APPENDIX C

GEOLOGY REPORTS

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PRELIMINARY SUBSOIL STUDY
PARCEL 1, RED MOUNTAIN RANCH
U.S. HIGHWAY 6, EAST OF EAGLE
EAGLE COUNTY, COLORADO

JOB NO. 115 548A

FEBRUARY 29, 2016

PREPARED FOR:

MR. MERV LAPIN
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PURPOSE AND SCOPE OF STUDY

This report presents the results of a preliminary subsoil study for Parcel 1, Red Mountain Ranch, U.S. Highway 6, east of Eagle, Eagle County, Colorado. The project site is shown on Figures 1A and 1B. The purpose of the study was to develop recommendations for planning and preliminary foundation and site grading designs. The study was conducted as part of our proposal for professional services to Mr. Merv Lapin dated November 10, 2015.

A field exploration program consisting of exploratory borings was conducted to obtain information on the general subsurface conditions. Samples of the subsoils and bedrock obtained during the field exploration were tested in the laboratory to determine their classification, compressibility or swell and other engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop preliminary recommendations for foundation types, depths and allowable pressures for assumed residential construction on the parcel, as well as for the site grading. 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. The report includes a discussion of the general geologic conditions and potential hazards at the site.

PROPOSED CONSTRUCTION

The parcel is currently planned to be developed as a multi-family and/or single family residential subdivision. The buildings will likely be one to two story wood frame structures probably without basement levels. Ground floors may be slab-on-grade and/or structurally supported over crawlspace. Grading for the structures is assumed to be relatively minor with cut depths between about 3 to 6 feet. We assume relatively light foundation loadings, typical of the proposed type of construction. The parcel is planned to be annexed into the Town of Eagle and have municipal water and sewer systems.

When building locations, grading and foundation loading information have been developed, we should be notified to re-evaluate the recommendations presented in this report and perform additional analyses as needed.

SITE CONDITIONS

Parcel 1, shown on Figures 1A and 1B, is about 40 acres in size and situated primarily on lower lying, natural terrain along the north bank of the Eagle River adjacent to U.S. Highway 6. About the eastern ⅓ of the site is a higher terrace which has been graded some by fill that in general appears relatively shallow. There are several larger fill piles. There is some material storage and equipment in the eastern portion, and a residence with an on-site wastewater septic disposal system in the extreme eastern portion of the parcel.

The ground surface across the site is variable but typically slopes down to the south and southwest toward the Eagle River with about 50 to 55 feet of elevation difference across the site. Slope grades are typically about 3 to 5% in the flatter areas of the site. The transition from the higher eastern portion of the parcel down to the lower lying terrain is moderately steep, about 8 to 15%, and about 10 to 15 feet high. The slopes down to the river along the south and southeast sides of the property range from relatively flat in the eastern portion (about 3 to 5%), strongly sloping to moderately steep in the middle portion (about 10 to 15%), and steep in the eastern portion (about 40 to 50%) where there is about 25 to 30 feet of elevation change down to the river.

Several small draws and drainage ditches were also observed on the site. Vegetation consists of grass and weeds with cottonwood trees along the river in the eastern and middle portions and scattered sagebrush. There are numerous cobbles and boulders up to about 2 or 3 feet in diameter on the ground surface of the site. Wetland areas adjacent the river are shown on the survey plans provided to us as well as river high water mark adjacent the south side of the parcel.

GEOLOGIC CONDITIONS

The soils at the site are mainly alluvium deposits of the Eagle River that transition from predominantly fine grained soils in the western and central portions, with older upper level gravel terrace deposits in the eastern portion. The underlying bedrock is the Eagle Valley Evaporite.

Potential geologic hazards that may impact development the site consist of compressible soils in the lower lying terrain, the potential for slope inability of the steep slope down to the river in the eastern portion of the site, and the potential for sinkhole and sinkhole development due to the underlying Evaporite. Compressible soils and potential for slope instability are discussed in the "Preliminary Design Recommendations" section of this report. The potential for sinkhole development is discussed below. The civil engineer and/or hydrologist should review the flood potential of the lower lying terrain near the river.

Bedrock of the Pennsylvanian age Eagle Valley Evaporite underlies the 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 property. 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, several sinkholes were observed scattered throughout the Eagle River and Brush Creek valley areas. These sinkholes appear similar to others associated with the Eagle Valley Evaporite in other areas of the Eagle River valley.

Sinkholes were not observed in the immediate area of the subject parcel, however, the site grading could have concealed possible sinkholes. No evidence of cavities was encountered in the subsurface materials; however, the exploratory borings were wide spread and relatively shallow, for preliminary 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 on Parcel 1 throughout the service life of the proposed residences, in our opinion, is low; however, the owners 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 December 3 and 4, 2015. Eight exploratory borings were drilled at the locations shown on Figures 1A and 1B to evaluate the general 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 Hepworth-Pawlak Geotechnical. The borings were field staked by the surveyor prior to the drilling.

Samples of the subsoils and bedrock were taken with 1⅜-inch and 2-inch I.D. spoon samplers. The samplers were driven into the subsoils and bedrock 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 and hardness of the bedrock. 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.

Slotted PVC pipe was installed in Boring 1, 2 and 5 to allow monitoring of the groundwater level.

SUBSURFACE CONDITIONS

Graphic logs of the subsurface conditions encountered at the site are shown on Figure 2. The subsoils were somewhat variable with respect to type, depth and engineering characteristics as discussed below.

The subsoils encountered in Borings 1 and 2 located in the lower lying terrain in the southwestern part of the site, below about ½ foot of topsoil, consisted of 3 to 8 feet of loose to medium dense, silty to very silty sand with scattered gravel and cobbles underlain by loose/medium stiff, intermixed sand and silt that was typically clayey and contained scattered gravel and possible cobbles. Below depths from 9½ to 14 feet, medium dense to dense, silty sand and gravel with cobbles and possible boulders was encountered and underlain at depths from 13 to 23 feet by hard to very hard, claystone/siltstone bedrock of the Eagle Valley Evaporite.

The subsoils encountered in Borings 3 through 5 located in the intermediate lower lying terrain in the middle portion of the parcel, below nil to about 1 foot of topsoil, consisted of nil to 4½ feet of generally medium dense, silty to very silty sand with scattered gravel and cobbles underlain by relatively dense, slightly silty to silty sandy gravel and cobbles with boulders that extended down to the depths drilled of 6½ to 11 feet where practical drilling refusal occurred.

The subsoils encountered in Borings 6 through 8 located on the upper terrace in the eastern portion of the parcel, below nil to about 3 feet of man-placed fill, consisted of relatively dense, slightly silty to silty sandy gravel and cobbles with boulders that extended down to the depths drilled of 5½ to 6½ feet where practical drilling refusal occurred. Fill depths vary across the site and could be deeper than those shown on the borings logs, and especially at the fill piles.

Free water was encountered only in Borings 1 and 2 at the time of drilling and when checked several days later as shown on the boring logs. The recent free water level depths were measured at 7 and 8½ feet in Borings 1 and 2, respectively. The upper soils were slightly moist to moist becoming very moist in Borings 1 and 2 near and below the free water level. The bedrock was wet due to its apparent fractured condition.

LABORATORY TESTING

Laboratory testing performed on samples obtained from the borings included natural moisture content and density, gradation analyses, and Atterberg limits. Results of swell-consolidation testing performed on relatively undisturbed drive samples of the sand and silt soils, presented on Figures 5 and 6, indicate moderate to high compressibility under conditions of loading and wetting. Results of gradation analyses performed on small diameter drive samples (minus 1½ inch fraction) of the natural coarse granular subsoils are shown on Figures 7 and 8. The laboratory testing is summarized in Table 1.

FOUNDATION BEARING CONDITIONS

The fine grained soils at the site possess low bearing capacity and moderate to high settlement potential. The sand and gravel with cobble soils and the sandy gravel and cobble soils possess moderate bearing capacity and relatively low settlement potential. The subgrade at assumed excavation depths across the site are expected to vary from the compressible sand and silt soils to the less compressible coarse granular soils to possibly existing fill. Spread footings can probably be used to support the assumed building construction provided some risk of settlement in the compressible soil areas is acceptable and subgrade improvements are made below the footings in these areas as needed. The subgrade improvements below the footings can probably consist of subexcavation to a depth of typically about 3 feet, placement of a geo-grid such as Tensar TX 140 and onsite coarse granular soils, or CDOT Class 2 aggregate base course.

In the deeper fine grained soil areas, extending the foundation bearing down to the less compressible, coarse granular soils or bedrock could be used to provide a relatively low risk foundation settlement alternative. Suitable deep foundation systems at this site include helical piers, screw piles or micro-piles and possibly driven piles.

Surcharge loading of the compressible soils with earth embankment could also be done to reduce settlement of spread footing foundation and can be evaluated if desired.

PRELIMINARY DESIGN RECOMMENDATIONS

The conclusions and recommendations presented below are based on the general proposed development, subsurface conditions encountered in the exploratory borings, and our experience in the area. The recommendations are suitable for planning and preliminary design, and site specific studies should be conducted for individual lot development.

FOUNDATIONS

Bearing conditions will vary depending on the specific location of the building on the property. Based on the nature of the assumed construction, spread footings bearing on the natural coarse granular subsoils or properly placed and compacted structural fill should be feasible. We expect the footings can be sized for an allowable bearing pressure in the range of 1,500 psf to 3,000 psf with the lower bearing pressures in the compressible soil areas or on structural fill. The higher bearing pressures can be used on the natural coarse granular soils. Structural fill placed below footings can consist of the on-site coarse granular soils, excluding debris, topsoil and oversized rocks, or a similar material can be imported.

Foundation walls should be well reinforced to span local anomalies, better withstand the effects of some differential settlement, and to resist lateral earth loadings when acting as retaining structures. Below grade areas and retaining walls should be protected from wetting and hydrostatic loading by use of an underdrain system. The footings should have a minimum depth of 48 inches for frost protection.

Buildings should have adequate set-back from the steep slope down to the river in the eastern portion of the site to not adversely impact slope stability. In general, we believe the building foundations should be behind or bear below an imaginary 1½ horizontal to 1 vertical line extending up from the base of the slope. This should be reviewed as the planning and preliminary design progress. A slope stability analyses could be done to better evaluate the recommended set-back if desired.

FLOOR SLABS

Slab-on-grade construction should be feasible for bearing on the natural soils or on compacted structural fill. There could be some post construction slab settlement at sites with compressible soils and subgrade improvements as discussed above may be needed. Structural fill placed below floor slabs can consist of the on-site coarse granular soils, excluding debris, topsoil and oversized rocks or a similar material can be imported.

To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints. Floor slab control joints should be used to reduce damage due to shrinkage cracking. A minimum 4-inch thick layer of free-draining gravel should underlie below grade level slabs to facilitate drainage.

UNDERDRAIN SYSTEM

Although free water was not encountered below probable structure excavation depths, it has been our experience in the area that local perched groundwater can develop during times of heavy precipitation or seasonal runoff. Frozen ground can also create a perched condition. An underdrain system should be provided to protect below-grade construction, such as retaining walls, crawlspace and basement areas from wetting and hydrostatic pressure buildup.

The drains should consist of drainpipe surrounded above the invert level with free-draining granular material. The drain should be placed at each level of excavation and at least 1 foot below lowest adjacent finish grade and sloped at a minimum 1% to a suitable gravity outlet or a sump where the water can be collected and pumped. A perimeter foundation drain around shallow (less than 4 feet deep) crawlspace building areas may not be needed where the natural soils are relatively free draining and with adequate compaction of foundation wall backfill and positive surface slope grade away from foundation walls but should be evaluated on an individual building basis.

SITE GRADING

All structural fill should be properly placed and compacted to reduce the risk of settlement and distress to facilities constructed on the fill. We expect existing fill on the site will need to be removed below building, roadway and utility areas, and replaced with compacted structural fill. Fill placed near the steep slope down to the river should be limited to a few feet in depth to minimize surcharge loading on the slope and possible slope instability. Fill depths placed on compressible soils in the lower part of the site should be limited to a few feet to limit surcharge settlement of the soils.

The on-site coarse granular soils, excluding debris, topsoil and oversized (plus 6-inch) rocks, or a similar material should be suitable as structural fill. We have not evaluated the existing fill piles on the site for their suitability as structural fill but based on cursory observations the piles are variable and contain considerable fine grained soils.

In general, structural fill at the site should be compacted to at least 95% of the maximum standard Proctor density (SPD) at a moisture content within about 2% of optimum. Some settlement of deeper fill areas should be expected, even if the material is placed correctly, and could result in distress to facilities constructed on the backfill. We expect settlement of select granular fill such as the on-site coarse granular soils (minus 6-inch fraction) compacted to at least 95% SPD will have long term settlement on the order of ½ to 1% of the fill depth. Increasing the fill compaction to at least (98% SPD to reduce fill settlement and/or allowing some time for the fill to settle before constructing on the fill could be done. The fill should be benched into the portions of the site exceeding 20% grade.

Structural fill placed below footing and building areas should be compacted to at least 98% SPD. Prior to fill placement, all existing fill and topsoil should be removed, the subgrade scarified to a depth of 8 inches, adjusted to near optimum moisture and compacted to at least 90% of standard Proctor density. In soft or wet areas, the subgrade may require drying or stabilization prior to fill placement. A geogrid and/or subexcavation of the unsuitable soil and replacement with coarse granular or aggregate base soils may be needed for the stabilization. The subgrade should be proofrolled. Areas that deflect excessively should be corrected before placing structural fill. Miscellaneous fill at the site should be compacted to at least 90% SPD.

Permanent unretained cut and fill slopes should be graded at 2 horizontal to 1 vertical or flatter and protected against erosion by revegetation, rock riprap or other means. Oversized rock from embankment fill construction will tend to collect on the outer face. A protection fence could be provided downslope of the embankment toe to prevent rockfall to below the site. We should review site grading plans for the project prior to construction.

SURFACE DRAINAGE

The grading plan for the subdivision should consider runoff from across the site and at individual building sites. Water should not be allowed to pond which could impact slope stability and foundations. To limit infiltration into the bearing soils next to buildings, exterior backfill should be well compacted and have a positive slope away from the building for a distance of at least 10 feet. Roof downspouts and drains should discharge well beyond the limits of all backfill and landscape irrigation should be restricted.

LIMITATIONS

This study has been conducted according to 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 our field observations, the exploratory borings located as shown on Figures 1A and 1B, the assumed 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 planning and preliminary design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation, conduct additional evaluations and review and monitor the implementation of our recommendations. Significant changes in the proposed/assumed construction 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,

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

COLORADO REGISTERED
DAVID A. YOUNG
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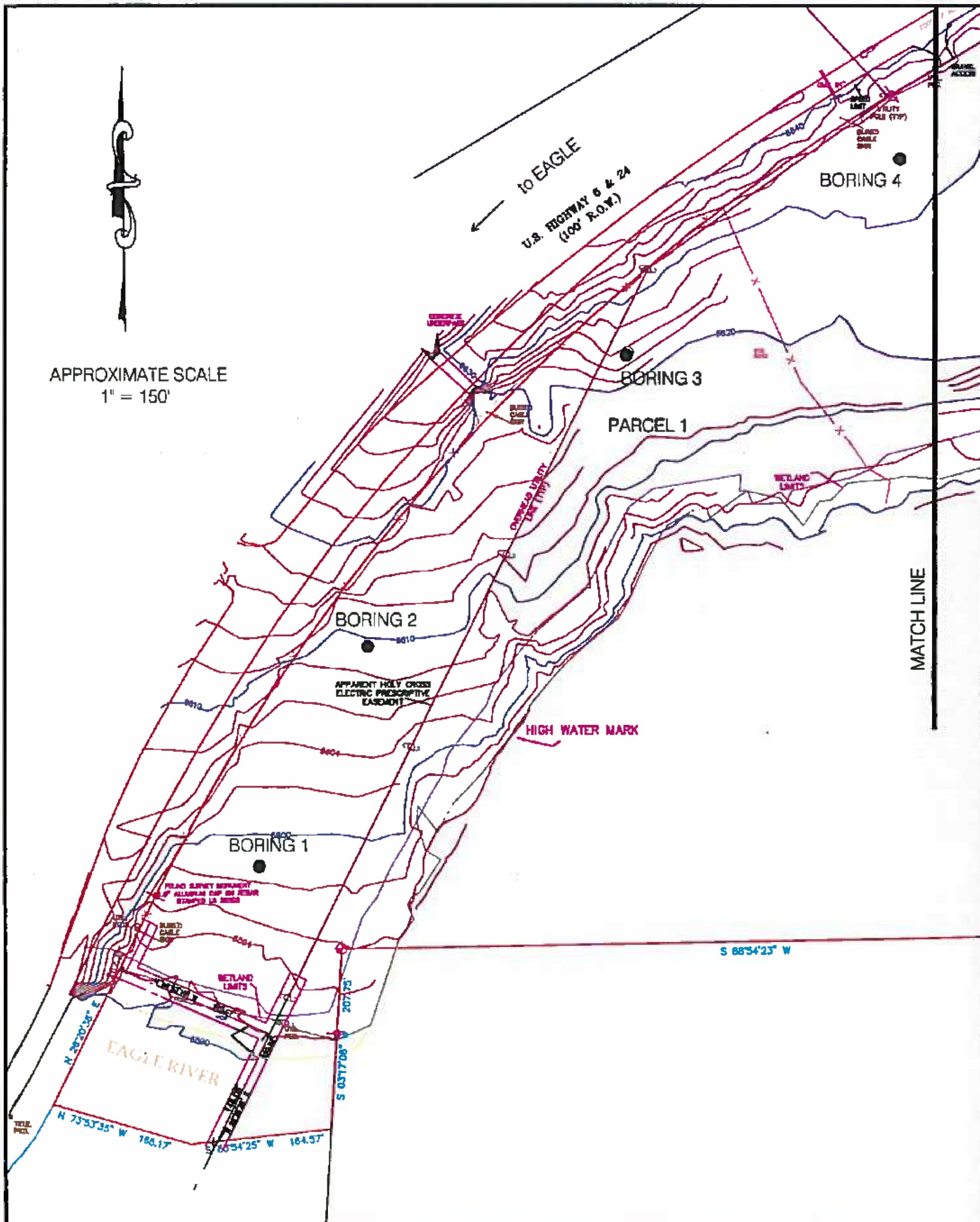
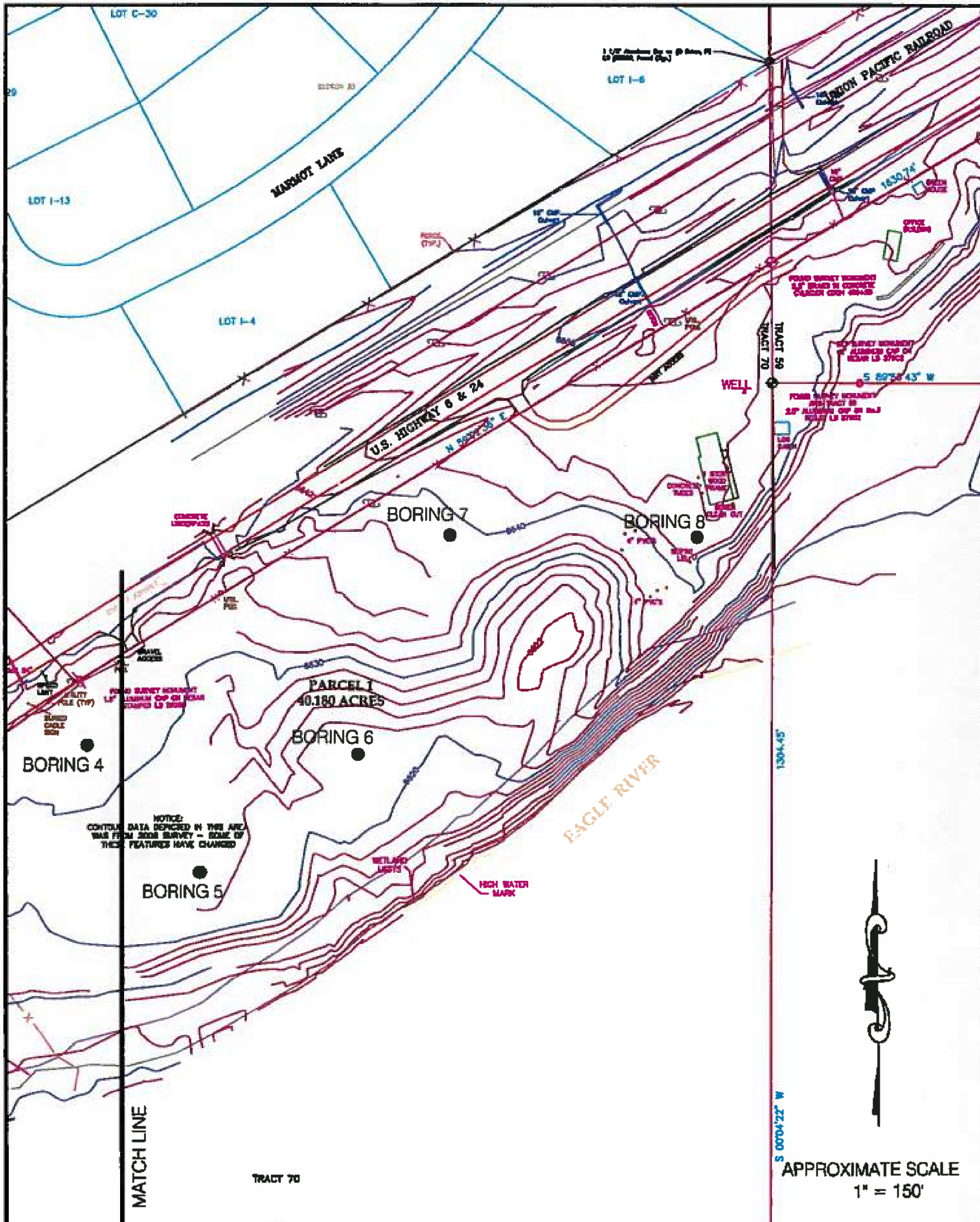
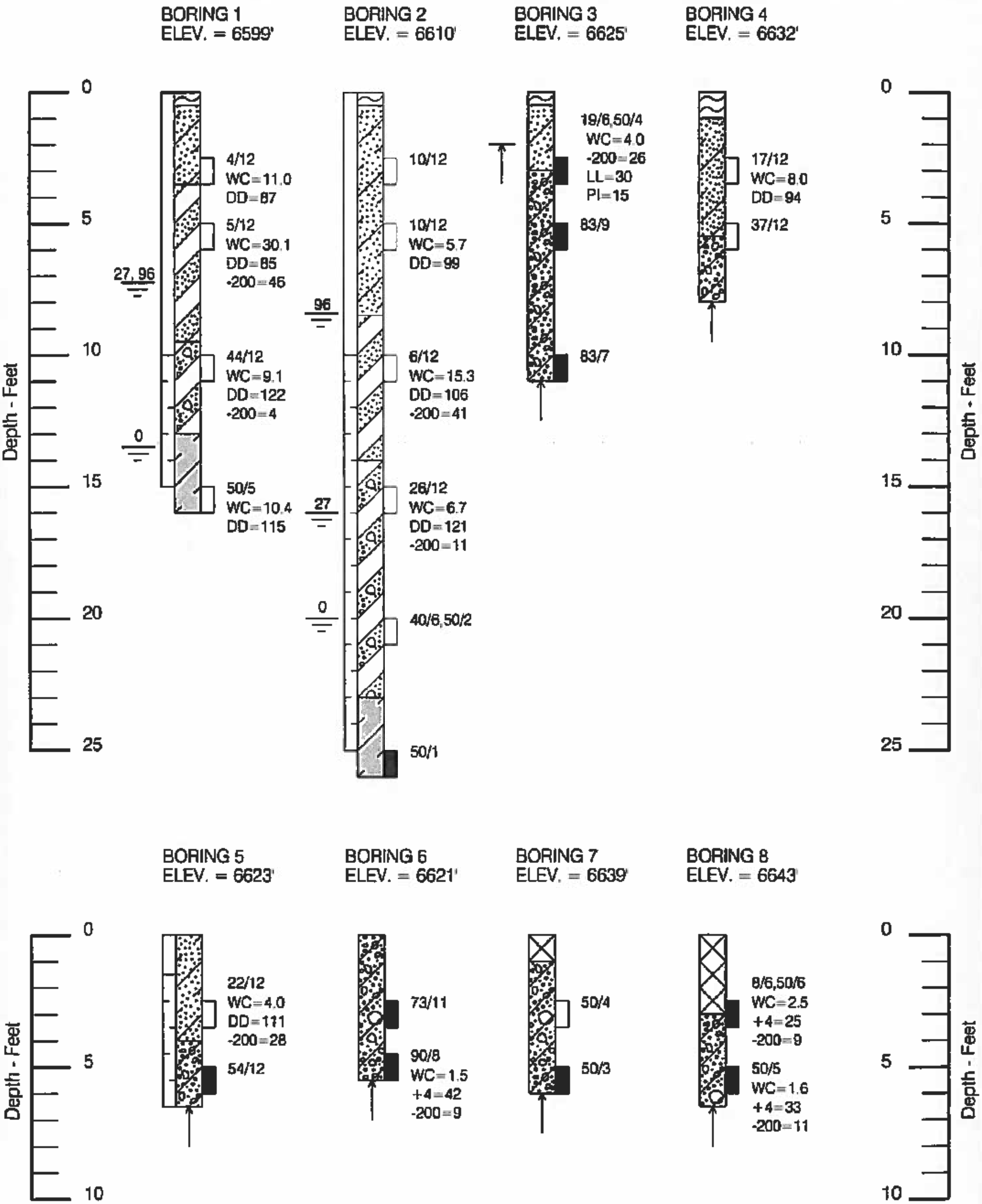


115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOCATION OF EXPLORATORY BORINGS	Figure 1A



115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOCATION OF EXPLORATORY BORINGS	Figure 1B



Note: Explanation of symbols is shown on Figure 3.

