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December 5, 2021

Black Mountain Project No. 210074-GEO

Cushing Civil Engineers
107 SE Washington Street, Suite 265
Portland, Oregon 97214

Attention: Mr. Kenny McManaway

Subject: Geotechnical Engineering Evaluation
John's Peak
2563 Johns Peak Road
Central Point, Oregon 97502

Black Mountain Consulting LLC (Black Mountain) is pleased to submit this report describing our recent geotechnical engineering evaluation for the John's Peak tower site. The purpose of our work was to interpret general surface and subsurface site conditions in order to provide recommendations for design and construction. Our scope of services was authorized by Cushing Civil Engineers (CCE) on behalf of Emergency Communications of Southern Oregon (ECSO), and consisted of a literature review, subsurface exploration, geotechnical analyses, and report preparation.

We prepared this report in accordance with generally accepted geotechnical engineering practices at the time we prepared it, for the exclusive use of CCE, ECSO, and their agents, for specific application to this project. Use or reliance upon this report by a third party is at their own risk. Black Mountain does not make any representation or warranty, express or implied, to such other parties as to the accuracy or completeness of this report or the suitability of its use by such other parties for any purpose whatever, known or unknown, to Black Mountain.

We appreciate the opportunity to be of service to you. If you have any questions, or if we can be of further assistance to you, please contact us at (503) 625.2517.

Respectfully Submitted,

Black Mountain Consulting LLC

Robert Nystrom, R.G.
Staff Geologist

EXPIRES 12/31/2022

Jeanne M. Niemer; P.E., G.E.
Principal Geotechnical Engineer

Attachment A	Figure 1 - Site Location Map Figure 2 - Site & Exploration Plan
Attachment B	Subsurface Exploration Log

Cushing Civil Engineers
Geotechnical Engineering Evaluation

John’s Peak
Central Point, Oregon

210074-GEO
December 2021

PROJECT DESCRIPTION

The project is located at 2563 Johns Peak Road, near Central Point, Jackson County, Oregon, as shown on the attached *Site Location Map,* Figure 1. The proposed project will consist of constructing a new approximately 120-foot emergency communications tower and installing ground equipment within an existing equipment shelter.

SITE CONDITIONS

Regional Geology

The geology of the area consists of a complex group of substantially faulted basalt flows, intrusive rocks, and alluvial sedimentary deposits. The region is characterized by hilly terrain and slopes created by recurring lava flows from local volcanic vents and subsequent erosion by numerous streams. The site is located on a unit of late Jurassic and early Cretaceous granitic rocks (KJg). Extensive flows of Triassic and/or Jurassic age andesite basalt (TRPv) (Walker, G.W. and MacLeod, N.S., 1991) as well as Paleozoic (possibly to Jurrasic) age sedimentary rocks (TRPZs) (Walker, G.W. and MacLeod, N.S., 1991) surround the site. Valley sediments to the east of the site consist of alluvial fan debris, colluvium and talus deposits (Qf) consisting of silt and basalt fragments, upper and Lower Cretaceous age clastic sedimentary rocks, Holocene and Pleistocene age terrace, pediment and lag gravels, cobbles, and boulders mixed with clay, silt and sand (Qt), and Pleistocene to Holocene age and Holocene age alluvial deposits (Qal) consisting of sand, gravel, and silt (Walker, G.W. and MacLeod, N.S., 1991).

Surface Conditions

The project site is located near the top of a prominent east-west trending ridge and is adjacent to existing communication facilities. The site is currently occupied by a communication tower and equipment shelter. The site has been graded level.

Subsurface Conditions

We explored the subsurface conditions at the project site on December 2, 2021. Due to site access limitations, our subsurface exploration was conducted approximately 60 feet south of the existing tower foundation. Our exploration consisted of advancing one test pit as shown on the attached Site and Exploration Plan, Figure 2. We logged and classified the subsurface materials in general accordance with the Manual Visual Classification Method (ASTM D 2488).

