

# Geotechnical Engineering Report

## Planned Waste Sludge Lagoons

903 Cozy Acres Road  
Mountain Pine, Arkansas  
GTS Project No. 23-55032

October 16, 2023



*Prepared For:*

**Crist Engineers, Inc.**

205 Executive Court  
Little Rock, Arkansas, 72205



[www.gtsconsulting.net](http://www.gtsconsulting.net)

October 16, 2023

Crist Engineers, Inc.  
205 Executive Court  
Little Rock, Arkansas, 72205

Attention: Mr. Kelly Vanlandingham, P.E., P.L.S.

RE: Geotechnical Engineering Report  
Planned Waste Sludge Lagoons  
Ouachita Water Treatment Plant  
903 Cozy Acres Road  
Mountain Pine, Arkansas  
GTS Project No. 23-55032

Mr. Vanlandingham:

This report provides the results of the subsurface exploration, laboratory testing, and geotechnical engineering analysis performed for the planned sludge lagoon improvements. The property evaluated by this report is located at the existing Ouachita Water Treatment Plant at 903 Cozy Acres Road in Mountain Pine, Arkansas. The approximate boundaries of the property are shown in Figure 1 within this report.

We appreciate the opportunity to be of assistance to you on this project. We encourage retaining GTS, Inc. to be involved in any pre-bid and pre-construction meetings to allow us to discuss the following findings and recommendations.

Please contact us if further explanation or clarification is required for portions of the report.

Sincerely,



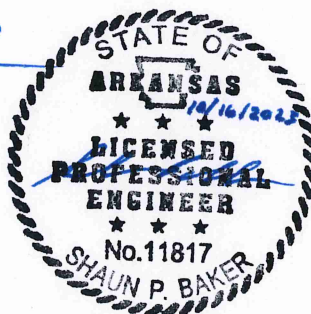
Certificate of Authorization No. 1251, expires 12/31/2023

A blue ink signature of Shaun P. Baker, consisting of stylized initials and a surname.

Shaun P. Baker, P.E.  
Arkansas No. 11817

SPB:TW

Copies: Addressee (PDF-email)



A blue ink signature of Travis Willis, written in a cursive style.

Travis Willis, P.E.  
Senior Project Engineer

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## **PROJECT DESCRIPTION and INFORMATION**

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### **Introduction.**

Our services were performed in accordance with GTS Proposal No. GTS5235063, authorized by Mr. Matt Dunn, P.E. of Crist Engineers, Inc. on August 24, 2023. The intent of the authorized scope of services was to explore the subsurface soil/rock conditions at the project site to provide recommendations for the slopes of the planned berms, both cut and fill slopes.

Our scope of services included evaluating the subsurface conditions at a total of eight (8) boring locations. Borings B-1 through B-4 were drilled to depths of about 16 to 20 feet below existing grades in the planned new lagoon footprints. Borings SB-1 through SB-4 were drilled to depths of about 13 ½ to 15 feet below existing grades in the new lagoon footprints and planned cut slopes.

The scope of services requested of GTS and provided in this report pertains to the evaluation of the site in preparation for construction of the planned new sludge lagoons. Providing any local or global slope stability analyses are outside of the authorized scope of services. GTS can provide these additional services upon request.

Our current scope of services is concluded with the issuance of this Geotechnical Engineering Report.

### **Project Site**

The project site is located at the existing Ouachita Water Treatment Plant located in Mountain Pine, Arkansas. The site is located about 450 feet east of the existing water treatment plant facility at the real property address of 903 Cozy Acres Road in Mountain Pine, Arkansas. Based on Google Earth images, the project site is currently occupied by three existing lagoons and the surrounding areas are predominantly covered by trees and grass. Additionally, an unpaved drive path provides access from Cozy Acres Road on the west side of the project site.

The general project site boundary is shown in yellow in Figure 1 on the following page.

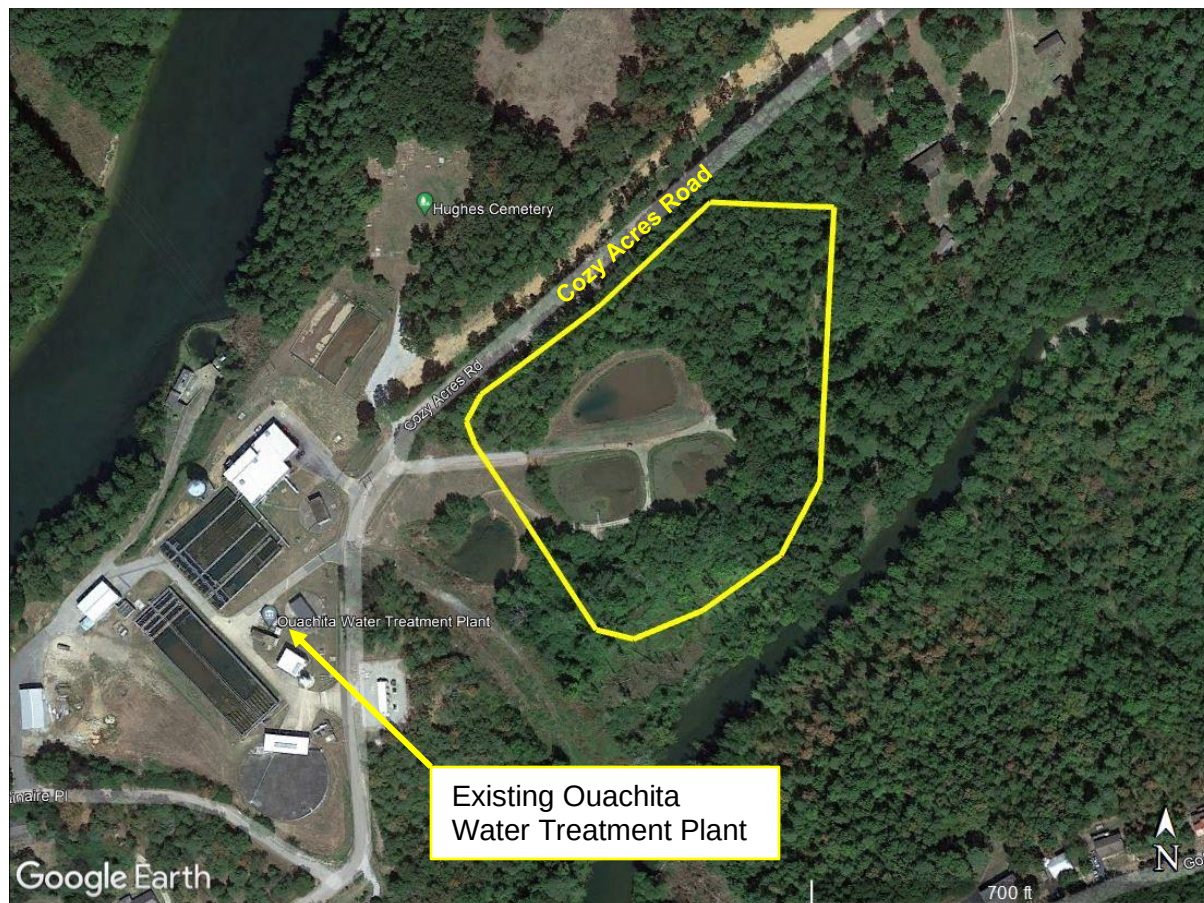


**Figure 1 - General Boundary of the Project Site**

## Planned Structures

Development plans are understood to consist of constructing two new waste sludge lagoons that will replace the three existing waste sludge lagoons. The following documents were provided to us by Crist Engineers, Inc. for this project:

- **Existing Conditions Site, prepared by Crist Engineers, Inc., dated August 2023** - a survey of the three currently existing lagoons.
- **08 Grading Plan, prepared by Crist Engineers, Inc., dated August 2023** - a preliminary site grading plan for permitting showing the proposed two new lagoons as well as the boring locations requested by the client.

Based on the existing grades shown on the Existing Conditions Plan, the project site generally consists of gently undulating hills surrounding the existing lagoons with existing elevations ranging from 460 feet to 410 feet from north to south, respectively. The existing lagoon slopes are estimated as approximately 1.3 to 2H:1V based on the existing grading provided to us.

According to the grading plans, the planned new lagoons will be surrounded by levees with a finished grade elevation of 440.50 feet at the access road crests. The areas of the site located outside of the levee perimeters will have varying slopes that range from as steep as 1.5H:1V (Horizontal to Vertical) in the northern portion, 3.6H:1V in the eastern portion, and 3.0H:1V in the southern portion. The northern lagoon will have slopes that range from 3.6H:1V to 2.5H:1V. The southern lagoon will have slopes that range from 3.3H:1V to 3.1H:1V.

If our understanding of the site grading plans is incorrect or if the grading plans change, please contact us to allow the recommendations in this report to be reviewed and, if necessary, revised.

## SUMMARY of SUBSURFACE FINDINGS

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### Site Geology

Based on the available geologic maps, the project site is located in the geologic unit mapped as the Devonian-Late Mississippian Arkansas Novaculite, MDa. The following description of this formation was obtained from the Stratigraphic Summary of Arkansas (Arkansas Geological Commission IC-36, 2004).

*Three Divisions of the Arkansas Novaculite are recognized. The Lower Division is white, massive-bedded novaculite with some interbedded gray shales near its base. The Middle Division is greenish to dark gray shales interbedded with many thin beds of dark novaculite. The Upper Division is white, thick bedded, often calcareous novaculite. Conodonts and other microfossils are sometimes common in this formation. The formation rests conformably on the Missouri Mountain Formation at most places, but the presence of conglomerates in a few places suggests a possible minor incipient submarine disconformity. The formation may attain a thickness of up to 900 feet in its southern outcrops, but it thins rapidly to as little as 50 feet to the north.*

### Surface

At the time of the field exploration, the developed portions of the site were predominantly covered by grass with gravel access roads. The undeveloped areas surrounding the existing sludge lagoons were covered by grass and trees. Approximately 4 inches of topsoil was encountered at the boring locations.

### Subsurface Conditions

#### Existing Fill

Existing fill materials extended from the ground surface to depths of about 8 ½ to 13 ½ feet at Borings B-2, B-3, B-4, and SB-1 and below the termination depth of about 20 feet at Boring B-1. The fill materials predominantly consisted of lean clay having varying amounts of silt, sand, and gravel; clayey gravel soils were also encountered, though less prevalent. Varying amounts of organics (sticks) were encountered within the fill at varying depths. The gravel generally consisted of angular chert/quartz and rounded pebbles.

