CLOSURE PLAN
AREA 8 IWTP SLUDGE LANDFILL CELLS 1 AND 2

Lake City Army Ammunition Plant
Area 8 IWTP Sludge Landfill 709503
Independence, Missouri

Revised June 2008
Aquaterra Project Number 2606.10

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

Prepared for:

Lake City Army Ammunition Plant

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Hazardous Waste Program
MO Dept. of Natural Resources

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ABSTRACT

This Hazardous Waste Management Act/Resource Conservation and Recovery Act (RCRA) closure plan was developed for the Industrial Waste Treatment Plant Landfill within Area 8 at Lake City Army Ammunition Plant (LCAAP). Cells 1 and Cell 2 of the industrial waste landfill were identified as having a RCRA listed hazardous waste, K046 from the wastewater treatment sludge generated from the manufacturing, formulation and loading of lead-based initiating compounds. Cells 1 and 2 were subsequently classified as a RCRA treatment, storage and disposal facility subject to RCRA hazardous waste regulations. This closure plan has been developed in accordance with Resource Conservation and Recovery Act (RCRA) closure requirements under 40 CFR 265 Subpart G and Missouri Department of Natural Resources Hazardous Waste Management Program's (HWP) requirements outlined in 10 CSR 25-7.265.

ACRONYMS

ATK	Alliant Techsystems
CFR	Code of Federal Regulations
CSR	Code of State Regulations
DA	Department of Army
Ft	Foot
GOCO	Government owned/Contractor operated
GWMW	Ground water monitoring well
IWTP	Industrial Wastewater Treatment Plant
HWP	Hazardous Waste Program
LCAAP	Lake City Army Ammunition Plant
MDNR	Missouri Department of Natural Resources
NPDES	National Pollutant Discharge Elimination System
HWMA	Hazardous Waste Management Act
PE	Professional Engineer
RCRA	Resource Conservation and Recovery Act
SWMP	Solid Waste Management Program
TCLP	Toxicity Characteristic Leaching Procedure
USEPA	U.S. Environmental Protection Agency
SHERP	Safety, Health and Emergency Response Plan

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1.0 INTRODUCTION

This plan has been prepared in response to RCRA closure requirements under 40 CFR 265 Subpart G and Missouri Department of Natural Resources Hazardous Waste Program's (HWP) requirements outlined in 10 CSR 25-7.265 and Solid Waste Management Program's requirements outlined in 10 CSR 80-3.010. The plan addresses closure for Cells 1 and 2 of the IWTP Sludge Landfill located in Area 8 at Lake City Army Ammunition Plant (LCAAP).

This Closure Plan provides the criteria necessary to achieve regulatory closure for IWTP Sludge Landfill Cells 1 and 2 located in Area 8 at LCAAP. This Plan includes the methods and schedules anticipated to achieve regulatory closure of the IWTP Sludge landfill cells. This closure plan includes a general description of Area 8 and identifies the maximum hazardous waste inventories within the Industrial Wastewater Treatment Plant (IWTP) Sludge Landfill. The facility is a federal facility and it is the responsibility of the United States Army to complete closure; therefore costs to complete such activities have not been included in this submittal.

2.0 FACILITY DESCRIPTION

This section provides background of Area 8 and the IWTP Sludge Landfill.

2.1 Site Description

The LCMP is a 3,935-acre government owned-contractor operated (GOCO) facility that was established in 1941 to manufacture and test small caliber ammunition for the U.S. Army. The facility has remained in continuous operation except for one 5-year period following World War II. LCMP is located 23 miles east of downtown Kansas City, Missouri in eastern Jackson County, mostly within the incorporated boundaries of Independence, Missouri.

Area 8 is located in the southwestern corner of the plant and covers approximately 126 acres (Figure 2-1). Area 8 was used from the mid-1960s until 1988 to dispose of sludge and dewatered oil residues from the industrial wastewater treatment plant settling basins. The IWTP Sludge Landfill is located in the southeast corner of Area 8 and has four cells, two of which (Cells 1 and 2) contain IWTP sludge with K046 hazardous waste, one of which contains IWTP sludge (Cell 4) and the other has never been used (Cell 3).

A portion of Area 8 holds an IWTP Sludge Landfill Permit issued by the Solid Waste Management Program. The initial solid waste permit (709502) was issued on June 27, 1979 for a total 18 acres, of which one acre was approved for ITWP sludge disposal. On September 11, 1981, Permit 709502 was superseded by Permit 709503. This permit included the original 18 acres with expansion of the disposal area from one acre to 9.5 acres for IWTP sludge disposal. The eight oil and grease pits permitted under 709503 were removed and certified closed in 1989 under an approved RCRA closure plan. Therefore, the oil and grease pits are not further discussed in this submittal.

In August 1983, the IWTP sludge from the manufacturing and formulation of lead-based initiating compounds was identified as a RCRA listed hazardous waste K046. It was determined that Cells 1 and 2 of the landfill contained K046 wastes, and they were classified as a RCRA treatment, storage, and disposal facility subject to RCRA hazardous waste regulations. Cell 3 has never received any wastes and Cell 4 received IWTP sludge after 1986 when lead-based initiating compound wastewater was not being processed at the IWTP, and therefore does not contain K046 listed waste.

In August 2006 the Remedial Investigation/Feasibility Study for Area 8 was prepared by ARCADIS G&M, Inc. This report indicates both Cells 1 and 2 are unlined, and the first visible activity in Cells 1 and 2 is noted on the 1982 EPIC photograph. Cell 4 is visible in the 1990 EPIC photograph, and Cell 3 is visible in the 1991 EPIC photograph. Both Cells 3 and 4 were constructed with 18-inch compacted clay liners, but wastes have not been disposed in Cell 3. A small pond has formed in Cell 3. Cells 3 and 4 did not receive any RCRA-listed wastes (EA, 1994). Non-hazardous waste was disposed and covered in Cell 4 (Abshier, 2005).

Cells 1 and Cells 2 are approximately equivalent in size. The internal wall dimensions are 250 feet long by 75 feet wide and 16 feet deep with 1.5:1 internal slopes. Approximately 17,500 cubic yards of IWTP sludge have been disposed in each cell with a total amount disposed in Cells 1 and 2 of 35,000 cubic yards.

To date, Cells 1,2 and 4 were covered with a minimum of two feet of clay soils plus one to two feet of protective cover soil between 1979 and 1990. In 1998, additional protective cover soil was added to Cell 2 in the form of a "maintenance cover" to address settling and to restore surface runoff patterns that channeled storm water off the landfill surface. In January 2008, the depth of cover was verified on the crown of Cell 4 utilizing a Geoprobe ®. Based on this investigation the uppermost 6 inches of soil consisted of topsoil underlain with 3.0 to 3.5 feet of compacted clay. In-place permeability testing indicates a permeability less than or equal to 1.0×10^{-7} em/sec. Due to an excellent stand of vegetation, only minor re-grading, to facilitate proper storm water drainage, may occur for cell 4. Soil test results have been included in Appendix A of this report.

To date, the landfill has not been officially closed by the HWP or SWMP. A draft closure plan and post-closure plan prepared by IT Corporation dated May 2001 was previously submitted to the HWP. To date, this plan has not been approved by the HWP or SWMP.

3.0 CLOSURE REGULATIONS

This Plan includes the methods and schedules anticipated to achieve regulatory closure of the portion of the IWTP Sludge Landfill that received the ITWP sludge. This section describes the regulatory basis for the Area 8 landfills (Cells 1 and 2) closure plan.

3.1 Applicable Regulations

The requirements for content and submittal of a RCRA closure plan are presented in 10 CSR 25-7.265(G) (20 CFR 265.112). The closure plan must contain at a minimum:

- A description of how each hazardous waste management unit will be closed
- A description of how final closure of the facility will be achieved
- An estimate of the maximum inventory of hazardous waste ever on site during the facility's active life
- A detailed description of closure methods, including actions necessary to remove waste and decontaminate the site
- A description of any other steps that may be necessary in order to comply with the closure standards, such as groundwater monitoring or leachate collection
- A schedule of closure dates for each unit and for final closure, including the amount of time that closure of each unit and related activities will take
- The expected year of final closure for facilities that use trust funds for financial assurance and for facilities without approved closure plans.

Additional state closure requirements:

- Compliance with 10 CSR 80 if a solid waste permit is required.
- When an owner/operator certifies a closure which did not result in removal of hazardous wastes to background levels, the owner/operator shall record, in accordance with state law, a notation on an instrument which is normally examined during title search that will notify, in perpetuity, a potential purchaser of the property that the land has been used to manage hazardous waste.
- An owner/operator shall submit a notarized statement to the department certifying that the owner/operator has caused the notation(s) to be recorded. The notation(s) shall be recorded with the recorder(s) of deeds in all counties in which the facility or part of the facility is located.

3.2 Capping

This closure plan provides for the placement of a cap meeting RCRA Subtitle C (hazardous waste landfill) requirements over Cells 1 and 2. Additionally, Cell 4 (non-hazardous) may have minor re-grading to facilitate run-on-runoff over the landfill surface. A RCRA Subtitle C cap includes at least the following components:

- 6-inch layer of topsoil capable of supporting vegetation;
- 18 inches of protective cover material;
- Drainage layer (12 inches of granular material or a geo-synthetic net with equivalent hydraulic capacity);
- 20 mil or thicker flexible geomembrane liner; and
- 2 feet of compacted clay with a hydraulic conductivity of 1×10^{-7} cm/sec or less.

Drawing 5 of Appendix E provides a detail of the final cover design. Please refer to Section 5.1 for more information regarding the final cover design.

Both Cells 3 and 4 have an 18-inch thick compacted clay liner with a hydraulic conductivity no greater than 1×10^{-7} cm/sec. The existing liners in Cells 1 and 2 are clay, but there is no documentation of the thickness or permeability of this clay. It is assumed that Cells 1 and 2 were constructed with an equivalent liner as Cells 3 and 4 (18-inch thick compacted clay liner with a hydraulic conductivity no greater than 1.0×10^{-7} cm/sec). Cells 1 and 2 are to be closed in-place and are expected to meet the RCRA closure performance criteria rather than the current Subtitle C landfill design requirements. It should be noted that Cells 1 and 2 were constructed prior to USEPA's (U.S. Environmental Protection Agency) codification of the minimum technological requirements for double liner systems in March 1986. Waste has not been placed in Cell 3; therefore, the soil material from Cell 3 will be used for construction of the compacted clay layer of the final cover. Off-site borrow material will also be used in the construction of the compacted clay layer.

The cap design also includes re-grading and surface drainage improvements to direct storm water away from Cells 1 and 2 to minimize infiltration into these Cells during storm events. The geosynthetic drainage net layer, piping, culverts, and drainage ditches in thedesign are all capable of handling a 25-year, 24-hour storm event. Removal and plugging of the eight existing lysimeters in Cells 1 through 4 will also be completed. Removal and plugging of the lysimeters will be completed in accordance with 10 CSR 23-4.080. If plugging of the lysimeters cannot be completed in accordance with 10 CSR 23-4.080 prior to abandonment, a variance will be required in accordance with 10 CSR 23-1.040.

Existing lysimeters are over 15 feet in depth and are located along the extents of Cells 1 through 4 and are not present in any disposal areas. These lysimeters may be excavated and entirely removed. Any void caused by excavating and removing a lysimeter will be backfilled with native soil and\or grout. Lysimeter tubing lines may also be buried approximately one foot below ground surface and run from lysimeter locations to sample locations for ease of access. In the case that tubing lines are buried in the subsurface, these lines will be excavated and removed. Voids caused by excavating will be backfilled with native soil.

During RCRA cap construction and re-grading operations associated with final closure, the hazardous wastes in Cells 1 and 2 will not be disturbed, moved, or encountered at any time. Since there are already several feet of clean soil cover in-place, contact with the waste in the cells is not anticipated.

4.0 MAXIMUM HAZARDOUS WASTE INVENTORY AND CHARACTERISTICS

As part of the previous LCAAP operations, wastewater from small arms ammunition production processes was discharged to the IWTP at LCAAP. At the time that Area 8 landfill cells were being used to dispose of sludge from the IWTP, the wastewater stream was mixed with lime and alum and then flowed to settling basins for settling and separation of the sludge. The settled sludge was removed from the basins and transported by truck to the cells for disposal.

The IWTP sludge was tested for metals and found to contain elevated levels for lead, in the range of 500 to 1,400 *mg/kg* total lead. However, analyses for TCLP (Toxicity Characteristic Leaching Procedure) lead showed values <0.5 *mg/L,* well below the RCRA hazardous waste level for toxicity characteristic of 5.0 *mg/L* (40 CFR 261.24). Although the sludge landfilled in the Area 8 cells is not a characteristic hazardous waste, it was determined to be a hazardous waste because K046 is a RCRA listed waste. K046 wastes are defined in 40 CFR 261.32 as wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds. As soon as the wastewater from the lead-based initiating compound (lead azide and lead styphnate) area was eliminated from the wastewater going to IWTP in March 1986, the sludge generated subsequently was reclassified as non-hazardous, and was landfilled in Cell 4.

None of the K046 sludge in Cells 1 and 2 has been removed, so the maximum inventory is the volume at the time the cells were covered in 1986 to 1990. This volume, estimated as the surface areas of the cells times the depth of sludge at the time of initial covering, is approximately 35,000 cubic yards. That volume has since been reduced by consolidation of the sludge layers within the cells due to the weight of the overlying soil cover.

5.0 DETAILED DESCRIPTION OF CLOSURE METHODS

This section provides the basis of the design for the RCRA cap for Cells 1 and 2.

5.1 Cap Design

The final cover system for Cells 1 and 2 will include the following components: a grading layer, a compacted clay layer, a geocomposite drainage layer, and protective cover material as described in Section 3.2.

The grading layer shall be graded to ensure that the closure area has a minimum slope of 3 percent. The thickness of this layer will vary between 0 to 24 inches depending on the existing contours.

The compacted soil layer will be constructed of clay from the walls and floor of Cell 3 or clay from a nearby, off-site borrow source that, when compacted appropriately, will achieve a permeability of 1 x 10^{-7} centimeters per second (cm/sec) or less. Pre-construction geotechnical testing was performed by Alpha-Omega Geotech, Inc. for clay samples collected on January 15, 2008 from Cells 3 and 4. Samples were collected from 1.5 feet to 3.75 feet below ground surface. Atterberg limit tests were performed for the soil samples and the ranges for the liquid limit, plastic limit, and plasticity index were from 47 to 55, 17 to 20, and 29 to 36, respectively. Soils ranged from 90.6 to 98.6 percent passing the No. 200 sieve. Soils were also classified with the USCS classification system as either low plasticity clay (CL) or high plasticity clay (CH). The hydraulic conductivity of the soil samples were also estimated using a falling head permeability test. Hydraulic conductivities were estimated to be 1.3x10-8 to 1.0x10^{-7} centimeters per second. Pre-construction soil testing results have been included in Appendix A of this report.

The compacted clay layer will be constructed in 6- to 8-inch thick (in place) lifts and compacted to within the required moisture and density tolerances for the soil material used. The soils will be compacted with equipment that kneads, compacts, and interbonds the soil from the bottom of the lift up, such as a sheep's foot compactor or high profile pad foot compactor. As compaction is achieved and the feet of the compactor walk out of the lift, the uppermost surface (except the final lift) will be left in a rough condition to promote inter-lift bonding of the soil for successive lifts. Such compaction efforts will help to reduce the formation of distinct lateral planes between lifts.

A single-sided 6 ounce geocomposite drainage layer will overlay the 24-inch thick compacted clay layer. The geocomposite will promote surface water infiltration from impacting the compacted clay layer.

The geocomposite drainage layer will be overlain by a minimum 30-inch thick soil layer. This 30-inch soil layer shall support vegetation and will protect the underlying layers from potential freeze-thaw damage. Appendix E outlines specifications for construction of the cap and procedures for construction are outlined the COAIOC plan located in Appendix F.

The vegetative soil layer will be seeded with Kentucky 31 Fescue at a rate of 4 lbs per 1000 sq. ft. Prior to construction of the vegetative soil layer of the final cover system, representative samples of the soil materials proposed for use will be collected and tested to verify the appropriate seed, lime and fertilizer application rates.

5.2 Stability

The RCRA landfill design regulations and closure regulations require a slope stability analysis be performed. Due to minimal changes in conditions at the site, the slope stability analysis contained in "Closure Plan Area 8 Special Waste Landfill Cells 1 and 2" submitted by IT Corporation dated May 2001 is sufficient for this closure plan. The slope stability analysis, included in Appendix B of this report, indicated that the cap system will be stable.

5.3 Settlement

Due to minimal changes at the site, the settlement analysis contained in "Closure Plan Area 8 Special Waste Landfill Cells 1 and 2" submitted by IT Corporation dated May 2001 is sufficient for this closure plan. The settlement analysis (AppendiX C) of this report indicates that the theoretical average settlement will be about 0.6 feet with a theoretical time for 90% consolidation ranges from 4.2 to 6.9 months.

5.4 Surface Water Run-on and Runoff

The final cover system design will minimize run-on and maximize run-off. As stated in the May 2001 Closure Plan, submitted by the IT Group, final sidewalls and embankments require a slope no steeper than 2.5:1 with a long-term factor of safety of 1.41. The final cover system will have a minimum thickness of 4.5 feet with a minimum slope of 3 percent to promote surface water run-off. The geocomposite drainage layer will promote water that infiltrates into the protective cover soil to drain out of the cap system. The horizontal extent

of the cap extends beyond the outer edges of the cells to further reduce the potential for infiltration.

As previously mentioned, soil material currently located in Cell 3 will be used during cap construction. The removal of Cell 3 soil material and subsequent grading of the area will eliminate the current area of ponded water and promote storm water run-off.

A new diversion ditch outside of the western perimeter of Cells 1 and 2 will be constructed. This perimeter ditch will capture potential run-on from the west as well as surface water run-off from closed Cells 1 and 2. The perimeter ditch will allow for storm water to flow away from the landfill and will reduce potential infiltration near the cells.

The perimeter ditch is also intended to control storm water run-on into the area of the eight closed RCRA oil and grease trenches located south of Cells 2 and 4. Post-closure care of these RCRA oil and gas trenches will be enhanced due to run-off controls provided as part of this closure plan.

Drainage ditches will be constructed on both sides of the new access road. These ditches will have the capacity to divert runoff from the cap away from the area. The runoff components described in this plan are designed to handle a 25-year, 24-hour storm event of 6.1 inches (National Weather Service Central Region, Technical Paper 40). Details of the proposed storm water management structures are shown on Drawing 5 of the enclosed drawings. Storm water management calculations are provided in Appendix D.

5.5 New Access Road

The current gravel access road located between Cells 1, 2, and 3 will be abandoned when the cap is constructed over Cells 1 and 2. A replacement access road will be located just north of Cell 1 and will serve to connect the current access road entering the area from the east with the current access road located west of Cells 1 and 2. The proposed road will be finished with a gravel surface to match the current road system and provide an all-weather surface to access the area.

6.0 OTHER ACTIVITIES NECESSARY FOR CLOSURE

This section describes other activities that are necessary for the closure of Cells 1 and 2.

6.1 Groundwater Monitoring

Since 1977, a groundwater monitoring network has been in place to monitor groundwater in Area 8. The IWTP Landfill Ground water monitoring well (GWMW) network consists of six wells (MW8-10, MW8-12, MW8-13, MW8-15, MW8-17, and MW8-19). Drawing 2 of Appendix E shows the locations of the GWMWs. The most recent sampling event occurred in November 2004.

6.2 Leachate Collection

Cells 1 and 2 do not have leachate collection systems therefore leachate removal and disposal is not addressed as part of this plan.

6.3 Safety

All routine activities occurring in Area 8 will follow the safety requirements outlined in the LCAAP Safety Plan. The LCAAP Safety Plan addresses personnel safety procedures for the facility. Routine activities include maintenance, monitoring, and engineering investigations. The LCAAP Safety Plan requires the contractor providing construction services to develop a site-specific Safety, Health and Emergency Response Plan (SHERP) to cover activities during cap construction. Procedures will include, at a minimum:

- Accident prevention
- Personnel protection
- Emergency response
- Personnel training
- Medical surveillance
- Decontamination

During cap construction, SHERP procedures will be executed in accordance with the following publications:

- USEPA Standing Operating Safety Guides,
- OSHA (Occupational Safety and Health Administration) Safety and Health Standards, 29 CFR, Parts 1910 and 1926

- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH 85-115

6.4 Site Security

The LCAAP facility is fenced and guarded; personnel entering the site are required to check in at the front gate and wear identification badges at all times. Site security procedures shall be conducted in accordance with LCAAP's security measures which may include general site security requirements, procedures for entrance control, security personnel duties and responsibilities, and procedures to be executed following security breaches. Area 8 is located through a second gate which is restricted to authorized personnel. Authorized personnel include those performing grounds maintenance, environmental monitoring activities, or engineering investigations for the landfill. All gates are locked and appropriate hazard communication signs are posted. Existing security procedures will continue to be maintained during closure activities.

After cap construction and final closure activities are completed, signs will be posted at the entrance to the landfill stating that the area is restricted to authorized personnel only. Only those performing maintenance or monitoring activities will be authorized for access to the landfill. Existing security procedures will also be maintained through post-closure.

6.5 Data Management

Data Management includes the management of submittals, sampling and analysis data, inspection reports, test data for cap materials, daily logs and QC reports. The construction contractor shall provide all closure related data to Alliant Techsystems (ATK) for transmittal to the Department of the Army (DA). The DA will proVide the MDNR with the required submittals.

6.6 Final Cover Construction Permits

Prior to initiating construction of the final cover system site-specific and state permits are needed.

Necessary site-specific permits include a safety permit, an excavation permit" and a fire extinguisher inspection. Site-specific permits are provided by ATK.

It is estimated that more than 5 acres will be disturbed during closure activities; therefore, a NPDES (National Pollutant Discharge Elimination System) Land Disturbance Permit is

required for Area 8 closure. This permit will be obtained before closure activities begin. Additionally, storm water run-off from Area 8 will continue to be monitored under the site's NPDES permit, permit number MO-0004880.

7.0 CLOSURE SCHEDULE

Within 30 days of approval of the Closure Plan, LCAAP will initiate closure activities for the final cover placement on Cells 1 and 2. Closure activities will be completed within 180 days of the initiation of closure activities.

8.0 CLOSURE PLAN AMENDMENTS

The conditions described in 40 CFR 265.112,"Closure Plan; Amendment of Plan". will be followed to implement potential changes to the approved Closure Plan. If an unexpected event occurs during the final closure period, the closure plan will be amended no later than 30 days after the unexpected event.

9.0 CERTIFICATION OF CLOSURE

Within 60 days of completion of closure activities, a professional engineer, registered in the State of Missouri, will certify that the facility was closed in accordance with approved permit documents and this Plan.

FIGURES

Site Map

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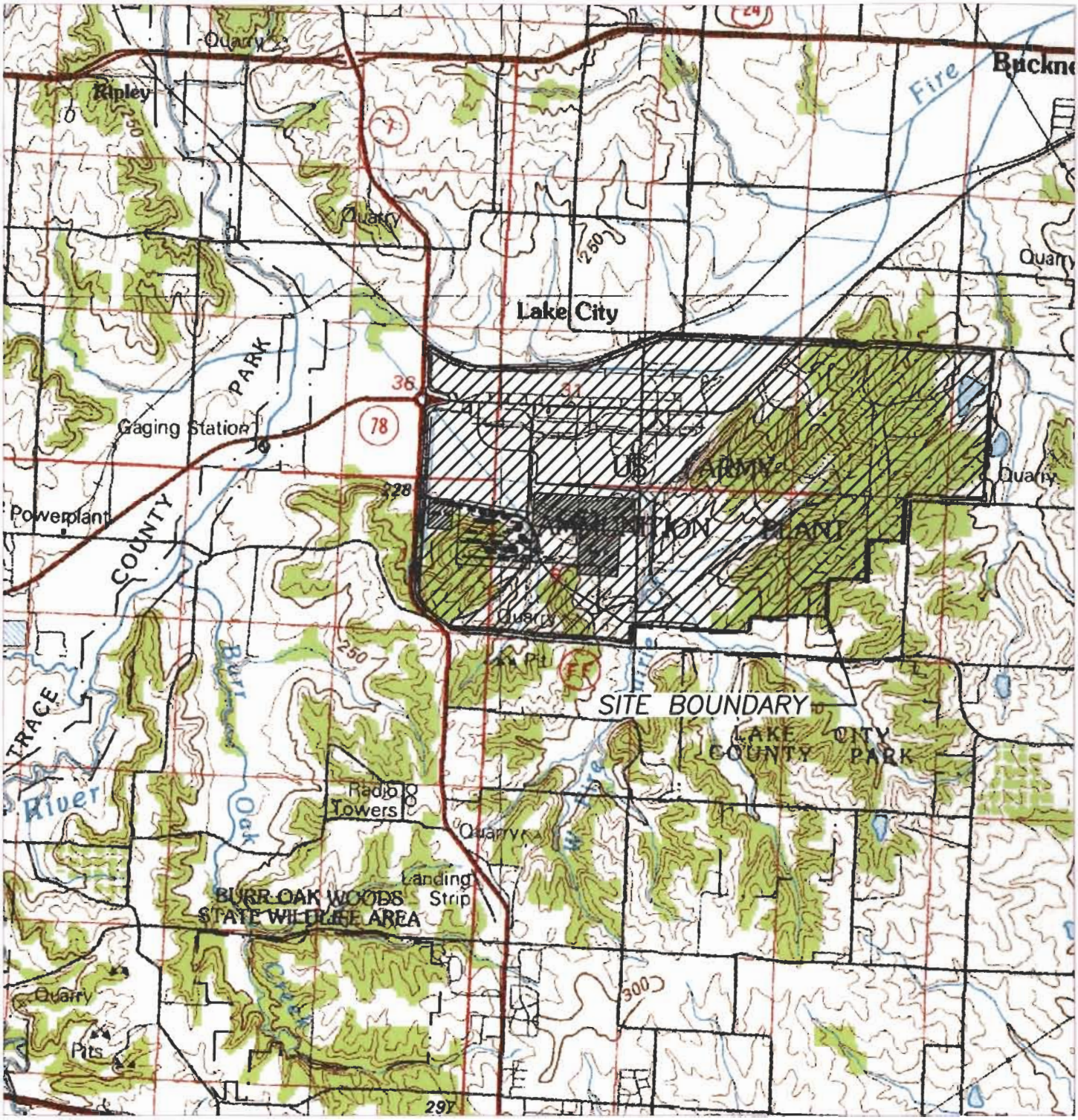

2500 0 2500 5000
SCALE FEET

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.
7311 West 130th Street, Suite 100
Overland Park, Kansas 66213

FIGURE 2-1 – SITE LOCATION MAP
2008 CLOSURE PERMIT DRAWINGS
LAKE CITY ARMY AMMUNITION PLANT
INDEPENDENCE, MISSOURI

Project Mgr. MAB	Drawn By NAG	Designed By NAG	Project No. 2606.10
Scale AS SHOWN	Date 3/12/08	File Name FIG 2-1 SITE MAP TOPO.DWG	Drawing No.

N:\ATK\Projects\2606.1 Lake City Cells 1 and 2 Closure\DWG\Fig 2-1 Site Map Topo.dwg March 18, 2008 10:04:29 am (ngu)

APPENDIX A

Pre-Construction Soil Test Results

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FALLING HEAD PERMEABILITY REPORT

(Method C: Rising Tail-Water)

ASTM D 5084

GEOTECH

PROJECT NAME: ATK Lake City Army Ammuntion Plant — PROJECT NO.: 8-118T

LOCATION:

BORING NO.: — SAMPLE NO.: P-6, Buket 1 — DEPTH: ---

SAMPLE TYPE: Remold - Flat bottom tamper — % COMPACTION: 96.2% of MDD & +0.3% of OMC

INITIAL DATA			FINAL DATA		
MOISTURE:	17.1	%	MOISTURE:	24.0	%
DRY UNIT WEIGHT:	102.2	pcf	DRY UNIT WEIGHT:	102.2	pcf
HEIGHT:	2.25	inches	HEIGHT:	2.25	inches
DIAMETER:	2.80	inches	DIAMETER:	2.80	inches
WEIGHT:	435.3	grams	WEIGHT:	460.9	grams
SATURATION:	71.2	%	SATURATION:	100.0	%

PERMEANT LIQUID: Deaired tap water

EFFECTIVE CONSOLIDATION STRESS: Maximum 3.4 psi — Minimum 3.0 psi

BACK PRESSURE: 90 psi — RANGE OF HYDRAULIC GRADIENT: 3.9 to 3.7

SAMPLE DESCRIPTION: Light brown LEAN CLAY

TEST DATA

DATE	TEST NO.	TIME (sec)	HEAD1 (cm)	HEAD 2 (cm)	TEMP °C
2/26/2008	1	28,800	22.0	21.4	26
2/27/2008	2	28,800	22.0	21.4	26
2/28/2008	3	28,800	22.0	21.4	26
2/29/2008	4	28,800	22.0	21.4	26
AVERAGE		28,800	22.0	21.4	26

k= 5.6E-08 cm/s — n/n20= 0.8694

k20= 4.9E-08 cm/s

k = Hydraulic Conductivity before n/n20 correction factor

k20= Hydraulic Conductivity after correction to 20 ° Celsius

This is a laboratory testing result. Field values may vary.

FALLING HEAD PERMEABILITY REPORT

(Method C: Rising Tail-Water)

ASTM D 5084

GEOTECH

PROJECT NAME: ATK Lake City Army Ammuntion Plant

PROJECT NO.: 8-118T

LOCATION:

BORING NO.: _____ SAMPLE NO.: P-2, Buket 1 DEPTH: ---

SAMPLE TYPE: Remold - Flat bottom tamper % COMPACTION: 96.0% of MDD & +1.0% of OMC

INITIAL DATA			FINAL DATA		
MOISTURE:	19.8	%	MOISTURE:	27.4	%
DRY UNIT WEIGHT:	102.2	pcf	DRY UNIT WEIGHT:	102.2	pcf
HEIGHT:	2.25	inches	HEIGHT:	2.25	inches
DIAMETER:	2.80	inches	DIAMETER:	2.80	inches
WEIGHT:	445.4	grams	WEIGHT:	473.6	grams
SATURATION:	82.5	%	SATURATION:	100.0	%

PERMEANT LIQUID: Deaired tap water

EFFECTIVE CONSOLIDATION STRESS: Maximum 3.4 psi Minimum 3.0 psi

BACK PRESSURE: 80 psi RANGE OF HYDRAULIC GRADIENT: 3.9 to 3.7

SAMPLE DESCRIPTION: Olive brown FAT CLAY

TEST DATA

DATE	TEST NO.	TIME (sec)	HEAD1 (cm)	HEAD 2 (cm)	TEMP °C
3/8 - 3/9	1	57,600	22.0	21.2	26
3/10 - 3/11	2	57,600	22.0	21.2	26
3/11 - 3/12	3	57,600	22.0	21.2	26
3/12 - 3/13	4	57,600	22.0	21.2	26
AVERAGE		57,600	22.0	21.2	26

k= 3.8E-08 cm/s n/n20= 0.8694

k20= 3.3E-08 cm/s

k = Hydraulic Conductivity before n/n20 correction factor

k20= Hydraulic Conductivity after correction to 20 ° Celsius

This is a laboratory testing result. Field values may vary.

Summary of Laboratory Testing

SLT 22205

Alpha-Omega Geotech, Inc.
1701 State Avenue
Kansas City, KS 66102
Office: (913) 371-0000 Fax: (913) 371-6710
Website: www.aogeotech.com

PROJECT NAME: ATK Lake City Army Ammunition Plant
PROJECT LOCATION:
PROJECT NUMBER: 8-118T
DATE: 1/23/2008

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	USCS Class.	% Passing No. 200	Unconfined Compression PSF	%e	% Swell	Remarks
P-1	Bucket-1		Olive brown FAT CLAY			51	19	32	CH	94.6				Please see the attached Grain Size, Limits, and Proctor Test Reports.
P-1	ST-1	1.5'-3.75'	Brown, speckled black and reddish brown FAT CLAY with iron stains	21.8	106.1									Please see the attached Permeability Test Report.
P-2	Bucket-1		Olive brown FAT CLAY			55	20	35	CH	98.6				Please see the attached Grain Size, Limits, and Proctor Test Reports.
P-2	ST-1	1.5'-3.75'	Brown, speckled black LEAN CLAY	28.6	94.9									Please see the attached Permeability Test Report.
P-3	Bucket-1		Brown, mottled dark brown FAT CLAY			56	20	36	CH	94.7				Please see the attached Grain Size and Limits Test Reports.
P-4	Bucket1		Light brown FAT CLAY			50	17	33	CH	90.6				Please see the attached Grain Size, Limits, and Proctor Test Reports.
P-5	Bucket-1		Brown FAT CLAY			53	18	35	CH	94.9				Please see the attached Grain Size and Limits Test Reports.
P-6	Bucket-1		Light brown LEAN CLAY			47	18	29	CL	93.8				Please see the attached Grain Size, Limits, and Proctor Test Reports.

FALLING HEAD PERMEABILITY REPORT

(Method C: Rising Tail-Water)

ASTM D 5084

PROJECT NAME:	ATK Lake City Army Ammunition Plant	PROJECT NO.:	8-118T
LOCATION:			
BORING NO.:		SAMPLE NO.: P-2, ST-1	DEPTH: 1.5' - 3.75'
SAMPLE TYPE:	Undisturbed	% COMPACTION:	----

INITIAL DATA			FINAL DATA		
MOISTURE:	28.6	%	MOISTURE:	29.1	%
DRY UNIT WEIGHT:	94.9	pcf	DRY UNIT WEIGHT:	94.9	pcf
HEIGHT:	2.28	inches	HEIGHT:	2.28	inches
DIAMETER:	2.87	inches	DIAMETER:	2.87	inches
WEIGHT:	472.4	grams	WEIGHT:	474.2	grams
SATURATION:	99.5	%	SATURATION:	100.0	%

PERMEANT LIQUID: Deaired tap water

EFFECTIVE CONSOLIDATION STRESS: Maximum 3.4 psi Minimum 3.0 psi

BACK PRESSURE: 90 psi RANGE OF HYDRAULIC GRADIENT: 3.8 to 3.2

SAMPLE DESCRIPTION: Brown, speckled black LEAN CLAY

TEST DATA

DATE	TEST NO.	TIME (sec)	HEAD1 (cm)	HEAD 2 (cm)	TEMP °C
1/25 -1/26	1	86,400	22.0	18.3	26
1/26 - 1/27	2	86,400	22.0	18.3	26
1/27 - 1/28	3	86,400	22.0	18.3	26
1/28 - 1/29	4	86,400	22.0	18.3	26
AVERAGE		86,400	22.0	18.3	26

k= 1.2E-07 cm/s n/n20= 0.8694

k20= 1.0E-07 cm/s

k = Hydraulic Conductivity before n/n20 correction factor

k20= Hydraulic Conductivity after correction to 20 ° Celsius

This is a laboratory testing result. Field values may vary.

