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SOIL AND FOUNDATION REPORT

Prepared For:
Trinity Building Contractor
833 Nickel Plate Road
Cripple Creek, CO 80813

Subject Site:
Lot 48, Rainbow Valley, Unit 9
258 Turnabout Lane
Florissant, CO 80816

11/11/2021 Project # 2021624

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Purpose

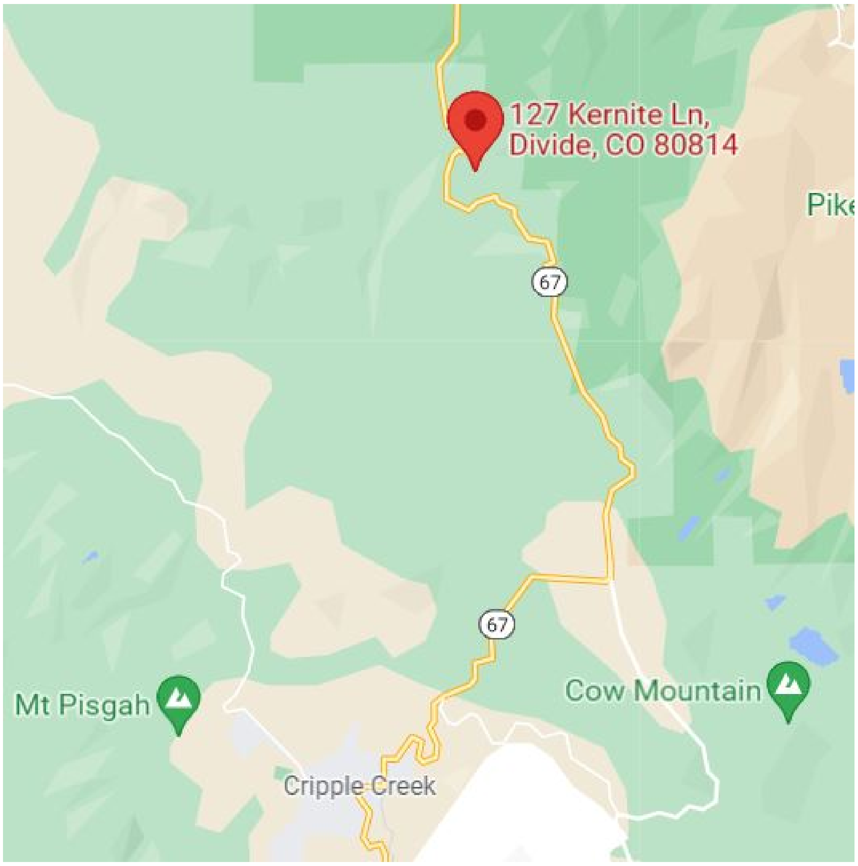
We conducted this investigation to evaluate subsurface conditions at the site and provide geotechnical engineering recommendations for the proposed residence. Our report was prepared from data developed during our field exploration, engineering analysis, and experience. This report includes a description of the subsurface conditions observed in an exploratory pit and presents geotechnical engineering recommendations for design and construction of the residence foundations, floor systems, and details influenced by the subsoils.

Recommendations contained in this report were developed based on our understanding of the planned construction. If plans differ significantly from the descriptions contained in the report, we should be informed so that we determine whether our recommendations and design criteria are appropriate.

Project Location and Site Conditions

The project is located north of Cripple Creek, Colorado as shown on the vicinity map below. Vegetation covering is primarily native grass and trees. The proposed building site is situated on the shoulder of a slope with a slopes ranging from of 20 to 33 percent to the east.

Vicinity Map



Proposed Construction

The proposed residence will be a one-story structure over a walk-out basement. The lower level will be a slab. Wood frame construction will be used above grade with cast-in-place concrete foundation walls below grade. Required excavations are not expected to exceed 8 feet for foundations. Foundation loads are expected to be low. The proposed location of the residence is shown on Figure 1.

Soils and Subsurface Conditions

Subsurface conditions were investigated by observing one exploratory pit excavated at the approximate locations shown on Figure 1. Subsurface conditions observed in the pit was logged by our representative who obtained samples of the soils during excavation. Graphic logs of the soils observed in the pit are shown on Figure 2.

Subsurface conditions observed in the test pit generally consisted of weathered granite bedrock. No groundwater was observed in the pit at the time of excavation.

