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D'APPOLONIA

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FEASIBLITY REPORT

Geotechnical Evaluation, Conceptual Spillway Options, and Recommendations

Pennsylvania Fish and Boat Commission
Franklin Township, Beaver County, Pennsylvania

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1.0 INTRODUCTION

D'Appolonia Engineering Division of Ground Technology, Inc. (D'Appolonia) has completed a feasibility study for construction of a new dam to re-establish a lake at the site of the former Hereford Manor Lakes. The Hereford Manor Lakes site is owned by Pennsylvania Fish and Boat Commission (PFBC) and located on Doe Run in Franklin Township, Beaver County, Pennsylvania. The site previously included two lakes formed by dams constructed as part of a nearby former mining operation. The lower dam was constructed in 1949 and the upper dam was constructed in 1957. The PFBC purchased the property in 1972. Due to dam safety deficiencies, that included excessive seepage, the lakes were drained and dams breached in 2012. Refer to Figure 1 for a site location plan.

This report summarizes D'Appolonia's subsurface exploration and laboratory testing, describes the subsurface conditions observed, and provides D'Appolonia's evaluation of site conditions as they pertain to the feasibility and design of a new dam. As part of the geotechnical evaluation and based on input from PFBC, D'Appolonia developed a conceptual embankment layout for the new dam. D'Appolonia also completed conceptual design calculations for auxiliary spillway options to safely pass the Probable Maximum Flood (PMF) as the Spillway Design Flood (SDF). This Feasibility Report is the instrument of service in culmination of the scope of services outlined in D'Appolonia's proposal to PFBC dated September 27, 2019.

2.0 SUBSURFACE EXPLORATION

D'Appolonia performed subsurface exploration activities at the Hereford Manor Lakes site between November 20, 2019 and November 26, 2019. The field activities for the exploration included the completion of six borings, B-1 through B-6. Refer to Figure 2 for a Subsurface Exploration plan that shows the locations of borings completed by D'Appolonia. The boring locations are also shown relative to the conceptual embankment plan in Figure 3. The borings were surveyed in the North American Datum of 1983 (NAD83). The as-drilled surveyed coordinates and elevations of the borings are summarized in Table 1. D'Appolonia subcontracted drilling services required to complete the borings to Terra Testing, Inc. (Terra) of Washington, Pennsylvania. A D'Appolonia representative was on-site full-time during subsurface exploration activities.

2.1 Borings

D'Appolonia completed six borings at the Hereford Manor Lakes site. Boring B-1was completed along the right abutment of the conceptual embankment layout near Doe Run. The purpose of Boring B-1 was to characterize soil and rock conditions along the right abutment of the proposed dam location. Borings B-2, B-5, and B-6 were completed in the bottom of the old lower lake. The purpose of these borings was to characterize soil and rock conditions within the footprint of the conceptual embankment along the centerline, upstream toe, and downstream toes. Borings B-3 and B-4 were completed at the left abutment. The purpose of these borings was to characterize soil and rock conditions along the left abutment of the conceptual embankment location.

Terra completed borings using a track mounted drill rig manufactured by Diedrich Drilling. Borings were advanced through soil using 3-1/4" inside diameter, 6-5/8" outside diameter, hollow stem augers. D'Appolonia collected disturbed soil samples using a 2-inch outside diameter split-barrel sampler and the standard penetration test (SPT) method with an automatic hammer drop system. Disturbed soil samples were used for field classification, estimation of consistency, and for laboratory testing. Below the depth at which split-barrel sampler refusal (SPT>50 blows/ft) was encountered, rock was sampled continuously for the remaining depth of select borings using a NQ size rock core barrel with water to flush the cuttings. All borings were grouted to within 1-foot of the ground surface using a cement-bentonite grout. The remaining depth was backfilled using drill cuttings.

A D'Appolonia field representative classified soil and rock samples that were encountered based on visual observations of the split-barrel samples and rock core samples. D'Appolonia's field representative documented subsurface conditions and the results of drilling activities on boring logs, which are included in Appendix A. Each boring log includes, but is not limited to, the following:

- date the boring was completed, and the initials of the D'Appolonia field representative who observed drilling;

- surveyed coordinates and ground surface elevation for the boring;
- drilling methods used, and the types and depth of samples collected;
- field classification of the soils encountered in split-barrel samples, including color, composition, consistency, and moisture conditions;
- field classification of weathered bedrock encountered in split-barrel samples including color, weathering, and hardness;
- field classification of bedrock in NQ rock core samples, including color, weathering, hardness, brokenness, and rock quality designation (RQD);
- results of laboratory tests on soil samples including, moisture content, Atterberg Limits, grain-size analysis, rock shear strength;
- recovery for each sample collected;
- SPT results for split-barrel samples; and
- groundwater levels measured in the boring and the time when the measurement was taken.

2.2 Laboratory Testing

D'Appolonia subcontracted geotechnical laboratory testing on soil samples collected in the borings to Geotechnics, Inc. of East Pittsburgh, Pennsylvania. The complete laboratory test results are included in Appendix B. The laboratory index test results are summarized in Table 2. The geotechnical laboratory testing program consisted of:

- Fourteen (14) Moisture Content (ASTM D2216),
- Fourteen (14) Grain Size Analysis (ASTM D422)
- Fourteen (14) Atterberg Limits (ASTM D4318), and
- One (1) Unconfined Compressive Strength (ASTM D7012 – Method C)

The primary focus of the testing was directed towards characterizing the site soils, determining the moisture conditions, and estimating geotechnical engineering properties.

The results from the Atterberg Limit tests indicate that the fine-grained soils encountered are low plasticity clays and silts with USCS symbols of CL and ML, respectively. The clay encountered during the exploration activities had plastic limits ranging between 14 and 25 and liquid limits ranging between

23 and 41. The silts encountered during exploration activities had plastic limits ranging between 16 and 27 and liquid limits ranging between 23 and 45.

For soils tested within the footprint of the old lake bottom, moisture content determinations indicated that the soils tested were generally between the plastic and liquid limits from the Atterberg limits determination. For Boring B-1, located between Doe Run and the stream running through the old lake bottom, ground water was encountered at a depth of 24.5-feet below the ground surface. Sample S-9, located from a depth of 24-feet to 25.5-feet below the ground surface was selected for lab testing and indicated that the soil was between the plastic and liquid limits from the Atterberg limit tests.

Sieve analyses were performed on samples from varying depths within the soil layers. The sieve analyses indicated that the soils tested were comprised predominantly of clayey and silty sands with an area of clayey gravel fill along the left abutment. The lab testing indicated that between 19 and 82 percent of the material, by weight, passed the #200 sieve.

3.0 SUBSURFACE CONDITIONS

The following sections present a summary of subsurface conditions based on borings completed as part of this subsurface exploration. Refer to Figure 4 for a geotechnical cross section (A-A) transverse to the crest of the conceptual embankment and Figure 5 for a geotechnical cross section (B-B) along the crest of the conceptual embankment.

3.1 Regional Geology

Franklin Township, PA is located in the Pittsburgh Low Plateau section of the Appalachian Plateaus physiographic province of southwestern Pennsylvania, mainly occurring in Greene and Washington Counties and extending into Westmoreland, Allegheny, and Fayette Counties. The Appalachian Plateaus physiographic province stretches from New York to Alabama and is composed mainly of sedimentary rocks, including sandstones, conglomerates, and shales, deposited during the Paleozoic period. The Pittsburgh Low Plateau section generally consists of narrow, relatively shallow valleys, smooth to irregular, undulating surfaces, strip mines and reclaimed land. Typical elevations range from 660 to 2,340 feet, with local relief typically between 400 to 500 feet. Underlying rock types generally consist of sandstone, shale, siltstone, coal, and limestone horizontally bedded originating from fluvial erosion, periglacial mass wasting, and strip mining.

Franklin Township and the area along Doe Run are part of the Allegheny and Conemaugh Formation geological units, a part of the Pennsylvanian system. The Allegheny Formation geological unit, typically encountered in valleys, consists predominantly of sandstone, sometimes in thick channels, shale, limestone, clay, and several commercial-grade coal beds. Principal members of the Allegheny Formation geological unit are the Upper and Lower Freeport Coal, Upper and Lower Freeport Limestone member, Butler Sandstone member, Upper, Middle, and Lower Kittanning Coal, Vanport Limestone member, and the Scrubgrass, Clarion, and Brookville coal seams. The Conemaugh Formation geological unit, typically encountered in hills and as outcrops along the valleys, consists predominantly of thinly bedded limestone, coal, shale, and sandstone. Principal members of the Conemaugh Formation geological unit are the Ames Limestone member, Pittsburgh Reds, Buffalo Sandstone member, Brush Creek Coal, and the Mahoning Sandstone member.

3.2 Right Abutment along Doe Run

D'Appolonia completed Boring B-1 to characterize the soil and bedrock conditions in the area of the right abutment. In Boring B-1, soil overburden generally consisted of silty sand, gravelly sand, and clayey sand to a depth of 30-feet. Overburden soil encountered in Boring B-1 was characterized as fill material and no native soil was encountered in the boring. Top of rock was encountered at approximately elevation (El.) 916' in Boring B-1 and generally consisted of dark gray, highly weathered to completely weathered, very broken, soft clayey shale. Competent rock was encountered at El. 913.5' and generally

consisted of light gray, unweathered to slightly weathered, unbroken to slightly broken, medium hard to hard, fine to medium-grained sandstone, underlain by clayey shale. D'Appolonia estimates that the sandstone encountered in Boring B-1 to be a part of the Upper Worthington Formation. Bedrock encountered in Borings B-1 is generally consistent with the documented Conemaugh member, as discussed above in the Geologic Background.

3.3 Proposed Dam Footprint within the Old Lower Lakebed

D'Appolonia completed Borings B-2, B-5, and B-6 to characterize the soil and bedrock conditions in footprint of the old lake bottom. Refer to Figure 4 for a cross section showing generalized subsurface conditions interpreted based on Borings B-2, B-5, and B-6. Overburden soil encountered in these borings generally consisted of clay, silty and clayey sand and gravel, and silt. In Boring B-6, at the downstream toe of the proposed embankment, clayey gravel was encountered to a depth of 3.0 feet and underlain by silt to a depth of 6.4 feet. In Boring B-2, located along the centerline of the conceptual embankment, silty and clayey sand was encountered to a depth of 9.0 feet. In Boring B-5, at the upstream toe of the conceptual embankment, clay was encountered to a depth of 6.0-feet and underlain by gravely sand to a depth of 9.8-feet.

Top of rock was typically encountered at an elevation between El. 915.7' and El. 917.5. Top of rock generally consisted of dark gray, highly weathered to completely weathered, very broken, soft clayey shale. In Boring B-6, clayey shale was not encountered. Competent rock was encountered between El. 915.7' and El. 916.8' and generally consisted of light gray, slightly weathered to moderately weathered, slightly broken to broken, medium hard to hard, fine to medium grained sandstone, underlain by coal and clayey shale. The sandstone encountered in Borings B-2 and B-6 was identified to be a part of the Upper Worthington member, a part of the Conemaugh Formation. Coal encountered in Boring B-2, at approximately El. 894.0', was identified to be the Middle Kittanning Coal seam, a part of the Allegheny Formation. Bedrock encountered in Borings B-2, B-5, and B-6 is generally consistent with the documented Conemaugh and Allegheny formations, as discussed above in the Geologic Background.

3.4 Left Abutment

D'Appolonia completed Borings B-3 and B-4 to characterize the soil and bedrock conditions in the area of the left abutment. Overburden soil encountered in these borings generally consisted of clayey gravel, sandy clay, and clayey sand. In Boring B-3, fill material consisting of clayey gravel was encountered to a depth of 12.5-feet and underlain by sandy clay. Top of rock was encountered at an elevation of approximately 939.6-feet, and generally consisted of gray, highly weathered to completely weathered, broken to very broken, very-soft to soft clayey shale. Competent rock was encountered at an elevation of approximately 935.8-feet and generally consisted of gray, highly weathered to completely weathered, broken to very broken, very-soft to soft clayey shale underlain by layers of sandstone and clayey shale. In Boring B-3, two layers of sandstone were encountered at approximately El. 929.6' and El. 917.8'.

Sandstone was generally light gray, unweathered to moderately weathered, unbroken to slightly broken, medium hard to hard, fine to medium grained. Sandstone encountered at approximately El. 929.6' was identified to be part of the Upper Worthington Member, a part of the Conemaugh formation.

In Boring B-4, Clayey Sand was encountered to a depth of 3.0-feet. Top of rock was encountered at an elevation of approximately 970.1-feet, and generally consisted of grayish brown, highly weathered to completely weathered, very broken, very soft to soft clayey shale. Competent rock was encountered at an elevation of approximately 963.6-feet and generally consisted of highly weathered to completed weathered, broken to very broken, very soft to soft, clayey shale underlain by layers of coal, sandstone, and shale. Coal was encountered in Boring B-4 at an elevation of approximately 943.3-feet and was identified to be the Brush Creek Coal seam, part of the Conemaugh formation. Sandstone was encountered at an elevation of approximately 940.3-feet and was generally light gray, slightly weathered to moderately weathered, slightly broken to broken, medium hard to hard, fine to medium grained. Sandstone encountered in Boring B-4 was identified to be part of the Upper Mahoning Sandstone Member, part of the Conemaugh formation. Bedrock encountered in Borings B-3 and B-4 was generally consistent with the documented Conemaugh formation, as discussed above in the Geologic Background.

4.0 CONCEPTUAL EMBANKMENT LAYOUT AND GEOTECHNICAL ANALYSES

D'Appolonia performed seepage and slope stability analyses to evaluate the conceptual embankment configuration. Based on the slope stability analyses the conceptual embankment configuration meets required factors of safety for long-term, maximum pool, and pseudo-static seismic load conditions. Geotechnical Calculations supporting the analysis are provided in Appendix C.

4.1 Seepage Analysis

D'Appolonia performed seepage analyses to evaluated seepage conditions and the estimate the potential phreatic surface through the conceptual dam configuration. Because the structure is new, there is no historical phreatic data for which to compare the result of the seepage analysis. As such the phreatic surface subsequently used for slope stability analyses is based on the results of seepage analyses using permeability parameters estimated from laboratory testing and field data. D'Appolonia performed seepage analyses for normal pool at El 988.5 and the maximum pool level at El. 993.5. The maximum pool level is the water surface elevation calculated from the Probable Maximum Flood, as described below in Section 5. The model geometry selected for the seepage analysis was at station 3+74 along the dam centerline, which is transverse to the dam crest. The hydraulic properties used for the seepage analysis were developed using correlations and recommendations provided in generally accepted geotechnical engineering publications. The phreatic surface resulting from the seepage analyses was used in the slope stability analyses. A summary of the Hydraulic Properties Used for Seepage Analyses is presented below:

Material	k_v (ft/sec)	k_h (ft/sec)	k_h/k_v
Fill/Mine Spoil	$1x10^{-6}$	$1x10^{-5}$	10
Sandy Clay/Clay/Silt	$1x10^{-7}$	$1x10^{-6}$	10
Clayey Sand/Gravelly Sand	$1x10^{-6}$	$1x10^{-5}$	10
Bedrock	$1x10^{-6}$	$1x10^{-5}$	10
Drain	$1x10^{-4}$	$1x10^{-4}$	1

4.2 Slope Stability Analysis

D'Appolonia performed engineering analyses to estimate material properties for the soils encountered in the test borings. Soil properties include total unit weight, effective friction angle, and effective cohesion. The engineering properties were developed based on visual sample descriptions, pocket penetrometer results, results of the laboratory index testing, and recommendations provided in generally accepted geotechnical engineering publications. A summary of recommended engineering properties for soil and rock is presented below:

Soil	Dry Unit Weight (PCF)	Saturated Unit Weight (PCF)	Effective Friction Angle (deg.)	Effective Cohesion, c' (psf)
Fill/Mine Spoil	113	127	32	0
Sandy Clay/Clay/Silt	98	120	32	0
Clayey Sand/Gravelly Sand	116	135	34	0

D'Appolonia performed slope stability analyses to evaluate the downstream slope for the Hereford Manor Lake Dam conceptual embankment configuration. The section used for the slope stability was at STA 3+37, which is transverse to the dam crest. The phreatic surfaces calculated from the seepage analysis were imported into the slope stability models. The conceptual embankment configuration includes a clay core and internal drain to reduce the phreatic surface, which results in higher factor of safety and improved slope stability conditions for the downstream slope. The conditions analyzed include the stability of the downstream slope for the normal and maximum pool under steady-state, long-term seepage conditions and seismic loading conditions. Seismic conditions were evaluated using pseudo static methods. Based on Dam Safety regulations for Pennsylvania, the minimum required factor of safety for long-term, static conditions at the normal pool and maximum pool are 1.5 and 1.4, respectively. The minimum required factor of safety for seismic loading is 1.1.

A summary of the required and calculated factor of safety is presented below:

Run No.	Design Condition	Pool Level	Required Factor of Safety	Calculated Factor of Safety
1	Steady-State Seepage Long-Term	988.5 normal	1.5	1.81
2	Seismic Loading Pseudo-Static	988.5 Normal	1.1	1.32
3	Steady-State Seepage Long-Term	993.5 Max.	1.4	1.78
4	Seismic Loading Pseudo-Static	993.5 Max.	1.1	1.28

5.0 CONCEPTUAL AUXILIARY SPILLWAY DESIGN

The following sections present a summary of the Hydrologic and Hydraulic analysis in support of the conceptual auxiliary spillway configurations for the new Hereford Manor Lake Dam.

5.1 Hydrologic Analysis

D'Appolonia competed an evaluation of the hydrologic conditions and characteristics of the proposed dam's watershed. The Autodesk Storm and Sanitary Analysis (SSA) 2018 program was used to model the site watershed and determine peak flow rates, peak discharge rates, and the lake's water surface elevation for multiple design storms.

5.1.1 Precipitation Data

Rainfall data for the proposed lake's location was obtained from using the Pennsylvania Department of Environmental Protection Probable Maximum Precipitation Study and Evaluation Tool (PADEP PMP Tool) in ArcGIS. The rainfall depths estimates are based on historical storm data for the delineated watershed of the proposed Hereford Manor Lake for each type of storm. The tool outputs the rainfall for the 1-HR through 24-HR storm of the local, tropical, and general storms for the area. The local storm rainfall data is the controlling data for this area and is used to determine the storm specific distribution for the 3-HR through 24-HR storms including a 2-HR Synthetic storm interpreted from the rainfall data.

Storm Specific Distributions	Rainfall Depth (in)
3-HR	18.50
6-HR	19.90
12-HR	20.40
24-HR	21.54
2-HR Synthetic	17.29

According to PADEP criteria, the 2-HR synthetic storm distribution is the PMF storm for the proposed Hereford Manor Lake, despite not having the highest rainfall depth. The 2-HR synthetic storm will have a high peak inflow rate and the highest WSEL of the proposed lake watershed using the storm specific distributions, the controlling factor to determine the PMF storm from the PADEP PMP Tool.

5.1.2 Watershed Delineation

The drainage area for the lake was delineated using Autodesk AutoCAD Civil 3D 2018 and LiDAR-derived 2-foot topographic contours. The LiDAR data was published by DCNR PAMap Program in 2007 and available on the Pennsylvania Spatial Data Access (PASDA) website. The contours were used to create a ground surface model. Autodesk Civil 3D's surface analyzing tools assisted in delineating the

watershed. The drainage area was modeled as a single subbasin discharging to the lake. The total watershed tributary to the proposed configuration is 2.28 square miles.

5.1.3 Curve Number and Time of Concentration

The United States Department of Agriculture (USDA) NRC's Runoff Curve Number (CN) method listed in the Technical Release 55 (TR-55) was used to determine runoff volumes due to land cover, hydrologic soil groups, and hydrologic conditions within the subbasin. The variable land cover was determined by utilizing Bing Map aerial imagery available in AutoCAD Civil 3D and Google Earth aerial imagery. Areas demarcated as "Residential" were assigned a curve number by using the approximate lot size and average percent impervious area per lot. In the Hereford Manor Lake watershed area, grassland and agricultural land was differentiated due to the slight difference in CN. Soil data was obtained from NRCS Web Soil Survey website referencing the Soil Survey Geographic Database (SSURGO). The site soils are comprised of 7 hydrologic soil groups. The watershed is divided according to land cover and the hydrologic soil groups; a runoff curve number is assigned to the delineated areas. Runoff curve numbers were selected from the TR-55 Table 2-2. The land cover areas and respective CN values are reported in the Table 3.

The time of concentration (TOC) is calculated using the longest hydraulic flow path from the hydraulically most distant point in the watershed to the watershed outlet. According to TR-55 methodology, sheet flow can have a maximum length of 100 feet, shallow concentration continues until the flow becomes channelized, and channel flow is determined by analyzing the topographic contours for concavity. The flow path is measured from the hydraulically most distant point to the lake's normal pool elevation. The flow times for each individual flow path component are listed in Table 4 along with the total time of concentration.

5.2 Auxiliary Spillway Design

The conceptual spillways options for Hereford Manor Lake Dam were designed to pass the PMF storm event, which was developed based on the 2-HR Synthetic storm. To pass the design storm safely, two conceptual spillway control structures are proposed. The first proposed control structure is a broad crested weir and the second proposed control structure is a labyrinth spillway. Each auxiliary spillway option is designed to provide Hereford Manor Lake Dam with a normal pool level at El. 988.5, the highest water level possible while maintaining the embankment crest. The proposed dam crest elevation is 994 feet will maintain 6 inches of freeboard during the PMF storm conditions, meeting dam safety requirements.

5.2.1 Option 1 – Open Channel Spillway

Conceptual auxiliary spillway Option 1 consist of concrete broad-crested weir with an open channel chute down the center of the dam. The weir will generally be centered in the middle of the valley to provide the

minimum length of 500 feet required to pass the PMF storm with 6 inches of freeboard. The spillway crest, as stated before, is at elevation 988.5 feet leaving the normal pool to be at elevation 988.5 feet. Refer to Appendix C for the spillway layout. The open channel spillway parameters are listed below:

Option 1 Spillway Parameters

Spillway Crest Elevation	988.5 ft
Weir Length	500 ft
Weir Width	45 ft

5.2.2 Options 2 and 3 - Labyrinth Spillway

The spillway control structure for conceptual auxiliary spillway Options 2 and 3 is a labyrinth weir. Option 2 has the labyrinth weir located at the right abutment and Option 3 has the labyrinth located at the left abutment. The labyrinth spillway is an overflow weir folded (in plan view) to provide a longer effective weir length for a given overall spillway width. The weir is designed as five complete labyrinth cycles with total width of the labyrinth of 167 feet. The spillway crest is at elevation 988.5 with the normal pool to be at elevation 988.5 feet. Refer to Appendix C for plan views and cross section of the spillway configurations. The labyrinth spillway parameters are listed below:

Option 2 and 3 Spillway Parameters

Spillway Crest Elevation	988.5 ft
Labyrinth Width	167 ft
Labyrinth Length	63.5 ft
Effective Weir Length	640 ft
Number of Cycles	5
Wall Thickness	1.8 ft

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the subsurface exploration, engineering evaluations of the proposed embankment configuration, and conceptual auxiliary spillway design described herein, D'Appolonia has developed the following conclusions and recommendations that relate to the feasibility of designing, permitting and constructing a new dam at the Hereford Manor Lakes site.

6.1 Subsurface Conditions

The right (western) abutment comprises a near vertical rock cut between El. 994' to El. 946' and an approximately 100-foot wide bench from El. 946 to El. 926 at the valley bottom. Based on results from the subsurface exploration, the bench consists of 24 feet of fill material that was likely placed to form the bench during prior mining operation. The fill is underlain by 6 feet of clayey sand. The combination of the near vertical rock cut and substantial depth of fill in the bench will result in difficult conditions for integrating new embankment fill into the right abutment. Dam safety concerns resulting from the conditions at the right abutment generally relate to lateral discontinuities and cracks forming the in the new fill that abuts the near vertical rock due to the differential settlement of fill relative to the rock cut. It is also likely that locating a concrete spillway structure at the right abutment, such as the labyrinth spillway shown in Option 2, will require rigorous foundation preparation and integration of an upstream cutoff wall that extends through overburden to bedrock.

In general, in-place fill material at the site is highly heterogenous with a visual classification ranging from gravelly sand to clayey gravel and is likely mine spoil from prior nearby mining operations. Due to the heterogenous conditions and coarse-grained composition, any in-place fill material within the footprint of the new dam is a potential seepage conduit and will require mitigation as part of the design and construction of a new dam at this site. Mitigation options for seepage through the in-place fill material includes a cut-off trench backfilled with low permeability soil or a concrete cut off wall keyed into rock.

As shown in Figure B-B, Borings B-2 and B-4 encountered highly weathered, very broken, coal layers in the bedrock foundation at an approximate depth of 30 feet. Each coal layer had a thickness of approximately 2 feet. The coal layers were encountered at different intervals in the bedrock lithology and represent different distinct coal formations. The 5-foot long rock core runs encompassing and adjacent to the coal layers had RQD values of zero, indicating fracturing in the rock above and below the coal layers. The coal layers, particularly the layer encountered at the left abutment, likely outcrop upstream of the proposed dam location and would likely be hydraulically connected to the new lake. Both coal layers are within the influence of the proposed dam and are likely seepage conduits through the bedrock. Mitigation of potential seepage though the coal layers and adjacent fractured rock zones will be required as part of the design and construction of a new dam at this site. Potential methods for mitigation of the potential seepage through these layers include foundation grouting or a concrete cut-off wall keyed into competent

rock. It is also highly likely that the coal layers extend up and down the valley such that moving the dam is not a viable solution to mitigate the risk of seepage issues associated with the layers.

6.2 Conceptual Embankment Layout

The conceptual embankment layout shown in Figure 3 and Figure 4 meets regulatory required factors of safety for long-term conditions under normal and peak pool levels and pseudo static seismic conditions. The conceptual embankment includes a 2.5H (horizontal):1V (vertical) upstream slope and a 3H:1V downstream slope. The downstream slope was configured at 3H:1V to allow for relatively easy maintenance. The embankment configuration requires 350,000 to 450,000 cubic yards of fill, depending on the foundation preparation requirements. Based on a preliminary review of the topographic features nearby the conceptual embankment location, sufficient quantities of borrow material could be harvested upstream and downstream of the dam. Removal of material upstream of the embankment would likely exacerbate potential foundation seepage issues previously discussed. D'Appolonia did not perform quantitative seepage analyses to specifically evaluate the potential flow through the foundation bedrock because it is beyond the scope of this study, but as discussed in the previous section there are subsurface conditions that will likely result in seepage issues and require mitigation. These conditions will need to be addressed as part of the design process and during construction of a new dam at this site.

6.3 Conceptual Auxiliary Spillway Options

6.3.1 Option 1 – Broad Crested Weir

D'Appolonia sized and evaluated the use of a broad crested weir to pass the design storm. Due to the topography and required weir length, the weir and spillway channel would need to be located on the dam. Locating the auxiliary spillway in embankment fill soil is generally not preferable due to rigorous design and construction requirements for protecting embankment soil and spillway structure from deleterious effects of embankment seepage and risk for erosion of the embankment soils. It is for these reasons that auxiliary spillway structures founded exclusively in embankment soils are generally not preferable and would pose significant issues with design and permitting of a new dam with a spillway configuration similar to Option 1. In D'Appolonia's professional opinion, a broad crested weir or other similar conventional open channel spillway control structures are not viable due to the weir width required to pass the design flood while maintaining the conceptual embankment crest elevation and a reasonable normal pool level in the lake. A conventional open channel spillway may be viable if the crest can be substantially increased or the pool level could be substantially reduced.

