QORE

PROPERTY SCIENCES

July 24, 2009

Kenvirons, Inc.
452 Versailles Road
Frankfort, KY 40601

Attention: Mr. Ken Taylor, P.E.

Subject: **Report of Geotechnical Exploration**
KY38 AND MARY WYNN WATER TANKS
Harlan County, Kentucky
QORE Project No. 24305400

Dear Mr. Taylor:

QORE, Inc. has completed the geotechnical exploration for the proposed tank. The purpose of this exploration was to obtain subsurface data at the sites pursuant to developing site preparation and foundation recommendations for the proposed construction. We conducted this project according to our proposal KY4934, dated June 15, 2009, which was authorized by Mr. R. Vaughn Williams – Vice President of Kenvirons. Our work scope included exploration at a total of three proposed tank sites and a package waste water treatment plant site. This report covers two of the water tanks. The other tank and package treatment plant sites are covered in separate reports. This report explains our understanding of the project, documents our findings, and presents our conclusions and geotechnical engineering recommendations.

QORE appreciates the opportunity to be of service. We look forward to helping you through project completion. If you have any questions, please call.

Respectfully submitted,

QORE, Inc.

Andrew M. Fiehler, P.E.
Project Engineer
Licensed Kentucky 23,977

STATE OF KENTUCKY — 7/24/09 — ANDREW M. FIEHLER — 23977 — LICENSED PROFESSIONAL ENGINEER

Michael D. Owens
Principal Geotechnical Consultant

Attachments: Report of Geotechnical Exploration
Appendices

S:projects\2009 projects\24305400r01

422 Codell Drive Lexington, Kentucky 40509 (859) 293 5518 fax (859) 299-2481

REPORT OF GEOTECHNICAL EXPLORATION
KY38 AND MARY WYNN WATER TANKS
HARLAN COUNTY, KENTUCKY
QORE Project No. 24305400

TABLE OF CONTENTS

REPORT OF GEOTECHNICAL EXPLORATION
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HARLAN COUNTY, KENTUCKY
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INTRODUCTION

QORE, Inc. has completed the geotechnical exploration for the proposed tank. The purpose of this exploration was to obtain subsurface data at the sites pursuant to developing site preparation and foundation recommendations for the proposed construction. We conducted this project according to our proposal KY4934, dated June 15, 2009, which was authorized by Mr. R. Vaughn Williams – Vice President of Kenvirons. This report explains our understanding of the project, documents our findings, and presents our conclusions and geotechnical engineering recommendations.

SITE DESCRIPTION

This report covers the proposed KY38 and Mary Wynn water tank sites. The KY38 water tank is located near the entrance to the abandoned Darby Mine No. 1 in eastern Harlan County, just north of Kentucky Highway 38. The proposed tank location was located adjacent to a fuel tank and the access drive for the mine in an overgrown area with chest high weeds. The proposed tank site was relatively level, sloping slightly downhill to the south. A small pond is shown on the site plan; however, the area was very overgrown and our field engineer did not observe the pond condition. Likewise, the dam of the pond was overgrown thus our engineer could not assess the condition of the dam.

The Mary Wynn tank is located in a small clearing in the woods along the crest of a ridgeline. The tank is accessed via a gravel road that extends up the hill from KY Highway 38 about 3 miles west of the KY38 Tank site. The hillsides adjacent to the tank site slope steeply downhill away from the tank. The provided topographic mapping indicates the hillsides are at an approximate slope angle of 1.5:1 H:V. Topographic site location maps showing the locations of the two tanks are included in Appendix A.

PROJECT INFORMATION

The information provided to QORE included location plan maps of the proposed tank sites and general information about the proposed tanks. The ground storage tanks will be the same size, with each one holding 47,000 gallons and being approximately 28 feet tall with a diameter of 17 feet.

The tank structural design will be determined by the tank supplier/constructor thus structural loading information and settlement criteria were not available at the time of this report. Considering the height of the tank, we would expect bearing pressures to exceed 2,000 psf. Settlement tolerances for similar tanks are typically 1.5 inches of total settlement and 0.75 inches of differential settlement. Our work scope included only the tank foundations and does not include evaluating the soil conditions along the access road alignment.

SITE GEOLOGY

We reviewed the USGS geologic quadrangle map at each of the tank sites. The KY38 tank is located within the *Keokee Quadrangle* (1971), which indicates the site is underlain by the Wise Formation. The Wise is a mixture of siltstone, shale, sandstone, and coal. The sandstones are generally light colored, medium grained, and moderately quartzose. There are four persistent sandstone members within the Wise with the Clover Fork sandstone being mapped immediately below the site. The Clover Fork varies in thickness from 45 to 65 feet. The shale and siltstone portions of the Wise are generally dark gray and can be indistinguishable. The Wise contains several coal beds and coal zones. Kentucky Cabinet for Mines and Minerals mapping indicates that the Darby Mine No. 1, located at the site, mined the Darby Coal seam which is in the formation below the Wise. The mine mapping does not indicate coal mining immediately beneath the proposed KY38 tank site.

The Mary Wynn tank site is located within the *Louellen Quadrangle (1973)* which indicates the site is underlain by the Mingo Formation. The Mingo Formation is a mixture of sandstone, shale, siltstone and coal. The sandstone is generally light to dark gray and massively bedded. The shale and siltstone are both medium to dark gray with fine sand and are interbedded. The Mingo Formation contains several coal beds/zones including the Kellioka coal bed. Mine mapping information available through the Kentucky Cabinet for Mines and Minerals indicates that there is an active mine whose permit area extends beneath the proposed Mary Wynn tank site. Presently, it does not appear that mining has occurred beneath the tank site based on our review of the available mapping. However, the mine mapping shows that mining is planned in the next two years. The Rex Coal Co, Inc. mine is currently mining the Kellioka coal bed. Based on the geologic mapping, the Kellioka coal bed is between 200 and 250 feet below the tank site elevation.

EXPLORATION METHODS

Field Exploration

We drilled three soil test borings to explore the subsurface conditions at each of the sites. Appendix A contains drawings showing the boring locations and proposed tank location. Mr. Andrew Fiehler, P.E. a QORE staff engineer, was on-site to observe pertinent site features and surface indications of site geology, to direct drilling operations, and to record and log the results of the soil sampling.

We obtained soil samples using a split-barrel sampler driven by an automatic hammer system according to ASTM D1586. Rock coring was used to sample auger refusal material in one boring at each of the sites. The stratification lines shown on the boring records represent the approximate boundaries between soil or rock types. The transitions may be more gradual than shown. Field sampling and testing procedures used by QORE are in general accordance with ASTM procedures and established geotechnical engineering practice. Appendix B contains brief descriptions of field procedures.

Laboratory Testing

Mr. Fiehler returned the recovered soil and rock core samples to the laboratory for testing. QORE performed Atterberg Limits tests and natural moisture content tests on representative samples from each site. Our laboratory test data is summarized in Appendix C.