Geology

We reviewed the following geologic mapping showing the site:

Geologic Map of the Pueblo Quadrangle, south-central Colorado, Colorado by Scott, G.R., Taylor, R.B, Epis, R.C, and Wobus, R.A with Colorado Geological Survey, 1976.

The site is mapped as Pikes Peak Granite. Neither the Geologic map, nor our site visit, found any geologic constraints for the planned construction.

Design Recommendations

Foundation Recommendations

The residence can be supported on footing foundations on the undisturbed, weathered bedrock. Prior to concrete placement, the footing areas should be moistened and compacted to provide a flat and level subgrade. Loose and disturbed soils should be removed or compacted. Our representative should observe conditions exposed in the completed foundation excavation to confirm whether the exposed soils are as anticipated and suitable for support of the foundation.

- Soils loosened during the forming process for the footings should be removed or compacted prior to placing concrete. Concrete must not be placed on snow, frozen soils, or saturated soils.

- Groundwater was not observed in our test pit during our investigation; however, some seepage may occur during foundation excavation, particularly if it occurs during precipitation events or seasonal runoff. The foundation areas and excavations should be protected from any groundwater and precipitation through the use of shallow trenches and sumps. Excavations should be sloped to a gravity discharge or to a temporary sump where water can be removed by pumping, if necessary.

- Footings can be sized using a maximum allowable soil pressure of 3,000 psf. We expect settlement of footings will be approximately 1 inch or less.

- To resist lateral loads, a coefficient of friction of 0.40 can be used for concrete in contact with soil. Lateral loads can be resolved by evaluating passive resistance using a passive equivalent fluid density of 350 pcf for onsite soil backfill that is compacted. These values have not been factored; appropriate factors of safety should be applied in design.

- Continuous wall footings should have a minimum width of at least 16 inches. Foundations for isolated columns should have minimum dimensions of 24 inches by 24 inches. Larger sizes may be required, depending upon foundation loads.

- Grade beams and foundation walls should be well reinforced, top and bottom, to span undisclosed loose or soft soil pockets and resist lateral earth pressures. We recommend reinforcement sufficient to span an unsupported distance of at least 10 feet. Reinforcement should be designed by the structural engineer.

- The soils under exterior footings should be protected from freezing. We recommend the bottom of footings be constructed at a depth of at least the local building code requirements.

Foundation Walls/Retaining Walls

Foundation walls which extend below-grade should be designed for lateral earth pressures where backfill is not present to about the same extent on both sides of the wall. Many factors affect the values of the design lateral earth pressure. These factors include, but are not limited to, the type, compaction, slope and drainage of the backfill, and the rigidity of the wall against rotation and deflection. For a very rigid wall where negligible or very little deflection will occur, an "at-rest" lateral earth pressure should be used in design. For walls that can deflect or rotate 0.5 to 1 percent of wall height (depending upon the backfill types), lower "active" lateral earth pressures are appropriate. Typical below-grade walls in residences deflect or rotate slightly under normal design loads, and that this deflection results in satisfactory wall performance. Thus, the earth pressures on the walls will likely be between the "active" and "at-rest" conditions.

