Wells Fargo Bank - Greeley

Geotechnical Engineering Report

Greeley, Colorado

February 6, 2025 | Terracon Project No. 21245060

Prepared for:

SGDesign, Inc.
3311 Elm Street, Suite 105
Dallas, Texas 75226

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February 6, 2025

SGDesign, Inc.
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Attn: John Schlueter
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Re: Geotechnical Engineering Report
Wells Fargo Bank - Greeley
West 10th Street and 69th Avenue
Greeley, Colorado
Terracon Project No. 21245060

Dear Mr. Schlueter:

We have completed the scope of Geotechnical Engineering services for the project referenced above in general accordance with Terracon Proposal No. P21245060 dated December 20, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor systems and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. Materials testing and construction observation services are provided by Terracon as well. We would be pleased to discuss these services with you. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon

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PROFESSIONAL ENGINEER
02/06/2025

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Field Engineer

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Attachments

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Report Summary

Topic [1]	Overview Statement [2]
Project Description	A geotechnical exploration has been performed for the proposed Wells Fargo Bank to be constructed at the northeast corner of West 10th Street and 69th Avenue in Greeley, Colorado. Five borings were performed to depths of approximately 15 to 29.9 feet below existing grades.
Geotechnical Characterization	Subsurface conditions encountered in our exploratory borings generally consisted of existing fill consisting of about 4 feet of clayey sand over about 4 feet of silty sand with varying amounts of gravel. In Boring No. B-2, existing fill consisting of clayey gravel with sand was encountered at a depth of approximately 4 to 7 feet below existing grades. Silty sand with varying amounts of gravel was encountered under the existing fill layer at depths of about 8 to 24 feet below existing grades. Lean clay with gravel and cobbles was encountered in Boring No. B-1 at a depth of approximately 24 to 29 feet below existing grades. Sandy lean clay was encountered in Boring No. P-2 at a depth of approximately 14 to 15.5 feet below existing grades. Claystone bedrock was encountered in Boring Nos. B-1 and B-2 at depths of approximately 24 to 29 feet below existing site grades. Groundwater not observed during our exploration.
Earthwork	On-site soils typically appear suitable for use as general engineered fill and backfill on the site provided they are placed and compacted as described in this report. Import materials (if needed) should be evaluated and approved by Terracon prior to delivery to the site.
Shallow Foundations	Shallow foundations are recommended for the proposed bank building and ancillary structures. We recommend the proposed building be constructed on a shallow, spread footing foundation system constructed on soils exposed in foundation excavations. Allowable bearing pressure = 2,250 psf Expected settlements: 1-inch total, ½ to ¾ inch differential
Deep Foundations	Though we recommend shallow foundations be used for the building, deep foundations can also be used for other structures at the site. Drilled shafts are a common foundation type in this region and can be used to support the structure loads through a

Topic [1]	Overview Statement [2]
	combination of end bearing and skin friction using parameters contained herein.
Floor Slab	A slab-on-grade **Floor Slab** can be used for the proposed building provided the soils are over-excavated to a depth of at least 1 foot below the bottom of the proposed floor slab and replaced with moisture conditioned, properly compacted engineered fill. On-site soils are suitable as engineered fill below floor slabs. Soils exposed at the base of the recommended over-excavation below floor slabs should be scarified to a depth of at least 10 inches, moisture conditioned, and properly compacted prior to placement of the over-excavation backfill.
Pavements	With subgrade prepared as noted in **Earthwork**. Recommended pavement thickness includes 4 inches of asphalt over 6 inches of aggregate base course in light-duty parking areas, and 6 inches of asphalt over 6 inches of aggregate base course in main drive lanes and loading areas. Thicker pavement sections may be needed for these sites if comparatively heavy traffic loads are anticipated.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Wells Fargo Bank to be located northeast of the intersection at West 10th Street and 69th Avenue in Greeley, Colorado. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Seismic site classification
- Site preparation and earthwork
- Foundation design and construction
- Floor system design and construction
- Lateral earth pressures
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown in the **Site Location and Exploration Plan** section of this report. The results of the laboratory testing performed on soil and bedrock samples obtained from the site during our field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	The project information described below is based on the following: ▪ WF Greeley Site Plan with Grading dated February 14, 2024 ▪ WF Greeley CO Proposed Site Plan dated February 14, 2024 ▪ Email correspondence with John Schlueter with SGDesign ▪ Compaction records from the H-P Greeley Subdivision, Eighth Replat project, provided by Terracon.
Project Description	We understand the project consists of the construction of a single-story Wells Fargo Bank. The footprint area of the new building is anticipated to be approximately 3,500 square feet. The proposed bank will have a drive-up ATM, a walk-up ATM, a walk-up night deposit, and a lobby ATM. Parking areas and drive lanes are planned around the building. No drive-thru canopy is anticipated.
Finished Floor Elevation	Plans were not provided at the time of this report. We anticipate the finished floor elevation for the proposed building will be near or slightly above site grades at the time of our geotechnical study.
Maximum Loads (assumed)	▪ Columns: 100 kips maximum ▪ Walls: 2 to 4 kips per linear foot (klf) maximum ▪ Slabs: 100 to 150 pounds per square foot (psf) maximum
Grading/Slopes	We understand the project site was recently mass graded and up to about 8 feet of fill was added to the site. Terracon performed the field density compaction testing for the new fill recently placed at this site.
Below-Grade Structures	We understand no below-grade areas are planned for this site.

Item	Description
Pavements	New pavements are planned as part of this project and will likely consist of flexible asphalt and rigid concrete pavement. Traffic loads were not available at the time of this proposal. We will assume traffic loads consistent with that of similar use. Unless information is provided prior to the report, we assume the traffic classification will consist of: ▪ Automobile Parking: Parking stalls for passenger vehicles and pickup trucks ▪ Main Traffic Corridors: Traffic consisting of passenger vehicles, single-unit delivery trucks and garbage trucks ▪ The pavement design period is 20 years.
Building Code	2021 International Building Code (IBC)

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The approximately 1-acre project site is located at the northeast corner of West 10th Street and 69th Avenue in Greeley, Colorado. Latitude/Longitude (approximate): 40.42179° N, 104.78934° W See **Site Location**
Existing Improvements	The project site is vacant. The site has been recently mass graded.
Current Ground Cover	Native grasses and weeds.
Existing Topography	Based on the WF Greeley Site Plan with Grading dated February 14, 2024, ground surface elevations at the project site slope from the west down towards the east with a total change in elevation of about 3 feet across the site.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Existing Fill**	Existing fill consisting of clayey sand, silty sand with varying amounts of gravel, and clayey gravel with sand; loose to very dense, light brown, brown, tan
2	**Sand**	Silty sand with varying amounts of gravel; loose to medium dense, light brown, brown, tan
3	**Clay**	Lean clay with varying amounts of gravel, cobbles and sand; stiff to very stiff, light brown, brown, red, gray, tan
4	**Weathered Bedrock**	Weathered claystone bedrock; firm, olive brown, dark gray, red-orange
5	**Bedrock**	Claystone bedrock; firm, olive brown, dark gray, red-orange

Groundwater Conditions

The boreholes were observed while drilling and shortly after completion of drilling for the presence and level of groundwater. Groundwater was not encountered during our field exploration.

Even though groundwater was not observed in the boreholes while drilling or for the short duration the borings could remain open, this does not necessarily mean the borings terminated are above groundwater. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials.

These observations represent short-term groundwater conditions at the time of and shortly after the field exploration and may not be indicative of other times or at other locations. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the scope of services for this project. However, we do not anticipate groundwater conditions will significantly impact the proposed construction.

Seismic Site Class

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil and bedrock properties observed at the site as described on the exploration logs and laboratory test results, our professional opinion is a **Seismic Site Classification of D** be considered for the project. Subsurface explorations at this site were extended to a maximum depth of about 29.9 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

Corrosivity

The table below lists the results of laboratory soluble sulfate, soluble chloride, sulfides, electrical resistivity, Redox, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils and bedrock with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary

Boring (Sample Depth)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	Sulfides (mg/kg)	Total Salts (mg/kg)	Electrical Resistivity (Ω-cm)[1]	Redox (mV)	pH
P-3 at 0.0 to 5.0 feet	14	5	Nil	575	2,100	+222	8.2

1. Laboratory electrical resistivity testing was performed on a saturated sample.

Results of water-soluble sulfate testing indicate Exposure Class S0 according to ACI 318. ASTM Type I or II portland cement or Type IL portland-limestone cement should be specified for all project concrete on and below grade. Foundation concrete should be designed for low sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

Numerous sources are available to characterize corrosion potential to buried metals using the parameters above. ANSI/AWWA is commonly used for ductile iron, while threshold values for evaluating the effect on steel can be specific to the buried feature (e.g., piling, culverts, welded wire reinforcement, etc.) or agency for which the work is performed. Imported fill materials may have significantly different properties than the site materials noted above and should be evaluated if expected to be in contact with metals used for construction. Consultation with a NACE certified corrosion professional is recommended for buried metals on the site.

Geotechnical Overview

Based on subsurface conditions encountered in the borings, the site appears suitable for the proposed construction from a geotechnical point of view provided certain precautions and design and construction recommendations described in this report are followed. We have identified several geotechnical conditions that could impact design, construction and performance of the proposed structure, pavements, and other site improvements. These included existing fill, expansive soils and bedrock, and potentially loose, low relative density soils. These conditions will require particular attention in project planning, design and during construction and are discussed in greater detail in the following sections.

Existing Fill

Existing fill was encountered to depths up to about 8 feet in the borings drilled at the site. Existing fill could exist at other locations on the site and extend to greater depths. Terracon performed the soil compaction testing at this site during fill placement. However, the fill material on the ground surface at the site has been exposed to weathering and should be reworked. We recommend over-excavating 1 foot of the existing fill below floor slabs and replacement with newly compacted engineered fill. All other areas should be scarified to a depth of at least 10 inches, moisture conditioned, and properly compacted prior to fill placement or construction.

Expansive Soils and Bedrock

Expansive soils and bedrock are present on this site; however, swell test results suggest the site soils are low swelling. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the structure, pavements, and flatwork is possible. The severity of cracking and other damage such as uneven floor slabs and flatwork will probably increase if modification of the site results in excessive wetting or drying of the expansive clays and/or claystone bedrock. Eliminating the risk of movement and cosmetic distress is generally not feasible. It is imperative the recommendations described in section **Grading and Drainage** section of the **Earthwork** section of this report be followed to reduce potential movement.

Low Relative Density Soils

Comparatively loose, low density sand soils were encountered at various depths throughout all of the borings completed at this site. These materials present a risk for potential settlement of shallow foundations, floor slabs, pavements and other surficial improvements. These materials can also be susceptible to disturbance and loss of strength under repeated construction traffic loads and unstable conditions could develop. Stabilization of loose or soft soils may be required at some locations to provide adequate support for construction equipment and proposed structures. Terracon should be contacted if these conditions are encountered to observe the conditions exposed and to provide guidance regarding stabilization (if needed).

Foundation and Floor System Recommendations

We believe the proposed building and ancillary structures can be constructed on a shallow, spread footing foundation system constructed on soils exposed in foundation excavations. On-site soils are suitable for use as engineered fill below foundations. Design recommendations for foundations for the proposed structure and related structural elements are presented in the **Shallow Foundations** section of this report.

