

Exhibit J  
Subsoil Study



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**SUBSOIL STUDY  
FOR FOUNDATION DESIGN  
PROPOSED BANK AND COMMERCIAL BUILDING  
HENDRICK DRIVE AND HIGHWAY 133  
CARBONDALE, COLORADO**

**PROJECT NO. 19-7-623**

**OCTOBER 29, 2019  
UPDATED NOVEMBER 4, 2022**

**PREPARED FOR:**

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## **PURPOSE AND SCOPE OF STUDY**

This report presents the results of a subsoil study for a proposed bank and commercial building to be located at Hendrick Drive and Highway 133, Carbondale, Colorado. The project site is shown on Figure 1. The purpose of the study was to develop recommendations for the foundation design. The study was conducted in accordance with our proposal for geotechnical engineering services to Realty Management Group dated October 4, 2019.

A field exploration program consisting of exploratory borings was conducted to obtain information on the subsurface conditions. Samples of the subsoils obtained during the field exploration were tested in the laboratory to determine their classification and other engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop recommendations for foundation types, depths and allowable pressures for the proposed building foundations. This report summarizes the data obtained during this study and presents our conclusions, design recommendations and other geotechnical engineering considerations based on the proposed construction and the subsurface conditions encountered.

## **PROPOSED CONSTRUCTION**

The proposed building will be a two-story structure with asphalt paved drives and parking areas and sidewalks as shown on Figure 1. Ground floor will be slab-on-grade. Grading for the structure is assumed to be relatively minor with cut depths between about 2 to 5 feet. We assume relatively light to moderate foundation loadings, typical of the proposed type of construction.

If building loadings, location or grading plans change significantly from those described above, we should be notified to re-evaluate the recommendations contained in this report.

## **SITE CONDITIONS**

The subject site was vacant at the time of our field exploration. Vegetation consists of grass, weeds and sparse trees. The ground surface is relatively flat and gently sloping down to the south.

## **SUBSIDENCE POTENTIAL**

Bedrock of the Pennsylvanian age Eagle Valley Evaporite underlies the subject site. These rocks are a sequence of gypsiferous shale, fine-grained sandstone and siltstone with some massive beds of gypsum and limestone. There is a possibility that massive gypsum deposits associated with

the Eagle Valley Evaporite underlie portions of the lot. Dissolution of the gypsum under certain conditions can cause sinkholes to develop and can produce areas of localized subsidence. During previous work in the area, sinkholes were observed scattered throughout the Carbondale area. These sinkholes appear similar to others associated with the Eagle Valley Evaporite in areas of the lower Roaring Fork River valley.

Sinkholes were not observed in the immediate area of the subject property. No evidence of cavities was encountered in the subsurface materials; however, the exploratory borings were relatively shallow, for foundation design only. Based on our present knowledge of the subsurface conditions at the site, it cannot be said for certain that sinkholes will not develop. The risk of future ground subsidence at the subject site throughout the service life of the proposed structures, in our opinion, is low; however, the owner should be made aware of the potential for sinkhole development. If further investigation of possible cavities in the bedrock below the site is desired, we should be contacted.

### **FIELD EXPLORATION**

The field exploration for the project was conducted on October 24, 2019. Seven exploratory borings were drilled at the locations shown on Figure 1 to evaluate the subsurface conditions. The borings were advanced with 4-inch diameter continuous flight augers powered by a truck-mounted CME-45B drill rig. The borings were logged by a representative of Kumar & Associates, Inc.

Samples of the subsoils were taken with a 1¾ inch I.D. spoon sampler. The sampler was driven into the subsoils at various depths with blows from a 140 pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D-1586. The penetration resistance values are an indication of the relative density or consistency of the subsoils. Depths at which the samples were taken and the penetration resistance values are shown on the Logs of Exploratory Borings, Figure 2. The samples were returned to our laboratory for review by the project engineer and testing.

### **SUBSURFACE CONDITIONS**

Graphic logs of the subsurface conditions encountered at the site are shown on Figure 2. The subsoils consist of about 3 to 6 inches of topsoil overlying dense, silty to clayey sand and gravel with cobbles and probable boulders. Boring 5 encountered 1 foot of silty sand fill soils disturbed by nearby construction. Drilling in the dense granular soils with auger equipment was difficult due to the cobbles and boulders and drilling refusal was encountered in the deposit.

