GEOTECHNICAL ENGINEERING REPORT
EAST CULPEPPER FLATS
REGIONAL WATER CONNECTION – PHASE 1
SAN JUAN COUNTY, NEW MEXICO

Submitted To:

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Submitted By:

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November 12, 2020
GEOMAT Project 202-3606

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November 12, 2020

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RE: Geotechnical Engineering Study
East Culpepper Flats Region Water Connection – Phase 1
San Juan County, New Mexico
GEOMAT Project No. 202-3606

GEOMAT Inc. (GEOMAT) has completed the geotechnical engineering exploration for the East Culpepper Flats Region Water Connection – Phase 1 Project located in San Juan County, New Mexico. This study was performed in general accordance with the scope of work described in our Proposal No. 182-04-24 - Phase 1, dated April 20, 2018.

The results of our engineering study, including the geotechnical recommendations, site plan, boring records, and laboratory test results are attached. Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, the proposed new water storage tank could be supported on a conventional ring wall foundation bearing on engineered fill. The proposed valve/booster and dispensing stations could be supported on shallow foundations bearing on engineered fill. The boring logs provide an indication of the subsurface conditions along the proposed alignment of the waterline. Other design and construction details, based upon geotechnical conditions, are presented in the report.

We have appreciated being of service to you in the geotechnical engineering phase of this project. If you have any questions concerning this report, please contact us.

Sincerely yours,
GEOMAT Inc.

Seth D. Yokel
Staff Geologist

Matthew J. Cramer, P.E.
President, Principal

Copies to: Addressee (1)

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SAN JUAN COUNTY, NEW MEXICO
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INTRODUCTION

This report contains the results of our geotechnical engineering exploration for the East Culpepper Flats Region Water Connection – Phase 1 Project located in San Juan County, New Mexico, as shown on the Site Plans in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations about:

- subsurface soil conditions
- lateral soil pressures
- soil resistivity
- drainage
- groundwater conditions
- earthwork
- foundation design and construction

The opinions and recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and experience with similar soil conditions, structures, and our understanding of the proposed project as stated below.

PROPOSED CONSTRUCTION

We understand the project will consist of approximately 4½ miles of 8-inch water line, a booster station with an associated above ground water tank, and a dispensing station. We understand the booster station will consist of a building on the order of 1,600 sf to house a booster pump(s) and the associated tank will be 14 feet in diameter with a capacity on the order of 15,000 gallons. The southern termini of the waterline will be at the intersection of County Road 3068 and will proceed north along New Mexico Highway 574 for approximately 4.5 miles. The waterline will be placed outside of the paved area of the highway by open trenching with an approximate bury depth of 48 inches, minimum, except at three highway crossings and an arroyo crossing where it will be placed by horizontal directional drilling methods.

SITE EXPLORATION

Our scope of services performed for this project included a site reconnaissance by a staff geologist, a subsurface exploration program, laboratory testing and engineering analyses.

Field Exploration:

Subsurface conditions at the tank, valve, booster and dispensing stations, and selected waterline locations were explored between October 21 and 23, 2020, by drilling 19 exploratory borings at the approximate locations shown on the Site Plans in Appendix A.

The borings were advanced to the following depths below existing ground surface with a CME-55 truck-mounted drill rig with continuous-flight, 7.25-inch O.D. hollow-stem augers:

Boring Number	Location	Total Depth (feet)
B-1	Waterline Alignment	10
B-2	Waterline Alignment	10
B-3	Waterline Alignment	10
B-4	Waterline Alignment	10
B-5	Waterline Alignment	10
B-6	Waterline Alignment	10
B-7	Waterline Alignment	10
B-8	Waterline Alignment	10
B-9	Waterline Alignment	10
B-10	Waterline Alignment	10
B-11	Waterline Alignment	10
B-12	Waterline Alignment	10
B-13	Waterline Alignment	10
B-14	Waterline Alignment	10
B-15	Arroyo Crossing	30
B-16	Arroyo Crossing	30
B-17	Valve and Booster Station	20
B-18	Above Ground Water Tank	20
B-19	Dispensing Station	20

The borings were continuously monitored by a staff geologist from our office who examined and classified the subsurface materials encountered, obtained representative samples, observed groundwater conditions, and maintained a continuous log of each boring.

Soil samples were obtained from the borings using a combination of standard 2-inch O.D. split spoon and 3-inch O.D. ring-lined barrel samplers. The samplers were driven using a 140-pound hammer falling 30 inches. The standard penetration resistance was determined by recording the number of hammer blows required to advance the sampler in six-inch increments. Representative bulk samples of subsurface materials were also obtained.

Groundwater evaluations were made in each boring at the time of site exploration. Soils were classified in accordance with the Unified Soil Classification System described in Appendix A. Boring logs were prepared and are presented in Appendix A.

Laboratory Testing:

Samples retrieved during the field exploration were transported to our laboratory for further evaluation. At that time, the field descriptions were confirmed or modified as necessary, and laboratory tests were performed to evaluate the engineering properties of the subsurface materials.

SITE CONDITIONS

Waterline Alignment:

The proposed waterline alignment follows 4½ miles of County Road 574/Old State Highway 173. Borings advanced on the waterline alignment sites were located along both sides of the roadway where it is understood the alignment will be based upon the preliminary drawings provided. However, at boring B-4, the boring was intended for the south side of the roadway, but due to overhead powerlines, the boring was moved to the north side.

The majority of the alignment explored is characterized by gently rolling hills and vegetated by native grass and small under brush.

A photograph of the general roadway conditions encountered is below.

Drill Rig at Boring B-7
View Towards the Southeast

Valve and Booster Station/Water Tank/Dispensing Station Site:

The Valve and Booster Station, Water Tank, and Dispensing Station site is approximately 900 feet northwest of the intersection of County Roads 574 and 3092. At the time of our exploration, the site was vegetated by a small growth of native grasses and underbrush. The area was relatively flat with a gentle slope from the west to the east with an elevation change no greater than 5 feet down towards County Road 574.

The photograph below depicts the site at the time of our exploration:

Drill Rig at Boring B-19
View towards the East

Arroyo Crossing Site:

The Arroyo crossing site is approximately 0.6 miles southeast of the northern termini of the waterline off of County Road 574. At the time of our exploration, the site was vegetated by a moderate to dense growth of native grasses and underbrush. The areas where we drilled were relatively flat hummocky terrain with moderate to steep slopes in other directions. The arroyo itself was approximately 10 -15 feet deep.

The photograph below depicts the site at the time of our exploration:

Drill Rig at Boring B-15
View towards the Southeast

SUBSURFACE CONDITIONS

General subsurface conditions encountered in the borings are presented in the following table:

Boring Number	Location	Subsurface Conditions
B-1	Waterline Alignment	FILL, Silty SAND, and Silty, Clayey SAND
B-2	Waterline Alignment	FILL, Sandy Lean CLAY, and SANDSTONE
B-3	Waterline Alignment	Clayey SAND
B-4	Waterline Alignment	Clayey SAND
B-5	Waterline Alignment	Clayey SAND
B-6	Waterline Alignment	FILL, Clayey SAND, and SHALE
B-7	Waterline Alignment	Silty SAND, SANDSTONE, and SHALE
B-8	Waterline Alignment	Clayey SAND
B-9	Waterline Alignment	Clayey SAND and Sandy Lean CLAY
B-10	Waterline Alignment	Clayey SAND and Sandy Lean CLAY
B-11	Waterline Alignment	Clayey SAND
B-12	Waterline Alignment	Clayey SAND
B-13	Waterline Alignment	FILL, Clayey SAND, and Silty SAND

B-14	Waterline Alignment	Clayey SAND
B-15	Arroyo Crossing	Silty SAND and Sandy Lean CLAY
B-16	Arroyo Crossing	Silty SAND and Sandy Lean CLAY
B-17	Valve and Booster Station	Silty SAND and Clayey SAND
B-18	Above Ground Water Tank	Silty SAND and Clayey SAND
B-19	Dispensing Station	Clayey SAND, Silty, Clayey SAND, SILTSTONE, and SHALE

Further subsurface condition details are shown on the Boring Logs presented in Appendix A.

Laboratory Test Results:

Results of all laboratory tests are presented in Appendix B.

Laboratory Corrosivity Test Results:

Three representative samples were submitted to an independent analytical laboratory for testing to help evaluate the potential for the on-site soils to corrode buried metal and/or concrete. The samples were tested for pH, electrical resistivity, and soluble sulfates and chlorides. Results of these tests are summarized in the table below. Complete reports of the results are included in Appendix B.

Lab No.	Boring No. / Depth	pH[1]	Laboratory Resistivity[2] (ohm-cm)	Soluble Sulfate[3] (% by weight)	Soluble Chloride[3] (% by weight)
1145	B-13 @ 1 - 5	7.97	1450	0.022	0.006
1148	B-15 @ 15	8.23	1590	0.023	0.004
1152	B-18 @ 2½	8.31	3730	0.007	ND*

[1]Analysis method EPA 9045D
[2]Analysis method EPA 9050A/2510B
[3]Analysis method EPA 300.0
*ND – Analyte NOT DETECTED at or above the reporting limit

Corrosion of Concrete:

The soluble sulfate content of the samples tested were all less than 0.10 percent (by weight) to which may be characterized as negligible to mild potential for corrosion (IBC Table 1904.3). According to the American Concrete Institute Building Code 318, when the sulfate content is less than 0.10 percent by weight in soil, any cement type may be used with a water-cement ratio maximum of 0.50, and a minimum concrete compressive strength of 4,000 psi required. All

concrete should be designed, mixed, placed, finished, and cured in accordance with the guidelines presented by the American Concrete Institute (ACI).