We believe a concrete slab-on-grade floor system can be used for the proposed building provided the soils are over-excavated to a depth of at least 1 foot below the bottom of proposed floor slab and replaced with moisture conditioned, properly compacted engineered fill. On-site soils are suitable for use as engineered fill below floor slabs. Soils exposed at the base of the recommended over-excavation below floor slabs should be scarified to a depth of at least 10 inches, moisture conditioned, and properly compacted prior to placement of the over-excavation backfill.

Design recommendations for a slab-on-grade floor system for the proposed structure are presented in the **Floor Slabs** section of this report. If the owner cannot accept the risk of floor slab movement associated with a slab-on-grade floor system, the use of a structural floor system can be considered. Terracon can be contacted to provide additional recommendations if a structural floor system is desired for the building.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include site preparation, excavations, subgrade preparation, soil stabilization (if needed), and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the project. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Prior to placing fill, existing vegetation, topsoil, and root mats should be removed. Complete stripping of the topsoil should be performed in the proposed building and parking/driveway areas. Stripped organic materials should be wasted from the site or used to re-vegetate landscaped areas or exposed slopes after completion of grading operations. Prior to the placement of fills, the site should be graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath proposed structures.

Where fill is placed on existing slopes steeper than 5H:1V, benches should be cut into the existing slopes prior to fill placement. The benches should have a minimum vertical face height of 1 foot and a maximum vertical face height of 3 feet and should be cut wide enough to accommodate the compaction equipment. This benching will help provide a positive bond between the fill and natural soils and reduce the possibility of failure along the fill/natural soil interface.

Although no evidence of underground facilities (such as septic tanks, cesspools and basements) was observed during the exploration and site reconnaissance, such features could be encountered during construction. If unexpected underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Existing Fill

As noted in **Geotechnical Characterization**, all of the borings encountered existing fill to depths of about 8 feet below the ground surface at the time of our field subsurface exploration. Existing fill could exist at other locations on the site and extend to greater depths. It is difficult to decipher the transition from native material from the compacted fill material above it, so the fill depths shown on our boring logs should be considered approximate. The fill was observed and tested by Terracon during placement prior to this geotechnical investigation. Our review of compaction test results indicate the existing fill was placed in general accordance with project specifications.

Excavation

We anticipate excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Excavations into the on-site soils will encounter weak/loose soil conditions with possible caving conditions. The bottom of excavations should be thoroughly cleaned of loose/disturbed materials prior to backfill placement and/or construction.

Any over-excavation that extends below the bottom of foundation elevation should extend laterally beyond all edges of the foundations at least 8 inches per foot of over-excavation depth below the foundation base elevation. The over-excavation should be backfilled to the foundation base elevation in accordance with the recommendations presented in this report.

Depending upon depth of excavation and seasonal conditions, surface water infiltration and/or groundwater may be encountered in excavations on the site. We anticipate pumping from sumps may be utilized to control water within excavations. Well points may be required for significant groundwater flow, or where excavations penetrate groundwater to a significant depth.

The subgrade soil conditions should be evaluated during the excavation process and the stability of the soils determined at that time by the contractors' Competent Person as defined by OSHA. Slope inclinations flatter than the OSHA maximum values may have to be used. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

As a safety measure, we recommend all vehicles and soil piles be kept a minimum lateral distance from the crest of the slope equal to the slope height. The exposed slope face should be protected against the elements.

Subgrade Preparation

After site preparation, and completion of the recommended over-excavation below floor slabs, the top 10 inches of the exposed ground surface should be scarified, moisture conditioned, and compacted to at least 95 percent of the maximum dry unit weight as determined by ASTM D698 before any construction.

For floor slabs, the top 10 inches of the exposed ground surface below the recommended over-excavation should be scarified, moisture conditioned, and compacted to at least 95 percent of the maximum dry unit weight as determined by ASTM D698.

For pavements, the top 12 inches of the exposed ground surface should be scarified, moisture conditioned, and compacted to at least 95 percent of the maximum dry unit weight as determined by ASTM D698.

Large areas of prepared subgrade should be proof rolled prior to new construction. Proof rolling is not required in areas which are inaccessible to proof rolling equipment. Subgrades should be proof rolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. Proof rolling should be performed under the observation of the Geotechnical Engineer or representative. Areas excessively deflecting under the proof roll should be delineated and subsequently addressed by the Geotechnical Engineer. Excessively wet or dry material should either be removed or moisture conditioned and compacted.

After the bottom of the excavation has been prepared as recommended above, engineered fill can be placed to bring the building pad and pavement subgrade to the desired grade. Engineered fill should be placed in accordance with the recommendations presented in subsequent sections of this report.

Subgrade Stabilization

Methods of subgrade stabilization/improvement, as described below, could include scarification, moisture conditioning and compaction, removal of unstable materials and replacement with granular fill (with or without geosynthetics), and chemical treatment. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

If the exposed subgrade is unstable during proof rolling operations, it could be stabilized using one of the methods described below.

- **Scarification and Compaction** - It may be feasible to scarify, dry, and compact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about

1 foot, if the unstable soil is at or near groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.

- **Crushed Stone** - The use of crushed stone or crushed concrete is a common procedure to improve subgrade stability. Typical undercut depths would be expected to range from about 6 to 24 inches below finished subgrade elevation. Crushed stone and/or concrete can be tracked or "crowded" into the unstable subgrade until a stable working surface is attained. The use of high modulus geosynthetics (i.e., geotextile or geogrid) could also be considered after underground work such as utility construction is completed. Prior to placing the geosynthetic, we recommend all below-grade construction, such as utility line installation, be completed to avoid damaging the geosynthetic. Equipment should not be operated above the geosynthetic until one full lift of crushed stone fill is placed above it.
- **Chemical Treatment** - Improvement of subgrades with portland cement, lime or fly ash could be considered for improving unstable soils. Chemical treatment should be performed by a pre-qualified contractor having experience with successfully treating subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the chemical treatment materials should be provided to the Geotechnical Engineer for review prior to use. The hazards of chemicals blowing across the site or onto adjacent properties should also be considered. Additional testing would be needed to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. Additional testing could include, but not be limited to, determining the most suitable chemical treating agent, the optimum amounts required, the presence of sulfates in the soil, and freeze-thaw durability of the subgrade.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed.

Fill Material Types

Fill for this project should consist of engineered fill. Engineered fill is fill that meets the criteria presented in this report and has been properly documented. On-site soils free of deleterious materials or approved granular and low plasticity cohesive imported materials may be used as fill material. Bedrock excavated during site development and construction can be reused as fill provided the material is broken down and thoroughly processed to a "soil-like" consistency, with no particles greater than 2 inches in size. The earthwork contractor should expect significant mechanical processing and moisture conditioning of the site soils and/or bedrock will be needed to achieve proper compaction.

Imported fill materials (if required) should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

Gradation	Percent Finer by Weight (ASTM C136)
3”	100
1”	70-100
No. 4 Sieve	30-100
No. 200 Sieve	15-50

Soil Properties	Values
Liquid Limit	35 (max.)
Plasticity Index	15 (max.)

Aggregate base course used below new pavements should meet CDOT requirements for Class 5 or 6 aggregate base course materials.

Other import fill material types may be suitable for use on the site depending upon proposed application and location on the site and could be tested and approved for use on a case-by-case basis.

Fill Placement and Compaction Requirements

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

Item	Description
Maximum Lift Thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e., jumping jack or plate compactor) is used
Minimum Compaction Requirements [1]	Engineered Fill: At least 95% of the maximum dry unit weight as determined by ASTM D698. Aggregate Base Course: At least 95% of maximum dry unit weight as determined by ASTM D1557 (or AASHTO T180) in pavement areas.

Item	Description
Water Content Range [2,3]	Cohesive (clay): -1% to +3% of optimum moisture content Granular (sand): -3% to +3% of optimum moisture content

1. We recommend engineered fill be tested for moisture content and compaction during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Moisture conditioned clay materials should not be allowed to dry out. A loss of moisture within these materials could result in an increase in the material's expansive potential. Subsequent wetting of these materials could result in undesirable movement.
3. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the fill material pumping when proof rolled.

Utility Trench Backfill

Any loose, soft, or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with engineered fill or bedding material in accordance with public works specifications for the utility to be supported. This recommendation is particularly applicable to utility work where settlement control of the utility is critical. Utility trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site materials are considered suitable for backfill of utility and pipe trenches provided the material is free of organic matter and deleterious substances.

Utility trench backfill should be placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Flooding or jetting for placement and compaction of backfill is not recommended. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill in non-pavement areas to reduce the infiltration and conveyance of surface water through the trench backfill.

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the trench plug material should be placed and compacted to comply with the water content and compaction recommendations for engineered fill stated previously in this report.

All underground piping within or near the proposed structure should be designed with flexible couplings, so minor deviations in alignment do not result in breakage or distress. Utility knockouts in foundation walls should be oversized to accommodate differential movements.

We recommend a representative of the Geotechnical Engineer provide full-time observation and compaction testing of trench backfill within building and pavement areas.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the buildings.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program.

Flatwork and pavements will be subject to post-construction movement. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the structure, care should be taken that joints are properly sealed and maintained to prevent the infiltration of surface water.

Planters located adjacent to structure should preferably be self-contained. Sprinkler mains and spray heads should be located a minimum of 5 feet away from the building line(s). Low-volume, drip style landscaped irrigation should be used sparingly near the building.

Exterior Slab Design and Construction

Exterior slabs-on-grade, exterior architectural features, and utilities founded on, or in backfill or the site soils will likely experience some movement due to the volume change of the material. Subgrade soils below new fill should be scarified to a depth of at least

10 inches, moisture conditioned, and compacted prior to placement/construction of new engineered fill, aggregate base course, or pavement/flatwork materials. Potential movement could be reduced by:

- Minimizing moisture increases in subgrade soils and new fill;
- Controlling moisture-density during subgrade preparation and new fill placement;
- Using designs which allow vertical movement between the exterior features and adjoining structural elements; and
- Placing control joints on relatively close centers.

Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation and topsoil), evaluation and remediation of existing fill materials, subgrade stabilization, as well as proof rolling and mitigation of unsuitable areas delineated by the proof roll. Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts.

In areas of foundation excavations, the bearing subgrade and exposed conditions at the base of the recommended over-excavation should be evaluated by the Geotechnical Engineer. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Spread Footings – Design Recommendations

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	2,250 psf
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Lateral Earth Pressure Coefficients [3]	On-site soil: Active, K_a = 0.27 Passive, K_p = 0.43 At-rest, K_o = 3.69
Sliding Resistance [4]	On-site soil: μ = 0.56
Moist Soil Unit Weight	On-site soil: γ = 115 pcf
Minimum Embedment Below Finished Grade [5]	Exterior footings in unheated areas: 30 inches Interior footings and column pads in heated areas: 12 inches
Estimated Total Movement [6]	About 1 inch or less
Estimated Differential Movement [6]	About ½ to ¾ of total movement

Item	Description

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume exterior grades are no steeper than 20% within 10 feet of structure. The design bearing pressure applies to a dead load plus design live load condition. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions.
2. Unsuitable or loose soils should be over-excavated and replaced with engineered fill per the recommendations presented in **Earthwork**.
3. Use of lateral earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or the footing forms be removed and compacted engineered fill be placed against the vertical footing face. Assumes no hydrostatic pressure. The lateral earth pressure coefficients are ultimate values and do not include a factor of safety. The foundation designer should include the appropriate factors of safety.
4. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.
5. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
6. The estimated movements presented above assume the maximum footing dimension is 7 feet for column footings and maximum footing width is 2.5 feet for continuous footings. Larger foundation footprints will likely require reduced net allowable soil bearing pressures to reduce risk for potential settlement.

