SUBSURFACE EXPLORATION REPORT
TUSCANY 2ND FILING – TRACT O – GROUNDWATER EVALUATION
NORTHEAST CORNER OF 47TH AVENUE AND 7TH STREET
EVANS, COLORADO
EEC PROJECT NO. 1202030

Prepared for:

City of Evans
1100 37th Street
Evans, Colorado 80620-2036

Attn: Mr. Todd Hepworth (thepworth@evanscolorado.gov)

Prepared by:

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June 5, 2020

EARTH ENGINEERING CONSULTANTS, LLC

City of Evans
1100 37th Street
Evans, Colorado 80620-2036

Attn: Mr. Todd Hepworth (thepworth@evanscolorado.gov)

Re: Subsurface Exploration/Geotechnical Engineering Report
Tuscany 2nd Filing – Tract O – Northeast Corner of 47th Avenue and 37th Street
Evaluation of Groundwater and Subsurface Conditions
City of Evans, Colorado
EEC Project No. 1202030

Mr. Hepworth:

Enclosed, herewith, are the results of the subsurface exploration completed by Earth Engineering Consultants LLC (EEC) personnel for the referenced project. The results presented herein are from the evaluation of field observations and laboratory test results obtained from eight (8) soil borings, five (5) of which were converted to short-term groundwater piezometers (PZs) and three (3) of which were converted to long-term groundwater monitoring wells (MWs) positioned around the perimeter of three (3) existing ponds (i.e., the north, middle and south ponds as depicted on the enclosed site plan), located generally northeast of the intersection of 47th Avenue and 37th Street in Evans, Colorado. The borings/piezometers/groundwater monitoring wells were drilled to depths of approximately 20-feet below current site grades. This evaluation was completed in general accordance with our proposal dated March 31, 2020.

INTRODUCTION AND BACKGROUND INFORMATION

On March 30, 2020, an EEC representative conducted a site visit and discussed the project scope of services with City of Evans personnel, Leon Blasco. The scope of services were to include but not limited to conducting a subsurface exploration to evaluate the subsurface soil, bedrock and groundwater conditions associated with the three (3) ponds, and to provide supplemental geotechnical engineering recommendations for lining the ponds, for addressing the left in-place tree stumps, and backfill/rip rap protection of the existing concrete structures which have experienced significant erosion issues.

Based on our understanding and review of the "*Technical Memorandum – Tuscany Development: Detention Pond System Evaluation*" report prepared by HDR, Inc. (HDR) and dated May 11, 2017,

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the original developer installed a series of three ponds (North, Middle and South) located on a tract of land along the western edge of Tuscany 2nd Filing (Tuscany) known as Tract O. Tract O was privately owned by DG Holdings 2, LLC and now is under the jurisdiction of the City of Evans. It is intended to store storm water runoff from Tuscany as well as non-potable irrigation water sourced from the Seven Lakes Irrigation Company and conveyed by the Greeley Loveland Irrigation Company (GLIC) Ditch. "*Figures 2 and 3"* below, taken directly from the HDR report show photos of the South Pond with the presence of significant elm tree cover. Please note the City of Evans has since removed all elm trees down to the stump left in-place at ground level. An opinion is provided in the analysis section of this report for addressing the trees stumps as part of the design and construction phase of the project.

Figure 2 – South Pond, East Bank

Figure 3 – South Pond, West Bank

As provided in the City of Evan's Request for Proposal (RFP) document: "*The City of Evans recently purchased Tract O in Tuscany Center, which was an overgrown tract of land that was designated as a combination stormwater / irrigation pond and open space for the subdivision. The development of the ponds and final grading was never completed, and the site has degraded over time. The City recently cleaned up the property and removed the excess vegetation. The tract of land is approximately 7.0 acres. Some of the infrastructure was completed but the grading was never finalized on the project as the developer went bankrupt. The grading did not allow for the water to flow between the ponds as intended and as a result, the areas around structures have significantly eroded over time creating an eyesore and a safety hazard."*

The City of Evans has prepared a "*Tract O Photo Log*" illustrating the present conditions of the site with all of the elm trees removed down to the stumps, and the erosion conditions around the concrete water feature structures and various flared end sections due to the original grading plans not being completed. A copy of the "*Tract O Photo Log*" is available upon request.

The City of Evans has indicated the objectives for this project include, but not limited to the items for the improvements to Tract O:

- *Remove the stumps from the bottom of the lower pond*
- *Line the bottom pond as a permanent water feature*
- *Fill in the eroded areas and stabilize them permanently*
- *Finalize the grading so that the water flows through the property (i.e. over the waterfall structures as intended between the ponds), and*
- *Repair the damaged stormwater infrastructure (e.g. replace the flared end sections that have fallen off due to erosion).*

Based on review of the original civil drawings dated March 29, 2002, and used herein as reference purposes, we understand the three (3) cascading ponds from north to south will be improved to the elevations as presented in the table below with the anticipated water level and spillway elevations as indicated herein.

Table I: Grading Plan and Anticipated Water and Spillway Elevations

	North Pond	Middle Pond	South Pond
Top of Embankment Elevation	4784	4778	4774
Bottom of Pond Elevation	4772	4767	4762
Normal Water Elevation	4781	4775.7	4771.5
High Water Elevation	4787.2	4777.2	4774.34
Spillway Elevation	4781	4775.7	4775.34

The side walls/embankments of the three (3) ponds are anticipated to be constructed with an approximate 3:1 slopes (horizontal to vertical) or flatter with either an "enhanced cohesive" earthen liner material or a PVC synthetic membrane liner placed along the wetted perimeter to reduce seepage and/or groundwater intrusion.

To evaluate and analyze the feasibility for the proposed cascading pond construction within the Tuscany Development on Tract O, EEC personnel were requested to perform a subsurface exploration which consisted of drilling and sampling the subsurface soils and underlying bedrock

around the perimeter of the three (3) existing contoured cascading ponds, (please refer to Figure No. 1 in the Appendix of this report), with a total of eight (8) test borings drilled to approximate depths of 20 feet below existing site grades. Upon completion of the drilling operations, five (5) of the borings were to be converted to short-term piezometers and the intent was to convert the other three (3) borings to long-term "registered" PVC cased groundwater monitoring/piezometer devices. Due to existing utility conflicts in the general vicinity of Boring/Monitoring Well 8 (MW-8), the boring was not completed. The City of Evans personnel were notified at the time of drilling.

The purpose of this report is to describe the subsurface conditions encountered within the completed seven (7) borings/piezometers/monitoring wells, analyze and evaluate the test data, and provide geotechnical recommendations concerning the design and construction of the proposed improvements to the three (3) ponds and associated infrastructure.

EXPLORATION AND TESTING PROCEDURES

The eight (8) test boring locations were established in the field by EEC personnel using a hand-held GPS unit referencing approximate horizontal coordinates from a "Google Earth" image of the site, and by estimating locations from identifiable site features. The approximate locations of the completed seven (7) test borings/PZs/MWs, identified herein as PZ-1, PZ-2, PZ-3, PZ-5 and PZ-6, as well as MW-4 and MW-7 are presented on Figure Nos. 1 and 2 in the Appendix of this report. Ground surface elevations at each piezometer location were estimated based on linear interpolations of the topographic contours presented on the grading plans completed in 2002 and recorded on each respective boring log. The locations of the test borings/PZs/MWs and ground surface elevations should be considered accurate only to the degree implied by the methods used to make the field measurements.

The seven (7) completed test borings/PZs/MWs were completed using a truck mounted, CME-75 drill rig equipped with a hydraulic head employed in drilling and sampling operations and were advanced using 4-1/2-inch nominal inside diameter hollow stem augers. After completing the drilling and sampling, and prior to removal of the hollow stem augers, PVC cased long-term MWs were installed in the open boreholes through the hollow stem augers at boring locations MW-4 andMW-7. The MWs were constructed with 2-inch nominal diameter schedule 40 manufactured well screen and riser pipe. In general, the MWs consisted of an approximate 10-foot section of flush threaded slotted well screen at the bottom of the boreholes with flush threaded solid riser pipe, as required, to extend the MWs above ground level. The screen portion of the MWs were backfilled

with 10/20 silica sand, with an approximate 2-foot bentonite plug/seal placed above the sand layer, and then backfilled with a blend of the auger cuttings generated and bentonite to the existing ground surface elevations. Cross-sectional schematics of the MW installations are indicated on the attached boring logs. As previously indicated temporary/short-term field/hand slotted PVC piezometers (PZs) were installed in Boring locations 1, 2, 3, 5, and 6 to allow for additional groundwater depth measurements. Those temporary PZs were removed and backfilled after water level measurements were recorded on May 21, 2020.

The State of Colorado Division of Water Resources was notified of intent to construct the three (3) MWs prior to beginning the field exploration. Copies of those notices with acknowledgement from the State Engineer's Office can be provided upon request. The well construction and test reports will be provided to the Division of Water Resources including copies of the boring logs provided with this report. If the monitoring wells will remain in place longer than an 18-month period, it will be necessary to notify the Division of Water Resources and complete registration of those wells. MW installation was completed by a licensed water well driller and was completed in accordance with the water well construction rules from the Division of Water Resources.

Samples of the subsurface materials encountered were obtained using split barrel sampling procedures. In the split barrel sampling procedure, standard sampling spoons are advanced into the ground by means of a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the split barrel sampler is recorded and is used to estimate the in-situ relative density of cohesionless soils and, to a lesser degree of accuracy, the consistency of cohesive soils and hardness of weathered bedrock. In conjunction with the split-spoon samples, various composite samples of the overburden subsoils and underlying bedrock materials were collected from the test borings for further laboratory analyses. All samples obtained in the field were sealed and returned to the laboratory for further examination, classification, and testing.

Laboratory moisture content tests were completed on each of the recovered split-spoon samples. In addition, the unconfined strength of appropriate samples was estimated using a calibrated hand penetrometer. Atterberg Limits and washed sieve analysis tests were completed to evaluate the quantity and plasticity of fines in select subsurface samples. Additional laboratory testing procedures included moisture-density relationship/standard Proctor density (ASTM Specification D698) and falling head permeability characteristics (ASTM Specification D5856) on the recovered

bulk/composite samples. Results of the outlined tests are indicated on the attached boring logs and/or summary sheets.

As part of the testing program, all samples were examined in the laboratory by an engineer and classified in general accordance with the attached General Notes and the Unified Soil Classification System, based on the soil's texture and plasticity. The estimated group symbol for the Unified Soil Classification System is indicated on the boring logs and a brief description of that classification system is included with this report. Classification of the bedrock was based on visual and tactual observation of disturbed samples and auger cuttings. Coring and/or petrographic analysis may reveal other rock types.

SUBSURFACE CONDITIONS

An EEC field engineer was on site during the May 6, 2020 drilling operations to evaluate the subsurface conditions encountered and direct the drilling activities. Field logs prepared by EEC site personnel were based on visual and tactual observation of disturbed samples and auger cuttings. The final boring logs included with this report may contain modifications to the field logs based on the results of laboratory testing and evaluation. Based on the results of the field borings and laboratory evaluation, subsurface conditions can be generalized as follows.

Sparse vegetation/weed growth, as evident in the site photographs in the Appendix of this report was encountered at the surface of each test boring. The subsurface materials encountered beneath the relatively thin surficial layer generally consisted of a zone of clayey sand, silty/clayey sand and/or sandy lean clay subsoils which extended to the underlying bedrock formation below. Siltstone/sandstone/claystone bedrock was encountered within each of the completed seven (7) borings at approximate depths of 9 to 17 feet below site grades and extended to the depths explored.