115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOGS OF EXPLORATORY BORINGS	Figure 2

LEGEND:

FILL; silty sand and gravel with cobbles, medium dense, slightly moist, brown.

TOPSOIL; organic silty clayey sand, slightly moist to moist, dark reddish brown.

SAND (SM-SC); silty to very silty, typically clayey, scattered gravel and cobbles, loose to medium dense, slightly moist to moist, reddish brown.

SAND AND SILT (SM-ML); clayey, scattered gravel and possible cobbles, loose/medium stiff, moist to very moist, reddish brown.

SAND AND GRAVEL (SM-GM); with cobbles and possible boulders, silty occasionally clayey, medium dense to dense, mixed brown.

GRAVEL AND COBBLES (GM); with boulders, sandy to very sandy, slightly silty to silty, dense to very dense, slightly moist to moist, mixed brown.

SILTSTONE/CLAYSTONE; hard to very hard, slightly moist to moist, grey-black, Eagle Valley Evaporite.

Relatively undisturbed drive sample; 2-inch I.D. California liner sample.

Drive sample; standard penetration test (SPT), 1 3/8 inch I.D. split spoon sample, ASTM D-1586.

4/12 Drive sample blow count; indicates that 4 blows of a 140 pound hammer falling 30 inches were required to drive the California or SPT sampler 12 inches.

0,27 Free water level in boring and number of days following drilling measurement was taken.

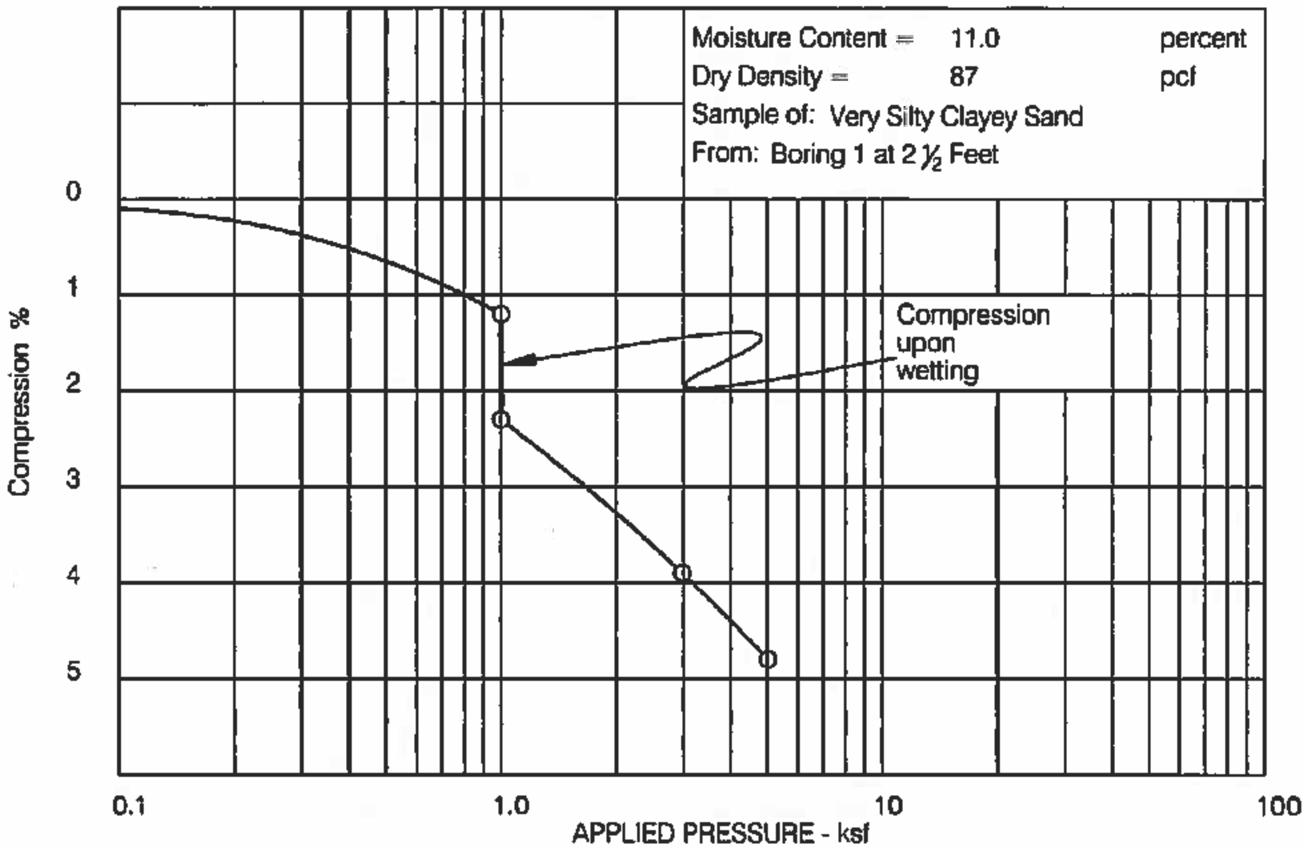
Indicates 1 1/2 inch diameter slotted PVC pipe installed in boring to depth shown.

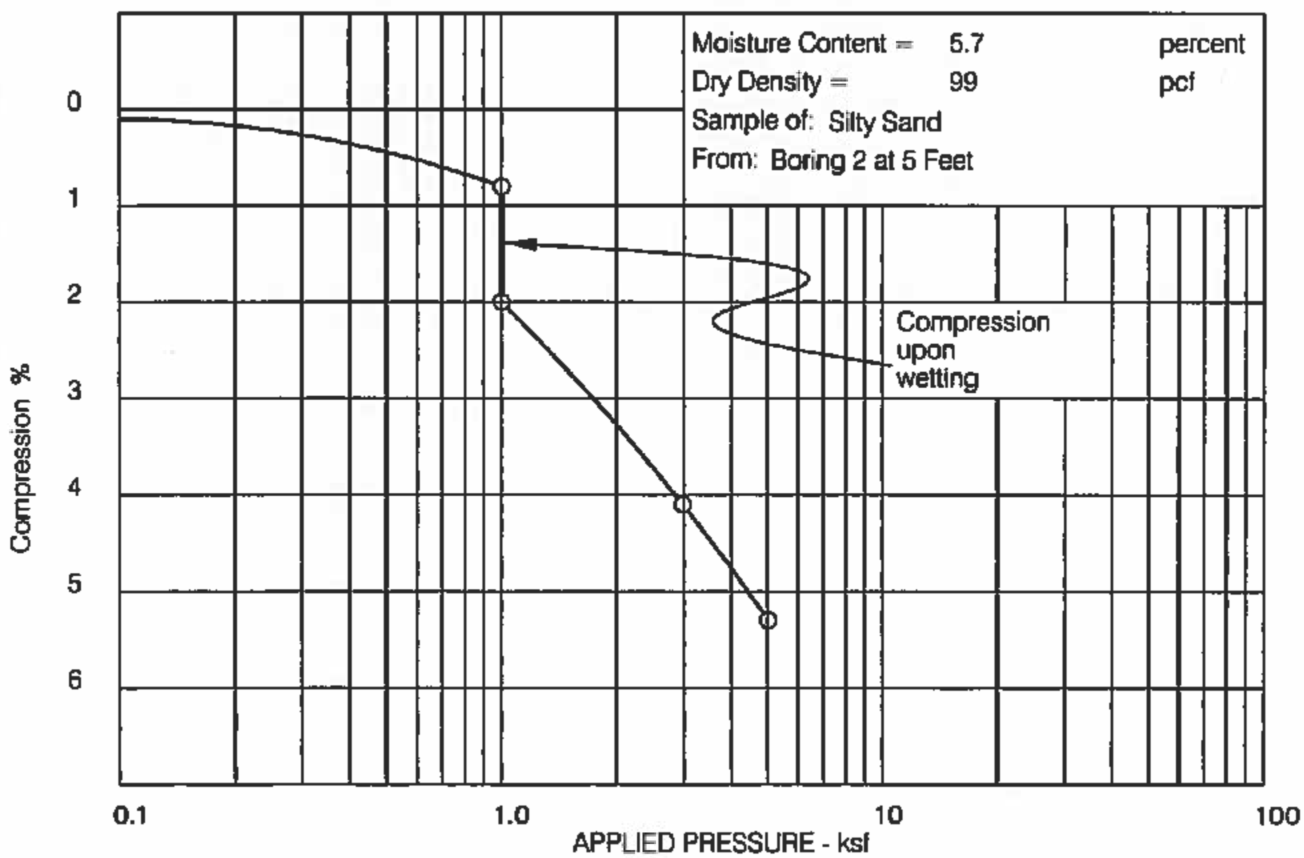
Practical drilling refusal. Where shown above bottom of log, indicates that multiple attempts were made to advance the boring.

115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LEGEND	Figure 3

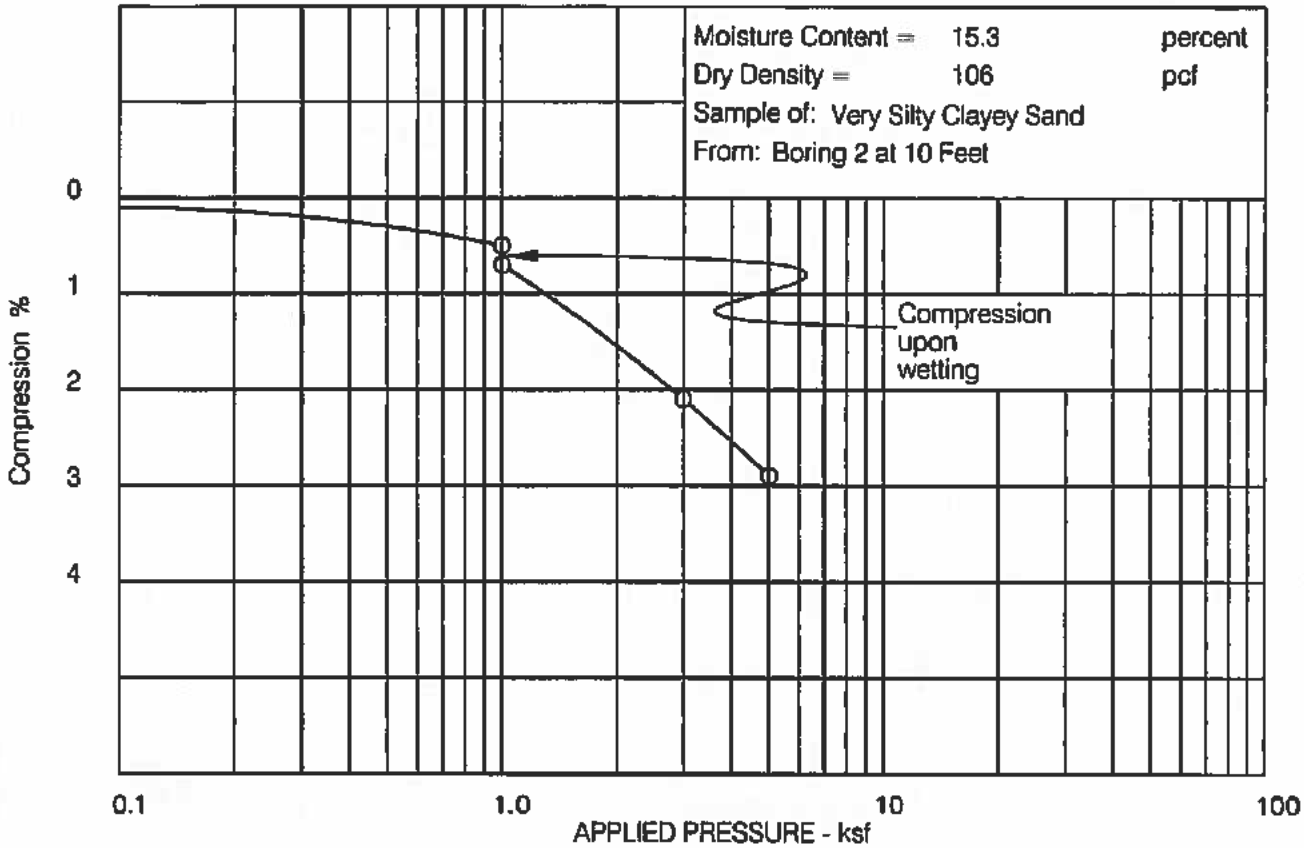
NOTES:

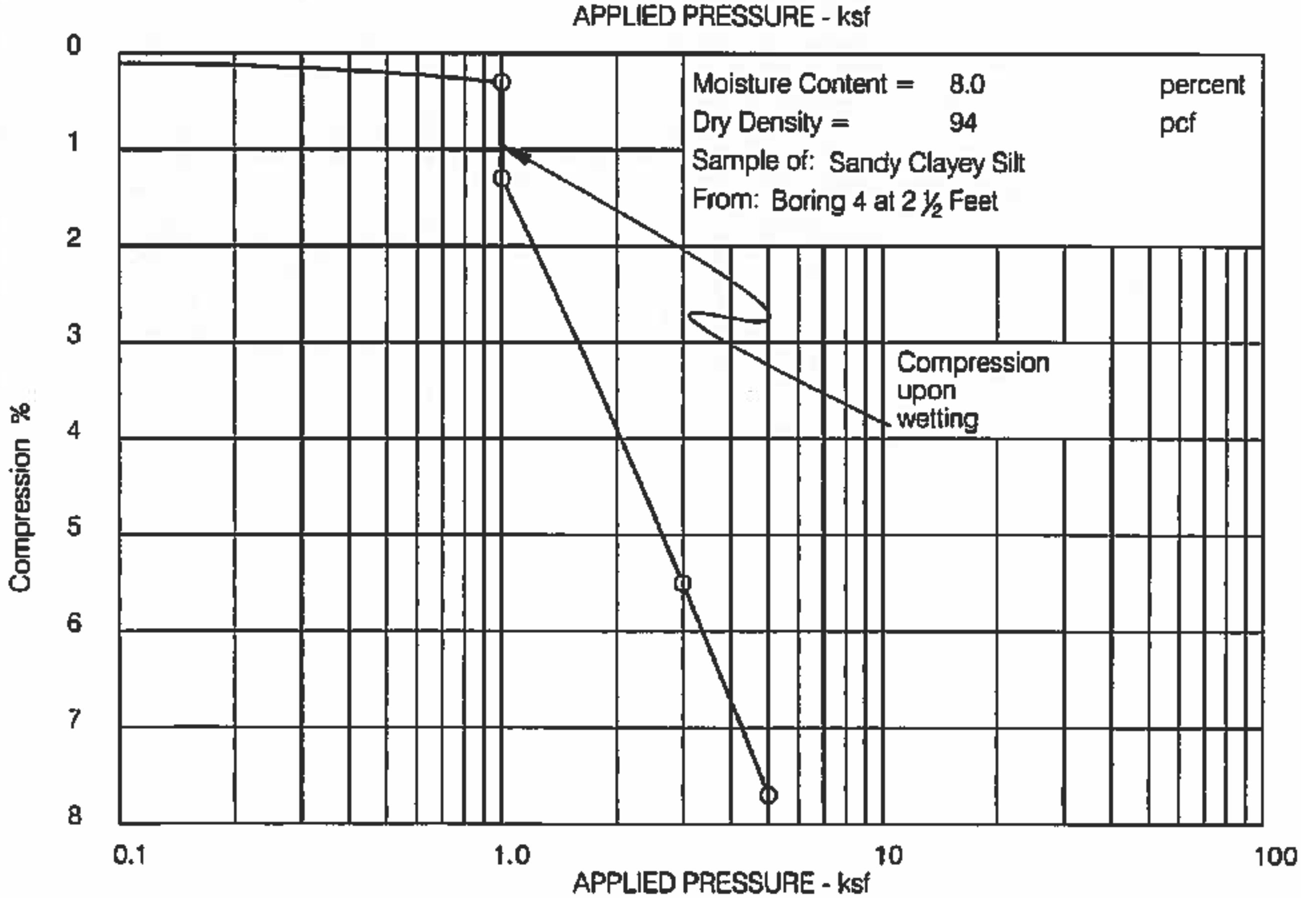
1. Exploratory borings were drilled on December 3 and 4, 2015 with 4-inch diameter continuous flight power auger.
2. Locations of exploratory borings were field staked by the surveyor, Archibeque Land Consultants.
3. Elevations of exploratory borings were obtained by interpolation between contours shown on the site plan provided. The logs of exploratory borings are drawn to depth.
4. The exploratory boring locations and elevations 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 transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. No free water was encountered in Borings 3 through 8. Fluctuations in water level may occur with time.
7. Laboratory Testing Results:
   WC = Water Content (%)
   DD = Dry Density (pcf)
   +4 = Percent retained on the No. 4 sieve
   -200 = Percent passing No. 200 sieve
   LL = Liquid Limit (%)
   PI = Plasticity Index (%)



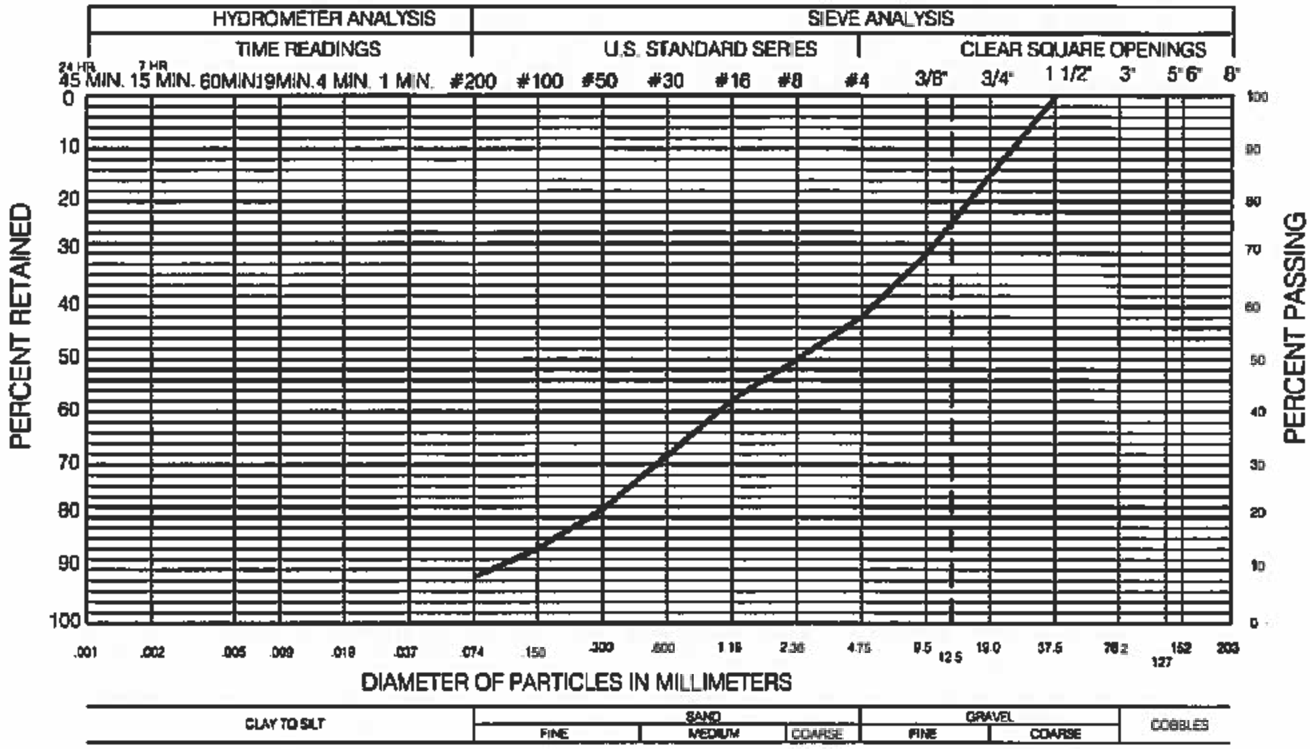


115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	SWELL-CONSOLIDATION TEST RESULTS	Figure 5





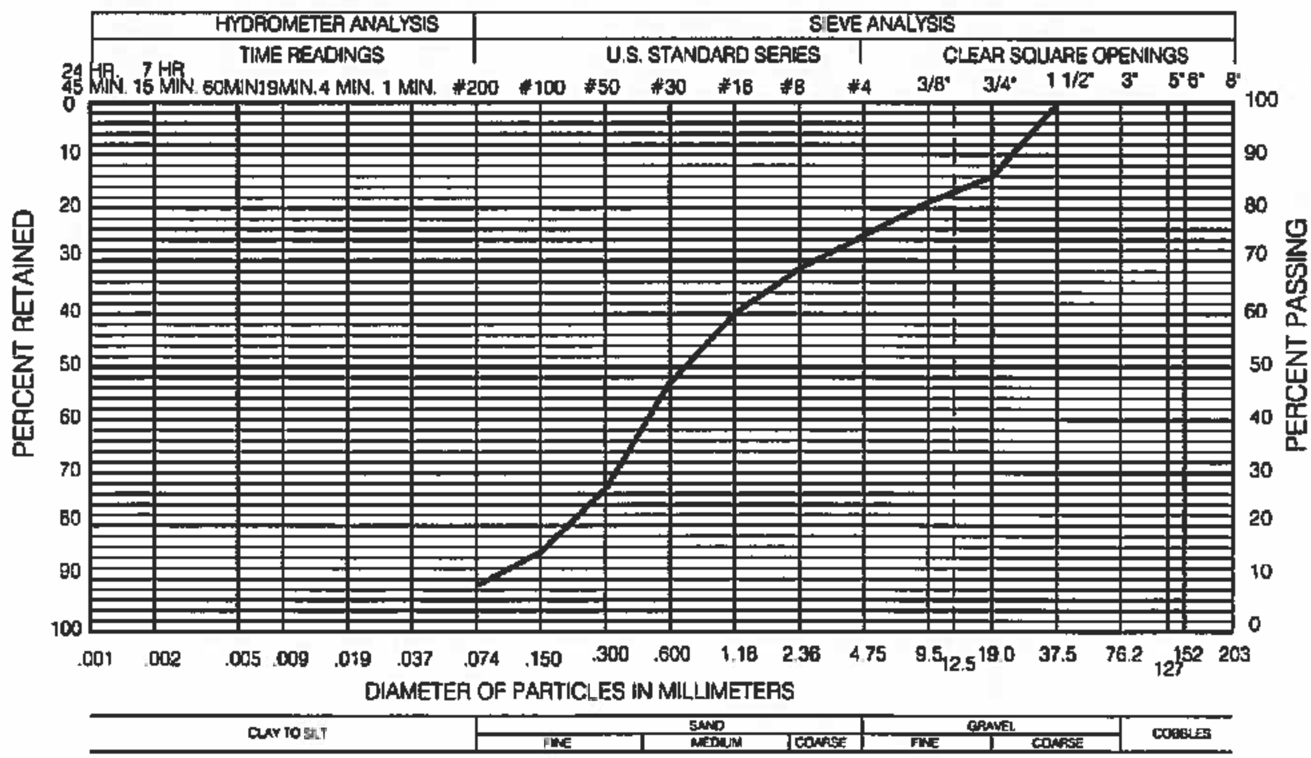
115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	SWELL-CONSOLIDATION TEST RESULTS	Figure 6