Footings should be proportioned to reduce differential foundation movement. As discussed, total movement resulting from the assumed structural loads is estimated to be on the order of about 1 inch. Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction and throughout the life of the structure. Failure to maintain the proper drainage as recommended in the **Grading and Drainage** section of the **Earthwork** section of this report will nullify the movement estimates provided above.

Any over-excavation that extends below the bottom of foundation elevation should extend laterally beyond all edges of the foundations at least 8 inches per foot of over-excavation depth below the foundation base elevation. The over-excavation should be backfilled to the foundation base elevation in accordance with the recommendations presented in this report.

Shallow Foundation Construction Considerations

As noted in **Earthwork**, foundation excavations should be evaluated under the observation of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of foundation excavations should be removed/reconditioned before foundation concrete is placed.

In addition, large cobbles or boulder-sized materials may be encountered beneath foundation areas. Such conditions could create point loads on the bottom of foundations, increasing the potential for differential foundation movement. If such conditions are encountered in the foundation excavations, the cobbles and/or boulders should be removed to a minimum depth of 6 inches and be replaced with engineered fill prepared as recommended in **Earthwork**.

To reduce the potential of "pumping" and softening of the foundation soils at the foundation bearing level and the requirement for corrective work, we suggest the foundation excavation for the building be completed remotely with a track-hoe operating outside of the excavation limits.

Foundation elements should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement.

Unstable subgrade conditions encountered in foundation excavations should be observed by Terracon to assess the subgrade and provide suitable alternatives for stabilization. Typical methods of stabilization/improvement are presented in the **Subgrade Stabilization** section of **Earthwork**.

Deep Foundations

Drilled Shaft Design Parameters

While shallow foundations are most appropriate for the proposed building, drilled piers are a viable option for canopies, entrance signs or other ancillary structures. Soil design parameters are provided below in the **Drilled Shaft Design Summary** table for the design of drilled shaft foundations. The values presented for allowable side friction and end bearing include a factor of safety.

Drilled Shaft Design Summary [1]

Depth (feet)	Stratigraphy [2]	Allowable Skin Friction (psf) [3]	Allowable End Bearing Pressure (psf) [4]
	Material		
0 to 3	Existing Fill	Ignore	Ignore

Drilled Shaft Design Summary [1]

Depth (feet)	Stratigraphy [2] Material	Allowable Skin Friction (psf) [3]	Allowable End Bearing Pressure (psf) [4]
3 to 8	Existing Fill	400	2,250
8 to 24	Silty Sand	400	4,000
24 to 29	Weathered Claystone Bedrock	500	5,000
29 to 30	Claystone Bedrock	1,000	12,000

1. Design capacities are dependent upon the method of installation and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
2. See Subsurface Profile in **Geotechnical Characterization** for more details on stratigraphy.
3. Applicable for compressive loading only. Reduce to 2/3 of values shown for uplift loading. The effective weight of the shaft can be added to uplift load resistance to the extent permitted by IBC.
4. Shafts should extend at least one diameter into the bearing stratum for end bearing to be considered.

Shafts should be adequately reinforced as designed by the Structural Engineer for both tension and shear to sufficient depths. Buoyant unit weights of the soil and concrete should be used in the calculations below the highest anticipated groundwater elevation.

Drilled shaft should have a minimum (center-to-center) spacing of three diameters. Closer spacing may require a reduction in axial load capacity. Axial capacity reduction can be determined by comparing the allowable axial capacity determined from the sum of individual piles in a group versus the capacity calculated using the perimeter and base of the pile group acting as a unit. The lesser of the two capacities should be used in design.

A minimum shaft diameter of 18 inches should be used. Drilled shafts should have a minimum length of 8 feet and should extend into the bearing strata at least one shaft/pile/bell diameter for the allowable end-bearing pressures listed in the above table.

Post-construction settlements of drilled shafts designed and constructed as described in this report are estimated to range from about ½ to ¾ inch. Differential settlement between individual shafts is expected to be ½ to ⅔ of the total settlement.

Drilled Shaft Lateral Loading

The following table lists input values for use in LPILE analyses. Modern versions of LPILE provide estimated default values of k_h and E_{50} based on strength and are recommended for the project. Since deflection or a service limit criterion will most likely control lateral capacity design, no safety/resistance factor is included with the parameters.

Stratigraphy[1]		LPILE Soil Model	S_u (psf)[2]	ϕ (deg)[2]	γ' (pcf)[2]	ε_{50}	K (pci)	
Depth (feet)	Soil Layer						Static	Cyclic
0 to 8	Existing Fill	Sand (Reese)	---	35°	115	Use Default Value		
8 to 24	Silty Sand	Sand (Reese)	---	35°	110	Use Default Value		
24 to 29	Weathered Claystone Bedrock	Stiff Clay w/o Free Water	4,000	---	120	Use Default Value		
29 to 30	Claystone Bedrock	Stiff Clay w/o Free Water	8,000	---	125	Use Default Value		

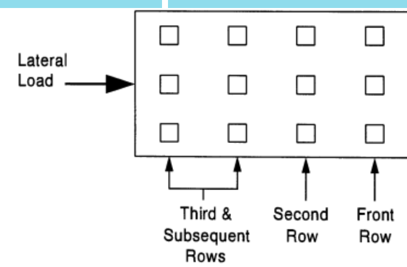
1. See Subsurface Profile in **Geotechnical Characterization** for more details on Stratigraphy.
2. Definition of Terms:
   S_u: Undrained shear strength
   ϕ: Internal friction angle
   γ': Effective unit weight

When shafts are used in groups, the lateral capacities of the shafts in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent shaft. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of pier foundations within a pile group are as follows:

Center to Center Pier Spacing [1,2]	P-Multiplier, P_m [3]		
	Front Row	Second Row	Third and Subsequent Rows
3B	0.8	0.4	0.3
4B	0.9	0.65	0.5
5B	1.0	0.85	0.7
6B	1.0	1.0	1.0

Center to Center Pier Spacing [1,2]	P-Multiplier, P_m [3]		
	Front Row	Second Row	Third and Subsequent Rows

1. Spacing in the direction of loading. B = pier diameter
2. For the case of a single row of piers supporting a laterally loaded grade beam, group action for lateral resistance of piers would need be considered when spacing is less than three pier diameters (measured center-to-center).
3. See adjacent figure for definition of front, second and third rows.



Spacing closer than 3D (where D is the diameter of the shaft) is not recommended without additional geotechnical consultation due to potential for the installation of a new shaft disturbing an adjacent installed shaft likely resulting in axial capacity reduction.

The load capacities provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the shafts should be checked to assure they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of shafts should be evaluated using an appropriate analysis method, and will depend upon the pier diameter, length, configuration, stiffness and “fixed head” or “free head” condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of shafts may be improved by increasing the diameter and possibly the length.

Drilled Shaft Construction Considerations

The drilling contractor should be experienced in the subsurface conditions observed at the site, and the excavations should be performed with equipment capable of providing a clean bearing surface. The drilled straight-shaft foundation system should be installed in general accordance with the procedures presented in "Standard Specification for the Construction of Drilled Piers", ACI Publication No. 336.1-01.

Due to soils likely caving and the deep bedrock, a full-depth temporary steel casing may be required to shore the sides of the pier excavations in the overburden. If casing is removed during concrete placement, care should be exercised to maintain concrete inside the casing at a sufficient level to resist earth and hydrostatic pressures present on a casing exterior. Water or loose/disturbed materials should be removed from the bottom of the drilled pier excavations prior to placement of concrete.

The drilling contractor should remove all soft and disturbed soils from the base of the drilled pier prior to placing concrete. The drilled shaft installation process should be performed under the observation of the Geotechnical Engineer. The Geotechnical Engineer should document the shaft installation process including soil/rock and groundwater conditions observed, consistency with expected conditions, and details of the installed shaft.

Care should be taken to not disturb the sides and bottom of the excavation during construction. The bottom of the shaft excavation should be free of loose material before concrete placement. Concrete should be placed as soon as possible after the foundation excavation is completed, to reduce potential disturbance of the bearing surface.

While withdrawing casing, care should be exercised to maintain concrete inside the casing at a sufficient level to resist earth and hydrostatic pressures acting on the casing exterior. Arching of the concrete, loss of seal and other problems can occur during casing removal and result in contamination of the drilled shaft. These conditions should be considered during the design and construction phases. Placement of loose soil backfill should not be permitted around the casing prior to removal.

The drilled shaft installation process should be performed under the observation of the Geotechnical Engineer. The Geotechnical Engineer should document the shaft installation process including soil/rock and groundwater conditions observed, consistency with expected conditions, and details of the installed shaft.

Floor Slabs

A slab-on-grade **Floor Slab** can be used for the proposed building provided the soils are over-excavated to a depth of at least 1 foot below the bottom of the proposed floor slab and replaced with moisture conditioned, properly compacted engineered fill. On-site soils are suitable as engineered fill below floor slabs. Soils exposed at the base of the recommended over-excavation below floor slabs should be scarified to a depth of at least 10 inches, moisture conditioned, and properly compacted prior to placement of the over-excavation backfill.

If the estimated movement cannot be tolerated, a structurally-supported floor system, supported independent of the subgrade materials, is recommended.

Subgrade soils beneath interior and exterior slabs and at the base of the over-excavation for removal of existing fill should be scarified to a depth of at least 10 inches, moisture conditioned, and compacted. The moisture content and compaction of subgrade soils should be maintained until slab construction.

Floor Slabs – Design Recommendations

Even when bearing on properly prepared soils, movement of the slab-on-grade floor system is possible should the subgrade soils undergo an increase in moisture content. We estimate movement of about 1 inch is possible. If the owner cannot accept the risk of slab movement, a structural floor should be used. If conventional slab-on-grade is utilized, the subgrade soils should be over-excavated and prepared as recommended above and in the **Earthwork** section of this report.

For structural design of concrete slabs-on-grade subjected to point loadings, a modulus of subgrade reaction of 225 pounds per cubic inch (pci) may be used for floors.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Additional floor slab design and construction recommendations are as follows:

- Positive separations and/or isolation joints should be provided between slabs and all foundations, columns, or utility lines to allow independent movement.
- Control joints should be saw-cut in slabs in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended) to control the location and extent of cracking.
- Interior utility trench backfill placed beneath slabs should be compacted in accordance with the recommendations presented in the Earthwork section of this report.
- Floor slabs should not be constructed on frozen subgrade.
- Other design and construction considerations, as outlined in the ACI Design Manual, Section 302.1R are recommended.

