DEPARTMENT OF THE ARMY
MCALESTER ARMY AMMUNITION PLANT
1 C TREE ROAD
MCALESTER OK 74501-9002

REPLY TO
ATTENTION OF

November 25, 2019

RECEIVED
DEC 05 2019
LAND PROTECTION DIVISION
DEPT. OF ENVIRON. QLTY

Environmental Management Office

Jeff Biddick
Land Protection Division
Oklahoma Department of Environmental Quality
707 North Robinson, P.O. Box 1677
Oklahoma City, Oklahoma 73101-1677

REF: Notice of Deficiency – Tier II Permit Modification for Vertical Expansion, McAlester Army Ammunition Plant, New Landfill Pittsburg County, Solid Waste Permit #3561014

Dear Mr. Biddick,

1. McAlester Army Ammunition Plant (MCAAP) has reviewed the comments presented by the Oklahoma Department of Environmental Quality (ODEQ) in the Notice of Deficiency (NOD) letter dated October 18, 2019. We have presented the original ODEQ comments below along with our responses. We hope you find the responses acceptable and that the changes reflected in the revised permit application address the concerns and noted deficiencies presented in the NOD letter to ODEQ's satisfaction.

Question. The Application includes a proposed expansion of the permit boundary, but no expansions of the waste boundary are proposed. Oklahoma Administrative Code (OAC) 252:515-1-31 and 51 include restrictions on the location of permit boundaries that were not addresses in the Application. Please provide demonstrations that the proposed permit boundary meets these requirements. Alternatively, MCAAP may reduce the permit boundary to the currently approved state and provide revised drawings and legal description.

Answer. MCAAP has decided to return to the originally approved landfill permit boundary. All figures and design drawing have been updated to show the original permit boundary and a copy of the original legal description has been incorporated into the revised permit application package.

Question. The Application proposes final cover consisting of 2.5 feet of compacted clay overlain by 6 inches of topsoil. In accordance with OAC 252:515-19-53(a), the erosion layer must consist of at least 12 inches of soil capable of sustaining plant growth. Alternatively, per OAC 252:515-19-53(c), DEQ may approve the use of an alternative final cover design upon demonstration the alternative provides protection equivalent to the prescriptive design. Please either correct this specification in the Application or provide a demonstration that the proposed design provides equivalent protection.

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Answer. The proposed final cover has been revised to consist of a compacted clay layer of 2.0 feet and soil suitable for sustaining vegetative growth to 12 inches. The design drawings have been revised to incorporate this change.

Question. The Application states that the borrow area will be reshaped and revegetated to blend with surrounding terrain within 180 days of the date the area ceased being used in accordance with OAC 252:515-19-55. Appendix 5, Figure 5-1 depicts a proposed borrow area final grading that is below surrounding grade and may result in ponding during rainfall events. Is this area intended to function as a natural pond/depression, or will this area be further reshaped to promote stormwater drainage?

Answer. After final grading, the borrow area will be a low-lying area that will act as a natural pond/depression, supporting a diverse ecosystem. This is intentional.

Question. . Appendix 9, Section B states that the barrier layer will have a hydraulic conductivity of no greater than 1.0×10^{5} cm/sec. Please correct this to 1.0×10^{-5} cm/sec.

Answer. The typographical error will be corrected and replacement pages provided.

Question. Section 7.1 states that no surface water monitoring program is necessary at the landfill, while an operational plan states that surface water monitoring will be conducted in accordance with MCAAP's Oklahoma Pollutant Discharge Elimination system (OPDES) permit. Please clarify this discrepancy.

Answer. MCAAP does conduct quarterly monitoring of the landfill stormwater in accordance with the approved OPDES general permit. However, MCAAP is not required to conduct annual numeric effluent monitoring for the landfill. Section 7.1 of the permit application will be revised to agree with the Operational Plan by making this distinction.

2. We look forward to hearing back from you regarding the status of the above referenced permit modification application. In the event that further review indicates the need for additional revision and/or clarifications, we will be happy to work with DEQ to resolve any outstanding issues so the permit modification can be approved as expeditiously as possible.

3. Please address any questions or comments to Mr. Jarrod Thomas, Environmental Engineer, at 918-420-7631 or email jarrod.d.thomas2.civ@mail.mil.

Sincerely,

Darrell L. Elliott

Darrell L. Elliott
Director, Environmental Management Office

Enclosure

APPLICATION TO MODIFY A SOLID WASTE DISPOSAL FACILITY PERMIT

Date: November 25, 2019 County: Pittsburg

Send to:
Solid Waste Permitting Unit
Waste Management Division
Dept. of Environmental Quality
707 N. Robinson (PO Box 1677)
Oklahoma City, OK 73101-1677

FOR DEQ USE

DEQ Log No. _____
No. Copies _____

Date Received: _____

McAlester Army Ammunition Plant proposes to modify the permit of
(Applicant's Name)
the McAlester AAP Type V Landfill, located at (See attached sheet)
(Facility Name) *(Exact legal description:*

metes & bounds, platted lot, or land survey. Append extra sheets if necessary)

in Pittsburg County, Oklahoma. We hereby make application for a modification of existing permit number 3561014 as required by the **Oklahoma Solid Waste Management Act** and the Rules pursuant thereto.

Remarks & brief description of proposed modification:
The proposed modification is for vertical expansion to allow placement of additional waste on top of existing waste cells.

Applicant or Authorized Agent:

Signature
Shane M. Upton
Typed Name
Address: McAlester Army Ammunition Plant
City: McAlester State: OK
Date signed: 11/25/19
Phone: (918) 420-6551

Preparing Engineer:

Signature
Gavin James
Typed Name
Address: 1718 South Cheyenne Avenue
City: Tulsa State: OK
Date signed: November 25, 2019
Phone: (918) 382-7581

PROFESSIONAL ENGINEER GAVIN JAMES 23714 OKLAHOMA

Facility Address (if any):
1 C Tree Road
McAlester Army Ammunition Plant
McAlester, OK 74501

DEQ USE ONLY

July 2016
DEQ Form #515-020

Corrected Final
RCRA-D Permit Modification Application for the Non-Hazardous Industrial Waste Landfill McAlester Army Ammunition Plant McAlester, Pittsburg County, Oklahoma 74501

CONTRACT NUMBER: W912BV-15-D-0017
TASK ORDER NO. W912BV18F0103

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS - TULSA DISTRICT
AND
MCALESTER ARMY AMMUNITION PLANT, OKLAHOMA

November 2019

PREPARED BY:

ALL CONSULTING
GOVERNMENT RELATIONS · ENERGY · PLANNING · TECHNOLOGY
ENGINEERING · ENVIRONMENTAL

TABLE OF CONTENTS

APPENDICES

TABLES

FIGURES

ACRONYMS

ACM	Asbestos Containing Material
bgs	below ground surface
cm/sec	centimeters per second
COD	Chemical Oxygen Demand
cy	cubic yard(s)
FEMA	Federal Emergency Management Administration
Landfill	McAlester Army Ammunition Plant Landfill
lbs/cy	pounds per cubic yard
MCAAP	McAlester Army Ammunition Plant
mg/l	milligrams per liter
msl	mean sea level
NFIP	National Flood Insurance Program
NHIW	non-hazardous industrial waste
OAC	Oklahoma Administrative Code
ODEQ	Oklahoma Department of Environmental Quality
OPDES	Oklahoma Pollutant Discharge Elimination System
PE	professional engineer
PI	plasticity index
PLS	professional Land surveyor
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
SVOC	Semivolatile Organic Compound
SWPPP	Storm Water Pollution Prevention Plan
TSCA	Toxic Substances Control Act
USGS	United States Geological Survey
VOC	Volatile Organic Compound

MCALESTER ARMY AMMUNITION PLANT TYPE V
LANDFILL PERMIT MODIFICATION APPLICATION
AUGUST 2019

1 General Information

1.1 Ownership

The Landfill site is owned by the U.S. Government and will be operated by McAlester Army Ammunition Plant (MCAAP) personnel. Proof of ownership is included as **Appendix 1**. Landfill operations will be performed under the direction of the Directorate of Engineering and environmental compliance will be performed under the direction of the Environmental Management office. The mailing address is:

McAlester Army Ammunition Plant
ATTN: Environmental Management Office
1 C Tree Road
McAlester, OK 74501-5000

1.2 Proof of Publication

Proof of publication of Public Notice will be forwarded under separate letterhead for inclusion in the application as **Appendix 2**.

1.3 Permitted Wastes

The Landfill is designed to handle industrial waste from operations at MCAAP. These wastes typically include:

1) empty cardboard boxes
2) plastic bottles
3) empty crushed cans of paint, paint thinner, etc.
4) metal turnings coated with machine oil
5) inert plastic material
6) small volumes of sandwich wrappings and pop bottles
7) containerized asbestos
8) water treatment plant clarifier sludge/filter backwash
9) sewage sludge

A more inclusive list can be found in **Appendix 13**.

1.4 Landfill Life and Capacity

The Landfill has received an average 2,204 tons of waste per year for the last five years, as reported by the Oklahoma Department of Environmental Quality (ODEQ). An additional 1,252,326 cubic yards (cy) of capacity will be added through this vertical expansion of the Landfill. The remaining life of the Landfill was estimated at approximately 119 years, considering the added capacity from vertical expansion.

1.5 Location

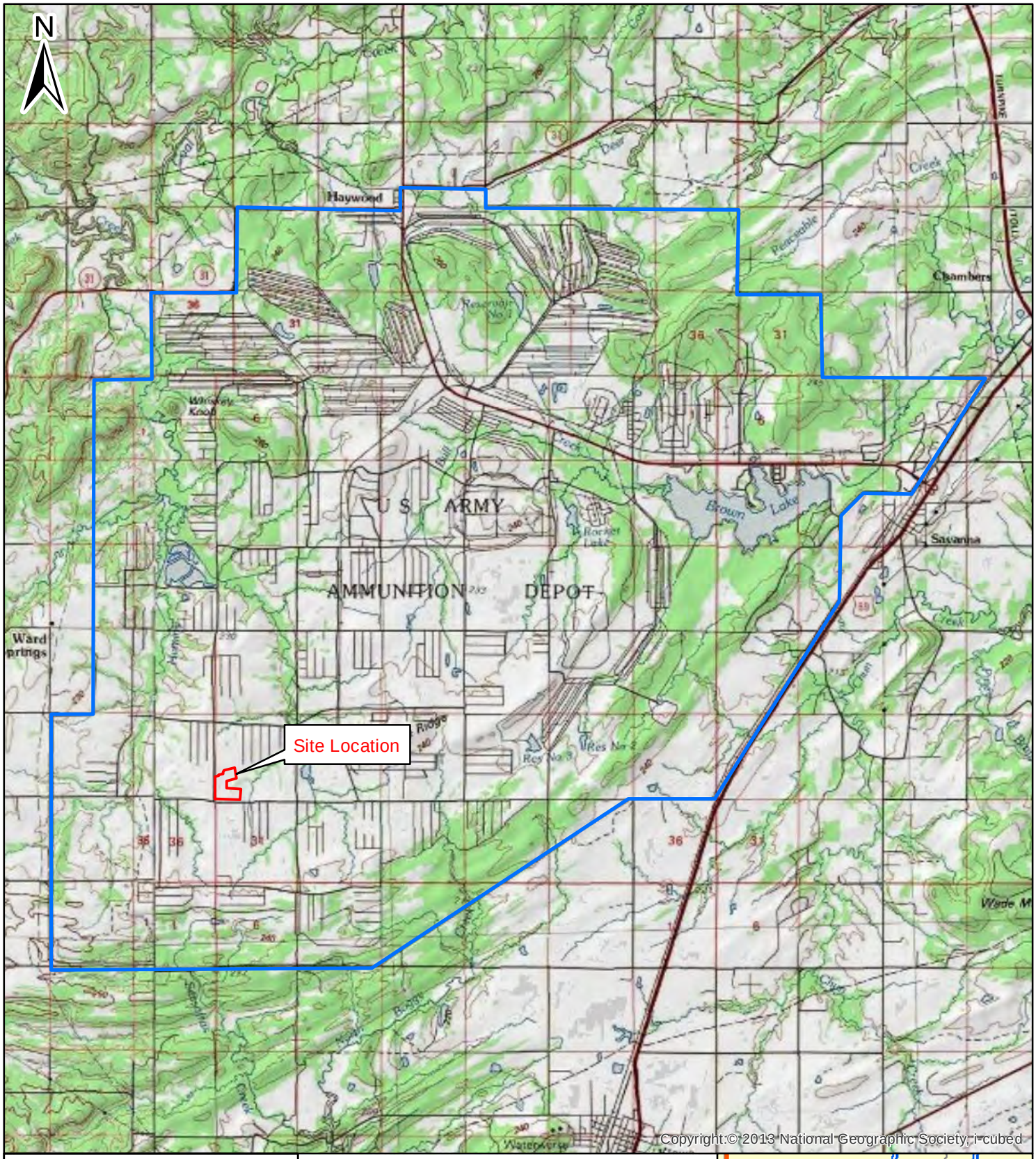
1) **General**. The Landfill occupies 49.279 acres more or less in the southwest corner of section 30 T4N R13E and that portion in the southeast corner of section 25 T4N R12E east of Road B as shown on the Site Location Map, **Figure 1**. **Figure 2** presents the Site Layout.

   Legal Description. Commencing at the iron pin with coordinates N. 533,255.363 E. 2,604,369.639, based on the Oklahoma South Zone State Plane Coordinates, said pin located at the intersection of Ashland Road and Road B near the corner of Section 25, Township 4 North, Range 12 East, Pittsburg County, Oklahoma:

   thence N5º59'01"W a distance of 15.72 feet to the point of beginning;
   thence S90º00'00"E a distance of 1600.00 feet;
   thence N0º00'00"E a distance of 685.00 feet;
   thence N90º00'00"W a distance of 903.00 feet;
   thence N0º00'00"E a distance of 500.00 feet;
   thence N7º30'00"E a distance of 660.00 feet;
   thence N10º30'00"W a distance of 677.60 feet;
   thence S74º30'00"W a distance of 705.00 feet;
   thence S28º00'00"W a distance of 120 feet;
   thence S10º30'00"E a distance of 160.00 feet;
   thence S81º00'00"W a distance of 283.00 feet;
   thence S18º00'00"W a distance of 51.30 feet;
   thence S81º00'00"W a distance of 210.20 feet;
   thence S0º00'00"W a distance of 1450.00 feet to the point of beginning;
   said tract containing 49.279 acres more or less.

1.6 Current Land Use

The site is currently used by MCAAP as a Non-Hazardous Industrial Waste (NHIW) facility.



MCAAP NHIW LANDFILL
McAlester, OK

Figure 1
Site Location Map

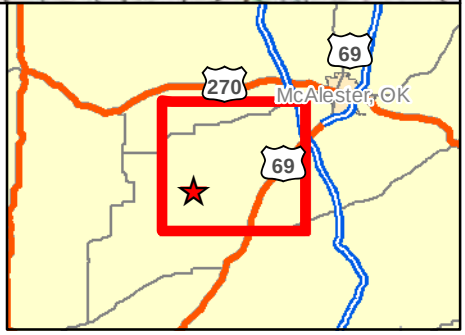
Project Manager: Charles McComas	November 08, 2019	Map Created by: Ben Bockelmann

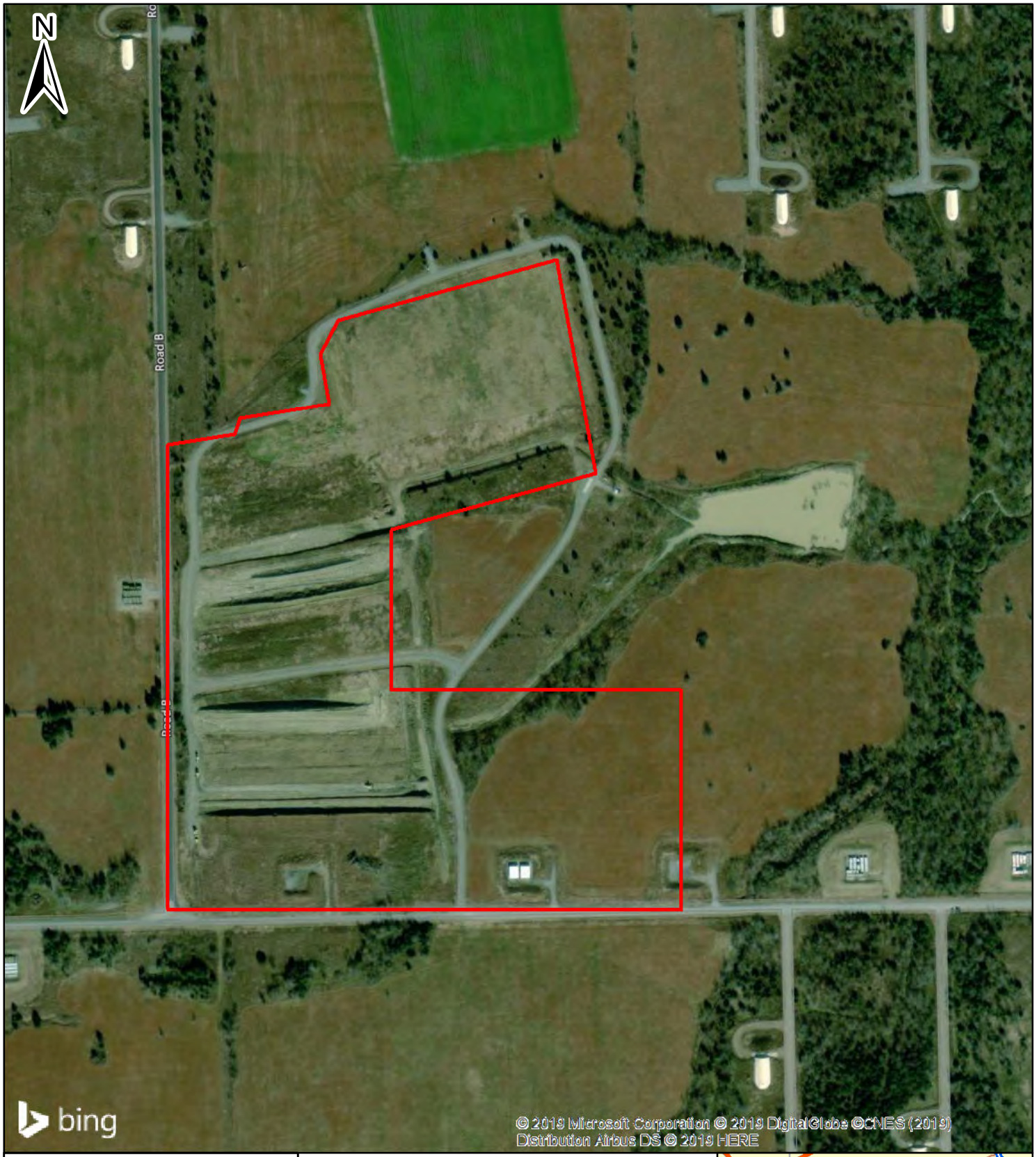
Prepared by:
ALL CONSULTING

Legend

- MCAAP NHIW Landfill
- MCAAP Site Boundary

0 1.25 2.5 5
Miles





MCAAP NHIW LANDFILL
McAlester, OK

Figure 2
Site Layout Map

Project Manager: Charles McComas	**November 08, 2019**	Map Created by: Ben Bockelmann

Prepared by:
ALL CONSULTING

Legend

Site Boundary

0 250 500 1,000
Feet

2 Investigations

2.1 Original Landfill Permit

Field work conducted as part of the original Landfill permitting process consisted of drilling 27 exploratory borings ranging in depth from 20.0 to 100.9 feet below the existing land surface from March 3, to April 8, 1987. One of the core borings was converted to a permanent monitoring well and eight borings were converted to temporary piezometers. Boring locations were located in the field by US Army Corps of Engineers personnel.

Representative soil and rock samples were obtained approximately every 3 feet or change of material. Auger samples were collected in jars and returned to the laboratory for examination, classification, and determination of engineering properties.

The other two borings were augured through the overburden and cored with air to approximately 100 feet with a 4-inch carboloy-tipped core barrel. The core samples were logged and saved in core boxes. Selected core samples were wrapped, sealed in paraffin and stored for examination as necessary. Eight 2-inch polyvinyl chloride (PVC) piezometers were installed at the site in holes encountering water to monitor long-term ground water variation. Three-foot screens were placed at the bottom of the hole and the annular space was backfilled with concrete sand and sealed with bentonite balls to isolate a zone.

A set of two falling head permeability tests was performed at each of five borings. Separate 6-inch diameter auger holes were drilled for each test to different depths. All the test holes were above the water table. The holes were filled with clean, clear water. Water level drop versus time was measured and recorded. The readings were plotted on graph paper and connected by a smooth line. Two points were then taken off the steep straight portion of the graph to be used in permeability calculations. The resulting calculated permeability was 3.78E-07 centimeters per second (cm/sec).

2.2 Vertical Landfill Expansion

A geotechnical survey was conducted by Belongia Consultants, Inc. in December of 2018. During the geotechnical survey, a total of 15 borings were placed around the perimeter of the existing Landfill, with depths ranging from 19 to 34 feet below ground surface (bgs). Four samples were collected in the upper 10 feet of each boring and one sample was collected every 5 feet thereafter to boring termination. Blow counts were recorded during progression of each boring to determine the standard penetration resistance. No geotechnical sampling within existing cells was conducted due to the potential for contact with asbestos.

All samples were analyzed for moisture content and unit dry weight. Unconfined compression tests were conducted on cohesive soil (clay) samples and moisture content and/or hand penetrometer analysis were conducted on granular soil (silty or sandy soils, miscellaneous fills, weathered bedrock, or other hard material) samples when applicable. Atterberg limits analyses were conducted for selected samples.

Results of the geotechnical survey indicated low- to moderate-strength fat clay soil to depths ranging from approximately 5 to 12 feet bgs. The fat clay was underlain by moderate- to high-strength shaley fat clay to depths ranging from 9 to 19.5 feet. This intermixed clay and shale unit was generally underlain by shale bedrock to the bottoms of the borings. The geotechnical survey analysis estimated the long-term consolidation of the load from the vertical expansion of the Landfill would be less than 6 inches. No groundwater was encountered in any of the 15 borings. Geotechnical survey results are presented in **Appendix 3**.

3 Site Conditions

3.1 Cultural Features

2) The current Landfill site is within the boundaries of MCAAP. The closest residence is 10,100 feet from the Landfill (**Figure 3**). The closest normally occupied building, Ashland Ammunition Transfer Depot, is 6,800 feet away. There are three ammunition storage bunkers approximately 715 feet from the active portion of the Landfill. There are no public or private wells within 8,700 feet of the Landfill.

3) The closest airport is McAlester Field, approximately 11.5 air miles away (**Figure 3**).

4) There are two roads fronting the site, Ashland Road and Road B. Both are improved hard-surface asphalt roads. The roads are owned and maintained by MCAAP.

5) There are no utility lines, transmission lines or pipelines that impinge on the permitted area.

3.2 Geology

1) **Regional Geology**. The area is located to the west of the frontal margin of the Ouachita Mountains. MCAAP is located in the broad Krebs Syncline between the Savanna and McAlester anticlines. The Krebs Syncline plunges 4 to 10 degrees southwestward and becomes a topographic basin in T4N R13E. The Pennsylvanian Thurman Sandstone and Boggy Shale are the principal formations that outcrop in the MCAAP area. The Boggy Shale consists of thin sandstone beds alternating with thick shale beds. The sandstone seams are variable in thickness and character and often contain fossils. The shale beds are generally dark, platy to blocky, carbonaceous and fossiliferous. The Thurman Sandstone is medium- to fine-grained, light brown and moderately cemented. A detailed description of the area is found in U.S. Geological Survey (USGS) Bulletins 874A and 874B. Detailed geologic logs of the Landfill area are presented in **Appendix 11**.

2) **Site Geology**

   a) **Soils**. The soil at the site is a residual clay formed from the weathering of the underlying Boggy Shale. The soil/rock interface is gradational and averages 6.5 feet deep. The upper soil horizon down to about 2.5 feet is classified by the Unified Soil Classification System as a low plasticity clay with a plasticity index (PI) of 14. It is a brown to brownish-gray, soft, damp to wet soil with organic material which becomes hard when dried. The portion passing the 200 mesh screen exceeds 80%. The lower horizon is classified as a clay with moderate plasticity, PI 30-35. It is a gray to tan-green, moderately stiff to hard, damp soil that grades into the shale below. The portion passing the 200 mesh screen generally exceeds 90%.

b) **Bedrock**. The formation underlying the Landfill is the Boggy Shale. As described in the geologic logs for core holes 117 and 118, it is a blocky, brown-gray to greenish black, slightly silty, moderately jointed, moderately soft to soft shale with some bedding evident in slightly more silty zones. The shale slakes rapidly when exposed to air. When treated like a soil and classified according to the Unified Soil Classification System, the shale is a clay with a PI of 19 to 35 with greater than 95% passing the 200 mesh screen. The upper sha1e zone, down to 27 or 28 feet, is slightly weathered as evidenced by some iron staining and softer strata. The shale below 27 to 28 feet is unweathered and similar to the weathered zone except for the presence of sub-rounded cemented siltstone nodules. A third shale zone containing pyritized plant fossils and brachiopoda fossils extends to 84 or 86 feet. Beneath the third zone, in the lowest zone, is a dark shale with a few tight joints. However, in core hole 118 from 85 feet, a discontinuous light gray siltstone grades at 90 feet into a 1.8-foot thick seam of fine- to medium-grained sandstone. The formation appears to be flat lying or with a small dip to the west, southwest. No faults or major structural features were encountered during the explorations. The permeability of the shale in the upper zones as measured in situ at five locations over the area varies from $4x10^{-9}$ to $1x10^{-6}$ cm/sec. A summary of the permeabilities is given in **Table 1**.

c) **Trench Cover.** The soil and shale excavated from the borrow area will have properties suitable for trench cover or backfill. The upper 2 1/2 feet of soil will be suitable for topsoil and capable of supporting plant growth within the first season.

Table 1: Summary of Permeability Measurements

DEPTH (feet)	MEASUREMENT (cm/sec)
HOLE 93	
4.6 - 14.1	2.00×10^{-8}
9.2 - 37.7	3.50×10^{-7}
HOLE 113	
3.5 - 15.5	1.30×10^{-7}
5.3 - 19.1	1.35×10^{-7}
HOLE 121	
5.1 - 15.6	6.02×10^{-8}
7.7 - 24.5	1.09×10^{-6}
HOLE 104	
3.1 - 15.5	1.47×10^{-8}
4.9 - 21.5	9.70×10^{-7}
HOLE 109	
4.6 - 15.2	4.48×10^{-9}
5.9 - 38.7	7.78×10^{-8}

Permeability measurements were originally presented in the 1988 MCAAP Type V Permit Application

3.3 Surface Water

1) S**tream Flow**. The general topography of the Landfill area can be seen in **Figure 1**. The site is near the top of a gentle hill. Sheet flow accounts for most of the water movement across the area. Three small intermittent streams collect the water and drain the area to the east. **Figure 4** shows the drainage areas and watershed boundaries. A small pond is located immediately upstream from the Landfill on the south side of Ashland Road. There are no other ponds or lakes on the stream before its confluence with the unnamed intermittent east fork of Hominy Creek. The Zone A or 100-year flood for this unnamed creek can be seen on the National Flood Insurance Program (NFIP) Flood Hazard Boundary Map, **Figure 5**.

2) **Water Quality**. There are no specific water quality studies in Hominy Creek or further downstream in Coal Creek. The water should be considered good quality. Stream quality measured in Gaines Creek north of McAlester and in McGee Creek near Stringtown south of McAlester varies in sulphates from 7.8 to 239 milligrams per liter (mg/l), in chlorides from 2 to 24 mg/l, in dissolved solids from 30 to 470 mg/l, in hardness (as $CaCO_3$) from 15 to 188 mg/l, and in specific conductance from 57 to 690 microhms/cm.

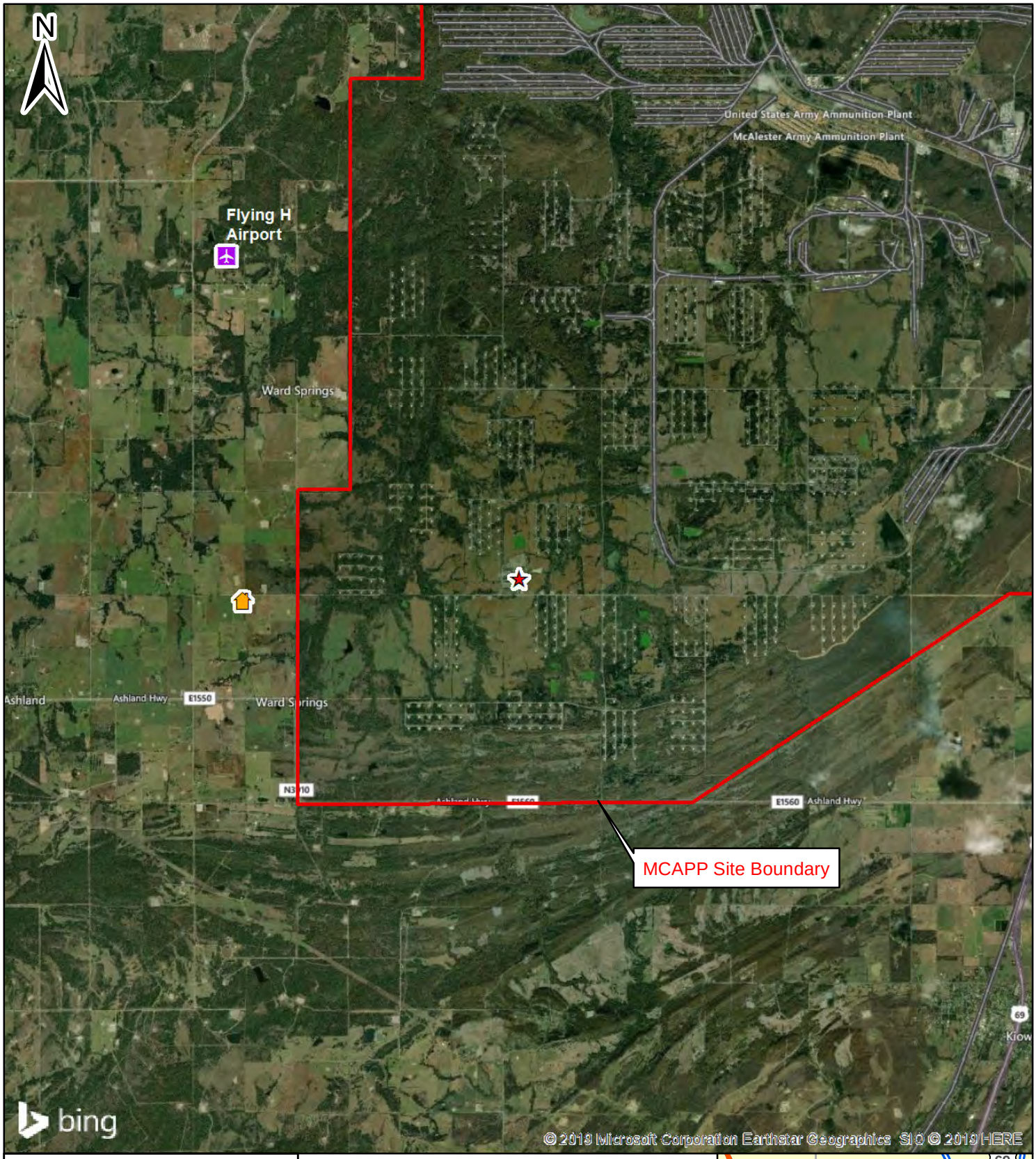
3.4 Groundwater

1) **Water-Bearing Strata**. The groundwater source is a permeable layer which apparently dips across the nearly flat lying strata to the northwest from a high in the southeast corner of the Landfill. Groundwater elevation data was collected during well sampling on February 8, 2017. During sampling, the highest water encountered was in MW-124B at an elevation of 753.79 feet, while the lowest water encountered was in MW-117 at an elevation of 722 feet. The recharge area for the first groundwater zone under the Landfill is immediately to the south and east of the Landfill along Ashland Road. The plane of the water bearing strata outcrops in the stream valley and surface water percolates through the overburden into the groundwater system. A map of the depth contour of water bearing strata is presented with the historical landfill plates in **Appendix 10**.

2) **Potentiometric Surface**. The groundwater is confined below a thick low-permeability shale. The potentiometric surface dips to the northwest at an increasing gradient which averages 0.014. The steeper gradient to the northwest indicates a decreasing permeability within the water-bearing strata. A potentiometric surface map is presented with the historical landfill plates in **Appendix 10**.

3) **Groundwater Quality and Use**. Groundwater in three monitoring wells at MCAAP Sediment Retention Basin in Section 23, T4N, R13E from a similar strata of the Boggy Shale has from 210 to 300 mg/1 chloride, 1,800 to 2,800 mg/l sulfate, and a specific conductance of 4.3 to 7.1 microhms/cm. There are no domestic or private water supply

wells within 1/2 mile or municipal or public water supply wells within 1 mile of the proposed site boundary. The closest to the Landfill that a public or private well could be drilled without permission of MCAAP is 8,700 feet.



MCAAP NHIW LANDFILL
McAlester, OK

Figure 3
Cultural Features Map

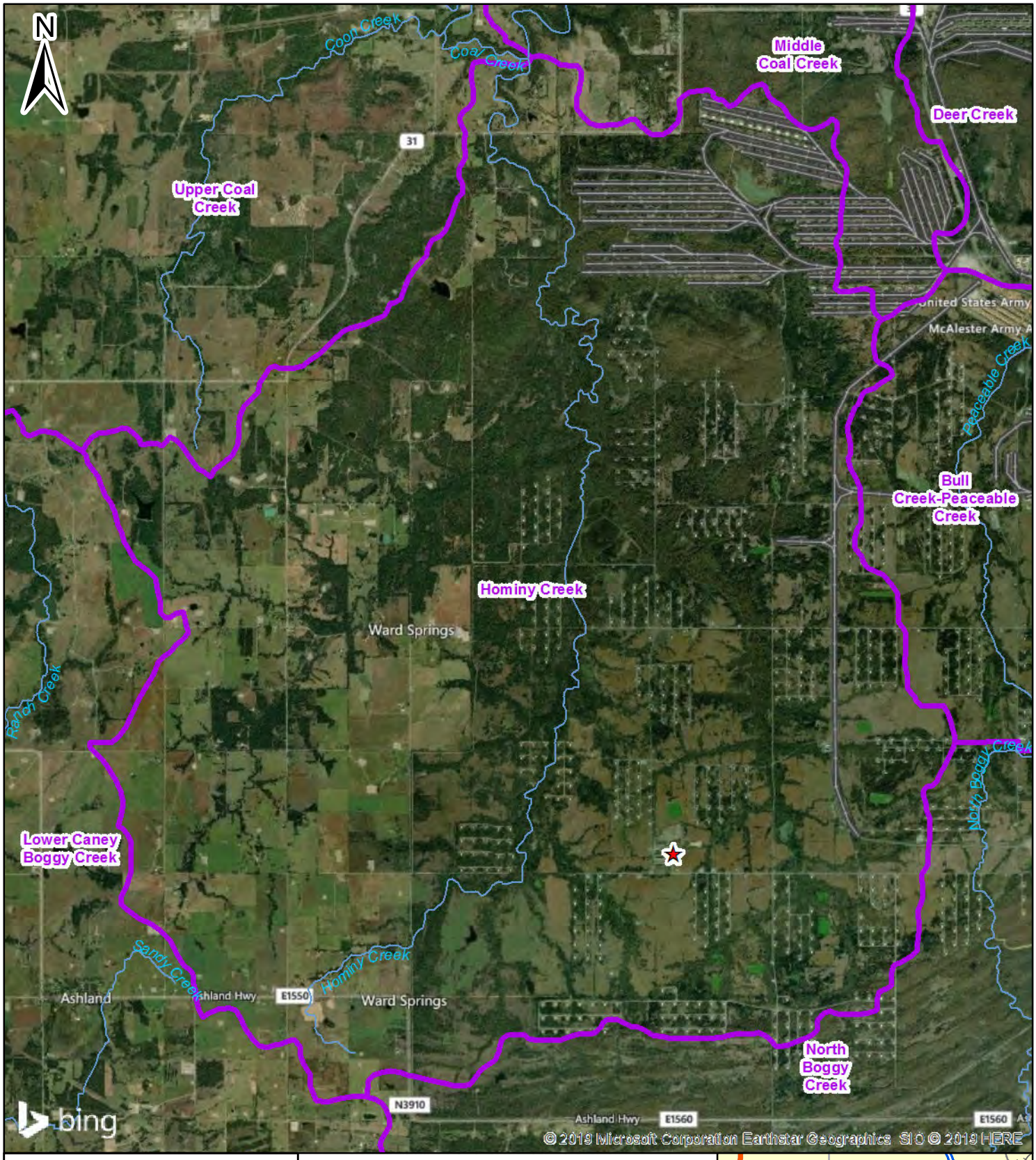
Project Manager: Charles McComas	**June 10, 2019**	Map Created by: Ben Bockelmann

Prepared by:
ALL CONSULTING

Legend

- MCAAP NHIW Landfill
- Airport
- Nearest Residence

0 1 2 4
Miles



MCAAP NHIW LANDFILL
McAlester, OK

Figure 4
Watershed Boundary Map

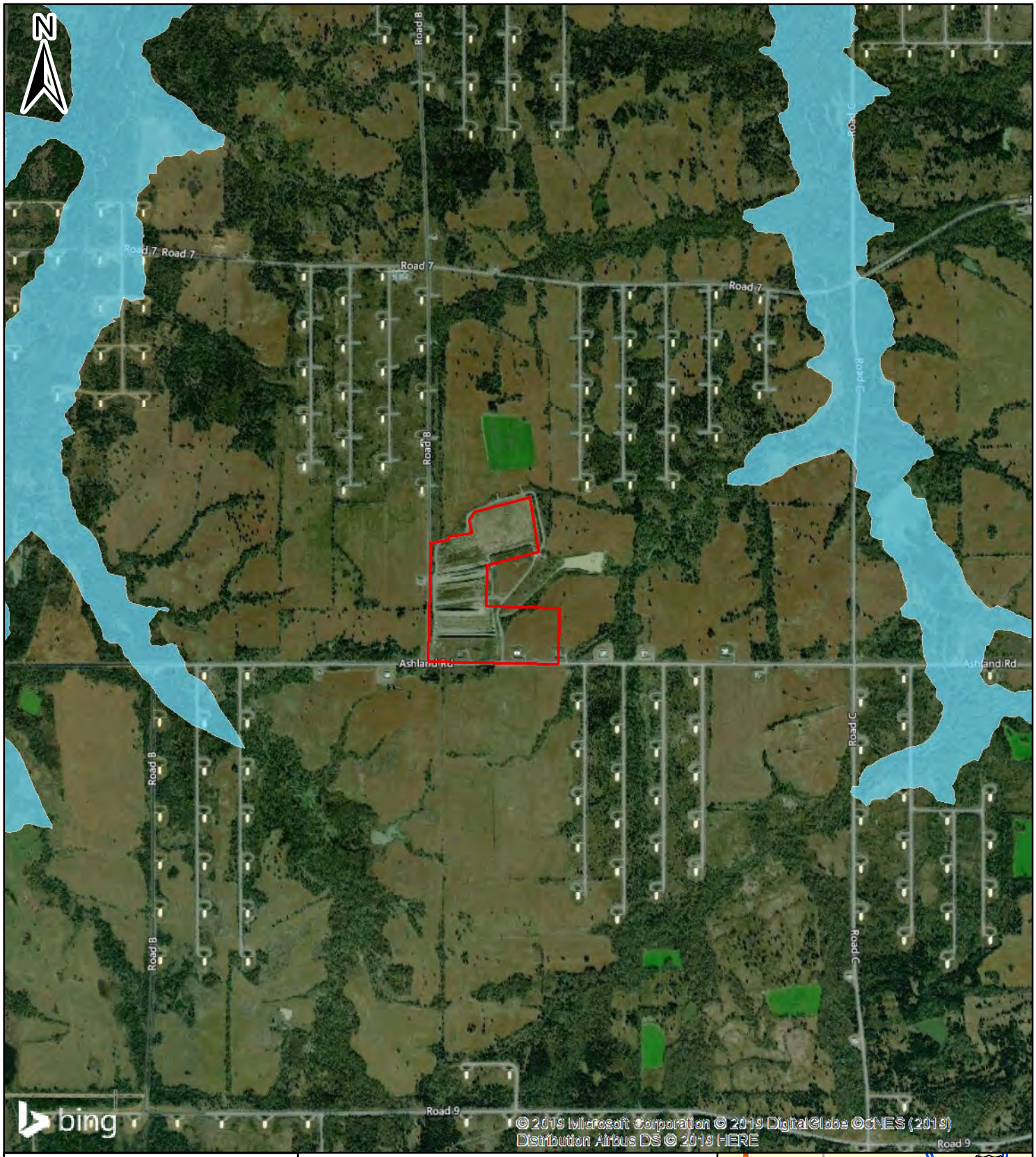
Project Manager: Charles McComas	**June 11, 2019**	Map Created by: Ben Bockelmann

Prepared by:
ALL CONSULTING

Legend

- MCAAP NHIW Landfill
- USA Detailed Streams
- HUC 12 Watershed Boundary

0 0.75 1.5 3
Miles



MCAAP NHIW LANDFILL
McAlester, OK

Figure 5
FEMA Flood Map

Project Manager: Charles McComas	**November 08, 2019**	Map Created by: Ben Bockelmann

Prepared by:
ALL CONSULTING

Legend

- Site Boundary
- Flood Zone A

0 0.25 0.5 1
Miles

4 Vertical Expansion Development

4.1 Construction Sequence

The Landfill will be developed in six phases, with each phase located on top of the current Landfill. The six phases will progress from the northern side of the Landfill, with each subsequent phase expanding to the south (**Figure 2**). The phases will be constructed for the purpose of managing and maintaining the waste disposal operations within the smallest practical area. This will aid in diverting storm water away from the active working face. Detailed description of the vertical expansion construction sequence is presented in **Appendix 7**.

Additional soil will be sourced from the on-site borrow area. The location of the borrow area is shown in **Figure 1** and **Figure 2**. The on-site soil borrow area shall be reshaped and revegetated, or otherwise reclaimed, to blend with surrounding terrain within 180 days of the date the area ceased being used in accordance with Oklahoma Administrative Code (OAC) 252:515-19-55.

The process of closing the Landfill will occur in stages as designed final elevations for each phase are reached. Most of the closure activities including maintenance and care will be completed during standard operation of the Landfill. The full Landfill Closure Plan is provided in **Appendix 9**.

4.2 Volume Calculations

Volume calculations are provided with the Life and Design Calculations in **Appendix 5**.

4.3 Drainage

Drainage from the Landfill will be designed, constructed, and maintained to conform to the requirements of OAC 252:515-17-2. This includes a run-on control system to prevent flow onto active portions of the facility during the peak discharge from a 24-hr, 25-year storm; and a run-off control system with sufficient capacity to collect and control all contaminated storm water resulting from a 24-hr, 25-year storm.

Storm water runoff within the waste disposal boundary is captured within the Landfill's storm water system. The storm water system is made up of diversion ditches, down chutes and perimeter storm water channels. The perimeter channels will be reconstructed in accordance with the new design to accommodate increased flows from the vertical expansion as the expansion is constructed. Run-off calculations and graphs for diversion ditches are proved in **Appendix 4**.

4.4 Construction Equipment

Construction equipment is covered in **Section 5.2**.

5 Site Operations

The Landfill Operation Plan is included as **Appendix 7** and includes general Landfill operation considerations for litter control, asbestos handling, erosion control for the soil borrow area, and descriptions of daily cover and lift construction procedures.

The Landfill will be environmentally safe and will not be a nuisance to adjacent areas when the procedures listed below are properly followed. It will also reduce hazards caused by vectors such as rats, flies, skunks and other scavengers.