GRAVEL 42 % SAND 49 % SILT AND CLAY 9 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Slightly Silty Sand and Gravel FROM: Boring 6 at 4 ½ Feet

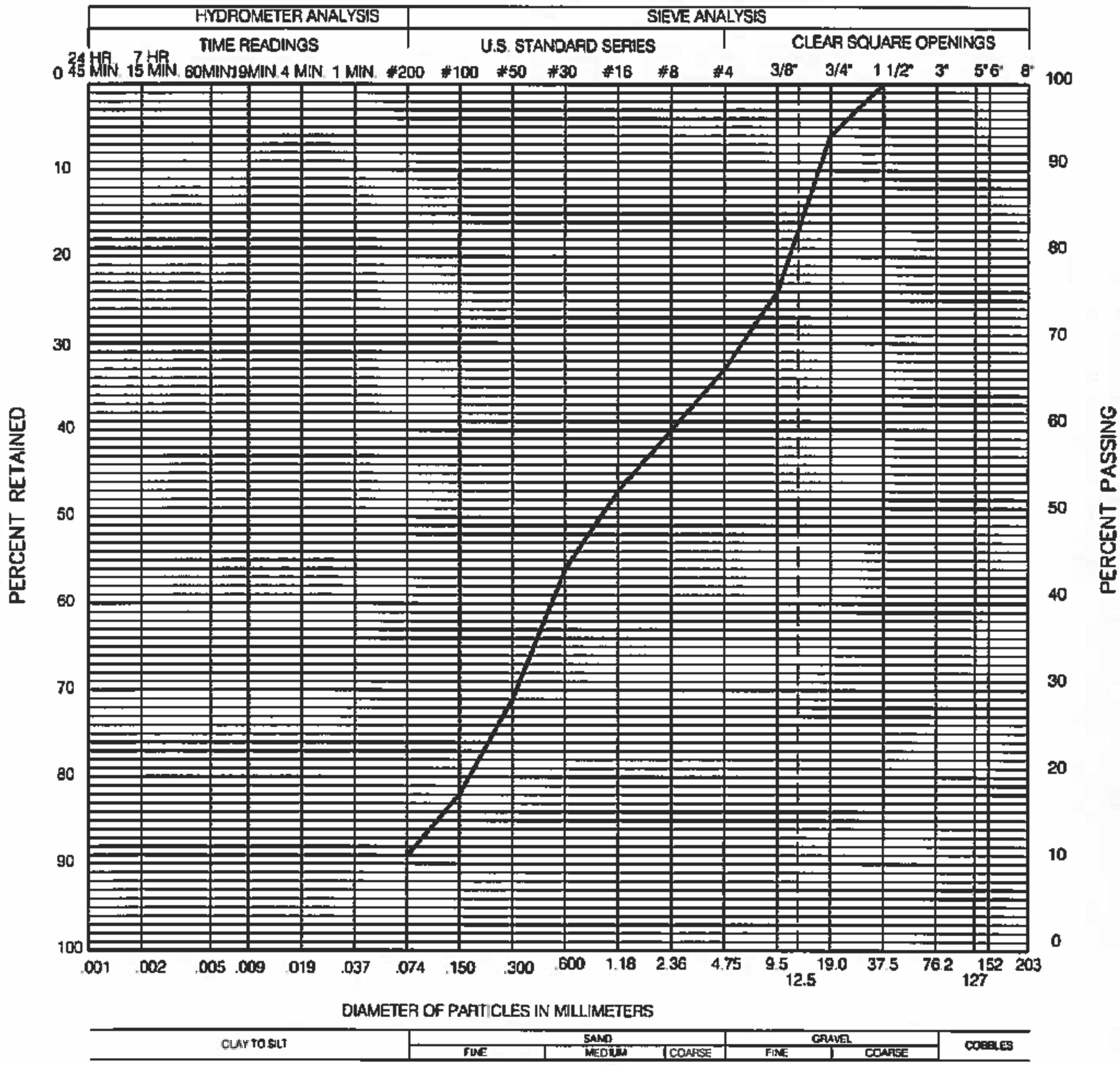


GRAVEL 25 % SAND 66 % SILT AND CLAY 9 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Slightly Silty Sand with Gravel FROM: Boring 8 at 2 ½ Feet

115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	GRADATION TEST RESULTS	Figure 7



GRAVEL 33 % SAND 56 % SILT AND CLAY 11 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Sand with Gravel FROM: Boring 8 at 5 Feet

115 548A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	GRADATION TEST RESULTS	Figure 8

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Job No. 115 548A

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY DENSITY	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH	SOIL OR BEDROCK TYPE
BORING	DEPTH (ft)	(%)	(pcf)	GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)	(PSF)	
1	2½	11.0	87							Very Silty Clayey Sand
	5	30.1	85			46				Very Silty Clayey Sand
	10	9.1	122			4				Slightly Silty Sand and Gravel
	15	10.4	115							Siltstone/Claystone
2	5	5.7	99							Silty Sand
	10	15.3	106			41				Very Silty Clayey Sand
	15	6.7	121			11				Silty Sand and Gravel
3	2½	4.0				26	30	15		Clayey Silty Sand
4	2½	8.0	94							Sandy Clayey Silt
5	2½	4.0	111			28				Silty Clayey Sand
6	4½	1.5		42	49	9				Slightly Silty Sand and Gravel
8	2½	2.5		25	66	9				Slightly Silty Sand with Gravel
	5	1.6		33	56	11				Silty Sand with Gravel

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The parcel is currently planned to be developed as large single family residential lots. The buildings will likely be one to three story wood frame structures possibly with basement levels. Ground floors may be slab-on-grade and/or structurally supported over crawlspace. Grading for the structures is expected to be relatively minor with cut depths between about 3 to 10 feet. We assume relatively light foundation loadings, typical of the proposed type of construction. The parcel is planned to be annexed into the Town of Eagle and have municipal water and sewer systems.

When building locations, grading and foundation loading information have been developed, we should be notified to re-evaluate the recommendations presented in this report and perform additional analyses as needed.

SITE CONDITIONS

Parcel 2, shown on Figure 1, is about 22 acres in size. The site is mostly an abandoned gravel pit located on the north bank of the Eagle River, between the river and U.S. Highway 6. The eastern part of the parcel is not shown on Figure 1 and not planned for development at this time.

The site was vacant and was covered with a few inches of snow at time of our field exploration. The terrain consists primarily of the relatively flat gravel pit bottom with a moderately steep cut slope on the northwestern side of the site below Highway 6 and extending to the west side of the parcel. The cut slope is about 20 to 30 feet high sloping down to the flat terrain of the gravel pit bottom, with grades of about 20 to 25% becoming steeper in the western portion of the site, on the order of 30 to 40%. The cut slope exposes natural coarse granular river terrace deposited soils. Along the southeast side of the site, there is a moderately steep to steep slope down to the Eagle River. This apparent natural slope is typically about 6 to 10 feet high and has grades from about 15 to 40%. The natural appearing terrain in the eastern part of the parcel shown on Figure 1 slopes down about 20 to 30 feet to the south towards the river at grades of about 20 to 30%. There is probably some fill on the site due to the previous grading.

Slope grade in the relatively flat, gravel pit bottom of the parcel is minor but in general down to the southwest. There is about 50 feet of elevation difference across the site. There is a drainage ditch in the middle portion of the site that trends from northwest to southeast to the river. Vegetation on the site consisted of grass and weeds in the graded portions with cottonwoods and willows near the river. There are cobbles and boulders up to several feet in diameter on the ground surface. Wetland areas adjacent the river are shown on the survey plans provided to us as well as river high water mark adjacent the southeast side of the site.

GEOLOGIC CONDITIONS

The natural soils at the site are alluvium terrace deposits of the Eagle River. The underlying bedrock is the Eagle Valley Evaporite Formation.

Potential geologic hazards that may impact the site consist of the potential for construction induced slope inability of the steeper slopes and the potential for sinkhole development due to the underlying Evaporite. The potential for construction induced slope instability is discussed in the "Preliminary Design Recommendations" section of this report. The potential for sinkhole development is discussed below. The civil engineer and/or hydrologist should review the flood potential of the lower lying terrain near the river.

Bedrock of the Pennsylvanian age Eagle Valley Evaporite underlies the 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 property. 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, several sinkholes were observed scattered throughout the Eagle River and Brush Creek valley areas. These sinkholes appear similar to others associated with the Eagle Valley Evaporite in other areas of the Eagle River valley.

Sinkholes were not observed in the immediate area of the subject parcel, however, the site grading could have concealed a possible sinkhole. No evidence of cavities was encountered in the subsurface materials; however, the exploratory borings were widely spaced and relatively shallow, for preliminary 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 on Parcel 2 throughout the service life of the proposed development, in our opinion, is low; however, the owners of the individual lots 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 December 2 and 4, 2015. Four exploratory borings were drilled at the locations shown on Figure 1 to evaluate the general 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 Hepworth-Pawlak Geotechnical, Inc. The borings were field staked by the surveyor prior to the drilling.

Samples of the subsoils and bedrock were taken with a 1⅜-inch I.D. spoon sampler. The sampler was driven into the subsoils and bedrock 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 and hardness of the bedrock. 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.

Temporary slotted PVC pipe was installed in Borings 2 and 4 to allow monitoring of the ground water level.

SUBSURFACE CONDITIONS

Graphic logs of the subsurface conditions encountered at the site are shown on Figure 2. The subsoils encountered, below nil to about 2 feet of topsoil, consisted of relatively dense, slightly silty to silty (and clayey with depth) sandy gravel and cobbles with boulders that extended down to the depths drilled of 3 to 7 feet in Borings 1, 3 and 4 where practical drilling refusal occurred. The dense, coarse granular soils in Boring 2 extended down to a depth of 12 feet where hard, sandstone/siltstone bedrock of the Eagle Valley Evaporite was encountered down to the boring depth of 21 feet.

Drilling in the dense coarse granular soils with auger equipment was difficult due to the cobbles and boulders and drilling refusal was encountered in the deposit in Borings 1, 3 and 4 as discussed above. There is probably existing fill on the site that was not encountered at our boring locations.

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 natural coarse granular subsoils are shown on Figure 4. The laboratory testing is summarized in Table 1.

Free water was encountered in Boring 2 at the time of drilling and no free water was encountered in Borings 1, 3 and 4. When Boring 2 was checked 2 or more days following drilling, free water level was about 9 to 10 feet below the ground surface. The soils were slightly moist to moist, and the bedrock was wet due to its apparent fractured condition.

FOUNDATION BEARING CONDITIONS

The natural coarse granular soils at the site possess moderate bearing capacity and relatively low settlement potential. Spread footings bearing on these soils should be suitable for foundation support of the buildings. Existing fill will need to be removed below buildings areas. It should be feasible to re-establish design footing bearing (and floor slab subgrade) elevation with compacted structural fill. The structural fill can consist of the on-site coarse granular soils excluding debris, topsoil and oversized (plus

6-inch) rocks, or a similar material can be imported.

PRELIMINARY DESIGN RECOMMENDATIONS

The conclusions and recommendations presented below are based on the general proposed development, subsurface conditions encountered in the exploratory borings, and our experience in the area. The recommendations are suitable for planning and preliminary design but site specific studies should be conducted for individual lot development.

FOUNDATIONS

Bearing conditions will vary depending on the specific location of the building on the property. Based on the nature of the proposed construction spread footings bearing on the natural coarse granular subsoils or properly placed and compacted structural fill should be feasible. We expect the footings can be sized for an allowable bearing pressure in the range of 2,000 psf to 3,000 psf with the lower bearing pressure for bearing on structural fill and the higher bearing pressure for the natural coarse granular soils. Structural fill placed below footings can consist of the on-site coarse granular soils, excluding debris, topsoil and oversized rocks (plus 6-inch), or a similar material can be imported.

Foundation walls should be well reinforced to span local anomalies, better withstand the effects of some differential settlement, and to resist lateral earth loadings when acting as retaining structures. Below grade areas and retaining walls should be protected from wetting and hydrostatic loading by use of an underdrain system. The footings should have a minimum depth of 48 inches for frost protection.

Buildings should be set-back from the moderately steep to steep slope down to the river along the southeastern side of the site to not adversely compact slope stability. In general, we believe the building foundations should be placed behind or bear below an imaginary 1½ horizontal to 1 vertical line extending up from the base of the slope. This should be reviewed as the planning and preliminary design progress.

FLOOR SLABS

Slab-on-grade construction should be feasible for bearing on the natural coarse granular soils or on compacted structural fill. Structural fill placed below floor slabs can consist of the on-site coarse granular soils, excluding debris, topsoil and oversized (plus 6-inch) rocks or a similar material can be imported.

To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints. Floor slab control joints should be used to reduce damage due to shrinkage cracking. A minimum 4-inch thick layer of free-draining gravel should underlie below grade slabs to facilitate drainage.

UNDERDRAIN SYSTEM

Although free water was encountered below probable structure excavation depths, it has been our experience in the area that local perched groundwater can develop during times of heavy precipitation or seasonal runoff. Frozen ground can also create a perched condition. An underdrain system should be provided to protect below-grade construction, such as retaining walls, crawlspace and basement areas from wetting and hydrostatic pressure buildup.

The drains should consist of drainpipe surrounded above the invert level with free-draining granular material. The drain should be placed at each level of excavation and at least 1 foot below lowest adjacent finish grade and sloped at a minimum 1% to a suitable gravity outlet or a sump where the water can be collected and pumped. A perimeter foundation drain around shallow (less than 4 feet deep) crawlspace building areas may not be needed where the natural soils are relatively free draining and with adequate compaction of foundation wall backfill and positive surface slope away from the foundation but should be evaluated on an individual building basis.

SITE GRADING

All structural fill should be properly placed and compacted to reduce the risk of settlement and distress to facilities constructed on the fill. We expect existing fill on the site will need to be removed below building, roadway and utility areas, and replaced with compacted structural fill. Fill placed near the moderately steep to steep slope down to the river should be limited in depth to a few feet to limit surcharge loading on the slope and possible slope instability. The existing cut slope along the northwest side of the site and the moderately steep, apparent natural slope in the eastern part of the site appear stable at their current grades. Some rockfall from the cut faces and natural coarse granular slopes could occur over time.

The on-site coarse granular soils, excluding debris, topsoil and oversized (plus 6 inch) rocks, or a similar material should be suitable as structural fill. In general, structural fill at the site should be compacted to at least 95% of the maximum standard Proctor density (SPD) at a moisture content within about 2% of optimum. Some settlement of deeper fill areas should be expected, even if the material is placed correctly, and could result in distress to facilities constructed on the backfill. We expect settlement of select granular fill such as the on-site coarse granular soils (minus 6-inch fraction) compacted to at least 95% SPD will have long term settlement on the order of ½ to 1% of the fill depth. Increasing the fill compaction to at least 98% SPD to reduce fill settlement and/or allowing some time for the fill to settle before constructing on the fill could be done. The fill should be benched into the portions of the site exceeding 20% grade.

Structural fill placed below footing and building areas should be compacted to at least 98% SPD. Prior to fill placement, all existing fill and topsoil should be removed, the subgrade scarified to a depth of 8 inches, adjusted to near optimum moisture and compacted to at least 90% of standard Proctor density. In soft or wet areas, the subgrade may require drying or stabilization prior to fill placement. A geogrid and/or subexcavation and replacement with coarse granular soils or aggregate base soils may be needed for the stabilization. The subgrade should be proofrolled. Areas that deflect excessively should be corrected before placing structural fill. Miscellaneous fill at the site should be compacted to at least 90% SPD.

Permanent unretained cut and fill slopes should be graded at 2 horizontal to 1 vertical or flatter and protected against erosion by revegetation, rock riprap or other means. Oversized rock from embankment fill construction will tend to collect on the outer face. A protection fence could be provided downslope of the embankment toe to prevent rockfall to below the slope. We should review site grading plans for the project prior to construction.

SURFACE DRAINAGE

The grading plan for the subdivision should consider runoff from across the site and at individual building sites. Water should not be allowed to pond which could impact slope stability and foundations. To limit infiltration into the bearing soils next to buildings, exterior backfill should be well compacted and have a positive slope away from the building for a distance of at least 10 feet. Roof downspouts and drains should discharge well beyond the limits of all backfill and landscape irrigation should be restricted.

LIMITATIONS

This study has been conducted according to 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 our field observations, the exploratory borings located as shown on Figure 1, the assumed 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 planning and preliminary design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation, conduct additional evaluations and review and monitor the implementation of our recommendations. Significant changes in the proposed/assumed construction 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,

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

COLORADO REGISTERED DAVID A. YOUNG 32-216 PROFESSIONAL ENGINEER 3-11-16

David A. Young, P.E.

Reviewed by:

Steven L. Pawlak, P.E.

DAY/ksw

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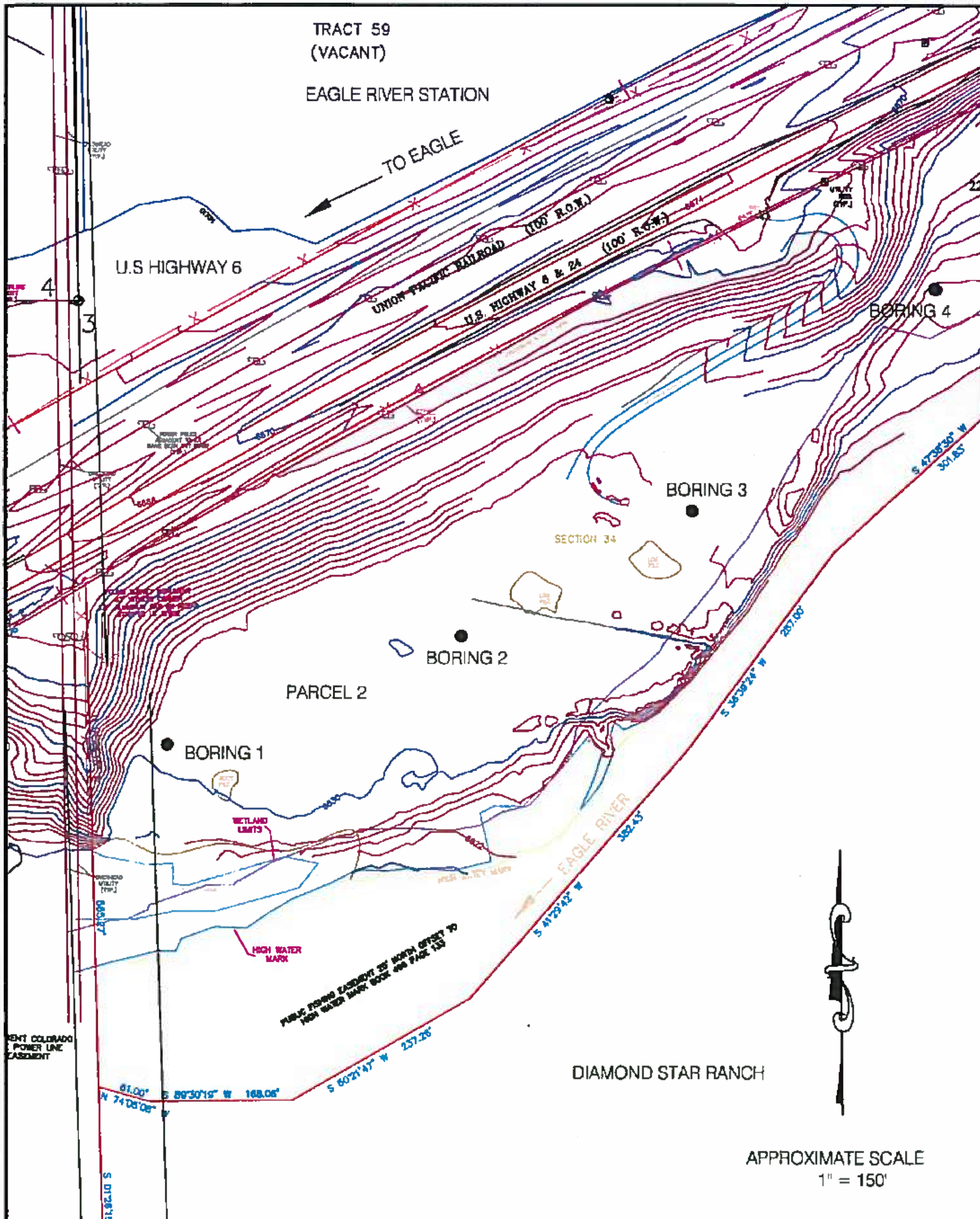
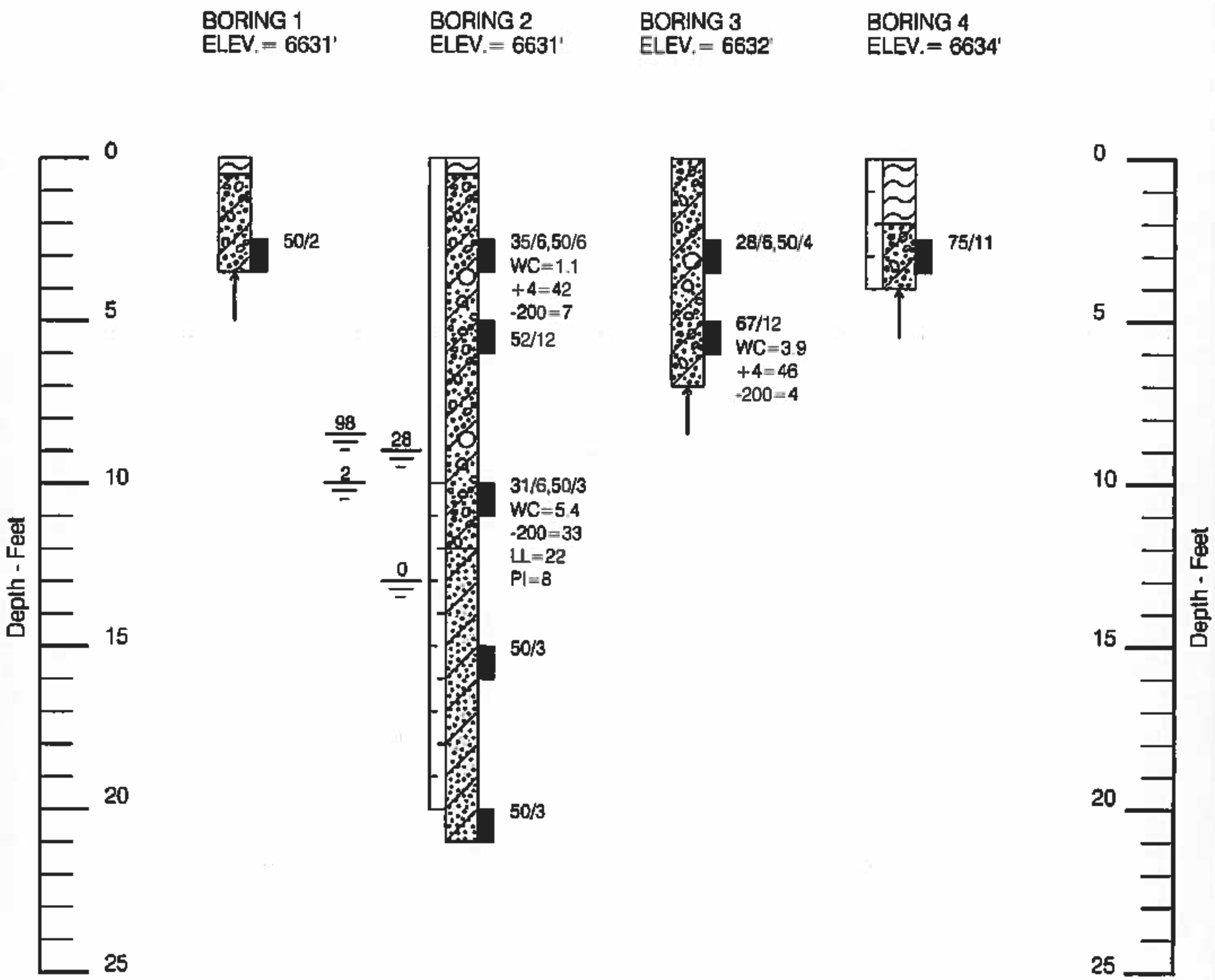
Alpine Engineering – Gary Brooks (brooks@alpinecivil.com)



115 548B	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOCATION OF EXPLORATORY BORINGS	Figure 1



Note: Explanation of symbols is shown on Figure 3.

