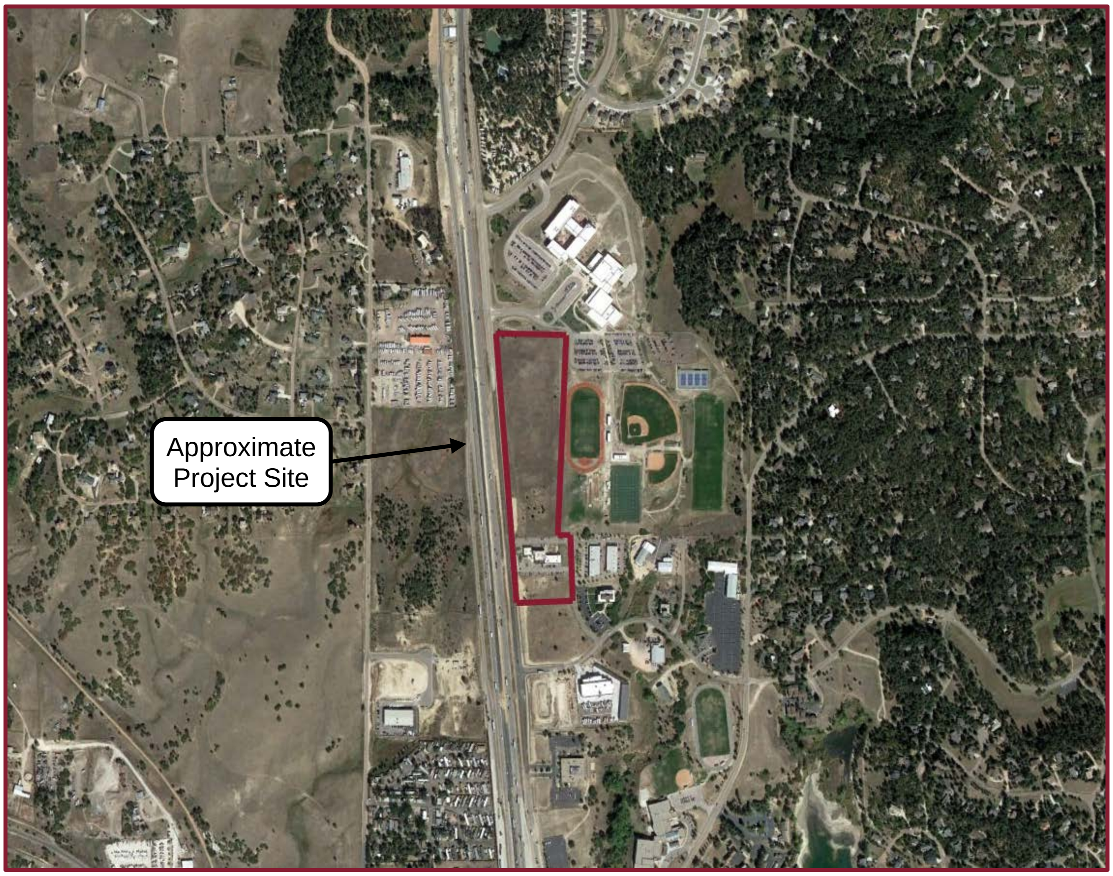
GROUND ENGINEERING

Preliminary Geotechnical Evaluation
18950 Base Camp Road
Monument, Colorado



Prepared For:
Central Development
1660 South Abilene Street, Suite 200
Denver, Colorado 80222

Attention: Mr. Jeremy Records

Job Number: 23-8001 **March 29, 2023**

TABLE OF CONTENTS

PURPOSE AND SCOPE OF STUDY

This report presents the results of a preliminary geotechnical evaluation performed by GROUND Engineering Consultants, Inc. (GROUND) for Central Development to develop preliminary geotechnical parameters for development within the approximate 14-acre site located at 18950 Base Camp Road in Monument, Colorado (El Paso County parcel numbers 7111000018 and 7111303004). Our study was conducted in general accordance with the GROUND's proposal number 2301-0138 dated January 26, 2023.

A field exploration program was conducted to obtain information on the subsurface conditions. Material samples obtained during the subsurface exploration were tested in the laboratory to provide data on the engineering characteristics of the site soils and bedrock. The results of the field exploration and laboratory testing are presented herein.

This preliminary report has been prepared to summarize the data obtained and to present our findings and conclusions based on the proposed development/improvements and the subsurface conditions encountered. Preliminary design parameters and a discussion of engineering considerations related to the proposed improvements are included herein. This report should be understood and utilized in its entirety; specific sections of the text, drawings, graphs, tables, and other information contained within this report are intended to be understood in the context of the entire report. This includes the *Closure* section of the report which outlines important limitations on the information contained herein.

This report was prepared for preliminary design purposes of Central Development based on our understanding of the proposed project at the time of preparation of this report. The data, conclusions, opinions, and preliminary geotechnical parameters provided herein should not be construed to be sufficient for other purposes, including the use by contractors, or any other parties for any reason not specifically related to the design of the project. Furthermore, the information provided in this report was based on the exploration and testing methods described below. Deviations between what was reported herein and the actual surface and/or subsurface conditions may exist, and in some cases those deviations may be significant.

The preliminary information presented in this report is not sufficient for design. Additional, structure-specific subsurface exploration and site evaluation MUST be performed prior to final design and construction.

PLANNED DEVELOPMENT

The project was in the early stages of planning and construction plans were not available at the time of this report preparation. Based on the provided real estate brochure[1], we understand the zoning of the property allows for multiple uses.

The project site is shown in Figure 1. If the proposed development differs significantly from that described above, GROUND should be notified to re-evaluate the conclusions and parameters contained herein.

SITE CONDITIONS

At the time of our subsurface exploration program, the project site was split into two parcels. The northern parcel consisted of vacant, undeveloped land with medium to tall grasses and scattered evergreen trees. The southern parcel consisted of an existing building with associated asphalt-paved parking areas, drive lanes, concrete flatwork, and an undeveloped area south of the building. Surveys depicting the existing topography of the site were unavailable at the time of this report preparation. Based on a USGS topographic map of the area[2], the site sloped from north to south and approximately 40 feet of relief was exhibited across the site. Crystal Creek was located approximately 600 feet east of the site. The site was bordered by a high school campus to the north and east, a storage facility to the south, and Monument Hill Road (I-25 Frontage Road) to the west.

[1] *Brochure 12-21-22.pdf.* 19950 Base Camp Road Sales flier. NAI Highland, LLC.
[2] United States Geological Survey. 2022. *Topographic Map of the Monument Quadrangle, Colorado – El Paso County.* 7.5 Minute Series.

Based on our cursory observations, the parking lot around the existing building at the site was in moderate condition, with some areas showing signs of thermal cracking. The existing building appeared to be in relatively good condition as viewed from the exterior.

Based on our review of Google Earth historical imagery, the building at the site was present as early as 1999 (earliest available image). The site appeared to have remained relatively unchanged since then.

GEOLOGIC SETTING AND HAZARDS

Site Geology

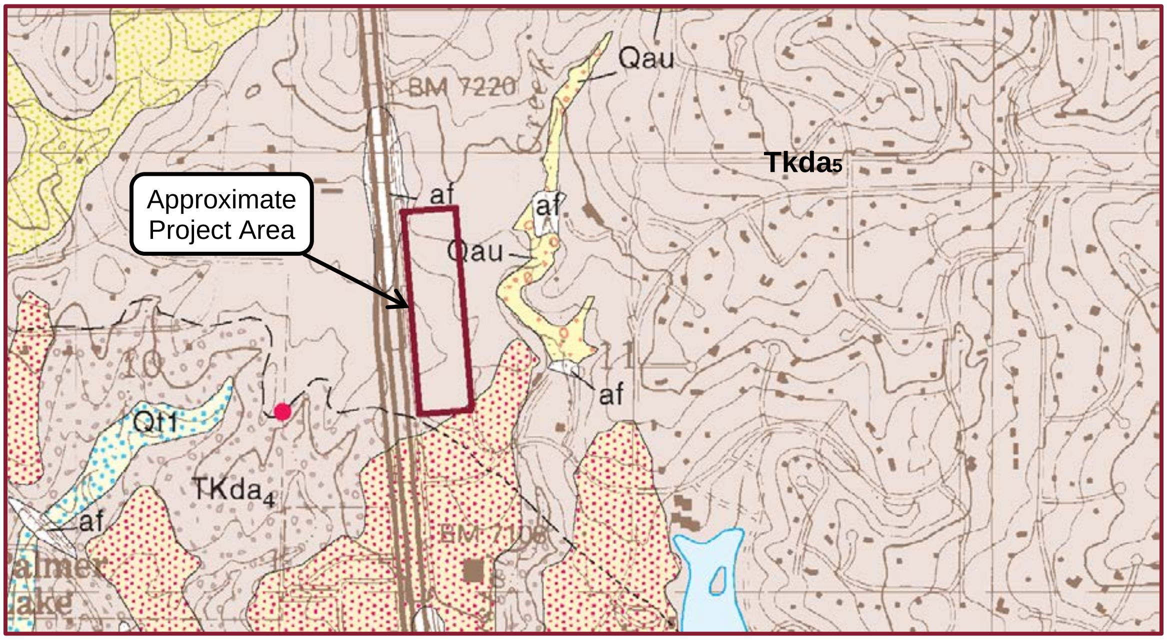
Available geologic maps (Madole and Thorson (2003)[3]) depict the site as underlain by the Eocene aged Dawson Formation Facies unit five (**TKda5**). The southernmost portions of the site are mapped to be underlain by a surficial layer of Pleistocene aged Middle alluvial-slope deposits (**Qas2**).