5.1 Operating Hours

The normal operating hours for the Landfill are from 0730 to 1500 hours, Monday through Thursday except on holidays. The operating hours may change during times when specific high-priority projects conducted within MCAAP are needed. Asbestos will be disposed of by appointment only.

5.2 Personnel and Equipment

An equipment operator/attendant will be on duty anytime wastes are delivered to the Landfill.

1) A portable building and sanitary facilities will be provided for employee office, shelter and comfort. A telephone or other means of communication will be provided for emergency communication.

2) The following equipment or equal will be used for excavation of the soil borrow area, daily operations, and site maintenance:

    a) Crawler/dragger

    b) Scrapper

    c) D-7 dozer

    d) Compactor/Dozer

    The crawler/dragger, scrapper, and D-7 dozer will be used for daily soil cover excavation and earth movement. The compactor/dozer will be used primarily for the day-to-day operations of spreading, compacting and covering the daily fill. The D-7 dozer will be used as a backup for the compactor/dozer.

3) Health and safety equipment will be available on site in accordance with MCAAP safety regulations to include fire extinguishers and first aid supplies.

5.3 Public Access Control

Public access is to the Landfill is not allowed by the MCAAP. Access to the Landfill is controlled by the MCAAP, which is a secured military facility. Artificial and/or natural barriers shall be used to discourage unauthorized traffic and uncontrolled dumping. Vehicular access will be restricted by a locked gate.

5.4 Solid Waste Acceptance

The Landfill is permitted to handle NHIW and asbestos from operations at the MCAAP. All waste delivered to the Landfill will be measured using the facility's scale that is tested and certified annually in accordance with OAC 252:515-19-33(a)(2). If the scale is inoperative, tonnage shall be estimated on a volume basis where 1 cy of waste shall be calculated to weigh 1/3 ton.

Fees and monthly reports are to be submitted to the ODEQ and filed in the operating record. Copies of the monthly and quarterly reporting forms to be submitted to the ODEQ are included in **Appendix 7**. Monthly reports shall be filed in the operating record and submitted to the ODEQ no later than the 15th of the month following the reporting period.

5.5 Operating Procedures

1) **Progression**. The Landfill will continue with the progression of the trench landfilling until the footprint of the proposed vertical expansion area is complete. The vertical expansion of the Landfill will occur in a sequence of six phases as described in **Appendix 7**. Phase I will begin at the northern side of the Landfill, with each subsequent phase expanding to the south. As maximum slopes of 4 feet horizontal to 1 foot vertical are achieved, the landfilling will move to the south.

   Waste Placement. Waste material will be deposited in the area identified as the working face. The slope of the working face will be no more than 4:1. The spreading and compaction operations are performed using a waste compactor with a push blade. The height of waste will generally not exceed 10 feet in height and is referred to as a lift. The width of the working face will be kept as small as practical. The waste will be placed next to the previous day's waste as described in **Appendix 7**.

2) **Asbestos Management.** Asbestos Containing Material (ACM) is regulated under 40 CFR Part 61, Subpart M and 29 CFR 1826.1101 and requires special handling and disposal practices. Disposition of asbestos will be in accordance with MCAAP's EM Plan 55. Asbestos will be disposed of in the Landfill "by appointment" only; that is, the date and time for placing asbestos in the Landfill will be arranged with the Landfill operator in advance. The asbestos disposition area is separate from the industrial waste area. Only asbestos certified personnel will be allowed in the asbestos disposition area while an active burial is being conducted. During ACM activities, no other types of waste will be accepted; the Landfill will be closed until the ACM is placed in the disposition area and ready for covering.

3) **Daily and Intermediate Cover**. Daily and intermediate cover will be applied in accordance with OAC 252:515-19-51(c)(1) and OAC 252:515-19-52. Each working day, 6 inches of daily cover material will be applied over solid waste disposed at the facility. This material shall consist of earthen material that is free of garbage, trash, or other unsuitable materials. Waste disposal areas that are not protected by final cover or managed with runoff control structures must receive intermediate cover consisting of an additional 12 inches of compacted earthen material capable of sustaining

vegetation. This earthen material shall also be free of garbage, trash, or unsuitable material. Vegetative cover (or ODEQ-approved alternate material) will be established and maintained at the Landfill for areas that remain inactive for a period of more than 1 year.

4) **Final Cover**. The final cover vegetation must be effective, long-lasting, and capable of self-regeneration and plant succession. Vegetation shall consist of species that are equal or superior to native vegetation during each season of the year. Permanent or interim vegetation shall be established in areas that have been undisturbed for 90 days or more.

   The final cover will be constructed when or as the final elevations of waste placement are achieved and will consist of a uniform layer of low shrink-swell clay equivalent to the natural liner material and will be compacted in no more than 8-inch lifts to a depth of 2 feet over the entire surface of the Landfill. A 12-inch layer of soil suitable for topsoil and capable of sustaining plant growth will be placed on the clay cover and vegetated.

5) **Borrow Source**. The on-site soil borrow area shall be reshaped and revegetated, or otherwise reclaimed, to blend with surrounding terrain within 180 days of the date the area ceased being used in accordance with OAC 252:515-19-55.

5.6 Storm Water Management

The storm water management plan for the Landfill includes provisions for control of storm water run-on and run-off associated with a 24-hour, 25-year storm event. During operations, storm water from the landfill area will be diverted to temporary ditches which will be routed to the perimeter storm water channels. The perimeter storm water channels then route the run-off to the proposed storm water pond. The storm water pond is designed to control the runoff from a 24-hour, 25-year storm event. During storm events less than a 24-hour, 25-year storm, the pond is designed with a skimmer to reduce total suspended solids before releasing them downstream to the existing pond. Stormwater management also includes controlling rainfall from outside permit boundary. This run-on is diverted around the landfill by perimeter berms and drainage channels. The Storm Water Run-on/Run-off Plan is included as **Appendix 8**.

5.7 Leachate Management

Storm water that interfaces with waste in the working face of the Landfill will be contained by temporary run-off ditches. The leachate will be allowed to be evaporated or absorbed by the underlying waste/earthen daily cover material. If the leachate does not evaporate or becomes an issue to contain, the Landfill will haul the leachate offsite for disposal.

6 Maintenance and Safety

6.1 Fire Safety

Fire extinguishers are provided for fire protection purposes on all equipment. MCAAP maintains an emergency response plan for the entire installation including the Landfill. The facility emergency response plan will be regularly updated to consider current Landfill operations. All employees will be familiar with emergency response and evacuation procedures.

6.2 Vectors

In general, vectors will not find suitable harborage in the Landfill due to the compaction and covering of the waste. However, if a vector problem should arise, an assessment of the operating conditions will be made and necessary corrective actions will be taken. If the vector problem persists after initial corrective action, a professional exterminator will be hired to mitigate the problem.

6.3 Litter Control

Blowing litter will be controlled in accordance with OAC 252:515-19-35. The Landfill will conduct unloading of waste in such a manner to reduce the blowing of waste from outside the working face. The working face will be covered at the end of each day as well as when necessary during the operational day to help minimize the scattering of waste. In addition, mobile litter fencing will be placed downwind of the active area during windy weather periods.

6.4 Dust Control

Dust resulting from vehicular traffic, construction activity, and Landfill operations will be kept to a minimum within the property through the utilization of a water truck, road base material, and/or vegetation establishment. If necessary, a water truck is utilized throughout the day to apply water to various haul roads throughout the site. During the life of the Landfill, water will be applied to the access roads to control dust on as-needed basis.

7 Monitoring

7.1 Surface Water

There are no perennial streams within 1/2 mile of the Landfill. There are no receiving lakes or impoundments within 1 mile downstream of the Landfill. Surface water quarterly monitoring will be conducted to comply with the facility's approved Oklahoma Pollutant Discharge Elimination System (OPDES) general permit. The facility is not required to conduct annual numeric effluent monitoring for the landfill. **Figure 4** is a watershed map of the Landfill area.

7.2 Groundwater

1) **Groundwater Monitoring Program**. The groundwater monitoring program is included as **Appendix 6**.

2) **Monitoring Well Installation**. One upgradient (MW-125) and three downgradient wells (MW-123, MW-124, and MW-117) were initially installed in 1987 to monitor the groundwater at the Landfill. Three of the four monitoring wells, MW-123, MW-124, and MW-125 were air drilled to the first water zone with a 7 7/8-inch rock bit. The fourth monitoring well, MW-117, was installed in core boring 117 which was reamed out with air to 7 7/8-inches. Core boring 117 was air cored to 100 feet. It encountered minor water at about 80 feet and no additional water zones were encountered below the first. Four-inch poly-vinyl-chloride (PVC) Schedule 40 pipe well casing with a 10-foot, 0.010-inch slotted screen was placed in each well. A 5-foot sump was placed in each downgradient well and a 2 1/2-foot sump was placed on the upgradient well. From experience in other wells in the Boggy Shale, the sump aids in preventing the screen from being clogged with clay particles. In the three downgradient wells, a sand filter was placed in the annular space to about 30 feet in order to provide reservoir capacity for very slowly recovering wells. In the upgradient well, the sand filter was brought up to 22.5 feet. Bentonite balls were hydrated with water and allowed to swell before the remainder of the hole was filled with cement/bentonite grout. A locking protective cover and three protective bollards were cemented into a 4-foot square concrete pad for each well.

   MW-124 monitored a very low permeability zone that was initially thought to be dry. As a result, MW-126 was installed in 1987 as a backup for MW-124 in the event it could not be sampled. MW-126 was drilled with a 5 5/8-inch drag bit by the USGS and set with 2-inch screw joint casing to the next lower water zone. The well was bottomed at 120 feet with a 10-foot, 0.010-inch slotted screen from 119 to 109 feet, a sand filter to 102 feet, and bentonite balls to 89 feet with the remainder of the annulus backfilled with cement/bentonite grout.

   Monitoring wells MW-123A and MW-124A were installed in 2004 as replacements to monitoring wells MW-123 and MW-124, respectively. Monitoring wells MW-123 and MW-124 were decommissioned by USACE in 2005. In November of 2006, monitoring well MW-124B was installed as a replacement of monitoring well MW-124A, which

demonstrated consistent elevated turbidity levels and a decrease in groundwater elevation of approximately 40 feet since its installation in September 2005. In August of 2013, monitoring well MW-LF-1 was installed to provide additional hydraulically downgradient coverage along the Landfill's north-northwest boundary. Monitoring well MW-126 was decommissioned in August 2013.

In February 2015, monitoring well MW-LF-2 was constructed approximately 300 feet south of the landfill's northeast corner boundary. The monitoring well was installed due to the potential for northeast groundwater flow identified in previous reports. The well borehole was drilled using a Mobile Drill B-80 air drilling rig equipped with an air rotary bit. Well boreholes were advanced with a 7 3/4-inch roller cone bit attached to API air rod. Rod flights of 10 feet were utilized for borehole advancement to a total depth of approximately 37 feet. After the final depth of the borehole was achieved, drilling rods and roller cone drill bit were removed from the borehole. The monitoring well was constructed inside the open borehole. The well was constructed with 4-inch Schedule 40 PVC pipe connected by screw threads to a 10-foot section of 4-inch Schedule 40 PVC screen with 0.01-inch slotted openings. The screened interval of the borehole was packed with a commercial fine to medium sand and sealed with bentonite. The well was constructed in accordance with standard procedures for the construction of groundwater monitoring well. The protective casing was set in a 36-inch square concrete pad and surrounded by three protective bollards.

Monitoring well schematics are presented in **Appendix 12**.

7.3 Gas

Explosive gas is not considered a problem due to the remote area and the absence of permanent structures within 700 feet of the Landfill. No formal gas monitoring programs are proposed. Explosive gas may, however, collect in low areas and in unventilated temporary structures. A portable explosive gas monitor will be used in the temporary workers building to detect the presence of explosive gas.

8 Landfill Expansion Design Sheets

Landfill expansion design drawings are presented in this Section.

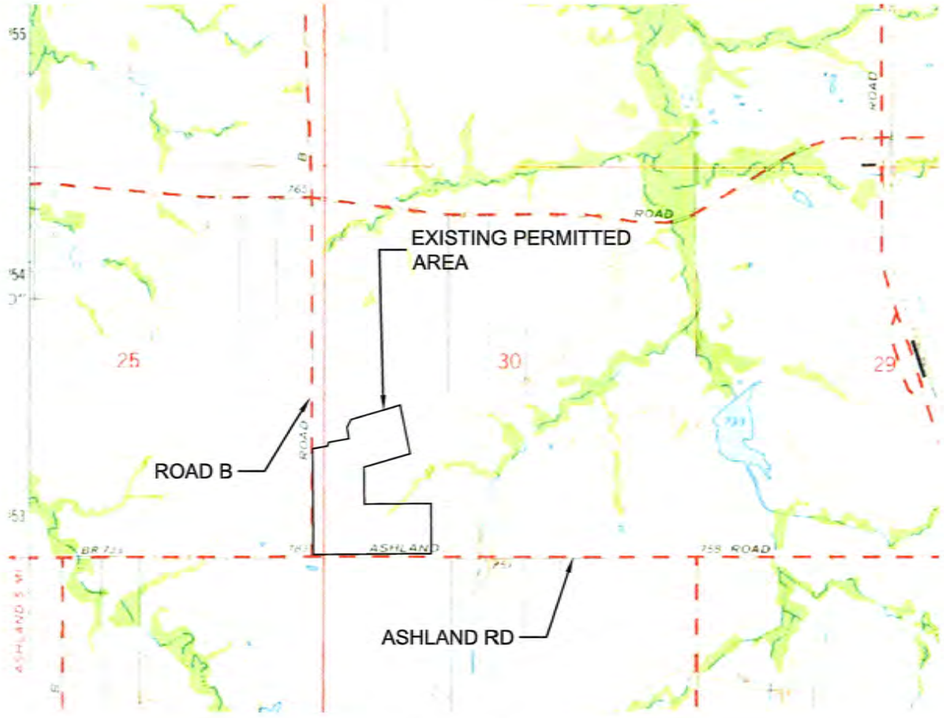
McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL
PITTSBURG COUNTY, OKLAHOMA
RCRA-D PERMIT MODIFICATION APPLICATION
AUGUST 2019

DRAWING INDEX	
No.	DRAWING TITLE
1	COVER SHEET
2	EXISTING SITE PLAN
3	PROPOSED FINAL ELEVATION PLAN
4	STORMWATER PLAN
5	CROSS-SECTION LOCATION MAP
6	CROSS-SECTION A-A'
7	CROSS-SECTION B-B'
8	CROSS-SECTION C-C'
9	CROSS-SECTION D-D'
10	CROSS-SECTION E-E'
11	FINAL COVER SYSTEM DETAILS
12	FINAL COVER SYSTEM DETAILS

CONTRACT NO. W912BV-15-0017

FINAL - AUGUST 2019

REVISED - NOVEMBER 2019



VICINITY MAP

McALESTER SW QUADRANGLE
SECTION 25 & 30
TOWNSHIP 4 NORTH RANGE 13 EAST
7.5 MINUTE SERIES (TOPOGRPHIC)

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GAVIN JAMES #PE.23714
ALL CONSULTING, LLC
OK CERTIFICATE OF AUTHORIZATION NUMBER: 6744
OK RENEWAL DATE: JUNE 30, 2020

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No.	REVISION

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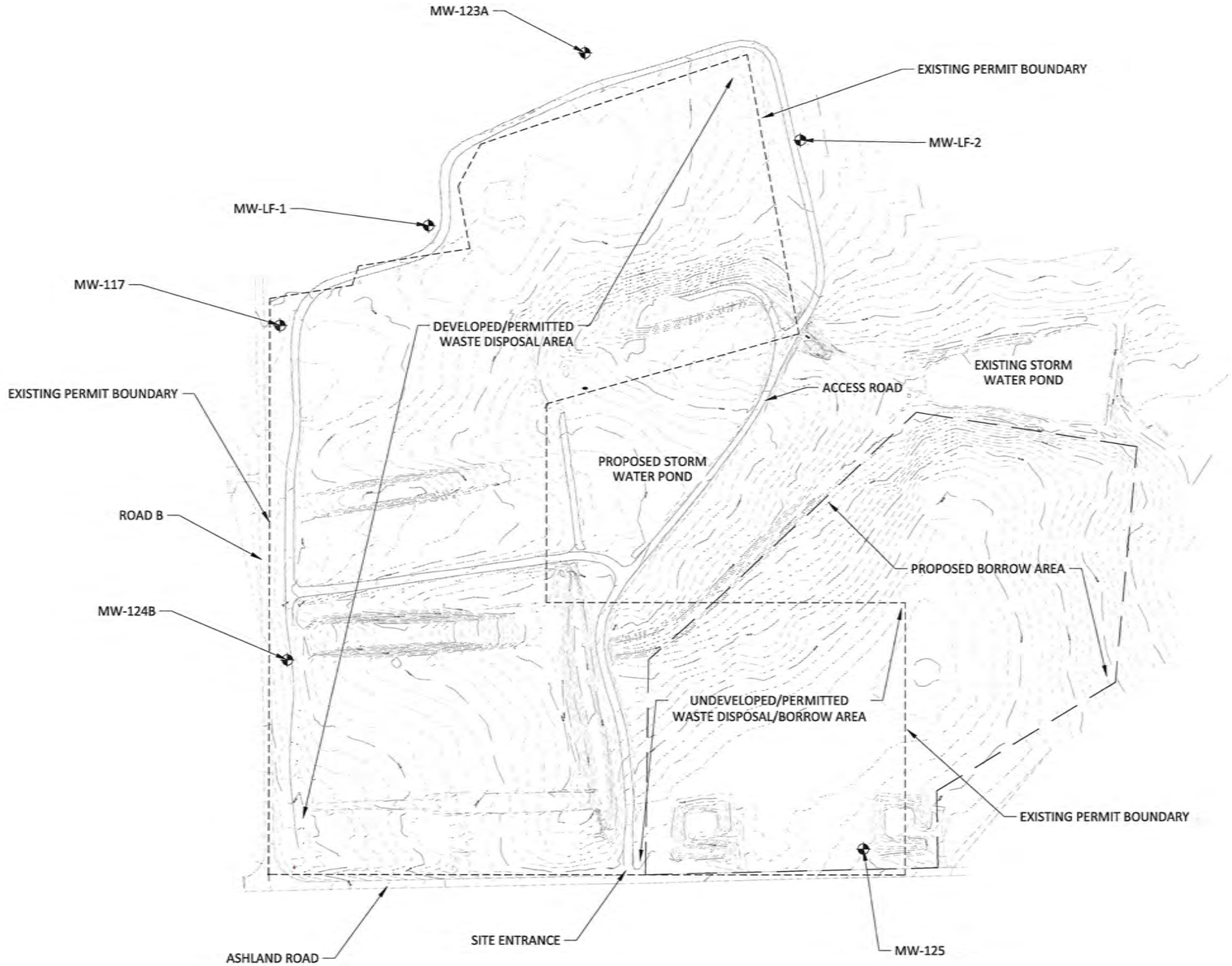

LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
1	11/6/2019	REMOVED PERMIT EXPANSION BOUNDARY	MD	GJJ

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GJJ	MD
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McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

EXISTING SITE LAYOUT

PITTSBURG COUNTY, OKLAHOMA

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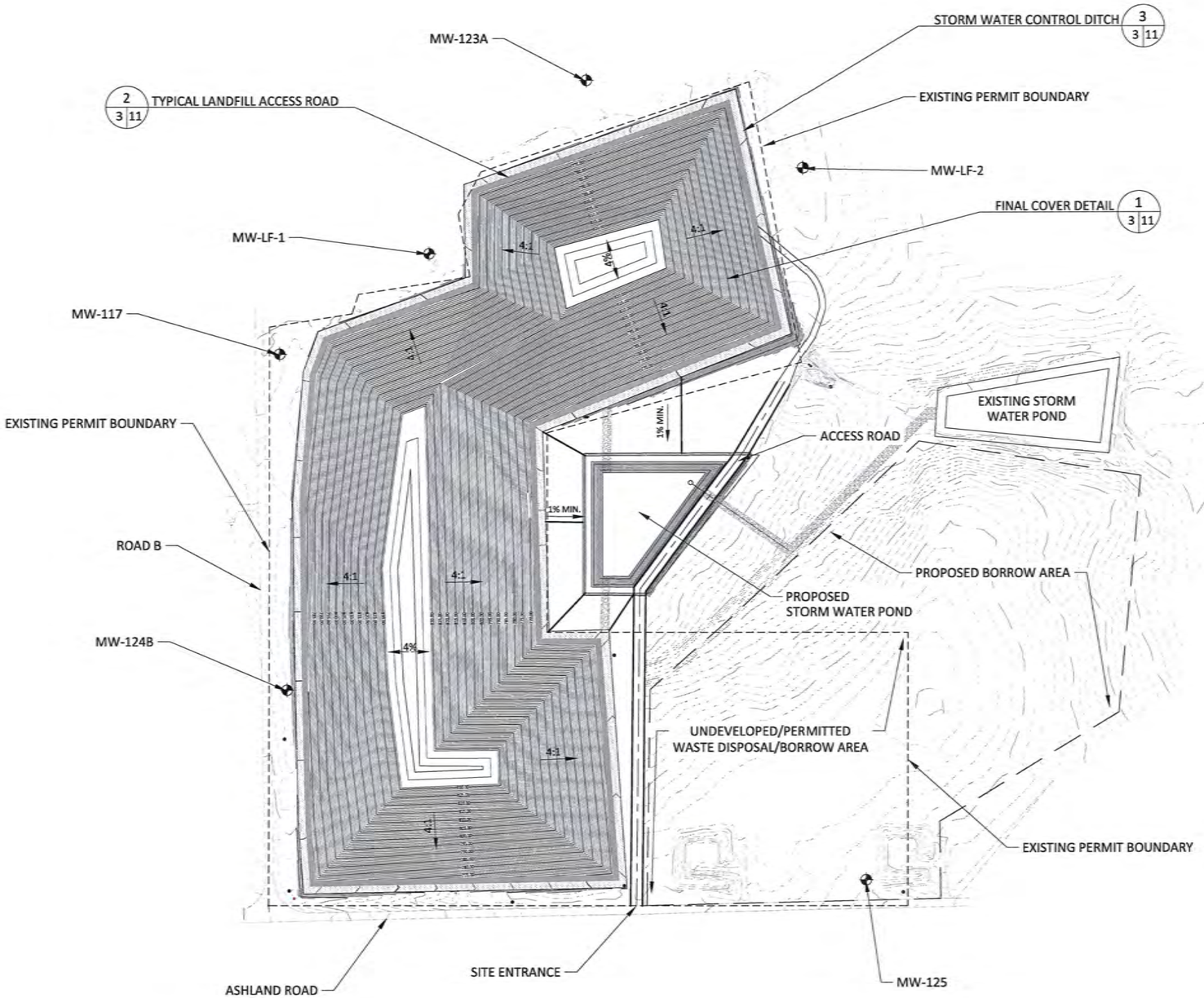

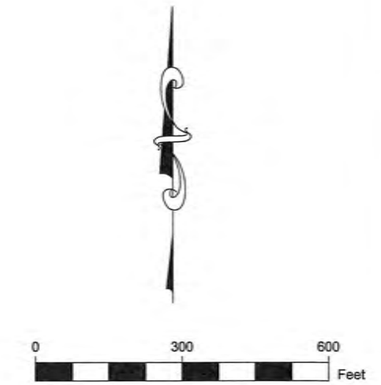

LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

REVISIONS				
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1	11/6/2019	REMOVED PERMIT EXPANSION BOUNDARY	MD	GJJ

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GJJ	MD
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McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

PROPOSED FINAL COVER PLAN

PITTSBURG COUNTY, OKLAHOMA

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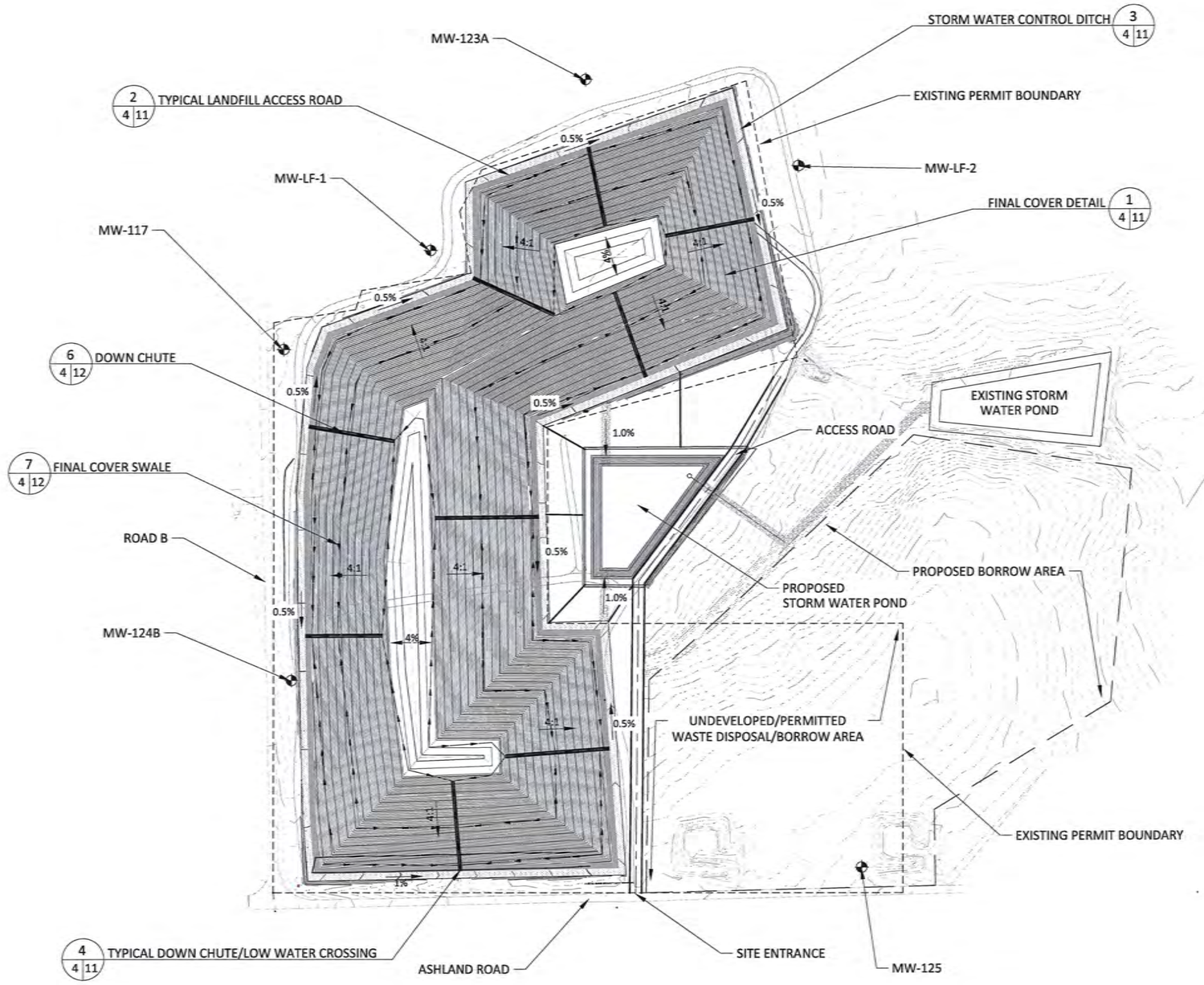

LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

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McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

STORM WATER PLAN PLAN

PITTSBURG COUNTY, OKLAHOMA

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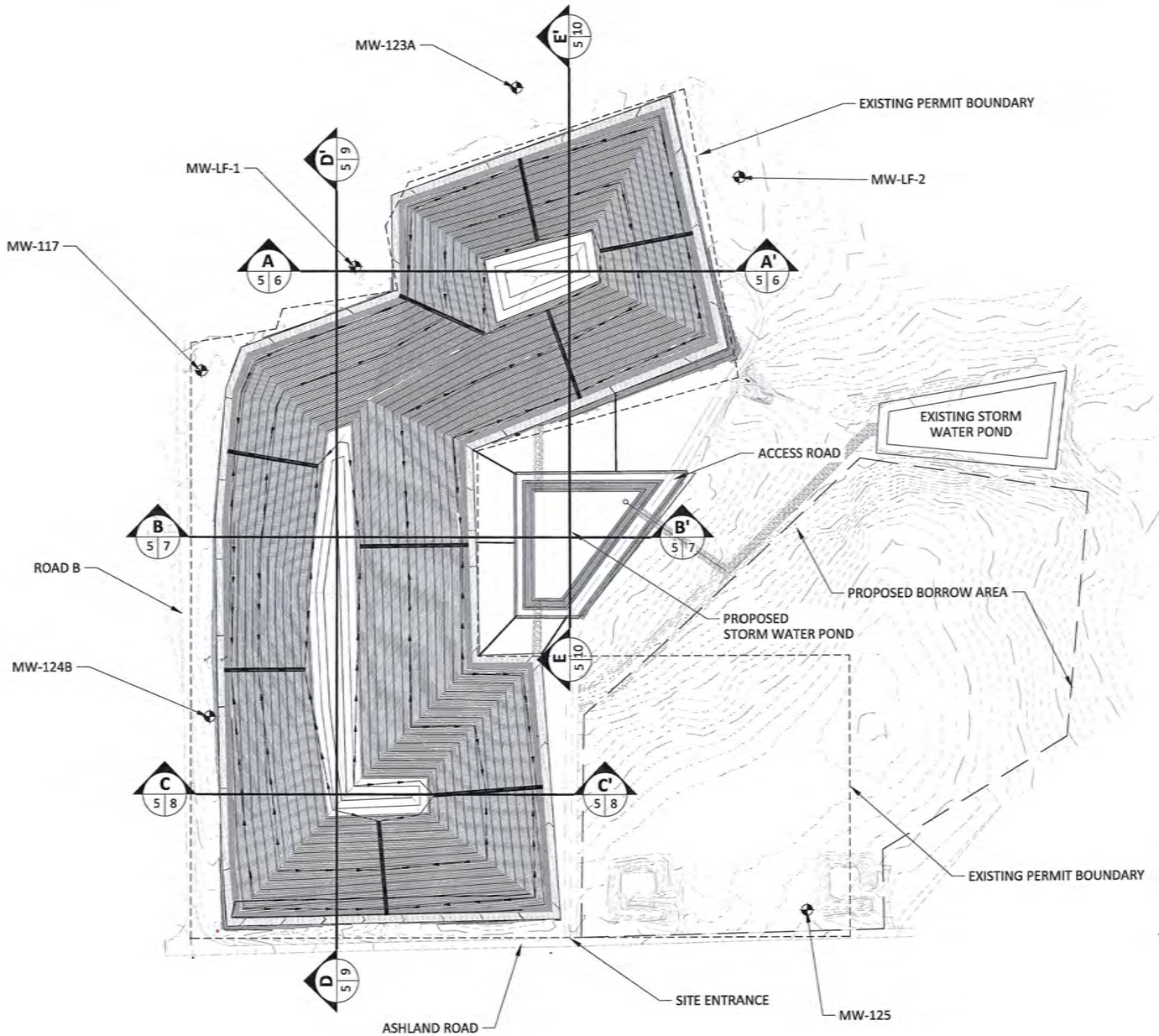

0 300 600 Feet

LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

REVISIONS				
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1	11/6/2019	REMOVED PERMIT EXPANSION BOUNDARY	MD	GJJ

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McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

CROSS-SECTION LOCATION MAP

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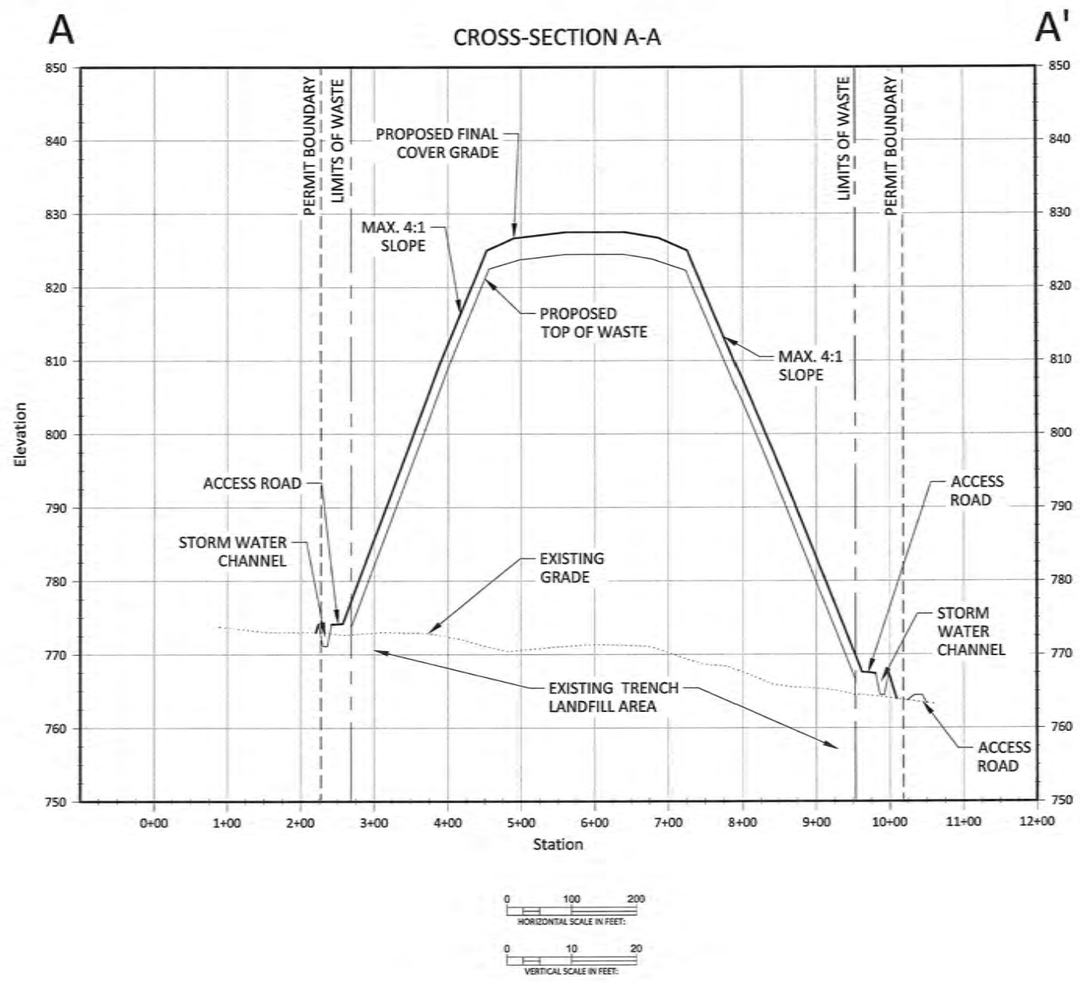

LEGEND	
.....	EXISTING GRADE SURFACE
———	PROPOSED TOP OF COVER
- - - - -	PROPOSED TOP OF WASTE
— — —	LIMITS OF WASTE
— — —	EXISTING PERMIT BOUNDARY

NOTES:

1. EXISTING GRADES BASED ON SURVEY PERFORMED ON NOVEMBER 28, 2018 BY BENCHMARK SURVEYING.
2. CROSS-SECTION LOCATION PROVIDED ON SHEET C-5.
3. FINAL COVER, ACCESS ROAD AND STORM WATER CHANNEL DETAILS PROVIDED ON SHEET C-11.

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
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GJJ	MD
PM	CHECKED
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NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL
CROSS-SECTION A-A'
PITTSBURG COUNTY, OKLAHOMA

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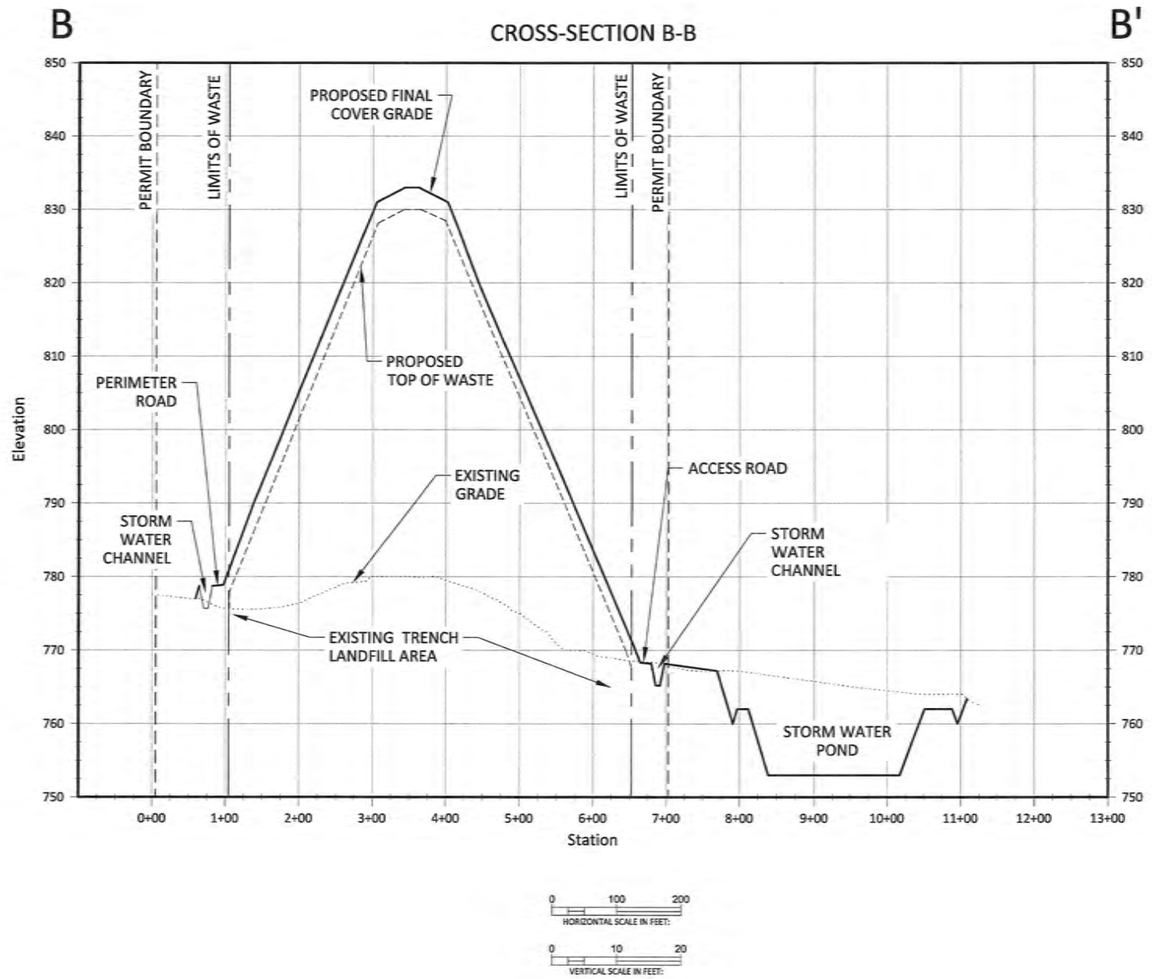

LEGEND	
	EXISTING GRADE SURFACE
	PROPOSED TOP OF COVER
	PROPOSED TOP OF WASTE
	LIMITS OF WASTE
	EXISTING PERMIT BOUNDARY

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McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

CROSS-SECTION B-B'

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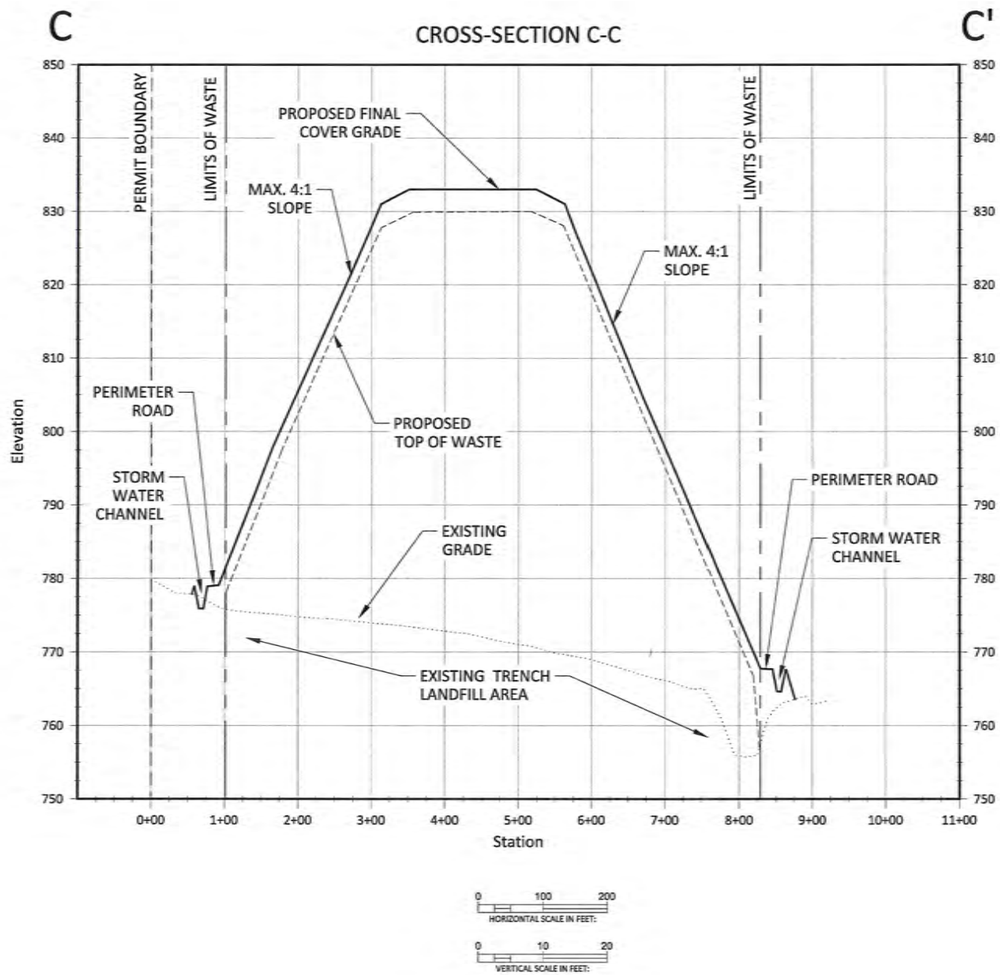

LEGEND	
.....	EXISTING GRADE SURFACE
———	PROPOSED TOP OF COVER
- - - - -	PROPOSED TOP OF WASTE
—— - ——	LIMITS OF WASTE
— — — —	EXISTING PERMIT BOUNDARY

NOTES:

1. EXISTING GRADES BASED ON SURVEY PERFORMED ON NOVEMBER 28, 2018 BY BENCHMARK SURVEYING.
2. CROSS-SECTION LOCATION PROVIDED ON SHEET C-5.
3. FINAL COVER, ACCESS ROAD AND STORM WATER CHANNEL DETAILS PROVIDED ON SHEET C-12.