115 548B	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOGS OF EXPLORATORY BORINGS	Figure 2

LEGEND:

TOPSOIL; root zone, silty sand with gravel, moist, dark brown.

GRAVEL AND COBBLES (GM-GC); with boulders, sandy to very sandy, slightly silty becoming silty and typically clayey with depth,dense to very dense, slightly moist to very moist with depth, brown, rocks are primarily subrounded to rounded.

SANDSTONE/SILTSTONE; hard, wet, brown to yellow brown, fractured. Eagle Valley Evaporite.

Drive sample; standard penetration test (SPT), 1 3/8 inch I.D. split spoon sample, ASTM D-1586.

39/12 Drive sample blow count; indicates that 39 blows of a 140 pound hammer falling 30 inches were required to drive the SPT sampler 12 inches.

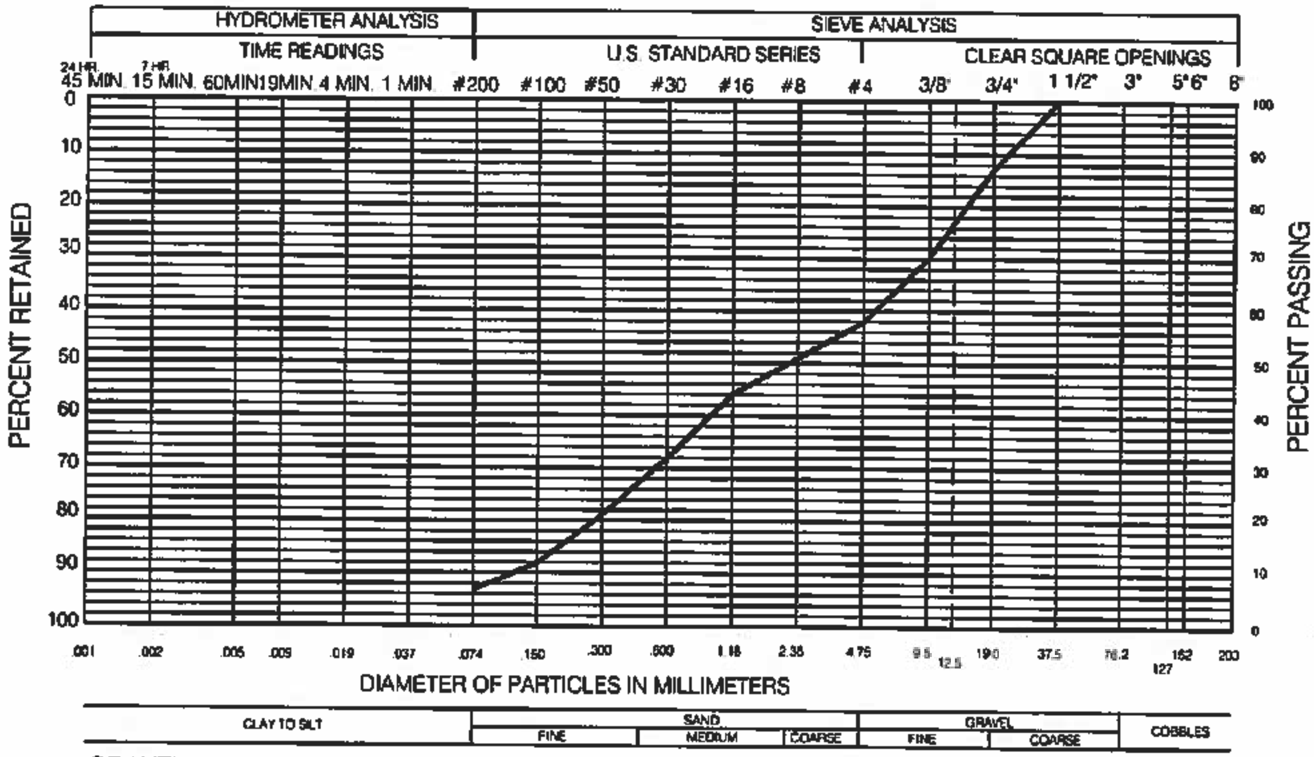
0,2 Free water level in boring and number of days following drilling measurement was taken.

Indicates slotted PVC pipe installed in boring to depth shown.

Practical drilling refusal.

NOTES:

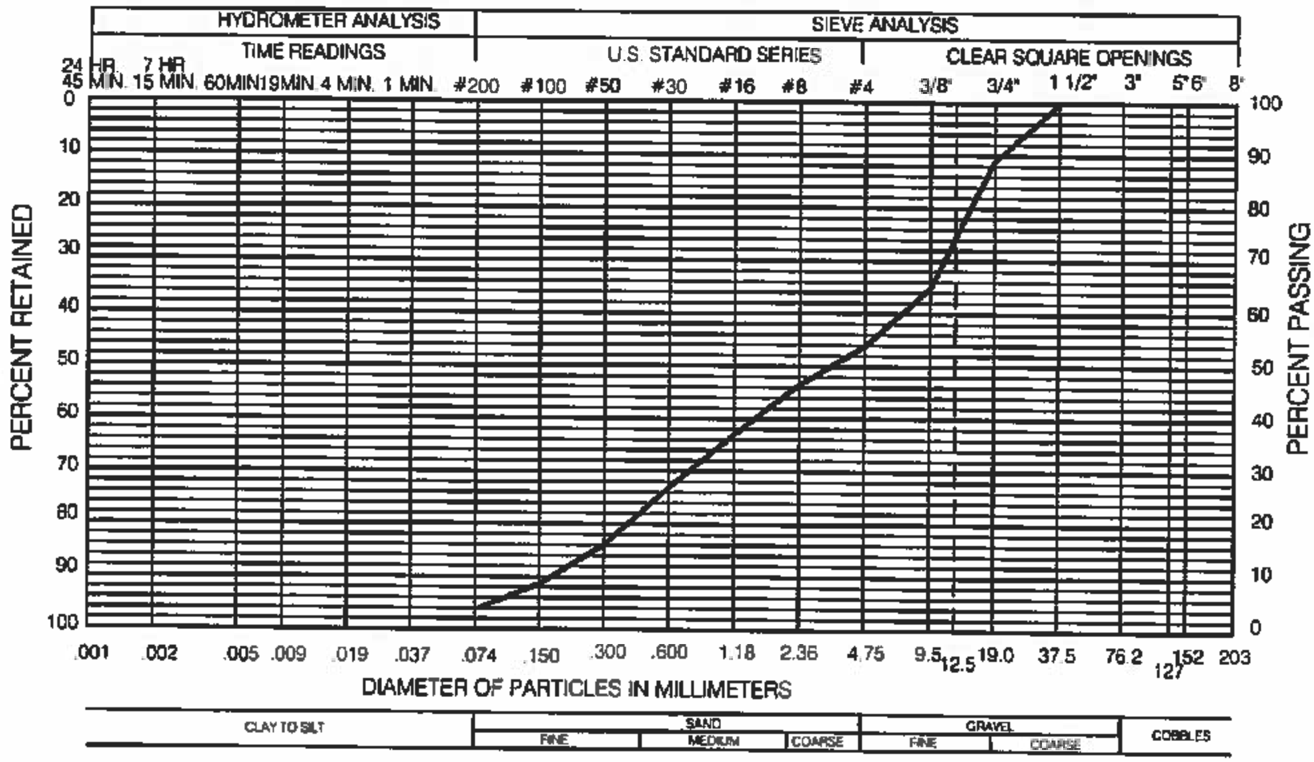
1. Exploratory borings were drilled on December 2 and 4, 2015 with 4-inch diameter continuous flight power auger.
2. Locations of exploratory borings were field staked by the surveyor, Archibeque Land Consultants.
3. Elevations of exploratory borings were obtained by interpolation between contours shown on the site plan provided. Boring logs are drawn to depth.
4. The exploratory boring locations and elevations 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 transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. No free water encountered in Borings 1, 3 and 4. Fluctuations in water level may occur with time.
7. Laboratory Testing Results:
   WC = Water Content (%)
   +4 = Percent retained on the No. 4 sieve
   -200 = Percent passing No. 200 sieve
   LL = Liquid Limit (%)
   PI = Plasticity Index (%)



GRAVEL 42 % SAND 51 % SILT AND CLAY 7 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Slightly Silty Sand and Gravel FROM: Boring 2 at 2 ½ Feet



GRAVEL 46 % SAND 50 % SILT AND CLAY 4 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Slightly Silty Sand and Gravel FROM: Boring 3 at 5 Feet

115 548B	HP Geotech Hepworth–Pawlak Geotechnical	GRADATION TEST RESULTS	Figure 4

Job No. 115 548B

HEPWORTH-PAWLAK GEOTECHNICAL, INC.
TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY DENSITY	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH		SOIL OR BEDROCK TYPE
BORING	DEPTH (ft)	(%)	(pcf)	GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)	(PSF)		
2	2½	1.1		42	51	7					Slightly Silty Sand and Gravel
	10	5.4				33	22	8			Silty Clayey Sand and Gravel
3	5	3.9		46	50	4					Slightly Silty Sand and Gravel

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PRELIMINARY SUBSOIL STUDY
PARCEL 3, RED MOUNTAIN RANCH
U.S. HIGHWAY 6, EAST OF EAGLE
EAGLE COUNTY, COLORADO

JOB NO. 115 548C

FEBRUARY 29, 2016

PREPARED FOR:

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a preliminary subsoil study for Parcel 3, Red Mountain Ranch, U.S. Highway 6, east of Eagle, Eagle County, Colorado. The project site is shown on Figures 1A and 1B. The purpose of the study was to develop recommendations for planning and preliminary foundation and site grading designs. The study was conducted as part of our proposal for professional services to Mr. Merv Lapin dated November 10, 2015.

A field exploration program consisting of exploratory borings was conducted to obtain information on the general subsurface conditions. Samples of the subsoils obtained during the field exploration were tested in the laboratory to determine their classification, compressibility or swell and other engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop preliminary recommendations for foundation types, depths and allowable pressures for assumed residential construction on the parcel, as well as for the site grading. 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. The report includes a discussion of the general geologic conditions and potential hazards at the site.

PROPOSED CONSTRUCTION

Planned development of the parcel is unknown at this time pending the findings of our study. If feasible, the parcel would likely be developed as residential lots. We assume the residential buildings will be typical of the area, possibly have basement levels, and have relatively light foundation loadings. The parcel will probably have domestic wells for water source and on-site wastewater disposal systems (OWTS).

When building locations, grading and foundation loading information have been developed, we should be notified to re-evaluate the recommendations presented in this report and perform additional analyses as needed.

SITE CONDITIONS

Parcel 3, shown on Figures 1A and 1B, is estimated at about 25 acres in size. The site is primarily an abandoned gravel pit located on the north bank of the Eagle River, between the river and U.S. Highway 6. Most of the parcel has been graded with considerable backfill of the gravel pit over the years, in an uncontrolled fashion to our knowledge. The western portion of the site appears more natural and was probably not part of the previous gravel pit.

The site is located on primarily alluvial terrace along the north bank of the Eagle River. The site was mostly vacant and covered with about ½ to 1 foot of snow at the time of our field exploration. There is an existing residence with associated structures located at the far western end of the parcel as well as canvas type storage structures located in the the northeast portion of the parcel, see Figures 1A and 1B.

The upper part of most of the site near U.S. Highway 6 has been graded relatively flat with fill. The fill is estimated at up to possibly 25 feet deep with a moderately steep to steep slope down on the south side toward relatively flat, lower lying terrain adjacent the river. The fill slopes are from about 12 to 25 feet high with grades ranging from about 30 to 50%. The more natural terrain in the western portion of the site is strongly sloping down to the southwest with grades on the order of 6 to 10%. The apparent natural slopes adjacent to and down to the river below the fill slope in the middle portion of the site are relatively flat. In the western and eastern portions of the site, the apparent natural slopes adjacent to and down to the river are about 10 to 12 feet high and moderately steep to steep with grades on the order of 30 to 50%.

There is a moderately deep natural drainage swale that discharges at the river near the western side of the site. Vegetation on the site consists of grass, weeds and scattered small brush, with cottonwood trees and willows near the river. Wetland areas adjacent the river are shown on the survey plans provided to us as well as the river high water mark adjacent the south side of the site.

GEOLOGIC CONDITIONS

The natural soils at the site are primarily alluvium terrace deposits of the Eagle River. In the northeast part of the parcel are apparent alluvial fan deposits from the hillside terrain to the north. The underlying bedrock is the Eagle Valley Evaporite. There is considerable man-placed fill on most of the site covering the natural coarse gravel alluvium and alluvial fan deposits.

Potential geologic hazards that may impact the site consist of the potential for construction induced slope inability of the steeper slopes, compressible nature of the alluvial fan deposit soils, and the potential for sinkhole development due to the underlying Evaporite. The potential for construction induced slope instability and compressible soils are discussed in the "Preliminary Design Recommendations" section of this report. The potential for sinkhole development is discussed below. The civil engineer and/or hydrologist should review the flood potential of the lower lying terrain near the river.

Bedrock of the Pennsylvanian age Eagle Valley Evaporite underlies the 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 property. 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, several sinkholes were observed scattered throughout the Eagle River and Brush Creek valley areas. These sinkholes appear similar to others associated with the Eagle Valley Evaporite in other areas of the Eagle River valley.

Sinkholes were not observed in the immediate area of the subject parcel, however, the site grading could have concealed possible sinkholes. No evidence of cavities was encountered in the subsurface materials; however, the exploratory borings were widely spaced and relatively shallow, for preliminary foundation design only, and the existing fill may have covered any sinkholes. 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 on Parcel 3 due to the underlying Evaporite throughout the service life of the proposed development, in our opinion, is low; however, the owners of the individual lots 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 between December 14 and 18, 2015. Ten exploratory borings were drilled at the locations shown on Figures 1A and 1B to evaluate the general subsurface conditions. The borings were field staked by the surveyor. 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 Hepworth-Pawlak Geotechnical, Inc.

Samples of the subsoils were taken with 1⅜-inch and 2-inch I.D. spoon samplers. The samplers were 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, Figures 2 and 3. The samples were returned to our laboratory for review by the project engineer and testing.

Slotted PVC pipe was installed in Borings 5, 7, 9 and 10 to allow monitoring of the groundwater levels.

SUBSURFACE CONDITIONS

Graphic logs of the subsurface conditions encountered at the site are shown on Figures 2 and 3. The subsoils encountered were variable but in general consisted from about 1 to about 20½ feet of man-placed fill overlying relatively dense, silty to slightly silty sandy gravel and cobbles with boulders (dense coarse granular soils). The variations in the subsoil profiles encountered in the borings are discussed below.

At Boring 1, underlying shallow fill, was 3 feet of very stiff, sandy clay overlying the dense coarse granular soils. At Boring 5, below a depth of 24 feet, dense slightly silty sand with scattered gravel and probable cobbles was encountered within the dense coarse granular soils and extended down to the drilled depth of 26 feet. Boring 6, below 8 feet of fill, encountered loose, clayey to silty sand with gravel and possible cobbles with the dense coarse granular soils encountered to the drilled depth of 21 feet. Boring 8 encountered an apparent 7 feet thick topsoil layer below 14 feet of fill with the dense coarse granular soils encountered at 21 feet. The topsoil may be fill but appeared natural.

The fill types varied from sandy to very sandy silty clay to clayey silty sand and gravel, typically containing cobbles and scattered boulders, and had variable density. Drilling in the dense coarse granular soils, and in areas of the fill, with auger equipment was difficult due to the cobbles and boulders and drilling refusal was encountered in the deposits in most borings. Borings 7 and 10 and Profile Boring 1 refused in the fill above the natural soils.

Free water was encountered only in Boring 5 at the time of drilling at a depth of 25 feet; however, the slotted PVC pipe could only be installed to a depth of 22 feet due to caving soils. When checked 14 days following drilling, no free water was encountered in Borings 5, 9 and 10. When checked 85 days following drilling, free water was measured at a depth of about 11½ feet in Boring 5, which is likely a perched condition due to snowmelt runoff and the clayey fill soils. The soils were typically slightly moist to moist, becoming wet near the bottom of Boring 5.

LABORATORY TESTING

Laboratory testing performed on samples obtained from the borings included natural moisture content and density, gradation analyses, and Atterberg limits. Results of swell-consolidation testing performed on a relatively undisturbed drive sample of the sandy clay from Boring 1, presented on Figure 5, indicate low to moderate compressibility under conditions of loading and wetting with a low swell potential when wetted under a constant 1,000 psf surcharge. Undisturbed samples of the clayey to silty sand soils (alluvial fan deposits) from Boring 6 for swell-consolidation testing were not possible due to the rock content. Results of gradation analyses performed on small diameter drive samples (minus 1½ inch fraction) of the fill and natural granular subsoils are shown on Figures 6 through 9. The laboratory testing is summarized in Table 1.

ENGINEERING ANALYSIS

Development of the site will likely require extensive grading consisting of removal and replacement of the fill in movement sensitive structure areas such as below buildings, roadways and utilities. The fill should preferably be a fairly well graded granular material compacted to a high degree to reduce settlements. Fill depths should be limited to reduce long term settlement or the fill placed and allowed to settle over time before structures and facilities are constructed on the fill.

The existing fill at the site is variable with respect to type, depth and engineering characteristics. Some of the fill at the site should be feasible for re-use as structural fill. The existing granular fill soils excluding oversized (plus 6-inch) rock should be feasible for use as structural fill at the site. Selective stockpiling and/or mixing of the soils will probably need to be done to achieve a suitable granular material. Some of the finer grained soils may also be feasible for use as structural fill in shallow fill areas.

Additional study including borings and/or backhoe pits should be done to better evaluate the suitability of the existing fill for use as structural fill.

We expect spread footings will be preferred for foundation support of buildings and should be feasible with proper planning and design for the assumed construction. Structural fill depth below buildings, utilities and roadways should be limited to about 8 to 12 feet to help control fill settlement and potential for distress to structures constructed on the fill, as well as allow the use of spread footings for foundation support. Deeper fills may be feasible and can be evaluated for settlement potential if desired.

The buildings could also be founded on driven or drilled piles extending to below the fill and into the natural dense coarse granular soils, and should provide a low risk of foundation settlement if properly installed.

PRELIMINARY DESIGN RECOMMENDATIONS

The conclusions and recommendations presented below are based on the general proposed development, subsurface conditions encountered in the exploratory borings, and our experience in the area. The recommendations are suitable for planning but more specific studies appear needed for preliminary design.

FOUNDATIONS

Bearing conditions will vary depending on the specific location of the buildings on the property. Based on the nature of the assumed construction, spread footings bearing on the natural subsoils or on a limited depth of properly placed and compacted structural fill should be feasible. We expect the footings can be sized for an allowable bearing pressure in the range of 1,500 psf to 2,000 psf for bearing on structural fill and the natural fine grained soils. An allowable bearing pressure of 3,000 psf can be used for bearing on the natural dense coarse granular soils. Structural fill placed below footings can consist of the on-site coarse granular soils, excluding debris, topsoil and oversized rocks, or a similar material can be imported. Providing a depth of structural fill below spread footings on the natural fine grained soils with hydro compression potential could be done to reduce the potential for foundation movement.

Foundation walls should be well reinforced to span local anomalies, better withstand the effects of some differential settlement, and to resist lateral earth loadings when acting as retaining structures. Below grade areas and retaining walls should be protected from wetting and hydrostatic loading by use of an underdrain system. The footings should have a minimum depth of 48 inches for frost protection.

Buildings should be set-back from the moderately steep to steep slope down to the river along the southern side of the site to not adversely impact slope stability. In general, we believe the building foundations should be placed behind or bear below an imaginary 1½ horizontal to 1 vertical line extending up from the base of the slope. This should be reviewed as the planning and preliminary designs progress.

FLOOR SLABS

Slab-on-grade construction should be feasible for bearing on the natural soils or on compacted structural fill. Slabs bearing on the natural fine grained soils may have some risk of movement primarily if the subgrade becomes wetted. Providing a depth of structural fill below floor slabs in the natural fine grained soil areas could be done to reduce the potential for slab settlement. Structural fill placed below floor slabs should be limited in depth and can consist of the on-site granular soils, excluding debris, topsoil and oversized (plus 6-inch) rocks or a similar material can be imported.

To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints. Floor slab control joints should be used to reduce damage due to shrinkage cracking. A minimum 4-inch thick layer of free-draining gravel should underlie below grade slabs to facilitate drainage.

UNDERDRAIN SYSTEM

Although free water was encountered below probable structure excavation depths, it has been our experience in the area that local perched groundwater can develop during times of heavy precipitation or seasonal runoff. Frozen ground can also create a perched condition. An underdrain system should be provided to protect below-grade construction, such as retaining walls, crawlspace and basement areas from wetting and hydrostatic pressure buildup.

The drains should consist of drainpipe surrounded above the invert level with free-draining granular material. The drain should be placed at each level of excavation and at least 1 foot below lowest adjacent finish grade and sloped at a minimum 1% to a suitable gravity outlet or a sump where the water can be collected and pumped. A perimeter foundation drain around shallow (less than 4 feet deep) crawlspace building areas may not be needed where the natural soils are relatively free draining and with adequate compaction of foundation wall backfill and positive surface slope away from the foundation, but should be evaluated on an individual building basis.

SITE GRADING

All structural fill should be properly placed and compacted to reduce the risk of settlement and distress to facilities constructed on the fill. We expect existing fill on the site will need to be removed below building, roadway and utility areas, and replaced with compacted structural fill. Fill placed near the moderately steep to steep slope down to the river should be limited in depth to a few feet to minimize surcharge loading on the slope and possible slope instability. Some rockfall from the fill slope faces and natural coarse granular slopes could occur over time.

The on-site coarse granular soils, excluding debris, topsoil and oversized (plus 6-inch) rocks, or a similar material should be suitable as structural fill. In general, structural fill at the site should consist of a fairly well graded material having a maximum size of 6 inches and less than about 30% passing the No. 200 size sieve. The structural fill should be compacted to at least 95% of the maximum standard Proctor density (SPD) at a moisture content within about 2% of optimum. Some settlement of deeper fill areas should be expected, even if the material is placed correctly, and could result in distress to facilities constructed on the backfill. We expect settlement of select granular fill such as the on-site coarse granular soils as the recommended material discussed above, compacted to at least 95% SPD will have long term settlement on the order of ½ to 1% of the fill depth. Increasing the fill compaction to at least 98% SPD to reduce fill settlement and/or allowing some time for the fill to settle before constructing on the fill could be done. The fill should be benched into the portions of the site exceeding 20% grade.

Structural fill placed below footing and building areas should be compacted to at least 98% SPD. Prior to fill placement, all existing fill and topsoil should be removed, the subgrade scarified to a depth of 8 inches, adjusted to near optimum moisture and compacted to at least 90% of standard Proctor density. In soft or wet areas, the subgrade may require drying or stabilization prior to fill placement. A geogrid and/or subexcavation and replacement with coarse granular soils or aggregate base soils may be needed for the stabilization. The subgrade should be proofrolled. Areas that deflect excessively should be corrected before placing structural fill. Miscellaneous fill at the site should be compacted to at least 90% SPD.

Permanent unretained cut and fill slopes should be graded at 2 horizontal to 1 vertical or flatter and protected against erosion by revegetation, rock riprap or other means. Oversized rock from embankment fill construction will tend to collect on the outer face. A protection fence could be provided downslope of the embankment toe to prevent rockfall to below the slope.

We should review site grading plans for the project and perform additional analyses as needed prior to construction.

SURFACE DRAINAGE

The grading plan for the development should consider runoff from above the site, across the site and at individual building sites. Water should not be allowed to pond which could impact slope stability and foundations. To limit infiltration into the bearing soils next to buildings, exterior backfill should be well compacted and have a positive slope away from the building for a distance of at least 10 feet. Roof downspouts and drains should discharge well beyond the limits of all backfill and landscape irrigation should be restricted.

PERCOLATION TESTING

Percolation testing was performed in two shallow, 4-inch diameter auger holes (P-1 and P-2) located near Profile Boring 1 (see Figure 1B for locations) to evaluate the general infiltration characteristics of the subsoils. The tests were performed in fill of unknown depth. The percolation test results summarized on Table 2 indicate a percolation rate of about 80 minutes per inch for the clayey fill. The test results may not be accurate due to the surface water in the boring freezing between measurements. Additional percolation testing should be done in the natural soil areas.