Corrosion of Metals:

Corrosion of buried ferrous metals can occur when electrical current flows from the metal into the soil. As the resistivity of the soil decreases, the flow of electrical current increases, increasing the potential for corrosion. A commonly accepted correlation between soil resistivity and corrosion of ferrous metals is shown in the following table:

Resistivity (ohm-cm)	Corrosivity
0 to 1,000	Severely Corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately Corrosive
>10,000	Mildly Corrosive

The samples tested had resistivity values ranging from 1,450 to 3,730 ohm-cm. Based on these laboratory results and the table above, the on-site soils would be characterized as corrosive to moderately corrosive toward ferrous metals. The potential for corrosion should be taken into account during the design process.

OPINIONS AND RECOMMENDATIONS

General:

The sites are considered suitable for the proposed pipeline, arroyo crossing, valve and booster station, water tank, and dispensing station based on the geotechnical conditions encountered and tested for this report.

Formational rock was encountered within the anticipated depth of excavation at Boring B-2 along the proposed pipeline. While the rock was not encountered in the other borings at the anticipated excavation depths for the pipeline, rock could exist at locations between the borings at these depths. Excavation of pipeline trenches in rock could be difficult in some locations.

Underground utilities, including communication and gas lines, are known to exist in some areas along the alignment, and should be expected during construction of the pipeline.

The existing moisture content of the soils encountered along the alignment were below the optimum moisture required for compaction in some locations. Moisture conditioning may be required to achieve adequate compaction.

Valve/Booster Station and Dispensing Station:

Based on the results of our subsurface exploration and laboratory testing, these structures could be supported on conventional shallow spread footings bearing or engineered fill.

Spread Footings Bearing on Engineered Fill:

The buildings could be supported on conventional shallow spread footings bearing on engineered fill. Footings should bear a minimum of 30 inches below finished grade to provide protection against frost heaving.

A minimum thickness of two (2.0) feet of engineered fill should be provided below the bottom of the footings and floor slabs. The engineered fill should extend a minimum of two (2.0) feet laterally beyond the edge of the footings.

Materials and compaction criteria for the engineered fill should be as recommended in the **Earthwork** section of this report. Adequate drainage should be provided to prevent the supporting soil/rock from undergoing significant moisture changes.

If there are any significant deviations from the assumed floor elevations, structure locations and/or loads noted at the beginning of this report, the opinions and recommendations of this report should be reviewed and confirmed/modified as necessary to reflect the final planned design conditions.

The recommended design bearing capacities and footing depths are presented in the following table.

Footing Depth[1] (ft)	Allowable Bearing Pressure (psf)	Bearing Material
2.5[2]	2,500	Engineered Fill
3.0	3,000	Engineered Fill

[1]Footing depth referenced below lowest adjacent finished grade. Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

[2] Minimum footing depth for frost protection.

Total and differential settlements resulting from the assumed structural loads are estimated to be on the order of 1/2 inch or less. Proper drainage should be provided in the final design and during construction and areas adjacent to the structure should be designed to prevent water from ponding or accumulating next to the structures.

Total and differential settlements should not exceed predicted values, provided that:

- Foundations are constructed as recommended, and
- Essentially no changes occur in water contents of foundation soils.

For foundations adjacent to descending slopes, a minimum horizontal setback of five (5) feet should be maintained between the foundation base and slope face. In addition, the setback should be such that an imaginary line extending downward at 45 degrees from the nearest foundation edge does not intersect the slope.

Footings and foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement.

Foundation excavations should be observed by GEOMAT. If the conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Water Tank Foundation:

Based on our understanding of the type of structure to be built and the results of our field subsurface exploration and laboratory testing, the Ground Storage Tank could be founded on a conventional concrete ring wall footing bearing on engineered fill.

A minimum thickness of three (3.0) feet of engineered fill should be provided below the bottom of the ring wall. The engineered fill should extend a minimum of two (2.0) feet laterally beyond the edge of the footing. An allowable bearing pressure of 2,500 psf may be used for ring wall footings bearing on engineered fill. The ring wall should bear a minimum of 30 inches below grade for frost protection.

The bottom of the tank should be supported on a minimum 3-inch thick cushion layer directly below the tank bottom as recommended in the **Preparation of Subgrade Below Tank** section of this report.

Total and differential settlements resulting from the assumed structural loads are estimated to be on the order of 1 inch or less for tank foundations constructed as recommended in the previous section.

Proper drainage should be provided in the final design and during construction and areas adjacent to the tank should be designed to prevent water from ponding or accumulating next to the structure.

We recommend the tank be filled with water to allow any settlement to occur prior to making final rigid piping connections. This operation could be conducted as part of a leak-test after the tank is constructed.

Total and differential settlements should not exceed predicted values, provided that:

- Foundations are constructed as recommended, and
- Essentially no changes occur in water contents of foundation soils.

Preparation of Subgrade Below Tank:

The bottom of the tank should be supported on engineered fill, as appropriate, as discussed in the **Water Tank Foundations** sections of this report.

In accordance with Section 13.4 of the American Water Works Association Standard D103-09, a layer of cushion material consisting of oiled sand, compacted crushed stone, fine gravel, clean sand, hydrated lime-sand mix, asphaltic road mix or similar material should be placed directly under the tank bottom. The cushion layer should be a minimum of 3 inches thick, or thicker as necessary, to reduce the potential for damage to the tank bottom by protrusions or other irregularities in the rock surface.

The minimum thickness of cushion material inside the ring wall should be 3 inches. The chloride and sulfate contents of the cushion material should be less than 100 ppm and 200 ppm, respectively.

Adequate drainage should be provided to prevent the supporting soils from undergoing significant moisture changes.

Seismic Considerations:

Seismic design parameters for the Water Tank were determined in accordance with the procedure in Section 13 of the 2005 American Water Works Association (AWWA) Standard D100-05, using ASCE hazard data available. These values are based on a Site Class of C, as determined using Table 25.

SEISMIC DESIGN PARAMETERS	
S_S	0.174 g
S_1	0.058 g
S_{MS}	0.227 g
S_{M1}	0.087 g
S_{DS}	0.151 g
S_{D1}	0.058 g

S_S = mapped spectral response acceleration at short periods
S_1 = mapped spectral response acceleration at 1-second period
S_{MS} = maximum considered earthquake spectral response acceleration for short periods
S_{M1} = maximum considered earthquake spectral response acceleration for 1-second period
S_{DS} = five-percent damped design spectral response acceleration at short periods
S_{D1} = five-percent damped design spectral response acceleration at 1-second period
g = gravitational acceleration, approximately 9.8 m/sec^2 or 32.2 ft/sec^2

The site classification per Table 25 is based on the average characteristics of the upper 100 feet of the site profile. Our scope of services for this project did not include any borings to verify the subsurface profile to a depth of 100 feet. The site classification was estimated based on the results of our subsurface exploration, experience with similar projects in the area, and a review of a geologic map of the project area. Additional exploration to greater depths would be required to verify the subsurface conditions below the depth explored for this report.

Lateral Earth Pressures:

For soils above any free water surface, recommended equivalent fluid pressures for unrestrained foundation elements are presented in the following table:

- **Active:**
  Granular soil backfill .....…… 30 psf/ft
  Undisturbed subsoil ..... 40 psf/ft

- **Passive:**
  Shallow foundation walls .....250 psf/ft
  Shallow column footings .....…….....…….. 350 psf/ft

- **Coefficient of base friction**: 0.40
  The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressures are recommended:

- **At rest:**
  Granular soil backfill.....50 psf/ft
  Undisturbed subsoil.....60 psf/ft

Fill against grade beams and retaining walls should be compacted to densities specified in **Earthwork**. Medium to high plasticity clay soils should not be used as backfill against retaining walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Over compaction may cause excessive lateral earth pressures that could result in wall movement.

Slopes:

Assuming fill specifications, compaction requirements, and recommended setbacks provided in this report are followed, cut and fill slopes as steep as to 2.5:1 (horizontal:vertical) should be stable. Depending upon specific project conditions, adequate factors of safety against slope failure may be available for steeper configurations. However, such a determination would require additional analysis.

Earthwork Recommendations for Construction:

General Considerations:

The opinions contained in this report for the proposed construction are contingent upon compliance with recommendations presented in this section. Although underground facilities such as foundations, septic tanks, cesspools, basements and irrigation systems were not encountered during site reconnaissance, such features could exist and might be encountered during construction.

Site Clearing:

1. Strip and remove any existing fill, debris and other deleterious materials from the proposed construction area. Any existing structures should be completely removed from below the new buildings/tank. All exposed surfaces below the structures should be free of mounds and depressions, which could prevent uniform compaction.

2. If unexpected fills or underground facilities are encountered during site clearing, we should be contacted for further recommendations. All excavations should be observed by GEOMAT prior to backfill placement.

3. Stripped materials consisting of vegetation and organic materials should be removed from the site, or used to re-vegetate exposed slopes after completion of grading operations. If it is necessary to dispose of organic materials on-site, they should be placed in non-structural areas, and in fill sections not exceeding 5 feet in height.

4. Sloping areas steeper than 5:1 (horizontal:vertical) should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be level and wide enough to accommodate compaction and earth moving equipment.

