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December 5, 2021

Black Mountain Project No. 210072-GEO

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

Attention: Mr. Kenny McManaway

Subject: Geotechnical Engineering Evaluation
Applegate Fire Station 4 NSB
12188 Williams Highway
Grants Pass, Oregon 97527

Black Mountain Consulting LLC (Black Mountain) is pleased to submit this report describing our recent geotechnical engineering evaluation for the Applegate Fire Station 4 NSB 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

Applegate Fire Station 4 NSB
Applegate, Oregon

210072-GEO
December 2021

PROJECT DESCRIPTION

The project is located at 12188 Williams Highway, near Grants Pass, Josephine County, Oregon, as shown on the attached *Site Location Map,* Figure 1. The proposed project will consist of constructing a new approximately 80-foot emergency communications tower adjacent to an existing building (Applegate Fire Station 4) and installing ground equipment within the existing building.

SITE CONDITIONS

Regional Geology

The geology of the area consists of a complex group of 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 Pleistocene to Holocene age alluvial fan debris, colluvium and talus deposits (Qf) consisting of silt and basalt fragments (Walker, G.W. and MacLeod, N.S., 1991) and Holocene age alluvial deposits (Qal) consisting of sand, gravel, and silt (Walker, G.W. and MacLeod, N.S., 1991) that have filled in the valley floor. The level plain is enclosed by steeper terrain comprised of late Jurassic and early Cretaceous granitic rocks (KJg) and extensive flows of Triassic and/or Jurassic age andesite basalt (TRPv) (Walker, G.W. and MacLeod, N.S., 1991).

Surface Conditions

The project site is located adjacent to an existing fire department station, and is currently vacant and level. The site is covered by a concrete pad and an asphalt-paved driveway provides access to the site. There was no standing water present at the time of our site visit.

Subsurface Conditions

We explored the subsurface conditions at the project site on December 1, 2021. We drilled one boring, using hollow-stem drilling methods, to approximately 22 feet below ground surface (bgs) to the west of the proposed tower, as shown on the attached *Site & Exploration Plan*, Figure 2. We performed Standard Penetration Tests (ASTM D 1586) at regular five-foot intervals. We logged and classified the subsurface materials in general accordance with the Manual Visual Classification Method (ASTM D 2488).

In boring B-1 we encountered medium stiff clay with varying amounts of sand that extended to about 7.5’ bgs. Below about 7.5’ bgs we encountered stiff silt with some clay that extended to about 12 feet bgs. We encountered dense sandy gravel below about 12 feet bgs that became very dense below about 17 feet bgs. We encountered very dense weathered granite at about 20 feet bgs and we terminated our boring, due to refusal, in this material at about 22 feet bgs.

We encountered groundwater at about 14 feet bgs and the ground level subsequently rose to about 13 feet bgs in the boring 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 and anticlines in the region. The nearest known fault is an unnamed fault located approximately two kilometers north 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 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 about 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 level, and is therefore not susceptible to earthquake-induced slope instability.

CONCLUSIONS

The tower can be supported on a drilled pier foundation that derives its support from the weathered granite that we encountered about 20 feet bgs.

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 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=1.03	S_1=0.45
Site Class	C	
Seismic Design Category	D	
Design Spectral Response Acceleration Parameters	S_{DS}=0.78	S_{D1}=0.43

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.

Drilled Pier Design Recommendations

Axial Capacity – Skin Friction:

For frictional resistance along the shaft of the drilled piers, acting both downward and in uplift, we recommend using the ultimate skin friction values listed below. We recommend that frictional resistance be neglected in the uppermost two feet below the ground surface. The ultimate skin friction values presented do not include a safety factor, in accordance with the provisions of the current EIA/TIA 222 code.

Ultimate Skin Friction	
Depth (feet)	**Skin Friction (psf)**
0-2	0
2-12	700
12-20	1200
20-22	1400

Axial Capacity – End Bearing:

We recommend that the drilled pier be located a minimum of two feet into the weathered granite that we encountered below 20 feet bgs. For vertical compressive soil bearing capacity, we recommend using the unit end bearing capacities presented below, where B is the diameter of the pier in feet and D is the depth into the bearing layer in feet, in accordance with the current EIA/TIA 222 code. *This ultimate end bearing capacity does not include a safety factor.*

Ultimate End Bearing Capacity		
Depth (feet)	**Bearing Capacity (tsf)**	**Limiting Point Resistance (tsf)**
20-	20 D/B	35

Notes: D = the embedment depth (in feet) into the bearing layer. B = pier diameter (feet).

Drilled Pier Lateral Capacity

Passive Earth Pressure Method: The passive earth pressure method is a simplified approach that is generally used to estimate an allowable lateral load capacity based on soil wedge failure theory. Although the lateral deflection associated with the soil wedge failure may be estimated, design lateral deflections using the passive earth pressure method should be considered approximate, due to the simplified nature of the method. A lateral deflection on the order of one-half inch would be required to mobilize the passive pressure presented below. Our recommended passive earth pressures for the soil layers encountered at this site are presented in the table below and do not include a safety factor. They may be assumed to act over an area measuring two pier diameters wide by eight pier diameters deep.

Ultimate Lateral Passive Earth Pressures	
Depth (feet)	**Passive Pressure (pcf)**
0-2	0
2-12	600
12-20	900
20-22	1200

For analyzing deflection, shear, bending moment, and soil response with respect to depth, in nonlinear soils under lateral loading using the computer program LPile, we recommend using the parameters shown below.