This Dawson formation is described to consist of massive, cross bedded, coarse grained sandstone and pebbly sandstone with claystone and siltstone interbeds. The Dawson Formation Facies Unit 5 typically consists of clayey sandstone with claystone and conglomerate beds. Well cemented beds are present in the formation; however, it can also be relatively weathered and easily erodible in areas. The claystones and siltstones encountered within this formation are commonly expansive.

The alluvial-slope deposits are generally described as poorly sorted sand and fine pebble-gravel deposited as sheet flow and stream deposited alluvium. Alluvial deposits, in the project area, commonly consist of fine to coarse sands and gravels with varying fractions of silts and clays. Cobbles and boulders are also present locally. Some of these larger clasts may not be suitable for reuse in project fills.

A portion of the above-referenced map is reproduced below.

[3] Madole, R.F. and Thorson, J.P. 2003, G*eologic Map of the Monument Quadrangle, El Paso County, Colorado*: Colorado Geological Survey Open-File Report OF 02-4, scale 1:24,000



Geologic Hazards

Expansive Soils and Bedrock Swelling clayey soils and bedrock change volume in response to changes in moisture content that can occur seasonally, or in response to changes in land use, including development. Expansion potentials vary with moisture contents, density, and details of the clay chemistry and mineralogy. The swell potential in any particular area can vary markedly both laterally and vertically due to the complex interbedding of the site soil and bedrock materials. Moisture changes also occur erratically, resulting in conditions that cannot always be predicted.

The shallow earth materials underlying the site included interbedded sandstone, siltstone, and claystone bedrock. The plasticity of the shallow site soils ranged from non- to moderately plastic. Swells of up to approximately 10.3 percent were measured in samples of the bedrock formation (weathered and comparatively unweathered) against various surcharge loads approximating in-place overburden pressures (see Table 1 and Appendix A). Design-level geotechnical evaluations of individual building sites, paved areas, flatwork, and other movement sensitive structures should include an assessment of the possible presence of swelling materials in the subsurface soils, so that appropriate, remedial design and construction can be implemented, if necessary.

Collapsible Soils Certain surficial deposits in the Front Range region of Colorado, typically eolian (wind-blown) materials are known to be susceptible to local hydro-consolidation or "collapse." Hydro-consolidation consists of a significant volume loss due to re-structuring of the constituent grains of the soil to a more compact arrangement upon wetting. Based on the Colorado Geologic Survey's Collapsible Soils of Colorado web map[4], the project site is not depicted to be located in an area that is considered to be susceptible to collapse.

Design-level geotechnical evaluations of individual structures, parking/pavement areas, etc. should include an assessment of the possible presence of collapsible materials in the subsurface soils, so that appropriate, remedial design and construction can be implemented, if necessary.

Radon Testing for the possible presence of radon gas prior to project development does not yield useful results regarding the potential accumulation of radon in completed structures. Radon accumulations typically are found in basements or other enclosed portions of buildings built in areas underlain at relatively shallow depths by granitic crystalline rock. The likelihood of encountering radon in concentrations exceeding applicable health standards on the subject site, underlain by sedimentary bedrock, is significantly lower.

Radon testing should be performed in each building on site, after construction is completed. Proper ventilation usually is sufficient to mitigate potential radon accumulations. Building designs should accommodate such ventilation for all building areas.

Seismic Activity / Faulting Neither site reconnaissance nor review of available geologic maps indicated the trace of an active or potentially active fault traversing the site. The nearest potentially active Quaternary age faults are the Rampart Range Fault and the Ute Pass Fault Zone[5]. The Rampart Range Fault (Rogers et. al., 1997[6]), is depicted approximately 3.3 miles west of the site and the Ute Pass Fault Zone (Widmann, 1997[7]) is depicted approximately 12.6 miles southwest of the site. Therefore, the likelihood of surface fault rupture at the site is considered to be low.

---

[4]*ON-006-04 – Collapsible Soils of Colorado*. Colorado Geological Survey. (no date). Retrieved from [https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=a6f816b35fb64d3da096e84af661f070], Accessed on 3/22/2023.

[5]*ON-001 – Colorado Earthquake and Fault Map.* Colorado Geological Survey (no date). Retrieved from [https://cgsarcimage.mines.edu/ON-001], Accessed on 3/22/2023

[6]Rogers, W.P., Kirkham, R.M., and Widmann, B.L., compilers, 1997, Fault number 2328, Rampart Range Fault, in Quaternary Fault and Fold Database of the United States: U.S. Geological Survey website, [http://earthquakes.usgs.gov/hazards/qfaults]

[7]Widmann, B.L., compiler, 1997, Fault number 2327, Ute Pass fault zone, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, [https://earthquakes.usgs.gov/hazards/qfaults]

Based on the subsurface conditions at the site and the risks associated with this nearest fault, the risk of liquefaction of the site soils is considered low.

We consider the site to fall within the parameters of a Seismic Site Class C site, in accordance with ASCE 7-16 (Table 20.3-1) based on extrapolation of available data to depth. If a quantitative assessment of the classification is needed, shear wave velocity testing to 100+ feet or other surface testing methods will be required. A proposal for this service can be provided upon request. Compared with other regions of Colorado, recorded earthquake frequency in the project area is moderate.

Slope Stability and Erosion Colton, Holligan, and Anderson (1975)[8], did not identify any landslides in the site vicinity. The Colorado Geologic Survey's Statewide Landslide Inventory Map[9] mapped small landslides in relatively rugged terrain about 2.5 miles to the southwest of the site. During our preliminary reconnaissance of site area, no evidence was obviously noted of large scale mass-wasting processes associated with steep slopes, such as landslides, slumps, or unusual soil creep. In addition, relatively shallow and competent bedrock was encountered during our subsurface exploration. Therefore, the likelihood of project developments being affected by existing large scale, unanticipated slope instabilities is considered low.

Preliminarily, un-retained, permanent slope cuts should be less than 10 feet in height and maintain a maximum 3 : 1 (horizontal : vertical) slope angle or less with proper erosion control measures implemented. Steeper and/or taller slopes may be possible, but must be evaluated on a case by case basis. Proper surface drainage controls to reduce the potential for erosional slope damage needs to be implemented in the grading design to control runoff, which may be increased due to proposed pavement surfaces, structures, and landscape irrigation. Re-vegetation or other means of protection should be used on graded slopes.

Flooding The project site lies approximately 600 feet west of Crystal Creek. The project site is depicted by FEMA (2018)[10] as Zone X indicating a minimal risk of flooding. The areas adjacent to Crystal Creek east of the site are depicted as Zone AE, designated as

---

[8]Colton, R.B., J.A. Holligan, and L.W. Anderson, 1975, *Preliminary Map of Landslide Deposits, Denver 1° x 2° Quadrangle, Colorado*, U.S. Geological Survey, Miscellaneous Field Studies Map MF-705.

[9]*ON-006-01 – Statewide Landslide Inventory Map.* Colorado Geological Survey (n.d.). Retrieved from [https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=9dd73db7fbc34139abe51599396e2648], Accessed on 3/22/2023

[10]FEMA, Effective 12/7/2018, El Paso County, CO, 080059, FIRM 08041C0276G

regulatory floodways. In general, the site does not appear to be vulnerable to flooding with the exception of heavy rainfall and associated temporary ponding of run-off in areas of relatively slow surface drainage. The site should be evaluated by a civil engineer in that regard.

Wetland Potential No obvious indications of conditions similar to jurisdictional wetlands were apparent during GROUND's site reconnaissance. According to the U.S. Fish and Wildlife Service[11], the project site does not contain designated wetland areas. Wetland areas are depicted in the areas adjacent to Crystal Creek. During site development, all regulations concerning wetland protection, as well as any other areas designated as wetlands by the Federal Wetlands Protection Act should be adhered to. Explicit designation of wetlands was not included as part of the scope of this study.

Mining Activity and Subsidence Review of available historical topographic maps and the Colorado Geologic Survey's Colorado Historic Coal Mines map[12], the Colorado Springs and Vicinity Natural Hazard Explorer[13], and other available published maps depicting areas of coal extraction, did not indicate past mining activities near the subject parcel. No obvious indications of mining activities were apparent on the site during the site reconnaissance. Therefore, there appears to be little potential for surface subsidence associated with consolidation of former mine workings at depth.

Published geologic maps do not indicate formations underlying the site at shallow depths that include evaporate (salt, gypsum, etc.) deposits, limestones, or other materials vulnerable to subsurface dissolution. Therefore, the likelihood of subsidence caused by dissolution or mining-related hazards appears to be low.

Based on the published information reviewed for the site and the findings of this preliminary assessment, the site appears to be feasible for development with respect to potential geologic hazards and general geotechnical design concerns.

---

[11]U.S. Fish and Wildlife Service, National Wetlands Inventory, [www.fws.gov/wetlands/data/Mapper.html] accessed on 3/23/2023.

[12]*ON-006-06 Colorado Historic Coal Mines*. Colorado Geological Survey. (no date). Retrieved from [https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=1891e3149eda44af9dc8af81c4dc58a8], Accessed on 3/27/2023.

[13]Colorado Springs and Vicinity Natural Hazard Explorer website. [https://www.arcgis.com/apps/MapSeries/index.html?appid=dce03f88b282442d8ec751fd439e357e], Accessed on 3/23/3023.