We excavated TP-1 at the southeast corner of an adjacent communication compound and we encountered approximately 4 feet of medium dense sand mantling dense to very dense sand at 4 feet below ground surface (bgs). This material is interpreted to be severely weathered granite. The very dense sand became weakly cemented below about 5 feet and we terminated our exploration, due to refusal, at approximately 7 feet bgs on severely to moderately weathered granite.

We did not encounter groundwater at the time of our exploration. Groundwater levels may fluctuate in response to changing precipitation patterns, off-site construction activities, and changes in site utilization.

SEISMIC HAZARD STUDY

Seismic Sources

There are three primary earthquake sources for this site: Cascadia Subduction Zone (CSZ) intraplate and interface earthquakes, and local crustal earthquakes that could occur in the North American Plate. CSZ intraplate earthquakes that could occur within the subducted Juan de Fuca plate are anticipated to have magnitudes on the order of 7.0 to 7.5, at a depth of about 40 to 60 km. This subduction is occurring beneath the North American Plate in the coastal regions between Vancouver Island and northern California. The fault trace is mapped approximately 50 to 120 km off the Oregon Coast. They present a low-moderate hazard.

An interface event earthquake on the seismogenic portion of the interface between the Juan de Fuca Plate and the North American Plate is capable of generating earthquakes with a moment magnitude of between 8.5 and 9.0. A magnitude 8.5 is expected to correspond to an average 10 percent of being exceeded in 50 years, and a magnitude 9.0 corresponds to an average 2 percent of being exceeded in 50 years.

Local crustal earthquakes may occur from northwest and northeast trending faults in the region. The nearest known fault is an unnamed fault located approximately 2.1 miles west of the site. This fault is classified as a Normal fault.

Site Specific Ground Motions

Our experience with ground motion modeling indicates that the site subsurface conditions are not susceptible to amplification beyond code spectra. We recommend that the code spectra for site soil Class B/C given in the Recommendations section be used for design of the tower.

Liquefaction, Fault Rupture, Slope Stability and Tsunami Inundation

The site soils are not susceptible to settlement from liquefaction during a design level earthquake.

Because the nearest known fault is over two kilometers from the site, hazards from fault rupture are low.

The site is located inland, outside of tsunami inundation areas.

The site is relatively flat, and is therefore not susceptible to earthquake-induced slope instability.

CONCLUSIONS

The tower can be supported on a mat foundation that derives its support from the weathered granite that we encountered about seven feet bgs. Rock anchors can provide additional resistance against overturning, if required.

Seismic Conditions

Based on our analysis of subsurface exploration logs and a review of published geologic maps, we interpret the on-site soil conditions to correspond to Site Class B/C, as defined by Table 1613.5.2 of the 2018 *International Building Code*.

Our specific recommendations are presented in the following sections.

GEOTECHNICAL DESIGN RECOMMENDATIONS

Seismic Design Parameters

Our recommended seismic design parameters are summarized in the table below, and were determined in accordance with ASCE/SEI 7-22.

Seismic Design Parameters		
	Short Period	**1 Second**
Mapped Spectral Acceleration Values	S_S=0.81	S_1=0.37
Site Class	B/C	
Seismic Design Category	D	
Design Spectral Response Acceleration Parameters	S_{DS}=0.48	S_{D1}=0.25

For purposes of seismic site characterization, we extrapolated the soil conditions that we observed below the exploration termination depth, based on our knowledge of the regional geology.

Mat Foundation

The base of the mat foundation should be located at a minimum depth of five feet bgs, on the weathered granite. After excavation to design grade, the subgrade should be cleaned of material loosened by excavation. Irregularities resulting from the excavation should be filled with sand, lean concrete, or other suitable material to produce a level bearing surface for the foundation.

We recommend using an ultimate static bearing capacity of 12,000 pounds per square foot (psf) for design of the foundation. In accordance with the provisions of the current EIA/TIA 222 code, this static bearing pressure does not incorporate a factor of safety. We estimate post construction settlements will be less than one inch. We estimate that the differential settlement will be approximately half of the total settlement.