6.3.2 Option 2 – Labyrinth Spillway at Right Abutment

D'Appolonia sized and evaluated the use of a labyrinth weir to pass the design flood. The primary benefit of the labyrinth weir is that, relative to conventional weirs, the labyrinth weir passes greater flows with a

smaller footprint. Option 2 consists of locating the labyrinth weir at the right abutment on top of the existing bench. As discussed previously, there is approximately 30 feet of overburden soil overlying bedrock near the right abutment. The depth of overburden soil and proximity to the near vertical rock cut will complicate foundation and spillway cutoff wall requirements. Locating the auxiliary spillway structure at the right abutment is beneficial because it is closer (relative to the left abutment) to the receiving stream and will require a shorter spillway channel downstream of the control structure. In D'Appolonia's professional opinion, locating the auxiliary spillway structure at the right abutment is not preferable due to complicated foundation construction requirements that may result in design and permitting issues.

6.3.3 Option 3 – Labyrinth Spillway at Left Abutment

Option 2 consists of locating the labyrinth weir at the left abutment. The labyrinth spillway shown in Option 3 is the same weir shown in Option 2. The benefit of locating the labyrinth spillway at the left abutment is that bedrock is relatively close to the existing ground surface such that the spillway structure can be founded directly on the bedrock. Relative to Option 2, Option 3 with the spillway at the left abutment will require a much less robust foundation and spillway cutoff system, but will require a longer spillway channel to direct spillway flow to the receiving stream. As discussed previously, a weathered coal layer was encountered in Boring B-4 on the left abutment and will require foundation treatment to mitigate seepage. Treatment of the foundation rock to mitigate seepage is required regardless of spillway location and is not specific to Option 3. In D'Appolonia's professional opinion, Option 3 with a labyrinth spillway located at the left abutment is the most technically viable option for the auxiliary spillway.

6.4 Construction Costs

D'Appolonia evaluated the potential construction cost for a new dam at the Hereford Manor Lakes site based on the results of the subsurface exploration, conceptual embankment layout, conceptual auxiliary spillway design completed as part of this Feasibility Study, and our current understanding of the project. Based on our evaluation of potential construction cost, D'Appolonia recommends an Engineer's Estimate of Probable Construction Cost of $19,550,00 be used for planning purposes. Key factors that we considered in developing this cost are the requirement for seepage mitigation in the foundation rock and in-place fill, substantial earthfill volumes, and the preferred location of auxiliary spillway being the left abutment as shown in Option 3. A rough breakdown of estimated construction costs for key construction activities is summarized in the following table. The cost summary table also included an estimated escalation of construction cost based on construction occurring during the Fiscal Year 2025 to account for time for design, permitting, and starting construction.

Construction Item	Engineer's Estimate of Probable Construction Cost
Mobilization	$ 500,000
Clearing, Grubbing, and General Site work	$ 1,000,000
Embankment Earthwork	$ 5,000,000
Internal Drainage System	$ 3,500,000
Control Tower and Principal Spillway	$ 1,000,000
Auxiliary Spillway and Channel	$ 2,000,000
Foundation Grouting or Cutoff wall	$ 4,000,000
Sub-Total (FY2020)	**$ 17,000,000**
Escalation (3.0%/FY for 5 Years)	$ 2,550,000
TOTAL (FY2025)	**$19,550,000**

7.0 REFERENCES

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8.0 REPORT LIMITATIONS

D'Appolonia prepared this report for the exclusive use for and specific application to the feasibility study and design of the proposed new dam at the Hereford Manor Lakes site in Franklin Township, Beaver County, PA. D'Appolonia is not responsible for use or interpretation of this report by any parties. The evaluation and recommendations contained in this report are based on the data obtained from the referenced subsurface exploration. The borings indicate subsurface conditions only at the specific locations and times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between such locations. The validity of the recommendations is based in part on assumptions about the stratigraphy between borings made by the geotechnical engineer.

D'Appolonia is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of D'Appolonia.

Our scope of services excludes testing or engineering evaluations associated with environmental conditions at the site, including the investigation or detection of the presence of any "biological pollutants" in or around the site where the phrase "biological pollutants" includes but is not limited to molds, spores, fungi, bacteria and viruses, and the byproducts of any such biological organisms.

9.0 CLOSING

In preparing this report, the professional services of D'Appolonia has been performed, findings obtained, and recommendations prepared per generally accepted engineering principles and practices. This statement is instead of all warranties, either expressed or implied.

If you have questions, please call.

Respectfully Submitted,
D'APPOLONIA ENGINEERING DIVISION OF GROUND TECHNOLOGY, INC.

Aaron J. Antell, P.E.
Principal Engineer

TABLES

Table 1
As-Drilled Boring Locations
Geotechnical Report
Geotechnical Evaluation for Feasibility Study and Design
of the Proposed New Dam
Franklin Township, Beaver County, Pennsylvania

Project No. 192838

Boring No.	Northing	Easting	Elevation
B-1	549,477.7	1,300,109.8	946.0
B-2	549,484.6	1,300,341.5	926.5
B-3	549,471.0	1,300,666.2	960.6
B-4	549,565.7	1,301,015.5	973.1
B-5	549,654.2	1,300,348.6	928.4
B-6	549,285.7	1,300,333.2	922.1

Table 2
Summary of Laboratory Index Test Results
Geotechnical Report
Geotechnical Evaluation for Feasibility Study and Design of the Proposed New Dam
Franklin Township, Beaver County, Pennsylvania

Project No. 192838

Boring No.	Sample ID	Depth		Water Content	Sieve Analysis				Atterberg Limits		
		From (ft)	To (ft)	%	USCS Symbol	<#4 (%)	<#40 (%)	<#200 (%)	USCS Symbol	LL (%)	PI (%)
B-1	S-2	3.0	4.5	8.2	SM	76	36	25	ML	26	6
B-1	S-4	9.0	10.5	8.7	SM	60	25	19	ML	28	8
B-1	S-6	15.0	16.5	7.4	SM	63	29	22	ML	25	5
B-1	S-9	24.0	25.5	21.8	SC	93	75	43	CL	23	9
B-1	S-10	27.0	28.5	9.0	SC	81	65	43	CL	33	14
B-2	S-1	0.0	1.5	29.6	SM	88	60	47	ML	45	18
B-2	S-2	3.0	4.5	20.4	SC	99	72	35	CL	25	9
B-3	S-2/S-4	3.0	10.5	7.5	GC	61	33	25	CL	28	9
B-3	S-7	18.0	19.5	18.9	CL	99	71	59	CL	41	16
B-4	S-1	0.0	1.5	15.8	SC	82	61	46	CL	28	10
B-5	S-2	3.0	4.5	25.6	CL	100	97	82	CL	36	16
B-5	S-3	6.0	7.5	12.9	SM	65	35	21	ML	23	7
B-6	S-1	0.0	1.5	12.1	GC	61	37	27	CL	31	10
B-6	S-2	3.0	4.5	25.8	ML	92	89	75	ML	34	10

Table 3
Curve Number
Geotechnical Report
Geotechnical Evaluation for Feasibility Study and Design
of the Proposed New Dam
Franklin Township, Beaver County, Pennsylvania

Project No. 192838

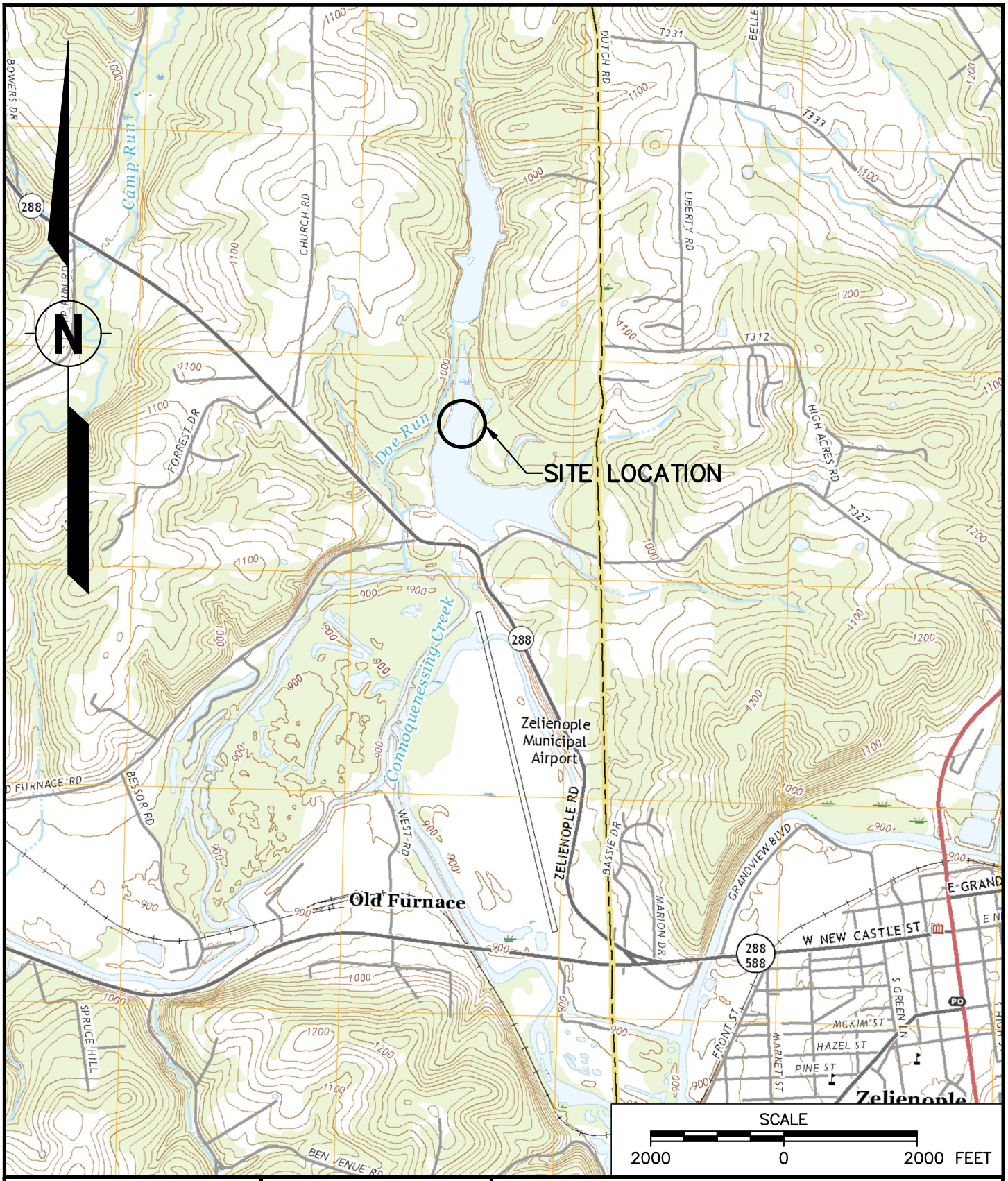
Cover Type	CN	Area (Acres)	HSG Rating	Weighted CN
Paved Roads	98	10.22	-	0.7
Residential 1 Acre Lots (20% Impervious)	51	1.17	A	0.0
Residential 1 Acre Lots (20% Impervious)	79	8.07	C	0.4
Residential 1 Acre Lots (20% Impervious)	84	8.99	D	0.5
Residential 2 Acre Lots (12% Impervious)	46	7.11	A	0.2
Residential 2 Acre Lots (12% Impervious)	65	0.99	B	0.0
Residential 2 Acre Lots (12% Impervious)	77	28.02	C	1.5
Residential 2 Acre Lots (12% Impervious)	82	139.19	D	7.8
Pasture, Grassland or Range, Fair Condition	69	3.57	B	0.2
Pasture, Grassland or Range, Fair Condition	79	60.79	C	3.3
Pasture, Grassland or Range, Fair Condition	84	59.01	D	3.4
Agricultural Land - Contoured Row Crops, Poor	72	50.55	A	2.5
Agricultural Land - Contoured Row Crops, Poor	79	21.30	B	1.2
Agricultural Land - Contoured Row Crops, Poor	84	111.40	C	6.4
Agricultural Land - Contoured Row Crops, Poor	88	246.14	D	14.8
Disturbed Area	79	9.08	C	0.5
Disturbed Area	84	18.38	D	1.1
Woods, Fair	36	20.61	A	0.5
Woods, Fair	60	10.36	B	0.4
Woods, Fair	73	378.46	C	18.9
Woods, Fair	79	183.57	D	9.9
Commercial / Disturbed Area	84	4.32	D	0.2
Water	100	79.65	-	5.5
		Total **1460.95**		**80.0**

Table 4
Time of Concentration
Geotechnical Report
Geotechnical Evaluation for Feasibility Study and Design of the Proposed New Dam
Franklin Township, Beaver County, Pennsylvania

Project No. 192838

Flow Type	Length (ft)	Slope (ft/ft)	Mannings n	Surface Cover	Est. Velocity (fps)	Flow Time (min)	Total TOC (min)
Sheet	100	0.045	0.100	Farmland	-	5.95	60.97
Shallow Concentrated	1407	0.052	-	Cultivated	2.05	11.44	
Open Channel	1178	0.070	0.040	-	-	3.19	
Open Channel	5117	0.025	0.070	-	-	34.29	
Open Channel	1697	0.019	0.030	-	-	6.10	

FIGURES



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HEREFORD MANOR LAKE

FEASIBILITY STUDY

FIGURE 1
SITE LOCATION MAP

PROJECT NUMBER: 192838	DRAWN BY: AMR	DATE: 12/20/2019	SCALE: AS SHOWN	DRAWING NO. 1	REV 0
FILE NAME: Figure 1 – Site Location Map.dwg	CHECKED BY: AJA	DATE: 02/11/2020			

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NOTES / REVISIONS

TOPOGRAPHRIC MAPPING OBTAINED FROM PENNSYLVANIA SPACIAL DATA ACCESS – PAMAP, DATED 2006.

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
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		3				
		2				
		1				

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PROJECT NUMBER: 192838
FILE NAME: Figure 2 – Subsurface Exploration Plan.dwg

DRAWN BY: AMR DATE: 12/20/2019
CHECKED BY: AJA DATE: 02/11/2020

HEREFORD MANOR LAKE
FEASIBILITY STUDY

FIGURE 2
SUBSURFACE EXPLORATION PLAN

SCALE: AS SHOWN | DRAWING NO. 2 | REV 0

Thursday, February 13, 2020 10:47:01 AM

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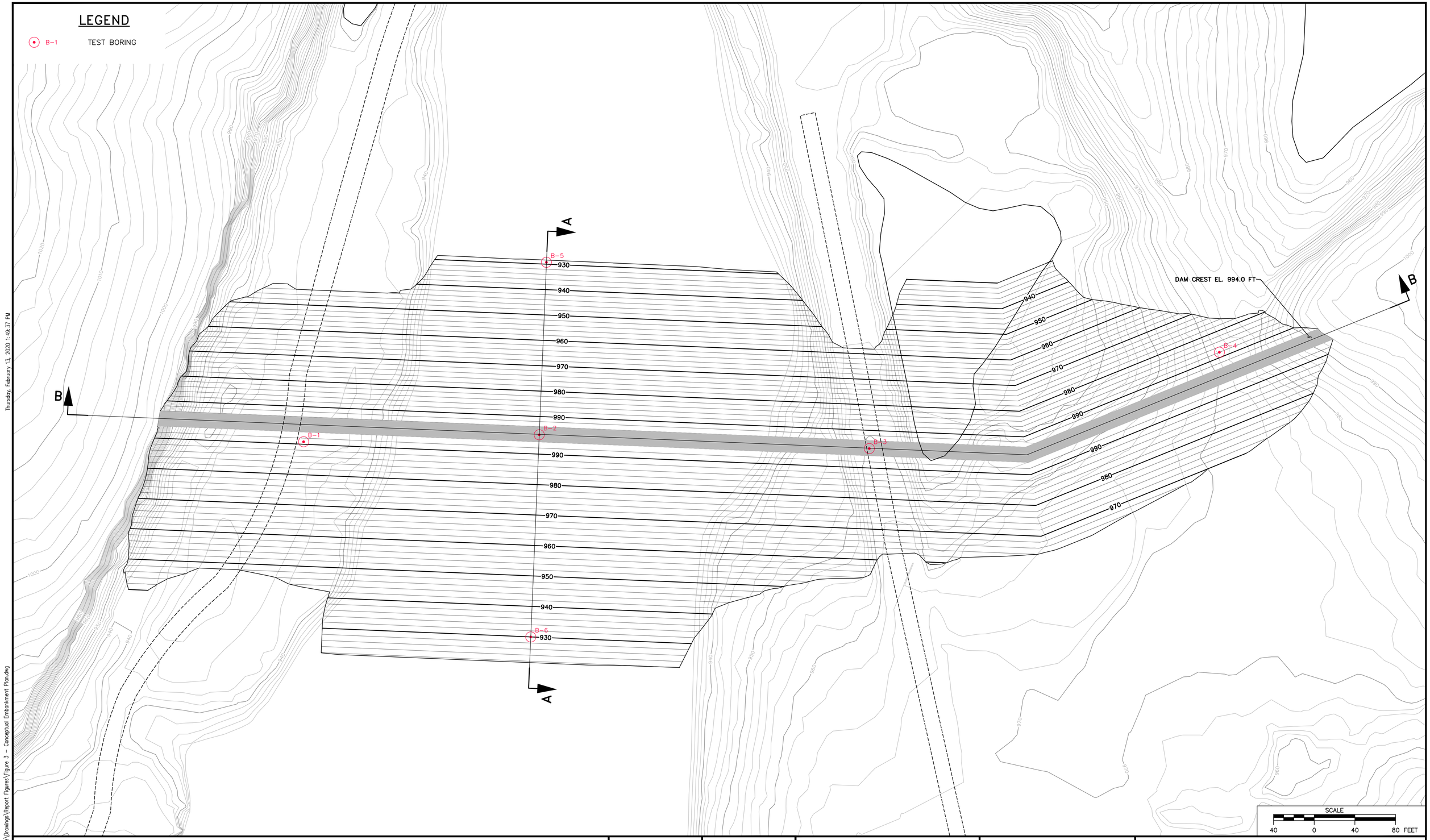
LEGEND

B-1 TEST BORING



NOTES / REVISIONS

TOPOGRAPHRIC MAPPING OBTAINED FROM PENNSYLVANIA SPACIAL DATA ACCESS – PAMAP, DATED 2006.

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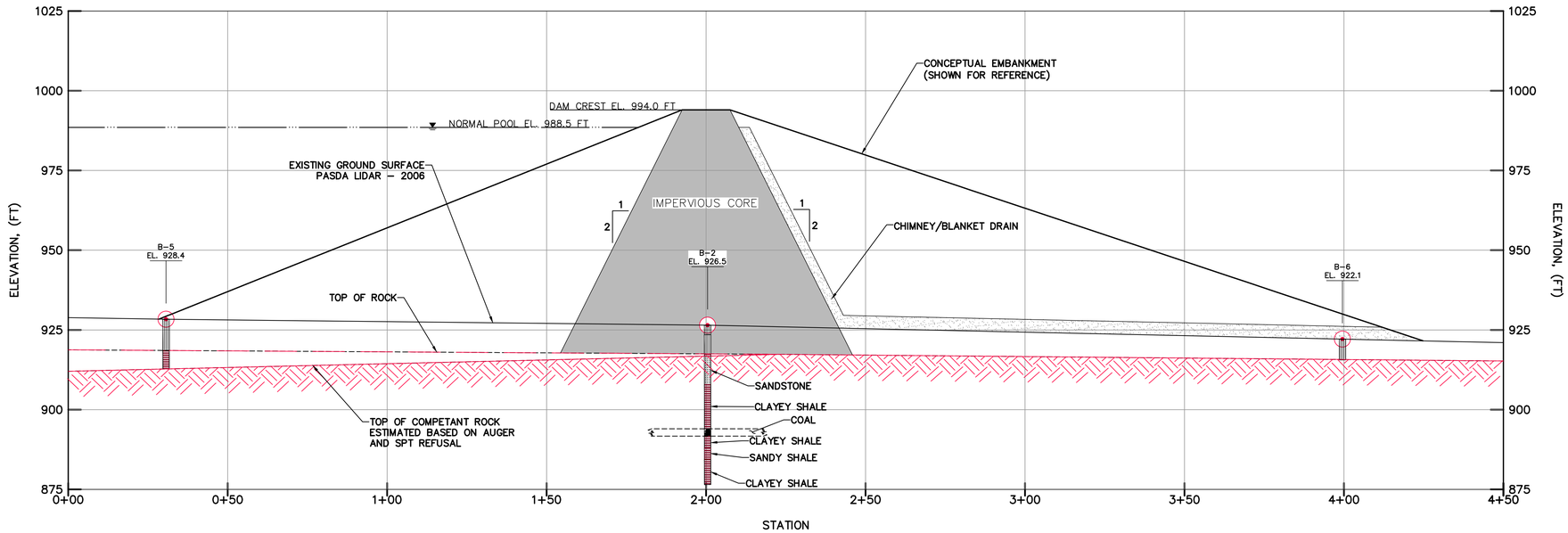
PROJECT NUMBER: 192838	DRAWN BY: AMR	DATE: 12/20/2019
FILE NAME: Figure 3 – Conceptual Embankment Plan.dwg	CHECKED BY: AJA	DATE: 02/11/2020

HEREFORD MANOR LAKE

FEASIBILITY STUDY

FIGURE 3
CONCEPTUAL EMBANKMENT PLAN

SCALE: AS SHOWN	DRAWING NO. 2	REV 0



SECTION A–A

SCALE
20 0 20 40 FEET

NOTES / REVISIONS

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
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		3				
		2				
		1				

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PROJECT NUMBER: 192838
FILE NAME: Figure 4–5 – Cross Sections.dwg
DRAWN BY: AMR
CHECKED BY: AJA
DATE: 12/20/2019
DATE: 02/11/2020

HEREFORD MANOR LAKE

FEASIBILITY STUDY

FIGURE 4
GEOTECHNICAL CROSS SECTION A–A

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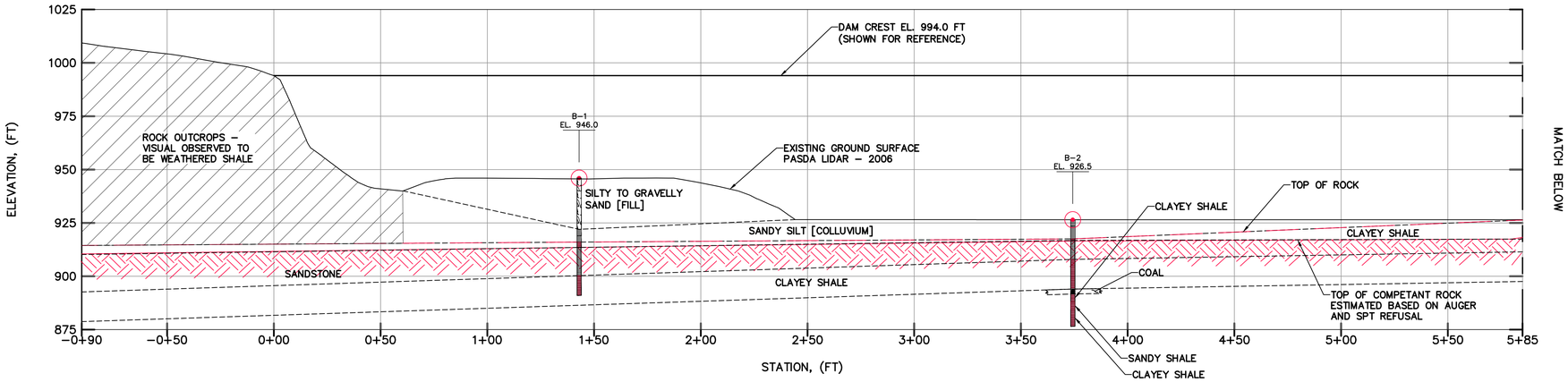
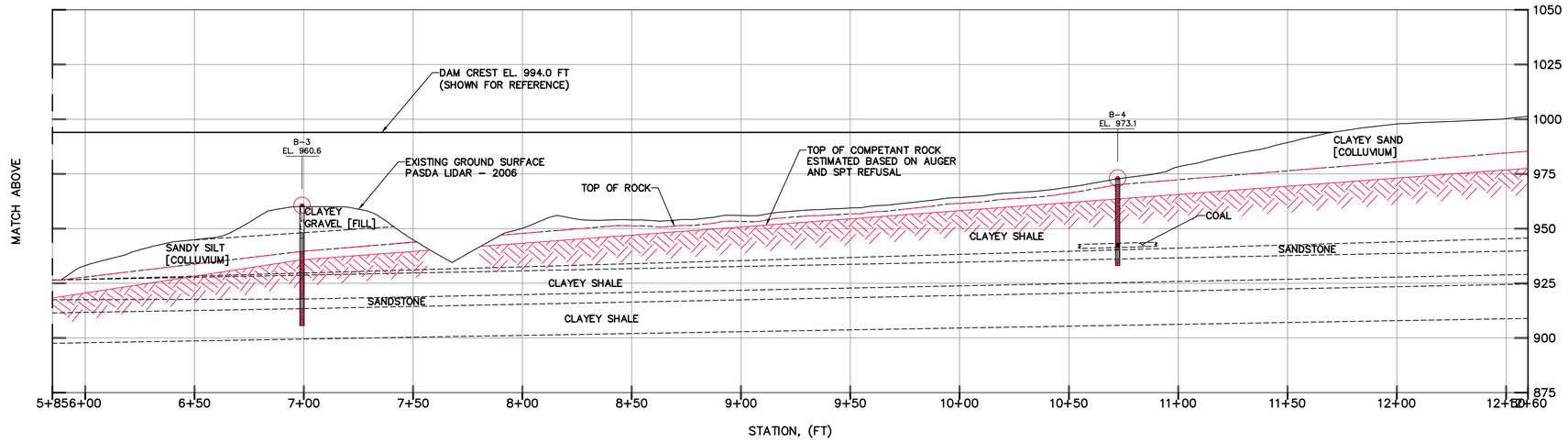


SECTION B–B (STA. –0+90 TO STA. 5+85)

SCALE
30 0 30 60 FEET



SECTION B–B (STA. 5+85 TO STA. 12+60)

SCALE
30 0 30 60 FEET

NOTES / REVISIONS

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
		4				
		3				
		2				
		1				

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PROJECT NUMBER: 192838	DRAWN BY: AMR	DATE: 12/20/2019
FILE NAME: Figure 4-5 – Cross Sections.dwg	CHECKED BY: AJA	DATE: 02/11/2020

HEREFORD MANOR LAKE

FEASIBILITY STUDY

FIGURE 5
GEOTECHNICAL CROSS SECTION B–B

SCALE: AS SHOWN	DRAWING NO. 5	REV 0

APPENDIX A

BORING LOGS

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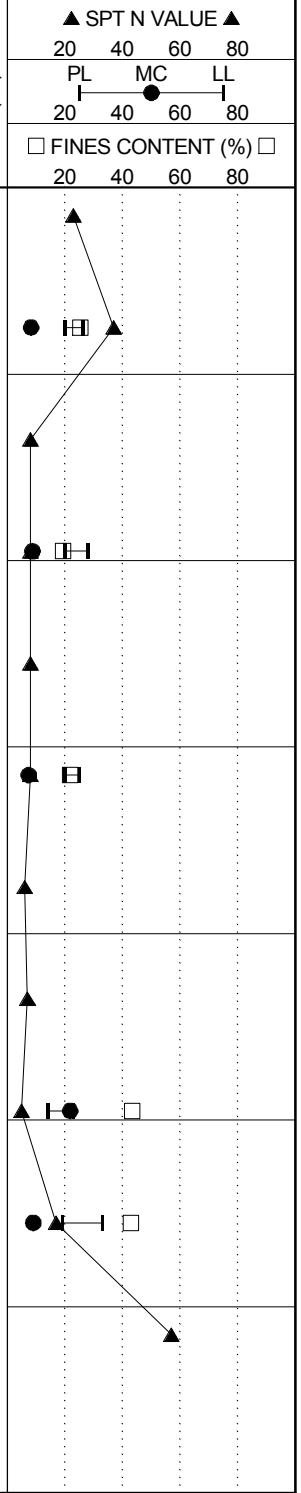
VISUAL CLASSIFICATION LOG