FALLING HEAD PERMEABILITY REPORT

(Method C: Rising Tail-Water)

ASTM D 5084

GEOTECH

PROJECT NAME: ATK Lake City Army Ammunition Plant — PROJECT NO.: 8-118T

LOCATION:

BORING NO.: — SAMPLE NO.: P-1, ST-1 — DEPTH: 1.5' - 3.75'

SAMPLE TYPE: Undisturbed — % COMPACTION: ----

INITIAL DATA			FINAL DATA		
MOISTURE:	21.8	%	MOISTURE:	22.6	%
DRY UNIT WEIGHT:	106.1	pcf	DRY UNIT WEIGHT:	106.1	pcf
HEIGHT:	2.70	inches	HEIGHT:	2.70	inches
DIAMETER:	2.88	inches	DIAMETER:	2.88	inches
WEIGHT:	596.5	grams	WEIGHT:	600.4	grams
SATURATION:	100.0	%	SATURATION:	100.0	%

PERMEANT LIQUID: Deaired tap water

EFFECTIVE CONSOLIDATION STRESS: Maximum 4.4 psi — Minimum 3.0 psi

BACK PRESSURE: 90 psi — RANGE OF HYDRAULIC GRADIENT: 13.5 to 13.2

SAMPLE DESCRIPTION: Brown, speckled black and reddish brown FAT CLAY with iron stains

TEST DATA

DATE	TEST NO.	TIME (sec)	HEAD1 (cm)	HEAD 2 (cm)	TEMP °C
1/25 -1/26	1	86,400	92.3	90.5	26
1/26 - 1/27	2	86,400	92.3	90.5	26
1/27 - 1/28	3	86,400	92.3	90.5	26
1/28 - 1/29	4	86,400	92.3	90.5	26
AVERAGE		86,400	92.3	90.5	26

k= 1.5E-08 cm/s — n/n20= 0.8694

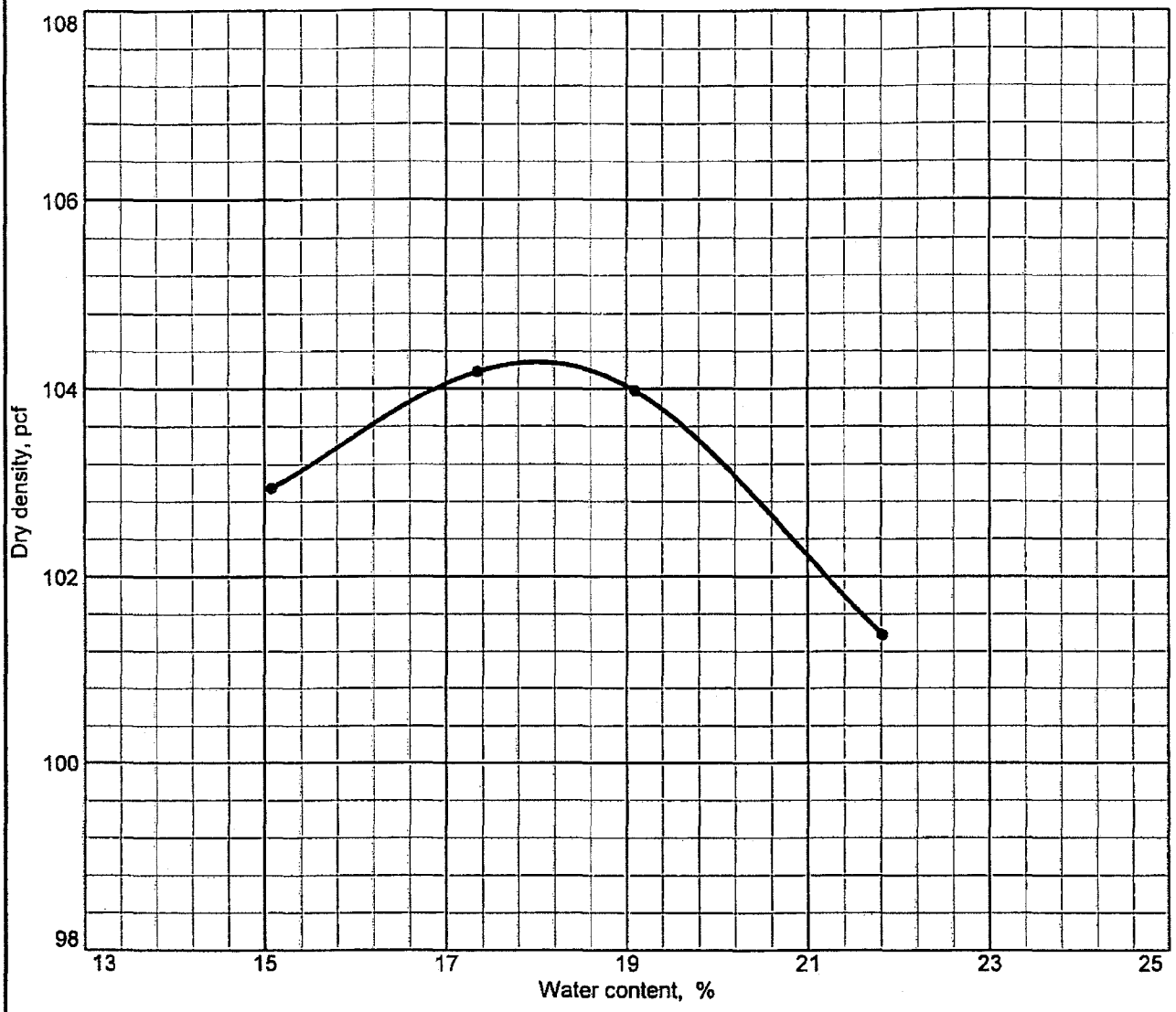
k20= 1.3E-08 cm/s

k = Hydraulic Conductivity before n/n20 correction factor

k20= Hydraulic Conductivity after correction to 20 ° Celsius

This is a laboratory testing result. Field values may vary.

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CH				51	32	1.4	94.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 104.3 pcf Optimum moisture = 18.0 %	Olive brown FAT CLAY

Project No. 8-118T **Client:** Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant

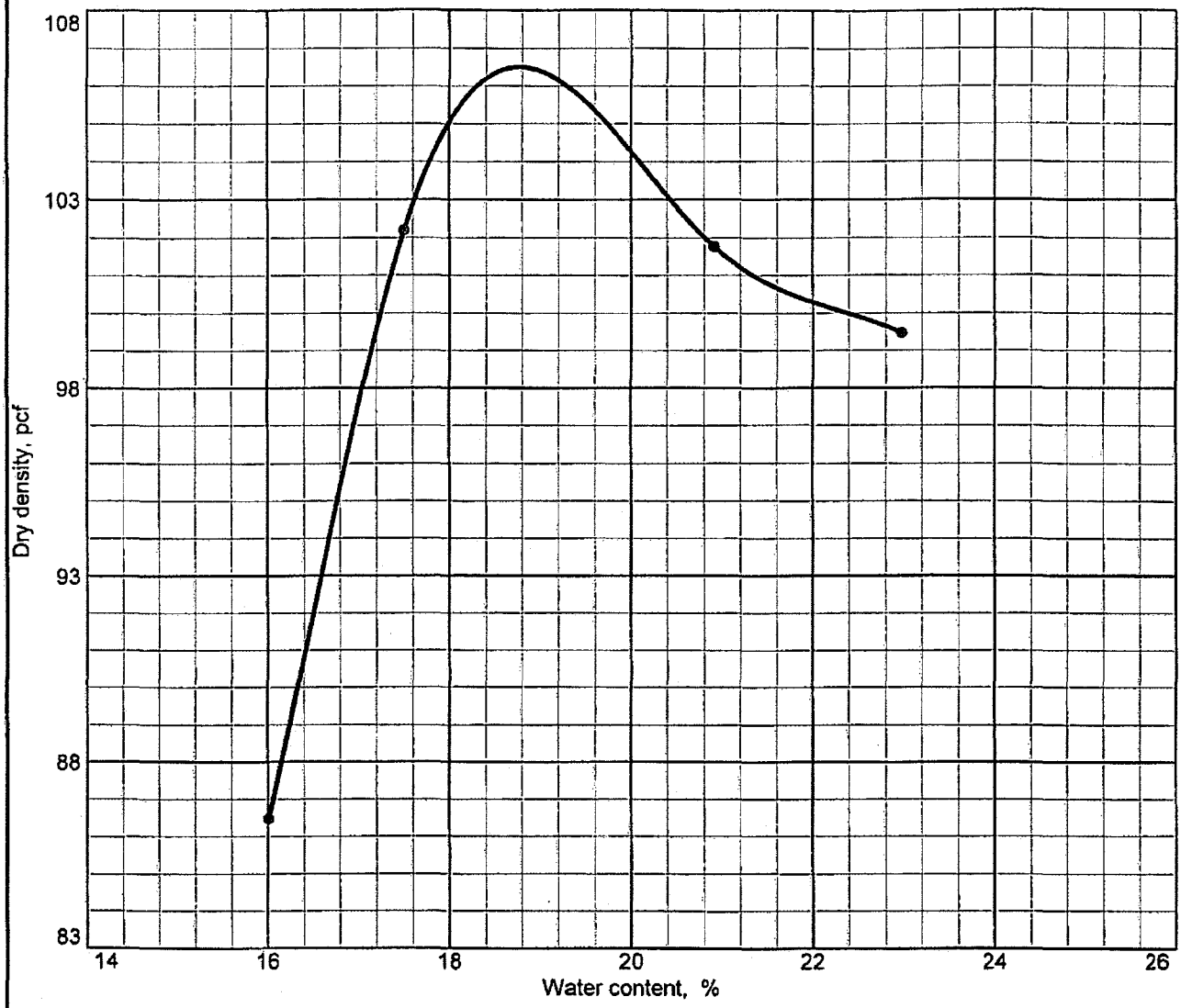
● **Source:** **Sample No.:** P-1, Bucket-1

Remarks:

Alpha-Omega Geotech, Inc.
(913) 371-0000

Figure 1 of 1

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CH				55	35	0.0	98.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.5 pcf Optimum moisture = 18.8 %	Olive brown FAT CLAY

Project No. 8-118T **Client:** Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant

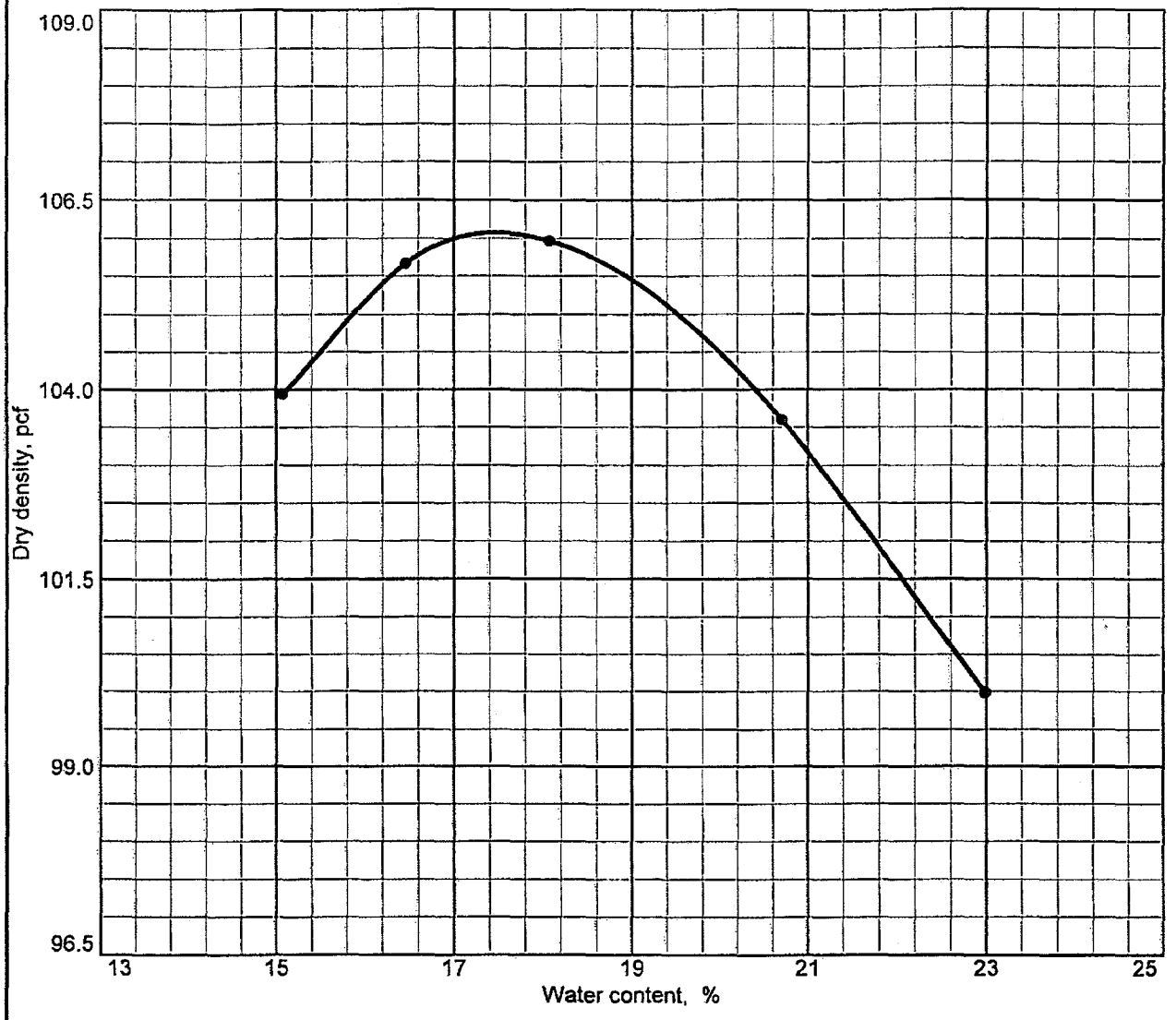
● **Source:** **Sample No.:** P-2, Bucket-1

Remarks:

GEOTECH **Alpha-Omega Geotech, Inc.**
(913) 371-0000

Figure 1 of 1

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CH				50	33		90.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.1 pcf Optimum moisture = 17.5 %	Light brown FAT CLAY

Project No. 8-118T **Client:** Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant

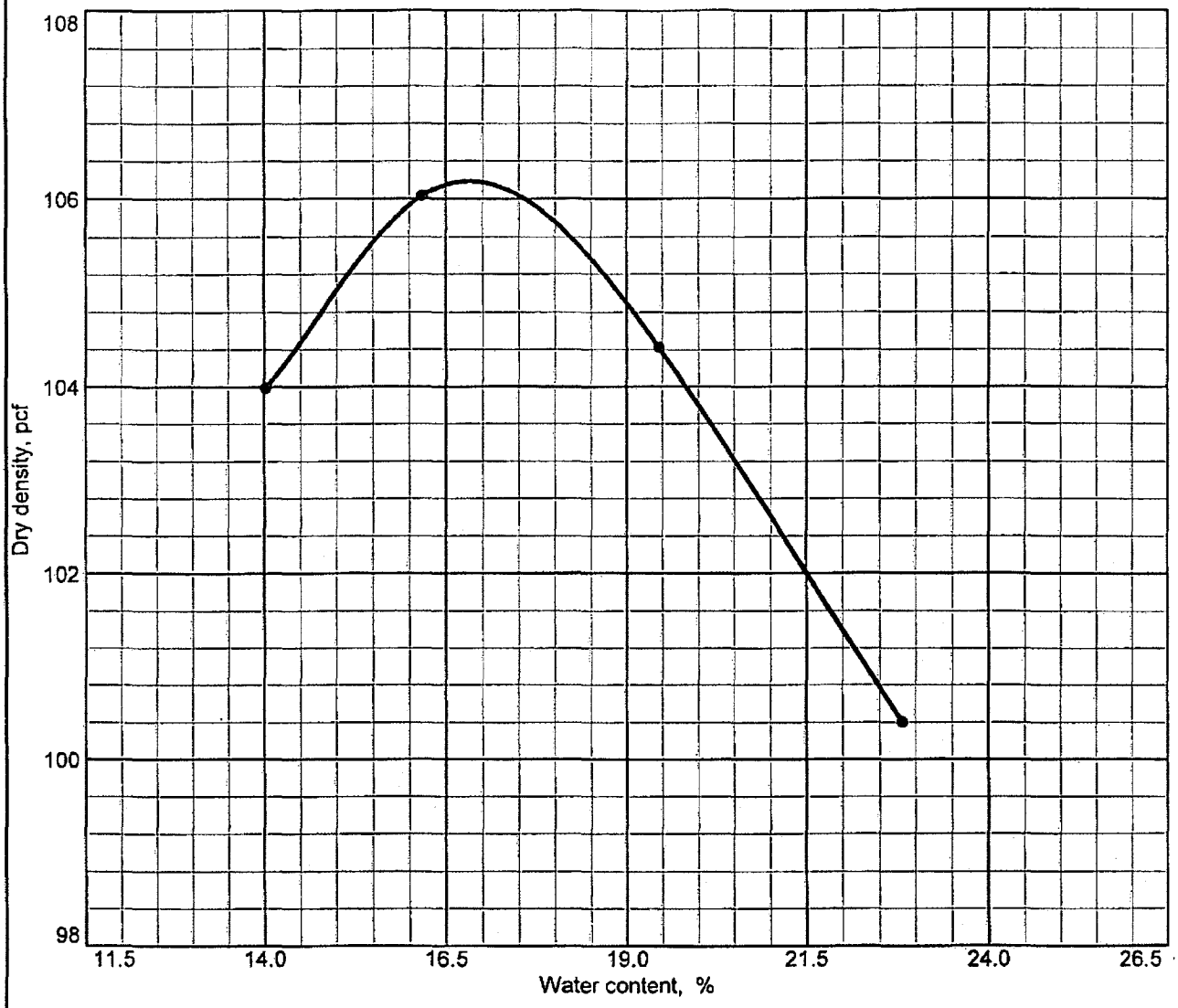
• **Source:** **Sample No.:** P-4, Bucket-1

Remarks:

Alpha-Omega Geotech, Inc.
GEOTECH
(913) 371-0000

Figure 1 of 1

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL				47	29		93.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.2 pcf Optimum moisture = 16.8 %	Light brown LEAN CLAY

Project No. 8-118T **Client:** Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant

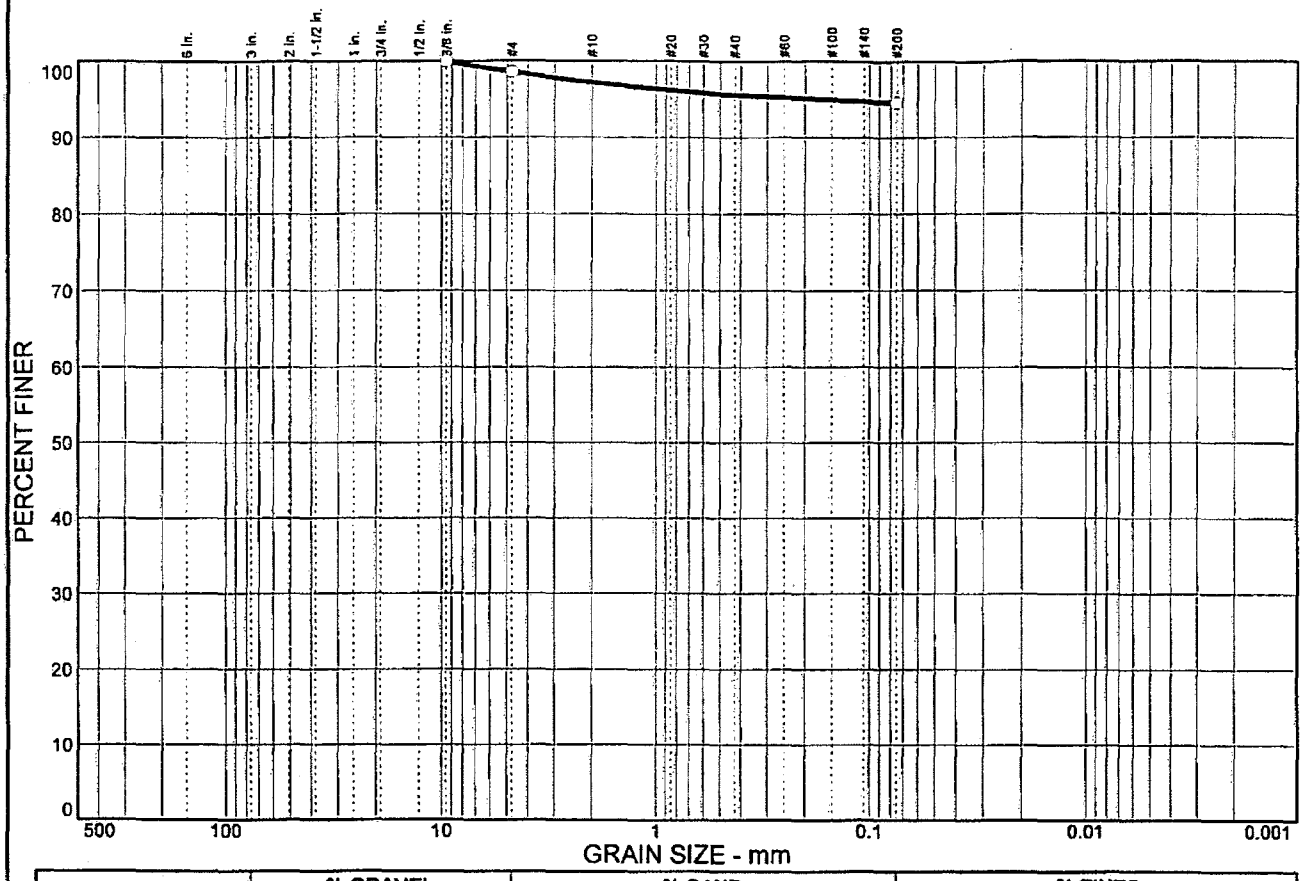
● **Source:** **Sample No.:** P-6, Bucket-1

Remarks:

Alpha-Omega Geotech, Inc.
(913) 371-0000

Figure 1 of 1

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	1.4	1.4	1.6	1.0	94.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	98.6		
#200	94.6		

* (no specification provided)

Material Description

Olive brown FAT CLAY

Atterberg Limits

PL= 19 LL= 51 PI= 32

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

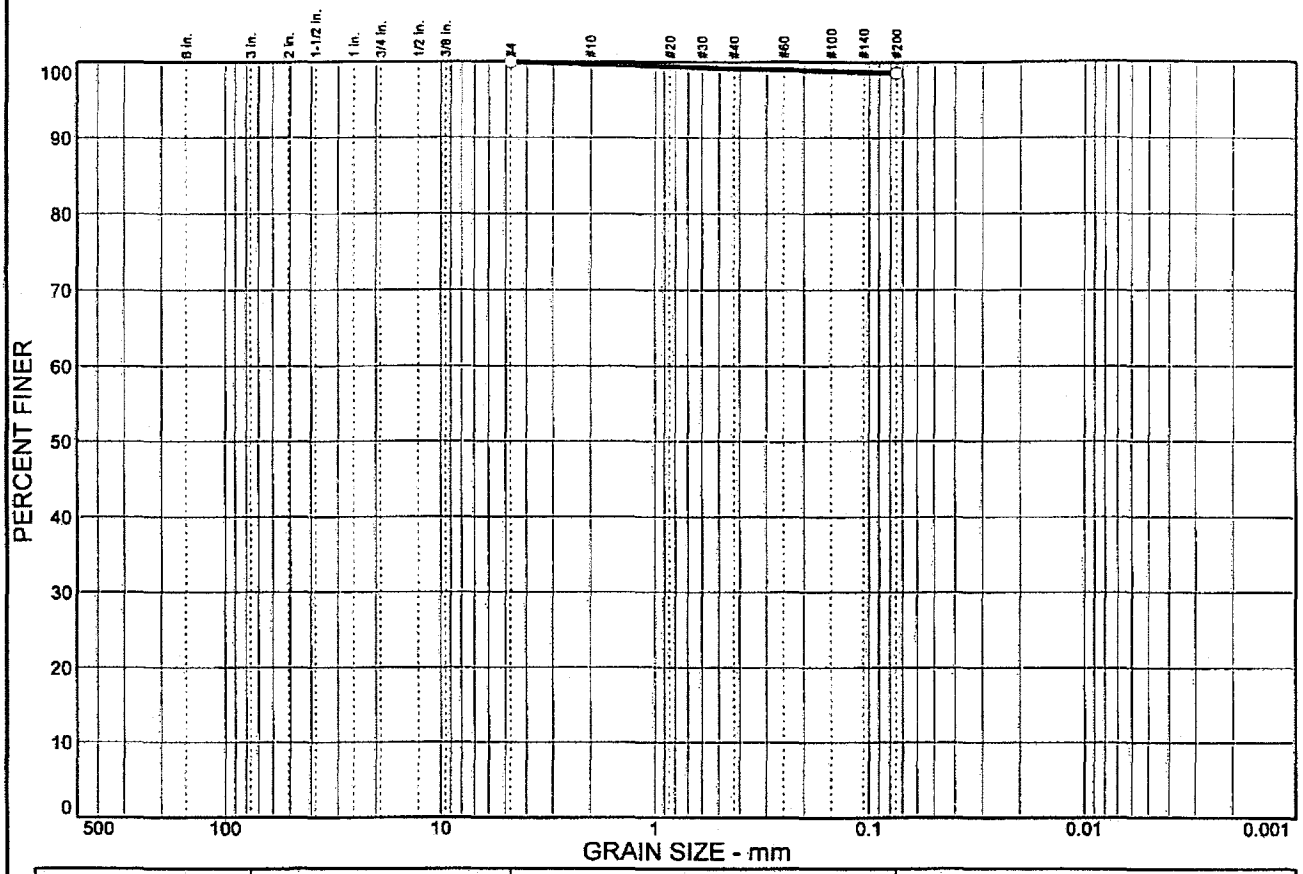
Sample No.: P-1, Bucket-1 **Source of Sample:** **Date:** 1/23/08
Location: **Elev./Depth:**

GEOTECH **Alpha-Omega Geotech, Inc.**

Client: Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant

Project No: 8-118T **Figure** 1 of 1

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.3	0.5	0.6	98.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#200	98.6		

* (no specification provided)

Material Description

Olive brown FAT CLAY

Atterberg Limits

PL= 20 LL= 55 PI= 35

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

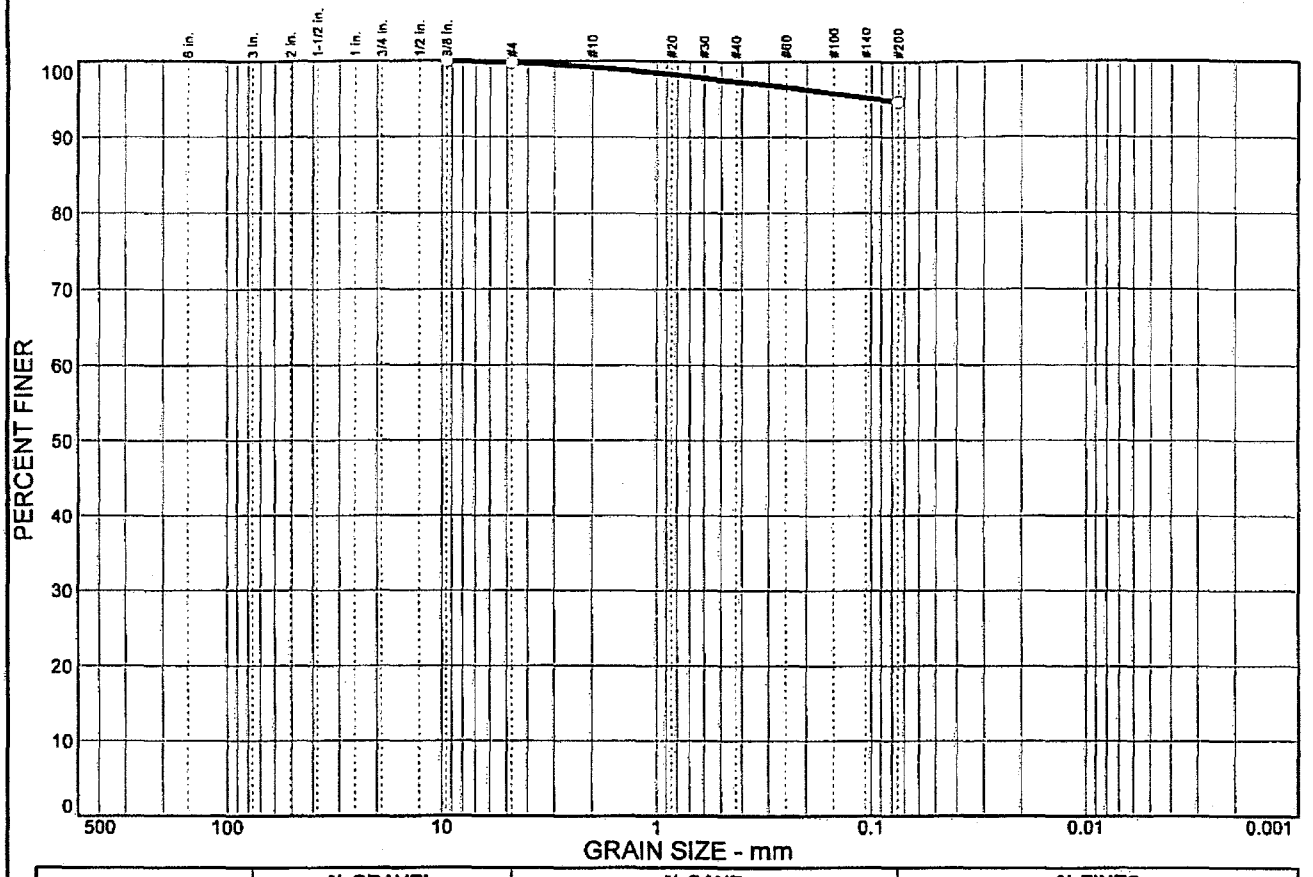
Remarks

Sample No.: P-2, Bucket-1 **Source of Sample:** **Date:** 1/23/08
Location: **Elev./Depth:**

Alpha-Omega Geotech, Inc.

Client: Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant
Project No: 8-118T **Figure** 1 of 1

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.2	0.6	1.8	2.7	94.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.8		
#200	94.7		

* (no specification provided)

Material Description

Brown, mottled dark brown FAT CLAY

Atterberg Limits

PL= 20 LL= 56 PI= 36

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

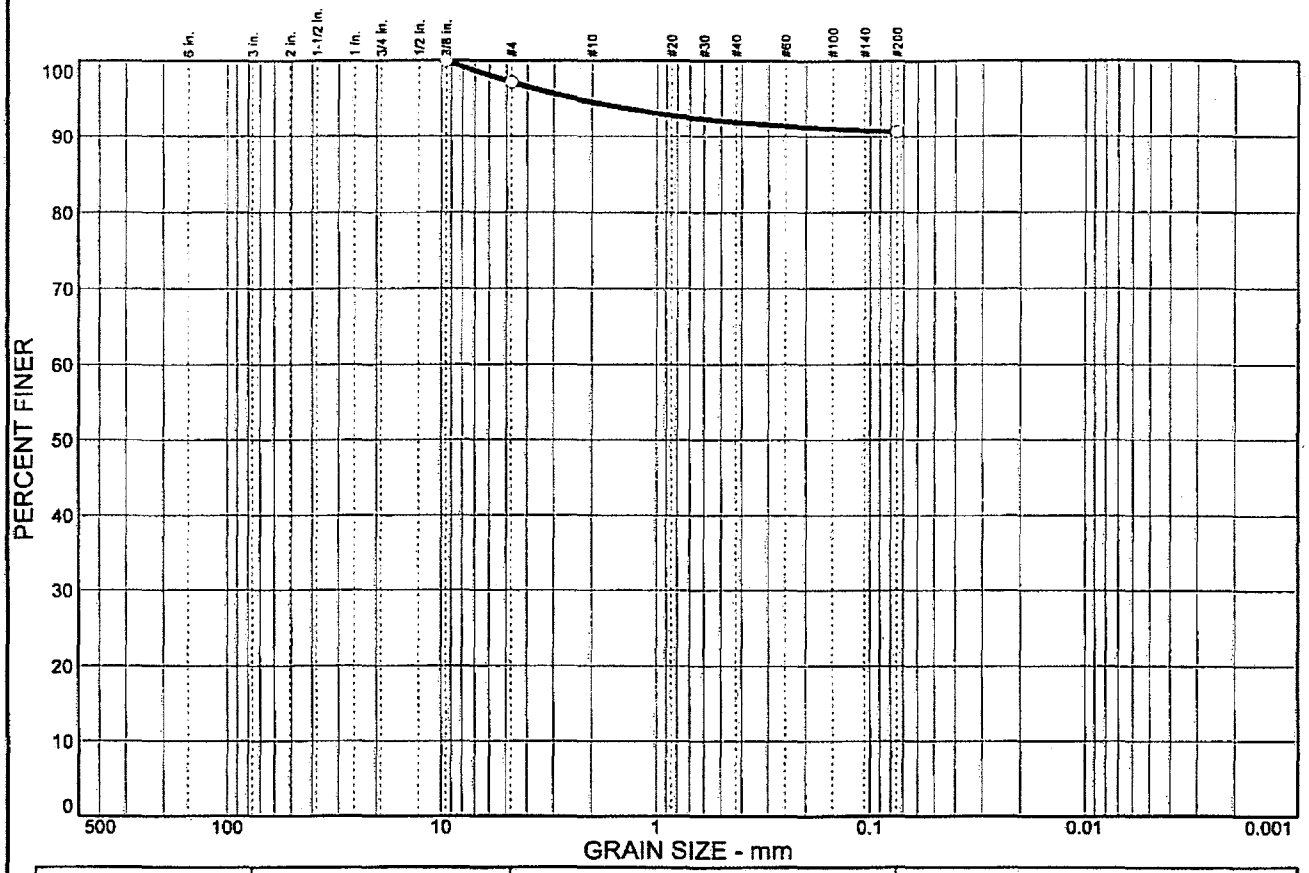
Remarks

Sample No.: P-3, Bucket-1 **Source of Sample:** **Date:** 1/23/08
Location: **Elev./Depth:**

Alpha-Omega Geotech, Inc.

Client: Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant
Project No: 8-118T **Figure** 1 of 1

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	2.8	2.7	2.7	1.2	90.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	97.2		
#200	90.6		

* (no specification provided)

Material Description

Light brown FAT CLAY

Atterberg Limits

PL= 17 LL= 50 PI= 33

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

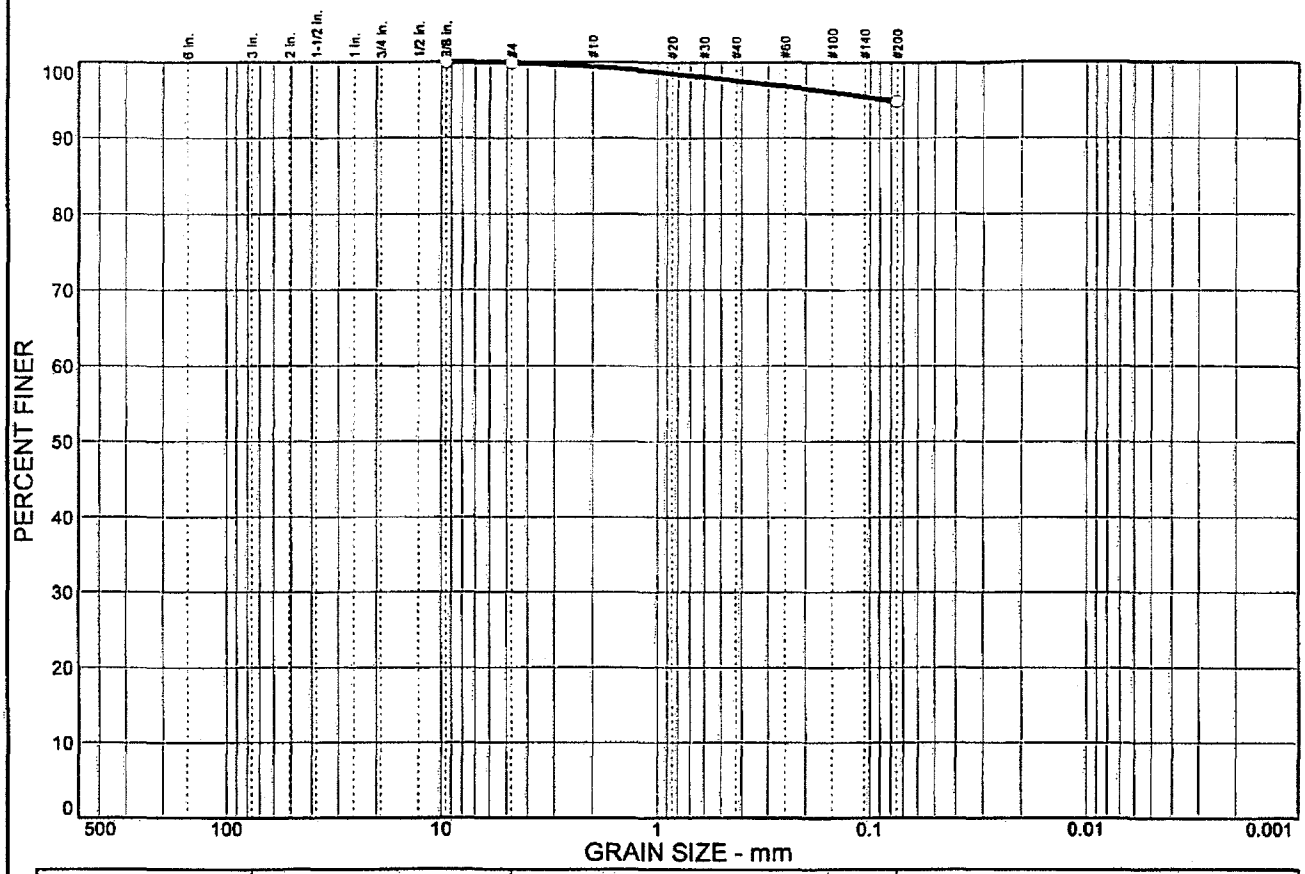
Remarks

Sample No.: P-4, Bucket-1 **Source of Sample:** **Date:** 1/23/08
Location: **Elev./Depth:**

Alpha-Omega Geotech, Inc.