5. All exposed areas which will receive fill, once properly cleared and benched where necessary, should be scarified to a minimum depth of eight inches, conditioned to near optimum moisture content, and compacted to at least 95% of standard proctor (ASTM D698). Scarification and moisture-conditioning is not required in areas of rock.

Excavation:

We present the following general comments regarding our opinion of the excavation conditions for the designers' information with the understanding that they are opinions based on our soil boring data. Test borings were drilled with a CME-55, truck-mounted, rotary auger drill rig using 7 ¼ inch OD hollow stem auger. Other types of equipment or techniques would be expected to result in differing degrees of ease or difficulty of excavation. More accurate information regarding the excavation conditions should be evaluated by contractors or other interested parties from test excavations using the equipment that will be used during construction.

Based on our subsurface evaluation it appears that shallow excavations in soils at the sites will be possible using standard excavation equipment. Excavations that encounter formational rock could be difficult and may necessitate the use of heavy-duty equipment and/or specialized techniques. Our notation of the degree of weathering of formational rock is a geological description of the material and is not intended to imply the degree of ease or difficulty of rock excavation.

Foundation Preparation:

Footings should bear on engineered fill as recommended in the **Opinion and Recommendations** section of this report. All loose and/or disturbed soils should either be compacted or removed from the bottoms of footing excavations prior to placement of reinforcing steel and/or concrete.

Engineered Fill Materials for Tanks and Foundations:

1. On-site or imported soils with low expansive potentials could be used as fill material for the following:
   - general site grading
   - foundation areas under building structures
   - foundation backfill under tanks

2. Select granular materials should be used as backfill behind walls that retain earth.

3. Imported soils to be used in structural fills should conform to the following:

Gradation	**Percent finer by weight (ASTM C136)**
3"	100
No. 4 Sieve	50-100
No. 200 Sieve	50 Max
Maximum expansive potential (%)*	1.5

* Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 144-psf surcharge and submerged.

1 Aggregate base should conform to Type I Base Course as specified in Section 303 of the 2019 New Mexico Department of Transportation (NMDOT) *"Standard Specifications for Highway and Bridge Construction."*

Placement and Compaction of Engineered Fill for Tanks/Foundations:

1. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

2. Un-compacted fill lifts should not exceed 10 inches loose thickness.

3. Materials should be compacted to the following:

Material	**Minimum Percent (ASTM D698)**
Subgrade soils beneath fill areas	95
Engineered fill soils	95
Miscellaneous backfill	90

4. On-site and imported soils should be compacted at moisture contents near optimum.

Compliance:

Recommendations for foundation elements supported on compacted fills depend upon compliance with **Earthwork** recommendations. To assess compliance, observation and testing should be performed by GEOMAT.

Drainage:

Surface Drainage:

Positive drainage should be provided during construction and maintained throughout the life of the proposed project. Infiltration of water into utility or foundation excavations must be prevented during construction. Surface features that could retain water in areas adjacent to the tank should be sealed or eliminated.

In areas where the v-ditch will not exist around the tank, we recommend that the area immediately surrounding the tank be paved or otherwise surfaced with a relatively impermeable material. Consideration could be given to placing a surficial layer of well-compacted low-permeability soil ("clay cap") around the perimeter of the tank to help reduce the potential for infiltration of water adjacent to the structure.

Protective slopes should be provided with a minimum grade of approximately 5 percent for at least 10 feet from perimeter walls. Raising the site grade may help improve drainage and reduce the potential for the expansive soils to become wet. Backfill against footings and in utility trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration.

Downspouts, roof drains or scuppers should discharge into splash blocks or extensions when the ground surface beneath such features is not protected by exterior slabs or paving. Water should discharge a minimum of 10 feet away from the tank.

Subsurface Drainage:

Free-draining, granular soils containing less than five percent fines (by weight) passing a No. 200 sieve should be placed adjacent to walls which retain earth. A drainage system consisting of either weep holes or perforated drain lines (placed near the base of the wall) should be used to intercept and discharge water which would tend to saturate the backfill. Where used, drain lines should be embedded in a uniformly graded filter material and provided with adequate clean-outs

for periodic maintenance. An impervious soil should be used in the upper layer of backfill to reduce the potential for water infiltration.

Pipeline Excavation and Backfilling:

Pipe should be installed in accordance with AWWA guidelines.

Although groundwater was not encountered in our test borings to the depths explored, it should be realized that the borings reveal subsurface conditions only at discrete locations. Similarly, formational rock was encountered at relatively shallow depths in some of the borings, and could be present in other areas along the alignment. If unexpected subsurface conditions are encountered during construction, we should be contacted to provide additional recommendations.

Underground utilities, including gas, water, and communications, are known to exist in some areas along the alignment, and should be expected during construction of the pipeline.

Excavation Safety:

Construction of stable temporary excavations is the responsibility of the contractor. Temporary slopes and excavations should be designed and constructed in accordance with applicable OSHA guidelines, as appropriate.

According to OSHA Construction Standards for Excavations, all excavations in soils greater than four feet in depth must be sloped, shored, or braced. Spoils must be placed at least two feet from the edge of the excavation to reduce the potential for sidewall failure due to excessive lateral pressures. All details regarding excavation safety, as described in OSHA regulations, shall be followed.

It should be noted that conditions affecting stability of slopes and excavations can change over time depending on variables such as weather, vibration or surcharges due to nearby equipment, etc. The contractor shall be responsible for monitoring and assessing conditions affecting soil stability during construction.

Pipeline Excavation:

We present the following general comments regarding our opinion of the excavation conditions for the designers' information with the understanding that they are opinions based on our soil boring data. Test borings were drilled with a CME-55, truck-mounted, rotary auger drill rig using 7 ¼ inch OD hollow stem auger. Other types of equipment or techniques would be expected to result in differing degrees of ease or difficulty of excavation. More accurate information regarding the excavation conditions should be evaluated by contractors or other interested parties from test excavations using the equipment that will be used during construction.

Based on our subsurface evaluation it appears that excavations in soils along the pipe alignment will be possible using standard excavation equipment. Excavations that encounter formational could be difficult and may necessitate the use of heavy-duty equipment and/or specialized techniques. Our notation of the degree of weathering of formational rock is a geological description of the material and is not intended to imply the degree of ease or difficulty of rock excavation.

Backfilling and Compaction:

Excavations should be backfilled to the planned finished grades using native or imported soils that are free of debris, rubble, frozen soil, organic material, or other deleterious material. Fill material should be free of cobbles or boulders greater than six inches in diameter. Excavated bedrock may not be suitable for use as backfill material.

Backfill material should be compacted to a minimum of 90 percent of maximum dry density as determined by ASTM D698. In areas where the final backfill is located under pavements or other structures, the upper two (2.0) feet of backfill should be compacted to a minimum of 95 percent of the D698 maximum dry density. Soils should be compacted at a moisture content between three (3.0) percent below and one (1.0) percent above optimum.

Backfill material should be placed in horizontal lifts using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. In the case of conflicting moisture and/or density specifications, the criteria specified by the prevailing jurisdiction should govern.

As shown on the **Summary of Soil Tests** table in Appendix B, some of the soils encountered in our test borings had in-place moisture contents lower than the optimum moisture determined by the laboratory proctor tests. Therefore, moisture conditioning of the native soils may likely be required if they are to be used as backfill material over the pipeline. Tilling, blade-rolling, or other methods of processing may be required to uniformly distribute moisture throughout the soil prior to compaction.

The fine-grained native soils may pump or become unstable or unworkable at high moisture contents. Workability may be improved by scarifying and drying. Over-excavation of wet zones and replacement with granular materials may be necessary. Lightweight excavation equipment may be required to reduce subgrade pumping.

GENERAL COMMENTS

It is recommended that GEOMAT be retained to provide a general review of final design plans and specifications in order to confirm that grading and foundation recommendations in this report have been interpreted and implemented. In the event that any changes of the proposed project are planned, the opinions and recommendations contained in this report should be reviewed and the report modified or supplemented as necessary.

GEOMAT should also be retained to provide services during excavation, grading, foundation, and construction phases of the work. Observation of footing excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present and is considered a necessary part of continuing geotechnical engineering services for the project. Construction testing, including field and laboratory evaluation of fill, backfill, concrete and steel should be performed to determine whether applicable project requirements have been met.

The analyses and recommendations in this report are based in part upon data obtained from the field exploration. The nature and extent of variations beyond the location of test borings may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities at the same time. No warranty, express or implied, is intended or made. We prepared the report as an aid in design of the proposed project. This report is not a bidding document. Any contractor reviewing this report must draw his own conclusions regarding site conditions and specific construction equipment and techniques to be used on this project.

This report is for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. This report has also not addressed any geologic hazards that may exist on or near the site.

This report may be used only by the Client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on and off site), or other factors may change over time and additional work may be required with the passage of time. Any party, other than the Client, who wishes to use this report, shall notify GEOMAT in writing of such intended use. Based on the intended use of the report, GEOMAT may require that additional

work be performed and that an updated report be issued. Non-compliance with any of these requirements, by the Client or anyone else, will release GEOMAT from any liability resulting from the use of this report by an unauthorized party.