The Existing Fill had very low to moderate shear strength during the exploration. Standard penetration test (SPT) N-values of 2 to 16 blows per foot (bpf) were recorded in the fill.

### Stratum I – Native Lean Clay Soils

Underlying the existing fill materials at Borings B-2, B-3, B-4, and SB-1 as well as below the ground surface at Borings SB-2 through SB-4, native, medium stiff to very stiff, lean clays and very loose, clayey sand soils were encountered and extended to depths of about 2 to 17 feet below existing grades. The Stratum I lean clays contained varying amounts of sand and gravel.

The Stratum I soils had low to moderate shear strength. N-values of 3 to 12 bpf were recorded in the Stratum I soils. Partial N-values of 40 blows for 6 inches of penetration and 50 blows for 2 inches of penetration were recorded in very dense, clayey sand at Boring SB-2.

### Stratum II – Clayey Gravel Soils

Underlying Stratum I soils at Borings B-4 and SB-1 through SB-4, native, medium dense to very dense, clayey gravel soils were encountered and extended to depths of about 8 to 18 ½ feet below existing grades. Also, hard chert or quartz was encountered at a depth of about 13 ½ feet at Boring SB-2. The gravel generally consisted of angular chert and quartz.

The Stratum II clayey gravels had moderate to high shear strength. N-values of 11 to 42 bpf and up to 50 blows for 4 inches of penetration were recorded in the Stratum II gravels.

### Stratum III – Shale

Directly underlying the Strata I and II native soils, moderately hard to hard shale was encountered and extended to termination depths of about 14 to 19 feet below existing grades at Borings B-2 through B-4 and SB-4. The upper portion of the shale was highly weathered at Boring B-3.

The Stratum III shale and chert/quartz had high shear strength. N-values of 50 blows for 1 to 5 inches of penetration were recorded in the Stratum III rock materials.

### **Auger Refusal/Hard Drilling Conditions**

Hard drilling conditions were encountered in shale (Stratum III) beginning at depths of about 8 to 17 feet below existing grades at Borings B-2 through B-4, SB-2, and SB-4. Also, hard drilling conditions were encountered within the very dense clayey sand and underlying clayey gravel soils (deeper portion of Stratum I and in Stratum II) beginning at a depth of about 5 feet at Boring SB-2. Auger refusal occurred while drilling in shale at depths of about 16 to 19 feet below existing grades at Borings B-2 through B-4, which were planned to be drilled to 20 feet.

### **Water Measurements**

Water observations were made by the drill crew while drilling and immediately after completing the borings. Free water was observed at depths of about 14 to 17 feet below existing grades

while drilling Borings B-2 through B-4. Water was also observed in these three borings at depths of about 10 to 17 ½ feet below existing grades immediately after completing the borings. No free water was observed while drilling or after completion at the remaining boring locations. The borings were backfilled with soil cuttings and bentonite after completing the field work and further water observations were not possible.

The depths to water are date-dependent measurements of groundwater levels at the time of the field exploration. Perched water could develop in the existing fill and Stratum I lean clay soils as well as near the soil-rock interface. Long-term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in these soil and rock types. The installation and periodic measurement of monitoring wells would be required to establish seasonal piezometric surfaces below this project site.

## GEOTECHNICAL ENGINEERING ANALYSIS

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### Geotechnical Considerations

#### Existing Fill

As previously described, existing fill extended from the ground surface to depths of about 8 ½ to 13 ½ feet at Borings B-2, B-3, B-4, and SB-1 and below the termination depth of about 20 feet at Boring B-1. The existing fill generally consisted of lean clay soil materials having very low to medium shear strength (N-values ranging from 2 to 16).

GTS, Inc. has no information regarding the placement and compaction history of the existing fill materials. Based on the varying composition and SPT N-values measured in the fill materials, we consider the existing fill materials to be poorly constructed in general accordance with current standard industry practices. There is a potential risk of unpredictable settlement and performance by constructing the new fills and the lagoons above the existing fill. This risk cannot be eliminated unless the existing fill materials are removed and replaced full depth with new fill constructed as recommended in this report. Based on our understanding of the planned new site development, we anticipate that the existing fill materials will likely be excavated and/or reconstructed, at least partially mitigating this risk.

#### Low Shear Strength Soils

In addition to the low-strength, existing fill materials, surficial, very loose, clayey sand was encountered at Boring SB-2 and extended to a depth of about 2 feet below existing grade. These low strength soils are not suitable for supporting new fills in their current condition. Where encountered, we recommend removing and replacing any low-strength soils full depth within the lagoon footprint areas and slopes. Recommendations are provided in the Mass Grading Recommendations section of this report for mitigating any low-strength soils.

#### Moisture Sensitive Soils

The existing fill materials and native lean clay soils are moisture-sensitive and subject to strength loss with increases in moisture content and when exposed to repetitive construction traffic during moderately wet to wet conditions. Ground improvement will likely be required during moderately wet to wet periods of the year and when wet site conditions develop.

#### Difficult Excavation

As previously described, hard drilling conditions were encountered in very dense clayey sand, clayey gravel, and shale beginning at depths of about 5 to 17 feet below existing grades at Borings B-2 through B-4, SB-2, and SB-4. Auger refusal occurred while drilling in shale at

depths of about 16 to 19 feet below existing grades at Borings B-2 through B-4. Based on the understood site grading, rock excavation means and methods are likely to be necessary near the depths and boring locations where hard drilling/auger refusal was encountered.

### **IBC Site Classification**

The subsurface conditions encountered at the boring locations are consistent with a Site Class C per the International Building Code (IBC), 2021 Edition. Boring B-4 was drilled to a depth of approximately 19 feet below the existing ground surface and terminated in shale. The subsurface conditions below the boring depth to 100 feet were estimated based on our knowledge of regional geologic conditions. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depths.

The following mapped acceleration parameters may be used in design in accordance with 2021 IBC (ASCE7-16):

- $S_s$ : 0.230g
- $S_1$ : 0.109g
- $F_a$ : 1.3
- $F_v$ : 1.5
- $S_{DS}$ : 0.200g
- $S_{D1}$ : 0.109g
- $PGA_M$ : 0.148g

These values were obtained using on-line seismic tools provided by the OSHPD/SEAOC (seismicmaps.org) at the Boring B-4 of Latitude: 34.549617°, Longitude: -93.180332°.

## MASS GRADING RECOMMENDATIONS

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The following recommendations are provided for constructing the new lagoons.

### Stripping of Surface Materials

Mass grading should extend a minimum of 5 feet outside of the lagoon footprints in all directions, which includes the berm footprints. Surface organics, trees and root bulbs, debris, and any surface or subsurface structures from previous site use should be removed from the areas of planned new construction. The topsoil material may be stockpiled and reused for landscaping, at the discretion of the design team.

The existing lagoons should be drained and dried. The sludge materials should not be re-used as fill for this project and should be budgeted to be hauled off or wasted away from the new lagoons.

We anticipate that existing fill materials will be encountered in the planned new lagoon subgrade after removal of the existing lagoons. As previously discussed, we recommend full-depth removal and replacement of the existing fill with new select fill. Based on the results of the laboratory testing, the existing fill materials could be re-used as select fill provided that they are tested, approved, and constructed as recommended in this report.

### General Mass Grading

After stripping surface materials, completing cuts necessary for grading, and completing any undercut to remove existing fill and low-strength soils, and before placing new fill, the exposed soils should be evaluated by GTS.

The exposed soils in the planned lagoon footprints should be evaluated for stability through proofrolling with a loaded, tandem-axle dump truck weighing at least 25 tons. In areas inaccessible to proofrolling, the exposed subgrade soils should be evaluated by GTS using hand probes, static cone penetrometer testing, and/or dynamic cone penetrometer testing. If shale (Stratum III) is exposed in the subgrade, the shale does not require proofrolling.

Where unstable soils are identified by proofrolling or other methods, they should be scarified, moisture conditioned, and compacted, or removed and replaced full depth with new select fill if they cannot be stabilized in place.

After proofrolling and removing and replacing any unstable or unsuitable soils, the exposed subgrade soils should be scarified a minimum depth of 9 inches, moisture conditioned and compacted as recommended in the Geotechnical Report Requirements and Specifications section of this report. Intact shale will not require scarification and compaction, but it should be cleaned of loose soil and rock pieces. After scarification and compaction, the exposed soils are suitable for the placement and compaction of new approved, select fill material.

If the prepared subgrade should become saturated, desiccated, frozen, or otherwise damaged prior to construction of the next lift of fill, the affected subgrade material should be scarified, moisture-conditioned and compacted prior to placing new fill.

### **Fill Placement**

Lifts of fill material required to reach plan finished subgrade elevation should be composed of tested and approved fill material and placed per the specifications shown in this report. Fill should be placed in near-horizontal lifts beginning in areas requiring the deepest amount of fill. The fill should be benched into the existing fill and native soils each lift. Fill should not be placed on frozen, saturated, desiccated, or unstable soils.

For constructing new soil fill on the lagoon berm slopes, the new materials should be benched into the existing slopes. The bench widths should be established based on the size of the equipment used to compact the fill. Bench heights should also be established based on the ability of the compaction equipment to sufficiently compact lifts of soil fill at the design slopes.

Any new soil fill slopes should be constructed (overbuilt) at least 5 feet wider than the planned finished slope face to achieve full compaction of the fill materials within the final slope. After compaction, the fill slope could then be cut to finished grade.

The requirements to meet for select fill material are provided in the Geotechnical Report Requirements and Specifications section of this report.

### **Re-Use of On-Site Soils as Fill**

Based on the results of the laboratory testing, the on-site existing fill materials (lean clays and clayey gravels) as well as the on-site lean clay, clayey sand, and clayey gravel soils could be re-used as select fill. We expect that the existing fill and native soils will likely be intermixed during mass grading. Larger, bulk samples of the on-site soils proposed for use as fill by the contractor should be sampled by GTS during mass grading and laboratory tested to confirm the apparent classification of these soils prior to re-use.

Imported soil fill for use as select fill should be tested and approved prior to use as fill on this site. Imported soil fill containing rock will need to be crushed into pieces no greater than 3 inches in any dimension prior to use.

### **Utility Backfill**

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. Utility trenches are a common source of water infiltration and migration. If utility trenches are backfilled with relatively clean granular material,

they should be capped with at least 18 inches of cohesive fill to reduce the infiltration and conveyance of surface water through the trench backfill.