SUBSURFACE CONDITIONS

Our work scope included exploration of three water tank sites. For ease of record keeping, borings at the KY38 Tank site were numbered in the 200's (i.e. – B-201) and the Mary Wynn Tank site were numbered in the 300's (i.e. – B-301).

KY38 Tank – Our borings encountered what appeared to be mine waste material. The mine waste material was a mixture of sandstone pieces with lean clay and sand. We were able to penetrate between 8 and 15 feet of the mine waste material with our augers before encountering auger refusal. In boring B-203 we encountered auger refusal at a depth of 8.5 feet at which point rock coring was begun. Auger refusal was believed to be encountered on a boulder as the recovered rock core samples were also a mixture of the sandstone pieces. The coring process was advanced to a depth of 24.5 feet in an effort to encounter bedrock before being terminated at the direction of the engineer. Bedrock was not encountered in the core hole.

Free groundwater was not encountered in the open borings at the completion of soil augering. Groundwater levels fluctuate with time due to seasonal rainfall, locally heavy precipitation events, construction activities, and other site-specific factors. Therefore, future groundwater levels may be encountered within the depths explored by our borings. It is common to encounter groundwater in perched or trapped zones within fills such as that encountered at the site. Amounts and flow duration from encountered water vary and depends on site specific characteristics and recent rainfall activity.

Mary Wynn Tank – Our borings encountered residual soils extending from the ground surface. We advanced our borings in the small clearing which was void of topsoil. However, outside of the clearing, we observed a layer of leaf litter and topsoil approximately six to eight inches thick. Boring B-301 encountered auger refusal at a depth of 1.5 feet, at which point rock coring was begun. The recovered core samples consisted of interbedded weathered sandstone and silty sand. The recoveries and the Rock Quality Designations (RQD) for the rock coring process indicated poor quality rock.

In borings B-302 and B-303, we were able to penetrate the weathered rock layers with the augers to a depth 14.3 feet in B-302 and the pre-determined termination depth of 15 .5 feet in B-303. The Standard Penetration Tests (SPT) in borings B-302 and B-303 indicated layers of weathered sandstone and silty sand similar to the recovered samples from B-301.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL DISCUSSION

KY38 Tank - The project site is located on what appears to be a mine waste dump. The site is located at the entrance to an abandoned underground coal mine, which is the likely source of the encountered fill material. We believe it is possible to construct the proposed tank at the project site, provided initial site preparation is performed and some additional design details are included. The site preparation and design details are discussed further in the following sections of the report.

There is an inherent risk of structurally significant settlement involved with leaving any of the existing spoil material in-place beneath the proposed tank. Our recommendations outlined below are intended to help reduce the potential for settlement. To completely remove the risk of settlement of the spoil material would require complete removal of all of the spoil and backfilling the excavation in a controlled manner. Another option for eliminating the risk of settlement of the spoil material would be to found the tank on deep foundations bearing on the underlying bedrock. These options would be more expensive. By constructing the tank on the project site, even implementing our recommendations, the owner must be willing to accept the risk of potentially structurally significant settlement.

Mary Wynn Tank – This tank site is located along the back of a residual ridgeline with steep side slopes. While our borings did not encounter "solid" bedrock, we believe that the encountered subsurface conditions are suitable for supporting the proposed water tank.

For ease of discussion, the following sections of the report outline our recommendations for the KY38 Tank. The recommendations for the Mary Wynn Tank begin on Page 8.

KY38 TANK

EARTHWORK RECOMMENDATIONS

All topsoil and organic materials should be stripped from the tank area to prepare the area for construction. The stripping can be limited to the immediate construction area. The removed topsoil should be spread in "landscape" areas only, outside of the construction area. Organic material should not be utilized as fill material.

To prepare the tank foundation area, we recommend that the tank footprint, plus a buffer of 10 feet, be excavated to a depth equal to the tank diameter below the foundation elevation. In this case a depth of 17 feet. After the excavation subgrade has been observed by a QORE engineer, the excavation can then be backfilled with compacted, structural fill material to the foundation bearing elevation.

The fill material should be compacted to a target density of at least 95 percent of the standard Proctor maximum dry density. Mine spoil used as structural fill should be placed in 6-inch lifts, unless it is demonstrated that adequate compaction is achieved with maximum lifts up to 12 inches thick. The maximum particle size should be limited to 6 inches in any dimension within the upper 2 feet of the foundation subgrade. We recommend limiting the lift thickness to 6 inches in the top 2 feet of the tank subgrade.

The material excavated from the tank footprint should be suitable for use as backfill. A standard Proctor test was not included in the scope of this project. We recommend that a standard Proctor test be performed prior to placement of the fill to determine the compaction criteria. Some selective culling or crushing of large diameter boulders may be required in order to reuse the excavated material as fill.

It has been our experience that the spoil is most adequately compacted by blading the lift into place, compacting with a CAT 825 or similar compactor, and finish rolling with a loaded scraper or haul truck. The compactor breaks down the material and seats the cobbles while the heavy rubber tired equipment provides the compaction. Since the backfill area will likely prevent access by heavy earthwork equipment, additional passes of the compactor will likely be required to achieve the required compaction. Adequacy of the compaction is determined qualitatively with supplemental data provided by the nuclear density gauge. Our evaluation criteria consists of the following:

- Lift thickness
- Particle size and gradation of material
- Intensity and uniformity of compactive effort and number of passes
- Response of the lift to construction traffic
- Moisture content
- Dry density

The dry density is not the determining factor in assessing the adequacy of the compactive effort and approval of the fill lift. If the contractor uses the recommended equipment, conforms with the material specifications, applies a uniform effort over the entire fill lift, traverses over the fill lift under the normal course of placing subsequent material, and the moisture content is within an acceptable range, the fill performance should be acceptable regardless of the density values obtained in the field. Therefore, only highly trained and qualified personnel should monitor fill placement.

The final site grades will also play an important role in the long term performance of the tank and site stability. Our experience with mine waste sites indicates that the materials can degrade and soften when exposed to water. Site grading should direct surface water and tank overflow water away from the tank via paved or concrete lined ditches. A ditch should also be constructed on the uphill side of the tank to direct surface water away from the tank area. Sealing the ground surface around the tank with a layer of clayey soil over the rocky backfill is an effective means of reducing the amount of water allowed into the subgrade.

FOUNDATION RECOMMENDATIONS

We recommend that the tank be designed to bear on a mat foundation, even though we recommend re-grading the tank site. The foundation should be designed for a maximum allowable bearing pressure of 2,000 psf. Our experience with mine waste sites indicates that the materials can degrade and soften when exposed to water. We recommend that once the foundation excavation has been approved by a QORE engineer, the reinforcing steel be placed and the foundation concrete be poured the same day. If this is not possible, a mud mat or layer of lean concrete should be placed in the excavation to protect the approved subgrade. We recommend that the mud mat be at least 4 inches thick and be poured neat to the excavation walls. The mud mat will also allow the reinforcing steel to be placed and kept clean.

