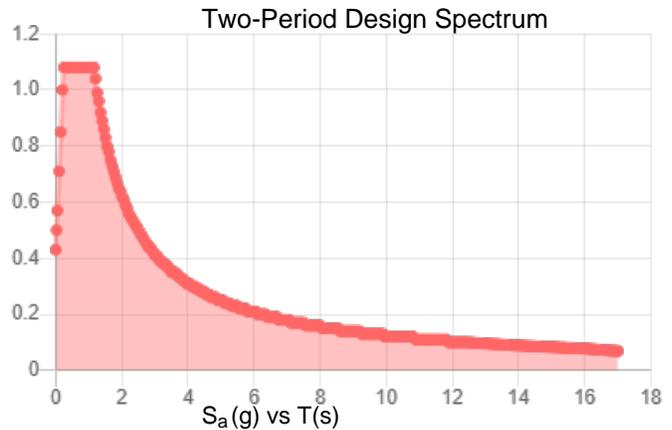
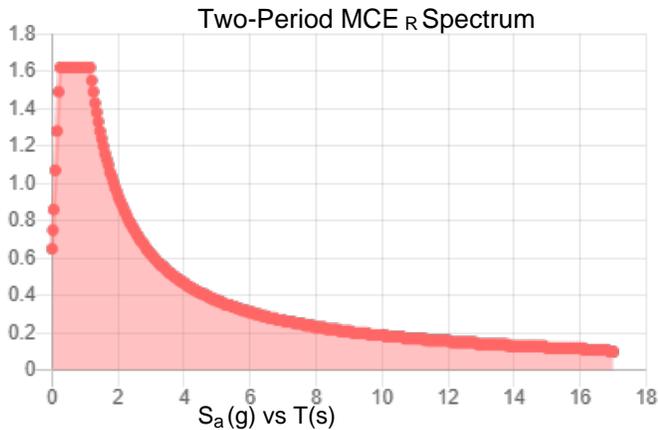
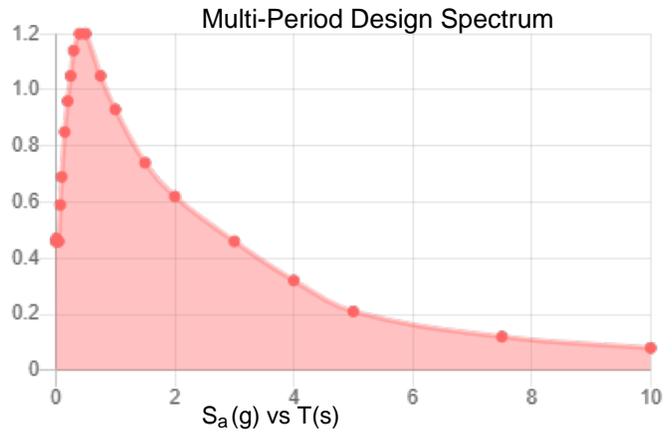
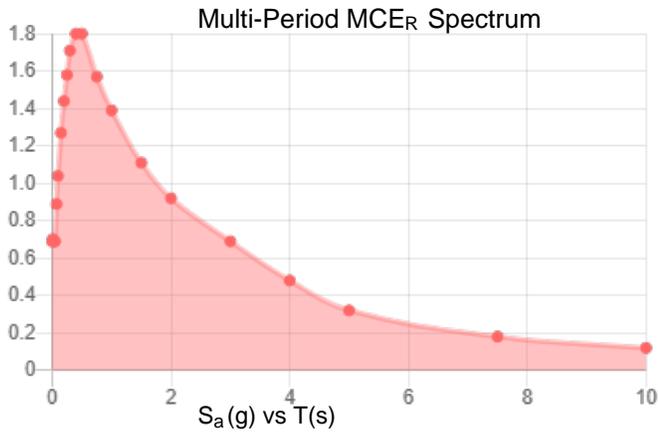


Site Soil Class: D - Stiff Soil

Results:

PGA _M :	0.53	T _L :	16
S _{MS} :	1.62	S _S :	1.5
S _{M1} :	1.86	S ₁ :	0.65
S _{DS} :	1.08	V _{S30} :	260
S _{D1} :	1.24		

Seismic Design Category: D



MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.



Data Accessed: Mon Dec 30 2024

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

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