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CROSS-SECTION C-C'
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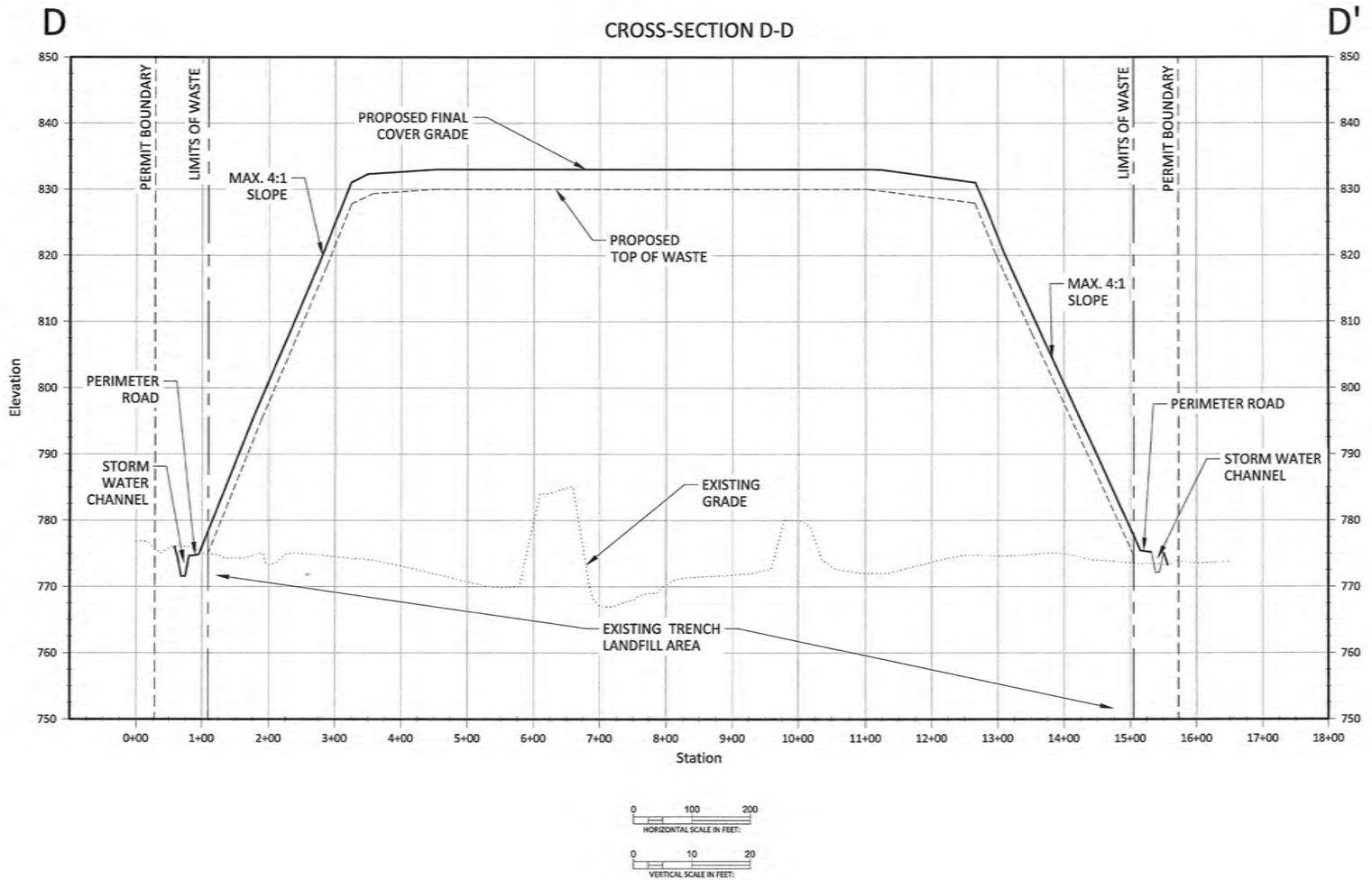

LEGEND
EXISTING GRADE SURFACE
PROPOSED TOP OF COVER
PROPOSED TOP OF WASTE
LIMITS OF WASTE
EXISTING PERMIT BOUNDARY

0 100 200
HORIZONTAL SCALE IN FEET:

0 10 20
VERTICAL SCALE IN FEET:

NOTES:

1. EXISTING GRADES BASED ON SURVEY PERFORMED ON NOVEMBER 28, 2018 BY BENCHMARK SURVEYING.
2. CROSS-SECTION LOCATION PROVIDED ON SHEET C-5.
3. FINAL COVER, ACCESS ROAD AND STORM WATER CHANNEL DETAILS PROVIDED ON SHEET C-12.

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GAVIN JAMES
OKLAHOMA

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EOR	DRAWN
GJJ	MD
PM	CHECKED
CBM	EB

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NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL
CROSS-SECTION D-D'
PITTSBURG COUNTY, OKLAHOMA

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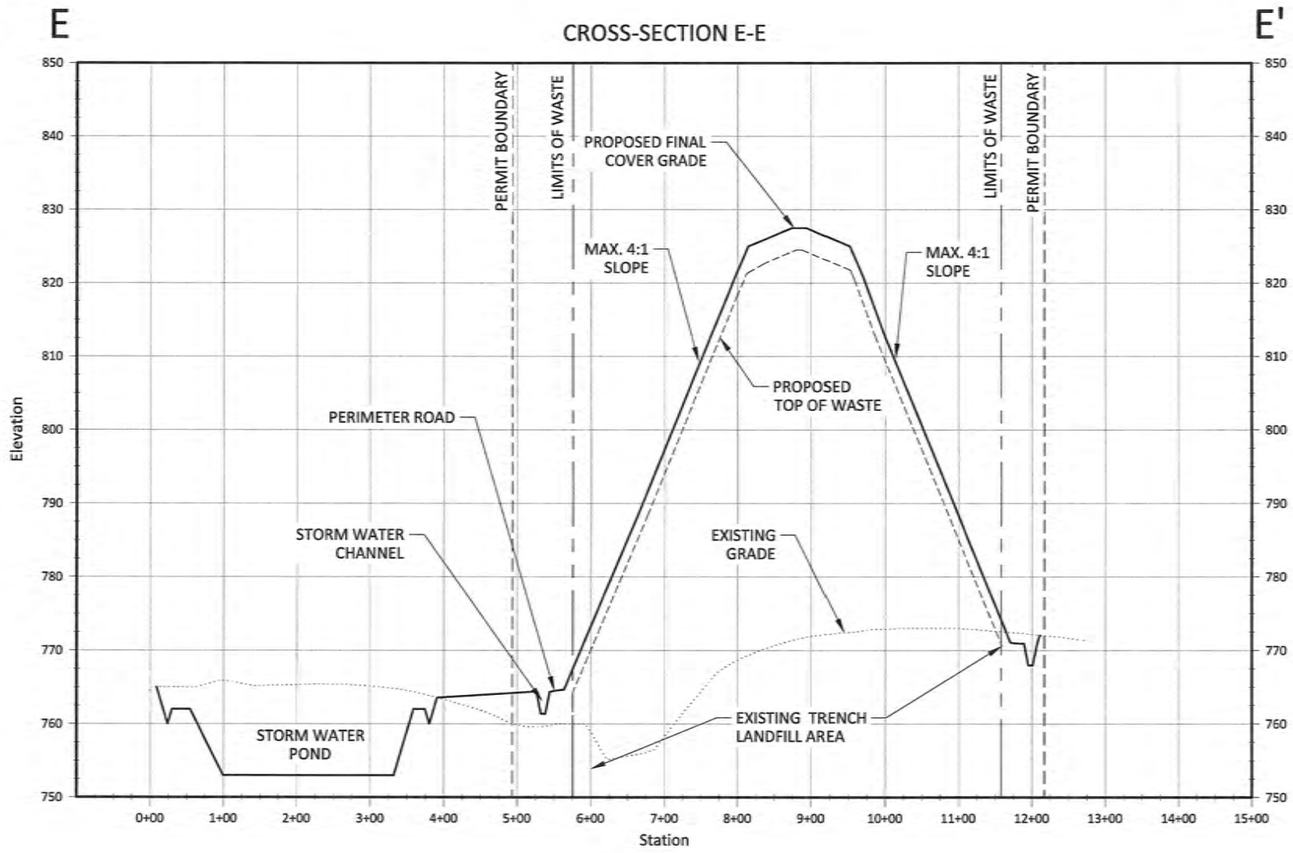

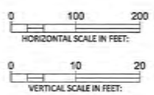

LEGEND	
	EXISTING GRADE SURFACE
	PROPOSED TOP OF COVER
	PROPOSED TOP OF WASTE
	LIMITS OF WASTE
	EXISTING PERMIT BOUNDARY

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11/19/19

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
1	11/6/2019	REVISED PROPOSED PERMIT BOUNDARY TO REFLECT EXISTING PERMIT BOUNDARY	MD	GJJ

EOR	DRAWN
GJJ	MD
PM	CHECKED
CBM	EB

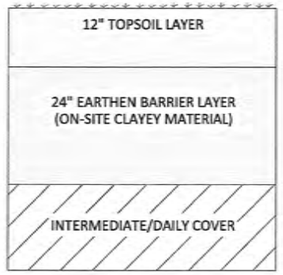
McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL
CROSS-SECTION E-E'
PITTSBURG COUNTY, OKLAHOMA

PREPARED FOR:
US Army Corps of Engineers

PREPARED BY:
ALL CONSULTING
GOVERNMENT RELATIONS - ENERGY - PLANNING - TECHNOLOGY ENGINEERING - ENVIRONMENTAL
1718 SOUTH CHEYENNE AVE, TULSA, OK 74119
PHONE: 918.382.7581
WWW.ALL-LLC.COM

PN #1720.PMT
AUGUST 2019
SHEET NO.
10 of 12

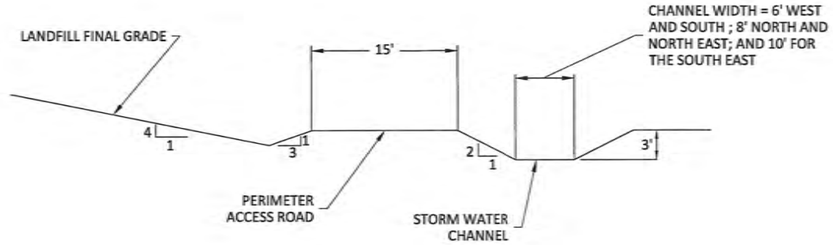
© 2019 ALL Consulting, LLC



FINAL COVER TYPICAL DETAIL

SCALE: N.T.S.

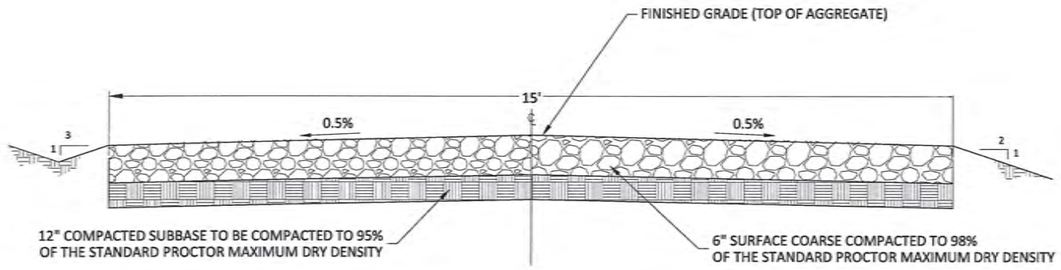
1 | 3 | 11



ACCESS ROAD - STORM WATER CHANNEL SECTION

SCALE: N.T.S.

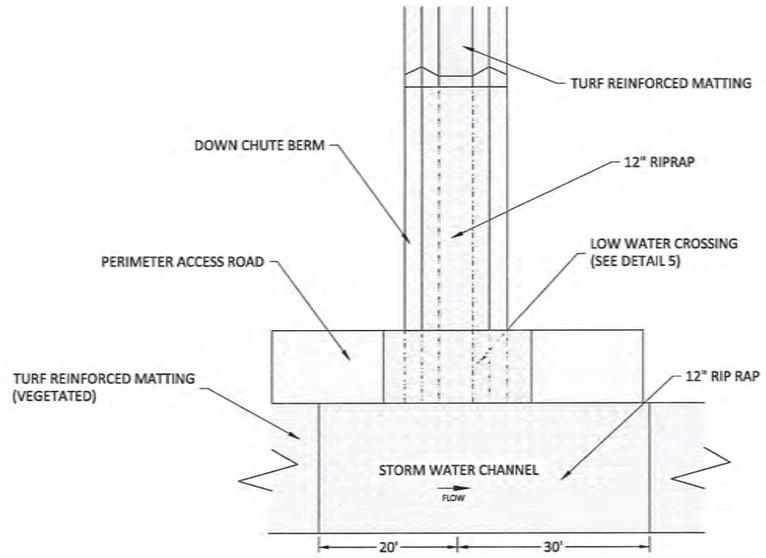
3 | 3 | 11



ACCESS ROAD TYPICAL DETAIL

SCALE: N.T.S.

2 | 3 | 11



DOWN CHUTE / LOW WATER CROSSING

SCALE: N.T.S.

4 | 3 | 11

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
1	11/2/2019	FINAL COVER TYPICAL DETAIL UPDATED	MD	GJJ

EOR	DRAWN
GJJ	MD
PM	CHECKED
CBM	EB

McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

FINAL COVER SYSTEM DETAILS

PITTSBURG COUNTY, OKLAHOMA

PREPARED FOR:

US Army Corps of Engineers

PREPARED BY:

ALL CONSULTING

GOVERNMENT RELATIONS - ENERGY - PLANNING - TECHNOLOGY ENGINEERING - ENVIRONMENTAL

1718 SOUTH CHEYENNE AVE, TULSA, OK 74119
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AUGUST 2019
SHEET NO.
11 of 12

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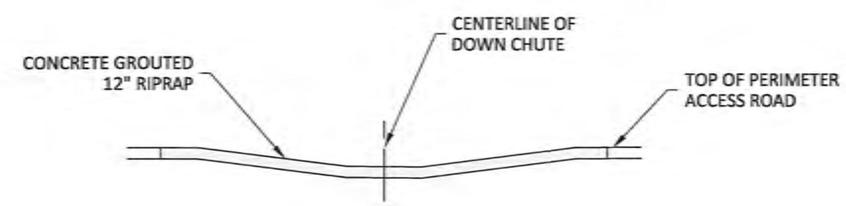
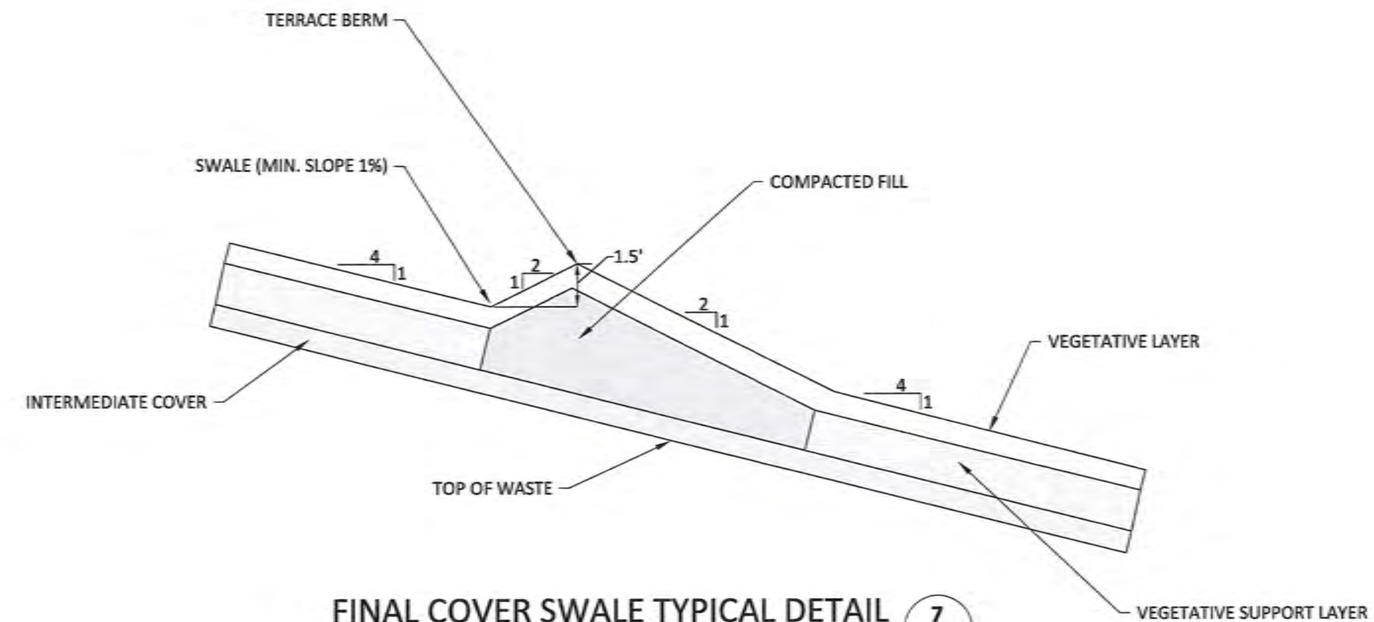
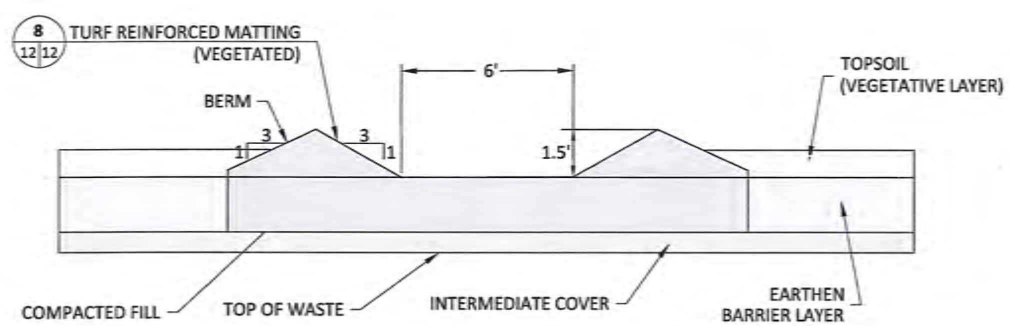


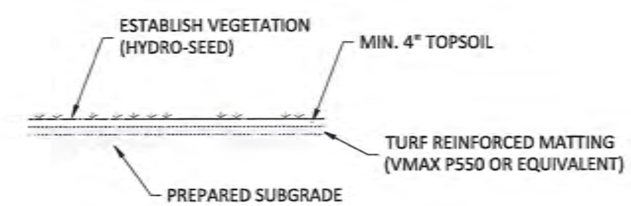
LOW WATER CROSSING TYPICAL DETAIL
SCALE: N.T.S.
5 / 4 | 12



FINAL COVER SWALE TYPICAL DETAIL
SCALE: N.T.S.
7 / 4 | 12



DOWN CHUTE TYPICAL DETAIL
SCALE: N.T.S.
6 / 4 | 12



TURF REINFORCED MATTING TYPICAL DETAIL
SCALE: N.T.S.
8 / 12 | 12

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD

EOR	DRAWN
GJJ	MD
PM	CHECKED
CBM	EB

McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL
FINAL COVER SYSTEM DETAILS
PITTSBURG COUNTY, OKLAHOMA

PREPARED FOR:
US Army Corps of Engineers

PREPARED BY:
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GOVERNMENT RELATIONS - ENERGY - PLANNING - TECHNOLOGY
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WWW.ALL-LLC.COM

PN #1720.PMT
AUGUST 2019
SHEET NO.
12 of 12

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Appendix 1
Proof of Ownership

APR 1 , 1943

Honorable Robert S. Kerr,
Governor of Oklahoma,
Oklahoma City, Oklahoma.

Dear Governor Kerr:

The laws of the State of Oklahoma (sections 1, 2, 3, and 4, title 80, Oklahoma Statutes, 1941) permit the assumption of exclusive Federal jurisdiction over lands within that State, acquired by the United States for military and certain other purposes.

Under section 355, Revised Statutes, as amended by the act of February 1, 1940 (54 Stat. 19), and by the act of October 9, 1940 (54 Stat. 1083; 40 U.S.C. 255), it is provided in effect that unless and until the United States has accepted jurisdiction over lands acquired or in which any interest shall have been acquired after February 1, 1940, it shall be conclusively presumed that no such jurisdiction has been accepted.

Accordingly, notice is hereby given that the United States accepts exclusive jurisdiction over all lands acquired by it for military purposes within the State of Oklahoma, title to which has heretofore vested in the United States, and over which exclusive jurisdiction has not heretofore been obtained.

It is requested that you return the inclosed copy of this letter, with an indorsement thereon over your signature stating the date of your receipt of this notice.

Sincerely yours,

HENRY L. STIMSON

Secretary of War.

The original of this letter of acceptance was received in the Office of the Governor on the 3d day of May, 1943.

Governor of the State of Oklahoma

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

Canc frp: Mar 78

IN REPLY REFER TO
OPNAVNOTE 3450
Ser [illegible]
13 SEP 1977

OPNAV NOTICE 3450

From: Chief of Naval Operations

Subj: Disestablishment of the Naval Ammunition Depots located at Hawthorne, Nevada and McAlester, Oklahoma

1. Authority. The Secretary of the Navy, effective 30 September 1977, has approved the disestablishment of the following shore activities, assigned to the Chief of Naval Operations for command and support:

Title of Official in Command, Mail Address, and Authorized Short Title for Message Addressing in accordance with [illegible]

a. Commanding Officer
Naval Ammunition Depot
Hawthorne, NV 89415

(SNDL: [illegible]) (Short Title: NAD HAWTHORNE NV)
(Activity Code: [illegible]) (UIC N: [illegible])

b. Commanding Officer
Naval Ammunition Depot
McAlester, OK 74501

(SNDL: [illegible]) (Short Title: NAD MCALESTER OK)
(Activity Code: [illegible]) (UIC N: [illegible])

2. Implementation. Commands, bureaus, and offices concerned are requested to take necessary action.

3. Information. The subject shore activities being disestablished are not management headquarters activities.

4. Cancellation Contingency. This notice may be retained for reference purposes.

[illegible]
[illegible]
[illegible]

Distribution:
SNDL [illegible] ([illegible] Office [illegible] Secretary)

~~PTC~~ #1
PTM
PTR
PTA
PTF File

(1)

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 Eisenhower Ave, Alexandria, VA 22333

(2) PERMANENT ORDERS 57-1 (3) 18 July 1977

1. Hawthorne Army Ammunition Plant XQ (W39YAA) CCNUM X10178 Hawthorne, Nevada 89415

~~Following organization/unit action directed.~~

Action: Unit reorganized
Assigned to: US Army Armament Materiel Readiness Command (ARRCOM)
Mission: As stated in Section I, TDA XQW39YAA.
Effective date: 1 October 1977
Military structure strength: 9 officers, 9 aggregate
Military authorized strength: 9 officers, 9 aggregate
Civilian structure strength: 778 DHUS, 778 aggregate
Civilian authorized strength: 758 DHUS, 758 aggregate
Accounting classification: N/A
Authority: DOD Directive 5160.65, 26 November 1975, subject: Single Manager Assignment for Conventional Ammunition
Additional instructions: None
Format: 740

(5) 2. McAlester Army Ammunition Plant XQ (W390AA) CCNUM X10178 McAlester, Oklahoma 74501

(4) Following organization/unit action directed.

~~Assigned to: US Army Armament Materiel Readiness Command (ARRCOM)~~

(6) Assigned to: US Army Armament Materiel Readiness Command (ARRCOM)
Mission: As stated in Section I, TDA XQW390AA.
Effective date: 1 October 1977
Military structure strength: 7 officers, 7 aggregate
Military authorized strength: 7 officers, 7 aggregate
Civilian structure strength: 808 DHUS, 808 aggregate
Civilian authorized strength: 778 DHUS, 778 aggregate
Accounting classification: N/A
Authority: DOD Directive 5160.65, 25 November 1975, subject: Single Manager Assignment for Conventional Ammunition
Additional instructions: None
Format: 740

PERMANENT ORDERS 57-1, HQ DARCOM, 18 Jul 1977

3. Crane Army Ammunition Activity XQ (W39ZAA) CCNUM X10173
Crane, Indiana 47522

Following organization/unit action directed.

Action: Unit reorganized
Assigned to: US Army Armament Materiel Readiness Command (ARRCOM)
Mission: As stated in Section I, TDA XQW39ZAA
Effective date: 1 October 1977
Military structure strength: 2 officers, 2 aggregate
Military authorized strength: 2 officers, 2 aggregate
Civilian structure strength: 751 DHUS, 751 aggregate
Civilian authorized strength: 749 DHUS, 749 aggregate
Accounting classification: N/A
Authority: DOD Directive 5160.65, 26 November 1975, subject: Single Manager Assignment for Conventional Ammunition
Additional instructions: None
Format: 740

FOR THE COMMANDER:

G. J. HAROLD
LTC, GS
Adjutant General

DISTRIBUTION
A and B
6--DRCCP
2--DRCGC-S
3--DRCIG
1--DRCIN
3--DRCIS-ER
1--DRCPA-M
4--DRCPA-O
1--DRCPA-P
2--DRCPT-ME
2--DRCPT-MT
2--DRCPT-S
2--DRCPT-SA
2--DRCPT-SP
2--DRCPT-SR
1--DRXAM-AR
1--DRXMM-CO
1--DRXMM-SM
20-DRXMM-TM
1--DRXMM-TS

14--HQDA (12-DAAG-OPR); (2-DAAG-HDA), Forrestal Bldg, WASH DC 20314
1--HQDA (DAMO-FDA), Pentagon, WASH DC 20310
1--Cdr, DARCOM Mil Pers Mgt Det, Edgewood Activity, MD 21010
1--Cdr, TRADOC, ATTN: ATLOG-MAT-PM, Fort Monroe, VA 23651
5--Cdr, Crane Army Ammunition Activity, Crane, IN 47522
5--Cdr, Hawthorne Army Ammunition Plant, Hawthorne, NV 89415
5--Cdr, McAlester Army Ammunition Plant, McAlester, OK 74501
5--Cdr, HQ ARRCOM, Rock Island, IL 61201

Appendix 2
Proof of Publication

PROOF OF PUBLICATION

PUBLISHED in the Tulsa World, April 20, 1988, Tulsa, OK

PUBLIC NOTICE FORM
Application for Solid Waste Disposal Site Permit

McAlester Army Ammunition Plant plans to file an application on April 15, 1988, with the Oklahoma State Department of Health seeking a permit for a new disposal site to be located at McAlester Army Ammunition Plant, Highway 69 South, McAlester, Oklahoma as follows:

Legal Description. Commencing at the iron pin with coordinates N. 533,255.363 E. 2,604,369.639, based on the Oklahoma South Zone State Plane Coordinates, said pin located at the intersection of Ashland Road and Road B near the corner of Section 25 Township 4 North, Range 12 East, Pittsburg County, Oklahoma; thence N5 degrees 39' 01"W a distance of 15.72 feet to the point of beginning; thence S90 degrees 00'00"E a distance of 1600.00 feet; thence N0 degrees 00'00"E a distance of 685.00 feet; thence N90 degrees 00'00"W a distance of 903.00 feet; thence N 0 degrees 00'00"E a distance of 500.00 feet; thence N7 degrees 30'00"E a distance of 660.00 feet; thence N10 degrees 30'00"W a distance of 677.60 feet; thence S74 degrees 30'00"W a distance of 705.00 feet; thence S28 degrees 00'00"W a distance of 120 feet; thence S10 degrees 30'00"E a distance of 160.00 feet; thence S81 degrees 00'00"W a distance of 283.00 feet; thence S18 degrees 00'00"W a distance of 51.30 feet; thence S81 degrees 00'00"W a distance of 210.20 feet; thence S 0 degrees 00'00"W a distance of 1450.00 feet to the point of beginning; said tract containing 49.279 acres more or less.

This would be a Type V solid waste disposal site or facility for the disposal of:

1. Empty cardboard boxes
2. Plastic bottles
3. Empty crushed cans of paint, paint thinner, etc.
4. Metal turnings coated with machine oil
5. Inert plastic material
6. Small volumes of sandwich wrappings and pop bottles
7. Containerized asbestos
8. Water treatment plant clarifier sludge/filter backwash
9. Sewage sludge

from load, assembling and packing of munitions and the operations and maintenance of the facility. If more specific information is desired, it may be obtained by contacting the applicant, or his designated representative at Commander, McAlester Army Ammunition Plant, ATTN: SMCMC-DEM, McAlester, Oklahoma 74501-5000, (918) 421-2551, or by contacting the Director of the Solid Waste Division, OSDH at (405) 271-5338, 1000 N.E. 10th Street, P.O. Box 53551, Oklahoma City, Oklahoma 73152.

Any person residing or doing business in Oklahoma may, within thirty (30) days of the date of the publication of this notice, submit written notice of opposition and request for a formal public meeting should be mailed to the Solid Waste Division of the Oklahoma State Department of Health, P.O. Box 53551, Oklahoma City, Oklahoma 73152.

ATTA HERE)

TITLE U. S. ARMY AMMUNITION PLANT

STATE OF OKLAHOMA, }
COUNTY OF TULSA } SS.

AFFIDAVIT:

I, Teri Forman, of lawful age, being duly sworn, upon oath deposes and says that he is the clerk of Tulsa World, a daily newspaper printed in the City of Tulsa, County of Tulsa, State of Oklahoma, and of a bona fide paid general circulation therein, printed in the English language, and that the notice by publication, a copy of which is hereto attached, was published in said newspaper for one ~~xxxxxxxxx consecutive~~ days ~~(xxxxxxxx~~ the first publication being on the 20th day of April, 19 88, and the last day of publication being on the 20th day of April, 19 88, and that said newspaper has been continuously and uninterruptedly published in said county during the period of more than One Hundred and Four (104) weeks consecutively, prior to the first publication of said notice, or advertisement, as required by Section one, Chapter four, Title 25 Oklahoma Session Laws, 1943, as amended by House Bill No. 495, 22nd Legislature, and thereafter, and complies with all of the prescriptions and requirements of the laws of Oklahoma. (The advertisement above referred to is a true and printed copy. Said notice was published in all editions of said newspaper and not in a supplement thereof.)

The advertisement above referred to, a true and printed copy of which is hereto attached, was published in said newspaper on the following dates, to-wit:

April 20, 1988

Said notice was published in the regular edition of said newspaper and not in a supplement thereof.

Publishing Fee - - - - $ 47.00

Notary fee - - - - $

TOTAL - - - - $ 47.00

Teri Forman
(Signature)

Subscribed and sworn to before me this 20th day of April, A. D., 19 88

PROOF OF PUBLICATION

PUBLISHED In the Tulsa Tribune, April 20, 1988, Tulsa, OK

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This would be a Type V solid waste disposal site or facility for the disposal of:
1. Empty cardboard boxes
2. Plastic bottles
3. Empty crushed cans of paint, paint thinner, etc.
4. Metal turnings coated with machine oil
5. Inert plastic material
6. Small volumes of sandwich wrappings and pop bottles
7. Containerized asbestos
8. Water treatment plant clarifier sludge/filter backwash
9. Sewage sludge
from load, assembling and packing of munitions and the operations and maintenance of the facility. If more specific information is desired, it may be obtained by contacting the applicant, or his designated representative at Commander, McAlester Army Ammunition Plant, ATTN: SMCMC-DEM, McAlester, Oklahoma 74501-5000, (918) 421-2551, or by contacting the Director of the Solid Waste Division, OSDH at (405) 271-5338, 1000 N.E. 10th Street, P.O. Box 53551, Oklahoma City, Oklahoma 73152.
Any person residing or doing business in Oklahoma may, within thirty (30) days of the date of the publication of this notice, submit written notice of opposition and request for a formal public meeting should be mailed to the Solid Waste Division of the Oklahoma State Department of

ATTA (E HERE)

TITLE , U. S. ARMY AMMUNITION PLANT

STATE OF OKLAHOMA, } SS.
COUNTY OF TULSA }

AFFIDAVIT:

I, Teri Forman, of lawful age, being duly sworn, upon oath deposes and says that he is the clerk of Tulsa Tribune, a daily newspaper printed in the City of Tulsa, County of Tulsa, State of Oklahoma, and of a bona fide paid general circulation therein, printed in the English language, and that the notice by publication, a copy of which is hereto attached, was published in said newspaper for one ~~consecutive~~ days ~~(or weeks)~~, the first publication being on the 20th day of April, 19 88, and the last day of publication being on the 20th day of April, 19 88, and that said newspaper has been continuously and uninterruptedly published in said county during the period of more than One Hundred and Four (104) weeks consecutively, prior to the first publication of said notice, or advertisement, as required by Section one, Chapter four, Title 25 Oklahoma Session Laws, 1943, as amended by House Bill No. 495, 22nd Legislature, and thereafter, and complies with all of the prescriptions and requirements of the laws of Oklahoma. (The advertisement above referred to is a true and printed copy. Said notice was published in all editions of said newspaper and not in a supplement thereof.)

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TOTAL - - - $ 47.00

Teri Forman
(Signature)

Subscribed and sworn to before me this 20th day of April, A. D., 19 88

Affidavit of Publication

State of Oklahoma }
County of Pittsburg } SS.

Owen Jones, of lawful age, being duly sworn and authorized, says that he

is General Manager of the McAlester News-Capital and Democrat, a daily newspaper printed in the City of McAlester, Pittsburg County, Oklahoma, a newspaper qualified to publish legal notice, advertisements and publications as provided in Section 106 of Title 25, Oklahoma Statues 1961, as amended, and complies with all other requirements of the laws of Oklahoma with reference to legal publications.

That said notice, a true copy of which is attached hereto, was published in the regular edition of said newspaper during the period and time of publication and not in a supplement, on

the following dates:

April 20, 19 88

Owen Jones

Subscribed and sworn to before me this 20 day of April, 19 88

Kathie Covey
Notary Public

My commission expires:

Nov. 19, 1989

Publication Fees, $ 62.23

COPY

(Published in the McAlester News-Capital and Democrat April 20, 1988.)

PUBLIC NOTICE FORM
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This would be a Type I solid waste disposal site or facility for the disposal of:

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5. Inert plastic material
6. Small volumes of sandwich wrappings and pop bottles
7. Containerized asbestos
8. Water treatment plant clarifier sludge/filter backwash
9. Sewage sludge

from load,assembling and packing of munitions and the operations and maintenance of the facility. If more specific information is desired, it may be obtained by contacting the applicant, or his designated representative at Commander, McAlester Army Ammunition Plant, ATTN: SMCMC-DEM, McAlester, Oklahoma 74501-5000, (918) 421-2551, or by contacting the Director of the Solid Waste Division, OSDH at (405) 271-5338, 1000 N.E. 10th Street, P.O. Box 53551, Oklahoma City, Oklahoma 73152.

during business ... Oklahoma may, within thirty (30) days of the date of the publication of this notice, submit written notice of opposition and request for a formal public meeting. Comments and requests for a formal public meeting should be mailed to the Solid Waste Division of the Oklahoma State Department of Health, P.O. Box 53551, Oklahoma City, Oklahoma 73152.

Appendix 3
Copies of Soil Test Results

SUBSURFACE EXPLORATION REPORT

PROPOSED LANDFILL MODIFICATIONS
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA

Project No. 1185060
December 21, 2018

Prepared for:

ALL CONSULTING
Tulsa, Oklahoma

Prepared by:

BELONGIA CONSULTANTS INC.
Broken Arrow, Oklahoma

BELONGIA CONSULTANTS, INC.

2145 W. Concord Circle
Broken Arrow, OK 74012
dlbelongia@peoplepc.com
(918) 251-5500

December 21, 2018

ALL Consulting
1718 South Cheyenne Ave
Tulsa, Oklahoma 74119

Attention: Mr. Gavin James, PE

Re: Subsurface Exploration
Proposed Landfill Modifications
McAlester Army Ammunition Plant
McAlester, Oklahoma
Project No. 1185060

Dear Mr. James:

We are submitting, herewith, the results of the subsurface exploration performed for the proposed landfill modifications at the McAlester Army Ammunition Plant in McAlester, Oklahoma.

The borings generally encountered low to moderate strength, fat clay soil to depths ranging from about 5 to 12 feet. The fat clay was underlain by moderate to high strength shaley fat clay to depths ranging from 9 to 19.5 feet. The overburden soils were underlain by shale bedrock to the bottom of the borings. General comments regarding potential consolidation of the soils supporting the new landfill are presented in the following report.

If you have any questions regarding the contents of this report or if we can be of further service, please do not hesitate to contact us.

Sincerely,
BELONGIA CONSULTANTS INC.

David L. Belongia, PE
Oklahoma No. 12908

12/21/18

DLB:PS
Enclosure
Copies To: Addressee (1)

TABLE OF CONTENTS

SUBSURFACE EXPLORATION REPORT

PROPOSED LANDFILL MODIFICATIONS
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA

Project No. 1185060
December 21, 2018

INTRODUCTION

This report presents the results of the subsurface exploration and geotechnical engineering services for the proposed landfill modifications at the McAlester Army Ammunition Plant in McAlester, Oklahoma. Fifteen soil borings extending to depths ranging from about 19 to 34 feet were drilled as part of the exploration. The results of the borings and a boring location diagram are attached.

We understand the project involves converting a trench type landfill to a pyramid type landfill. As part of this conversion, it is proposed to add about 75 feet of landfill material to the existing landfill.

The purpose of this report is to describe the subsurface conditions encountered in the borings; analyze the data obtained and provide general comments regarding potential consolidation of the soils supporting the new landfill.

SUBSURFACE EXPLORATION PROCEDURES

Fifteen soil borings were drilled for the project. The borings were staked in the field by ALL Consulting personnel. The boring locations should be considered accurate only to the degree implied by the methods used to locate them.

The borings were drilled with a truck mounted drill rig using continuous hollow stem augers to advance the borings. Representative soil samples were obtained using the split-barrel and thin wall tube sampling procedure in general accordance with the appropriate ASTM procedure.

Disturbed samples are obtained in the split-barrel sampling procedure by driving a 2-inch O.D. split-barrel sampler into the ground using a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler were recorded in the field and are shown on the boring logs as the standard penetration resistance (SPT-N) value. The number of blows required to advance the sampler the final 12 inches or less of a standard 18-inch sampling interval indicate the in-place relative density of granular soils

and, to a lesser degree of accuracy, the consistency of cohesive soils, and the hardness of weathered bedrock. A greater efficiency is achieved with the automatic hammer, compared to the conventional safety hammer operated with a cathead and rope. The effect of this increased efficiency has been considered in interpreting the standard penetration resistance values for this project.

In the thin wall tube sampling procedure, a thin wall steel tube is hydraulically pushed into the soil to obtain a relatively undisturbed soil sample.

The soil samples obtained in the field were sealed and returned to our laboratory for further examination, testing and classification.

During the drilling operation, field boring logs were prepared by the drill crew. These logs report drilling and sampling methods, sampling intervals, soil and groundwater conditions encountered, and the driller's visual evaluation of the conditions between samples. The final boring logs, included in this report, has been prepared based on the driller's field logs and has been modified, where appropriate, based on the results of the laboratory observation and testing.

LABORATORY TESTING PROGRAM

Moisture content and, where applicable, calibrated hand penetrometer tests were performed on the split-barrel samples. The calibrated penetrometer test provides an indication of the unconfined compressive strength of a cohesive soil. In addition, unconfined compressive strength and dry unit weight tests were performed on selected portions of the thin wall tube samples.

In addition, Atterberg limits tests were performed on selected soil samples. The Atterberg limits indicate the plasticity of a cohesive soil and are used to approximate the soil's potential for volume change with variation in moisture content. The laboratory test results are reported on the boring logs.

The soil samples were examined in our laboratory by an experienced geotechnical engineer and were classified based on the soil's texture and plasticity in accordance with the attached General Notes and Unified Soil Classification System. The estimated Unified System group symbols are shown on the boring log. A brief description of the Unified Soil Classification System is attached. Disturbed samples of the bedrock materials were classified in accordance with the General Notes and described using commonly accepted geotechnical terminology. Petrographic analysis may reveal other rock types.

SUBSURFACE CONDITIONS

The subsurface conditions encountered at the boring locations are shown on the attached boring logs and are briefly described below. The stratification lines on the boring logs represent the approximate boundary between soil and rock types; in-situ, the transition between materials may be gradual and indistinct.

Three to four inches of surface vegetation and topsoil was encountered at some of the boring locations. Fill material consisting of brown and dark brown, lean and lean to fat clay with varying amounts of gravel was encountered at boring locations B-1, B-4, B-5 and B-7, to depths of about 2 feet. The surface materials, where encountered, were underlain by dark brown, brown, reddish brown and gray, fat clay, trace gravel to depths ranging from about 5 to 12 feet. The fat clay was underlain by olive brown and gray, shaley fat clay to depths ranging from about 9 to 19.5 feet. The clay was underlain by olive gray to gray, highly weathered shale, trace sandstone, which extended to the bottom of the borings.

GROUNDWATER CONDITIONS

Groundwater level observations were made while drilling and immediately after completing the borings to evaluate groundwater conditions. As shown in the lower left corner of the boring logs, no groundwater was encountered in the borings at these times.

The groundwater level observations made during our exploration provide an indication of the groundwater conditions at the time the boring was performed. Longer monitoring in piezometers or cased holes would be required to evaluate longer-term groundwater conditions. Fluctuations in the amount of perched water, if any, and groundwater levels should be expected throughout the years depending upon variations in the amount of rainfall, runoff, evaporation, and other hydrological factors not apparent at the time of our exploration.

ANALYSIS AND RECOMMENDATIONS

Geotechnical Considerations

We understand the existing landfill consists of 45 to 50 foot wide trenches that extend to depths ranging from about 7 to 20 feet below existing grade. There is an approximate 7 foot wide buffer between each trench.

The borings generally encountered low to moderate strength, fat clay soil to depths ranging from about 5 to 12 feet. The fat clay was underlain by moderate to high strength

shaley fat clay to depths ranging from 9 to 19.5 feet. The overburden soils were underlain by shale bedrock to the bottom of the borings.

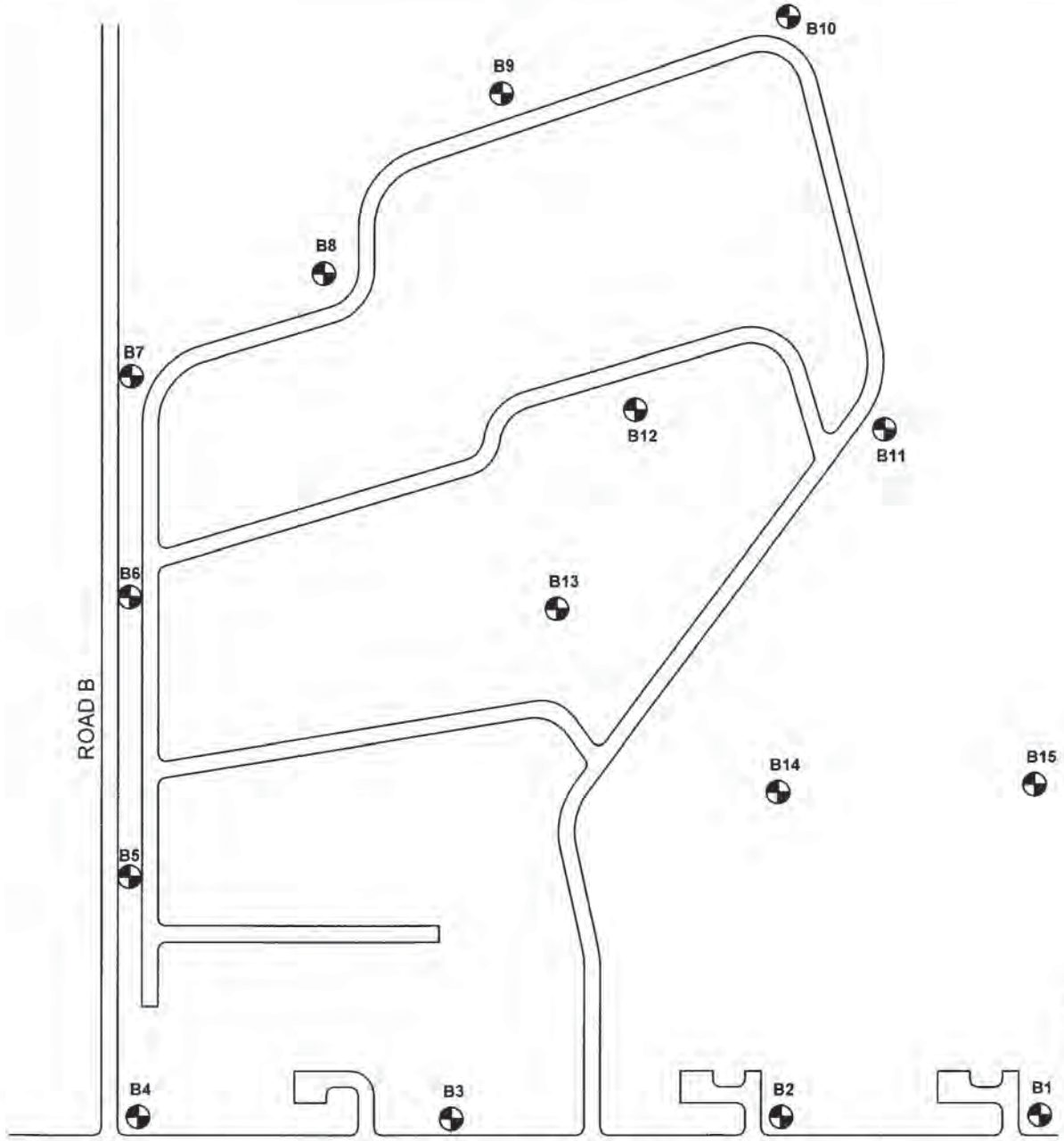
Based on the results of the borings, it is assumed that the trenches extend into the moderate to high strength, shaley fat clay. Based on estimated weights for the waste material and daily cover, the maximum stress that would be transferred to the underlying soil would be about 3800 pounds per square foot.