The overburden slightly cohesive subsoils were medium stiff to stiff, and generally, with the exception of the silty sand / silty, clayey sand subsoils encountered in PZ-1 and PZ-6, exhibited permeability characteristics conducive for earthen liner material; although the availability may be limited. The underlying siltstone/claystone bedrock, where encountered, was weathered to moderately hard to become hard, and generally less weathered with depth. The claystone lenses of the bedrock formation also exhibited permeability characteristics conducive for earthen liner material.

The stratification boundaries indicated on the boring logs represent the approximate locations of changes in soil and rock types. In-situ, the transition of materials may be gradual and indistinct.

GROUNDWATER CONDITIONS

Observations were made while drilling, on May 8, 2020 and again on May 21, 2020, to detect the presence and depth to hydrostatic groundwater within the PZs/MWs. At the time of our field exploration and the subsequent measuring episodes, groundwater and/or the presence of a water via either a perched/trapped condition on the top of the relatively impervious bedrock and/or fractures/fissures within the bedrock formation, was measured at depths ranging from 7-1/2 to 18 feet below existing site grades. The various recorded measurements are listed on the upper right-hand corner of each boring log/piezometer included in the Appendix of this report.

Fluctuations in groundwater levels can occur over time depending on variations in hydrologic conditions, and other conditions not apparent at the time of this report. Monitoring in cased borings, such as MW-4 and MW-7 installed for this project and protected from the infiltration of surface water, can more accurately evaluate the depth and fluctuation in groundwater levels. EEC anticipates performing periodic groundwater measurement over the next several months to evaluate the groundwater fluctuations.

Zones of perched and/or trapped groundwater may occur at times in more permeable zones in the subsurface soil, in soils overlying bedrock, on top of the bedrock surface or within permeable fractures in the bedrock materials. The location and amount of groundwater and/or perched water is dependent upon several factors, including hydrologic conditions, type of site development, irrigation demands on or adjacent to the site, and seasonal and weather conditions. The observations provided in this report represent groundwater conditions at the time of the field exploration, and may not be indicative of other times, or at other locations.

As part of our geotechnical engineering assessment we prepared a groundwater contour map, Figure No. 2, based on the water level reading measurements obtained on May 8, 2020. The contour elevations were based on the approximate ground surface elevations at each boring/PZ/MW location, and the approximate depth at which groundwater was encountered. As shown on the groundwater contour map, the hydrologic gradient/piezometric surface flow is generally in the south

direction. The groundwater contour map presented herein is for illustration purposes only; variations may exist between boring locations across the site.

ANALYSIS AND RECOMMENDATIONS

Moisture Density Relationship-Standard Proctor Density

EEC personnel performed standard Proctor density (ASTM Specification D698) tests on various composite samples of overburden and underlying bedrock materials collected during our field exploration. For each composite sample, soil classification/Atterberg Limits and minus No. 200 Sieve wash gradations in conjunction with the standard Proctor density tests were performed. The results of the soil classification and standard Proctor density testing on the various composite samples collected during our subsurface exploration are presented in the table below with curves provided in the Appendix of this report.

Table II: Summary of Laboratory Compaction Characteristics and Classification of Soils

Sample ID	Standard Proctor Density		Soil Classification			
	Optimum Moisture Content, %	Maximum Dry Density, PCF	Liquid Limit	Plastic Index	% (-) No. 200 Sieve	Description
Comp. Sample from PZ-1, 3, 5 and 6 @ 0.0’ – 5.0’	13.5	116.5	31	16	48.9	Sandy Lean Clay (CL) / Clayey Sand (SC)
MW-4 @ 0.0’ - 8.0’	16.5	109.0	26	13	71.0	Lean Clay with Sand (CL)
Comp. Sample of Claystone Bedrock	18.5	104.5	35	15	94.9	Claystone Bedrock – Lean Clay (CL)

We understand one of the considerations for lining the three (3) cascading ponds would be with the use of an earthen liner constructed with the excavated on-site overburden cohesive subsoils and underlying bedrock materials obtained during the excavation phases and/or incorporating a percentage of bentonite into the proposed earthen liner materials to enhance the material’s permeability characteristics. Consideration might also be given for the use of a product produced by Seepage Control, which would be incorporated into the proposed earthen liner material to enhance the material’s seepage characteristics, similar to a bentonite mixture. The amount and incorporation of this product would be the responsibility of Seepage Control. Additional information regarding Seepage Control can be provided upon request. As further mentioned in this report the primary

focus is to create a uniform/consistent cohesive material having falling head permeability characteristics of 1 x 10^{-7} cm/sec or slower.

Laboratory Falling Head Permeability Tests

EEC conducted three (3) falling head permeability tests (ASTM Specification D5856), two (2) on remolded overburden materials (Sample "A" – PZ-1, through PZ-6, Sample "B" – MW-4 upper 8 feet) and one (1) of the underlying bedrock materials (Sample "C") obtained from the various soil borings at various intervals as described herein. The samples were remolded to near optimum moisture contents and were compacted to approximately 95% of each material's standard Proctor maximum dry density (ASTM Specification D698) test results. The results from these three (3) tests indicated coefficients of permeability (k-values) ranging from 1 x10^{-6} cm/sec to 1.5 x 10^{-8} cm/sec. These measured k-values indicate the underlying bedrock materials have permeability and/or seepage characteristics suitable for reuse in constructing the earthen liner; however the fine granular subsoils (i.e., Sample "A" and Sample "B"), without any enhancement provided (i.e., incorporation with bentonite mixture and/or Seepage Control product), would not be suitable for use as a standalone source. For this project we recommend the approved earthen liner material have an equivalent k-value of 1x10^{-7} cm/sec or slower. The laboratory test results for the three (3) falling head permeability samples are presented in the Appendix of this report.

General Geotechnical Considerations

Field and laboratory test results indicate the slightly cohesive soils encountered in the borings are medium stiff/medium dense in consistency and/or relative density and may be suitable for use as an earthen liner material; however the addition of approximately 3% by dry unit weight of bentonite would be required to achieve the recommended k-value/coefficient of permeability of 1x10^{-7} cm/sec or slower. The siltstone/claystone bedrock, based on the laboratory test results, appears suitable for use as an earthen liner.

For use as an earthen liner, material should generally have a coefficient of permeability of 1x10^{-7} cm/sec or slower. It is our opinion the existing overburden cohesive materials encountered within at least three (3) of the four (4) piezometers generally conform to typical earthen liner specifications. For the fine granular materials, consideration could be given to blending or mixing in bentonite and/or the Seepage Control product to enhance the material's permeability

characteristics. If selected, the bentonite-clay mixture and/or the Seepage Control product alternative should be incorporated into the on-site subsoils to create an approved cohesive material capable of achieving a coefficient of permeability of 1 x 10^{-7} cm/sec or slower. The bentonite clay material and/or Seepage Control product, should be disked into the onsite soils, moisture conditioned to (+/-) 2% of the materials' optimum moisture content and compacted to at least 95 percent of the material's Standard Proctor Density (ASTM Specification D698) test results. Additional testing procedures would be required if this is to be considered.

Due to the lack of a sufficient amount of suitable cohesive type soils on site and/or the undermining of the underlying bedrock formation to create adequate amount of earthen liner material, EEC is providing two liner concepts. The first would be to import cohesive soils to the site and/or incorporate bentonite and/or a Seepage Control product into the on-site subsoils generally conforming to the design recommendations contained in the "*Earthwork*" section of this report and construct the earthen liner along the wetted perimeter accordingly, or install a PVC membrane liner material conforming to the manufacturer's installation requirements. The design concept for the liner is to reduce the potential for seepage and groundwater intrusion, as well as to enhance the holding capacity of each pond. As emphasized herein, EEC is focusing more on the earthen liner approach. If a PVC membrane liner is the desired option, EEC can provide additional recommendations upon request.

With use of an earthen liner and/or a PVC membrane liner, it is typically suggested that the bottom of any pond be at least 3-feet above maximum anticipated groundwater level, or the construction of a deepened core trench into the underlying bedrock formation be installed to reduce groundwater intrusion. A minimum/permanent operating level of water is also necessary to minimize the amount of groundwater intrusion by maintaining a constant head as well as to reduce the buoyancy effects on the PVC liner. As further discussed in this report a determination, by either the design team members and/or owners, should be made to see if a water balance evaluation is required prior to activation of this pond.

The pond's embankments/wetted perimeter should consist of a homogeneous cohesive material constructed with relatively impervious clay and/or bedrock material having a coefficient of permeability, (k-value) of 1x10^{-7} cm/sec or slower when compacted to at least 95% of standard Proctor density (ASTM Specification D698). We suggest the improvements of the existing embankments be cut to at an approximate 1:1 slope and the proposed/enhanced earthen liner be

constructed on a minimum 3:1 (horizontal: vertical) or flatter slopes around the perimeter. The design of wave and slope protection for the pond is beyond the scope of subsurface exploration study and should be reviewed during the final design stages.

Earthen Liner/Wetted Perimeter Improvements

Groundwater and/or the initial presence of a water surface as previously discussed was encountered within the PZs/MWs at approximate depths of 7-1/2 to 18-feet below existing site grades. To reduce the potential for groundwater fluctuations to impact and/or enter the ponds, we suggest the bottom of the pond have a minimum separation of 3-feet above the maximum anticipate rise in groundwater and/or a minimum 3-foot earthen liner layer be placed and compacted as part of the wetted perimeter improvements along the bottom of the reservoir. Dewatering may be required to achieve the earthen liner improvements along the bottom portion of the ponds. Consideration could be given to installing a deepened core trench, which extends into the underlying bedrock formation, around the perimeter of the ponds to further reduce the potential for groundwater intrusion. Additional recommendations can be provided upon request. A 90-day water balance/seepage analysis may be required for the proposed cascading pond improvements. Included below are typical guidelines for developing a raw water storage pond.

The performance of the raw water storage pond may be required to conform to the "Colorado State Engineer Guidelines for Lining Criteria for Gravel Pits" dated August 1999. The general guidelines state the following:

> ***"1.0 Design Standard:*** *The intent of the reservoir lining design is to achieve groundwater inflow (leakage rate) into the reservoir that is not greater than 0.03 $ft^3/day/ft^2$ ($1x10^{-5}$ $cm^3/cm^2/sec$) multiplied by the length of the perimeter wall in feet, multiplied by the average vertical depth of the perimeter wall as measured from the ground surface to the pit bottom along the toe of the pit side slope, plus 0.0015 $ft^3/day/ft^2$ ($5x10^{-7}$ $cm^3/cm^2/sec$) multiplied by the area of the bottom of the liner system or natural bedrock bounded by the perimeter wall.*
>
> ***2.0 Construction Standards:*** *The applicant must demonstrate the constructed liner meets the requirements of the design by performing appropriate quality control*

observations and tests. The applicant shall provide written documentation of the work performed and results of the quality control field and laboratory tests.

***3.0 Performance Standards**: The Performance Standard shall be three times the Design Standard as described above. The performance Standard shall be applied to an initial test of competency of the liner, as well as to the on-going operation of the reservoir.*

3.1 Initial Liner Test

For Mined Pits: The unregulated groundwater inflow to the reservoir will be tested by evacuating the contents of the reservoir and observing the inflow of water over a period of 90 days. The start of the test will be under essentially dry conditions.