Client: Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant
Project No: 8-118T **Figure** 1 of 1

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.1	0.5	1.8	2.7	94.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.9		
#200	94.9		

* (no specification provided)

Material Description

Brown FAT CLAY

Atterberg Limits

PL= 18 LL= 53 PI= 35

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

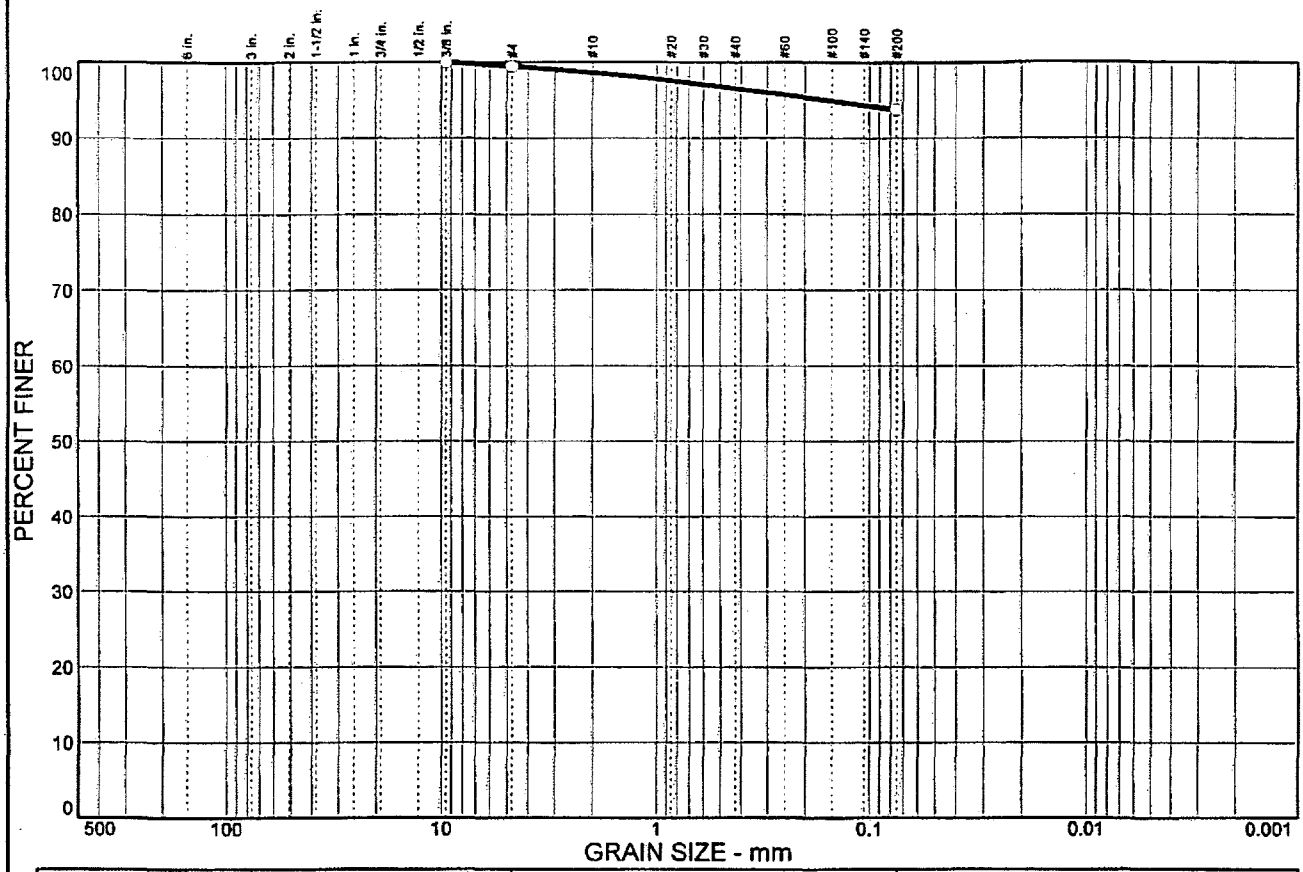
Remarks

Sample No.: P-5, Bucket-1 **Source of Sample:** **Date:** 1/23/08
Location: **Elev./Depth:**

Alpha-Omega Geotech, Inc.

Client: Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant
Project No: 8-118T **Figure** 1 of 1

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.5	0.8	2.1	2.8	93.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.5		
#200	93.8		

* (no specification provided)

Material Description

Light brown LEAN CLAY

Atterberg Limits

PL= 18 LL= 47 PI= 29

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

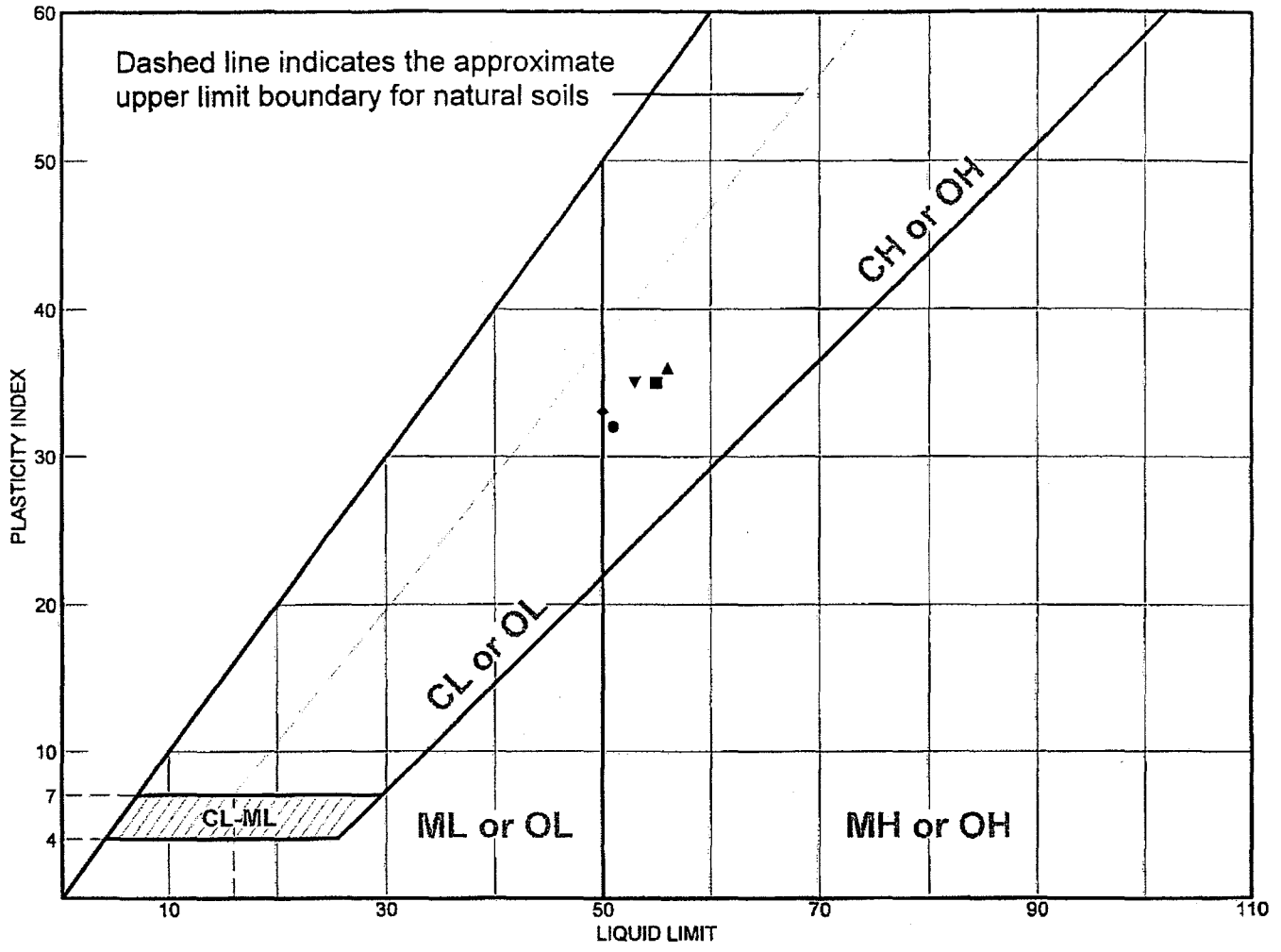
Remarks

Sample No.: P-6, Bucket-1 **Source of Sample:** **Date:** 1/23/08
Location: **Elev./Depth:**

Alpha-Omega Geotech, Inc.

Client: Aquaterra Environmental
Project: ATK Lake City Army Ammunition Plant
Project No: 8-118T **Figure** 1 of 1

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive brown FAT CLAY	51	19	32	95.6	94.6	CH
■	Olive brown FAT CLAY	55	20	35	99.2	98.6	CH
▲	Brown, mottled dark brown FAT CLAY	56	20	36	97.4	94.7	CH
◆	Light brown FAT CLAY	50	17	33	91.9	90.6	CH
▼	Brown FAT CLAY	53	18	35	97.6	94.9	CH

Project No. 8-118T **Client:** Aquaterra Environmental

Project: ATK Lake City Army Ammunition Plant

ATK Lake City Army Ammunition Plant

● **Source:** **Sample No.:** P-1, Bucket-1

■ **Source:** **Sample No.:** P-2, Bucket-1

▲ **Source:** **Sample No.:** P-3, Bucket-1

◆ **Source:** **Sample No.:** P-4, Bucket-1

▼ **Source:** **Sample No.:** P-5, Bucket-1

Remarks:

●

■

▲

◆

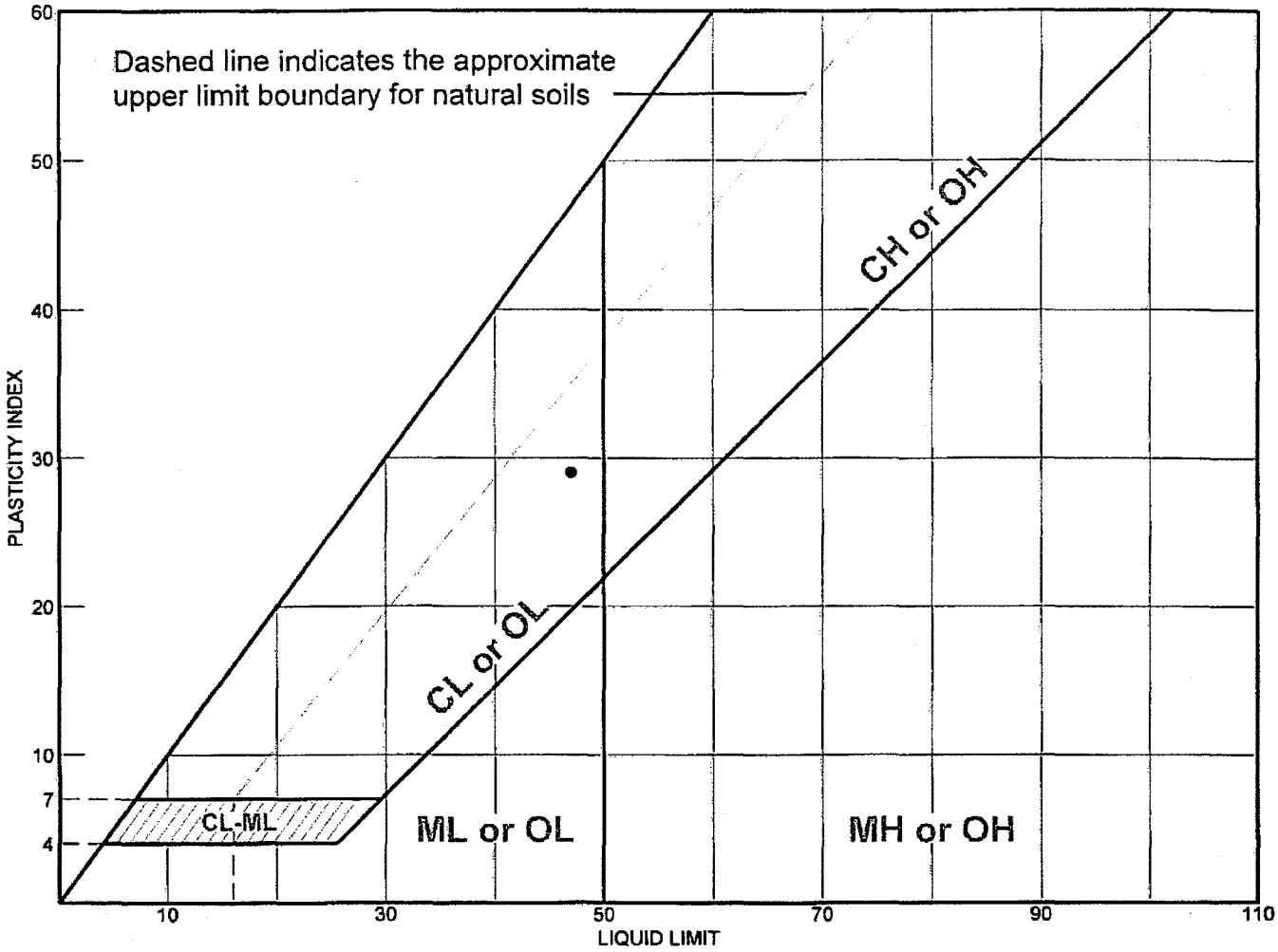
▼

Alpha-Omega Geotech, Inc.

GEOTECH

(913) 371-0000

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light brown LEAN CLAY	47	18	29	96.6	93.8	CL

Project No. 8-118T **Client:** Aquaterra Environmental

Project: ATK Lake City Army Ammunition Plant

● **Source:** **Sample No.:** P-6, Bucket-1

Remarks:

●

Alpha-Omega Geotech, Inc.

(913) 371-0000

Figure 2 of 2

APPENDIX B

Slope Stability Analysis obtained from

"Closure Plan Area 8 Special Waste Landfill Cells 1 and 2"

Submitted by **IT** Corporation dated May 2001

AQUATERRA

ENVIRONMENTAL SOLUTIONS, INC.

Soil Properties
Area 8 Soil Repository

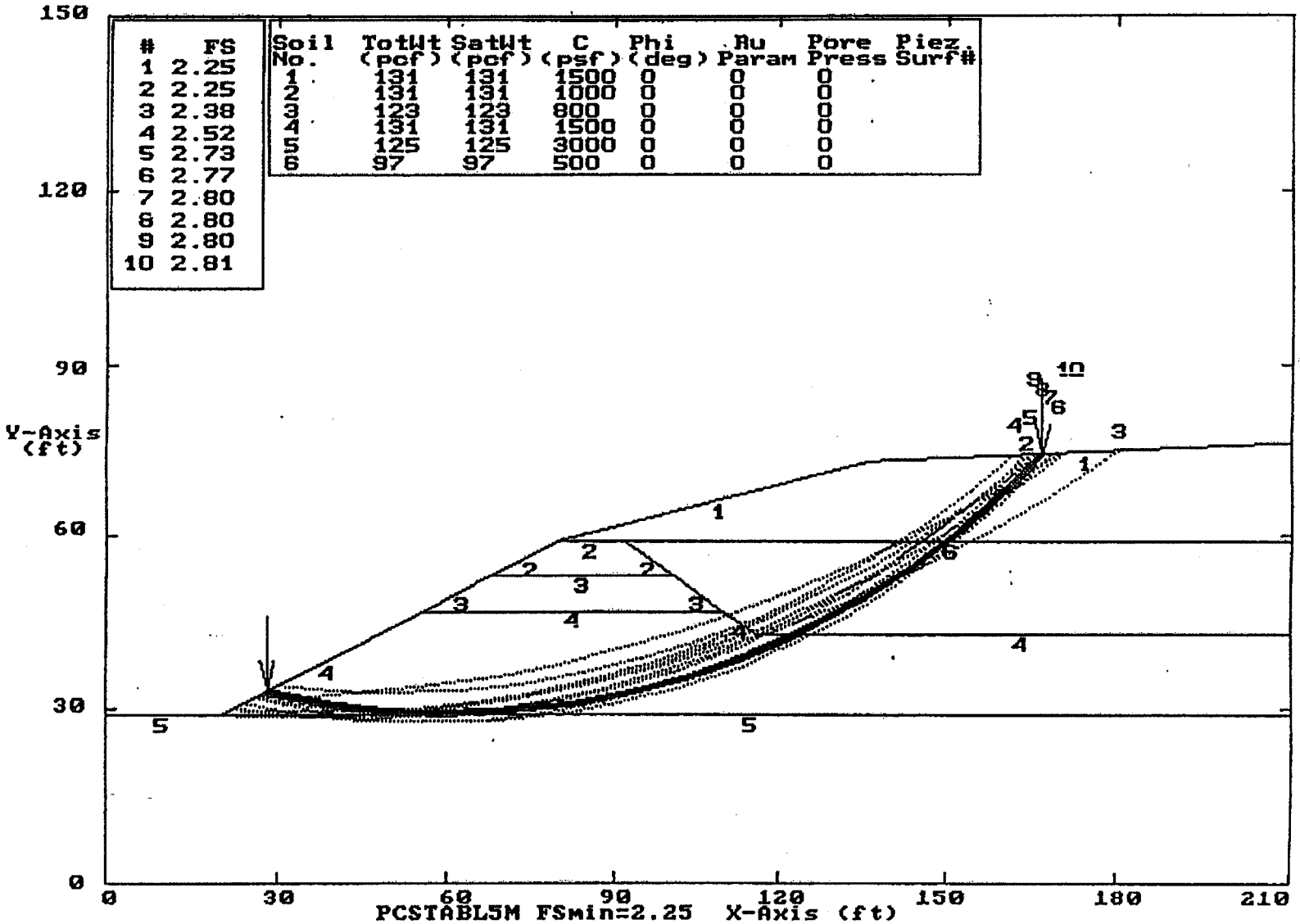
Layer	Description	USC	Moist Unit Weight	Short Term		End of Construction		Long Term C=0	
				Cohesion	Internal Friction	Cohesion	Internal Friction	Cohesion	Internal Friction
			PCF	ksf	Deg.	ksf	Deg.	ksf	Deg.
1	Clay, stiff ~~Load Soil~~	CL-CH ~~Assume~~	131	1.5	0	0.75	18	0	28
2	Clay, Firm to Stiff	CH	131	1.0	0	0.5	16	0	26
3	Clay, Firm	CH	123	0.8	0	0.4	16	0	26
4	Clay, Stiff	CL	131	1.5	0	0.75	20	0	30
5	Clay, Very Stiff	CL	131	3.0	0	1.5	20	0	30
6a	Clay, Stiff	CL-CH	125	1.0	0	0.5	18	0	28
6b	Sludge, Soft or Loose	CL-ML	80 ~~97~~	0.5	0	0.25	12	0	20
Factor of Safety				**2.25**		**2.35**		1.22 ~~1.36~~	

Properties were estimated using predominantly Borings B-8 and B-9, but considering all available data

LCAAP - AREA 8 SOIL REPOSITORY SHORT TERM CONDITION - SLUDGE FILL
Ten Most Critical. C:LCST_SLD.PLT By: SMQ 01-20-00 1:29pm

#	FS
1	2.25
2	2.25
3	2.38
4	2.52
5	2.73
6	2.77
7	2.80
8	2.80
9	2.80
10	2.81

Soil No.	TotWt (pcf)	SatWt (pcf)	C (psf)	Phi (deg)	Ru Param	Pore Press	Piez. Surf#
1	131	131	1500	0	0	0	
2	131	131	1000	0	0	0	
3	123	123	800	0	0	0	
4	131	131	1500	0	0	0	
5	125	125	3000	0	0	0	
6	97	97	500	0	0	0	



** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 01-20-00
Time of Run: 1:29pm
Run By: SMQ
Input Data Filename: C:LCST_SLD.IN
Output Filename: C:LCST_SLD.OUT
Plotted Output Filename: C:LCST_SLD.PLT

PROBLEM DESCRIPTION LCAAP - AREA 8 SOIL REPOSITORY
SHORT TERM CONDITION - SLUDGE FILL

BOUNDARY COORDINATES

6 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	29.00	20.00	29.00	5
2	20.00	29.00	56.00	47.00	4
3	56.00	47.00	68.00	53.00	3
4	68.00	53.00	80.00	59.00	2
5	80.00	59.00	136.00	73.00	1
6	136.00	73.00	210.00	76.00	1
7	92.00	59.00	210.00	59.00	6
8	80.00	59.00	92.00	59.00	2
9	92.00	59.00	101.00	53.00	2
10	68.00	53.00	101.00	53.00	3
11	101.00	53.00	110.00	47.00	3
12	56.00	47.00	110.00	47.00	4
13	110.00	47.00	116.00	43.00	4
14	116.00	43.00	210.00	43.00	4
15	20.00	29.00	210.00	29.00	5

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	131.0	131.0	1500.0	.0	.00	.0	0
2	131.0	131.0	1000.0	.0	.00	.0	0
3	123.0	123.0	800.0	.0	.00	.0	0
4	131.0	131.0	1500.0	.0	.00	.0	0
5	125.0	125.0	3000.0	.0	.00	.0	0
6	97.0	97.0	500.0	.0	.00	.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

110 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 11 Points Equally Spaced Along The Ground Surface Between X = 10.00 ft.
and X = 30.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 180.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

11.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.00	33.00
2	38.80	30.90
3	49.72	29.63

4	60.72	29.18
5	71.71	29.56
6	82.64	30.76
7	93.45	32.79
8	104.08	35.62
9	114.47	39.25
10	124.55	43.65
11	134.27	48.80
12	143.58	54.66
13	152.41	61.21
14	160.73	68.41
15	166.52	74.24

Circle Center At X = 61.2 ; Y = 175.1 and Radius, 145.9

*** 2.251 ***

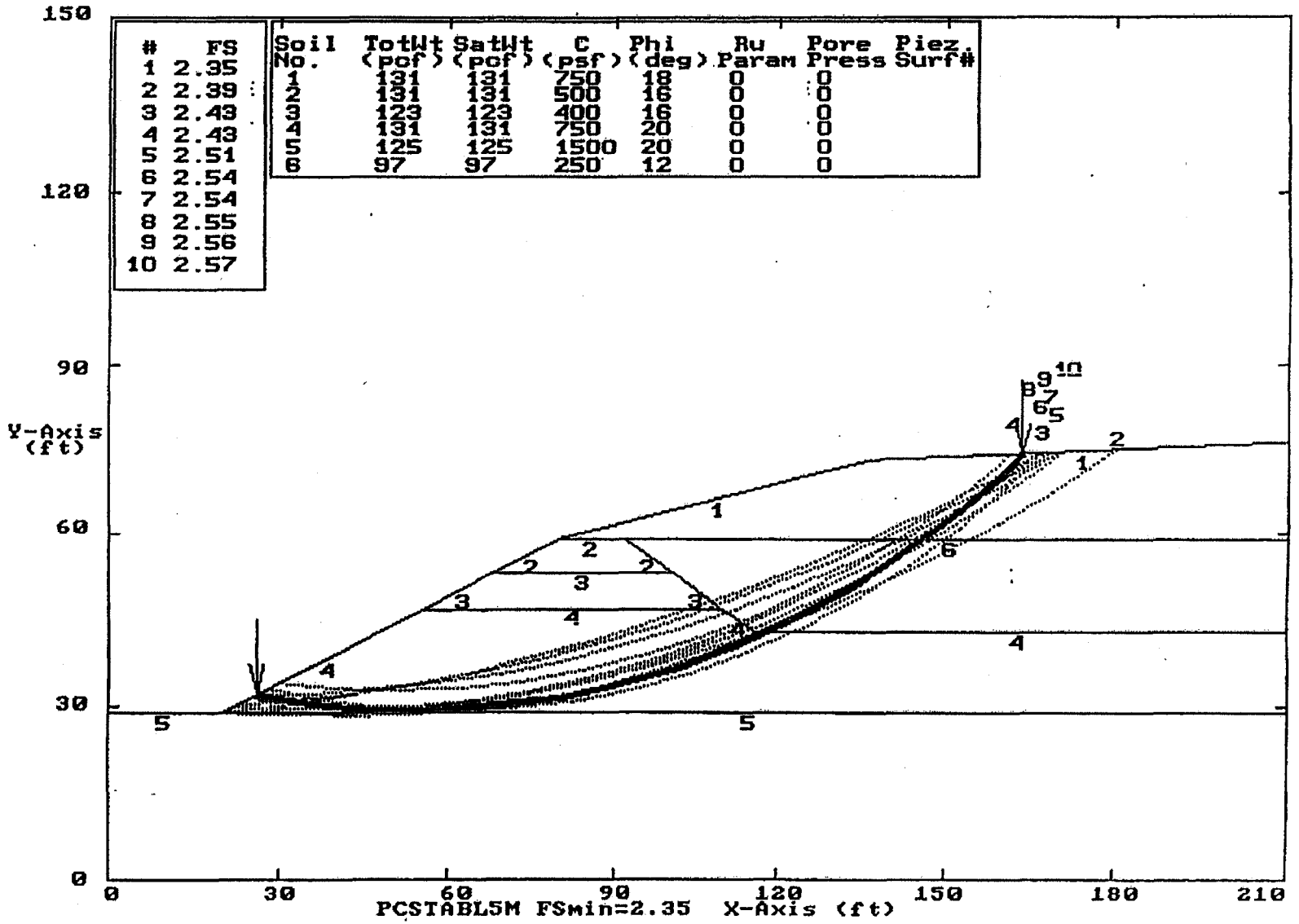
Individual data on the 24 slices

Slice No.	Width Ft (m)	Weight Lbs (kg)	Water Force Top Lbs (kg)	Water Force Bot Lbs (kg)	Tie Force Norm Lbs (kg)	Tie Force Tan Lbs (kg)	Earthquake Force Hor Lbs (kg)	Earthquake Force Ver Lbs (kg)	Surcharge Load Lbs (kg)
1	10.8	5301.7	.0	.0	.0	.0	.0	.0	.0
2	10.9	15551.6	.0	.0	.0	.0	.0	.0	.0
3	6.3	13098.5	.0	.0	.0	.0	.0	.0	.0
4	4.7	11633.6	.0	.0	.0	.0	.0	.0	.0
	7.3	20633.6	.0	.0	.0	.0	.0	.0	.0
6	3.7	11693.9	.0	.0	.0	.0	.0	.0	.0
7	8.3	28835.3	.0	.0	.0	.0	.0	.0	.0
8	2.6	9812.7	.0	.0	.0	.0	.0	.0	.0
9	9.4	35335.3	.0	.0	.0	.0	.0	.0	.0
10	1.5	5531.2	.0	.0	.0	.0	.0	.0	.0
11	7.5	27916.7	.0	.0	.0	.0	.0	.0	.0
12	3.1	11021.5	.0	.0	.0	.0	.0	.0	.0
13	5.9	20449.9	.0	.0	.0	.0	.0	.0	.0
14	4.5	14679.1	.0	.0	.0	.0	.0	.0	.0
15	1.5	4860.9	.0	.0	.0	.0	.0	.0	.0
16	7.1	21503.6	.0	.0	.0	.0	.0	.0	.0
17	1.5	4414.2	.0	.0	.0	.0	.0	.0	.0
18	9.7	27776.6	.0	.0	.0	.0	.0	.0	.0
19	1.7	4744.6	.0	.0	.0	.0	.0	.0	.0
20	7.6	18986.9	.0	.0	.0	.0	.0	.0	.0
21	5.9	12286.2	.0	.0	.0	.0	.0	.0	.0
22	3.0	5282.1	.0	.0	.0	.0	.0	.0	.0
23	8.3	9832.0	.0	.0	.0	.0	.0	.0	.0
24	5.8	2120.7	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

LCAAP - AREA 8 SOIL REPOSITORY END OF CONSTRUCTION - SLUDGE FILL
Ten Most Critical. C:LCEOCSLD.PLT By: SMQ 01-25-00 10:15am



#	FS
1	2.35
2	2.39
3	2.43
4	2.43
5	2.51
6	2.54
7	2.54
8	2.55
9	2.56
10	2.57

Soil No.	TotWt (pcf)	SatWt (pcf)	C (psf)	Phi (deg)	Ru Param	Pore Press	Piez. Surf#
1	131	131	750	18	0	0	
2	131	131	500	16	0	0	
3	123	123	400	16	0	0	
4	131	131	750	20	0	0	
5	125	125	1500	20	0	0	
6	97	97	250	12	0	0	

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 01-25-00
Time of Run: 10:15am
Run By: SMQ
Input Data Filename: C:LCEOCSLD.IN
Output Filename: C:LCEOCSLD.OUT
Plotted Output Filename: C:LCEOCSLD.PLT

PROBLEM DESCRIPTION LCAAP - AREA 8 SOIL REPOSITORY
END OF CONSTRUCTION - SLUDGE FILL

BOUNDARY COORDINATES

6 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	29.00	20.00	29.00	5
2	20.00	29.00	56.00	47.00	4
3	56.00	47.00	68.00	53.00	3
4	68.00	53.00	80.00	59.00	2
5	80.00	59.00	136.00	73.00	1
6	136.00	73.00	210.00	76.00	1
7	92.00	59.00	210.00	59.00	6
8	80.00	59.00	92.00	59.00	2
9	92.00	59.00	101.00	53.00	2
10	68.00	53.00	101.00	53.00	3
11	101.00	53.00	110.00	47.00	3
12	56.00	47.00	110.00	47.00	4
13	110.00	47.00	116.00	43.00	4
14	116.00	43.00	210.00	43.00	4
15	20.00	29.00	210.00	29.00	5

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	131.0	131.0	750.0	18.0	.00	.0	0
2	131.0	131.0	500.0	16.0	.00	.0	0
3	123.0	123.0	400.0	16.0	.00	.0	0
4	131.0	131.0	750.0	20.0	.00	.0	0
5	125.0	125.0	1500.0	20.0	.00	.0	0
6	97.0	97.0	250.0	12.0	.00	.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

110 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 11 Points Equally Spaced Along The Ground Surface Between X = 10.00 ft.
and X = 30.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 180.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

11.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.00	32.00
2	36.88	30.36
3	47.84	29.49

4	58.84	29.41
5	69.82	30.11
6	80.72	31.58
7	91.49	33.82
8	102.07	36.83
9	112.42	40.57
10	122.47	45.04
11	132.17	50.22
12	141.49	56.06
13	150.37	62.56
14	158.76	69.67
15	163.31	74.11

Circle Center At X = 54.5 ; Y = 184.2 and Radius, 154.9

*** 2.350 ***

Individual data on the 24 slices

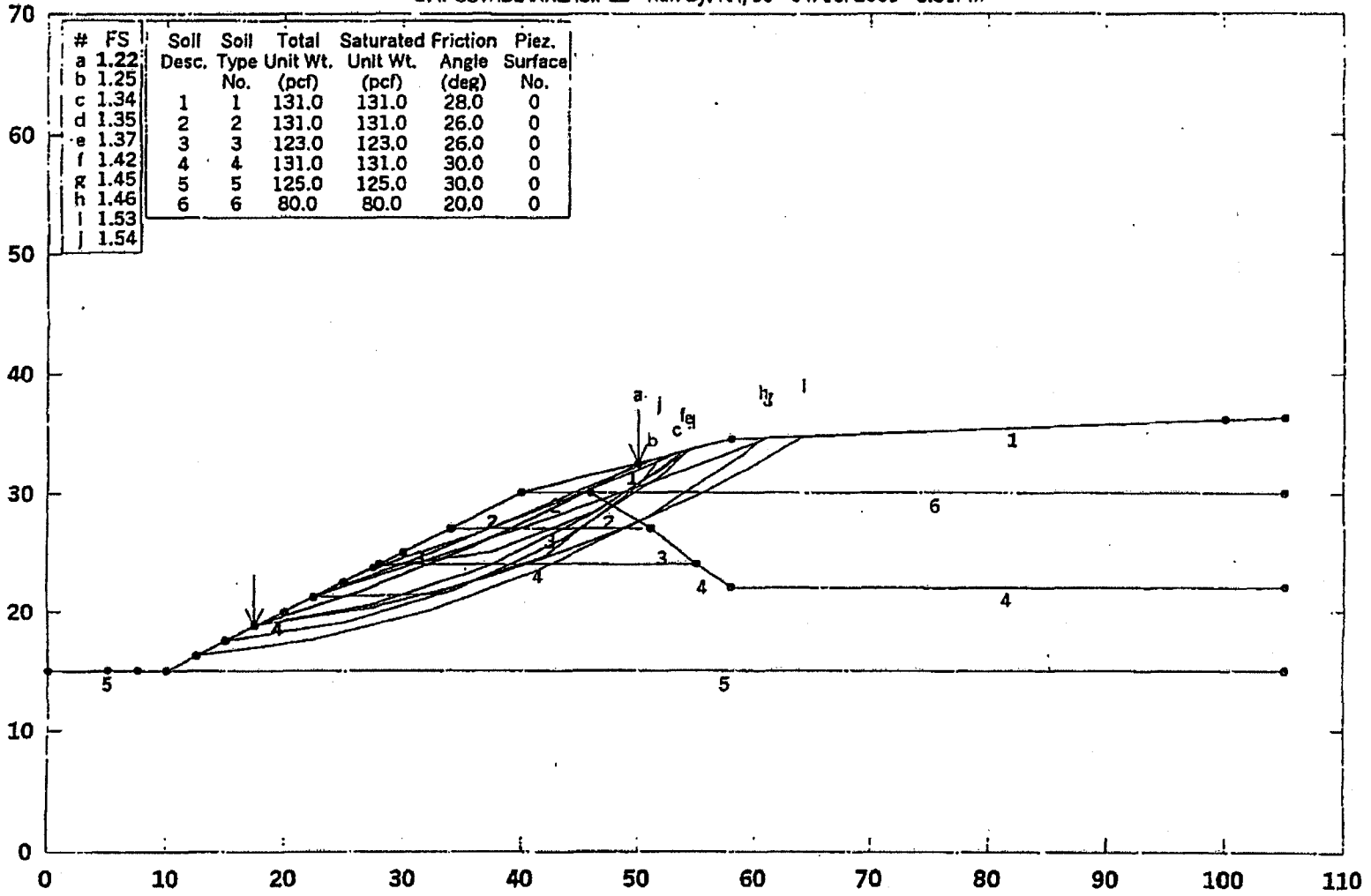
Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	10.9	5043.7	.0	.0	.0	.0	.0	.0	.0
2	11.0	14729.5	.0	.0	.0	.0	.0	.0	.0
3	8.2	16559.9	.0	.0	.0	.0	.0	.0	.0
[illegible]	2.8	6795.7	.0	.0	.0	.0	.0	.0	.0
[illegible]	9.2	24931.7	.0	.0	.0	.0	.0	.0	.0
6	1.8	5496.1	.0	.0	.0	.0	.0	.0	.0
7	10.2	33729.2	.0	.0	.0	.0	.0	.0	.0
8	.7	2571.1	.0	.0	.0	.0	.0	.0	.0
9	10.8	38735.4	.0	.0	.0	.0	.0	.0	.0
10	.5	1847.2	.0	.0	.0	.0	.0	.0	.0
11	9.0	31520.4	.0	.0	.0	.0	.0	.0	.0
12	1.1	3613.9	.0	.0	.0	.0	.0	.0	.0
13	7.9	25605.6	.0	.0	.0	.0	.0	.0	.0
14	2.4	7386.0	.0	.0	.0	.0	.0	.0	.0
15	3.6	10490.7	.0	.0	.0	.0	.0	.0	.0
16	1.9	5275.6	.0	.0	.0	.0	.0	.0	.0
17	4.6	12714.5	.0	.0	.0	.0	.0	.0	.0
18	9.7	25752.2	.0	.0	.0	.0	.0	.0	.0
19	3.8	9592.1	.0	.0	.0	.0	.0	.0	.0
20	5.5	12630.1	.0	.0	.0	.0	.0	.0	.0
21	4.0	8090.8	.0	.0	.0	.0	.0	.0	.0
22	4.9	8096.3	.0	.0	.0	.0	.0	.0	.0
23	8.4	8400.3	.0	.0	.0	.0	.0	.0	.0
24	4.5	1266.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

LCAAP - AREA 8 CAP LONG TERM - COVER LOAD

G:\PCSTABL\AREA8.PL2 Run By: KA; JS 04/10/2001 3:31PM



#	FS
a	1.22
b	1.25
c	1.34
d	1.35
e	1.37
f	1.42
g	1.45
h	1.46
i	1.53
j	1.54

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
1	1	131.0	131.0	28.0	0
2	2	131.0	131.0	26.0	0
3	3	123.0	123.0	26.0	0
4	4	131.0	131.0	30.0	0
5	5	125.0	125.0	30.0	0
6	6	80.0	80.0	20.0	0