Appendix A

Approximate Not to Scale	SITE PLAN (5 of 5) Boring Locations (approximate) GEOMAT Project No. 202-3606 Date of Exploration: October 22, 2020	PROJECT East Culpepper Flats Regional Water Connection, Phase 1 San Juan County, New Mexico

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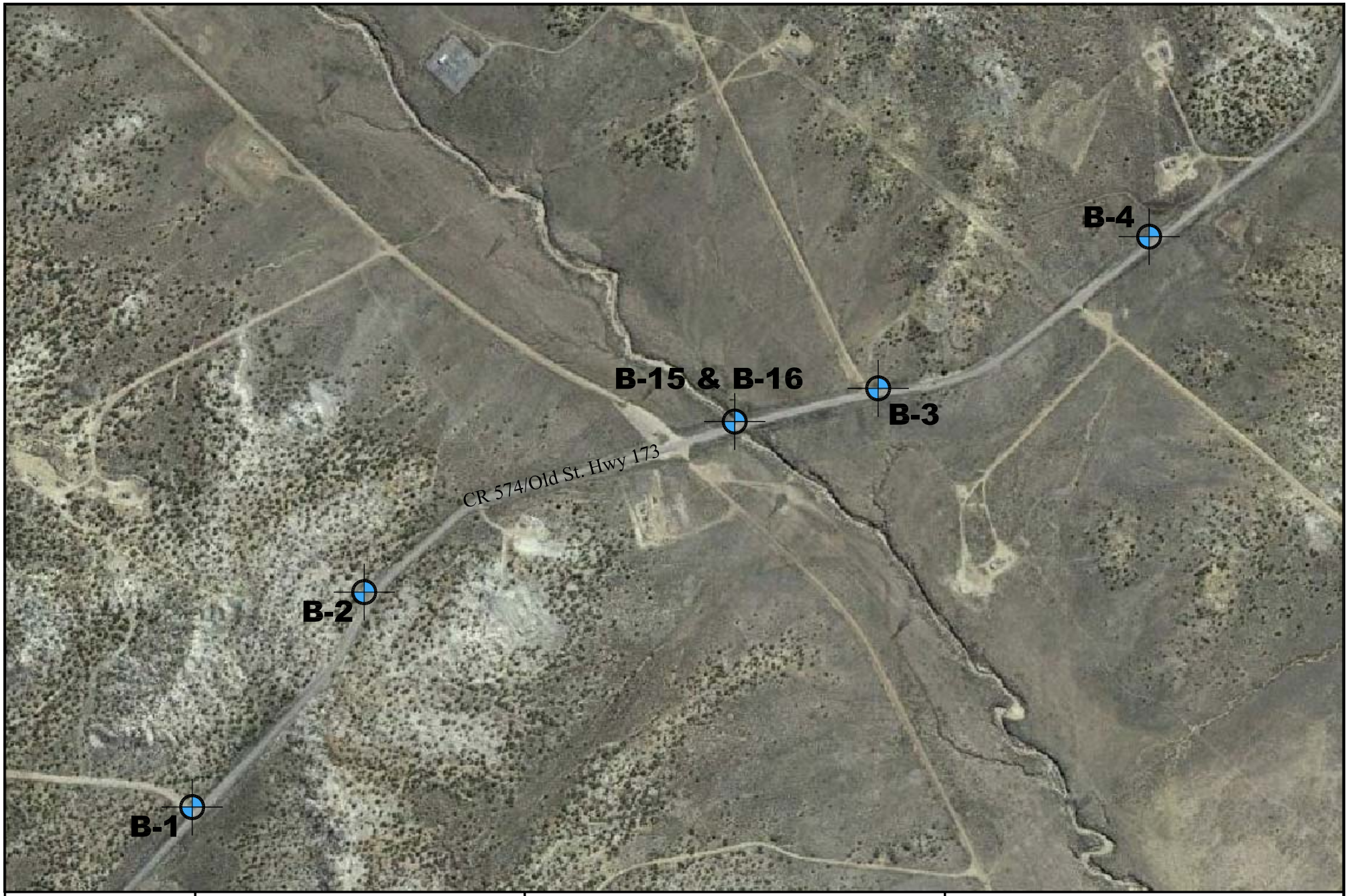

Approximate

Not to Scale

SITE PLAN (1 of 5)

Boring Locations (approximate)

GEOMAT Project No. 202-3606

Date of Exploration: October 21 & 22, 2020

PROJECT

East Culpepper Flats
Regional Water Connection, Phase 1
San Juan County, New Mexico

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Approximate Not to Scale	SITE PLAN (2 of 5) Boring Locations (approximate) GEOMAT Project No. 202-3606 Date of Exploration: October 21, 2020	PROJECT East Culpepper Flats Regional Water Connection, Phase 1 San Juan County, New Mexico

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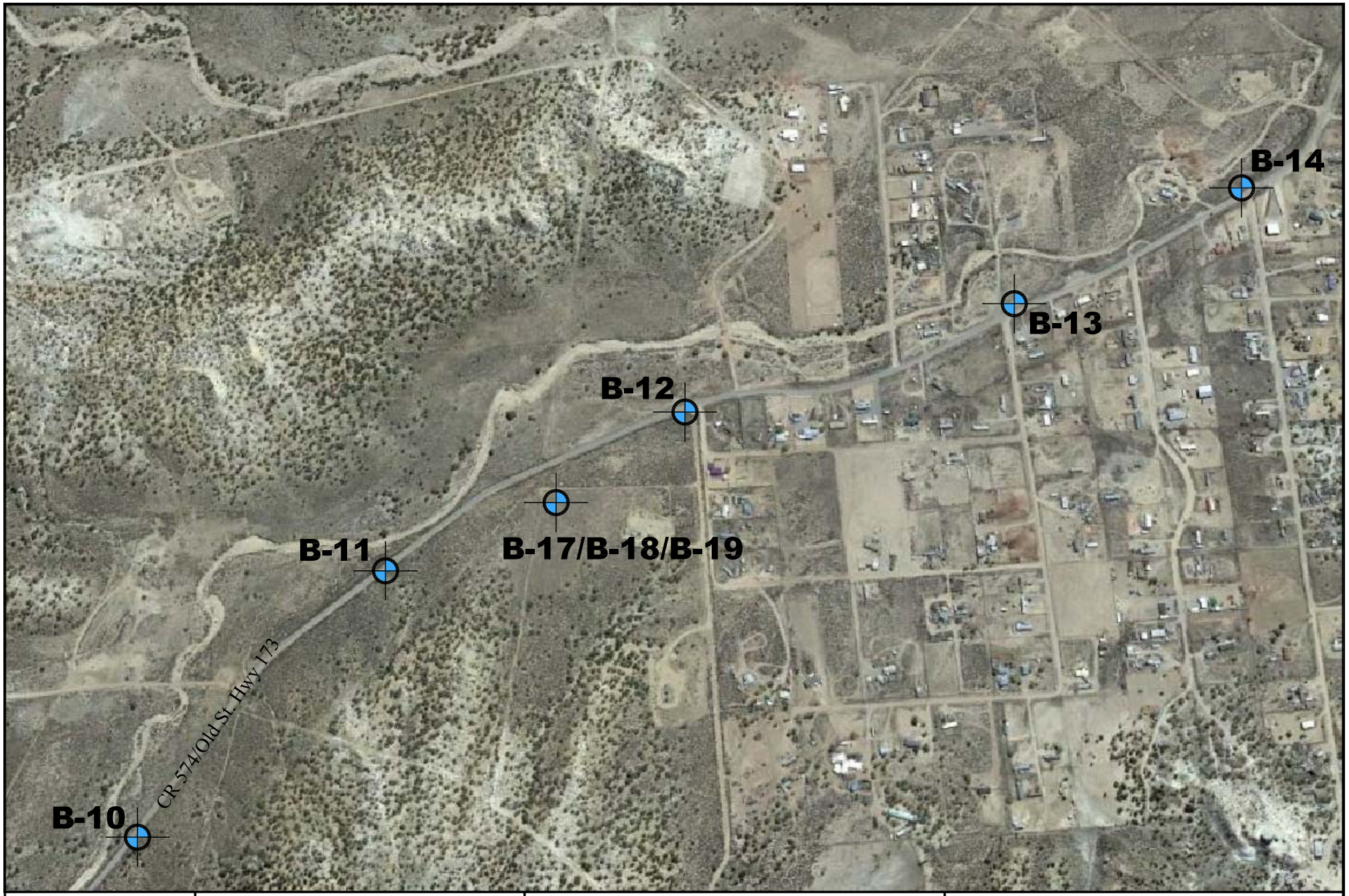

Approximate

Not to Scale

SITE PLAN (3 of 5)

Boring Locations (approximate)

GEOMAT Project No. 202-3606

Date of Exploration: October 21-23, 2020

PROJECT

East Culpepper Flats
Regional Water Connection, Phase 1
San Juan County, New Mexico