BORING B-1
PAGE 1 OF 2

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

DATE STARTED: 11/25/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/26/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Right Abutment, Access Road **GROUND WATER LEVELS:**
ELEVATION: 946 ft. ▽ **TIME OF DRILLING:** 24.5 ft / El. 921.5 ft
(N) 549,477.66 **(E)** 1,300,109.77 ▼ **END OF DRILLING:** 14.2 ft / El. 931.8 ft
AFTER DRILLING: N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)
0	S-1		**Silty Sand**, Some Gravel, Medium Dense To Dense, Brownish Gray To Brown, Dry To Moist, [Fill]		1.5 (100)	3-12-11 (23)	
	S-2			SM	1.5 (100)	10-22-15 (37)	
5			6.0 940.0				
	S-3		**Gravelly Sand**, Some Silt, Loose, Dark Brownish Gray, Dry To Moist, [Fill]		1.5 (100)	3-5-3 (8)	
10	S-4			SM	1.4 (93)	4-5-3 (8)	
	S-5		▼		1.5 (100)	9-5-3 (8)	
15	S-6			SM	1.5 (100)	3-3-5 (8)	
	S-7				1.5 (100)	5-3-3 (6)	
20	S-8		S-8: Light Brown In Color		1.3 (87)	2-4-3 (7)	
			24.0 922.0				
25	S-9		▽ **Clayey Sand**, Trace Gravel, Loose, Light Brown To Grayish Brown, Moist To Wet, [Fill]	SC	1.5 (100)	2-2-3 (5)	
			27.0 919.0				
	S-10		**Clayey Sand**, Some Gravel, Trace Organics, Medium Dense, Orangeish Brown, Moist To Wet, [Fill]	SC	1.5 (100)	6-8-9 (17)	
30			30.0 916.0				
	S-11		**Clayey Shale**, Highly Weathered To Completely Weathered, Very Broken, Soft, Thinly Laminated, Dark Gray, Orange Staining		1.5 (100)	17-25-32 (57)	
			32.5 913.5				
35			**Sandstone**, Fine- To Medium-Grained, Unweathered To Slightly Weathered, Unbroken To Slightly Broken, Medium Hard To Hard, Light Gray, With Shale Streaks		4.7	3.6	



NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

(Continued Next Page)

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PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

VISUAL CLASSIFICATION LOG

BORING B-1

DATE STARTED: 11/25/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/26/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Right Abutment, Access Road
ELEVATION: 946 ft.
(N) 549,477.66 **(E)** 1,300,109.77
GROUND WATER LEVELS:
TIME OF DRILLING: 24.5 ft / El. 921.5 ft
END OF DRILLING: 14.2 ft / El. 931.8 ft
AFTER DRILLING: N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35	R-1		**Sandstone**, Fine- To Medium-Grained, Unweathered To Slightly Weathered, Unbroken To Slightly Broken, Medium Hard To Hard, Light Gray, With Shale Streaks		(94)	(72)		
40	R-2				5.0 (100)	1.1 (22)		
			43.5 902.5					
45	R-3		**Clayey Shale**, Slightly Weathered To Moderately Weathered, Slightly Broken To Broken, Soft, Thinly Laminated, Dark Gray To Black, With Sandstone Streaks		5.0 (100)	0.9 (18)		
50	R-4				5.0 (100)	1.4 (28)		
55	R-5		55.0 891.0		2.5 (100)	0.8 (32)		
			Auger Refusal at 32.5 feet. **Bottom of Boring at 55.0 feet.**					
60								
65								
70								

NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

DAPP BORING LOG 192838 - HEREFORD MANOR LAKE.GPJ NOLAN RUN DATABASE TEMP.GDT 2/6/20

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VISUAL CLASSIFICATION LOG

BORING B-2
PAGE 1 OF 2

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

DATE STARTED: 11/25/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/25/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Proposed Centerline, Old Lake Bottom
ELEVATION: 926.49 ft.
(N) 549,484.56 **(E)** 1,300,341.54
GROUND WATER LEVELS:
TIME OF DRILLING: Dry
END OF DRILLING: 3.3 ft / El. 923.2 ft
AFTER DRILLING: N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)
0	S-1		**Silty Sand**, Trace Gravel, Trace Organics, Very Loose, Grayish Brown, Moist, [Fill]	SM	1.1 (73)	0-1-3 (4)	
			3.0 / 923.5				
	S-2		**Clayey Sand**, Trace Gravel, Very Loose, Orangeish Brown, Moist To Wet, [Colluvium], Pockets of Shale Fragments	SC	1.5 (100)	2-2-2 (4)	
5			6.0 / 920.5				
	S-3		**Clayey Sand**, Trace Gravel, Medium Dense, Orangeish Brown, Moist To Wet, [Colluvium]		0.2 (13)	10-13-13 (26)	
			9.0 / 917.5				
10	S-4		9.7 / 916.8 **Clayey Shale**, Highly Weathered To Completely Weathered, Very Broken, Soft, Thinly Laminated, Dark Gray		0.9 (100)	6-50/0.4'	>>
	R-1		**Sandstone**, Fine- To Medium-Grained, Slightly Weathered To Moderately Weathered, Slightly Broken To Broken, Medium Hard To Hard, Light Gray, With Shale Streaks		1.9 (95)	0.0 (0)	
15	R-2				4.3 (86)	0.4 (8)	
			18.6 / 907.9				
20	R-3		**Clayey Shale**, Moderately Weathered To Highly Weathered, Broken To Very Broken, Soft, Thinly Laminated, Dark Gray To Black		5.0 (100)	0.0 (0)	
25	R-4				5.0 (100)	1.7 (34)	
30	R-5				5.0 (100)	0.0 (0)	
			32.5 / 894.0				
35	R-6		**Coal**, Highly Weathered To Completely Weathered, Very Broken, Very Soft To Soft, Black		5.0	0.0	
			34.8 / 891.7				

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
☐ FINES CONTENT (%) ☐ 20 40 60 80

NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

(Continued Next Page)

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(412) 856-9440 FAX (412) 856-9535

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

VISUAL CLASSIFICATION LOG

BORING B-2

DATE STARTED: 11/25/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/25/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Proposed Centerline, Old Lake Bottom
ELEVATION: 926.49 ft.
(N) 549,484.56 **(E)** 1,300,341.54
GROUND WATER LEVELS:
TIME OF DRILLING: Dry
END OF DRILLING: 3.3 ft / El. 923.2 ft
AFTER DRILLING: N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35			**Clayey Shale**, Moderately Weathered To Highly Weathered, Slightly Broken To Broken, Soft, Thinly Laminated, Light Gray		(100)	(0)		
	R-7		38.5 888.0		3.0 (100)	3.0 (100)		
40			**Sandy Shale**, Unweathered To Slightly Weathered, Unbroken To Slightly Broken, Medium Hard To Hard, Thinly Laminated, Light Gray					
	R-8		42.0 884.5		1.9 (95)	1.9 (95)		
			Clayey Shale, Slightly Weathered To Moderately Weathered, Broken To Very Broken, Soft, Thinly Laminated, Dark Gray To Black					
45	R9				5.0 (100)	0.4 (8)		
	R-10				3.0 (100)	1.0 (33)		
50			50.0 876.5					
			SPT And Auger Refusal at 10 feet. **Bottom of Boring at 50.0 feet.**					
55								
60								
65								
70								

NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

DAPP BORING LOG 192838 - HEREFORD MANOR LAKE.GPJ NOLAN RUN DATABASE TEMP.GDT 2/6/20

D'APPOLONIA
701 RODI ROAD, FLOOR 2
PITTSBURGH, PENNSYLVANIA 15235-4559
(412) 856-9440 FAX (412) 856-9535

VISUAL CLASSIFICATION LOG

BORING B-3

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

DATE STARTED: 11/20/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/21/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Left Abutment, Acces Road **GROUND WATER LEVELS:**
TIME OF DRILLING: 22.9 ft / El. 937.7 ft
ELEVATION: 960.56 ft. **END OF DRILLING:** 11.8 ft / El. 948.8 ft
(N) 549,470.98 **(E)** 1,300,666.15 **AFTER DRILLING:** N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)
0	S-1		0.3 **Clayey Gravel**, Medium Dense To Dense, Gray, Dry, [Fill] 960.3		1.5 (100)	3-5-7 (12)	
			Clayey Gravel, Some Sand, Loose To Medium Dense, Orangeish Brown To Brown, Dry To Moist, [Fill]				
	S-2				0.8 (53)	3-3-2 (5)	
5	S-3		S-3: Sandstone Fragments (Cobble/Boulder)	GC	1.5 (100)	4-6-6 (12)	
10	S-4		S-4: Trace Organics		0.7 (47)	3-2-4 (6)	
	S-5		12.5 948.1 **Sandy Clay**, Trace Gravel, Stiff, Orangeish Brown And Grayish Brown, Dry To Moist, [Colluvium]		1.5 (100)	4-2-4 (6)	1.25 1.5 1.25
15	S-6		15.0 945.6 **Sandy Clay**, Trace Gravel, Stiff To Very Stiff, Light Brown To Orangeish Tan, Dry To Moist, [Colluvium]		1.5 (100)	2-6-8 (14)	3.0 2.25 3.5
20	S-7			CL	1.5 (100)	5-7-9 (16)	4.0 2.5 3.25
	S-8		21.0 939.6 **Clayey Shale**, Highly Weathered To Completely Weathered, Broken To Very Broken, Very Soft To Soft, Thinly Laminated, Light Gray To Gray, Orange And Black Staining		1.5 (100)	13-11-13 (24)	
25	S-9		21.0' - 21.8': Severe Orange and Black Staining		0.8 (100)	24-50/0.3'	
	R-1				2.2 (100)	0.0 (0)	
30	R-2				3.4 (68)	0.8 (16)	
			31.0 929.6				
			31.8 **Sandstone**, Fine- To Medium-Grained, Slightly Weathered To Moderately Weathered, Unbroken To Slightly Broken, Medium Hard To Hard, Light Gray 928.8				
35	R-3		**Clayey Shale**, Moderately Weathered To Highly Weathered, Broken To Very Broken, Soft, Thinly		4.5	0.8	

SPT N VALUE: 20 40 60 80
PL MC LL: 20 40 60 80
FINES CONTENT (%): 20 40 60 80

NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

(Continued Next Page)

D'APPOLONIA
701 RODI ROAD, FLOOR 2
PITTSBURGH, PENNSYLVANIA 15235-4559
(412) 856-9440 FAX (412) 856-9535

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

VISUAL CLASSIFICATION LOG

BORING B-3

DATE STARTED: 11/20/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/21/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Left Abutment, Acces Road **GROUND WATER LEVELS:**
TIME OF DRILLING: 22.9 ft / El. 937.7 ft
ELEVATION: 960.56 ft. **END OF DRILLING:** 11.8 ft / El. 948.8 ft
(N) 549,470.98 **(E)** 1,300,666.15 **AFTER DRILLING:** N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35			Laminated, Dark Gray To Black, Orange Staining **Clayey Shale**, Moderately Weathered To Highly Weathered, Broken To Very Broken, Soft, Thinly Laminated, Dark Gray To Black, Orange Staining		(90)	(16)		
40	R-4				4.7 (94)	0.9 (18)		
			42.8 917.8					
45	R-5		**Sandstone**, Fine- To Medium-Grained, Unweathered To Slightly Weathered, Unbroken To Slightly Broken, Medium Hard To Hard, Light Gray, With Shale Streaks		4.9 (98)	3.5 (70)		
			45.8 914.8					
50	R-6		**Sandy Shale**, Slightly Weathered To Moderately Weathered, Unbroken To Slightly Broken, Soft, Thinly Laminated, Dark Gray To Black		5.0 (100)	2.5 (50)		
55	R-7		55.0 905.6		3.0 (100)	1.6 (53)		
60			**SPT And Auger Refusal at 24.8 feet.** **Bottom of Boring at 55.0 feet.**					
65								
70								

NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

DAPP BORING LOG 192838 - HEREFORD MANOR LAKE.GPJ NOLAN RUN DATABASE TEMP.GDT 2/6/20

D'APPOLONIA
701 RODI ROAD, FLOOR 2
PITTSBURGH, PENNSYLVANIA 15235-4559
(412) 856-9440 FAX (412) 856-9535

VISUAL CLASSIFICATION LOG

BORING B-4
PAGE 1 OF 2

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

DATE STARTED: 11/21/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/21/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Left Abutment, Walking Trail
ELEVATION: 973.06 ft.
(N) 549,565.72 **(E)** 1,301,015.52
GROUND WATER LEVELS:
TIME OF DRILLING: Dry
END OF DRILLING: 3.8 ft / El. 969.3 ft
AFTER DRILLING: N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)
0	S-1		**Clayey Sand**, Some Gravel, Loose, Orangeish Brown To Grayish Brown, Dry To Moist, [Colluvium]	SC	1.3 (87)	2-3-3 (6)	
			3.0 970.1				
5	S-2		**Clayey Shale**, Completely Weathered To Highly Weathered, Very Broken, Very Soft To Soft, Thinly Laminated, Grayish Brown, Orange And Black Staining		1.2 (80)	4-7-9 (16)	
	S-3				1.4 (93)	3-15-25 (40)	
10	S-4		9.5 963.6		0.5 (100)	50	
	R-1		**Clayey Shale**, Highly Weathered To Completely Weathered, Broken To Very Broken, Very Soft To Soft, Thinly Laminated, Gray, Orange And Black Staining		2.5 (100)	0.0 (0)	
15	R-2				5.0 (100)	0.0 (0)	
20	R-3				5.0 (100)	1.9 (38)	
25	R-4				5.0 (100)	0.0 (0)	
30	R-5		29.8 943.3		4.5 (90)	0.0 (0)	
			Coal, Moderately Weathered To Highly Weathered, Very Broken, Very Soft To Soft, Black				
			31.7 941.4				
			32.8 **Clayey Shale**, Highly Weathered To Completely Weathered, Broken To Very Broken, Soft, Thinly Laminated, Light Gray 940.3				
35	R-6				5.0	1.4	

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
☐ FINES CONTENT (%) ☐ 20 40 60 80

NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

(Continued Next Page)

D'APPOLONIA
701 RODI ROAD, FLOOR 2
PITTSBURGH, PENNSYLVANIA 15235-4559
(412) 856-9440 FAX (412) 856-9535

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

VISUAL CLASSIFICATION LOG

BORING B-4

DATE STARTED: 11/21/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/21/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** NQ Wireline (Cuttings Rem. w/H2O)
LOCATION: Left Abutment, Walking Trail **GROUND WATER LEVELS:**
ELEVATION: 973.06 ft. **TIME OF DRILLING:** Dry
(N) 549,565.72 **(E)** 1,301,015.52 **END OF DRILLING:** 3.8 ft / El. 969.3 ft
AFTER DRILLING: N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35								
			Sandstone, Fine- To Medium-Grained, Slightly Weathered To Moderately Weathered, Slightly Broken To Broken, Medium Hard To Hard, Light Gray, With Shale Streaks		(100)	(28)		
			37.0 936.1					
	R-7		**Clayey Shale**, Slightly Weathered To Moderately Weathered, Slightly Broken To Broken, Soft, Thinly Laminated, Light Gray		3.0 (100)	1.4 (47)		
40			40.0 933.1 39.4' - 40.0': Calcarious					
			SPT And Auger Refusal at 9.5 feet. **Bottom of Boring at 40.0 feet.**					
45								
50								
55								
60								
65								
70								

NOTES:
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- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

DAPP BORING LOG 192838 - HEREFORD MANOR LAKE.GPJ NOLAN RUN DATABASE TEMP.GDT 2/6/20

D'APPOLONIA
701 RODI ROAD, FLOOR 2
PITTSBURGH, PENNSYLVANIA 15235-4559
(412) 856-9440 FAX (412) 856-9535

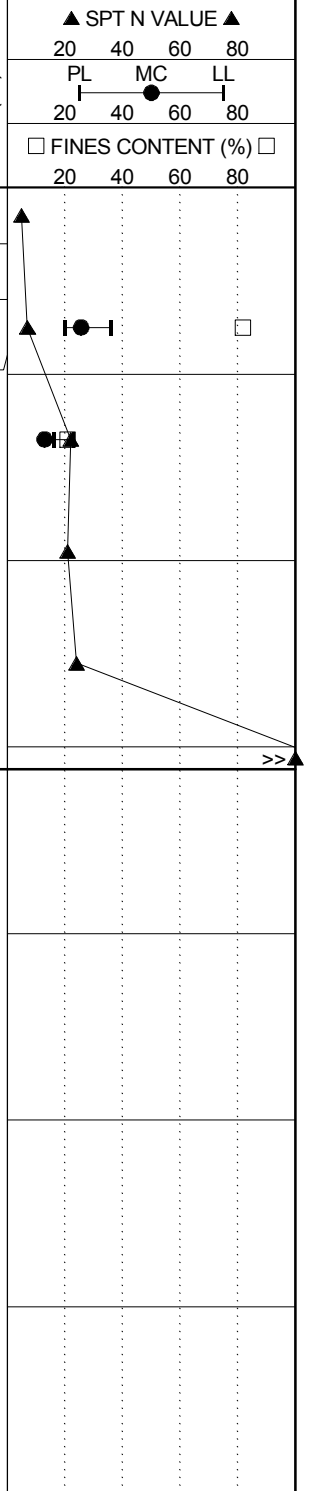
VISUAL CLASSIFICATION LOG

BORING B-5

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

DATE STARTED: 11/22/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/22/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** N/A
LOCATION: Upstream Toe, Old Lake Bottom **GROUND WATER LEVELS:**
TIME OF DRILLING: N/A
ELEVATION: 928.36 ft. **END OF DRILLING:** Dry
(N) 549,654.20 **(E)** 1,300,348.60 **AFTER DRILLING:** N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)
0	S-1		**Clay**, Some Sand, Trace Organics, Medium Stiff To Stiff, Grayish Brown Orangeish Brown, Moist To Wet, [Colluvium]		1.4 (93)	1-2-3 (5)	1.5
	S-2			CL	1.5 (100)	1-4-3 (7)	1.5 2.0 1.0
5			6.0 922.4				
	S-3		**Gravelly Sand**, Some Silt, Medium Dense, Grayish Brown To Orangeish Brown, Moist To Wet, [Colluvium]	SM	1.5 (100)	8-13-9 (22)	
10	S-4		9.8 918.6		1.5 (100)	6-9-12 (21)	
	S-5		**Clayey Shale**, Completely Weathered To Highly Weathered, Broken To Very Broken, Very Soft To Soft, Thinly Laminated, Dark Gray		1.3 (87)	9-11-13 (24)	
15	S-6		15.6 912.8		0.6 (100)	18-50/0.1'	
			SPT And Auger Refusal at 15.6 feet. **Bottom of Boring at 15.6 feet.**				
20							
25							
30							
35							



NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

D'APPOLONIA
701 RODI ROAD, FLOOR 2
PITTSBURGH, PENNSYLVANIA 15235-4559
(412) 856-9440 FAX (412) 856-9535

VISUAL CLASSIFICATION LOG

BORING B-6
PAGE 1 OF 1

PROJECT: Hereford Manor Lake
PROJECT NUMBER: 192838
LOCATION: Harmony, Butler County, Pennsylvania
CLIENT: Pennsylvania Fish and Boat Commission

DATE STARTED: 11/22/2019 **DRILLING CONTRACTOR:** Terra Testing Inc.
DATE COMPLETED: 11/22/2019 **DRILLER:** Doug Novotny
LOGGED BY: AMR **DRILLING METHOD:** 3-1/4" ID HSA, 2" OD SBS (6.625")
CHECKED BY: ZSG **CORING METHOD:** N/A
LOCATION: Downstream Toe, Old Lake Bottom **GROUND WATER LEVELS:**
TIME OF DRILLING: N/A
ELEVATION: 922.13 ft. **END OF DRILLING:** 3.0 ft / El. 919.1 ft
(N) 549,285.67 **(E)** 1,300,333.17 **AFTER DRILLING:** N/A

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	FIELD DESCRIPTION	LAB USCS	RECOVERY, ft (%)	SPT BLOW COUNT (N / ft) / RQD, ft (% RQD)	EST q_u (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
0	S-1		**Clayey Gravel**, Some Sand, Loose, Orangeish Brown To Dark Grayish Brown, Moist To Wet, [Fill]	GC	0.8 (53)	0-3-3 (6)		
			▼ 3.0 / 919.1					
	S-2		**Silt**, Some Sand, Trace Gravel, Soft To Medium Stiff, Orangeish Tan And Light Gray, Moist To Wet, [Colluvium]	ML	1.2 (80)	1-8-14 (22)	0.5 0.25	
5								
	S-3		6.4 / 915.7		0.5 (100)	50		
			6.5 / 915.6 **Sandstone**, Fine- To Medium-Grained, Completely Weathered To Highly Weathered, Soft To Medium Hard, Light Gray And Tan					
			SPT And Auger Refusal at 6.5 feet.					
10			**Bottom of Boring at 6.5 feet.**					
15								
20								
25								
30								
35								

NOTES:
- The stratification lines represent the approximate boundary lines between soil types. In situ, the transitions may be gradual.
- Estimated q_u for soil samples are based on pocket penetrometer tests.
- Estimated q_u for intact rock core are based on laboratory tests.

DAPP BORING LOG 192838 - HEREFORD MANOR LAKE.GPJ NOLAN RUN DATABASE TEMP.GDT 2/6/20

APPENDIX B

LABORATORY TEST RESULTS

January 3, 2020

Project No. 2019-726-001

Mr. Aaron Antell
D'Appolonia
701 Rodi Rd, Floor 2
Pittsburgh, PA 15235

Transmittal
Laboratory Test Results
Hereford Mnr. Lake 192838

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens that were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectfully submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

MOISTURE CONTENT

ASTM D 2216-10

Client: D'Appolonia
Client Reference: Hereford Mnr. Lake 192838
Project No.: 2019-726-001

Lab ID:	001	002	003	004	005
Boring No.:	B-1	B-1	B-1	B-1	B-1
Depth (ft):	3.0-4.5	9.0-10.5	15.0-16.5	24.0-25.5	27.0-28.5
Sample No.:	S-2	S-4	S-6	S-9	S-10
Tare Number	22	20	28	46	12
Wt. of Tare & Wet Sample (g)	69.75	51.81	50.94	43.76	49.46
Wt. of Tare & Dry Sample (g)	65.10	48.33	47.99	37.45	46.09
Weight of Tare (g)	8.34	8.47	8.28	8.47	8.80
Weight of Water (g)	4.65	3.48	2.95	6.31	3.37
Weight of Dry Sample (g)	56.76	39.86	39.71	28.98	37.29
Water Content (%)	**8.2**	**8.7**	**7.4**	**21.8**	**9.0**

Lab ID	006	007	008	009	010
Boring No.	B-2	B-2	B-3	B-3	B-4
Depth (ft)	0.0-1.5	3.0-4.5	3.0-10.5	18.0-19.5	0.0-1.5
Sample No.	S-1	S-2	S-2 & S-4	S-7	S-1
Tare Number	30	8	42	17	38
Wt. of Tare & Wet Sample (g)	32.82	64.72	48.53	46.72	44.36
Wt. of Tare & Dry Sample (g)	27.26	55.15	45.74	40.64	39.44
Weight of Tare (g)	8.49	8.31	8.43	8.47	8.36
Weight of Water (g)	5.56	9.57	2.79	6.08	4.92
Weight of Dry Sample (g)	18.77	46.84	37.31	32.17	31.08
Water Content (%)	**29.6**	**20.4**	**7.5**	**18.9**	**15.8**

Notes :

Tested By TO *Date* 12/18/19 *Checked By* JLK *Date* 12/19/19

DCN: CT-S1 DATE: 3/18/13 REVISION: 4

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MOISTURE CONTENT

ASTM D 2216-10

Client: D'Appolonia
Client Reference: Hereford Mnr. Lake 192838
Project No.: 2019-726-001

Lab ID:	011	012	013	014
Boring No.:	B-5	B-5	B-6	B-6
Depth (ft):	3.0-4.5	6.0-7.5	0.0-1.5	3.0-4.5
Sample No.:	S-2	S-3	S-1	S-2
Tare Number	4	39	19	3105
Wt. of Tare & Wet Sample (g)	41.48	45.89	44.89	58.44
Wt. of Tare & Dry Sample (g)	34.72	41.61	40.93	48.15
Weight of Tare (g)	8.35	8.47	8.28	8.22
Weight of Water (g)	6.76	4.28	3.96	10.29
Weight of Dry Sample (g)	26.37	33.14	32.65	39.93
Water Content (%)	**25.6**	**12.9**	**12.1**	**25.8**

Notes :

Tested By TO *Date* 12/18/19 *Checked By* JLK *Date* 12/19/19

DCN: CT-S1 DATE: 3/18/13 REVISION: 4

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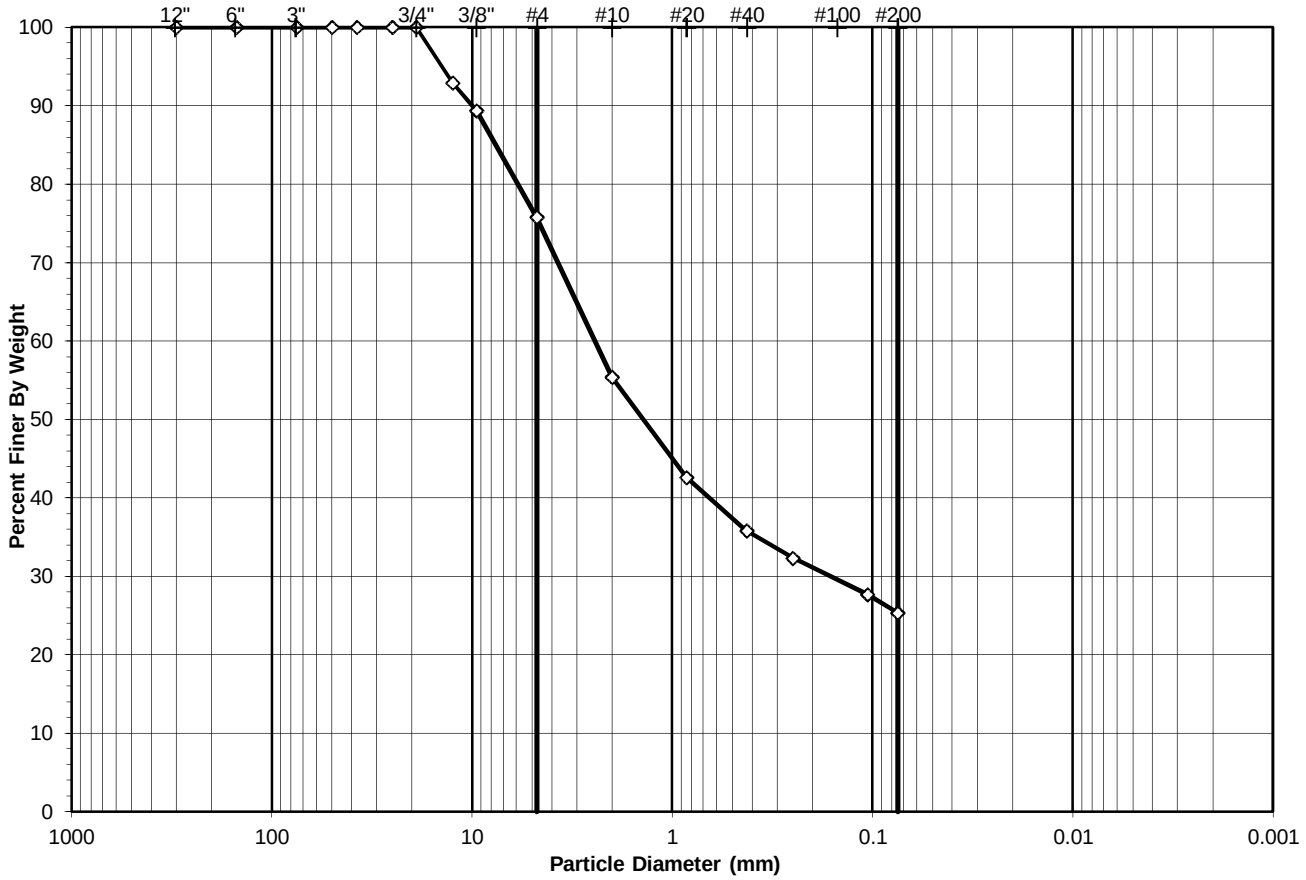
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-001	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	24.21
#4 To #200	*Sand*	50.47
Finer Than #200	*Silt & Clay*	25.32