GSTABL7 FSmin=1.22

Safety Factors Are Calculated By The Modified Bishop Method

STED

```
                    ***  GSTABL7  ***
        ** GSTABL7 by Garry H. Gregory, P.E. **
** Version 1.0, January 1996; Version 1.15, April 2000 **
              --Slope Stability Analysis--
            Simplified Janbu, Modified Bishop
              or Spencer`s Method of Slices
      (Based on STABL6-1986, by Purdue University)
Run Date:                    04/10/2001
Time of Run:                 3:31PM
Run By:                      KA; JS
Input Data Filename:         G:area8.in
Output Filename:             G:area8.OUT
Unit System:                 English
Plotted Output Filename:     G:area8.PLT
PROBLEM DESCRIPTION    LCAAP - AREA 8 CAP
                       LONG TERM - COVER LOAD
BOUNDARY COORDINATES
    6 Top   Boundaries
   15 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	15.00	10.00	15.00	5
2	10.00	15.00	28.00	24.00	4
3	28.00	24.00	34.00	27.00	3
4	34.00	27.00	40.00	30.00	2
5	40.00	30.00	58.00	34.50	1
6	58.00	34.50	105.00	36.40	1
7	46.00	30.00	105.00	30.00	6
8	40.00	30.00	46.00	30.00	2
9	46.00	30.00	51.00	27.00	2
10	34.00	27.00	51.00	27.00	3
11	51.00	27.00	55.00	24.00	3
12	28.00	24.00	55.00	24.00	4
13	55.00	24.00	58.00	22.00	4
14	58.00	22.00	105.00	22.00	4
15	10.00	15.00	105.00	15.00	5

ISOTROPIC SOIL PARAMETERS
6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	131.0	131.0	0.0	28.0	0.00	0.0	0
2	131.0	131.0	0.0	26.0	0.00	0.0	0
3	123.0	123.0	0.0	26.0	0.00	0.0	0
4	131.0	131.0	0.0	30.0	0.00	0.0	0
5	125.0	125.0	0.0	30.0	0.00	0.0	0
6	80.0	80.0	0.0	20.0	0.00	0.0	0

```
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
110 Trial Surfaces Have Been Generated.
 10 Surfaces Initiate From Each Of 11 Points Equally Spaced
Along The Ground Surface Between  X =   5.00(ft)
                              and  X =  30.00(ft)
Each Surface Terminates Between   X =  50.00(ft)
                              and  X = 100.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =  0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Examined.  They Are Ordered - Most Critical
      First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Failure Surface Specified By  5 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.50	18.75

```
          2          26.97        21.98
          3          36.24        25.72
          4          45.29        29.96
          5          50.02        32.50
     Circle Center At X =  -36.4 ; Y =  192.5  and Radius,  181.9
          ***      1.217    ***
          Individual data on the    10  slices
                      Water  Water     Tie     Tie     Earthquake
                      Force  Force    Force   Force       Force   Surcharge
Slice  Width   Weight   Top    Bot    Norm    Tan     Hor     Ver    Load
 No.    (ft)    (lbs)  (lbs)  (lbs)  (lbs)   (lbs)   (lbs)   (lbs)  (lbs)
  1     9.5     933.8    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  2     1.0     210.8    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  3     4.0     905.9    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  4     2.0     518.6    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  5     2.2     641.7    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  6     2.7     861.0    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  7     1.0     336.8    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  8     5.3    1344.4    0.0    0.0    0.0     0.0     0.0     0.0    0.0
  9     0.1      11.9    0.0    0.0    0.0     0.0     0.0     0.0    0.0
 10     4.7     408.7    0.0    0.0    0.0     0.0     0.0     0.0    0.0
     Failure Surface Specified By  5 Coordinate Points
       Point       X-Surf       Y-Surf
        No.         (ft)         (ft)
          1         22.50        21.25
          2         31.84        24.82
          3         41.12        28.55
          4         50.34        32.43
          5         51.14        32.78
     Circle Center At X = -189.9 ; Y =  590.3  and Radius,  607.4
          ***      1.245    ***
     Failure Surface Specified By  4 Coordinate Points
       Point       X-Surf       Y-Surf
        No.         (ft)         (ft)
          1         27.50        23.75
          2         37.00        26.89
          3         46.36        30.40
          4         53.26        33.32
     Circle Center At X =  -43.1 ; Y =  253.4  and Radius,  240.2
          ***      1.343    ***
     Failure Surface Specified By  6 Coordinate Points
       Point       X-Surf       Y-Surf
        No.         (ft)         (ft)
          1         17.50        18.75
          2         27.32        20.63
          3         36.83        23.74
          4         45.85        28.04
          5         54.26        33.46
          6         54.42        33.61
     Circle Center At X =    7.8 ; Y =   96.1  and Radius,   78.0
          ***      1.352    ***
     Failure Surface Specified By  6 Coordinate Points
       Point       X-Surf       Y-Surf
        No.         (ft)         (ft)
          1         15.00        17.50
          2         24.88        19.03
          3         34.46        21.92
          4         43.53        26.11
          5         51.94        31.53
          6         54.33        33.58
     Circle Center At X =    9.3 ; Y =   87.5  and Radius,   70.3
          ***      1.371    ***
     Failure Surface Specified By  4 Coordinate Points
       Point       X-Surf       Y-Surf
        No.         (ft)         (ft)
          1         27.50        23.75
```

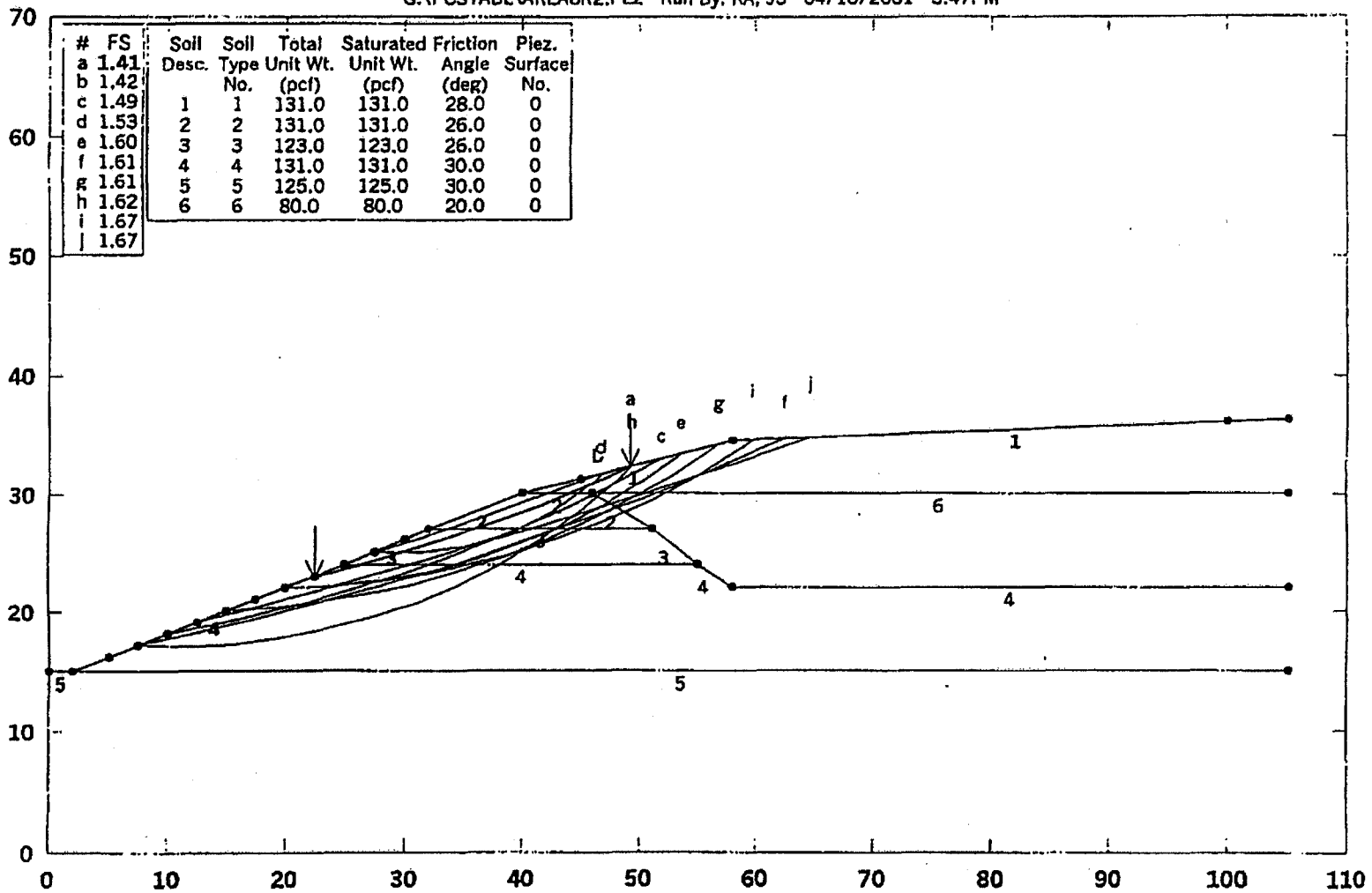
```
    2          37.42        25.01
    3          46.76        28.57
    4          53.85        33.46
Circle Center At X =    27.3 ; Y =    64.8  and Radius,    41.0
      ***      1.423    ***
Failure Surface Specified By  6 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          22.50        21.25
    2          32.00        24.36
    3          41.47        27.57
    4          50.91        30.89
    5          60.31        34.30
    6          61.17        34.63
Circle Center At X = -259.0 ; Y =   897.5  and Radius,   920.4
      ***      1.448    ***
Failure Surface Specified By  7 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          12.50        16.25
    2          22.40        17.64
    3          32.11        20.06
    4          41.50        23.48
    5          50.49        27.87
    6          58.96        33.19
    7          60.77        34.61
Circle Center At X =     4.3 ; Y =   110.9  and Radius,    95.0
      ***      1.459    ***
Failure Surface Specified By  6 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          17.50        18.75
    2          27.36        20.40
    3          37.06        22.86
    4          46.52        26.10
    5          55.68        30.11
    6          64.30        34.75
Circle Center At X =     2.3 ; Y =   139.5  and Radius,   121.7
      ***      1.528    ***
Failure Surface Specified By  5 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          22.50        21.25
    2          32.50        21.52
    3          41.97        24.73
    4          50.07        30.59
    5          51.86        32.97
Circle Center At X =    26.6 ; Y =    54.5  and Radius,    33.5
      ***      1.536    ***
```

LCAAP - AREA 8 CAP LONG TERM - COVER LOAD

G:\PCSTABL\AREA8R2.PL2 Run By: KA; JS 04/10/2001 3:47PM

#	FS
a	1.41
b	1.42
c	1.49
d	1.53
e	1.60
f	1.61
g	1.61
h	1.62
i	1.67
j	1.67

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
1	1	131.0	131.0	28.0	0
2	2	131.0	131.0	26.0	0
3	3	123.0	123.0	26.0	0
4	4	131.0	131.0	30.0	0
5	5	125.0	125.0	30.0	0
6	6	80.0	80.0	20.0	0



GSTABL7 FSmin=1.41

Safety Factors Are Calculated By The Modified Bishop Method

STED

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                    ***  GSTABL7  ***
        ** GSTABL7 by Garry H. Gregory, P.E. **
** Version 1.0, January 1996; Version 1.15, April 2000 **
              --Slope Stability Analysis--
            Simplified Janbu, Modified Bishop
              or Spencer`s Method of Slices
      (Based on STABL6-1986, by Purdue University)
Run Date:                    04/10/2001
Time of Run:                 3:47PM
Run By:                      KA; JS
Input Data Filename:         G:area8r2.in
Output Filename:             G:area8r2.OUT
Unit System:                 English
Plotted Output Filename:     G:area8r2.PLT
PROBLEM DESCRIPTION    LCAAP - AREA 8 CAP
                       LONG TERM - COVER LOAD
BOUNDARY COORDINATES
    6 Top   Boundaries
   15 Total Boundaries
Boundary      X-Left      Y-Left     X-Right     Y-Right     Soil Type
   No.         (ft)        (ft)        (ft)        (ft)      Below Bnd
    1          0.00       15.00        2.00       15.00          5
    2          2.00       15.00       25.00       24.00          4
    3         25.00       24.00       32.00       27.00          3
    4         32.00       27.00       40.00       30.00          2
    5         40.00       30.00       58.00       34.50          1
    6         58.00       34.50      105.00       36.40          1
    7         46.00       30.00      105.00       30.00          6
    8         40.00       30.00       46.00       30.00          2
    9         46.00       30.00       51.00       27.00          2
   10         32.00       27.00       51.00       27.00          3
   11         51.00       27.00       55.00       24.00          3
   12         25.00       24.00       55.00       24.00          4
   13         55.00       24.00       58.00       22.00          4
   14         58.00       22.00      105.00       22.00          4
   15          2.00       15.00      105.00       15.00          5
ISOTROPIC SOIL PARAMETERS
 6 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)   Param.   (psf)     No.
  1   131.0    131.0      0.0      28.0    0.00      0.0       0
  2   131.0    131.0      0.0      26.0    0.00      0.0       0
  3   123.0    123.0      0.0      26.0    0.00      0.0       0
  4   131.0    131.0      0.0      30.0    0.00      0.0       0
  5   125.0    125.0      0.0      30.0    0.00      0.0       0
  6    80.0     80.0      0.0      20.0    0.00      0.0       0
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
110 Trial Surfaces Have Been Generated.
 10 Surfaces Initiate From Each Of 11 Points Equally Spaced
Along The Ground Surface Between  X =   5.00(ft)
                              and  X =  30.00(ft)
Each Surface Terminates Between   X =  45.00(ft)
                              and  X = 100.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =  0.00(ft)
 4.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Examined.  They Are Ordered - Most Critical
      First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Failure Surface Specified By  9 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1         22.50        23.02
```

2	26.37	24.03
3	30.22	25.14
4	34.03	26.35
5	37.81	27.66
6	41.55	29.06
7	45.26	30.57
8	48.92	32.17
9	49.18	32.30

Circle Center At X = -13.8 ; Y = 170.6 and Radius, 151.9
*** 1.414 ***

Individual data on the 14 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.5	53.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.3	69.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.1	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	3.8	391.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.8	262.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	2.0	344.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.9	351.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.9	370.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	2.2	436.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.6	289.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	2.3	345.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1.4	156.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	3.7	192.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.50	25.07
2	31.31	26.28
3	35.11	27.54
4	38.89	28.85
5	42.66	30.20
6	46.40	31.60
7	46.41	31.60

Circle Center At X = -66.5 ; Y = 327.9 and Radius, 317.1
*** 1.425 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	18.13
2	13.93	18.90
3	17.83	19.78
4	21.70	20.77
5	25.55	21.87
6	29.36	23.09
7	33.13	24.42
8	36.86	25.86
9	40.55	27.40
10	44.19	29.06
11	47.79	30.82
12	51.33	32.68
13	51.81	32.95

Circle Center At X = -14.2 ; Y = 153.0 and Radius, 137.0
*** 1.485 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.50	25.07
2	31.50	25.01
3	35.46	25.60
4	39.27	26.82