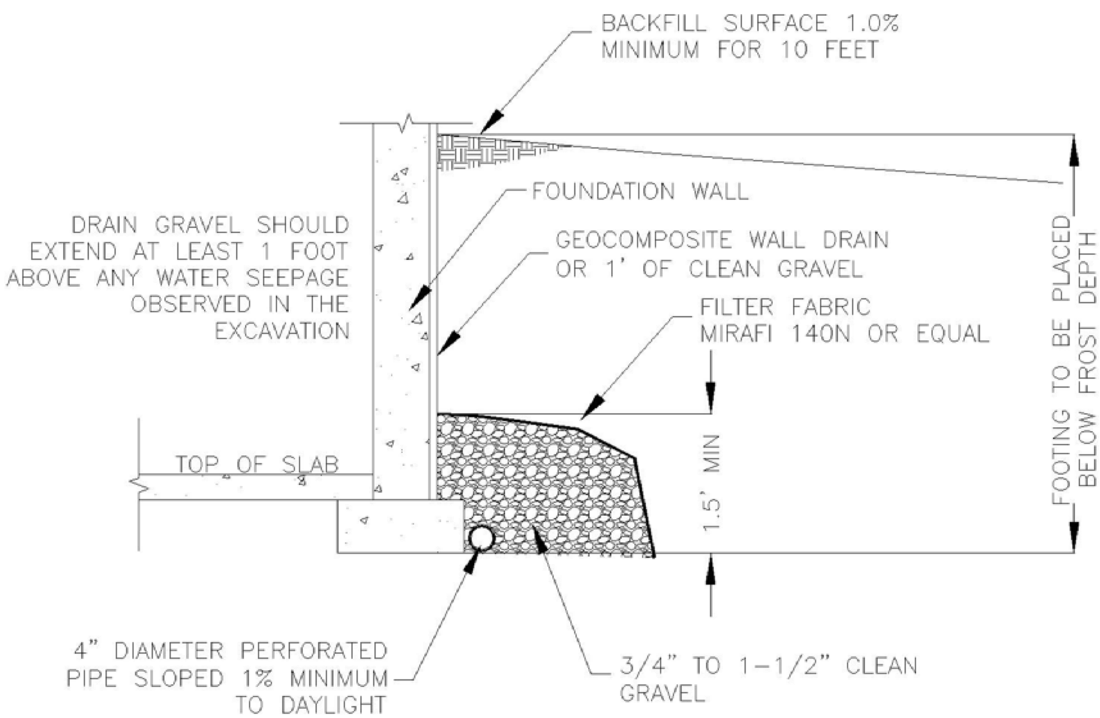
If on-site soils are used as backfill and the backfill is not saturated, we recommend design of basement walls at this site using an equivalent fluid density of at least 50 pcf. This value assumes deflection; some minor cracking of walls may occur. If very little wall deflection is desired, a higher design value is appropriate. The structural engineer should also consider site-specific grade restrictions, the effects of large openings on the behavior of the walls, and the need for lateral bracing during backfill.

Retaining walls that are free to rotate and allow the active earth pressure condition to develop can be designed using an equivalent fluid density of at least 40 pcf for on-site soil backfill.

Proper placement and compaction of foundation backfill is important to reduce infiltration of surface water and settlement of backfill. The excavated weathered bedrock can be used as backfill, provided it is are free of rocks larger than 6 inches in diameter, organics, and debris. The upper 2 feet of fill should be a relatively impervious material to limit infiltration. Backfill which will support surface improvements (patios, driveways, etc.) should be placed in thin loose lifts, moisture conditioned to within +/-2 percent of optimum moisture content, and compacted to at least 95 percent of ASTM D 698 maximum dry density. Thickness of lifts will likely need to be reduced if there are small confined areas of backfill, which limit the size and weight of compaction equipment. Some settlement of the backfill should be expected even if the material is placed and compacted properly. In our experience, settlement of properly compacted backfill could be on the order of 0.5 to 1 percent of backfill thickness. Methods to reduce the risk of backfill settlement include using a granular material and increasing the minimum compaction level. Moisture content and density of the backfill should be tested during placement. Observation of the compaction procedure is necessary.

Drainage Systems

Water from snow melt, precipitation and irrigation of landscaping frequently flows through relatively permeable backfill placed adjacent to a residence, and collects on the surface of less permeable soils occurring at the bottom of foundation excavations. To reduce the likelihood water pressure will develop outside foundation walls and the risk of accumulation of water at the crawl space level, we recommend a foundation drain be installed anywhere retaining conditions exist. The drain should be installed along the entire basement perimeter. Below is a typical drain detail.



FOOTING TO FOUNDATION WALL DETAIL

Surface Drainage

Surface drainage is critical to the performance of foundations, floor slabs and concrete flatwork. The following recommendations should be observed during and after construction. Inundation of the excavation areas should be avoided during construction. The ground surface surrounding any buildings should be sloped to drain water away from the foundation in all directions. We recommend providing a slope of at least 12 inches in the first 10 feet in landscape areas where possible, and a slope of at least 3 inches in the first 10 feet in paved areas. A swale should be provided around the uphill side of the building to divert surface runoff. The upper 2 feet of the backfill should be a relatively impervious type material to prevent excess water from entering the foundation areas. Any downspouts and drains should be installed so that the water discharges well away from the backfill areas. Landscape irrigation within 5 feet of the foundation walls should be avoided.