If the three (3) cascading ponds are to conform, *a water balance must be performed to demonstrate the balance of the inflows (i.e. precipitation and groundwater) and outflows (i.e. evaporation) equals the change in storage volume by a minimum of a 90-day test. Ongoing monitoring of the water balance may also be required as determined by the Division Engineer."*

It is recommended any vegetation within the limits of the pond configuration be stripped and removed. It is anticipated that excavation of the pond could be accomplished by conventional type excavation equipment; however specialized or rubber tired equipment may be necessary when approaching the bottom of the pond due to the presence of groundwater and/or the presence of a possible perched surface water condition. Special precautions may be required to maintain a working platform at the bottom of pond due to the potential for soft/compressible conditions at or near the groundwater and/or perched surface interface.

The berms/embankments surrounding each of the ponds should be lined as part of the wetted perimeter with an approved earthen liner material. Approved materials used in the earthen liner/embankment should be placed in maximum 9-inch thick loose lifts, adjusted in moisture content, and compacted to at least 95% of the materials' maximum dry density as determined in accordance with ASTM Specification D698. The moisture of the liner materials should be adjusted to be within the range of ±2% of standard Proctor optimum moisture at the time of compaction. All earthwork/compaction activities should be field verified/approved by means of field density testing procedures and visual observations. The approved liner material, when compacted to at least 95%

of the materials' maximum dry density should have a coefficient of permeability of 1 x 10^{-7} cm/sec or slower. The liner thickness is a function of the material used to construct the earthen embankments, the material's in-situ permeability characteristics, as well as the piezometric head or volume of water planned for short and/or long-term purposes.

Based on our understanding of the proposed ponds and our experience with materials with similar properties, we expect the majority of on-site overburden cohesive soils, excluding the fine granular silty sand without some sort of enhancement provided, and underlying bedrock material, (processed to at least 2-inch minus nominal particle size), would be suitable for use as a low permeability earthen embankment material as intended. Variations and characteristics of the bedrock may exist across the pond. Seepage could occur through interbedded sandstone seams.

Care should be taken to provide a consistent, uniform low permeability cohesive material for use as the earthen liner. The materials' permeability should continually be evaluated during construction to verify acceptance, and upon completion of the pond, in-situ flex-wall permeability tests (ASTM Specification D5084) should be performed for final compliance purposes.

For any proposed intake and/or outlet pipes, or any other intrusions penetrating the cohesive liner embankments, the pipes should be properly bedded and backfilled with approved, relatively impervious cohesive soils. The intrusions/pipes should be surrounded by a minimum of 2-feet of relatively impervious cohesive materials having a coefficient of permeability of 1x10^{-7} cm/sec. or slower when properly compacted as described herein. The backfill should be compacted to a minimum of 95% of the material's standard Proctor density as determined by ASTM D698. Anti-seep collars should be placed around all inlet and outlet pipes.

Operational procedures and variations of water levels should be carefully monitored to reduce the potential for desiccation/drying of the earthen liner material and creating fractures or seepage channels within the wetted perimeter; thus, allowing for possible water loss. If practical, consideration could be given to maintaining a "pre-determined" water level within the pond during the non-irrigation/water supply season.

Other Considerations and Recommendations

Groundwater was observed at depths of approximately 7-1/2 to 18-feet below present site grades. Excavations extending to the wetter soils could create difficulties for backfilling of the utility/pipe

trenches with drying of the subgrade soils required to use those materials as backfill. In general, the subgrade soils could be used as backfill soils although care will be necessary to maintain sufficient moisture to reduce potential for post-construction movement.

Excavations into the on-site soils will encounter a variety of conditions. Excavations into the clays can be expected to stand on relatively steep temporary slopes during construction; however, caving soils may also be encountered especially in close proximity to the groundwater table. Groundwater seepage should also be anticipated for utility excavations. Pumping from sumps may be utilized to control water within the excavations. Well points may be required for significant groundwater flow, or where excavations penetrate groundwater to a significant depth. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

Recommendations Regarding Tree Stumps and the Erosional Conditions

Included herein are supplemental recommendations regarding the "left-in-place" tree stumps surrounding and/or within the existing pond configurations. In our opinion the tree stumps should all be removed regardless of the liner approach selected by the City of Evans. If a synthetic liner is selected, tree stumps potentially could protrude through the liner product and damage the structural integrity of the liner and create seepage. If an earthen liner approach is selected possible deterioration/degradation of the tree stumps could occur causing seepage paths within the earthen liner and loss of water storage capacity.

In areas where erosion has occurred over the years due to the grading plan not being completed in 2002 and the water taking a non-designed course, (i.e., not flowing over the spillway but rather around and undermining the concrete structure as evidence in the photo to the left, we provide the following recommendations. These structures should be backfilled with approved on-site materials in uniform 9-inch lifts, moisture conditioned to (+/-) 2% of the materials optimum moisture content, and mechanically compacted to at least 95% of the material's maximum dry density as determined by ASTM Specification D698. After completing all backfill procedures consideration should also be given to installing rip rap within the drainage path to maintain the structural integrity of the backfill zone and allow the flow to continue downgradient in the designated design path.

GENERAL COMMENTS

The analysis and recommendations presented in this report are based upon the data obtained from the soil borings performed at the indicated locations and from any other information discussed in this report. This report does not reflect any variations, which may occur between borings or across the site. The nature and extent of such variations may not become evident until construction. If variations appear evident, it will be necessary to re-evaluate the recommendations of this report.

It is recommended that the geotechnical engineer be retained to review the plans and specifications so comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. It is further recommended that the geotechnical engineer be retained for testing and observations during earthwork and foundation construction phases to help determine that the design requirements are fulfilled.

This report has been prepared for the exclusive use of the City of Evans and/or assignee for specific application to the project discussed and has been prepared in accordance with generally accepted

geotechnical engineering practices. No warranty, express or implied, is made. In the event that any changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing by the geotechnical engineer.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we can be of further service to you in any other way, please do not hesitate to contact us.

Very truly yours,
Earth Engineering Consultants, LLC

David A. Richer, P.E.
Senior Geotechnical Engineer

Reviewed by: Jacob Silverman, P.E.
Geotechnical Engineer

DRILLING AND EXPLORATION

DRILLING & SAMPLING SYMBOLS:

SS: Split Spoon - 13/8" I.D., 2" O.D., unless otherwise noted
ST: Thin-Walled Tube - 2" O.D., unless otherwise noted
R: Ring Barrel Sampler - 2.42" I.D., 3" O.D. unless otherwise noted
PA: Power Auger
HA: Hand Auger
DB: Diamond Bit = 4", N, B
AS: Auger Sample
HS: Hollow Stem Auger
PS: Piston Sample
WS: Wash Sample
FT: Fish Tail Bit
RB: Rock Bit
BS: Bulk Sample
PM: Pressure Meter
WB: Wash Bore

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL : Water Level
WCI: Wet Cave in
DCI: Dry Cave in
AB : After Boring
WS : While Sampling
WD : While Drilling
BCR: Before Casing Removal
ACR: After Casting Removal

Water levels indicated on the boring logs are the levels measured in the borings at the time indicated. In pervious soils, the indicated levels may reflect the location of ground water. In low permeability soils, the accurate determination of ground water levels is not possible with only short term observations.

DESCRIPTIVE SOIL CLASSIFICATION

Soil Classification is based on the Unified Soil Classification system and the ASTM Designations D-2488. Coarse Grained Soils have move than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are described as : clays, if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse grained soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their consistency. Example: Lean clay with sand, trace gravel, stiff (CL); silty sand, trace gravel, medium dense (SM).

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Consistency
< 500	Very Soft
500 - 1,000	Soft
1,001 - 2,000	Medium
2,001 - 4,000	Stiff
4,001 - 8,000	Very Stiff
8,001 - 16,000	Very Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS:

N-Blows/ft	Relative Density
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80	Very Dense
80 +	Extremely Dense

PHYSICAL PROPERTIES OF BEDROCK

DEGREE OF WEATHERING:

Slight	Slight decomposition of parent material on joints. May be color change.
Moderate	Some decomposition and color change throughout.
High	Rock highly decomposed, may be extremely broken.

HARDNESS AND DEGREE OF CEMENTATION:

Limestone and Dolomite:

Hard	Difficult to scratch with knife.
Moderately	Can be scratched easily with knife.
Hard	Cannot be scratched with fingernail.
Soft	Can be scratched with fingernail.

Shale, Siltstone and Claystone:

Hard	Can be scratched easily with knife, cannot be scratched with fingernail.
Moderately Hard	Can be scratched with fingernail.
Soft	Can be easily dented but not molded with fingers.

Sandstone and Conglomerate:

Well Cemented	Capable of scratching a knife blade.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken apart easily with fingers.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests					Soil Classification: Group Symbol	Soil Classification: Group Name
Coarse - Grained Soils more than 50% retained on No. 200 sieve	Gravels more than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	Cu≥4 and 1<Cc≤3[E]		GW	Well-graded gravel [F]
			Cu<4 and/or 1>Cc>3[E]		GP	Poorly-graded gravel [F]
		Gravels with Fines more than 12% fines	Fines classify as ML or MH		GM	Silty gravel [G,H]
			Fines Classify as CL or CH		GC	Clayey Gravel [F,G,H]
	Sands 50% or more coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	Cu≥6 and 1<Cc≤3[E]		SW	Well-graded sand [I]
			Cu<6 and/or 1>Cc>3[E]		SP	Poorly-graded sand [I]
		Sands with Fines more than 12% fines	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid Limit less than 50	inorganic	PI>7 and plots on or above "A" Line		CL	Lean clay [K,L,M]
			PI<4 or plots below "A" Line		ML	Silt [K,L,M]
		organic	Liquid Limit - oven dried / Liquid Limit - not dried	<0.75	OL	Organic clay [K,L,M,N] / Organic silt [K,L,M,O]
	Silts and Clays Liquid Limit 50 or more	inorganic	PI plots on or above "A" Line		CH	Fat clay [K,L,M]
			PI plots below "A" Line		MH	Elastic Silt [K,L,M]
		organic	Liquid Limit - oven dried / Liquid Limit - not dried	<0.75	OH	Organic clay [K,L,M,P] / Organic silt [K,L,M,O]
Highly organic soils		Primarily organic matter, dark in color, and organic odor			PT	Peat

[A]Based on the material passing the 3-in. (75-mm) sieve

[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C]Gravels with 5 to 12% fines required dual symbols:

GW-GM well graded gravel with silt

GW-GC well-graded gravel with clay

GP-GM poorly-graded gravel with silt

GP-GC poorly-graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:

SW-SM well-graded sand with silt

SW-SC well-graded sand with clay

SP-SM poorly graded sand with silt

SP-SC poorly graded sand with clay

[E]$Cu=D_{60}/D_{10}$ $Cc=\frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to

[G]If fines classify as CL-ML, use dual symbol GC-CM, or SC-SM.