Laboratory testing performed on samples obtained from the borings included natural moisture content, gradation analyses and Atterberg limits. Results of gradation analyses performed on small diameter drive samples (minus 1½-inch fraction) of the coarse granular subsoils are shown on Figures 3 and 4. The Atterberg limits testing show the upper soils to have low plasticity. The laboratory testing is summarized in Table 1.

No free water was encountered in the borings at the time of drilling and the subsoils were slightly moist to moist.

## **DESIGN RECOMMENDATIONS**

### **FOUNDATIONS**

Considering the subsurface conditions encountered in the exploratory borings and the nature of the proposed construction, we recommend the building be founded with spread footings bearing on the natural granular soils.

The design and construction criteria presented below should be observed for a spread footing foundation system.

- 1) Footings placed on the undisturbed natural granular soils should be designed for an allowable bearing pressure of 3,000 psf. Based on experience, we expect settlement of footings designed and constructed as discussed in this section will be about 1 inch or less.
- 2) The footings should have a minimum width of 18 inches for continuous walls and 2 feet for isolated pads.
- 3) Exterior footings and footings beneath unheated areas should be provided with adequate soil cover above their bearing elevation for frost protection. Placement of foundations at least 36 inches below exterior grade is typically used in this area.
- 4) Continuous foundation walls should be reinforced top and bottom to span local anomalies such as by assuming an unsupported length of at least 10 feet. Foundation walls acting as retaining structures (if any) should also be designed to resist a lateral earth pressure corresponding to an equivalent fluid unit weight of at least 45 pcf for the onsite soils, excluding organics and rock larger than 6 inches, as backfill.
- 5) All existing fill, topsoil and any loose or disturbed soils should be removed and the footing bearing level extended down to the relatively dense natural granular soils. The exposed soils in footing area should then be moistened and compacted.

- 6) A representative of the geotechnical engineer should observe all footing excavations prior to concrete placement to evaluate bearing conditions.

## FLOOR SLABS

The natural on-site soils, exclusive of topsoil, are suitable to support lightly to moderately loaded slab-on-grade construction. To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints which allow unrestrained vertical movement. Floor slab control joints should be used to reduce damage due to shrinkage cracking. The requirements for joint spacing and slab reinforcement should be established by the designer based on experience and the intended slab use. A minimum 4-inch layer of relatively well graded sand and gravel, such as road base should be placed beneath interior slabs for support. This material should consist of minus 2-inch aggregate with at least 50% retained on the No. 4 sieve and less than 12% passing the No. 200 sieve.

All fill materials for support of floor slabs should be compacted to at least 95% of maximum standard Proctor density at a moisture content near optimum. Required fill can consist of the on-site granular soils devoid of vegetation, topsoil and oversized rock.

We recommend vapor retarders conform to at least the minimum requirements of ASTM E1745 Class C material used below slabs with floor covering sensitive to moisture. Certain floor types are more sensitive to water vapor transmission than others. For floor slabs bearing on angular gravel or where flooring system sensitive to water vapor transmission are utilized, we recommend a vapor barrier be utilized conforming to the minimum requirements of ASTM E1745 Class A material. The vapor retarder should be installed in accordance with the manufacturers' recommendations and ASTM E1643

## UNDERDRAIN SYSTEM

It is our understanding the proposed finished floor elevation at the lowest level is at or above the surrounding grade. Therefore, a foundation drain system is not required.

If the finished floor elevation of the proposed structure is revised to have a floor level below the surrounding grade, we should be contacted to provide recommendations for an underdrain system. All earth retaining structures should be properly drained.

## PAVEMENT DESIGN SECTION

A pavement section is designed to distribute concentrated traffic loads to the subgrade. Pavement design procedures are based on strength properties of the subgrade and pavement

materials assuming stable, uniform subgrade conditions. Certain soils are frost susceptible and could impact pavement performance. Frost susceptible soils are problematic when there is a free water source. If those soils are wetted, the resulting frost heave movements can be large and erratic. Therefore, pavement design procedures assume dry subgrade conditions by providing proper surface and subsurface drainage.

**Subgrade Materials:** For design purposes, the soil support value of the subgrade was selected based on an Hveem 'R' value of 20 for flexible (asphalt) pavements and a modulus of subgrade reaction of 100 pci was selected for rigid (portland cement) pavements. The soils are considered slightly to moderately susceptible to frost action.