INITIAL SUBSURFACE EXPLORATION

Subsurface exploration for the project was conducted on February 14, 2023. A total of six (6) test holes were drilled using a track-mounted drill rig advancing continuous flight auger. The test holes were advanced to depths of approximately 24 to 50 feet below existing grades. The test holes were advanced to their termination depths to evaluate the subsurface conditions as well as to retrieve soil and bedrock samples for laboratory testing and analysis. A representative of GROUND directed the subsurface exploration, logged the test holes in the field, and prepared the samples for transport to our laboratory. The test holes were backfilled immediately following drilling operations due to safety concerns.

Samples of the subsurface materials were retrieved with a 2-inch I.D. 'California' liner sampler and a 1⅜-inch I.D. standard penetration test sampler. The samplers were driven into the substrata with blows from a 140-pound hammer falling 30 inches, a procedure similar to the Standard Penetration Test described by ASTM Method D1586. Penetration resistance values, when properly evaluated, indicate the relative density or consistency of soils. A composite bulk sample was obtained from the test hole auger returns. The depth at which the samples were obtained and associated penetration resistance values are shown on the test hole logs.

GROUND utilized the Client-provided parcel map indicating existing features, Google Earth imagery, and a hand-held GPS device to determine the locations of the test holes. The approximate locations of the test holes are shown on Figure 1. Logs of the test holes are presented on Figure 2 and Appendix A. Explanatory notes and a legend are provided on Figure 3.

LABORATORY TESTING

Samples retrieved from our test holes were examined and visually classified in the laboratory by the project engineer. Laboratory testing of soil and bedrock samples included standard property tests, such as natural moisture contents, dry unit weights, grain size analyses, and Atterberg limits. Swell-consolidation, water soluble sulfate, and corrosivity testing was also performed on select samples. Laboratory tests were performed in general accordance with applicable ASTM protocols. Results of the laboratory testing program are summarized in Tables 1 and 2 and Appendix A. Gradation and hydrometer plots are provided in Appendix B.

SUBSURFACE CONDITIONS

The subsurface conditions encountered in the test holes generally consisted of approximately 6 to 7 inches of topsoil[14], underlain by weathered sandstones, claystones, and siltstones to depths of approximately 1½ to 9 feet below existing grades or sand to a depth of approximately 3½ feet (encountered in Test Hole 6). Comparatively unweathered sandstone, claystone, and siltstone bedrock was encountered below the sands and weathered sandstones and claystones and extended to the depths explored. The weathered and comparatively unweathered bedrock consisted predominantly of sandstones with local claystones and siltstones.

It also should be noted that coarse gravel, cobbles, and boulders are not well represented in samples obtained from small diameter test holes. At this site, therefore, it should be anticipated that gravel and cobbles, and possibly boulders, may be present in subsurface soils and bedrock, even where not included in the general descriptions of the site soil types below.

Although fill materials were not encountered in the test holes, fill will likely be encountered if new development encroaches on the existing building facility. Delineation of the complete lateral and vertical extents of any fills at the site, or their composition, was beyond our present scope of services. If fill soil volumes and compositions at the site are of significance, they should be further evaluated using test pits.

Sands consisted of fine to coarse, silty to clayey sands with gravels. They were slightly plastic, medium dense, slightly moist, and brown in color.

Weathered Sandstones, Claystones, and Siltstones consisted of fine to coarse, relatively clean to clayey to silty, weathered sandstones with locally interbedded layers of weathered sandy siltstones and claystones. Gravels were noted locally. They were slightly to moderately plastic, firm, dry to wet, and brown to gray in color. Iron staining was noted locally.

Sandstone, Claystone, Siltstone Bedrock consisted of fine to coarse, relatively clean to silty to clayey sandstones with locally interbedded layers of claystones, siltstones, and sandy claystones. Gravels were noted locally. They were non- to highly plastic, dry to very

[14] 'Topsoil' as used herein is defined geotechnically. The materials so described may or may not be suitable for landscaping or as a growth medium for plants that may be proposed for the project.

moist, hard to very hard and relatively resistant, and white-brown to brown in color. Iron staining was noted commonly.

Groundwater was not encountered in the test holes at the time of drilling. The test holes were backfilled upon drilling completion per Code of Colorado Regulations (2 CCR 402-2). Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, nearby rivers and creeks, land use, and the development of transient, perched water conditions. The groundwater observations performed during our exploration must be interpreted carefully as they are short-term and do not constitute a groundwater study. In the event the Client desires additional/repeated groundwater level observations, GROUND should be contacted; additional exploration and fees will be necessary in this regard.

Swell-Consolidation Testing suggested a potential for swell in the tested site materials. Swells of up to approximately 10.3 percent were measured upon wetting under surcharge pressures corresponding to the estimated overburden pressure (see Table 1 and Appendix A).

PRELIMINARY GEOTECHNICAL CONSIDERATIONS ON DEVELOPMENT

<u>Presented below are preliminary considerations and parameters regarding geotechnical aspects of the proposed development. These considerations and parameters are provided to assist with preliminary project planning.</u> <u>**Additional, structure-specific studies must be performed prior to final design.**</u>

Specific grading information (neither proposed nor existing) and site plans were unavailable at the time of this report preparation. Building use and loading information were also unavailable at the time of this report preparation.

Geotechnical Risk A source of geotechnical risk at the site is the presence of expansive earth materials and relatively shallow bedrock. Based on our laboratory testing program, swells of ranging up to approximately 10.3 percent were measured in the weathered and comparatively unweathered siltstone and claystone bedrock and swells ranging up to approximately 1 percent were measured in samples of silty to clayey sandstone bedrock. Our experience indicates these significantly expansive bedrock materials have caused significant and damaging post-construction movements in the greater project area. In some cases, drilled piers with lengths greater than 100 feet and structurally-supported floors have been prescribed to mitigate the effects of these expansive materials in the Colorado Front Range. The highest swells were measured in samples of the weathered claystones and claystone/siltstone bedrock at the site; however, the majority of the samples obtained from our test holes consisted of sandstones, of which did not exhibit significant potentials for swell. Structure-specific studies which further evaluate the lateral and vertical extents of expansive bedrock in the subgrade of proposed improvements will be necessary.

Additionally, the bedrock at the site was hard to very hard and relatively resistant. Excavations extending into the bedrock will be difficult and may entail greater than typical wear on excavation or drilling equipment in good working condition.

We estimated that foundation and floor systems placed directly on the on-site earth materials could experience post-construction movements (heave) on the order of 1 to 5 inches or more, based on the swell data obtained for this preliminary evaluation. Additional swell and consolidation testing could indicate a potential for greater or lesser movements locally and should be performed during design-level geotechnical evaluations.

GROUND is available to discuss these and other geotechnical considerations upon request.

Anticipated Foundation/Floor Systems Below is a general discussion of potential foundation/floor systems for the project. They are provided to assist in general overall project cost estimates but may not contain enough information for specific cost analysis. All discussions/parameters provided herein are subject to revisions and modifications after site-specific studies are performed. **Additionally, specific tenant requirements for corporate facilities should be provided during the final geotechnical studies for individual structures.**

Preliminarily, for the least risk of post-construction foundation movements, structures could be founded on deep foundation systems consisting of drilled piers with structural floors. Utilizing this option as well as other applicable information provided in this report, GROUND anticipates potential post-construction foundation movements on the order of approximately ½-inch. Dilled pier foundation systems may be more appropriate where higher proportions of claystone/siltstone are encountered.

Drilled Pier Foundation System: For the least risk of post-construction movement, a deep foundation system should be used to support structures. This includes any attached building appurtenances. Commonly, along the Front Range area, deep foundations consisting of drilled piers advanced into the underlying formational bedrock are used to reduce potential structural movements as a result of heave (expansive materials) or consolidation to an owner-acceptable level. As stated previously, building specific conditions will need to be identified, verified, and evaluated to provide final parameters.

Anticipated piers may be designed for allowable end bearing pressures of 30,000 to 40,000 psf and skin friction values of 2,250 to 3,000 psf for the portion of the pier penetrating the bedrock below the depth of wetting (anticipated to be approximately 20 feet). Piers will require an estimated minimum length of 39 feet or more, and minimum penetrations into competent bedrock of 19 feet or greater (not considering below grade levels or the addition of fill material). A minimum pier diameter of 18 inches is anticipated. The actual pier lengths and diameters, however, should be based on the design loads, etc., as determined by the structural engineer following site-specific geotechnical explorations.

Other deep/intermediate foundation options may also be feasible for this project site, such as micro-piles, screw piles, etc., depending upon structural loads.

Structure Floor System: Structural floors should be utilized as the floor system with the least potential for movement. A structural floor should be supported on grade beams and straight-shaft drilled piers in the same manner as the building structure. The floors should span over a well ventilated crawl space or void forms.

As an alternate foundation/floor system (but not equal in performance), a shallow foundation/floor system consisting of spread footings and a slab-on-grade floor system may be utilized for the proposed structures provided over-excavation is performed and a uniform fill thickness (fill prism) is constructed beneath and beyond the structure in order to reduce (but not eliminate) the potential for movement (heave). If site-specific geotechnical evaluations do not encounter claystone/siltstone or other expansive materials, foundations may bear directly on the undisturbed sandstone. A greater than typical amount of test holes per building footprint area may be necessary to determine the proportion of sandstone vs claystone/siltstone materials. Utilizing this option as well as other applicable information provided in this report, GROUND anticipates potential post-construction foundation movements on the order of approximately 1 to 1½ inches or more.