We recommend that a French drain be constructed around the perimeter of the tank foundation. The drain should tie into the site drainage to direct the collected water away from the tank and recompacted area. French drains are typically constructed by lining an excavation with filter fabric and backfilling with open graded crushed stone such as KYDOT #57 stone. The filter fabric should be of sufficient length to overlap at the top of the excavation to completely enclose the stone backfill.

A detailed settlement analysis (with consolidation testing) was beyond the scope of this report. When constructing on spoil fill sites such as this one, the Owner must be willing to accept the risk of settlement, even if some ground modification is performed. The risk of settlement is proportional to the depth and age of the fill, as well as the compactive effort applied to the fill during placement. Due to the heterogeneous composition of the spoil fill, it is difficult to accurately predict a magnitude of expected settlement.

Seismic Information

The American Water Works Association (AWWA) site classification definitions (as described in AWWA D100-05) are analogous to the 2007 Kentucky Building Code (KBC) site seismic classifications as defined in Table 1615.1.1 of the code. Based on our evaluation of the subsurface conditions at the project site, we recommend a site classification of "E". This relatively low site classification is based partly on the fact that our borings encountered moderately low consistency spoils within the depths explored and did not encounter any residual soil or bedrock.

MARY WYNN TANK

EARTHWORK RECOMMENDATIONS

All topsoil and organic materials should be stripped from the tank area to prepare the area for construction. The stripping can be limited to the immediate construction area. Based on field observations at the time of drilling, expect stripping depths of about ½ foot to penetrate the topsoil and leaf litter. Removal of trees should include the rootball. The removed topsoil should be spread in "landscape" areas only, outside of the construction area. Organic material should not be utilized as fill material.

Structural Fill Placement

The site plans indicate that about two to three feet of soil fill placement will be required at the tank site. Ideally, structural fill is defined as inorganic natural soil with a maximum particle size of 3 inches and maximum dry density of at least 95 pounds per cubic foot (pcf) when tested by the standard Proctor method (ASTM D698) and a plasticity index (PI) of less than 30 percent. Our laboratory testing indicates that the cut material can be used as structural fill. During construction, standard Proctor testing and Atterberg limits testing of proposed fill soils (on-site and/or off-site) should be performed to determine the maximum dry density and plasticity of the soil prior to use as structural soil fill. Soils with a PI greater than or equal to 30 percent may be used in deeper fills, provided they are kept at least 3 feet below the design subgrade elevation.

Fill placement should occur in relatively thin (6 to 8-inch) layers and be compacted to at least 95 percent of the standard Proctor maximum dry density. The moisture content of the fill should be maintained within 3 percent of the soil's optimum moisture content even though compaction may be achieved at moisture contents outside the specified range.

In-place density testing must be performed on structural fill as a check that the previously recommended compaction criteria have been achieved. This allows our project engineer to monitor the quality of the fill construction and verify that his design criterion is being achieved in the field. We further recommend that these tests be performed on a full-time basis by QORE. The testing frequency for density tests performed on a full-time basis can be determined by our personnel based on the area to be tested, the grading equipment used, and construction schedule. Tests should be performed at vertical intervals of 8-inches or less (the recommended lift thickness) as the fill is being placed.

FOUNDATION RECOMMENDATIONS

Based on the provided design information, we recommend that the tank be founded on a mat foundation. We recommend that the tank foundations be founded on weathered rock and sized for a maximum allowable bearing capacity of 2,500 pounds per square foot (psf). We recommend a minimum foundation bearing elevation of 1821 feet MSL.

Since the foundation bearing surface will likely be weathered sandstone with clay seams, the material will degrade quickly when exposed to water. We recommend that once the foundation excavation has been approved by a QORE engineer, the reinforcing steel be placed and the concrete foundation be poured the same day. If this is not possible, a mud mat or layer of lean concrete can be placed in the excavation to seal the subgrade. We recommend that the mud mat be at least 4 inches thick and be poured neat to the excavation walls. The mud mat will also allow the reinforcing steel to be placed and kept clean.

We also recommend that the site be graded to direct surface water away from the foundations. Backfilling around the foundation with compacted soil fill will help reduce the amount of water which can infiltrate the subgrade.

A detailed settlement analysis with consolidation testing was beyond the scope of this report. With the mat foundation bearing on weathered rock, we anticipate that the settlement will be less than the maximum tolerable settlement of 1.5 inches using the maximum allowable bearing pressure. For this type of foundation system, the differential settlement across the tank is usually about one-half the total settlement.

Seismic Information

The American Water Works Association (AWWA) site classification definitions (as described in AWWA D100-05) are analogous to the 2007 Kentucky Building Code (KBC) site seismic classifications as defined in Table 1615.1.1 of the code. Based on our evaluation of the subsurface conditions at the project site, we recommend a site classification of "C".

FOLLOW-UP SERVICES

Our services should not end with the submission of this geotechnical report. QORE should be kept involved throughout the design and construction process to maintain continuity and to verify that our recommendations are properly interpreted and implemented. To achieve this, we should be retained to review project plans and specifications with the designers to see that our recommendations are fully incorporated. We also should be retained to monitor and test the site preparation and foundation construction. If we are not allowed the opportunity to continue our involvement on this project, we cannot be held responsible for the recommendations in this report.

Foundation construction will be a critical aspect of this project. Our familiarity with the site and with the foundation recommendations will make us a valuable part of your construction quality assurance team. In addition, a qualified engineering technician should observe and test all structural concrete and steel. Only experienced, qualified persons trained in geotechnical engineering and familiar with foundation construction should be allowed to monitor and test foundations. Normally, full-time monitoring of the site work and foundation installation is appropriate.

LIMITATIONS

This report has been prepared for the exclusive use of Kenvirons, Inc. for specific application to this project. Our conclusions and recommendations have been prepared using generally accepted standards of geotechnical engineering practice in the Commonwealth of Kentucky. No other warranty is expressed or implied. This company is not responsible for the conclusions, opinions, or recommendations of others based on these data.

Our conclusions and recommendations are based on the limited design information furnished to us, the data obtained from this geotechnical exploration, and our past experience. They do not reflect variations in the subsurface conditions that are likely to exist between our borings and in unexplored areas of the site resulting from the variability of the soils and bedrock at these sites as well as past fill placement at the KY38 tank site. If such variations become apparent during construction, it will be necessary for us to re-evaluate our conclusions and recommendations based upon on-site observation of the conditions.

If the overall design or location of the water tank is changed, the recommendations contained in this report must not be considered valid unless our firm reviews the changes and our recommendations modified and verified in writing. When the design is finalized, we should be given the opportunity to provide the additional service of reviewing the foundation plan, grading plan, and applicable portions of the project specifications. This review will allow us to check whether these documents are consistent with the intent of our recommendations.

We recommend that the owners retain these services and that QORE be allowed to continue our involvement in the project through these phases of construction. Our firm is not responsible for interpretation of the data contained in this report by others, nor do we accept any responsibility for job site safety, which is the sole responsibility of the contractor.