Lateral loads acting on the foundations can be resisted by passive earth pressure on one side of the foundation and by friction along the soil-concrete interface at the base of the foundation. We recommend using an ultimate foundation base friction coefficient of 0.72 for the weathered granite. A passive earth pressure of 700 pounds per-cubic-foot (pcf), expressed as an equivalent fluid unit weight, may be used for that portion of the foundation embedded more than one foot below finished exterior subgrade elevation. These lateral resistance values do not incorporate a safety factor, in accordance with the provisions of the current EIA/TIA 222 code. In order to develop these capacities, concrete must be poured neat in excavations, the adjacent grade must be level, and the static ground water level must remain below the base of the footing throughout the year. The passive pressure within the upper foot of embedment should be neglected.

Eccentric loads and moments acting on the foundation produce a skewed bearing pressure distribution to the ground. The mat foundation should be sized so that the resultant load acts within the middle third of the foundation for one-way and two-way eccentric loading to maintain a compressive contact pressure along the base of the foundation. The maximum bearing pressure from the eccentric loading must be less than the allowable bearing pressure.

Uplift loads can be resisted by the self-weight of the mat and the backfill directly overlying the embedded mat foundation. The overlying soils can be re-used as backfill over the mat provided it is prepared and placed in accordance with recommendations contained in the Structural Fill section of this report. For preliminary design purposes, the total unit weight of the overlying soils can be assumed to be 100 pounds per cubic foot (pcf). We anticipate that rock anchors will be required to resist overturning.

Excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations. It is the contractor's responsibility to select the excavation and dewatering methods, to monitor the excavations for safety and to provide any shoring required to protect personnel and adjacent improvements.

Rock Anchors

Rock anchors should be installed a minimum of 10 feet into the underlying granite bedrock. We recommend using an allowable grout/ground interface bond strength of 60 psi for design. The upper two feet of embedment should be ignored for design purposes. The allowable grout/ground bond strength includes a factor of safety of 3. Rock anchors should be designed to meet the loading conditions as specified by the structural engineer.

Rock anchors should consist of steel bars installed in the center of a grouted drill hole. Steel bars should consist of #8 or larger deformed thread bar, in accordance with ASTM A 615, Grade 60 minimum and should be epoxy coated or hot dip galvanized for corrosion protection. The drill hole should be cleaned of deleterious material prior to placement of grout and steel and should be a minimum of one inch larger than the anchor diameter or as needed to provide sufficient cover between the ground and steel. Centralizers should be placed along the steel bar at a minimum of three feet from the bottom of the steel bar and three feet from the top of the steel bar with a maximum spacing of 10 feet. Centralizers shall be fabricated from schedule 40 PVC pipe, steel, or material non-detrimental to the reinforcing steel. Grout properties and mix design shall be as specified by the structural engineer.

Installation records for each rock anchor should include, at a minimum, drilling equipment and procedures, ground conditions during drilling, anchor number, anchor design load, type and size of reinforcing steel, total anchor length, and grout properties.

Verification Tests: We recommend that pre-production verification testing be performed on at least one anchor to verify the design of the anchor system and the construction methods proposed prior to installing the remaining production anchors. We should review the results of the verification test prior to beginning installation of the remaining anchors. The maximum verification test load should be 200 percent of the design load, as established by the structural engineer.

Proof Tests: Proof tests should be performed on the remaining anchors to verify consistent ground conditions and construction performance. The maximum proof test load should be 120 percent of the design load.

We recommend that a representative from Black Mountain be present for the duration of rock anchor construction and testing.

Spread Footings

Lightly loaded structures such as the equipment shelter can be supported on spread footings. Continuous-wall and isolated-spread footings should be at least 18 and 24 inches wide, respectively. For frost protection, the footings should be located at least 24 inches below the lowest adjacent grades or deeper if required by local building code.