**Pavement Section:** Since anticipated traffic loading information was not available at the time of report preparation, an 18 kip equivalent daily load application (EDLA) of 15 was assumed for combined automobile and truck traffic areas. This loading is typical of a low traffic driveway and should be checked by the project civil engineer. A Regional Factor of 2.0 was assumed for this area of Garfield County based on the site terrain, drainage and climatic conditions.

Based on the assumed parameters, the pavement section in areas of combined automobile and truck traffic should consist of 8 inches of CDOT Class 6 base course and 4 inches of asphalt surface. An alternate section of 6 inches of CDOT Class 6 base course and 3 inches of asphalt surface can be used for automobile only parking areas.

As an alternative to asphalt pavement and in areas where truck turning movements are concentrated, the pavement section can consist of 6 inches of portland cement concrete on 4 inches of CDOT Class 6 base course.

The section thicknesses assume structural coefficients of 0.14 for aggregate base course, 0.44 for asphalt surface and design strength of 4,500 psi for portland cement concrete. The material properties and compaction should be in accordance with the project specifications.

**Subgrade Preparation:** Prior to placing the pavement section, the entire subgrade area should be stripped of vegetation and topsoil, scarified to a depth of 8 inches, adjusted to a moisture content near optimum and compacted to at least 95% of the maximum standard Proctor density. The pavement subgrade should be proof rolled with a heavily loaded pneumatic-tired vehicle. Pavement design procedures assume a stable subgrade. Areas which deform excessively under heavy wheel loads are not stable and should be removed and replaced to achieve a stable subgrade prior to paving.



**Drainage:** The collection and diversion of surface drainage away from paved areas is extremely important to the satisfactory performance of pavement. Drainage design should provide for the removal of water from paved areas and prevent wetting of the subgrade soils. Uphill roadside ditches should have an invert level at least 1 foot below the road base.

## SURFACE DRAINAGE

The following drainage precautions should be observed during construction and maintained at all times after the bank building has been completed:

- 1) Inundation of the foundation excavations and underslab areas should be avoided during construction.
- 2) Exterior backfill should be adjusted to near optimum moisture and compacted to at least 95% of the maximum standard Proctor density in pavement and slab areas and to at least 90% of the maximum standard Proctor density in landscape areas.
- 3) The ground surface surrounding the exterior of the building should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 6 inches in the first 10 feet in unpaved areas and a minimum slope of 2½ inches in the first 10 feet in paved areas. Free-draining wall backfill (if any) should be covered with filter fabric and capped with about 2 feet of the on-site finer graded soils to reduce surface water infiltration.
- 4) Roof downspouts and drains should discharge well beyond the limits of all backfill.
- 5) Landscaping which requires regular heavy irrigation should be located at least 5 feet from foundation walls.

## LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory borings drilled at the locations indicated on Figure 1, the proposed type of construction and our experience in the area. Our services do not include determining the presence, prevention or possibility of mold or other biological contaminants (MOBC) developing in the future. If the client is concerned about MOBC, then a professional in this special field of practice should be consulted. Our findings include interpolation and extrapolation of the subsurface conditions identified at the exploratory borings and variations in the subsurface conditions may not become evident until excavation is performed. If conditions encountered

during construction appear different from those described in this report, we should be notified so that re-evaluation of the recommendations may be made.

This report has been prepared for the exclusive use by our client for design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation and field services during construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted. Significant design changes may require additional analysis or modifications to the recommendations presented herein. We recommend on-site observation of excavations and foundation bearing strata and testing of structural fill by a representative of the geotechnical engineer.

Respectfully Submitted,

**Kumar & Associates, Inc.**



Steven L. Pawlak, P.E.