USCS Symbol:
SM, TESTED

USCS Classification:
SILTY SAND WITH GRAVEL

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-001	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	2042	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	363.18	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	363.18	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	147.86	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	215.32	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	215.32
Dry Weight of - 3/4" Sample (g)	215.32	Weight of Minus #200 Material (g):	54.52
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	160.80
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	215.32		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	15.25		7.08	7.08	0.00	92.92	**92.92**
3/8"	9.50	7.61		3.53	10.62	0.00	89.38	**89.38**
#4	4.75	29.26		13.59	24.21	0.00	75.79	**75.79**
#10	2.00	43.95		20.41	44.62	0.00	55.38	**55.38**
#20	0.85	27.54	(**)	12.79	57.41	0.00	42.59	**42.59**
#40	0.425	14.63		6.79	64.20	0.00	35.80	**35.80**
#60	0.250	7.54		3.50	67.70	0.00	32.30	**32.30**
#140	0.106	9.96		4.63	72.33	0.00	27.67	**27.67**
#200	0.075	5.06		2.35	74.68	0.00	25.32	**25.32**
Pan	-	54.52		25.32	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/23/19 Checked By JLK Date 12/23/19

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ONE POINT ATTERBERG LIMITS

ASTM D 4318-17 (SOP - S4)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-001	Soil Description:	BROWN SILT

(MInus No. 40 sieve material, Airdried)

Liquid Limit Test	**1**	**2**
Tare Number:	612	546
Weight of Tare & Wet Sample (g):	39.95	40.53
Weight of Tare & Dry Sample (g):	35.88	36.41
Weight of Tare (g):	19.8	20.47
Weight of Water (g):	4.07	4.12
Weight of Dry Sample (g):	16.08	15.94
Moisture Content (%):	**25.3**	**25.8**
Number of Blows:	**29**	**28**

Blows	**K-factor**
20	0.974
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	633	607	
Weight of Tare & Wet Sample (g):	25.38	24.52	
Weight of Tare & Dry Sample (g):	24.29	23.5	
Weight of Tare (g):	18.92	18.4	
Weight of Water (g):	1.09	1.02	
Weight of Dry Sample (g):	5.37	5.1	
Moisture Content (%):	**20.3**	**20.0**	**0.3**

Note: The acceptable range of the two Moisture contents is ± 1.4

Liquid Limit Test Results

Test 1

LL = 25.3

LL^{CORR} = 26

Test 2

LL = 25.8

LL^{CORR} : 26

Summary

Liquid Limit (%):	**26**
Plastic Limit (%):	**20**
Plasticity Index (%):	**6**
USCS Symbol:	**ML**

As Received Moisture Content

ASTM D2216-10

Tare Number:	22
Wt. of Tare & Wet Sample (g):	69.75
Wt. of Tare & Dry Sample (g):	65.10
Weight of Tare (g):	8.34
Weight of Water (g):	4.7
Weight of Dry Sample (g):	56.8
Was As Received MC Preserved:	**Yes**
Moisture Content (%):	**8.2**

Tested By FS *Date* 12/19/19 *Checked By* JLK *Date* 12/20/19

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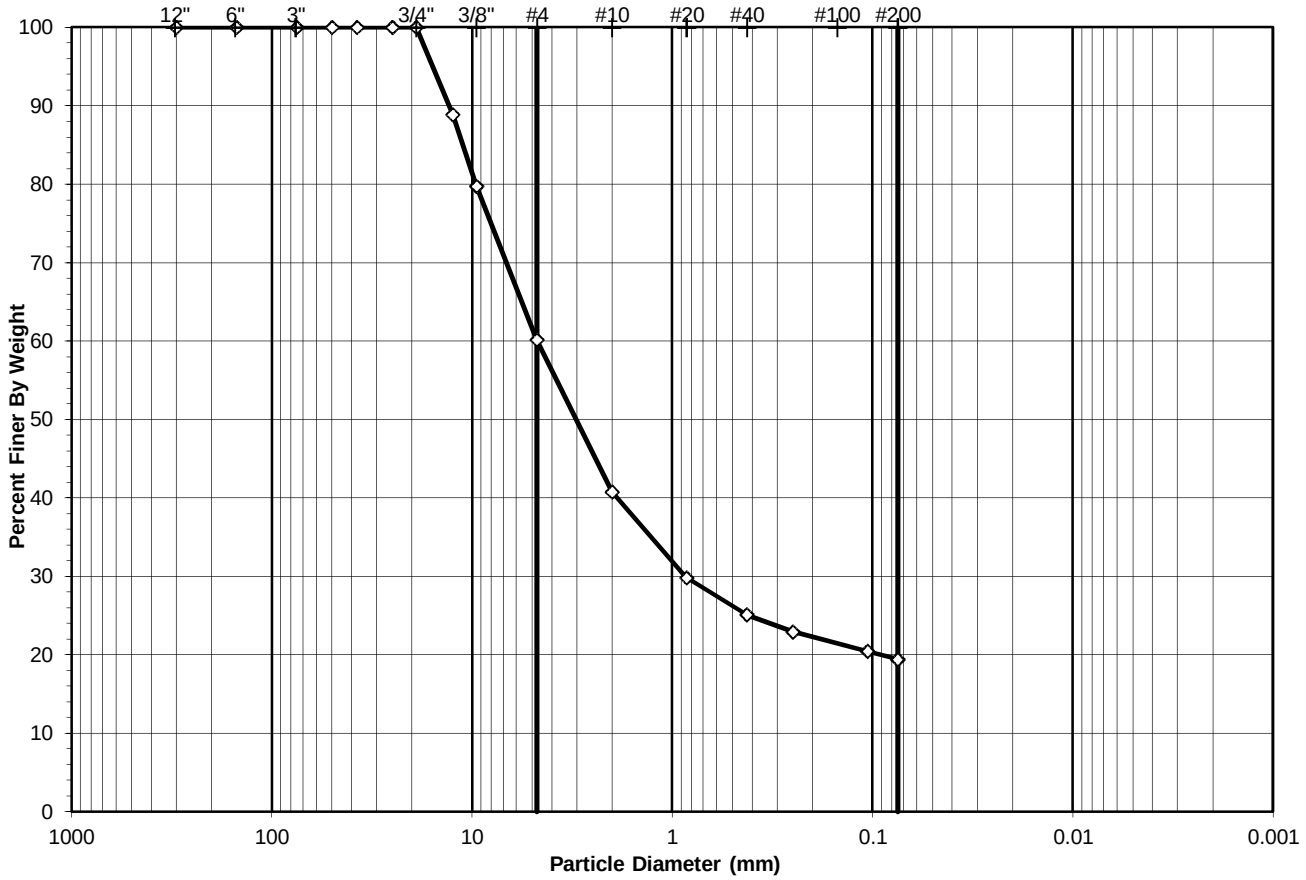
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	9.0-10.5
Project No.:	2019-726-001	Sample No.:	S-4
Lab ID:	2019-726-001-002	Soil Color:	Brown

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	39.82
#4 To #200	*Sand*	40.78
Finer Than #200	*Silt & Clay*	19.40

USCS Symbol:
SM, TESTED

USCS Classification:
SILTY SAND WITH GRAVEL

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	9.0-10.5
Project No.:	2019-726-001	Sample No.:	S-4
Lab ID:	2019-726-001-002	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	2033	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	352.38	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	352.38	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	147.40	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	204.98	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	204.98
Dry Weight of - 3/4" Sample (g)	204.98	Weight of Minus #200 Material (g):	39.76
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	165.22
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	204.98		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	22.80		11.12	11.12	0.00	88.88	**88.88**
3/8"	9.50	18.72		9.13	20.26	0.00	79.74	**79.74**
#4	4.75	40.11		19.57	39.82	0.00	60.18	**60.18**
#10	2.00	39.81		19.42	59.24	0.00	40.76	**40.76**
#20	0.85	22.43	(**)	10.94	70.19	0.00	29.81	**29.81**
#40	0.425	9.66		4.71	74.90	0.00	25.10	**25.10**
#60	0.250	4.50		2.20	77.10	0.00	22.90	**22.90**
#140	0.106	5.03		2.45	79.55	0.00	20.45	**20.45**
#200	0.075	2.16		1.05	80.60	0.00	19.40	**19.40**
Pan	-	39.76		19.40	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/31/19 Checked By JLK Date 12/31/19

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ONE POINT ATTERBERG LIMITS

ASTM D 4318-17 (SOP - S4)

Client:	D'Applonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	9.0-10.5
Project No.:	2019-726-001	Sample No.:	S-4
Lab ID:	2019-726-001-002	Soil Description:	BROWN SILT

(MInus No. 40 sieve material, Airdried)

Liquid Limit Test	**1**	**2**
Tare Number:	288	0
Weight of Tare & Wet Sample (g):	33.34	30.47
Weight of Tare & Dry Sample (g):	31.12	28.2
Weight of Tare (g):	23.16	20.13
Weight of Water (g):	2.22	2.27
Weight of Dry Sample (g):	7.96	8.07
Moisture Content (%):	**27.9**	**28.1**
Number of Blows:	**27**	**27**

Blows	**K-factor**
20	0.974
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	307	115	
Weight of Tare & Wet Sample (g):	25.48	24.69	
Weight of Tare & Dry Sample (g):	24.45	23.7	
Weight of Tare (g):	19.41	18.62	
Weight of Water (g):	1.03	0.99	
Weight of Dry Sample (g):	5.04	5.08	
Moisture Content (%):	**20.4**	**19.5**	**0.9**

Note: The acceptable range of the two Moisture contents is ± 1.4

Liquid Limit Test Results

Test 1

LL = 27.9

LL^{CORR} = 28

Test 2

LL = 28.1

LL^{CORR} = 28

Summary

Liquid Limit (%):	**28**
Plastic Limit (%):	**20**
Plasticity Index (%):	**8**
USCS Symbol:	**ML**

As Received Moisture Content

ASTM D2216-10

Tare Number:	20
Wt. of Tare & Wet Sample (g):	51.81
Wt. of Tare & Dry Sample (g):	48.33
Weight of Tare (g):	8.47
Weight of Water (g):	3.5
Weight of Dry Sample (g):	39.9
Was As Received MC Preserved:	**Yes**
Moisture Content (%):	**8.7**

Tested By FS *Date* 12/26/19 *Checked By* JLK *Date* 12/31/19

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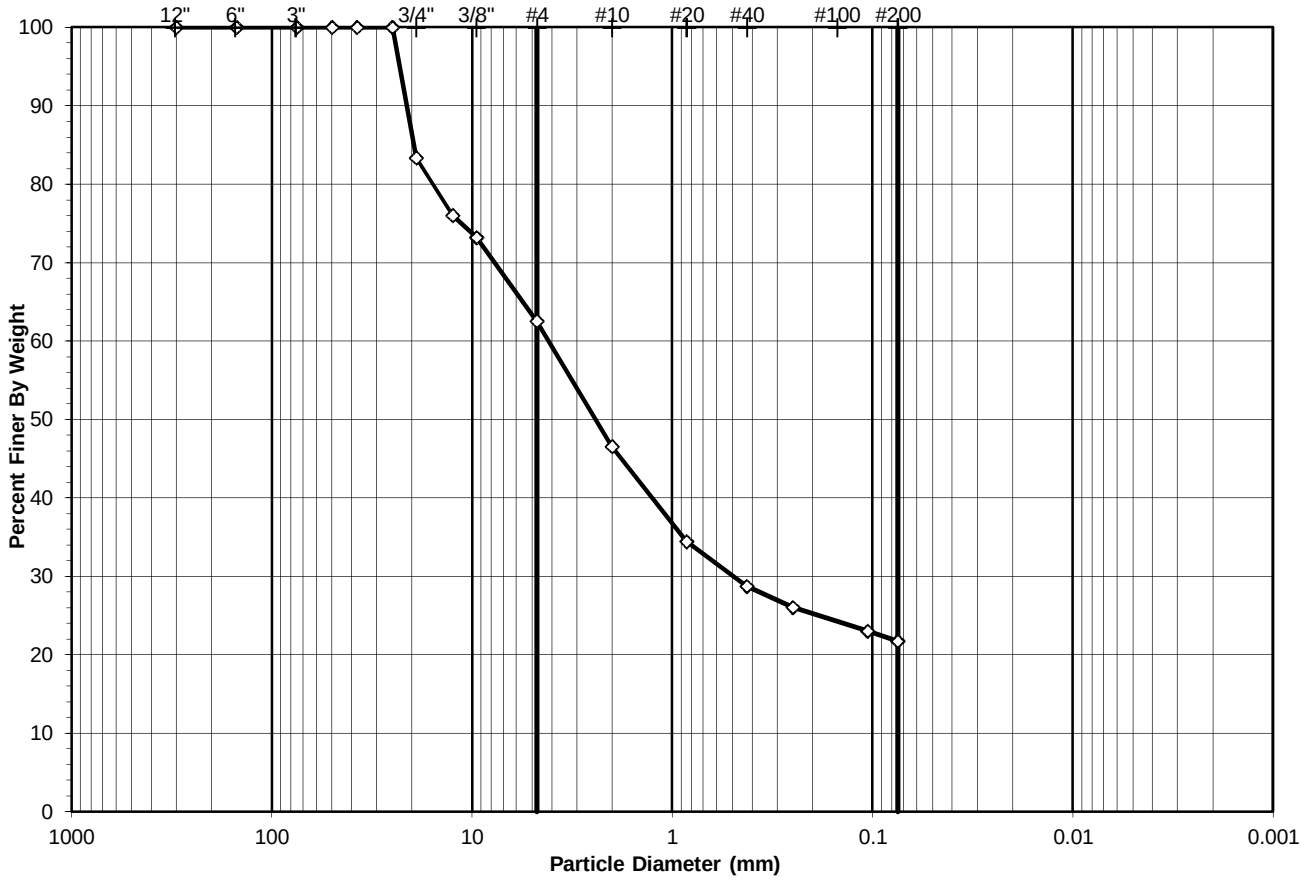
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	15.0-16.5
Project No.:	2019-726-001	Sample No.:	S-6
Lab ID:	2019-726-001-003	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	37.45
#4 To #200	*Sand*	40.83
Finer Than #200	*Silt & Clay*	21.72

USCS Symbol:
SM, TESTED

USCS Classification:
SILTY SAND WITH GRAVEL

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	15.0-16.5
Project No.:	2019-726-001	Sample No.:	S-6
Lab ID:	2019-726-001-003	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1460	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	341.88	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	341.88	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	142.46	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	199.42	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	199.42
Dry Weight of - 3/4" Sample (g)	166.26	Weight of Minus #200 Material (g):	43.32
Wet Weight of +3/4" Sample (g)	33.16	Weight of Plus #200 Material (g):	156.10
Dry Weight of + 3/4" Sample (g)	33.16		
Total Dry Weight of Sample (g):	199.42		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	100.00	**100.00**
3/4"	19.0	33.16		16.63	16.63	83.37	**83.37**
1/2"	12.5	14.64		7.34	23.97	76.03	**76.03**
3/8"	9.50	5.62		2.82	26.79	73.21	**73.21**
#4	4.75	21.26		10.66	37.45	62.55	**62.55**
#10	2.00	31.90		16.00	53.44	46.56	**46.56**
#20	0.85	24.20	(**)	12.14	65.58	34.42	**34.42**
#40	0.425	11.34		5.69	71.27	28.73	**28.73**
#60	0.250	5.38		2.70	73.96	26.04	**26.04**
#140	0.106	6.01		3.01	76.98	23.02	**23.02**
#200	0.075	2.59		1.30	78.28	21.72	**21.72**
Pan	-	43.32		21.72	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/31/19 Checked By JLK Date 12/31/19

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ONE POINT ATTERBERG LIMITS

ASTM D 4318-17 (SOP - S4)

Client:	D'Applonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	15.0-16.5
Project No.:	2019-726-001	Sample No.:	S-6
Lab ID:	2019-726-001-003	Soil Description:	BROWN SILT

(MInus No. 40 sieve material, Airdried)

Liquid Limit Test	**1**	**2**
Tare Number:	531	341
Weight of Tare & Wet Sample (g):	30.85	30.53
Weight of Tare & Dry Sample (g):	28.78	28.51
Weight of Tare (g):	20.62	20.44
Weight of Water (g):	2.07	2.02
Weight of Dry Sample (g):	8.16	8.07
Moisture Content (%):	**25.4**	**25.0**
Number of Blows:	**23**	**23**

Blows	**K-factor**
20	0.974
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	631	606	
Weight of Tare & Wet Sample (g):	25.02	25.21	
Weight of Tare & Dry Sample (g):	23.99	24.08	
Weight of Tare (g):	18.84	18.5	
Weight of Water (g):	1.03	1.13	
Weight of Dry Sample (g):	5.15	5.58	
Moisture Content (%):	**20.0**	**20.3**	**-0.3**

Note: The acceptable range of the two Moisture contents is ± 1.4

Liquid Limit Test Results

Test 1

LL = 25.4

LL^{CORR} = 25

Test 2

LL = 25.0

LL^{CORR} = 25

Summary

Liquid Limit (%):	**25**
Plastic Limit (%):	**20**
Plasticity Index (%):	**5**
USCS Symbol:	**ML**

As Received Moisture Content

ASTM D2216-10

Tare Number:	28
Wt. of Tare & Wet Sample (g):	50.94
Wt. of Tare & Dry Sample (g):	47.99
Weight of Tare (g):	8.28
Weight of Water (g):	3.0
Weight of Dry Sample (g):	39.7
Was As Received MC Preserved:	**Yes**
Moisture Content (%):	**7.4**

Tested By FS *Date* 12/27/19 *Checked By* JLK *Date* 12/31/19

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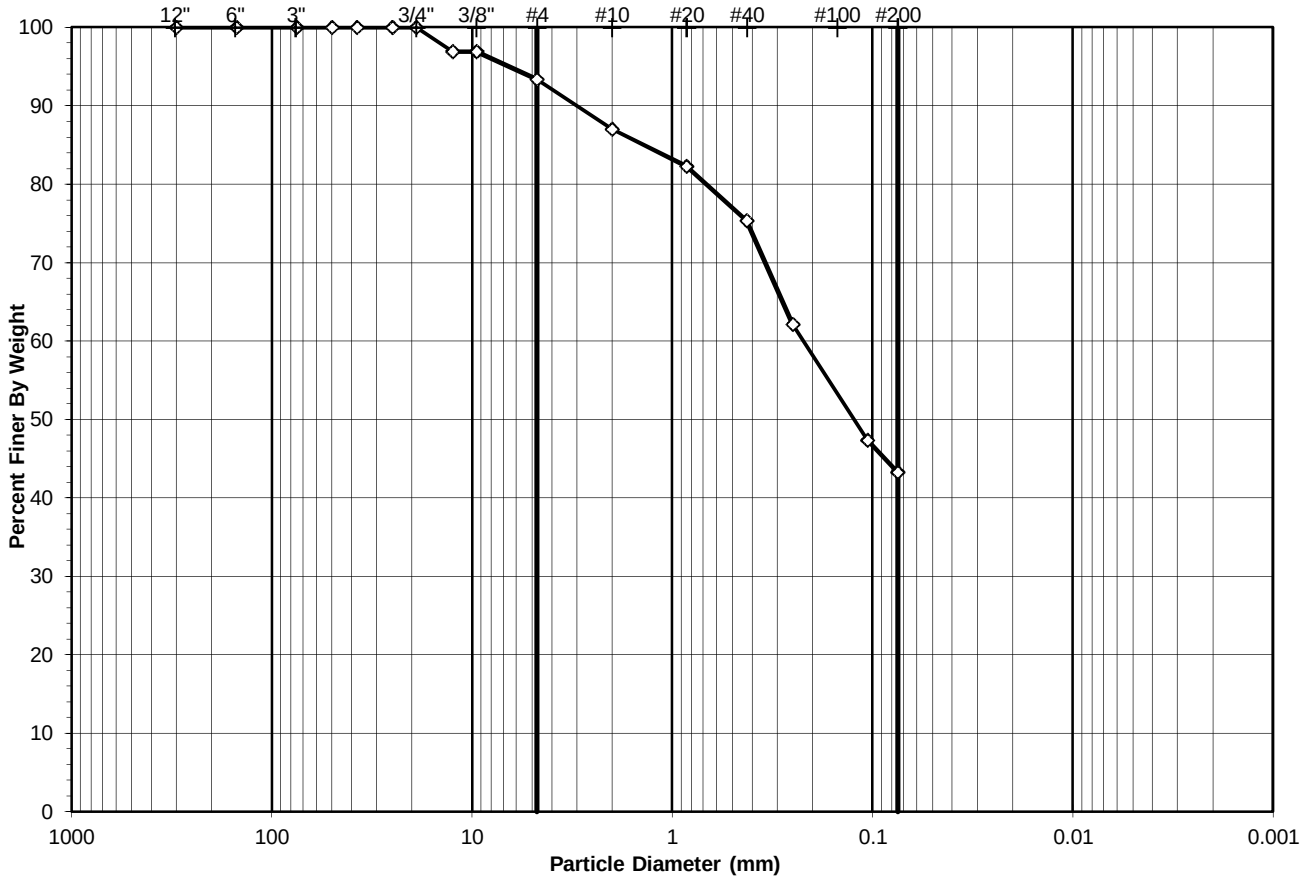
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	24.0-25.5
Project No.:	2019-726-001	Sample No.:	S-9
Lab ID:	2019-726-001-004	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	6.63
#4 To #200	*Sand*	50.09
Finer Than #200	*Silt & Clay*	43.28

USCS Symbol:
SC, TESTED

USCS Classification:
CLAYEY SAND

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	24.0-25.5
Project No.:	2019-726-001	Sample No.:	S-9
Lab ID:	2019-726-001-004	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1477	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	355.89	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	355.89	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	144.27	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	211.62	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	211.62
Dry Weight of - 3/4" Sample (g)	211.62	Weight of Minus #200 Material (g):	91.59
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	120.03
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	211.62		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	6.50		3.07	3.07	0.00	96.93	**96.93**
3/8"	9.50	0.00		0.00	3.07	0.00	96.93	**96.93**
#4	4.75	7.52		3.55	6.63	0.00	93.37	**93.37**
#10	2.00	13.43		6.35	12.97	0.00	87.03	**87.03**
#20	0.85	10.03	(**)	4.74	17.71	0.00	82.29	**82.29**
#40	0.425	14.64		6.92	24.63	0.00	75.37	**75.37**
#60	0.250	27.98		13.22	37.85	0.00	62.15	**62.15**
#140	0.106	31.30		14.79	52.64	0.00	47.36	**47.36**
#200	0.075	8.63		4.08	56.72	0.00	43.28	**43.28**
Pan	-	91.59		43.28	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/31/19 Checked By JLK Date 12/31/19

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	24.0-25.5
Project No.:	2019-726-001	Sample No.:	S-9
Lab ID:	2019-726-001-004	Soil Description:	BROWN LEAN CLAY

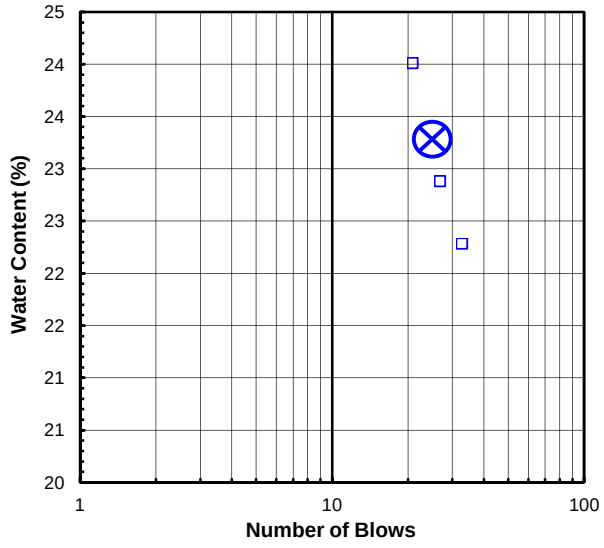
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	46	612	336	339	U
Wt. of Tare & Wet Sample (g):	43.76	40.10	40.89	40.68	L
Wt. of Tare & Dry Sample (g):	37.45	36.40	37.10	36.77	T
Weight of Tare (g):	8.47	19.79	20.53	20.48	I
Weight of Water (g):	6.3	3.7	3.8	3.9	P
Weight of Dry Sample (g):	29.0	16.6	16.6	16.3	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**21.8**	**22.3**	**22.9**	**24.0**	N
Number of Blows:		**33**	**27**	**21**	T