LIMITATIONS

This study has been conducted according to 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 our field observations, the exploratory borings located as shown on Figure 1, the assumed 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 planning and preliminary design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation, conduct additional evaluations and review and monitor the implementation of our recommendations. Significant changes in the proposed/assumed construction 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,

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

COLORADO REGISTERED DAVID A. YOUNG 32-216 3-16-16 PROFESSIONAL ENGINEER

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Reviewed by:

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DAY/ksw

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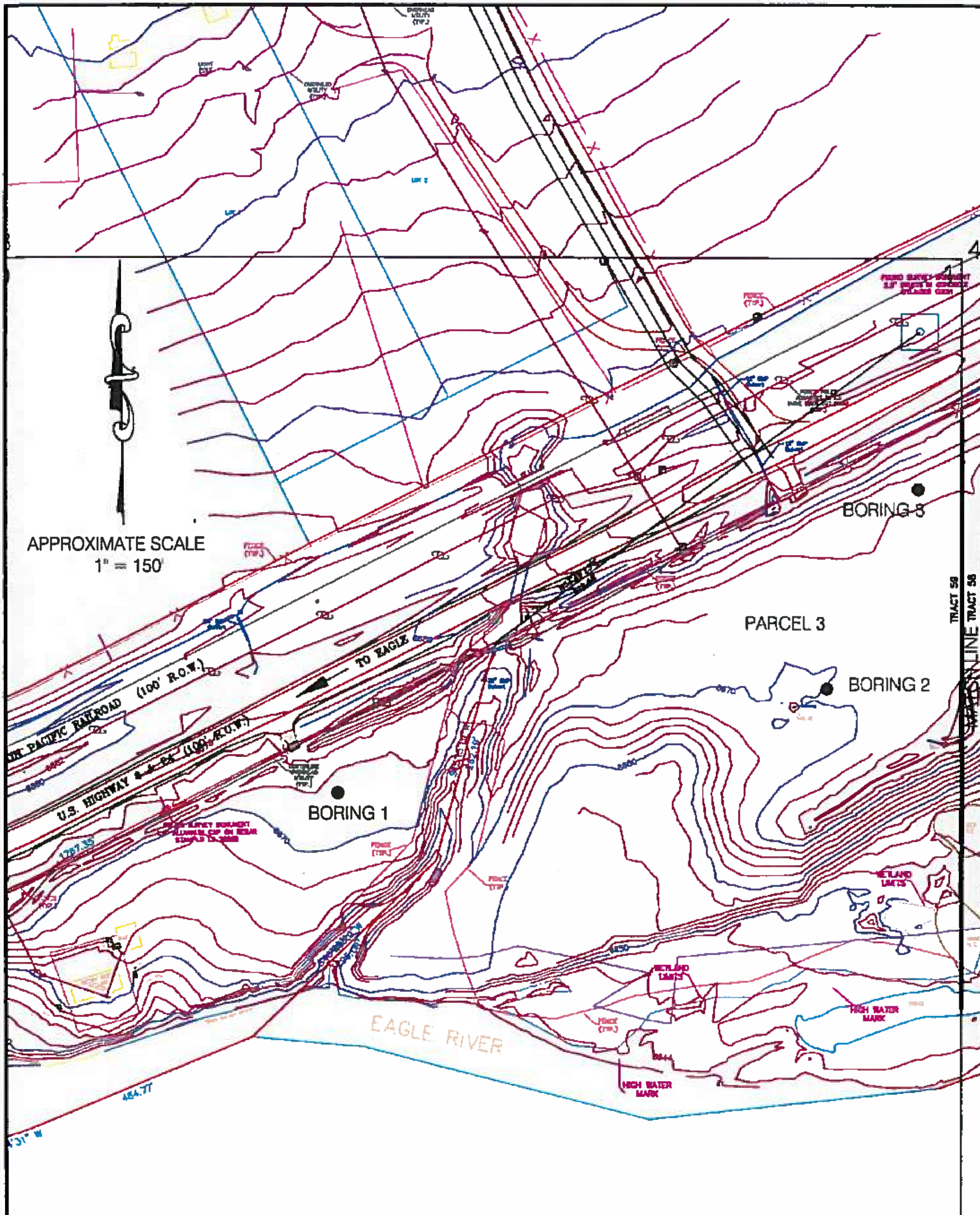
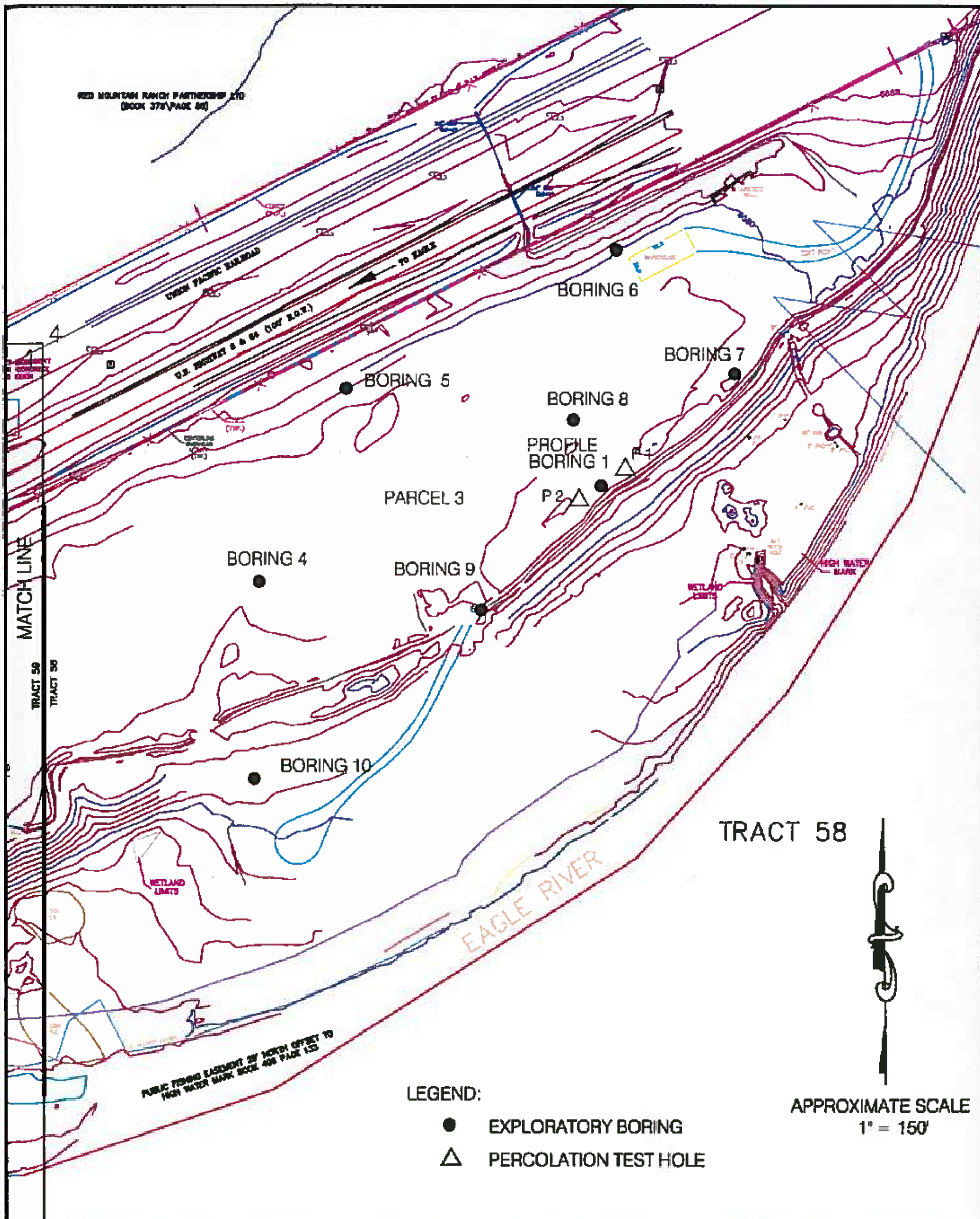
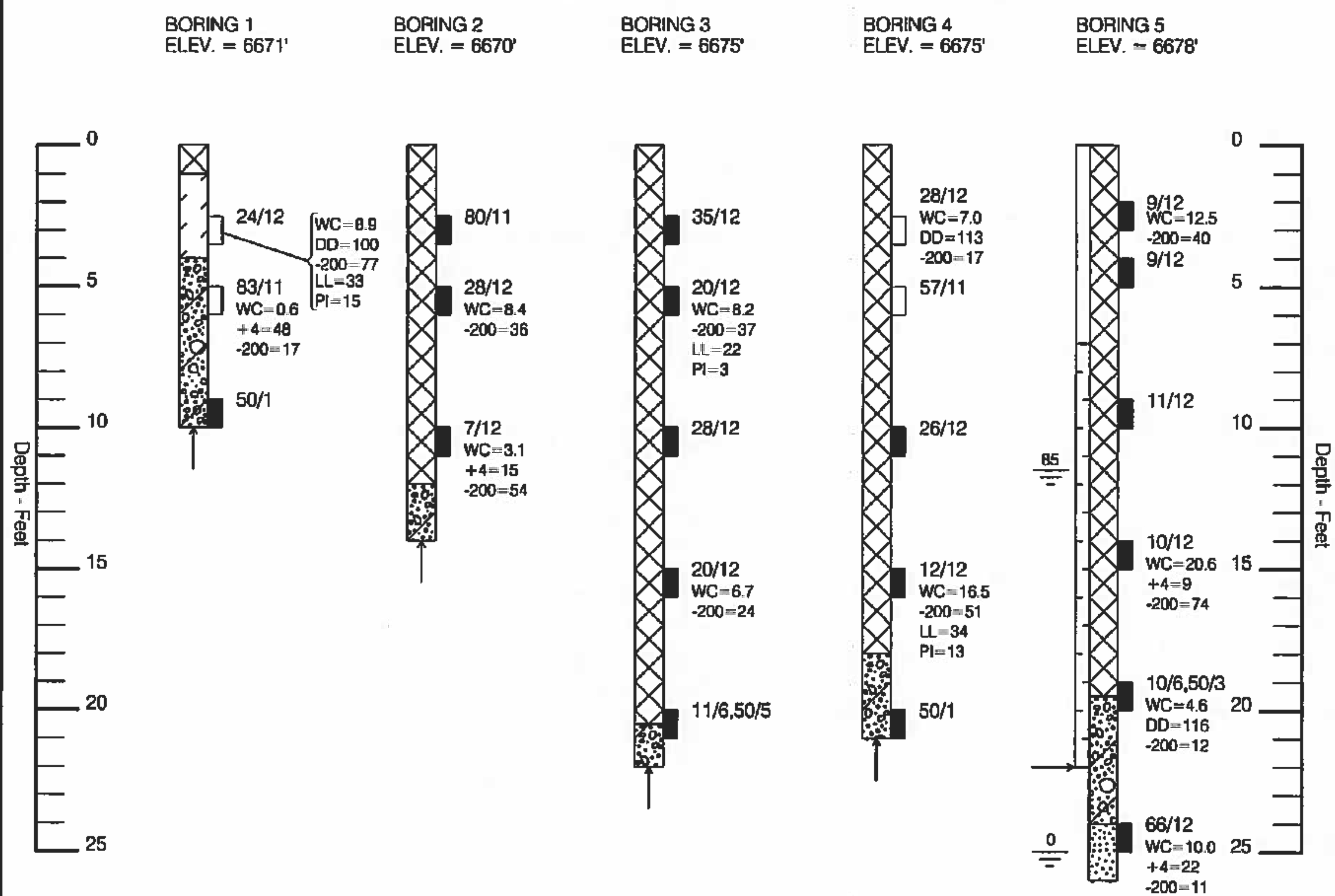
Alpine Engineering – Gary Brooks (brooks@alpinecivil.com)



115 548C	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOCATION OF EXPLORATORY BORINGS	Figure 1A

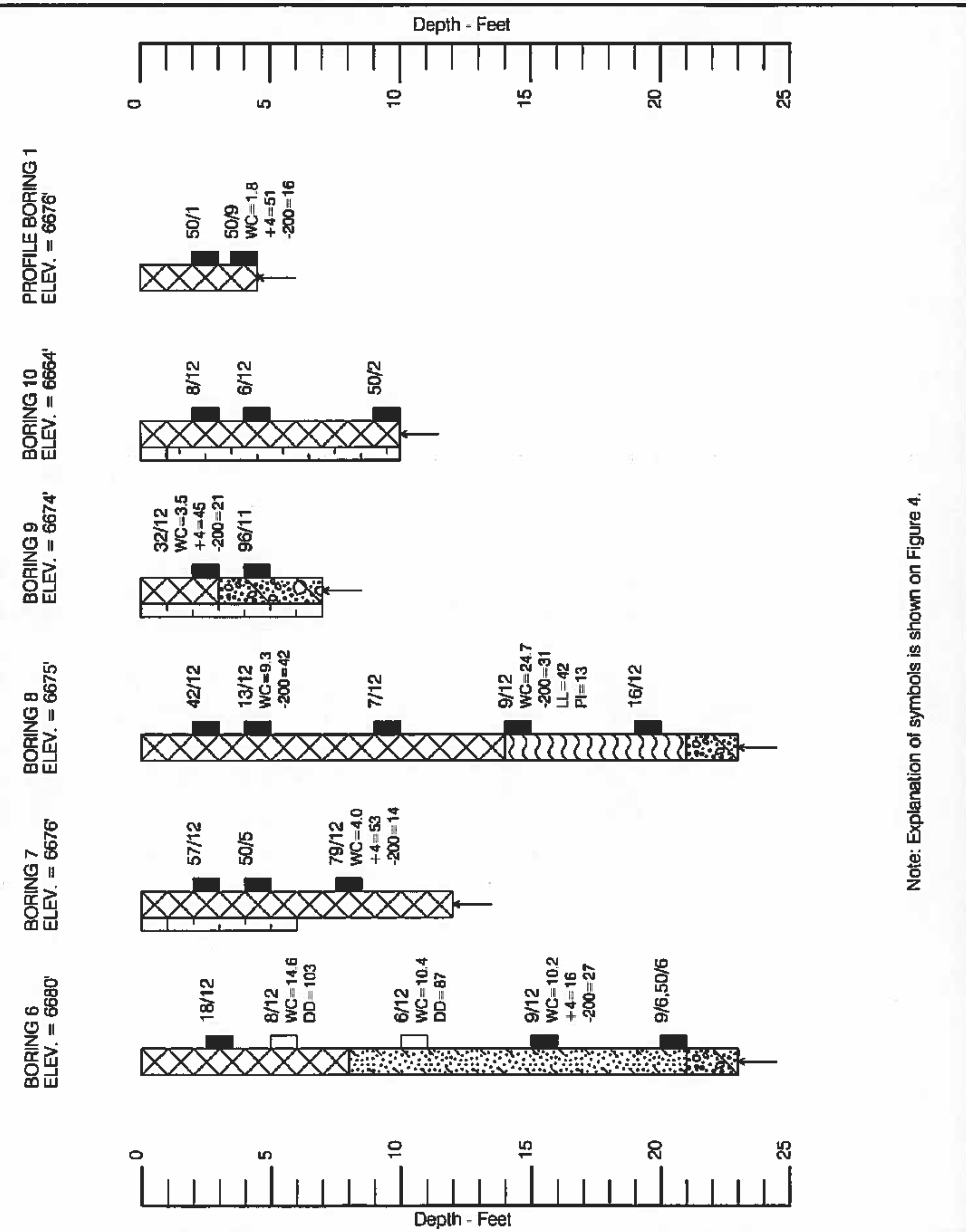


115 548C	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOCATION OF EXPLORATORY BORINGS	Figure 1B



Note: Explanation of symbols is shown on Figure 4.

115 548C	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOGS OF EXPLORATORY BORINGS	Figure 2



115 548C	HP Geotech Hepworth-Pawlak Geotechnical	LOGS OF EXPLORATORY BORINGS	Figure 3

LEGEND:

FILL; man-placed sandy to very sandy silty clay with gravel to clayey to silty sand mixed with gravel, with cobbles and boulders, variable density, slightly moist to very moist, mixed brown to dark brown, some wood concrete and asphalt debris, and some topsoil.

TOPSOIL; organic clayey silty sand with gravel, medium dense, very moist, dark brown to black, possibly fill.

CLAY (CL); sandy, scattered gravel, very stiff, slightly moist, light brown, medium plasticity.

SAND (SM-SC); silty to clayey, gravelly, possible cobbles, loose, moist, red-brown, rocks are primarily subangular, low to non-plastic fines.

GRAVEL AND COBBLES (GM); with boulders, sandy, silty to slightly silty, dense to very dense, slightly moist to moist, brown, rocks are primarily subrounded to rounded.

SAND (SM-SP); slightly silty, scattered gravel, probable cobbles, dense, wet, brown.

Relatively undisturbed drive sample; 2-inch I.D. California liner sample.

Drive sample; standard penetration test (SPT), 1 3/8 inch I.D. split spoon sample, ASTM D-1586.

24/12 Drive sample blow count; indicates that 24 blows of a 140 pound hammer falling 30 inches were required to drive the California or SPT sampler 12 inches.

0.85 Free water level in boring and number of days following drilling measurement was taken.

Indicates slotted PVC pipe installed in boring to depth shown.

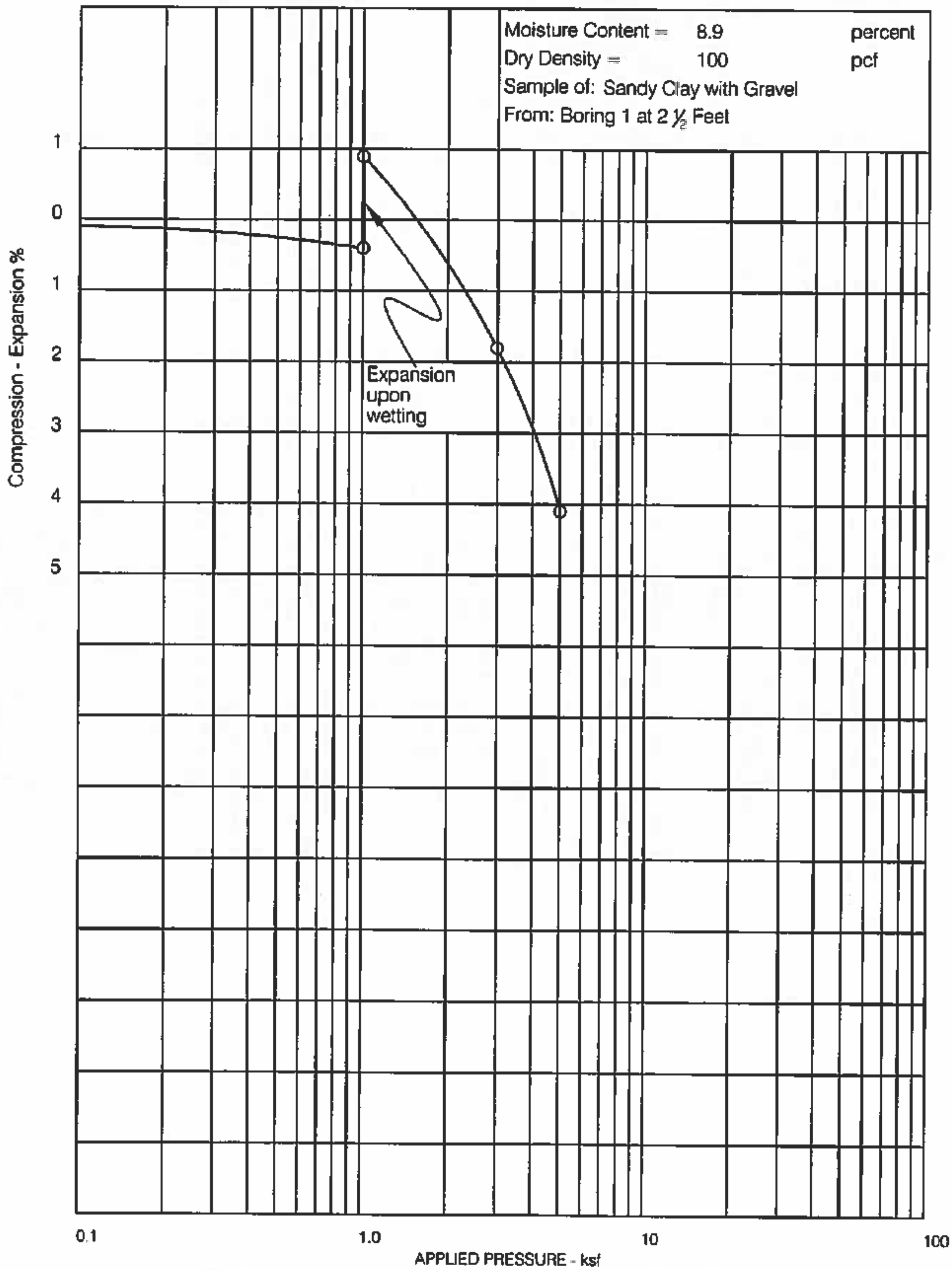
Practical drilling refusal.

Depth boring caved immediately following drilling.