Assuming the bottom of trenches are extended into the shaley clay, we estimate the long term consolidation of the shaley clay, due to the above load, would be less than 6 inches. Of course, some long term consolidation of the waste material and daily cover would also occur.

GENERAL COMMENTS

The general comments presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations which may occur away from the borings or across the site. The nature and extent of such variations may not become evident until construction.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Belongia Consultants reviews the changes, and either verifies or modifies the conclusions of this report in writing.



LEGEND

SOIL BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

SOIL BORING LOCATION DIAGRAM

PROPOSED LANDFILL MODIFICATIONS
MCALESTER ARMY AMMUNITION PLANT
MCALESTER, OKLAHOMA

Project Mngr: DLB	Belongia Consultants Inc. 2145 W. Concord Circle Broken Arrow, OK 74012	Project No: 01185060
Designed By: DLB		Scale: Not to Scale
Checked By: DLB		Date: DECEMBER 2018
Approved By: DLB		Drawn By: DLB
File Name: 01185060		Figure No: 1

LOG OF BORING NO. B-1

CLIENT

ENGINEER **ALL Consulting**

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT **Proposed Landfill Modifications**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
	3" Topsoil				HS						
	FILL: LEAN CLAY WITH GRAVEL dark brown and brown			1	SS	5	6				
2			CH	2	SS	10	7	28.5		*2000	S-2 LL=62 PL=24 PI=38
	FAT CLAY, TRACE GRAVEL brown and reddish-brown				HS						
4											
	FAT CLAY WITH GRAVEL brown, reddish-brown and gray	5	CH GC	3	SS	10	12	24.8		*3000	
					HS						
9			CH	4	SS	12	35	18.2		*6000	
	SHALEY FAT CLAY olive gray and gray	10			HS						
14.5				5	SS	10	30/6" 50/6"	16.5			
	HIGHLY WEATHERED SHALE olive gray to gray	15			HS						
19				6	SS	6	50/6"	14.2			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▼	▼
WL		

Belongia Consultants, Inc.

BORING STARTED			11-14-18
BORING COMPLETED			11-14-18
RIG	CME 45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-2

CLIENT

ENGINEER **ALL Consulting**

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT **Proposed Landfill Modifications**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
	4" Topsoil				HS						
	FAT CLAY dark brown		CH	1	SS	12	7	27.5			
2	FAT CLAY, TRACE GRAVEL brown reddish brown and gray		CH	2	SS	14	8	27.1		*1500	
			CH	3	ST	16		27.7	101		
5	FAT CLAY olive brown	5	CH	4	SS	10	15	19.0		1580	S-4 LL=59 PL=28 PI=31
					HS						
9	SHALEY FAT CLAY olive gray		CH	5	SS	16	45	16.8			
		10			HS						
			CH	6	SS	14	59	16.6			
		15			HS						
19.5				7	SS	14	30/6" 50/6"	14.8			
20	HIGHLY WEATHERED SHALE olive gray	20									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▼	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-3

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	FAT CLAY, TRACE GRAVEL dark brown				HS					
			CH	1	SS	10	6	26.1		
			CH	2	SS	16	8	25.8		*2000
					HS					
		5	CH	3	SS	10	17	27.5		*2000
					HS					
	9		CH	4	SS	12	35	18.3		*4000
	SHALEY FAT CLAY olive brown and gray	10			HS					
			CH	5	SS	14	57			
		15			HS					
	19			6	SS	8	20/6"	15.7		
	HIGHLY WEATHERED SHALE dark gray to gray	20			HS		50/6"			
				7	SS	5	50/6"	13.8		
		25			HS					
	28.8			8	SS	3	50/4"	12.9		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▽	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-4

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	FILL: LEAN TO FAT CLAY WITH GRAVEL brown and dark brown				HS					
		2		1	SS	12	14	14.7		
	FAT CLAY brown and olive brown		CH	2	SS	16	13	24.0		*2000
					HS					
		5	CH	3	SS	12	19	17.7		*3000
					HS					
		9	CH	4	SS	14	45	16.7		*6000
	SHALEY FAT CLAY olive brown and gray	10			HS					
		14		5	SS	8	20/6" 50/6"	14.9		
	HIGHLY WEATHERED SHALE, TRACE SANDSTONE olive gray	15			HS					
		18		6	SS	5	50/6"	12.5		
	HIGHLY WEATHERED SHALE gray	20			HS					
				7	SS	5	50/6"	11.3		
		25			HS					
				8	SS	3	50/4"	8.9		
		30			HS					

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▼	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060 GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-4

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	HIGHLY WEATHERED SHALE gray									
	33.8			9	SS	3	50/3"			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▼	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-5

CLIENT

ENGINEER **ALL Consulting**

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT **Proposed Landfill Modifications**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
	FILL: LEAN TO FAT CLAY WITH GRAVEL brown and dark brown				~~HS~~						
				1	SS	10	7	19.3			
	2										
	FAT CLAY brown and dark brown		CH	2	SS	14	6	32.4			S-2 LL=60 PL=23 PI=37
			CH	3	ST	16		29.2	98	1400	
		5	CH	4	SS	6	5	25.0			
					HS						
	8.5										
	FAT CLAY, TRACE GRAVEL olive gray		CH	5	SS	12	25	18.9		*3000	S-5 LL=57 PL=24 PI=33
		10			HS						
	12										
	SHALEY FAT CLAY olive gray		CH	6	SS	16	52	16.6		*6000	
		15			HS						
	19										
	HIGHLY WEATHERED SHALE olive gray to gray			7	SS	10	20/6" ~~50/6"~~	14.7			
		20			HS						
				~~8~~	~~SS~~	~~4~~	~~50/6"~~				
		25			HS						
	28.8										
				~~9~~	~~SS~~	~~3~~	~~50/4"~~	~~10.9~~			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▽	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-6

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	FAT CLAY, TRACE GRAVEL brown				HS					
			CH	1	SS	10	5	33.8		*1000
			CH	2	SS	14	9	27.1		*1500
					HS					
	5	5								
	FAT CLAY olive brown		CH	3	SS	16	31	18.2		*4000
					HS					
	9		CH	4	SS	14	44	16.4		
	SHALEY FAT CLAY olive gray	10			HS					
	14.5			5	SS	14	20/6" 50/6"	17.9		
	HIGHLY WEATHERED SHALE olive gray to gray	15			HS					
				6	SS	12	30/6" 50/6"	15.7		
		20			HS					
				7	SS	5	50/6"	10.1		
		25			HS					
	28.8			8	SS	3	50/4"	10.2		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▼	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-7

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	3"Topsoil				HS					
	FILL: LEAN CLAY WITH GRAVEL			1	SS	6	5	12.7		
	2 brown									
	FAT CLAY		CH	2	SS	14	7	24.3		
	brown									
	4									
	FAT CLAY, TRACE GRAVEL		CH	3	ST	16		24.8	106	1620
	brown, reddish brown and gray	5	CH	4	SS	14	29	21.1		
					HS					
	9									
	SHALEY FAT CLAY		CH	5	SS	16	51	16.6		
	olive brown and gray	10			HS					
	14.5			6	SS	12	30/6" 50/6"	16.1		
	HIGHLY WEATHERED SHALE	15			HS					
	gray			7	SS	6	50/6"	13.8		
		20			HS					
				8	SS	5	50/6"	12.6		
		25			HS					
	28.8			9	SS	3	50/4"	12.5		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼	
WL	▽	▼	
WL			

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-8

CLIENT

ENGINEER **ALL Consulting**

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT **Proposed Landfill Modifications**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
	4" Topsoil				HS						
	FAT CLAY dark brown		CH	1	SS	10	4	30.5			
	2.5		CH	2	SS	14	9	26.7		*2000	S-2 LL=67 PL=26 PI=41
	FAT CLAY brown				HS						
		5	CH	3	SS	12	14	23.7		*3000	
					HS						
	9		CH	4	SS	15	48	16.6			
	SHALEY FAT CLAY olive gray	10			HS						
	14.5		CH	5	SS	12	30/6" 50/6"	16.5			
	HIGHLY WEATHERED SHALE gray	15			HS						
				6	SS	5	50/6"	14.6			
		20			HS						
				7	SS	6	50/6"	14.9			
		25			HS						
	29			8	SS	5	50/6"	11.9			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▼	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-9

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
	FAT CLAY brown				HS						
			CH	1	SS	14	6	9.1			
			CH	2	SS	16	12	8.7		*2000	
	3.5 FAT CLAY brown, reddish brown and gray		CH	3	ST	16		24.7	105	1820	
	6	5	CH	4	SS	15	42	9.1			
	SHALEY FAT CLAY olive gray				HS						
			CH	5	SS	15	57				S-5 LL=54 PL=26 PI=28
		10			HS						
	14			6	SS	8	20/6" 50/6"				
	HIGHLY WEATHERED SHALE, TRACE SANDSTONE olive gray and reddish brown	15			HS						
				7	SS	8	25/6" 50/6"				
		20			HS						
	24			8	SS	5	50/6"				S-8 LL=56 PL=25 PI=31

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼	
WL	▽	▼	
WL			

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/15/18

LOG OF BORING NO. B-10

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
	FAT CLAY brown and olive gray		CH	1	SS	10	5	32.9			
			CH	2	SS	15	17	23.7		*3000	
					HS						
	5	5	CH	3	ST	16		15.0	118	*3000	
	SHALEY FAT CLAY olive brown and gray				HS						
	9			4	SS	8	20/6" 50/+6"	15.2			S-4 LL=57 PL=26 PI=31
	HIGHLY WEATHERED SHALE olive gray	10			HS						
				5	SS	14	30/6" 50/6"	15.9			
		15			HS						
	19			6	SS	8	50/6"	15.2			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼	
WL	▽	▼	
WL			

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/15/18

LOG OF BORING NO. B-11

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	4" Topsoil				HS					
	FAT CLAY		CH	1	SS	12	6	28.8		
	2 brown									
	FAT CLAY, TRACE GRAVEL		CH	2	SS	14	27	19.5		*3000
	brown and olive brown				HS					
		5	CH	3	SS	15	21	19.0		*3000
					HS					
	8.5									
	SHALEY FAT CLAY		CH	4	SS	16	57	17.5		*8000
	olive gray	10			HS					
			CH	5	SS	14	61	17.2		
		15			HS					
	19									
	19.5 HIGHLY WEATHERED SHALE			6	SS	10	30/6" 50/6"	13.3		
	gray									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼	
WL	▽	▼	
WL			

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-12

CLIENT

ENGINEER **ALL Consulting**

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT **Proposed Landfill Modifications**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	4" Topsoil				HS					
	FAT CLAY		CH	1	SS	10	5	29.3		
2	brown									
	FAT CLAY, TRACE GRAVEL		CH	2	SS	14	11	22.4		*2000
	brown and olive brown				HS					
		5	CH	3	SS	11	21	19.3		*3000
					HS					
9			CH	4	SS	16	58	17.7		
	SHALEY FAT CLAY	10			HS					
	olive gray and reddish brown									
14.5				5	SS	14	30/6" 50/6"	15.5		
	HIGHLY WEATHERED SHALE	15			HS					
	olive gray to gray									
19.3				6	SS	6	25/6" 50/4"	13.1		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▼	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-13

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	4" Topsoil				HS					
	FAT CLAY brown		CH	1	SS	10	4	32.0		
	2.5		CH	2	SS	12	11	23.5		*2000
	FAT CLAY olive gray				HS					
		5	CH	3	SS	15	25	18.1		*3000
					HS					
	8.5									
	SHALEY FAT CLAY olive gray		CH	4	SS	14	58	16.9		
		10			HS					
	14			5	SS	10	35/6" 50/6"	15.8		
	HIGHLY WEATHERED SHALE olive gray	15			HS					
	19			6	SS	6	50/6"	15.5		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼	
WL	▽	▼	
WL			

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-14

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	FAT CLAY brown				HS					
			CH	1	SS	12	3	35.5		
2										
	FAT CLAY, TRACE GRAVEL olive brown		CH	2	SS	14	19	22.8		*2500
					HS					
		5	CH	3	SS	15	37	17.3		*4000
6										
	SHALEY FAT CLAY, TRACE GRAVEL olive gray				HS					
			CH	4	SS	16	43	16.7		
		10			HS					
14										
	HIGHLY WEATHERED SHALE gray			5	SS	10	27/6" 50/6"	16.5		
		15			HS					
19										
				6	SS	6	50/6"	14.5		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▽	▼
WL		

Belongia Consultants, Inc.

BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/13/18

LOG OF BORING NO. B-15

CLIENT

ENGINEER
ALL Consulting

SITE **McAlester Army Ammunition Plant**
McAlester, Oklahoma

PROJECT
Proposed Landfill Modifications

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	4" Topsoil				HS					
	FAT CLAY		CH	1	SS	12	4	23.5		
	2 dark brown									
	FAT CLAY		CH	2	SS	14	18	22.9		*3000
	olive brown and gray		CH	3	ST	12		19.5	114	*3000
		5	CH	4	SS	14	27	17.6		
					HS					
	9									
	SHALEY FAT CLAY		CH	5	SS	15	47	17.3		
	olive brown and gray	10			HS					
			CH	6	SS	12	52	16.5		
		15			HS					
	19.5			7	SS	12	27/6" 50/6"	15.8		
	20 HIGHLY WEATHERED SHALE	20								
	olive gray									

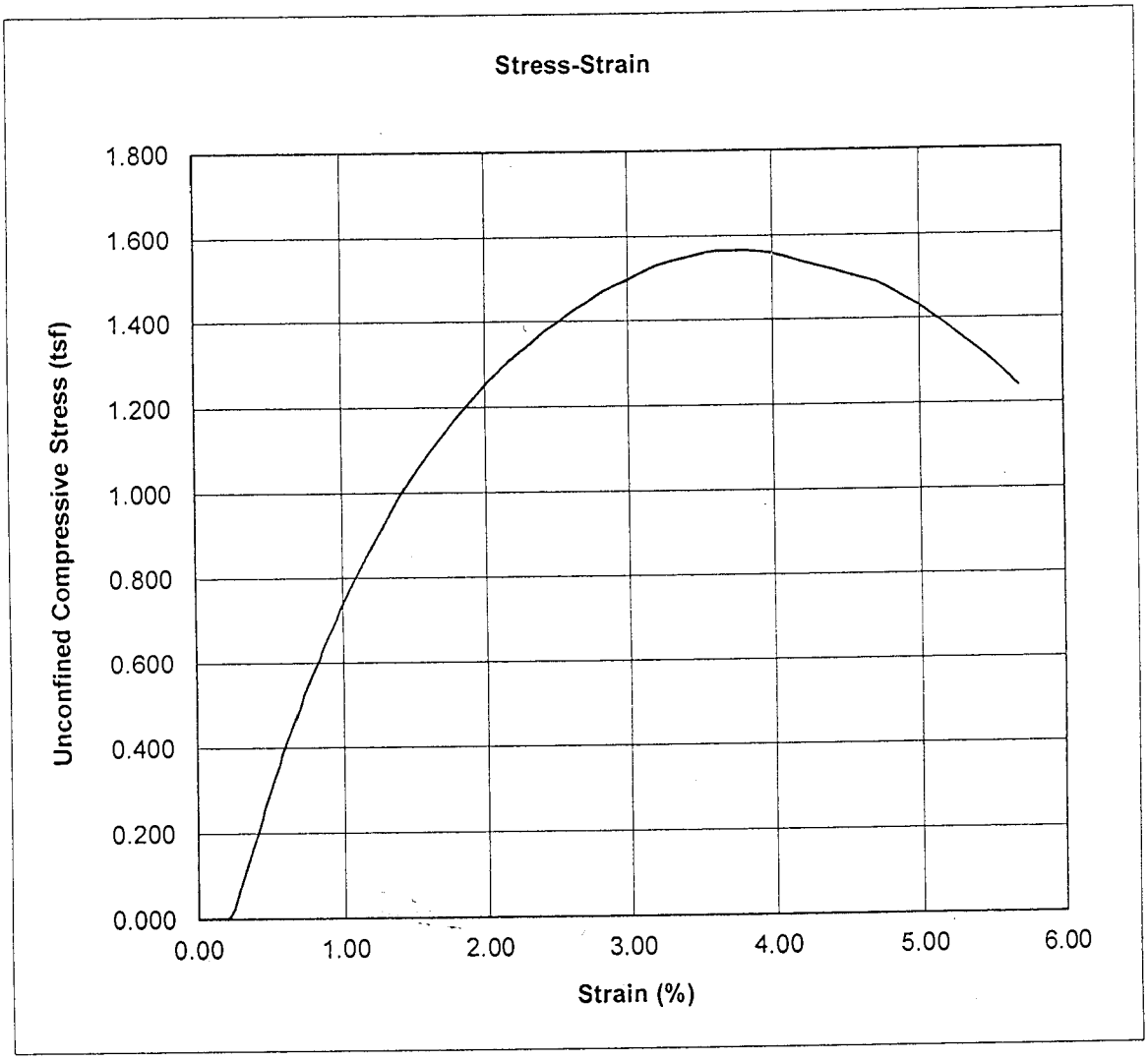
The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼	
WL	▽	▼	
WL			

Belongia Consultants, Inc.

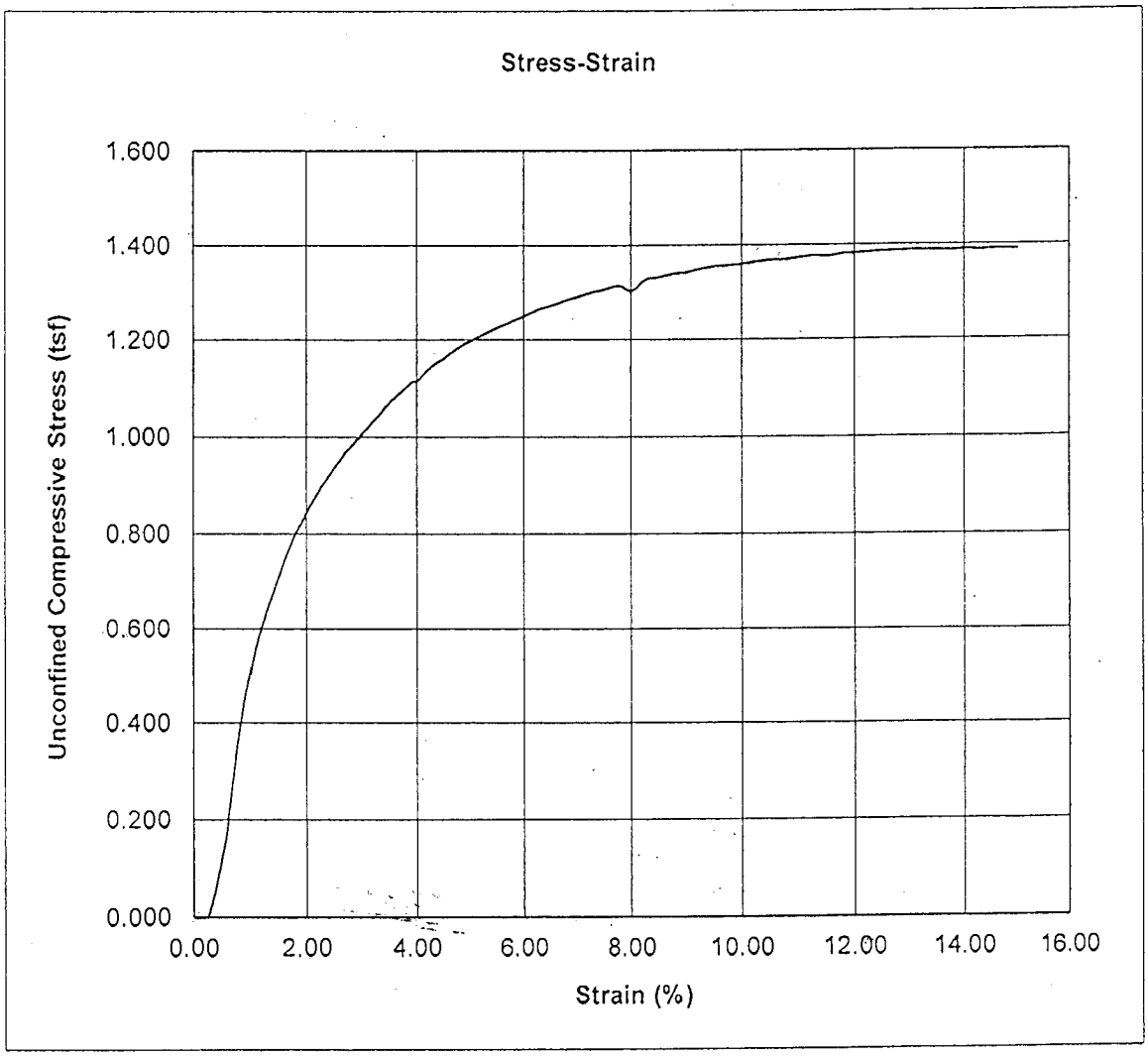
BORING STARTED	11-14-18		
BORING COMPLETED	11-14-18		
RIG	CME-45	FOREMAN	TB
APPROVED	DLB	JOB #	1185060

BOREHOLE 1185060.GPJ BELONGIA 12/15/18



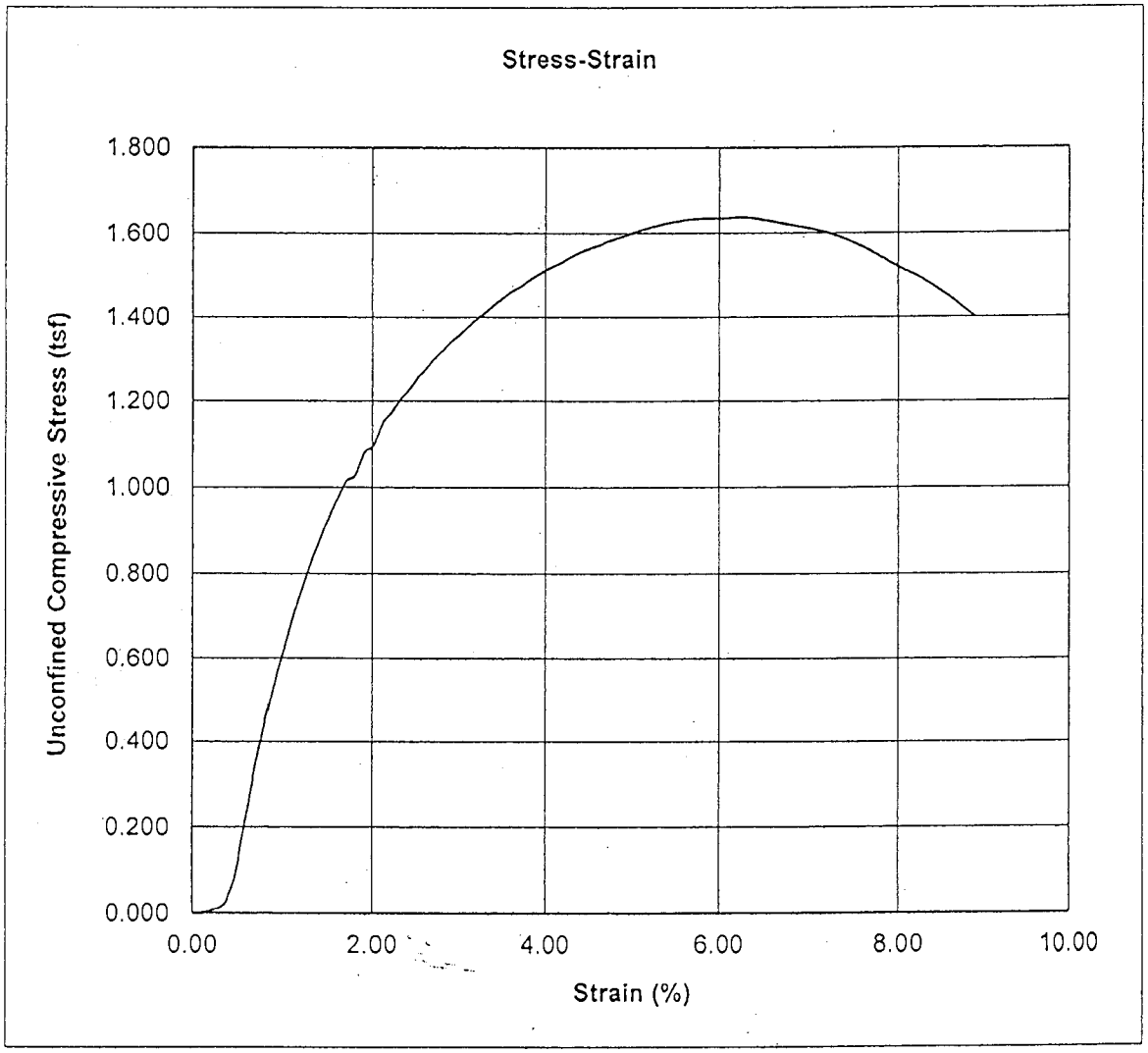
RESULTS OF UNCONFINED COMPRESSIVE STRENGTH TEST

B-2, S-3 3.5-5'



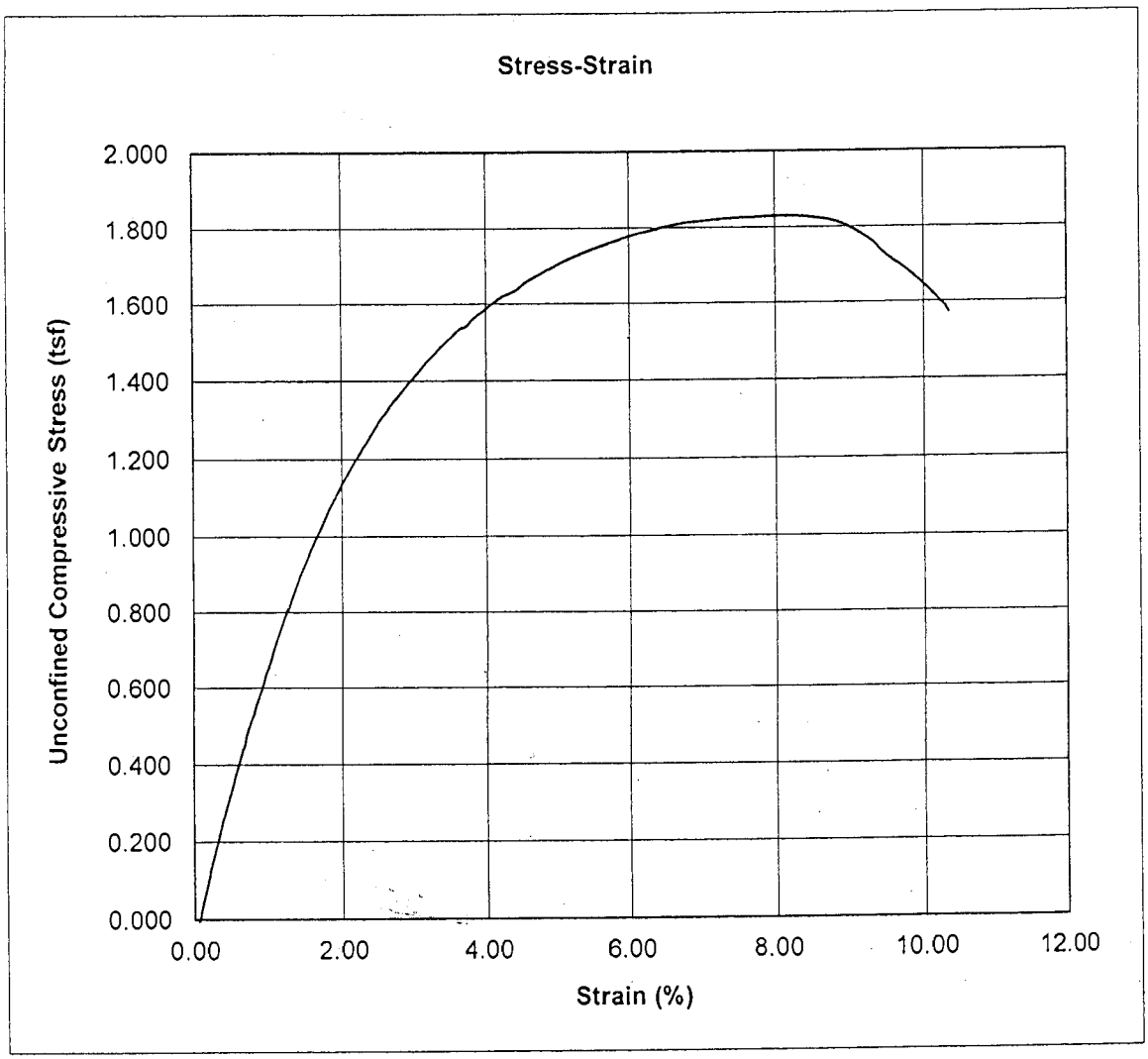
RESULTS OF UNCONFINED COMPRESSIVE STRENGTH TEST

B-5, S-3 3.5-5'



RESULTS OF UNCONFINED COMPRESSIVE STRENGTH TEST

B-7, S-3 3.5-5'



RESULTS OF UNCONFINED COMPRESSIVE STRENGTH TEST

B-9, S-3 3.5-5'

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

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

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	<2	Very Soft
500 – 1,000	2-3	Soft
1,001 – 2,000	4-6	Medium Stiff
2,001 – 4,000	7-12	Stiff
4,001 – 8,000	13-26	Very Stiff
8,000+	26+	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
50+	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz ($Si0_2$), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

PHYSICAL PROPERTIES:

DEGREE OF WEATHERING

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

HARDNESS AND DEGREE OF CEMENTATION

Limestone and Dolomite:

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

Shale, Siltstone and Claystone

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

Sandstone and Conglomerate

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

BEDDING AND JOINT CHARACTERISTICS

Bed Thickness	Joint Spacing	Dimensions
Very Thick	Very Wide	> 10′
Thick	Wide	3′ - 10′
Medium	Moderately Close	1′ - 3′
Thin	Close	2″ - 1′
Very Thin	Very Close	.4″ - 2″
Laminated	—	.1″ - .4″

Bedding Plane	A plane dividing sedimentary rocks of the same or different lithology.
Joint	Fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.
Seam	Generally applies to bedding plane with an unspecified degree of weathering.

SOLUTION AND VOID CONDITIONS

Solid	Contains no voids.
Vuggy (Pitted)	Rock having small solution pits or cavities up to ½ inch diameter, frequently with a mineral lining.
Porous	Containing numerous voids, pores, or other openings, which may or may not interconnect.
Cavernous	Containing cavities or caverns, sometimes quite large.

UNIFIED SOIL CLASSIFICATION SYSTEM

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

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

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

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

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

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

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

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

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

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

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

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

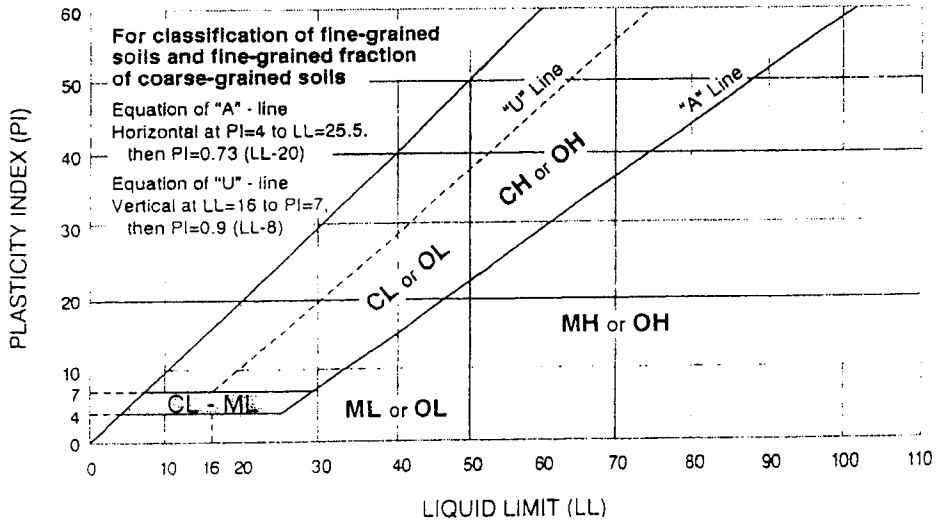
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

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

[O] PI < 4 or plots below "A" line.

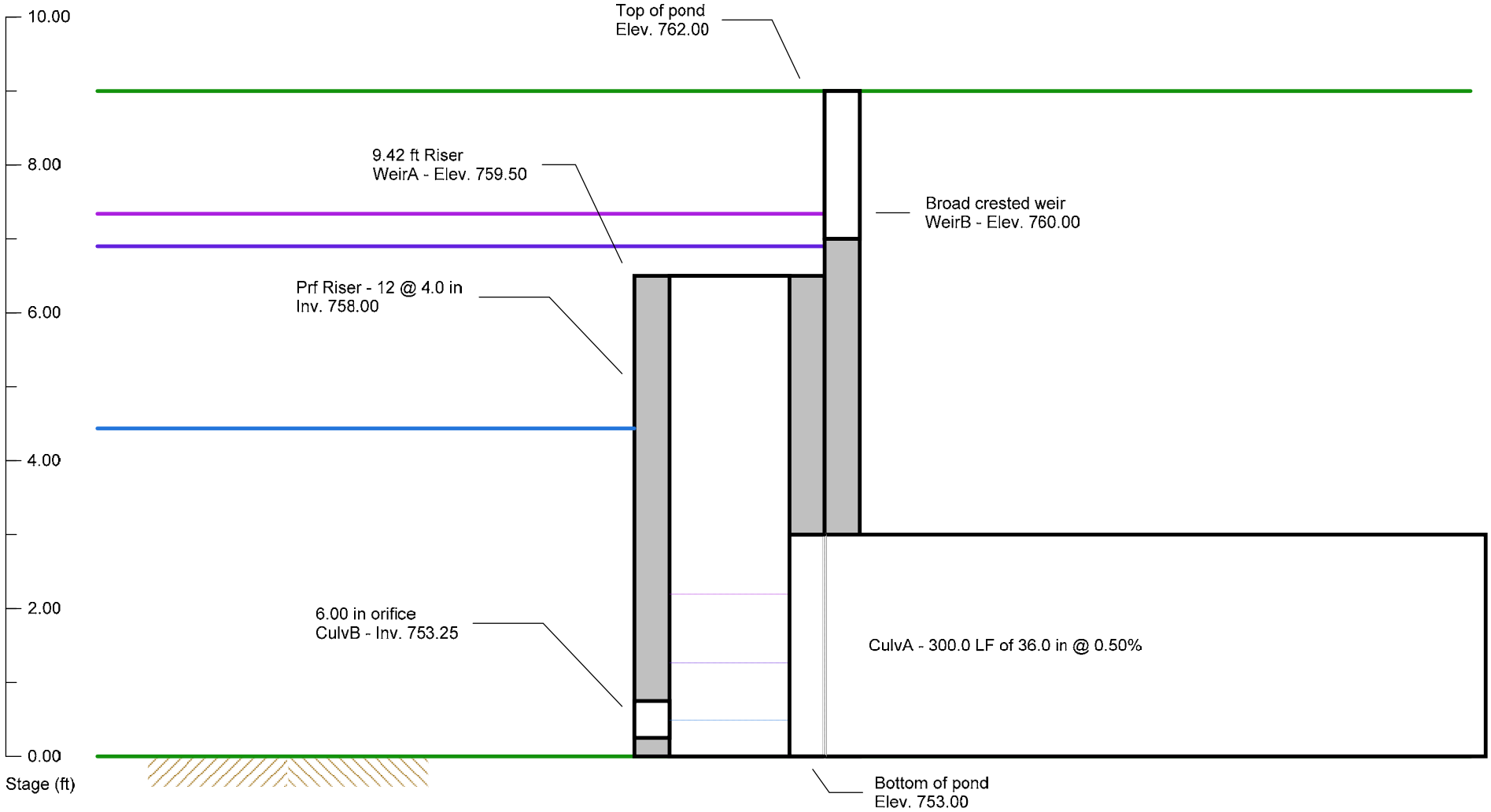
[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Appendix 4
Drainage Calculations

Pond No. 1 - Stormwater Pond



Section
NTS

100-yr
25-yr
2-yr

Inflow hydrograph = 38. Combine - To Pond (MD1,2ALT and MDC1,2)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Mar 25 2019

Downspout Rv3

Trapezoidal

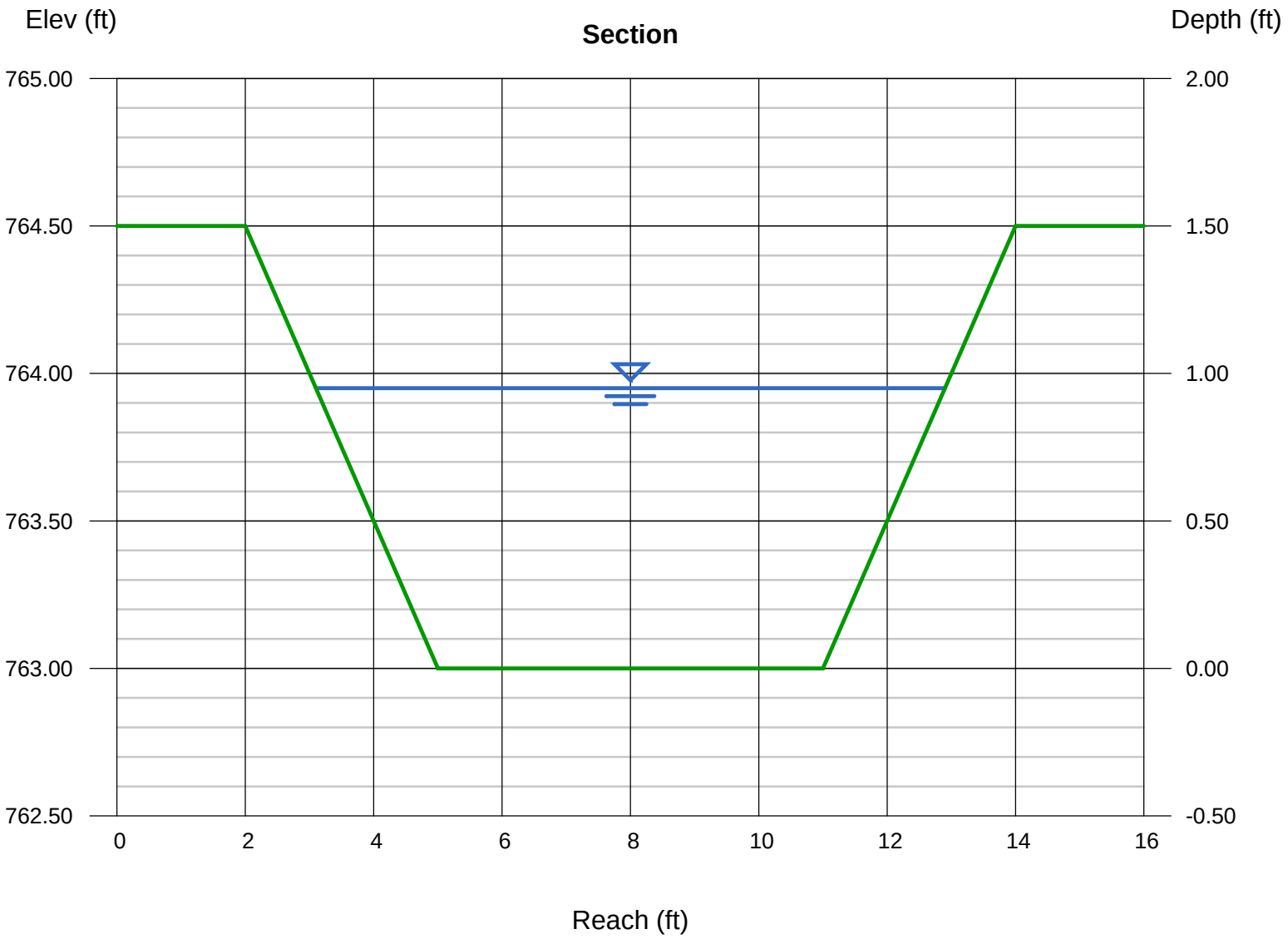
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 763.00
Slope (%)	= 25.00
N-Value	= 0.100

Calculations

Compute by:	Known Q
Known Q (cfs)	= 45.00

Highlighted

Depth (ft)	= 0.95
Q (cfs)	= 45.00
Area (sqft)	= 7.50
Velocity (ft/s)	= 6.00
Wetted Perim (ft)	= 10.25
Crit Depth, Yc (ft)	= 1.07
Top Width (ft)	= 9.80
EGL (ft)	= 1.51



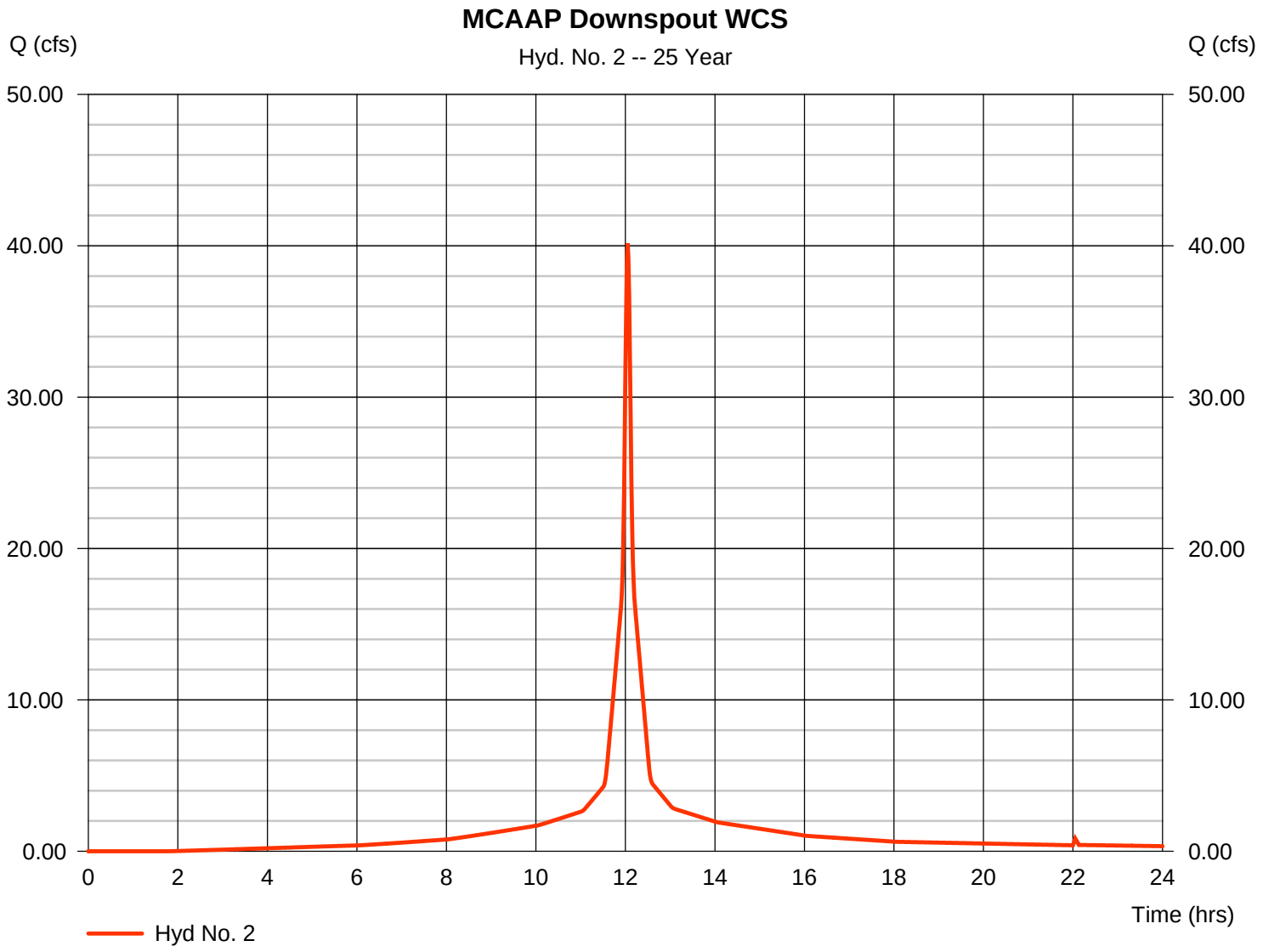
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Wednesday, 03 / 27 / 2019