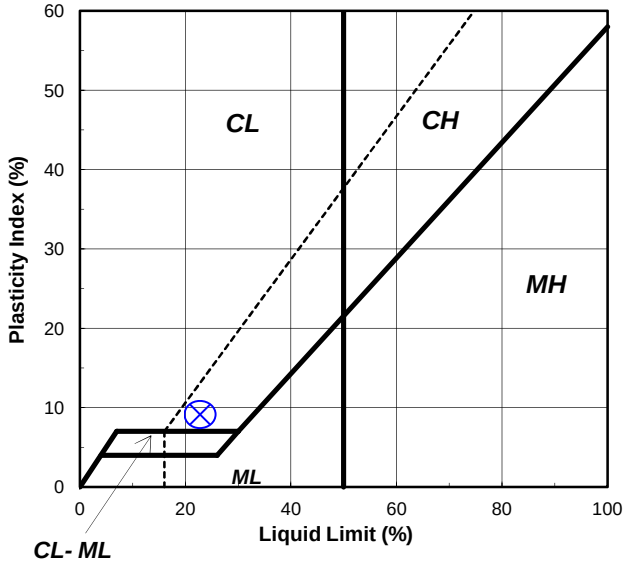
Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	328	629	
Wt. of Tare & Wet Sample (g):	25.94	24.77	
Wt. of Tare & Dry Sample (g):	25.16	24.02	
Weight of Tare (g):	19.40	18.70	
Weight of Water (g):	0.8	0.8	
Weight of Dry Sample (g):	5.8	5.3	
Moisture Content (%):	**13.5**	**14.1**	**-0.6**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**23**
Plastic Limit (%):	**14**
Plasticity Index (%):	**9**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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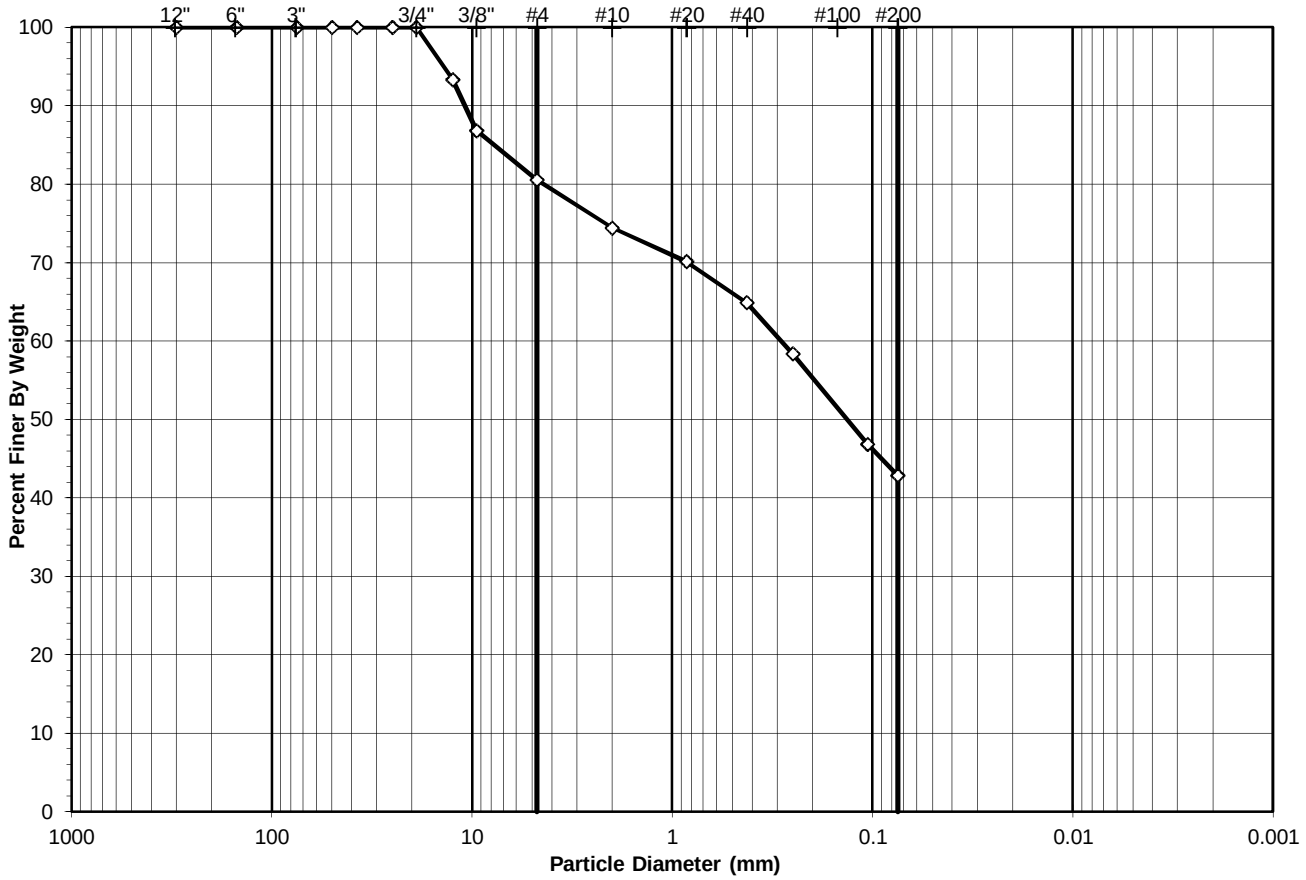
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	27.0-28.5
Project No.:	2019-726-001	Sample No.:	S-10
Lab ID:	2019-726-001-005	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	19.44
#4 To #200	*Sand*	37.70
Finer Than #200	*Silt & Clay*	42.87

USCS Symbol:
SC, TESTED

USCS Classification:
CLAYEY SAND WITH GRAVEL

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	27.0-28.5
Project No.:	2019-726-001	Sample No.:	S-10
Lab ID:	2019-726-001-005	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1443	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	284.24	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	284.24	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	144.50	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	139.74	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	139.74
Dry Weight of - 3/4" Sample (g)	139.74	Weight of Minus #200 Material (g):	59.90
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	79.84
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	139.74		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	9.30		6.66	6.66	0.00	93.34	**93.34**
3/8"	9.50	9.11		6.52	13.17	0.00	86.83	**86.83**
#4	4.75	8.75		6.26	19.44	0.00	80.56	**80.56**
#10	2.00	8.59		6.15	25.58	0.00	74.42	**74.42**
#20	0.85	5.95	(**)	4.26	29.84	0.00	70.16	**70.16**
#40	0.425	7.32		5.24	35.08	0.00	64.92	**64.92**
#60	0.250	9.12		6.53	41.61	0.00	58.39	**58.39**
#140	0.106	16.13		11.54	53.15	0.00	46.85	**46.85**
#200	0.075	5.57		3.99	57.13	0.00	42.87	**42.87**
Pan	-	59.90		42.87	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/31/19 Checked By JLK Date 12/31/19

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-1
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	27.0-28.5
Project No.:	2019-726-001	Sample No.:	S-10
Lab ID:	2019-726-001-005	Soil Description:	BROWN LEAN CLAY

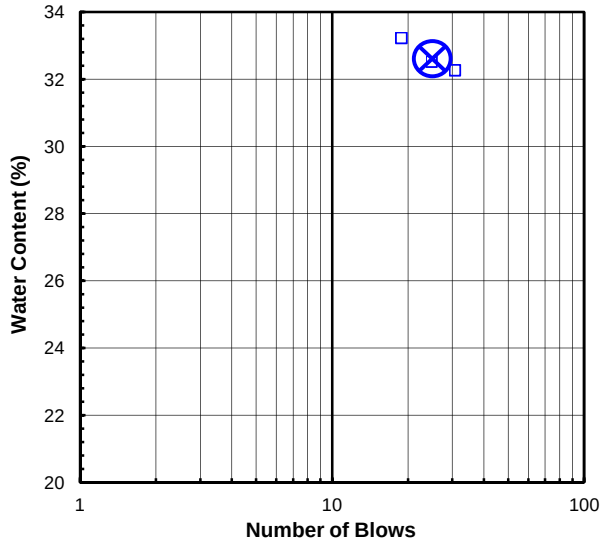
***Note: The* USCS symbol used with this test refers only to the minus No. 40** (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	12	646	619	216	U
Wt. of Tare & Wet Sample (g):	49.46	39.67	39.69	39.33	L
Wt. of Tare & Dry Sample (g):	46.09	34.77	34.78	34.32	T
Weight of Tare (g):	8.80	19.57	19.67	19.23	I
Weight of Water (g):	3.4	4.9	4.9	5.0	P
Weight of Dry Sample (g):	37.3	15.2	15.1	15.1	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**9.0**	**32.2**	**32.5**	**33.2**	N
Number of Blows:		**31**	**25**	**19**	T

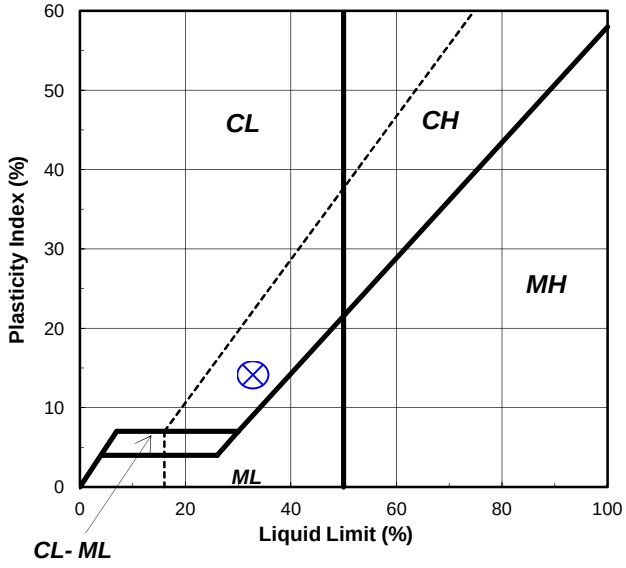
Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	605	307	
Wt. of Tare & Wet Sample (g):	24.93	25.57	
Wt. of Tare & Dry Sample (g):	23.95	24.58	
Weight of Tare (g):	18.89	19.42	
Weight of Water (g):	1.0	1.0	
Weight of Dry Sample (g):	5.1	5.2	
Moisture Content (%):	**19.4**	**19.2**	**0.2**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**33**
Plastic Limit (%):	**19**
Plasticity Index (%):	**14**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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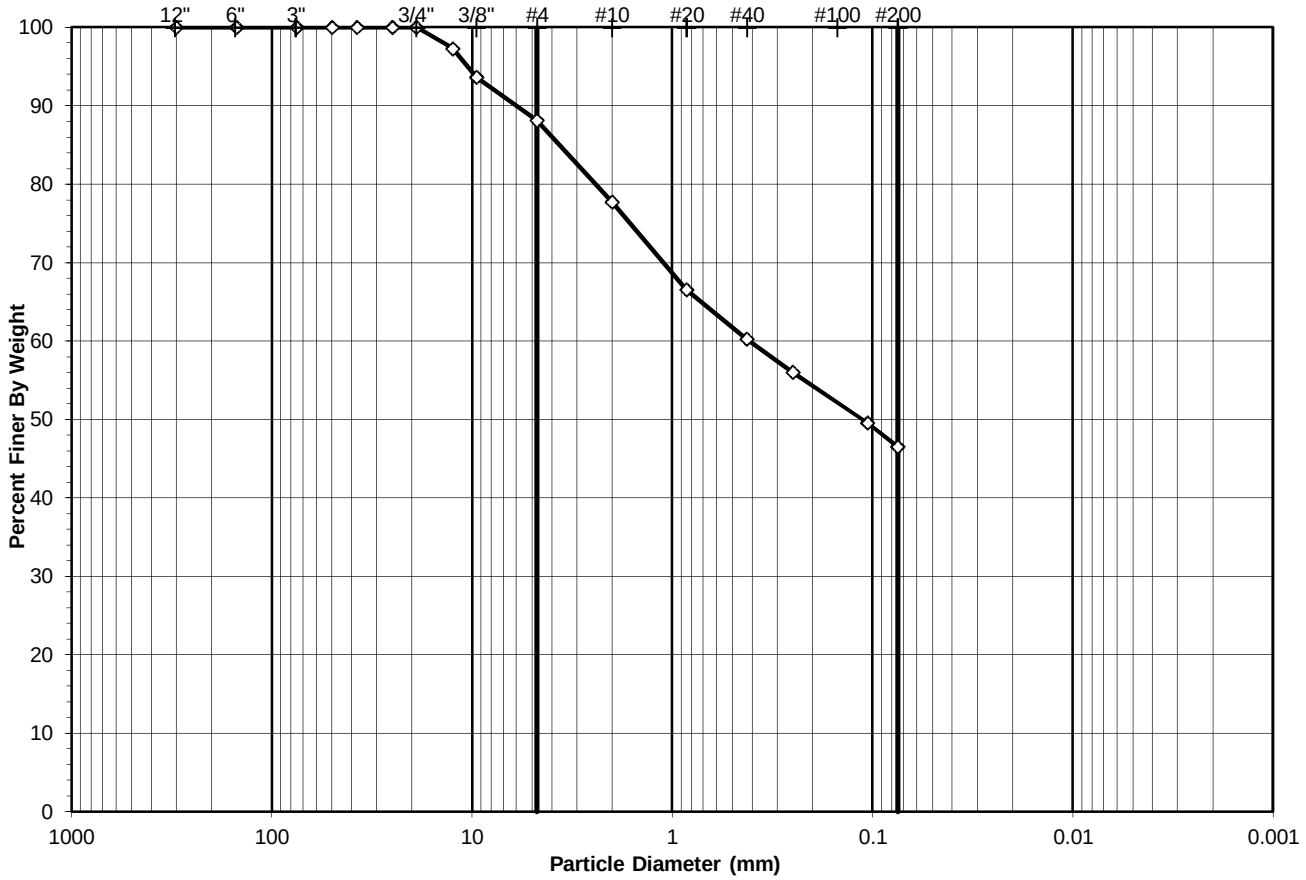
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-2
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-006	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	11.86
#4 To #200	*Sand*	41.63
Finer Than #200	*Silt & Clay*	46.51

USCS Symbol:
SM, TESTED

USCS Classification:
SILTY SAND

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-2
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-006	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	2027	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	290.05	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	290.05	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	147.47	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	142.58	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	142.58
Dry Weight of - 3/4" Sample (g)	142.58	Weight of Minus #200 Material (g):	66.32
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	76.26
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	142.58		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	3.88		2.72	2.72	0.00	97.28	**97.28**
3/8"	9.50	5.16		3.62	6.34	0.00	93.66	**93.66**
#4	4.75	7.87		5.52	11.86	0.00	88.14	**88.14**
#10	2.00	14.84		10.41	22.27	0.00	77.73	**77.73**
#20	0.85	15.94	(**)	11.18	33.45	0.00	66.55	**66.55**
#40	0.425	8.97		6.29	39.74	0.00	60.26	**60.26**
#60	0.250	6.03		4.23	43.97	0.00	56.03	**56.03**
#140	0.106	9.23		6.47	50.44	0.00	49.56	**49.56**
#200	0.075	4.34		3.04	53.49	0.00	46.51	**46.51**
Pan	-	66.32		46.51	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/31/19 Checked By JLK Date 12/31/19

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-2
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-006	Soil Description:	BROWN SILT

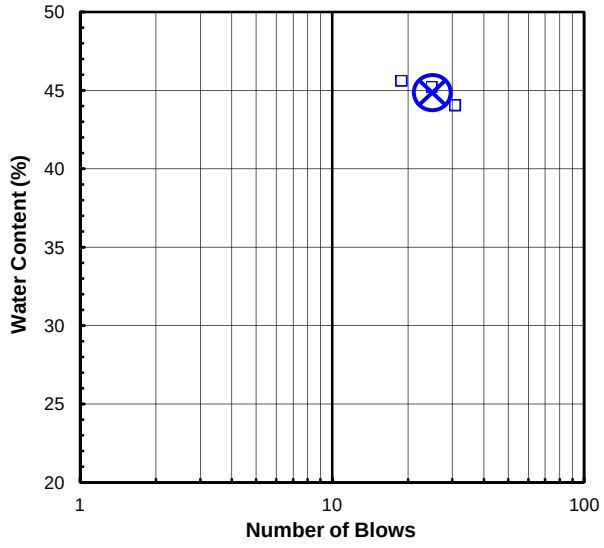
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	30	111	300	642	U
Wt. of Tare & Wet Sample (g):	32.82	39.41	44.84	40.12	L
Wt. of Tare & Dry Sample (g):	27.26	33.25	38.48	33.81	T
Weight of Tare (g):	8.49	19.25	24.40	19.96	I
Weight of Water (g):	5.6	6.2	6.4	6.3	P
Weight of Dry Sample (g):	18.8	14.0	14.1	13.9	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**29.6**	**44.0**	**45.2**	**45.6**	N
Number of Blows:		**31**	**25**	**19**	T

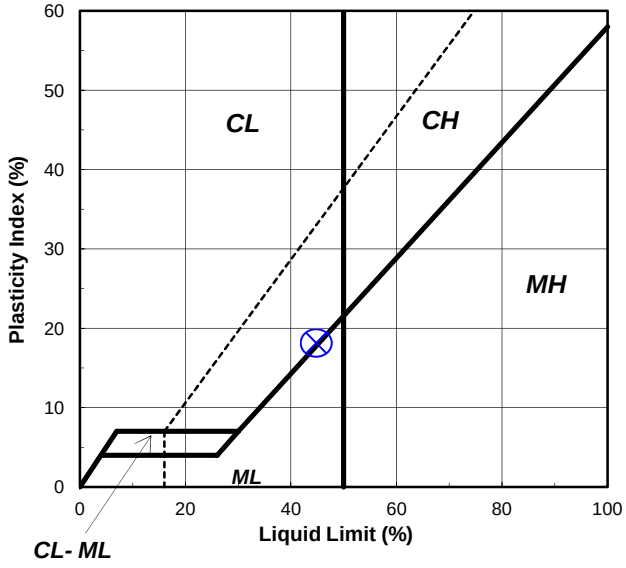
Plastic Limit Test	1	2	Range
Tare Number:	144	286	
Wt. of Tare & Wet Sample (g):	24.05	21.80	
Wt. of Tare & Dry Sample (g):	22.80	20.48	
Weight of Tare (g):	17.99	15.61	
Weight of Water (g):	1.3	1.3	
Weight of Dry Sample (g):	4.8	4.9	
Moisture Content (%):	**26.0**	**27.1**	**-1.1**
Note: The acceptable range of the two Moisture Contents is ±			0.84

Test Results	
Liquid Limit (%):	**45**
Plastic Limit (%):	**27**
Plasticity Index (%):	**18**
USCS Symbol:	**ML**

Flow Curve



Plasticity Chart



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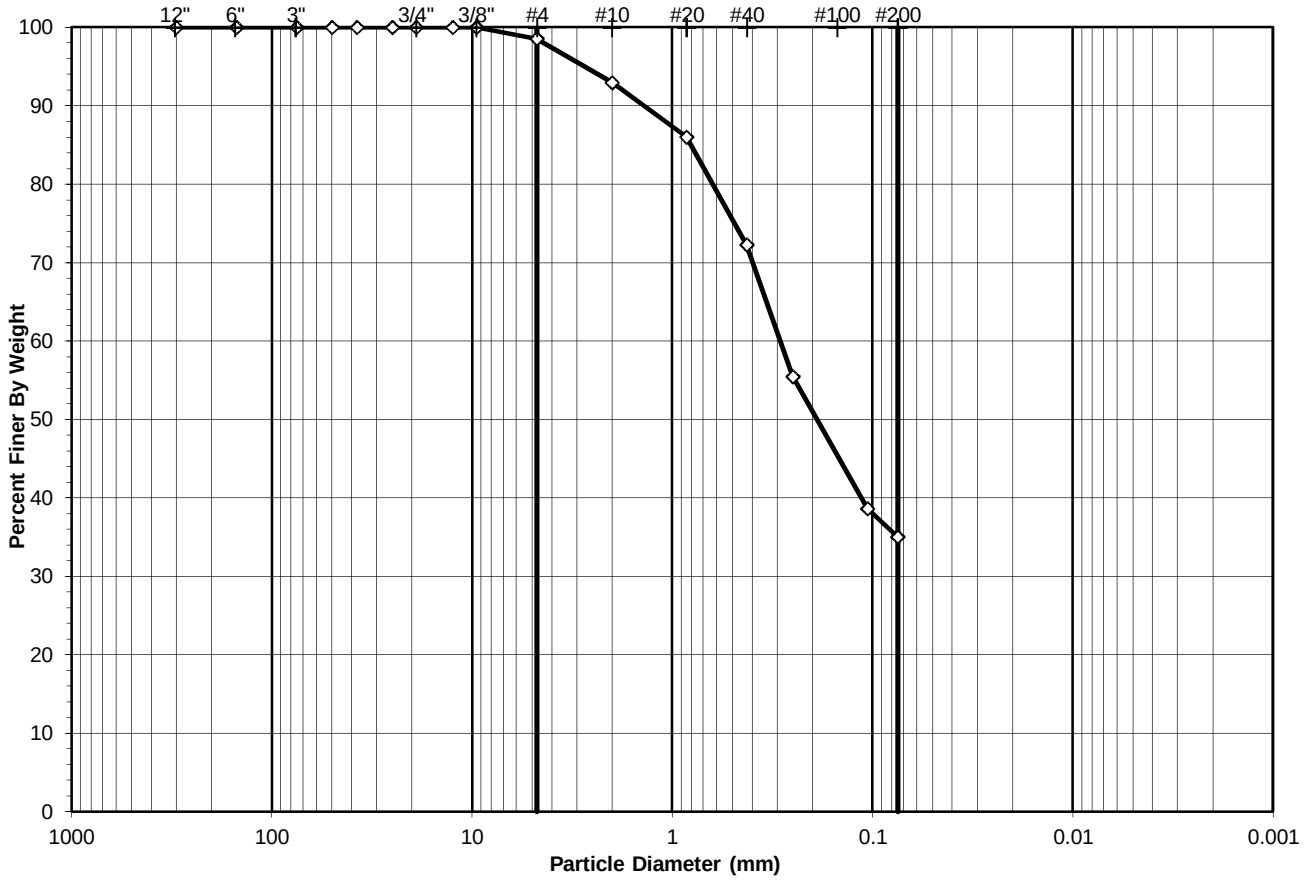
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-2
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-007	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	1.44
#4 To #200	*Sand*	63.53
Finer Than #200	*Silt & Clay*	35.03

USCS Symbol:
SC, TESTED

USCS Classification:
CLAYEY SAND

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-2
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-007	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1432	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	274.80	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	274.80	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	144.64	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	130.16	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	130.16
Dry Weight of - 3/4" Sample (g)	130.16	Weight of Minus #200 Material (g):	45.60
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	84.56
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	130.16		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00		0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00		0.00	0.00	0.00	100.00	**100.00**
#4	4.75	1.87		1.44	1.44	0.00	98.56	**98.56**
#10	2.00	7.28		5.59	7.03	0.00	92.97	**92.97**
#20	0.85	9.05	(**)	6.95	13.98	0.00	86.02	**86.02**
#40	0.425	17.88		13.74	27.72	0.00	72.28	**72.28**
#60	0.250	21.87		16.80	44.52	0.00	55.48	**55.48**
#140	0.106	21.92		16.84	61.36	0.00	38.64	**38.64**
#200	0.075	4.69		3.60	64.97	0.00	35.03	**35.03**
Pan	-	45.60		35.03	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/31/19 Checked By JLK Date 12/31/19

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-2
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-007	Soil Description:	BROWN LEAN CLAY

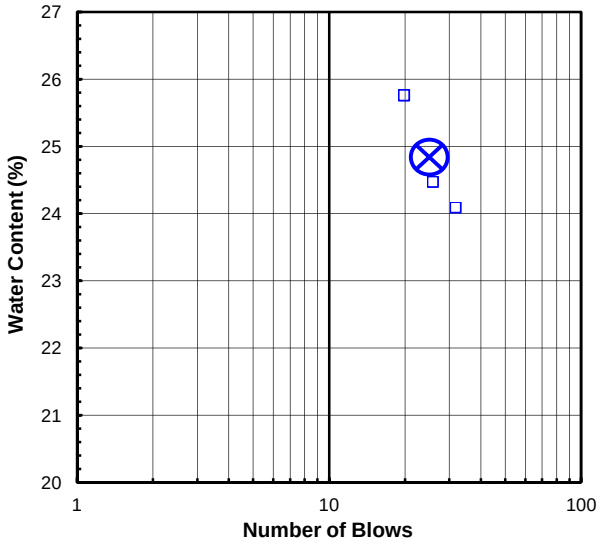
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	8	631	227	220	U
Wt. of Tare & Wet Sample (g):	64.72	40.07	38.18	39.43	L
Wt. of Tare & Dry Sample (g):	55.15	36.15	34.23	35.30	T
Weight of Tare (g):	8.31	19.87	18.08	19.26	I
Weight of Water (g):	9.6	3.9	4.0	4.1	P
Weight of Dry Sample (g):	46.8	16.3	16.2	16.0	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**20.4**	**24.1**	**24.5**	**25.7**	N
Number of Blows:		**32**	**26**	**20**	T

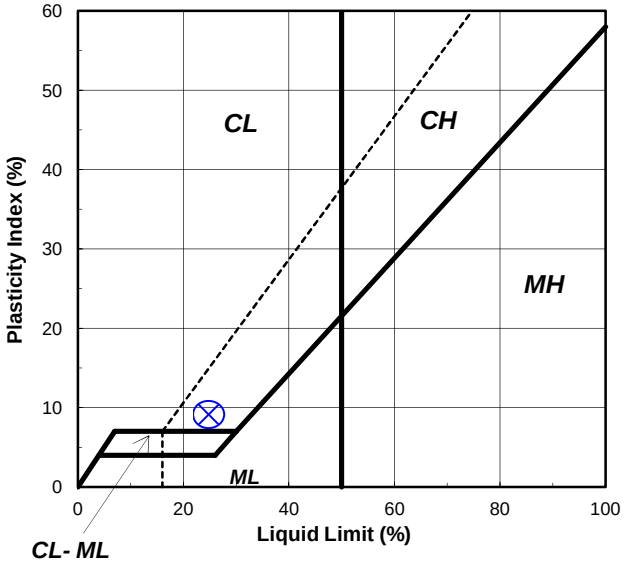
Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	607	310	
Wt. of Tare & Wet Sample (g):	24.42	25.47	
Wt. of Tare & Dry Sample (g):	23.58	24.63	
Weight of Tare (g):	18.40	19.37	
Weight of Water (g):	0.8	0.8	
Weight of Dry Sample (g):	5.2	5.3	
Moisture Content (%):	**16.2**	**16.0**	**0.2**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**25**
Plastic Limit (%):	**16**
Plasticity Index (%):	**9**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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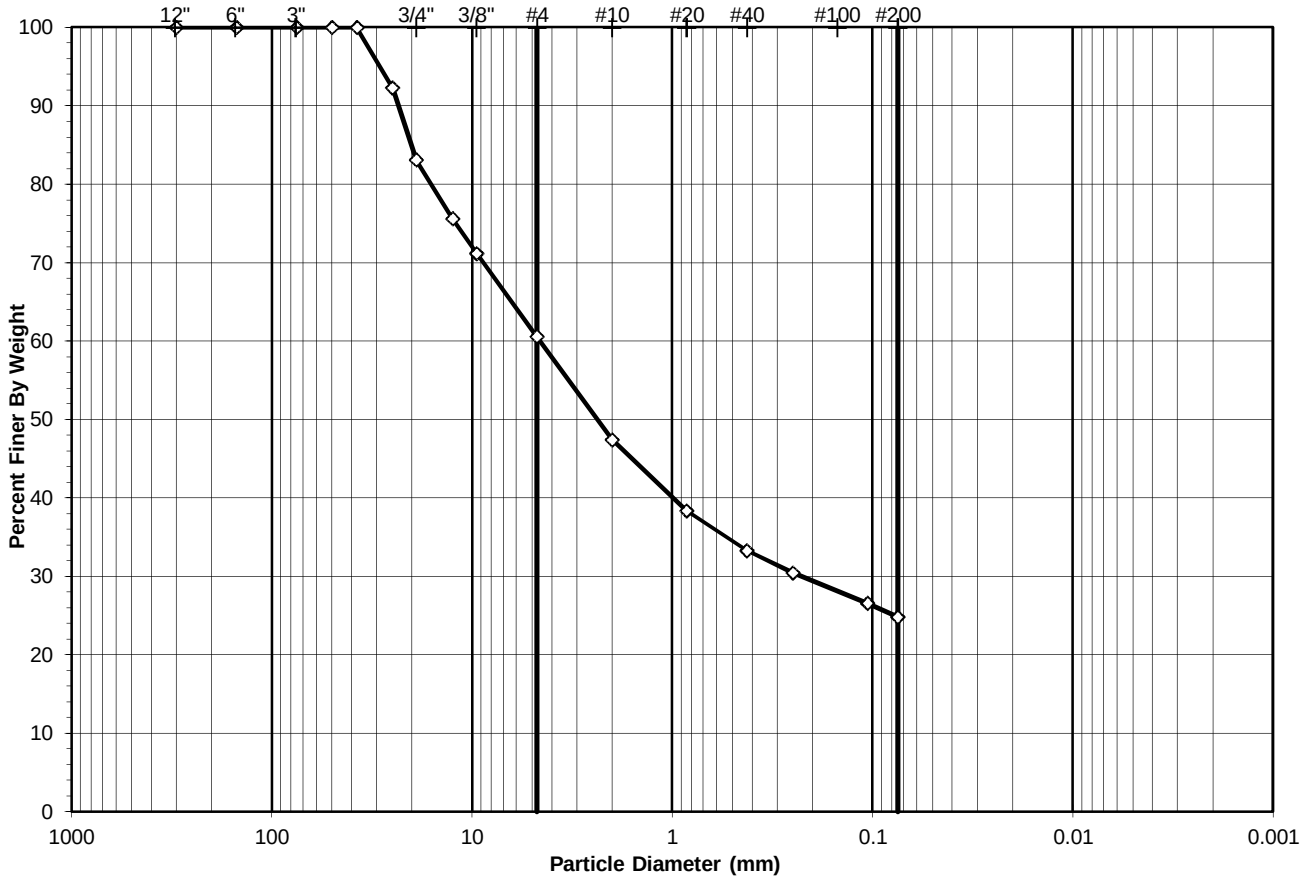
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-3
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-10.5
Project No.:	2019-726-001	Sample No.:	S-2 & S-4
Lab ID:	2019-726-001-008	Soil Color:	Dark Brown