```
    5          42.83        28.63
    6          46.06        30.99
    7          46.74        31.68
Circle Center At X =   29.9 ; Y =   49.7  and Radius,   24.8
      ***      1.529   ***
Failure Surface Specified By 11 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         20.00        22.04
    2         24.00        22.21
    3         27.97        22.66
    4         31.90        23.39
    5         35.78        24.40
    6         39.57        25.68
    7         43.26        27.22
    8         46.83        29.02
    9         50.26        31.07
   10         53.54        33.36
   11         53.58        33.40
Circle Center At X =   19.6 ; Y =   78.5  and Radius,   56.4
      ***      1.595   ***
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          7.50        17.15
    2         11.41        17.99
    3         15.31        18.89
    4         19.19        19.84
    5         23.07        20.85
    6         26.92        21.91
    7         30.76        23.03
    8         34.59        24.20
    9         38.39        25.43
   10         42.18        26.72
   11         45.95        28.05
   12         49.70        29.44
   13         53.43        30.89
   14         57.14        32.39
   15         60.83        33.94
   16         62.53        34.68
Circle Center At X =  -48.9 ; Y =  289.2  and Radius,  277.9
      ***      1.605   ***
Failure Surface Specified By 13 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         15.00        20.09
    2         18.99        20.35
    3         22.96        20.82
    4         26.91        21.49
    5         30.81        22.36
    6         34.67        23.43
    7         38.46        24.69
    8         42.19        26.14
    9         45.84        27.78
   10         49.40        29.60
   11         52.87        31.60
   12         56.23        33.77
   13         56.84        34.21
Circle Center At X =   11.7 ; Y =   98.9  and Radius,   78.9
      ***      1.613   ***
Failure Surface Specified By 13 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          7.50        17.15
    2         11.50        17.05
    3         15.49        17.24
```

4	19.47	17.71
5	23.40	18.46
6	27.26	19.49
7	31.04	20.80
8	34.72	22.37
9	38.28	24.19
10	41.70	26.27
11	44.96	28.58
12	48.05	31.12
13	49.32	32.33

Circle Center At X = 10.9 ; Y = 73.2 and Radius, 56.1
*** 1.618 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.00	22.04
2	24.00	22.23
3	27.98	22.64
4	31.93	23.26
5	35.84	24.08
6	39.70	25.12
7	43.50	26.37
8	47.23	27.82
9	50.88	29.46
10	54.43	31.30
11	57.88	33.33
12	59.75	34.57

Circle Center At X = 18.5 ; Y = 96.0 and Radius, 74.0
*** 1.667 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	12.50	19.11
2	16.37	20.13
3	20.23	21.17
4	24.09	22.24
5	27.94	23.32
6	31.78	24.42
7	35.62	25.54
8	39.45	26.69
9	43.28	27.85
10	47.10	29.03
11	50.92	30.23
12	54.73	31.45
13	58.53	32.69
14	62.33	33.95
15	64.75	34.77

Circle Center At X = -183.6 ; Y = 768.4 and Radius, 774.5
*** 1.675 ***

APPENDIXC

Settlement Analysis obtained from

"Closure Plan Area 8 Special Waste Landfill Cells 1 and 2"

Submitted by IT Corporation dated May 2001

AQUATERRA

ENVIRONMENTAL SOLUTIONS, INC.

SETTLEMENT ANALYSES
SUMMARY OF RESULTS

	Total Settlement, Feet	90% Consolidation Time, Months
Cell 1	0.60	4.2
Cel/2	0.65	6.9

Summary of Laboratory Test Results
Area 8 Soil Repository

Boring	Depth	Dry Wt.	Moisture	Wet Wt.	Cc	Eo	Qu, psf	USC/PI
B-2	4 to 7	35.4	133.8	82.8	1.82	3.6693		CH/39
		53	77.4	94.0			556	
B-4	7.5-10	94.6	25.2	118.4	0.22	0.7482		CL/25
		83.8	31.8	110.4			1013	
B-5	7.50	94.1	27.4	119.9			2073	CH/27
B-7	7.50	64.2	52	97.6			1215	
B-8	9 to 11	41.3	89.5	78.3	0.9	3.002		NP-ML
		72	69.2	121.8			1215	
B-3	10-12.5	101.2	23.7	125.2	0.19	0.6342		CL/31
		100.6	25.6	126.4			5019	
B-1	7.5	99	22.7	121.5	0.17	0.6707		CH/34
		101.5	22.2	124.0			3752	
B-6	7.5	95.9	27.6	122.4				CL/26
	13	95.6	26.1	120.6	0.2	0.7299		
	13	101.2	23.9	125.4			3857	CH/33
B-9	7.5	100.3	22.4	122.8	0.19	0.6493		CH/43
	13		22.1					CH/33

Depth	B-2 Cell 1 SPT-N	B-2 W%	B-2 Dry Wt.	B-3 Cell 1 SPT-N	B-3 W%	B-3 Dry Wt.	B-4 Cell 2 SPT-N	B-4 W%	B-4 Dry Wt.	B-5 Cell 2 SPT-N	B-5 W%	B-5 Dry Wt.	B-7 Cell 4 SPT-N	B-7 W%	B-7 Dry Wt.	B-8 Cell 4 SPT-N	B-8 W%	B-8 Dry Wt.
0	6	17.7		8	16.5		11			10	13.6		9	13.4		12	12.4	
1	7			8			14	13.0		11			8			16		
2	4	18.0		10	19.4		11	17.4		14	14.8		10	14.1		17	11.3	
3	4	14.2		[redacted]			8	21.9		7	20.5		6	19.9		8	22.0	
4	[redacted]			[redacted]			8	24.9		7	19.3		9			15		
5	[redacted]			[redacted]			6			5			[redacted]			11		
6	[redacted]			[redacted]			[redacted]	23.7		4	27.4		[redacted]			10	25.6	
7	[redacted]			[redacted]			[redacted]			[redacted]			[redacted]			13		
8	[redacted]			[redacted]			[redacted]			[redacted]			[redacted]			[redacted]		
9	12	22.7		13			[redacted]			[redacted]			[redacted]			[redacted]		
10		29.3		Cc0.19	25.6	100.6pcf	[redacted]	33.9		[redacted]	26.0		[redacted]	41.7		Cc=0.9	Qu=1220psf	
11			93.9pcf	Qu=5019 psf			[redacted]			[redacted]			[redacted]			[redacted]		
12	3.5tsf	22.5			19.3		[redacted]			[redacted]			[redacted]			[redacted]		
13	3.5tsf			19		14'	[redacted]			0tsf @13'			[redacted]			[redacted]		

Penetration values are blows for 12 inchs, but the values have been modified by using the initial 6 inches seating blows to provide a penetration value for each 1-foot increment. Hand penetrometer values are given in tons per square foot (tsf).

Depth	B-1 810 SPT-N	W%	Dry Wt.	LL	PI	-200	B-6 805 SPT-N	W%	Dry Wt.	LL	PI	-200	B-9 790 SPT-N	W%	Dry Wt.	LL	PI	-200
0	8	12.9					13	12.7					11	15.2				
1.5	16	13.1					17	12.4					7	18.3				
3	14	20.5		55	35	99	7	18.3					9	17				89
4.5	9	23.4					[illegible]	[illegible]				[illegible]	11	17.8				
6	[illegible]	[illegible]					[illegible]	21.4					[illegible]	[illegible]				
7.5	[illegible]	22.2		52	34	99	[illegible]	27.6	95.9			90	[illegible]	22.4	100.3	64	43	92
9	7.5' to 10' qu=3752psf, Cc=0.17						[illegible]						7.5 to 10 Cc=0.19					
10	42	14.1				11.5'	11						[illegible]	[illegible]				
11.5	100	[illegible]	Shale Weathered				6	22					15	21.2				
13	100	[illegible]		[illegible]	16	99		23.9	101.2	53	33	90	13	22.1		52	33	99
14.5	100	[illegible]					13' to 15' qu=3857psf, Cc=0.2						12	22.9				15'
16		[illegible]					14	22.8					12	22				
17.5							11	20.8					11	23.5		44	25	88
19.5							16	19										
21																		
22.5												24.5'						
24							18	17.2		43	25	85	10	22.7				
25.5																		
27												29'						
29							80	16.4					24	19.8				
30							Shale, Weathered											
31.5																		
33																		
34												35'	20	20.2				
36																		
37.5							Shale											
39													27	19.7				
40.5																		
42																		44'
44													100	12				
45																		
46.5													Sandy Shale					
48																		
49.5																		

Area 8 Soil Repository

Strata	Top, ft	Bottom, ft	Stratum Thickness	Unit Weight, pcf	Total Pressure, pcf	Av Pressure on Stratum, pcf	H, ft	$p_{0,ksf}$	Δp, ksf	e_0	C_c	S, ft
Cover Soil	0	1	1	111	111	55.5	1	0.056	0.535	0.700	0.2	0.12
	1	2	1	111	222	166.5	1	0.167	0.535	0.700	0.2	0.07
	2	3	1	111	333	277.5	1	0.278	0.535	0.700	0.2	0.05
	3	4	1	111	444	388.5	1	0.389	0.535	0.800	0.3	0.06
Sludge	4	5	1	53	497	470.5	1	0.471	0.535	3.669	0.9	0.06
	5	6	1	53	550	523.5	1	0.524	0.535	3.669	0.9	0.06
	6	7	1	53	603	576.5	1	0.577	0.535	3.669	0.9	0.05
	7	8	1	53	656	629.5	1	0.630	0.535	3.669	0.9	0.05
	8	9	1	53	709	682.5	1	0.683	0.535	3.669	0.9	0.05
Soil/sludge	9	10	1	100	809	759	1	0.759	0.535	3.002	0.3	0.02
	10	11	1	100	909	859	1	0.859	0.535	3.002	0.3	0.02
	11	12	1	100	1009	959	1	0.959	0.535	3.002	0.3	0.01
	12	13	1	100	1109	1059	1	1.059	0.535	3.002	0.3	0.01
Native	13	14	1	120	1229	1169	1	1.169	0.535	0.700	0.1	0.00

Time of Consolidation

U	T	H	c_v	t, days	t, months
0%	0	16	0.1717	0	0
10%	0.008	16	0.1717	1.19	0.0
20%	0.031	16	0.1717	4.62	0.2
30%	0.071	16	0.1717	10.58	0.4
40%	0.126	16	0.1717	18.77	0.6
50%	0.197	16	0.1717	29.35	1.0
60%	0.287	16	0.1717	42.76	1.4
70%	0.403	16	0.1717	60.04	2.0
80%	0.567	16	0.1717	84.48	2.8
90%	0.848	16	0.1717	126.35	4.2

Projected Settlement at Borings B-2, B-3 (Cell 1) **Total =** **0.65**

Area 8 Soil Repository

Strata	Top, ft	Bottom, ft	Stratum Thickness	Unit Weight, pcf	Total Pressure, pcf	Average Pressure on Stratum, pcf	H, ft	p_0	Δp	e_0	C_c	S, ft
Cover Soil	0	1	1	118	118	59	1	0.059	0.535	0.7	0.2	0.12
	1	2	1	118	236	177	1	0.177	0.535	0.7	0.2	0.07
	2	3	1	118	354	295	1	0.295	0.535	0.7	0.2	0.05
	3	4	1	118	472	413	1	0.413	0.535	0.7	0.2	0.04
	4	5	1	118	590	531	1	0.531	0.535	0.7	0.2	0.04
	5	6	1	118	708	649	1	0.649	0.535	0.7	0.2	0.03
Sludge A	6	7	1	84	792	750	1	0.75	0.535	0.7	0.2	0.03
	7	8	1	84	876	834	1	0.834	0.535	0.7	0.2	0.03
	8	9	1	84	960	918	1	0.918	0.535	3.0	0.9	0.04
	9	10	1	84	1044	1002	1	1.002	0.535	3.0	0.9	0.04
	10	11	1	84	1128	1086	1	1.086	0.535	3.0	0.9	0.04
	11	12	1	84	1212	1170	1	1.17	0.535	3.0	0.9	0.04
	12	13	1	84	1296	1254	1	1.254	0.535	3.0	0.9	0.03
Native	13	14	1	125	1421	1358.5	1	1.3585	0.535	0.5	0.1	0.00

Time of Consolidation:

U	T	H	c_v	t, days	t, months
0%	0	13	0.069		
10%	0.008	13	0.069	1.96	0.07
20%	0.031	13	0.069	7.59	0.25
30%	0.71	13	0.069	173.78	5.79
40%	0.126	13	0.069	30.84	1.03
50%	0.197	13	0.069	48.22	1.61
60%	0.287	13	0.069	70.25	2.34
70%	0.403	13	0.069	98.64	3.29
80%	0.567	13	0.069	138.78	4.63
90%	0.848	13	0.069	207.55	6.92

Projected Settlement at Boring B-4 (Cell 2) Total = **0.60**

APPENDIX D

STORM WATER MANAGEMENT CALCULATIONS

Channel Calculations

Culvert Calculations

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

Channel Calculations

AQUATERRA CALCULATION SHEET
ENVIRONMENTAL SOLUTIONS, INC.

PAGE ____ OF ____
PROJECT NO. 2606.10

CLIENT ATK
PROJECT LCAAP
Cell 1+2 Closure

SUBJECT Stormwater Permitting
Drainage channel calc.

Prepared by NAG Date 2/25/06
Reviewed by ____ Date ____
Approved by ____ Date ____

Q = 10 cfs - 25 yr - 24 hr storm
- Assuming all flows to one point (worst case scenario)

n = 0.0375, Mannings for grass lined channel (weeds/brush/bushy willows)
slope = 0.02 (min slope) → 0.055 max (from original pdf's)
2:1 sideslopes
48" bottom

Min slope (0.02): Velocity = 3.59 fps
Depth = 7.7" ⇒ 8 + 12 ⇒ 20"
Use 24" min Height ⇒ 32 % full

Max slope (0.055): Velocity = 5.0 fps
Depth = 5.6" ⇒ 6 + 12 = 18"
Use 24" min Height ⇒ 24 % full

0.02 Slope - Grass Lined Mannings

Channel Calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	10.0000 cfs
Slope	0.0200 ft/ft
Manning's n	0.0375
Height	24.0000 in
Bottom width	48.0000 in
Left slope	2.0000 ft/ft (VIR)
Right slope	2.0000 ftlft (VIR)

Computed Results:

Depth.....	7.7384 in
Velocity	3.5876 fps
Full Flowrate ..	62.5903 cfs
Flow area	2.7874 ft2
Flow perimeter	65.3037 in
Hydraulic radius	6.1465 in
Top width	55.7384 in
Area	10.0000 ft2
Perimeter	101.6656 in
Percent full	32.2435 %

Critical Information

Critical depth	0.0000 in
Critical slope	0.0000 ft/ft
Critical velocity	0.0000 fps
Critical area	0.0000 ft2
Critical perimeter	0.0000 in
Critical hydraulic radius	0.0000 in
Critical top width	0.0000 in
Specific energy.....	0.0000 ft
Minimum energy	0.0000 ft
Froude number	0.0000
Flow condition.....	Critical

0.055 slope (max from existing topos) - Grass Lined Mannings

Channel Calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	10.0000 cfs
Slope	0.0550 ft/ft
Manning's n	0.0375
Height	24.0000 in
Bottom width	48.0000 in
Left slope	2.0000 ft/ft (V/H)
Right slope	2.0000 ft/ft (V/H)

Computed Results:

Depth	5.6600 in
Velocity	5.0052 fps
Full Flowrate	103.7943 cfs
Flow area	1.9979 ft2
Flow perimeter	60.6562 in
Hydraulic radius	4.7431 in
Top width	53.6600 in
Area	10.0000 ft2
Perimeter	101.6656 in
Percent full	23.5834 %

Critical Information

Critical depth	0.0000 in
Critical slope	0.0000 ft/ft
Critical velocity.....	0.0000 fps
Critical area	0.0000 ft2
Critical perimeter	0.0000 in
Critical hydraulic radius	0.0000 in
Critical top width	0.0000 in
Specific energy	0.0000 ft
Minimum energy	0.0000 ft
Froude number	0.0000
Flow condition....	Critical

Culvert Calculations

AQUATERRA CALCULATION SHEET
ENVIRONMENTAL SOLUTIONS, INC.

CLIENT ATK
PROJECT LCAAP closure

SUBJECT Culvert - Storm water calcs

PAGE ____ OF ____
PROJECT NO. 2606.10
Prepared by ____ Date ____
Reviewed by ____ Date ____
Approved by ____ Date ____

- Planned to Use 12" CMP
- Calculate capacity of pipe Using Land Desktop - Pipe Calculator
  - Assume a slope of 0.5% - Mannings 0.02 (CMP)
  - Assume a depth of flow of 12" (full capacity)

  → Velocity = 2.1 fps - Ok

  → Flowrate = 1.63 cfs ⇒ No Good - our max flow is 10 cfs

Recommend using a 24" culvert
- This will handle all runoff from cover through a single culvert and keep velocity reasonable for grass lining (outfall culvert will take the full 10 cfs)

Use Culvert Calculator : Eastern Culvert (full 10 cfs flow)

1.) Assume: Tailwater ≈ 0
length = 20'
Diameter = 24"
n = 0.024 (CMP)
0.4' drop over 20' ⇒ Slope = 2%

Velocity = 5.7 fps ⇒ Pipe 83% full
(will need rip-rap lining)

2.) Northern Culvert (Assume takes less than half of cover flow so Assume 5 cfs of the full 10 cfs.)

Assume: Tailwater ≈ 0
Length = 20'
Diameter = 24"
n = 0.024 (CMP)

0.2' drop over 20' ⇒ slope ⇒ 1.0%

Velocity = 4.35 fps ⇒ Pipe 65% full

Eastern Culvert - 10cfs flow

Culvert Calculator

All calculator output should be verified prior to design use

Entered Data:

Shape	Circular
Number of Barrels	I
Solving for..	Headwater
Chart Number.....	1
Scale Number	1
Chart Description	CONCRETE PIPE CULVERT; NO BEVELED RING ENTRANCE
Scale Description	SQUARE EDGE ENTRANCE WITH HEADWALL
Overtopping.....	Orf
Flowrate	10.0000 cfs
Manning's n	0.0240
Roadway Elevation	800.0000 ft
Inlet Elevation	769.0000 ft
Outlet Elevation	768.6000 ft
Diameter	24.0000 in
Length	20.0000 ft
Entrance Loss	0.0000
Tailwater	0.0010 ft

Computed Results:

Headwater	770.6733 ft Inlet Control
Slope	0.0200 ftlft
Velocity	5.7157 fps

Messages:

Inlet head> Outlet head.
Computing Inlet Control headwater.
Solving Inlet Equation 26.
Solving Inlet Equation 28.
Headwater: 770.6733 ft

DIS- CHARGE Flow	HEAD- WATER ELEV.	INLET CONTROL DEPTH	OUTLET CONTROL DEPTH	FLOW TYPE	NORMAL DEPTH	CRITICAL DEPTH	VEL.	OUTLET DEPTH	VEL.	TAILWATER DEPTH
cfs	ft	ft	ft	111	111	fps	ft	fps	ft	
2.00	769.83	0.66	0.83	NA	5.50	13.58	3.34	0.46	0.00	0.00

Inlet Elevation 769.0000 ft
Outlet Elevation 768.8000 ft
Diameter 24.0000 in
Length 20.0000 ft
Entrance Loss 0.0000
Tailwater 0.0010 ft

Computed Results:
Headwater 770.2848 ft Outlet Control
Slope 0.0100 *ft/ft*
Velocity..... 4.3500 fps

Messages:
Outlet head> hllet head.
Computing Outlet Control headwater.
Outlet not submerged.
Normal Depth: 10.6710 in
Critical Depth: 9.4526 in
Flow is subcritical.
Normal depth> critical depth.
Tailwater depth < normal depth.
M2 drawdown profile.
Tailwater depth <= critical depth.
Depth computed with direct step method starting at critical depth.
Headwater: 770.2848 ft

DIS- CHARGE Flow cfs	HEAD- WATER ELEV. ft	INLET CONTROL DEPTH ft	OUTLET CONTROL DEPTH ft	FLOW TYPE	NORMAL DEPTH in	CRITICAL DEPTH in	OUTLET VEL. fps	TAILWATER DEPTH ft	TAILWATER VEL. fps	DEPTH ft
2.00	769.65	0.65	0.57	NA	6.56	5.89	2.88	0.55	0.00	0.00
4.00	769.95	0.95	0.86	NA	9.43	8.42	3.49	0.79	0.00	0.00
6.00	770.21	1.21	1.11	NA	11.85	10.39	3.88	0.99	0.00	0.00
8.00	770.45	1.45	1.33	NA	14.13	12.08	4.16	1.18	0.00	0.00
10.00	770.67	1.67	1.55	NA	16.47	13.58	4.35	1.37	0.00	0.00
12.00	770.90	1.90	1.75	NA	19.22	14.94	4.45	1.60	0.00	0.00
14.00	771.61	2.12	2.61	M2	24.00	14.94	4.46	2.00	0.00	0.00
16.00	771.72	2.39	2.72	M2	24.00	14.94	5.09	2.00	0.00	0.00
18.00	771.85	2.63	2.85	M2	24.00	14.94	5.73	2.00	0.00	0.00
20.00	772.00	2.93	3.00	M2	24.00	14.94	6.37	2.00	0.00	0.00
22.00	772.27	3.27	3.17	NA	24.00	24.00	7.00	2.00	0.00	0.00
24.00	772.64	3.64	3.37	NA	24.00	24.00	7.64	2.00	0.00	0.00
26.00	773.05	4.05	3.59	NA	24.00	24.00	8.28	2.00	0.00	0.00

28.00	773.48	4.48	3.85	NA	24.00	24.00	8.91	2.00	0.00	0.00
30.00	773.95	4.95	4.14	NA	24.00	24.00	9.55	2.00	0.00	0.00
32.00	774.45	5.45	4.46	NA	24.00	24.00	10.19	2.00	0.00	0.00
34.00	774.98	5.98	4.81	NA	24.00	24.00	10.82	2.00	0.00	0.00
36.00	775.55	6.55	5.19	NA	24.00	24.00	11.46	2.00	0.00	0.00
38.00	776.14	7.14	5.60	NA	24.00	24.00	12.10	2.00	0.00	0.00
40.00	776.77	7.77	6.04	NA	24.00	24.00	12.73	2.00	0.00	0.00
42.00	777.69	8.43	8.69	M2	24.00	24.00	13.37	2.00	0.00	0.00
44.00	778.38	9.13	9.38	M2	24.00	24.00	14.01	2.00	0.00	0.00
46.00	779.11	9.85	10.11	M2	24.00	24.00	14.64	2.00	0.00	0.00
48.00	779.86	10.61	10.86	M2	24.00	24.00	15.28	2.00	0.00	0.00
50.00	780.65	11.40	11.65	M2	24.00	24.00	15.92	2.00	0.00	0.00

APPENDIX E

Area 8 Cells 1 and 2 IWTP Sludge Landfill 2008
Closure Permit Drawings and Project Manual

Closure Permit Drawings

Project Manual

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

Closure Permit Drawings

(

LAKE CITY ARMY AMMUNITION PLANT

INDEPENDENCE, MISSOURI

AREA 8 CELLS 1 & 2 INDUSTRIAL WASTE TREATMENT SLUDGE LANDFILL

2008 CLOSURE PERMIT DRAWINGS

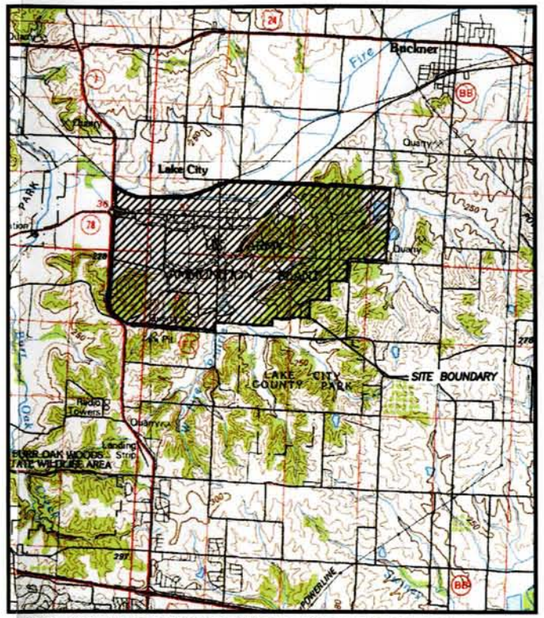
PREPARED BY

AQUATERRA

ENVIRONMENTAL SOLUTIONS, INC.

7311 WEST 130TH STREET, STE 100
OVERLAND PARK, KS 66213
(913) 681-0030 FAX (913) 681-0012

PROJECT NO. 2606.10
MARCH 2008



BASE MAP IS A PORTION OF THE USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE: INDEPENDENCE, MISSOURI, 1957
SCALE: 1" = 5000'

LANDFILL LOCATION MAP

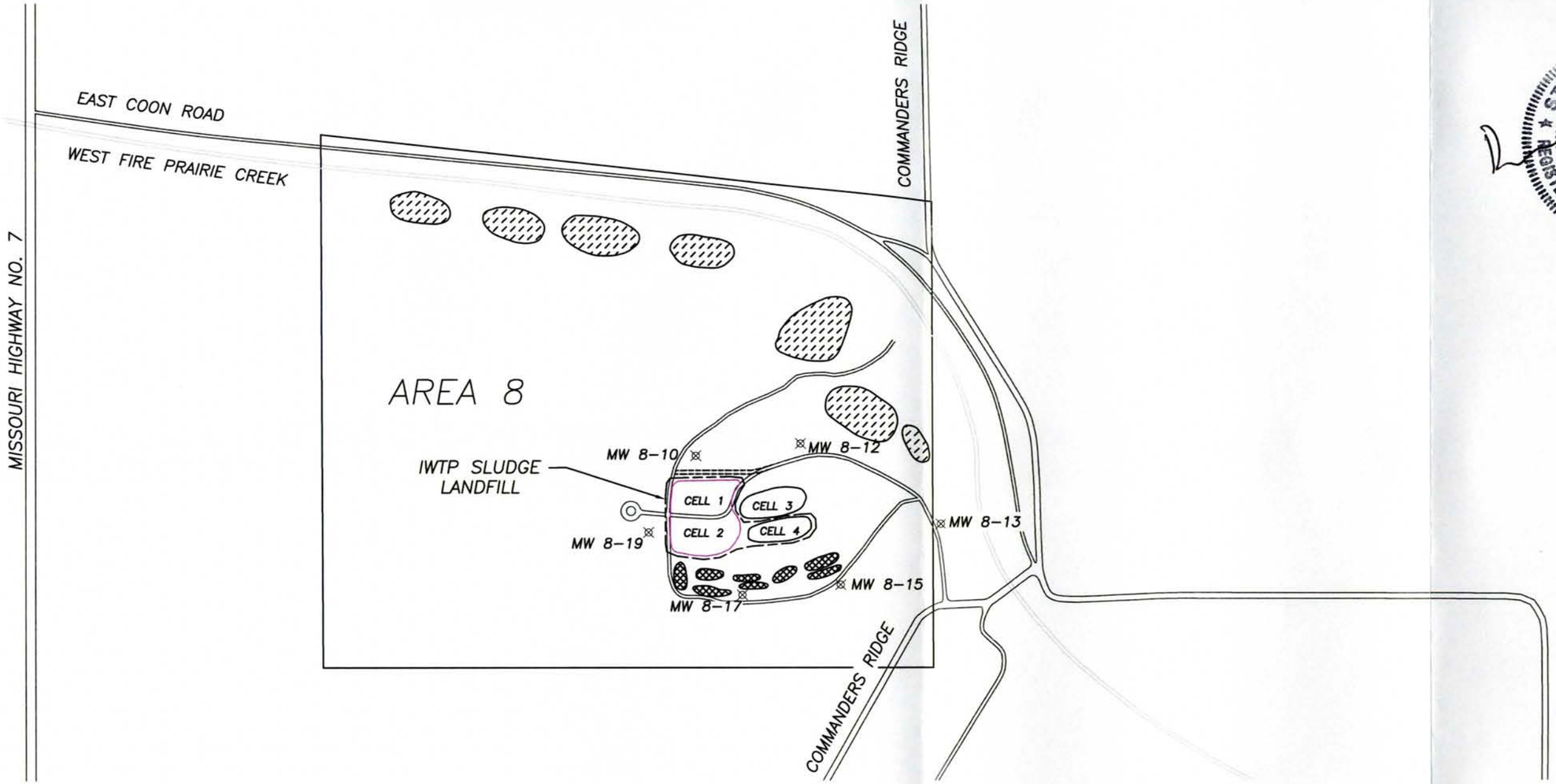
DRAWING INDEX

DRAWING NO.	TITLE
1	TITLE/COVER SHEET
2	SITE LAYOUT
3	LEVELING LAYER GRADING PLAN
4	FINAL DEVELOPMENT PLAN
5	DETAILS

NOTE: FOR PERMIT USE ONLY, NOT INTENDED FOR CONSTRUCTION.

STATE OF MISSOURI
DOUGLAS LEE DOERR
NUMBER E-28982
REGISTERED PROFESSIONAL ENGINEER

3/18/08



LEGEND

- PROPOSED COVER BOUNDARY
- IWTP WASTE BOUNDARY
- EXISTING ROADS
- PROPOSED ROAD
- EXISTING CREEK
- GROUNDWATER MONITORING WELL
- WASTE DISPOSAL AREAS OUTSIDE 2008 CLOSURE AREA
- OIL AND GREASE TRENCHES

NOTES:

1. FOR PERMIT USE ONLY. NOT INTENDED FOR CONSTRUCTION.

500 0 500 1000

SCALE FEET

STATE OF MISSOURI
DOUGLAS LEE DOERR
NUMBER E-28982
REGISTERED PROFESSIONAL ENGINEER

3/18/08

REV.	DATE	BY	DESCRIPTION
R5	-	5BY	-
R4	-	4BY	-
R3	-	3BY	-
R2	-	2BY	-
R1	-	1BY	-
R0	-	0BY	-

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.
7311 West 130th Street, Suite 100
Overland Park, Kansas 66213

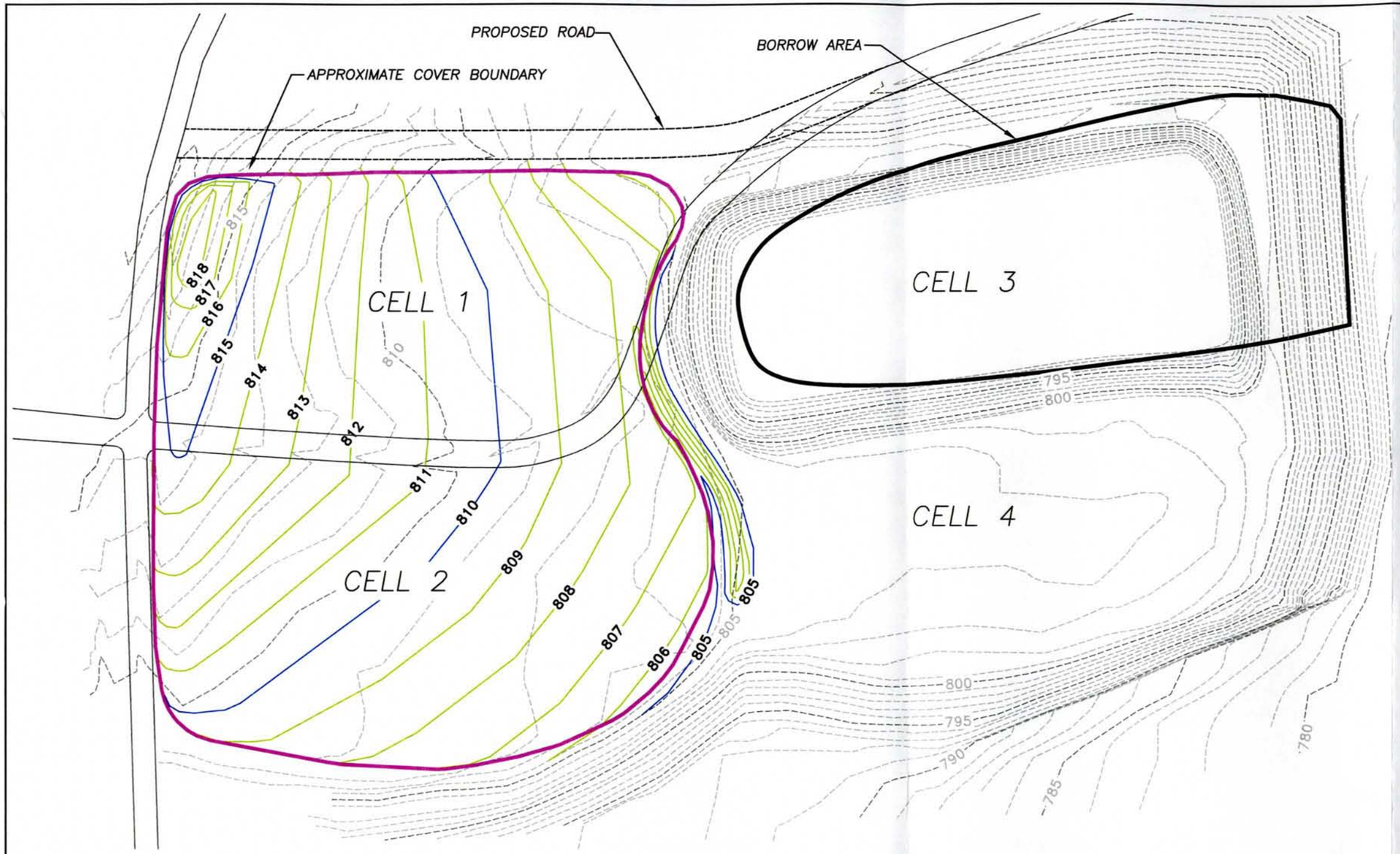
CLIENT: ALLIANT TECHSYSTEMS, INC.
LAKE CITY ARMY AMMUNITION PLANT
INDEPENDENCE, MISSOURI

DRAWN BY: NAG DESIGNED BY: NAG PROJECT MGR: MAB
ELECTRONIC FILE NAME: D2 SITE LAYOUT.DWG DATE: 3/12/08

SITE LAYOUT
AREA 8 CELLS 1 & 2 CLOSURE
INDUSTRIAL WASTE TREATMENT LANDFILL

REV.: 0 DRAWING NUMBER: 2 PROJECT NUMBER: 2808.10 SHT. 2 OF 5

H:\JOB\PROJECTS\2808.10 - CELLS 1 AND 2 CLOSURE\DWG\D2 SITE LAYOUT.DWG



LEGEND

- PROPOSED COVER BOUNDARY
- PROPOSED BORROW AREA BOUNDARY
- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- PROPOSED LEVELING LAYER 1' CONTOURS
- PROPOSED LEVELING LAYER 5' CONTOURS
- EXISTING ROADS
- PROPOSED ROADS

NOTES:

1. FOR PERMIT USE ONLY. NOT INTENDED FOR CONSTRUCTION.
2. CONTOURS DIGITIZED FROM "IT CORPORATION" DRAWING "C2" DATED 4/7/99. CONTOURS ARE APPROXIMATE AND WILL BE RESURVEYED PRIOR TO COMMENCING CLOSURE ACTIVITIES.
3. PROPOSED LEVELING LAYER CONTOURS BASED ON AVAILABLE SURVEY DATA. ACTUAL EXISTING CONTOURS WILL BE VERIFIED PRIOR TO CLOSURE ACTIVITIES AND THE PROPOSED CONTOURS WILL BE ADJUSTED AS NECESSARY.
4. EXISTING ROAD LOCATED BETWEEN CELLS 1, 2, AND 3 TO BE ABANDONED. NEW ROAD TO BE CONSTRUCTED NORTH OF CELL 1.
5. CELL 3 WAS CONSTRUCTED BUT NEVER UTILIZED AS A DISPOSAL AREA. SOIL MATERIAL FROM CELL 3 TO BE EXCAVATED FOR USE IN CLOSURE ACTIVITIES AND THE FORMER CELL 3 AREA WILL BE REGRADED TO PROMOTE POSITIVE SURFACE WATER DRAINAGE.

60 0 60 120
SCALE FEET

STATE OF MISSOURI
DOUGLAS LEE DOERR
NUMBER E-26982
REGISTERED PROFESSIONAL ENGINEER
3/18/08

REV.	DATE	BY	DESCRIPTION
R5	-	5BY	-
R4	-	4BY	-
R3	-	3BY	-
R2	-	2BY	-
R1	-	1BY	-
R0	-	0BY	-

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.
7311 West 130th Street, Suite 100
Overland Park, Kansas 66213

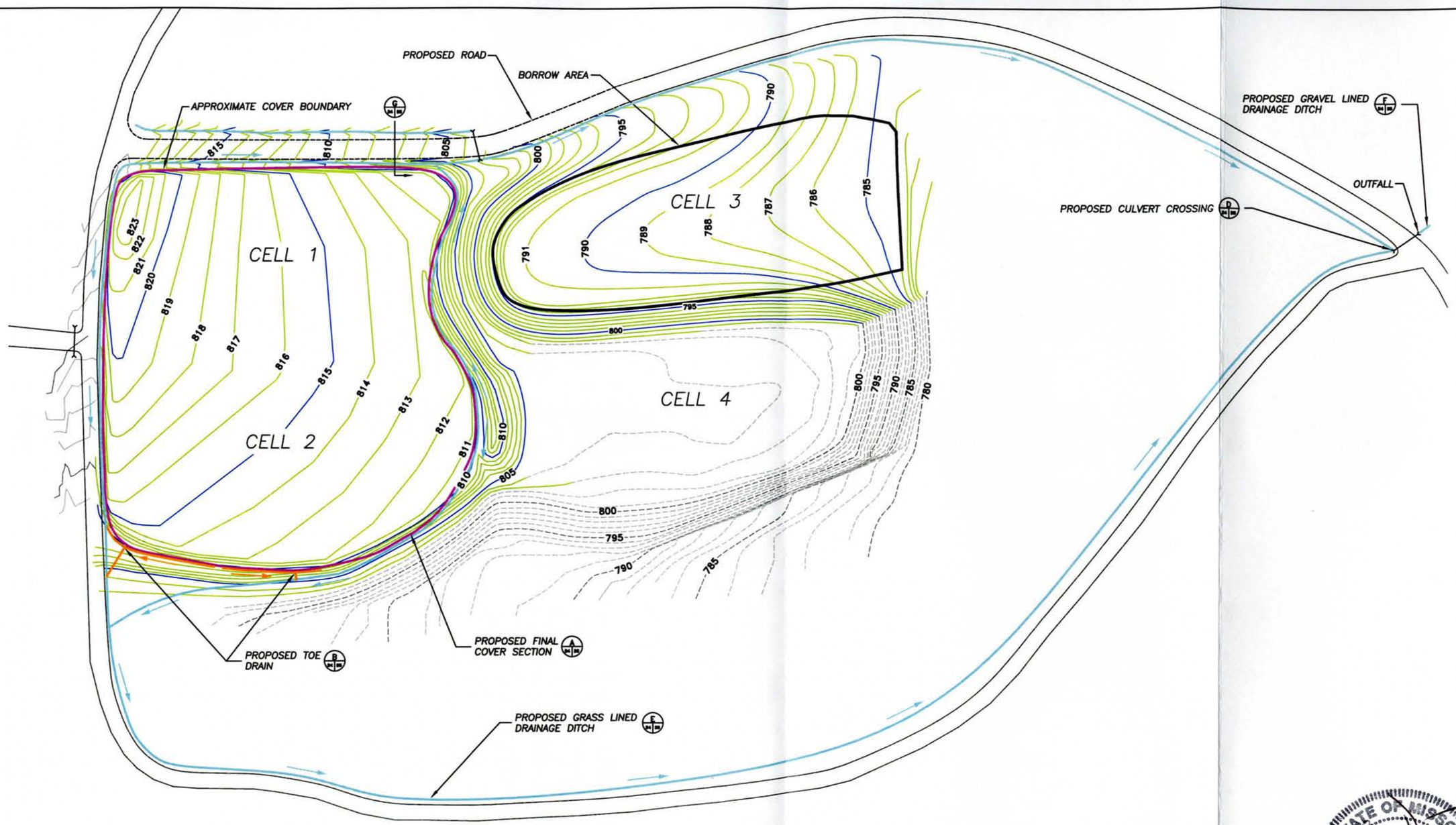
CLIENT: ALLIED TECHSYSTEMS, INC.
LAKE CITY ARMY AMMUNITION PLANT
INDEPENDENCE, MISSOURI

DRAWN BY: NAG DESIGNED BY: NAG PROJECT MGR: NAB
ELECTRONIC FILE NAME: 03 GRADING PLAN R2.DWG DATE: 3/12/08

SITE LAYOUT
AREA 8 CELLS 1 & 2 CLOSURE
INDUSTRIAL WASTE TREATMENT LANDFILL

REV: 0 DRAWING NUMBER: 3 PROJECT NUMBER: 2806.10 SHT. 3 OF 5

H:\JTK\PROJECTS\2806.10 - CELLS 1 AND 2 CLOSURE\DWG\03 GRADING PLAN R2.DWG



LEGEND

- PROPOSED COVER BOUNDARY
- PROPOSED BORROW AREA BOUNDARY
- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- PROPOSED TOP OF COVER 1' CONTOUR
- PROPOSED TOP OF COVER 5' CONTOUR
- EXISTING ROADS
- PROPOSED ROAD
- PROPOSED DRAINAGE DITCH
- PROPOSED TOE DRAIN

NOTES:

1. FOR PERMIT USE ONLY. NOT INTENDED FOR CONSTRUCTION.
2. CONTOURS DIGITIZED FROM "IT CORPORATION" DRAWING "C2" DATED 4/7/99. CONTOURS ARE APPROXIMATE AND WILL BE RESURVEYED PRIOR TO COMMENCING CLOSURE ACTIVITIES.
3. PROPOSED TOP OF COVER CONTOURS BASED ON AVAILABLE SURVEY DATA. ACTUAL EXISTING CONTOURS WILL BE VERIFIED PRIOR TO CLOSURE ACTIVITIES AND THE PROPOSED CONTOURS WILL BE ADJUSTED AS NECESSARY.
4. EXISTING ROAD LOCATED BETWEEN CELLS 1, 2, AND 3 TO BE ABANDONED. NEW ROAD TO BE CONSTRUCTED NORTH OF CELL 1.
5. CELL 3 WAS CONSTRUCTED BUT NEVER UTILIZED AS A DISPOSAL AREA. SOIL MATERIAL FROM CELL 3 TO BE EXCAVATED FOR USE IN CLOSURE ACTIVITIES AND THE FORMER CELL 3 AREA WILL BE REGRADED TO PROMOTE POSITIVE SURFACE WATER DRAINAGE.
6. MINIMUM SLOPE OF 0.5% ON DRAINAGE DITCH AND TOE DRAIN.

STATE OF MISSOURI
DOUGLAS LEE DOERR
NUMBER E-28982
REGISTERED PROFESSIONAL ENGINEER
3/18/08

80 0 80 160
SCALE FEET

REV.	DATE	BY	DESCRIPTION
R5	-	5BY	-
R4	-	4BY	-
R3	-	3BY	-
R2	-	2BY	-
R1	-	1BY	-
R0	-	0BY	-

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.
7311 West 130th Street, Suite 100
Overland Park, Kansas 66213

CLIENT: ALLIANT TECHSYSTEMS, INC.
LAKE CITY ARMY AMMUNITION PLANT
INDEPENDENCE, MISSOURI

DRAWN BY: NAG DESIGNED BY: NAG PROJECT MGR: MAB
ELECTRONIC FILE NAME: 04 FINAL GRADING PLAN R4.DWG DATE: 3/12/08

SITE LAYOUT
AREA 8 CELLS 1 & 2 CLOSURE
INDUSTRIAL WASTE TREATMENT LANDFILL

REV.: 0 DRAWING NUMBER: 4 PROJECT NUMBER: 2808.10 SHT. 4 OF 5

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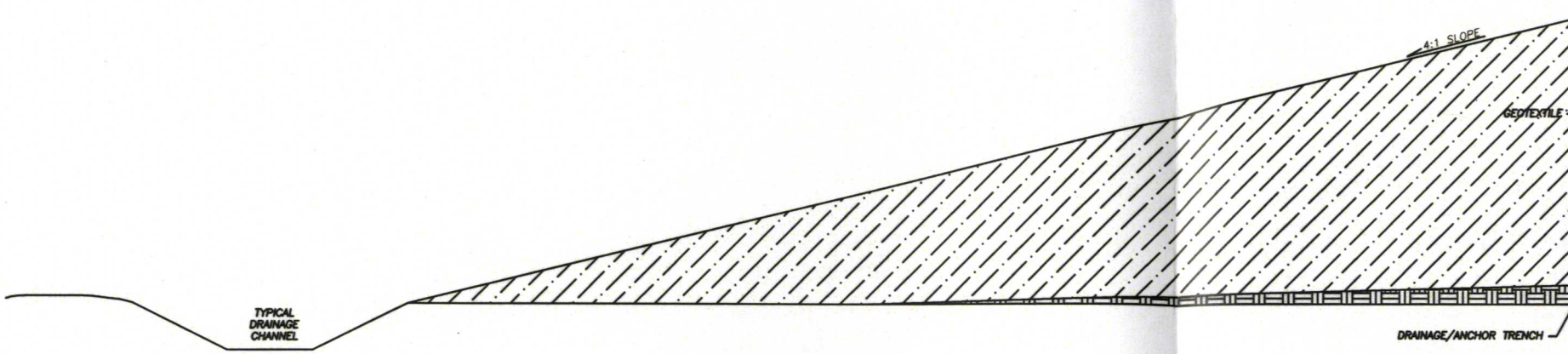
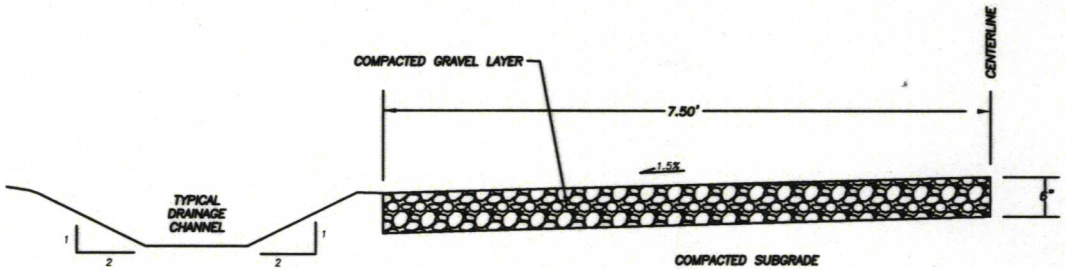
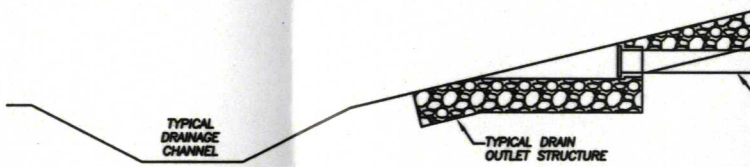


A TYPICAL CAP DETAIL
NOT TO SCALE

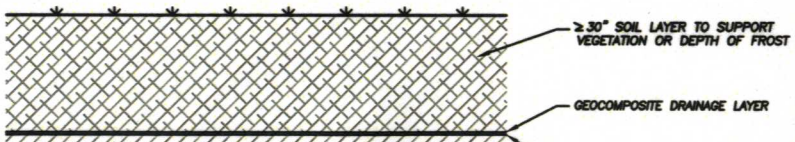


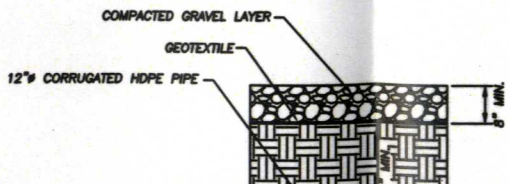
NOTE: CONSTRUCT ROAD SYMMETRICAL ABOUT CENTERLINE

B TYPICAL GRAVEL ACCESS ROAD
NOT TO SCALE



C PERIMETER DRAINA





EROSION

Project Manual

AQUATERRA

PROJECT MANUAL
CLOSURE PLAN
AREA 8 IWTP SLUDGE LANDFILL CELLS 1 & 2
LAKE CITY ARMY AMMUNITION PLANT
INDEPENDENCE, MISSOURI

Aquaterra Project Number 2606.10
March 2008

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

Prepared for:

Lake City Army Ammunition Plant

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

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SECTION 01120	General Provisions and Definitions
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NOT USED

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NOT USED

PROJECT MANUAL
CLOSURE PLAN
AREA 8 IWTP SLUDGE LANDFILL CELLS 1 AND 2
LAKE CITY ARMY AMMUNITION PLANT
MARCH 2008

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Certification

Aquaterra Environmental Solutions, Inc. hereby certifies that the 1.84-acre Cell 1 and 2 Closure Construction Technical Specifications were prepared using generally accepted engineering practice and in substantial compliance with the permit documents and applicable state regulations.

Prepared and Submitted By:

Doug Doerr, P.E.
Principal
Aquaterra Environmental Solutions, Inc.

BID FORM
(NOT INCLUDED FOR PERMITTING PURPOSES)

CONSTRUCTION QUALITY ASSURANCE PLAN
(INSERT UPON MDNR APPROVAL)

TECHNICAL SPECIFICATIONS

DIVISION I

GENERAL REQUIREMENTS

Section 01010

SCOPE OF WORK

1.1 LOCATION OF WORK

Lake City Army Ammunition Plant is located approximately nine miles east of Independence, Missouri on Missouri Highway.

1.2 INTENT OF THE CONTRACT

The intent of this Contract is to provide information regarding the construction and completion of the Work in accordance with the Construction Drawings and Technical Specifications using a standard of care consistent with the solid waste facility construction industry and in compliance with the Missouri Department of Natural Resources (MDNR) approved permit documents, applicable regulations, and consistent with the other requirements contained herein. Unless otherwise specified, the CONTRACTOR shall furnish all labor, materials, tools, equipment and incidentals that are necessary to complete the work in a proper, complete, and acceptable manner in accordance with the Construction Drawings and these Technical Specifications.

1.3 DESCRIPTION OF WORK

The Work to be performed for this Contract includes, but is not necessarily limited to, the construction of approximately 1.84 acres of composite landfill cover at the Area 8 IWTP Sludge Landfill.

The construction items from the bottom of the final cover cross section to the top, consist of the following:

- Removing existing vegetation and re-grading existing soil to provide a smooth and stable subgrade. No waste may be excavated or removed.

- Constructing a zero (0) to twenty (24) inch thick leveling layer to ensure a three (3.0) percent slope.

- Constructing a two (2.0) foot thick compacted earthen layer, with a maximum hydraulic conductivity of 1×10^{-7} centimeters per second (cm/sec).

- Installing single sided geocomposite drainage net (6 ozJyd^2 non-woven geotextile heat bonded of a 0.2 inch thick HOPE geonet).

- Constructing a two and a half (2.5) foot thick nominally compacted vegetation support soil layer.

In addition to the construction items or activities listed above, the Work shall include the following:

- Installing and maintaining erosion and sediment control structures

- Clearing and grubbing the soil borrow areas

- Excavating and stockpiling the topsoil from the cell 3 material, and the removal and stockpiling of all rocks or other unsuitable material from the cell 3 material

- Constructing storm water management structures

- Installing the perforated HOPE pipe toe drain and associated materials

- Preventing desiccation cracking in the compacted earthen cover by watering until the time of placement of vegetative layer

- Constructing appropriate storm water drainage ditches

- Grading surrounding area or roads outside landfill boundary to tie into final cover and perimeter drainage ditch

- Seeding, fertilizing and mulching the final cover construction area and revegatate other areas disturbed by construction operations

- Maintaining of stockpiles, storm water management, and all other Work as required per the Construction Drawings, Technical Specifications, and Construction Quality Assurance (CQA) Plan

All Work shall be carried out and maintained per the Contract Drawings and Technical Specifications subject to the approval of the Engineer, Owner, and Construction Quality Assurance (CQA) consultant.

CONTRACTOR shall be responsible for any damage its operations cause to any portion of the Work or job site, regardless of the circumstances, and shall repair this damage to the approval of the CQA CONSULTANT at no additional cost to the OWNER.

CONTRACTOR shall be responsible for all dewatering, cleanup, and repairs required due to precipitation or freezing; associated costs are to be included in the bid. The CONTRACTOR shall also be responsible for dust control and maintaining all required haul roads during construction.

1.4 OWNER-SUPPLIED MATERIALS

For the purpose of this Contract, the OWNER will provide the following:

1. On-site borrow source for soil materials.

All other construction materials required for this project shall be supplied by the CONTRACTOR.

1.5 OWNER-SUPPLIED SERVICES

Services to be provided by the OWNER for this project include:

1. OWNER will provide an adequate storage area and equipment parking area in the vicinity of the construction area.

2. OWNER will provide a Site Contact to interface with CONTRACTORS working at the site.

3. OWNER will provide a source of water for construction purposes.

4. OWNER will provide approval of Work.

1.6 CONTRACTOR'S SCOPE OF WORK

The CONTRACTOR shall furnish all labor, materials, and equipment for the construction of the Work as shown and indicated on the Contract Drawings and described in the Technical Specifications and CQA Plan less the specific Owner-supplied materials referenced in

Section 1.4. The scope of work covered by this Contract includes, but is not necessarily limited to, the following. These items correspond to the items in the bid worksheet.

1. Furnish all transportation, equipment, and labor required to supply all materials and equipment at the site. CONTRACTOR shall provide for the unloading of any OWNER-supplied materials at the site, including but not limited to geocomposite, and related materials.

2. Furnish materials, labor, and equipment required to construct and maintain temporary erosion and sedimentation control structures within the construction and borrow areas, as required for "best management practices" and to satisfy federal, state, and/or local regulations.

3. Furnish material, labor, and equipment necessary to clear and grub the existing vegetation from the borrow area.

4. Furnish materials, labor and equipment necessary to strip and stockpile topsoil from the borrow area for later incorporation into the project. The top three feet of soil from the original ground surface are considered topsoil. CONTRACTOR shall maintain stockpile and borrow areas to prevent any delays due to access by suppliers of materials. Adequate drainage shall be provided in soil borrow and stockpile areas during their use and development by CONTRACTOR.

5. Furnish materials, labor, and equipment necessary to regrade the existing landfill to provide a smooth and stable base grade to begin construction as shown on the Contract Drawings and as described and indicated in the Technical Specifications and CQA Plan.

6. Furnish materials, labor and equipment necessary to construct the 2.0-foot thick low permeability soil layer ($1 \times 10.^{7}$ cm/sec maximum hydraulic conductivity) as shown on the Contract Drawings and as described and indicated in the Technical Specifications and CQA Plan. All deleterious materials (rocks, limbs, stumps, and similar items) shall be removed from the soil and disposed on-site as directed by the OWNER. Furnish materials, labor, and equipment necessary to coordinate and prepare the top of low permeability soil layer surface for installation of the geocomposite materials, as described and indicated in the Technical Specifications and CQA Plan.

7. Furnish materials, labor, and equipment necessary to construct the 2.5-foot thick vegetation support soil layer. Low ground pressure equipment is required to spread the soil over the geocomposite layer to avoid damaging the underlying geocomposite layer.

8. Furnish materials, labor, and equipment necessary to construct the storm water management structures as depicted on the Contract Drawings and as indicated in the Technical Specifications.

9. Furnish materials, labor, and equipment necessary to construct the storm water drainage ditches as depicted on the Contract Drawings and as indicated in the Technical Specifications. Construction of the storm water drainage ditches may require regrading of the perimeter access road. Regrading of surrounding area required to field fit the perimeter storm water drainage ditch is the responsibility of the CONTRACTOR.

10. Furnish materials, labor, and equipment necessary to construct the perforated HOPE pipe *toe* drains as depicted on the Contract Drawings and as indicated in the Technical Specifications.

11. Furnish materials, labor, and equipment necessary to establish vegetation on the cover and other disturbed soil areas in accordance with the Technical Specifications.

12. Prepare as-constructed survey for top of leveling layer, top of compacted soil layer, and top of vegetation support soil layer.

In addition to the above items, the CONTRACTOR shall provide all surveying services necessary to maintain horizontal and vertical control during execution of all work at the site, provide a full-time project manager/construction superintendent who shall direct and oversee all work for the duration of the project and shall interface directly with the OWNER and COA CONSULTANT, and provide all necessary facilities (Le. construction trailer, electrical, sanitary, potable water, facsimile, and telephone) as may be required by the CONTRACTOR'S personnel. The CONTRACTOR shall comply with Guarantee Requirements as outlined in ATTACHMENT A. The Owner shall provide prior approval of any CONTRACTOR facility locations.

1.7 SERVICES TO BE FURNISHED BY OTHERS

1. COA Services

2. Design Services

1.8 COORDINATION BETWEEN CONTRACTORS

Before any Work is installed, CONTRACTOR shall carefully check all Contract Drawings and Technical Specifications for each trade and job condition. Any lack of coordination between his Work, other Contractors, Drawings, Specifications, or job conditions shall be immediately reported to OWNER in writing. If CONTRACTOR fails to call such conflict or lack of coordination between other Contractors, plans, specifications, or job conditions to OWNER'S attention before any Work is done, it will be assumed that no conflict or lack of coordination exists, and that all deadlines in the approved schedule will be met.

Notwithstanding the above, every attempt will be made by CONTRACTOR, OWNER, and COA CONSULTANT to ensure well-eoordinated operations and construction activities during the project.

1.9 SCHEDULE

Timely completion of the Work required for this Contract is essential. The selection of the successful bidder may be determined by his schedule as well as his bid amount. The CONTRACTOR shall provide a detailed schedule that includes specific durations for completion of the Work as detailed above.

End of Section 01010

SECTION 01110

MEASUREMENT AND PAYMENT

01110.1 SUMMARY

A. This section describes the measurement methods to be used and general payment description for each different section of work.

01110.2 DESCRIPTION OF WORK

A. Unless specified as a Lump Sum item, all Contract prices shall be based on a price per unit of measurement for materials or services. The Contract Price shall be adjusted for the actual quantities required and approved by the OWNER.

B. The CONTRACTOR shall take all measurements and compute all preliminary pay quantities, using methods sufficiently accurate to satisfy the ENGINEER. A professional surveyor registered in Missouri shall perform the CONTRACTOR'S measurement.

C. The ENGINEER shall verify all measurements and determine final pay quantities.

D. Payment shall only be made for Work as specifically described in these Specifications and the Agreement.

E. Payment shall only be made for approved, in-place materials and Work, unless specifically permitted by these specifications.

01110.3 DESCRIPTION OF ITEMS

A. Mobilization and Demobilization

1. Measurement

The Work required for this item shall be measured on the basis of satisfactory evidence of mobilization of sufficient labor, equipment and material to adequately advance the Work.

2. Payment

The Lump Sum Price of Mobilization and Demobilization shall be payment in full for all labor, equipment, material and other incidentals to the site, as well as CONTRACTOR provided utilities and ongoing related expenses, considered normal for administration of the work. Twenty-five (25) percent of the Lump Sum price bid shall be paid with the first payment request following satisfactory evidence of mobilization of sufficient labor, equipment and material to adequately progress the work of this contract. Twenty-five (25) percent of the Lump Sum price bid shall be paid with the payment request subsequent to the payment request in which the initial payment of this item is made. Fifty (50) percent of the Lump Sum price bid shall be paid with the Final Payment request.

phrases. Except as worded to the contrary, indicated requirements whether stated imperatively or otherwise shall be fulfilled (performed).

B. Items of Work are specified by section. Specifications or requirements of one or more sections may apply to or be referenced in other sections.

C. The CONTRACTOR shall perform or provide items of Work stated and shall comply with the requirements stated in each section, unless the items are specifically assigned to other CONTRACTORS, the ENGINEER, or the OWNER.

D. The term "provide" or "provided" shall mean furnished and installed by the CONTRACTOR.

01120.4 QUALITY ASSURANCE / QUALITY CONTROL

A. The OWNER shall retain the ENGINEER to perform COA for the Work.

B. The ENGINEER shall monitor and document the Work completed by the CONTRACTOR. Performance criteria set forth in the Technical Specifications and as shown on the Construction Drawings shall be the standard for the Work to be performed by the CONTRACTOR.

C. The CONTRACTOR shall be responsible for reworking or removing and replacing nonconforming construction materials that do not meet the requirements of the Technical Specifications and the Construction Drawings.

01120.5 PERMITS

A. The CONTRACTOR shall be responsible for all local, state, and federal permitting including, but not limited to, land disturbance, onsite fuel storage, hot work and off-site borrow area permits.

B. The CONTRACTOR shall be required to obtain all necessary specific permits from OPERATOR as discussed in ATIACHMENT A.

END OF SECTION 01120

SECTION 01130

SPECIAL PROVISIONS

01130.1 SUMMARY

A. This section includes special provisions and administrative procedures required during construction operations.

01130.2 LEACHATE

A. Leachate is liquid that has percolated through waste and contains extracted dissolved or suspended solids.

01130.3 UTILITIES

A. CONTRACTOR is responsible for providing any temporary water, power, and sanitary facilities required at the site during the construction of the Work.

01130.4 SAFETY AND PROTECTION

A. General

1. CONTRACTOR is advised that the proposed Work will be performed at the Lake City Army Ammunition Plant. CONTRACTOR shall comply with all Federal, State, and local safety codes, ordinances, and regulations, including the requirements of the Occupational Safety and Health Administration (OSHA), the Division of Industrial Safety, and other such safety measures as may be required by the above-mentioned regulatory agencies whenever any work is being performed at the installation.

2. CONTRACTOR shall implement fire control measures during construction. CONTRACTOR shall be responsible for fire control and submit a safety plan and fire control procedures (to which he will adhere during the entire Contract time) to the ENGINEER.

3. First aid facilities conforming at least to the minimum requirements of OSHA shall be provided in a readily accessible location or locations.

4. CONTRACTOR shall make all reports available as required by any authority having jurisdiction and shall permit all safety inspections of the Work being performed under this contract. Before proceeding with any construction work, the CONTRACTOR shall take the necessary action to comply with all provisions for safety and accident prevention.

5. CONTRACTOR shall be prepared to respond to potential injuries, illnesses, or

situations of imminent hazard to employees or public health and safety. Personnel from local medical facilities shall be contacted in case of a medical need, and the quickest route to these facilities shall be determined in advance.

B. Landfill Safety Hazards

1. Potential landfill safety hazards may include the following:

a. Fires or explosions may occur in confined or enclosed spaces.

b. Heavy acid gases, including hydrogen sulfide may be present. Hydrogen sulfide is a colorless, toxic, flammable gas which, in low concentrations, has an offensive odor described as that of rotten eggs. It is unlikely that hazardous concentrations of hydrogen sulfide will build up except in vaults or other confined spaces. In addition, hydrogen sulfide quickly numbs the olfactory senses so that reliance upon odor can lead to a very dangerous condition and cause instant death.

c. Wildlife, which could represent hazards to humans, including rattlesnakes and black widow spiders may be present. Rodents, birds, and stray dogs should be treated as potential hazards.

2. Air quality studies consistently show that concentrations of most potentially hazardous substances (Priority Pollutants) in the ambient air are well below threshold limits. However, in confined or enclosed areas or venting sources of gas on or adjacent to landfills, dangerous concentrations of combustible and possibly toxic gases may accumulate. Oxygen depletion may also occur in these areas of confinement; therefore, planning shall be performed followed by safety procedures which shall be continuously observed.

C. Level of Protection

1. Three levels of protection are described as follows:

a. Level D: Coveralls, chemical-resistant boots with steel toe and shank, hard hat and goggles.

b. Level C: A National Institute for Occupational Safety and Health (NIOSH)-approved half-face air purifying respirator with acid gas/organic vapor cartridges and goggles (or safety glasses) may be worn when none to very limited accidental exposure is anticipated. Appropriate protective clothing, eg., Tyvek suit, chemical-resistant boots with steel toe and shank, goggles, inner and outer chemical-resistant gloves, and hard hat.

OR

Level C: A NIOSH-approved full-face air purifying mask connected by a hose to a portable combination-type nonorganic vapor/acid gas canister with HEPA filter. Appropriate protective clothing, e.g., Tyvek suit with gloves and boots.

c, Level B: A portable, self-contained breathing apparatus with same protective clothing as mentioned above.

2. All clothing must be appropriately donned, secured, taped, and worn.