Important Information about Your

Geotechnical Engineering Report

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

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

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

APPENDIX A

SITE LOCATION/TOPOGRAPHIC MAP

BORING LOCATION PLAN

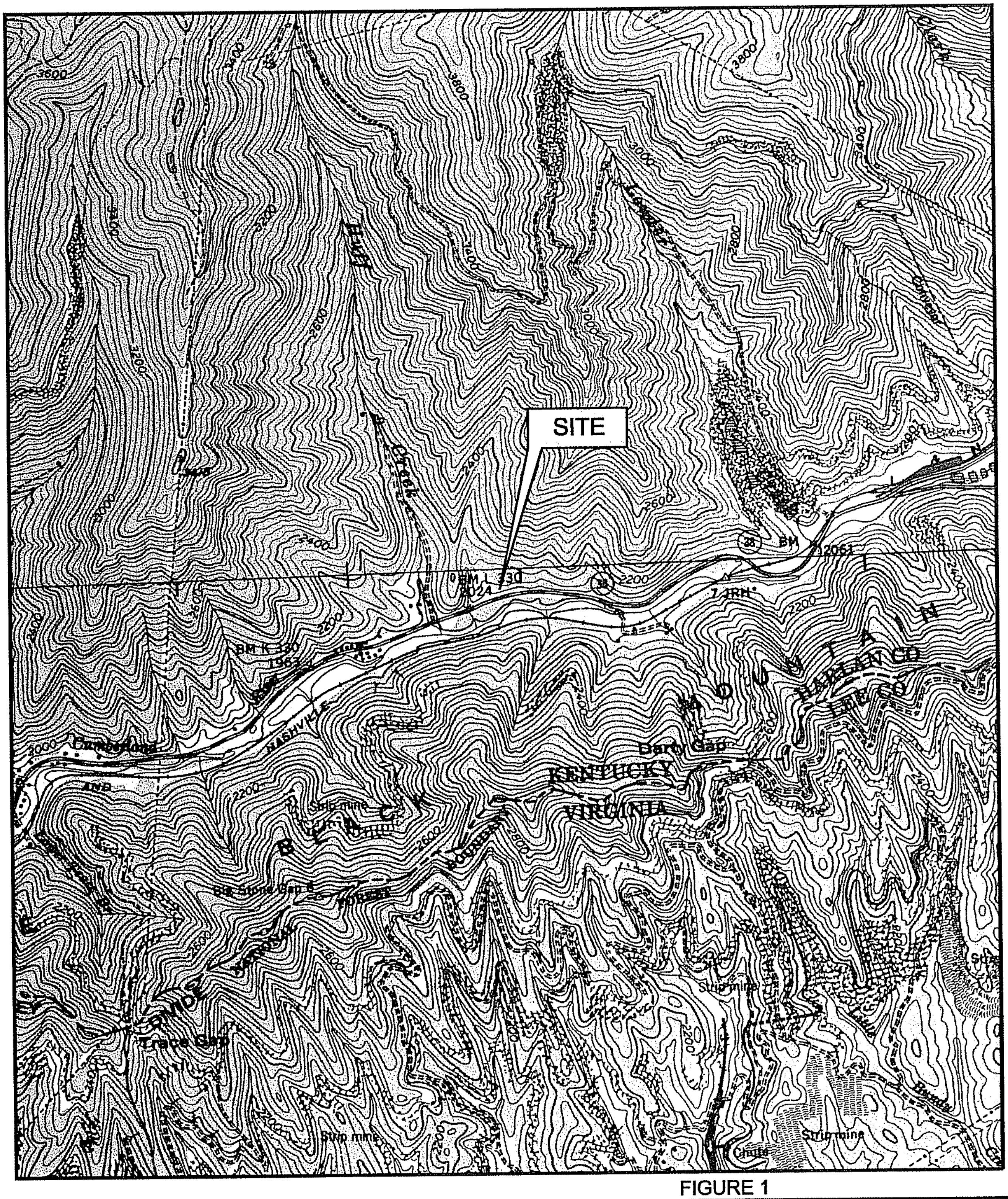


FIGURE 1

SITE LOCATION/TOPOGRAPHIC MAP
KY 38 WATER STORAGE TANK

LOCATION: HARLAN COUNTY, KENTUCKY

QORE PROJECT NUMBER: 24305400

BLACK MOUNTAIN UTILITY DISTRICT

N

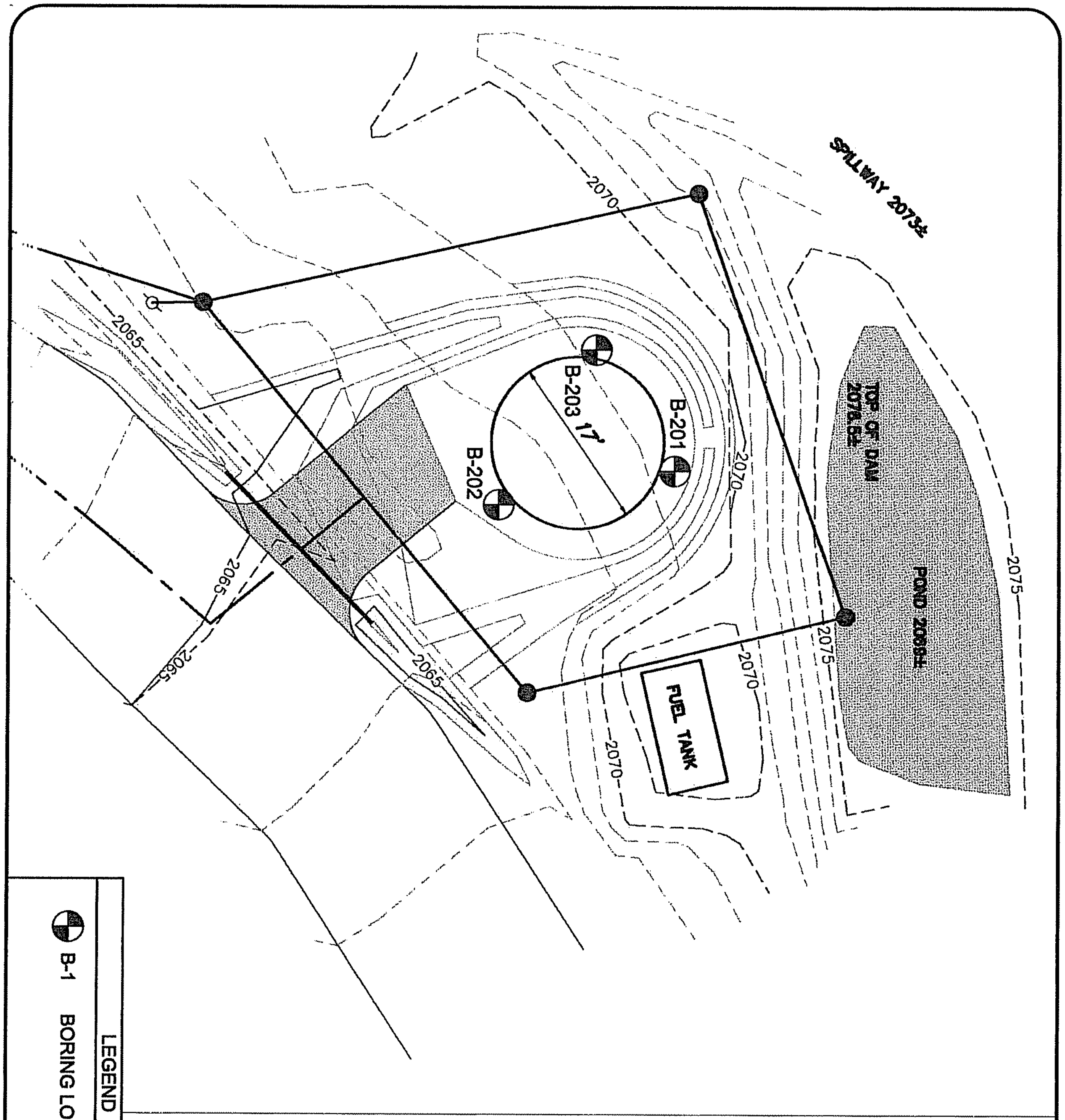
0 1000 2000 3000

GRAPHIC SCALE IN FEET

SCALE: 1" = 2000'
DATE: 7/3/2009
DRAWN BY: RLW
CHECKED BY: AMF

SOURCE:
USGS TOPOGRAPHIC MAP
BENHAM, KY DATED 1979
KEOKEE, KY DATED 1978

QORE PROPERTY SCIENCES
422 CODELL DRIVE, LEXINGTON, KENTUCKY 40509
PHONE (859) 293-5518 / FAX (859) 299-2481



LEGEND

B-1 BORING LOCATION

Graphic Scale: 1" = 10'

10' 0 10'

FIGURE 2
SOUNDING LOCATION PLAN
BLACK MOUNTAIN UTILITY DISTRICT
KY 38 WATER STORAGE TANK
HARLAN COUNTY, KENTUCKY

DATE:	7/3/2009
REV. DATE:	
SCALE:	1" = 10'
CHECKED BY:	AMF
DRAWN BY:	RJW
PROJECT NO.:	24305400

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422 Codell Drive - Lexington, KY 40509
Phone (859) 293-5518 - Fax (859) 299-2481