Slabs

The weathered bedrock found on site is suitable to support lightly loaded floor slabs. The weathered bedrock soils must be free of topsoil. It is recommended that the floor slabs be underlain by a minimum of 4 inches of clean gravel. This material should consist of minus 2-inch aggregate with at least 50% retained on the No. 4 sieve and less than 2% passing the No. 200 sieve. Slabs should be separated from exterior walls and interior bearing members with slip joints which allow free vertical movement of the slabs. Frequent control joints should be provided, in accordance with American Concrete Institute (ACI) recommendations, to reduce problems associated with shrinkage and curling.

Structural fill for floor slabs can be used including use of native soils (excavated weathered bedrock) that are free from organic matter, rocks larger than 6 inches in diameter, and debris. Structural fill beneath slabs should be placed in thin loose lifts, moisture conditioned to within +/-2 percent of optimum moisture content, and compacted to at least 95 percent of ASTM D 698 maximum dry density.

Radon

Radon is a gaseous, radioactive element that comes from the radioactive decay of uranium, which is commonly found in igneous rocks. The average indoor radon level in Colorado is above the recommended action level of 4 pCi/L as recommended by the Environmental Protection Agency. Testing for radon gas at the site is beyond the scope of this study. Typically, radon mitigation systems consist of ventilation systems installed beneath lower level slabs and crawlspaces. These mitigation systems can normally be installed during construction at a relatively low cost, which is recommended. We are not experts in radon testing or mitigation. If the client is concerned about radon, then a professional in this special field of practice should be consulted.

Site Visits and Observations

Recommendations in this report are contingent upon confirmation of the excavated foundation soils. We recommend that 285 Engineering, Inc. provide construction observation services to allow us the opportunity to verify whether soil conditions are consistent with those found during this investigation. If others perform these observations, they must accept responsibility to judge whether the recommendations in this report remain appropriate. An observation and site visit shall be performed after the excavation for the footings, prior to footing placement. An additional site visit is recommended after the foundation drain has been installed, prior to backfill.

Limitations

The conclusions and recommendations within this report are based upon the site visit, soils studies, the proposed type of construction, and experience in the area. The study has been completed in accordance with generally accepted geotechnical engineering practices in this area. Possible variations in the subsurface conditions may increase the risk of foundation movement. This report does not represent a warranty implied or expressed. Our findings are based upon subsurface conditions observed and variations in subsurface conditions may not become evident until the excavation is completed. If conditions encountered during the excavation and construction process appear different than the details of this report, a re-evaluation is required, and this office should be notified so new recommendations can be made.

Prepared by: Reviewed by:

Jessica Wiersma Roger J. Shafer, P.E.