Footings should bear directly on the medium dense to very dense sand or on structural fill placed in accordance with our recommendations. Footings bearing on the medium dense to very dense sand or structural fill should be sized for an allowable bearing capacity of 2,500 psf. We estimate post construction settlements will be less than one inch for the above recommended bearing capacity. We estimate that the differential settlement will be approximately half of the total settlement. Our recommended bearing capacity is based on limiting settlements and includes a factor of safety of 3 against bearing capacity failure.

Lateral loads acting on the foundations can be resisted by passive earth pressures on the sides of the foundation and by friction along the soil-concrete interface at the base of the foundation. We recommend using an allowable passive earth pressure of 300 pounds per cubic foot (pcf) for foundations confined by the basalt or structural fill placed in accordance with our recommendations. The passive pressure within the upper two feet of embedment should be neglected. We recommend an allowable coefficient of friction of 0.34. In order to develop these capacities, concrete must be poured neat in excavations, the adjacent grade must be level, and the static ground water level must remain below the base of the footing throughout the year. These allowable lateral resistance values include a minimal factor of safety of 1.5.

Floor Slabs

We recommend a 6-inch-thick layer of imported granular structural fill be placed and compacted over the prepared subgrade. The granular fill should be placed in 6-inch-thick lifts and compacted to at least 95 percent of the maximum dry density, as determined by the American Society for Testing and Materials (ASTM) D 1557. A modulus of subgrade reaction value of 100 pounds per cubic inch (pci) may be used to design the floor slab.

Foundation Construction Considerations

A geotechnical engineer from Black Mountain (or their representative) should confirm suitable bearing conditions and evaluate the foundation subgrades. Observations should also confirm that loose or soft material, organics, unsuitable fill, or old topsoil zones were removed. Localized deepening of footing excavations may be required to penetrate any deleterious materials.

Because foundation stresses are transferred outward as well as downward into the bearing soils, all footing over-excavations should extend horizontally outward from the footing edge a distance equal to the one half the over-excavation depth for the structural backfill.

CONSTRUCTION RECOMMENDATIONS

Site Preparation

Clearing and Stripping: After surface and near-surface water sources have been controlled, the construction areas should be cleared and stripped of organic matter and other deleterious materials. Silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads should be used as required to reduce sediment transport during construction to acceptable levels.

Where present, fill and existing topsoil should be stripped and removed from proposed development locations and for a five-foot-margin around such areas. Based on our explorations, we anticipate the depth of stripping to be less than about a foot, although greater stripping depths may be required if deleterious materials are encountered. Deleterious materials encountered during site preparation should be removed from the subgrade soils and hauled off site for disposal. Stripped material should be transported off site for disposal or stockpiled for use in landscaped areas. If stripping operations occur during wet weather, a generally greater stripping depth might be required in order to remove disturbed moisture-sensitive soils; therefore, stripping is best performed during a period of dry weather.

Excavations: We anticipate that site grading will be minimal. Where required, temporary soil cuts associated with site excavations or regrading activities should be adequately sloped back to prevent sloughing and collapse, unless a shoring box or other suitable excavation side wall bracing is provided. It is the responsibility of the contractor to ensure that excavations are properly sloped or braced for worker safety protection, in accordance with OSHA safety guidelines.

Dewatering: Based on our subsurface exploration, we do not anticipate groundwater seepage within the tower mat excavation. If water is encountered, we anticipate that pumping from sumps located in the trench will likely be effective in removing water resulting from seepage or perched groundwater.

Final Grades: Final site grades should slope downward away from the structure at a minimum of two percent and runoff should be conveyed to a suitable drainage outlet. Additionally, the area surrounding the structure could be capped with concrete, asphalt or compacted, low-permeability soils to reduce surface water infiltration into the subsurface soils near the foundation.

Structural Fill

The following recommendations for structural fill are provided for design and construction purposes, if required.

Materials: Structural fill includes any fill materials placed under footings, pavements, or driveways and backfill over the embedded mat foundation. Typical materials used for structural fill include: clean, well-graded sand and gravel; clean sand; crushed rock; controlled-density fill (CDF); lean-mix concrete; and various soil mixtures of silt, sand, and gravel. Recycled concrete, asphalt, and glass derived from pulverized parent materials may also be used as structural fill when combined with an equal volume or more of silt, sand, and/or gravel. Use of the on-site soils as structural fill is also feasible.