Floor Slab Construction Considerations

Movements of slabs-on-grade using the recommendations discussed in previous sections of this report will likely be reduced and tend to be more uniform. The estimates discussed above assume that the other recommendations in this report are followed. Additional movement could occur should the subsurface soils become wetted to significant depths, which could result in potential excessive movement causing uneven floor slabs and severe cracking. This could be due to over watering of landscaping, poor drainage, improperly functioning drain systems, and/or broken utility lines. Therefore, it is imperative that the recommendations presented in this report be followed.

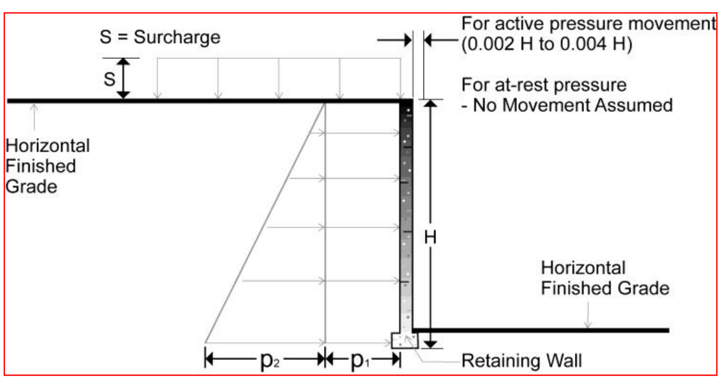
Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and engineered fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Lateral Earth Pressures

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3] p_1 (psf)	Equivalent Fluid Pressures (psf) [2,4]	
			Unsaturated	Submerged
Active (Ka)	0.27	(0.27)S	(30)H	(75)H
At-Rest (Ko)	0.43	(0.43)S	(50)H	(85)H
Passive (Kp)	3.69	---	---	---

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance. Fat clay or other expansive soils should not be used as backfill behind the wall.
2. Uniform, horizontal backfill, with a maximum unit weight of 115 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. To achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 degrees from vertical for the active case.

Footings, floor slabs or other loads bearing on backfill behind walls may have a significant influence on the lateral earth pressure. Placing footings within wall backfill and in the zone of active soil influence on the wall should be avoided unless structural analyses indicate the wall can safely withstand the increased pressure.

The lateral earth pressure recommendations given in this section are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls (also termed MSE walls). Recommendations covering these types of wall systems are beyond the scope of services for this assignment. However, we would be pleased to develop a proposal for evaluation and design of such wall systems upon request.

Pavements

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavements – Subgrade Preparation

On most project sites, the site grading is accomplished relatively early in the construction phase. Fills are typically placed and compacted in a uniform manner. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, or rainfall/snow melt. As a result, the pavement subgrade may not be suitable for pavement construction and corrective action will be required. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance or instability. We recommend the pavement subgrade be thoroughly proof rolled with a loaded tandem-axle dump truck prior to final grading and paving. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving.

Prior to pavement construction, the top 12 inches of the exposed ground surface should be scarified, moisture conditioned, and compacted as described in this report before any new fill is placed or constructed. After the subgrade has been scarified and compacted and before placement of new fill and pavement, we recommend the subgrade be proof rolled as described above.

Pavements – Design Recommendations

Design of new privately-maintained pavements for the project has been based on the procedures described by the National Asphalt Pavement Associations (NAPA) and the American Concrete Institute (ACI).

We assumed the following design parameters for NAPA flexible pavement thickness design:

- Automobile Parking Areas
    - Class I - Parking stalls and parking lots for cars and pick-up trucks, with Equivalent Single Axle Load (ESAL) up to 7,000 over 20 years
- Main Traffic Corridors

- Class II – Parking lots with a maximum of 10 trucks per day with Equivalent Single Axle Load (ESAL) up to 27,000 over 20 years (including trash trucks)
- Subgrade Soil Characteristics
  - USCS Classification – SC, classified by NAPA as medium

We assumed the following design parameters for ACI rigid pavement thickness design based upon the average daily truck traffic (ADTT):

- Automobile Parking Areas
  - ACI Category A: Automobile parking with an ADTT of 1 over 20 years
- Main Traffic Corridors
  - ACI Category A: Automobile parking area and service lanes with an ADTT of up to 10 over 20 years
- Subgrade Soil Characteristics
  - USCS Classification – SC
- Concrete modulus of rupture value of 600 psi

We should be contacted to confirm and/or modify the recommendations contained herein if actual traffic volumes differ from the assumed values shown above.

Recommended alternatives for flexible and rigid pavements are summarized for each traffic areas as shown in the following table.

Traffic Area	Alternative	Recommended Pavement Thicknesses (Inches)			
		Asphaltic Concrete Surface	Portland Cement Concrete	Aggregate Base Course	Total
Automobile Parking (NAPA Class I and ACI Category A)	A	4	--	6	10
	B	--	5	4 [1]	9
Main Traffic Corridors (NAPA Class II and ACI Category A)	A	6	--	6	12
	B	--	6	4 [1]	10

1. Although not required for structural support, a minimum 4-inch thick aggregate base course layer is suggested for the portland cement concrete (PCC) pavements to help reduce the potential for slab curl, shrinkage cracking, and subgrade "pumping" through joints.

Aggregate base course should consist of a blend of sand and gravel which meets strict specifications for quality and gradation. Use of materials meeting Colorado Department of Transportation (CDOT) Class 5 or 6 specifications is recommended for aggregate base course. Aggregate base course should be placed in lifts not exceeding 6 inches and compacted to a minimum of 95 percent of the maximum dry unit weight as determined by ASTM D1557 (or AASHTO T180).

Asphaltic concrete should be composed of a mixture of aggregate, filler and additives (if required) and approved bituminous material. The asphalt concrete should conform to approved mix designs stating the Superpave properties, optimum asphalt content, job mix formula and recommended mixing and placing temperatures. Aggregate used in asphalt concrete should meet particular gradations. Material meeting CDOT Grading S or SX specifications or equivalent is recommended for asphalt concrete. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in maximum 3-inch lifts and compacted within a range of 92 to 96 percent of the theoretical maximum (Rice) density (ASTM D2041).

Where rigid pavements are used, the concrete should be produced from an approved mix design with the following minimum properties:

Properties	Value
Compressive strength	4,500 psi
Cement type	Type I or II portland cement, or Type IL portland-limestone cement
Entrained air content (%)	5 to 8
Concrete aggregate	ASTM C33 and CDOT section 703

Concrete should be deposited by truck mixers or agitators and placed a maximum of 90 minutes from the time the water is added to the mix. Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation per ACI 330 and ACI 325. The location and extent of joints should be based upon the final pavement geometry.

Proper joint spacing will also be required for PCC pavements to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

For areas subject to concentrated and repetitive loading conditions (if any) such as dumpster pads, truck delivery docks and ingress/egress aprons, we recommend using a portland cement concrete pavement with a thickness of at least 7 inches underlain by at least 4 inches of granular base. Prior to placement of the granular base, the subgrade soils should be prepared as previously discussed. For dumpster pads, the concrete pavement area should be large enough to support the container and tipping axle of the refuse truck.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Site grades should slope a minimum of 2 percent away from the pavements;
- The subgrade and the pavement surface have a minimum 2 percent slope to promote proper surface drainage;
- Consider appropriate edge drainage and pavement under drain systems;
- Install pavement drainage surrounding areas anticipated for frequent wetting;
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils; and
- Placing compacted, low permeability backfill against the exterior side of curb and gutter.

Pavements – Construction Considerations

Openings in pavement, such as landscape islands, are sources for water infiltration into surrounding pavements. Water collects in the islands and migrates into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavements – Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

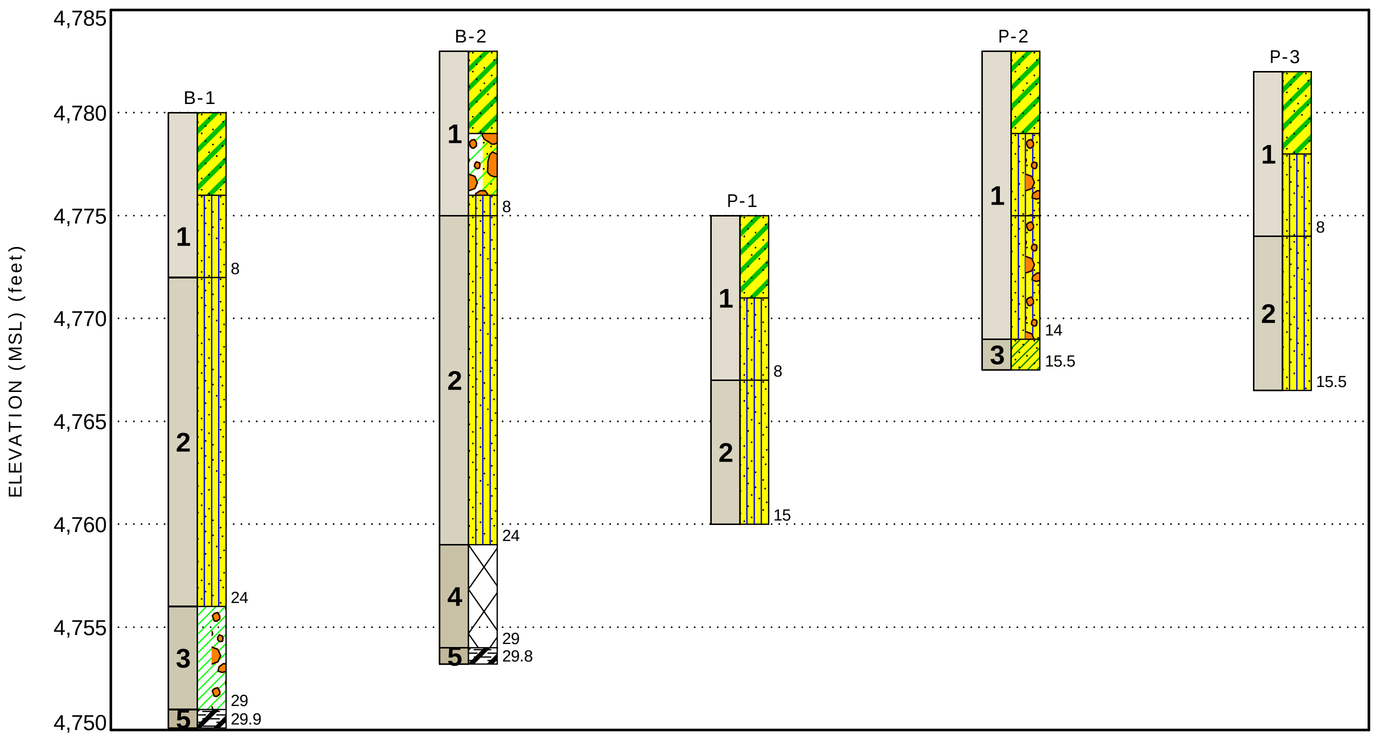
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Figures

Contents:

1510 44th St Unit 1
Evans, CO

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Fill	Existing fill consisting of clayey sand, silty sand with varying amounts of gravel, and clayey gravel with sand; loose to very dense, light brown, brown, tan
2	Sand	Silty sand with varying amounts of gravel; loose to medium dense, light brown, brown, tan
3	Clay	Lean clay with varying amounts of gravel, cobbles and sand; stiff to very stiff, light brown, brown, red, gray, tan
4	Weathered Bedrock	Weathered claystone bedrock; firm, olive brown, dark gray, red-orange
5	Bedrock	Claystone bedrock; very hard, olive brown, dark gray, red-orange

Legend

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
2 (Boring Nos. B-1 and B-2)	29.8 to 29.9	In the planned building area
3 (Boring Nos. P-1 through P-3)	15 to 15.5	In planned pavement areas

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±15 feet) and referencing existing site features. Approximate ground surface elevations were estimated using a publicly available USGS topographic map. If surface elevations and a more precise boring layout are desired, we recommend the borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted, drill rig using continuous-flight, solid-stem augers. Sampling was performed using standard split-barrel and modified California barrel sampling procedures. Bulk samples of auger cuttings from the upper approximately 5 feet of each borehole were also collected for laboratory testing. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. In the modified California barrel sampling procedure, a 2½-inch outer diameter split-barrel sampling spoon is used for sampling. Modified California barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. Modified California barrel sampler blow counts are not considered N-values. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer.