Hyd. No. 2

MCAAP Downspout WCS

Hydrograph type	=	SCS Runoff	Peak discharge	=	40.16 cfs
Storm frequency	=	25 yrs	Time to peak	=	12.05 hrs
Time interval	=	1 min	Hyd. volume	=	127,953 cuft
Drainage area	=	5.360 ac	Curve number	=	94
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.00 min
Total precip.	=	7.29 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 2

MCAAP Downspout WCS

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 70.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.19		0.00		0.00		
Land slope (%)	= 25.00		0.00		0.00		
Travel Time (min)	**= 0.97**	**+**	**0.00**	**+**	**0.00**	**=**	**0.97**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 6.75		3.40		0.00		
Wetted perimeter (ft)	= 7.12		8.20		0.00		
Channel slope (%)	= 1.00		25.00		0.00		
Manning's n-value	= 0.030		0.100		0.015		
Velocity (ft/s)	=4.79						
			4.13				
					0.00		
Flow length (ft)	({0})583.0		250.0		0.0		
Travel Time (min)	**= 2.03**	**+**	**1.01**	**+**	**0.00**	**=**	**3.04**

Total Travel Time, Tc ..... 4.01 min

Channel Report

Terrace Berm WCS

Triangular

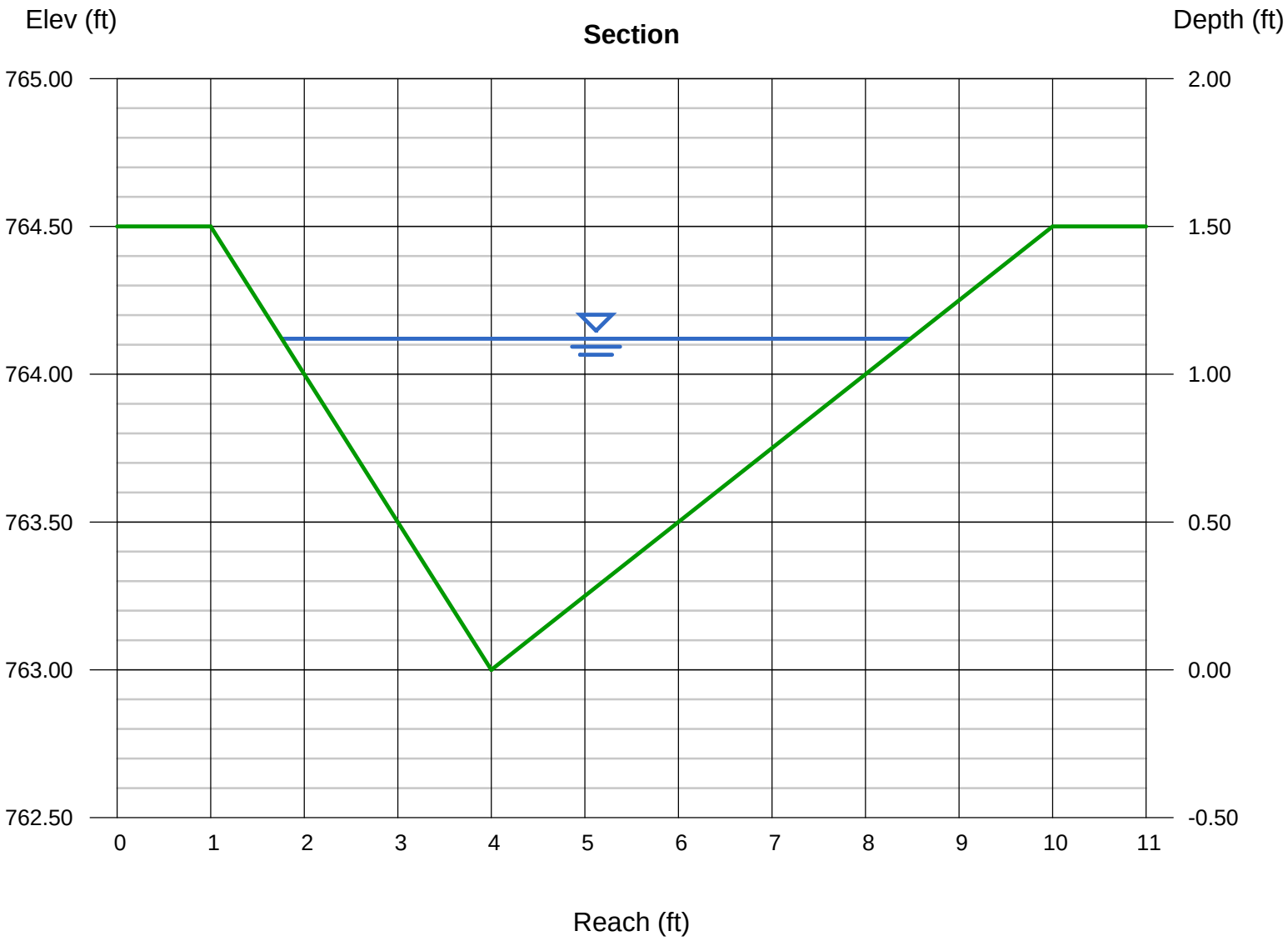
Side Slopes (z:1)	= 2.00, 4.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 763.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 12.00

Highlighted

Depth (ft)	= 1.12
Q (cfs)	= 12.00
Area (sqft)	= 3.76
Velocity (ft/s)	= 3.19
Wetted Perim (ft)	= 7.12
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 6.72
EGL (ft)	= 1.28



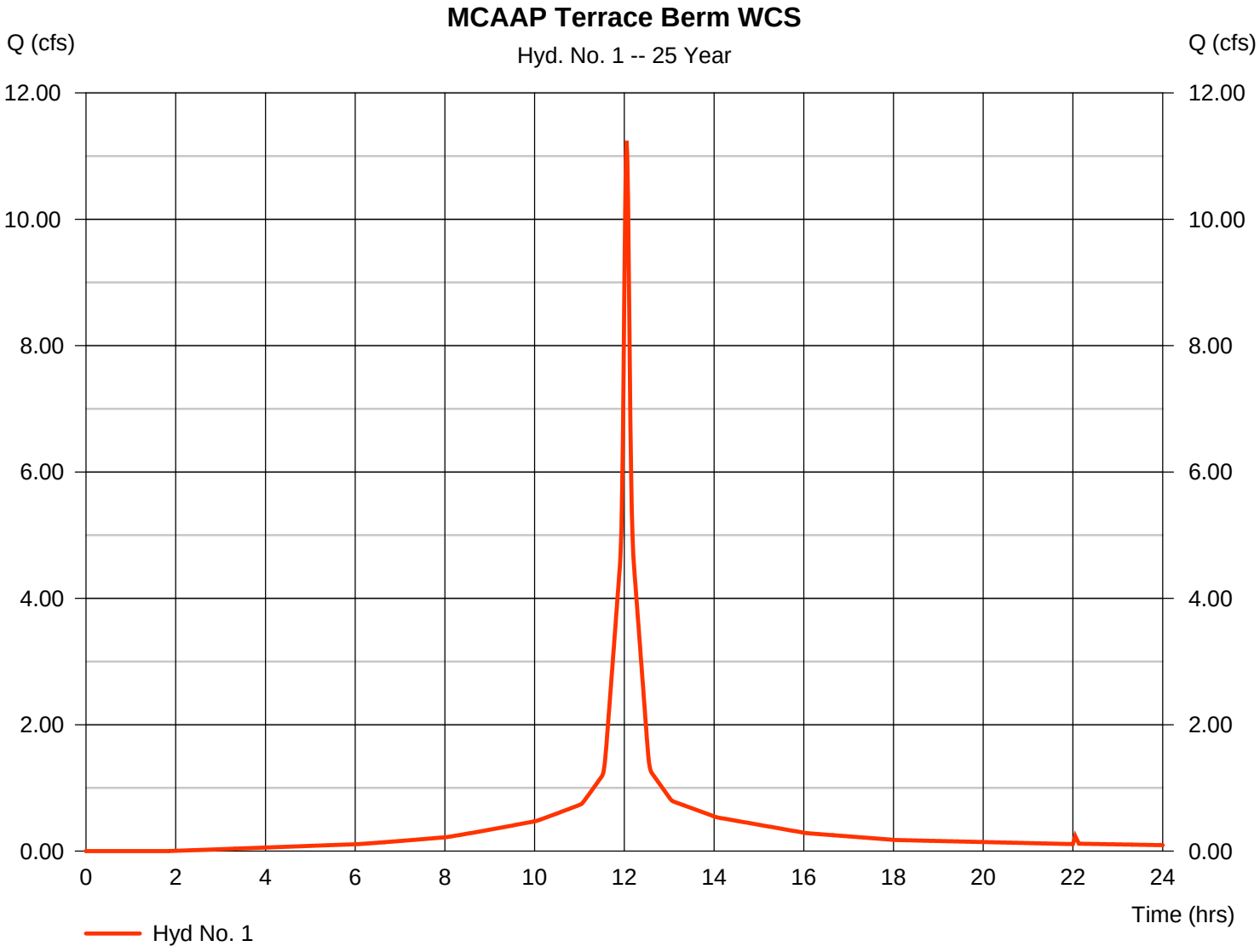
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 — Wednesday, 03 / 13 / 2019

Hyd. No. 1

MCAAP Terrace Berm WCS

Hydrograph type	= SCS Runoff	Peak discharge	= 11.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.05 hrs
Time interval	= 1 min	Hyd. volume	= 35,808 cuft
Drainage area	= 1.500 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 3.80 min
Total precip.	= 7.29 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 1

MCAAP Terrace Berm WCS

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 200.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.19		0.00		0.00		
Land slope (%)	= 25.00		0.00		0.00		
Travel Time (min)	**= 2.25**	**+**	**0.00**	**+**	**0.00**	**=**	**2.25**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 6.75		0.00		0.00		
Wetted perimeter (ft)	= 7.12		0.00		0.00		
Channel slope (%)	= 1.00		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.79						
			0.00				
					0.00		
Flow length (ft)	({0})440.0		0.0		0.0		
Travel Time (min)	**= 1.53**	**+**	**0.00**	**+**	**0.00**	**=**	**1.53**

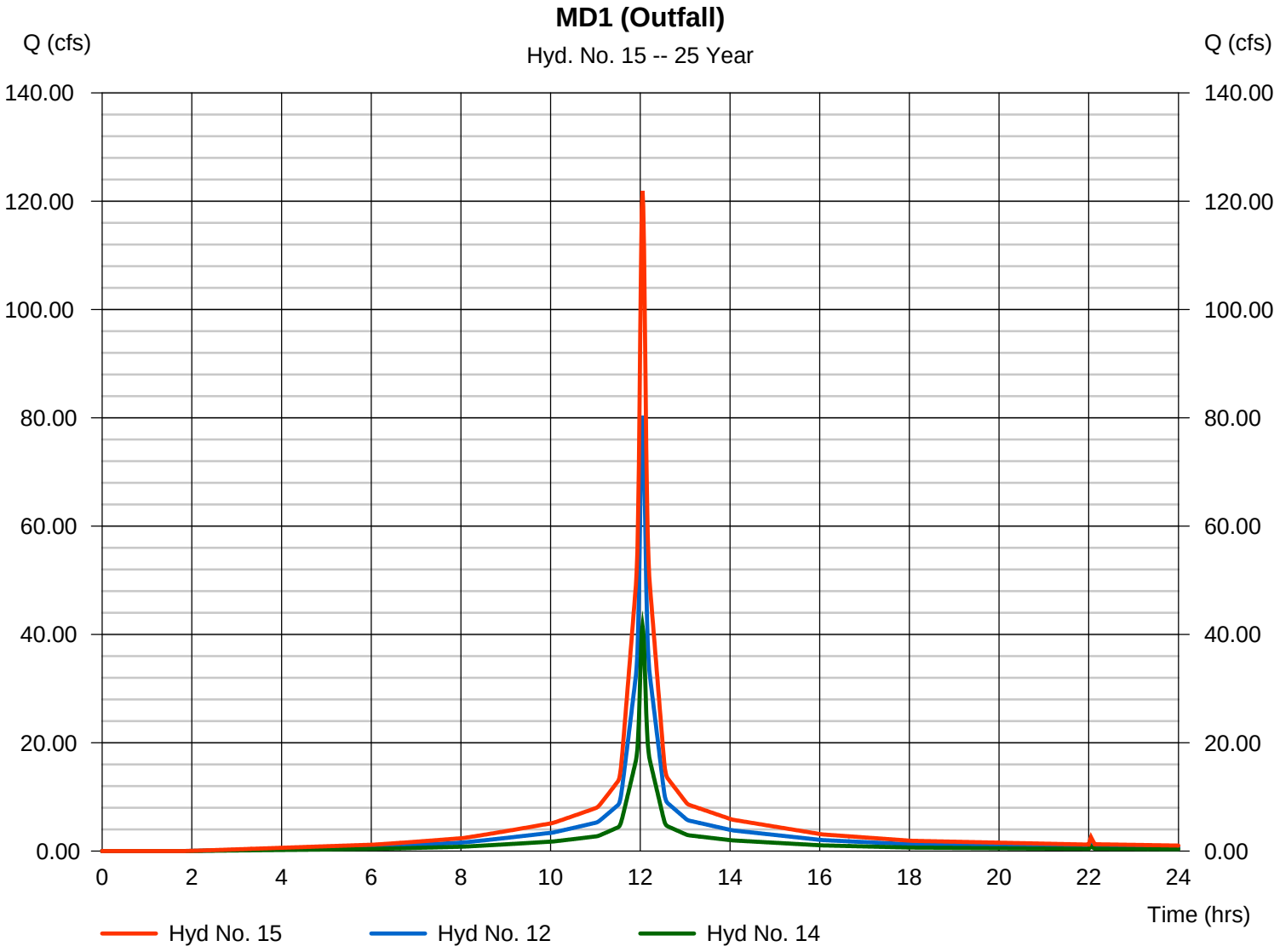
Total Travel Time, Tc ..... 3.78 min

Hydrograph Report

Hyd. No. 15

MD1 (Outfall)

Hydrograph type	=	Combine	Peak discharge	=	121.92 cfs
Storm frequency	=	25 yrs	Time to peak	=	12.05 hrs
Time interval	=	1 min	Hyd. volume	=	388,425 cuft
Inflow hyds.	=	12, 14	Contrib. drain. area	=	0.000 ac



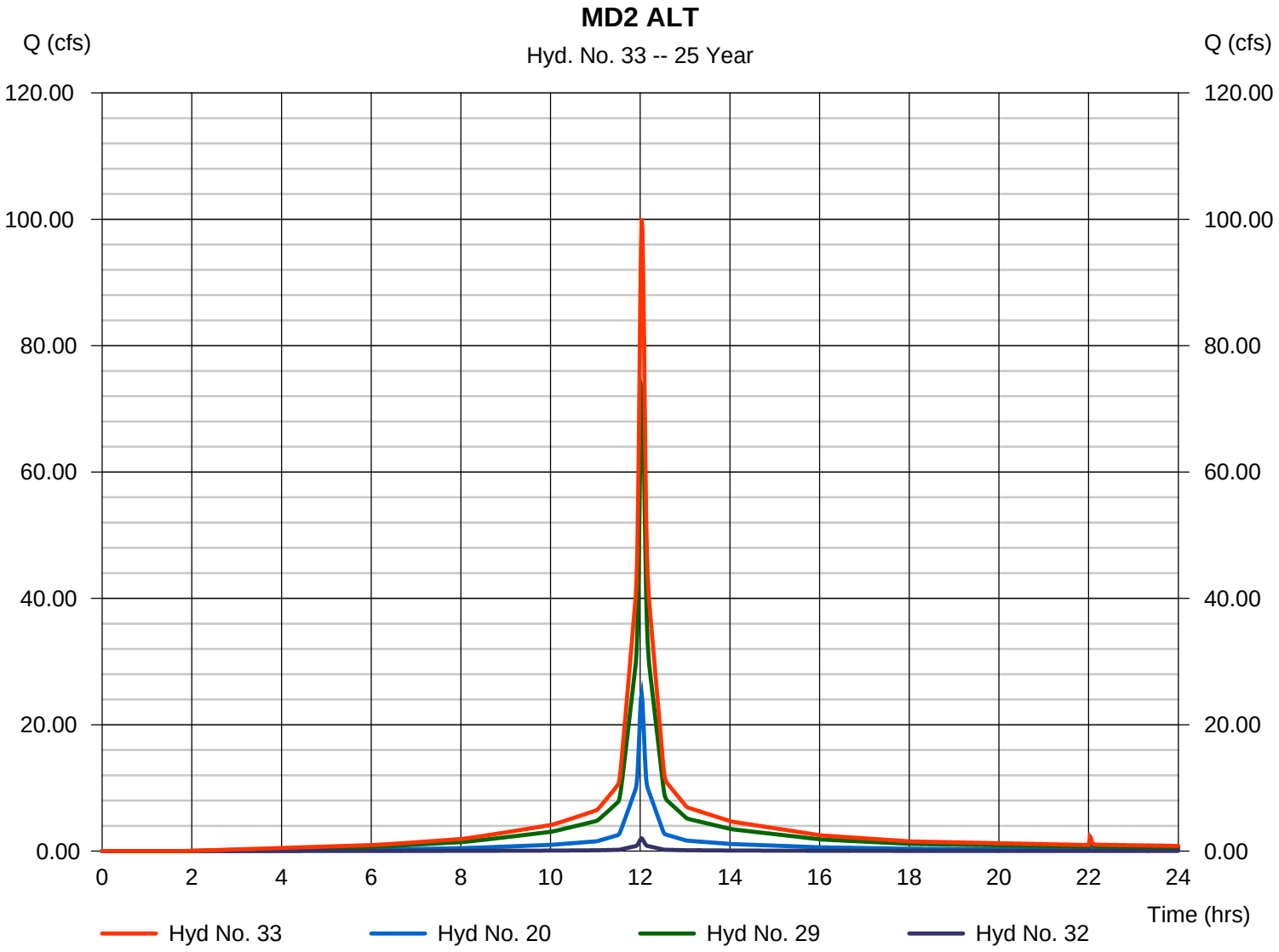
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Wednesday, 03 / 27 / 2019

Hyd. No. 33

MD2 ALT

Hydrograph type	=	Combine	Peak discharge	=	100.12 cfs
Storm frequency	=	25 yrs	Time to peak	=	12.03 hrs
Time interval	=	1 min	Hyd. volume	=	311,886 cuft
Inflow hyds.	=	20, 29, 32	Contrib. drain. area	=	3.610 ac



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 28 2019

North Channel

Trapezoidal

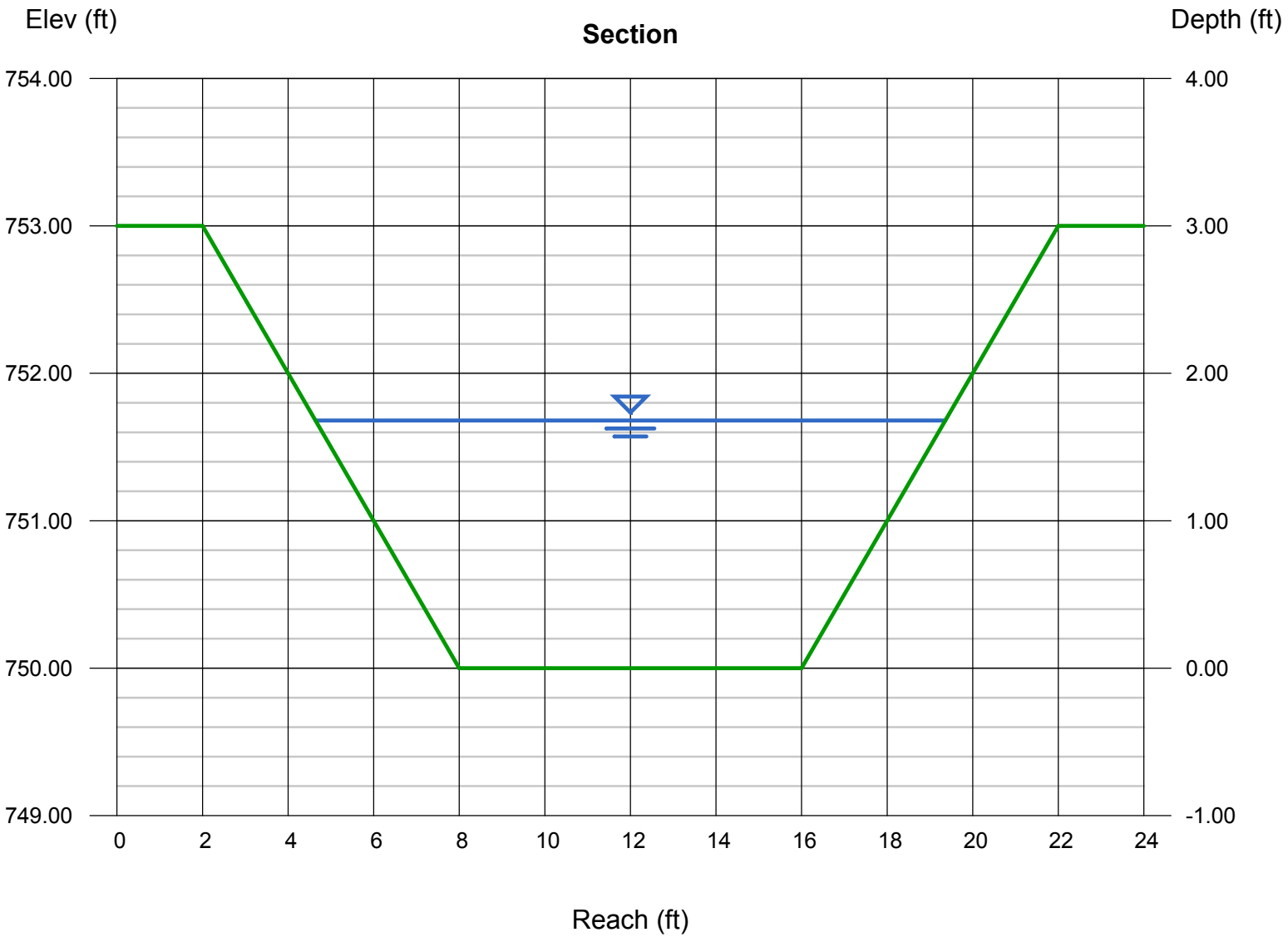
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 750.00
Slope (%)	= 0.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 76.50

Highlighted

Depth (ft)	= 1.68
Q (cfs)	= 76.50
Area (sqft)	= 19.08
Velocity (ft/s)	= 4.01
Wetted Perim (ft)	= 15.51
Crit Depth, Yc (ft)	= 1.27
Top Width (ft)	= 14.72
EGL (ft)	= 1.93



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 28 2019

North Outfall

Trapezoidal

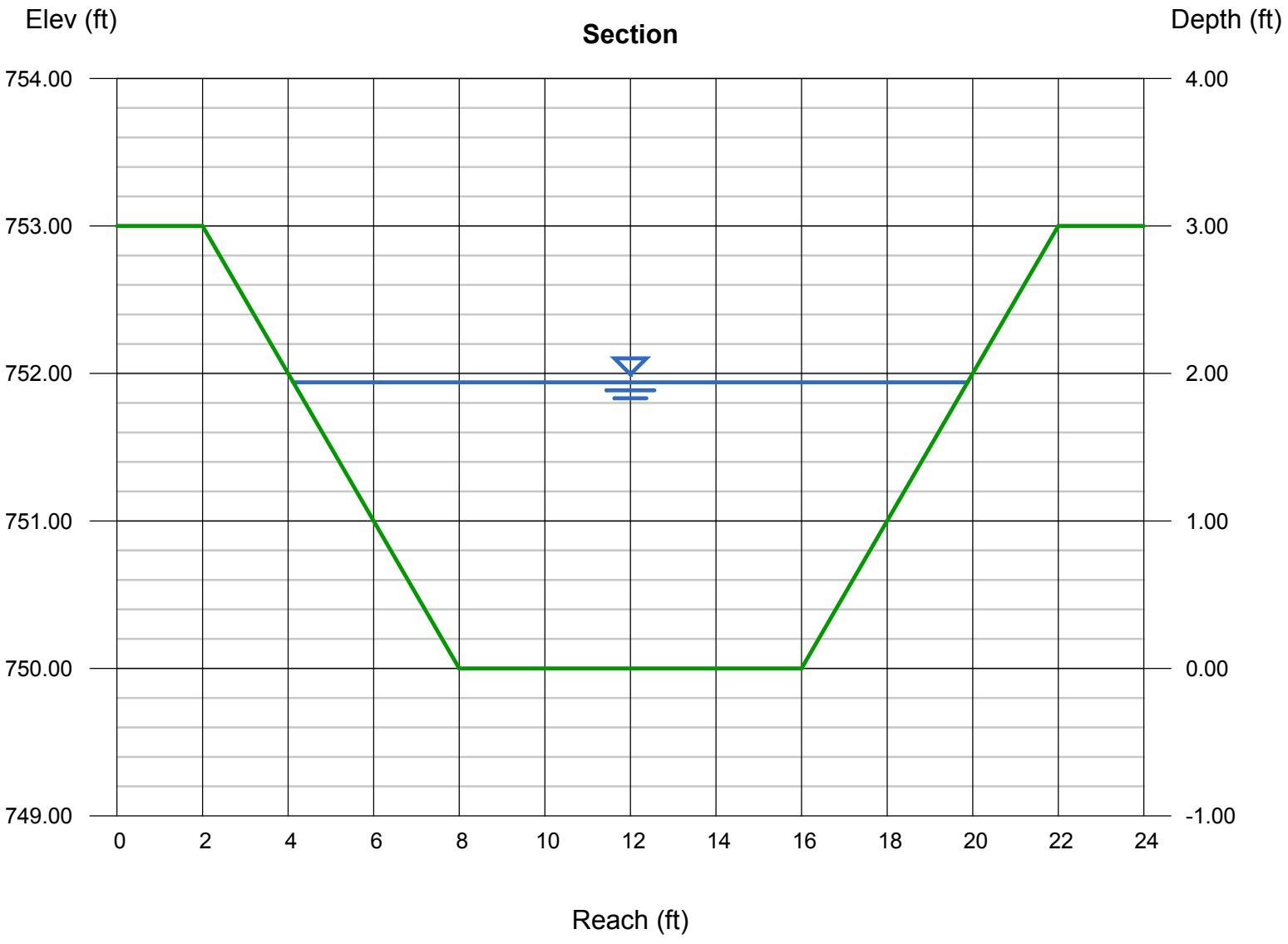
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 750.00
Slope (%)	= 0.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 100.12

Highlighted

Depth (ft)	= 1.94
Q (cfs)	= 100.12
Area (sqft)	= 23.05
Velocity (ft/s)	= 4.34
Wetted Perim (ft)	= 16.68
Crit Depth, Yc (ft)	= 1.49
Top Width (ft)	= 15.76
EGL (ft)	= 2.23

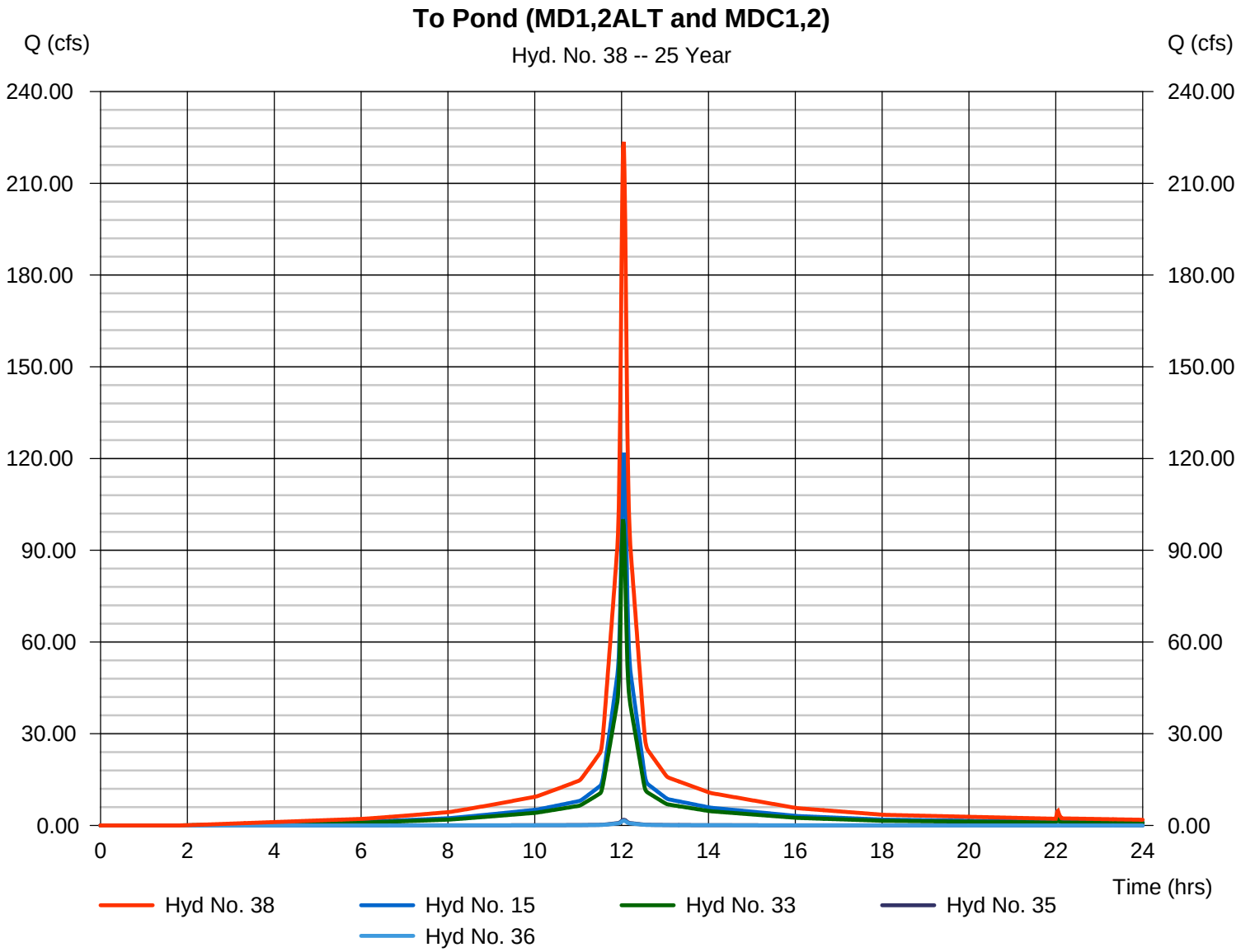


Hydrograph Report

Hyd. No. 38

To Pond (MD1,2ALT and MDC1,2)

Hydrograph type	= Combine	Peak discharge	= 223.55 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.05 hrs
Time interval	= 1 min	Hyd. volume	= 711,292 cuft
Inflow hyds.	= 15, 33, 35, 36	Contrib. drain. area	= 0.460 ac



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

South Channel

Trapezoidal

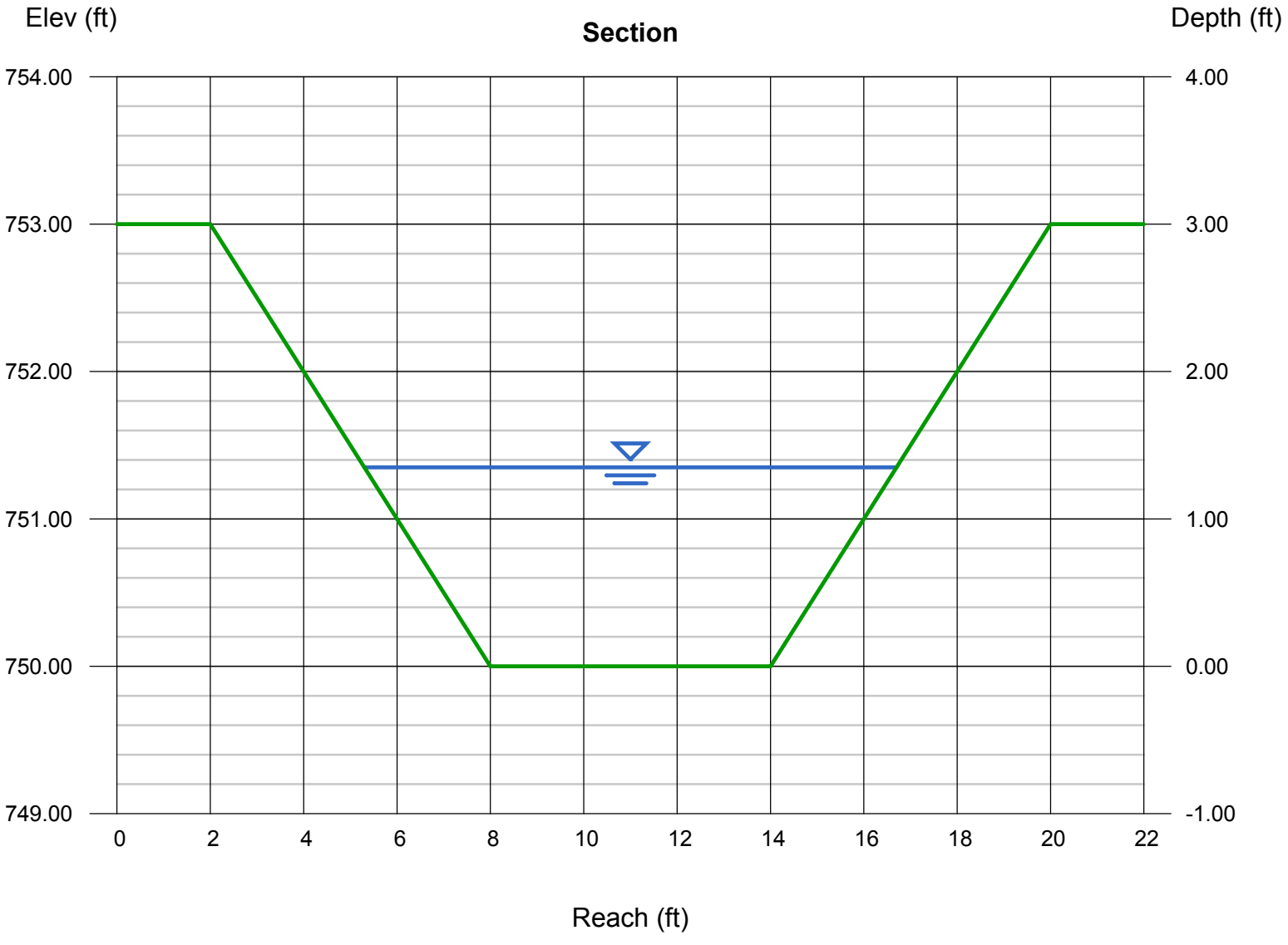
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 750.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 57.14

Highlighted

Depth (ft)	= 1.35
Q (cfs)	= 57.14
Area (sqft)	= 11.74
Velocity (ft/s)	= 4.87
Wetted Perim (ft)	= 12.04
Crit Depth, Yc (ft)	= 1.23
Top Width (ft)	= 11.40
EGL (ft)	= 1.72



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 28 2019

South Outfall

Trapezoidal

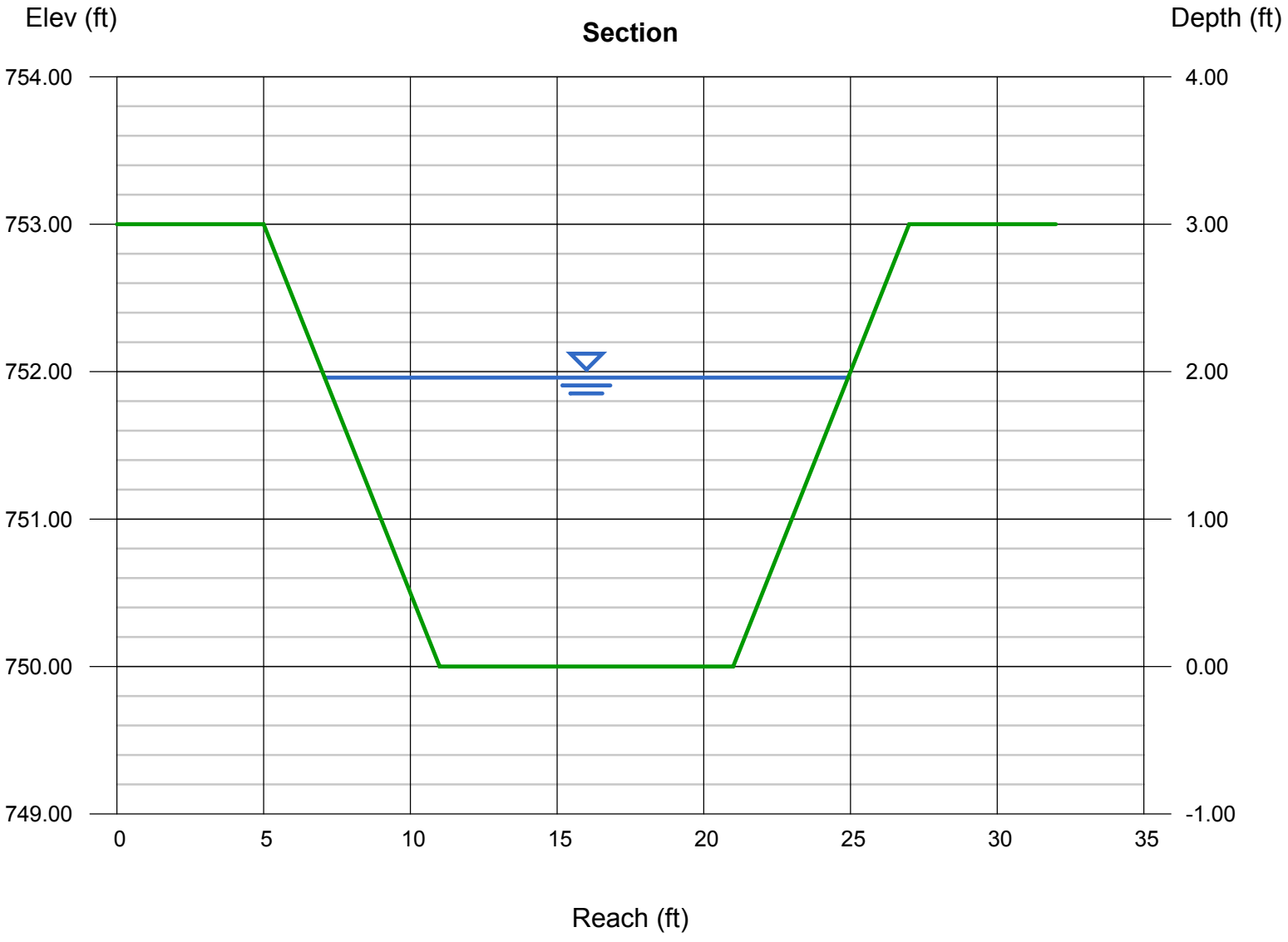
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 750.00
Slope (%)	= 0.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 121.92

Highlighted

Depth (ft)	= 1.96
Q (cfs)	= 121.92
Area (sqft)	= 27.28
Velocity (ft/s)	= 4.47
Wetted Perim (ft)	= 18.77
Crit Depth, Yc (ft)	= 1.50
Top Width (ft)	= 17.84
EGL (ft)	= 2.27



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 28 2019

West Channel

Trapezoidal

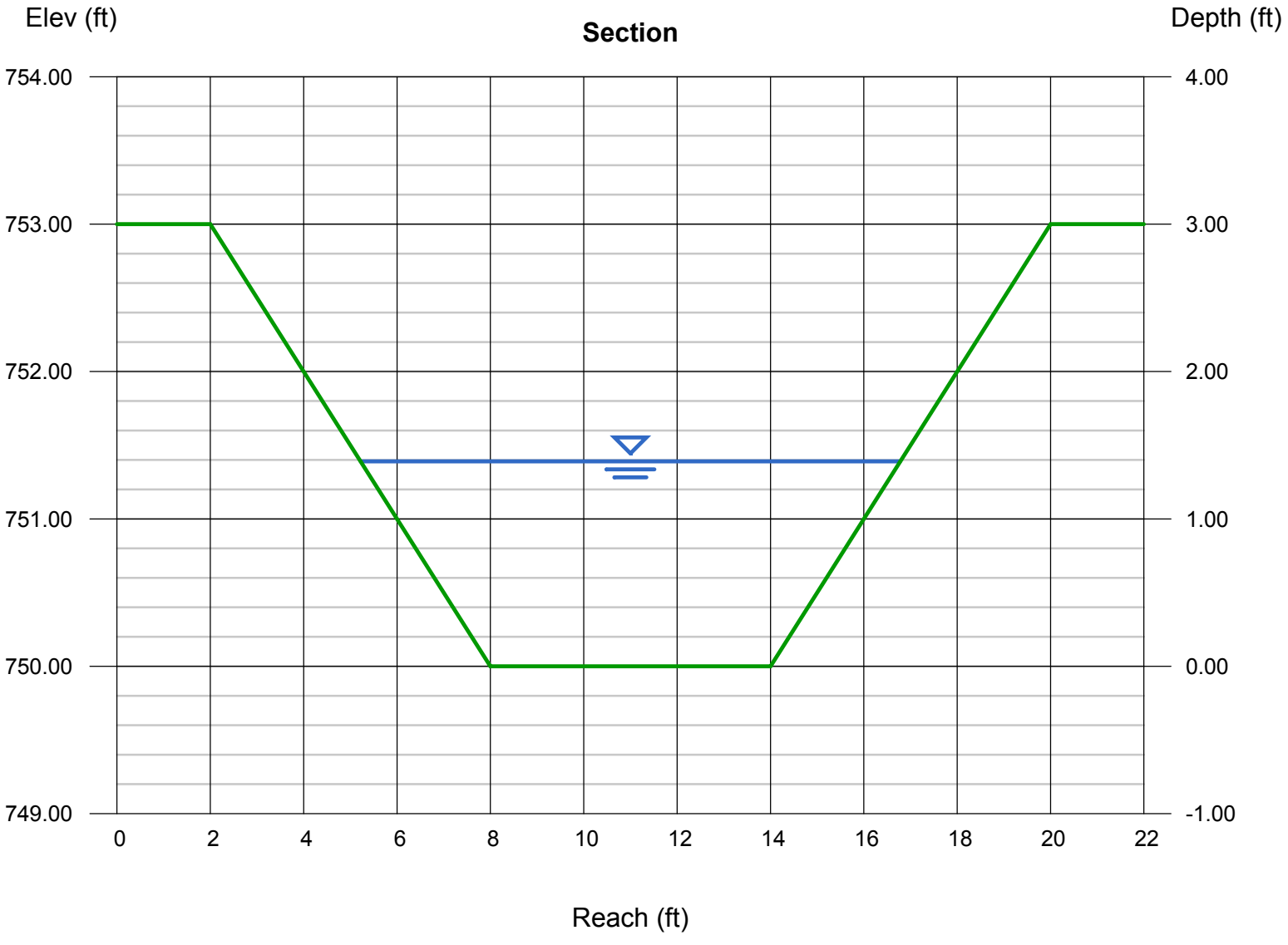
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 750.00
Slope (%)	= 0.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 42.20

Highlighted

Depth (ft)	= 1.39
Q (cfs)	= 42.20
Area (sqft)	= 12.20
Velocity (ft/s)	= 3.46
Wetted Perim (ft)	= 12.22
Crit Depth, Yc (ft)	= 1.03
Top Width (ft)	= 11.56
EGL (ft)	= 1.58



Appendix 5
Life and Design Calculations

LIFE AND DESIGN CALCULATIONS
MCALESTER ARMY AMMUNITION PLANT

I. Life and Design Capacity of Facility

The original design capacity for the McAlester Army Ammunition Plant Landfill (Landfill) is approximately 400,325 cubic yards (cy). A summary of the capacity increase associated with this Landfill expansion is listed below:

Original Design Capacity	400,325 cy
Proposed Capacity Increase due to Landfill expansion	1,252,326 cy
New Design Capacity	1,652,651 cy

The existing permitted landfill has a remaining airspace of 25,654 cy (as of December 31, 2018). The proposed vertical expansion of the Landfill will increase the remaining airspace to 1,277,980 cy.