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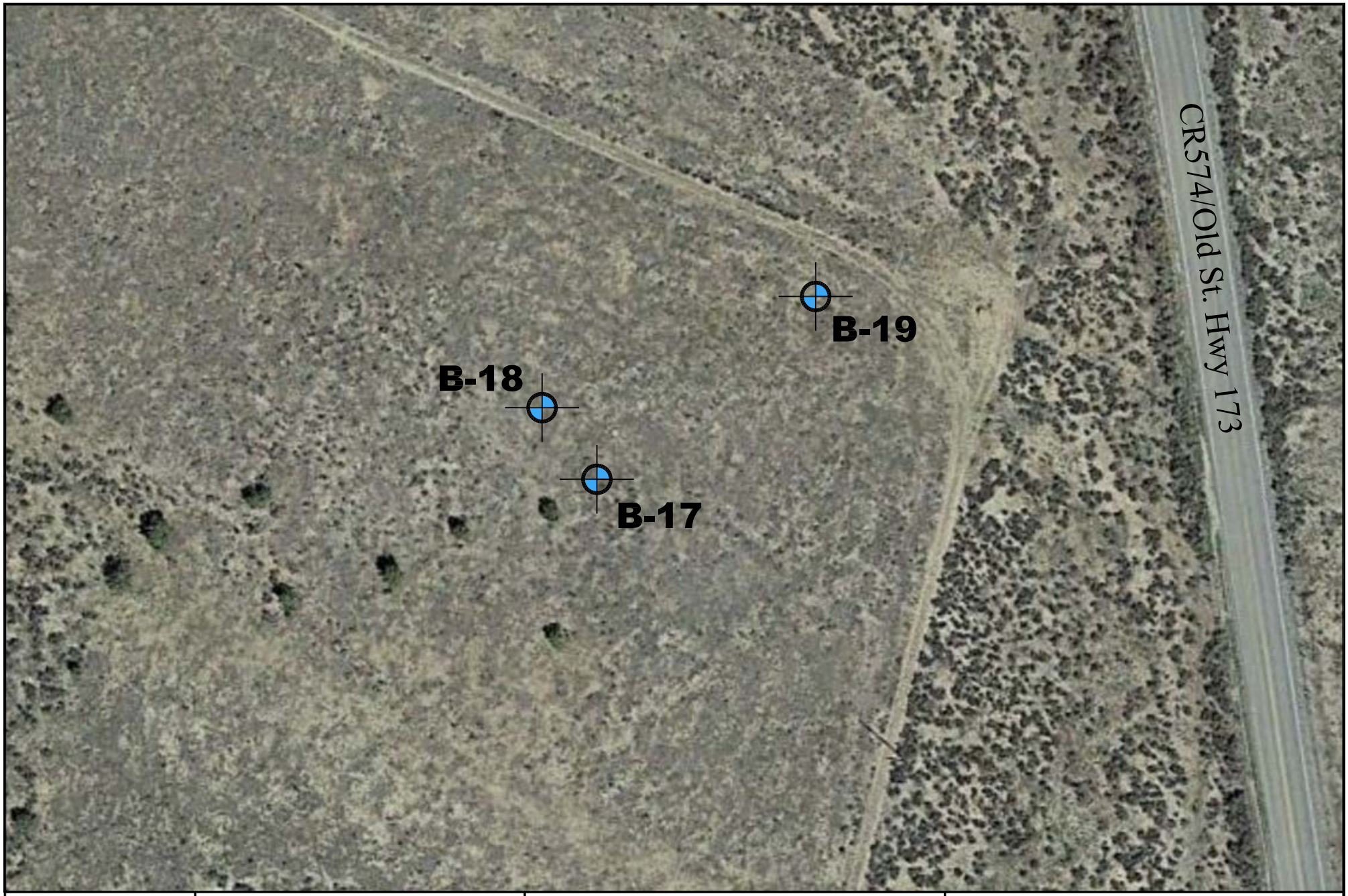

Approximate

Not to Scale

SITE PLAN (4 of 5)

Boring Locations (approximate)

GEOMAT Project No. 202-3606

Date of Exploration: October 22 & 23, 2020

PROJECT

East Culpepper Flats
Regional Water Connection, Phase 1
San Juan County, New Mexico

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Boring B-1

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/21/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Bulk and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	None
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
							GP		1	Poorly graded GRAVEL with sand, brown, fine- to coarse-grained, slightly damp (FILL)
									2	
					GRAB				3	Silty SAND with gravel and trace cobble, gray/brown, fine- to coarse-grained, medium dense, slightly damp
									4	
				5-6-5			SM		5	
					SS				6	no cobble, trace gravel
									7	
									8	
									9	grades to silty, clayey sand
				4-5-5			SC-SM		10	Silty, Clayey SAND, gray/brown, fine- to coarse-grained, medium dense, slightly damp, weak carbonate cementation
					SS				11	
									12	Total Depth 11½ feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-2

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk, Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/21/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
							GP		1	Poorly graded GRAVEL with sand, brown, fine- to coarse-grained, slightly damp (FILL)
							CL		2	
									3	Sandy Lean CLAY, gray/white, slightly damp grades to sandstone
					GRAB				4	
				23-50/5"	R		RK		5	SANDSTONE, gray, fine- to coarse-grained, moderately weathered, weak to moderate cementation
									6	
									7	
									8	
									9	
				50/5"					10	
					SS				11	dark gray shale at base of sample
									12	Total Depth 10 feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-3

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk, Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/21/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
103.5			6.9	7-10	A R				1–10	Clayey SAND, gray/brown, fine- to coarse-grained, loose, slightly damp trace gravel and cobble no cobble, weak carbonate cementation
				3-3-3	SS				11	
									12–33	Total Depth 11½ feet

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-4

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk, Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/21/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
	28	11			GRAB				1	Clayey SAND, brown, fine- to coarse-grained, very loose to loose, slightly damp
									2	
									3	gray/brown
									4	
				4-5-5	SS				5	
									6	
									7	
									8	
									9	
									10	
				4-6	R				11	contains non-plastic lens
									12	Total Depth 11 feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
									24	
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									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-5

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/21/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
					GRAB				1	Clayey SAND, brown, fine- to coarse-grained, loose, slightly damp
				3-2-3	SS		SC		6	tan, non-plastic layer approximately 8" thick
				4-4-4	SS				11	
									12	Total Depth 11½ feet

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-6

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/21/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Bulk, Ring and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	None
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
							GP		1	Poorly graded GRAVEL with sand and cobble, brown, fine- to coarse-grained, slightly damp (FILL)
									2	
					GRAB		SC		3	Clayey SAND, brown, fine- to coarse-grained, slightly damp to damp
									4	
				6-19					5	gray/brown
					R				6	SHALE, gray/green, slightly damp, weakly fissile/friable, slightly weathered
							RK		7	
									8	
									9	
				14-21-20					10	
					SS				11	
									12	Total Depth 11½ feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-7

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/21/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Bulk and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	None
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
					GRAB		SM		1	Silty SAND with trace gravel and cobble, gray/tan, fine- to coarse-grained, slightly damp
									2	
									3	no cobble
									4	
									5	tan
				50/4"	SS				6	SANDSTONE, gray, fine- to coarse-grained, slightly damp, slightly weathered, moderate cementation
							RK		7	
									8	
									9	
				17-27-26	SS		RK		10	SHALE, gray/brown, slightly damp, weakly fissile/friable
									11	
									12	Total Depth 11½ feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-8

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/21/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results				Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
Dry Density (pcf)	% Passing #200 Sieve	Plasticity Index	Moisture Content (%)							
	29	11			GRAB				1 2 3 4	Clayey SAND with trace gravel, tan/gray, fine- to coarse-grained, loose, slightly damp
				3-4-4	SS		SC		5 6 7 8 9	tan/brown contains non-plastic layer approximately 4"
				2-4-4	SS				10 11	
									12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33	Total Depth 11½ feet

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-9

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk, Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/21/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
98.0			8.8	6-8	GRAB R		SC		1 2 3 4 5 6 7 8	Clayey SAND, gray/brown, fine- to coarse-grained, loose, slightly damp gravel/cobble lens weak carbonate cementation grades to sandy lean clay
				4-5-6	SS		CL		9 10 11	Sandy Lean CLAY, gray/brown, stiff, slightly damp
									12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33	Total Depth 11½ feet

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-10

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/21/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Bulk and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	None
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
					A		SC		1	Clayey SAND with trace gravel, brown/gray, fine- to coarse-grained, loose, slightly damp
				4-4-5	SS				2 3 4 5 6 7 8 9	
										grades to sandy lean clay
				14-18-20	SS		CL		10 11	Sandy Lean CLAY, dark gray/brown, hard, slightly damp, weak carbonate cementation
									12	Total Depth 11½ feet
									13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-11

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk, Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/23/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results				Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
Dry Density (pcf)	% Passing #200 Sieve	Plasticity Index	Moisture Content (%)							
	41	15			GRAB				1 2 3	Clayey SAND with trace gravel, brown, fine- to coarse-grained, very loose to loose, slightly damp
97.7			8.9	3-5	R		SC		4 5 6	clay rich layer in cuttings weak carbonate cementation
				4-5-3	SS				7 8 9 10 11	
									12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33	Total Depth 11½ feet

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-12

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/23/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Bulk and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	None
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
									1	Clayey SAND with trace gravel, brown, fine- to coarse-grained, loose, slightly damp
					GRAB				2	
									3	
									4	clay rich layer in cuttings
				2-3-4	SS	☒	SC		5	
									6	contains non-plastic layer approximately 8" thick
									7	
									8	
									9	
									10	
				4-4-4	SS	☒			11	fine- to medium-grained, no gravel
									12	Total Depth 11½ feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
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									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-13

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/23/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
							GP		1	Poorly graded GRAVEL with sand and cobble, tan, fine- to coarse-grained, slightly damp (FILL)
	45	15			GRAB		SC		2	Clayey SAND , brown, fine- to coarse-grained, loose, slightly damp
				2-2-2	SS				3	
									4	
									5	
									6	contains sandy lenses
									7	
									8	
									9	grades to silty sand
				4-5-4	SS		SM		10	Silty SAND, tan/gray, fine- to coarse-grained, loose, slightly damp to dry
									11	
									12	Total Depth 11½ feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