Spread Footing Foundation System: In general, we anticipate that structures underlain by properly moisture-density treated site materials (anticipated depths ranging up to approximately 7 feet beneath the underslab gravel layer) could be founded on shallow foundation systems and designed for allowable soil bearing pressures of 2,500 to 3,000 psf. The actual depth of the fill prism will depend on the amount of sandstone vs siltstone/claystone encountered beneath the building footprint(s). Selective grading operations may also be beneficial to separate non-expansive sandstone and expansive claystone/siltstone during the over-excavation process, so that only non-expansive materials are placed as fill in the fill prism construction. If claystone/siltstone or other expansive materials are not encountered in site-specific geotechnical evaluations, fill prism construction may not be necessary. Spread footings should have a minimum footing dimension of 14 or more inches. Actual footing dimensions should be determined by the Structural Engineer, based on the design loads. Final geotechnical exploration in order to confirm foundations must be performed prior to final design.

Slab-on-Grade Floor System: The site materials, exclusive of topsoil, vegetation, and deleterious materials, are suitable to support lightly to moderately loaded slab-on-grade construction, provided they are properly moisture-density treated to a depth determined following a final geotechnical evaluation (see anticipated depths discussed above). An allowable subgrade vertical modulus (K) value of 75 to 100 pci could be assumed for slabs. These values are for a 1-foot x 1-foot plate; they should be adjusted for slab dimension.

Exterior Flatwork It may be beneficial to support critical flatwork, such as flatwork at entrance and exits of buildings, on a fill section like that for a slab-on-grade floor to achieve similar performance. In other areas, it may be beneficial to perform limited remedial earthwork beneath less critical flatwork to potentially reduce project costs but in turn increasing potential post-construction movements. Flatwork areas with a low tolerance for movement should be founded on drilled piers and structurally supported.

Surface and Subsurface Drainage Wetting of the bearing soils/bedrock can lead to loss of support and greater than anticipated settlements on most sites. Project plans should include establishment and maintenance of effective drainage (both surface and subsurface).

Underdrains can be a beneficial part of the site drainage program; the use of underdrains will help limit the risk of post-construction movements. Additionally, buildings with below-grade or partially below-grade levels should be provided with underdrains.

Preliminary Pavement Sections *The following initial or preliminary pavement sections are based on current grades and the shallow on-site soils. Actual pavement sections should be determined by design level studies.*

Preliminary Pavement Thicknesses We anticipate pavement sections for the private internal drives and parking areas may consist of a full depth asphalt section ranging from approximately 3 to 6 inches of asphalt. Equivalent composite sections could be used as well. A minimum section of 6 inches of Portland cement concrete underlain by at least 6 inches of Class 6 aggregate base course may also be necessary. Heavy truck traffic and loading/unloading areas should ideally be designed as a reinforced slab and consist of at least 6 to 7 inches of concrete underlain by at least 6 inches of Class 6 aggregate base course. Additionally, composite sections consisting of asphalt over aggregate base course may be utilized.

Potential Remedial Earthwork For private pavement areas, remedial earthwork will vary depending on the owner's tolerance for movement and level of future maintenance that the owner is willing to perform throughout the life of a facility. To achieve similar potential movements as a foundation/floor system, a similar fill section should be performed beneath pavement areas. Lesser depths of remedial earthwork may be performed, but will result in an increased potential for movement and subsequent pavement distress. Based on the shallow materials encountered in preliminary test holes, we anticipate that remedial earthwork on the order of 1 to 5 feet could be appropriate.

PRELIMINARY WATER-SOLUBLE SULFATES

The concentration of water-soluble sulfates measured in a selected sample retrieved from the test holes was less than the detectable limit to approximately 0.03 percent by weight (See Table 2). Such concentrations of soluble sulfates represent a negligible environment for sulfate attack on concrete exposed to these materials. Degrees of attack are based on the scale of 'negligible,' 'moderate,' 'severe' and 'very severe' as described in the "Design and Control of Concrete Mixtures," published by the Portland Cement Association (PCA). The Colorado Department of Transportation (CDOT) utilizes a corresponding scale with 4 classes of severity of sulfate exposure (Class 0 to Class 3) as described in the published table below.

REQUIREMENTS TO PROTECT AGAINST DAMAGE TO CONCRETE BY SULFATE ATTACK FROM EXTERNAL SOURCES OF SULFATE

Severity of Sulfate Exposure	**Water-Soluble Sulfate (SO_4) In Dry Soil** *(%)*	**Sulfate (SO_4) In Water** *(ppm)*	**Water Cementitious Ratio** *(maximum)*	**Cementitious Material Requirements**
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1500	0.45	Class 1
Class 2	0.21 to 2.00	1501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Based on our test results and PCA and CDOT guidelines, GROUND recommends the use of the appropriate cement in all concrete exposed to site soils and bedrock, conforming to one of the following requirements:

1) ASTM C150 Type I, II, III, or V.

2) ASTM C595 Type IL, IP, IP(MS), IP(HS), or IT.

The contractor should be aware that certain concrete mix components affecting sulfate resistance including, but not limited to, the cement, entrained air, and fly ash, can affect workability, set time, and other characteristics during placement, finishing and curing. The contractor should develop mix(es) for use in project concrete which are suitable with regard to these construction factors, as well as sulfate resistance. A reduced, but still significant, sulfate resistance may be acceptable to the owner, in exchange for desired construction characteristics.

PRELIMINARY SOIL CORROSIVITY

The degree of risk for corrosion of metals in soils commonly is considered to be in two categories: corrosion in undisturbed soils and corrosion in disturbed soils. The potential for corrosion in undisturbed soil is generally low, regardless of soil types and conditions, because it is limited by the amount of oxygen that is available to create an electrolytic cell.

In disturbed soils, the potential for corrosion typically is higher, but is strongly affected by soil chemistry and other factors.

A preliminary corrosivity analysis was performed to provide a general assessment of the potential for corrosion of ferrous metals installed in contact with earth materials at the site, based on the conditions existing at the time of GROUND's evaluation. Soil chemistry and physical property data including pH, reduction-oxidation (redox) potential, and qualitative sulfide content were obtained. Test results are summarized on Table 2.

Soil Resistivity In order to assess the "worst case" for mitigation planning, a sample of material retrieved from the test holes was tested for resistivity in the laboratory, after being saturated with water, rather than in the field. Resistivity also varies inversely with temperature. Therefore, the laboratory measurements were made at a controlled temperature. Measurements of electrical resistivity indicated values ranging from approximately 2,807 to 46,346 ohm-centimeters in selected samples of site earth materials.

pH Where pH is less than 4.0, soil serves as an electrolyte; the pH range of about 6.5 to 7.5 indicates soil conditions that are optimum for sulfate reduction. In the pH range above 8.5, soils are generally high in dissolved salts, yielding a low soil resistivity.[15] Testing of selected samples of site earth materials indicated pH values ranging from of approximately 7.0 to 8.0.

Reduction-Oxidation testing in selected samples indicated negative potentials: approximately -45 to -4 millivolts. Such low potentials typically create a more corrosive environment. The redox potential of a soil is significant because the most common sulfate-reducing bacteria can only live in anerobic conditions. A negative redox potential indicates anaerobic conditions in which sulfate reducers thrive.

Sulfide Reactivity testing indicated 'positive' results in the local soils and bedrock. The presence of sulfides in the earth materials suggests a more corrosive environment. A positive sulfide reaction reveals a potential problem caused by sulfate-reducing bacteria. Anaerobic conditions are regarded as potentially corrosive.

[15] American Water Works Association ANSI/AWWA C105/A21.5-05 Standard.

Corrosivity Assessment The American Water Works Association (AWWA) has developed a point system scale used to predict corrosivity. The scale is intended for protection of ductile iron pipe but is valuable for project steel selection. When the scale equals 10 points or higher, protective measures for ductile iron pipe are indicated. The AWWA scale is presented below. The soil characteristics refer to the conditions at and above pipe installation depth.

TABLE A.1 SOIL-TEST EVALUATION

Soil Characteristics	*Values*	*Points*
Resistivity *(Ω-cm)*	< 1,500	10
	≥ 1,500 – 1,800	8
	> 1,800 – 2,100	5
	> 2,100 – 2,500	2
	> 2,500 – 3,000	1
	> 3,000	0
pH	0 – 2	5
	2 – 4	3
	4 – 6½	0
	6½ – 7½	0*
	7½ – 8½	0
	> 8½	3
Redox Potential *(mV)*	> 100	0
	50 – 100	3½
	0 – 50	4
	< 0	5
Sulfide Reactivity	Positive	3½
	Trace	2
	Negative	0
Moisture	Poor drainage (continuous wet)	2
	Fair drainage (generally moist)	1
	Good drainage (generally dry)	0

* *If sulfides are present and low or negative redox-potentials results are obtained, add 3 points for this range.*

Based on a maximum possible score of 25.5 using the AWWA method, the value of 10 for the use of corrosion protection, and a maximum score of approximately 15½ in the tested site earth materials, the site earth materials appear to comprise a severely corrosive environment for buried metals.

If additional information is needed regarding soil corrosivity, then the American Water Works Association or a corrosion engineer should be contacted. It should be noted, however, that changes to the site conditions during construction, such as the import of other soils, or the intended or unintended introduction of off-site water, might alter corrosion potentials significantly.

PRELIMINARY PROJECT EARTHWORK

The following preliminary criteria and considerations are for private improvements; public roadways or utilities should be constructed in accordance with applicable municipal / agency standards. Additionally, these criteria and considerations are for general planning purposes. They should not be anticipated to be sufficient for all future site improvements.

General Considerations Site grading should be performed as early as possible in the construction sequence to allow settlement of fills and surcharged ground to be realized to the greatest extent prior to subsequent construction.