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	39.40
#4 To #200	*Sand*	35.80
Finer Than #200	*Silt & Clay*	24.80

USCS Symbol:
GC, TESTED

USCS Classification:
CLAYEY GRAVEL WITH SAND

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-3
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-10.5
Project No.:	2019-726-001	Sample No.:	S-2 & S-4
Lab ID:	2019-726-001-008	Soil Color:	Dark Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1619	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	561.78	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	561.78	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	148.08	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	413.70	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	413.70
Dry Weight of - 3/4" Sample (g)	343.90	Weight of Minus #200 Material (g):	102.58
Wet Weight of +3/4" Sample (g)	69.80	Weight of Plus #200 Material (g):	311.12
Dry Weight of + 3/4" Sample (g)	69.80		
Total Dry Weight of Sample (g):	413.70		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.00**
1"	25.0	31.88		7.71	7.71	92.29	**92.29**
3/4"	19.0	37.92		9.17	16.87	83.13	**83.13**
1/2"	12.5	31.05		7.51	24.38	75.62	**75.62**
3/8"	9.50	18.42		4.45	28.83	71.17	**71.17**
#4	4.75	43.73		10.57	39.40	60.60	**60.60**
#10	2.00	54.59		13.20	52.60	47.40	**47.40**
#20	0.85	37.40	(**)	9.04	61.64	38.36	**38.36**
#40	0.425	21.05		5.09	66.72	33.28	**33.28**
#60	0.250	11.72		2.83	69.56	30.44	**30.44**
#140	0.106	16.02		3.87	73.43	26.57	**26.57**
#200	0.075	7.34		1.77	75.20	24.80	**24.80**
Pan	-	102.58		24.80	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 12/31/19 Checked By JLK Date 12/31/19

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-3
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2 & S-4
Lab ID:	2019-726-001-008	Soil Description:	DARK BROWN LEAN CLAY

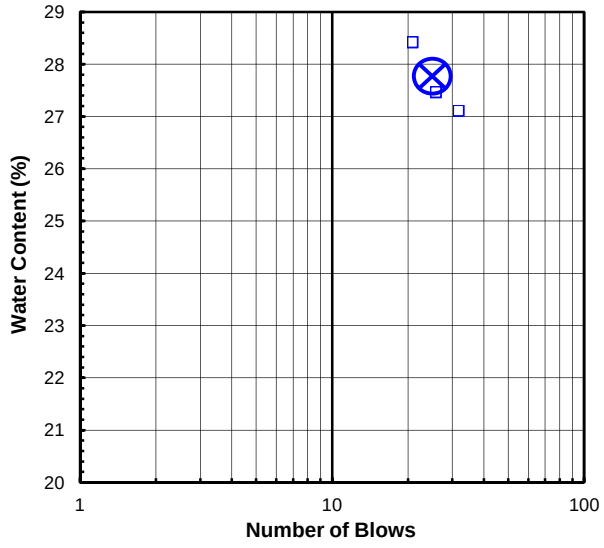
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	42	526	121	224	U
Wt. of Tare & Wet Sample (g):	48.53	40.60	39.58	39.83	L
Wt. of Tare & Dry Sample (g):	45.74	36.30	35.24	35.39	T
Weight of Tare (g):	8.43	20.43	19.43	19.76	I
Weight of Water (g):	2.8	4.3	4.3	4.4	P
Weight of Dry Sample (g):	37.3	15.9	15.8	15.6	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**7.5**	**27.1**	**27.5**	**28.4**	N
Number of Blows:		**32**	**26**	**21**	T

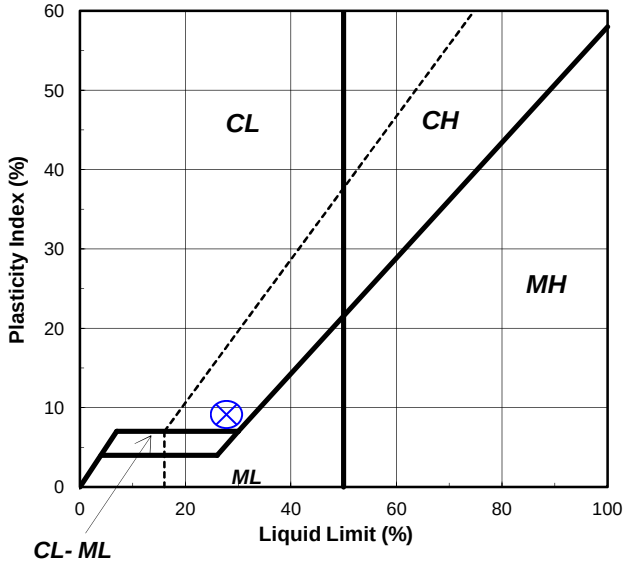
Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	632	633	
Wt. of Tare & Wet Sample (g):	24.96	25.07	
Wt. of Tare & Dry Sample (g):	24.01	24.09	
Weight of Tare (g):	18.83	18.92	
Weight of Water (g):	0.9	1.0	
Weight of Dry Sample (g):	5.2	5.2	
Moisture Content (%):	**18.3**	**19.0**	**-0.6**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**28**
Plastic Limit (%):	**19**
Plasticity Index (%):	**9**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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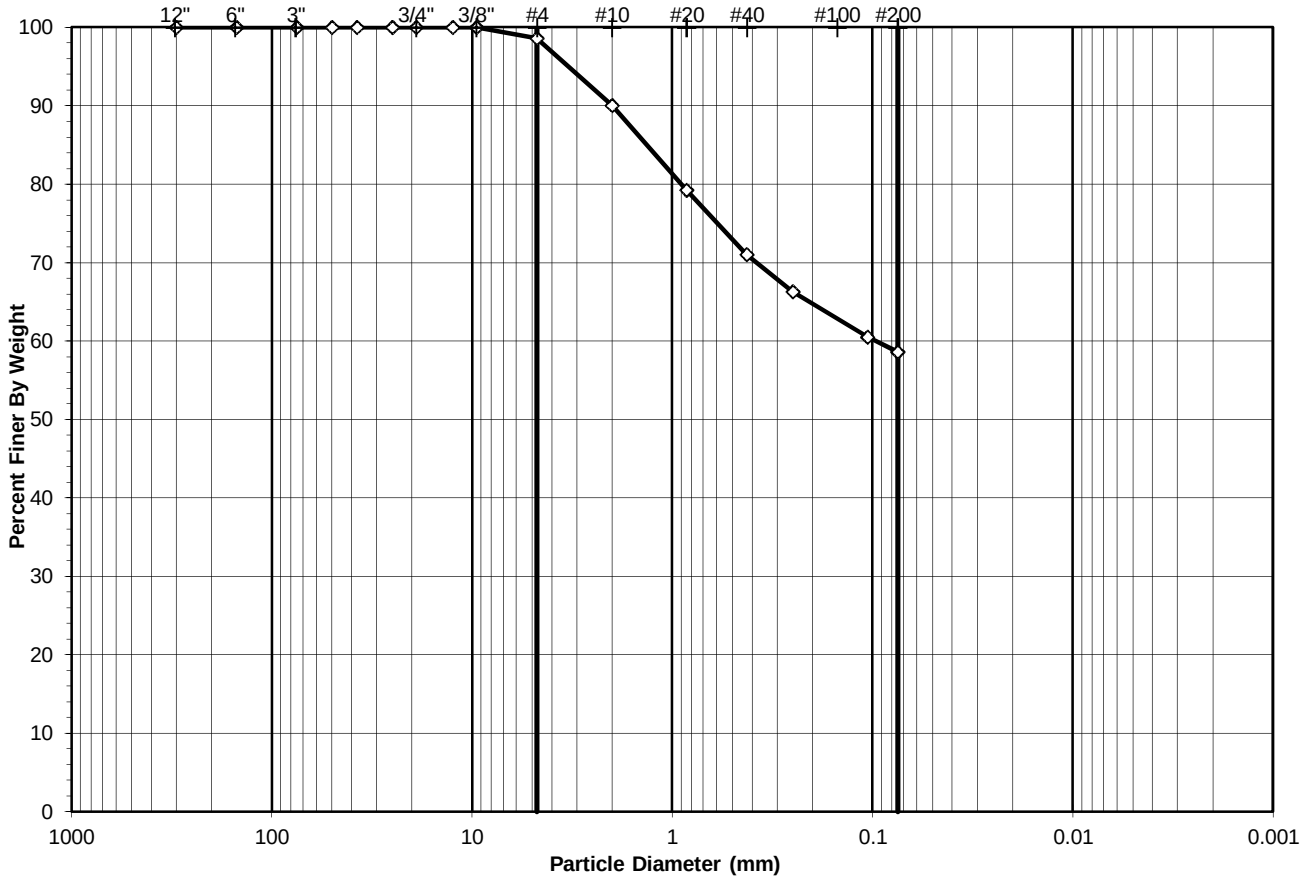
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-3
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	18.0-19.5
Project No.:	2019-726-001	Sample No.:	S-7
Lab ID:	2019-726-001-009	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	1.38
#4 To #200	*Sand*	40.02
Finer Than #200	*Silt & Clay*	58.60

USCS Symbol:
CL, TESTED

USCS Classification:
SANDY LEAN CLAY

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-3
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	18.0-19.5
Project No.:	2019-726-001	Sample No.:	S-7
Lab ID:	2019-726-001-009	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1456	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	296.65	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	296.65	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	132.64	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	164.01	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	164.01
Dry Weight of - 3/4" Sample (g)	164.01	Weight of Minus #200 Material (g):	96.11
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	67.90
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	164.01		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00		0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00		0.00	0.00	0.00	100.00	**100.00**
#4	4.75	2.26		1.38	1.38	0.00	98.62	**98.62**
#10	2.00	14.07		8.58	9.96	0.00	90.04	**90.04**
#20	0.85	17.69	(**)	10.79	20.74	0.00	79.26	**79.26**
#40	0.425	13.47		8.21	28.96	0.00	71.04	**71.04**
#60	0.250	7.79		4.75	33.71	0.00	66.29	**66.29**
#140	0.106	9.48		5.78	39.49	0.00	60.51	**60.51**
#200	0.075	3.14		1.91	41.40	0.00	58.60	**58.60**
Pan	-	96.11		58.60	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 1/2/20 Checked By JLK Date 1/3/20

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-3
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	18.0-19.5
Project No.:	2019-726-001	Sample No.:	S-7
Lab ID:	2019-726-001-009	Soil Description:	BROWN LEAN CLAY

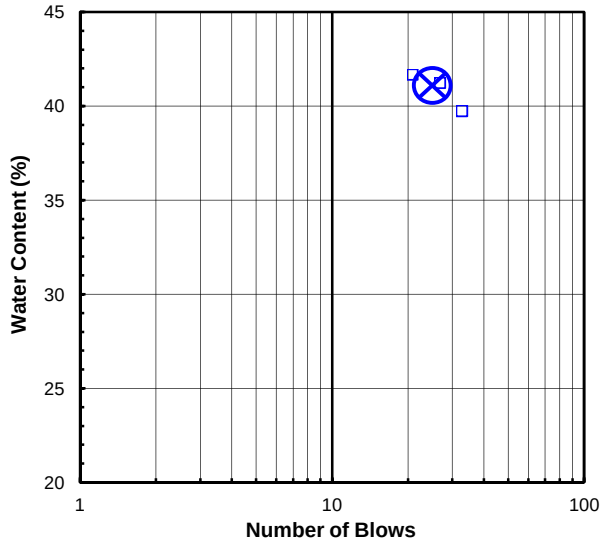
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	17	646	219	121	U
Wt. of Tare & Wet Sample (g):	46.72	39.62	38.75	39.47	L
Wt. of Tare & Dry Sample (g):	40.64	33.92	32.89	33.58	T
Weight of Tare (g):	8.47	19.56	18.66	19.43	I
Weight of Water (g):	6.1	5.7	5.9	5.9	P
Weight of Dry Sample (g):	32.2	14.4	14.2	14.2	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**18.9**	**39.7**	**41.2**	**41.6**	N
Number of Blows:		**33**	**27**	**21**	T

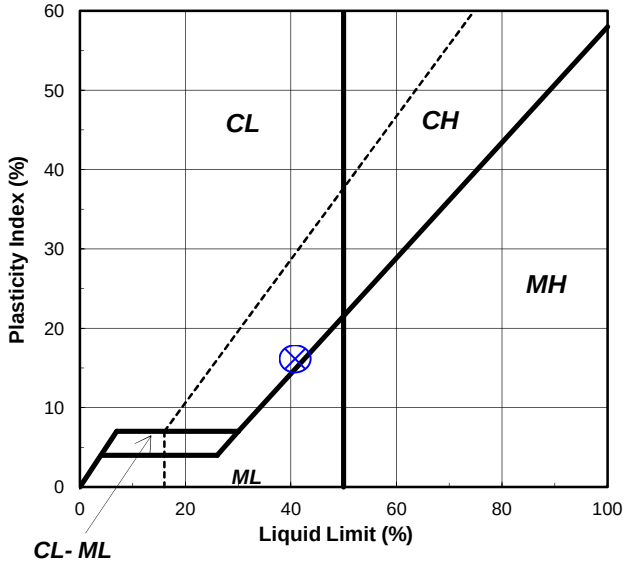
Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	632	328	
Wt. of Tare & Wet Sample (g):	25.05	25.58	
Wt. of Tare & Dry Sample (g):	23.80	24.31	
Weight of Tare (g):	18.83	19.39	
Weight of Water (g):	1.3	1.3	
Weight of Dry Sample (g):	5.0	4.9	
Moisture Content (%):	**25.2**	**25.8**	**-0.7**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**41**
Plastic Limit (%):	**25**
Plasticity Index (%):	**16**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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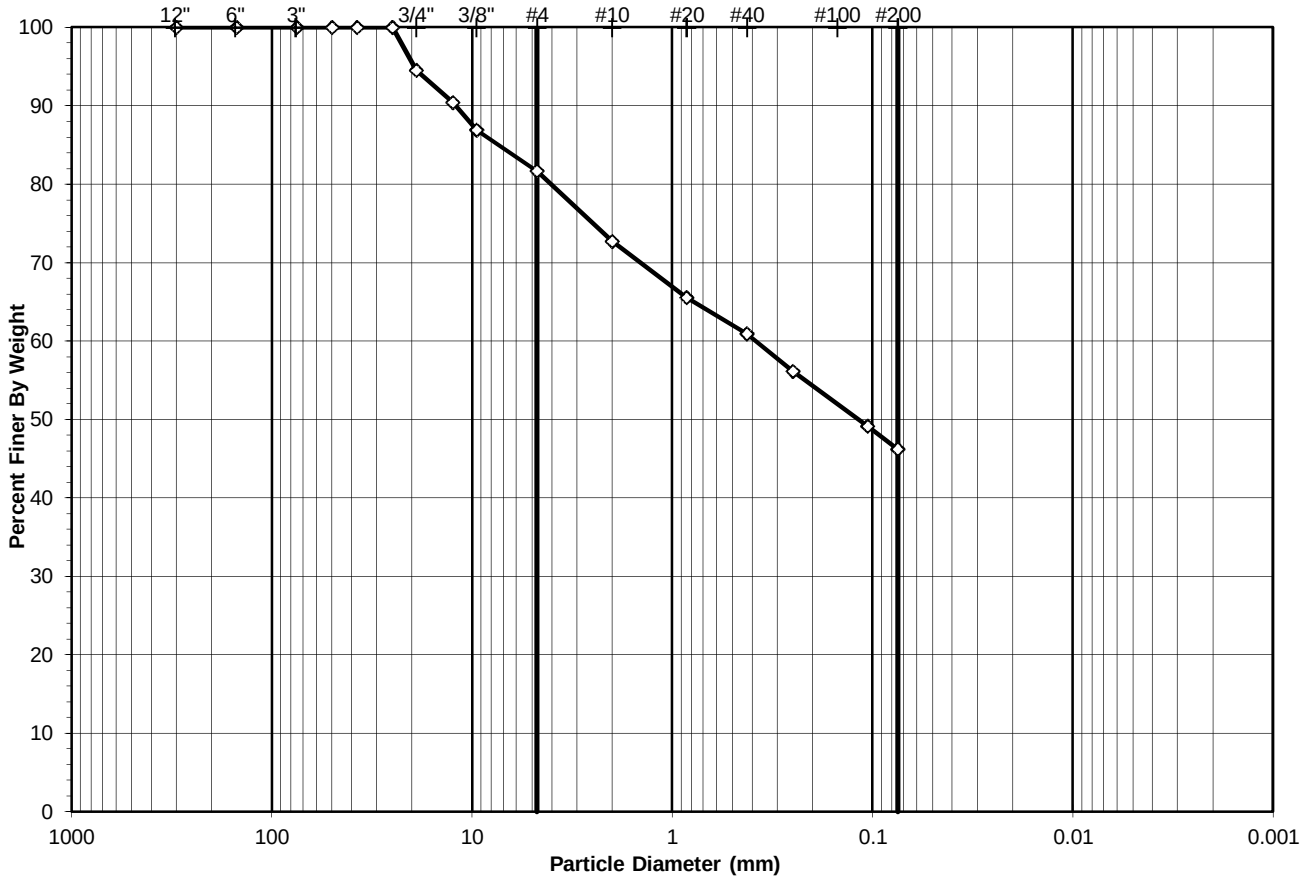
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-4
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-010	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	18.30
#4 To #200	*Sand*	35.48
Finer Than #200	*Silt & Clay*	46.22

USCS Symbol:
SC, TESTED

USCS Classification:
CLAYEY SAND WITH GRAVEL

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-4
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-010	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1491	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	288.61	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	288.61	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	142.32	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	146.29	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	146.29
Dry Weight of - 3/4" Sample (g)	138.29	Weight of Minus #200 Material (g):	67.62
Wet Weight of +3/4" Sample (g)	8.00	Weight of Plus #200 Material (g):	78.67
Dry Weight of + 3/4" Sample (g)	8.00		
Total Dry Weight of Sample (g):	146.29		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	100.00	**100.00**
3/4"	19.0	8.00		5.47	5.47	94.53	**94.53**
1/2"	12.5	5.98		4.09	9.56	90.44	**90.44**
3/8"	9.50	5.14		3.51	13.07	86.93	**86.93**
#4	4.75	7.65		5.23	18.30	81.70	**81.70**
#10	2.00	13.14		8.98	27.28	72.72	**72.72**
#20	0.85	10.47	(**)	7.16	34.44	65.56	**65.56**
#40	0.425	6.77		4.63	39.07	60.93	**60.93**
#60	0.250	7.00		4.79	43.85	56.15	**56.15**
#140	0.106	10.24		7.00	50.85	49.15	**49.15**
#200	0.075	4.28		2.93	53.78	46.22	**46.22**
Pan	-	67.62		46.22	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 1/2/20 Checked By JLK Date 1/3/20

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-4
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-010	Soil Description:	BROWN LEAN CLAY

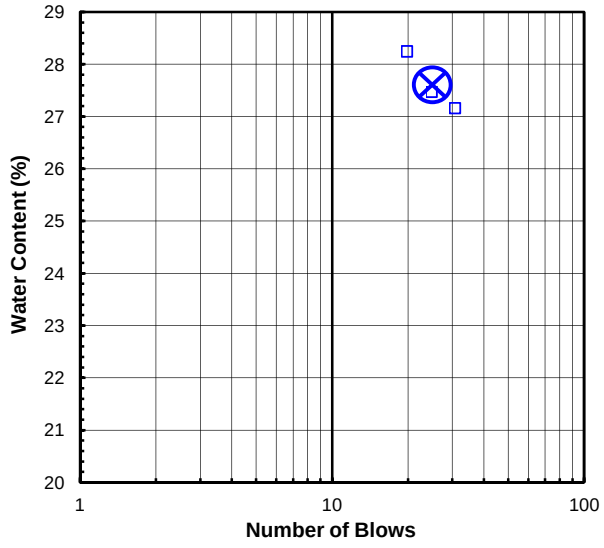
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	38	111	339	535	U
Wt. of Tare & Wet Sample (g):	44.36	39.58	40.58	40.47	L
Wt. of Tare & Dry Sample (g):	39.44	35.24	36.25	36.01	T
Weight of Tare (g):	8.36	19.25	20.48	20.21	I
Weight of Water (g):	4.9	4.3	4.3	4.5	P
Weight of Dry Sample (g):	31.1	16.0	15.8	15.8	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**15.8**	**27.1**	**27.5**	**28.2**	N
Number of Blows:		**31**	**25**	**20**	T

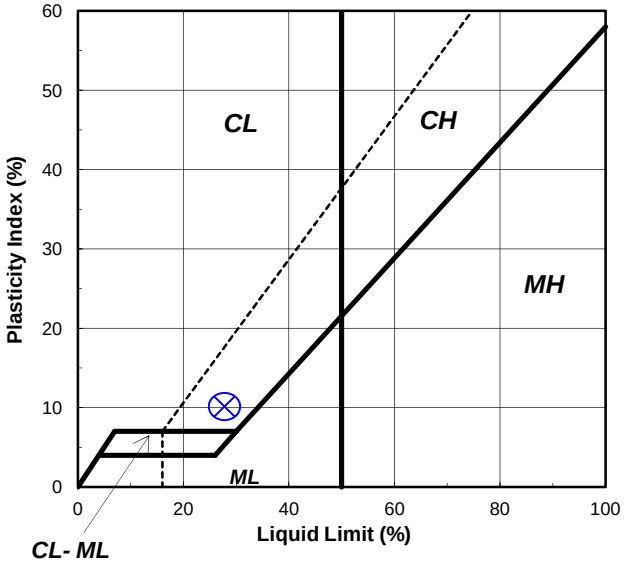
Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	307	606	
Wt. of Tare & Wet Sample (g):	25.55	24.62	
Wt. of Tare & Dry Sample (g):	24.60	23.68	
Weight of Tare (g):	19.41	18.49	
Weight of Water (g):	0.9	0.9	
Weight of Dry Sample (g):	5.2	5.2	
Moisture Content (%):	**18.3**	**18.1**	**0.2**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**28**
Plastic Limit (%):	**18**
Plasticity Index (%):	**10**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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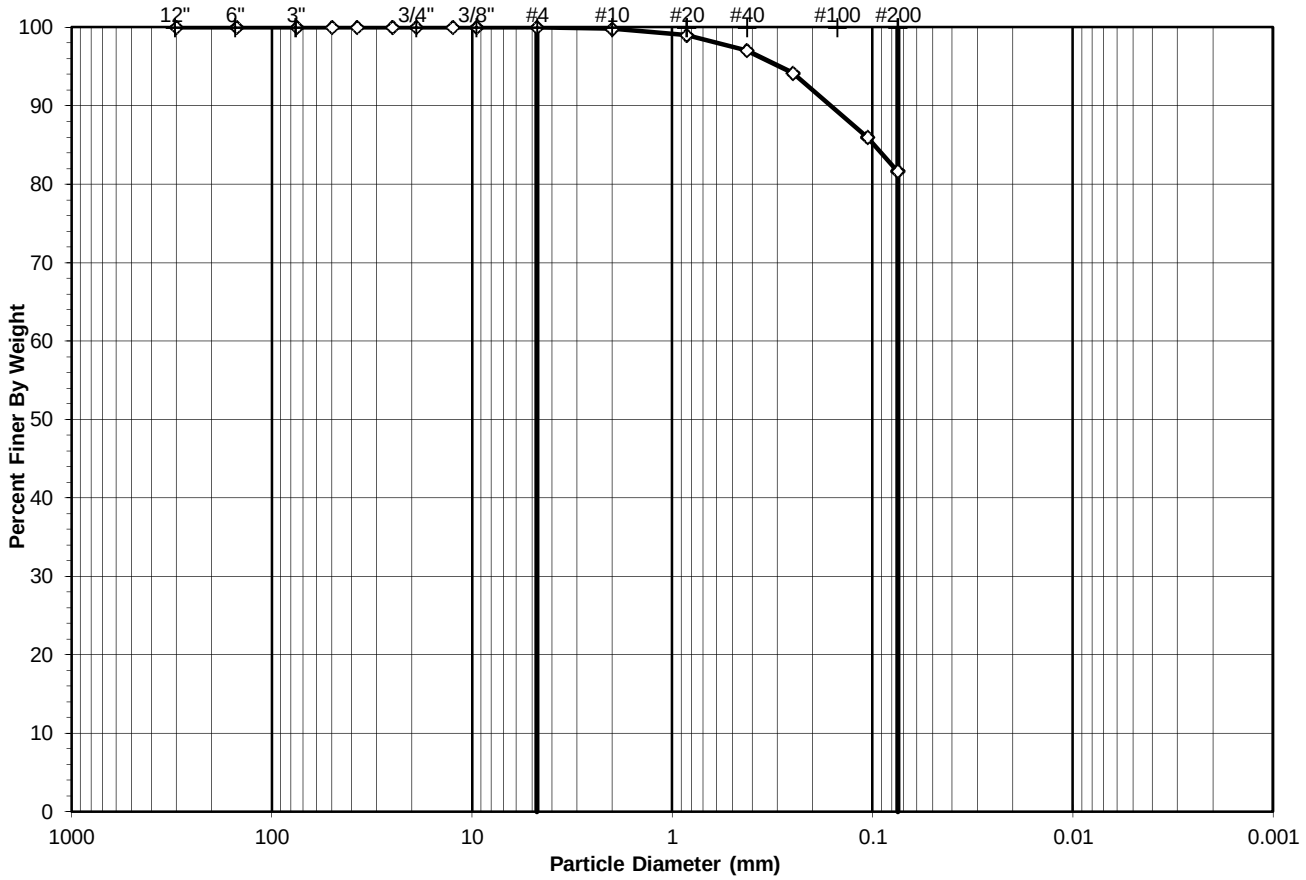
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-5
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-011	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	18.33
Finer Than #200	*Silt & Clay*	81.67