GEOMAT INC.
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Farmington, NM 87401
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Fax (505) 326-5721

Boring B-14

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk, Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/23/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
									1	Clayey SAND, gray/brown, fine- to coarse-grained, loose, slightly damp
					GRAB				2	
									3	
									4	
95.9			8.0	5-7	R		SC		5	
									6	weak carbonate cementation
									7	
									8	
									9	
				4-5-5	SS				10	
									11	contains non-plastic lens
									12	Total Depth 11½ feet
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
									21	
									22	
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-15

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/22/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Bulk, Ring and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	None
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
									1	Silty SAND with trace gravel, gray/brown, fine- to coarse-grained, loose, slightly damp
					GRAB		SM		2	
									3	
									4	
				4-5-5	SS				5	
									6	tan/gray
									7	
									8	
									9	grades to sandy lean clay
105.5			11.5	6-8	R				10	Sandy Lean CLAY, brown, stiff, slightly damp to damp
									11	
									12	
									13	
							CL		14	
									15	
				8-6-6	SS				16	contains sandy lens
									17	
									18	
									19	grades to silty sand
				6-7-8	SS				20	Silty SAND, tan/gray, fine- to coarse-grained, medium dense, slightly damp
									21	
									22	
									23	
							SM		24	
									25	
				7-9-11	SS				26	contains trace gravel
									27	
									28	
									29	grades to sandy lean clay
									30	Sandy Lean CLAY, brown, very stiff, slightly damp, weak carbonate cementation
				9-8-10	SS		CL		31	
									32	contains sandy lens
									33	Total Depth 31½ feet

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Boring B-16

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/22/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Bulk, Ring and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	None
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	% Passing #200 Sieve	Plasticity Index	Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
							SM		1	Silty SAND with trace gravel, gray/brown, fine- to coarse-grained, slightly damp
					GRAB				2	
									3	
									4	grades to sandy lean clay
				8-9-8	SS				5	Sandy Lean CLAY, gray/brown, stiff to very stiff, slightly damp
									6	
									7	
									8	
									9	
	58	27		8-9-9	SS				10	
									11	
									12	
									13	
									14	
				11-13	R				15	
									16	contains sandy lens
									17	
							CL		18	
									19	
									20	
				9-10-9	SS				21	
									22	
									23	
									24	
									25	
				10-12-11	SS				26	
									27	
									28	
									29	
									30	
				4-6-6	SS				31	
									32	contains sandy lens
									33	Total Depth 31½ feet

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Boring B-17

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/22/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: Valve and Booster

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
							SM		1	Silty SAND, gray/brown, fine- to coarse-grained, slightly damp
									2	
98.7			4.9	6-8	R				3	grades to clayey sand
									4	Clayey SAND, gray/brown, fine- to medium-grained, loose to medium dense, slightly damp
	39	8		5-6-4	SS		SC		5	
									6	weak carbonate cementation
									7	
									8	
									9	
									10	
				4-6	R				11	Interlayered Silty SAND and Clayey SAND, tan/gray, fine- to coarse-grained, loose, slightly damp
									12	
									13	
									14	
				3-3-4	SS		SC-SM		15	
									16	
									17	
									18	
									19	
				3-5-3	SS				20	
									21	
									22	Total Depth 21½ feet
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-18

Project Name:	E. Culp. Flats: Reg. Water Conn.	Date Drilled:	10/23/2020
Project Number:	202-3606	Latitude:	Not Determined
Client:	Bohannan Huston	Longitude:	Not Determined
Site Location:	San Juan County, NM	Elevation:	Not Determined
Rig Type:	CME-55	Boring Location:	See Site Plan
Drilling Method:	7.25" O.D. Hollow Stem Auger	Groundwater Depth:	None Encountered
Sampling Method:	Ring and Split spoon samples	Logged By:	SY
Hammer Weight:	140 lbs	Remarks:	Tank
Hammer Fall:	30 inches		

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
									1	Interlayered Silty SAND and Clayey SAND, tan/gray, fine- to coarse-grained, loose to medium dense, slightly damp
				7-6-5	SS				2	
									3	
									4	
							SC-SM		5	
100.2			4.1	7-11	R				6	weak carbonate cementation in clayey sand lenses
									7	
									8	
									9	grades to solely clayey sand
				4-5-6	SS				10	Clayey SAND, tan/gray, fine- to medium-grained, loose to medium dense, slightly damp, weak carbonate cementation
									11	
									12	
									13	
									14	
				5-10	R		SC		15	
									16	
									17	
									18	
									19	
									20	
				4-5-5	SS				21	
									22	Total Depth 21½ feet
									23	
									24	
									25	
									26	
									27	
									28	
									29	
									30	
									31	
									32	
									33	

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

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Boring B-19

Project Name: E. Culp. Flats: Reg. Water Conn.
Project Number: 202-3606
Client: Bohannan Huston
Site Location: San Juan County, NM
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Ring and Split spoon samples
Hammer Weight: 140 lbs
Hammer Fall: 30 inches

Date Drilled: 10/23/2020
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: SY
Remarks: Dispensing Station

Laboratory Results				Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
Dry Density (pcf)	% Passing #200 Sieve	Plasticity Index	Moisture Content (%)							
95.0	23	10	6.6	6-7	R		SC		1–8	Clayey SAND, tan/gray, fine- to medium-grained, loose, slightly damp, weak carbonate cementation
				4-5-5	SS					non-plastic lens at base of sample
				5-9	R		SC-SM		9–13	Silty, Clayey SAND, tan/gray, fine- to coarse-grained, loose, slightly damp
				34-50/6"	SS		RK		14–18	SIILTSTONE, gray/tan, slightly damp, slightly weathered
									19	grades to shale
				17-50/6"	SS		RK		20–21	SHALE, gray, slightly damp, moderately fissile/friable
									22–33	Total Depth 21 feet

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample PP = Pocket Penetrometer

GEOMAT 202-3606.GPJ GEOMAT.GDT 11/9/20

UNIFIED SOIL CLASSIFICATION SYSTEM					CONSISTENCY OR RELATIVE DENSITY CRITERIA
Major Divisions			Group Symbols	Typical Names	
Coarse-Grained Soils More than 50% retained on No. 200 sieve	**Gravels** 50% or more of coarse fraction retained on No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Standard Penetration Test Density of Granular Soils
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Penetration Resistance, N (blows/ft.) / Relative Density
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures	0-4 Very Loose
			GC	Clayey gravels, gravel-sand-clay mixtures	5-10 Loose
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines	11-30 Medium Dense
			SP	Poorly graded sands and gravelly sands, little or no fines	31-50 Dense
		Sands with Fines	SM	Silty sands, sand-silt mixtures	>50 Very Dense
			SC	Clayey sands, sand-clay mixtures	Standard Penetration Test Density of Fine-Grained Soils
Fine-Grained Soils 50% or more passes No. 200 sieve	**Silts and Clays** Liquid Limit 50 or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Penetration Resistance, N (blows/ft.) / Consistency / Unconfined Compressive Strength (Tons/ft2)
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	<2 Very Soft <0.25
			OL	Organic silts and organic silty clays of low plasticity	2-4 Soft 0.25-0.50
	Silts and Clays Liquid Limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous free sands or silts, elastic silts	4-8 Firm 0.50-1.00
			CH	Inorganic clays of high plasticity, fat clays	8-15 Stiff 1.00-2.00
			OH	Organic clays of medium to high plasticity	15-30 Very Stiff 2.00-4.00
Highly Organic Soils			PT	Peat, mucic & other highly organic soils	>30 Hard >4.0

U.S. Standard Sieve Sizes

>12"	12"	3"	3/4"	#4	#10	#40	#200

Boulders	Cobbles	Gravel		Sand			Silt or Clay
		coarse	fine	coarse	medium	fine	

MOISTURE CONDITIONS

Dry	Absence of moist, dusty, dry to the touch
Slightly Damp	Below optimum moisture content for compaction
Moist	Near optimum moisture content, will moisten the hand
Very Moist	Above optimum moisture content
Wet	Visible free water, below water table

MATERIAL QUANTITY

trace	0-5%
few	5-10%
little	10-25%
some	25-45%
mostly	50-100%

OTHER SYMBOLS

R Ring Sample
S SPT Sample
B Bulk Sample
▼ Ground Water

BASIC LOG FORMAT:

Group name, Group symbol, (grain size), color, moisture, consistency or relative density. Additional comments: odor, presence of roots, mica, gypsum, coarse particles, etc.

EXAMPLE:

SILTY SAND w/trace silt (SM-SP), Brown, loose to med. Dense, fine to medium grained, damp

UNIFIED SOIL CLASSIFICATION SYSTEM

TEST DRILLING EQUIPMENT & PROCEDURES

Description of Subsurface Exploration Methods

Drilling Equipment – Truck-mounted drill rigs powered with gasoline or diesel engines are used in advancing test borings. Drilling through soil or softer rock is performed with hollow-stem auger or continuous flight auger. Carbide insert teeth are normally used on bits to penetrate soft rock or very strongly cemented soils which require blasting or very heavy equipment for excavation. Where refusal is experienced in auger drilling, the holes are sometimes advanced with tricone gear bits and NX rods using water or air as a drilling fluid.