[H]If fines are organic, add "with organic fines" to group name

[I]If soil contains >15% gravel, add "with gravel" to group name

[J]If Atterberg limits plots shaded area, soil is a CL-ML, Silty clay

[K]if soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

[L]If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

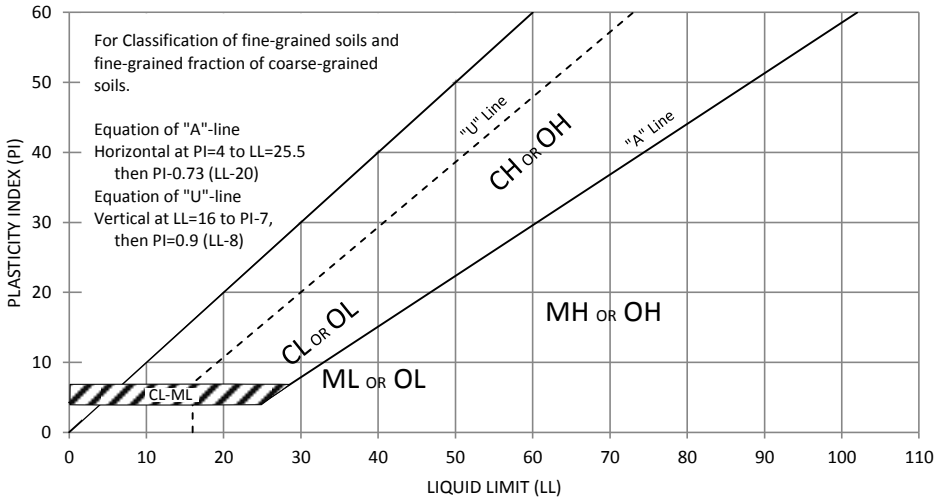
[M]If soil contains ≥30% plus No. 200 predominantly gravel, add "gravelly" to group name.

[N]PI≥4 and plots on or above "A" line.

[O]PI≤4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.



TUSCANY 2ND FILING
EVANS, COLORADO
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MAY 2020

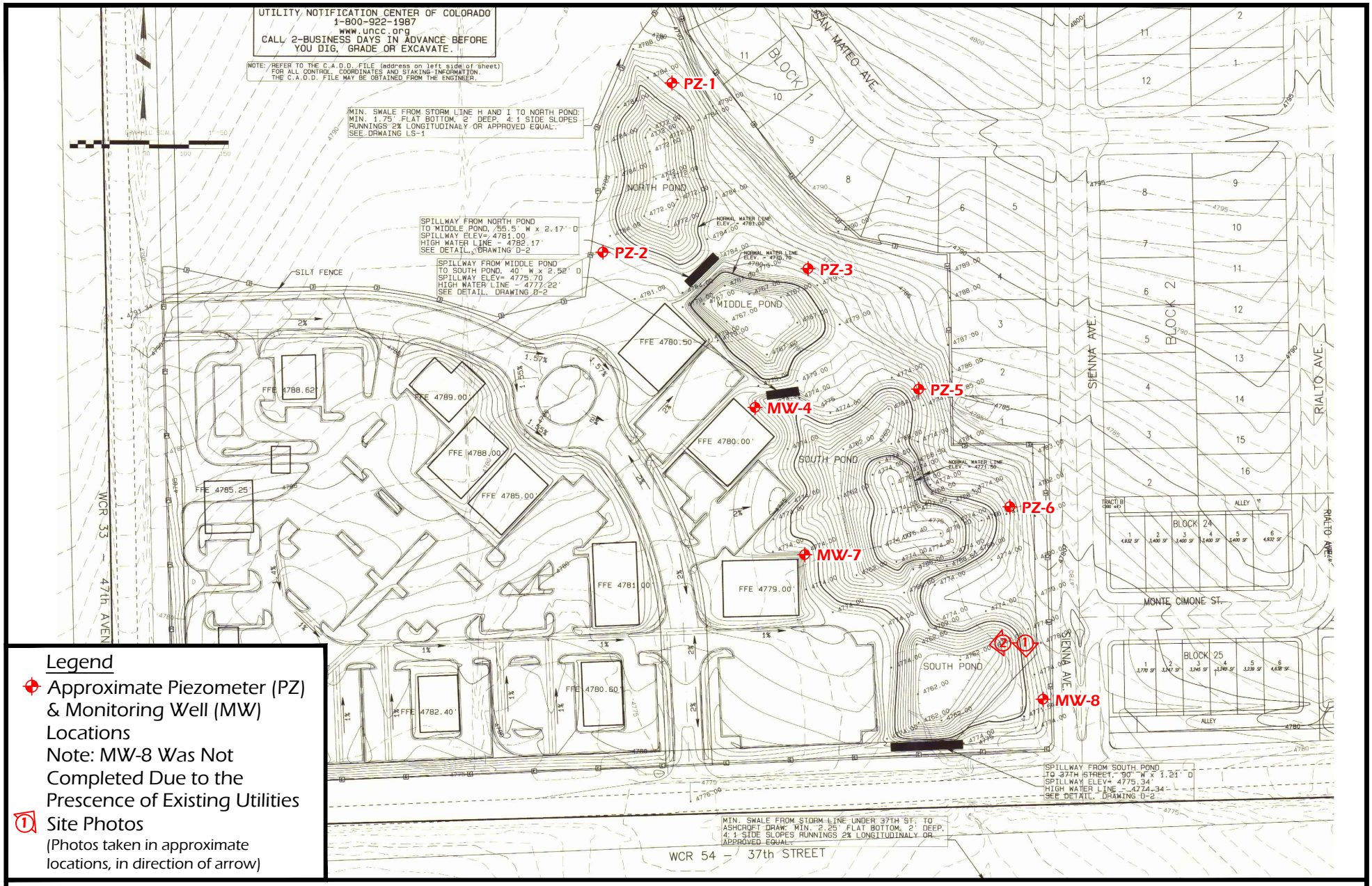

Figure 1: Boring Location Diagram
Tuscany Development Detention Ponds - Evans, Colorado
EEC Project #: 1202030
May 2020

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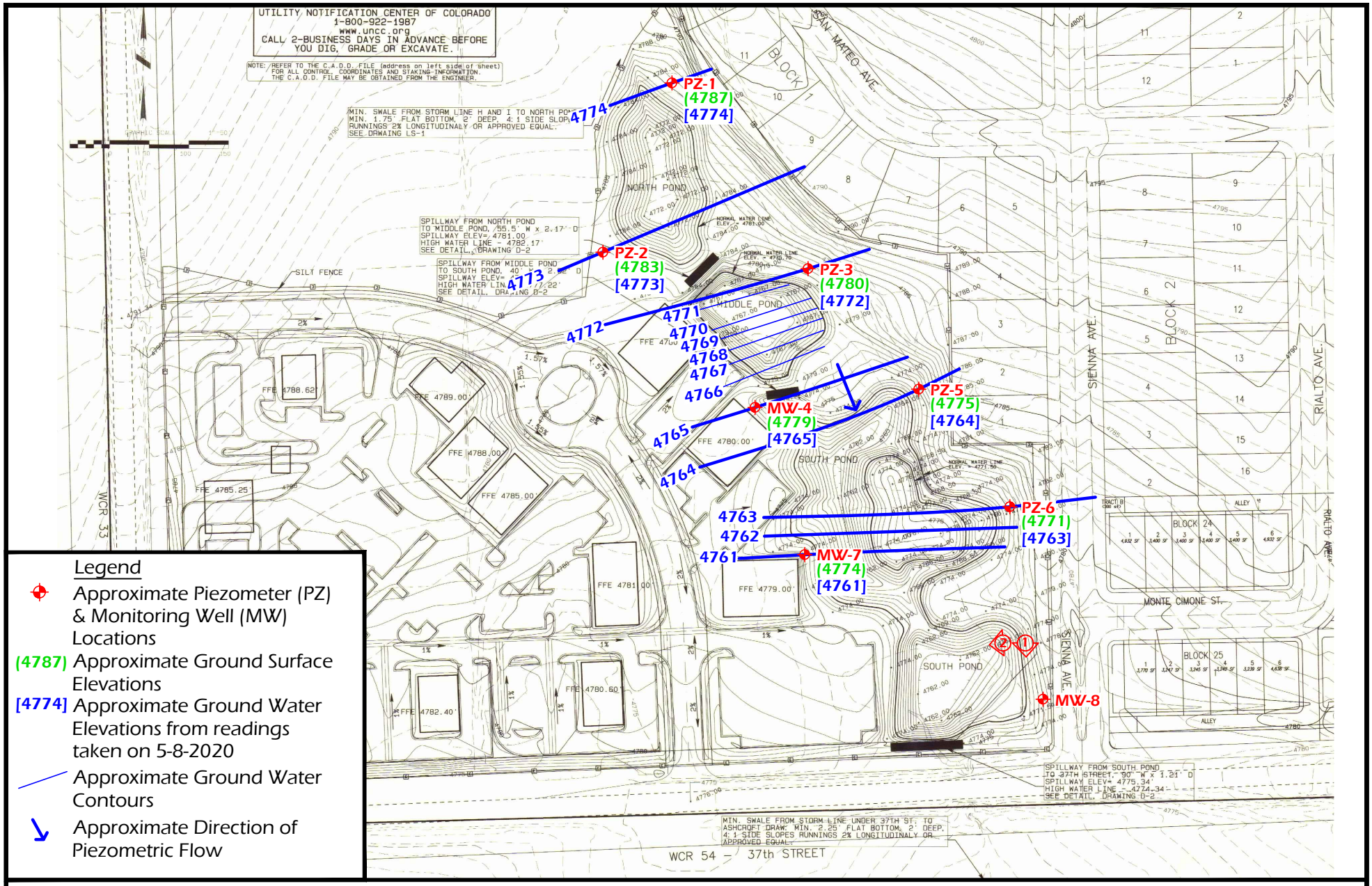

Figure 2: Groundwater Contour Diagram
Tuscany Development Detention Ponds - Evans, Colorado
EEC Project #: 1202030
May 2020

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TUSCANY NON-POTABLE WATER - TRACT O

EVANS, COLORADO

PROJECT NO: 1202030	**LOG OF BORING PZ-1**	**DATE: MAY 2020**	
RIG TYPE: CME55	*SHEET 1 OF 1*	**WATER DEPTH**	
FOREMAN:	**START DATE** 5/6/2020	**WHILE DRILLING**	**18'**
AUGER TYPE: 4" CFA	**FINISH DATE** 5/6/2020	**5/8/2020**	**12.9'**
SPT HAMMER: AUTOMATIC	**APPROX. SURFACE ELEV** 4787	**5/21/2020**	**12.9'**

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % @ 500 PSF
SILTY SAND (SM) brown / rust medium dense to loose		1, 2, 3, 4									
	SS	**5**	**16**	**3500**	**5.3**		**23**	**3**	**27.3**		
		6, 7, 8, 9									
	SS	**10**	**6**	**3000**	**13.0**						
		11, 12, 13									
CLAYSTONE brown / rust highly weathered / moderately hard		14									
	SS	**15**	**17**	**1000**	**23.6**						
		16, 17, 18, 19									
	SS	**20**	**47**	**3500**	**19.8**						
BOTTOM OF BORING DEPTH 20.5'		21, 22, 23, 24, **25**									

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TUSCANY NON-POTABLE WATER - TRACT O

EVANS, COLORADO

PROJECT NO: 1202030	**LOG OF BORING PZ-2**	**DATE: MAY 2020**	
RIG TYPE: CME55	*SHEET 1 OF 1*	**WATER DEPTH**	
FOREMAN:	**START DATE** 5/6/2020	**WHILE DRILLING**	**None**
AUGER TYPE: 4" CFA	**FINISH DATE** 5/6/2020	**5/8/2020**	**9.9'**
SPT HAMMER: AUTOMATIC	**APPROX. SURFACE ELEV** 4783	**5/21/2020**	**9.9'**