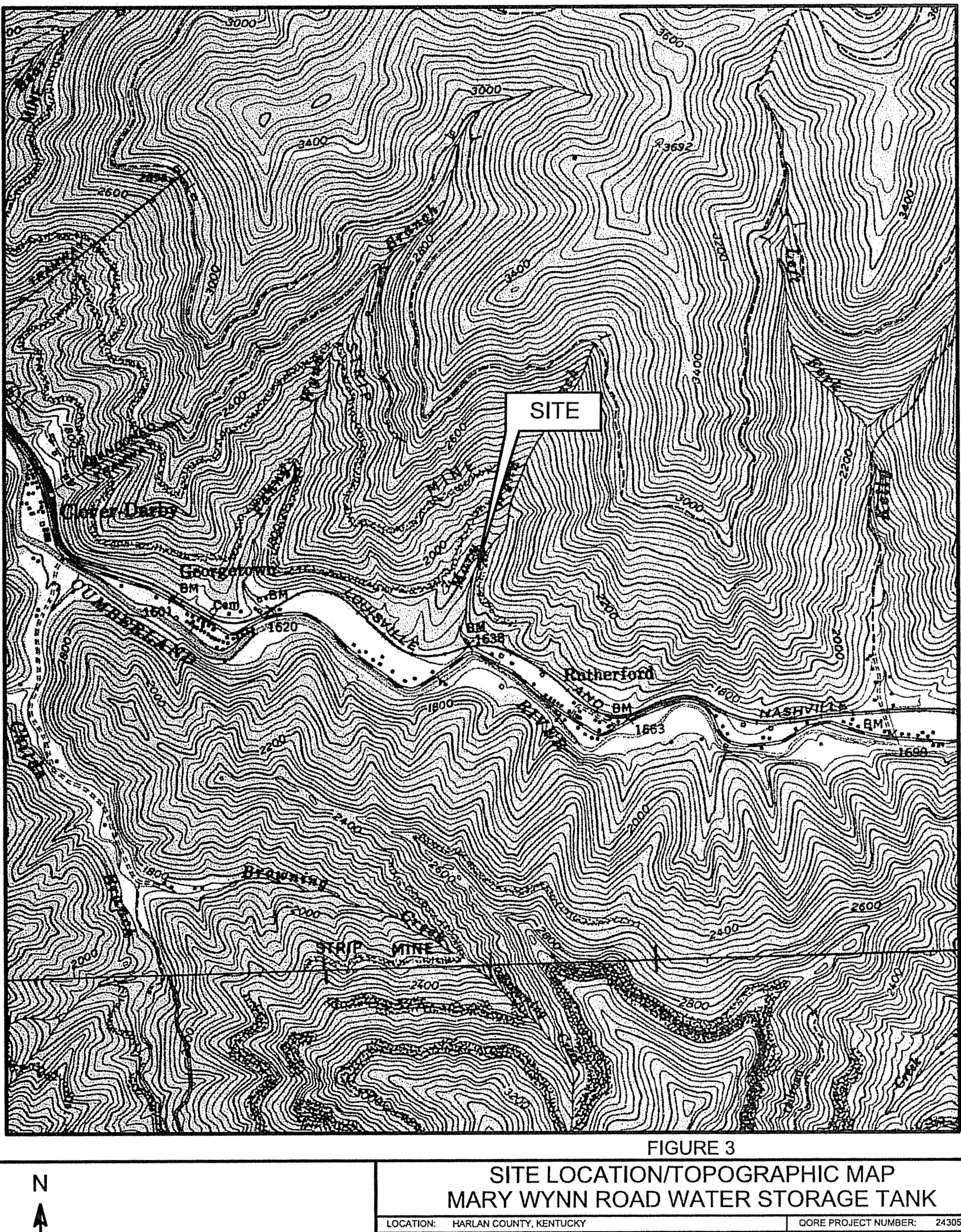

FIGURE 3

SITE LOCATION/TOPOGRAPHIC MAP
MARY WYNN ROAD WATER STORAGE TANK

N

0 1000 2000 3000

GRAPHIC SCALE IN FEET

LOCATION: HARLAN COUNTY, KENTUCKY

QORE PROJECT NUMBER: 24305400

BLACK MOUNTAIN UTILITY DISTRICT

SCALE:	1" = 2000'
DATE:	7/3/2009
DRAWN BY:	RLW
CHECKED BY:	AMF

SOURCE:
USGS TOPOGRAPHIC MAP
LOUELLEN, KENTUCKY
DATED 1982

QORE PROPERTY SCIENCES
422 CODELL DRIVE, LEXINGTON, KENTUCKY 40509
PHONE (859) 293-5518 / FAX (859) 299-2481

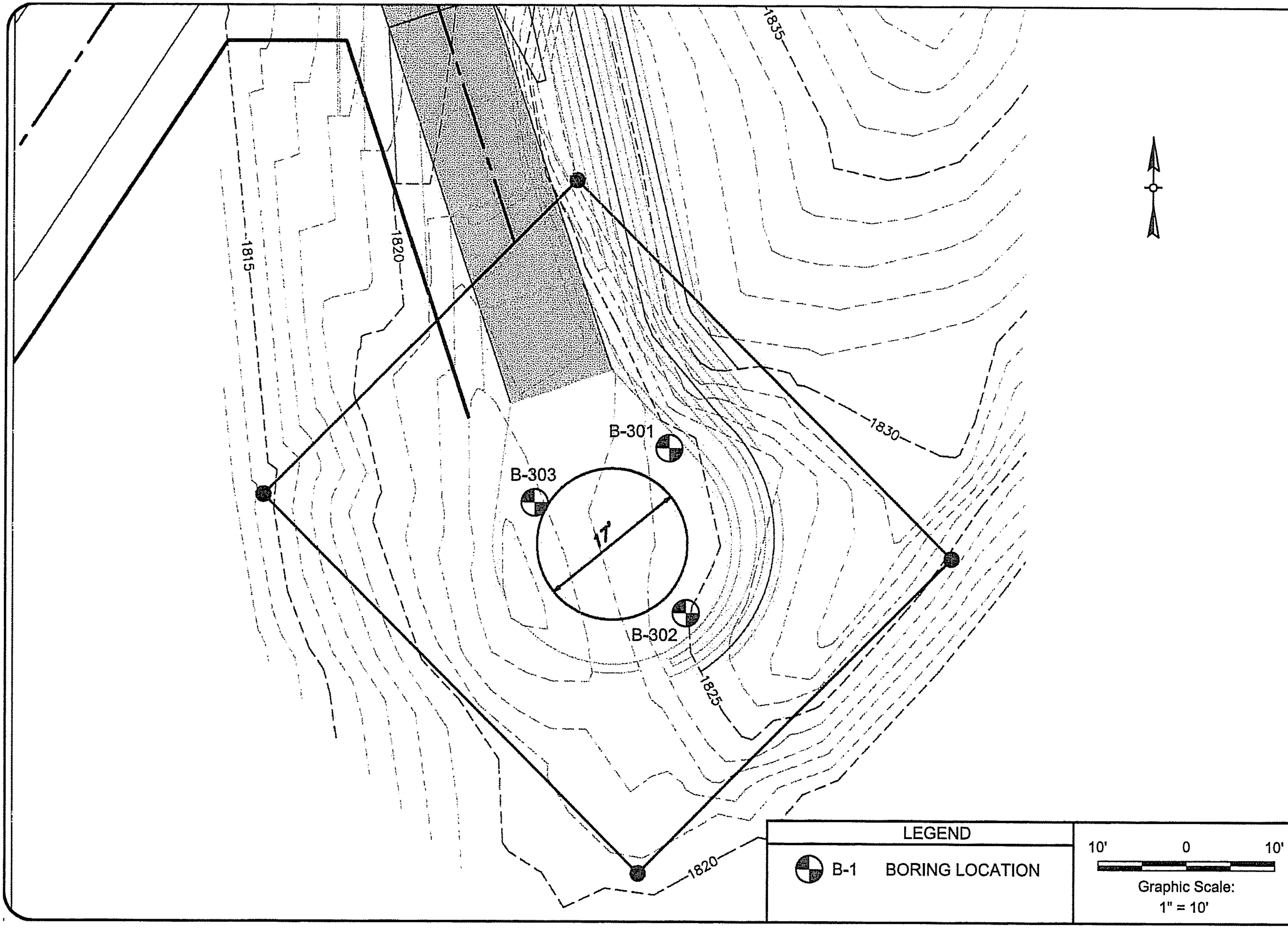

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FIGURE 4
BORING LOCATION PLAN
BLACK MOUNTAIN UTILITY DISTRICT
MARY WYNN ROAD WATER TANK
HARLAN COUNTY, KENTUCKY

DATE:	7/3/2009
REV. DATE:	
SCALE:	1" = 10'
CHECKED BY:	AMF
DRAWN BY:	RLW
PROJECT NO.:	24305400

APPENDIX B

TEST BORING LEGEND

TEST BORING RECORDS

FIELD TESTING PROCEDURES

TEST BORING RECORD LEGEND

FINE AND COARSE GRAINED SOIL INFORMATION

COARSE GRAINED SOILS (SANDS & GRAVELS)

N	Relative Density
0-4	Very Loose
5-10	Loose
11-20	Firm
21-30	Very Firm
31-50	Dense
Over 50	Very Dense

FINE GRAINED SOILS (SILTS & CLAYS)

N	Consistency	Qu, KSF Estimated
0-1	Very Soft	0-0.5
2-4	Soft	0.5-1
5-8	Firm	1-2
9-15	Stiff	2-4
16-30	Very Stiff	4-8
Over 31	Hard	8+

PARTICLE SIZE

Boulders	Greater than 300 mm (12 in)
Cobbles	75 mm to 300 mm (3 to 12 in)
Gravel	4.74 mm to 75 mm (3/16 to 3 in)
Coarse Sand	2 mm to 4.75 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silts & Clays	Less than 0.075 mm