Prior to earthwork construction, concrete/asphalt, vegetation, and other deleterious materials should be removed and disposed of off-site or stockpiled for reuse evaluation. Relic underground utilities should be abandoned in accordance with applicable regulations, removed as necessary, and properly capped.

Topsoil present on-site should not be incorporated into ordinary fills. Instead, topsoil should be stockpiled during initial grading operations for placement in areas to be landscaped or for other approved uses. Topsoil was observed on the site at the time of our subsurface exploration. The topsoil was not tested for quality and may not be suitable for all landscaping purposes.

Tree trunks and roots may be present within, under, or adjacent to the proposed improvement footprints. The contractor should take care to assure that all tree roots, where present, are removed prior to filling or construction of foundations, floors or other improvements. Relatively deep excavations may be required to accomplish proper removal of roots and associated organic materials.

Existing Fill Soils Fill materials were not encountered during the subsurface exploration program, however fill materials may be encountered near the existing building facility. Actual contents and composition of all the fill materials are not known; therefore, some of the excavated fill materials may not be suitable for replacement as backfill. The geotechnical engineer should be retained during site excavations to observe the excavated fill materials and provide guidance for its suitability for reuse.

Use of Existing Native Soils and Bedrock Overburden soils that are free of trash, organic material, construction debris, and other deleterious materials are suitable, in general, for placement as compacted fill. Organic materials should not be incorporated into project fills.

The claystone and siltstone bedrock at the site are expansive, and selective grading operations should be considered so that such materials are not placed as fill beneath movement sensitive areas such as buildings, pavements, flatwork, etc. These materials should be separated as much as possible during grading operations so that they are not incorporated into fill beneath movement sensitive areas.

Fragments of rock and cobbles larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. Such fragments should not consist of non-durable sedimentary bedrock materials (i.e., siltstone, claystone, or sandstone bedrock). In general, such materials should be placed as deeply as possible in the project fills. Existing asphalt or road base materials from the existing parking lot at the site, if processed sufficiently, could potentially be used as grading materials. A geotechnical engineer should be consulted regarding appropriate parameters for usage of such materials on a case-by-case basis when such materials have been identified during earthwork. Standard parameters that likely will be generally applicable can be found in Section 203 of the current CDOT Standard Specifications for Road and Bridge Construction.

Imported Fill Materials If it is necessary to import material to the site, the imported soils should be free of organic material and other deleterious materials. **Imported material should consist of soils that have less than 35 percent passing the No. 200 Sieve and should have a plasticity index of less than 10.** Representative samples of the materials proposed for import should be tested and approved by the geotechnical engineer prior to transport to the site.

Fill Platform Preparation Prior to filling, the top 8 to 12 inches of in-place materials on which fill soils will be placed should be scarified, moisture conditioned and properly compacted in accordance with the parameters below to provide a uniform base for fill placement. If over-excavation is to be performed, then these parameters for subgrade preparation are for the subgrade **below the bottom** of the specified over-excavation depth.

If surfaces to receive fill expose loose, wet, soft, or otherwise deleterious material, additional material should be excavated, or other measures taken to establish a firm platform for filling. The surfaces to receive fill must be effectively stable prior to placement of fill.

Fill Placement Fill materials should be thoroughly mixed to achieve a uniform moisture content, placed in uniform lifts not exceeding 8 inches in loose thickness, and properly compacted.

Soils that classify as **GP, GW, GM, GC, SP, SW, SM, or SC** in accordance with the USCS classification system (granular materials) should be compacted to **95 or more percent** of the maximum modified Proctor dry density at moisture contents within 2 percent of optimum moisture content as determined by ASTM D1557.

Soils that classify as **ML, MH, CL, or CH** should be compacted to **95 percent** of the maximum standard Proctor density at moisture contents from the optimum moisture content to 3 percent above the optimum moisture content as determined by ASTM D698.

No fill materials should be placed, worked, rolled while they are frozen, thawing, or during poor/inclement weather conditions.

Care should be taken with regard to achieving and maintaining proper moisture contents during placement and compaction. Materials that are not properly moisture conditioned may exhibit significant pumping, rutting, and deflection at moisture contents near optimum and above. The contractor should be prepared to handle soils of this type, including the use of chemical stabilization, if necessary.

Compaction areas should be kept separate, and no lift should be covered by another until relative compaction and moisture content within the ranges are obtained.

Settlements Settlements will occur in filled ground, typically on the order of 1 to 2 percent of the fill depth. If fill placement is performed properly and is tightly controlled, in GROUND's experience the majority (on the order of 60 to 80 percent) of that settlement will typically take place during earthwork construction, provided the contractor achieves the compaction levels provided herein. The remaining potential settlements likely will take several months or longer to be realized, and may be exacerbated if these fills are subjected to changes in moisture content.

Stress Release in Over-Consolidated Soils The removal of large quantities of soils or bedrock (over 5 feet) may result in stress release of the underlying, over-consolidated materials. Stress release usually results in some degree of expansion of the soil strata. It is difficult to quantify the actual amount of expansion that may occur; however, it is possible for the expansion associated with stress release to impact the performance of the structure(s) founded in these areas. It may be advantageous to perform deep cuts as soon as possible to allow as much of the anticipated stress release to occur prior to construction of structures as possible.

Cut and Filled Slopes Permanent site slopes supported by on-site soils up to 10 feet in height may be constructed no steeper than 3 (H) to 1 (V). In the event slopes greater than 10 feet in height are planned, a slope stability analysis should be performed. Minor raveling or surficial sloughing should be anticipated on slopes cut at this angle until vegetation is well re-established. Surface drainage should be designed to direct water away from slope faces.

Use of Squeegee Relatively uniformly graded fine gravel or coarse sand, i.e., “squeegee,” or similar materials commonly are proposed for backfilling foundation excavations, utility trenches (excluding approved pipe bedding), and other areas where employing compaction equipment is difficult. In general, GROUND does not suggest this procedure for the following reasons:

Although commonly considered “self-compacting,” uniformly graded granular materials require densification after placement, typically by vibration. The equipment to densify these materials is not available on many job-sites.

Even when properly densified, uniformly graded granular materials are permeable and allow water to reach and collect in the lower portions of the excavations backfilled with those materials. This leads to wetting of the underlying soils and resultant potential loss of bearing support as well as increased local heave or settlement.

Wherever possible, excavations should be backfilled with approved, on-site soils placed as properly compacted fill. Where this is not feasible, use of “Controlled Low Strength Material” (CLSM), i.e., a lean, sand-cement slurry (“flowable fill”) or a similar material for backfilling should be considered.

Where “squeegee” or similar materials are proposed for use by the contractor, the design team should be notified by means of a Request for Information (RFI), so that the proposed use can be considered on a case-by-case basis. Where “squeegee” meets the project requirements for pipe bedding material, however, it is acceptable for that use.

PRELIMINARY EXCAVATION CONSIDERATIONS

Excavation Difficulty Test holes for the subsurface exploration were advanced to the depths indicated on the test hole logs by means of conventional, track-mounted, geotechnical drill equipment. Very hard and comparatively resistant bedrock materials were encountered in the test holes at shallow depths. We anticipate that excavation into the bedrock will be slow even with conventional, heavy-duty, excavating equipment, and will entail greater than typical wear on the equipment used. The contractor and project team should anticipate some of the site bedrock may be very hard and may require greater than typical efforts to excavate. Blasting or the use of a hydraulic hammer may be necessary to excavate the site bedrock.

Groundwater Groundwater was not encountered in the test holes at the time of drilling. The test holes were backfilled upon drilling completion per Code of Colorado Regulations (2 CCR 402-2). Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, nearby rivers and creeks, land use, and the development of transient, perched water conditions. The groundwater observations performed during our exploration must be interpreted carefully as they are short-term and do not comprise a groundwater study. In the event the Client desires additional/repeated groundwater level observations, GROUND should be contacted; additional exploration and fees will be necessary in this regard.

ADDITIONAL EXPLORATION REQUIREMENTS

The above data and conclusions are based on preliminary subsurface exploration only. Additional geotechnical studies must be performed to further evaluate the site for building-specific parameters and conclusions regarding foundation and floor system, final site grading, and pavement sections.

CLOSURE

Limitations This report has been prepared for Central Development as it pertains to development within the 14-acre site located at 18950 Base Camp Road as described herein. It should not be assumed to contain sufficient information for other parties or other purposes. The Client has agreed to the terms, conditions, and liability limitations outlined in our agreement between Central Development and GROUND. Reliance upon our report is not granted to any other potential owner, contractor, or lender.

Any changes in project plans or schedule should be brought to the attention of a geotechnical engineer, in order that the geotechnical conclusions in this report may be re-evaluated and, as necessary, modified.

The preliminary geotechnical conclusions and parameters in this report were based on subsurface information from a limited number of exploration points, as shown in *Figure 1*, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration. Design modifications may be necessary by the project team; this may result in an increase in project costs and schedule delays. In addition, a contractor who obtains information from this report for development of his scope of work or cost estimates does so solely at his own risk and may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor should obtain the additional geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes, but is not limited to, information regarding excavation conditions, earth material usage, current depths to groundwater, etc. Because of the necessarily limited nature of the subsurface exploration performed for this study, the contractor should be allowed to evaluate the site using test pits or other means to obtain additional subsurface information to prepare his bid.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, work should cease and a geotechnical engineer should be retained at once, so that our conclusions and design parameters for this site may be re-evaluated in a timely manner and dependent aspects of project design can be modified, as necessary.

The materials present on-site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed structure and pavement will depend on implementation of the conclusions and information in this report and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will exceed estimates provided herein and should therefore be expected by Central Development.