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % @ 500 PSF
SPARSE VEGETATION		1									
SILTY SANDY CLAY (CL) brown loose to medium stiff		2 3 4									
	SS	**5**	**7**	**2000**	**13.5**						
		6 7 8 9									
SANDY CLAY (CL) brown / rust / tan medium stiff to stiff with trace gravel	SS	**10**	**11**	**1500**	**16.2**						
		11 12 13									
CLAYSTONE brown / gray / rust highly weathered / moderately hard		14									
	SS	**15**	**29**	**6000**	**21.3**		**41**	**17**	**95.3**		
*bedrock classified as LEAN CLAY (CL)		16 17 18 19									
	SS	**20**	**42**	**7500**	**18.6**						
BOTTOM OF BORING DEPTH 20.5'		21 22 23 24 **25**									

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TUSCANY NON-POTABLE WATER - TRACT O

EVANS, COLORADO

PROJECT NO: 1202030	**LOG OF BORING PZ-3**	**DATE: MAY 2020**	
RIG TYPE: CME55	*SHEET 1 OF 1*	**WATER DEPTH**	
FOREMAN:	**START DATE** 5/6/2020	**WHILE DRILLING**	**9'**
AUGER TYPE: 4" CFA	**FINISH DATE** 5/6/2020	**5/8/2020**	**8'**
SPT HAMMER: AUTOMATIC	**APPROX. SURFACE ELEV** 4780	**5/21/2020**	**8'**

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % @ 500 PSF
SPARSE VEGETATION		1									
SILTY SANDY CLAY (CL)		2									
brown		3									
loose to medium stiff		4									
	SS	**5**	**8**	**2000**	**18.6**						
		6									
		7									
		8									
		9									
SILTSTONE / SANDSTONE / CLAYSTONE											
brown / rust	SS	**10**	**12**	**1500**	**29.7**						
highly weathered/poorly cemented		11									
		12									
		13									
		14									
CLAYSTONE	SS	**15**	**28**	**5500**	**21.0**		**41**	**19**	**84.9**		
brown / rust											
highly weathered / moderately hard		16									
		17									
		18									
		19									
	SS	**20**	**50**	**5000**	**25.6**						
BOTTOM OF BORING DEPTH 20.5'		21									
		22									
		23									
		24									
		25									

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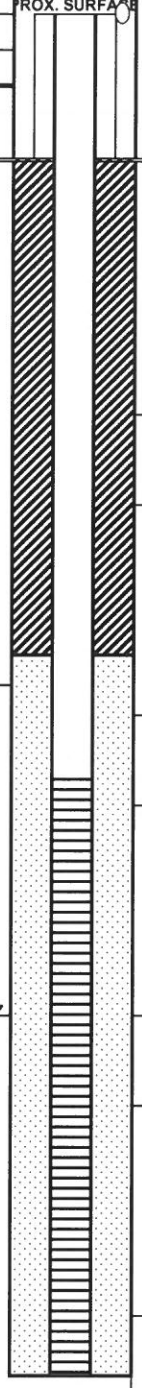
TUSCANY NON-POTABLE WATER - TRACT O
EVANS, COLORADO

PROJECT NO: 1202030		DATE:	MAY 2019
	LOG OF BORING MW-4		SHEET 1 OF 1
RIG TYPE: CME-75	PZ DETAILS	START DATE	5/6/2020
FOREMAN: DG		FINISH DATE	5/6/2020
AUGER TYPE: 4-1/4" ID HSA		Approx. Ground Surface Elev.	4779
SPT HAMMER: AUTOMATIC		TOP OF CASING ELEV.	4782

WATER DEPTH	
WHILE DRILLING	None
CHECKED 5/8/20	14.4'
CHECKED 5/21/20	14.5'



SOIL DESCRIPTION	SAMPLE TYPE	D (feet)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL-CONSOLIDATION PRESSURE	SWELL-CONSOLIDATION % - 500 PSF
LEAN CLAY with SAND (CL) - FILL brown		1									
		2									
		3									
		4									
	SS	5	12	6500	19.2		35	16	73.5		
		6									
		7									
		8									
		9									
SANDY LEAN CLAY (CL) brown medium stiff	SS	10	8	1500	20.3						
		11									
		12									
		13									
		14									
CLAYSTONE brown / gray / rust highly weathered to moderately hard	SS	15	33	8500	21.9		45	21	24	92.5	
		16									
		17									
		18									
		19									
	SS	20	50/10.5"	2000	19.7						
BOTTOM OF BORING DEPTH 20.5'		21									
		22									
		23									
		24									
		25									

PIEZOMETER LEGEND

- 2-Inch Diameter Flush Threaded- Schedule 40 PVC riser pipe
- Flush Threaded Riser Pipe backfilled w/ cuttings & bentonite
- Bentonite Seal
- 2-Inch Dia. Flush Threaded- Schedule 40 PVC Slotted pipe
- Silica Sand

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TUSCANY NON-POTABLE WATER - TRACT O

EVANS, COLORADO

PROJECT NO: 1202030	**LOG OF BORING PZ-5**	**DATE: MAY 2020**	
RIG TYPE: CME55	*SHEET 1 OF 1*	**WATER DEPTH**	
FOREMAN:	**START DATE** 5/6/2020	**WHILE DRILLING**	**13'**
AUGER TYPE: 4" CFA	**FINISH DATE** 5/6/2020	**5/8/2020**	**10.8'**
SPT HAMMER: AUTOMATIC	**APPROX. SURFACE ELEV** 4775	**5/21/2020**	**10.8'**

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % @ 500 PSF
SPARSE VEGETATION		1									
SANDY LEAN CLAY (CL) brown		2									
with organics		3									
		4									
	SS	**5**	**6**	**3000**	**18.2**		**31**	**14**	**61.3**		
		6									
		7									
		8									
		9									
	SS	**10**	**5**	**500**	**23.3**						
		11									
		12									
		13									
		14									
	SS	**15**	**9**	**2500**	**19.6**						
		16									
		17									
CLAYSTONE brown / rust / gray highly weathered / moderately hard		18									
		19									
	SS	**20**	**38**	**4500**	**21.4**						
BOTTOM OF BORING DEPTH 20.5'		21									
		22									
		23									
		24									
		25									

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TUSCANY NON-POTABLE WATER - TRACT O

EVANS, COLORADO

PROJECT NO: 1202030	**LOG OF BORING PZ-6**	**DATE: MAY 2020**	
RIG TYPE: CME55	*SHEET 1 OF 1*	**WATER DEPTH**	
FOREMAN:	**START DATE** 5/6/2020	**WHILE DRILLING**	**7.5'**
AUGER TYPE: 4" CFA	**FINISH DATE** 5/6/2020	**5/8/2020**	**7.7'**
SPT HAMMER: AUTOMATIC	**APPROX. SURFACE ELEV** 4771	**5/21/2020**	**7.6'**

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % @ 500 PSF
SPARSE VEGETATION		1									
SILTY SAND (SM) brown medium dense to loose with gravel		2									
		3									
		4									
	SS	**5**	**7**	**4000**	**16.3**		**22**	**4**	**11.1**		
		6									
		7									
		8									
		9									
	SS	**10**	**3**		**10.7**						
		11									
		12									
		13									
		14									
	SS	**15**	**13**		**18.3**						
		16									
CLAYSTONE brown / gray / rust highly weathered / moderately hard		17									
		18									
		19									
	SS	**20**	**46**	**5500**	**22.6**						
BOTTOM OF BORING DEPTH 20.5'		21									
		22									
		23									
		24									
		25									

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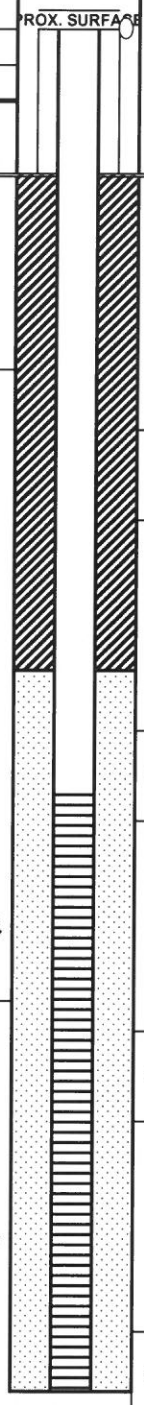
TUSCANY NON-POTABLE WATER - TRACT O
EVANS, COLORADO

PROJECT NO: 1202030		DATE:	MAY 2019
	LOG OF BORING MW-7		SHEET 1 OF 1
RIG TYPE: CME-75	PZ DETAILS	START DATE	5/6/2020
FOREMAN: DG		FINISH DATE	5/6/2020
AUGER TYPE: 4-1/4" ID HSA		Approx. Ground Surface Elev.	4774
SPT HAMMER: AUTOMATIC		TOP OF CASING ELEV.	4776

WATER DEPTH	
WHILE DRILLING	18.0'
CHECKED 5/8/20	12.9'
CHECKED 5/21/20	13.3'



SOIL DESCRIPTION	SAMPLE TYPE	D (feet)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL-CONSOLIDATION PRESSURE	SWELL-CONSOLIDATION % - 500 PSF
SANDY LEAN CLAY (CL) - FILL brown / rust		1, 2, 3, 4									
SILTY, CLAYEY SAND (SC-SM) brown / rust medium dense to loose	SS	5	20	9000+	7.9		24	5	30.8		
		6, 7, 8, 9									
	SS	10	4	1000	13.4						
		11, 12, 13, 14									
CLAYSTONE brown / gray / rust highly weathered / moderately hard *bedrock classified as LEAN CLAY (CL)	SS	15	31	6000	22.9		37	11	87.9		
		16, 17, 18, 19									
	SS	20	47	5500	20.3						
BOTTOM OF BORING DEPTH 20.5'		21, 22, 23, 24, 25									

PIEZOMETER LEGEND

- 2-Inch Diameter Flush Threaded- Schedule 40 PVC riser pipe
- Flush Threaded Riser Pipe backfilled w/ cuttings & bentonite
- Bentonite Seal
- 2-Inch Dia. Flush Threaded- Schedule 40 PVC Slotted pipe
- Silica Sand