### **Grading and Drainage**

During construction, grades should be developed to direct surface water flow away from or around the site. Exposed subgrades should be sloped to provide positive drainage so that saturation of the subgrade is avoided. Surface water should not be permitted to accumulate on the site to reduce the potential for strength loss of the subgrade soils.

Water was observed at depths of about 10 to 17 ½ feet below existing grades while drilling and after completing Borings B-2 through B-4. The observed water levels might be affected by the water levels in the existing lagoons. If water develops in excavations, we anticipate that sump pits and suction pumps could be used to alleviate the water seepage. The need for dewatering and dewatering system design should be based on the actual subsurface water conditions encountered at the time of construction.

### **Difficult Excavation Potential**

Based on the subsurface conditions encountered at the boring locations, we expect that the existing fill materials and native clay (Stratum I and portions of Stratum II) soils can be excavated using conventional excavation equipment. We expect that a heavy-duty track hoe will be required to excavate the very dense clayey sand and clayey gravel soils encountered at Boring SB-2. If required to excavate shale (Stratum III), we expect that heavy-duty excavation equipment with rock ripping and rock teeth attachments will likely be required.

In general, track hoes and dozers with rock excavation attachments are expected to be required below the depths where we encountered hard drilling. The use of hydraulic or pneumatic hammers and rock breakers are expected to be required near and below the depths where we encountered hard drilling. Controlled blasting could be required to excavate rock below the depths where we encountered auger refusal.

Greater rock excavation effort is expected in limited access excavations, such as for utility trenches. Rock excavation during mass grading is anticipated to be less difficult than in limited access excavations due to presence of clay seams, degree of weathering, natural fracturing, and layering in the shale, chert, and quartz beds.

### **Temporary Earth Slopes and Excavations**

Temporary earth slopes will be constructed during development of the project site. The recommended maximum temporary slopes for the existing fill materials and native soils are 2 H:1 V (Horizontal:Vertical) and for the deeper, hard shale is nearly vertical. Alternatively, local

construction practices allow for benched excavations (4 feet vertical followed by 4 feet horizontal) with an effective slope of 1H:1V.

The contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of the excavation sides and bottom. All excavations should comply with applicable local, state, and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards.

### Permanent Earth Slopes

Constructed cut and fill earth slopes are planned for the new lagoons and surrounding slopes at the project site. As summarized in the Project Information section, we understand that the planned new lagoons will be surrounded by levees with a finished grade elevation of 440.50 feet. The lagoon bottom elevations will range from about EL 420 to 425 feet. The northern lagoon will have slopes that range from 3.6H:1V to 2.5H:1V. The southern lagoon will have slopes that range from 3.3H:1V to 3.1H:1V.

The areas of the site located outside of the levee perimeters will have varying slopes that range from as steep as 1.5H:1V (Horizontal to Vertical) in the northern portion of the overall site, 3.6H:1V in the eastern portion, and 3.0H:1V in the southern portion.

Table 1 below summarizes recommended slopes for permanent cut and fill earth slopes for this project. Based on designing permanent slopes for this project using the recommended maximum slopes in Table 1, we anticipate a minimum factor of safety of 1.3 for long-term slopes constructed as recommended in this report.

**Table 1 : Recommended Maximum Slopes for Permanent Earth Slopes**

| On-Site Materials                                                                                                              | Recommended Maximum Slope <sup>1</sup><br>(horizontal:vertical) |
|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| On-Site, Native, Stiff to Hard, Lean Clay; Medium Dense to Dense Clayey Sand and Clayey Gravel (Strata I and II) Soils         | 3H:1V                                                           |
| Native, Very Dense, Clayey Gravel (portions of Stratum II) and Intact, Soft, Highly Weathered Shale (Stratum III) <sup>3</sup> | 1.5H:1V                                                         |
| Intact, Moderately Hard to Hard, Dark Gray Shale <sup>3</sup>                                                                  | 0.5H:1V                                                         |
| Newly Placed and Compacted Fill Material <sup>2</sup>                                                                          | 3H:1V                                                           |

***Continued from Page 15.***

- <sup>1</sup> The given slope does not account for a surcharge or flooding/saturation.
- <sup>2</sup> The given slope is recommended provided the fill material meets the requirements provided in the Geotechnical Report Requirements and Specifications section of this report.
- <sup>3</sup> The slope should be further refined based on a visual evaluation of the differential weathering and jointing of the rock during mass grading by a GTS engineer.

Based on the subsurface conditions encountered at Boring SB-2 for the northern cut slope, we anticipate that the 1.6H:1V cut slope can be achieved in the very dense clayey sand and clayey gravel soils. However, the upper 5 feet consisting of very loose to loose clayey sand at Boring SB-2 should be sloped at 3H:1V or armored with rip rap, concrete/shotcrete, or other mechanical stabilization.

The fill materials and native clay/gravel soils encountered at Borings SB-1 and SB-4 are not suitable for the designed 1.6H:1V slope in the northern portion of the lagoon. Mechanical stabilization or armoring will be required to construct this portion of the lagoon slope.

Slope stability analysis should be performed for steeper and/or taller permanent slopes. If the slopes shown on the Grading Plan provided to us are required for the design, we recommend that slope stability analyses be performed to evaluate these slopes. Depending on the slope design requirements, rapid-drawdown and steady-state flow conditions should also be evaluated. GTS can provide slope stability services after the final design plans have been completed, if interested.

Permanent cut slopes should be protected by vegetation or other means to reduce the potential for erosion, or shallow, localized sloughing. Also, to reduce the potential of surface water from running over the crest of the cut slopes onto the cut slopes, we recommend surface drainage ditches be constructed along the top of the cut slopes a few feet behind the crest where necessary to intercept surface runoff from upslope. These ditches should discharge at locations beyond the ends of the cut slopes.

## GEOTECHNICAL REPORT REQUIREMENTS and SPECIFICATIONS

Unless otherwise stated in this report, the recommendations contained in this report are based on the compaction specifications and material types noted in Table 2, Table 3, and the paragraphs on the following page.

**Table 2: Compaction Criteria**

| Type of Material                                                       | Moisture-Density Specification | Minimum Dry Density (percentage of Proctor) | Range from Optimum Moisture Content (%) |
|------------------------------------------------------------------------|--------------------------------|---------------------------------------------|-----------------------------------------|
| Select Fill Material – New Lagoon Berms and Slopes                     | ASTM D1557 (Modified Proctor)  | 95                                          | -2 to +2                                |
| General Fill Material – Outside of the Planned Lagoon Berms and Slopes | ASTM D1557 (Modified Proctor)  | 95                                          | -1 to +3                                |
| ARDOT Class 7 Aggregate Base Course, if needed                         | ASTM D1557 (Modified Proctor)  | 95                                          | Adequate to Achieve Compaction          |

**Table 3: Soil Fill Material Requirements**

| Type of Soil Fill | Location/Use                                 | Maximum LL <sup>1</sup> | Maximum PI <sup>1</sup> | USCS Classifications                                                      |
|-------------------|----------------------------------------------|-------------------------|-------------------------|---------------------------------------------------------------------------|
| Select            | All Areas                                    | 45                      | 20                      | CL, SC, SP, SW, SM, SP-SC, GC, GP, GW, GM, GP-GC, Crushed Rock            |
| General           | Areas outside of the Lagoon Berms and Slopes | 50                      | 30                      | CL, CL-CH, CH, SC, SP, SW, SM, SP-SC, GC, GP, GW, GM, GP-GC, Crushed Rock |

Fill material should have a maximum nominal aggregate size of 3 inches or less after placement and compaction.

Fill needed for site grading and constructing the lagoon berms should be placed in loose lifts not exceeding 9 inches in thickness (compacted lift thickness of approximately 6 to 7 inches). We recommend the fill be tested for density every lift during site grading, with a minimum of one test every 10,000 square feet of the structure area. The recommended moisture content and compaction of the fill should be maintained until fills are completed.

## **SUBSURFACE EXPLORATION and PROCEDURES**

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The subsurface exploration consisted of drilling and sampling at a total of eight (8) boring locations, identified as Borings B-1 through B-4 and SB-1 through SB-4. Borings B-1 through B-4 were drilled to depths of about 16 to 20 feet below existing grades within the existing berms to be removed as part of the new lagoon construction. Borings SB-1 through SB-4 were drilled to depths of about 13 ½ to 15 feet below existing grades within the planned lagoons and the planned cut slopes.

The boring locations were established in the field by GTS using a commercial hand-held GPS unit. The approximate boring locations are shown on the attached Boring Location Diagrams. The ground surface elevations were estimated from the ground surface contours shown on the Grading Plan provided to us by Crist Engineers, Inc. The elevations are rounded to the nearest whole foot and shown near the top of the boring logs. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used to define them. The results of the borings are provided in Appendix A.

The borings were drilled with a truck-mounted Geoprobe 3100GT drill rig. Disturbed samples and estimates of the in-situ shear strengths of the existing fill, natural soils, and weathered rock were obtained using an automatic-hammer-driven split-barrel sampler in general accordance with the Standard Penetration Test (SPT) at the boring locations.

An automatic SPT-hammer was used to advance the split-barrel sampler in the boreholes. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Two composite bulk samples, identified as Bulk #1 and Bulk #2, were collected from auger cuttings at selected boring locations. Bulk sample Bulk #1 was comprised of auger cuttings collected from depths of about 5 to 10 feet below existing grades at Borings B-1 through B-3. Bulk sample Bulk #2 was comprised of auger cuttings collected from depths of about 1 to 5 feet below existing grades at Borings SB-2 through SB-4.

The soil and rock samples obtained in the field were sealed to reduce moisture loss and taken to the GTS soil laboratory for further examination, testing, and classification. The results of laboratory tests on select samples are shown on the boring logs and are presented in Appendix B.

Field logs were prepared during the drilling and sampling of the borings. These logs report sampling methods, sampling intervals, soil, rock, and groundwater conditions, and notes regarding soil, rock, and drilling conditions observed between sample depths. The final boring logs, included in this report, have been prepared based on the field logs and have been modified, where appropriate, based on the results of the laboratory observation.

## LABORATORY TESTING and PROCEDURES

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The soil samples were examined in the laboratory by an experienced geotechnical engineer and classified based on the soil's texture and plasticity, in accordance with the Unified Soil Classification System. The estimated Unified Soil Classification System group symbols are shown on the boring logs.

Hand penetrometer tests were performed on select intact cohesive samples. Unfactored hand penetrometer test values are shown on the boring logs as filled squares.