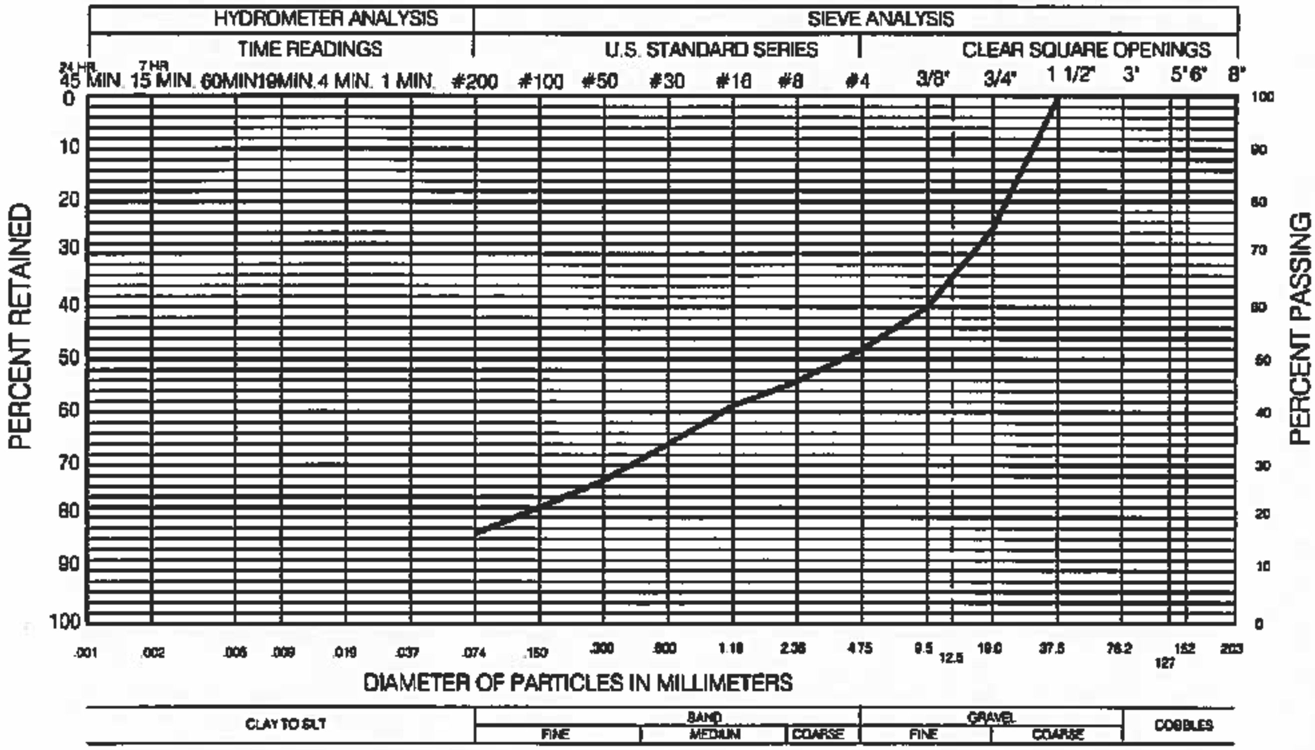
NOTES:

1. Exploratory borings were drilled between December 14, and 18, 2015 with 4-inch diameter continuous flight power auger.
2. Locations of exploratory borings were field staked by surveyor, Archibeque Land Consultants.
3. Elevations of exploratory borings were obtained by interpolation between contours shown on the site plan provided.
4. The exploratory boring locations and elevations 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 transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. Free water encountered only in Boring 5. Fluctuations in water level may occur with time.
7. Laboratory Testing Results:
   WC = Water Content (%)
   DD = Dry Density (pcf)
   +4 = Percent retained on the No. 4 sieve
   -200 = Percent passing No. 200 sieve
   LL = Liquid Limit (%)
   PI = Plasticity Index (%)

115 548C	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LEGEND AND NOTES	Figure 4



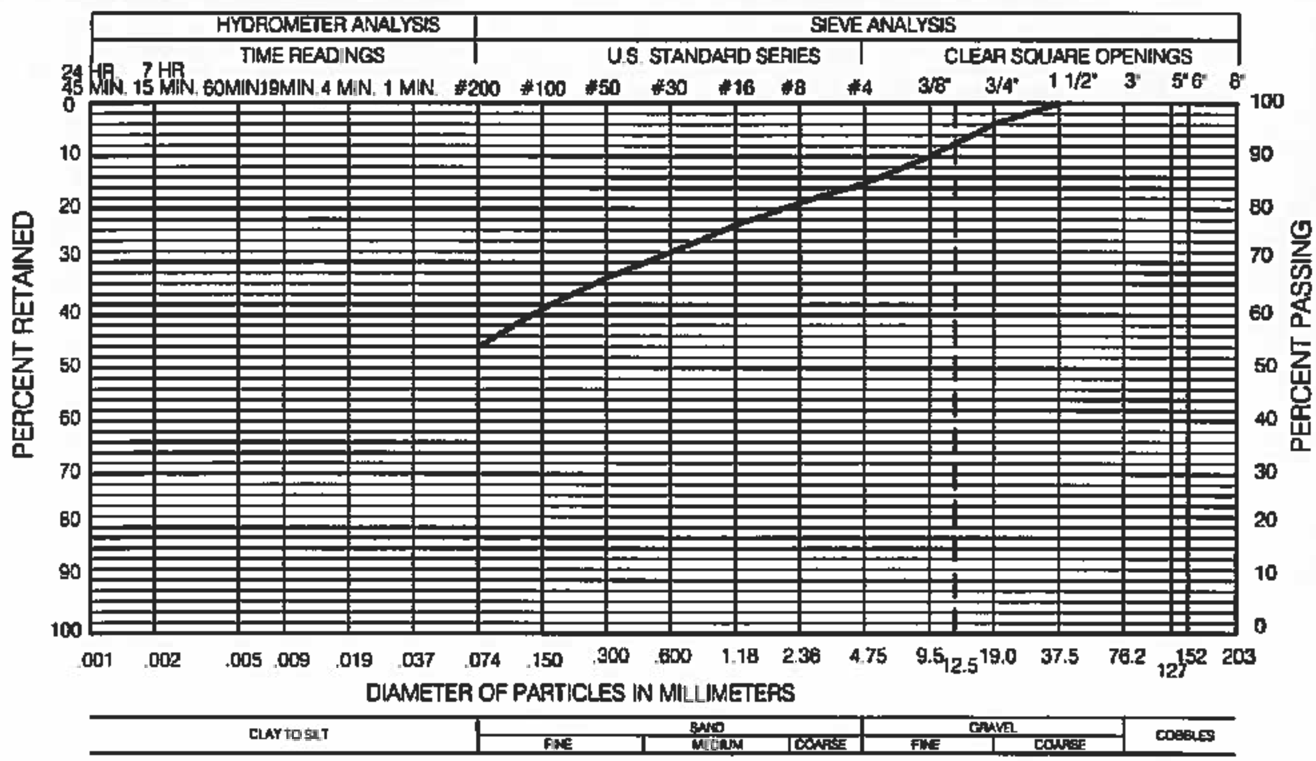
115 548C	HP Geotech Hepworth-Pawlak Geotechnical	SWELL-CONSOLIDATION TEST RESULTS	Figure 5



GRAVEL 48 % SAND 35 % SILT AND CLAY 17 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Sandy Gravel FROM: Boring 1 at 5 Feet

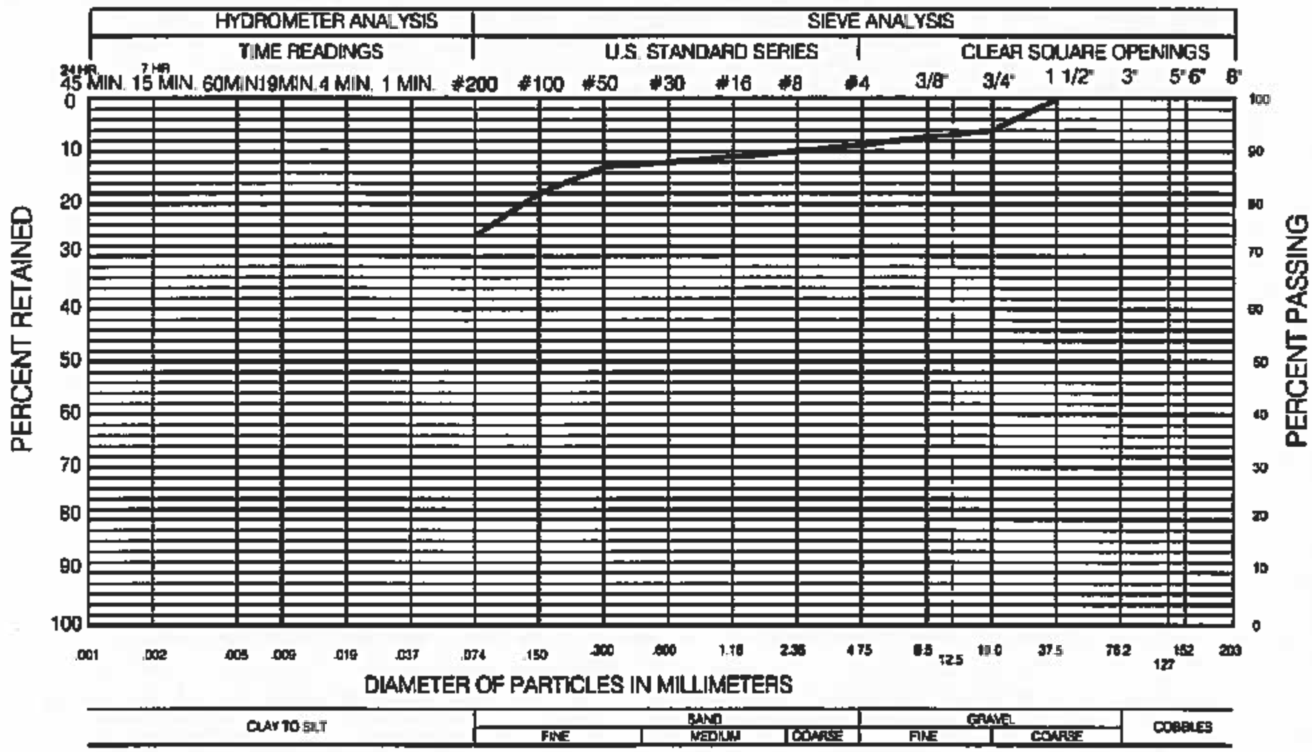


GRAVEL 15 % SAND 31 % SILT AND CLAY 54 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Sandy Silty Clay with Gravel (Fill) FROM: Boring 2 at 10 Feet

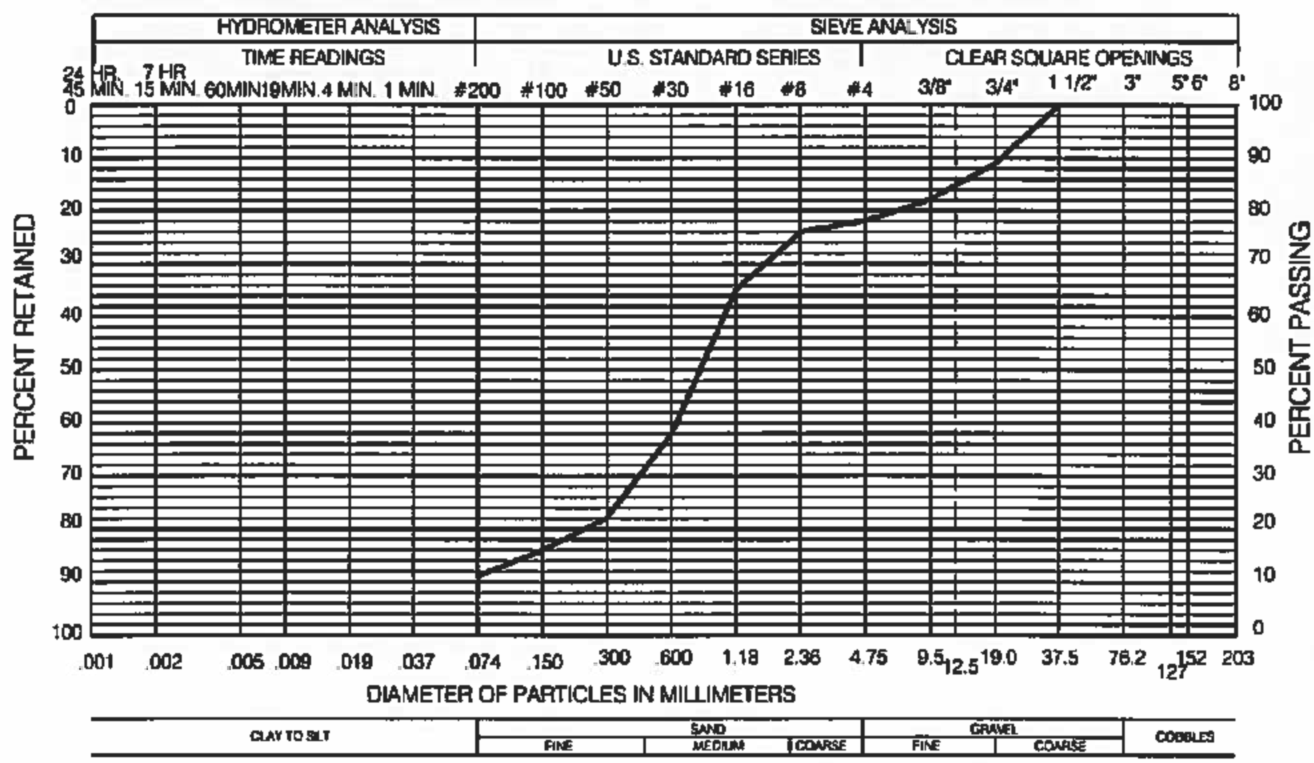
115 548C	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	GRADATION TEST RESULTS	Figure 6



GRAVEL 9 % SAND 17 % SILT AND CLAY 74 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Sandy Silty Clay with Gravel (Fill) FROM: Boring 5 at 14 Feet

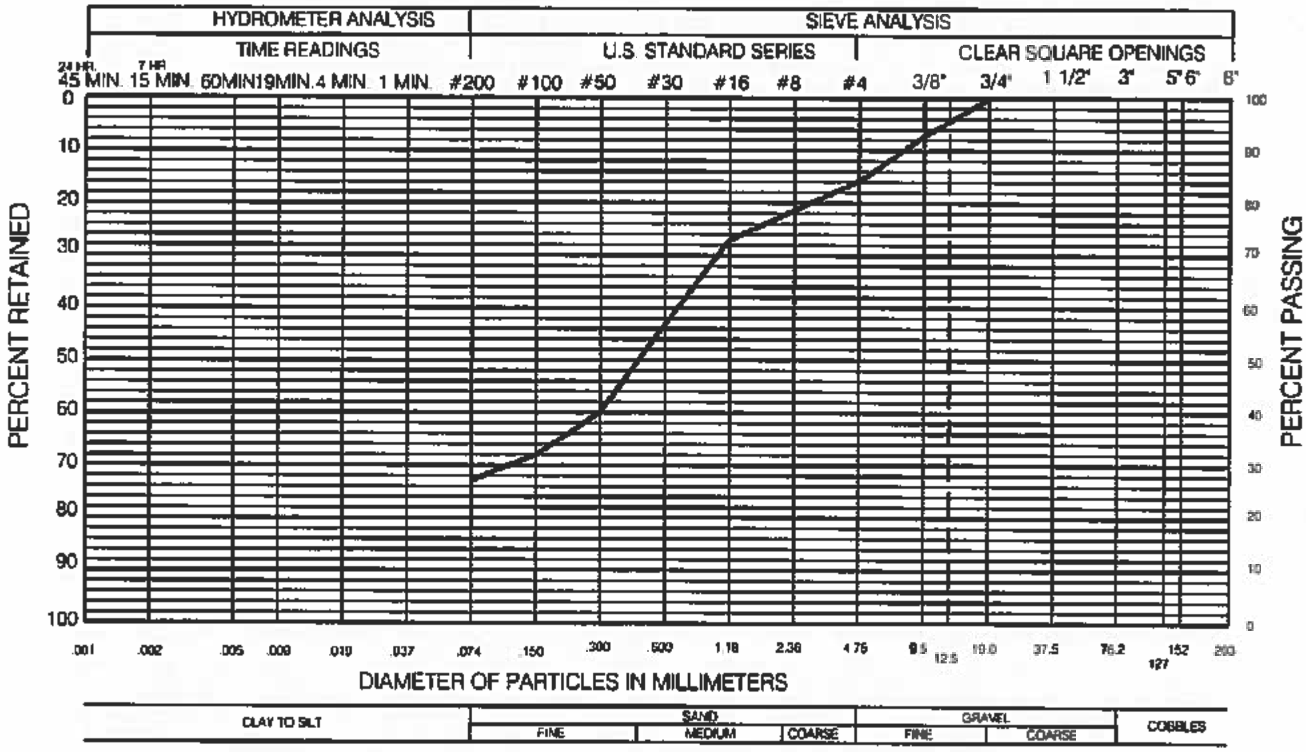


GRAVEL 22 % SAND 67 % SILT AND CLAY 11 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Sand with Gravel FROM: Boring 5 at 24 Feet

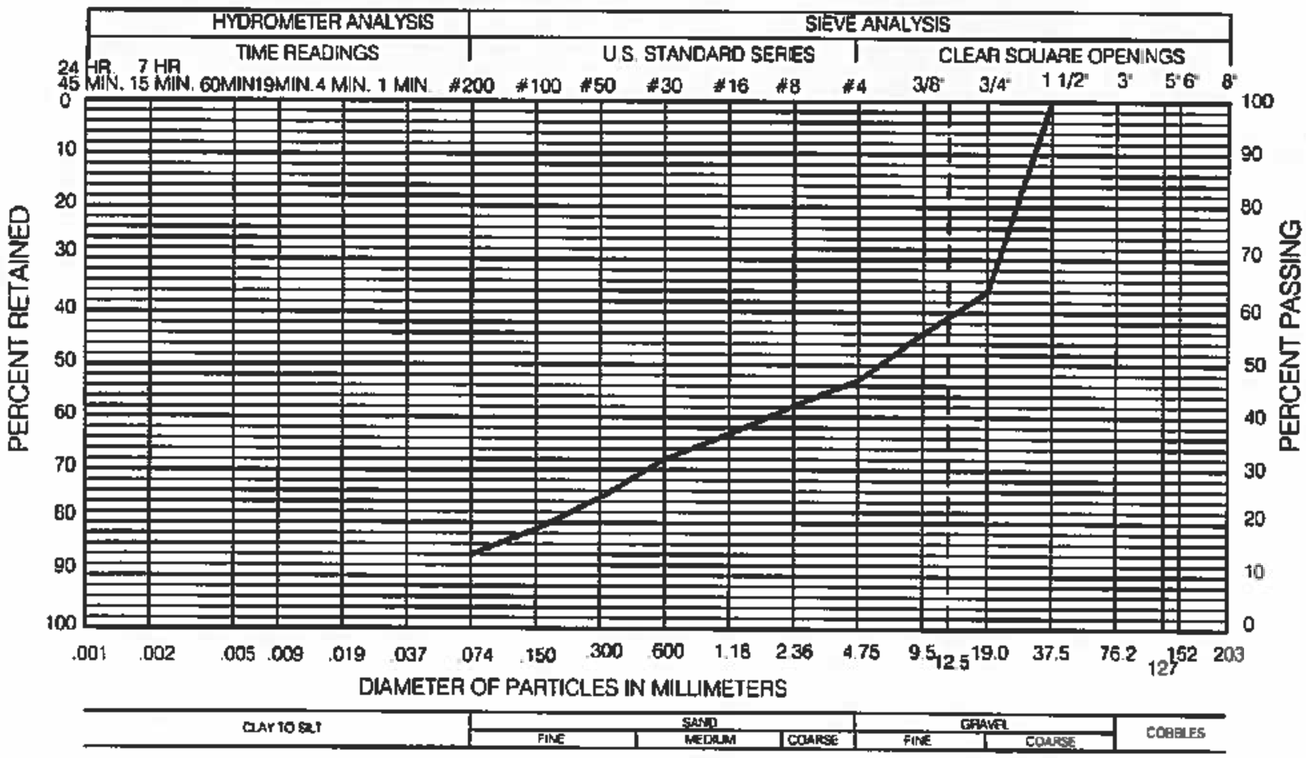
115 548C	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	GRADATION TEST RESULTS	Figure 7



GRAVEL 16 % SAND 57 % SILT AND CLAY 27 %

LIQUID LIMIT % PLASTICITY INDEX %

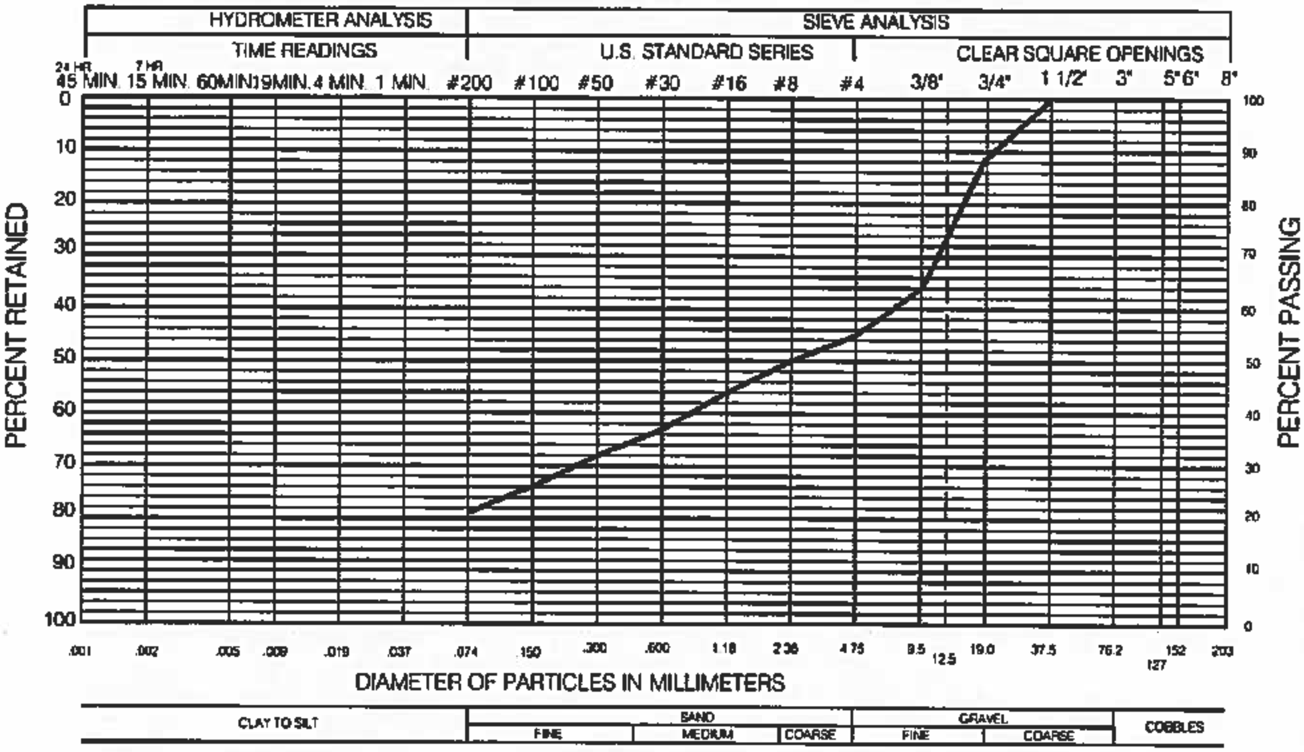
SAMPLE OF: Clayey Silty Sand with Gravel FROM: Boring 6 at 15 Feet



GRAVEL 53 % SAND 33 % SILT AND CLAY 14 %

LIQUID LIMIT % PLASTICITY INDEX %

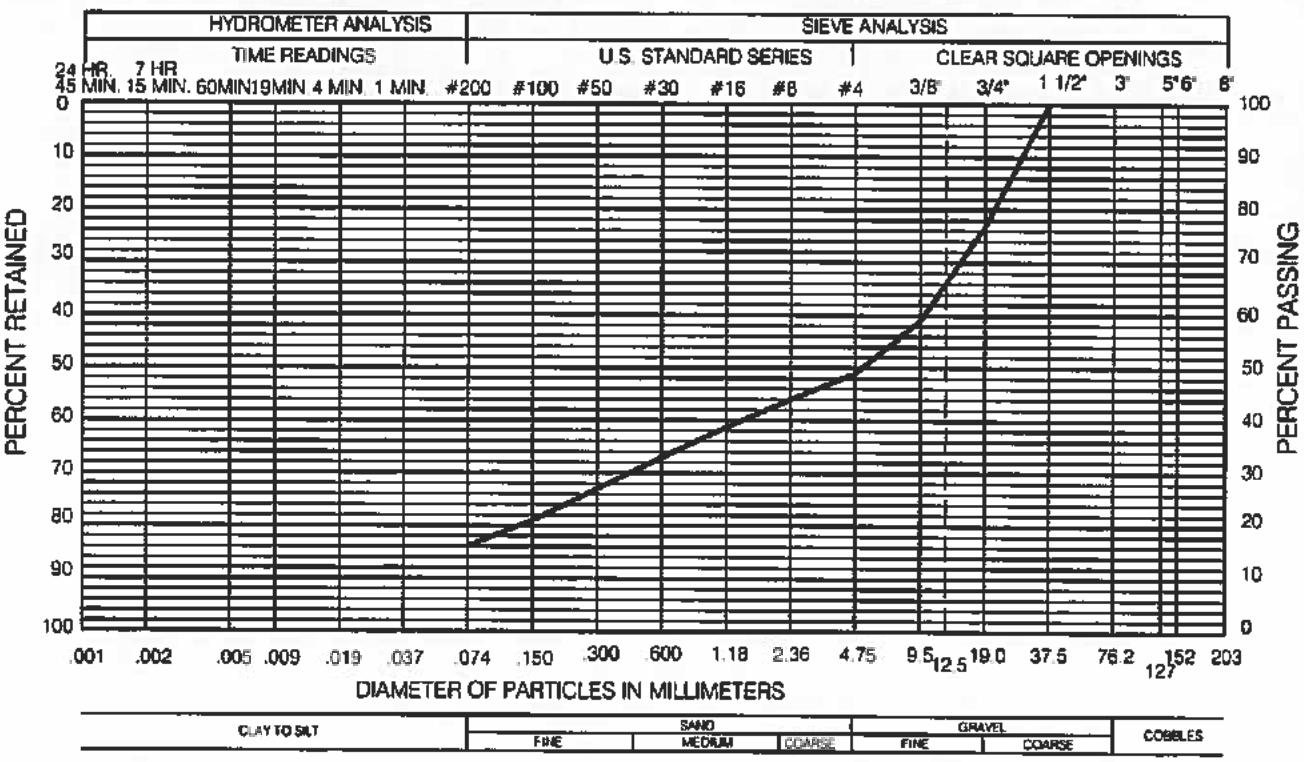
SAMPLE OF: Silty Sandy Gravel (Fill) FROM: Boring 7 at 7 ½ Feet



GRAVEL 45 % SAND 34 % SILT AND CLAY 21 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Clayey Sandy Gravel (Fill) FROM: Boring 9 at 2 Feet



GRAVEL 51 % SAND 33 % SILT AND CLAY 16 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Clayey Sandy Gravel (Fill) FROM: Profile Boring 1 at 3 ½ Feet

115 548C	HP Geotech Hepworth–Pawlak Geotechnical	GRADATION TEST RESULTS	Figure 9

HEPWORTH-PAWLAK GEOTECHNICAL, INC.
TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Job No. 115 548C

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY DENSITY	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH	SOIL OR BEDROCK TYPE
BORING	DEPTH (ft)	(%)	(pcf)	GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)	(PSF)	
1	2½	8.9	100			77	33	15		Sandy Clay with Gravel
	5	0.6		48	35	17				Silty Sandy Gravel
2	5	8.4				36				Clayey Sand and Gravel (Fill)
	10	3.1		15	31	54				Sandy Silty Clay with Gravel (Fill)
3	5	8.2				37	22	3		Clayey Silty Sand and Gravel (Fill)
	15	6.7				24				Clayey Silty Sand and Gravel (Fill)
4	2½	7.0	113			17				Silty Sand with Gravel (Fill)
	15	16.5				51	34	13		Very Sandy Clay (Fill)
5	2	12.5				40				Silty Clayey Sand (Fill)
	14	20.6		9	17	74				Sandy Silty Clay with Gravel (Fill)
	19	4.6	116			12				Silty Sand with Gravel (Fill)
	24	10.0		22	67	11				Silty Sand with Gravel

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY DENSITY	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH	SOIL OR BEDROCK TYPE
BORING	DEPTH (ft)	(%)	(pcf)	GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)	(PSF)	
6	5	14.6	103							Silty Sand with Gravel (Fill)
	10	10.4	87							Silty Sand with Gravel
	15	10.2		16	57	27				Clayey Silty Sand with Gravel
7	7½	4.0		53	33	14				Silty Sandy Gravel (Fill)
8	4	9.3				42				Silty Clayey Sand with Gravel (Fill)
	14	24.7				31	42	13		Organic Clayey Silty Sand (Topsoil/Peat)
9	2	3.5		45	34	21				Silty Clayey Sandy Gravel (Fill)
Profile Boring 1	3½	1.8		51	33	16				Silty Clayey Sandy Gravel (Fill)

HEPWORTH-PAWLAK GEOTECHNICAL, INC.
TABLE 2
PERCOLATION TEST RESULTS

JOB NO. 115 548C

HOLE NO.	HOLE DEPTH (INCHES)	LENGTH OF INTERVAL (MIN)	WATER DEPTH AT START OF INTERVAL (INCHES)	WATER DEPTH AT END OF INTERVAL (INCHES)	DROP IN WATER LEVEL (INCHES)	AVERAGE PERCOLATION RATE (MIN./INCH)
P-1	29½	20	26½	25½	1	
			25½	24⅞	⅝	
			24⅞	24½	⅜	
			24½	24 ¼	¼	
			24¼	24	¼	
			24	23¾	¼	
			23¾	23½	¼	80
P-2	31½	20	26¼	25⅝	⅝	
			25⅝	25¼	⅜	
			25¼	25	¼	
			25	24¾	¼	
			24¾	24½	¼	80

Note: Percolation test holes were performed in 4-inch diameter auger holes and soaked on 12/17/15. Tests were performed in fill. Water surface in test hole was freezing between readings. The average percolation rates were based on the last three readings of each test.