We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. Groundwater was not observed at these times in the boreholes.

Our exploration team prepared field boring logs as part of the drilling operations. The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the subsurface conditions at the boring locations based on field data, observation of samples, and laboratory test results.

We backfilled the borings with auger cuttings after completion of drilling. Our services did not include repair of the site beyond backfilling the boreholes. Excess auger cuttings were dispersed in the general vicinity of the boreholes. Because backfill material often settles below the surface after a period, we recommend checking boreholes periodically and backfilling, if necessary.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry Unit Weight
- Unconfined Compressive Strength
- Atterberg Limits
- Grain-size Analysis
- One-dimensional Swell
- Corrosive Properties

The laboratory testing program often included examination of soil samples by an engineer and/or geologist. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System. A brief description of this classification system as well as the General Notes can be found in the **Supporting Information** section.

Laboratory test results are indicated on the boring logs and are presented in depth in the **Exploration Results** section. Laboratory tests are performed in general accordance with applicable local standards or other acceptable standards. In some cases, variations to methods are applied as a result of local practice or professional judgement.

Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

Site Location and Exploration Plans

Contents:

Note: All attachments are one page unless noted above.

Site Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

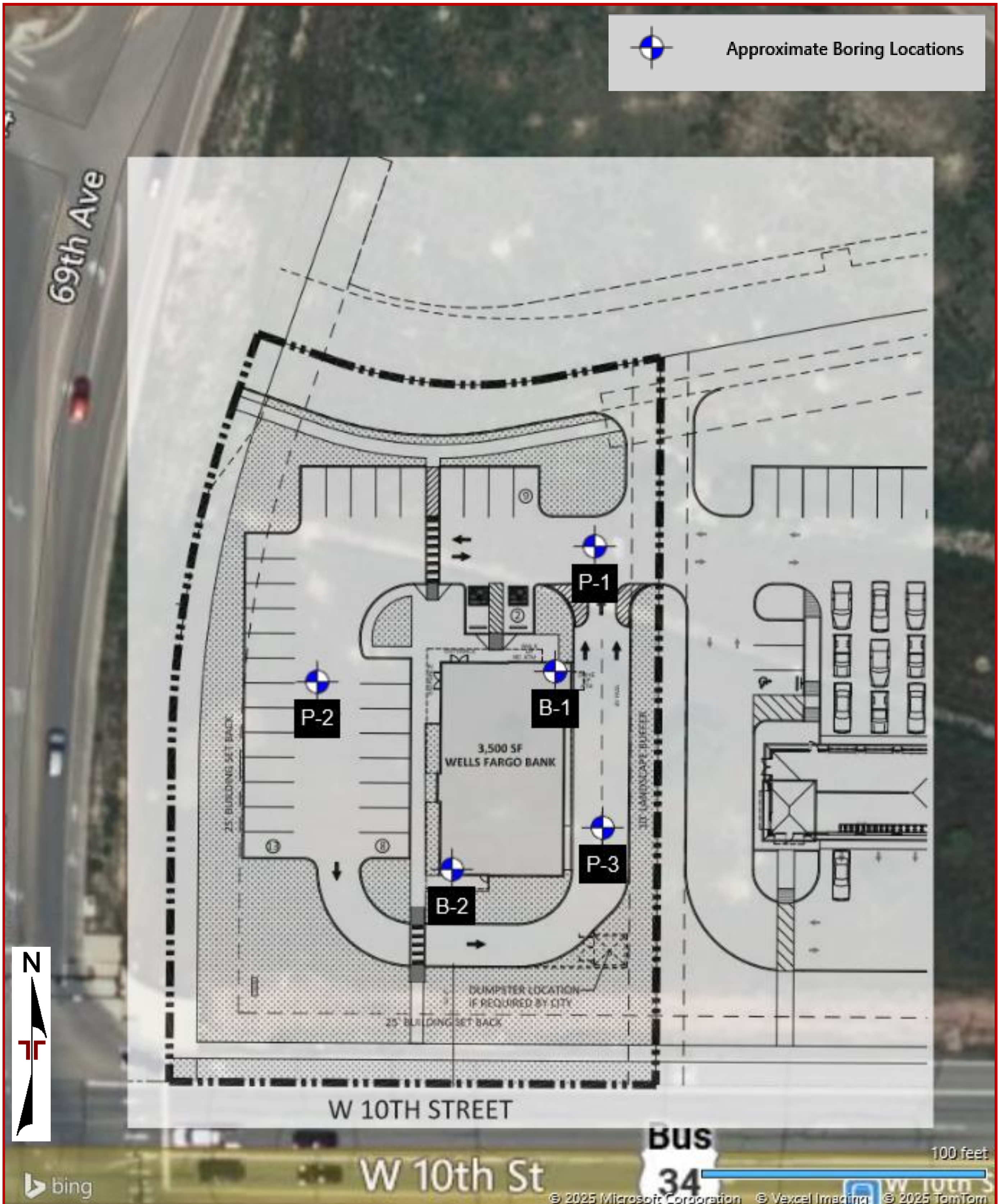


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

Terracon
1510 44th St Unit 1
Evans, CO

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 40.4219° Longitude: -104.7893°

Depth (Ft.) Elevation: 4780 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)
1	0.0 – 4.0	**FILL - CLAYEY SAND (SC)**, brown, medium dense	4776
1	4.0 – 8.0	**FILL - SILTY SAND**, light brown to brown, loose to medium dense	4772
2	8.0 – 24.0	**SILTY SAND**, light brown to brown, medium dense; with gravel at about 19 feet	4756
3	24.0 – 29.0	**LEAN CLAY WITH GRAVEL**, with cobbles, brown with red and gray, very stiff	4751
5	29.0 – 29.9	**CLAYSTONE BEDROCK**, olive brown with gray, very hard, with clay lenses	4750.1

Boring Terminated at 29.9 Feet

Approx. Depth (Ft.)	Sample Type	Field Test Results	Swell-Consol/ Load (%/psf)	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2–3	Ring sample	9-10 19/12"	+0.1/200		10.5	114	26-18-8	37.6
4–5.5	Split spoon	6-9-15 N=24			8.1			
7–8	Ring sample	7-9 16/12"			4.5	95		
9–10.5	Split spoon	5-6-7 N=13			5.3			
14–15	Ring sample	9-15 24/12"			6.0	102		
19–20.5	Split spoon	7-10-13 N=23			7.4			
24–25	Ring sample	9-16 25/12"			9.6	112		
29–29.9	Split spoon	22-50/5"			20.9			

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from a publicly available USGS map

Notes

Water Level Observations
No free water observed

Advancement Method
4-inch diameter, continuous-flight, solid-stem augers

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic; Hammer Efficiency = 68%

Driller
Terracon Fort Collins

Logged by
P.Agudelo

Boring Started
01-09-2025

Boring Completed
01-09-2025

Wells Fargo Bank - Greeley
West 10th Street and 69th Avenue | Greeley, CO
Terracon Project No. 21245060

Terracon
1510 44th St Unit 1
Evans, CO

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 40.4217° Longitude: -104.7894°

Elevation: 4783 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)
1	0.0 – 4.0	**FILL - CLAYEY SAND**, brown, dense	4779
1	4.0 – 7.0	**FILL - CLAYEY GRAVEL WITH SAND (GC)**, light brown to brown, medium dense	4776
1	7.0 – 8.0	**FILL - SILTY SAND**, light brown to brown, loose	4775
2	8.0 – 24.0	**SILTY SAND**, light brown to brown, loose	4759
4	24.0 – 29.0	**WEATHERED CLAYSTONE BEDROCK**, olive brown with dark gray and red-orange, firm	4754
5	29.0 – 29.8	**CLAYSTONE BEDROCK (CL)**, olive brown with dark gray and red-orange, very hard, with clay lenses	4753.2

Boring Terminated at 29.8 Feet

Approx. Depth (Ft.)	Field Test Results	Swell-Consol/ Load (%/psf)	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2	14-18-29 N=47			7.8			
4	17-23 40/12"	+0.2/500		4.9	128	26-18-8	27.3
7	4-4-4 N=8			5.1			
9	4-5 9/12"			7.2			
14	4-3-2 N=5			9.1			
19	5-9 14/12"			9.6	105		
24	5-10-18 N=28			25.7			
29	22-50/4"		3460	18.8	102	42-18-24	90

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from a publicly available USGS map

Water Level Observations
No free water observed

Drill Rig
CME 55

Hammer Type
Automatic; Hammer Efficiency = 68%

Driller
Terracon Fort Collins

Notes

Advancement Method
4-inch diameter, continuous-flight, solid-stem augers

Logged by
P.Agudelo

Boring Started
01-09-2025

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Completed
01-09-2025

Terracon
1510 44th St Unit 1
Evans, CO

Boring Log No. P-1

Location: See Exploration Plan

Latitude: 40.4220° Longitude: -104.7892°

Elevation: 4775 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation	Sample Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell-Consol/ Load (%/psf)	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		**FILL - CLAYEY SAND**, brown to dark brown, loose											
				2-3			7-9 16/12"	<+0.1/200		10.6	114		
	4.0	**FILL - SILTY SAND**, brown to tan, medium dense	4771	4-5.5			7-8-9 N=17			10.2			
				7-8			8-11 19/12"			11.1	115		
2	8.0	**SILTY SAND**, brown to tan, medium dense	4767	9-10.5			6-7-8 N=15			9.7			
				14-15			10-13 23/12"			6.2	98		
	15.0	***Boring Terminated at 15 Feet***	4760										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from a publicly available USGS map

Notes

Water Level Observations
No free water observed

Advancement Method
4-inch diameter, continuous-flight, solid-stem augers

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic; Hammer Efficiency = 68%

Driller
Terracon Fort Collins

Logged by
P.Agudelo

Boring Started
01-09-2025

Boring Completed
01-09-2025

Terracon
1510 44th St Unit 1
Evans, CO

Boring Log No. P-2

Location: See Exploration Plan

Latitude: 40.4219° Longitude: -104.7896°

Elevation: 4783 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)
1	0.0 – 4.0	**FILL - CLAYEY SAND**, brown, medium dense	4779
1	4.0 – 8.0	**FILL - SILTY SAND WITH GRAVEL**, tan to brown, medium dense	4775
1	8.0 – 14.0	**SILTY SAND WITH GRAVEL**, tan to brown, loose	4769
3	14.0 – 15.5	**SANDY LEAN CLAY (CL)**, light brown to tan, stiff	4767.5