The laboratory testing was performed by GTS, Inc. in general accordance with the American Society for Testing and Materials (ASTM) test designations shown in the table below:

**Table 4: Laboratory Test Method Designations**

| Laboratory Test                      | Test Designation | Method (if applicable) |
|--------------------------------------|------------------|------------------------|
| Moisture Content of Soil             | ASTM D2216-10    | Method A               |
| Visual Classification of Soil Types  | ASTM D2488       |                        |
| USCS Classification                  | ASTM D2487       |                        |
| Atterberg Limits                     | ASTM D4318       | Method A               |
| Sieve Analysis                       | ASTM D422        |                        |
| Percent Passing No. 200 Sieve (P200) | ASTM D1140       |                        |
| Modified Proctor                     | ASTM D1557       | Method C               |

The results of the laboratory testing are presented on the boring logs and in Appendix B.

## GEOTECHNICAL REPORT LIMITATIONS

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The recommendations contained in this report are based on our interpretation of subsurface conditions encountered at the discrete boring locations. Variations between the subsurface conditions anticipated in this report and actual project site conditions may occur away from the boring locations.

If significant differences between the findings of the borings and site conditions are observed, GTS, Inc. should be contacted to assess the variation and, if necessary, reevaluate the recommendations contained in this report.

## ENVIRONMENTAL EXCLUSION

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A Geotechnical Engineering Report assesses the engineering properties of soil and rock. No environmental assessment of a project site is performed during a geotechnical exploration. If the owner is concerned about the potential for environmental hazards at the project site, additional studies should be performed by GTS, Inc.

**Crist Engineers, Inc.**

Planned Waste Sludge Lagoons  
Ouachita Water Treatment Plant  
903 Cozy Acres Road  
Mountain Pine, Arkansas  
GTS Project No. 23-55032



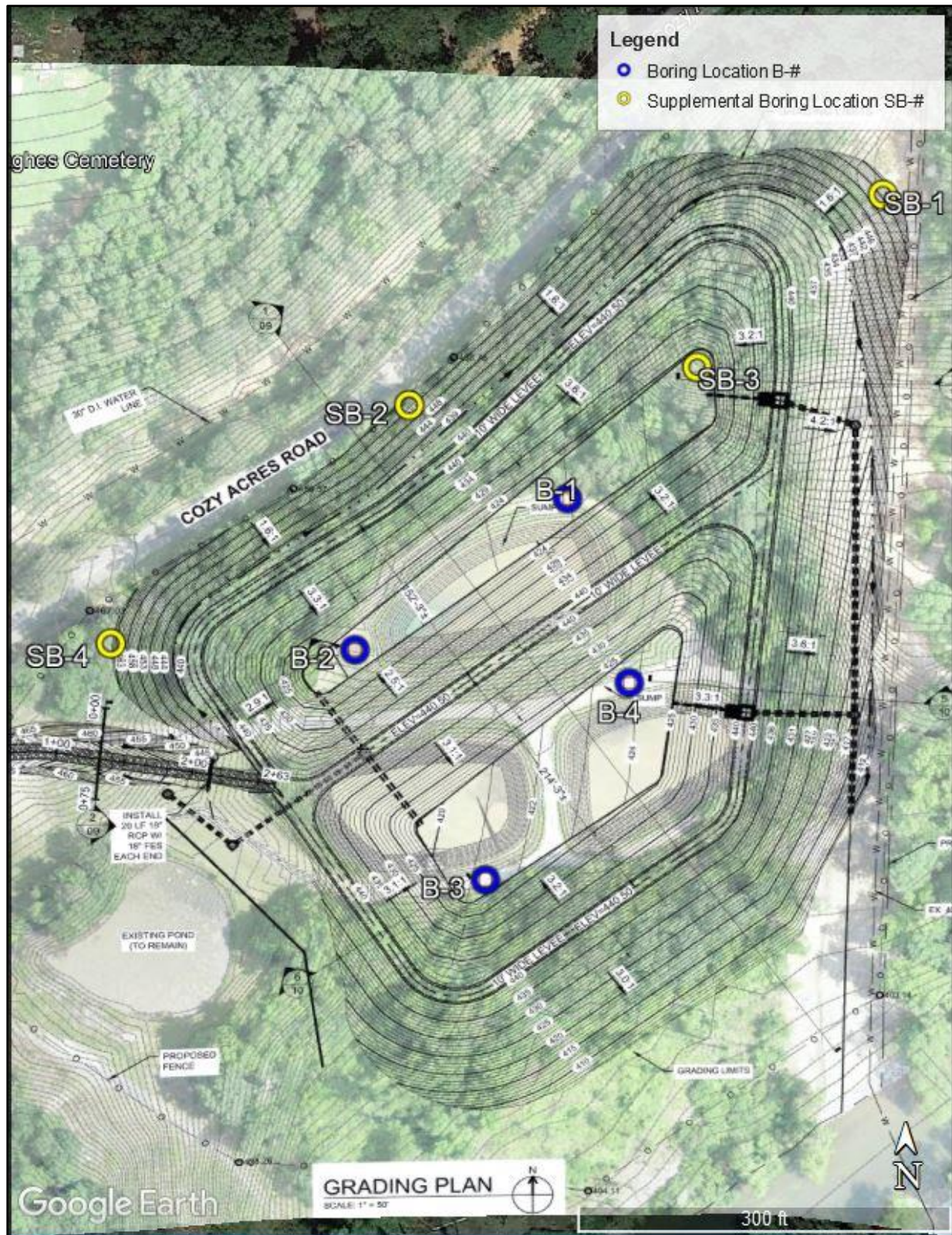
## APPENDIX A

Boring Location Diagrams

Boring Logs

Soil Classification Legend

Rock Classification Legend



**Boring Location Diagram (Site Grading Plan)**



**Boring Location Diagram (Google Earth Image)**

# LOG OF BORING NO.B-1

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, New North Lagoon

| DEPTH, FT | SYMBOL                                                                             | SAMPLES                                                                            | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                                      | USCS | %<#200    | HAND PENETROMETER, TSF ■ |     |     |     | BLOWS PER FT |    |    |
|-----------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------|----------------|----------------------------------------------------------------------------------------------|------|-----------|--------------------------|-----|-----|-----|--------------|----|----|
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      |           | LAB. COHESION, TSF ▲     |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      |           | WATER CONTENT, % ●       |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches                                        |      |           | 0.4                      | 0.8 | 1.2 | 1.6 |              |    |    |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      |           | PL  —————  LL            |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      |           | 20                       | 40  | 60  | 80  |              |    |    |
| 0         |  |  |            |                | El.=440.0                                                                                    |      |           |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    | 1          | 18             | FILL: Clayey Gravel, with sand brown and reddish brown                                       | FILL |           | ●                        |     |     |     |              | 15 |    |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      | El.=438.0 |                          |     |     |     |              |    |    |
| 2.5       |                                                                                    |                                                                                    | 2          | 15             | FILL: Silty Lean Clay brown and grayish brown, trace organics (thin sticks)                  | FILL |           | ●                        | ├─  |     |     |              | 10 |    |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      | El.=436.5 |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    | 3          | 18             | FILL: Lean Clay brown and grayish brown, trace sand and gravel, trace organics (thin sticks) | FILL |           | ●                        | ├─  |     |     |              | 9  |    |
| 5         |                                                                                    |                                                                                    |            |                |                                                                                              |      | El.=435.0 |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    | 4          | 13             | FILL: Gravelly Lean Clay brown and reddish brown, with sand                                  | FILL |           | ●                        |     |     |     |              |    | 16 |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |
| 7.5       |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    |            |                | El.=431.5                                                                                    |      |           |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    | 5          | 15             | FILL: Sandy Lean Clay reddish brown                                                          |      |           | ●                        | ├─  |     |     | 7            |    |    |
| 10        |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |
| 12.5      |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    | 6          | 3              |                                                                                              | FILL |           |                          |     |     |     | 10           |    |    |
| 15        |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |
|           |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |
| 17.5      |                                                                                    |                                                                                    |            |                |                                                                                              |      |           |                          |     |     |     |              |    |    |

COMPLETION DEPTH: 20 ft.

DATE: 9/13/2023

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

DEPTH TO WATER: DURING DRILLING: Dry

AT COMPLETION: Dry

AT 24 HOURS: Backfilled



Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

Project No.: 23-55032Page 2 of 2

# LOG OF BORING NO.B-2

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, New North Lagoon

| DEPTH, FT | SYMBOL | SAMPLES | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                                     | USCS | %<#200 | HAND PENETROMETER, TSF<br>LAB. COHESION, TSF<br>0.4 0.8 1.2 1.6<br>WATER CONTENT, %<br>PL LL<br>20 40 60 80 | BLOWS PER FT |
|-----------|--------|---------|------------|----------------|---------------------------------------------------------------------------------------------|------|--------|-------------------------------------------------------------------------------------------------------------|--------------|
| 0         |        |         |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches                                       |      |        |                                                                                                             |              |
|           |        |         | 1          | 15             | FILL: Sandy Lean Clay<br>reddish brown, trace gravel                                        | FILL |        |                                                                                                             | 5            |
| 2.5       |        |         | 2          | 9              | FILL: Lean Clay<br>brown, dark brown, and reddish brown,<br>with sand and gravel            |      |        |                                                                                                             | 5            |
|           |        |         | 3          | 12             | - less gravel, reddish brown only, moist<br>below about 3½ feet                             |      |        |                                                                                                             | 5            |
| 5         |        |         | 4          |                |                                                                                             | FILL |        |                                                                                                             | 19           |
| 7.5       |        |         |            |                |                                                                                             |      |        |                                                                                                             |              |
| 10        |        |         | 5          |                | FILL: Sandy Lean Clay<br>reddish brown, trace gravel (angular<br>chert and rounded pebbles) | FILL |        |                                                                                                             | 12           |
| 12.5      |        |         |            |                |                                                                                             |      |        |                                                                                                             |              |
| 15        |        |         | 6          | 18             | LEAN CLAY<br>stiff, light gray and light brown, trace<br>shale fragments                    | CL   |        |                                                                                                             | 12           |
| 17.5      |        |         | 7          | 0              | SHALE<br>hard, dark gray                                                                    | ROCK |        |                                                                                                             | 50/1"        |

COMPLETION DEPTH: 17.1 ft.

DATE: 9/13/2023

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

DEPTH TO WATER: DURING DRILLING: 14 ft.

AT COMPLETION: 10 ft.