ALL DEVELOPMENT CONTAINS INHERENT RISKS. It is important that ALL aspects of this report, as well as the estimated performance (and limitations with any such estimations) of proposed improvements are understood by Central Development. Utilizing the geotechnical parameters and measures herein for planning, design, and/or construction constitutes understanding and acceptance of the conclusions with regard to risk and other information provided herein, associated improvement performance, as well as the limitations inherent within such estimates. Ensuring correct interpretation of the contents of this report by others is not the responsibility of GROUND. If any information referred to herein is not well understood, it is imperative that Central Development or the owner contact the author or a GROUND principal immediately. We will be available to meet to discuss the risks and remedial approaches presented in this report, as well as other potential approaches, upon request.

This report was prepared in accordance with generally accepted soil and foundation engineering practice in the project area at the date of preparation. Current applicable codes may contain criteria regarding performance of structures and/or site improvements which may differ from those provided herein. Our office should be contacted regarding any apparent disparity.

GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or conclusions contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect.

This document, together with the concepts and conclusions presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Re-use of, or improper reliance on this document without written authorization and adaption by GROUND Engineering Consultants, Inc., shall be without liability to GROUND Engineering Consultants, Inc.

GROUND appreciates the opportunity to complete this portion of the project and welcomes the opportunity to provide Central Development or the owner with a proposal for design-level geotechnical studies, construction observation and materials testing.

Sincerely,

GROUND Engineering Consultants, Inc.

Brian J. Knecht, P.G.

Reviewed by Jason A. Smith, REM, P.E.

GOOGLE EARTH AERIAL IMAGE (10/06/2019)

6
⊕ Indicates test hole numbers and approximate locations.

NOT TO SCALE

GROUND ENGINEERING

JOB NO.:	23-8001
FIGURE:	1

LOCATION OF TEST HOLES

GROUND ENGINEERING

LOGS OF THE TEST HOLES

CLIENT: Central Development

JOB NO: 23-8001

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

PROJECT LOCATION: Monument, CO

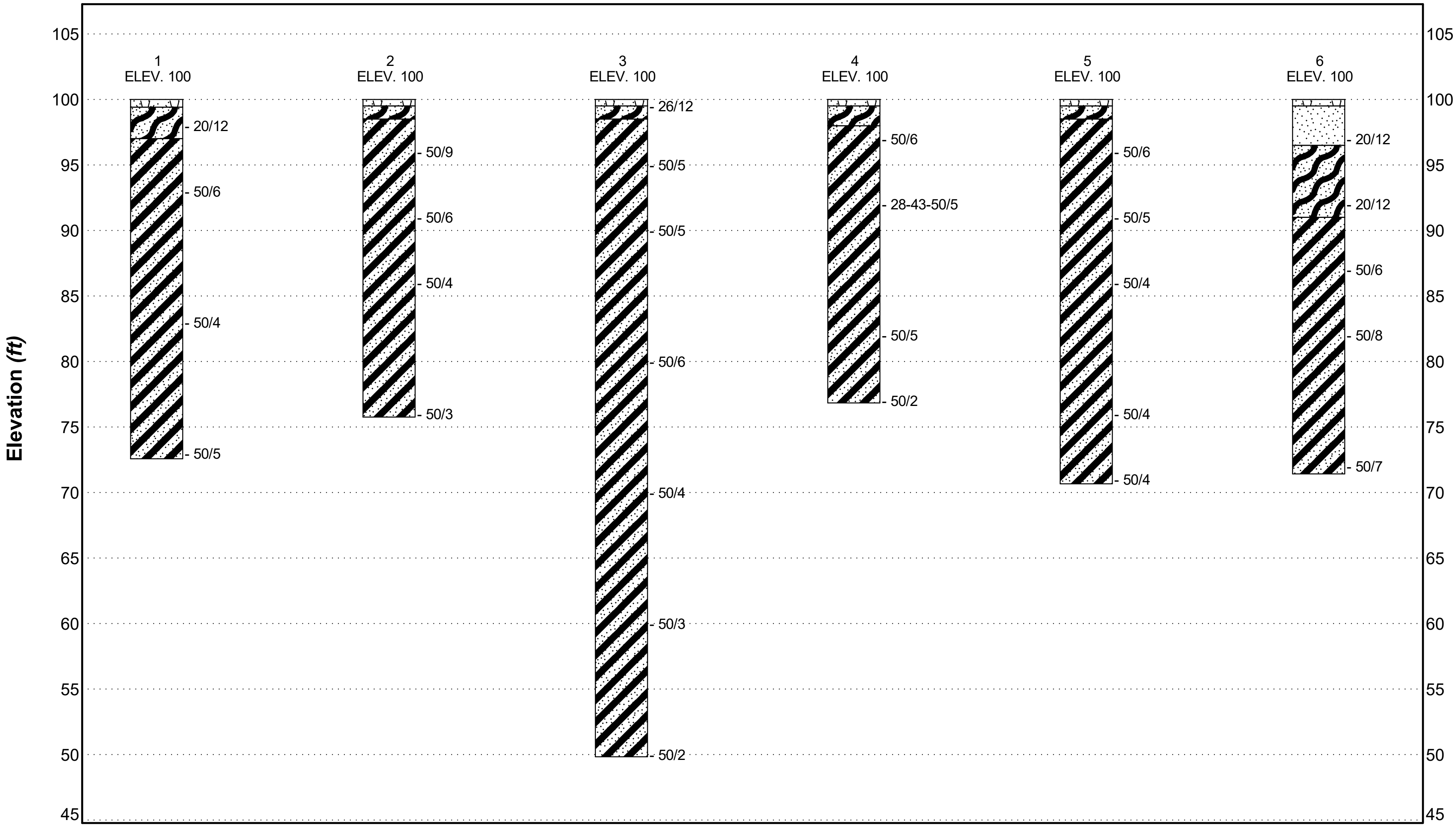


FIGURE 2

LEGEND AND NOTES

GROUND ENGINEERING

CLIENT: Central Development

JOB NO: 23-8001

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

PROJECT LOCATION: Monument, CO

MATERIAL SYMBOLS

TOPSOIL

SANDS

WEATHERED SANDSTONES, CLAYSTONES and SILTSTONE

SANDSTONE, CLAYSTONE, and SILTSTONE, BEDROCK

NOTE: See Detailed Logs for Material descriptions.

SAMPLER SYMBOLS

Modified California Liner Sampler
23 / 12 Drive sample blow count indicates 23 blows of a 140 pound hammer falling 30 inches were required to drive the sampler 12 inches.

Standard Penetration Test Sampler
20-25-30 Drive sample blow count, indicates 20, 25, and 30 blows of a 140 pound hammer falling 30 inches were required to drive the sampler 18 inches in three 6 inch increments.

NOTES

1. Test holes were drilled on 2/14/2023 with 4" Solid Stem Auger.

2. Locations of the test holes were determined approximately by pacing from features shown on the site plan provided.

3. Elevations of the test holes were not measured and the logs of the test holes are drawn to depth. Nominal elevation of "100 feet" indicates existing ground level at the test hole at the time of drilling.

4. The test hole locations and elevations should be considered accurate only to the degree implied by the method used.

5. The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.

6. Groundwater level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.

7. The material descriptions on these logs are for general classification purposes only. See full text of this report for descriptions of the site materials & related information.

8. All test holes were immediately backfilled upon completion of drilling, unless otherwise specified in this report.

ABBREVIATIONS

- Water Level at Time of Drilling, or as Shown
- Water Level at End of Drilling, or as Shown
- Water Level After 24 Hours, or as Shown

NV	No Value
NP	Non-Plastic

TABLE 1: SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Natural Moisture Content	Natural Dry Density	Gradation			Atterberg Limits		Swell/Consolidation		USCS Equivalent Classification	AASHTO Equivalent Classification (Group Index)	Sample Description
Test Hole No.	Depth *(feet)*	*(%)*	*(pcf)*	Gravel *(%)*	Sand *(%)*	Fines *(%)*	Liquid Limit	Plasticity Index	Volume Change *(%)*	Surcharge Pressure *(psf)*			
1	2	8.4	105.7	3	80	16.8	22	5	-	-	SC-SM	A-2-4 (0)	Weathered SANDSTONE
1	17	8.4	119.9	2	59	38.8	25	9	-	-	SC	A-4 (0)	SANDSTONE Bedrock
2	4	14.5	111.8	0	12	88.3	49	20	7.8	500	ML	A-7-6 (20)	SILTSTONE Bedrock
2	9	6.2	116.4	2	70	28.3	21	3	-	-	SM	A-2-4 (0)	SANDSTONE Bedrock
3	0.5	9.2	138.7	0	44	55.8	36	15	10.3	200	s(CL)	A-6 (6)	Weathered CLAYSTONE
3	5	8.8	125.2	0	69	31.0	33	11	-	-	SC	A-2-6 (0)	SANDSTONE Bedrock
3	40	13.3	105.8	0	73	26.8	30	7	-	-	SM	A-2-4 (0)	SANDSTONE Bedrock
4	3	11.7	110.3	2	54	44.2	*NV*	*NP*	1	375	SM	A-4 (0)	SANDSTONE Bedrock
4	18	10.0	122.6	0	42	58.4	33	14	2.1	2,250	s(CL)	A-6 (6)	CLAYSTONE Bedrock
5	4	5.7	112.1	1	75	24.1	29	5	-	-	SM	A-2-4 (0)	SANDSTONE Bedrock
5	24	10.0	120.3	0	66	34.4	33	12	-	-	SC	A-2-6 (0)	SANDSTONE Bedrock
6	8	17.9	108.2	3	47	49.7	38	13	0.2	1,000	SC	A-6 (4)	SANDSTONE Bedrock
6	13	12.0	118.7	0	78	21.9	34	8	-	-	SM	A-2-4 (0)	SANDSTONE Bedrock