Boring Terminated at 15.5 Feet

Approx. Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Swell-Consol/ Load (%/psf)	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2 – 3.5		Split spoon	7-10-15 N=25			9.3			
4 – 5		Ring-lined barrel	10-12 22/12"			5.8	107		
7 – 8.5		Split spoon	6-6-6 N=12			3.1			
9 – 10		Ring-lined barrel	6-9 15/12"			4.3	94		
14 – 15.5		Split spoon	7-7-8 N=15			9.6		27-14-13	54.4

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from a publicly available USGS map

Notes

Water Level Observations
No free water observed

Advancement Method
4-inch diameter, continuous-flight, solid-stem augers

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic; Hammer Efficiency = 68%

Driller
Terracon Fort Collins

Logged by
P.Agudelo

Boring Started
01-09-2025

Boring Completed
01-09-2025

Terracon
1510 44th St Unit 1
Evans, CO

Boring Log No. P-3

Location: See Exploration Plan

Latitude: 40.4217° Longitude: -104.7892°

Elevation: 4782 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)	Sample Depth (Ft.)	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.0–4.0	**FILL - CLAYEY SAND (SC)**, brown, very dense	4778	2–3.5	18-32-44 N=76	7.8		24-14-10	42
1	4.0–8.0	**FILL - SILTY SAND**, tan to light brown, medium dense	4774	4–5	24-26 50/12"	6.5	115		
				7–8.5	7-5-5 N=10	5.6			
2	8.0–15.5	**SILTY SAND**, tan to light brown, loose to medium dense	4766.5	9–10	5-7 12/12"	9.6	104		
				14–15.5	6-6-7 N=13	9.0			

Boring Terminated at 15.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from a publicly available USGS map

Water Level Observations
No free water observed

Notes

Advancement Method
4-inch diameter, continuous-flight, solid-stem augers

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 55

Hammer Type
Automatic; Hammer Efficiency = 68%

Driller
Terracon Fort Collins

Logged by
P.Agudelo

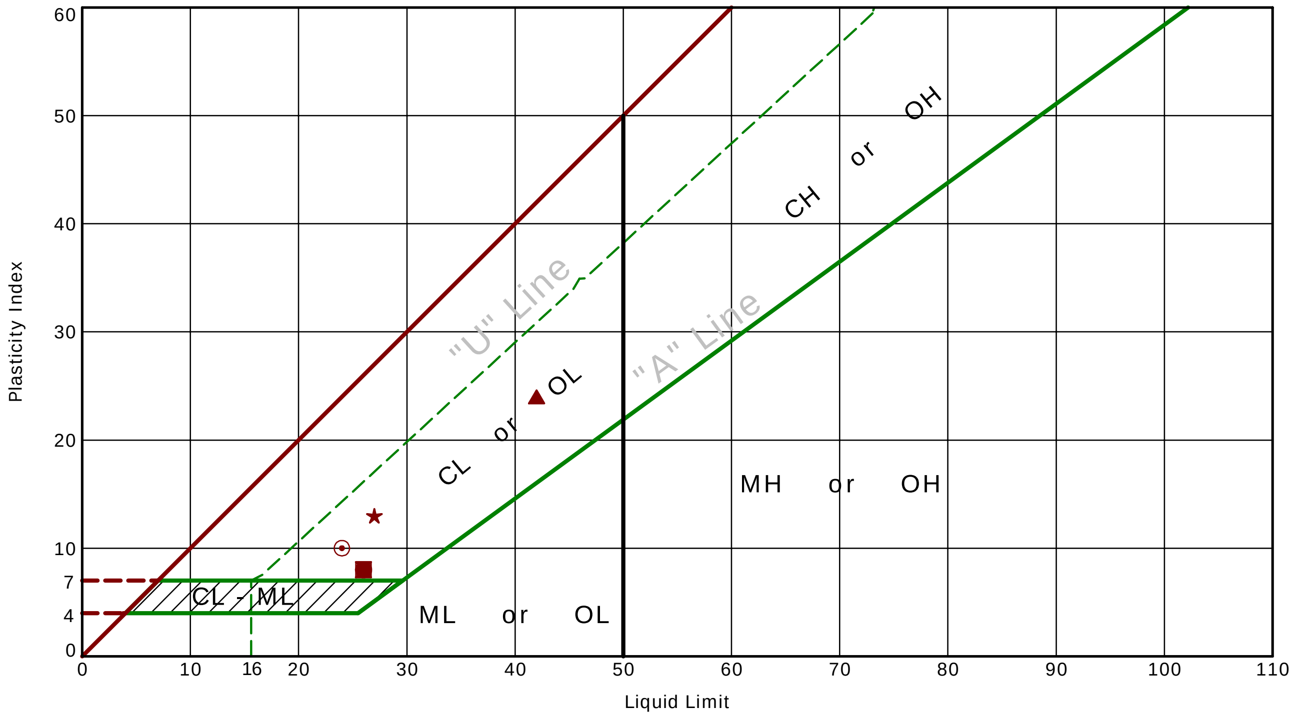
Boring Started
01-09-2025

Boring Completed
01-09-2025

Terracon
1510 44th St Unit 1
Evans, CO

Atterberg Limit Results

ASTM D4318

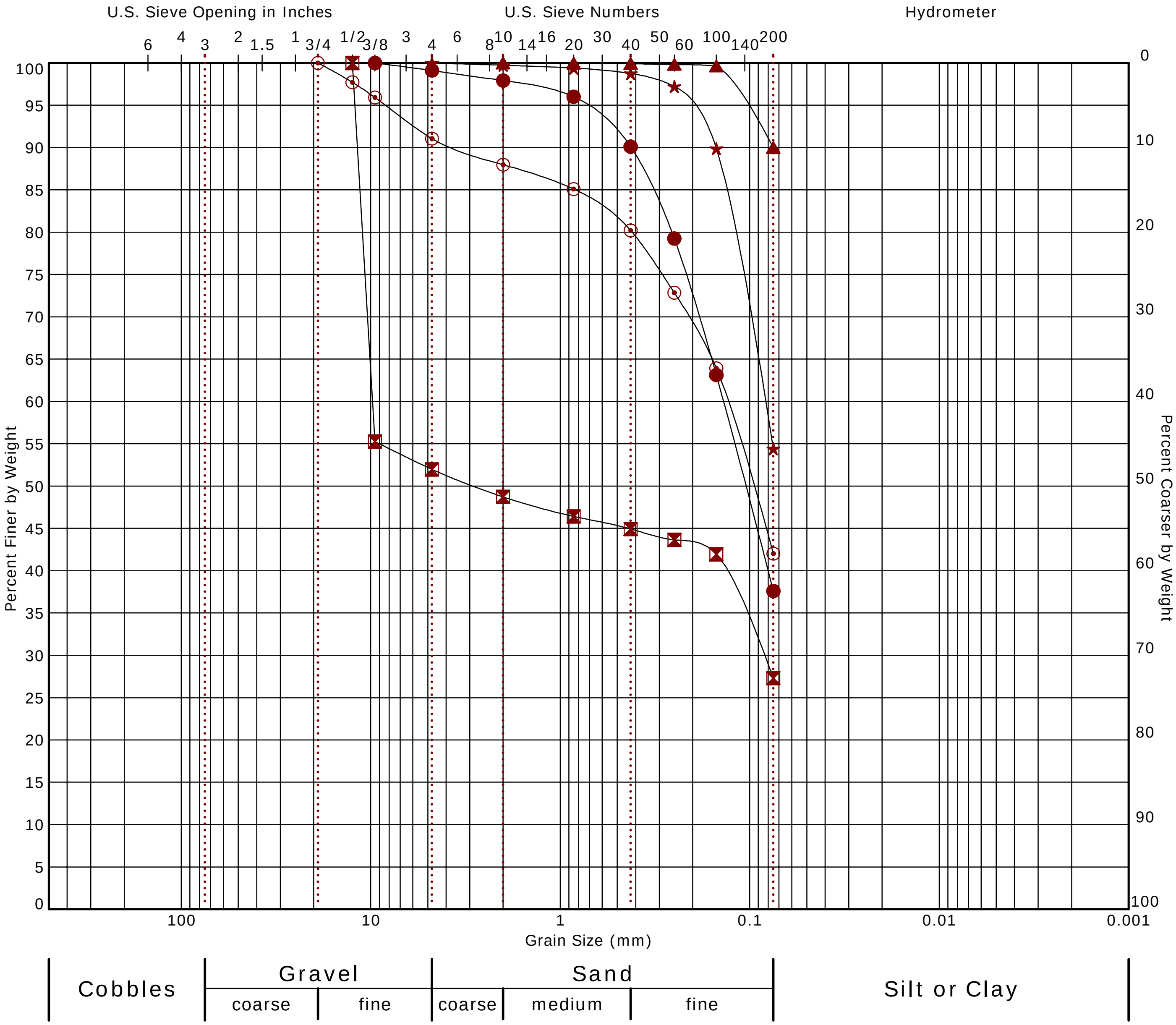


	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	2 - 3	26	18	8	37.6	SC	FILL - CLAYEY SAND
⊠	B-2	4 - 5	26	18	8	27.3	GC	FILL - CLAYEY GRAVEL with SAND
▲	B-2	29 - 29.8	42	18	24	90.0	CL	CLAYSTONE BEDROCK
★	P-2	14 - 15.5	27	14	13	54.4	CL	SANDY LEAN CLAY
⊙	P-3	2 - 3.5	24	14	10	42.0	SC	FILL - CLAYEY SAND