AT 24 HOURS: Backfilled

# LOG OF BORING NO.B-2

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, New North Lagoon

| DEPTH, FT | SYMBOL | SAMPLES | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL    | USCS | %<#200 | HAND PENETROMETER, TSF ■ |     |     |     | BLOWS PER FT |  |
|-----------|--------|---------|------------|----------------|----------------------------|------|--------|--------------------------|-----|-----|-----|--------------|--|
|           |        |         |            |                |                            |      |        | LAB. COHESION, TSF ▲     |     |     |     |              |  |
|           |        |         |            |                |                            |      |        | 0.4                      | 0.8 | 1.2 | 1.6 |              |  |
|           |        |         |            |                |                            |      |        | WATER CONTENT, % •       |     |     |     |              |  |
|           |        |         |            |                |                            |      |        | PL ————— LL              |     |     |     |              |  |
|           |        |         |            |                |                            |      |        | 20                       | 40  | 60  | 80  |              |  |
|           |        |         |            |                | El.=424.9-                 |      |        |                          |     |     |     |              |  |
|           |        |         |            |                | BOTTOM OF BORING AND AUGER |      |        |                          |     |     |     |              |  |
|           |        |         |            |                | REFUSAL ON BLACK SHALE AT  |      |        |                          |     |     |     |              |  |
|           |        |         |            |                | ABOUT 17 FEET              |      |        |                          |     |     |     |              |  |
| 20        |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
| 22.5      |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
| 25        |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
| 27.5      |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
| 30        |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
| 32.5      |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
| 35        |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                            |      |        |                          |     |     |     |              |  |

# LOG OF BORING NO.B-3

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**  
Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, New South Lagoon

| DEPTH, FT | SYMBOL                                                                                                                                                                                                                                                            | SAMPLES                                                                             | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                                                              | USCS      | %<#200 | HAND PENETROMETER, TSF ■ |     |     |                 | BLOWS PER FT |  |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------|----------------|----------------------------------------------------------------------------------------------------------------------|-----------|--------|--------------------------|-----|-----|-----------------|--------------|--|
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        | LAB. COHESION, TSF ▲     |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        | WATER CONTENT, % ●       |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches                                                                |           |        | 0.4                      | 0.8 | 1.2 | 1.6             |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        | PL ————— LL              |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        | 20                       | 40  | 60  | 80              |              |  |
| 0         |                                                                                                                                                                                 |   |            |                | El.=430.0                                                                                                            |           |        |                          |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     | 1          | 18             | <u>FILL: Lean Clay</u><br>brown and yellowish brown, with sand<br>and rounded gravel (pebbles)                       | FILL      |        | ●                        |     |     |                 | 11           |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      | El.=428.0 |        |                          |     |     |                 |              |  |
| 2.5       |                                                                                                                                                                                                                                                                   |                                                                                     | 2          | 9              | <u>FILL: Gravelly Lean Clay</u><br>brown, reddish brown, light gray, and<br>yellowish brown, trace organics (sticks) | FILL      |        | ●                        |     |     |                 | 6            |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      | El.=426.5 |        |                          |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     | 3          | 8              | <u>FILL: Sandy Lean Clay</u><br>reddish brown, moist                                                                 | FILL      |        | ●                        |     | ■   |                 | 2            |  |
| 5         |                                                                                                                                                                                                                                                                   |                                                                                     |            |                | - changing to brown, reddish brown,<br>and dark brown, trace organics (sticks)<br>below about 5 feet                 |           |        | ●                        |     |     |                 | 6            |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     | 4          | 12             |                                                                                                                      |           |        |                          |     |     |                 |              |  |
| 7.5       |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        |                          |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     | 5          | 7              | - changing to reddish brown, trace sand<br>and chert gravel below about 8½ feet                                      |           | 64     | ●                        |     |     |                 | 5            |  |
| 10        |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        |                          |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        |                          |     |     |                 |              |  |
| 12.5      |                                                                                                                                                                                                                                                                   |                                                                                     |            |                |                                                                                                                      |           |        |                          |     |     |                 |              |  |
|           | <br><br> |  |            |                | El.=417.0                                                                                                            | CL        |        |                          |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     | 6          | 15             | <u>LEAN CLAY</u><br>very stiff, light brown, light gray, and<br>yellowish brown, with shale fragments                | ROCK      |        | ●                        |     |     | 30/6",<br>50/5" |              |  |
| 15        |                                                                                                                                                                                                                                                                   |                                                                                     |            |                | <u>HIGHLY WEATHERED SHALE</u><br>soft, grayish brown                                                                 | ROCK      |        |                          |     |     |                 |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     | 7          | 4              | <u>SHALE</u><br>hard, dark gray                                                                                      |           |        |                          |     |     | 50/4"           |              |  |
|           |                                                                                                                                                                                                                                                                   |                                                                                     |            |                | El.=414.0                                                                                                            |           |        |                          |     |     |                 |              |  |
| 17.5      |                                                                                                                                                                                                                                                                   |                                                                                     |            |                | BOTTOM OF BORING AND AUGER<br>REFUSAL ON BLACK SHALE AT<br>ABOUT 16 FEET                                             |           |        |                          |     |     |                 |              |  |

COMPLETION DEPTH: 16 ft.

DEPTH TO WATER: DURING DRILLING: 15 ft.

DATE: 9/13/2023

AT COMPLETION: 15 ft.

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

AT 24 HOURS: Backfilled

# LOG OF BORING NO.B-4

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, New South Lagoon

| DEPTH, FT | SYMBOL | SAMPLES | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                                                | USCS | %<#200 | HAND PENETROMETER, TSF ■<br>LAB. COHESION, TSF ▲<br>0.4 0.8 1.2 1.6<br>WATER CONTENT, % ●<br>PL ——— LL<br>20 40 60 80 | BLOWS PER FT |
|-----------|--------|---------|------------|----------------|--------------------------------------------------------------------------------------------------------|------|--------|-----------------------------------------------------------------------------------------------------------------------|--------------|
| 0         |        |         |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches                                                  |      |        |                                                                                                                       |              |
| 1         |        |         | 1          | 18             | FILL: Gravelly Lean Clay<br>brown and reddish brown                                                    | FILL |        |                                                                                                                       | 12           |
| 2.5       |        |         | 2          | 12             |                                                                                                        |      |        |                                                                                                                       |              |
| 3         |        |         | 3          | 0              | FILL: Sandy Lean Clay<br>reddish brown                                                                 |      |        |                                                                                                                       | 11           |
| 4         |        |         | 4          | 0              |                                                                                                        | FILL | 52     |                                                                                                                       | 2            |
| 5         |        |         |            |                |                                                                                                        |      |        |                                                                                                                       | 9            |
| 7.5       |        |         |            |                |                                                                                                        |      |        |                                                                                                                       |              |
| 10        |        |         | 5          | 18             | LEAN CLAY<br>stiff, reddish brown, light gray, light brown, and yellowish brown, trace sand and gravel | CL   |        |                                                                                                                       | 10           |
| 12.5      |        |         |            |                |                                                                                                        |      |        |                                                                                                                       |              |
| 15        |        |         | 6          | 14             | CLAYEY GRAVEL<br>medium dense, brown, light brown, and gray, with shale fragments                      | GC   |        |                                                                                                                       | 29           |
| 17.5      |        |         | 7          | 4              |                                                                                                        |      |        |                                                                                                                       | 50/4"        |

COMPLETION DEPTH: 19 ft.

DATE: 9/13/2023

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

DEPTH TO WATER: DURING DRILLING: 17 ft.

AT COMPLETION: 17.5 ft.

AT 24 HOURS: Backfilled

# LOG OF BORING NO.B-4

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, New South Lagoon

| DEPTH, FT | SYMBOL | SAMPLES | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                  | USCS | %<#200 | HAND PENETROMETER, TSF ■ |     |     |     | BLOWS PER FT |  |
|-----------|--------|---------|------------|----------------|--------------------------------------------------------------------------|------|--------|--------------------------|-----|-----|-----|--------------|--|
|           |        |         |            |                |                                                                          |      |        | LAB. COHESION, TSF ▲     |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        | 0.4                      | 0.8 | 1.2 | 1.6 |              |  |
|           |        |         |            |                |                                                                          |      |        | WATER CONTENT, % •       |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        | PL ————— LL              |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        | 20                       | 40  | 60  | 80  |              |  |
|           |        |         |            |                | SHALE<br>hard, dark gray                                                 | ROCK |        |                          |     |     |     |              |  |
|           |        |         |            |                | El.=413.0                                                                |      |        |                          |     |     |     |              |  |
| 20        |        |         |            |                | BOTTOM OF BORING AND AUGER<br>REFUSAL ON BLACK SHALE AT<br>ABOUT 19 FEET |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
| 22.5      |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
| 25        |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
| 27.5      |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
| 30        |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
| 32.5      |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
| 35        |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |
|           |        |         |            |                |                                                                          |      |        |                          |     |     |     |              |  |

# LOG OF BORING NO.SB-1

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, Northeast Cut Slope

| DEPTH, FT | SYMBOL                                                                              | SAMPLES                                                                             | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                              | USCS | %<#200 | HAND PENETROMETER, TSF ■ |     |     |     | BLOWS PER FT |   |
|-----------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------|----------------|--------------------------------------------------------------------------------------|------|--------|--------------------------|-----|-----|-----|--------------|---|
|           |                                                                                     |                                                                                     |            |                |                                                                                      |      |        | LAB. COHESION, TSF ▲     |     |     |     |              |   |
|           |                                                                                     |                                                                                     |            |                |                                                                                      |      |        | WATER CONTENT, % ●       |     |     |     |              |   |
|           |                                                                                     |                                                                                     |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches                                |      |        | 0.4                      | 0.8 | 1.2 | 1.6 |              |   |
|           |                                                                                     |                                                                                     |            |                |                                                                                      |      |        | PL                       | LL  |     |     |              |   |
|           |                                                                                     |                                                                                     |            |                |                                                                                      |      |        | 20                       | 40  | 60  | 80  |              |   |
| 0         |    |    | 1          | 9              | POSSIBLE FILL: Lean Clay<br>brown and reddish brown, with sand<br>and gravel (chert) | FILL |        | ●                        |     |     |     |              | 3 |
| 2.5       |                                                                                     |                                                                                     | 2          | 0              | POSSIBLE FILL: Lean Clay<br>reddish brown, trace sand and gravel                     | FILL |        | ●                        |     |     |     |              | 8 |
|           |                                                                                     |                                                                                     | 3          | 0              |                                                                                      |      | ●      |                          |     |     |     | 12           |   |
| 5         |                                                                                     |                                                                                     | 4          | 0              |                                                                                      |      | ●      |                          |     |     |     | 11           |   |
| 7.5       |  |  |            |                |                                                                                      |      |        |                          |     |     |     |              |   |
|           |                                                                                     |                                                                                     | 5          | 16             | SANDY LEAN CLAY<br>medium stiff, reddish brown and brown,<br>trace rootlets          | CL   |        | ●                        |     |     |     | 5            |   |
| 10        |                                                                                     |                                                                                     |            |                |                                                                                      |      |        |                          |     |     |     |              |   |
| 12.5      |  |  |            |                |                                                                                      |      |        |                          |     |     |     |              |   |
|           |                                                                                     |                                                                                     | 6          | 18             | CLAYEY GRAVEL<br>medium dense, reddish brown and<br>brown, with sand, chert gravel   | GC   |        | ●                        |     |     |     | 14           |   |
| 15        |                                                                                     |                                                                                     |            |                | BOTTOM OF BORING AT ABOUT 15<br>FEET                                                 |      |        |                          |     |     |     |              |   |
| 17.5      |                                                                                     |                                                                                     |            |                |                                                                                      |      |        |                          |     |     |     |              |   |

COMPLETION DEPTH: 15 ft.