3. Based on prevailing site conditions, it is anticipated that Level D protection shall be enforced for site activities at all times. However, at the discretion of the ENGINEER, if higher levels of protection are required, the CONTRACTOR will be compensated for the additional levels of protection provided by a Change Order when specifically ordered by the ENGINEER.

4. With consideration for the fact that excessive application of "level of protection" can also be a safety hazard (such as causing accidents due to limitations of vision, clumsiness, and heat stress), the level of protection may be adjusted with the approval of the ENGINEER. Under no circumstances will personnel be allowed to be overexposed beyond allowable limits. If the ENGINEER feels it is necessary to adjust the level of protection, the proper recommendations will be made.

5. Chemical cartridge respirators can be used for gaseous contaminants (not hydrogen sulfide) only if oxygen concentration is satisfactory and if the chemical contaminants have been identified, the concentrations are monitored, the cartridges are effective in removing the contaminants, and if the contaminants have good warning properties. If all of the above conditions cannot be satisfied, a special auxiliary plan is required. Air purifying respirators will not be used for protection in environments containing constituents which have poor warning properties and which are near, at, or above, or can reasonably be expected to be near, at, or above the threshold limit value. Initial characterization in conjunction with continuous monitoring of total hydrocarbons in parts per million (ppm) as methane can be used to monitor conditions to ensure dangerous levels are not reached. Written records of monitoring should be maintained.

6. Self-contained breathing apparatus or supplied-air masks shall be used when entering areas containing oxygen deficient atmospheres, unknown atmospheres, or atmospheres considered to be at or above Immediately Dangerous to Life and Health (IDLH) levels (as declared and published by NIOSH). Under no circumstances should any worker ever inhale raw, undiluted landfill gas.

7. The length of time a canister or cartridge is effective in removing hazardous material from the ambient air will depend on the concentration of hazardous material in the air and the level of effort required for a worker to accomplish his assigned tasks. The higher the breathing rate, the more frequently canisters will need to be replaced. These maximum operating periods vary according to manufacturer, so it will be necessary to monitor the total usage of cartridges and canisters during all work requiring a respirator. Monitoring will be the responsibility of the CONTRACTOR.

8. The cartridges or respirators chosen will be rated for the removal of both organic vapors and acid gases. The type of respirator recommended has been based on an 8-hour day for each worker at the site. Disposable clothing, if worn, shall be WOrn only once and then securely bagged in plastic and placed in a trash receptacle. Under no circumstances shall workers be permitted to wear the disposable clothing, or rubber boots off site.

D. Planning

1. The address, telephone number, and location map of the local hospital and medical emergency room shall be prominently posted. In addition, the telephone number of ambulance and fire departmenUrescue units shall be posted.

2. Fires or explosions in confined areas are caused by a source of ignition. Smoking shall be strictly forbidden. Nonsparking and/or explosion-proof tools shall be used in vaults, trenches, or other enclosed areas. Positive ventilation is required in construction shacks or other structures on or near a landfill. Temporary structures on the landfill surface shall be constructed on supports with a ventilated area under the main floor.

E. General Requirements

1. The CONTRACTOR shall assign a site Safety Officer during the course of the Work. The site Safety Officer shall conduct safety orientation and instruction at all meetings with all workers prior to the start of operations. This person shall be trained in the use of all of the recommended safety equipment. The workers shall be advised concerning the kind and degree of hazard associated with the operations and the safety precautions required. Any persons employed after the initiation of operations shall also be oriented and instructed on said safety hazards and precautions.

2. Smoking or open flames shall be prohibited within the landfill site construction area or as directed by the ENGINEER.

3. No worker shall be allowed to work alone at any time in or immediately near an excavation and/or construction area. Another worker shall be present at the site, but shall maintain a safe distance to preclude possible adverse impacts from landfill gas.

4. Periodically during excavation and construction, the work area shall be monitored for levels of methane and hydrogen sulfide with results recorded and available for review by the ENGINEER.

5. No worker shall handle excavated refuse without wearing work gloves.

6. Construction equipment shall be equipped with a vertical exhaust at least 5 feet above grade and/or with spark arrestors.

7. Motors utilized in the excavation area shall be explosion-proof.

8. No arc welding shall be permitted in or within 50 feet of an excavation area or as directed by the ENGINEER.

9. No excavation or drilled hole greater than 12 inches deep shall be left open overnight unless securely covered in an acceptable manner.

10. All personnel must wear hard hats.

11. A minimum of two fire extinguishers of the 50-pound dry chemical type shall be maintained or kept within easy access of working area.

12. Startup and shutdown of equipment shall not be performed in areas of exposed refuse.

13. In addition to conforming to the safety rules and regulations of governmental authorities having jurisdiction, the CONTRACTOR is advised of the presence of methane gas emanating from the natural decomposition of refuse buried at the jobsite and shall take precautions to ensure the safety of workers and the public.

14. CONTRACTOR shall demonstrate to the ENGINEER on a daily basis that all safety equipment is functioning properly, that all monitoring instruments are calibrated, and that the instrument operators are sufficiently knowledgeable in the use of the safety equipment.

15. A copy of the safety plan shall be posted at the jobsite. Scheduled meetings shall be held to review the safety program.

16. CONTRACTOR shall adequately identify and guard all hazardous areas and conditions by visual warning devices and, where necessary, physical barriers. Such devices shall, at a minimum, conform to the requirements of OSHA.

F. Safety Equipment

1. Prior to commencement of the construction of landfill gas migration control facilities, the following equipment shall be provided by the CONTRACTOR:

   a. Hard hats, work gloves, coveralls, and chemical-resistant boots with steel-toe and shank for all personnel.

   b. First aid kit, eye wash station, stretcher, and blankets.

   c. Two fire extinguishers, 50-pound dry chemical-type.

d. No smoking signs.

e. Barricades.

f. Ladders.

g. Suitable cover plate for excavations that will remain open at end of Working day.

h. Clean water, soap, and paper towels.

01130.5 SITE CONDITIONS

A. **CONTRACTOR** shall be responsible for having determined to his/her satisfaction, prior to the submission of his bid, the nature and location of the Work, the conformation of the ground, the character and quality of the landfill, the type and quantity of materials to be encountered, the character of equipment and facilities needed preliminary to and during the execution of the Work, the general and local conditions, and all other matters which can in any way affect the Work under the Contract. The prices established for the Work to be completed will reflect all costs pertaining to the Work. Any claims for extras based on landfill or groundwater table conditions will not be allowed.

*****END OF SECTION 01130*****

SECTION 01210

UNIT PRICES

1210.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1210.2 DEFINITIONS

A. Unit price is an amount proposed by bidders, stated on the Bid Form or in letter format, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if the estimated quantities of Work required by the Technical Specifications and Construction Drawings are increased or decreased.

1210.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, profit, and applicable taxes.

B. Refer to the Bid Form for instructions regarding the methods of measurement and payment for unit prices.

C. The OWNER reserves the right to reject the CONTRACTOR'S measurement of work-in-place that involves use of established unit prices, and to have this work measured, at the OWNER'S expense, by an independent surveyor acceptable to the CONTRACTOR.

*****END OF SECTION 01210*****

SECTION 01310

PROJECT MANAGEMENT AND COORDINATION

01310.1 SUMMARY.

A. This section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:

1. General project coordination procedures.

2. Conservation.

3. Administrative and supervisory personnel.

4. Cleaning and protection.

01310.2 COORDINATION

A. CONTRACTOR shall coordinate construction operations included in accordance with the Technical Specifications and Construction Drawings to assure efficient and orderly installation of each part of the Work including:

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

3. Make provisions to accommodate items scheduled for later installation.

B. CONTRACTOR shall coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Installation and removal of temporary facilities.

2. Delivery and processing of submittals.

3. Progress meetings.

4. Project closeout activities.

C. CONTRACTOR shall coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.

01310.3 SUBMITIALS

A. No later than five days prior to commencement of construction operations, CONTRACTOR shall submit a list of the CONTRACTOR'S principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. The listing shall also identify individuals and their duties and responsibilities. List their addresses and telephone numbers. CONTRACTOR shall post copies of the list in the Project meeting room, the temporary field office, and near each temporary telephone.

01310.4 GENERAL COORDINATION PROVISIONS

A. CONTRACTOR shall require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. CONTRACTOR shall not allow questionable Work to proceed until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER and/or OWNER.

01310.5 CLEANING AND PROTECTION

A. CONTRACTOR shall clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration until Substantial Completion.

B. CONTRACTOR shall clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

END OF SECTION 01310

SECTION 01320

PROJECT MEETINGS

01320.1 SUMMARY

A. This section includes requirements regarding attendance at project update meetings. CONTRACTOR'S representatives shall attend all project conferences and progress meetings and shall be authorized to act on behalf of the CONTRACTOR.

01320.2 PRE-CONSTRUCTION CONFERENCE

A. Conference shall be held at a date, time, and location selected by OWNER.

B. Conference shall be attended by:

1. CONTRACTOR'S Office Representative;

2. CONTRACTOR'S Resident Superintendent;

3. Any SUBCONTRACTOR or Supplier whom CONTRACTOR may invite or ENGINEER may request;

4. ENGINEER'S Representative; and

5. OWNER.

C. The agenda shall include, but not be limited to, the following subjects:

1. Presentation of the preliminary construction progress schedule and preliminary submittal schedule.

2. Verification of required bonds and insurance certifications prior to OWNER signing Notice to Proceed.

3. Review of procedures for handling submittals.

4. Direction of correspondence and coordinating responsibility between CONTRACTORS.

5. Review of required attendees and agenda at any scheduled progress meetings.

6. Review of Equal Employment Opportunity Commission (EEOC) and Occupational Safety and Health Administration (OSHA) requirements.

7. Field and laboratory testing of material requirements.

8. Schedule of values, application for payment and progress payment procedures.

9. OWNER'S jobsite rules and regulations.

01320.3 PROGRESS MEETINGS

A. CONTRACTOR shall attend all progress meetings, at a minimum of one per week, and any such additional meetings as requested by OWNER or ENGINEER. Progress meetings will be held at the project site.

B. Progress meetings shall be attended by:

1. ENGINEER'S Representative;

2. CONTRACTOR'S Resident Superintendent;

3. SUBCONTRACTORS as appropriate to agenda;

4. Suppliers as appropriate to agenda; and

5. OWNER.

C. The suggested agenda shall include, but not be limited to, the following subjects:

1. Review and approval of record of previous meeting.

2. Review of work progress since previous meeting.

3. Field observations, problems and conflicts.

4. Problems which are or could impact schedule.

5. Review of off-site delivery schedules.

6. Corrective measures and procedures to regain schedule (if applicable).

7. Coordination of CONTRACTOR'S schedules.

8. Planned activities and progress during upcoming work period.

9. New or additional work activities.

10. Review submittal schedule and expedite submittals as required.

11. Review of site quality and safety standards.

12. Pending design changes and/or substitutions.

13. Review proposed changes for effect on construction schedule and completion date.

14. Other business as needed.

END OF SECTION 01320

SECTION 01340

SUBMITTALS

01340.1 SUMMARY

A. This section includes instructions to CONTRACTOR regarding submittal procedures, review, and approval.

01340.2 GENERAL SUBMITTAL REQUIREMENTS

A. This Section specifies procedural requirements for work-related submittals, which include shop drawings, substitutions, product data, samples, construction progress schedules, quality control test results and other miscellaneous work-related submittals.

B. Administrative submittals such as listing of manufacturers, suppliers, subcontractors, bonds, payment applications and insurance certificates shall also be covered under this section.

C. Documentation requirements are covered by detailed requirements listed herein. The ENGINEER will determine if documentation is complete as submitted by the CONTRACTOR, and reserves the right to disapprove any materials, schedules, methods, equipment, plans, drawings, or other submittals that do not meet the contract requirements.

D. Types of work-related submittals:

1. Substitutes or "or equal" items:

   a. This item shall include material or equipment CONTRACTOR requests ENGINEER or OWNER to accept as a substitute for items specified or described by using proprietary name or name of a particular supplier.

2. Shop drawings:

   a. This item shall include technical data and drawings specifically prepared for this project, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports, instructions, operations and maintenance manuals, design mix formulas, measurements, and similar information not in standard print form.

01340.3 SUBMITTAL PROCEDURES

A. CONTRACTOR shall prepare and submit to ENGINEER for review and approval a submittal schedule.

1. A preliminary submittal schedule shall be submitted to ENGINEER at least five days before the scheduled pre-construction conference.

2. ENGINEER will review schedule for requirements related to other work and usage of Project Site.

3. Within one week after the pre-construction conference. CONTRACTOR shall prepare and submit a final submittal schedule to ENGINEER.

4. As applicable, each submittal shall be prepared and transmitted to ENGINEER sufficiently in advance of the scheduled performance of the related work or other applicable activity. Material submittals must be approved by the ENGINEER prior to delivery to the site.

B. CONTRACTOR shall coordinate submittals as follows:

1. CONTRACTOR shall coordinate preparation and processing of each submittal with other submittals and related work activities, such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.

2. CONTRACTOR shall coordinate submittal of different units of interrelated work so that one submittal shall not be delayed by ENGINEER needing to review a related submittal. ENGINEER reserves the right to withhold action on any submittal requiring coordination with other submittals until related submittals are received.

C. CONTRACTOR shall prepare submittals as follows:

1. CONTRACTOR shall stamp and sign each submittal certifying review and acceptance of submittal.

2. CONTRACTOR shall provide transmittal form identifying:

a. Date and revision of submittal;

b. Project title and number;

c. Submittal and transmittal number;

d. Contract identification;

e. Applicable names of CONTRACTOR, Supplier, and Manufacturer;

f. Identification of product with equipment identification numbers, if applicable, and specification section number; and

g. Variations from requirements of the Technical Specifications and Construction Drawings.

01340.4 ACTION OF SUBMITTALS

A. ENGINEER'S action shall include:

1. General

a. Except for submittals for record and similar purposes, where action and retum on submittals is required or requested, ENGINEER shall review each submittal, mark with appropriate action and retum. Where submittal must be held for coordination, ENGINEER will advise CONTRACTOR.

b. ENGINEER will stamp each submittal to be retumed with a uniform, self-explanatory action stamp, appropriately marked and executed to indicate whether submittal retumed is for unrestricted use, final-but restricted use (as marked), must be revised and resubmitted (use not permitted), or without action (as explained on transmittal form).

B. Action Stamp

1. Approved: Where submittal is so marked, work covered by submittal may proceed provided it complies with requirements of the Technical Specifications. Acceptance of work will depend upon that compliance.

2. Approved with noted exceptions: When submittal is so marked, work covered by submittal may proceed provided it complies with both the notations and/or corrections marked on the submittal and with the requirements of the Technical Specifications. Acceptance of work will depend upon that compliance.

3. Not approved: When submittal is so marked, work covered by sUbmitta,1 shall not proceed as submittal does not comply with the requirements of the Technical Specifications. A new submittal shall be prepared which meets the' Technical Specifications.

4. Revise and resubmit: When submittal is so marked, work covered by submittal shall not proceed (including purchasing, fabrication, or material delivery) as submittal does not comply with the requirements of the Technical Specifications. Submittal shall be revised or a new submittal prepared in accordance with the ENGINEER'S notations stating reasons for returning submittal. Repeat as necessary to obtain different action marking.

01340.5 SAMPLES

A. Submit full-size samples cured and finished as specified and identical with the material proposed.

1. Include the following:

a. Specification Section number and reference.

b. Generic description of the Sample.

c. Sample source.

d. Product name or name of the manufacturer.

e. Availability and delivery time.

2. Submit samples for review of size, kind, color, pattern, and texture, for a check of these characteristics, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed. Where variations are inherent in the material, submit at least three units that show limits of the variations.

a. Refer to other Sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar characteristics.

b. Refer to other Sections for samples to be incorpQrated in the Work. Samples must be undamaged at time of use.

c. Samples not incorporated into the Work, or designated as the OWNER'S property, are the CONTRACTOR'S property and shall be removed from the site.

01340.6 QUALITY CONTROL SUBMITTALS

A. Submit quality control submittals, including design data, certifications, manufacturer's instructions, and manufacturer's field reports required under other Sections of the Technical Specifications.

1. Where it is required that certification of a product or installation complies with specified requirements is required, submit a notarized certification from the manufacturer certifying compliance. Certification shall be signed by an officer authorized to sign documents on behalf of the company.

*****END OF SECTION 01340*****

SECTION 01350

ENVIRONMENTAL PROTECTION

1350.1 SUMMARY

A. Section includes furnishing all labor, material and equipment required for the protection of the environment during construction operations including:

1. Compliance with laws.
2. Noise.
3. Land Resources Protection.
4. Water Resources Protection.
5. Air Resources Protection.
6. Recording and Preserving Historical and Archeological Finds.
7. Protection of Wildlife.
8. Disposal of Debris.
9. Maintenance of Pollution Control Facilities During Construction.
10. Dust Control.
11. Odor Control.
12. Litter.

1350.2 DEFINITIONS

A. Environmental Protection - Protection of the environment in its natural state to the greatest extent possible during project construction, and an effort to enhance the natural appearance in its final condition. Environmental protection requires consideration of noise level, and protection of air, water and land resources. It involves solid waste management, and activities aimed at abatement of pollution in general.

1350.3 SUBMITTALS

A. CONTRACTOR shall submit to ENGINEER for approval, proposals for implementing this section on environmental protection. Copies of all permit applications and plans will be submitted to the ENGINEER as needed for review prior to site mobilization.

1350.4 COMPLIANCE WITH LAWS

A. It is the CONTRACTOR'S responsibility to assure himself/herself that all applicable Federal, State and local laws concerning pollution of rivers, streams, waterways and drainage channels are being complied with by his personnel and subcontractors.

B. When CONTRACTOR is in non-compliance with applicable Federal, State, and'iocallaws or regulations, OWNER may issue an order stopping all or part of the work until satisfactory corrective actions have been taken. No part of the time lost due to any such stop order shall be made subject of a claim for extension of time, or for extra compensation or damages by the CONTRACTOR.

1350.5 NOISE LEVELS

A. Excessive use of vehicle horns and unmuffled exhaust systems will not be tolerated. CONTRACTOR is to take corrective action to eliminate such deficiencies.

1350.6 LAND RESOURCES PROTECTION

A. CONTRACTOR shall preserve all land resources within site premises in their present condition or restore them to a natural condition at project completion except as otherwise delineated by specifications.

B. areas where CONTRACTOR will deforest or clear shall be restored to their former condition.

C. Selective placement of materials shall be done so as to minimize erosion. CONTRACTOR shall comply with all applicable laws concerning soil erosion and sediment control.

1350.7 WATER RESOURCES PROTECTION

A. CONTRACTOR shall not pollute any streams, rivers, waterways or drainage channels with fuels, oils, solvents, acids, insecticides, herbicides, trash or other harmful material and/or substances. Secondary or dual containment will be provided for all above-ground fuel storage tanks.

B. Soil erosion shall be kept to a minimum by use of rough grading.

C. and run-off storm water shall be controlled.

1350.8 AIR RESOURCES PROTECTION

A. CONTRACTOR shall minimize pollution of air.

B. Measures shall be taken to prevent fires, excessive vehicle smoke and excessive releases of organic vapors to atmosphere dUring excavations.

1350.9 PROTECTION OF FISH AND WILDLIFE

A. CONTRACTOR shall perform all work in a manner that will not endanger fish and wildlife. CONTRACTOR will not be permitted to alter water flows or otherwise disturb native habitat adjacent to the work area, which, in the opinion of the ENGINEER, are critical to fish and wildlife.

1350.10 DISPOSAL OF DEBRIS

A. All debris resulting from CONTRACTOR operations on this site shall be removed and disposed at CONTRACTOR'S expense. Transport and disposal shall comply with all applicable Federal, State and local laws. Such materials are to be removed from the site prior to final completion and acceptance of the work.

B. Excavated soil and fill materials shall be disposed at the site as directed by the OWNER and ENGINEER.

C. Excavation of waste materials shall not occur. Disruption of the industrial waste treatment sludge is prohibited. The OWNER and ENGINEER should be contacted immediately if waste is encountered.

1350.11 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. CONTRACTOR shall maintain all facilities provided for pollution control as long as construction operations continue.

B. CONTRACTOR is responsible to maintain and service his/her equipment in a suitable and clean manner. CONTRACTOR shall prohibit the discharge, leaking, or spilling of any fuels, oils, grease, lubricants or other potentially hazardous substances to the surface. Any contamination caused by the CONTRACTOR'S equipment or operations shall be immediately reported to the OWNER or ENGINEER. A clean up plan shall be prepared and executed by the CONTRACTOR to the satisfaction of the OWNER and ENGINEER.

1350.12 DUST CONTROL

A. CONTRACTOR shall be responsible for maintaining dust control during the completion of the construction.

B. Trucked water shall be used for dust control as approved by the OWNER and ENGINEER.

1350.13 ODOR CONTROL

A. CONTRACTOR shall be responsible for maintaining odor control during construction.

B. Excavated materials causing odors shall be loaded directly onto trucks provided by the CONTRACTOR and shall be disposed at the working face of the landfill on a continuous basis as directed by the ENGINEER. All excavated refuse materials shall be disposed by the end of the work day. Under no circumstances shall odorous excavated materials remain on the transport truck for longer than one (1) hour.

1350.14 LITTER

A. CONTRACTOR shall be required to control, collect, and dispose all litter excavated or exposed during construction.

END OF SECTION 01350

SECTION 01400

QUALITY ASSURANCE AND CONTROL SERVICES

01400.1 SUMMARY

A. This section includes the responsibilities of the CONTRACTOR to cooperate and coordinate with a third party Technical Representative

01400.2 DESCRIPTION OF WORK

A. OWNER shall employ and pay for the services of the Technical Representative to perform construction monitoring and testing services to assure the OWNER that the Work is completed according to the Specifications and Drawings.

B. CONTRACTOR shall cooperate with the Technical Representative to facilitate the execution of its required services.

C. Employment of the Technical Representative shall in no way relieve the CONTRACTOR'S obligations to perform the Work and supply materials in accordance with the Contract Documents.

D. The CONTRACTOR shall provide all quality control testing and services required by the Specifications, Drawings, or the CONTRACTOR'S approved Construction Quality Assurance (COA) Plan. The CONTRACTOR shall also provide any additional testing he requires to control construction quality at no additional cost to the OWNER. Quality control testing and services do not include activities performed by the Technical Representative.

01400.3 CONTRACTOR'S RESPONSIBILITIES

The CONTRACTOR shall:

A. Cooperate with the Technical Representative and its personnel and provide access to Work and to Supplier's operations.

B. Secure and deliver to the Technical Representative adequate quantities of representative samples of materials proposed to be used which require testing.

C. Furnish copies of Supplier's test reports as required.

D. Furnish incidental labor and facilities:

1. To provide access to Work to be tested.

2. To obtain and handle samples at the Project site or at the source of the product to be tested.

3. To facilitate inspections and tests.

4. For storage and curing of test samples.

E. Coordinate activities to accommodate services with a minimum delay. Notify Technical Representative 48 hours in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. When tests or inspections cannot be performed after such notice, reimbursing the OWNER for laboratory personnel and travel expenses incurred due to CONTRACTOR'S negligence.

F. Employ and pay for the services of a separate, qualified independent testing laboratory to perform additional inspections, sampling and testing required:

1. For the CONTRACTOR'S convenience;

2. As required by the Specifications or approved COA Plans; or

3. When initial tests indicate Work does not comply with Contract Documents.

G. Promptly notify the Technical Representative of observed irregularities or deficiencies of Work or products.

H. Promptly submit three copies of a written report of each test to Technical Representative. Each report shall include:

1. Date issued.

2. Project title and number.

3. Testing laboratory name, address and telephone number.

4. Name and signature of laboratory inspector.

5. Date and time of sampling or inspection.

6. Record of temperature and weather conditions.

7. Date of test.

8. Identification of product and specification section.

9. Location of sample or test in the Project.

10. Type of inspection or test.

11. Results of tests and compliance with Contract Documents.

12. Interpretation of test results, when requested by Technical Representative.

I. Be responsible for retesting where results of inspections and tests prove unsatisfactory and indicates noncompliance with requirements.

01400.4 REPAIR AND PROTECTION

Unless specified otherwise, the CONTRACTOR shall protect construction exposed for testing and shall repair construction damaged by sampling, testing, or inspection.

*****END OF SECTION 01400*****

SECTION 01420

TESTING LABORATORY SERVICES

01420.1 SUMMARY

A. This section includes the requirements associated with the retention and performance of testing laboratory services associated with the Project including:

1. Limits on testing laboratory authority.

2. CONTRACTOR responsibilities.

3. Schedule of inspections and tests.

01420.2 SELECTION AND PAYMENT

A. CONTRACTOR shall employ and pay for testing and laboratory services to perform specified inspections and tests as described in the Technical Specifications and as shown on the Construction Drawings.

B. OWNER shall retain the ENGINEER for the Project to perform COA inspection and testing.

01420.3 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory shall not release, revoke, alter, or enlarge the requirements of the Technical Specifications.

B. Laboratory shall not approve or accept any portion of the Work.

C. Laboratory shall not assume any duties of CONTRACTOR.

D. Laboratory shall have no authority to stop the Work.

01420.4 CONTRACTOR RESPONSIBILITIES

A. CONTRACTOR shall employ and utilize quality control inspection and testing services to verify and document that the requirements of the Technical Specifications have been met.

B. CONTRACTOR shall cooperate with laboratory personnel and provide access to the Work.

C. CONTRACTOR shall provide incidental labor and equipment to assist in obtaining and handling samples at the site.

D. CONTRACTOR shall notify ENGINEER 24 hours prior to expected time for operations requiring quality control and/or quality assurance inspections and testing services.

01420.5 SCHEDULE OF INSPECTIONS AND TESTS

A. Quality control and quality assurance inspections and tests shall be scheduled between the **CONTRACTOR** and the **ENGINEER** for the required Work.

B. **CONTRACTOR** shall be responsible for assuring that all necessary and required inspection, sampling, and testing requirements have been completed, in this and any other Technical Specification Section before covering and continuing with the Work.

*****END OF SECTION 01420*****

SECTION 01510

TEMPORARY FACILITIES AND CONTROLS

1510.1 SUMMARY

A. Section includes furnishing, installation, and maintenance of temporary facilities and controls required for construction. All facilities shall be removed upon completion of Work.

1510.2 REGULATIONS AND STANDARDS

A. CONTRACTOR shall comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:

1. Building code requirements.
2. Health and safety regulations.
3. Police, fire department, and rescue squad rules.
4. Environmental protection regulations.

B. Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."

1510.3 TEMPORARY WATER FACILITIES

A. Provide, maintain and pay for potable and nonpotable water services required to support construction operations. Install service(s) at time of site mobilization.

B. OPERATOR shall make arrangements to obtain potable and nonpotable water from off-site source(s).

C. CONTRACTOR shall be responsible to protect water supply facilities used within the jobsite, including freeze protection.

1510.4 TEMPORARY SANITARY FACILITIES

A. Provide, maintain and pay for sanitary facilities required to support construction operations. Sanitary facilities shall be in compliance with state and local health and sanitation regulations. Provide facilities at time of site mobilization.

B. Separate sanitary facilities for men and women shall be provided.

C. CONTRACTOR shall not use existing sanitary facilities.

D. CONTRACTOR shall clean area of facilities daily and maintain in sanitary condition. Provide toilet paper, paper towels and soap in suitable dispensers.

1510.5 TEMPORARY FIRE PROTECTION

A. Provide, maintain in working order and pay for fire extinguisher and such other equipment as dictated by OSHA, the National Electric Code (NEC) and the National Fire. Protection Association (NFPA No. 70).

1510.6 WATER CONTROL

A. CONTRACTOR shall, at all times, grade site to drain and maintain excavations free of water. CONTRACTOR shall provide, operate and maintain pumping equipment.

B. CONTRACTOR shall protect site from ponding or running water. CONTRACTOR shall provide water barriers, (such as hay bales and silt fences) as necessary to protect site from soil erosion.

C. CONTRACTOR shall exercise caution and attempt to minimize increases in suspended solids and turbidity in surface waters within and adjacent to construction areas. Spoils shall not be deposited in surface waters. CONTRACTOR shall control and minimize sediment run-off and excavation erosion to surface waters.

1510.7 ACCESS ROADS

A. CONTRACTOR shall provide, maintain and pay for temporary roadways required to support and carry out construction operations in a clean, dust free and drivable condition.

B. Extend and relocate roadways as work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Site access and temporary roadways shall stay within designated landfill boundaries.

D. Traffic control at the Work entrance and within the Work area shall be performed as part of this requirement and shall include proper signs. barricades and diversions.

1510.8 DAMAGE TO EXISTING PROPERTY

A. CONTRACTOR shall replace or repair CONTRACTOR caused damage to existing buildings, sidewalks, roads, parking lot surfacing or any other existing asset.

1510.9 PARKING

A. CONTRACTOR shall arrange for temporary parking areas to accommodate construction personnel.

B. Costs shall be borne by CONTRACTOR.

1510.10 FIELD OFFICES AND BUILDINGS

A. CONTRACTOR shall provide and maintain a temporary field office for CONTRACTOR'S use if it is necessary to complete the Work.

B. OWNER will provide a temporary field office for ENGINEER.

1510.11 TEMPORARY ELECTRICITY AND LIGHTING

A. CONTRACTOR shall provide portable generators of sufficient capacity if necessary.

1510.12 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

A. CONTRACTOR shall remove temporary abovegrade or buried utilities, equipment, facilities and materials prior to final application for payment inspection.

B. CONTRACTOR shall grade, repair and restore areas used for temporary facilities.

C. CONTRACTOR shall restore any existing facilities used during construction to original condition and restore permanent facilities used during construction to specified condition.

1510.13 COSTS

A. CONTRACTOR shall obtain and pay for permits, inspections, and temporary easements.

B. CONTRACTOR shall pay for installation, operation, maintenance and removal of temporary facilities, utilities and controls.

1510.14 MATERIALS

A. CONTRACTOR shall provide new materials. If acceptable to the OWNER, the CONTRACTOR may use undamaged, previously used materials in serviceable condition. Provide materials suitable for the use intended.

1510.15 INSTALLATION, GENERAL

A. Use qualified personnel to install temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work, and a minimum interference to the regular activities at the site. Relocate and modify facilities as required.

1. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
2. Conditions of Use: Keep temporary facilities clean and neat in appearance. Operate safely and efficiently. Relocate as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

1510.16 SUPPORT FACILITIES INSTALLATION

A. Locate field offices, storage sheds, and other construction and support facilities for easy access. Maintain facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the OWNER.

B. Review subparagraph below with OWNER'S insurance carrier.

1. Provide incombustible construction for offices, shops, and sheds located within the construction area or within 30 feet of building lines. Comply with requirements of NFPA241.
2. Field Offices: Provide heated and air-conditioned, insulated, weather-tight temporary offices of size to accommodate personnel at the Project Site. Provide offices on foundations adequate for normal loading. Provide units with lockable entrances, operable windows, and serviceable finishes. Keep the office clean and orderly for use for small progress meetings. Insert additional equipment, such as fax or copying machines.
3. Storage and Fabrication Sheds: Install sheds equipped to accommodate materials and equipment involved. Sheds may be open shelters or fully enclosed spaces within the building.
4. Dewatering Facilities and Drains: For temporary drainage and dewatering operations not directly associated with construction, comply with dewatering requirements of applicable of the Technical Specifications. Where feasible, utilize the same facilities. Maintain excavations and construction free of water.

5. Waste Collection and Disposal: Collect waste daily and dispose as agreed with OWNER.

1510.17 **OPERATION**

A. Enforce discipline in use of temporary facilities. Limit availability to intended uses to minimize waste and abuse.

1510.18 **MAINTENANCE**

A. Maintain facilities in operating condition until removal. Protect from damage by freezing temperatures and similar elements. Maintain temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid damage.

1510.19 **PROTECTION**

A. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect during excavation.

1510.20 **TERMINATION AND REMOVAL**

A. Remove each temporary facility when the need has ended, when replaced by a permanent facility or no later than Substantial Completion. Complete or restore permanent construction delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and temporary facilities are the CONTRACTOR'S property. The OWNER reserves the right to take possession of project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during the construction period.

END OF SECTION 01510

SECTION 01620

SECURITY

01620.1 SUMMARY

A. This section includes the requirement to maintain a secure Project Site during the completion of construction activities.

01620.2 ENTRANCE CONTROL

A. Control of persons and vehicles entering and leaving the Project Site shall be provided by the CONTRACTOR during the construction period on-site. Access to the site is controlled by OWNER, if additional after hours security is deemed necessary by CONTRACTOR; Pinkerton Government Services shall be used. The CONTRACTOR shall exclude personnel from the site not properly identified. The CONTRACTOR shall:

1. Maintain a current list of persons allowed on site and submit a copy of the list to the OWNER and ENGINEER for access.

2. CONTRACTOR must sign in upon entering the Project Site and to sign out when leaving.

01620.3 SITE SECURITY PROTOCOLS

A. The CONTRACTOR shall submit a set of Project Site security protocols to the OWNER and ENGINEER. These protocols shall address as a minimum:

1. Description of standard operating procedures for responses to emergency situations such as contingencies, telephone numbers, radio frequencies, and call signs.

B. CONTRACTOR shall be responsible for the security of all his/her personnel, equipment, vehicles, field offices, sheds, and employee facilities during the active construction period. CONTRACTOR shall be responsible for loss or injury to persons or property where his work is involved and shall provide such security and take such precautionary measures to protect CONTRACTOR'S and OWNER'S interests. CONTRACTOR shall not receive monetary compensation or additional construction time for any equipment or material losses due to site security breaches, such as vandalism or theft.

END OF SECTION 01620

SECTION 01710

CONSTRUCTION LAYOUT AND SURVEYING

1710.1 SUMMARY

A. Section specifies the OWNER'S and CONTRACTOR'S construction survey responsibilities.

1710.2 CONSTRUCTION SURVEYING

A. CONTRACTOR shall complete the layout of the Work from the control points and pre-construction staking provided by the OWNER and shall be responsible for all measurements that may be required for execution of the Work to the location and limits prescribed in the Technical Specifications and Construction Drawings, subject to such modification as may be required to meet changed conditions of the Work.

B. CONTRACTOR shall be responsible for all grade staking and location/control surveys during the completion of the Work.

1710.3 QUALITY CONTROL