In accordance with Oklahoma Administrative Code (OAC) 252:515-27-8, an economic "life of site" estimate has been developed using the following formula:

$L = \{[V - (P \times V)] \times D\} \div W$, where

L = Life of the disposal facility in years;
V = Total volume of airspace available for waste disposal and daily cover in cubic yards;
P = Annual percentage of “V” that will be consumed by daily cover;
D = Anticipated density of waste compacted in-place in pounds per cubic yard; and
W = Amount of waste received in the previous year in pounds.

The design life of site calculation was performed utilizing the amount of waste received in the previous year (2018: 2,145.49 tons) and the assumption that P = 20% and a conservative D = 500 pounds per cubic yard (lbs/cy) (OAC 252:515- 27-8(a)(2) uses 1000 lbs/cy). Utilizing the above values and equation, the remaining design life of the disposal facility is estimated to be approximately 119 years as of January 1, 2019. The actual life of the facility will vary depending on factors such as actual disposal rates, types of materials disposed, amount of daily and intermediate cover materials used, the settlement and decomposition of in-place wastes, and the in-place density achieved over the operational life of the facility.

II. Soil Borrow Volume

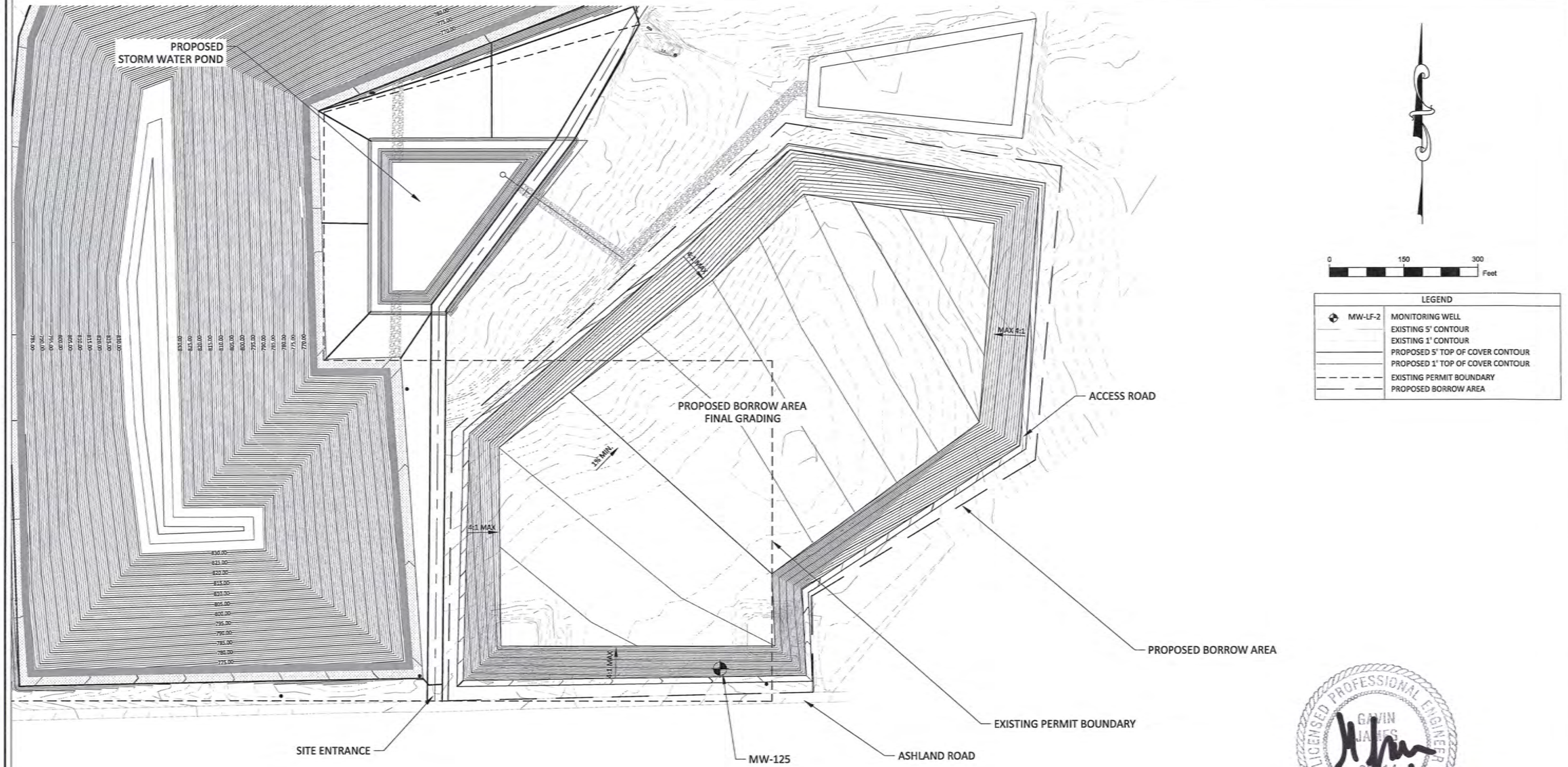
The proposed expansion will require an increase in the amount of soil borrow in order to operate and complete final closure of the Landfill. The amount of soil borrow volume required will include daily cover, intermediate and final cover as well as storm water diversion and earthen channel material requirements. The daily cover volumes can be estimated using the Oklahoma Department of Environmental Quality’s (ODEQ’s) percentage (20% cited above) of total airspace capacity. Therefore the daily cover volume required is:

1,277,980 cy X 0.20 = 255,596 cy

The intermediate and final cover calculated from the design (2.0 feet of clayey on-site material and 1.0 foot of vegetative layer) will require 140,275 cy.

The storm water control will require an additional 38,000 cy of earthen material. Therefore, the total amount of borrow volume required is approximately 433,871 cy.

The final grading for the borrow area proposed as part of the Landfill's vertical expansion is shown on **Figure 5-1**. The total volume of available borrow material is 584,387 cy.



LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

LICENSED PROFESSIONAL ENGINEER
GAVIN JAMES
OKLAHOMA
11/14/19

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
1	11/6/2019	REMOVED PERMIT EXPANSION BOUNDARY	MD	GJJ

EOR	DRAWN
GJJ	MD
PM	CHECKED
CBM	EB

McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

BORROW AREA FINAL GRADING PLAN

PITTSBURG COUNTY, OKLAHOMA

PREPARED FOR:
US Army Corps of Engineers

PREPARED BY:
ALL CONSULTING
GOVERNMENT RELATIONS - ENERGY - PLANNING - TECHNOLOGY ENGINEERING - ENVIRONMENTAL
1718 SOUTH CHEYENNE AVE, TULSA, OK 74119
PHONE: 918.382.7581
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PN #1720.PMT
JUNE 2019

Figure 5-1

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Appendix 6
Groundwater Monitoring Program

GROUNDWATER MONITORING PROGRAM
MCALESTER ARMY AMMUNITION PLANT

I. Introduction

A. Purpose and Scope.

The objective of collecting groundwater for analysis is to provide a sample to the laboratory which represents the same geochemical conditions which occur in the aquifer. Because certain parameters are more susceptible to change than others, various techniques are needed depending on what will be tested. The purpose of this monitoring plan is to discuss sample collection techniques for the parameters which will be sampled from the groundwater monitoring wells at the proposed landfill site, McAlester Army Ammunition Plant (MCAAP). Groundwater monitoring well locations are shown in **Figure 6-1**. The parameters to be tested in the groundwater samples are listed in **Table 6-1**.

Table 6-1:
Parameters to Be Tested

Parameter	Frequency
pH	Semi-Annually
Specific Conductivity	Semi-Annually
Chemical Oxygen Demand (COD)	Semi-Annually
Calcium	Semi-Annually
Chloride	Semi-Annually
Explosives	Semi-Annually
Magnesium	Semi-Annually
Metals	Semi-Annually
Nitrate	Semi-Annually
Sodium	Semi-Annually
Carbonates	Semi-Annually
Potassium	Semi-Annually
Sulfate	Semi-Annually
SVOCs	Semi-Annually
VOCs	Semi-Annually

B. Sampling Strategy.

The best sequence of operations for sampling is as follows:

1. Evacuate slow recharge wells at the outset of the sampling day.
2. Evacuate and sample other wells.
3. Sample slow rechargers, if possible.
4. Return to lab and preserve samples.
5. Prepare samples for shipment.
6. Deliver samples to shipping station.

Do not sample more wells than can be prepared for shipment in one day. Refrigerate samples as soon as sampling is complete or more frequently if sampling is not proceeding expeditiously. Most of the wells will not recharge very quickly.

II. Collection

A. Static Water Levels.

Before any other work is done at the well, the water level shall be taken with an electric probe or other suitable means, and measured from the top of the casing or opening in the well cap. Record the water level to the nearest hundredth of a foot in the logbook (described below) as well as any problems noted with the general condition of the well. Rinse the probe in distilled/deionized water immediately before lowering it into the well and after removing it from the well.

B. Well Evacuation Procedures.

Prior to sample collection, sampling personnel will purge the monitoring wells of stagnant water to ensure that representative water of the groundwater system is collected for analysis. Wells will be purged utilizing submersible electrical pumps or bailers. Purging will generally procedures outlined in the ASTM Standard D 6771-02, "Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Groundwater Quality Investigations." Tubing or Teflon bailers will be dedicated to a single well and disposed of after the well is purged and sampled.

An adequate purge volume is normally achieved when three to five well volumes of standing water in the well have been removed. However, with low flow purging techniques the parameters typically stabilize before three well volumes, negating the need to purge a full three to five well volumes. Field sampling personnel will monitor pH, specific conductance, dissolved oxygen, temperature, and turbidity of the groundwater removed during purging and recorded these parameters and the volume of water removed. Purging is considered to be complete when the well is pumped dry, or when three consecutive readings for the aforementioned parameters are within the following limits.

pH: (±0.1 unit),

Specific Conductance: (10%),

Dissolved Oxygen: (10% for values greater than 0.5 mg/L, or three consecutive measurements of less than 0.5 mg/L),

Temperature: (stable for three consecutive readings),

Turbidity: (10% for values greater than 5 NTU, or three consecutive measurements of less than 5 NTU)

Measurements will be taken on a frequency that is based on the initial calculated purge volume to ensure a sufficient number of readings to evaluate stability. Groundwater sampling logs will be prepared and submitted along with copies of the sample chains of custody in the semi-annual reports submitted to ODEQ.

C. Well Setups Used at the landfill.

All of the monitoring wells at the landfill are open wells. These wells, which do not contain dedicated equipment, should be evacuated with a Teflon bailer or a peristaltic pump in accordance with ASTM Standard D6771-02. Dedicated disposable equipment will be used for each individual well to minimize cross-contamination.

D. Well Sampling

1. General Procedures.

All monitoring wells should be sampled using a low flow sampling procedure with independent dedicated equipment for individual wells. The pump should be set at the mid-screen point in each well, or at a point representing the middle of the water column if the top of the water is below the screen. The field sampler should fill laboratory provided sample containers in accordance with the method specified sampling procedure. **Table 6-2** lists the requirements for all of the parameters at the site.

2. Field Measured Parameters.

Prior to sample collection, pH and Specific Conductance should be determined in the field with pH and conductivity meters. Enough groundwater should be collected and put into a beaker to allow the electrodes to be immersed. Calibrate the meter with two of the buffer solutions, either pH 4.0 and 7.0 or pH 7.0 and 9.0, and then measure and record the pH of the sample to the nearest 0.05 unit. The electrodes should be rinsed with distilled/deionized water between each sample. After the pH measurements, determine the specific conductance in a similar manner, following the directions with the conductivity meter. The approximate temperature must be known, which can be determined from the pH meter. Rinse the probe between samples. Discard this sample when pH and specific conductance measurements are completed.

Table 6-2:
Sampling Procedures for Parameters to Be Tested

Parameter	Container	Refrigeration Required	Preparation
pH	NA	NA	Field measurement
Specific Conductivity	NA	NA	Field measurement
COD	1-liter glass or plastic	Yes	Sulfuric acid to pH<2
Metals, Calcium, Sodium, Potassium,	1-liter plastic	Yes	Nitric acid to pH<2
Chloride, Sulfate, Nitrate	1-liter glass or plastic	Yes	None required

Explosives	2-liter glass	Yes	Brim full, no air bubbles or agitation
Magnesium	1-liter glass	Yes	None required
Carbonates	1-liter glass or plastic	Yes	None required
SVOCs	2-liter glass	Yes	Brim full, no air bubbles or agitation
VOCs	2-40 milliliter glass	Yes	Brim full, no air bubbles or agitation
COD = Chemical Oxygen Demand SVOC = Semivolatile Organic Compound VOC = Volatile Organic Compound			

III. Preparation Techniques

A. Sample Preparation.

1. Refrigeration.

Samples must be kept under refrigeration as much as possible. After collection is complete, put the samples into the refrigerator. Remove them to filter and preserve them, and return them to the refrigerator until they are put into the ice chests for shipment. Refrigerate all of the samples if space permits. Otherwise refrigerate only those so indicated in **Table 6-1**.

2. Chemical Preservatives.

Chemical preservatives such as acids (sulfuric, and nitric) are added in accordance with accepted analytical method requirements to prevent chemical reactions which would change the concentration of the parameter to be tested. In general, the appropriate amount of preservatives are supplied within the containers provided by the receiving analytical laboratory. However, there may be occasions when the laboratory provides the preservative separately for addition to the sample container following sample collection. In such cases, the laboratory will supply the required amount of preservative based upon the anticipated sample volume.

B. Blanks.

Blanks are used to verify that the sample collection and handling processes have not resulted in cross contamination. Blanks are typically provided by the laboratory. If no blanks are provided, the two types of blanks to be prepared are described below.

1. Travel Blanks.

At the onset of the sampling event, a set of containers will be filled with distilled/deionized water and transported within the sampling cooler during field sampling activities. The Travel Blanks will have appropriate labels affixed travel blank labels and will be shipped to the receiving analytical laboratory along with the monitoring well samples. Travel blanks will be analyzed for VOCs.

2. Equipment Blanks.

In the event that non-dedicated and/or non-disposable equipment is used to collect groundwater samples, a set of containers will be filled by running distilled/deionized water drawn sampling equipment used that day after it has been cleaned and rinsed. Use the same preservation procedures as described above. Equipment Blanks will be shipped along with the monitoring well samples to the receiving laboratory and analyzed for the same suite of parameters as the monitoring well samples.

C. Cleaning.

Non-disposable field equipment that is not used to sample for organics may be cleaned with distilled/ deionized water and allowed to air dry. Other non-disposable field equipment used in organics sampling must be cleaned with a non-phosphate detergent, such as Liquinox ®, rinsed with distilled/deionized water and allowed to air dry.

IV. SHIPMENT

Place all sample containers in resealable plastic bags and stored in coolers on ice. Samples in glass containers should be wrapped in plastic packing material prior to final packaging. Place all samples in doubled resealable plastic bags, inside a doubled plastic trash bag inside a cooler. Ensure that ice and appropriate sample blanks are packed with the field sample shipment in accordance with laboratory specifications. Place the chain of custody document inside a resealable plastic bag, separate from ice. Apply custody seals and secured the cooler with shipping tape. Deliver the ice chests to the shipping station.

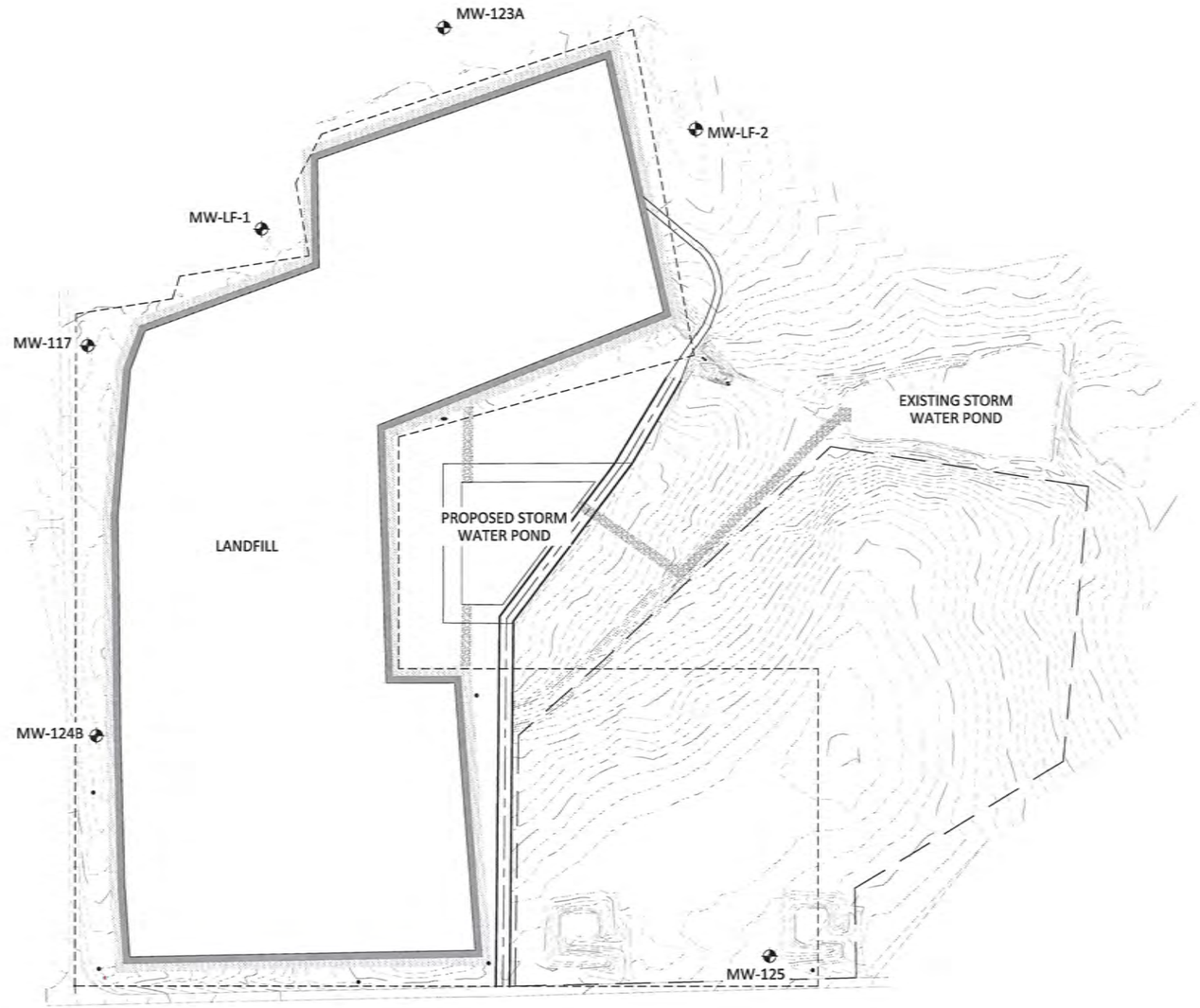
V. PAPERWORK

A. Field Logs.

Keep a field log of all operations and record the following: well number, date, water level, well evacuation procedure and rate of recharge, sample method, pH and conductivity readings, any unusual conditions noted (odor or color of water, well damage, etc.), time of collection, time of preservation, time dropped off at shipping station, your names, and any information regarding blanks. The field logs will be included in the semi-annual reports submitted to ODEQ.

B. Chain of Custody Form.

The chain of custody form is required to establish possession of the samples from their collection to their final receipt in the laboratory. The form shall be filled in accordance with laboratory requirements and signed by the field sample collector and the sample preparer. The chain of custody will be enclosed in the sample cooler and samples will remain within sight or secured at all times.



0 300 600 Feet

LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

LICENSED PROFESSIONAL ENGINEER
GAVIN J. JONES
OKLAHOMA

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
1	11/6/2019	REMOVED PERMIT EXPANSION BOUNDARY	MD	GJJ

EOR	DRAWN
GJJ	GJJ
PM	CHECKED
CBM	EB

McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

SITE LAYOUT

PITTSBURG COUNTY, OKLAHOMA

PREPARED FOR:
US Army Corps of Engineers

PREPARED BY:
ALL CONSULTING
GOVERNMENT RELATIONS - ENERGY - PLANNING - TECHNOLOGY
ENGINEERING - ENVIRONMENTAL
1718 SOUTH CHEYENNE AVE, TULSA, OK 74119
PHONE: 918.382.7581
WWW.ALL-LLC.COM

PN #1720.PMT
JUNE 2019

Figure 6-1

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Appendix 7
Landfill Operation Plan

LANDFILL OPERATIONS PLAN
MCALESTER ARMY AMMUNITION PLANT

I. Introduction

The McAlester Army Ammunitions Plant Landfill (Landfill) is owned by the U.S. Government and is operated by McAlester Army Ammunitions Plant (MCAAP) personnel. The Landfill operates under Oklahoma Department of Environmental Quality (ODEQ) Solid Waste Permit Number 3561014. The Landfill only accepts non-hazardous industrial waste from operations at the MCAAP in accordance with the permit.

This document constitutes an operating plan for the Landfill and is intended to provide a reference and directive for operating and maintaining the Landfill facility. The Landfill Operations Plan is to be used in conjunction with the latest version of approved permit design drawings and the July 2019 RCRA-D NHIW Landfill Permit Modification Application. Together, these documents describe the daily operational procedures and protocol to be followed to ensure continued compliance while protecting public health and safety.

The Landfill Operations Plan will need to be updated periodically to reflect current operations. Revisions to this document may require submittal to ODEQ for review and approval.

A. Operating Hours

The normal operating hours for the Landfill are from 0730 to 1500 hours, Monday through Thursday except on holidays. The operating hours may change during times when specific high-priority projects conducted within MCAAP are needed. Asbestos will be disposed of by appointment only.

B. Personnel and Equipment

An equipment operator/attendant will be on duty any time wastes are delivered to the Landfill. Landfill personnel are responsible for compiling and maintaining Landfill records, filing facility reports with ODEQ, interfacing with solid waste collection personnel, and operating and maintaining the Landfill. Working together, the personnel are collectively responsible for operating and maintaining the Landfill and associated Landfill facilities in a manner consistent with this Landfill Operations Plan, the facility permit, and applicable ODEQ rules and regulations. Personnel training regarding Landfill operations, equipment operation/maintenance, and general safety is to be provided to each Landfill employee by MCAAP.

A portable building and sanitary facilities will be provided for employee office, shelter and comfort. Personnel are required to carry mobile phones or other means of communication will be provided for emergency communication. The following equipment or equal will be used for daily operations and site maintenance.

- Crawler/dragger
- Scrapper
- D-7 Dozer

- Compactor/Dozer

The crawler/dragger, scrapper, and D-7 dozer will be used for daily soil cover excavation and earth movement. The compactor/dozer will be used primarily for the day-to-day operations of spreading, compacting and covering the daily fill. The D-7 dozer will be used as a backup for the compactor/dozer.

C. Public Access Control

Per Oklahoma Administrative Code (OAC) 252:515-19-32, artificial and/or natural barriers shall be used to discourage unauthorized traffic and uncontrolled dumping. Access to the Landfill is controlled by the MCAAP which is a secured military facility. Public Access is to the Landfill is not allowed by the MCAAP.

II. Solid Waste Acceptance

A. Permitted Waste

The Landfill is permitted to handle non-hazardous industrial waste from operations at the MCAAP. These wastes may include:

- Empty cardboard boxes
- Plastic bottles
- Empty crushed cans of paint, paint thinner, etc.
- Metal turnings coated with machine oil
- Inert plastic material
- Small volumes of sandwich wrappings and pop bottles
- Containerized asbestos
- Water treatment plant clarifier sludge/filter backwash
- Sewage sludge

B. Waste Measuring

All waste delivered to the Landfill will be measured using the facility's scale that is tested and certified annually in accordance with OAC 252:515-19-33(a)(2). If the scale is inoperative, tonnage shall be estimated on a volume basis where 1 cy of waste shall be calculated to weigh 1/3 ton. Fees and monthly reports are to be submitted to the ODEQ and filed in the operating record. An example of the monthly and quarterly reporting forms to be submitted to the ODEQ are included in **Attachment 7-1** of this Plan. Monthly reports shall be filed in the operating record and submitted to the ODEQ no later than the 15th of the month following the reporting period.

III. Landfill Operations

This section outlines the general procedures and guidelines for waste placement and cover material at the Landfill.

A. Landfill Progression

The Landfill will continue with the progression of the trench landfilling until the footprint of the proposed vertical expansion area is complete. The vertical expansion of the Landfill will occur in a sequence of phases as shown in **Figure 7-1**. Phase I will begin at the northern side of the Landfill, with each subsequent phase expanding to the south. As maximum slopes of four feet horizontal to one foot vertical are achieved, the landfilling will move to the south.

B. Waste Placement

Waste material will be deposited in the area identified as the working face. The working face is a sloped surface upon which the waste is compacted in layers. The slope of the working face will be no more than four feet horizontal to one foot vertical (4:1). The spreading and compaction operations are performed using a waste compactor with a push blade. The compactor generally remains on the slope of the working face and compacts the waste by repeatedly traversing both parallel and perpendicular to the slope. Depending on the nature and type of waste disposed, a dozer may be used to push waste at or near the toe of the working face up the working face slope to the compactor. The height of waste will generally not exceed 10 feet in height and is referred to as a lift.

The width of the working face will be kept as small as practical. The waste will be placed next to the previous day's waste until an established row length is reached. Another row is then started parallel to the previously constructed row. As the row's form lifts over each area, the top of each Landfill lift should slope in such a manner to allow surface runoff to drain away from the working face. After a number of rows have been constructed (creating a lift), a second lift is constructed over the first lift. Waste placement will alternate between various lifts of waste and will allow Landfill traffic to discharge waste at various levels. This method will allow the earthmoving equipment to stockpile daily cover at the top of the day's waste, if necessary.

C. Asbestos Management

Disposal of asbestos at the Landfill will follow the ODEQ guide on Asbestos Management. Asbestos Containing Material (ACM) is regulated under 40 CFR Part 61, Subpart M and 29 CFR 1826.1101 and requires special handling and disposal practices. Disposition of asbestos will be in accordance with MCAAP's EM Plan 55. Asbestos will be disposed of in the Landfill "by appointment" only; that is, the date and time for placing asbestos in the Landfill will be arranged with the Landfill operator in advance. The asbestos disposition area is separate from the industrial waste area. Only asbestos certified personnel will be allowed in the asbestos disposition area while an active burial is being conducted. During ACM activities, no other types of waste will be accepted; the Landfill will be closed until the ACM is placed in the disposition area and ready for covering.

1. **Containerization:** ACM wastes resulting from removal/abatement projects shall be double bagged in 6-mil plastic bags and tagged with an appropriate warning label. All large, bulky items when removed, shall be doubled-wrapped in sheets of 6-mil plastic, secured with duct tape, and properly labelled. Glovebags will be used for the removal of piping. All ACM waste is double wrapped while wet and placed in 10-mil dumpster liner

during the removal process. Prior to transport the dumpster liner will be zipped and secured closed and all tie downs will be removed. The truck driver will transport the secured dumpster liner to the landfill. The bag will be checked for damage prior to transport and when it arrives at landfill. Asbestos is transported to the Landfill double wrapped and in a 10-mil dumpster liner with no visible emissions from this process.

2. **Protective Clothing:** During the removal of asbestos from facility structures, workers are required to wear protective clothing and respirators. Personal protective equipment consisting of full-body protective clothing and a high-efficiency particulate absorption filter respirator will be worn to hand-place the ACM in the Landfill.

3. **Placing ACM:** An Asbestos disposition area shall be designated prior to the appointment to dispose of ACM. The asbestos disposition area will generally be located adjacent the working face. The working face will be covered with a minimum 6-inches of soil material and a berm will be constructed of soil material to segregate an area large enough to handle the appointed disposal.

   The dumpster will be opened and the dumpster liner will be released into landfill while the truck moves forward. The shops/contractor will remain present with EM program manager while bag is released from dumpster. If the double wrapped asbestos is deemed necessary to be hand-placed or equipment such as a sky-trak must be utilized to place the double wrapped asbestos in landfill without the dumpster liner, the individuals hand-placing asbestos in the landfill will require the same level of full-body protective clothing and high-efficiency particulate absorption filter respirators. There will be no visible emissions from this process.

4. **Cover:** Sufficient soil cover material will be staged in proximity to the asbestos disposition area prior to the appointment to allow placement of cover as soon as the ACM has been deposited. The dumpster liner will then be covered by landfill operator with 6-inches of soil material under guidance of the EM program manager. There will be no visible emissions from this process.

D. Daily and Intermediate Cover

The Landfill is to be developed in phases as presented in **Figure 7-1**. The Phases will be constructed for the purpose of managing and maintaining the waste disposal operations within the smallest practical area. This will aid in diverting storm water away from the active working face.

In accordance with OAC 252:515-19-51(c)(1), the Landfill will apply 6 inches of daily cover material over solid waste disposed at the facility each working day. Daily cover material shall consist of earthen material that is free of garbage, trash, or other unsuitable materials. By applying 6 inches of earthen cover, disease vectors, water infiltration, and blowing litter associated with the Landfill operations will be controlled.

In accordance with OAC 252:515-19-52, waste disposal areas that are not protected by final cover or managed with runoff control structures must receive intermediate cover consisting of an additional 12 inches of compacted earthen material capable of sustaining vegetation. The earthen material shall be free of garbage, trash, or unsuitable material. Vegetative cover (or ODEQ-

approved alternate material) will be established and maintained at the Landfill for areas that remain inactive for a period of more than 1 year.

E. Final Cover

The final cover will be constructed when or as the final elevations of waste placement are achieved. Terraces and storm water management structures will be constructed as the final cover is installed. The final cover will consist of a uniform layer of low shrink-swell clay equivalent to the natural liner material and will be compacted in no more than 8-inch lifts to a depth of 2 feet over the entire surface of the Landfill. A 12-inch layer of soil suitable for topsoil and capable of sustaining plant growth will be placed on the clay cover and vegetated. The final cover vegetation must be effective, long-lasting, and capable of self-regeneration and plant succession. Vegetation shall consist of species that are equal or superior to native vegetation during each season of the year. Permanent or interim vegetation shall be established in areas that have been undisturbed for 90 days or more.

F. Borrow Source

The on-site soil borrow area shall be reshaped and revegetated, or otherwise reclaimed, to blend with surrounding terrain within 180 days of the date the area ceased being used in accordance with OAC 252:515-19-55.

IV. Storm Water Management

The storm water management plan for the Landfill includes provisions for control of storm water run-on and run-off associated with a 24-hour, 25-year storm event. Storm water runoff within the waste disposal boundary is captured within the Landfill's storm water system. The storm water system is made up of diversion ditches, down chutes and perimeter storm water channels. As the Landfill is constructed, the perimeter channels will extend around the vertical expansion. During operations, storm water will be diverted to temporary ditches, which will be routed to the perimeter storm water channels. The perimeter storm water channels then route the run-off to the proposed storm water pond. The storm water pond is designed to control the runoff from a 24-hour, 25-year storm event. During storm events less than a 24-hour, 25-year storm, the pond is designed with a skimmer to reduce total suspended solids before releasing them downstream to the existing pond.

Storm water run-off from the Landfill site is managed within the current storm water system described above. Drainage swales and letdown channels will convey storm water run-off from the final cover to perimeter storm water channels and then to the proposed storm water pond. Run-off from the active working face will be contained within the waste disposal area using temporary berms.

During disposal operations, diversion berms and ditches should be utilized as necessary to minimize the amount of storm water that enters any active disposal areas. Additionally, non-active areas should be covered with daily and intermediate cover to reduce the infiltration of water.

V. Leachate Management

Storm water that interfaces with waste in the working face of the Landfill will be contained by temporary run-off ditches. The leachate will be allowed to be evaporated or absorbed by the underlying waste/earthen daily cover material. If the leachate does not evaporate or becomes an issue to contain, the Landfill will haul the leachate offsite for disposal.

VI. Landfill Maintenance and Safety

A. Fire Safety

Fire extinguishers are provided for fire protection purposes on all equipment. MCAAP maintains an emergency response plan for the entire installation including the Landfill. The facility emergency response plan will be regularly updated to consider current Landfill operations. All employees will be familiar with emergency response and evacuation procedures.

B. Vectors

In general, vectors will not find suitable harborage in the Landfill due to the compaction and covering of the waste. However, if a vector problem should arise, an assessment of the operating conditions will be made and necessary corrective actions will be taken. If the vector problem persists after initial corrective action, a professional exterminator will be hired to mitigate the problem.

C. Litter Control

Blowing litter will be controlled in accordance with OAC 252:515-19-35. The Landfill will conduct unloading of waste in such a manner as to reduce the blowing of waste from outside the working face. The working face will be covered at the end of each day and as necessary during the operational day to help minimize the scattering of waste. In addition, mobile litter fencing will be placed downwind of the active area during windy weather periods.

D. Dust Control

Dust resulting from vehicular traffic, construction activity, and Landfill operations will be kept to a minimum within the property through the utilization of a water truck, road base material, and/or vegetation establishment. If necessary, a water truck is utilized throughout the day to apply water to various haul roads throughout the site. During the life of the Landfill, water will be applied to the access roads to control dust on as-needed basis.

VII. Environmental Monitoring

A. Surface Water Monitoring

Surface water will be monitored in accordance with the MCAAP's current Oklahoma Pollutant Discharge Elimination System (OPDES) permit.

Numerous storm water drainage control structures will be constructed at the Landfill. These structures include perimeter channels, letdown channels, and terraces. Routine maintenance must

be conducted on these structures to ensure proper operation. These drainage structures will be inspected in accordance with the facility's Storm Water Pollution Prevention Plan (SWPPP). If erosion damage has occurred to a drainage structure, it will be repaired as soon as possible. Temporary surface run-on and run-off control will be implemented as operationally necessary to reduce the amount of run-on and run-off coming into contact with the active refuse face of the Landfill or to reduce erosion from disturbed areas of the site.

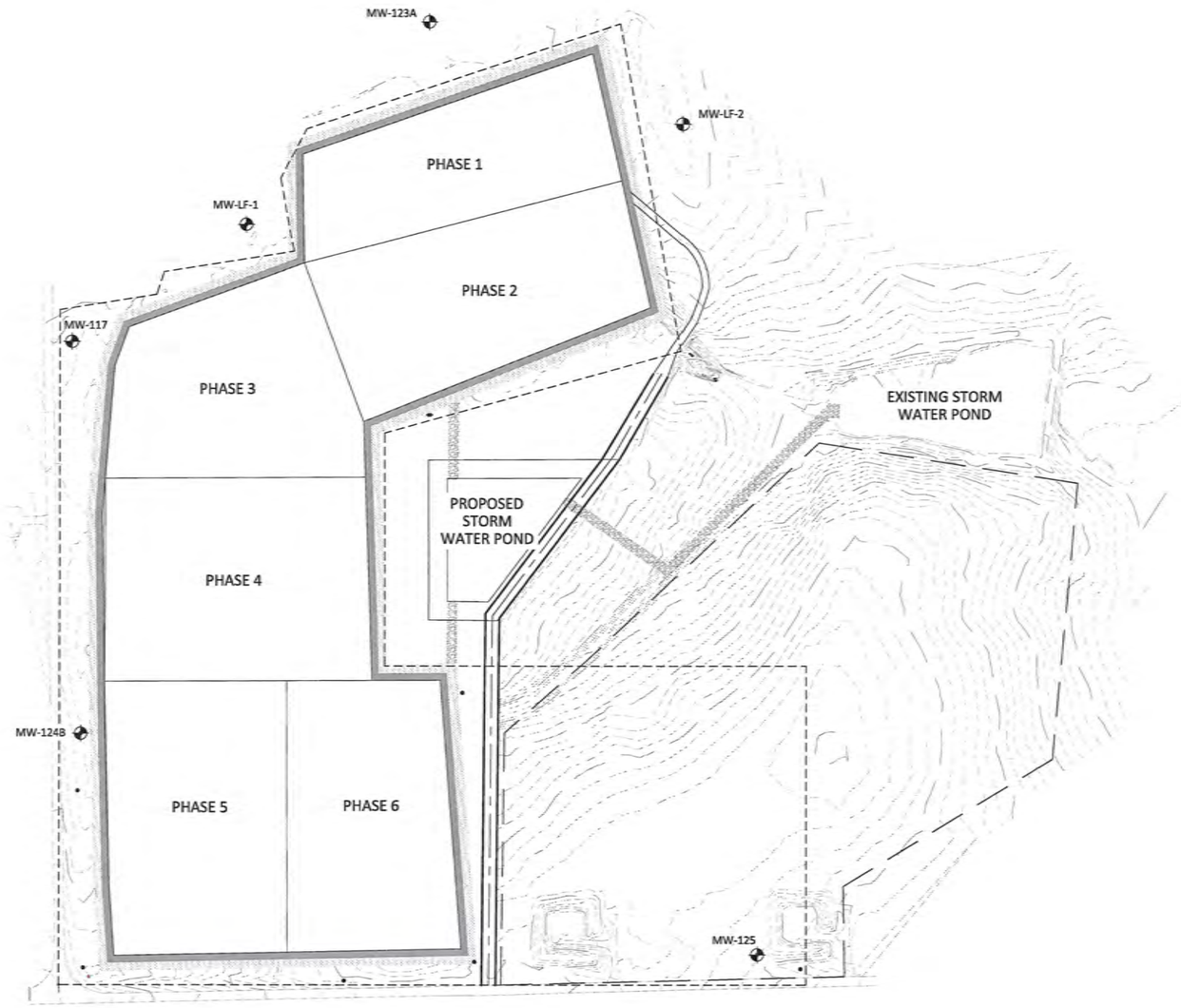
B. Groundwater Monitoring

Groundwater will be monitored in accordance with the approved Groundwater Monitoring Plan for the Landfill, which is maintained in the facility's operating record.

VIII. Recordkeeping

In accordance with OAC 252:515-19-40, the operating record of the facility will be maintained on-site, for the Landfill the operating record must be maintained within the MCAAP. The operating record will include all records concerning the planning, construction, operation, closing, and post-closure monitoring of the facility until the post-closure monitoring period is terminated.

The location demonstration reports include all permits required by local, state and federal agencies concerning all operation at the site. The daily operational record will record operational information including the amount of waste received, any unusual circumstances that may take place during operations, and any other pertinent information regarding the general work carried out at the facility. The monitoring and test results will be maintained in the operating record and submitted to the ODEQ. A copy of all groundwater and storm water records will be kept on-site for review by any local, state, or federal agency. The ODEQ Guidance on Recordkeeping and Reporting is included in **Attachment 7-2**.



0 300 600 Feet

LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

LICENSED PROFESSIONAL ENGINEER
GAVIN JAMES
OKLAHOMA

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
1	11/6/2019	REMOVED PERMIT EXPANSION BOUNDARY	MD	GJJ

EOR	DRAWN
GJJ	MD
PM	CHECKED
CBM	EB

McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

CONSTRUCTION SEQUENCE

PITTSBURG COUNTY, OKLAHOMA

PREPARED FOR:
US Army Corps of Engineers

PREPARED BY:
ALL CONSULTING
GOVERNMENT RELATIONS - ENERGY - PLANNING - TECHNOLOGY
ENGINEERING - ENVIRONMENTAL
1718 SOUTH CHEYENNE AVE, TULSA, OK 74119
PHONE: 918.382.7581
WWW.ALL-LLC.COM

PN #1720.PMT
JUNE 2019

Figure 7-1

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Attachment 7-1

NHIW Monthly Report

Month/Year: Facility:_____ Permit Number:_____

Date	Generator Name	Waste Name	App #	Amount

DEQ Form #520-821R Revised July 1998

QUARTERLY RETURN FOR SOLID WASTE LANDFILLS

Due no later than 30 days after the end of each calendar quarter

Permit Number	Quarter	Year	DEQ Invoice Number

For Office Use Only

Facilty Name: _____

Mailing Address: _____

1.	Number of operating days this quarter (see instructions)		days
2.	Total weight, in tons, of waste received during this quarter		tons
2a.	Weight received, in tons, which was productively reused or recovered and sold (see instructions)		tons
2b.	Weight received, in tons, from a DEQ approved emergency or special event (see instructions)		tons
2c.	Weight received, in tons, from large industrial waste generators under the large industrial waste generator exemption (see instructions)		tons
3.	Weight subject to state disposal fees (line 2 minus sum of lines 2a, 2b, and 2c)	0.00	tons
4.	Total volume, in cubic yards, of waste received during this quarter		yd3
4a.	Weight received, in cubic yards, which was productively reused or recovered and sold (see instructions)		yd3
4b.	Weight received, in cubic yards, from a DEQ approved emergency or special event (see instructions)		yd3
4c.	Weight received, in cubic yards, from large industrial waste generators under the large industrial waste generator exemption (see instructions)		yd3
5.	Volume subject to state disposal fee (line 4 minus sum of lines 4a, 4b, and 4c)	0.00	yd3
6.	Volume weight subject to state disposal fee (multiply line 5 by 0.33)	0.00	tons
7.	Determine volume weight from total volume (multiply line 4 by 0.33)	0.00	tons
8.	Total weight received (add line 2 and line 7)	0.00	tons
9.	Average weight received per operating day (divide line 8 by line 1)	0.00	tons/day
10.	Weight received subject to state disposal fee (add line 3 and line 6)	0.00	tons
10a.	See instructions		
11.	Enter state disposal fee (If line 10a < $40,000, line 10 x $1.50, otherwise, line 10 x $1.25)	0.00	
12.	Enter capital investment waiver (see instructions)	0.00	
13.	Determine total capital investment waiver to date (see instructions)		
14.	Enter handling waiver (see instructions)	0.00	
15.	Enter total allowable waivers (add line 12 and line 14)	0.00	
16.	Penalties (see instructions)		
17.	**TOTAL STATE DISPOSAL FEE DUE** (line 11 plus line 16 minus line 15)	0.00	

Typed/Printed Name of Authorized Agent: _____ Date: _____

Signature of Authorized agent: _____ Phone No.: _____

Email Address: _____

Remit original report with payment to:

Oklahoma Department of Environmental Quality
Administrative Service - Accounts Receivable
P.O. Box 2036
Oklahoma City, OK 73101-2036

Remit copy of report to:

Oklahoma Department of Environmental Quality
Land Protection Division
P.O. Box 1677
Oklahoma City, OK 73101-1677

Electronic submissions should be submitted to: solidwastereports@deq.ok.gov bernice.green@deq.ok.gov

INSTRUCTIONS FOR COMPLETING THE QUARTERLY RETURN FOR SOLID WASTE LANDFILLS

GENERAL INSTRUCTIONS

All solid waste landfills, except generator owned and operated non-hazardous industrial waste monofills, are required by 27A O.S. §2-10-802 to collect fees on solid waste received at the landfill.