USCS Symbol:
CL, TESTED

USCS Classification:
LEAN CLAY WITH SAND

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-5
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-011	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	2015	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	294.68	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	294.68	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	145.40	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	149.28	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	149.28
Dry Weight of - 3/4" Sample (g)	149.28	Weight of Minus #200 Material (g):	121.92
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	27.36
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	149.28		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00		0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00		0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00		0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.30		0.20	0.20	0.00	99.80	**99.80**
#20	0.85	1.18	(**)	0.79	0.99	0.00	99.01	**99.01**
#40	0.425	2.89		1.94	2.93	0.00	97.07	**97.07**
#60	0.250	4.34		2.91	5.83	0.00	94.17	**94.17**
#140	0.106	12.19		8.17	14.00	0.00	86.00	**86.00**
#200	0.075	6.46		4.33	18.33	0.00	81.67	**81.67**
Pan	-	121.92		81.67	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 1/2/20 Checked By JLK Date 1/3/20

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-5
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-011	Soil Description:	BROWN LEAN CLAY

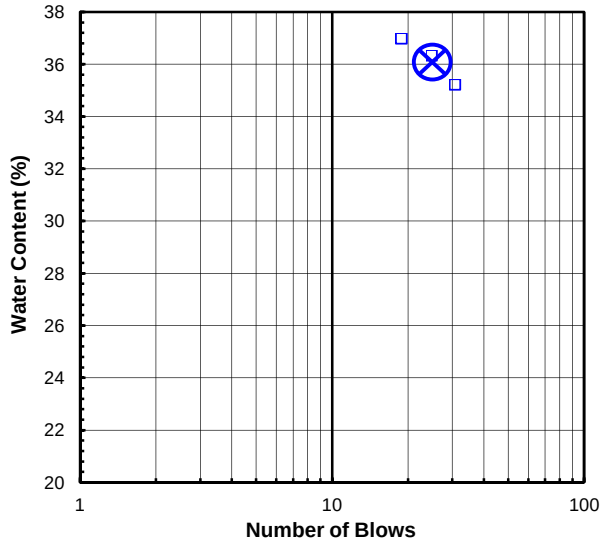
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	4	1252	531	178	U
Wt. of Tare & Wet Sample (g):	41.48	39.02	40.82	38.72	L
Wt. of Tare & Dry Sample (g):	34.72	33.77	35.44	33.24	T
Weight of Tare (g):	8.35	18.85	20.62	18.41	I
Weight of Water (g):	6.8	5.3	5.4	5.5	P
Weight of Dry Sample (g):	26.4	14.9	14.8	14.8	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**25.6**	**35.2**	**36.3**	**37.0**	N
Number of Blows:		**31**	**25**	**19**	T

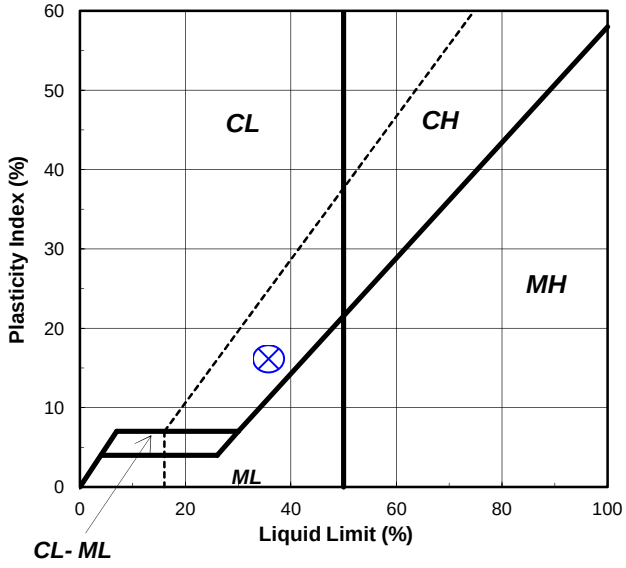
Plastic Limit Test	1	2	Range
Tare Number:	633	609	
Wt. of Tare & Wet Sample (g):	24.98	24.87	
Wt. of Tare & Dry Sample (g):	23.95	23.85	
Weight of Tare (g):	18.92	18.80	
Weight of Water (g):	1.0	1.0	
Weight of Dry Sample (g):	5.0	5.1	
Moisture Content (%):	**20.5**	**20.2**	**0.3**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**36**
Plastic Limit (%):	**20**
Plasticity Index (%):	**16**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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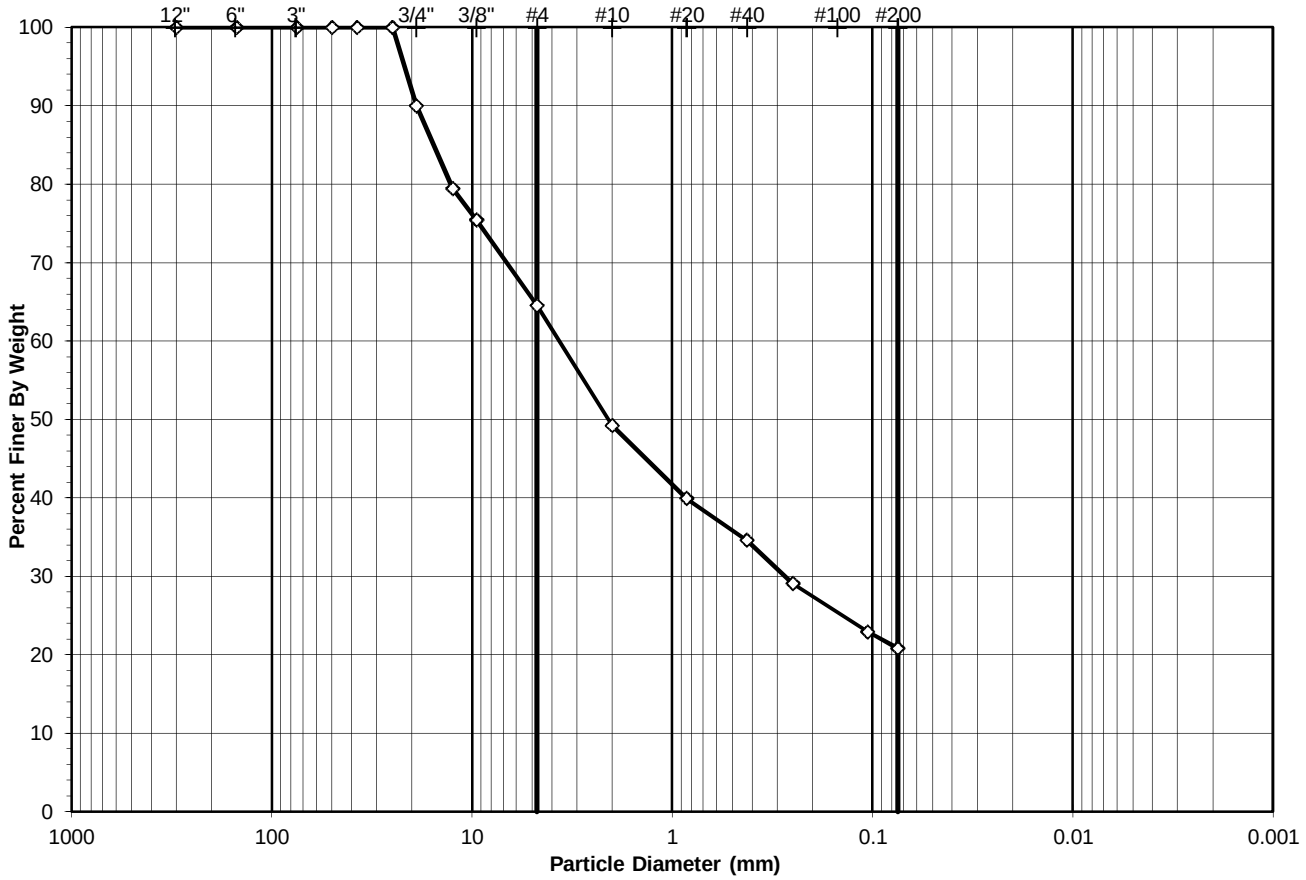
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-5
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	6.0-7.5
Project No.:	2019-726-001	Sample No.:	S-3
Lab ID:	2019-726-001-012	Soil Color:	Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	35.45
#4 To #200	*Sand*	43.72
Finer Than #200	*Silt & Clay*	20.83

USCS Symbol:
SM, TESTED

USCS Classification:
SILTY SAND WITH GRAVEL

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-5
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	6.0-7.5
Project No.:	2019-726-001	Sample No.:	S-3
Lab ID:	2019-726-001-012	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1420	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	342.60	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	342.60	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	144.64	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	197.96	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	197.96
Dry Weight of - 3/4" Sample (g)	178.18	Weight of Minus #200 Material (g):	41.23
Wet Weight of +3/4" Sample (g)	19.78	Weight of Plus #200 Material (g):	156.73
Dry Weight of + 3/4" Sample (g)	19.78		
Total Dry Weight of Sample (g):	197.96		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	100.00	**100.00**
3/4"	19.0	19.78		9.99	9.99	90.01	**90.01**
1/2"	12.5	20.88		10.55	20.54	79.46	**79.46**
3/8"	9.50	7.92		4.00	24.54	75.46	**75.46**
#4	4.75	21.60		10.91	35.45	64.55	**64.55**
#10	2.00	30.30		15.31	50.76	49.24	**49.24**
#20	0.85	18.37	(**)	9.28	60.04	39.96	**39.96**
#40	0.425	10.57		5.34	65.38	34.62	**34.62**
#60	0.250	10.92		5.52	70.89	29.11	**29.11**
#140	0.106	12.26		6.19	77.09	22.91	**22.91**
#200	0.075	4.13		2.09	79.17	20.83	**20.83**
Pan	-	41.23		20.83	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 1/2/20 Checked By JLK Date 1/3/20

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ONE POINT ATTERBERG LIMITS

ASTM D 4318-17 (SOP - S4)

Client:	D'Applonia	Boring No.:	B-5
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	6.0-7.5
Project No.:	2019-726-001	Sample No.:	S-3
Lab ID:	2019-726-001-012	Soil Description:	BROWN

(MInus No. 40 sieve material, Airdried)

Liquid Limit Test	**1**	**2**
Tare Number:	182	216
Weight of Tare & Wet Sample (g):	39.54	39.26
Weight of Tare & Dry Sample (g):	35.82	35.52
Weight of Tare (g):	19.39	19.22
Weight of Water (g):	3.72	3.74
Weight of Dry Sample (g):	16.43	16.3
Moisture Content (%):	**22.6**	**22.9**
Number of Blows:	**23**	**22**

Blows	**K-factor**
20	0.974
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	101	631	
Weight of Tare & Wet Sample (g):	23	24.85	
Weight of Tare & Dry Sample (g):	22.19	24.04	
Weight of Tare (g):	16.97	18.84	
Weight of Water (g):	0.81	0.81	
Weight of Dry Sample (g):	5.22	5.2	
Moisture Content (%):	**15.5**	**15.6**	**-0.1**

Note: The acceptable range of the two Moisture contents is ± 1.4

Liquid Limit Test Results

Test 1

LL = 22.6

LL^{CORR} = 22

Test 2

LL = 22.9

LL^{CORR} = 23

Summary

Liquid Limit (%):	**23**
Plastic Limit (%):	**16**
Plasticity Index (%):	**7**
USCS Symbol:	**ML**

As Received Moisture Content

ASTM D2216-10

Tare Number:	39
Wt. of Tare & Wet Sample (g):	45.89
Wt. of Tare & Dry Sample (g):	41.61
Weight of Tare (g):	8.47
Weight of Water (g):	4.3
Weight of Dry Sample (g):	33.1
Was As Received MC Preserved:	**Yes**
Moisture Content (%):	**12.9**

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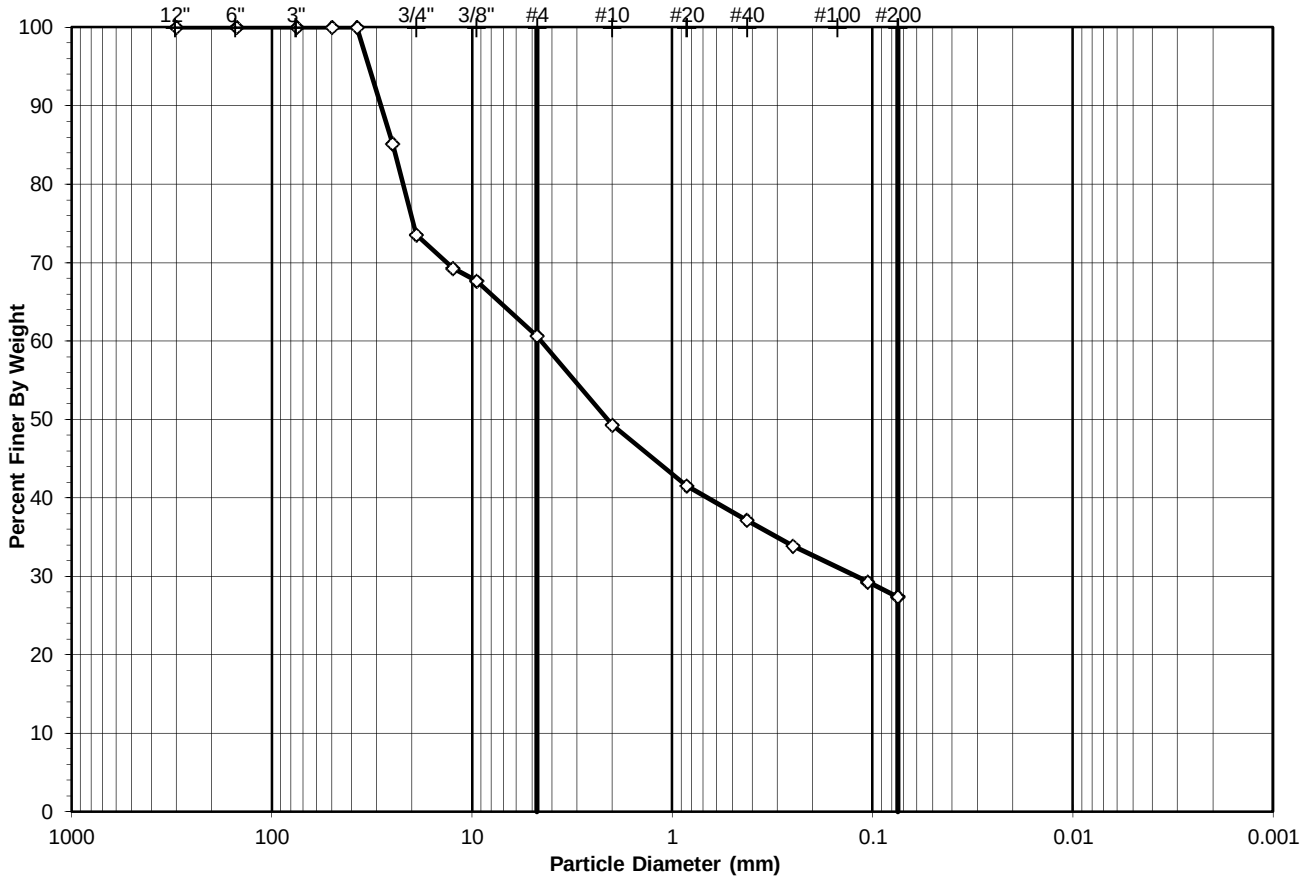
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-6
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-013	Soil Color:	Dark Brown

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	39.34
#4 To #200	*Sand*	33.27
Finer Than #200	*Silt & Clay*	27.38

USCS Symbol:
GC, TESTED

USCS Classification:
CLAYEY GRAVEL WITH SAND

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-6
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-013	Soil Color:	Dark Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1542	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	294.43	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	294.43	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	144.09	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	150.34	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	150.34
Dry Weight of - 3/4" Sample (g)	110.57	Weight of Minus #200 Material (g):	41.17
Wet Weight of +3/4" Sample (g)	39.77	Weight of Plus #200 Material (g):	109.17
Dry Weight of + 3/4" Sample (g)	39.77		
Total Dry Weight of Sample (g):	150.34		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.00**
1"	25.0	22.31		14.84	14.84	85.16	**85.16**
3/4"	19.0	17.46		11.61	26.45	73.55	**73.55**
1/2"	12.5	6.43		4.28	30.73	69.27	**69.27**
3/8"	9.50	2.41		1.60	32.33	67.67	**67.67**
#4	4.75	10.54		7.01	39.34	60.66	**60.66**
#10	2.00	17.09		11.37	50.71	49.29	**49.29**
#20	0.85	11.64	(**)	7.74	58.45	41.55	**41.55**
#40	0.425	6.61		4.40	62.85	37.15	**37.15**
#60	0.250	4.96		3.30	66.15	33.85	**33.85**
#140	0.106	6.88		4.58	70.73	29.27	**29.27**
#200	0.075	2.84		1.89	72.62	27.38	**27.38**
Pan	-	41.17		27.38	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 1/2/20 Checked By JLK Date 1/3/20

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-6
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	0.0-1.5
Project No.:	2019-726-001	Sample No.:	S-1
Lab ID:	2019-726-001-013	Soil Description:	DARK BROWN LEAN CLAY

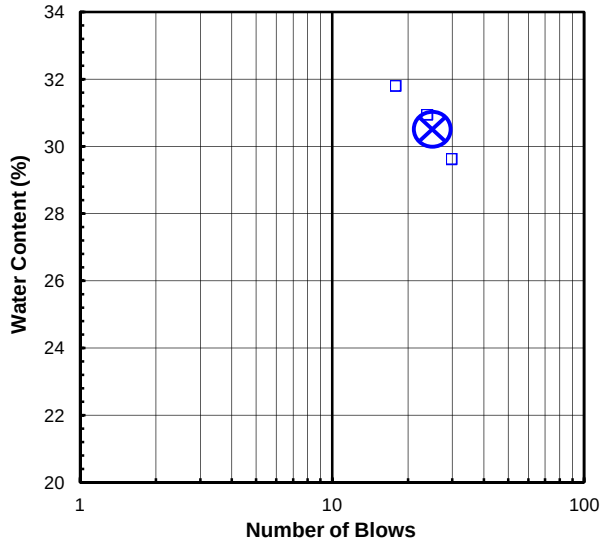
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	19	224	143	220	U
Wt. of Tare & Wet Sample (g):	44.89	29.84	28.72	29.42	L
Wt. of Tare & Dry Sample (g):	40.93	27.54	26.33	26.97	T
Weight of Tare (g):	8.28	19.77	18.60	19.26	I
Weight of Water (g):	4.0	2.3	2.4	2.5	P
Weight of Dry Sample (g):	32.7	7.8	7.7	7.7	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**12.1**	**29.6**	**30.9**	**31.8**	N
Number of Blows:		**30**	**24**	**18**	T

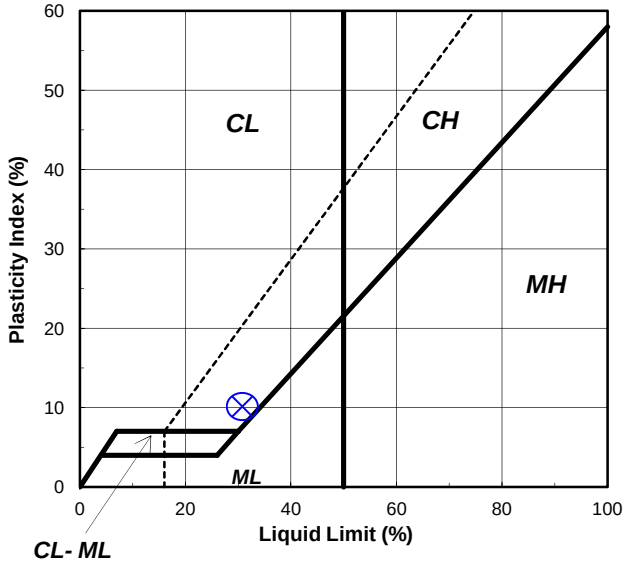
Plastic Limit Test	1	2	Range
Tare Number:	602	600	
Wt. of Tare & Wet Sample (g):	24.70	24.98	
Wt. of Tare & Dry Sample (g):	23.61	23.91	
Weight of Tare (g):	18.49	18.88	
Weight of Water (g):	1.1	1.1	
Weight of Dry Sample (g):	5.1	5.0	
Moisture Content (%):	**21.3**	**21.3**	**0.0**
Note: The acceptable range of the two Moisture Contents is ±			1.12

Test Results	
Liquid Limit (%):	**31**
Plastic Limit (%):	**21**
Plasticity Index (%):	**10**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By FS *Date* 12/30/19 *Checked By* JLK *Date* 12/31/19

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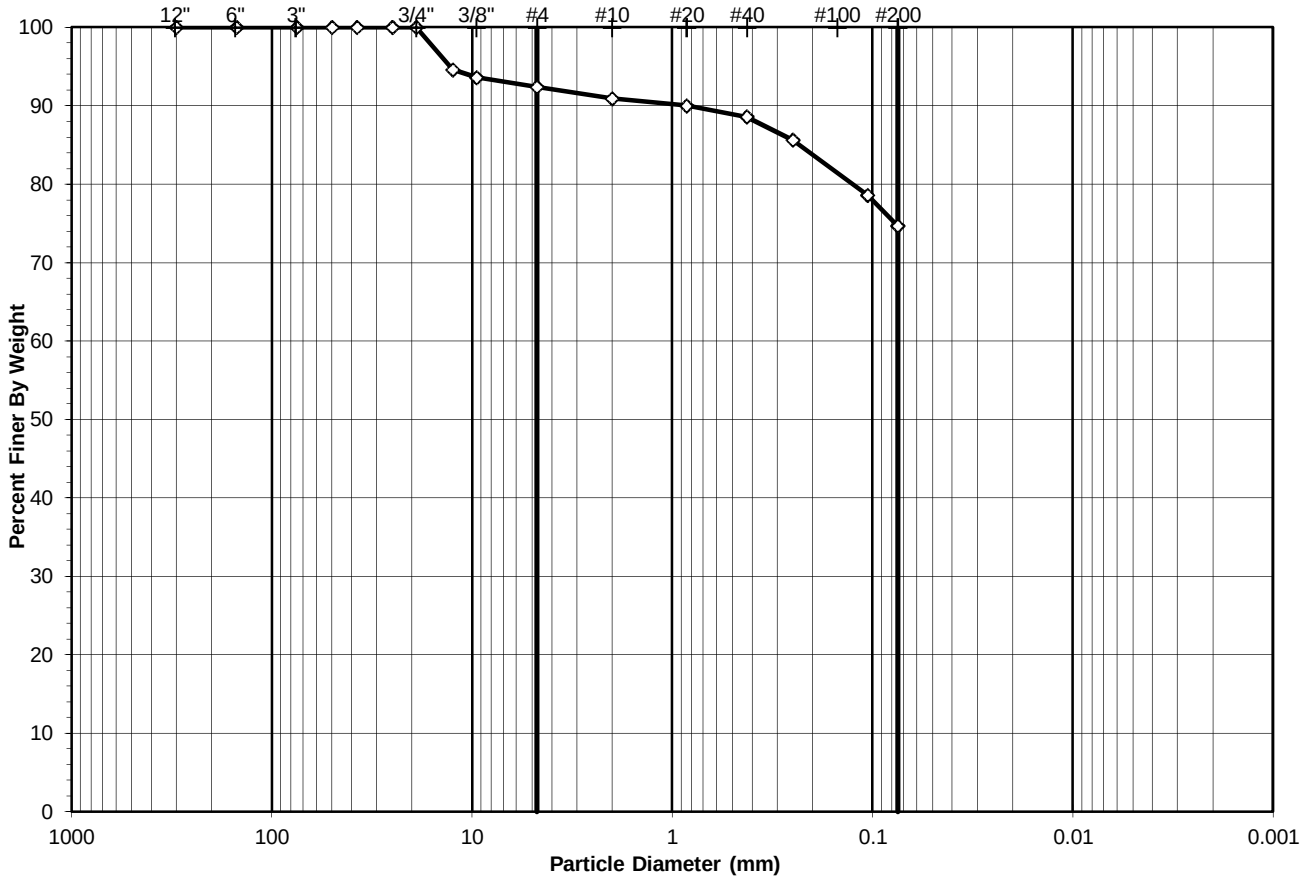
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-6
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-014	Soil Color:	Brown

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	7.59
#4 To #200	*Sand*	17.73
Finer Than #200	*Silt & Clay*	74.68

USCS Symbol:
ML, TESTED

USCS Classification:
SILT WITH SAND

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0

S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	D'Appolonia	Boring No.:	B-6
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-014	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	1512	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	325.27	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	325.27	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	149.35	Weight of Tare (g):	NA
Weight of Water (g):	0.00	Weight of Water (g):	NA
Weight of Dry Soil (g):	175.92	Weight of Dry Soil (g):	NA
Moisture Content (%):	**0.0**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	175.92
Dry Weight of - 3/4" Sample (g)	175.92	Weight of Minus #200 Material (g):	131.38
Wet Weight of +3/4" Sample (g)	0.00	Weight of Plus #200 Material (g):	44.54
Dry Weight of + 3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g):	175.92		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)		Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00		0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00		0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	9.51		5.41	5.41	0.00	94.59	**94.59**
3/8"	9.50	1.74		0.99	6.39	0.00	93.61	**93.61**
#4	4.75	2.10		1.19	7.59	0.00	92.41	**92.41**
#10	2.00	2.62		1.49	9.08	0.00	90.92	**90.92**
#20	0.85	1.62	(**)	0.92	10.00	0.00	90.00	**90.00**
#40	0.425	2.45		1.39	11.39	0.00	88.61	**88.61**
#60	0.250	5.22		2.97	14.36	0.00	85.64	**85.64**
#140	0.106	12.38		7.04	21.40	0.00	78.60	**78.60**
#200	0.075	6.90		3.92	25.32	0.00	74.68	**74.68**
Pan	-	131.38		74.68	100.00	0.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By DS Date 1/3/20 Checked By JLK Date 1/3/20

DCN: CT-S3TW DATE: 8/19/19 REVISION: 0 *S:Excel\Excel QA\Spreadsheets\SieveHydJ.xls*

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	D'Appolonia	Boring No.:	B-6
Client Reference:	Hereford Mnr. Lake 192838	Depth (ft):	3.0-4.5
Project No.:	2019-726-001	Sample No.:	S-2
Lab ID:	2019-726-001-014	Soil Description:	BROWN SILT

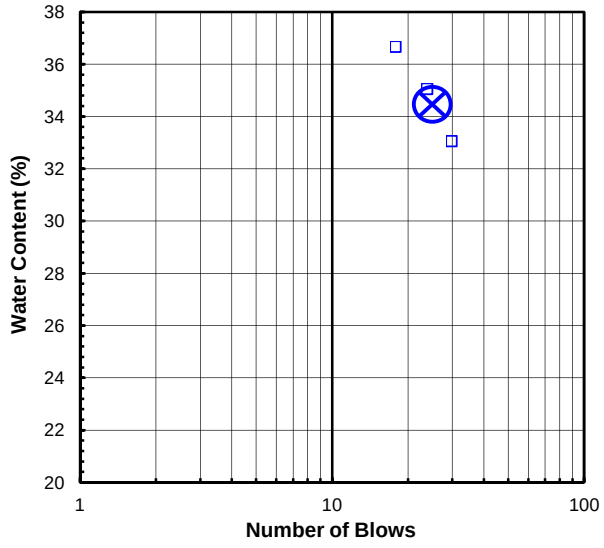
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	3105	336	316	227	U
Wt. of Tare & Wet Sample (g):	58.44	40.72	40.87	38.33	L
Wt. of Tare & Dry Sample (g):	48.15	35.71	35.55	32.90	T
Weight of Tare (g):	8.22	20.54	20.36	18.08	I
Weight of Water (g):	10.3	5.0	5.3	5.4	P
Weight of Dry Sample (g):	39.9	15.2	15.2	14.8	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**25.8**	**33.0**	**35.0**	**36.6**	N
Number of Blows:		**30**	**24**	**18**	T