The **STANDARD PENETRATION TEST** as defined by ASTM D 1586 is a method to obtain a disturbed soil sample for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D./2-inch O.D. split-barrel sampler is driven three 6-inch increments with a 140 lb. hammer falling 30 inches. The hammer can either be of a trip, free-fall design, or actuated by a rope and cathead. The blow counts required to drive the sampler the final two increments are added together and designate the N-value defined in the above tables.

ROCK PROPERTIES

ROCK QUALITY DESIGNATION (RQD)

Percent RQD	Quality
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

ROCK HARDNESS

Very Hard:	Rock can be broken by heavy hammer blows.
Hard:	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows.
Moderately Hard:	Small pieces can be broken off along sharp edges by considerable hard thumb pressure; can be broken with light hammer blows.
Soft:	Rock is coherent but breaks very easily with thumb pressure at sharp edges and crumbles with firm hand pressure.
Very Soft:	Rock disintegrates or easily compresses when touched; can be hard to very hard soil.

$$\text{Recovery} = \frac{\text{Length of Rock Core Recovered}}{\text{Length of Core Run}} \times 100$$

$$\text{RQD} = \frac{\text{Sum of 4 In. and longer Rock Pieces Recovered}}{\text{Length of Core Run}} \times 100$$

63 REC
NQ
43 RQD

Core Diameter	Inches
BQ	1-7/16
NQ	1-7/8
HQ	2-1/2

SYMBOLS

KEY TO MATERIAL TYPES

Topsoil; Asphalt; Crushed Limestone; Fill Material; Shot-rock Fill; Low Plasticity Inorganic Silt; High Plasticity Inorganic Silt; Low Plasticity Inorganic Clay; High Plasticity Inorganic Clay; Low Plasticity Inorganic Silt or Clay