Coring Equipment – Portable electric core drills are used when recovery of asphalt or concrete cores is necessary. The core drill is equipped with either a 4" or 6" diameter diamond core barrel. Water is generally used as a drilling fluid to facilitate cooling and removal of cuttings from the annulus.

Sampling Procedures - Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In most cases, 2" outside diameter, 1 3/8" inside diameter, samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" outside diameter samplers lined with 2.42" inside diameter brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. These values are expressed in blows per foot on the boring logs. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. "Undisturbed" sampling of softer soils is sometimes performed with thin-walled Shelby tubes (ASTM D1587). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Where samples of rock are required, they are obtained by NX diamond core drilling (ASTM D2113).

Boring Records - Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the logs.

Appendix B

LAB NO.	BORING	SAMPLE DEPTH (ft)	MOISTURE %	DENSITY		SIEVE ANALYSIS, CUMULATIVE PERCENT PASSING													ATTERBERG LIMITS			CLASSIFICATION
				WET (pcf)	DRY (pcf)	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 10	No. 16	No. 30	No. 40	No. 50	No. 100	No. 200	LL	PL	PI	
1139	B-3	5	6.9	110.7	103.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Clayey **SAND** (SC)
1140	B-4	1 - 5	-	-	-	100	100	100	99	98	97	97	93	74	62	52	38	28	27	16	11	Clayey **SAND** (SC)
1141	B-8	1 - 5	-	-	-	100	100	99	98	93	90	89	86	72	63	54	39	29	33	22	11	Clayey **SAND** (SC)
1142	B-9	5	8.8	106.7	98.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Clayey **SAND** (SC)
1143	B-11	1 - 5	-	-	-	100	100	100	98	97	96	96	93	81	73	66	56	41	29	14	15	Clayey **SAND** (SC)
1144	B-11	5	8.9	106.4	97.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Clayey **SAND** (SC)
1145	B-13	1 - 5	-	-	-	100	100	100	100	96	92	92	88	79	73	68	58	45	30	15	15	Clayey **SAND** (SC)
1146	B-14	5	8.0	103.5	95.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Clayey **SAND** (SC)
1147	B-15	10	11.5	117.6	105.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Sandy Lean **CLAY** (CL)
1148	B-15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Sandy Lean **CLAY** (CL)
1149	B-16	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58	48	21	27	Sandy Lean **CLAY** (CL)
1150*	B-17	2½	4.9	103.5	98.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Clayey **SAND** (SC)
1151	B-17	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	28	20	8	Clayey **SAND** (SC)
1152	B-18	2½	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Interlayered Silty **SAND** (SM) & Clayey **SAND** (SC)
1153*	B-18	5	4.1	104.3	100.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Interlayered Silty **SAND** (SM) & Clayey **SAND** (SC)
1154*	B-19	2½	6.6	101.3	95.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Clayey **SAND** (SC)
1155	B-19	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	27	17	10	Clayey **SAND** (SC)

* = Consolodation Test Attached

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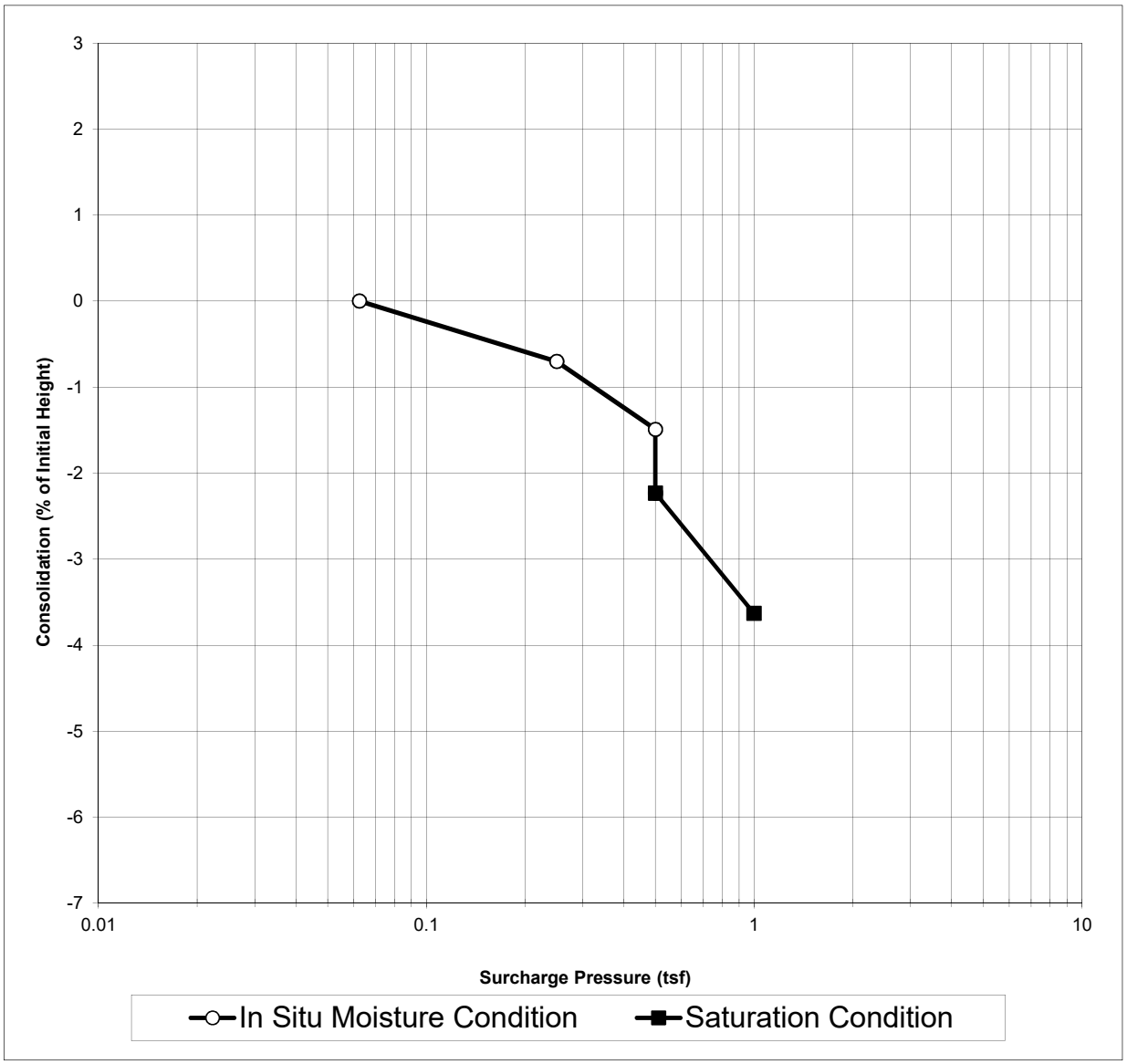
SUMMARY OF SOIL TESTS

Project	East Culpepper Flats Regional Water Connection - Phase 1
Job No.	202-3606
Location	San Juan County New Mexico
Date of Exploration	10/21-23/2020

PROJECT:	East Culpepper Flats Regional Water Connection - Phase 1	**JOB NO:**	202-3606
CLIENT:	Bohannan Huston	**WORK ORDER NO:**	NA
MATERIAL:	Clayey SAND (SC)	**LAB NO:**	1150
SAMPLE SOURCE:	B-17 @ 2½'	**DATE SAMPLED:**	10/22/2020
SAMPLE PREP.:	In Situ	**SAMPLED BY:**	SY

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.44
INITIAL MOISTURE CONTENT	4.9%	FINAL MOISTURE CONTENT	21.9%
INITIAL DRY DENSITY(pcf)	98.7	FINAL DRY DENSITY(pcf)	101.9
INITIAL DEGREE OF SATURATION	15%	FINAL DEGREE OF SATURATION	70%
INITIAL VOID RATIO	0.68	FINAL VOID RATIO	0.62
ESTIMATED SPECIFIC GRAVITY	2.651	SATURATED AT	0.5 tsf