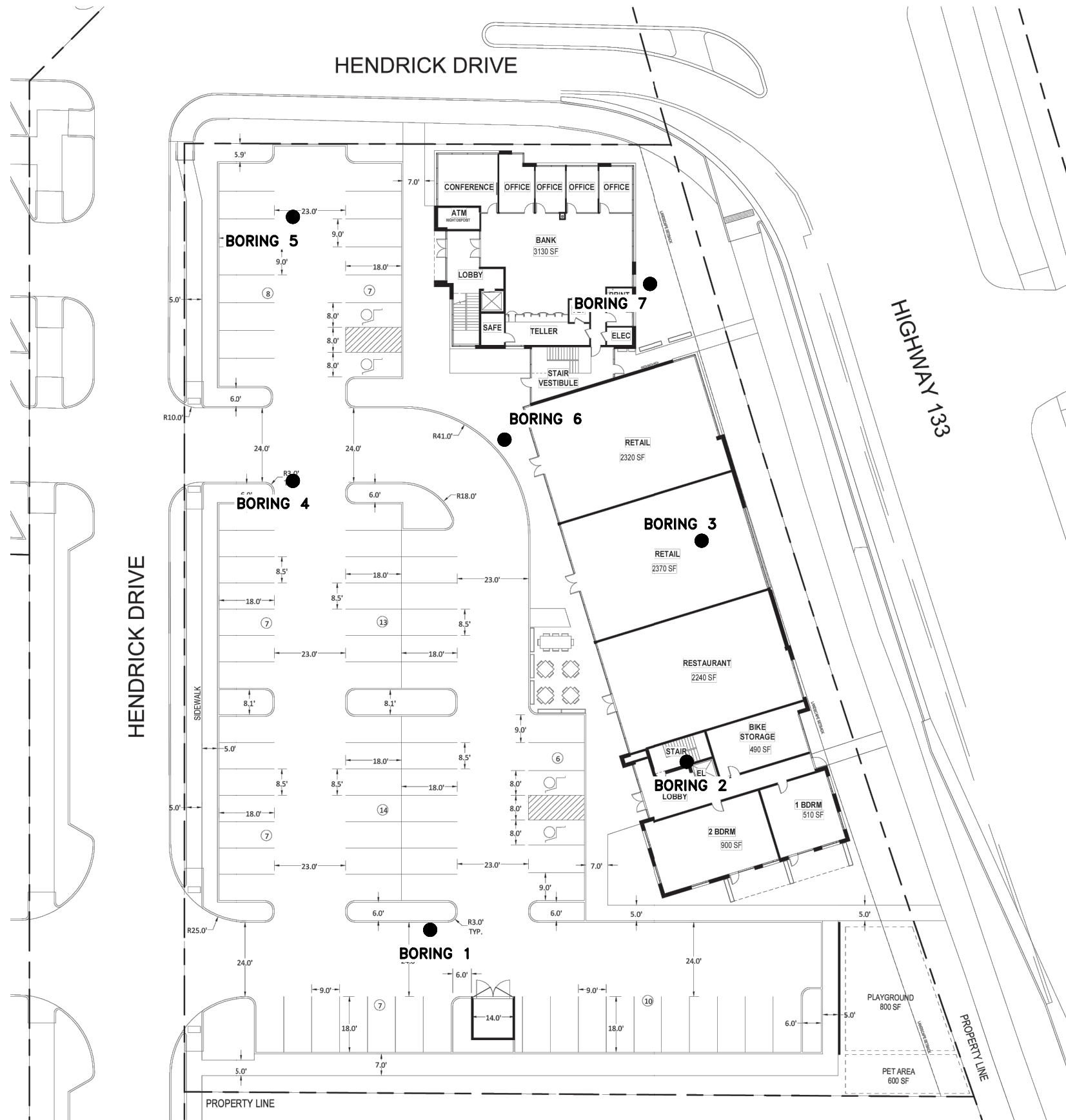
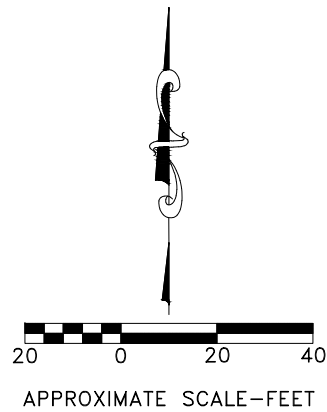
Reviewed by:

*James H. Parsons*

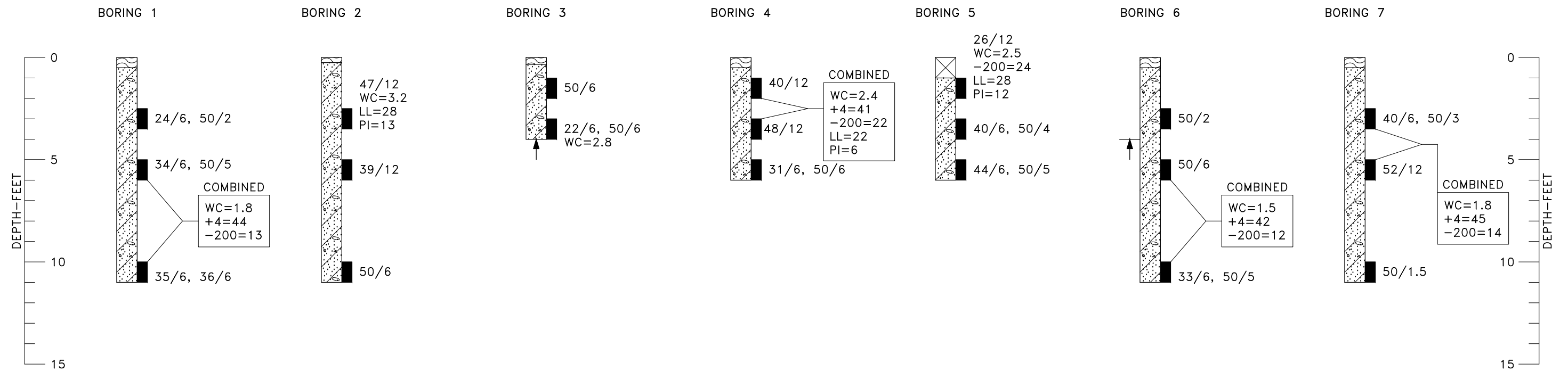
James H. Parsons, P.E.