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PRELIMINARY SUBSOIL STUDY
PARCEL 4, RED MOUNTAIN RANCH
U.S. HIGHWAY 6, EAST OF EAGLE
EAGLE COUNTY, COLORADO

JOB NO. 115 548D

FEBRUARY 29, 2016

PREPARED FOR:

MR. MERV LAPIN
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TABLE OF CONTENTS

PURPOSE AND SCOPE OF STUDY

This report presents the results of a preliminary subsoil study for Parcel 4, Red Mountain Ranch, U.S. Highway 6, east of Eagle, Eagle County, Colorado. The project site is shown on Figures 1A and 1B. The purpose of the study was to develop recommendations for planning and preliminary foundation and site grading designs. The study was conducted as part of our proposal for professional services to Mr. Merv Lapin dated November 10, 2015.

A field exploration program consisting of exploratory borings was conducted to obtain information on the general 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 preliminary recommendations for foundation types, depths and allowable pressures for assumed residential construction on the parcel, as well as for the site grading. 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. The report includes a discussion of the general geologic conditions at the site.

PROPOSED CONSTRUCTION

The parcel is currently planned to be developed as large single family residential lots. The buildings will likely be one to three story wood frame structures possibly with basement levels. Ground floors may be slab-on-grade and/or structurally supported over crawlspace. Grading for the structures is expected to be relatively minor with cut depths between about 3 to 10 feet. We assume relatively light foundation loadings, typical of the proposed type of construction. The parcel will probably have domestic wells for water source and on-site wastewater disposal systems (OWTS).

When building locations, grading and foundation loading information have been developed, we should be notified to re-evaluate the recommendations presented in this report and perform additional analyses as needed.

SITE CONDITIONS

The parcel is estimated at about 20 acres in size and is located on an alluvial terrace along the north bank of the Eagle River, between the river and U.S. Highway 6. The site was vacant at the time of our field exploration and covered with about 4 to 6 inches of snow. The site has undergone grading in areas but does not appear to be a previous gravel pit.

The terrain is relatively flat in the upper part of the parcel near Highway 6 with a slope down to the south and southwest. There is a moderately steep to steep slope down along the southern side of the parcel. The moderately steep to steep slope is down to the Eagle River in the eastern portion and down to relatively flat, low lying terrain adjacent the river in the western portion. The slope grades in the flatter terrain near Highway 6 range from about 3 to 7% then become moderately steep to steep down about 10 to 30 feet at grades from about 10 to 40%. Total elevation difference across the parcel is about 55 feet.

There is a drainage ditch along Highway 6 and a drainage ditch near the center of the parcel draining south toward the river that were not flowing water at the time of our field exploration. Vegetation consists of tall grass and weeds with brush and sagebrush, and cottonwood trees at the river edge. There are numerous cobbles and boulders to several feet in diameter on the ground surface. Wetland areas adjacent the river are shown on the survey plans provided to us as well as river high water mark adjacent the south side of the parcel.

GEOLOGIC CONDITIONS

The natural soils at the site are primarily alluvium terrace deposits of the Eagle River. Overlying the terrace alluvium in the northern part of the site is apparent alluvial fan deposits from the hillside drainages to the north. The underlying bedrock is the Eagle Valley Evaporite. There is some man-placed fill on areas of the site covering the natural coarse granular alluvium and alluvial fan deposits.

Potential geologic hazards that may impact the site consist of the potential for construction induced slope inability of the steeper slopes, compressible nature of the alluvial fan deposit soils, and the potential for sinkhole development due to the underlying Evaporite. The potential for construction induced slope instability and compressible soil conditions are discussed in the "Preliminary Design Recommendations" section of this report. The potential for sinkhole development is discussed below. The civil engineer and/or hydrologist should review the flood potential of the lower lying terrain near the river.

Bedrock of the Pennsylvanian age Eagle Valley Evaporite underlies the 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 property. 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, several sinkholes were observed scattered throughout the Eagle River and Brush Creek valley areas. These sinkholes appear similar to others associated with the Eagle Valley Evaporite in other areas of the Eagle River valley.

Sinkholes were not observed in the immediate area of the subject parcel, however, the site grading could have concealed possible sinkholes. No evidence of cavities was encountered in the subsurface materials; however, the exploratory borings were widely spaced and relatively shallow, for preliminary foundation design only, and the existing fill may have covered any sinkholes. 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 on Parcel 4 due to the underlying Evaporite, throughout the service life of the proposed residences, in our opinion, is low; however, the owners of the individual lots 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 December 18 and 21, 2015. Four exploratory borings were drilled at the locations shown on Figures 1A and 1B to evaluate the general subsurface conditions. The boring locations were field staked by the surveyor. 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 Hepworth-Pawlak Geotechnical, Inc.

Samples of the subsoils were taken with 1⅜-inch and 2-inch I.D. spoon samplers. The samplers were 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 encountered were variable but in general consisted of nil to 12 feet or more of man-placed fill overlying stiff, silty clay and/or relatively dense, silty sandy gravel and cobbles with boulders (dense coarse granular soils) with depth. The variations in the subsoil profiles encountered in the borings are discussed below.

At Boring 1, man-placed fill was encountered to the drilled depth of 12 feet where refusal occurred. At Borings 2 through 4, below about ½ foot of topsoil or 2 feet of man-placed fill, about 1½ to 2½ feet of stiff, slightly sandy to sandy silty clay (alluvial fan deposits) was encountered and underlain by the dense coarse granular soils. At Profile Boring 1, man-placed fill was encountered to the drilled depth of 9 feet where refusal occurred.

The fill was generally clayey to silty and sandy to very sandy gravel, typically containing cobbles and scattered boulders, and had variable density. Drilling in the coarse granular soils, and in areas of the fill, with auger equipment was difficult due to the cobbles and boulders and drilling refusal was encountered in the deposits in all borings.

No free water was not encountered in the borings at the time of drilling and subsoils were slightly moist to moist.

LABORATORY TESTING

Laboratory testing performed on samples obtained from the borings included natural moisture content and density, gradation analyses, and Atterberg limits. Results of swell-consolidation testing performed on a relatively undisturbed drive sample of the sandy silty clay from Boring 4, presented on Figure 4, indicate low compressibility under existing moisture conditions and light loading. The sample showed a moderate collapse potential when wetted under a constant 1,000 psf surcharge and moderately high compressibility when loaded after wetting. Results of gradation analyses performed on small diameter drive samples (minus 1½ inch fraction) of the fill and natural granular subsoils are shown on Figures 5 and 6. The laboratory testing is summarized in Table 1.

FOUNDATION BEARING CONDITIONS

The natural coarse granular soils at the site possess moderate bearing capacity and relatively low settlement potential. The silty clay alluvial fan soils possess low bearing capacity and generally moderate settlement potential, especially when wetted. Spread footings bearing on these soils should be suitable for foundation support of the buildings with precautions to limit settlements. Existing fill will need to be removed below buildings areas. It may also be desirable to remove the silty clay soils below footing (and floor slab) areas to provide a low risk of foundation and floor slab settlement. It should be feasible to re-establish design footing bearing and floor slab subgrade elevation with compacted structural fill. The structural fill can consist of the on-site coarse granular soils excluding debris, topsoil and oversized (plus 6-inch) rocks, or a similar material can be imported.

PRELIMINARY DESIGN RECOMMENDATIONS

The conclusions and recommendations presented below are based on the general proposed development, subsurface conditions encountered in the exploratory borings, and our experience in the area. The recommendations are suitable for planning and preliminary design but site specific studies should be conducted for individual lot development.

FOUNDATIONS

Bearing conditions will vary depending on the specific location of the buildings on the property. Based on the nature of the assumed construction, spread footings bearing on the natural subsoils or on a limited depth of properly placed and compacted structural fill should be feasible. We expect the footings can be sized for an allowable bearing pressure in the range of 1,000 psf to 2,000 psf for bearing on structural fill and the natural fine grained silty clay soils. An allowable bearing pressure of 3,000 psf can be used for bearing on the natural dense coarse granular soils. Structural fill placed below footings can consist of the on-site coarse granular soils, excluding debris, topsoil and oversized (minus 6 inch) rocks, or a similar material can be imported. Removing the fine grained soils or providing a depth of structural fill below spread footings on the natural fine grained soils with hydro-compression potential could be needed to reduce the potential for foundation movement.

Foundation walls should be well reinforced to span local anomalies, better withstand the effects of some differential settlement, and to resist lateral earth loadings when acting as retaining structures. Below grade areas and retaining walls should be protected from wetting and hydrostatic loading by use of an underdrain system. The footings should have a minimum depth of 48 inches for frost protection.

Buildings should be set-back from the moderately steep to steep slope down to the river along the southeastern side of the site to not adversely impact slope stability. In general, we believe the building foundations should be placed behind or bear below an imaginary 1½ horizontal to 1 vertical line extending up from the base of the slope. This should be reviewed as the planning and preliminary designs progress.

FLOOR SLABS

Slab-on-grade construction should be feasible for bearing on the natural soils or on compacted structural fill. Slabs bearing on the hydro-compressive silty clay soils will have a risk of settlement if the subgrade becomes wetted. Structural fill placed below floor slabs can consist of the on-site coarse granular soils, excluding debris, topsoil and oversized (plus 6-inch) rocks, or a similar material can be imported.

To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints. Floor slab control joints should be used to reduce damage due to shrinkage cracking. A minimum 4-inch thick layer of free-draining gravel should underlie below grade slabs to facilitate drainage.

UNDERDRAIN SYSTEM

Although free water was not encountered during our field exploration, it has been our experience in the area that local perched groundwater can develop during times of heavy precipitation or seasonal runoff. Frozen ground can also create a perched condition. An underdrain system should be provided to protect below-grade construction, such as retaining walls, crawlspace and basement areas from wetting and hydrostatic pressure buildup.

The drains should consist of drainpipe surrounded above the invert level with free-draining granular material. The drain should be placed at each level of excavation and at least 1 foot below lowest adjacent finish grade and sloped at a minimum 1% to a suitable gravity outlet or a sump where the water can be collected and pumped. A perimeter foundation drain around shallow (less than 4 feet deep) crawlspace building areas may not be needed where the natural soils are relatively free draining and with adequate compaction of foundation wall backfill and positive surface slope away from the foundation, but should be evaluated on an individual building basis.

SITE GRADING

All structural fill should be properly placed and compacted to reduce the risk of settlement and distress to facilities constructed on the fill. We expect existing fill on the site will need to be removed below building, roadway and utility areas, and replaced with compacted structural fill. It may also be desirable to remove hydro-compressive soils below building areas. Fill placed near the moderately steep to steep slope down to the river should be limited in depth to a few feet to limit surcharge loading on the slope and possible slope instability. Some rockfall from the cut faces and coarse granular soils in the steep natural slopes could occur over time.

The on-site coarse granular soils, excluding debris, topsoil and oversized (plus 6 inch) rocks, or a similar material should be suitable as structural fill. In general, structural fill at the site should be compacted to at least 95% of the maximum standard Proctor density (SPD) at a moisture content within about 2% of optimum. Some settlement of deeper fill areas should be expected, even if the material is placed correctly, and could result in distress to facilities constructed on the backfill. We expect settlement of select granular fill such as the on-site coarse granular soils (minus 6-inch fraction) compacted to at least 95% SPD will have long term settlement on the order of ½ to 1% of the fill depth. Increasing the fill compaction to at least 98% SPD to reduce fill settlement and/or allowing adequate time for the fill to settle before constructing on the fill could be done. The fill should be benched into the portions of the site exceeding 20% grade.

Structural fill placed below footing and building areas should be compacted to at least 98% SPD. Prior to fill placement, all existing fill and topsoil should be removed, the subgrade scarified to a depth of 8 inches, adjusted to near optimum moisture content and compacted to at least 90% of standard Proctor density. In soft or wet areas, the subgrade may require drying or stabilization prior to fill placement. A geogrid and/or subexcavation and replacement with coarse granular soils or aggregate base soils may be needed for the stabilization. The subgrade should be proofrolled. Areas that deflect excessively should be corrected before placing structural fill. Miscellaneous fill at the site should be compacted to at least 90% SPD.

Permanent unretained cut and fill slopes should be graded at 2 horizontal to 1 vertical or flatter and protected against erosion by revegetation, rock riprap or other means. Oversized rock from embankment fill construction will tend to collect on the outer face. A protection fence could be provided downslope of the embankment toe to prevent rockfall to below the slope. We should review site grading plans for the project prior to construction.

SURFACE DRAINAGE

The grading plan for the subdivision should consider runoff from across the site and at individual building sites. Water should not be allowed to pond which could impact slope stability and foundations. To limit infiltration into the bearing soils next to buildings, exterior backfill should be well compacted and have a positive slope away from the building for a distance of at least 10 feet. Roof downspouts and drains should discharge well beyond the limits of all backfill and landscape irrigation should be restricted.

PERCOLATION TESTING

Percolation testing was performed in two shallow, 4-inch diameter auger holes (P-1 and P-2) located near Profile Boring 1 (see Figure 1A for locations) to evaluate the general infiltration characteristics of the subsoils. The tests were performed in fill of unknown depth. The percolation test results summarized in Table 2 indicate a percolation rate of about 20 to 40 minutes per inch for the silty to clayey fill. Additional percolation testing should be done in the natural soil areas.

LIMITATIONS

This study has been conducted according to 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 our field observations, the exploratory borings located as shown on Figure 1, the assumed 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 planning and preliminary design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation, conduct additional evaluations and review and monitor the implementation of our recommendations. Significant changes in the proposed/assumed construction 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,

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

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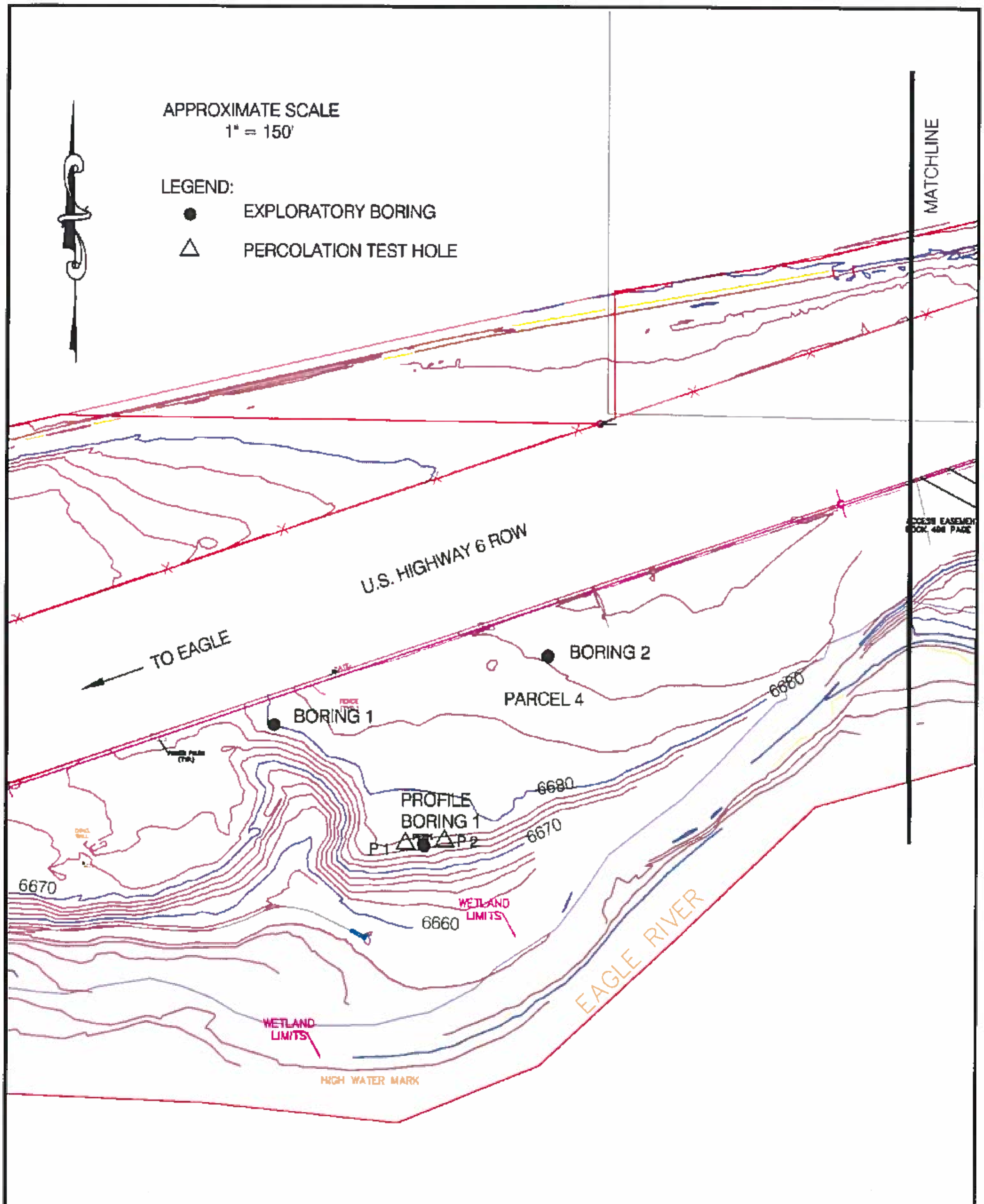
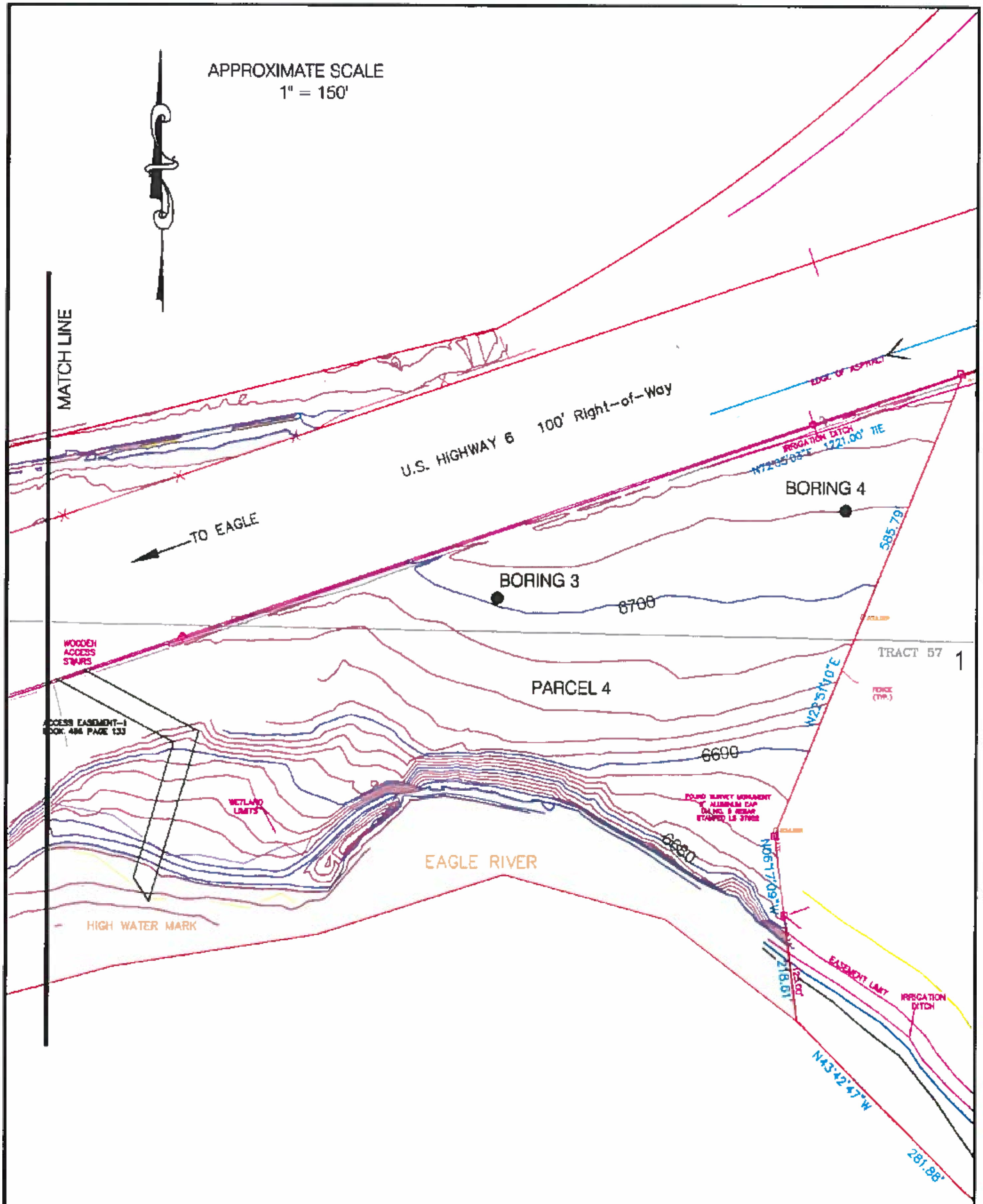
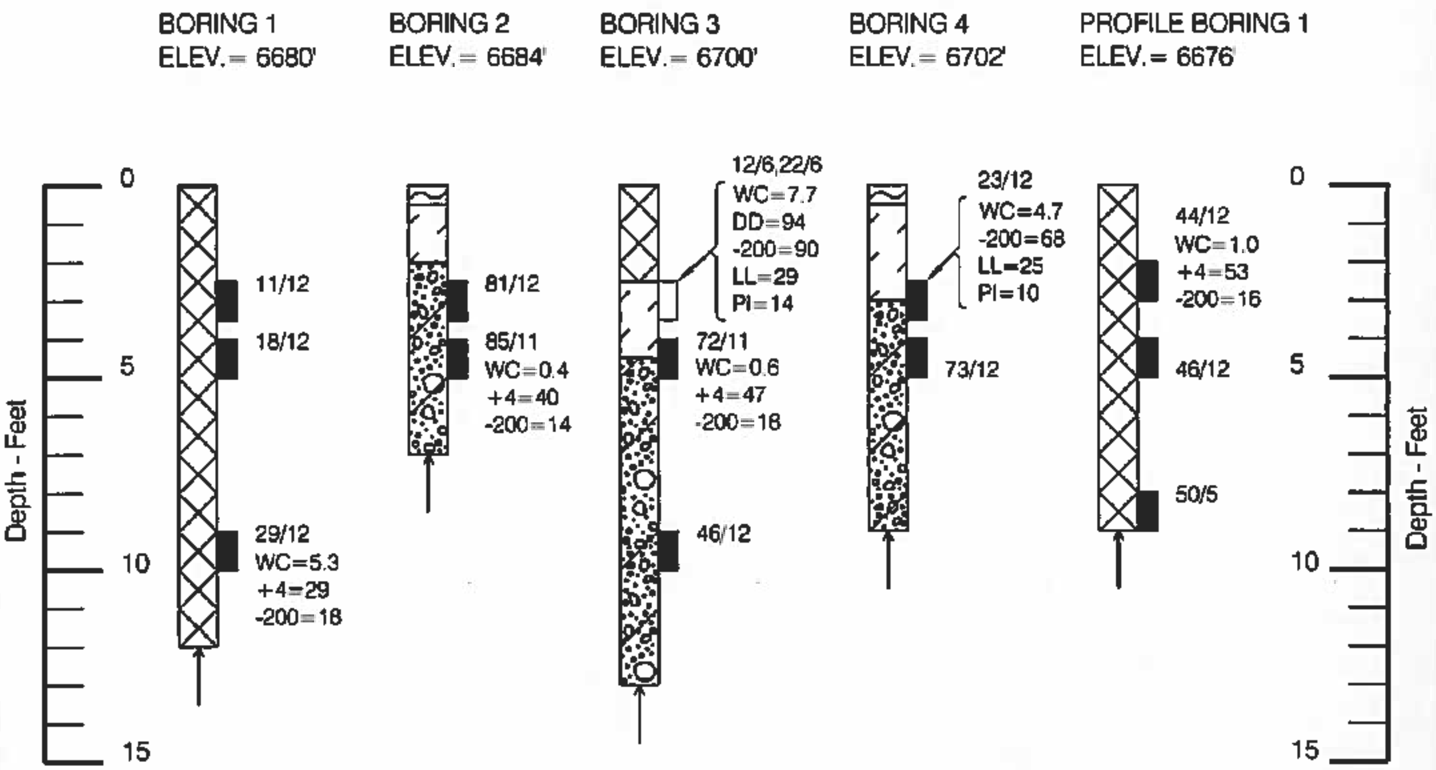