DATE: 9/13/2023

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

DEPTH TO WATER: DURING DRILLING: Dry

AT COMPLETION: Dry

AT 24 HOURS: Backfilled



# LOG OF BORING NO.SB-2

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, North Cut Slope

| DEPTH, FT | SYMBOL | SAMPLES | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                                     | USCS | %<#200 | HAND PENETROMETER, TSF ■<br>LAB. COHESION, TSF ▲<br>0.4 0.8 1.2 1.6<br>WATER CONTENT, % ●<br>PL ——— LL<br>20 40 60 80 | BLOWS PER FT    |
|-----------|--------|---------|------------|----------------|---------------------------------------------------------------------------------------------|------|--------|-----------------------------------------------------------------------------------------------------------------------|-----------------|
| 0         |        |         |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches<br>El.=460.0                          |      |        |                                                                                                                       |                 |
| 2.5       |        |         | 1          | 4              | CLAYEY SAND, with gravel<br>very loose to loose, brown                                      |      |        |                                                                                                                       | 3               |
|           |        |         | 2          | 12             |                                                                                             |      |        |                                                                                                                       | 9               |
|           |        |         | 3          | 15             | - medium dense at about 3½ feet                                                             | SC   |        |                                                                                                                       | 22              |
| 5         |        |         | 4          | 15             | - very dense at about 5 feet                                                                |      |        |                                                                                                                       | 40/6",<br>50/2" |
| 7.5       |        |         |            |                |                                                                                             |      |        |                                                                                                                       |                 |
| 10        |        |         | 5          | 16             | CLAYEY GRAVEL<br>very dense, reddish brown and brown,<br>with sandy clay seams<br>El.=451.5 | GC   |        |                                                                                                                       | 48/6",<br>50/4" |
| 12.5      |        |         |            |                |                                                                                             |      |        |                                                                                                                       |                 |
|           |        |         | 6          | 1              | CHERT/QUARTZ GRAVEL<br>very dense, white and light gray<br>El.=447.0                        | GP   |        |                                                                                                                       | 50/1"           |
| 15        |        |         |            |                | El.=446.4<br>BOTTOM OF BORING AT ABOUT 13½ FEET                                             |      |        |                                                                                                                       |                 |
| 17.5      |        |         |            |                |                                                                                             |      |        |                                                                                                                       |                 |

COMPLETION DEPTH: 13.6 ft.

DEPTH TO WATER: DURING DRILLING: Dry

DATE: 9/13/2023

AT COMPLETION: Dry

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

AT 24 HOURS: Backfilled

# LOG OF BORING NO.SB-3

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**

Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, New North Lagoon

| DEPTH, FT | SYMBOL | SAMPLES | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                                                 | USCS | %<#200 | HAND PENETROMETER, TSF ■<br>LAB. COHESION, TSF ▲<br>0.4 0.8 1.2 1.6<br>WATER CONTENT, % ●<br>PL ————— LL<br>20 40 60 80 | BLOWS PER FT |
|-----------|--------|---------|------------|----------------|---------------------------------------------------------------------------------------------------------|------|--------|-------------------------------------------------------------------------------------------------------------------------|--------------|
| 0         |        |         |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches                                                   |      |        |                                                                                                                         |              |
|           |        |         | 1          | 18             | El.=445.0<br><u>LEAN CLAY</u><br>very stiff, brown, with sand, trace gravel                             | CL   |        | ●                                                                                                                       | 18           |
| 2.5       |        |         | 2          | 15             | El.=443.0<br><u>CLAYEY GRAVEL</u><br>medium dense, brown and reddish<br>brown, chert gravel             | GC   |        | ●                                                                                                                       | 22           |
|           |        |         | 3          | 15             |                                                                                                         |      |        | ●                                                                                                                       | 20           |
| 5         |        |         | 4          | 10             |                                                                                                         |      |        | ●                                                                                                                       | 27           |
| 7.5       |        |         |            |                |                                                                                                         |      |        |                                                                                                                         |              |
|           |        |         | 5          | 18             | El.=436.5<br><u>CLAYEY GRAVEL</u><br>medium dense, gray and light brown,<br>with sand, trace clay seams | GC   |        | ●                                                                                                                       | 11           |
| 10        |        |         |            |                |                                                                                                         |      |        |                                                                                                                         |              |
| 12.5      |        |         | 6          | 18             |                                                                                                         |      |        |                                                                                                                         | 28           |
| 15        |        |         |            |                | El.=430.0<br>BOTTOM OF BORING AT ABOUT 15<br>FEET                                                       |      |        |                                                                                                                         |              |
| 17.5      |        |         |            |                |                                                                                                         |      |        |                                                                                                                         |              |

COMPLETION DEPTH: 15 ft.

DATE: 9/13/2023

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

DEPTH TO WATER: DURING DRILLING: Dry

AT COMPLETION: Dry

AT 24 HOURS: Backfilled



# LOG OF BORING NO.SB-4

Planned Ouachita Water Treatment Plant Waste Sludge Lagoons  
903 Cozy Acres Road, Mountain Pine, Arkansas

**GTS, Inc.**  
Geotechnical & Testing Services

Fayetteville, AR

Project No.: 23-55032

Location: Refer to Boring Location Diagram, Northwest Cut Slope

| DEPTH, FT | SYMBOL | SAMPLES | SAMPLE No. | RECOVERY (in.) | DESCRIPTION OF MATERIAL                                                             | USCS | %<#200 | HAND PENETROMETER, TSF ■<br>LAB. COHESION, TSF ▲<br>0.4 0.8 1.2 1.6<br>WATER CONTENT, % ●<br>PL ——— LL<br>20 40 60 80 | BLOWS PER FT |
|-----------|--------|---------|------------|----------------|-------------------------------------------------------------------------------------|------|--------|-----------------------------------------------------------------------------------------------------------------------|--------------|
| 0         |        |         |            |                | Surface Description=Bare Ground<br>Topsoil = 4 inches                               |      |        |                                                                                                                       |              |
|           |        |         | 1          | 15             | LEAN CLAY<br>stiff, brown                                                           | CL   |        |                                                                                                                       | 12           |
| 2.5       |        |         | 2          | 12             | CLAYEY GRAVEL<br>medium dense to dense, brown and reddish brown                     | GC   |        |                                                                                                                       | 24           |
|           |        |         | 3          | 18             |                                                                                     |      |        |                                                                                                                       | 37           |
| 5         |        |         | 4          | 18             |                                                                                     |      |        |                                                                                                                       | 42           |
| 7.5       |        |         |            |                |                                                                                     |      |        |                                                                                                                       |              |
|           |        |         | 5          | 5              | SHALE, with chert/quartz layers<br>soft to moderately hard, grayish brown and brown | ROCK |        |                                                                                                                       | 50/5"        |
| 10        |        |         |            |                |                                                                                     |      |        |                                                                                                                       |              |
| 12.5      |        |         |            |                |                                                                                     |      |        |                                                                                                                       |              |
|           |        |         | 6          | 3              |                                                                                     |      |        |                                                                                                                       | 50/3"        |
| 15        |        |         |            |                | BOTTOM OF BORING AT ABOUT 14 FEET                                                   |      |        |                                                                                                                       |              |
| 17.5      |        |         |            |                |                                                                                     |      |        |                                                                                                                       |              |

COMPLETION DEPTH: 13.8 ft.

DATE: 9/13/2023

RIG: Geoprobe 3100GT, Truck-Mounted Rig, Automatic Hammer

DEPTH TO WATER: DURING DRILLING: Dry

AT COMPLETION: Dry

AT 24 HOURS: Backfilled



# SOIL CLASSIFICATION LEGEND

| APPARENT CONSISTENCY OF COHESIVE SOILS (PECK, HANSON & THORNBURN 1974, AASHTO 1988) |                                      |                                  |                  |                                                         |
|-------------------------------------------------------------------------------------|--------------------------------------|----------------------------------|------------------|---------------------------------------------------------|
| Descriptor                                                                          | SPT N <sub>60</sub><br>(blows/foot)* | Pocket Penetrometer,<br>Qp (tsf) | Torvane<br>(tsf) | Field Approximation                                     |
| Very Soft                                                                           | < 2                                  | < 0.25                           | < 0.12           | Easily penetrated several inches by fist                |
| Soft                                                                                | 2 – 4                                | 0.25 – 0.50                      | 0.12 – 0.25      | Easily penetrated several inches by thumb               |
| Medium Stiff                                                                        | 5 – 7                                | 0.50 – 1.0                       | 0.25 – 0.50      | Penetrated several inches by thumb w/moderate effort    |
| Stiff                                                                               | 8 – 12                               | 1.0 – 2.0                        | 0.50 – 1.0       | Readily indented by thumbnail                           |
| Very Stiff                                                                          | 12 – 30                              | 2.0 – 4.0                        | 1.0 – 2.0        | Indented by thumb but penetrated only with great effort |
| Hard                                                                                | > 30                                 | > 4.0                            | > 2.0            | Indented by thumbnail with difficulty                   |

\* Using SPT N<sub>60</sub> is considered a crude approximation for cohesive soils.