A. CONTRACTOR shall perform surveying required to verify construction quantities for measurement and payment acceptable to the ENGINEER.

B. CONTRACTOR will complete "As-built" surveys.

1710.4 SUBMITTALS

A. Submit legible copies of survey notes and documentation verifying accuracy of survey work to ENGINEER upon request.

1710.5 PROJECT RECORD DOCUMENTS

A. At project completion, survey notes and documentation verifying survey work shall be submitted to ENGINEER.

1710.6 SURVEY REFERENCE POINTS

A. OWNER will provide one (1) permanent survey benchmark for survey control and reference points near the project work area.

B. CONTRACTOR shall be responsible to protect survey control and reference points. CONTRACTOR shall be responsible for all grade staking and location/control surveys.

1710.7 FIELD ENGINEERING REQUIREMENTS

A. CONTRACTOR shall utilize recognized field engineering practices.

B. CONTRACTOR shall periodically verify elevations, lines and levels by instrumentation and similar appropriate means, such as grade stakes for fill placement and slopes.

1710.8 SURVEYS FOR MEASUREMENT AND PAYMENT

A. Surveys shall be performed to determine quantities of unit cost work and to establish measurement reference lines. Notify OWNER and ENGINEER prior to starting work.

B. CONTRACTOR'S engineer or representative shall calculate quantities for payment purposes. All quantities must be approved by the ENGINEER. The OWNER reserves the right to reject the CONTRACTOR'S measurement of work-in-place that involves use of established unit

prices, and to have this work measured and/or calculated, at the OWNER'S expense, by an independent engineer or surveyor acceptable to the CONTRACTOR.

1710.9 GENERAL

A. Lateral extents of waste in the construction area shall be determined by the CONTRACTOR prior to commencement of construction activities.

B. Benchmark monuments and other control points for horizontal and vertical control will be provided by the OWNER.

C. CONTRACTOR shall carefully preserve all established monuments, benchmarks, reference points, stakes, and other control points.

1. Promptly replace lost or destroyed Project Site control points at no additional cost to OWNER.
2. Base replacements on original survey control points.
3. CONTRACTOR shall be responsible for any construction errors or loss of time resulting from loss or disturbance of control points.

D. CONTRACTOR shall notify OWNER in writing of benchmarks, reference lines. or other control points which may have been disturbed or which appear to be off line or grade.

1710.10 PERFORMANCE

A. CONTRACTOR shall complete the Work from the field layout and stakes provided by the OWNER. CONTRACTOR shall be responsible for all measurements that may be required for execution of the work to the location and limits prescribed in the Technical Specifications and Construction Drawings. subject to such modification as may be required to meet changed conditions in the work.

B. CONTRACTOR shall perform all surveys required for determining quantities for progress payment estimates.

C. OWNER or ENGINEER does not guarantee the existence and location of underground facilities or utilities. Before beginning work. CONTRACTOR shall investigate and verify the existence and location of underground facilities.

D. CONTRACTOR will perform "As-Built" surveying.

END OF SECTION 01710

SECTION 01720

CONTRACT CLOSEOUT PROCEDURES

01720.1 SUMMARY

A. This section includes administrative provisions for Substantial Completion and for Final Acceptance required for Contract Closeout following the completion of the Work.

01720.2 SUBSTANTIAL COMPLETION

A. When CONTRACTOR considers Work (or designated portion of Work) is substantially completed, submit written notice with list of items completed or corrected.

B. Should inspection by ENGINEER find Work is not substantially complete, the ENGINEER will promptly notify CONTRACTOR in writing, listing observed deficiencies and create an entry into the deficiency/correction log.

C. CONTRACTOR shall remedy deficiencies and send a second written notice of substantial completion. ENGINEER shall observe and approve all corrections and note in deficiency/correction log.

D. When ENGINEER finds Work is substantially complete, ENGINEER will prepare a Certificate of Substantial Completion.

01720.3 FINAL COMPLETION

A. When CONTRACTOR considers Work is complete, submit written certification:

1. Technical Specifications and Construction Drawings have been reviewed.

2. Work has been inspected for compliance with Technical Specifications and Construction Drawings.

3. Work has been completed in accordance with Technical Specifications and Construction Drawings, and deficiencies listed with Certificate of Substantial Completion have been corrected.

4. Work is complete and ready for final inspection.

B. Should ENGINEER'S inspection find Work incomplete, the ENGINEER will promptly notify CONTRACTOR in writing listing observed deficiencies.

C. CONTRACTOR shall remedy deficiencies and send a second certification of final completion.

D. When ENGINEER finds Work is complete, the ENGINEER will consider closeout submittals.

E. CONTRACTOR will submit all data required to the ENGINEER for the preparation of the project record drawings.

01720.4 REINSPECTION FEES

A. Should status of completion of Work require reinspection by ENGINEER due to failure of work to comply with CONTRACTOR'S claims on initial inspection, ENGINEER may deduct the amount of ENGINEER compensation for reinspection services from final payment to CONTRACTOR.

01720.5 CLOSEOUT SUBMITTALS

A. Evidence of Payment and Release of Liens shall be in accordance with Conditions of the Contract.

01720.6 RECORD DOCUMENT SUBMITTALS

A. Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure location. Provide access to record documents for the OWNER'S reference during normal working hours.

B. Maintain a clean, undamaged set of blue-line or black-line 'prints of Construction Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately.

1. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work.

2. Mark new information that is important to the OWNER, but was not shown on Construction Drawings or Shop Drawings.

3. Note related change-order numbers where applicable.

4. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.

C. Maintain one complete copy of the Technical Specifications, including addenda,. Include with the Technical Specifications one copy of other written construction documents, such as Change Orders and modifications issued in printed form during construction.

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Technical Specifications and modifications.

2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.

3. Note related record drawing information and product data.

4. Upon completion of the Work, submit record Technical Specifications to the OWNER for the OWNER'S records.

01720.7 STATEMENT OF ADJUSTMENT OF ACCOUNTS

A. Submit final statement reflecting adjustments to Contract Sum indicating:

1. Original contract sum.

2. Previous change orders.

3. Changes under allowances.

4. Changes under unit prices.

5. Deductions for uncorrected work.

6. Penalties.

7. Deductions for liquidated damages.

8. Deduction for re-inspection fees.

9. Other adjustments to contract sum.

10. Total contract sum as adjusted.

11. Previous payments.

12. Sum remaining due.

B. ENGINEER will issue a final change order reflecting approved adjustments to contract sum not previously made by change orders.

01720.8 APPLICATION FOR FINAL PAYMENT

A. When all adjustments have been made. CONTRACTOR shall submit application for final payment andretainage.

01720.9 PAYMENT

A. There shall be no separate payment to CONTRACTOR for any work associated with this section. Any work required to be performed shall be considered as included in the unit or lump sum prices paid for the work involved.

01720.10 FINAL CLEANING

A. General cleaning is required during construction.

B. Remove temporary structures, tools, equipment, supplies, and surplus materials.

C. Remove temporary protection and facilities installed for protection of the Work during construction.

D. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the OWNER'S property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.

1. Where extra materials of value remain after completion of associated Work, they become the OWNER'S property. Dispose of these materials as directed by the OWNER.

E. Repairs

1. Repair damaged protective coated surfaces.

2. Repair roads, walks, fences, and other items damaged or deteriorated because of construction operations.

3. Restore all ground areas affected by construction operations.

*** END OF SECTION 01720***

DIVISION II

SITE WORK

SECTION 02150

SITE CLEARING AND GRUBBING

2150.1 SUMMARY

A. Section includes the clearing, grubbing and stripping of small brush, trees, and miscellaneous vegetation from the construction areas as shown on the Construction Drawings.

2150.2 RELATED SECTIONS

A. Section 02240 EARTHWORK

2150.3 QUALITY ASSURANCE AND QUALITY CONTROL

A. Site clearing and grubbing shall be performed in a manner that does not disturb existing structures, utilities, monitoring wells or other facilities not indicated to be removed or abandoned as directed by the ENGINEER.

B. Site clearing and grubbing shall be coordinated with the utility companies.

C. Cleared and grubbed materials shall be disposed at the site as directed by the OWNER.

2150.4 SUBMITTALS

A. None.

2150.5 PROTECTION OF EXISTING SITE

A. CONTRACTOR is expected to visit the site to observe the site grades and conditions under which the Work will be performed.

B. A site reconnaissance with the OWNER, ENGINEER, and CONTRACTOR will be conducted to identify and tag plant life designated to remain.

C. CONTRACTOR is to protect from damage during construction existing site improvements to remain. Restore damaged improvements to their original condition, as acceptable to OWNER and COA CONSULTANT.

D. Do not excavate within drip line of trees, unless otherwise indicated by the OWNER.

E. Repair or replace trees and vegetation indicated to remain as final landscaping that are damaged by construction operations in a manner approved by OWNER and COA CONSULTANT.

F. Locate, identify and protect above and below ground utilities. Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted in writing. Arrange to provide temporary utility services as directed by the COA CONSULTANT.

2150.6 CLEARING AND GRUBBING

A. Remove trees and shrubs from areas required for access to site and execution of Work. Any trees removed will be hauled off-site for disposal or at the decision of the OWNER (or defined by OWNER) chipped and placed in a selected location.

B. Remove stumps and main root balls from cleared areas. Stumps, roots and other organic debris shall be removed to a depth of not less than eighteen (18) inches below grade. Within areas to be filled, stump holes and depressions shall be backfilled with subgrade material and compacted. Stockpile grubbed materials at a location determined by the OWNER.

C. Strip site vegetation, including roots, from cleared and grubbed areas. Stockpile this material at a location determined by the OWNER.

D. Vegetative materials removed from the construction work areas shall be disposed at the site as directed by the OWNER.

END OF SECTION 02150

SECTION 02240

EARTHWORK

2240.1 SUMMARY

A. Section includes the excavating, filling, compacting, grading and related Work items necessary to complete the construction of the final cover.

2240.2 RELATED SECTIONS

A. Compacted Earthen Cover: SECTION 02241

2240.3 QUALITY ASSURANCE AND QUALITY CONTROL

A. The OWNER will retain the COA CONSULTANT to perform COA for the project. The COA CONSULTANT will monitor and document the Work completed by the CONTRACTOR. Performance criteria set forth in the Technical Specifications and as shown on the Construction Drawings will be the standard for the Work to be performed by the CONTRACTOR.

B. The COA CONSULTANT will perform the field and laboratory soil and granular material testing, in order to pre-qualify the materials, as described in the Technical Specifications (except for proof-rolling, and other similar items which the CONTRACTOR shall perform and the COA CONSULTANT will observe). The CONTRACTOR shall be responsible for providing adequate notice prior to needing in-place field and laboratory tests performed (e.g., density, moisture content or hydraulic conductivity testing). The CONTRACTOR shall schedule Work activities to avoid interruptions and impacting the progress schedule and be aware that some laboratory tests may require more than one week to complete (hydraulic conductivity).

C. The CONTRACTOR shall be responsible for reworking or removing and replacing nonconforming soil and other construction materials that do not meet the requirements of the Technical Specifications, the Construction Drawings, and as directed by the COA CONSULTANT.

D. The CONTRACTOR shall be responsible for all survey work required to complete construction in accordance with the required lines and elevations as described in the Technical Specifications and as shown on the Construction Drawings.

E. The CONTRACTOR shall perform "As-Built" surveying including closure area layout, subgrade, top of compacted soil liner, and top of vegetation support soil layer.

F. Reference Standards and Documents:

1. American Society for Testing and Materials (ASTM) most current versions:

a. ASTM D422 - Test Method for Particle-Size Analysis of Soils.

b. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5-lb. Rammer and 12-in. Drop (Standard Proctor).

c. ASTM D2216 - Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.

d. ASTM D2487 - Standard Test Method for Classification of Soils for Engineering Purposes.

e. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

f. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

g. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

h. ASTM D5084 - Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible-Wall Permeameter.

2240.4 SUBMITTALS

A. Electronic and hard copy as-built drawings shall be submitted to OWNER and ATK by the CONTRACTOR at the completion of the project.

2240.5 TOLERANCES

A. Excavation and backfill grades will conform to the lines, grades, sections and elevations shown on the Construction Drawings. Grading tolerances will be plus or minus 0.1 foot

unless otherwise stated. There is no negative thickness tolerance for the soil cover layer and vegetation support soil layer thickness.

2240.6 MATERIALS

A. General

1. All fill material must be approved by the COA CONSULTANT.

2. The final surface of all excavated areas and all areas designated to receive fill will be prepared and accepted in accordance with this section of the Technical Specifications. The final surface will also be free of loose material, clods and any other debris including grade stakes and hubs.

3. Natural subgrade soils or compacted fill softened by frost, flooding, weather or any other natural or man-made events will be removed and replaced or recompacted in accordance with the requirements specified herein.

4. Fill will not be placed on snow, ice, or frozen ground surfaces.

B. Leveling Layer

1. Leveling layer materials will refer to materials used for the construction of the leveling layer.

2. Leveling layer materials will be removed from the borrow area as directed by the OWNER or the COA CONSULTANT.

3. The leveling layer materials will be prepared by the CONTRACTOR and tested by the COA CONSULTANT to verify compliance with the Technical Specifications and the Construction Drawings.

4. Leveling layer fill soil will be free of debris, roots, organic matter, frozen matter, roots, wood, peat, cinders, rubbish, and stones having any dimension greater than two (2) inches or any other deleterious materials. Leveling layer fill soil will be a clay-rich soil.

C. Compacted Soil Cover

1. Compacted soil cover materials will refer to materials used for the construction of the compacted soil cover.

2. Compacted soil cover materials will be removed from the borrow area as directed by the OWNER or the COA CONSULTANT.

3. The compacted soil cover materials will be prepared by the CONTRACTOR and tested by the COA CONSULTANT to verify compliance with the Technical Specifications and the Construction Drawings.

4. Compacted soil cover materials will be free of debris, roots, organic matter, frozen matter, wood, peat, cinders, rubbish, and stones having any dimension greater than two (2) inches or any other deleterious materials. Soil will be capable of being compacted to the minimum specified density and achieve the maximum allowable hydraulic conductivity (1×10^{-7} cm/sec).

D. Vegetation Support Soil Layer

1. Vegetation support soil materials will refer to materials used for the construction of the vegetation support soil layer.

2. Vegetation support soils will be removed from the borrow area as directed by the OWNER or the COA CONSULTANT.

3. The vegetation support soil layer will be prepared by the CONTRACTOR and tested by the COA CONSULTANT to verify compliance with the Technical Specifications and the Construction Drawings.

4. The vegetation support soil layer materials will be free of debris, roots, organic matter, frozen matter, wood, peat, cinders, rubbish, and stones having any dimension greater than two (2) inches or any other deleterious materials. Soil will be nominally compacted.

2240.7 CLEARING AND GRUBBING

A. All areas where site grading, cutting, or filling will take place will be cleared and grubbed as described in Section 02150 SITE CLEARING AND GRUBBING.

2240.8 SURFACE DRAINAGE

A. The CONTRACTOR will control grading around excavations to prevent surface water from flowing into excavation areas. CONTRACTOR shall drain or pump as required to continuously maintain all excavations and trenches free of water or mud from any source and discharge to approved drains or drainage channels.

B. The CONTRACTOR shall provide surface water diversion as needed at the CONTRACTOR'S expense, without obstructing current site water and traffic flow as directed by the OWNER. Drainage features will be removed at the CONTRACTOR'S expense if directed by tne OWNER.

2240.9 EXCAVATION

A. The CONTRACTOR shall implement erosion control measures for soil stockpiles. Stockpiles will be graded to provide positive drainage at all times.

B. The CONTRACTOR shall apply water as needed to the project construction areas to minimize airborne dust as directed by the OWNER or COA CONSULTANT.

C. The CONTRACTOR shall excavate all loose soil materials (e.g., colluvium, alluvium, or landslide debris) from any area to receive backfill. The OWNER or COA CONSULTANT will determine the extent of over-excavation required.

D. The final surface of all excavated areas and all areas designated to receive fill will be prepared, proof-rolled and accepted by the COA CONSULTANT in accordance with the Technical Specifications.

E. The final surface of all excavated areas and all areas designated to receive fill will be free of loose material, clods and any other debris including grade stakes and hubs.

2240.10 PLACEMENT AND COMPACTION

A. The OWNER and COA CONSULTANT will be notified forty eight (48) hours prior to CONTRACTOR placing any fill material.

B. The CONTRACTOR shall place and compact fill in accordance with industry standard construction practices and procedures.

C. Hauling and spreading equipment will not be considered compaction equipment.

D. Exposed areas to receive fill, backfill, or embankment shall be proofrolled to detect localized zones of excessively wet, unstable, organic, or low bearing capacity materials to the extent as follows:

1. Proofroll as a single-pass operation with conventional compaction equipment during subgrade preparation and prior to placement of fill, and as a spot check process without the need for complete coverage per unit area of tire. Soft spots shall be overexcavated, backfilled, and compacted with suitable material.

E. The CONTRACTOR shall be responsible for maintaining proper lift thickness. The maximum loose lift thickness will not exceed eight (8) inches.

F. For structural components (not including the low permeability compacted soil cover or the vegetation support soil layer) soil lifts shall be compacted to a minimum of 95 percent of the maximum dry density as determined by Standard Proctor procedures and be between minus two (-2) percent below optimum moisture content and plus four (4) percent of optimum moisture content or as determined by the testing performed in accordance with ASTM 0698 by the COA CONSULTANT.

G. Each accepted lift will be left rough or scarified at least two (2) inches before placing the next overlying lift.

H. Final surfaces will be graded to the lines and elevations shown on the Construction Drawings.

I. Final surfaces will be smooth drum rolled and be free of loose material, clods, and other debris including grade stakes and hubs.

J. Compact each lift so that the in-place dry unit weight and moisture content are within the acceptable placement zone as indicated by the COA CONSULTANT.

K. The structural fill material for the anchor trench backfill material will be nominally compacted to the satisfaction of the COA CONSULTANT.

L. The CONTRACTOR shall place the vegetation support soil layer so as not to damage the underlying geosynthetics (geomembrane cover and geocomposite). Low ground pressure equipment shall be used to spread the vegetation support soil. Any damage to the geosynthetics will be repaired at the CONTRACTOR'S expense.

END **OF SECTION** 02240

SECTION 02241

COMPACTED EARTHEN COVER

2241.1 SUMMARY

A. This Section describes Work necessary to construct a 24-inch thick compacted earthen cover, including all filling, backfilling, sorting, moisture conditioning, processing, compacting, and all related items necessary to complete the Work indicated or specified.

2241.2 RELATED SECTIONS

1. Section 02150 CLEARING AND GRUBBING
2. Section 02240 EARTHWORK
3. Section 02250 GEOTEXTILE

2241.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM 0698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ftlbflfe(600 kNm/m^3)).
2. ASTM 02216 - Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
3. ASTM 02922 - Density of Soil and SOil-Aggregate in Place by Nuclear Methods (Shallow Depth).
4. ASTM 03017 - Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
5. ASTM 05084 - Falling Head Hydraulic Conductivity Determination Using a Flexible Wall Permeameter.

2241.4 SUBMITTALS AND CONSTRUCTION RECORDS

A. Submittals:

1. A detailed plan for moisture conditioning, placing, processing, compacting, final grading, and maintaining the compacted earthen cover. This plan shall include, but is not limited to, the following information:
   a. Listing of the proposed types, manufacturer, and model number of the placement and moisture conditioning equipment, along with a detailed description of placement and moisture conditioning methods. Methods of grade and lift thickness control should be discussed in detail.
   b. A listing of the proposed processing equipment, including manufacturer and model number, and a detailed description of the processing procedure.
   c. A listing of the proposed compaction equipment, including manufacturer and model number, and a detailed description of compaction methods.
   d. A detailed description of final grading equipment, including manufacturer .and model number, and procedures for final grading of the compacted soil cover surface and preparation of the surface for geomembrane cover placement.

e. A detailed description of the proposed methods and equipment for maintenance and protection of the compacted earthen cover surface from desiccation, freezing, and other damaging events.

B. Construction Records:

1. Survey information as described in this Section.

2241.5 EARTHEN COVER MATERIAL

A. The earthen cover shall be compacted within the acceptable moisture and dry density placement zone as provided by COA CONSULTANT at a later date. Typically the acceptable range is greater than or equal to ninety five (95) percent of maximum dry density as determined by the Standard Proctor test and with moisture content at optimum to four (4) percent above optimum moisture content.

B. The earthen cover material shall have a maximum particle size of three (3) inches in any dimension, and shall be kept free of organic matter and foreign debris at the time of placement.

2241.6 EQUIPMENT

A. Equipment for compacting and shaping the compacted earthen cover shall, at a minimum, consist of the following:

1. A footed drum roller imparting a kneading action to the soil material, with a foot length of at least seven and one half (7 1/2) inches or the loose lift thickness, whichever is greater, and having a minimum static weight of 40,000 pounds.
2. A smooth steel drum roller or rubber tired roller for shaping the compacted soil surface prior to placement of the geomembrane cover.

B. Equipment for processing the soil cover material after placement and prior to compaction shall consist of a rotary or drummed stabilizer mixer, pulver mixer, rotovator, or road reclaimer that will thoroughly process and mix the loose lift, providing a maximum particle size of two (2) inches.

2241.7 EARTHEN COVER LEVELING LAYER

A. Backfill as required to construct leveling layer to the elevations and grades indicated on the construction drawings.

B. Scarify or disc leveling layer to a minimum depth of six (6) inches, if necessary, to remove unacceptable large particles.

C. Compact scarified or disced leveling layer and proofroll unscarified leveling layer with heavy construction equipment such as a fully loaded scraper or tandem axel dump truck. Compaction, when used, shall continue until the surface is relatively even, rutting depth is less than two (2) inches, and pumping does not occur. Areas where pumping or rutting is in excess of two (2) inches with proofrolling, or continues to occur with compaction, shall be undercut, backfilled with suitable materials, and compacted until deficient conditions are

D. Leveling layer material shall not have rock or gravel particles larger than three (3) inches in any dimension within the upper three (3) inches.

E. Construction of the compacted earthen cover shall not begin until the leveling layer has been prepared in accordance with these Specifications and approved by the OWNER and CQA CONSULTANT.

2241.8 EARTHEN COVER PLACEMENT

A. Construct compacted earthen cover to the contours and elevations indicated.

B. The compacted earthen cover shall be developed, in general, by compacting successive 6-inch thick layers (maximum compacted lift thickness) of approved soil material for a total compacted earthen cover thickness of not less than two (2) feet.

C. Compacted earthen cover material shall be placed in loose lifts not exceeding eight (8) inches in thickness.

D. If necessary compacted earthen cover material shall be processed after placement with a pulver mixer, rotovator, road reclaimer, or other similar approved processing equipment so that clod size does not exceed three (3) inches in any dimension. Processing shall extend a minimum of one (1) inch into successive underlying lifts.

E. Final compacted thickness of each lift shall not be greater than six (6) inches.

F. Compact each lift so that the in-place dry unit weight and moisture content are within the acceptable placement zone as indicated by the COA CONSULTANT.

G. Adjust moisture content of compacted earthen cover material as follows:

1. In amounts less than two (2) percent after placement, but prior to processing and compaction. Moisture content may be adjusted less than two (2) percent during the processing stage, if the processing equipment allows for direct addition of water and processing equipment will produce a uniformly mixed material with even moisture distribution.
2. In amounts greater than two (2) percent:
   a. Prior to placement at a separate location.
   b. In a maximum twelve (12)-inch thick layer of material.
   c. With tilling equipment such that the compacted earthen cover material will wet or dry evenly.
3. With a distributor bar or other approved equipment that will distribute moisture evenly and at a constant rate.

H. Stagger horizontal joints between overlying and underlying lifts a minimum of five (5) feet.

I. Protect soil cover from damage caused by freezing, desiccation or other harsh exposure conditions.

J. Protect the compacted earthen cover after placement of the final lift so that the in-place dry unit weight and moisture content are maintained within the acceptable placement zone until the final lift is covered by the geomembrane cover.

K. If the soil cover is damaged by exposure, remove the lift, adjust the moisture content if required, and recompact to meet the requirements of this Specification.

L. The final surface lift shall not contain rock or stone particles larger than one half (1/2) inches in maximum dimension.

2241.9 FIELD QUALITY ASSURANCE/QUALITY CONTROL

A. Quality Assurance:

1. A CQA CONSULTANT has been retained by the OWNER to monitor CONTRACTOR'S compliance with the Contract DraWings and Technical Specifications. The CQA CONSULTANT is also required to monitor compliance with the CQA Plan. The CQA Plan is included for review with the project manual.
2. The CQA CONSULTANT will perform the tests prescribed in the CQA Plan to determine conformance with project specifications and specified density and hydraulic conductivity relationships.
3. Method of test may be any of the following:
   a. Density and Unit Weight by Sand Cone, ASTM 01556.
   b. Density and Unit Weight by Balloon, ASTM 02167.
   c. Density and Water Content by Nuclear Methods, ASTM 02922/03017.
   d. Density of Soil in Place by Drive-Cylinder, ASTM 02937.

B. Quality Control:

1. Perform quality control testing considered necessary to permit completion of the Work in compliance with these Specifications.
2. Rework areas identified by the CQA CONSULTANT as not meeting the project specifications or placement criteria until those areas satisfy the project specifications or placement criteria as indicated by the CQA CONSULTANT.

*****END OF SECTION 02241*****

SECTION 02300

GEOCOMPOSITE

02300.1 SUMMARY

A. This section describes the material and placement requirements for the geocomposite associated with the construction of the final cover system.

B. The geocomposite associated with the construction of the Cover System shall be supplied and installed by the CONTRACTOR.

C. The geocomposite shall be installed on top of the compacted clay cover.

02300.2 QUALITY ASSURANCE AND QUALITY CONTROL

A. Quality control testing of the geocomposite shall be performed by the CONTRACTOR and shall be in accordance with these Technical Specifications. Conformance sampling shall be completed at a minimum frequency of one sample every 100,000 square feet or one per lot of geotextile delivered and will be preformed before shipment to the Project Site.

B. The OWNER will retain the ENGINEER to perform CQA for the project. The ENGINEER will monitor and document the work completed by the CONTRACTOR. Performance criteria set forth in the Technical Specifications, CONTRACTOR'S CQA plan, manufacturer's recommendation, and as shown on the Construction Drawings shall be the standard for the Work to be performed by the CONTRACTOR.

C. The CONTRACTOR shall be responsible for removing and replacing nonconforming geocomposite materials that do not meet the requirements of the Technical Specifications and the Construction Drawings at no additional cost to the OWNER.

D. American Society for Testing and Materials (ASTM) most current versions:

1. ASTM 01505-98 Standard Test Method for Density of Plastics by the Density-Gradient Technique

2. ASTM 01603-94 Standard Test Method for Carbon Black in Olefin Plastics

3. ASTM 04355-02 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus

4. ASTM 04491-99 Standard Test Method for Water Permeability of Geotextiles by Permittivity

5. ASTM 04632-00 Standard Test Method for Gab Breaking Load and Elongation of Geotextiles

6. ASTM D4716-00 Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

7. ASTM D4751-99 Standard Test Method for Determining Apparent Opening Size of a Geotextile

8. ASTM D4833-88 (1996) Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

9. ASTM D5035-95 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

10. ASTM D5199-99 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

11. ASTM D5261-92 (1996) Standard Test Method for Measuring the Mass Per Unit Area of Geotextiles

E. Geosynthetic Research Institute (GRI)

1. GRI GC-7 Determination of Adhesion and Bond Strength of Geocomposites.

02300.3 SUBMITTALS

A. Material/product verification data and quality control test results shall be submitted to the ENGINEER including:

1. Manufacturer's specifications and installation recommendations for the geocomposite.

2. Quality control certificates signed by a responsible entity employed by geocomposite manufacturer. Each quality control certificate shall include roll identification numbers, testing procedures and results of quality control tests.

02300.4 GEOCOMPOSITE

A. Shall consist of geotextile heat-bonded to both sides of geonet as described below. No burning through geotextile will be permitted.

B. Shall be manufactured of new, first quality products designed and manufactured specifically for maintaining drainage between cover soil and compacted clay cover on landfill side slopes.

C. Shall be free of tears, punctures, or contamination by foreign material. All such defects shall be repaired in a manner satisfactory to the CQA Officer.

D. The minimum hydraulic conductivity of the geocomposite shall be 10 em/sec.

E. The geotextile shall be 6 oz/yd^2.

F. HOPE Geocomposite properties are as follows:

Property	Test Method	Value
Geocomposife		
Transmissivity, gal/min ft	ASTM 04716	1.2
Ply Adhesion, Ib/in	ASTM 07005	1.0
Geonet core		
Transmissivity, gal/min ft	ASTM 04716	5.0
Thickness, mils	ASTM 05199	200
Density, g/cm2	ASTM 01505	0.94
Tensile Strength, Ib	ASTM 05035	45
Carbon Black Content, %	ASTM 01603	1.5- 3.0
Geotextile (prior to lamination)		
Mass per Unit Area, oz/yd²	ASTM 05261	6
Grab Tensile, Ib	ASTM 04632	160
Puncture Strength, Ib	ASTM 04833	90
Apparent Opening Size, US sieve	ASTM 04751	70
Permittivity, sec-	ASTM 04491	1.5
UV Resistance, %	ASTM 04355	70

02300.5 MATERIAL DELIVERY AND PROTECTION

A. Receive, store, and handle the geocomposite materials as recommended by manufacturer. Cover all materials completely while stored at the Project Site prior to use.

B. Damaged material on rolls shall be cut out and removed from the Project Site.

02300.6 INSTALLATION

A. Install geocomposite and all accessories in strict accordance with geocomposite manufacturer/fabricator's instructions, and as specified herein.

B. Install geocomposite on the placed compacted clay cover using careful procedures with minimum handling. Unroll panels as close to their final position as possible.

C. Field Overlap and Securing for Geocomposite:

1. Composite surfaces to be overlapped shall be cleaned before overlapping.

2. Overlap adjacent rolls approximately 4 inches and secure by plastic ties approximately every 5 feet along the roll length. Plastic ties shall be white or another bright color for easy inspection. Metallic ties shall not be allowed.

3. In the corners of the side slopes, where overlaps between rolls of geocomposite are staggered, install an extra layer of geocomposite from the top to the bottom of slope.

4. Secure all geocomposite rolls in-place with sandbags or equivalent. Install sandbags during geocomposite placement and retain in-place.

5. On slopes. anchor the geocomposite into a trench as indicated on the Construction Drawings.

D. Adhere to the following stipulations while working on or near the geocomposite:

1. No smoking shall be allowed.

2. No glass or metal containers or other sharp objects shall be used.

3. No construction installation equipment shall pass over any exposed fabric surface.

4. Remove snow and water from the ground surface prior to geocomposite installation.

*****END OF SECTION 02300*****

SECTION 02900

SEEDING, FERTILIZING, AND MULCHING

2910.1 SUMMARY

A. Section includes requirements, procedures, and methods related to the CONTRACTOR'S responsibilities for the completion of seeding, fertilizing, and mulching to vegetate the Final Cover construction area and to revegetate all other areas disturbed by construction operations.

2910.2 RELATED SECTIONS

A. Section 02240 EARTHWORK

2910.3 QUALITY ASSURANCE AND QUALITY CONTROL

A. Seeding and fertilizing shall be completed in accordance with the materials manufacturer's recommendations, the Technical Specifications or as directed by the OWNER or ENGINEER.

B. Seeding in windy weather or when soil is dry, excessively wet, frozen, or other untillable condition shall not be permitted.

C. Protection: Seeded, fertilized, and mulched areas shall be protected against traffic, vehicle or pedestrian, or other use immediately after completion of work by placing appropriate signs or barriers around the seeded area.

2910.4 SUBMITTALS

A. Material manufacturer's and supplier's specifications and test data for seed, fertilizer, and mulch materials shall be submitted to the ENGINEER to demonstrate compliance with these Technical Specifications.

B. CONTRACTOR shall submit soil analysis to determine the appropriate seed, lime and fertilizer application rates. The results shall be submitted to the ENGINEER for approval prior to commencing construction.

2910.5 SEED

A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysis of North America and as required below. The specified seed mixture, application rates, and planting dates may be revised at the OWNER'S request.

1. Planting Schedule:

Planting Date	Crop Type	Proportional Application Rate
Final date: November 15	Little Bluestem	3/ Acre
	Big Bluestem	1.5/ Acre
	Switch Grass	2/ Acre
	Side Oats Grama	1.75/ Acre

2. Moldy seed or seed that has been damaged in storage shall not be used.

3. The maximum noxious weed seed shall be less than 2% of the species.

2910.6 INOCULANTS

A. Leguminous seeds shall be inoculated or treated with the proper quantity of cultures for the particular legume to be sown in accordance with the manufacturer's directions for inoculating seeds.

B. The time lapse for sowing of inoculated seed shall be in accordance with the manufacturer's recommendations.

2910.7 FERTILIZER AND LIME

A. Fertilizer shall be a standard commercial product which when applied at the proper rate will supply the quantity of total nitrogen, available phosphoric acid, and soluble potassium as specified herein.

B. Lime shall be of natural limestone containing not less than 375 pounds effective neutralizing material (ENM) per acre or equal as approved by the ENGINEER.

C. The fertilizer and lime shall be delivered to the site in clean, sealed containers which bear a label fUlly describing the contents, the chemical analysis of each nutrient. the fertilizer grade, the net bulk and the name and address of the manufacturer.

D. Fertilizer shall not be incorporated into the soil more than four (4) weeks prior to seeding.

E. Lime shall be incorporated into the soil within three (3) days of application.

2910.8 MULCH

A. Mulch shall be straw of wheat or oats.

B. Mulch shall be free of weed seeds and other noxious and undesirable seeds.

C. Mulch shall be clean and relatively free of foreign material and not be in an advanced stage of decomposition.

D. Mulch shall be spread uniformly to form a continuous blanket not less than one and one-half (1-1/2) inches or more than two (2) inches loose measurement over seeded areas.

E. The mulch material shall be uniformly spread at the specified rate by hand or with special mulch-spreading equipment. Mulching shall immediately follow seeding operations. The mulch shall be uniformly applied over seeded areas at the rate of one (1) pound per square yard. Care shall be exercised so as not to use an excessive amount of mulch or unduly disturb the grass seeding.

F. Straw mulch shall be crimped into the soil by means of a straw crimper manufactured specifically for such purposes.

2910.9 WATER

A. Water shall be clean and potable and secured from a source approved by the OWNER or ENGINEER.

B. Water newly seeded area in a timely and effective manner to prevent drought or flooded conditions. Application shall be made at rates less than or equal to soil infiltration rates as determined by the ENGINEER. Short, more frequent water application to low permeability areas and steeper slopes shall be required to prevent surface ponding or surface runoff. Erosion damage caused by excess irrigation water shall be repaired at the CONTRACTOR'S expense.

2910.10 TURF ESTABLISHMENT

A. The CONTRACTOR shall provide and maintain a uniform stand of established turf grass species having attained a height of six (6) inches, and consisting of no less than one hundred (100) plants per square foot throughout the seeded areas until the entire project has been accepted by the OWNER.

*** END OF SECTION 02900 ***

DIVISION XV

MECHANICAL

SECTION 15020

HIGH DENSITY POLYETHYLENE (HOPE) CORRUGATED PIPING

15020.1 SUMMARY

A. Section includes furnishing all labor, materials, equipment, and incidentals necessary to install perforated, corrugated high density polyethylene (HDPE) piping and pipe fittings for the geocomposite drainage layer toe drain as shown on the Construction Drawings.

B. Related Work Specified Elsewhere:

1. Earthwork: SECTION 02240

2. Geocomposite: SECTION 02300

C. HDPE corrugated piping is to be supplied and installed by CONTRACTOR.

15020.2 REFERENCES

A. American Association of State Highway and Transportation OffiCials (AASHTO):

1. AASHTO M 252M - Corrugated Polyethylene Drainage Tubing

2. AASHTO M 294M - Corrugated Polyethylene Pipe, 305-mm to 915-mm (12-in to 36-in) Diameter

B. American Society for Testing and Materials (ASTM):

1. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastometric Seals

2. ASTM F405 - Corrugated Polyethylene (PE) Tubing and Fittings

3. ASTM F667 - Large Diameter Corrugated Polyethylene Tubing and Fittings

4. ASTM F758 - Smooth-Wall Poly(Vinyl Chloride) PVC Plastic Underdrain Systems for Highway, Airport, and Similar Drainage

5. ASTM F949 - Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

15020.3 SUBMITTALS

A. Two randomly selected samples of each type of pipe and fitting, prior to delivery of materials to the site.

B. Certifications from the manufactures attesting that materials meet specification requirements.

15020.4 DELIVERY, STORAGE, AND HANDLING

A. Transportation

1. Care shall be taken during transportation of the pipe that it is not cut or damaged.

B. Storage

1. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe.

2. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions.

3. Materials placed in storage shall be protected from the weather, humidity, and temperature variations, dirt and dust, or other contaminants. Pipe shall not be exposed to direct sunlight for more than 6 months from time of manufacture to installation.

C. Handling Pipe Lengths

1. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipes.

2. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two (2) slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground.

15020.5 MATERIALS

A. Pipe shall be of the type and size indicated. Appropriate transitions, adapters, or joint details shall be used where pipes of different types or materials are connected. All fittings shall be pipe manufacturer's standard type and shall conform to the indicated specification.

B. Plastic Pipe

1. Plastic pipe shall contain ultraviolet inhibitor to provide protection for exposure to direct sunlight.

2. Corrugated Polyethylene (PE) Drainage Pipe

a. The CONTRACTOR shall furnish the following:

i. ASTM F405 heavy duty for pipe 80 to 150 mm (3 to 6 inches) in diameter inclusive

ii. ASTM F667 for pipe 200 to 600 mm (8 to 24 inches) in diameter

OR

iii. AASHTO M252M for pipe 80 to 250 mm (3 to 10 inches) in diameter

iv. AASHTO M294M for pipe 300 to 600 mm (12 to 24 inches) in diameter

C. Circular Perforations in Plastic Pipe

Perforation and slot sizing is based on embedment gradation, flow requirements, and structural considerations. The embedment material gradation is in turn based on the gradation of the surrounding soil. To minimize the migration of fines into the coarser material, while maintaining adequate permeability, the following criteria should be met:

1. All soils except clays without sand or silt fraction must meet the following requirements:

a. 15 percent size of drainage or filter material divided by 85 percent size of material to be drained less than or equal to 5

2. Clays without a sand or silt fraction must meet the following specifications:

a. 15 percent size of drainage or filter material divided by 85 percent size of material to be drained less than or equal to 5

b. 15 percent size of drainage or filter material less than or equal to 0.4 mm

3. All soils, in addition to the previous requirements, must meet the following criteria:
   a. 15 percent size of drainage or filter material divided by 85 percent size of material to be drained less than or equal to 5

   b. 85 percent size of drainage or filter material divided by slot width greater than or equal to 1.2 mm

   c. 85 percent size of drainage or filter material divided by hole diameter greater than or equal to 1.0 mm

4. Circular holes shall be cleanly cut, not more than 8 mm (5/16 inch) or less than 5 mm (3/16 inch) in diameter and arranged in rows parallel to the longitudinal axis of the pipe.

5. Perforations shall be approximately 75 mm (3 inches) apart, center-to-center, along rows.

6. The rows shall be approximately 38 mm (1-1/2 inches) apart and arranged in a staggered pattern so all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference.

7. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket. Perforations shall continue at uniform spacing over the entire pipe length.

8. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the OWNER.

D. Slotted Perforations in Plastic Pipe

1. Circumferential slots shall be cleanly cut so as not to restrict the water inflow and uniformly spaced along the tubing length and circumference. Slot width shall not exceed 3 mm (1/8 inch) or be less than 0.79 mm (1/32 inch).

2. The individual slot length shall not exceed the following:

   a. 32 mm (1-1/4 inches) on 75 mm (3 inch) diameter tubing

   b. 10 percent of the tubing's inside nominal circumference on 100 to 200 mm (4 to 8 inch) diameter tubing

   c. 65 mm (2-1/2 inches) on 250 mm (10 inch) diameter tubing

3. Slot rows shall be symmetrically spaced so they are fully contained in quadrants of the pipe.

4. Slots shall be centered in the profile wall pipe corrugation valleys.

5. The water inlet area shall be a minimum of 1058 square millimeters per linear meter (0.5 square inch per liner foot) of tubing.

6. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior OWNER's approval.

E. Fittings

1. Fittings shall be of compatible materials for pipe, of corresponding weight and quality, and as specified herein.

15020.6 INSTALLATION

A. Pipe shall be installed as depicted on the Construction Drawings.

B. Pipe shall be completely wrapped in the geocomposite drainage layer and shall not be in direct contact with the overlying cover soils.

C. The terminal ends of the pipe at the west and east ends of the project shall be fitted with a cover to prevent soil intrusions into the end of the pipe and allow future connection when the final cover is extended.

*****END OF SECTION 15020*****

APPENDIX F

CQAIQC Plan

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AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PLAN AREA 8 IWTP SLUDGE LANDFILL CELLS 1 AND 2

Lake City Army Ammunition Plant
Area 8 IWTP Sludge Landfill 709503
Independence, Missouri

Revised June 2008
Aquaterra Project Number 2606.10

Prepared for:

Lake City Army Ammunition Plant

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

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Appendix A Construction Quality Assurance/ Quality Control Example Forms

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AREA 8 IWTP SLUDGE LANDFILL CELLS 1 AND 2
Lake City Army Ammunition Plant Area 81WTP Sludge Landfill 709503
Independence, Missouri
Revised June 2008

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Certification

This Construction Quality Assurance! Quality Control Plan has been prepared in accordance with good engineering practice, including consideration of industry standards and the requirements of the Missouri Department of Natural Resources.

Prepared by
Doug Doerr, P.E.
Principal
Aquaterra Environmental Solutions, Inc.

CONSTRUCTION QUALITY ASSURANCE PLAN
AREA 8 IWTP SLUDGE LANDFILL CELLS 1 AND 2
Lake City Army Ammunition Plant
Independence, Missouri
Revised June 2008

1.0 INTRODUCTION

The Hazardous Waste Management Act/Resource Conservation and Recovery Act (RCRA) requires construction quality assurance (COA) and construction quality control (COC) on RCRA disposal facility components to ensure quality landfill construction. CQA is typically performed by a party independent to the facility owner and contractor to document the quality of construction on key landfill components. COC procedures are typically performed by the contractor and/or owner throughout construction to ensure that landfill components are constructed in accordance with applicable construction standards and specifications. The technical guidance document entitled Ouality Assurance and Quality Control for Waste Containment Facilities (EPA/600/R-93/182) produced by the U.S. Environmental Protection Agency specifically defines the roles that COA and COC play during landfill construction:

- COA: A planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. CQA includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. CQA refers to the measures taken by the COA organization to assess if the contractor or installer is in compliance with the plans and specifications for a project.

- COC: A planned system of inspections that is used to directly monitor and control the quality of a construction project. COC is normally performed by the earthwork contractor or geosynthetics installer and is necessary to achieve quality in the constructed or installed system. COC refers to measures taken by the contractor or installer to determine compliance with the requirements for material and workmanship as stated in the plans and specifications for the project.

Typical landfill components that require COA and CQC procedures are as follows:

- Subgrade Excavation and/or Backfilling (where applicable);
- Low Permeability Soil Liner/Cap;
- Geomembrane Liner;
- Geotextiles and/or Geocomposites; and
  Leachate Collection System.

This plan focuses on the *CONOC* activities to be completed by an independent third-party, and addresses the leveling layer, compacted clay cover, geocomposite, and the vegetative soil layer for the final cover system to be constructed for the Closure of Area 8 IWTP Sludge Landfill Cells 1 and 2 at the Lake City Army Ammunition Plant (LCAAP) IWTP Sludge Waste Landfill 709503 near Independence, Missouri. The facility is owned and operated by LCAAP (Owner). This plan has been prepared in general conformance with the State of Missouri Solid Waste Management Rules. This plan has been developed in accordance with RCRA closure requirements under 40 CFR 265 Subpart G, Missouri Department of Natural Resources (MDNR) Hazardous Waste Management Program's (HWP) requirements outlined in 10 CSR 25-7.265 and MDNR Solid Waste Management Program's (SWMP) requirements outlined in 10 CSR 80-3.010.

This document outlines methods of construction, quality assurance/ quality control testing procedures, and reporting requirements to be used during the construction of the final cover system. The *CONOC* personnel for the final cover construction for the LCAAP IWTP Sludge Landfill Cell Closure will also coordinate with the contractor(s) and their COC personnel to ensure that construction is in accordance with the approved permit documents and available plans and specifications. Should the COC efforts of the contractor(s) appear to be insufficient, the *CONOC* personnel will coordinate with the contractor(s) to further ensure that the permit documents and plans and specifications are adhered to. The *CONOC* procedures outlined in this document fulfill the requirements of the Missouri Hazardous Waste Regulations and Missouri Solid Waste Management Regulations and will provide the information and documentation necessary to certify that landfill components were constructed in accordance with the approved permit documents.

A copy of this *CONOC* plan is to be maintained at the landfill for use during final cover construction. Any revisions to the design or the approved *CONOC* Plan shall require a permit modification to be reviewed by the HWP and SWMP. The HWP and SWMP must be kept informed throughout the closure process. The HWP and SWMP will review all records and results from the implementation of the *CONOC* Plan.

2.0 GENERAL CONDITIONS

2.1 Responsibility and Authority

LCAAP will be responsible for the implementation of this *CONOC* Plan. The following is a list of responsible personnel:

Owner's Representative

A representative of LCAAP shall be responsible for coordination between the Owner, the construction crew, and the third party *CONOC* Engineer. With prior notification to the HWP and SWMP, the Owner may delegate authority, and correspondingly, shall be responsible to see that the *CONOC* Plan is followed.

CONOC Engineer

A professional engineer licensed to practice in Missouri shall be retained by the Owner or delegated authority to provide on-site construction oversight, quality assurance! quality control testing, and a final report demonstrating that the requirements of this *CONOC* Plan are met. In addition, the *CONOC* Engineer or his designee shall coordinate with the contractor(s) and!or installer(s) and their COC personnel for the purposes of sharing COA and COC information. Should it become apparent to the *CONOC* Engineer or his designee that construction quality is substandard, the *CONOC* Engineer shall inform the Owner of the apparent deficiencies such that adjustments can be made. The *CONOC* Engineer must be employed by an organization that operates independently of the LCAAP contract operator, construction contractor, and Owner. The *CONOC* Engineer will be responsible for certifying .that construction was completed in accordance with the approved engineering design plans and specifications.

CONOC Inspector

If the *CONOC* Engineer cannot serve to provide on-site inspection of the all cover construction activities and reporting, the *CONOC* Engineer shall designate a *CONOC* Inspector to perform those duties. The *CONOC* Inspector shall be an individual that represents the *CONOC* Engineer and provides on-site construction oversight, quality assurance and quality control testing, and general observance and documentation of construction. The *CONOC* Inspector will document on-site construction activities on a Daily Field Activities Report. An example of this report is included in Appendix A.

2.2 Inspection and Testing

This *CONOC* Plan describes the inspection and testing of four critical components of the landfill final cover system, listed below. The *CONOC* Inspector, under supervision of the *CONOC* Engineer, will be present on-site to monitor the placement and compaction of all

components of the final cover system. The following sections outline minimum requirements and guidelines to be followed to execute the CONOC Plan.

1. Leveling Layer;
2. Compacted Clay Cover;
3. Geocomposite; and
4. Vegetative Soil Layer

Throughout the construction activities, communication will playa major role in completing a successful construction project and achieving the requirements of the approved plans and specifications and permit documents. At a minimum, the following communications guidelines will be met:

- Pre-Construction Meeting: A meeting involving the Owner or designated representative, CONOC personnel, and the contractor(s) shall take place prior to the start of construction. This meeting should include discussion of: each party's responsibilities; lines or means of communication; procedures for changes or problems; CONOe procedures and requirements; level of HWP and SWMP involvement; and other issues as they pertain to the construction project.

- Daily Progress Meetings: Regularly scheduled, daily meetings between CONOC personnel and the contractor(s) shall take place to review and discuss such topics as previous work, future work, construction problems, schedule revisions, and other issues that require attention on a frequent basis.

- Other Meetings: Unscheduled meetings shall take place as required to address issues such as construction progress and changed conditions as circumstances dictate.

Under all circumstances, the HWP and SWMP will be given seven days advance notification prior to placement of compacted clay components, placement of geocomposite, and placement of the vegetative soil layer. The HWP and SWMP reserve the right to inspect all components of final cover construction.

3.0 LEVELING LAYER

The leveling layer will provide the subgrade/sub-base for the final cover system. The compacted clay cover (See Section 4.0) will be constructed directly on top of the leveling layer. The leveling layer will provide a firm base for the final cover construction. The leveling layer shall be graded to ensure that the closure area has a minimum slope of 3 percent. The thickness of this layer will vary between 0 to 24 inches depending on the existing contours. The following section describes leveling layer preparation requirements.

3.1 Leveling layer Preparation

The *COA/OC* Engineer or his appointed COA/OC Inspector will identify and ensure that the leveling layer preparation/construction is carried out in accordance with the approved plans and specifications. In addition, the COA/OC Inspector will identify unexpected conditions encountered during leveling layer construction/preparation and record all minor changes to the plans and construction procedures on the as-built drawings. At a minimum, the assigned personnel will complete the following:

- Observe and record the placement of the leveling layer.
- Verify that soft, organic or other undesirable materials (e.g., large particle sizes that can not be filled and compacted prior to cover placement) are removed prior to compacted clay cover construction.
- Verify leveling layer construction in accordance with the applicable sampling, testing, and survey program(s).
- Prior to compacted clay placement, inspect the leveling layer for soft spots, pumping, or deleterious materials and verify recompaction or removal and replacement of identified areas.
- Verify that all debris, including plant materials such as trees, stumps, and roots, and rocks of size large enough to interfere with proper placement/compaction are removed prior to leveling layer construction and preparation.
- Prevent the placement of frozen material or the placement of material on frozen ground.
- Record the types of compaction equipment utilized for subgrade construction.
- Periodically photograph the leveling layer construction and finished leveling layer surface.
- Verify that prior to compacted clay cover component placement, the upper six inches of soil leveling layer is disked, re-compacted, and graded to provide a workable surface on which to construct the compacted clay cover component.

- Survey the finished leveling layer on a maximum of 1DO-foot intervals and along each line where a change in grade occurs to assure that the leveling layer has been completed in accordance with the approved plans and specifications. The survey shall be completed by a Missouri-registered surveyor to confirm and document leveling layer elevations and to establish project coordinates.

For the IWTP Sludge landfill Closure, the leveling layer will be constructed of soil materials that are classified as CI, CH, or SC material in accordance with the Unified Soil Classification System.

The CONOC Engineer or CONOC Inspector will observe placement of the leveling layer to verify conformance with the required placement method and thickness.

The upper soil portion of the leveling layer will be placed to form a relatively smooth base on which to construct the compacted clay cover. Placement of the leveling layer will be in 6-inch to 8-inch lifts and compacted to a minimum of 95 percent of standard Proctor maximum dry density. A testing program consisting of density testing with a nuclear density gauge (ASTM D 6981) will be completed at a frequency of one test per acre per lift to verify that the leveling layer meets the density requirements.

4.0 COMPACTED CLAY COVER

The compacted clay cover portion of the final cover system is to be constructed and tested in accordance with the approved permit documents and this *CQA/QC* Plan. This section covers material conformance testing, general construction procedures, and testing requirements.

For the LCAAP IWTP Sludge Landfill Cells 1 and 2 closure, the *CQA/QC* Engineer will develop an "acceptable placement range". Conformance testing will be required to demonstrate that the compacted clay meets the required specifications.

4.1 Materials Conformance Testing

Prior to construction of the compacted clay cover component of the final cover system, representative samples of the materials proposed for use will be collected and tested to verify that the clay to be used for construction meet the project specifications as determined by the pre-qualification testing that was previously completed. The following tests may be performed as prescribed by the *CQA/QC* Engineer.

Test Method	Test Description
ASTM D 2216	Laboratory Determination of Water (Moisture) Content
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg Limits)
ASTM D 422	Particle Size Analysis of Soil
ASTM D 1140	Amount of Material in Soils Finer than the No. 200 Sieve
ASTM D 698	Moisture - Density Relations for Soils and Soil-Aggregate Mixtures Using 5.5-lb. (2.48 kg) Rammer and 12-in. (305-mm) Drop (Standard Proctor Test). (Note: The Modified or Reduced Proctor Tests may be substituted or added to the Standard Proctor Test as necessary.)
ASTM D 5084	Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 2487	Unified Soil Classification
ASTM D 2922	Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

In order for a material to qualify for use as compacted clay material, it must have a group symbol of CI, CH, or SC according to the Unified Soil Classification System. In addition, each soil used for construction must also meet the following criteria:

- Allow more than 30 percent passage through a No. 200 sieve;
- Have a liquid limit equal to or greater than 20;
- Have a plasticity index equal to or greater than 10; and
- Have a coefficient of permeability of $1x10^{-7}$ centimeters per second (cm/sec) or less for cover construction when compacted to a density and moisture content deemed acceptable by preconstruction testing.

Prior to compacted clay cover construction, testing shall be completed to ensure that the borrow material satisfy the above criteria at the following frequency:

Test Method	Frequency
USCS Classification (ASTM D 2487)	1 test per 5,000 cubic yards and change in soil quality or borrow area
Particle Size (ASTM D 422)	1 test per 5,000 cubic yards and change in soil quality or borrow area
Atterberg Limits (ASTM D 4318)	1 test per 5,000 cubic yards and change in soil quality or borrow area
Hydraulic Conductivity (ASTM D 5084)	1 test per 5,000 cubic yards and change in soil quality or borrow area

If it is discovered that the soils tested are different from the prequalified soil classifications (via sieve analyses and Atterberg Limits), additional testing shall be completed to define an acceptable placement range (based on moisture and density specifications).

The CQA/OC Engineer shall be responsible for assigning and completing the appropriate testing to develop a compacted clay placement range for the selected borrow material if one does not exist. The placement range shall be developed based on previous testing and use of the borrow material, if available, as well as the test results obtained from preconstruction testing. The placement range (Le., "acceptable zone") shall be based on the appropriate moisture and dry unit weight values and used in conjunction with quality assurance testing during final cover construction to achieve the required permeability.

Acceptable ranges of dry density and moisture content were determined from previously completed pre-qualification sampling. Results of the pre-qualification sampling are presented in Appendix A of the Closure Plan. The acceptable dry density value for construction materials is 102.2 or greater. Acceptable values for moisture content range from 17.1 to 20.8 for lean clays and from 19.8 to 22.8 for fat clays.

4.2 Compacted Clay Construction Procedures

Prior to construction of the compacted clay cover, the leveling layer will be filled to the elevations specified on the project plans as discussed in Section 3.1. The compacted clay cover material is to be placed in accordance with the criteria and procedures developed during preconstruction clay testing, and in accordance with project specific guidelines. Construction progress will be monitored by use of the initial subgrade survey in combination with grade stakes or intermediate surveying during construction, as necessary.

The compacted clay cover will be constructed in 6-inch to 8-inch in-place thickness lifts compacted to within the required moisture and density tolerances for the clay material used. The clay will be compacted with equipment that kneads, compacts, and interbonds the clay from the bottom of the lift up, such as a sheep's foot compactor or high profile pad foot compactor. As compaction is achieved and the feet of the compactor walk out of the lift, the uppermost surface (except the final lift) will be left in a rough condition to promote inter.,.lift bonding of the clay. Such compaction efforts will help to reduce the formation of distinct lateral planes between lifts. Material conditioning procedures and compaction equipment rolling patterns may be evaluated and modified as necessary to yield a workable, consistent, and suitable compacted clay material.

4.3 Quality Assurancel Quality Control Monitoring and Testing

A *COAlOC* Inspector, under the supervision of the COAlOC Engineer, is to be present on-site to monitor the placement and compaction of the clay cover.

Field moisture and density tests will be performed at a minimum frequency of one per 10,000 square feet per lift and will be completed with a nuclear density gauge in substantial compliance with ASTM D 2922 and 3017. Moisture and density test locations shall be selected randomly; however, tests shall not be grouped together horizontally or vertically from one lift to another. Results of the moisture and density tests will be recorded on a Nuclear Density Gauge Test Record, similar to the one provided in Appendix A. The nuclear density gauge shall be calibrated in accordance with manufacturer's instructions and ASTM 3017-88 requirements. Moisture/density calibration will be performed at the start of each day the nuclear density gauge is used or at a change in gauges. Unstable or erratic gauges shall not be used for quality assurance testing.

Should the results of field moisture and density tests fail to fall within the placement range or "acceptable zone", the lift in question shall be reworked and retested. The area to be reworked shall be bounded by the nearest passing moisture/density test locations. Drying, wetting, additional compaction, or a combination thereof shall be used to bring the nonconforming area to an acceptable level.

The final compacted clay cover surface will be smooth and free of large angular particles or foreign objects that may damage the geocomposite layer.

During compacted clay cover construction, verification of in-place hydraulic conductivity (ASTM D 5084) shall be conducted to ensure the permeability of the cover system is achieved. Thin walled steel tube (e.g., Shelby tube) samples shall be collected at a frequency of one test per lift. All holes into the compacted clay cover made as a result of hydraulic conductivity samples and density tests shall be completely filled with bentonite by the CONOC Engineer.

Prior to geocomposite installation above the compacted clay cover, the moisture content of the compacted clay shall be maintained to control cracking. If desiccation cracks are observed in excess of 1 inch deep, the surface shall be lightly scarified, moisture conditioned, recompacted, re-graded, and rolled to provide a smooth surface for geocomposite installation.

4.4 Thickness Verification

The thickness of the compacted clay cover portion of the final cover system shall be verified by a surveyor licensed to practice in the State of Missouri. The surveyor must be employed by an organization that operates independently of the landfill contract operator, construction contractor, Owner, and permit holder. The surveyor may be employed by the *CONOC* Engineer.

Prior to construction of the compacted clay cover, a survey shall be completed on a minimum of 1DO-foot grid system to document the top of leveling layer elevations. Additional survey shots shall be taken at the toe and top of slopes and grade changes at a minimum. At the conclusion of compacted clay cover construction area, a survey will be completed at approximately the same 1DO-foot grid point locations as well as the toe and top of slopes and grade changes, to verify the required compacted clay cover component thickness was achieved. Acceptable tolerances for surveying shall be +0.1 foot for elevations and ±1.0 foot for horizontal coordinates.

5.0 GEOCOMPOSITE DRAINAGE LAYER

Geocomposite drainage material required for the project will be installed by a qualified third-party geosynthetics contractor.

Geocomposite material that is required for the project is to be tested and installed in accordance with the approved permit documents and manufacturer's installation instructions. Care shall be used during construction to ensure that geocomposite materials are not damaged.

The *COA/OC* Engineer or his representative shall log-in all rolls of geocomposite material that arrive on site and review the manufacturer's QC certification documentation. Each roll shall be documented on a Material Inventory Log similar to that found in Appendix A. Storage of geocomposite material shall be done in a manner that reasonably protects the material from puncture, denting, deformation of rolls, and other damaging situations prior to its deployment. UV sensitive geosynthetics should be stored in undamaged opaque coverings and protected from standing water during storage. Photo documentation of geocomposite installation and repair procedures will be included in the Certification of Closure Report.

5.1 Materials Conformance Testing

Prior to installation of the geocomposite, the CQA/OC Engineer shall obtain geocomposite samples at a minimum frequency of one sample per 100,000 square feet of material installed or one sample per lot of geotextile delivered. The following tests shall be performed to verify that the geocomposite material conforms to the project specifications:

Geocomposite:

Test Method	Test Description
ASTM D 4716	Transmissivity
ASTM D 7055	Ply Adhesion

Geonet Core:

Test Method	Test Description
ASTM D 4716	Transmissivity
ASTM D 5199	Thickness
ASTM D 1505	Density
ASTM D 5035	Tensile Strength
ASTM D 1603	Black Carbon Content

Geotextile:

Test Method	Test Description
ASTM D 5261	Mass per Unit Area
ASTM D 4632	Grab Tensile
ASTM D 4833	Puncture Strength
ASTM D 4751	Apparent Opening Size
ASTM D 4491	Permittivity
ASTM D 4355	UV Resistance

For each of the properties listed above, the material shall meet the following standards:

Property	Test Method	Value
Geocomposite		
Transmissivity, gal/min ft	ASTM D4716	1.2
Ply Adhesion, lb/in	ASTM D7005	1.0
Geonet core		
Transmissivity, gal/min ft	ASTM D4716	5.0
Thickness, mils	ASTM D5199	200
Density, *g/cm;!*	ASTM D1505	0.94
Tensile Strength, lb	ASTM D5035	45
Carbon Black Content, %	ASTM D1603	1.5 - 3.0
Geotextile (prior to lamination)		
Mass per Unit Area, *oz/yd2*	ASTM D5261	6
Grab Tensile, lb	ASTM D4632	160
Puncture Strength, lb	ASTM D4833	90
Apparent Opening Size, US sieve	ASTM D4751	70
Permittivity, sec-	ASTM D4491	1.5
UV Resistance, %	ASTM D4355	70

Deviations from this testing protocol due to changes in test methods or industry standards shall be approved by the CQA/QC Engineer.

5.2 Construction Procedures

In general, the geocomposite shall be installed according to the project specifications and proper documentation of the installation shall be completed. At a minimum, the follOWing guidelines shall be followed:

Deployed geocomposite shall be weighted at its edges during times of excessive wind.

- Geocomposite to be deployed on slopes shall first be anchored and rolled down the slope in a controlled manner.
- Geocomposite shall not be deployed horizontally across slopes unless approved by the COA/OC Engineer.
- Care shall be taken when cutting geocomposite in place to not cut or damage other associated geosynthetic materials.
- Care shall be taken to avoid trapping rocks or other sharp objects between geocomposite and the compacted clay layer.
- Tears or rips in the geotextile portion of the geocomposite shall be patched with like geotextile material. Patches shall be a minimum of two feet beyond the edges of the hole or tear.

Adjacent geocomposite rolls shall be joined according to project specifications and manufacturer's instructions. At a minimum the following procedures shall be followed:

- Tears or rips in geotextile portion of the geocomposite shall be patched with like geotextile material.
- Adjacent edges of the geonet along the length of the geocomposite roll shall be placed with the edges of each geonet butted against each other.
- The adjacent edges shall be joined by tying the geonet structure with plastic (not metal) cable ties spaced every five feet along the roll length.
- Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of 12 inches across the roll width.

  Where the geocomposite is anchored in an anchor trench, the geonet portion should be tied every six inches along the geocomposite edges.

6.0 VEGETATIVE SOIL LAYER

The vegetative soil layer portion of the final cover system is to be constructed in accordance with the approved permit documents and this *CONOC* Plan. This section covers the general construction procedures of the vegetative soil layer.

6.1 Materials Conformance Testing

Prior to construction of the vegetative soil layer of the final cover system, representative samples of the soil materials proposed for use will be collected and tested to verify the appropriate seed, lime and fertilizer application rates. The *CONQC* Engineer will be responsible for assuring that the soil used for the vegetative layer will be adequate to establish and support vegetation.

6.2 Vegetative Soil Construction Procedures

The vegetative soil layer of the final cover system will be placed above the 24-inch compacted clay layer and geocomposite drainage layer. The vegetative soil layer is required to be at least 30 inches thick. The soil material used for vegetation layer must be adequate to establish and support vegetation.

6.3 Quality Assurance

A *CONOC* Inspector, under the supervision of the *CQNQC* Engineer, is to be present on-site to monitor the placement of the vegetative soil layer portion of the final cover system. Thickness verification will be completed for the compacted clay and vegetative soil portions of the final cover as described in Section 4.4.

7.0 REPORTING

Proper documentation of the *CONOC* process is an important aspect of construction documentation. In addition to the completion of the forms and logs mentioned previously, the following reports shall be completed.

7.1 Daily Reports

The *CONOC* Inspector is to provide daily written reports to the *CONOC* Engineer during the days when inspections are made. These reports will include information about the work accomplished each day; tests and observations that were made; and descriptions of the adequacy of the work performed. At a minimum, the reports should include the following:

- Date, project name, location, cell involved in construction, equipment utilized, and personnel involved in major activities.
- Description of weather conditions, including temperature, cloud cover, and precipitation.
- Description of the type of construction, inspection, and testing activity for the day.
- Location of construction activity for the day.
- Location of tests completed.
- Discussion of construction methods (Le., equipment make/model, number of compactor passes, etc.) as they relate to previous cell construction.
- Results of construction activity (Le., first lift completed, etc.).
- Description of construction materials used including reference to certifications, test results, etc.
- Location of observation activity or location from which the sample(s) were obtained.
- Standard methods and frequency used for tests.
- Results of testing performed (passing or failing).
- Equipment calibration results.
- Construction or testing problems and required actions.
- Photographic documentation of construction progress including time, date, location, and name of photographer.
- Signature of the *CQNQC* Inspector.

Appendix A includes example *CQNOC* forms including:

- Daily Activities Field Report
- Nuclear Density Gauge Test Record
- Material Inventory Log
- Geosynthetics forms?

7.2 Design Change Documentation

On occasion it may be necessary to modify the design during construction activities. Changes to the design or deviation from the permit documents must be approved by the Owner, HWP and SWMP.

7.3 Deviation from CQAlQC Plan

During the course of construction, deviations from the approved CQA/QC Plan may be necessary due to various construction issues, permit modifications, regulatory changes, new technology, or changes to accepted standards. Deviations from this CQA/QC Plan must be documented and approved by the Owner and the HWP and SWMP prior to their implementation.

7.4 Final Certification

At the completion of the final cover construction, the CQA/QC Engineer will prepare the Certification of Closure Report for submittal to the HWP and SWMP. This report will bear the CQA/QC Engineer's Missouri Professional Engineer's seal and date. The Certification of Closure Report will be submitted to the HWP and SWMP for review. The Certification of Closure Report will contain the following:

- A certification (signed, sealed, and dated) by the CQA/QC Engineer stating that the construction of the cell has been completed in accordance with the engineering design and the CQA/QC Plan.
- As-built drawings (signed, sealed, and dated) by the CQA/QC Engineer and survey certification (signed, sealed, and dated) by a Missouri registered land surveyor or a Missouri-licensed professional engineer
- CQA/QC field data and laboratory test results
- CQA/QC inspection reports, certifications, and photographs

APPENDIX A

CONSTRUCTION QUALITY ASSURANCEI QUALITY CONTROL EXAMPLE FORMS

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

DAILY FIELD ACTIVITIES REPORT

Client Name: _____ Date: _____
Aquaterra Project Name: _____ Start Time: _____
Aquaterra Project Number: _____ Stop Time: _____
Project Location: _____

Task: _____

Weather Information

Contractors, Personnel, and Equipment On Site

Work Areas/Boundaries

Testing Equipment Used/Observed and Calibration/Re-Calibration Documentation

Tests Completed/Observed

Work Comments/Observations and Test Results

Material(s) Delivered to Site

Aquaterra Personnel

AQUATERRA
ENVIRONMENTAL SOLUTIONS, INC.

Nuclear Density Gauge Test Record

Page: _____

Aquaterra CQA Technician: _____

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

_____

Aquaterra Project Number: _____

Material Designation: _____ _____ _____ _____ _____

Target Dry Density: _____ _____ _____ _____ _____

Maximum Density: _____ _____ _____ _____ _____

Target Moisture Range: _____ _____ _____ _____ _____

Target Percent Compaction: _____ _____ _____ _____ _____

Standard Density: _____

Standard Moisture: _____

Date	Test-Lift Number	Material Designation	Lift Range (in.)	Location	Probe Depth (in.)	Wet Density (pcf)	Water Weight (lbs.)	Dry Density (pcf)	Water Content (%)	Percent Compaction (%)	Pass/ Fail

Material Inventory Record

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

_____

Aquaterra Project Number: _____

Page _____ of _____

Aquaterra CQA Technician: _____

Material Type: _____

Date Received	Roll No.	Lot/ Batch	Roll Size			QC Docs Received	Date Used	Remarks
			Width (ft)	Length (ft)	Area (sq. ft)			
12/28/08								

AQUATERRA

Trial Weld Record

Page _____ of _____

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

_____

Aquaterra Project Number: _____

Specifications: _____ mil

	Wedge	Extrusion
Peel(P)	_____	_____
Shear(S)	_____	_____

Aquaterra CQA Technician: _____

Installing Company: _____

QC Personnel: _____

Trial Weld Number	Date	Time	Weather	Seamer Initials	Machine Number	Machine Properties	Weld Type	Type of Material		Test Values lbs/inch									Pass/ Fail	Comments
									P											
									S											
									P											
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AQUATERRA

Panel Placement Record

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

_____

Aquaterra Project Number: _____

Page: _____ **of** _____

Aquaterra CQA Technician: _____

Date	Time	Panel Number	Roll Number	Panel Length (ft)	Panel Width (ft)	Panel Location/Comments

AQUATERRA

Repair Record

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

_____

Aquaterra Project Number: _____

Page _____ **of** _____

Aquaterra CQA Technician: _____

_____

Repair Date	Repair Number	Panel/ Seam	Seamer Initials	Machine Number	Trial Weld Number	Repair Type	Repair Size	Test Date	Tester Initials	Test P/F	Location/Comments

AQUATERRA

Seam/Non-Destructive Test Record

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

_____

Aquaterra Project Number: _____

Page _____ of _____

Aquaterra CQA Technician: _____

Seaming Information											Non-Destructive Testing Information										
Date	Time	Seam Number	Seam Length	Seamer Initials	Machine Number	Trial Weld #	Direction Seamed	Weather/ Temp	Destruct Number	Comments	Date Tested	Addn'l Test #'s	Tester Initials	Pressure Start	Pressure End	Pressure +/-	Time Start	Time End	P/F	Vacuum Box P/F	Location/ Comments
								°F													
								°F													
								°F													
								°F													
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AQUATERRA

Destructive Test Record

Page _____ of _____

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

Aquaterra Project Number: _____

Specifications: _____ mil

	Wedge	Extrusion
Peel (P)	≥ _____	≥ _____
Shear (S)	≥ _____	≥ _____

_____ of _____ bones

Aquaterra CQA Technician: _____

Installing Company: _____

QC Personnel _____

Destruct ID	Date	Seam Number	Seamer Initials	Machine Number	Weld Type		Test Values lbs/inch										Pass / Fail Field	Pass / Fail Lab	Location
						P													
						S													
						P													
						S													
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AQUATERRA

Additional Non-Destructive Test Record

Client Name: _____

Aquaterra Project Name: _____

Project Location: _____

_____

Aquaterra Project Number: _____

Page _____ of _____

Aquaterra CQA Technician: _____

Date	Test Number	Seam Number	Tester Initials	Pressure			Time		P/F	Vacuum Box P/F	Location/Comments
				Start	End	+/-	Start	End			

AQUATERRA