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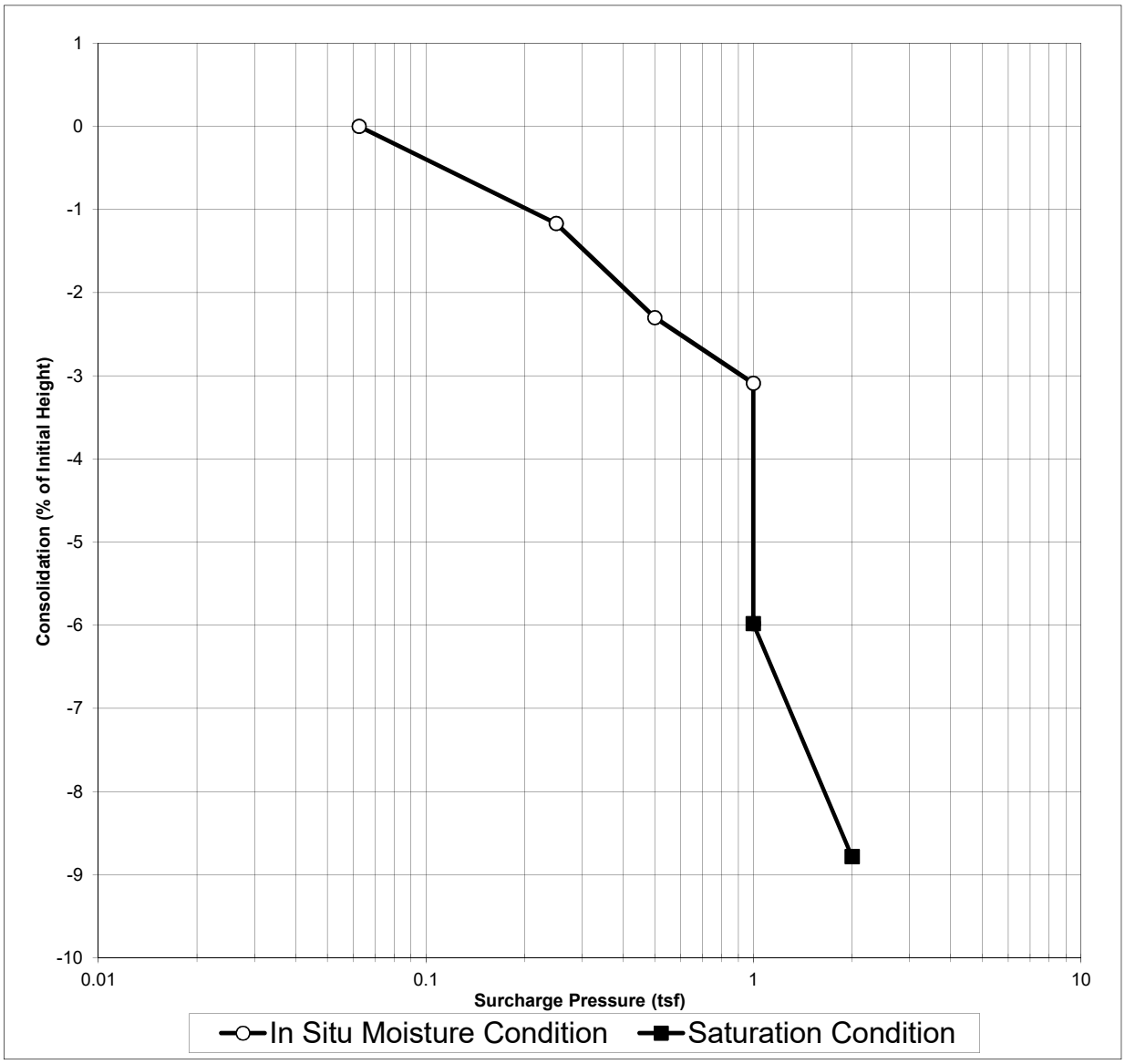
PROJECT:	East Culpepper Flats Regional Water Connection - Phase 1	**JOB NO:**	202-3606
CLIENT:	Bohannan Huston	**WORK ORDER NO:**	NA
MATERIAL:	Interlayered Silty SAND and Clayey SAND	**LAB NO:**	1153
SAMPLE SOURCE:	B-18 @ 5'	**DATE SAMPLED:**	10/23/2020
SAMPLE PREP.:	In Situ	**SAMPLED BY:**	SY

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.46
INITIAL MOISTURE CONTENT	4.1%	FINAL MOISTURE CONTENT	18.8%
INITIAL DRY DENSITY(pcf)	100.2	FINAL DRY DENSITY(pcf)	102.9
INITIAL DEGREE OF SATURATION	13%	FINAL DEGREE OF SATURATION	61%
INITIAL VOID RATIO	0.66	FINAL VOID RATIO	0.61
ESTIMATED SPECIFIC GRAVITY	2.651	SATURATED AT	1 tsf

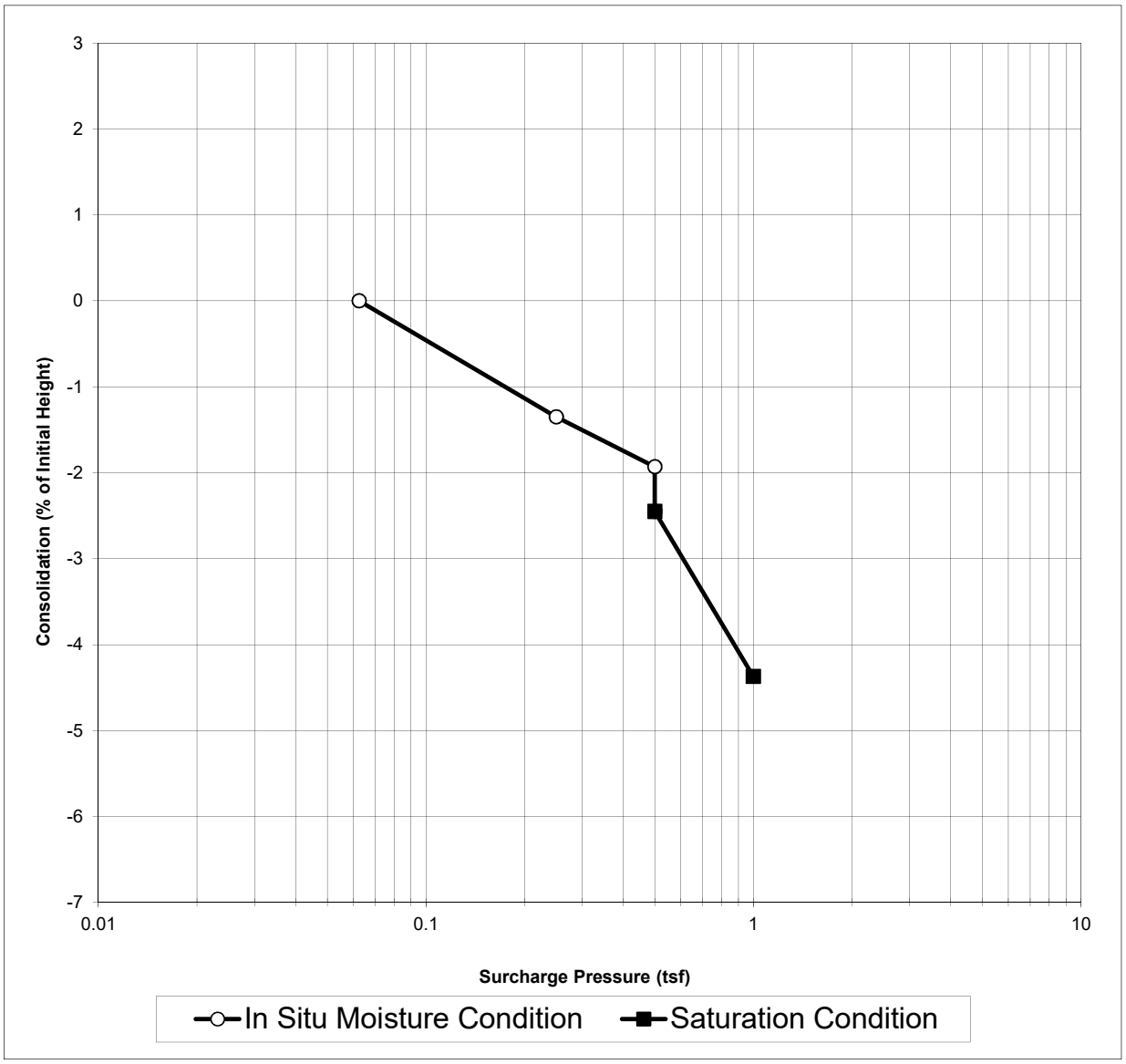


GEOMAT INC.

PROJECT:	East Culpepper Flats Regional Water Connection - Phase 1	**JOB NO:**	202-3606
CLIENT:	Bohannan Huston	**WORK ORDER NO:**	NA
MATERIAL:	Clayey SAND (SC)	**LAB NO:**	1154
SAMPLE SOURCE:	B-19 @ 2½'	**DATE SAMPLED:**	10/23/2020
SAMPLE PREP.:	In Situ	**SAMPLED BY:**	SY

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.40
INITIAL MOISTURE CONTENT	6.6%	FINAL MOISTURE CONTENT	23.7%
INITIAL DRY DENSITY(pcf)	95.0	FINAL DRY DENSITY(pcf)	98.9
INITIAL DEGREE OF SATURATION	18%	FINAL DEGREE OF SATURATION	71%
INITIAL VOID RATIO	0.75	FINAL VOID RATIO	0.67
ESTIMATED SPECIFIC GRAVITY	2.651	SATURATED AT	0.5 tsf



GEOMAT INC.

LABORATORY TESTING PROCEDURES

Laboratory testing is performed by trained personnel in our accredited laboratory or may be subcontracted by GEOMAT through a qualified outside laboratory if necessary. Actual types and quantities of tests performed for any project will be dependent upon subsurface conditions encountered and specific design requirements.

The following is an abbreviated table of laboratory testing that may be performed by GEOMAT with the applicable standards listed. Testing for a specific project may include all or a selected subset of the laboratory work listed. Laboratory testing beyond those listed may be available and could be incorporated into the project scope at the discretion of GEOMAT.

PROCEDURE	ASTM	AASHTO
Moisture Content	ASTM D2216	AASHTO T 265
Sieve Analysis	ASTM C136	AASHTO T 27
Fines Content	ASTM D1140	T 11
Hydrometer	ASTM D422	T 88
Atterberg Limits	ASTM D4318	AASHTO T 89/T 90
Soil Compression/Expansion	ASTM D2435	T 216
Soil Classification	ASTM D2487	M 145
Direct Shear	ASTM D3080	T 236
Unconfined Compressive Strength of Soils	ASTM D2166	T 208
Unconfined Compressive Strength of Rock Cores	ASTM D4543	-

Appendix C

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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