| APPARENT DENSITY OF COHESIONLESS SOILS (AASHTO 1988) |                                        |
|------------------------------------------------------|----------------------------------------|
| Descriptor                                           | SPT N <sub>60</sub> Value (blows/foot) |
| Very Loose                                           | 0 – 3                                  |
| Loose                                                | 4 – 8                                  |
| Medium Dense                                         | 9 – 29                                 |
| Dense                                                | 30 – 49                                |
| Very Dense                                           | ≥ 50                                   |

| MOISTURE (ASTM D2488-06) |                                                                                                                     |
|--------------------------|---------------------------------------------------------------------------------------------------------------------|
| Descriptor               | Criteria                                                                                                            |
| Dry                      | Absence of moisture, dusty, dry to the touch, well below optimum moisture content (per ASTM D698 or D1557)          |
| Moist                    | Damp but no visible water                                                                                           |
| Wet                      | Visible free water, usually soil is below water table, well above optimum moisture content (per ASTM D698 or D1557) |

| PERCENT OR PROPORTION OF SOILS (ASTM D2488-06)                                                                        |                                          |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Descriptor                                                                                                            | Criteria                                 |
| Trace                                                                                                                 | Particles are present but estimated < 5% |
| Few                                                                                                                   | 5 – 10%                                  |
| Little                                                                                                                | 15 – 25%                                 |
| Some                                                                                                                  | 30 – 45%                                 |
| Mostly                                                                                                                | 50 – 100%                                |
| Percentages are estimated to nearest 5% in the field. Use "about" unless percentages are based on laboratory testing. |                                          |

| SOIL PARTICLE SIZE (ASTM D2488-06) |                                                                                                    |
|------------------------------------|----------------------------------------------------------------------------------------------------|
| Descriptor                         | Size                                                                                               |
| Boulder                            | > 12 inches                                                                                        |
| Cobble                             | 3 to 12 inches                                                                                     |
| Gravel - Coarse<br>Fine            | ¾ inch to 3 inches<br>No. 4 sieve to ¾ inch                                                        |
| Sand - Coarse<br>Medium<br>Fine    | No. 10 to No. 4 sieve (4.75mm)<br>No. 40 to No. 10 sieve (2mm)<br>No. 200 to No. 40 sieve (.425mm) |
| Silt and Clay ("fines")            | Passing No. 200 sieve (0.075mm)                                                                    |

| UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2488)                           |                                                     |                   |              |                                                                        |
|---------------------------------------------------------------------------|-----------------------------------------------------|-------------------|--------------|------------------------------------------------------------------------|
| Major Division                                                            |                                                     |                   | Group Symbol | Description                                                            |
| <b>Coarse Grained Soils</b><br><br>(more than 50% retained on #200 sieve) | <b>Gravel</b> (50% or more retained on No. 4 sieve) | Clean Gravel      | GW           | Well-graded gravels and gravel-sand mixtures, little or no fines       |
|                                                                           |                                                     |                   | GP           | Poorly graded gravels and gravel-sand mixtures, little or no fines     |
|                                                                           |                                                     | Gravel with fines | GM           | Silty gravels and gravel-sand-silt mixtures                            |
|                                                                           |                                                     |                   | GC           | Clayey gravels and gravel-sand-clay mixtures                           |
|                                                                           | <b>Sand</b> (> 50% passing No. 4 sieve)             | Clean sand        | SW           | Well-graded sands and gravelly sands, little or no fines               |
|                                                                           |                                                     |                   | SP           | Poorly-graded sands and gravelly sands, little or no fines             |
|                                                                           |                                                     | Sand with fines   | SM           | Silty sands and sand-silt mixtures                                     |
|                                                                           |                                                     |                   | SC           | Clayey sands and sand-clay mixtures                                    |
| <b>Fine Grained Soils</b><br><br>(50% or more passing #200 sieve)         | <b>Silt and Clay</b> (liquid limit < 50)            |                   | ML           | Inorganic silts, rock flour and clayey silts                           |
|                                                                           |                                                     |                   | CL           | Inorganic clays of low-medium plasticity, gravelly, sandy & lean clays |
|                                                                           |                                                     |                   | OL           | Organic silts and organic silty clays of low plasticity                |
|                                                                           | <b>Silt and Clay</b> (liquid limit > 50)            |                   | MH           | Inorganic silts and clayey silts                                       |
|                                                                           |                                                     |                   | CH           | Inorganic clays or high plasticity, fat clays                          |
|                                                                           |                                                     |                   | OH           | Organic clays of medium to high plasticity                             |
| <b>Highly Organic Soils</b>                                               |                                                     |                   | PT           | Peat, muck and other highly organic soils                              |



| GRAPHIC SYMBOL LEGEND |  |                                               |
|-----------------------|--|-----------------------------------------------|
| SPT                   |  | Standard Penetration Test (2" OD), ASTM D1586 |
| GRAB                  |  | Grab Sample                                   |
| ST                    |  | Shelby Tube, ASTM D1587 (pushed)              |
| AUGER                 |  | Boring Advanced Through Drilling              |
| CORE                  |  | Rock coring                                   |

# ROCK CLASSIFICATION LEGEND

| WEATHERING DESCRIPTORS FOR INTACT ROCK (USBR, 2001) |                                                                                                                                                                   |                                                                        |                                                                                          |                                                                                                                              |                                                      |                                                                                                                                                          |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Descriptor                                          | Chemical Weathering-Discoloration-Oxidation                                                                                                                       |                                                                        | Mechanical Weathering and Grain Boundary Conditions                                      | Texture and Solutioning                                                                                                      |                                                      | General Characteristics                                                                                                                                  |
|                                                     | Body of Rock                                                                                                                                                      | Fracture Surfaces                                                      |                                                                                          | Texture                                                                                                                      | Solutioning                                          |                                                                                                                                                          |
| Fresh                                               | No discoloration, not oxidized                                                                                                                                    | No discoloration or oxidation                                          | No separation, intact (tight)                                                            | No change                                                                                                                    | No solutioning                                       | Hammer rings when crystalline rocks are struck                                                                                                           |
| Slightly Weathered                                  | Discoloration or oxidation limited to surface or short distance from fractures; some feldspar crystals are dull                                                   | Minor or complete discoloration or oxidation of most surfaces          | No visible separation, intact (tight)                                                    | Preserved                                                                                                                    | Minor leaching of some soluble minerals may be noted | Hammer rings when crystalline rocks are struck; body of rock not weakened                                                                                |
| Moderately Weathered                                | Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy"                                  | All fracture surfaces are discolored or oxidized                       | Partial separation of boundaries visible                                                 | Generally preserved                                                                                                          | Soluble minerals may be mostly leached               | Hammer does not ring when rock is struck; body of rock is slightly weakened                                                                              |
| Intensely Weathered                                 | Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent or chemical alteration produces in-situ disaggregation | All fracture surfaces are discolored or oxidized; surfaces are friable | Partial separation; rock is friable; granitics are disaggregated in semi-arid conditions | Altered by chemical disaggregation such as via hydration or argillation                                                      | Leaching of soluble minerals may be complete         | Dull sound when struck with hammer; usually can be broken with moderate to heavy manual pressure or by light hammer blow; rock is significantly weakened |
| Decomposed                                          | Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay        |                                                                        | Complete separation of grain boundaries (disaggregation)                                 | Resembles a soil; partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete |                                                      | Can be granulated by hand; resistant minerals such as quartz may be present as "stringers" or "dikes"                                                    |

| RELATIVE STRENGTH OF INTACT ROCK |                                     |
|----------------------------------|-------------------------------------|
| Descriptor                       | Uniaxial Compressive Strength (psi) |
| Extremely Hard                   | > 30,000                            |
| Very Hard                        | 14,500 – 30,000                     |
| Hard                             | 7,000 – 14,500                      |
| Moderately Hard                  | 3,500 – 7,000                       |
| Soft                             | 700 – 3,500                         |
| Very Soft                        | 150 – 700                           |
| Extremely Soft                   | < 150                               |

| BEDDING SPACING (modified USBR, 2001) |                              |
|---------------------------------------|------------------------------|
| Descriptor                            | Thickness or Spacing         |
| Massive                               | > 10 feet                    |
| Very thickly bedded                   | 3 to 10 feet                 |
| Thickly bedded                        | 1 to 3 feet                  |
| Moderately bedded                     | 3-5/8 inches to 1 foot       |
| Thinly Bedded                         | 1-1/4 inches to 3-5/8 inches |
| Very thinly bedded                    | 3/8 inch to 1-1/4 inches     |
| Laminated                             | < 3/8 inch                   |

| CORE RECOVERY CALCULATION (%)                                                                   |
|-------------------------------------------------------------------------------------------------|
| = $\frac{\text{length of recovered core pieces}}{\text{total length of core run}} \times 100\%$ |

| RQD CALCULATION (%)                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------|
| = $\frac{\text{length of intact core pieces} > 4 \text{ in}}{\text{total length of core run (inches)}} \times 100\%$ |



| ROCK HARDNESS (modified USBR, 2001) |                                                                                                                                                |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Descriptor                          | Criteria                                                                                                                                       |
| Extremely hard                      | Cannot be scratched with pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows                                      |
| Very hard                           | Cannot be scratched with pocket knife or sharp pick; breaks with repeated heavy hammer blows                                                   |
| Hard                                | Can be scratched with pocket knife or sharp pick with heavy pressure; heavy hammer blows required to break specimen                            |
| Moderately hard                     | Can be scratched with pocket knife or sharp pick with light or moderate pressure; breaks with moderate hammer blows                            |
| Moderately soft                     | Can be grooved 1/16 inch with pocket knife or sharp pick with moderate or heavy pressure; breaks with light hammer blow or heavy hand pressure |
| Soft                                | Can be grooved or gouged with pocket knife or sharp pick with light pressure; breaks with light to moderate hand pressure                      |
| Very soft                           | Can be readily indented, grooved, or gouged with fingernail, or carved with pocket knife; breaks with light hand pressure                      |

## APPENDIX B

Results of Laboratory Classification Tests

Results of Grain Size Distribution Tests

Results of Moisture-Density Relationship (Modified Proctor) Tests

**Plasticity Chart**

For classification of fine-grained soils and fine-grained fraction of coarse-grained soils

Equation of "A" Line  
Horizontal at  $PI=4$  to  $PI=25.5$ , then  $PI=0.73(LL-20)$

Equation of "U" Line  
Vertical at  $LL=16$  to  $PI=7$  then  $PI=0.9(LL-8)$

Soil Classification Regions:

- CH (Clayey Hard)
- OH & MH (Overconsolidated & Medium Plasticity)
- CL (Clayey Low Plasticity)
- ML & OL (Medium Liquid Limit & Organic Liquid Limit)