NV = No value, NP = Non-plastic

TABLE 2: SUMMARY OF SOIL CORROSION TEST RESULTS

Sample Location		Water Soluble Sulfates	pH	Redox Potential	Sulfide Reactivity	Resistivity	Sample Description
Test Hole No.	Depth *(feet)*	*(%)*		*(mv)*		*(ohm-cm)*	
1	7	0.03	7.7	- 33	Positive	36,484	SANDSTONE Bedrock
6	3	< 0.01	8.0	- 45	Positive	46,346	Weathered SANDSTONE
1 - 6	0 - 10	< 0.01	7.0	- 4	Positive	2,807	Silty, Clayey SAND

Job No. 23-8001

Appendix A

Detailed Test Hole Logs

GROUND ENGINEERING

TEST HOLE 1

CLIENT: Central Development

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

JOB NO: 23-8001

PROJECT LOCATION: Monument, CO

Elevation (ft)	Depth (ft)	Material Descriptions and Drilling Notes
100	0	**TOPSOIL:** Approximately 7 inches of topsoil.
		WEATHERED SANDSTONES, CLAYSTONES, and SILTSTONES: Fine to coarse, relatively clean to clayey to silty, weathered sandstones with locally interbedded layers of weathered sandy siltstones and claystones. Gravels were noted locally. They were slightly to moderately plastic, firm, dry to wet, and brown to gray in color. Iron staining was noted locally.
95	5	
		SANDSTONE, CLAYSTONE, and SILTSTONE BEDROCK: Fine to coarse, relatively clean to silty to clayey sandstones with locally interbedded layers of claystones, siltstones, and sandy claystones. Gravels were noted locally. They were non- to highly plastic, dry to very moist, hard to very hard and relatively resistant, and white-brown to brown in color. Iron staining was noted commonly.
90	10	
85	15	
80	20	
75	25	

Approx. Depth (ft)	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
~2	Sample	20/12	8.4	105.7	17	22	5			SC-SM
~7	Sample	50/6								
~17	Sample	50/4	8.4	119.9	39	25	9			SC
~27	Sample	50/5								

Bottom of borehole at Approx. 27.42 feet.

GROUND ENGINEERING

TEST HOLE 2

CLIENT: Central Development

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

JOB NO: 23-8001

PROJECT LOCATION: Monument, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
100	0		**TOPSOIL:** Approximately 6 inches of topsoil.										
			WEATHERED SANDSTONES, CLAYSTONES, and SILTSTONES: Fine to coarse, relatively clean to clayey to silty, weathered sandstones with locally interbedded layers of weathered sandy siltstones and claystones. Gravels were noted locally. They were slightly to moderately plastic, firm, dry to wet, and brown to gray in color. Iron staining was noted locally.										
95	5				50/9	14.5	111.8	88	49	20	7.8 (500)		ML
			SANDSTONE, CLAYSTONE, and SILTSTONE BEDROCK: Fine to coarse, relatively clean to silty to clayey sandstones with locally interbedded layers of claystones, siltstones, and sandy claystones. Gravels were noted locally. They were non- to highly plastic, dry to very moist, hard to very hard and relatively resistant, and white-brown to brown in color. Iron staining was noted commonly.										
90	10				50/6	6.2	116.4	28	21	3			SM
85	15				50/4								
80	20												
					50/3								

Bottom of borehole at Approx. 24.25 feet.

TEST HOLE 3

GROUND ENGINEERING

CLIENT: Central Development

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

JOB NO: 23-8001

PROJECT LOCATION: Monument, CO

Elevation (ft)	Depth (ft)	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
100	0	**TOPSOIL:** Approximately 6 inches of topsoil.		26/12	9.2	138.7	56	36	15	10.3 (200)		s(CL)
		WEATHERED SANDSTONES, CLAYSTONES, and SILTSTONES: Fine to coarse, relatively clean to clayey to silty, weathered sandstones with locally interbedded layers of weathered sandy siltstones and claystones. Gravels were noted locally. They were slightly to moderately plastic, firm, dry to wet, and brown to gray in color. Iron staining was noted locally.										
95	5			50/5	8.8	125.2	31	33	11			SC
		SANDSTONE, CLAYSTONE, and SILTSTONE BEDROCK: Fine to coarse, relatively clean to silty to clayey sandstones with locally interbedded layers of claystones, siltstones, and sandy claystones. Gravels were noted locally. They were non- to highly plastic, dry to very moist, hard to very hard and relatively resistant, and white-brown to brown in color. Iron staining was noted commonly.										
90	10			50/5								
85	15											
80	20			50/6								
75	25											
70	30			50/4								
65	35											
60	40			50/3	13.3	105.8	27	30	7			SM
55	45											
50	50			50/2								

Bottom of borehole at Approx. 50.17 feet.

TEST HOLE 4

GROUND ENGINEERING

CLIENT: Central Development

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

JOB NO: 23-8001

PROJECT LOCATION: Monument, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits		Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
									Liquid Limit	Plasticity Index			
100	0		**TOPSOIL:** Approximately 6 inches of topsoil.										
			WEATHERED SANDSTONES, CLAYSTONES, and SILTSTONES: Fine to coarse, relatively clean to clayey to silty, weathered sandstones with locally interbedded layers of weathered sandy siltstones and claystones. Gravels were noted locally. They were slightly to moderately plastic, firm, dry to wet, and brown to gray in color. Iron staining was noted locally.		50/6	11.7	110.3	44	NV	NP	1 (375)		SM
95	5												
			SANDSTONE, CLAYSTONE, and SILTSTONE BEDROCK: Fine to coarse, relatively clean to silty to clayey sandstones with locally interbedded layers of claystones, siltstones, and sandy claystones. Gravels were noted locally. They were non- to highly plastic, dry to very moist, hard to very hard and relatively resistant, and white-brown to brown in color. Iron staining was noted commonly.		28-43-50/5								
90	10												
85	15												
					50/5	10	122.6	58	33	14	2.1 (2250)		s(CL)
80	20												
					50/2								

Bottom of borehole at Approx. 23.17 feet.

TEST HOLE 5

GROUND ENGINEERING

CLIENT: Central Development

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

JOB NO: 23-8001

PROJECT LOCATION: Monument, CO

Elevation (ft)	Depth (ft)	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
100	0	**TOPSOIL:** Approximately 6 inches of topsoil.										
		WEATHERED SANDSTONES, CLAYSTONES, and SILTSTONES: Fine to coarse, relatively clean to clayey to silty, weathered sandstones with locally interbedded layers of weathered sandy siltstones and claystones. Gravels were noted locally. They were slightly to moderately plastic, firm, dry to wet, and brown to gray in color. Iron staining was noted locally.										
95	5			50/6	5.7	112.1	24	29	5			SM
		SANDSTONE, CLAYSTONE, and SILTSTONE BEDROCK: Fine to coarse, relatively clean to silty to clayey sandstones with locally interbedded layers of claystones, siltstones, and sandy claystones. Gravels were noted locally. They were non- to highly plastic, dry to very moist, hard to very hard and relatively resistant, and white-brown to brown in color. Iron staining was noted commonly.										
90	10			50/5								
85	15			50/4								
80	20											
75	25			50/4	10	120.3	34	33	12			SC
				50/4								

Bottom of borehole at Approx. 29.33 feet.

GROUND ENGINEERING

TEST HOLE 6

CLIENT: Central Development

PROJECT NAME: 18950 Base Camp Road-Preliminary Geotech

JOB NO: 23-8001

PROJECT LOCATION: Monument, CO

Elevation (ft)	Depth (ft)	Material Descriptions and Drilling Notes
100	0	**TOPSOIL:** Approximately 6 inches of topsoil.
		SANDS: Fine to coarse, silty to clayey sands with gravels. They were slightly plastic, medium dense, slightly moist, and brown in color.
95	5	**WEATHERED SANDSTONES, CLAYSTONES, and SILTSTONES:** Fine to coarse, relatively clean to clayey to silty, weathered sandstones with locally interbedded layers of weathered sandy siltstones and claystones. Gravels were noted locally. They were slightly to moderately plastic, firm, dry to wet, and brown to gray in color. Iron staining was noted locally.
90	10	**SANDSTONE, CLAYSTONE, and SILTSTONE BEDROCK:** Fine to coarse, relatively clean to silty to clayey sandstones with locally interbedded layers of claystones, siltstones, and sandy claystones. Gravels were noted locally. They were non- to highly plastic, dry to very moist, hard to very hard and relatively resistant, and white-brown to brown in color. Iron staining was noted commonly.
85	15	
80	20	
75	25	

Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
20/12								
20/12	17.9	108.2	50	38	13	0.2 (1000)		SC
50/6	12	118.7	22	34	8			SM
50/8								
50/7								

Bottom of borehole at Approx. 28.58 feet.