Placement and Compaction: When used as structural fill, the on-site soils should be placed in lifts with a maximum thickness of 8 inches and compacted to not less than 92 percent of the material's maximum dry density, as determined by ASTM D-1557. The on-site soils should be moisture-conditioned to within 3 percent of the optimum moisture content (ASTM D-1557). If the on-site soils cannot be properly moisture-conditioned, we recommend using imported granular material for structural fill.

Imported granular structural fill should consist of angular pit or quarry run rock, crushed rock, or crushed gravel and sand that is fairly well graded between coarse and fine particle sizes. The fill should contain no organic matter or other deleterious materials, have a maximum particle size of one inch, and have less than 5 percent passing the U.S. No. 200 Sieve. In deep excavations, or where subgrade soils require stabilization, the particle size may be increased to four inches. The percentage of fines can be increased to 12 percent of the material passing the U.S. No. 200 Sieve if placed during dry weather and provided the fill material is moisture-conditioned, as necessary, for proper compaction. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D-1557. During the wet season or when wet subgrade conditions exist, the initial lift thickness should be increased to 24 inches and should be compacted by rolling with a smooth-drum, nonvibratory roller.

CDF and lean-mix concrete do not require special placement or compaction procedures. Regardless of location or material, all structural fill should be placed over firm, unyielding subgrade soils. If earthwork takes place during freezing conditions, we recommend that all exposed subgrades be allowed to thaw and be recompacted prior to placing subsequent lifts of structural fill.

CONSTRUCTION OBSERVATIONS

Satisfactory earthwork performance depends on the quality of construction. Sufficient monitoring of the contractor's activities is a key part ensuring that work is completed in accordance with the construction drawings and specifications. We recommend that a representative from Black Mountain observe that the subsurface conditions are consistent with the anticipated conditions, and that foundation subgrades are suitable for placement of structural fill, rebar, or concrete for the new structures.

Some jurisdictions require a final letter of geotechnical compliance before they will provide a final signoff on a permit. It is incumbent on the client to determine if a final letter of geotechnical compliance is required by the jurisdiction. If such a letter is required, a representative from Black Mountain MUST observe drilled pier excavations and foundation subgrades PRIOR to concrete being poured for the foundation. If Black Mountain does not perform this observation, we cannot provide a final letter of geotechnical compliance, and a permit will not be eligible for final sign-off. ***It is the owner's responsibility to ensure that Black Mountain is notified in a timely manner (i.e., at least 48 hours prior to the required site observation) of the need for our services on site during construction.***

CLOSURE

We have prepared this report for use by the owner/developer and other members of the design and construction team for the proposed tower site. The opinions and recommendations contained within this report are not intended to be, nor should they be, construed as a warranty of subsurface conditions, but are forwarded to assist in the planning and design process.