L-Pile Input Parameters

Soil Type	**Depth (ft)**	**Effective Unit Weight (pcf)**	**Strain e50**	**Undrained Shear Strength (psf)**	**Friction Angle (deg)**
Clay	2-12	110	0.01	350	0
Sand	12-20	48	-	-	36
Sand	20-22	48	-	-	38

Pier Construction Considerations:

We encountered groundwater at about 13 feet bgs in the boring at the time of our exploration. If groundwater is encountered during drilling, it may be necessary to pump accumulated groundwater prior to pier concrete placement. Alternatively, the use of bentonite slurry could be utilized to stabilize the drilled pier excavation. The drilling contractor should be prepared to clean out the bottom of the pier excavation if loose soil is observed or suspected, with or without the presence of slurry or groundwater. As a minimum, we recommend that the drilling contractor have a cleanout bucket on site to remove loose soils and/or mud from the bottom of the pier. If groundwater is present and abundant within the pier hole, we recommend that the foundation concrete be tremied from the bottom of the hole to displace the water and minimize the risk of contaminating the concrete mix. We recommend that concrete be placed by tremie methods if more than 3 inches of water has accumulated in the excavation.

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 sign off on a final 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 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.

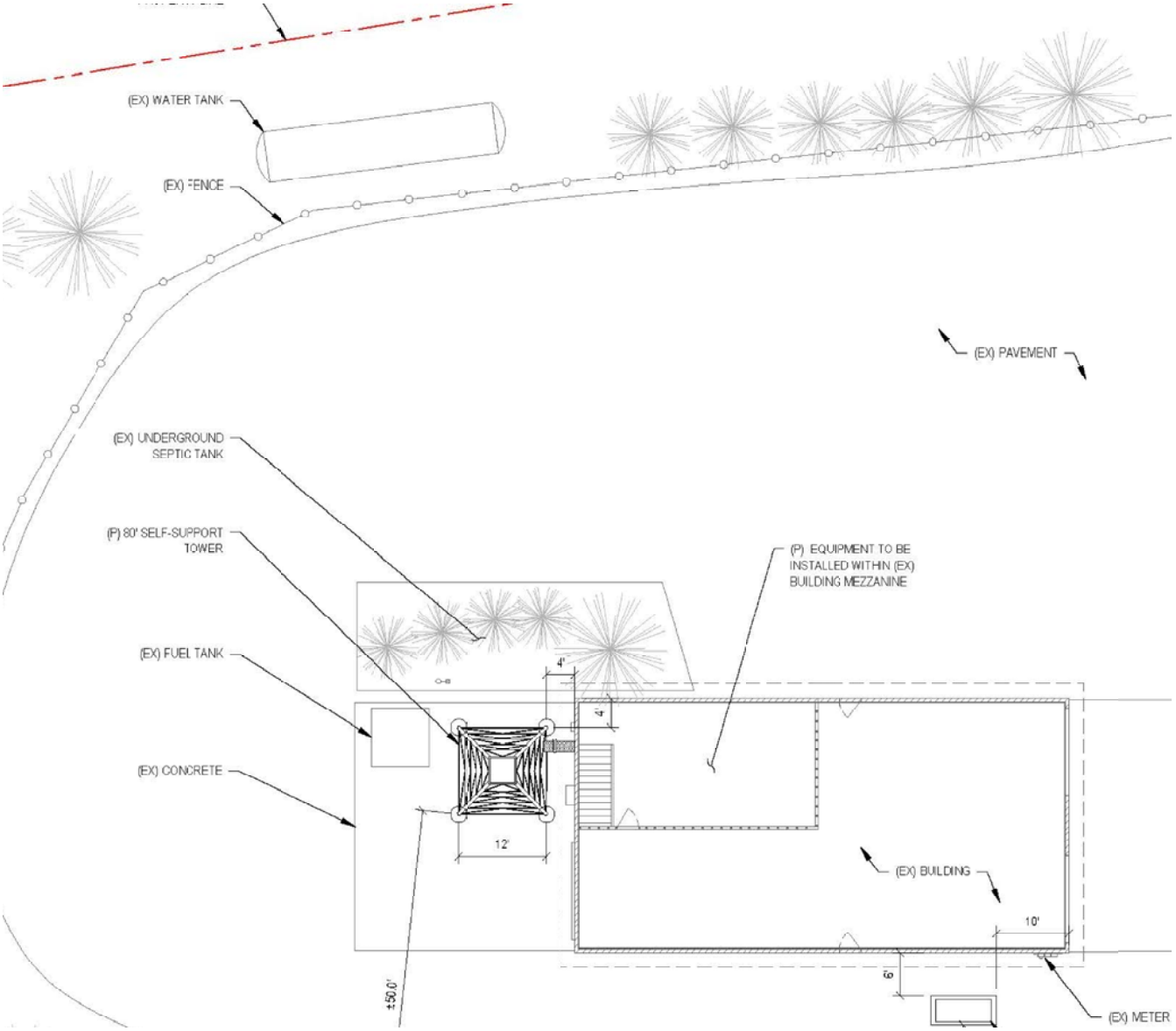
We have made observations based on our explorations that indicate the soil conditions at only those specific locations and only to the depths penetrated. These observations do not necessarily reflect soil types, strata thickness, or water level variations that may exist in other locations. If subsurface 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


(EX) WATER TANK
(EX) FENCE
(EX) PAVEMENT
(EX) UNDERGROUND SEPTIC TANK
(P) 80' SELF-SUPPORT TOWER
(P) EQUIPMENT TO BE INSTALLED WITHIN (EX) BUILDING MEZZANINE
(EX) FUEL TANK
(EX) CONCRETE
4'
4'
12'
(EX) BUILDING
10'
6'
±50.0'
(EX) METER

ATTACHMENT B

SUBSURFACE EXPLORATION LOG