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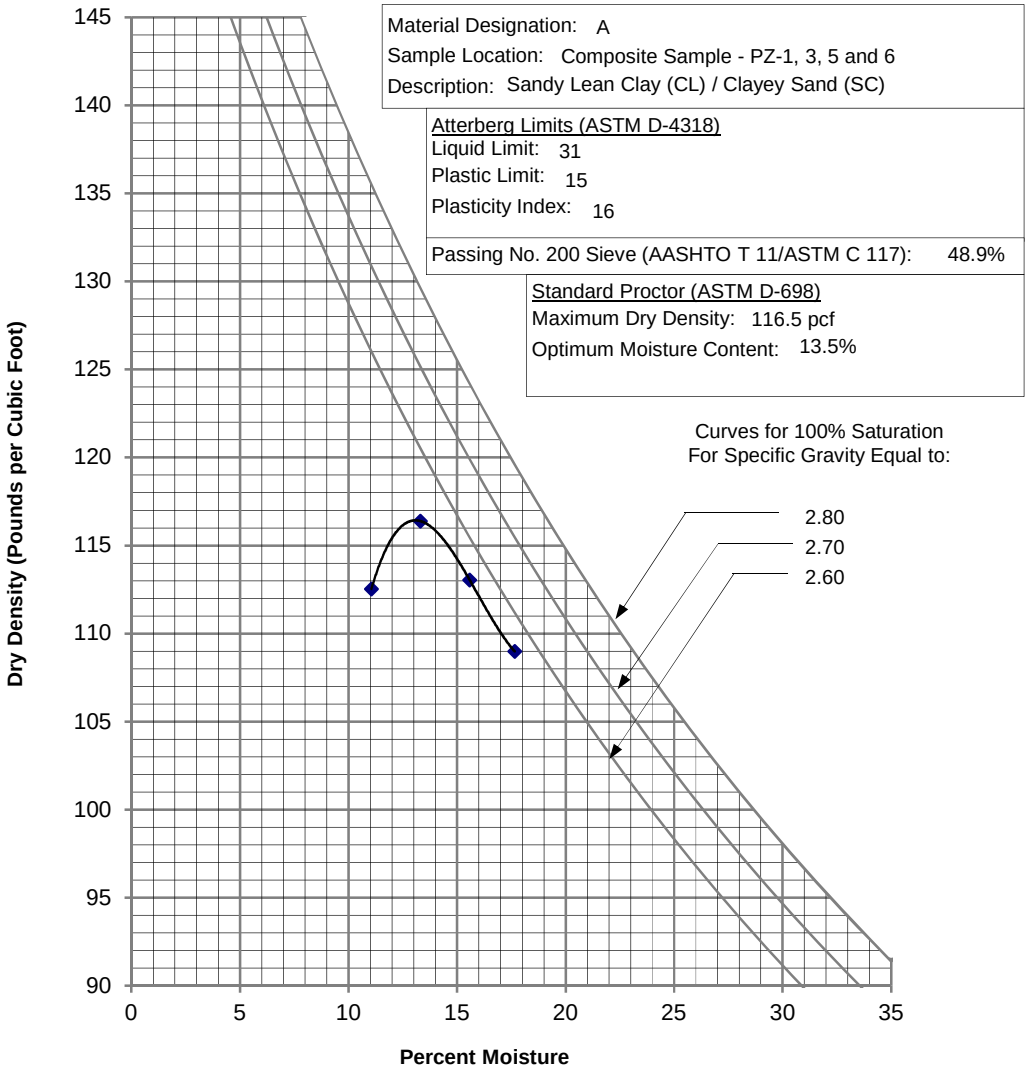
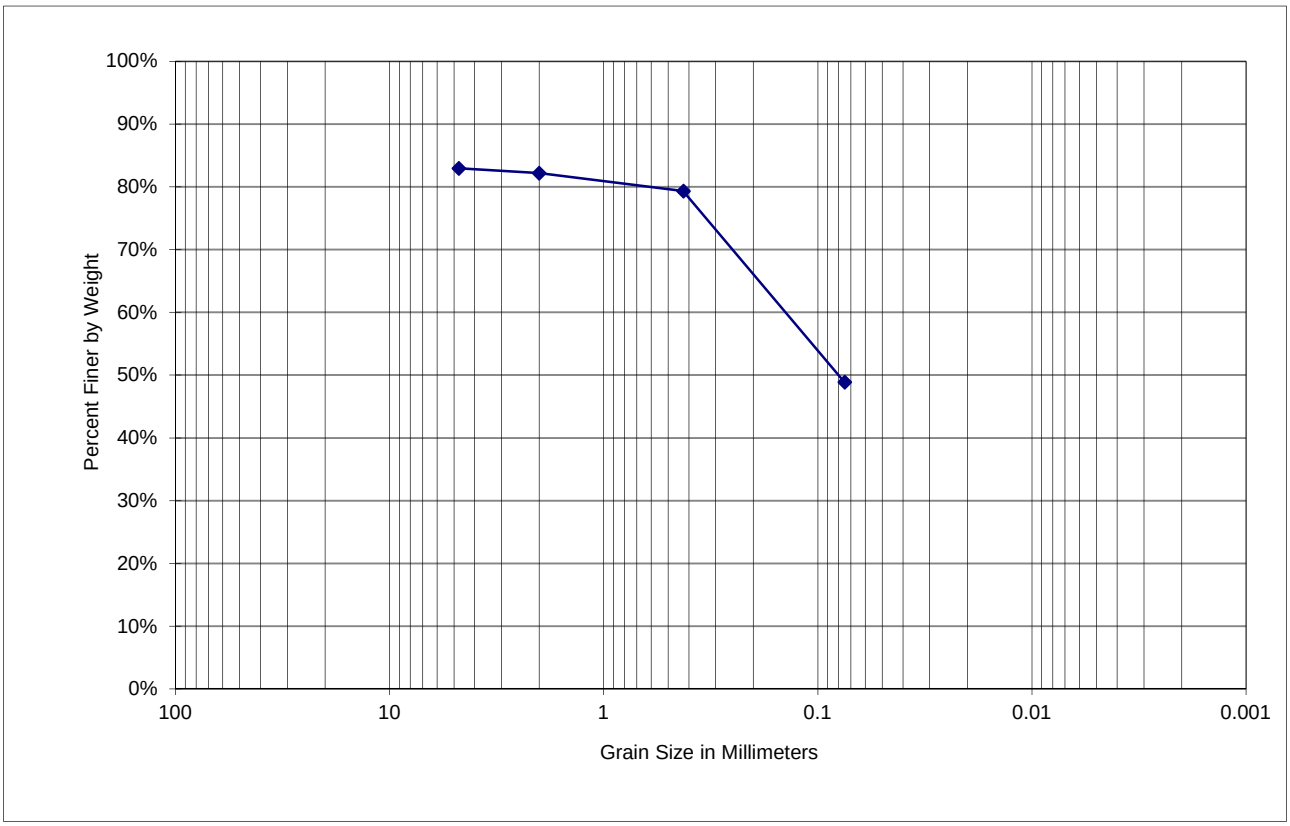
SUMMARY OF LABORATORY CLASSIFICATION/MOISTURE-DENSITY RELATIONSHIP



Project: Tuscany Ponds - Tract O
Evans, Colorado
Project No: 1202030
Date May 2020

EARTH ENGINEERING CONSULTANTS, LLC

SUMMARY OF LABORATORY CLASSIFICATION / MOISTURE-DENSITY RELATIONSHIP



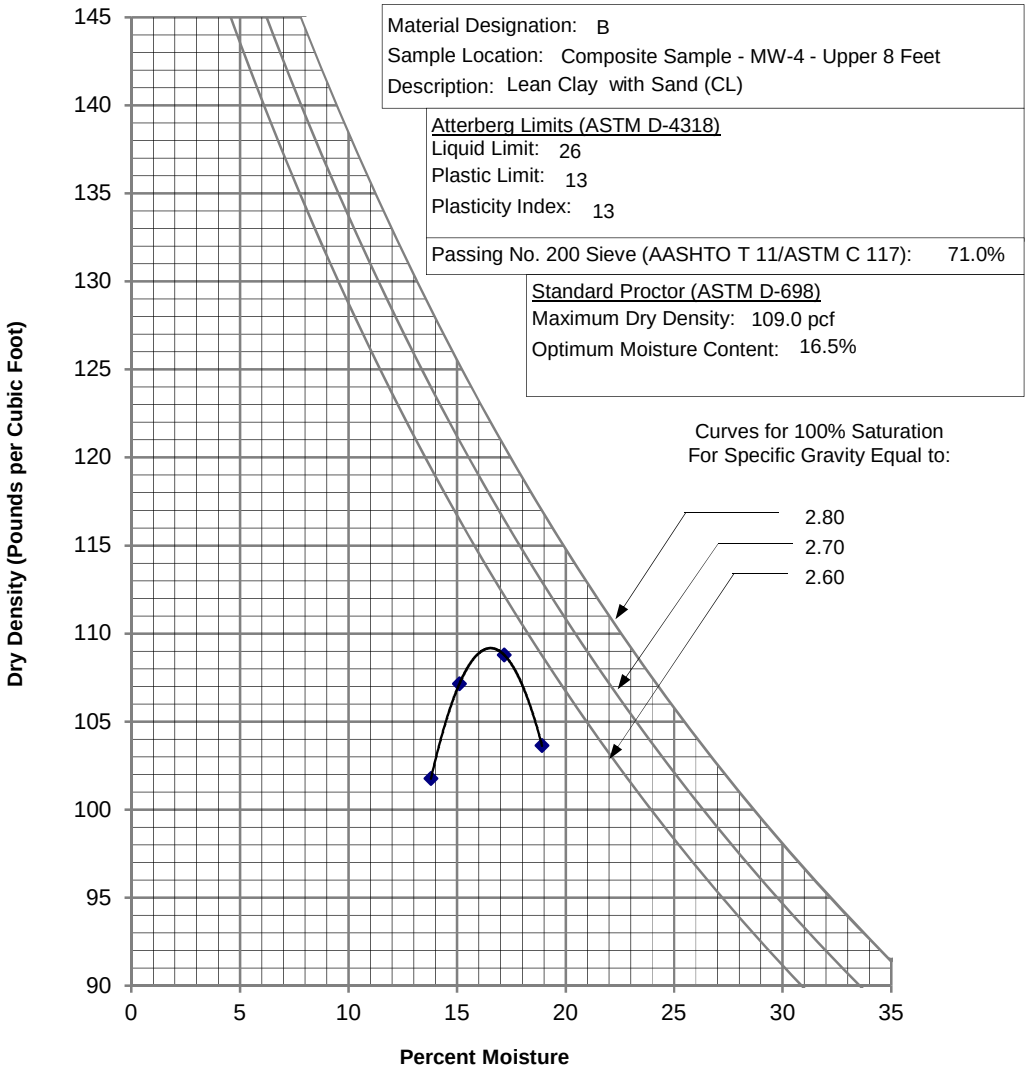
Sieve Size	Percent Passing
No. 4	83%
No. 10	82%
No. 40	79%
No. 200	48.9%

Material Designation: A
Sample Location: Composite Sample - PZ-1, 3, 5 and 6
Material Description: Sandy Lean Clay (CL) / Clayey Sand (SC)

Project: Tuscany Ponds - Tract O
Evans, Colorado
Project No: 1202030
Date May 2020