115 548D	HP Geotech Hepworth–Pawlak Geotechnical	LOCATION OF EXPLORATORY BORINGS AND PERCOLATION TEST HOLE	Figure 1A



115 548D	HP Geotech Hepworth–Pawlak Geotechnical	LOCATION OF EXPLORATORY BORINGS	Figure 1B



Note: Explanation of symbols is shown on Figure 3.

115 548D	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	LOGS OF EXPLORATORY BORINGS	Figure 2

LEGEND:

FILL; man-placed clayey to silty and sandy to very sandy gravel with cobbles and boulders, variable density, slightly moist to moist, brown to dark brown, mixed with some topsoil.

TOPSOIL; organic sandy silty clay, medium stiff, moist, dark brown.

CLAY (CL); silty, slightly sandy to sandy, stiff, slightly moist, light brown to reddish brown, low to medium plasticity, typically calcareous.

GRAVEL AND COBBLES (GP-GM); with boulders, silty, sandy to very sandy, dense to very dense, slightly moist, light brown to brown, rocks are primarily subrounded.

Relatively undisturbed drive sample; 2-inch I.D. California liner sample.

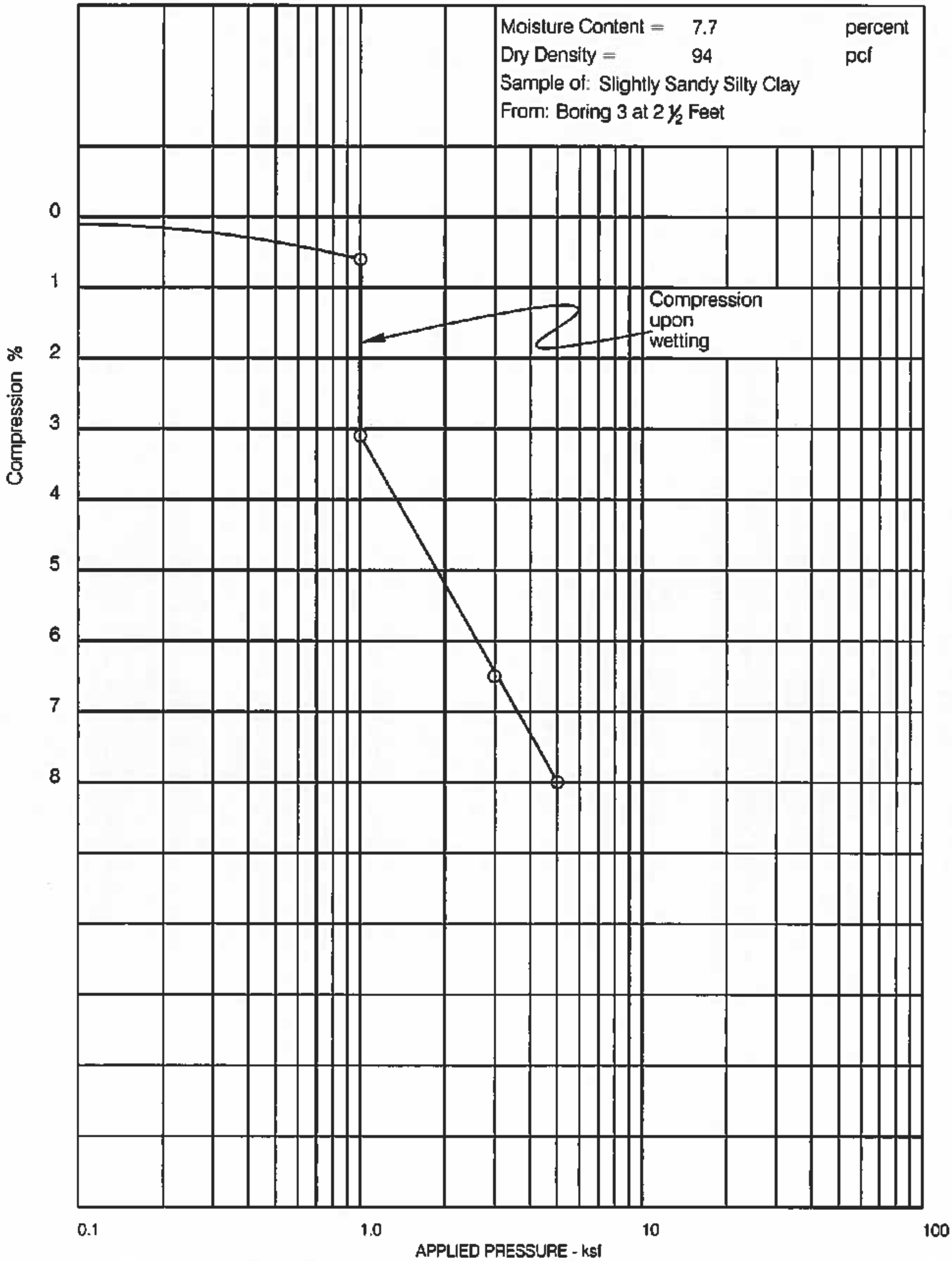
Drive sample; standard penetration test (SPT), 1 3/8 inch I.D. split spoon sample, ASTM D-1586.

23/12 Drive sample blow count; indicates that 23 blows of a 140 pound hammer falling 30 inches were required to drive the California or SPT sampler 12 inches.

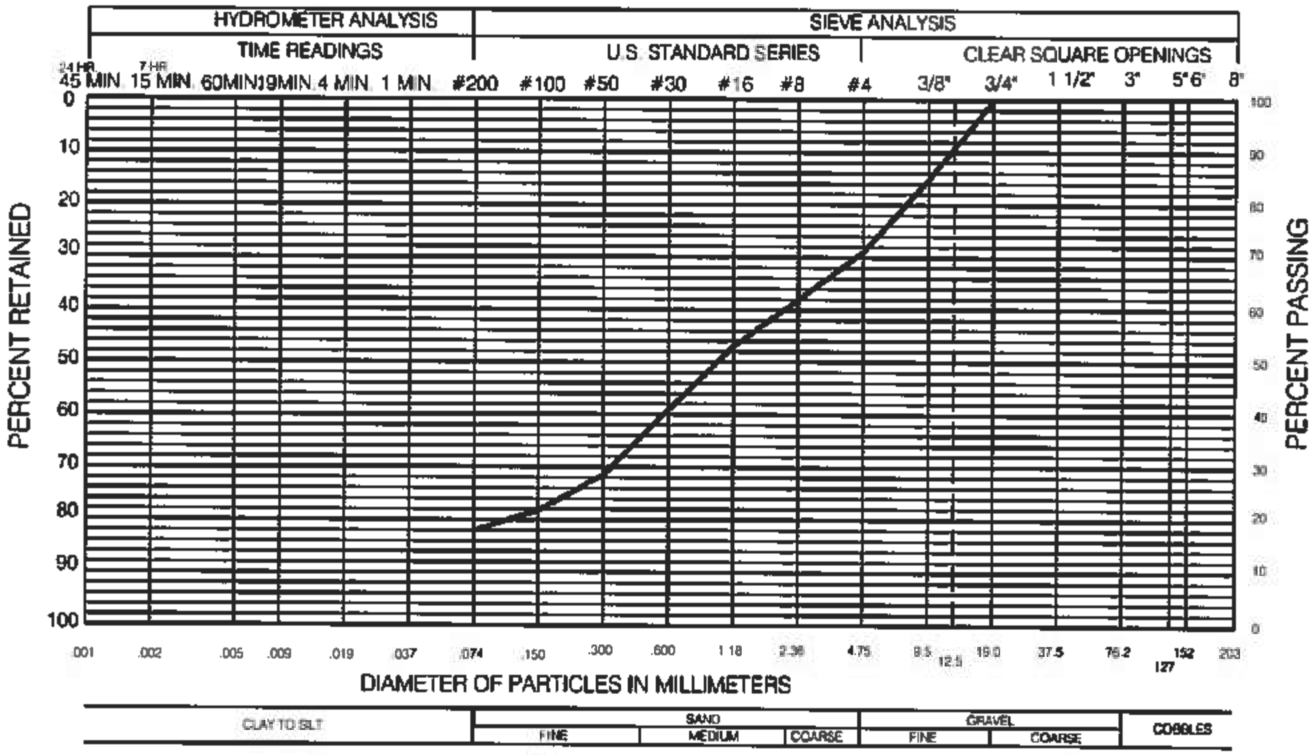
Practical drilling refusal.

NOTES:

1. Exploratory borings were drilled on December 18 and 21, 2015 with 4-inch diameter continuous flight power auger.
2. Locations of exploratory borings were field staked by surveyor, Archibeque Land Consulting.
3. Elevations of exploratory borings were obtained by interpolation between contours shown on the site plan provided. Boring logs are drawn to depth.
4. The exploratory boring locations and elevations 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 transitions may be gradual.
6. No free water was encountered in the borings at the time of drilling. Fluctuation in water level may occur with time.
7. Laboratory Testing Results:
   WC = Water Content (%)
   DD = Dry Density (pcf)
   +4 = Percent retained on the No. 4 sieve
   -200 = Percent passing No. 200 sieve
   LL = Liquid Limit (%)
   PI = Plasticity Index (%)



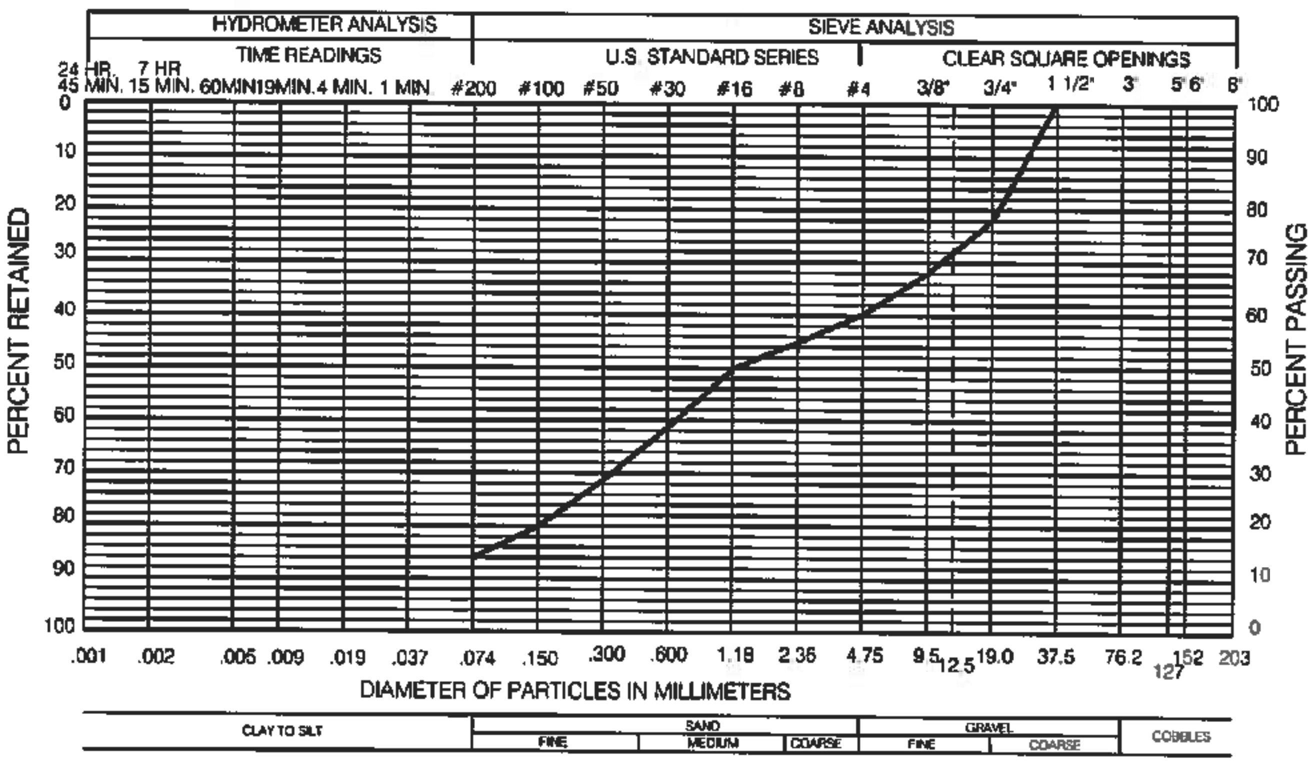
115 548D	HP Geotech Hepworth-Pawlak Geotechnical	SWELL-CONSOLIDATION TEST RESULTS	Figure 4



GRAVEL 29 % SAND 53 % SILT AND CLAY 18 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Clayey Sand with Gravel (Fill) FROM: Boring 1 at 9 Feet

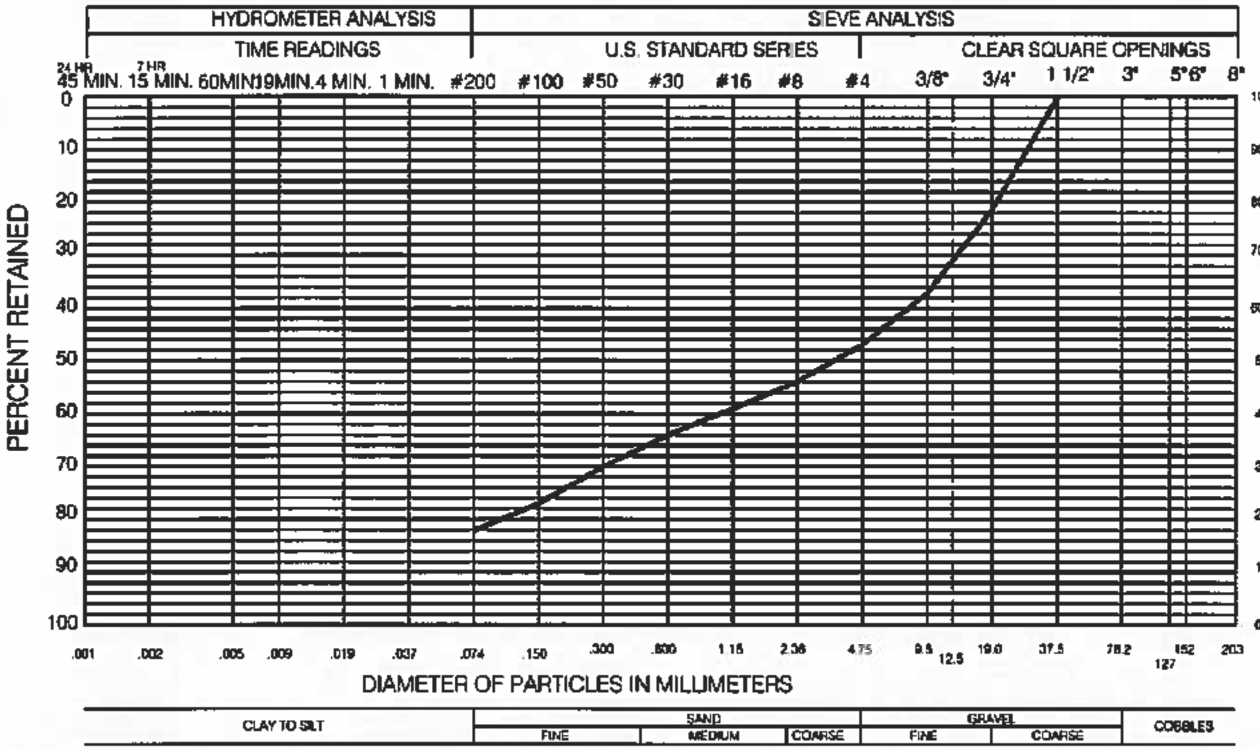


GRAVEL 40 % SAND 46 % SILT AND CLAY 14 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Sand and Gravel FROM: Boring 2 at 4 Feet

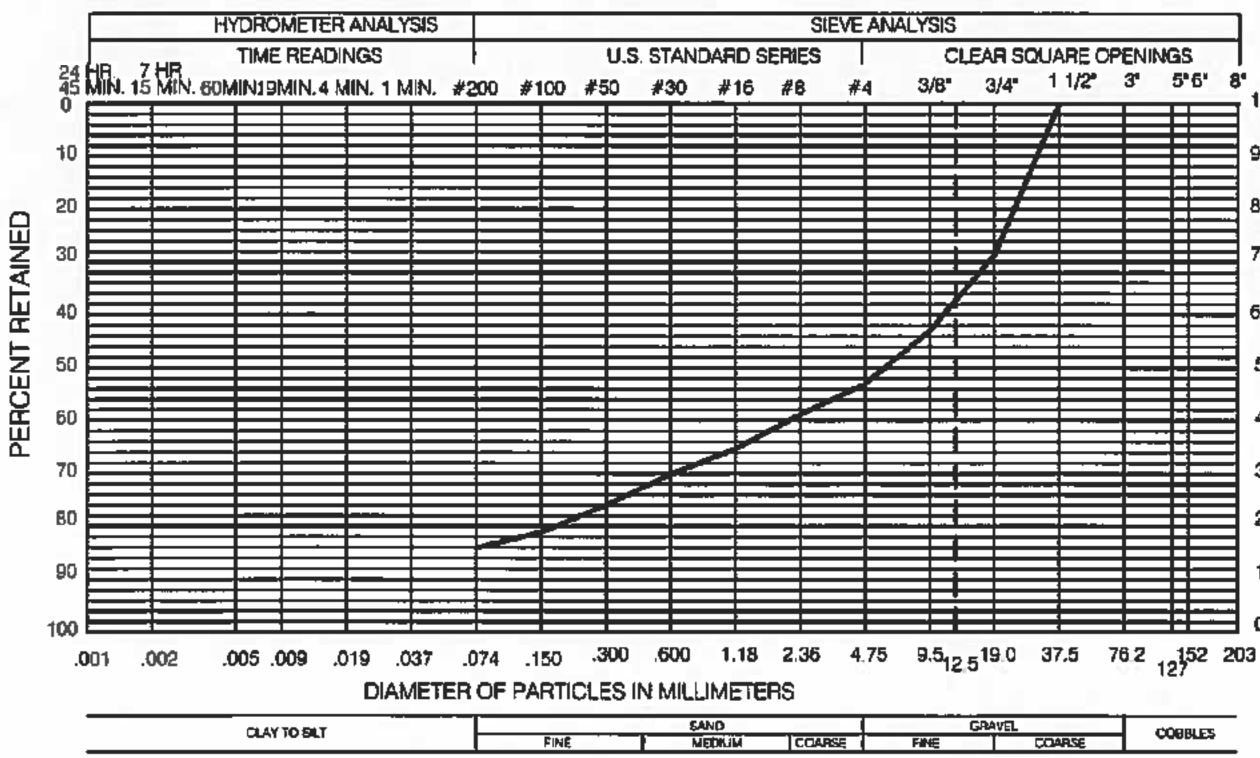
115 548D	HP Geotech Hepworth–Pawlak Geotechnical	GRADATION TEST RESULTS	Figure 5



GRAVEL 47 % SAND 35 % SILT AND CLAY 18 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Sandy Gravel FROM: Boring 3 at 4 Feet



GRAVEL 53 % SAND 31 % SILT AND CLAY 16 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Silty Clayey Sandy Gravel (Fill) FROM: Profile Boring 1 at 2 Feet

115 548D	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	GRADATION TEST RESULTS	Figure 6

HEPWORTH-PAWLAK GEOTECHNICAL, INC.
TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Job No. 115 548D

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY DENSITY	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH	SOIL OR BEDROCK TYPE
BORING	DEPTH (ft)	(%)	(pcf)	GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)	(PSF)	
1	9	5.3		29	53	18				Clayey Sand with Gravel (Fill)
2	4	0.4		40	46	14				Silty Sand and Gravel
3	2½	7.7	94			90	29	14		Slightly Sandy Silty Clay
	4	0.6		47	35	48				Silty Sandy Gravel
4	2½	4.7				68	25	10		Sandy Silty Clay
Profile Boring 1	2	1.0		53	31	16				Silty Clayey Sandy Gravel (Fill)

HEPWORTH-PAWLAK GEOTECHNICAL, INC.
TABLE 2
PERCOLATION TEST RESULTS

JOB NO. 115 548D

HOLE NO.	HOLE DEPTH (INCHES)	LENGTH OF INTERVAL (MIN)	WATER DEPTH AT START OF INTERVAL (INCHES)	WATER DEPTH AT END OF INTERVAL (INCHES)	DROP IN WATER LEVEL (INCHES)	AVERAGE PERCOLATION RATE (MIN./INCH)
P-1	28¼	10	23¼	22	1 ¼	
			22	21	1	
			21	20¼	¾	
			20¼	19½	¾	
			19½	18¾	¾	
			18¾	18¼	½	
			18¼	17¾	½	
			17¾	17¼	½	
			17¼	16¾	½	20
P-2	25¾	10	22¾	21¾	1	
			21¾	21	¾	
			21	20½	½	
			20½	20	½	
			20	19½	½	
			19½	19¼	¼	
			19¼	19	¼	
			19	18¾	¼	
			18¾	18½	¼	40

Note: Percolation tests were performed in 4-inch diameter auger drilled holes on December 18, 2015. The average percolation rates were based on the last three readings of each test.