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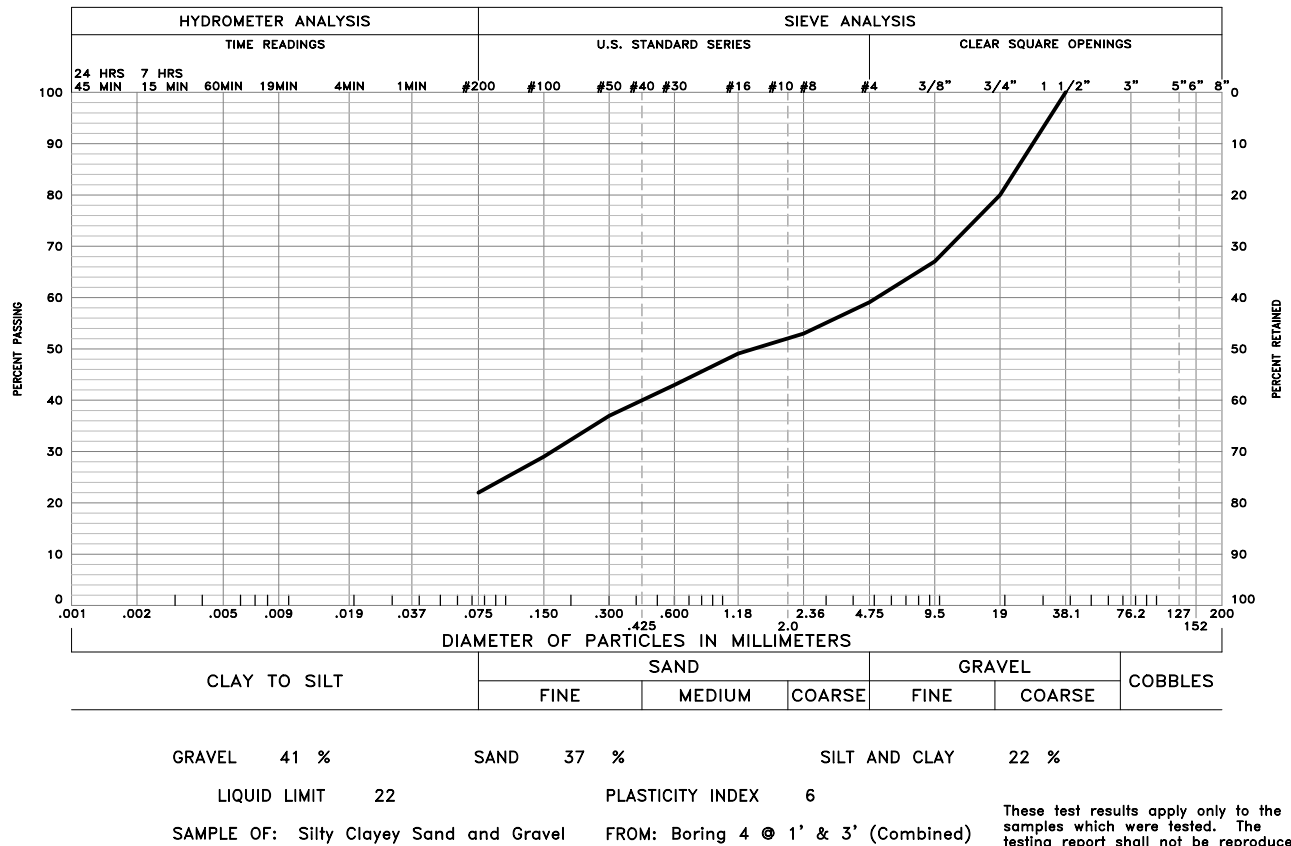
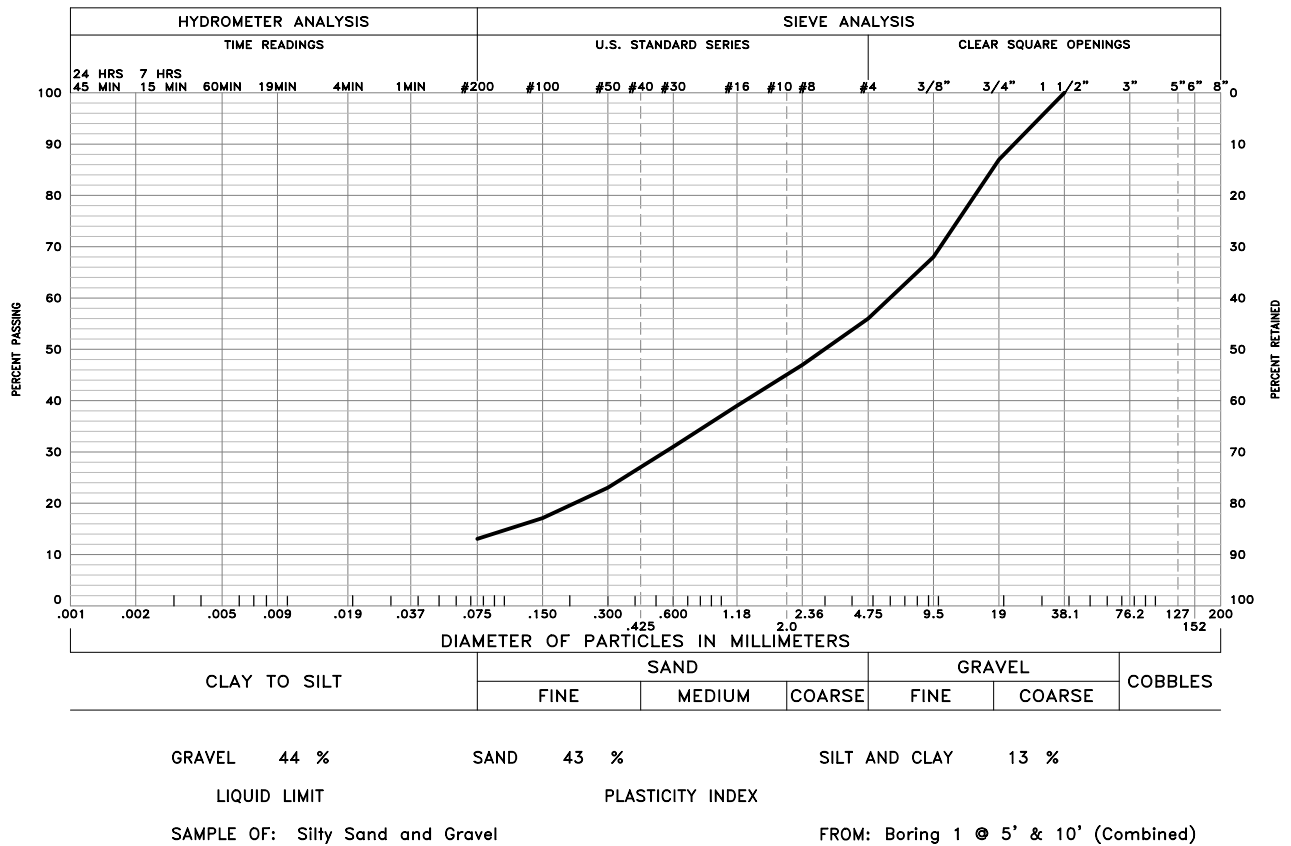