Terracon
1510 44th St Unit 1
Evans, CO

Grain Size Distribution

ASTM D422 / ASTM C136



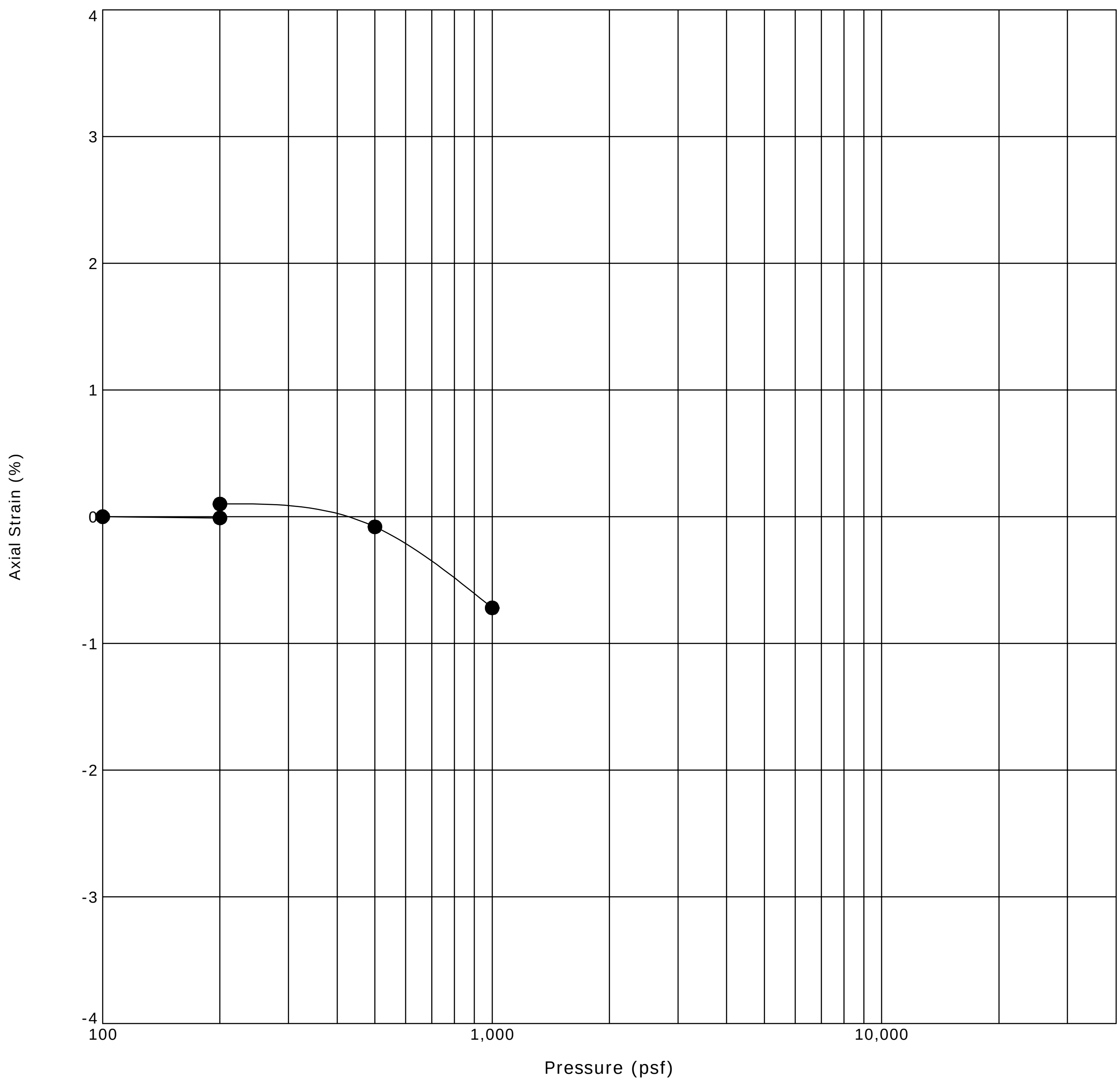
Boring ID		Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
●	B-1	2 - 3	FILL - CLAYEY SAND	SC	A-4 (0)	26	18	8		
⊠	B-2	4 - 5	FILL - CLAYEY GRAVEL with SAND	GC	A-2-4 (0)	26	18	8		
▲	B-2	29 - 29.8	CLAYSTONE BEDROCK	CL	A-7-6 (22)	42	18	24		
★	P-2	14 - 15.5	SANDY LEAN CLAY	CL	A-6 (4)	27	14	13		
⊙	P-3	2 - 3.5	FILL - CLAYEY SAND	SC	A-4 (1)	24	14	10		

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	B-1	2 - 3	9.5	0.138			0.0	0.9	61.5	37.6		
⊠	B-2	4 - 5	12.5	9.78	0.085		0.0	48.0	24.7	27.3		
▲	B-2	29 - 29.8	2				0.0	0.0	10.0	90.0		
★	P-2	14 - 15.5	4.75	0.084			0.0	0.0	45.6	54.4		
⊙	P-3	2 - 3.5	19	0.132			0.0	8.9	49.0	42.0		

Terracon
1510 44th St Unit 1
Evans, CO

One-Dimensional Swell or Collapse

ASTM D4546



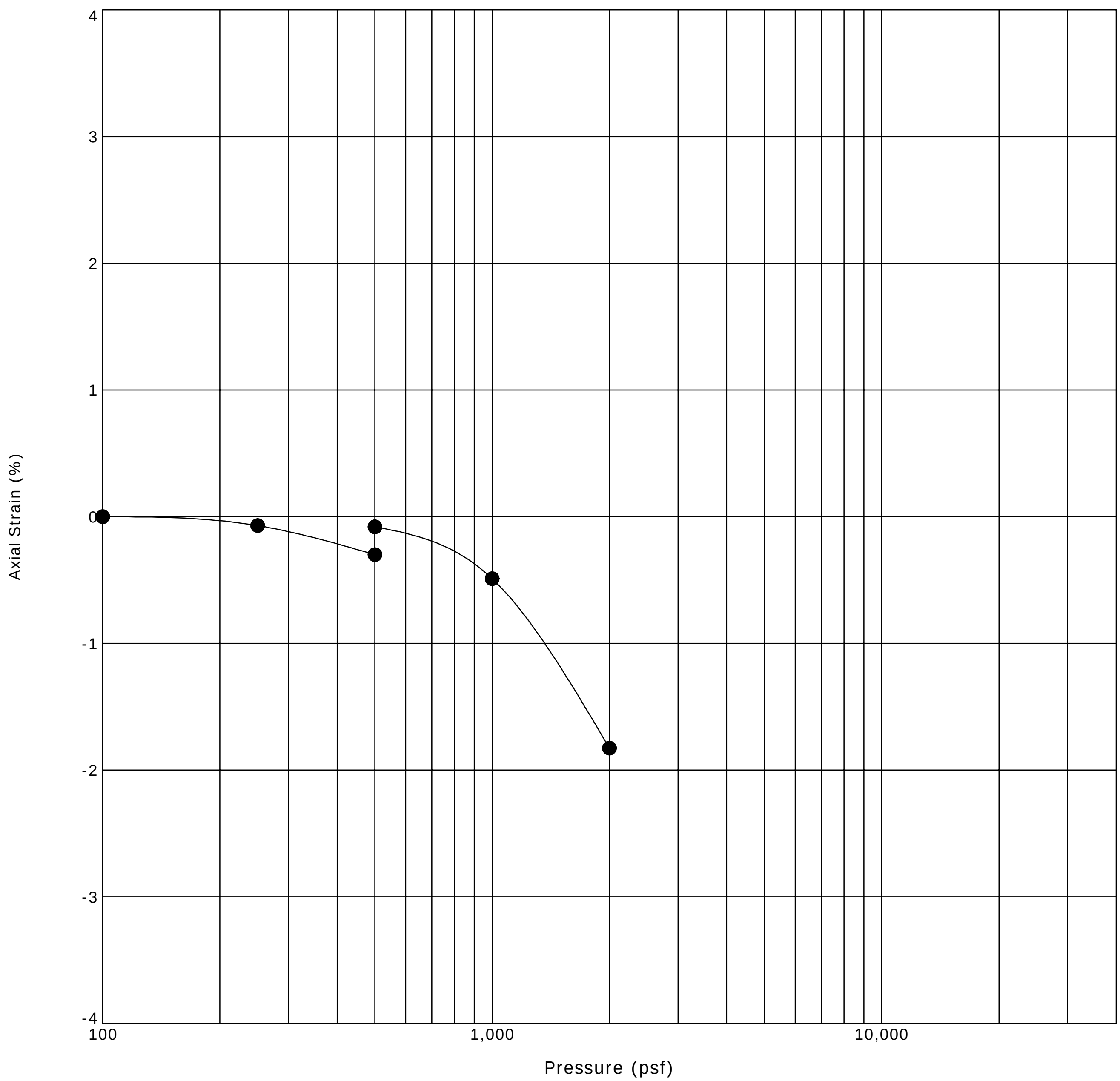
	Boring ID	Depth (Ft)	Description	USCS	γ_d (pcf)	WC (%)
●	B-1	2 - 3	FILL - CLAYEY SAND (SC)	SC	111	10.5

Notes: Sample exhibited 0.1 percent swell upon wetting under an applied pressure of 200 psf.

Terracon
1510 44th St Unit 1
Evans, CO

One-Dimensional Swell or Collapse

ASTM D4546



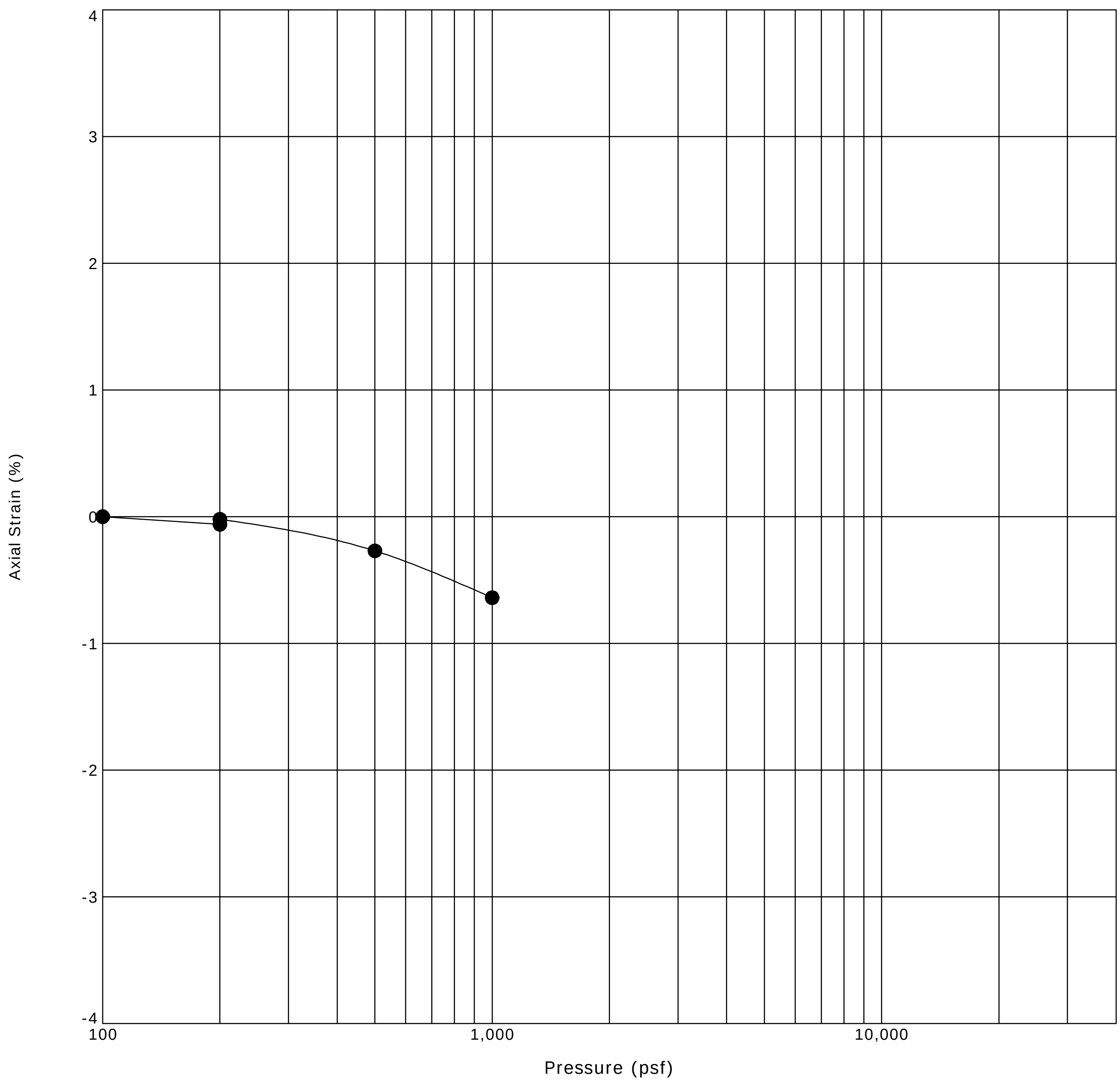
	Boring ID	Depth (Ft)	Description	USCS	γ_d (pcf)	WC (%)
●	B-2	4 - 5	FILL - CLAYEY GRAVEL with SAND (GC)	GC	109	4.9

Notes: Sample exhibited 0.2 percent swell upon wetting under an applied pressure of 500 psf.