This return should be completed and returned to the Financial and Human Resources Division of the Department of Environmental Quality no later than 30 days after the end of each calendar quarter. Calendar quarters are: 1st quarter--January 1 through March 31, 2nd quarter--April 1 through June 30, 3rd quarter--July 1 through September 30, 4th quarter--October 1 through December 31.

If the return and fees cannot be submitted within 30 days of the end of the quarter, an extension for up to 30 days may be granted by the Department. A request for an extension must be submitted no later than the due date of the return and must include a detailed description of why the extension is needed. The Department will notify you if the extension is granted or not. Please note that extensions cannot be granted which will result in a due date of more than 60 days after the end of the quarter.

SPECIFIC LINE INSTRUCTIONS

Line 1: Enter the number of days during the quarter the landfill was open to receive waste.

Line 2a & 4a: The activities must be included in, and conducted in accordance with, the landfill's permit. Records pertaining to this fee exemption must be included with the quarterly return. Exemption documentation is to include: 1) waste types and 2) weight/volume recycled and method of recycling for each waste type. **If this information is not included, the claim may be disallowed.**

Line 2b & 4b: A copy of the DEQ's written approval waiving the fee must be included with the quarterly return. **If a copy is not included, the claim may be disallowed.**

Line 2c & 4c: Enter the amount of waste received from large industrial waste generators **which was accompanied by a large industrial waste generator fee exemption certificate issued by the DEQ.**

Line 10a: If utilizing the capital investment waiver, enter line 13 from previous quarter, otherwise enter $40,000.00.

Line 12: **If not utilizing the capital investment waiver, enter $0.00, otherwise see below.**
If line 13 of last quarter's return is $40,000, enter $0.00, otherwise:
If line 9 is less than 100 tons/day, multiply line 8 by $0.50.
If line 9 is equal to or more than 100 tons/day, multiply line 8 by $0.25.

NOTE: Records documenting the capital investment and the use of the funds must be included with the quarterly return.

Line 13: **If not utilizing the capital investment wiaver, enter $0.00, otherwise, see below.**
If line 13 of last quarter's return is less than $40,000, add line 13 of last quarter's return and line 12 of this quarter's return. return. If line 13 of last quarter's return is $40,000, enter $40,000.00.

Line 14: **If not utilizing the capital investment wiaver, enter $0.00, otherwise see below.**
If line 13 of last quarter's return is less than $40,000.00, enter $0.00.
If line 13 of last quarter's return is $40,000 AND this return is filed on time, multiply line 11 by 0.10. Otherwise, enter $0.00.

PENALTIES

There is a 5% penalty for returns postmarked more than 30 days after the due date (or filed after the extension date). Your penalty is determined by multiplying line 11 of the return by 0.05 and including this figure on line 16.

There is a 15% penalty per month for returns postmarked more than 60 days after the due date of the return. Your penalty is determined by multiplying line 11 of the return by 0.15, then by the number of months which have elapsed after the due date (or the extension date if applicable) and including this figure on line 16.

If you have any questions, please contact Amber Edwards, Land Protection Division Solid Waste Unit (405) 702-5133.

Attachment 7-2

DEQ Guidance on Recordkeeping and Reporting

Regulatory Reference: OAC 252:515-19-40

Applicability. McAlester Army Ammunition Plant (MCAAP) Non-Hazardous Industrial Waste Landfill.

NOTE: The guidance text herein has been modified to remove portions that are not applicable to MCAAP and to incorporate practices conducted by the facility that meet and/or exceed the regulatory requirements.

Purpose. To provide guidance on the records to be maintained in the facility operating record and submitted to the DEQ.

Technical Discussion. All solid waste disposal facilities are required to maintain an operating record containing all records concerning the planning, construction, operation, closing and, if applicable, post-closure monitoring of the facility. [1] Preferably, the operating record should be maintained at the disposal facility; however, an off-site location near the facility which is under the direct control of the owner/operator and accessible during DEQ inspections can be used. For the purposes of this rule, facility records maintained by consultants cannot be considered part of the operating record.

Various Subchapters of OAC 252:515 identify records that must be maintained and/or submitted to the DEQ. This guidance will identify those records so that owner/operators can ensure all required records are being maintained and submitted in a timely manner.

Subchapters 3 through 31 - Permit Applications and Related Documents

- All applications for new and modified permits must be submitted to the DEQ and maintained in the operating record. The permit application includes all text related to the application as well as all maps, drawings, construction plans, QA/QC reports, legal access documents, public notices, etc. required by other Subchapters.
- All correspondence to/from the DEQ related to the permit application must be maintained in the operating record.
- A copy of the approved permit and all associated modifications must be maintained in the operating record.

Subchapter 9 - Groundwater Monitoring and Corrective Action

- Within 60 days of groundwater sampling, a copy of groundwater monitoring results and associated statistical analysis (or cumulative analysis data for C/D landfills) must be placed in the operating record and submitted to the DEQ.
- Within 14 days of determining there is a statistically significant increase (SSI) in one or more monitoring constituents, the DEQ must be notified of the SSI in writing and a copy of the notice placed in the operating record.

[1] This includes all correspondence to/from the DEQ.

- Within 90 days of determining there is a statistically significant increase, either an assessment monitoring program, or a demonstration that the increase was not caused by the facility, must be submitted to the DEQ and placed in the operating record.
- Within 14 days of receiving the results from an assessment monitoring event, the DEQ must be notified of the constituents that were detected.
- Prior to a public meeting to discuss an assessment of corrective measures, the DEQ must be provided with:
  - an affidavit (with a copy of the published notice) showing that public notice of the meeting was published in a local newspaper;
  - copies of certified mail receipts showing that the entities identified in OAC 252:515-9-113(b) were notified of the public meeting; and
  - property and mineral ownership maps covering the area within a 2 mile radius of the facility.
- Within 60 days of the public meeting to discuss an assessment of corrective measures, a proposed remedy must be submitted to DEQ for approval and a copy placed in the operating record.
- When the remedy is complete, a certification signed by the owner/operator and a qualified groundwater scientist must be submitted to the DEQ for approval and the approved certification placed in the operating record.

Subchapter 13 - Leachate Collection and Management

- Documentation must be submitted to the DEQ and maintained in the operating record showing any underground storage tanks used to store leachate meet the requirements of the Oklahoma Corporation Commission at OAC 165:25, Subchapter 1, Part 8.
- Plans for leachate recirculation and/or irrigation must be submitted to the DEQ and maintained in the operating record, as well as all correspondence to/from DEQ related to those plans.
- Any testing results required by leachate recirculation/irrigation plans must be submitted to DEQ and maintained in the operating record.
- If leachate is discharged to a POTW, a copy of a letter from the POTW stating it will accept the leachate must be placed in the operating record and submitted to the DEQ.
- The results of any testing required by the POTW must be maintained in the operating record.
- If leachate is discharged under an OPDES permit, a copy of the permit must be maintained in the operating record.
- Any testing required by the OPDES permit must be submitted to DEQ and maintained in the operating record.

NOTE: Quarterly leachate reports are no longer required to be maintained or submitted.

Subchapter 17 - Stormwater Management

- A copy of the Stormwater Pollution Prevention Plan and OPDES Sector L permit must be maintained in the operating record.
- A copy of the OPDES stormwater permit for construction sites must be maintained in the operating record for any on- or off-site soil borrow areas of greater than one acre in size.
- OPDES Sector L visual monitoring and Numeric Effluent Limitation Monitoring results must be maintained in the operating record.

- The Annual Comprehensive Site Compliance Evaluation Report must be submitted to the DEQ's WQD no later than March 1st for the previous calendar year.
- All NELM monitoring results must be submitted to the DEQ no later than January 15th of each year for the previous year's reporting period (January 1 thru December 31).

Subchapter 19 - Operational Requirements

- Monthly waste receipt reports must be submitted to the DEQ and a copy placed in the operating record no later than the 15th of the month following the reporting month.[2]
- To avoid penalties, quarterly returns and fees for landfills must be submitted to the DEQ within 30 days of the end of the quarter.[3] A copy of the quarterly return must be maintained in the operating record.
- Copies of approved out-of-state waste disposal plans must be on file with the DEQ and maintained in the operating record, as well as all correspondence to/from DEQ related to the development of the approved plan.
- The DEQ must be notified at least 5 working days in advance of any proposed changes to an approved out-of-state waste disposal plan.
- Copies of initial design capacity reports required by the New Source Performance Standards (NSPS), as well as required updates to the design capacity, must be submitted to the DEQ and placed in the operating record.
- Copies of all test results required by NSPS must be submitted to DEQ and maintained in the operating record.
- Landfills accepting asbestos must maintain the records identified in the Management of Friable Asbestos guidance document.

Subchapter 25 - Closure and Post-Closure Care

- Copies of closure and post-closure plans, all amendments, maps, drawings, construction plans, QA/QC reports, legal access documents, etc. required by the plans must be submitted to the DEQ and maintained in the operating record. All correspondence to/from the DEQ related to the permit application must also be maintained in the operating record.
- Documentation of all activities performed for closure must be submitted to the DEQ with the final closure report and placed in the operating record.
- A copy of the land records notice as recorded must be submitted to the DEQ at the conclusion of closure activities.
- All correspondence to/from the DEQ related to closure and/or post-closure activities must be maintained in the operating record.
- No later than April 1st of each year, a post-closure maintenance and monitoring report must be submitted to the DEQ, and a copy placed in the operating record.
- At the conclusion of post-closure, a Certification of Post-closure Performance must be submitted to the DEQ.

[2] Monthly reports are not required to be submitted to the DEQ for large NHIW generator landfills, generator owned and operated NHIW monofills, transfer stations, and processing facilities (including incinerators and regulated medical waste facilities). However, records identifying the amount of waste received must be maintained in the operating record and made available to DEQ upon request.

[3] Returns and fees submitted later than this are subject to penalties and are not eligible for the handling waiver.

Appendix 8
Storm Water Run-On/Run-Off Plan

STORM WATER RUN-ON/RUN-OFF PLAN
MCALESTER ARMY AMMUNITION PLANT

I. Introduction

The McAlester Army Ammunitions Plant Landfill (Landfill) is owned by the U.S. Government and is operated by McAlester Army Ammunitions Plant (MCAAP) personnel. The Landfill operates under Oklahoma Department of Environmental Quality (ODEQ) Solid Waste Permit Number 3561014. The Landfill only accepts non-hazardous industrial waste from operations at the MCAAP in accordance with the permit.

Wastes disposed at the Landfill include:

- Empty cardboard boxes
- Plastic bottles
- Empty crushed cans of paint, paint thinner, etc.
- Metal turnings coated with machine oil
- Inert plastic material
- Small volumes of sandwich wrappings and pop bottles
- Containerized asbestos
- Water treatment plant clarifier sludge/filter backwash
- Sewage sludge

In accordance with Oklahoma Administrative Code (OAC) 252:515-17-2, all active landfill disposal facilities in the State of Oklahoma shall be designed, constructed, and maintained with: (1) a run-on control system to prevent flow onto active protions of the facility during the peak diascharge from a 24-hr, 25-year storm; and (2) a run-off control system with sufficient capacity to collect and control all contaminated stornmwater resulting from a 24-hour, 25-year storm.

This Run-On and Run-Off Control Plan has been prepared to satisfy the rquirements of this statute.

II. Run-On Controls

OAC 252:515-17-2(1) requires existing non-hazardous industrial waste (NHIW) disposal facilities to design, construct, operate and maintain a run-on control system to prevent the flow onto the active portion of the Landfill during the peak discharge from a 24-hour, 25-year storm event. In order to verify that the Landfill complies with the run-on control system requirements, drainage calculations were performed assuming a 25-year, 24-hour storm precipitation of 7.5 inches, based on the current National U.S. Geological Survey (USGS) Rainfall Summary. Drainage calculations are provided in **Appendix 4** of the RCRA-D Landfill Permit.

To prevent run-on flow from a 24-hour, 25-year storm event from entering the active portion of the landfill during operations, run-on water will be directed around the perimeter of the Landfill. The perimeter storm water infrastructure is designed to be constructed at higher elevations than the surrounding terrain. The perimeter ditch and storm water pond are also bordered by berms that

would prevent run-on from a 24-hour, 25-year storm event.

III. Run-Off Controls

OAC 252:517-13-2(2) requires existing NHIW landfill facilities to design, construct, operate and maintain a run-off control system from the active portion of the Landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Run-off from the capped portions of the Landfill is designed to run along diversion ditches, down chutes, and perimeter storm channels, and subsequently into a surface impoundment designed to control runoff from a 24-hour, 25-year storm event. As the Landfill is constructed, the perimeter storm water channels will be extended around the vertical expansion.

Storm water run-off from the active working face will be contained within the waste disposal area using temporary berms. Diversion berms and ditches will be utilized to minimize the amount of storm water that enters active disposal areas. The berms and ditches will be moved as the working face changes, keeping any storm water that contacts waste within the open face of the landfill. Non-active areas will be covered with daily intermediate cover to reduce infiltration of storm water.

Storm water that comes into contact with waste will be considered leachate and will be contained within the waste disposal area using temporary berms. The leachate will be allowed to evaporate or infiltrate the active portion of the Landfill. Should the leachate fail to evaporate or becomes an issue to contain, it will be transported offsite for disposal.

IV. Plan Amendments

In accordance with OAC 252:515-25-2(c)(2), MCAAP will amend this written Run-On and Run-Off Control Plan at any time provided the revised plan is placed in the facility's operating record. MCAAP is required to amend this written Run-On and Run-Off Control Plan whenever there is a permit modification that would substantially affect the closure or post-closure requirements or duties.

V. Record Keeping Requirements

In accordance with OAC 252:515-19-40(a), MCAAP must maintain this Run-On and Run-Off Control Plan in the facility operating record. Unless specified otherwise, each file must be retained until the post-closure monitoring period is terminated. The landfill closure plan is provided in **Appendix 9**.

Appendix 9
Landfill Closure Plan

LANDFILL CLOSURE PLAN
MCALESTER ARMY AMMUNITION PLANT

I. Introduction

The McAlester Army Ammunitions Plant Landfill (Landfill) is owned by the U.S. Government and is operated by McAlester Army Ammunitions Plant (MCAAP) personnel. The Landfill operates under Oklahoma Department of Environmental Quality (ODEQ) Solid Waste Permit Number 3561014 and is a Non-Hazardous Industrial Waste (NHIW) facility. The Landfill only accepts non-hazardous industrial waste from operations at the MCAAP in accordance with the permit.

Oklahoma Administrative Code (OAC) 252:515-25-31 requires that the Landfill be closed in accordance with an approved plan and in a manner that minimizes the need for further maintenance and controls and minimizes post-closure escape of waste and waste constituents to the environment.

Closure requirements specific to the Landfill are presented in Section II of this plan. More specifically, Section II addresses the design of the final cover system, grading plans for waste disposal areas, soil budget, phased closure plans, contingencies for unexpected closure, ancillary facilities, monitoring systems, and certification and notification requirements pertaining to closure. Section III presents a general closure schedule associated with the planned sequential closure of Landfill and associated closure activity timelines. Section IV addresses the estimated cost for closure

II. Closure Requirements

The MCAAP Landfill permit area will consist of approximately 49.279 acres. Once waste disposal operations cease at the Landfill or as areas reach final design grades, closure procedures will be initiated as outlined herein. The following subsections discuss the general landfill design, and the activities and considerations required for proper closure of the facility.

A. General Landfill Design

The Landfill is permitted to handle industrial waste from operations at the MCAAP. These wastes may include:

- Empty cardboard boxes
- Plastic bottles
- Empty crushed cans of paint, paint thinner, etc.
- Metal turnings coated with machine oil
- Inert plastic material
- Small volumes of sandwich wrappings and pop bottles
- Containerized asbestos

- Water treatment plant clarifier sludge/filter backwash
- Sewage sludge

A more detailed list is provided in **Appendix 13**.

The Landfill will continue with the progression of the trench landfilling until the footprint of the proposed vertical expansion area is complete. The vertical expansion of the Landfill will occur in a sequence of six phases as presented in **Figure 9-1**. Phase I will begin at the northern side of the landfill, with each subsequent phase expanding to the south. As maximum slopes of four feet horizontal to one foot vertical are achieved, the landfilling will progress to the south.

The entire permitted waste disposal area will be 49.279 acres, which represents the largest area of the disposal facility requiring final cover during the active phase. It is anticipated that the final cover will be installed in phases throughout the life of the facility. Based on the 2019 Permit Modification Application, the total design capacity of the landfill is 1,652,651 cubic yards (cy), which represents the maximum inventory of waste anticipated to ever be on-site during the active life of the facility.

B. Final Cover System Description

The final cover will be constructed when or as the final elevations of waste placement are achieved. Terraces and storm water management structures will be constructed as the final cover is installed. The final cover will consist of a uniform layer of low shrink-swell clay equivalent to the natural liner material and will be compacted in no more than 8-inch lifts to a depth of 2 feet over the entire surface of the Landfill. A 12-inch layer of soil suitable for topsoil and capable of sustaining plant growth will be placed on the clay cover and vegetated. The final cover vegetation must be effective, long-lasting, and capable of self-regeneration and plant succession. Vegetation shall consist of species that are equal or superior to native vegetation during each season of the year. Permanent or interim vegetation shall be established in areas that have been undisturbed for 90 days or more.

Should the Landfill close unexpectedly (prior to attaining final design contours), the final cover will be applied to areas that have received waste after the area has been shaped and graded as necessary. MCAAP will submit a permit modification application to ODEQ representing re-designed final contours and permanent storm water structures prior to a premature closure of the Landfill.

During the installation of the final cover system, the construction methods and material consistency will be monitored, tested, and documented in accordance with current and applicable regulatory requirements.

The final cover system for the Landfill will include a compacted earthen barrier layer overlain by an erosion layer. Prior to installation of the compacted barrier layer, the subgrade will be prepared by removing any established vegetative cover, then reworking any daily or intermediate cover layers to provide a smooth, stable, uniformly graded subgrade surface for the construction of the final cover system.

The barrier layer will be at least 30 inches in thickness with a hydraulic conductivity no greater than 1.0×10^{-5} centimeters per second (cm/sec) and will be constructed in accordance with the following minimum standards:

- The material shall be substantially free of organics, frozen material, foreign objects, or other deleterious materials;
- Earthen material selected for the construction of the barrier layer shall be demonstrated that it will satisfy the hydraulic conductivity requirement;
- The largest particle size allowed shall be less than 2 inches in diameter;
- Earthen material shall be compacted in lifts that do not exceed 8 inches in a loose condition and/or 6 inches in a compacted condition; and
- Lifts shall be moisture conditioned and compacted to the extent possible to achieve a minimum in place density of 95% of the soil maximum dry density based on as standard proctor analysis.

The erosion layer shall be a minimum of six inches in thickness and shall be placed as soon as possible after the barrier layer is completed. Material to be used for the erosion layer will be of sufficient quality to support vegetative growth. Soil enhancers (e.g., lime, fertilizer, etc.) are to be applied as needed and if required. The exterior side-slopes of the completed Landfill will not exceed 4:1 and the top of the landfill will be graded to a minimum slope of 4% to facilitate positive drainage.

C. Final Grading Plan

The final grading plan associated with the Landfill is presented on **Sheet C-4** of the Permit Drawings. Generally, the final cover system will be graded to drain at a minimum slope of 4% and a maximum slope of 25%. The top of the 4:1 slopes will be constructed to an elevation that generally does not exceed 835 feet above mean sea level (msl). The maximum height of the Landfill grading plan will generally not exceed 838 feet above msl.

The design of the final cover system includes provisions for storm water diversion swales and storm water down chutes. The diversion swales, down chutes, and perimeter storm water channels will assist in managing and controlling storm water run-off associated with the final cover system while minimizing the potential for erosion. The diversion swale will generally be at least 18 inches in height. The down chutes will consist of a 6-foot wide trapezoidal channel that is at least 18 inches deep. The down chutes will be lined with a geotextile filter fabric/rip-rap, concrete revetment, or equivalent high-velocity channel lining material. The final grading plan for the Landfill includes provisions for perimeter drainage and access as shown on the Permit Drawings. The perimeter storm water channel will consist of a trapezoidal channel at least 3 feet deep and 6 feet wide on the south and west sides if the Landfill and 8 feet wide on the north and east sides of the Landfill. The perimeter storm water channel will be lined with a geotextile filter fabric/rip-rap, concrete revetment, or equivalent high velocity channel lining material.

The existing storm water and process water impoundment east of the landfill and the proposed relocated impoundment adjacent to eastern boundary of the landfill will manage storm water run-off from the landfill area. All discharges storm water from the landfill will be via an Oklahoma Pollutant Discharge Elimination System (OPDES) permitted outfall located on the east side of the landfill site.

D. Soil Budget

An adequate quantity of soil material suitable for use as a compacted barrier layer is available within the permit area. It is estimated that the final cover system will require roughly 140,275 cy of material for the construction of the barrier layer (24-inch thickness) and erosion layer (12-inch thickness). The storm water control will require an additional 38,000 cy of earthen material; therefore, the total amount of borrow volume required is approximately 433,871 cy. The total volume of available borrow material has been calculated to be 584,387 cy.

E. Anticipated Phased Closure

The development plan for the Landfill consists of six phases as shown on the Permit Drawings included in the August 2019 Permit Modification Application and previously discussed in this Closure Plan. It is anticipated that as phases are developed and achieve final elevations, phased closure will similarly be implemented.

Once the outer slopes of Phase 1 and 2 have reached final grades, it is anticipated that final cover will be constructed over those areas either in phases or at one time. In a similar manner, Phases 3, 4, 5, and 6 will be ready to receive final cover upon the outer slope of each phase attaining final grade. Engineering plans for any proposed partial or phased closure project will be submitted to ODEQ for approval prior to implementation.

F. Unexpected Closure

In the event that the landfill must close prior to reaching the landfill final grades, the following procedures and standards shall apply.

- Engineering plans will be developed to address site closure at the time of unexpected closure.
- Areas that have received waste shall be shaped and graded to a minimum slope of 4% and a maximum slope of 4:1.
- Final cover shall be applied to all areas that have received waste to a minimum thickness of 36 inches including a 24-inch barrier layer and 12-inch erosion layer (capable of sustaining vegetative growth).
- Final cover drainage diversion swales should be installed for every 25 feet of vertical landfill height on 4:1 side slopes. The drainage diversion swales should divert storm water run-off to the down chutes described in previous sections.
- All areas disturbed by landfill activity including exempt fill areas shall be graded, shaped, and seeded.

- Erosion control mechanisms such as hay bales, silt fences, rip-rap, erosion control matting, and channel lining shall be installed as needed and required to minimize erosion while stabilizing surface soils.

Notification, certification, and reporting requirements per **Section F** shall apply to the unexpected closure scenario.

G. Ancillary Facilities and Monitoring Systems

1. Surface Water Monitoring

Surface water will be monitored in accordance with the MCAAP's current OPDES permit.

Numerous storm water drainage control structures will be constructed at the landfill. These structures include perimeter channels, down chutes, and drainage diversion swales. Routine maintenance must be conducted on these structures to ensure proper operation. These drainage structures will be inspected in accordance with the facility's Storm Water Pollution Prevention Plan (SWPPP). If erosion damage has occurred to a drainage structure, it will be repaired as soon as possible. Temporary surface run-on and run-off control will be implemented as operationally necessary to reduce the amount of run-on and run-off coming into contact with the active refuse face of the landfill or to reduce erosion from disturbed areas of the site.

2. Groundwater Monitoring

Groundwater will be monitored in accordance with the approved Groundwater Monitoring Plan for the Landfill, which is maintained in the facility's operating record.

H. Notification and Certification Requirements

MCAAP will notify ODEQ in writing prior to beginning any closure activities at the site. For any partial or phased closure project, construction will be performed and monitored in accordance with current and applicable regulatory requirements and a certification document will be prepared and sealed by a professional engineer (PE) registered in the State of Oklahoma for submittal to ODEQ providing the following items at minimum:

- Certification by the PE stating that the area was closed in accordance to the approved Closure Plan, the permit, and applicable regulations;
- As-built drawings prepared by a professional land surveyor (PLS) documenting the thicknesses of the barrier and erosion layers and providing as-built grades; and
- Related drawings, plans, or specifications, and narrative describing how closure was performed.

Although final cover placement, QC, and certification may occur in phases, final closure of the site will not occur until the entire landfill has been filled to the design contours or if waste disposal operations cease at the site (whichever comes first). In accordance with OAC 252:515-25-33, final closure shall begin within 90 days after the last receipt of waste or at the time ODEQ approves amendments to the Closure Plan, whichever is later.

Upon completion of the final closure for the entire site, a Certification of Final Closure shall be prepared and sealed by a PE registered in the State of Oklahoma for submittal to ODEQ providing the following items at minimum:

- Signature of the owner/operator;
- Certification by the PE stating that the area was closed according to the approved closure plan, the permit, and applicable regulations;
- Related drawings, plans, or specifications, and narrative describing how closure was performed and completed;
- As-built drawings prepared by a PLS documenting the thicknesses of the barrier and erosion layers and providing final as-built grades; and
- A summary of the post-closure monitoring activities required and, if necessary, an updated post-closure plan shall be submitted.

Once the closure has been accepted by ODEQ, a notice shall be recorded with the facility property deed in Pittsburg County giving notice to any potential purchaser or lessee that the site was used for the disposal of solid waste and has been closed. The notice shall specify the type, location, and quantity of waste disposed. A copy of the notice is to be sent to ODEQ and maintained in the facility permanent operating record. The notice must also state that the site will be monitored for a specified period, that a survey plat has been filed with ODEQ, and shall contain a prominent note stating that the land has been used for solid waste disposal and that future uses may be restricted.

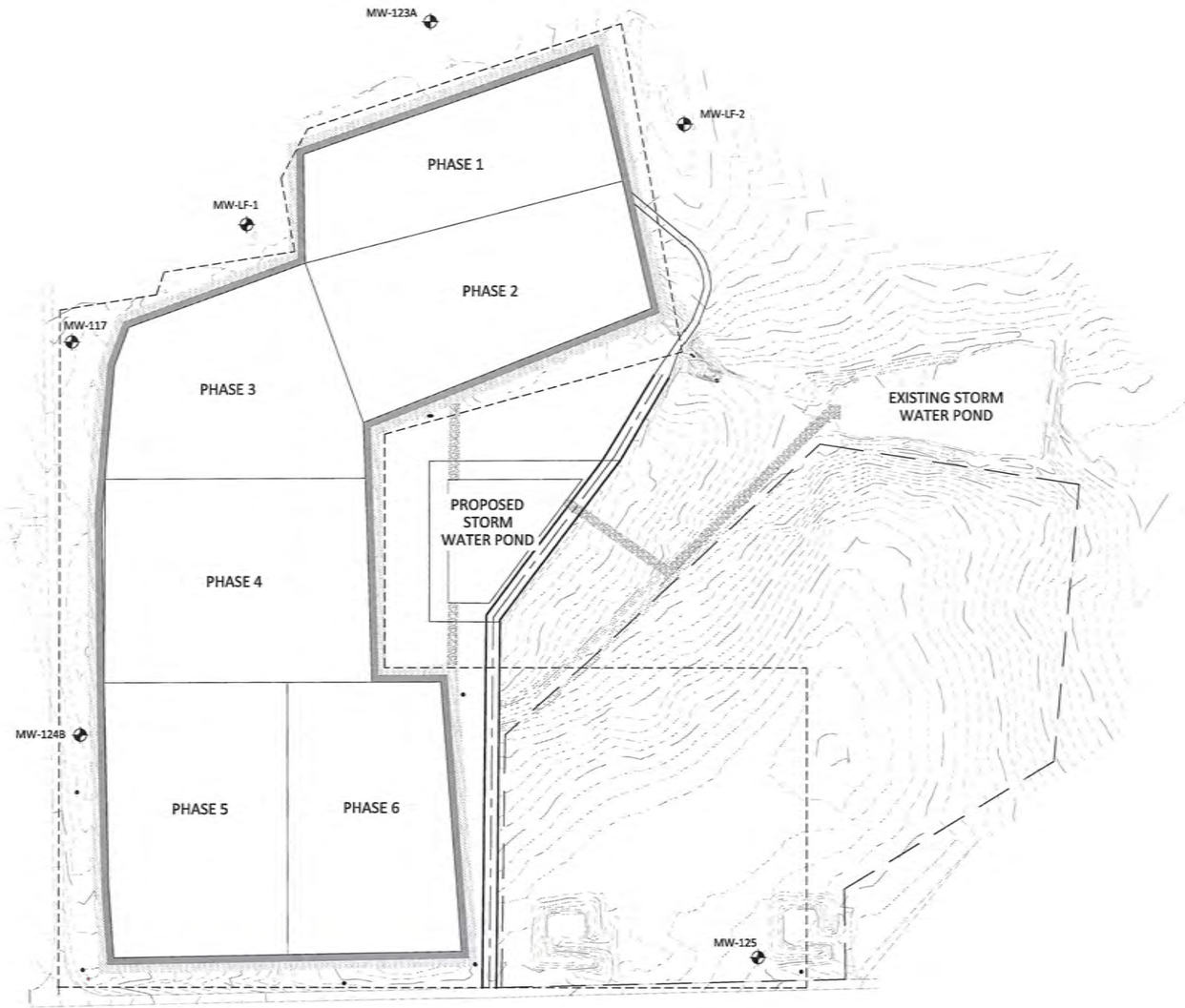
Final closure of the site must be approved by ODEQ in writing. After final closure certification has been approved by ODEQ the post-closure care period will commence.

III. Closure Schedule

As designed, the Landfill should provide useful waste disposal capacity for MCAAP for several years. Additional airspace capacity provided by the August 2019 Permit Modification Application is expected to provide the Landfill with space needed to operate through the year 2138 (119 years as of January 1, 2019). The actual life of the facility will vary depending on factors such as actual disposal rates, types of materials disposed, amount of daily and intermediate cover materials used, the settlement and decomposition of in-place wastes, and the in-place density achieved over the operational life of the facility. It is anticipated that final cover will be applied in phases as areas reach the final design contours and are not at risk of disturbance from landfill activities.

ODEQ shall be notified in writing prior to the beginning of final closure of a facility or closure of a disposal cell. Closure activities shall begin no later than 90 days after the final receipt of wastes at the facility or final receipt of wastes into a disposal cell as applicable.

Closure activities will generally consist of the construction of the final cover system including construction of required storm water controls and reclamation of soil borrow areas. Closure activities shall be completed according to this Closure Plan within 180 days after closure activities are initiated.



0 300 600 Feet

LEGEND	
MW-LF-2	MONITORING WELL
	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
	PROPOSED 5' TOP OF COVER CONTOUR
	PROPOSED 1' TOP OF COVER CONTOUR
	EXISTING PERMIT BOUNDARY
	PROPOSED BORROW AREA

LICENSED PROFESSIONAL ENGINEER
GAVIN J. JAMES
OKLAHOMA
11/6/19

REVISIONS				
No.	DATE	DESCRIPTION	DRAWN	CHKD
1	11/6/2019	REMOVED PERMIT EXPANSION BOUNDARY	MD	GJJ

EOR	DRAWN
GJJ	MD
PM	CHECKED
CBM	EB

McALESTER ARMY AMMUNITIONS PLANT
NON-HAZARDOUS INDUSTRIAL WASTE LANDFILL

CONSTRUCTION SEQUENCE

PITTSBURG COUNTY, OKLAHOMA

PREPARED FOR:
US Army Corps of Engineers

PREPARED BY:
ALL CONSULTING
GOVERNMENT RELATIONS - ENERGY - PLANNING - TECHNOLOGY
ENGINEERING - ENVIRONMENTAL
1718 SOUTH CHEYENNE AVE, TULSA, OK 74119
PHONE: 918.382.7581
WWW.ALL-LLC.COM

PN #1720.PMT
JUNE 2019

Figure 9-1

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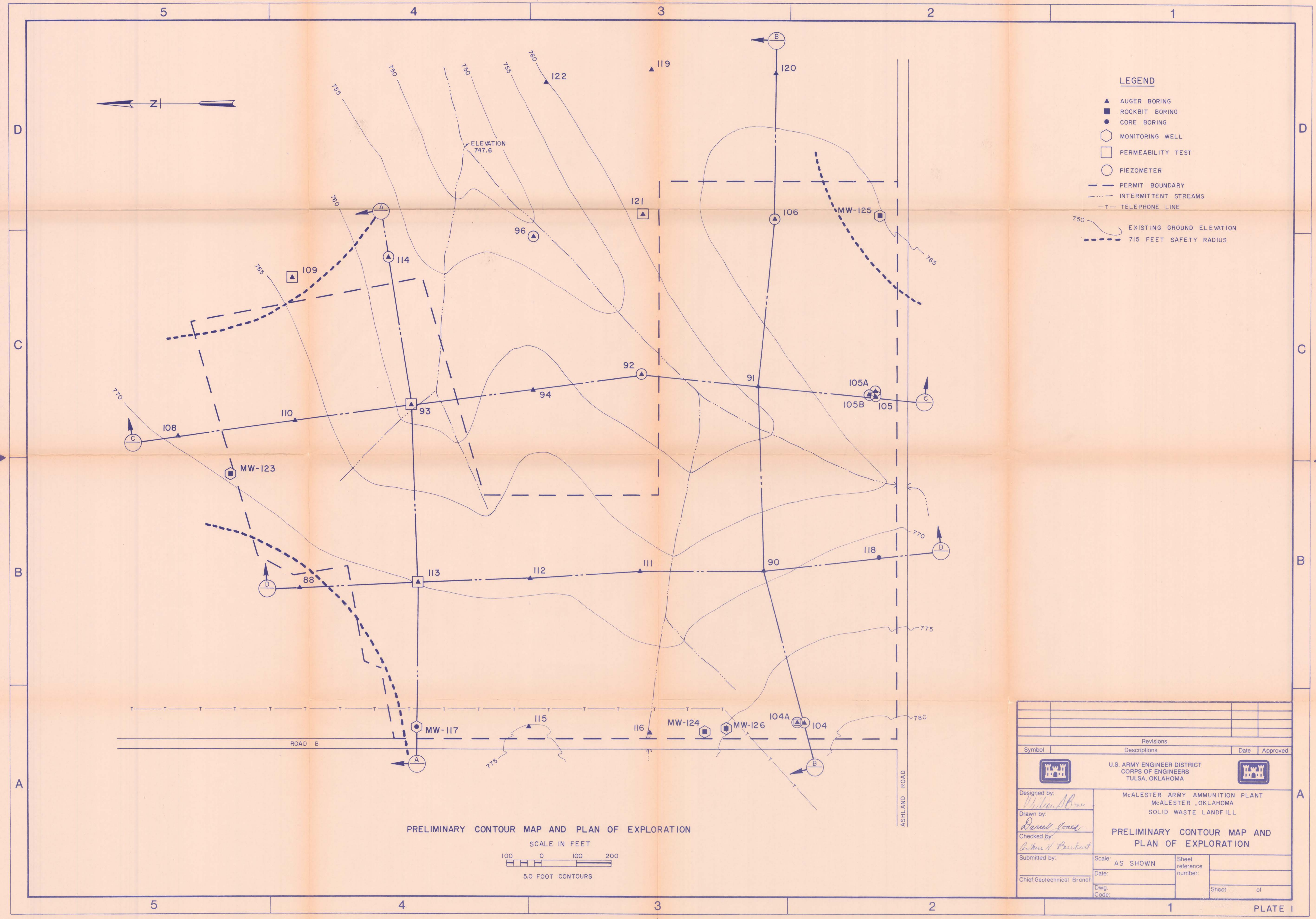
Appendix 10
Historical Landfill Plates



Symbol	Descriptions	Date	Approved

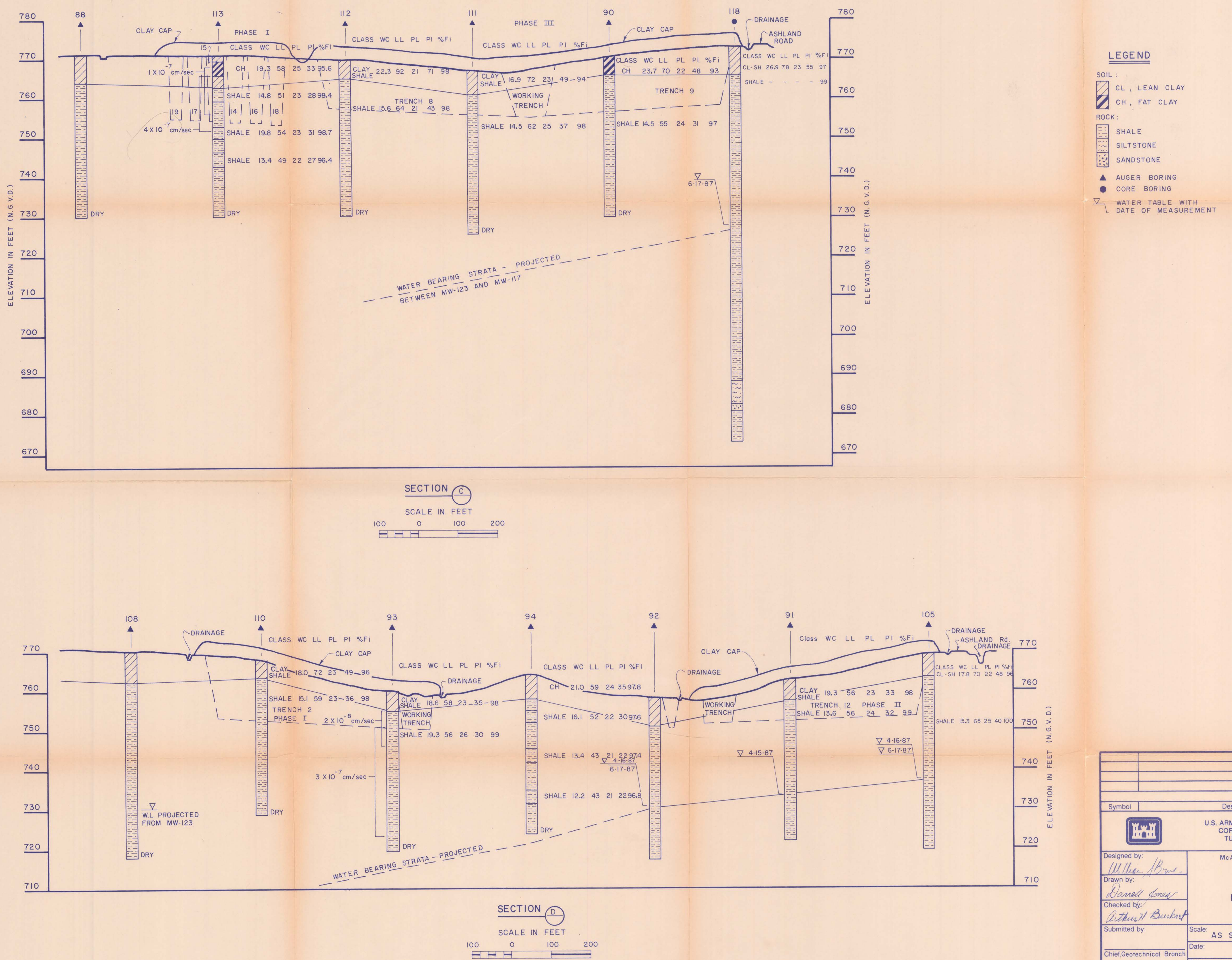
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

PRELIMINARY CONTOUR MAP AND PLAN OF EXPLORATION

Designed by:
Drawn by: Darrell Jones
Checked by:
Submitted by:
Chief, Geotechnical Branch
Scale: AS SHOWN
Date:
Dwg. Code:
Sheet reference number:
Sheet of

PLATE I



Symbol	Descriptions	Date	Approved
	Revisions		

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: [signature]
Drawn by: [signature]
Checked by: [signature]
Submitted by:
Chief, Geotechnical Branch

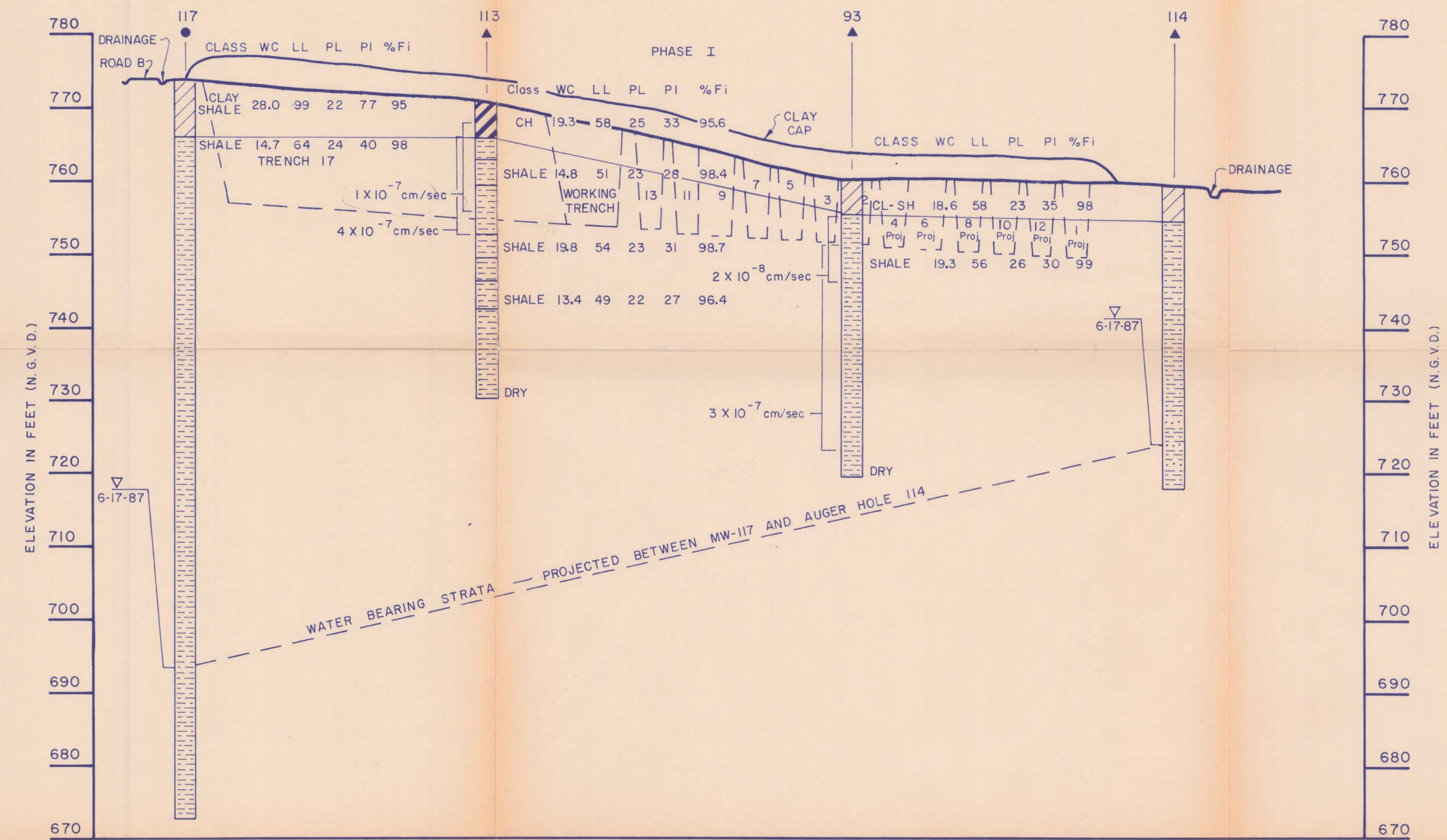
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