Soil Data Points (approximate values):

| Soil Type | Liquid Limit (LL) | Plasticity Index (PI) |
|-----------|-------------------|-----------------------|
| CL        | 25                | 5                     |
| ML        | 25                | 7                     |
| CL        | 26                | 10                    |
| ML        | 27                | 10                    |
| CL        | 28                | 11                    |
| ML        | 28                | 11                    |
| CL        | 29                | 12                    |
| ML        | 29                | 12                    |

[illegible]

**GTS, Inc.**  
Geotechnical & Testing Services

**PROJECT** Quachita WTP Sludge Lagoons

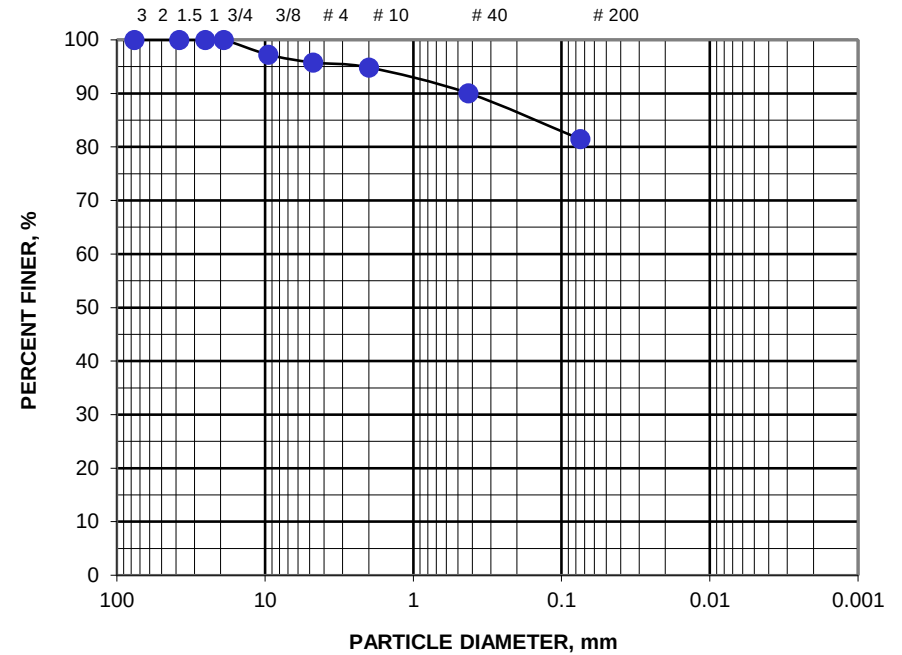
**JOB NO.** 23-55032 **DATE** 10/6/2023

| SAMPLE LOCATION       | B-1, B-2 & B-3                | SIEVE SIZE | PERCENT PASSING |
|-----------------------|-------------------------------|------------|-----------------|
| SAMPLE NO.            | Bulk #1                       | 3.00"      | 100.0%          |
|                       |                               | 1.50"      | 100.0%          |
| DEPTH (FT)            | 5 to 10                       | 1.00"      | 100.0%          |
|                       |                               | 3/4"       | 100.0%          |
| LIQUID LIMIT          | 24                            | 3/8"       | 97.2%           |
|                       |                               | No. 4      | 95.8%           |
| PLASTIC LIMIT         | 19                            | No. 10     | 94.9%           |
|                       |                               | No. 40     | 90.0%           |
| PLASTICITY INDEX      | 5                             | No. 200    | 81.5%           |
| VISUAL CLASSIFICATION | Reddish Brown Sandy Lean Clay |            |                 |

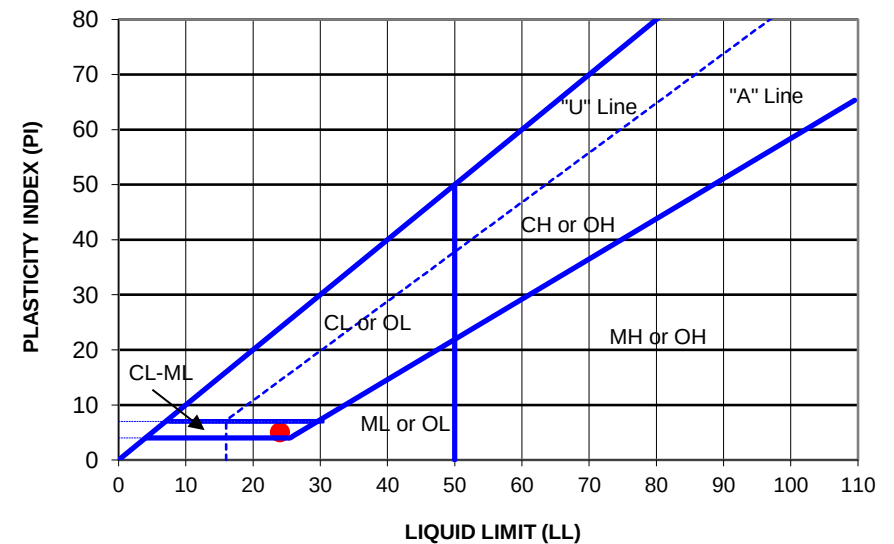
| ASTM DESCRIPTION            | AASHTO CLASSIFICATION | AASHTO GI |
|-----------------------------|-----------------------|-----------|
| Silty Clay with Sand, CL-ML | A-4                   | 2         |

**GRAIN SIZE DISTRIBUTION CURVE**

U.S. STANDARD SIEVE OPENINGS IN INCHES & STANDARD SIEVE NUMBERS



**PLASTICITY CHART**



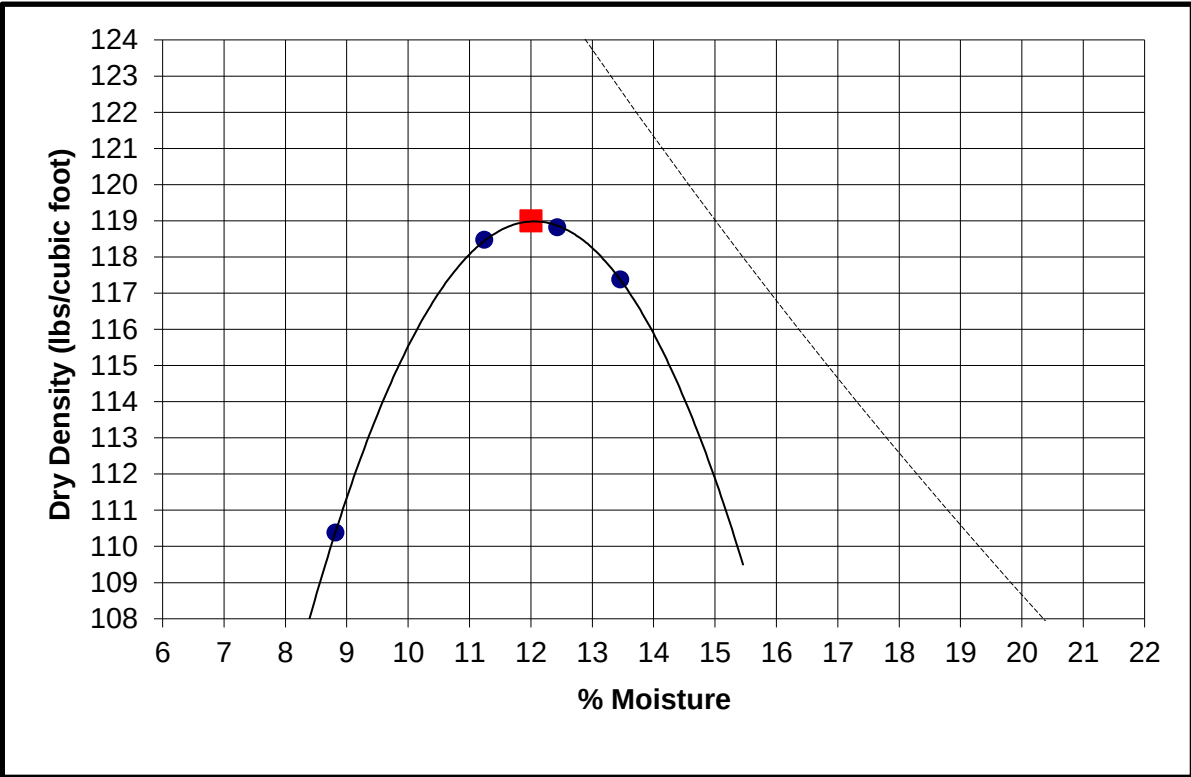




LABORATORY COMPACTION CHARACTERISTICS OF SOIL

|                                                       |                             |              |            |                     |                             |     |    |
|-------------------------------------------------------|-----------------------------|--------------|------------|---------------------|-----------------------------|-----|----|
| CLIENT:                                               | Crist Engineers, Inc.       | DATE:        | 10/6/23    | SAMPLE LOCATION:    | B-1, B-2 & B-3              | LL= | 24 |
| PROJECT NUMBER:                                       | 23-55032                    | SAMPLE NO.   | Bulk #1    | SAMPLE DESCRIPTION: | Silty Clay with Sand, CL-ML | PL= | 19 |
| PROJECT NAME:                                         | Ouachita WTP Sludge Lagoons | TEST METHOD: | ASTM D1557 | AASHTO CLASS.:      | A-4                         | PI= | 5  |
| VISUAL CLASSIFICATION: Reddish Brown, Sandy Lean Clay |                             |              |            |                     |                             |     |    |

|                                          |       |
|------------------------------------------|-------|
| Maximum Dry Density<br>(lbs./cubic foot) | 119.0 |
| Optimum Moisture<br>(percent)            | 12.0  |



## LABORATORY COMPACTION CHARACTERISTICS OF SOIL

CLIENT: Crist Engineers, Inc. DATE: 10/6/23 SAMPLE LOCATION: SB-2, SB-3, SB-4 LL= 24

PROJECT NUMBER: 23-55032 SAMPLE NO. Bulk #2 SAMPLE DESCRIPTION: Silty, Clayey Sand, SC-SM PL= 18

PROJECT NAME: Ouachita WTP Sludge Lagoons TEST METHOD: ASTM D1557 AASHTO CLASS.: A-4 PI= 6

VISUAL CLASSIFICATION: Brown, Silty Sand with Gravel

Maximum Dry Density  
(lbs./cubic foot)

**118.2**

Optimum Moisture  
(percent)

**10.9**