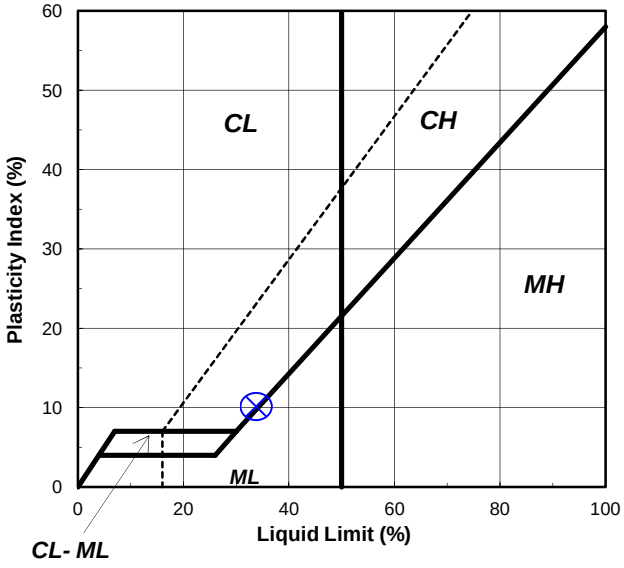
Plastic Limit Test	1	2	Range
Tare Number:	115	17	
Wt. of Tare & Wet Sample (g):	24.77	24.15	
Wt. of Tare & Dry Sample (g):	23.59	22.90	
Weight of Tare (g):	18.61	17.76	
Weight of Water (g):	1.2	1.3	
Weight of Dry Sample (g):	5.0	5.1	
Moisture Content (%):	**23.7**	**24.3**	**-0.6**
Note: The acceptable range of the two Moisture Contents is ±			0.84

Test Results	
Liquid Limit (%):	**34**
Plastic Limit (%):	**24**
Plasticity Index (%):	**10**
USCS Symbol:	**ML**

Flow Curve



Plasticity Chart



Tested By FS *Date* 12/31/19 *Checked By* JLK *Date* 1/2/20

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UNCONFINED COMPRESSION STRENGTH of INTACT ROCK CORE SPECIMENS

ASTM D 7012-14 Method C
This method does not report strain rate or deformation.
Sample Prep and Conformance Verification: ASTM D 4543-08

Client:	D'Appolonia	Boring No.:	B-1
Client Project:	Hereford Manor Lake 192838	Depth (ft):	35.0-35.6
Project No.:	2019-726-001	Sample ID:	R-1
Lab ID No.:	2019-726-001-015	Moisture Condition:	As Received-Unpreserved

Specimen Weight (g): 512.84

SPECIMEN LENGTH (in)		SPECIMEN DIAMETER (in):	
Reading 1:	4.02	Reading 1:	1.98
Reading 2:	4.02	Reading 2:	1.98
Reading 3:	4.02	Average:	**1.98**
Average:	**4.02**	Area (in^2):	3.08
		L/D:	2.03

MOISTURE CONTENT

Tare Number:	3502	Total Load (lb):	62,240
Wt. of Tare & Wet Sample (g):	404.76	**Uniaxial Compressive Strength (psi):**	**20,180**
Wt. of Tare & Dry Sample (g):	404.25		
Weight of Tare (g):	8.07	Fracture Type:	**Shattered**
Weight of Wet Sample (g):	396.69		
Sample Volume (cm^3):	203.35	Rate of Loading (lb/sec):	201
Moisture Content (%):	0.13	Time to Break (min:sec):	5:09.14
Unit Wet Weight (g/cm^3):	2.522	Deviation From Straightness[3]:	
Unit Wet Weight (pcf):	157.4		
Unit Dry Weight (g/cm^3):	2.519	AXIAL: *Pass* TOP: *Pass* BOTTOM: *Pass*	
Unit Dry Weight (pcf):	157.2		

Physical Description: Rock Core

Notes:

1) Moisture conditions at time of the test are: As Received-Unpreserved
2) Sample prep conforms to ASTM D4543-08 "best effort" if applicable
3) Deviation from straightness, Procedure A of ASTM D 4543-08
   Pass/Fail criteria: gap < 0.02 = Pass, gap > 0.02 = Fail
4) Temperature is laboratory room temperature.
5) D4543 Prep and D7012 Testing Equipment Used:
6) Tool / Machine List:
   G788 Compression Machine
   G1661 Digital Calipers, G1380 Dial Gauge
   G1616 Straight Edge, G1571 Feeler Gauge
   G1633 V-Block, G1634 Rock Saw, G1635 Grinder

Tested By: JAC Date: 12/30/19 *Checked By:* NJM *Date:* 12/31/19

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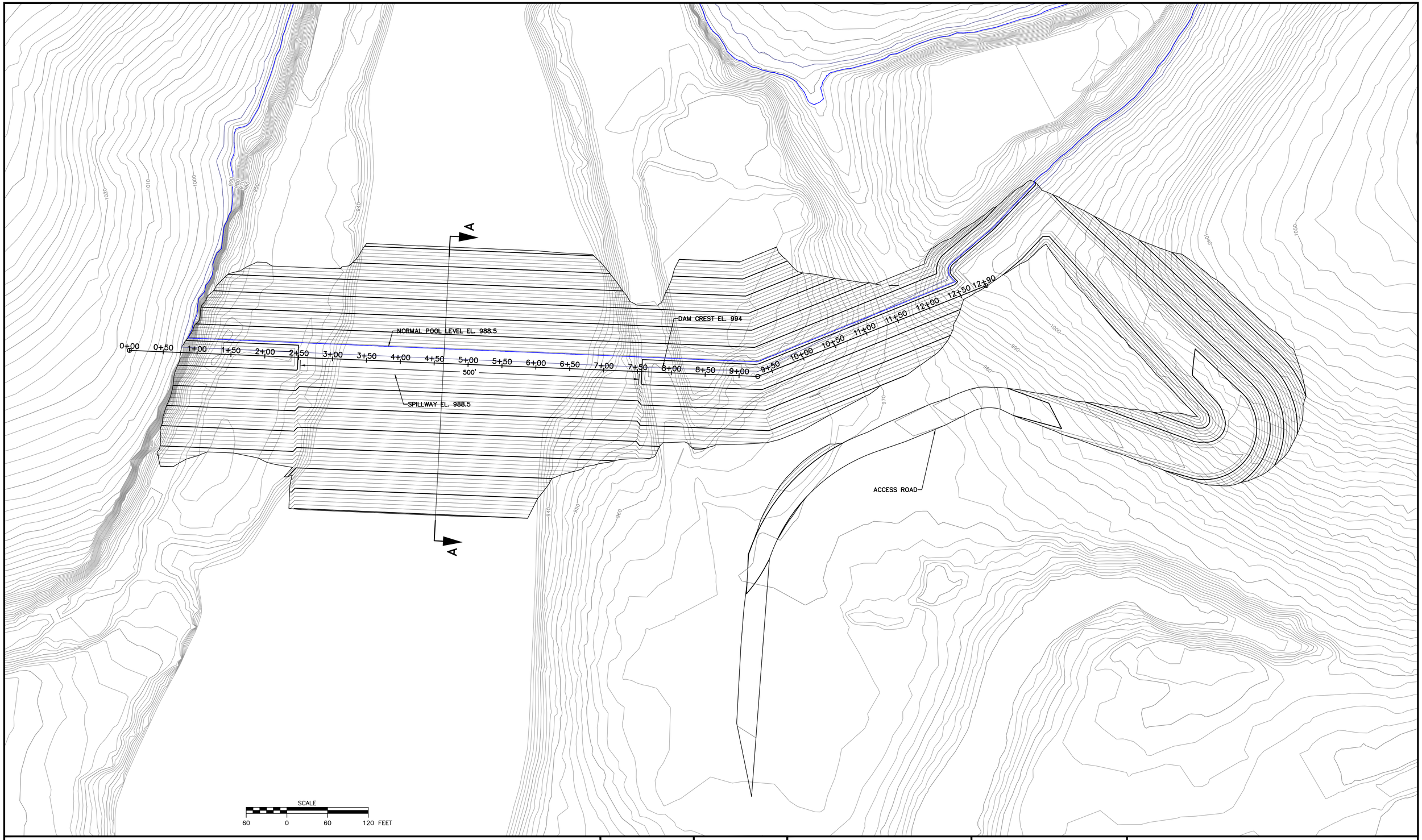
APPENDIX C

CONCEPTUAL SPILLWAY OPTIONS

PLOTTED: Friday, January 24, 2020 10:05:13 AM



NOTES / REVISIONS

REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
4				
3				
2				
1				

ISSUED FOR | DATE

SEAL:

D'APPOLONIA
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PITTSBURGH, PENNSYLVANIA 15235-4559
(412) 856-9440 FAX (412) 856-9535

PROJECT NUMBER: 192838
FILE NAME: CONCEPTUAL SPILLWAY OPTIONS.DWG

DRAWN BY: AMR | DATE: 01/24/2020
CHECKED BY: AJA | DATE: --/--/2020

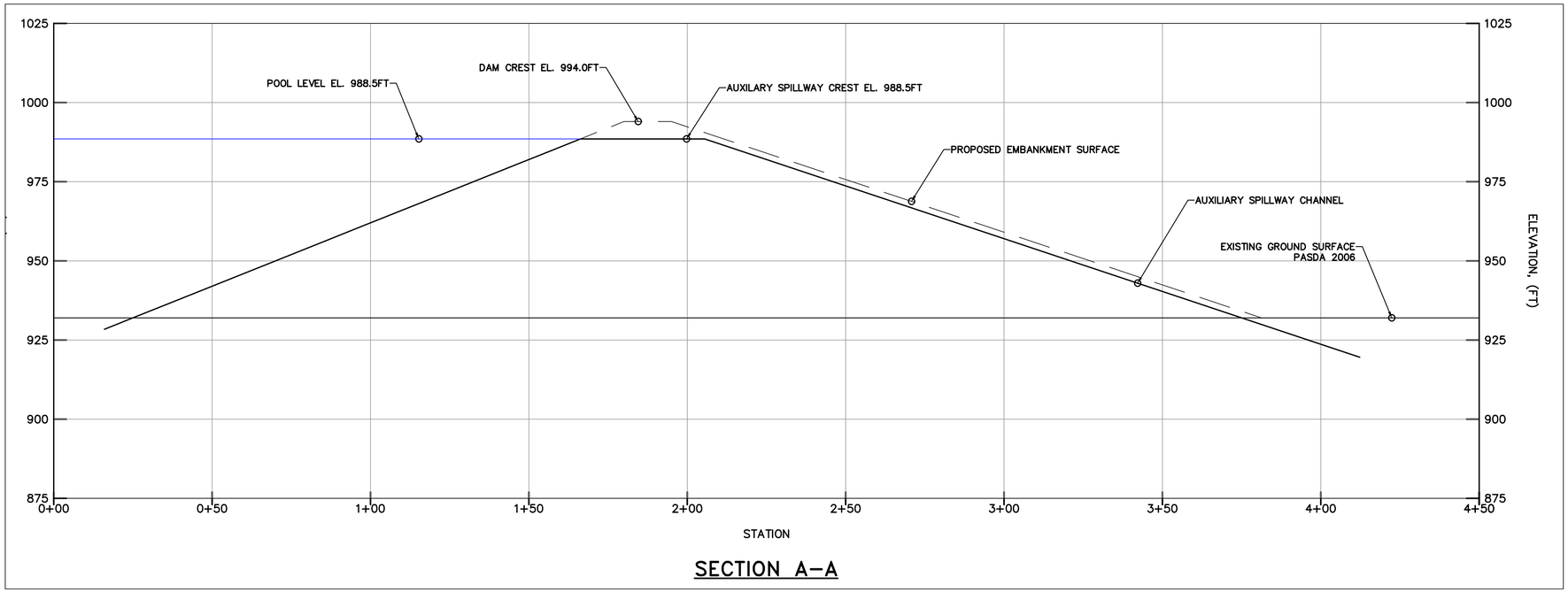
HEREFORD MANOR LAKE

FEASIBILITY STUDY

SPILLWAY OPTION 1 – PROPOSED CONDITIONS
CHANNEL

SCALE: AS SHOWN | DRAWING NO. 1 | REV 0

R:\2019\192838 – Hereford Manor Lake\Drawings\Conceptual\Conceptual Spillway Options.dwg



SECTION A–A

SCALE
20 0 20 40 FEET

NOTES / REVISIONS

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
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		3				
		2				
		1				

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PROJECT NUMBER: 192838
FILE NAME: CONCEPTUAL SPILLWAY OPTIONS.DWG
DRAWN BY: AMR DATE: 01/24/2020
CHECKED BY: AJA DATE: --/--/2020

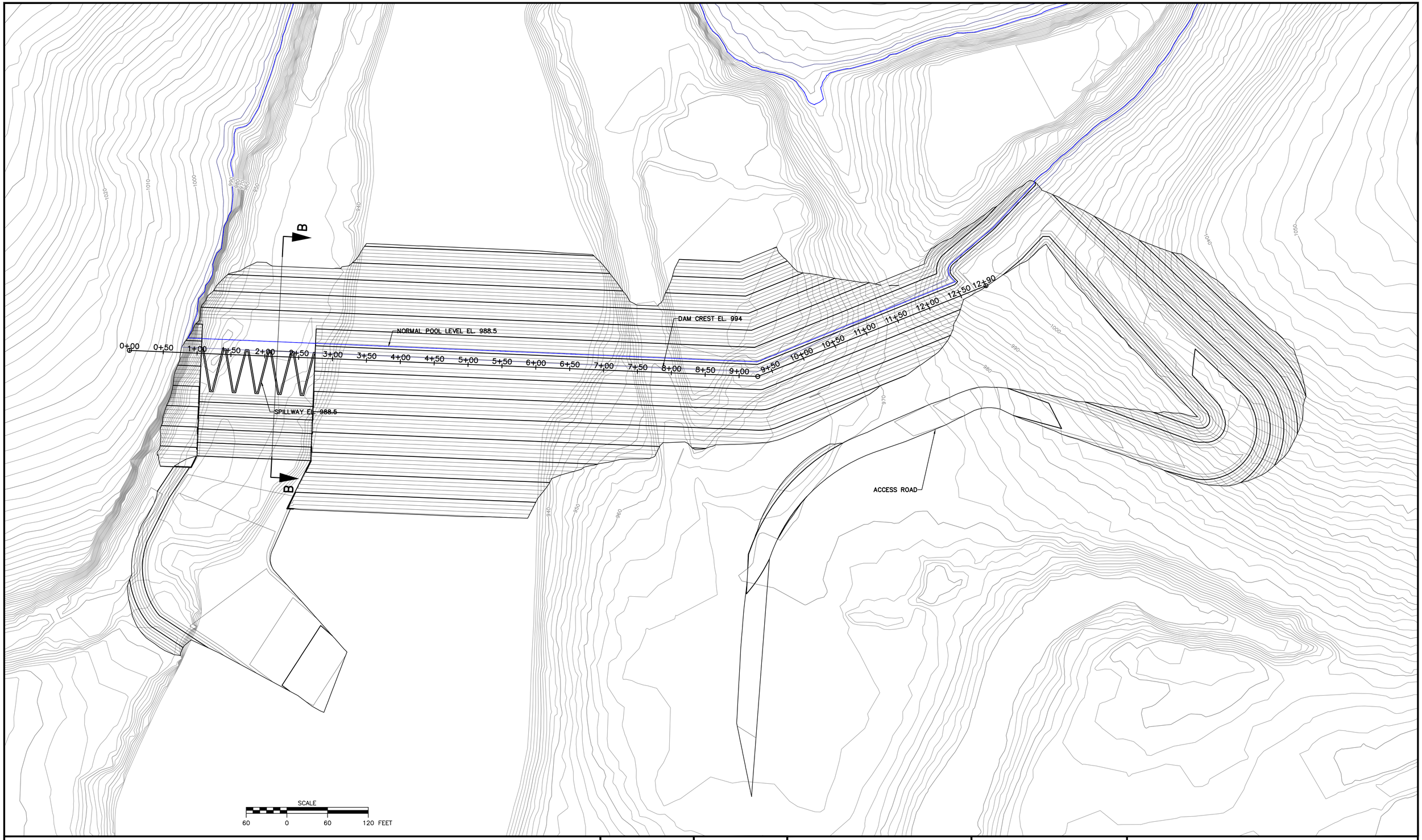
HEREFORD MANOR LAKE

FEASIBILITY STUDY

SPILLWAY OPTION 1 – CROSS SECTION

SCALE: AS SHOWN | DRAWING NO. 2 | REV 0

PLOTTED: Friday, January 24, 2020 10:06:08 AM



NOTES / REVISIONS

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
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		3				
		2				
		1				

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PROJECT NUMBER: 192838	DRAWN BY: AMR	DATE: 01/24/2020
FILE NAME: CONCEPTUAL SPILLWAY OPTIONS.DWG	CHECKED BY: AJA	DATE: --/--/2020

HEREFORD MANOR LAKE

FEASIBILITY STUDY

SPILLWAY OPTION 2 – PROPOSED CONDITIONS
CHANNEL

SCALE: AS SHOWN	DRAWING NO. 3	REV 0

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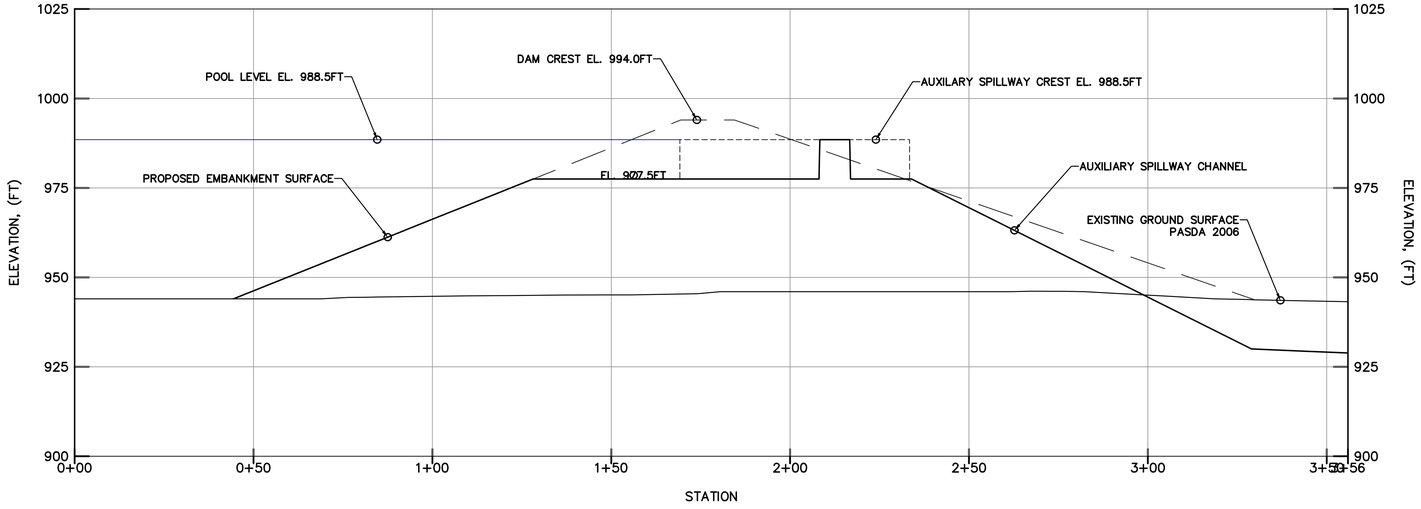

SECTION B–B

SCALE
20 0 20 40 FEET

NOTES / REVISIONS

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
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		3				
		2				
		1				

SEAL:

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PROJECT NUMBER: 192838
FILE NAME: CONCEPTUAL SPILLWAY OPTIONS.DWG

DRAWN BY: AMR DATE: 01/24/2020
CHECKED BY: AJA DATE:--/--/2020

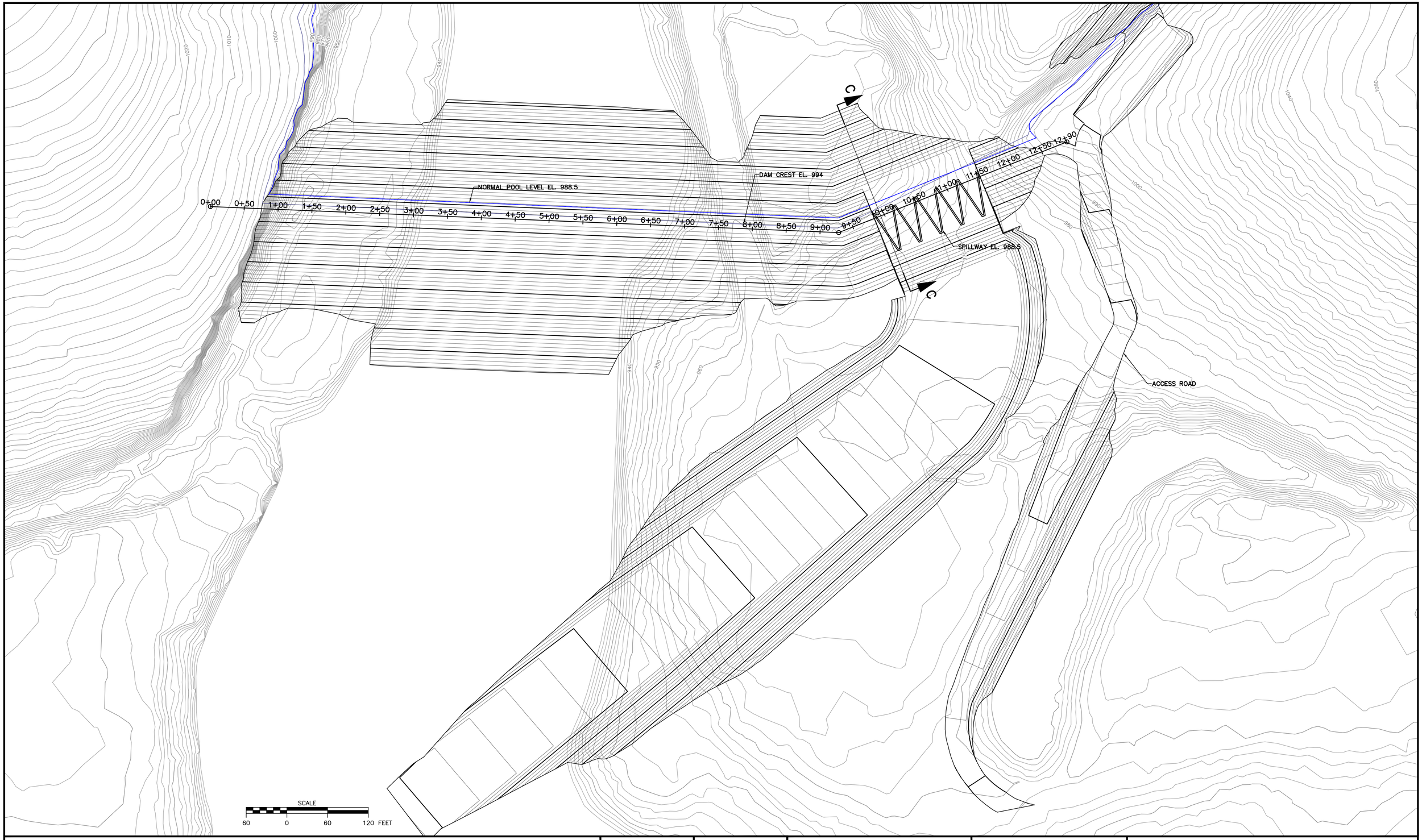
HEREFORD MANOR LAKE

FEASIBILITY STUDY

SPILLWAY OPTION 2 – CROSS SECTION

SCALE: AS SHOWN | DRAWING NO. 4 | REV 0

PLOTTED: Friday, January 24, 2020 10:06:55 AM



NOTES / REVISIONS

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
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		3				
		2				
		1				

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PROJECT NUMBER: 192838	DRAWN BY: AMR	DATE: 01/24/2020
FILE NAME: CONCEPTUAL SPILLWAY OPTIONS.DWG	CHECKED BY: AJA	DATE: --/--/2020

HEREFORD MANOR LAKE

FEASIBILITY STUDY

SPILLWAY OPTION 3 – PROPOSED CONDITIONS
CHANNEL

SCALE: AS SHOWN	DRAWING NO. 5	REV 0

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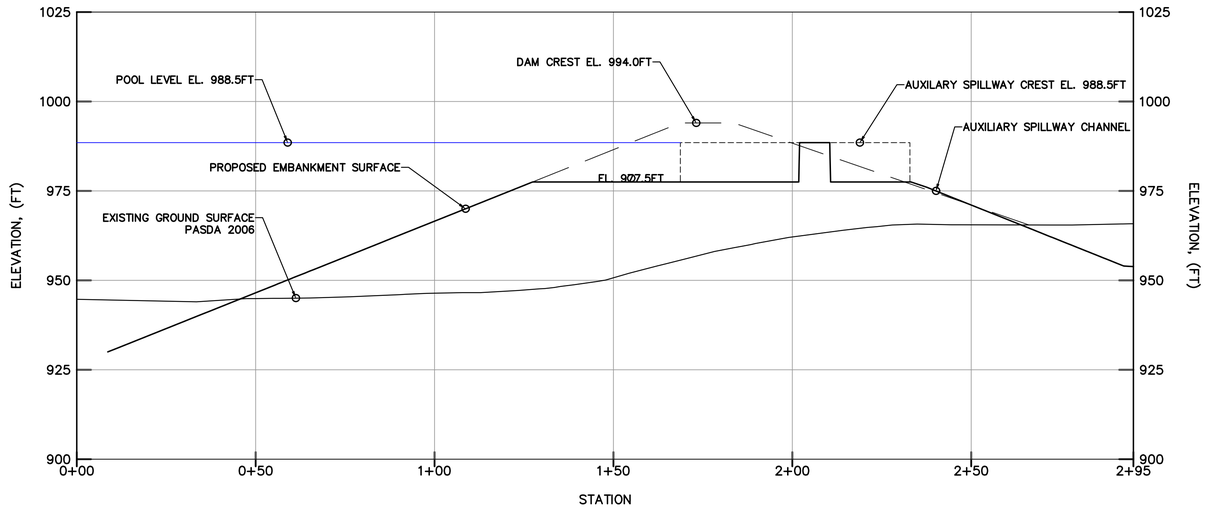

SECTION C–C (1)

SCALE
20 0 20 40 FEET

NOTES / REVISIONS

ISSUED FOR	DATE	REV.	REVISION DESCRIPTION	MADE BY	CHKD BY	DATE
		4				
		3				
		2				
		1				

SEAL:

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PROJECT NUMBER: 192838
FILE NAME: CONCEPTUAL SPILLWAY OPTIONS.DWG

DRAWN BY: AMR DATE: 01/24/2020
CHECKED BY: AJA DATE:--/--/2020

HEREFORD MANOR LAKE
FEASIBILITY STUDY

SPILLWAY OPTION 3 – CROSS SECTION

SCALE: AS SHOWN | DRAWING NO. 6 | REV 0