1510 44th St Unit 1
Evans, CO

One-Dimensional Swell or Collapse

ASTM D4546



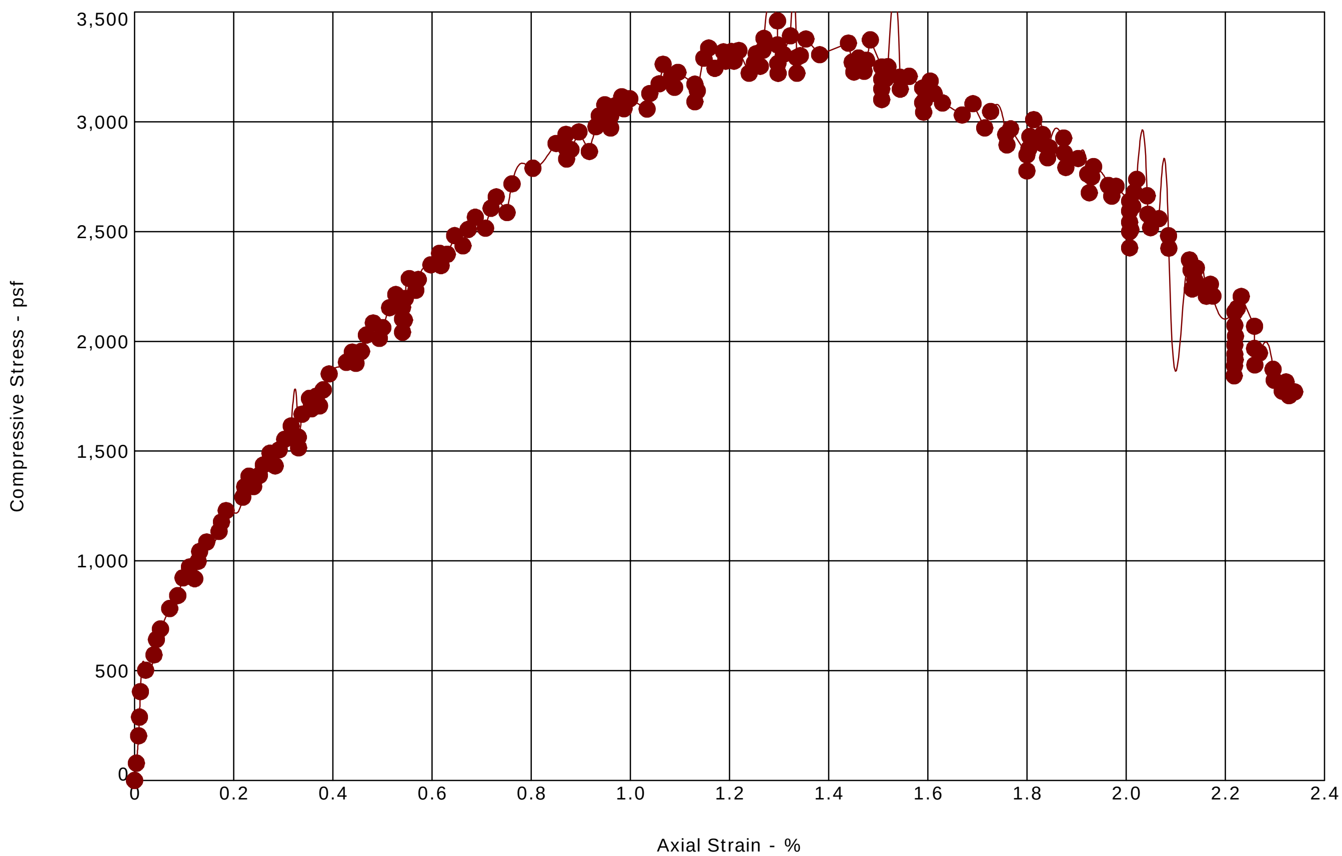
Boring ID		Depth (Ft)	Description	USCS	γ_d(pcf)	WC (%)
●	P-1	2 - 3	FILL - CLAYEY SAND		114	10.6

Notes: Sample exhibited less than 0.1 percent swell upon wetting under an applied pressure of 200 psf.

Terracon
1510 44th St Unit 1
Evans, CO

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B-2	29 - 29.8	CARS	42	18	24	90.0	CLAYSTONE BEDROCK (CL)

Specimen Failure Mode

Specimen Test Data

Moisture Content (%):	18.8
Dry Density (pcf):	102
Diameter (in.):	1.93
Height (in.):	4.02
Height / Diameter Ratio:	2.08
Calculated Saturation (%):	78.48
Calculated Void Ratio:	0.65
Assumed Specific Gravity:	2.7
Failure Strain (%):	1.30
Unconfined Compressive Strength (psf):	3459
Undrained Shear Strength (psf):	1730
Strain Rate (in/min):	
Remarks:	

Client	Project
SGDesign	Wells Fargo Bank - Greeley
Dallas, TX	21245060

Date Received: 1/17/2025

Results from Corrosion Testing

Sample Location	P-3
Sample Depth (ft.)	0.0'-5.0'
pH Analysis, AASHTO T289	8.21
Water Soluble Sulfate, ASTM C1580, (mg/kg)	14
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Chloride, ASTM D512, (mg/kg)	5
Red-Ox, ASTM G200, (mV)	+222
Total Salts, AWWA 2520 B, (mg/kg)	575
Resistivity (Saturated), ASTM G57, (ohm-cm)	2100

Analyzed By: ChrisAnne Ross
Staff Geologist

Supporting Information

Contents:

Note: All attachments are one page unless noted above.

Terracon
1510 44th St Unit 1
Evans, CO

General Notes

Sampling	Water Level	Field Tests
Auger Cuttings Modified California Ring Sampler Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				Bedrock		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Ring Sampler (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (psf)	Standard Penetration or N-Value (Blows/Ft.)	Ring Sampler (Blows/Ft.)	Consistency	Standard Penetration or N-Value (Blows/Ft.)	Ring Sampler (Blows/Ft.)
Very Loose	0 - 3	0 - 5	Very Soft	less than 500	0 - 1	< 3	Weathered	< 20	< 24
Loose	4 - 9	6 - 14	Soft	500 to 1,000	2 - 4	3 - 5	Firm	20 - 29	24 - 35
Medium Dense	10 - 29	15 - 46	Medium Stiff	1,000 to 2,000	4 - 8	6- 10	Medium Hard	30 - 49	36 - 60
Dense	30 - 50	47 - 79	Stiff	2,000 to 4,000	8 - 15	11 - 18	Hard	50 - 79	61 - 96
Very Dense	> 50	≥ 80	Very Stiff	4,000 to 8,000	15 - 30	19 - 36	Very Hard	>79	> 96
			Hard	> 8,000	> 30	> 36			

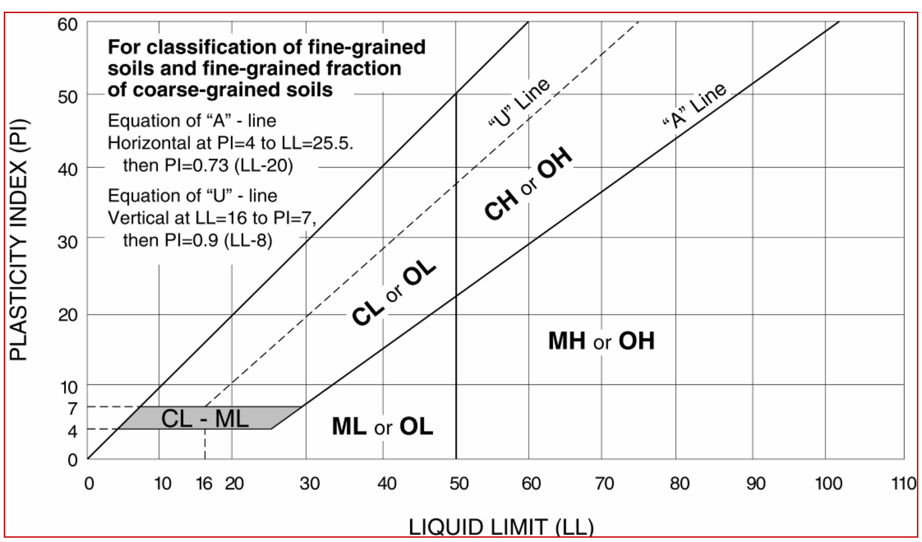
Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



Rock Classification Notes

WEATHERING	
Term	**Description**
Fresh	Mineral crystals appear bright; show no discoloration. Features show little or now staining on surfaces. Discoloration does not extend into intact rock.
Slightly weathered	Rock generally fresh except along fractures. Some fractures stained and discoloration may extend <0.5 inches into rock.
Moderately weathered	Significant portions of rock are dull and discolored. Rock may be significantly weaker than in fresh state near fractures. Soil zones of limited extent may occur along some fractures.
Highly weathered	Rock dull and discolored throughout. Majority of rock mass is significantly weaker and has decomposed and/or disintegrated; isolated zones of stronger rock and/or soil may occur throughout.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The rock mass or fabric is still evident and largely intact. Isolated zones of stronger rock may occur locally.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi**
Extremely strong	Can only be chipped with geological hammer. Rock rings on hammer blows. Cannot be scratched with a sharp pick. Hand specimens require several hard hammer blows to break.	>36,000
Very strong	Several blows of a geological hammer to fracture. Cannot be scratched with a 20d common steel nail. Can be scratched with a geologist's pick only with difficulty.	15,000-36,000
Strong	More than one blow of a geological hammer needed to fracture. Can be scratched with a 20d nail or geologist's pick. Gouges or grooves to ¼ inch deep can be excavated by a hard blow of a geologist's pick. Hand specimens can be detached by a moderate blow.	7,500-15,000
Medium strong	One blow of geological hammer needed to fracture. Can be distinctly scratched with 20d nail. Can be grooved or gouged 1/16 in. deep by firm pressure with a geologist's pick point. Can be fractured with single firm blow of geological hammer. Can be excavated in small chips (about 1-in. maximum size) by hard blows of the point of a geologist's pick;	3,500-7,500
Weak	Shallow indent by firm blow with geological hammer point. Can be gouged or grooved readily with geologist's pick point. Can be excavated in pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.	700-3,500
Very weak	Crumbles under firm blow with geological hammer point. Can be excavated readily with the point of a geologist's pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.	150-700

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Intensely fractured	< 2.5 inches	**Laminated**	< ½-inch
Highly fractured	2.5 – 8 inches	**Very thin**	½ – 2 inches
Moderately fractured	8 inches to 2 feet	**Thin**	2 inches – 1 foot
Slightly fractured	2 to 6.5 feet	**Medium**	1 – 3 feet
Very slightly fractured	> 6.5 feet	**Thick**	3 – 10 feet
		Massive	> 10 feet

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.