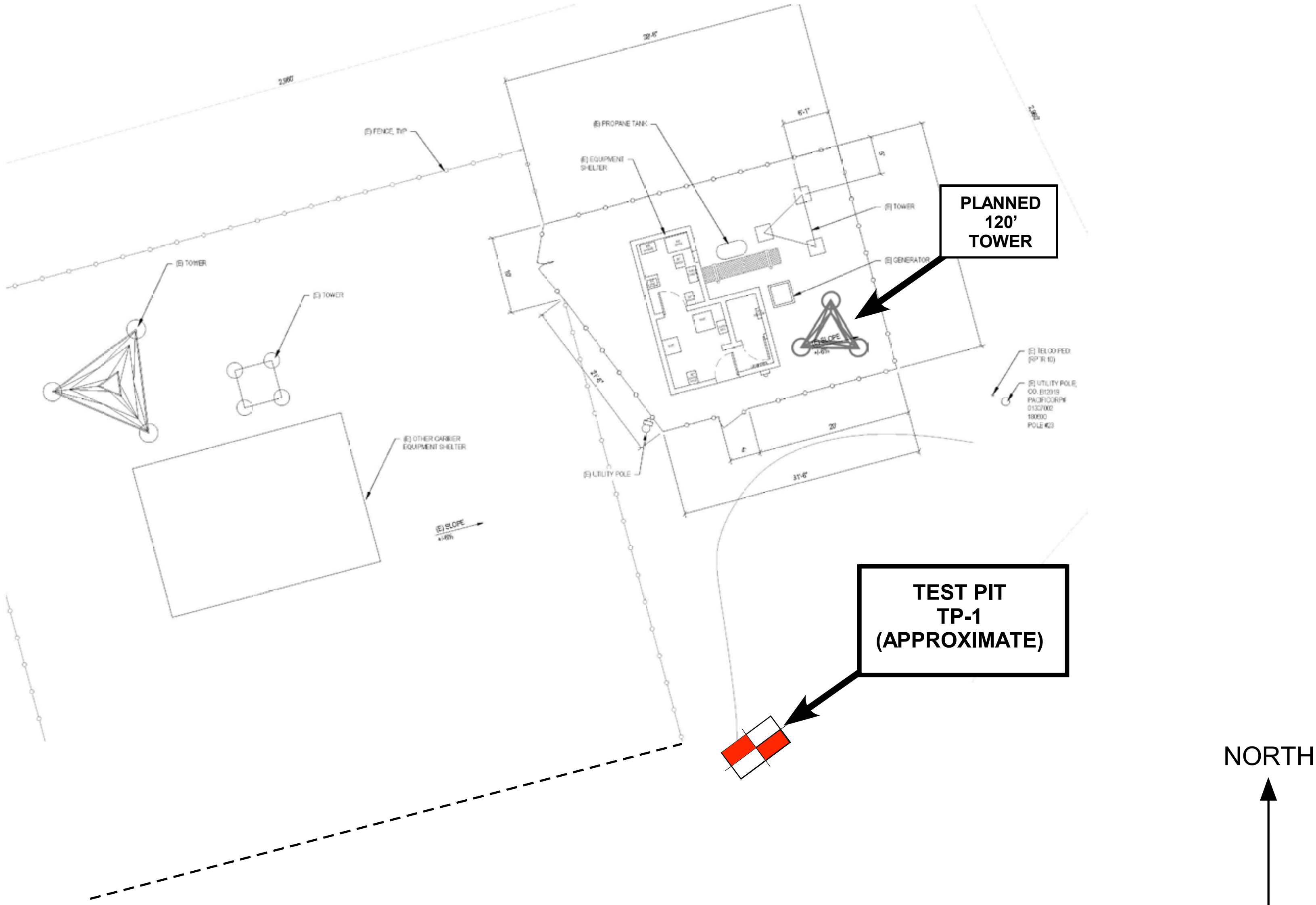
We have made observations based on our explorations that indicate the soil conditions at only those specific locations and only to the depths penetrated. These observations do not necessarily reflect soil types, strata thickness, or water level variations that may exist in other locations. If subsurface conditions vary from those anticipated, Black Mountain will provide additional geotechnical recommendations, if necessary. The future performance and integrity of the improvements will depend largely on proper initial site preparation, drainage, and construction procedures. Observation by experienced geotechnical personnel should be considered an integral part of the construction process.

The conclusions and recommendations contained in this report are based on our understanding of the currently proposed project, as derived from written and verbal information supplied to us by the client. When the design has been finalized, we recommend that our firm review to see that our recommendations have been interpreted and implemented as intended. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

ATTACHMENT A

FIGURES



Drawing provided by Cushing Civil Engineers, Not to Scale

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FIGURE 2 - Site & Exploration Plan

Project : 210074-GEO

Client : Cushing Civil Engineers

Location

John's Peak
2563 John's Peak Road
Central Point, Oregon 97502

Date : December 2021

ATTACHMENT B

SUBSURFACE EXPLORATION LOG