High Plasticity Inorganic Silt or Clay; Organic Silts/Clays; Well-Graded Gravel; Poorly-Graded Gravel; Silty Gravel; Clayey Gravel; Well-Graded Sand; Poorly-Graded Sand; Silty Sand; Clayey Sand

Peat; Limestone; Sandstone; Siltstone; Claystone; Weathered Rock; Dolomite; Granite; Gneiss; Schist

Amphibolite; Metagraywacke; Phylite

SOIL PROPERTY SYMBOLS

N:	Standard Penetration, BPF
M:	Moisture Content, %
LL:	Liquid Limit, %
PI:	Plasticity Index, %
Qp:	Pocket Penetrometer Value, TSF
Qu:	Unconfined Compressive Strength Estimated Qu, TSF
γ_D:	Dry Unit Weight, PCF
F:	Fines Content

SAMPLING SYMBOLS

Undisturbed Sample; No Sample Recovery; Split-Spoon Sample; Water Level After Drilling; Rock Core Sample; Extended Time Reading; Auger or Bag Sample

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-201**

PROJECT: Harlan County Water Tanks	JOB NO: 24305400	REPORT NO:
PROJECT LOCATION: Harlan County, KY		
ELEVATION:	BORING STARTED: 6/30/2009	BORING COMPLETED: 6/30/2009
DRILLING METHOD: 4" HSA	RIG TYPE: CME-550	HAMMER: AUTO
GROUNDWATER (ft):	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: KY 38 Tank

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (In)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
		0	FILL - Mixture of Clayey Sand (SC), with silt and sandstone pieces, brown and tan, moist			10				10 - 8 - 8
						10				7 - 6 - 6
		5				10				4 - 9 - 8
						14				6 - 20 - 34
		10				10				3 - 11 - 19
			FILL - Sandstone Boulder			3				8 - 50/0.3
		15	Auger Refusal at 14.8 feet							
		20								

BORING NO: **B-202**

QORE PROPERTY SCIENCES

TEST BORING RECORD

PROJECT: Harlan County Water Tanks	JOB NO: 24305400	REPORT NO:
PROJECT LOCATION: Harlan County, KY		
ELEVATION:	BORING STARTED: 6/30/2009	BORING COMPLETED: 6/30/2009
DRILLING METHOD: 4" HSA	RIG TYPE: CME-550	HAMMER: AUTO
GROUNDWATER (ft):	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: KY 38 Tank

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
		0	FILL - Mixture of Clayey Sand (SC), with silt and sandstone pieces, brown and tan, moist			10				4 - 5 - 7
						12				6 - 11 - 12
						14				4 - 7 - 12
		5				14				4 - 9 - 13
						12				7 - 9 - 9
		10								
			FILL - Sandstone Boulder			12				2 - 4 - 22
		15	Auger Refusal at 14.8 feet							
		20								

CRA/G2 24305400.GPJ QOR_CORP.GDT 7/24/09

BORING NO: **B-203**

TEST BORING RECORD

QORE™ PROPERTY SCIENCES

PROJECT: Harlan County Water Tanks		JOB NO: 24305400	REPORT NO:
PROJECT LOCATION: Harlan County, KY			
ELEVATION:	BORING STARTED: 6/30/2009		BORING COMPLETED: 6/30/2009
DRILLING METHOD: 4" HSA	RIG TYPE: CME-550		HAMMER: AUTO
GROUNDWATER (ft):		BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: KY 38 Tank

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (In)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
		0	FILL - Mixture of Clayey Sand (SC), with silt and sandstone pieces, brown and tan, moist			12				7 - 7 - 7
						12				8 - 5 - 9
		5				12				4 - 15 - 16
						10				6 - 6 - 9
			Auger Refusal at 8.5 feet / Begin Coring							
		10	FILL - Mixture of Clayey Sand (SC), with silt and numerous sandstone boulders, brown and tan							
		15								
		20								
		25	Coring Terminated at 24.5 feet							
		30								

CRAIG2 24305400.GPJ QO3_CORP.GDT 7/24/09

QORE PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-301**

PROJECT: Harlan County Water Tanks		JOB NO: 24305400	REPORT NO:
PROJECT LOCATION: Harlan County, KY			
ELEVATION: 1,825.1	BORING STARTED: 6/30/2009		BORING COMPLETED: 6/30/2009
DRILLING METHOD: 4" HSA	RIG TYPE: CME-550		HAMMER: AUTO
GROUNDWATER (ft):		BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Surface elevations measured relative to site benchmark of 1831.45 ft

Mary Wynn Tank

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	1825.1	0	Lean Clay (CL) sandy, STIFF, orange, moist			12				8 - 14 - 50/0.4
	1824.1		Weathered Sandstone, orange and tan, moist							
	1823.6		Auger Refusal at 1.5 feet / Begin Coring							
			Interbedded Sandstone and clay seams.			6	20			
			Sandstone, tan and orange, fine to medium grained, medium bedded							
		5	Clay seams, sandy and silty, tan and orange, moist							
						17	15			
		10								
						22	0			
		15								
						24	0			
	1806.1		Coring Terminated at 19.0 feet							
		20								

CRANG2 24305400.GPJ QOR_CORR.GDT 7/24/09

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-302**

PROJECT: Harlan County Water Tanks	JOB NO: 24305400	REPORT NO:
PROJECT LOCATION: Harlan County, KY		
ELEVATION: 1,825.1	BORING STARTED: 7/1/2009	BORING COMPLETED: 7/1/2009
DRILLING METHOD: 4" HSA	RIG TYPE: CME-550	HAMMER: AUTO
GROUNDWATER (ft):	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Surface elevations measured relative to site benchmark of 1831.45 ft

Mary Wynn Tank

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	1825.1	0	Lean Clay (CL) sandy, FIRM, tan, moist			14				2 - 2 - 3
						6				1 - 3 - 3
	1821.1	5	Interbedded Weathered Sandstone and silty Sand (SM), sampled as VERY STIFF soil, tan and orange, moist			18				10 - 10 - 14
						18				7 - 12 - 14
		10				18				10 - 15 - 14
						0				50/0.3
	1810.7	15	Auger Refusal at 14.4 feet							
		20								

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-303**

PROJECT: Harlan County Water Tanks	JOB NO: 24305400	REPORT NO:
PROJECT LOCATION: Harlan County, KY		
ELEVATION: 1,823.5	BORING STARTED: 7/1/2009	BORING COMPLETED: 7/1/2009
DRILLING METHOD: 4" HSA	RIG TYPE: CME-550	HAMMER: AUTO
GROUNDWATER (ft):	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Surface elevations measured relative to site benchmark of 1831.45 ft

Mary Wynn Tank

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	1823.5	0	Interbedded Weathered Sandstone and silty Sand (SM), sampled as VERY STIFF soil, tan and orange, moist			12				11 - 9 - 9
						9				10 - 17 - 16
		5				10				7 - 12 - 16
						16				5 - 7 - 12
		10				15				7 - 9 - 12
		15				16				6 - 10 - 12
	1808.0		Boring Terminated at 15.5 feet at engineer's discretion without encountering auger refusal.							
		20								

CRAIG2 24305400.GPJ COR_CORP.GDT 7/24/09

FIELD TESTING PROCEDURES

Field Operations: The general field procedures employed by CORE Property Sciences are summarized in ASTM D 420 which is entitled "Investigating and Sampling Soils and Rocks for Engineering Purposes." This recommended practice lists recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the subsurface conditions. These techniques are:

a. Continuous 2-1/2 or 3-1/4 inch I.D. hollow stem augers;
b. Wash borings using roller cone or drag bits (mud or water);
c. Continuous flight augers (ASTM D 1425).