EARTH ENGINEERING CONSULTANTS, LLC

SUMMARY OF LABORATORY CLASSIFICATION/MOISTURE-DENSITY RELATIONSHIP



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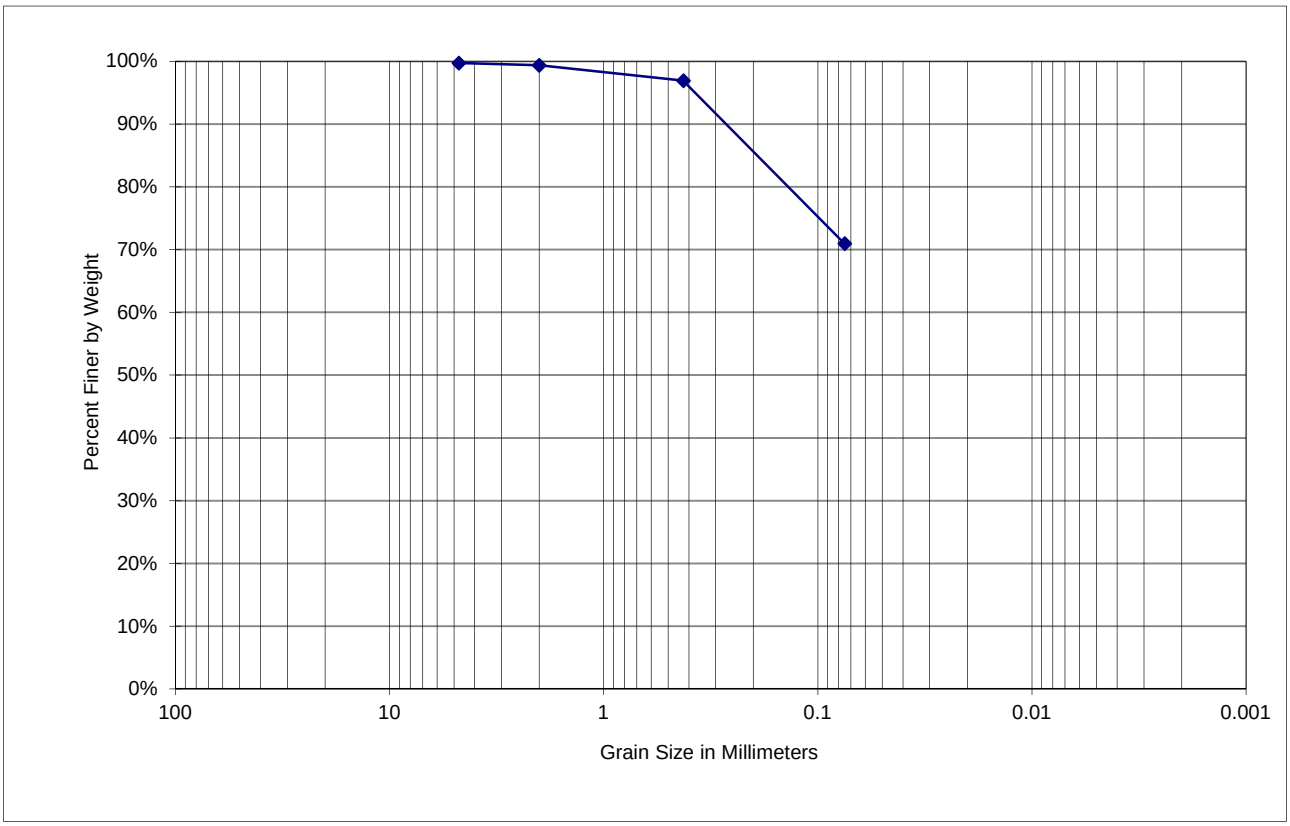
SUMMARY OF LABORATORY CLASSIFICATION / MOISTURE-DENSITY RELATIONSHIP



Sieve Size	Percent Passing
No. 4	100%
No. 10	99%
No. 40	97%
No. 200	71.0%

Material Designation: B
Sample Location: Composite Sample - MW-4 - Upper 8 Feet
Material Description: Lean Clay with Sand (CL)

Project: Tuscany Ponds - Tract O
Evans, Colorado
Project No: 1202030
Date May 2020

EARTH ENGINEERING CONSULTANTS, LLC

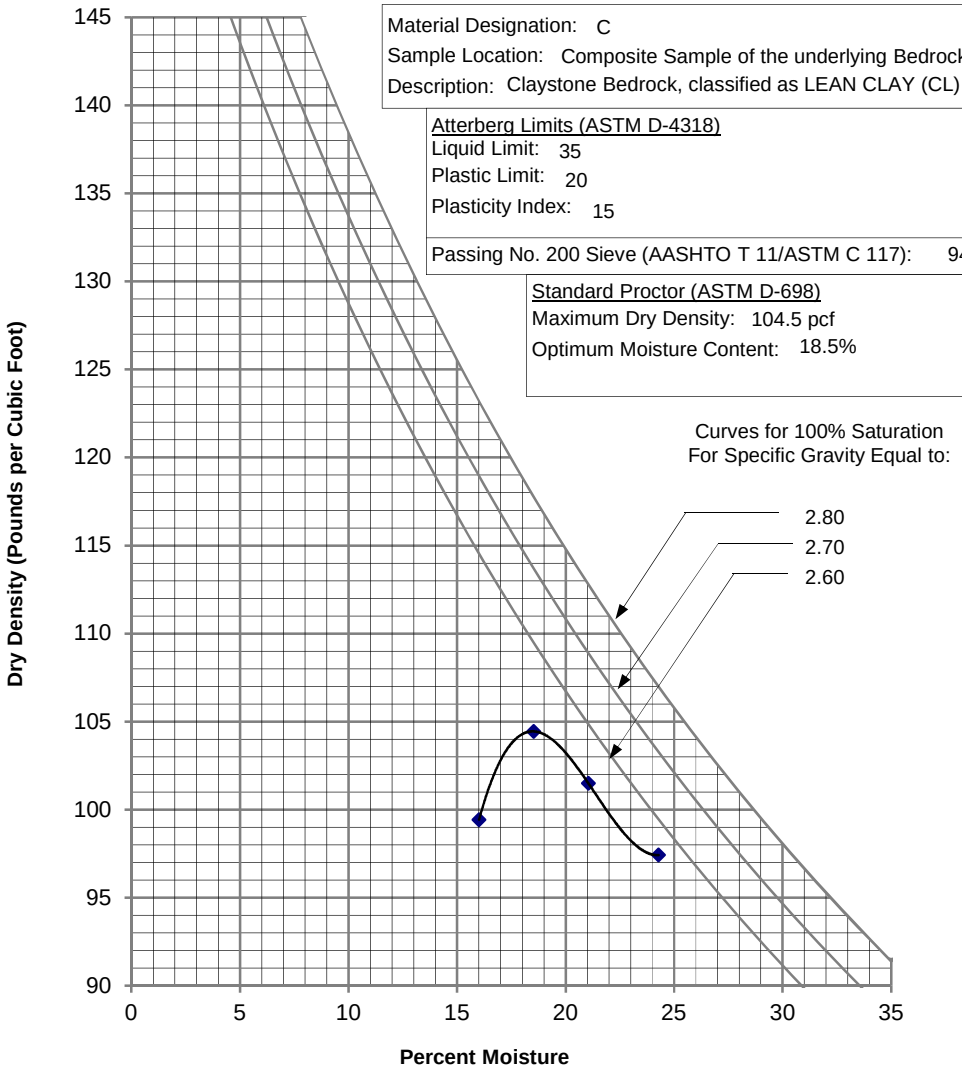
SUMMARY OF LABORATORY CLASSIFICATION/MOISTURE-DENSITY RELATIONSHIP

Material Designation: C
Sample Location: Composite Sample of the underlying Bedrock
Description: Claystone Bedrock, classified as LEAN CLAY (CL)

Atterberg Limits (ASTM D-4318)
Liquid Limit: 35
Plastic Limit: 20
Plasticity Index: 15

Passing No. 200 Sieve (AASHTO T 11/ASTM C 117): 94.9%

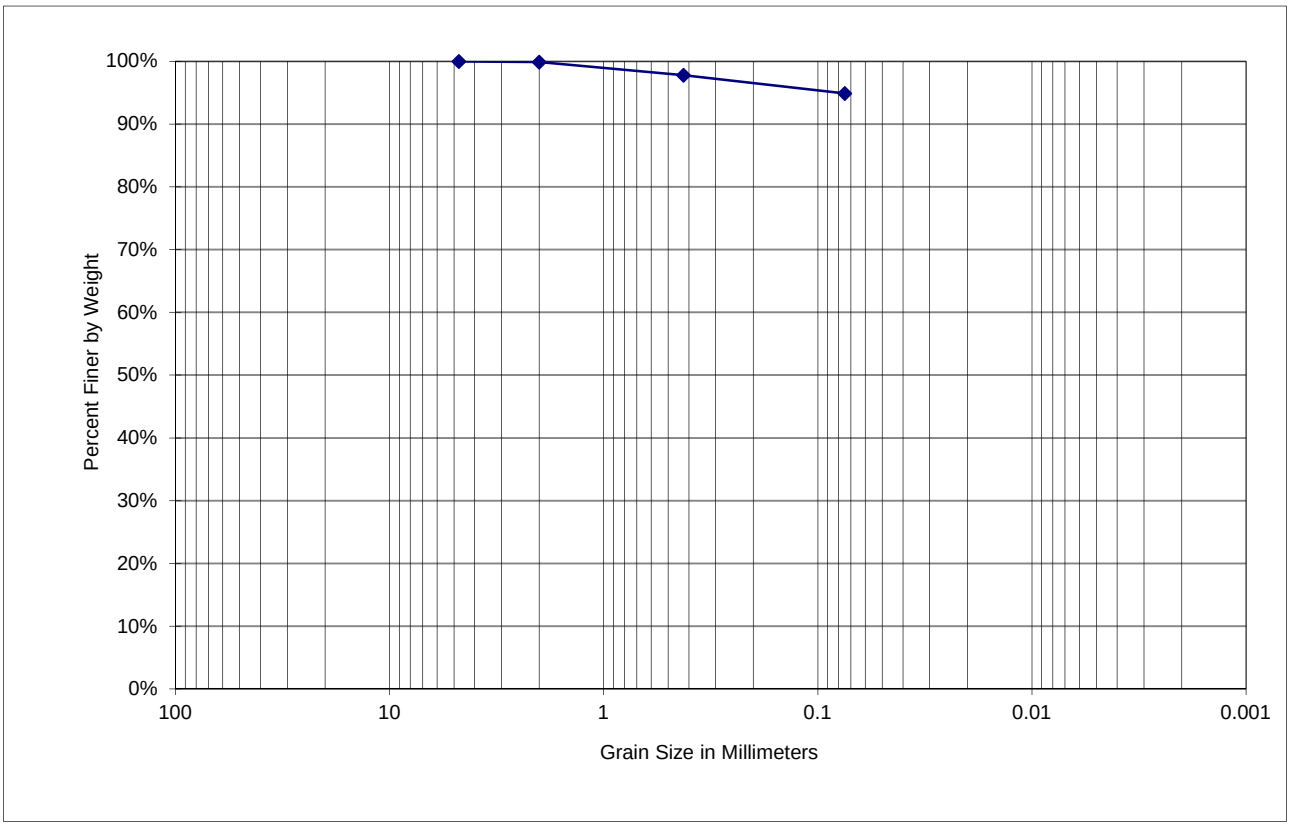
Standard Proctor (ASTM D-698)
Maximum Dry Density: 104.5 pcf
Optimum Moisture Content: 18.5%



Project: Tuscany Ponds - Tract O
Evans, Colorado
Project No: 1202030
Date May 2020

EARTH ENGINEERING CONSULTANTS, LLC

SUMMARY OF LABORATORY CLASSIFICATION / MOISTURE-DENSITY RELATIONSHIP



Sieve Size	Percent Passing
No. 4	100%
No. 10	100%
No. 40	98%
No. 200	94.9%

Material Designation: C
Sample Location: Composite Sample of the underlying Bedrock
Material Description: Claystone Bedrock, classified as LEAN CLAY (CL)

Project: Tuscany Ponds - Tract O
Evans, Colorado
Project No: 1202030
Date May 2020