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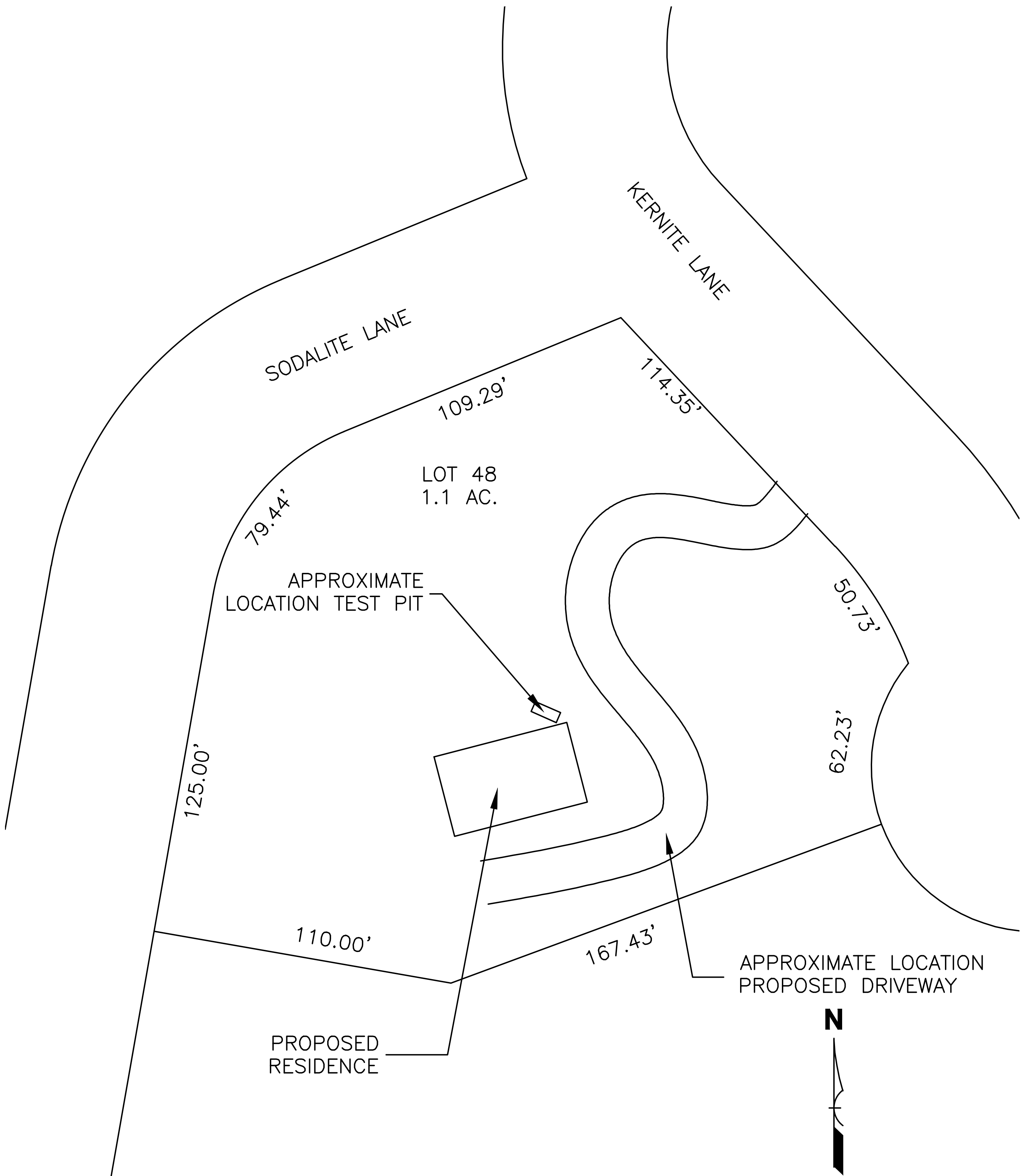
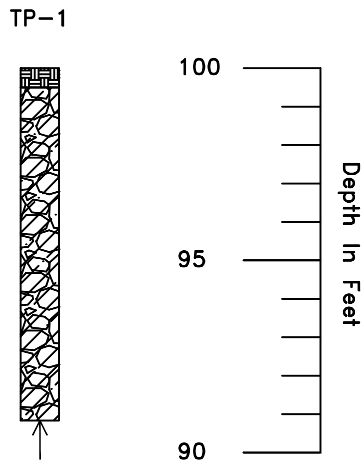
JLW:RJS

Attachments:
Figure 1 – Locations of Test Pit
Figure 2 – Summary of Test Pit



SITE PLAN
SCALE: 1" = 50'

285 ENGINEERING P.O. BOX 1048 CONIFER, CO 80433 (720)-515-1781	**PROJECT #:** 2021624 **LOCATION:** 127 KERNITE LANE CRIPPLE CREEK, CO 80813 **CLIENT:** TRINITY BUILDING CONTRACTOR	DATE: 11/11/2021 SCALE: SHOWN REVISIONS:	LOCATIONS OF TEST PIT(S) FIGURE 1



LEGEND:

 TOPSOIL – sandy clay with organics, moist, dark brown. (OL)

 WEATHERED BEDROCK – excavates to a gravel and slightly sandy.

NOTES:

1. Groundwater was not observed in the pit at the time of excavation. Groundwater levels can fluctuate.
2. Pit location shown on Figure 1 was measured from site features and are not the result of a survey.
3. This test pit is subject to the explanations, limitations and conclusions contained in this report.

285 ENGINEERING P.O. BOX 1048 CONIFER, CO 80433 (720)-515-1781	**PROJECT #:** 2021624 **LOCATION:** 127 KERNITE LANE CRIPPLE CREEK, CO 80813 **CLIENT:** TRINITY BUILDING CONTRACTOR	DATE: 11/11/2021 SCALE: N/A REVISIONS:	SUMMARY LOGS OF TEST PIT(S) FIGURE 2