#### LEGEND

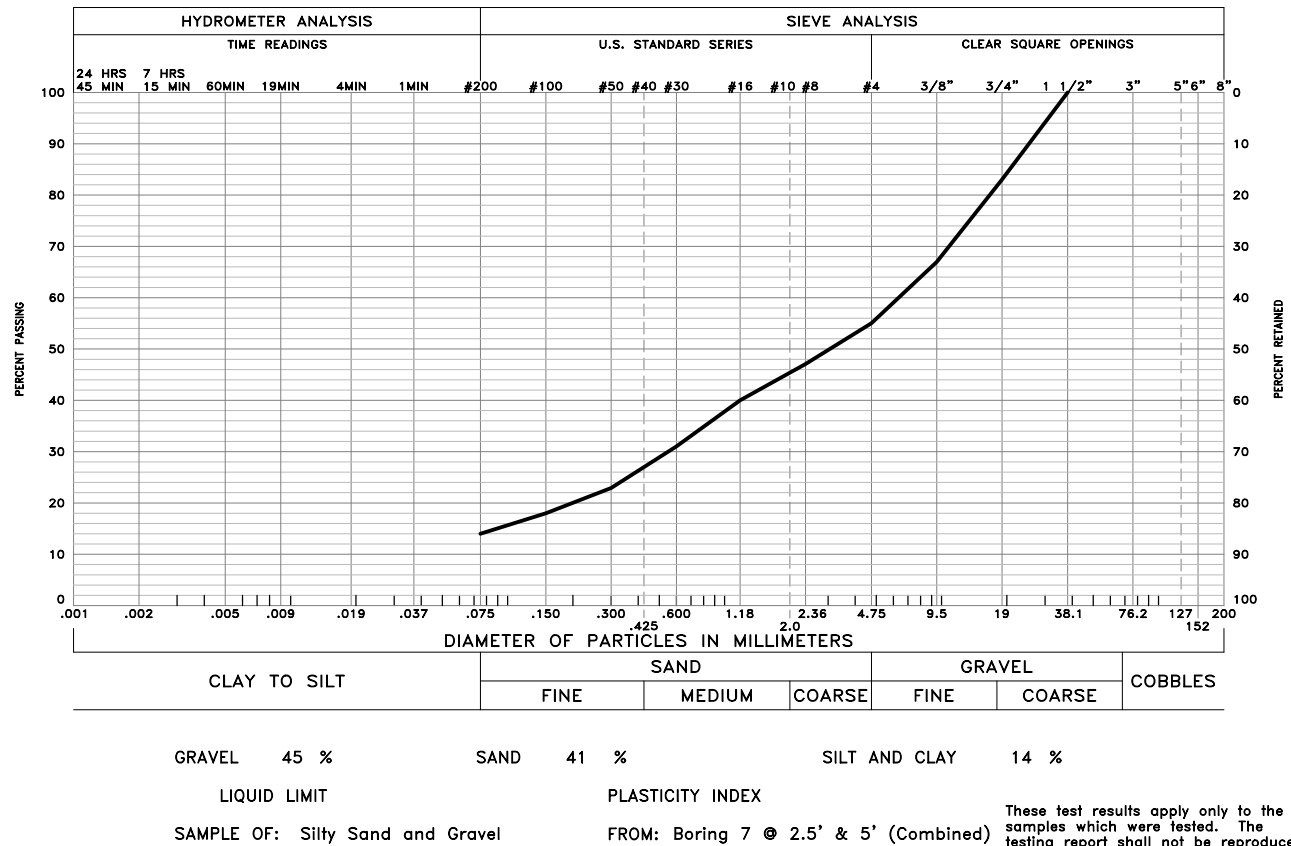
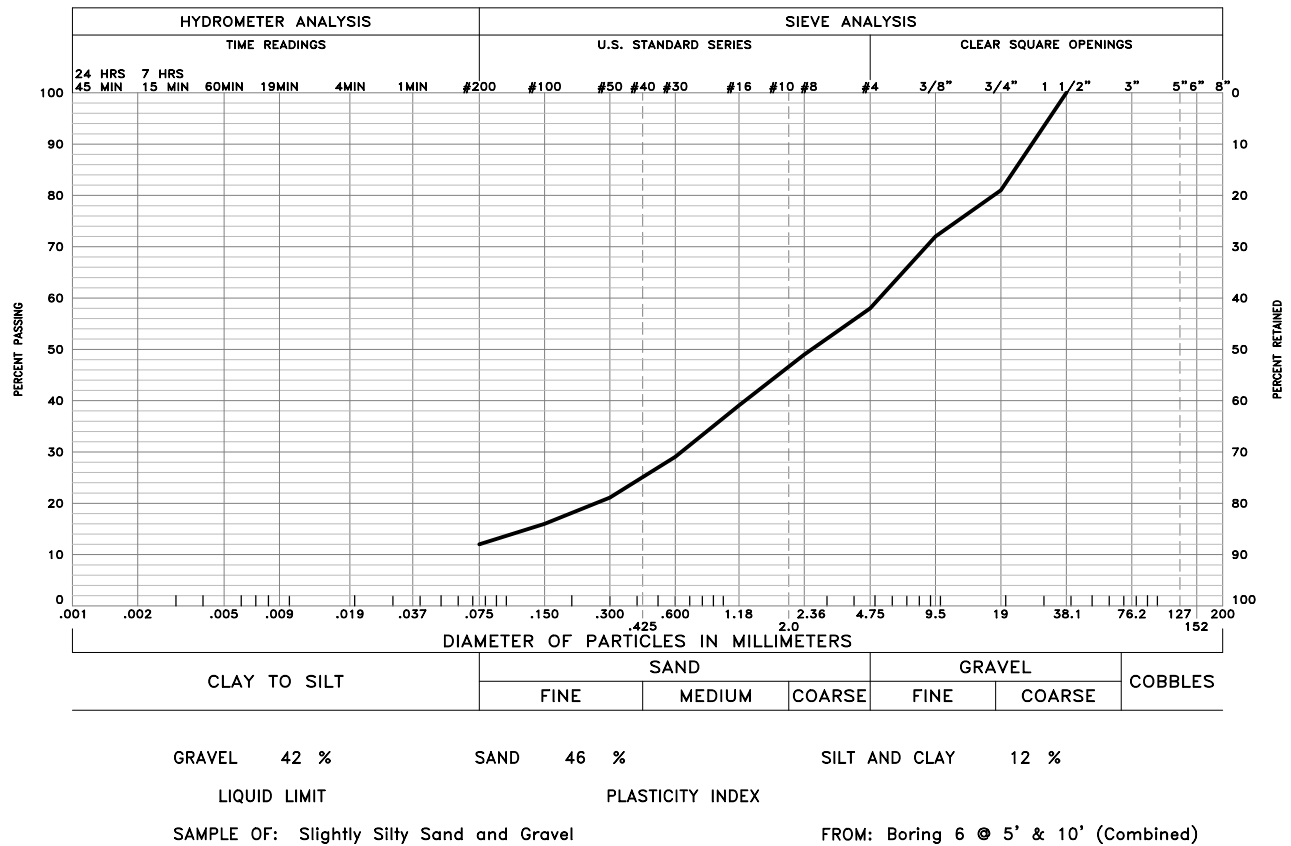
- TOPSOIL: SAND AND GRAVEL, SILTY, MOIST, BROWN, SLIGHT ORGANICS.
- FILL: SAND, SILTY, SLIGHT ORGANICS, SLIGHTLY MOIST, BROWN.
- GRAVEL AND SAND (GM-SM); COBBLES, PROBABLE BOULDERS, SILTY TO CLAYEY, DENSE, SLIGHTLY MOIST, BROWN. SUBANGULAR TO ROUNDED ROCK
- DRIVE SAMPLE, 1 3/8-INCH I.D. SPLIT SPOON STANDARD PENETRATION TEST.
- 50/2 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 50 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 2 INCHES.
- PRACTICAL AUGER REFUSAL. WHERE SHOWN ABOVE BOTTOM OF BORING, INDICATES THAT MULTIPLE ATTEMPTS WERE MADE TO ADVANCE THE HOLE.

#### NOTES

1. THE EXPLORATORY BORINGS WERE DRILLED ON OCTOBER 24, 2019 WITH A 4-INCH-DIAMETER CONTINUOUS-FLIGHT POWER AUGER.
2. THE LOCATIONS OF THE EXPLORATORY BORINGS WERE MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED.
3. THE ELEVATIONS OF THE EXPLORATORY BORINGS WERE NOT MEASURED AND THE LOGS OF THE EXPLORATORY BORINGS ARE PLOTTED TO DEPTH.
4. THE EXPLORATORY BORING LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
5. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOGS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.
6. GROUNDWATER WAS NOT ENCOUNTERED IN THE BORINGS AT THE TIME OF DRILLING.
7. LABORATORY TEST RESULTS:  
WC = WATER CONTENT (%) (ASTM D2216);  
+4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D6913);  
-200= PERCENTAGE PASSING NO. 200 SIEVE (ASTM D1140);  
LL = LIQUID LIMIT (ASTM D4318);  
PI = PLASTICITY INDEX (ASTM D4318).



These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.



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**Project No. 19-7-623**

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