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are reported on a field test boring record by a field engineer who is on site to direct the drilling operations and log the recovered samples. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soils in general accordance with the procedures outlined in ASTM D 2488 and prepares the final boring records that are the basis for all evaluations and recommendations.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designating the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report. The detailed data collection methods using during this study are discussed on the following pages.

Soil Test Borings: Soil test borings were made at the site at locations shown on the attached Boring Plan. Soil sampling and penetration testing were performed in accordance with ASTM D 1586.

The borings were made by mechanically twisting a 5-5/8" outer diameter auger into the soil. At regular intervals, the drilling tools were removed and samples obtained with a standard 1.4 inch I.D., 2 inch O.D., split tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "penetration resistance".

Representative portions of the samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined to verify the driller's field classifications. Test Boring Records are attached which graphically show the soil descriptions and penetration resistances.

Soil Auger Soundings: Soil auger soundings were made at the site at the locations shown on the attached Boring Location Plan. The soundings were performed by mechanically twisting a steel auger into the soil. However, unlike the soil test borings, a smaller diameter solid stem auger was used and no split-spoon samples were obtained. The driller provided a general description of the soil encountered by observing the soils brought to the surface by the twisting auger. The auger was advanced until refusal materials were encountered and the refusal depth was noted by the driller. The auger is then withdrawn and the depths to water or caved materials are then measured and recorded by the driller.

Soil auger soundings provide a rapid, economical method of obtaining the approximate bedrock depth, groundwater depth, and general soil conditions at locations where detailed soil testing and sampling is not required.

Water Level Readings: Water table readings are normally taken in conjunction with borings and are recorded on the "Test Boring Records". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of the hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The time of boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using an electrical probe to detect the water level surface. Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

APPENDIX C

SUMMARY OF LABORATORY TEST DATA

LABORATORY TESTING PROCEDURES

QORE PROPERTY SCIENCES
422 Codell Drive, Lexington, KY 40509

Laboratory Data Summary

AASHTO R18

PROJECT NAME: *Harlan Co. Tanks - KY 38 Tank*

PROJECT NUMBER: *24305400*
REPORT DATE: *07/09/09*

BORING NO.	SAMPLE DEPTH, FT.	SAMPLE TYPE*	USCS	NATURAL MOISTURE CONTENT, %	ATTERBERG LIMITS			MAX. DRY DENSITY PCF /OPTIMUM MOISTURE %	UNIT WEIGHT, PCF		UNCONFINED COMPRESSIVE STRENGTH, PSF	MATERIAL FINER THAN NO. 200, %	SPECIFIC GRAVITY	CBR, %
					L.L.	P.L.	P.I.		WET	DRY				
B-201	1.5-3.0	SPT		16.8										
B-201	4.0-5.5	SPT	SC	19.6	37	24	13							
B-201	6.5-8.0	SPT		16.2										
B-201	9.0-10.5	SPT		12.7										

QORE PROPERTY SCIENCES
422 Codell Drive, Lexington, KY 40509

Laboratory Data Summary

PROJECT NAME: *Harlan Co. Tanks - Mary Wynn Tank*

PROJECT NUMBER: *24305400*
REPORT DATE: *07/09/09*

BORING NO.	SAMPLE DEPTH, FT.	SAMPLE TYPE	USCS	NATURAL MOISTURE CONTENT, %	ATTERBERG LIMITS			MAX. DRY DENSITY PCF /OPTIMUM MOISTURE %	UNIT WEIGHT, PCF		UNCONFINED COMPRESSIVE STRENGTH, PSF	MATERIAL FINER THAN NO. 200, %	SPECIFIC GRAVITY	CBR, %
					L.L.	P.L.	P.I.		WET	DRY				
B-302	1.5-3.0	SPT		21.9										
B-302	4.0-5.5	SPT	SM	14.4	NP	NP	NP							
B-302	6.5-8.0	SPT		13.7										
B-302	9.0-10.5	SPT		17.0										
B-303	1.5-3.0	SPT		14.1										
B-303	4.0-5.5	SPT		10.3										
B-303	6.5-8.0	SPT		14.7										
B-303	9.0-10.5	SPT		14.9										

LABORATORY TESTING PROCEDURES

Soil Classification: Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our "Test Boring Records."

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary: grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D 2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties obtained are presented in this report.

Compaction Tests: Compaction tests are run on representative soil samples to determine the dry density obtained by a uniform compactive effort at varying moisture contents. The results of the test are used to determine the moisture content and unit weight desired in the field for similar soils. Proper field compaction is necessary to decrease future settlements, increase the shear strength of the soil and decrease the permeability of the soil.

The two most commonly used compaction tests are the Standard Proctor test and the Modified Proctor test. They are performed in accordance with ASTM D 698 and D 1557, respectively. Generally, the Standard Proctor compaction test is run on samples from building or parking areas where small compaction equipment is anticipated. The Modified compaction test is generally performed for heavy structures, highways, and other areas where large compaction equipment is expected. In both tests a representative soil sample is placed in a mold and compacted with a compaction hammer. Both tests have four alternate methods.

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Matl. Finer Than	No. of Layers	No. of Blows/Layer
Standard	A	5.5 lb./12"	4"	No. 4 sieve	3	25
D 698	B	5.5 lb./12"	4"	3/8" sieve	3	25
	C	5.5 lb./12"	6"	3/4" sieve	3	56

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Matl. Finer Than	No. of Layers	No. of Blows/Layer
Modified	A	10 lb./18"	4"	No. 4 sieve	5	25
D 1557	B	10 lb./18"	4"	3/8" sieve	5	25
	C	10 lb./18"	6"	3/4" sieve	5	56

The moisture content and unit weight of each compacted sample is determined. Usually 4 to 5 such tests are run at different moisture contents. Test results are presented in the form of a dry unit weight versus moisture content curve. The compaction method used and any deviations from the recommended procedures are noted in this report.

Atterberg Limits: Portions of the samples are taken for Atterberg Limits testing to determine the plasticity characteristics of the soil. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes sufficiently "wet" to flow as a heavy viscous fluid. The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into tiny threads. The liquid limit and plastic limit are determined in accordance with ASTM D 4318.

Moisture Content: The Moisture Content is determined according to ASTM D 2216.