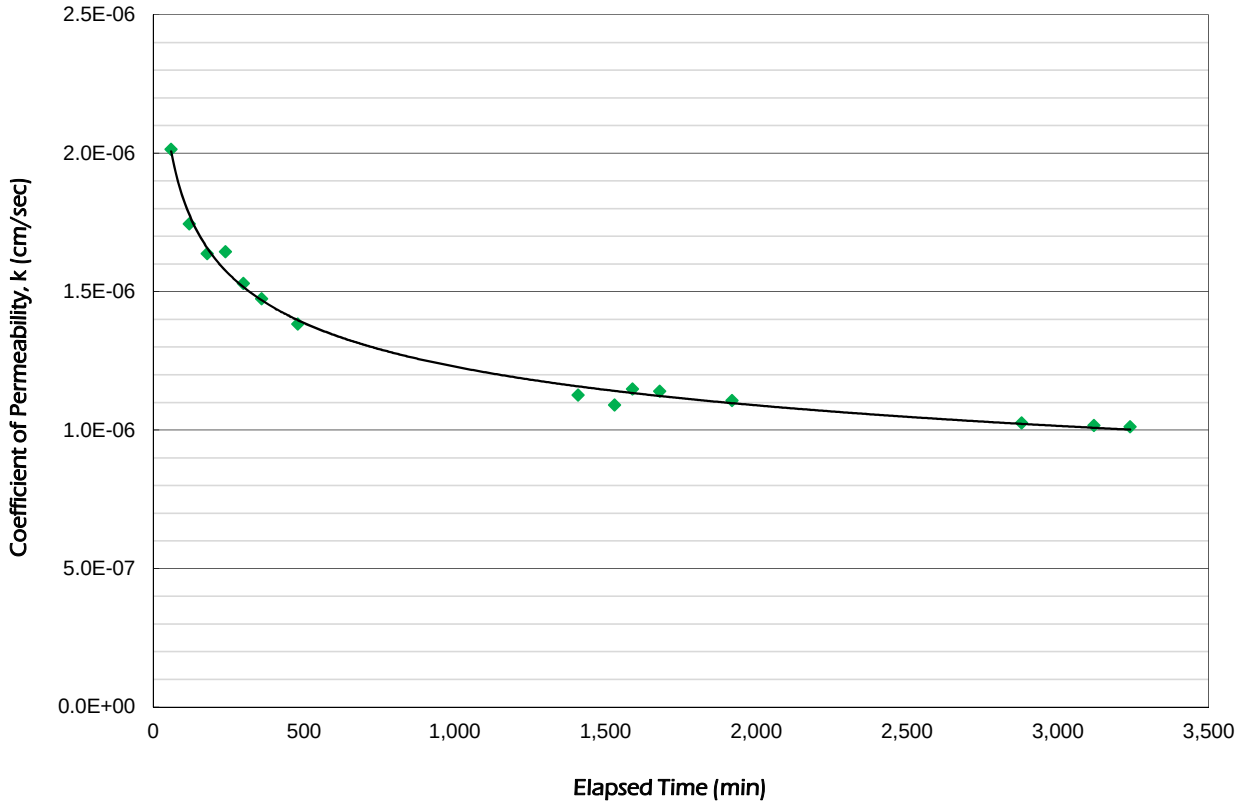
EARTH ENGINEERING CONSULTANTS, LLC

Permeability Test Results (ASTM D5856)

City of Evans - Tuscany Ponds - Evans, Colorado

Sample:	Composite Sample PZ-1, PZ-3, PZ-5 and PZ-6 - Overburden Soils - Sample "A"				
Material Description:	brown Clayey Sand (SC)			% Compaction:	95.1%
Liquid Limit:	31	Plasticity Index:	16	% Passing #200:	48.9
Initial Moisture:	13.3%	Dry Density:	110.8 pcf	Final Moisture:	16.9%

Coefficient of Permeability, k = 1.01 x 10^{-6} cm/s



Project Name: City of Evans - Tuscany Ponds

Location: Evans, Colorado

Project Number: 1202030

Date: May 2020

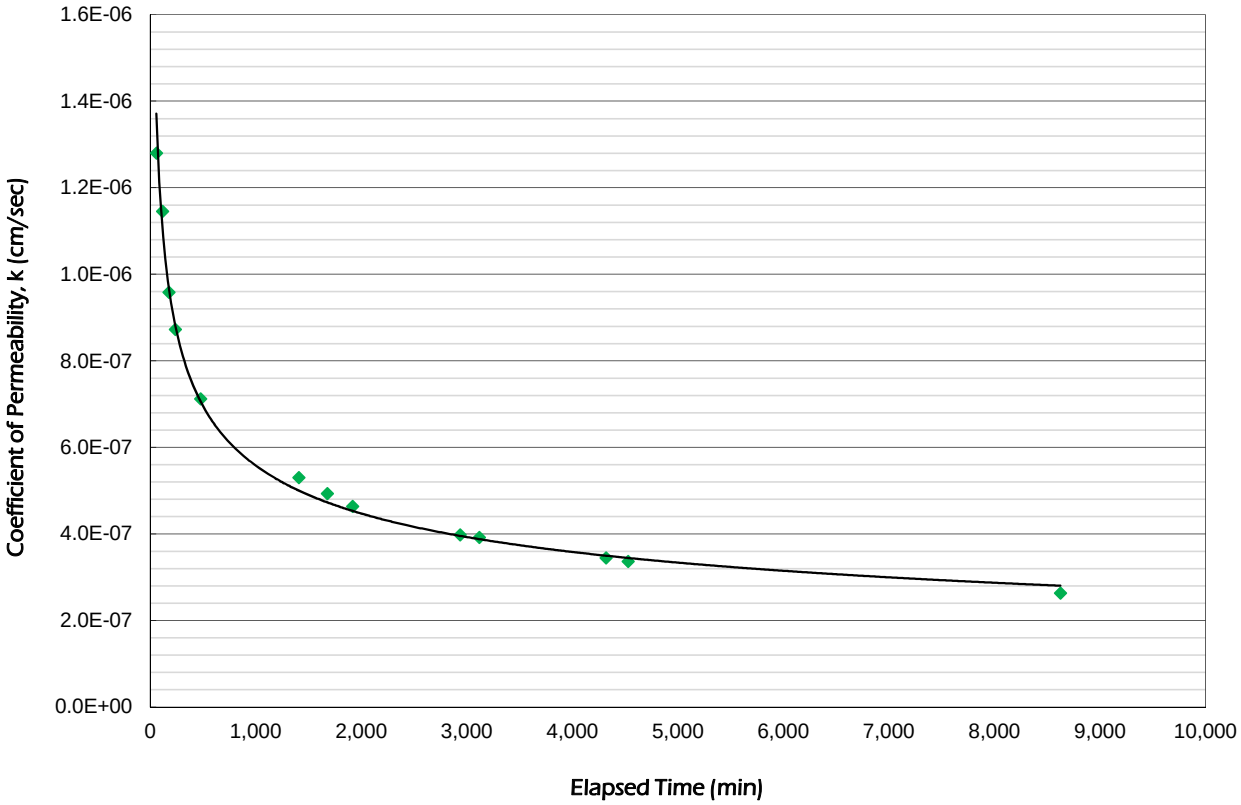
EARTH ENGINEERING CONSULTANTS, LLC

Permeability Test Results (ASTM D5856)

City of Evans - Tuscany Ponds - Evans, Colorado

Sample:	Composite Sample - MW-4 Upper 8-Feet of Overburden Soils - Sample "B"				
Material Description:	Sandy Lean Clay (CL) / Clayey Sand (SC)			% Compaction:	95%
Liquid Limit:	26	Plasticity Index:	13	% Passing #200:	71.0
Initial Moisture:	16.7%	Dry Density:	103.4 pcf	Final Moisture:	22.4%

Coefficient of Permeability, k = 2.6 x 10^{-7} cm/s



Project Name:	City of Evans - Tuscany Ponds
Location:	Evans, Colorado
Project Number:	1202030
Date:	May 2020

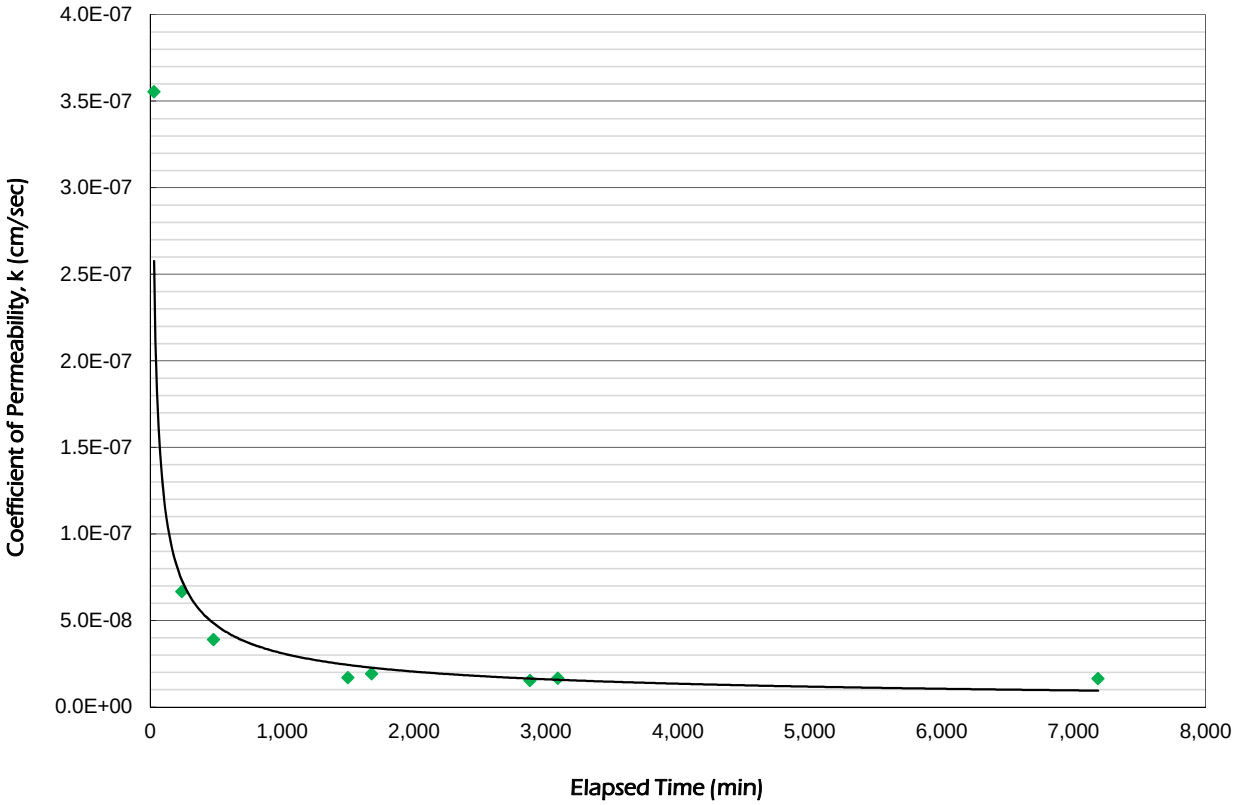
EARTH ENGINEERING CONSULTANTS, LLC

Permeability Test Results (ASTM D5856)

City of Evans - Tuscany Ponds - Evans, Colorado

Sample:	Composite Sample - Underlying Bedrock Material - SAMPLE "C"				
Material Description:	Claystone Bedrock, classified as LEAN CLAY (C			% Compaction:	95%
Liquid Limit:	35	Plasticity Index:	15	% Passing #200:	95
Initial Moisture:	18.9%	Dry Density:	98.9 pcf	Final Moisture:	23.6%

Coefficient of Permeability, k = 1.5 x 10^{-8} cm/s



Project Name: City of Evans - Tuscany Ponds

Location: Evans, Colorado

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