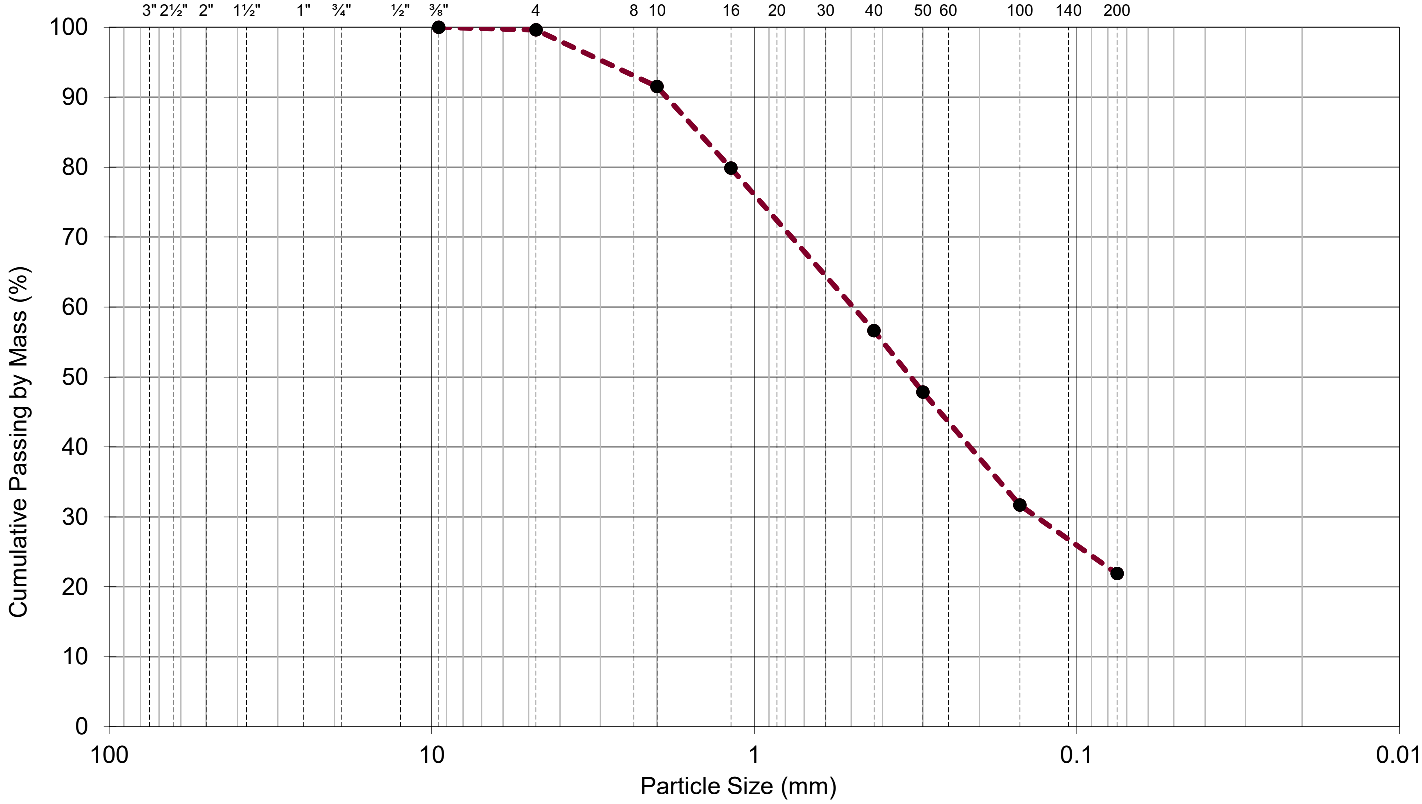
Appendix B

Gradation and Hydrometer Testing Results

Project No.: 23-8001

18950 Base Camp Road - Preliminary Geotechnical Evaluation

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	100	D90	1.867
5 in	125	-	No. 8	2.36	-	D85	1.489
4 in	100	-	No. 10	2.00	92	D80	1.188
3 in	75	-	No. 16	1.18	80	D60	0.493
2.5 in	63	-	No. 20	0.85	-	D50	0.327
2 in	50	-	No. 30	0.60	-	D40	0.214
1.5 in	37.5	-	No. 40	0.425	57	D30	0.133
1 in	25.0	-	No. 50	0.300	48	D15	-
3/4 in	19.0	-	No. 60	0.250	-	D10	-
1/2 in	12.5	-	No. 100	0.150	32	D05	-
3/8 in	9.5	100	No. 140	0.106	-	Cu	-
No. 4	4.75	100	No. 200	0.075	21.9	Cc	-

Location: 6 at 13 feet
Description: SANDSTONE Bedrock

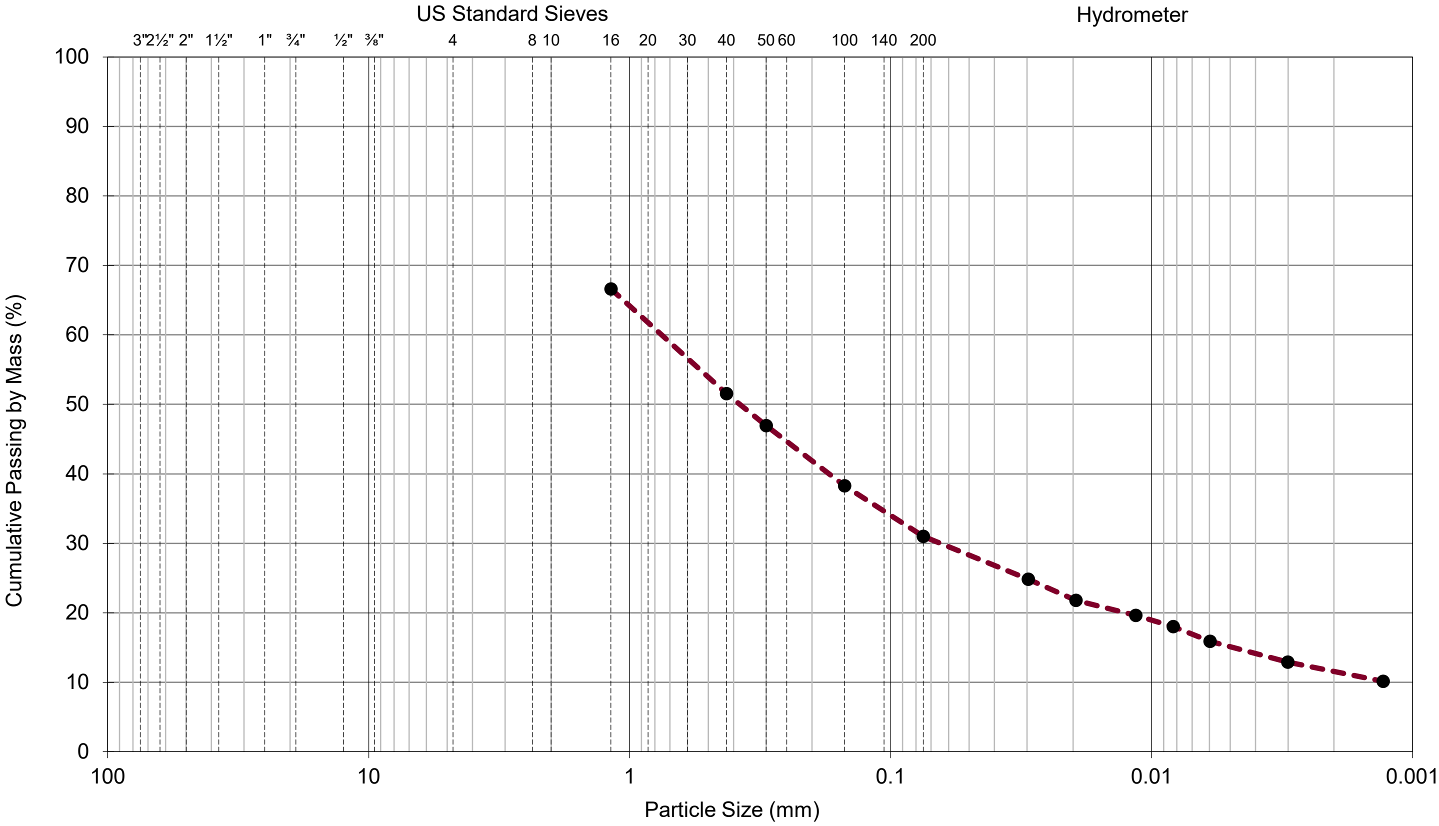
Classification: SM / A-2-4 (0)
Liquid Limit: 34
Plasticity Index: 8

Gravel (%): 0
Sand (%): 78
Silt/Clay (%): 22

Project No.: 23-8001

18950 Base Camp Road - Preliminary Geotechnical Evaluation

Gradation and Hydrometer (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Hydrometer		Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	-	0.030	25	D90	#N/A
5 in	125	-	No. 8	2.36	-	0.019	22	D85	#N/A
4 in	100	-	No. 10	2.00	-	0.012	20	D80	#N/A
3 in	75	-	No. 16	1.18	67	0.008	18	D60	0.754
2.5 in	63	-	No. 20	0.85	-	0.006	16	D50	0.378
2 in	50	-	No. 30	0.60	-	0.003	13	D40	0.172
1.5 in	37.5	-	No. 40	0.425	52	0.001	10	D30	-
1 in	25.0	-	No. 50	0.300	47	-	-	D15	-
3/4 in	19.0	-	No. 60	0.250	-	-	-	D10	-
1/2 in	12.5	-	No. 100	0.150	38	-	-	D05	-
3/8 in	9.5	-	No. 140	0.106	-	-	-	Cu	-
No. 4	4.75	-	No. 200	0.075	31.0	-	-	Cc	-

Location: 3 at 5 feet
Description: SANDSTONE Bedrock

Classification: SC / A-2-6 (0)
Liquid Limit: 33
Plasticity Index: 11
Activity: 1.0

Gravel (%): 0
Sand (%): 69
Silt/Clay (%): 31
< .002 mm (%): 12