NORTH - SOUTH GEOLOGIC CROSS SECTIONS

Scale: AS SHOWN
Date:
Dwg. Code:
Sheet reference number:
Sheet of

PLATE 2

FOR LEGEND: SEE PLATE NO. 2



SECTION (A)

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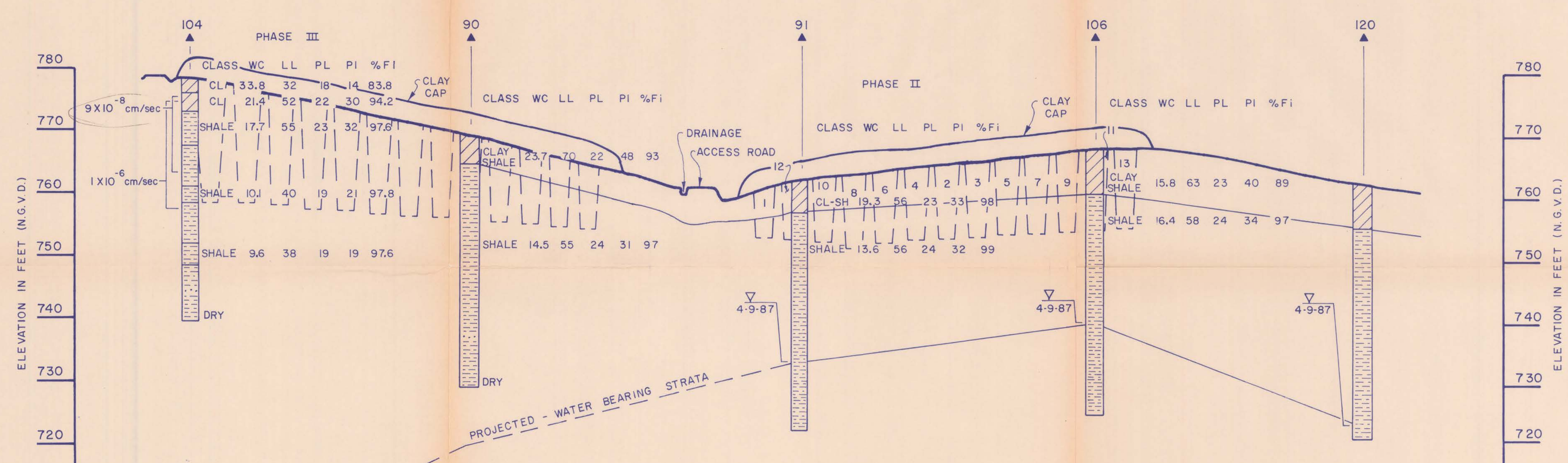

SECTION (B)

SCALE IN FEET

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Symbol	Descriptions	Date	Approved
	Revisions		

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: [signature]
Drawn by: Darrell Jones
Checked by: Arthur H. Burkart
Submitted by:
Chief, Geotechnical Branch

McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

EAST – WEST GEOLOGIC
CROSS SECTIONS

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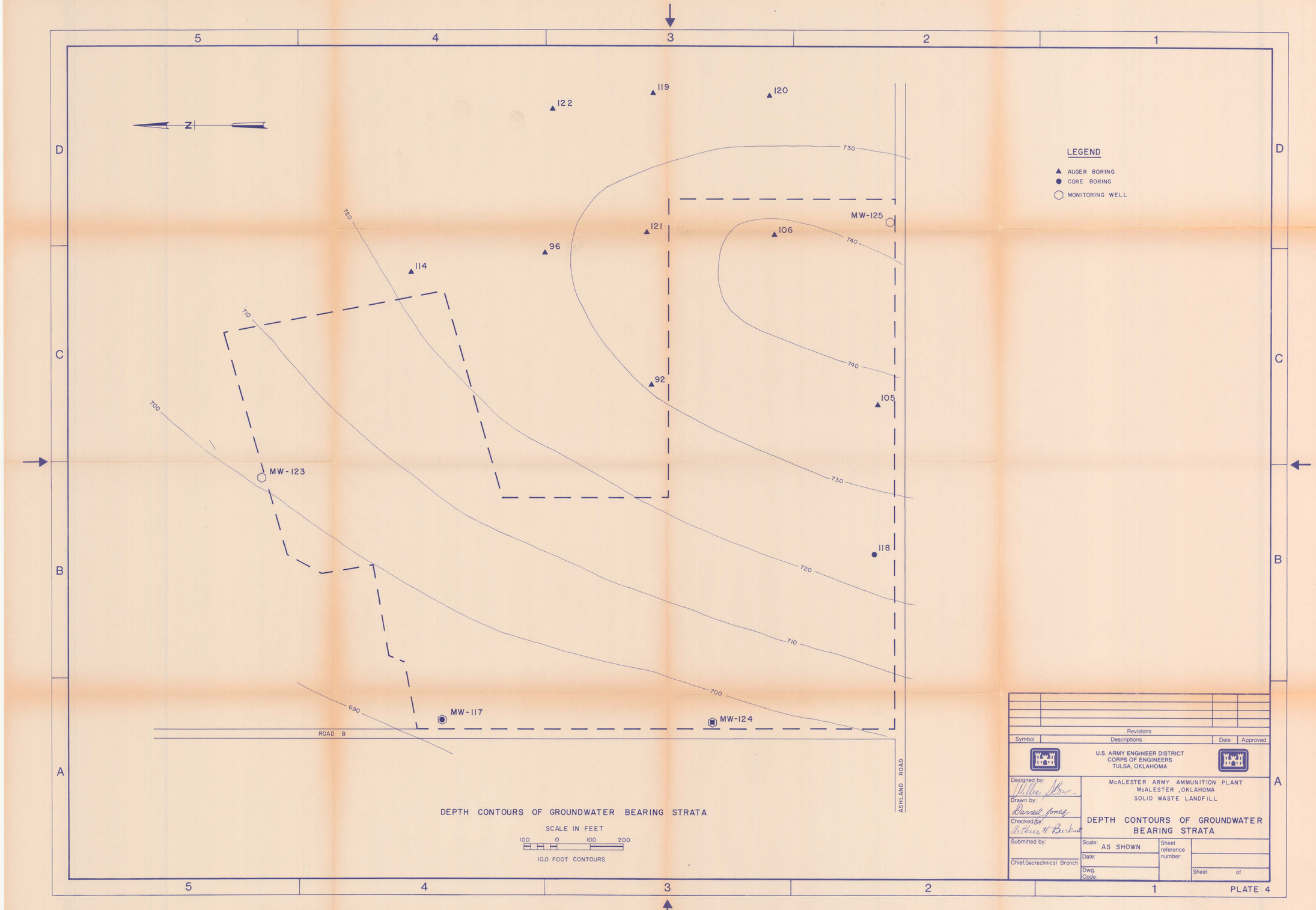
Sheet of

PLATE 3



DEPTH CONTOURS OF GROUNDWATER BEARING STRATA

SCALE IN FEET

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10.0 FOOT CONTOURS

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: William J. Brown

Drawn by: Darrell Jones

Checked by: Fuller H. Burkett

McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

DEPTH CONTOURS OF GROUNDWATER BEARING STRATA

Submitted by:

Chief, Geotechnical Branch

Scale: AS SHOWN

Date:

Dwg. Code:

Sheet reference number:

Sheet of

PLATE 4

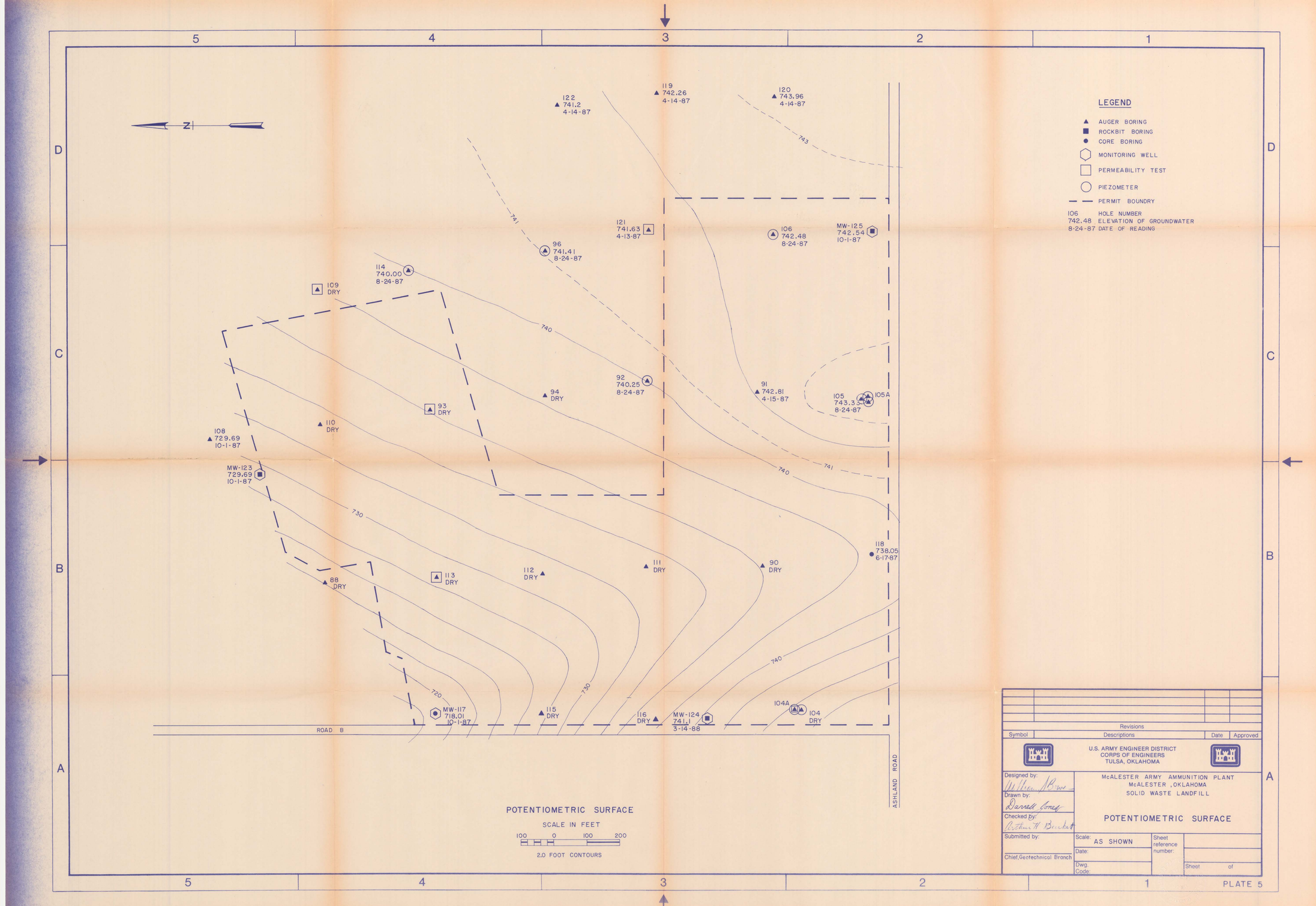
N
LEGEND
AUGER BORING
ROCKBIT BORING
CORE BORING
MONITORING WELL
PERMEABILITY TEST
PIEZOMETER
PERMIT BOUNDRY
106 HOLE NUMBER
742.48 ELEVATION OF GROUNDWATER
8-24-87 DATE OF READING
122 ▲ 741.2 4-14-87
119 ▲ 742.26 4-14-87
120 ▲ 743.96 4-14-87
121 741.63 4-13-87
106 742.48 8-24-87
MW-125 742.54 10-1-87
96 741.41 8-24-87
114 740.00 8-24-87
109 DRY
92 740.25 8-24-87
91 ▲ 742.81 4-15-87
105 743.33 8-24-87
105A
94 DRY
93 DRY
110 DRY
108 ▲ 729.69 10-1-87
MW-123 729.69 10-1-87
118 738.05 6-17-87
90 DRY
111 DRY
112 DRY
113 DRY
88 DRY
MW-117 718.01 10-1-87
115 DRY
116 DRY
MW-124 741.1 3-14-88
104A
104 DRY
ROAD B
ASHLAND ROAD
741
740
730
720
743
POTENTIOMETRIC SURFACE
SCALE IN FEET
100 0 100 200
2.0 FOOT CONTOURS
Revisions
Symbol | Descriptions | Date | Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA
Designed by:
Drawn by: Darrell Comer
Checked by: Arthur H. Beckett
Submitted by:
Chief, Geotechnical Branch
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL
POTENTIOMETRIC SURFACE
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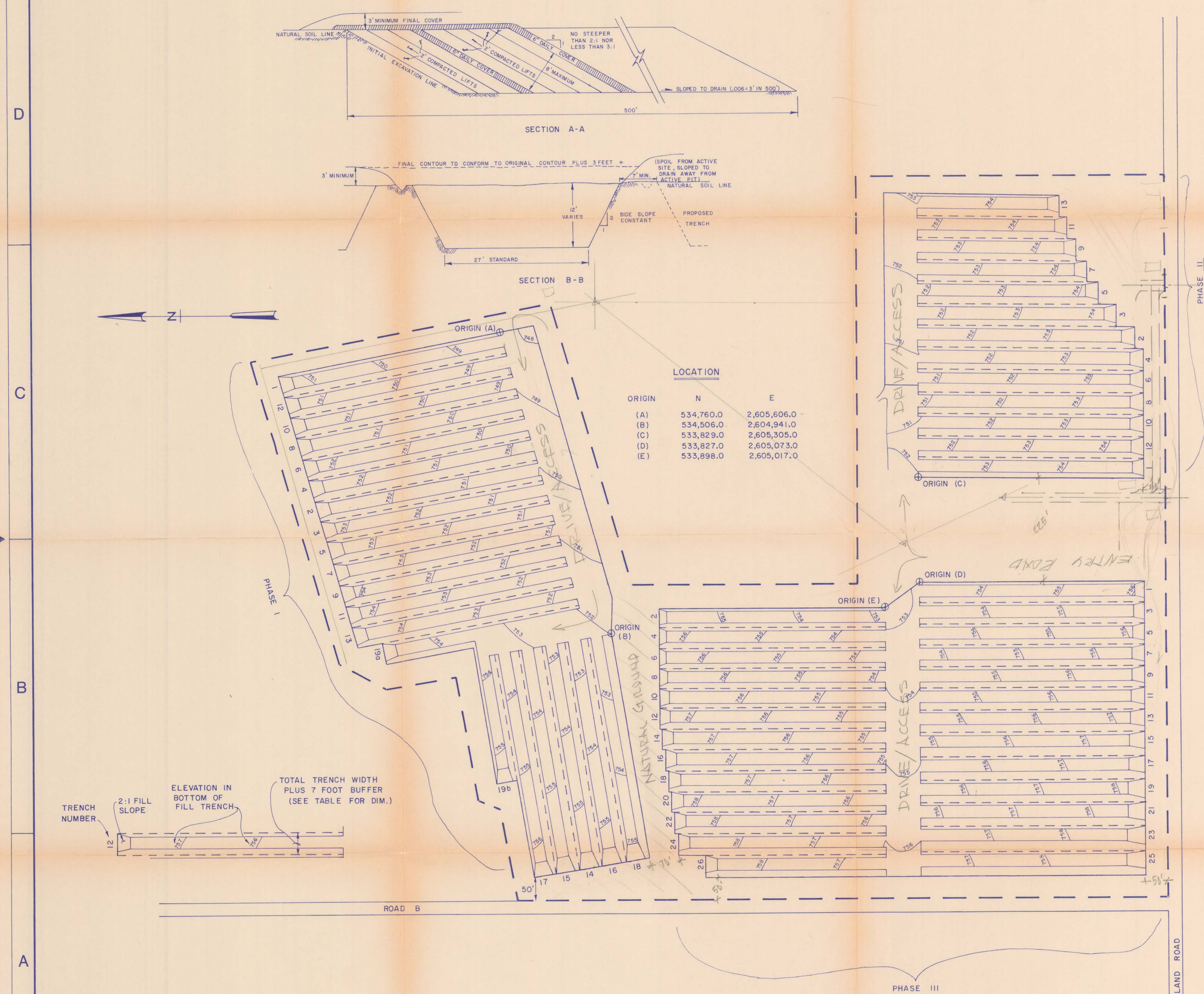
PLATE 5



LOCATION

ORIGIN	N	E
(A)	534,760.0	2,605,606.0
(B)	534,506.0	2,604,941.0
(C)	533,829.0	2,605,305.0
(D)	533,827.0	2,605,073.0
(E)	533,898.0	2,605,017.0

TRENCH DESIGN AND EXCAVATION PLAN

SCALE IN FEET

100 0 100 200

PHASE 1

TRENCH NO.	TRENCH LENGTH	CENTERLINE OF TRENCH FROM ORIGIN (A) OR (B)	TOTAL TRENCH WIDTH PLUS 7 FOOT BUFFER	MAX. DEPTH	MIN. DEPTH
1	500'	20.5(A)	48'	14'	8'
2	500'	310.0 (A)	48'	14'	8'
3	500'	358.2(A)	48'	14'	8'
4	500'	261.7(A)	48'	14'	8'
5	500'	407.0(A)	49'	15'	8'
6	500'	213.5(A)	48'	14'	8'
7	500'	455.2(A)	48'	14'	8'
8	500'	165.2(A)	48'	14'	8'
9	500'	503.5(A)	48'	14'	8'
10	500'	117.0(A)	48'	14'	8'
11	500'	551.7(A)	48'	14'	9'
12	500'	68.7(A)	48'	14'	8'
13	500'	600.0(A)	48'	14'	10'
14	500'	133.5(B)	52'	18'	13'
15	500'	185.0(B)	51'	17'	14'
16	500'	81.5(B)	52'	18'	13'
17	500'	235.5(B)	50'	16'	14'
18	500'	29.5(B)	52'	18'	13'
19a	195'	649.5(A)	48'	14'	13'
19b	280'	285.5(B)	50'	16'	14'

PHASE II

TRENCH NO.	TRENCH LENGTH	CENTERLINE OF TRENCH FROM ORIGIN (C)	TOTAL TRENCH WIDTH PLUS 7 FOOT BUFFER	MAX. DEPTH	MIN. DEPTH
1	500'	26.5'	46'	12'	7'
2	483'	318.0'	49'	15'	10'
3	442'	366.5'	48'	14'	10'
4	500'	269.0'	49'	15'	9'
5	402'	414.5'	48'	14'	10'
6	500'	220.0'	49'	15'	8'
7	375'	462.5'	48'	14'	10'
8	500'	171.0'	49'	15'	8'
9	352'	510.0'	47'	13'	9'
10	500'	122.0'	49'	15'	7'
11	332'	557.0'	47'	13'	9'
12	500'	73.5'	48'	14'	6'
13	317'	604.0'	47'	13'	9'

PHASE III

TRENCH NO.	TRENCH LENGTH	CENTERLINE OF TRENCH FROM ORIGIN (D) OR (E)	TOTAL TRENCH WIDTH PLUS 7 FOOT BUFFER	MAX. DEPTH	MIN. DEPTH
1	500'	19.0(D)	45'	11'	9'
2	500'	18.0(E)	43'	9'	8'
3	500'	64.5(D)	46'	12'	9'
4	500'	61.5(E)	44'	10'	8'
5	500'	111.0(D)	47'	13'	10'
6	500'	105.5(E)	44'	10'	8'
7	500'	158.5(D)	48'	14'	11'
8	500'	150.0(E)	45'	11'	9'
9	500'	206.5(D)	48'	14'	11'
10	500'	195.0(E)	45'	11'	11'
11	500'	255.0(D)	49'	15'	12'
12	500'	240.5(E)	46'	12'	12'
13	500'	304.5(D)	50'	16'	12'
14	495'	286.5(E)	46'	12'	12'
15	500'	355.0(D)	51'	17'	12'
16	487'	332.5(E)	46'	13'	12'
17	500'	406.5(D)	52'	18'	13'
18	479'	379.0(E)	47'	13'	13'
19	500'	459.0(D)	53'	19'	14'
20	471'	426.0(E)	47'	13'	13'
21	500'	512.0(D)	53'	19'	14'
22	463'	473.0(E)	47'	13'	13'
23	500'	565.5(D)	54'	20'	15'
24	454'	520.5(E)	48'	14'	13'
25	500'	620.0(D)	55'	21'	15'
26	400'	569.0(E)	49'	15'	14'

Symbol	Descriptions	Date	Approved

Revisions

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

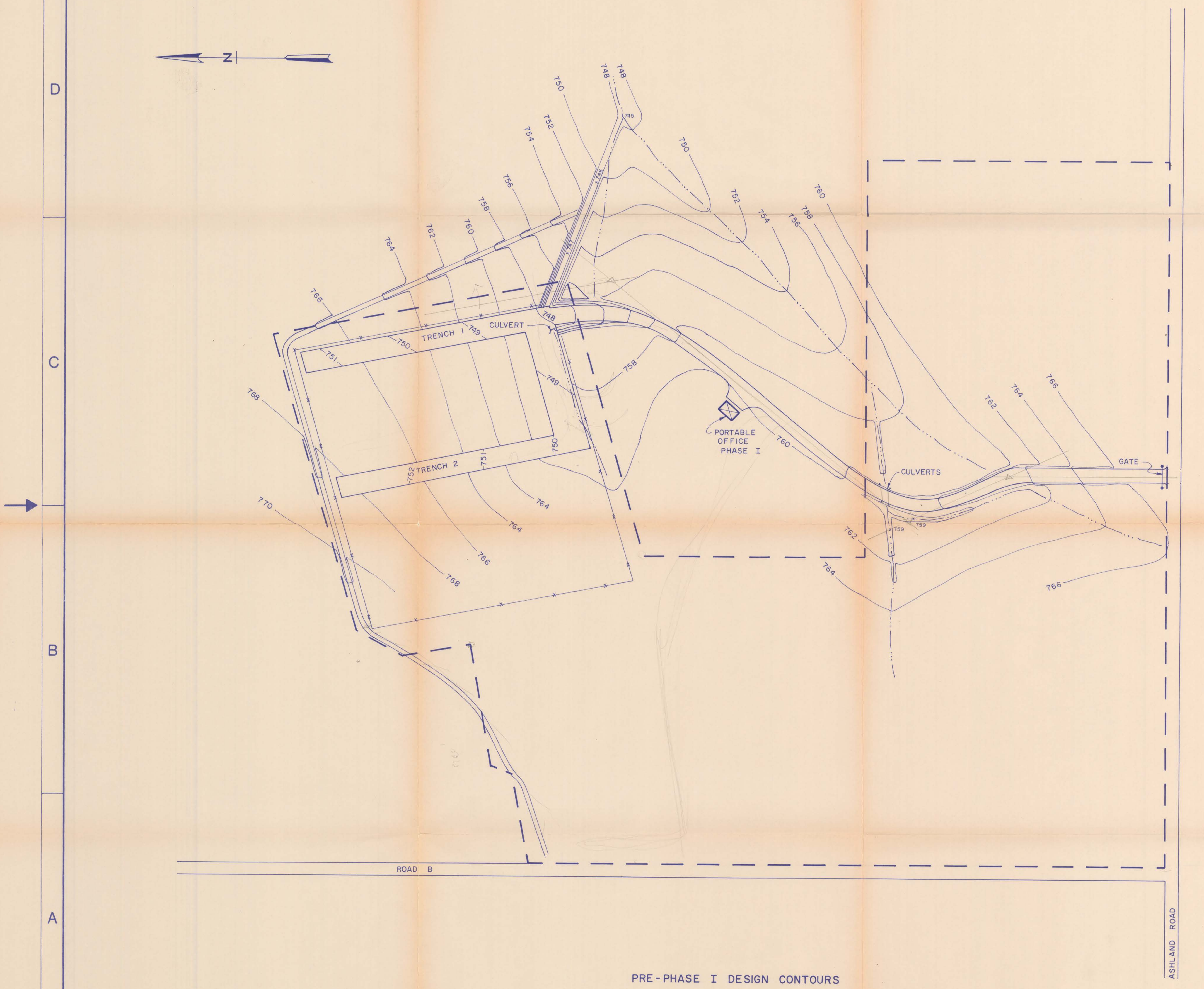
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

TRENCH DESIGN AND EXCAVATION PLAN

Designed by: William [signature]
Drawn by: Darrell Jones
Checked by: Arthur H. Burkard
Submitted by:
Chief, Geotechnical Branch

Scale: AS SHOWN
Date:
Dwg. Code:
Sheet reference number:
Invitation No. DACA 56- -B-
Contract No. DACA 56- -C-
Sheet of

PLATE 6



NOTES:
1. 2 FOOT CONTOURS ARE INTERPOLATED FROM 5 FOOT CONTOURS.
2. ONE FOOT CONTOURS ARE SHOWN IN BOTTOM OF TRENCHS. CONTOURS ON TRENCH WALLS ARE DELETED FOR SIMPLICITY.

—x—x—x— TRASH FENCE

PRE-PHASE I DESIGN CONTOURS

SCALE IN FEET

100 0 100 200

Symbol	Revisions Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

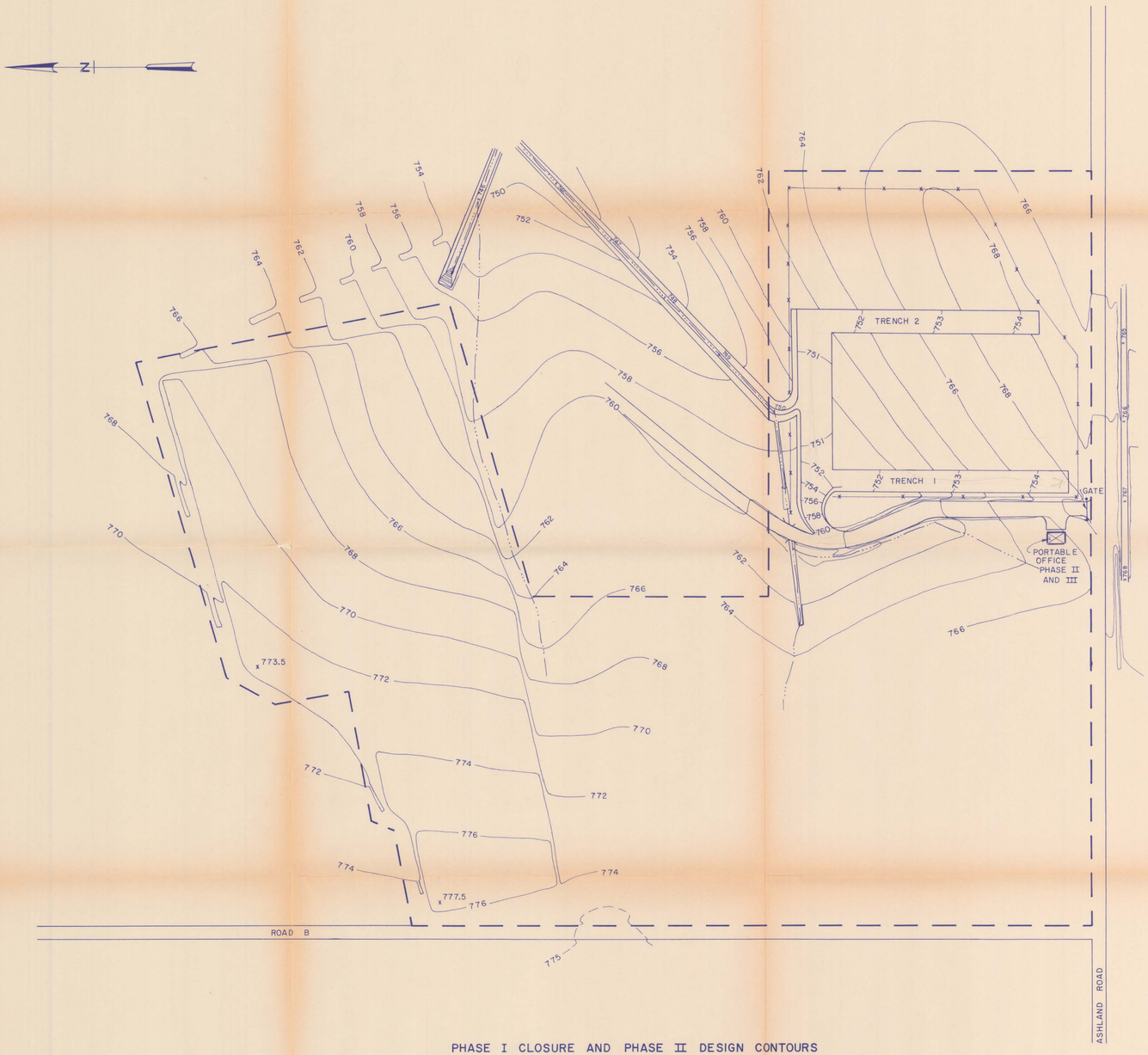
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

PRE-PHASE I DESIGN CONTOURS

Designed by: William S. Bowe
Drawn by: Darrell Jones
Checked by: Arthur H. Bierbaut
Submitted by:
Chief, Geotechnical Branch

Scale: AS SHOWN
Date:
Dwg. Code:
Sheet reference number:
Sheet of

PLATE 7



NOTES:

1. 2 FOOT CONTOURS ARE INTERPOLATED FROM 5 FOOT CONTOURS.
2. ONE FOOT CONTOURS ARE SHOWN IN BOTTOM OF TRENCHS. CONTOURS ON TRENCH WALLS ARE DELETED FOR SIMPLICITY.

TRASH FENCE

PHASE I CLOSURE AND PHASE II DESIGN CONTOURS

SCALE IN FEET

100 0 100 200

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: Walter A. Brown
Drawn by: Daniel Jones
Checked by:

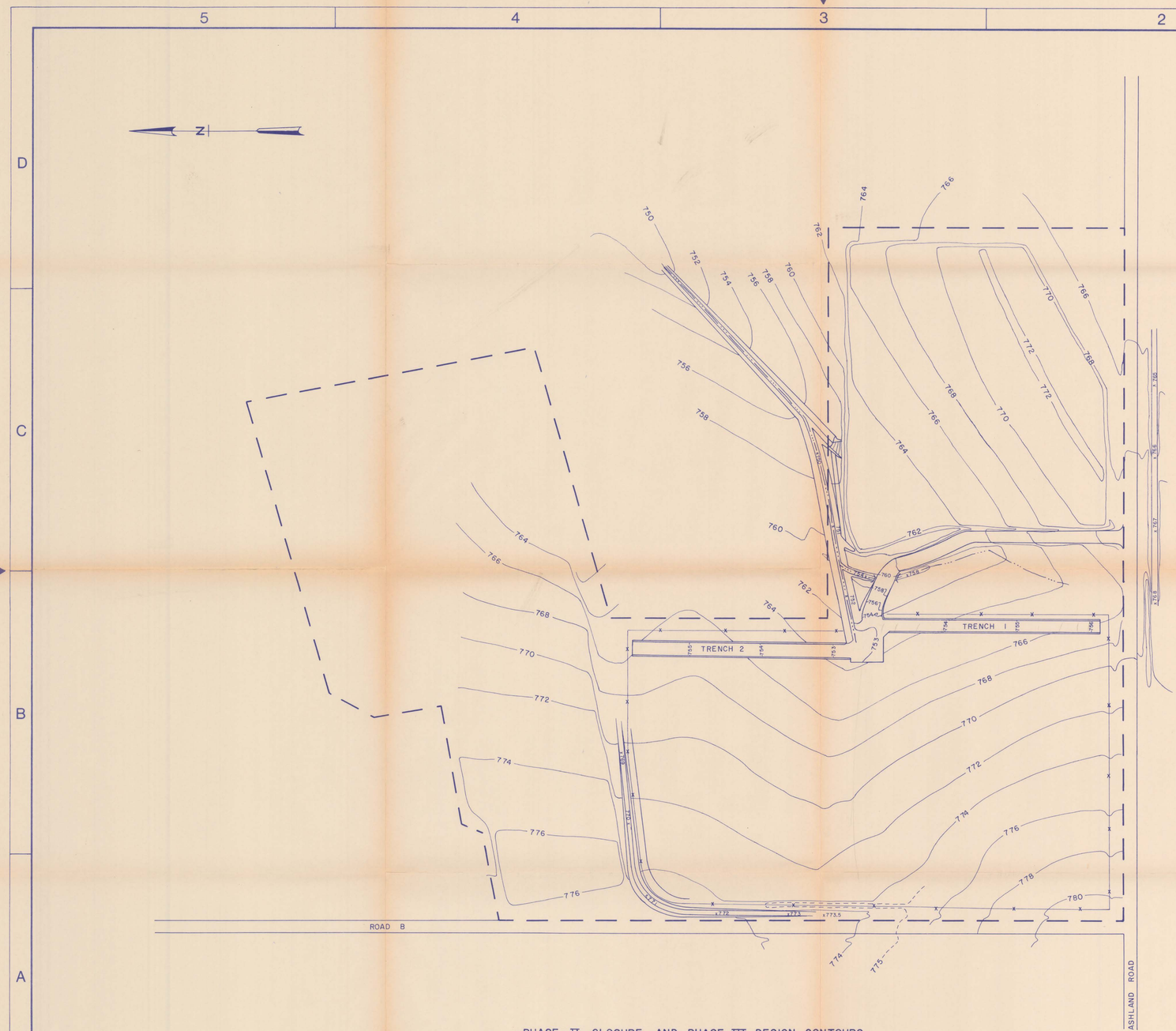
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

PHASE I CLOSURE AND PHASE II DESIGN CONTOURS

Submitted by:
Chief, Geotechnical Branch

Scale: AS SHOWN
Date:
Dwg. Code:
Sheet reference number:
Sheet: of

PLATE 8



NOTES:

1. 2 FOOT CONTOURS ARE INTERPOLATED FROM 5 FOOT CONTOURS.
2. ONE FOOT CONTOURS ARE SHOWN IN BOTTOM OF TRENCHS. CONTOURS ON TRENCH WALLS ARE DELETED FOR SIMPLICITY.

TRASH FENCE

PHASE II CLOSURE AND PHASE III DESIGN CONTOURS

SCALE IN FEET

100 0 100 200

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: William A Brown
Drawn by: Darrell Jones
Checked by: Arthur N Beckstedt

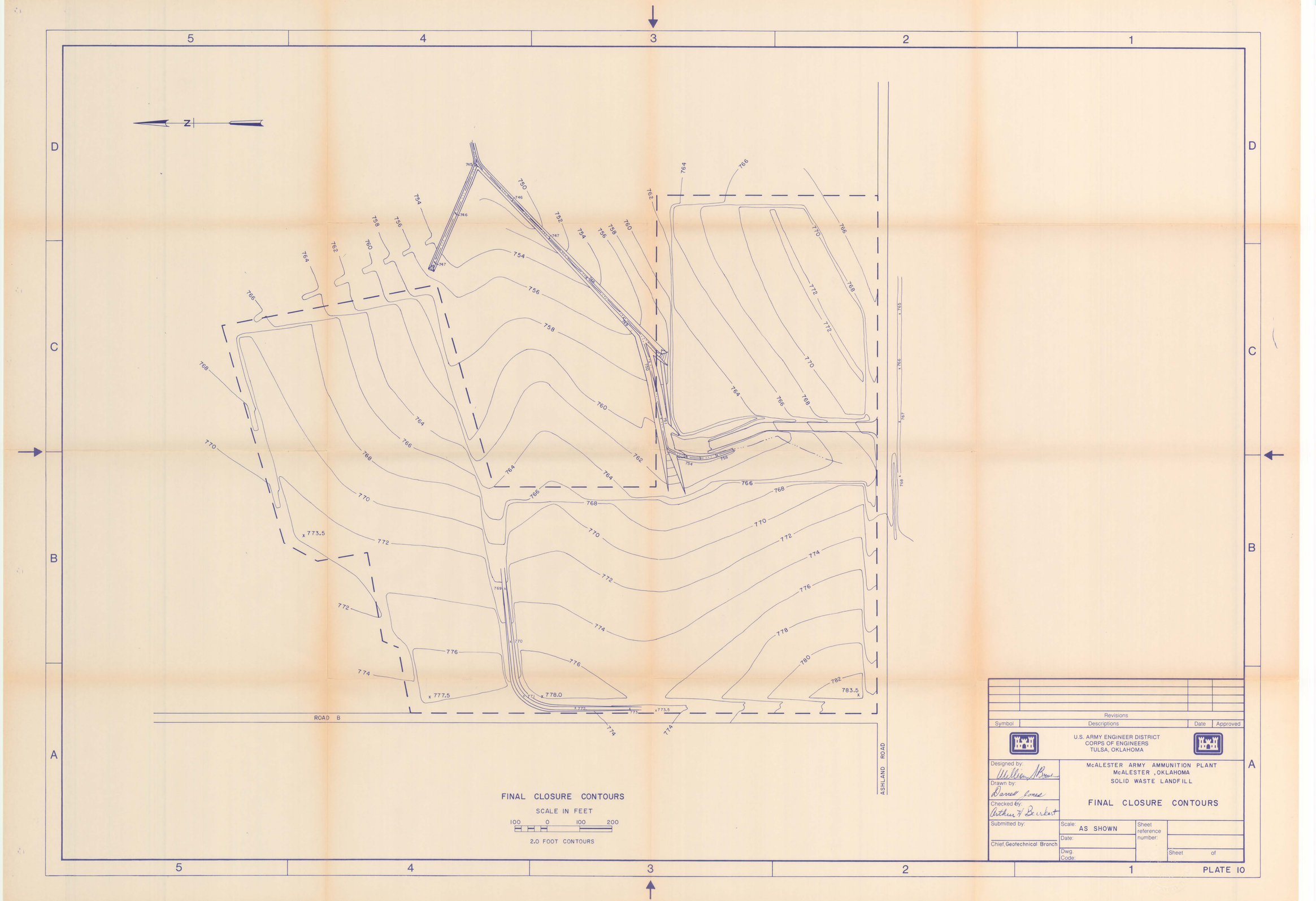
McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

PHASE II CLOSURE AND PHASE III DESIGN CONTOURS

Submitted by: Chief, Geotechnical Branch

Scale: AS SHOWN
Date:
Dwg. Code:
Sheet reference number:
Sheet of

PLATE 9



Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: Melissa J. Brown
Drawn by: Darrell Jones
Checked by: Arthur F. Beckert
Submitted by: Chief, Geotechnical Branch

McALESTER ARMY AMMUNITION PLANT
McALESTER, OKLAHOMA
SOLID WASTE LANDFILL

FINAL CLOSURE CONTOURS

Scale: AS SHOWN
Date:
Dwg. Code:
Sheet reference number:
Sheet of

PLATE 10

Appendix 11
Historical Geologic Logs

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS

1. PROJECT	LANDFILL SITING (SECTION 30)
2. LOCATION (Coordinates or Station)	534991.20 2604785.70
3. DRILLING AGENCY	TULSA DISTRICT
4. HOLE NO. (As shown on drawing title and file number)	88
5. NAME OF DRILLER	WYATT
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	7.0
8. DEPTH DRILLED INTO ROCK	34.0
9. TOTAL DEPTH OF HOLE	41.0
10. SIZE AND TYPE OF BIT	5.5" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO OF OVER–	DISTURBED 13 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY 3/16/87
16. DATE HOLE	STARTED 03/12/87 COMPLETED 03/12/87
17. ELEVATION TOP OF HOLE	771.0
18. TOTAL CORE RECOVERY FOR BORING	100.0 %
19. SIGNATURE OF INSPECTOR	FLAMING

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 7.0) BROWN, MOIST, WET 0.0–1.0. TAN GREEN, DRY MOD. FIRM 1.0–7.0'.		J–1	WATER LEVEL 3–16–87 38.52' (MUD) MOVE OVER HOLE 6" AUGER 0.0–41.0' CLEANED OUT HOLE HOLE OPEN TO 38.8'
	4				J–2	
					J–3	TYPE AUGER ZONE 0.0– 41.0
764.0			TOP OF ROCK			SAMPLE DEPTH J–1 0.0– 1.0 J–2 1.0– 4.0 J–3 4.0– 7.0 J–4 7.0– 10.5 J–5 10.5– 14.0 J–6 14.0– 17.0 J–7 17.0– 21.0 J–8 21.0– 24.0 J–9 24.0– 27.0 J–10 27.0– 30.4 J–11 30.4– 34.0 J–12 34.0– 37.5 J–13 37.5– 41.0
	8		SHALE (SH) (7.0 – 41.0) 7.0–10.5 TAN GREEN, MOD FIRM 10.5–24.0 GREEN TAN FIRM, DRY. 24.0–41.0 DK. GRAY, DRY, VERY FIRM.		J–4	
	12				J–5	
	16				J–6	
					J–7	
	20					
					J–8	
	24				J–9	
	28				J–10	
	36				J–12	
					J–13	
731.0	40		BOTTOM OF HOLE @ 41.0'			

HOLE NO. 90

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 333859.70	2604858.40	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 90		13. TOTAL NO OF OVER– DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 03/18/87	COMPLETED 03/19/87
7. THICKNESS OF OVERBURDEN 4.5		17. ELEVATION TOP OF HOLE 769.6	
8. DEPTH DRILLED INTO ROCK 36.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 40.5		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION g	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
765.1	4		CLAY (CL) (0.0 – 4.5) 0.0–1.5 BROWN ORANGE, MOIST 1.5–4.5 TAN GREEN, MOIST. TOP OF ROCK		J–1 J–2	HOLE DRY AT 37.1 AT TIME OF DRILLING. TYPE AUGER ZONE 0.0– 40.5 SAMPLE DEPTH J–1 0.0– 1.5 J–2 1.5– 4.5 J–3 4.5– 7.5 J–4 7.5– 11.0 J–5 11.0– 14.5 J–6 14.5– 17.5 J–7 17.5– 21.0 J–8 21.0– 24.5 J–9 24.5– 28.0 J–10 28.0– 31.0 J–11 31.0– 34.0 J–12 34.0– 38.0 J–13 38.0– 40.5
	8		(SH) (4.5 – 40.5) TAN GREEN, WEA. MOD. FIRM WEATHERED 4.5–17.5. GREEN TAN, FIRM 17.5–24.5. DK. GRAY, V. FIRM 24.5–40.5. SANDSTONE 32.2', 33.0', 37.0, 38.0'.		J–3 J–4	
	12				J–5	
	16				J–6	
	20				J–7	
	24				J–8	
	28				J–9	
	32				J–10	
	36				J–12	
729.6	40		BOTTOM OF HOLE @ 40.5'		J–13	

HOLE NO. 92

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 534018.90 2605414.90		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 92		13. TOTAL NO OF OVER- DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 03/17/87	COMPLETED 03/17/87
7. THICKNESS OF OVERBURDEN 7.0		17. ELEVATION TOP OF HOLE 757.9	
8. DEPTH DRILLED INTO ROCK 33.5		18. TOTAL CORE RECOVERY FOR BORING 100.0 %	
9. TOTAL DEPTH OF HOLE 40.5		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 7.0) 0.0–1.5 BROWN, MOIST. 1.5–7.0 TAN GREEN, MOIST.		J–1	ENCOUNTERED WATER IN SS STREAK 27.5–31.0'.
					J–2	INSTALLED PIEZOMETER TO DETERMINE WATER TABLE.
	4				J–3	TYPE AUGER ZONE 0.0– 40.5
750.9			TOP OF ROCK			SAMPLE DEPTH J–1 0.0– 1.5 J–2 1.5– 4.5 J–3 4.5– 7.0 J–4 7.0– 10.5 J–5 10.5– 13.5 J–6 13.5– 17.0 J–7 17.0– 20.5 J–8 20.5– 24.0 J–9 24.0– 27.5 J–10 27.5– 31.0 J–11 31.0– 34.0 J–12 34.0– 37.0 J–13 37.0– 40.5
	8		SHALE (SH) (7.0 – 40.5) 7.0–13.5 TAN GREEN WEATHERED, MOD. FIRM. 13.5–20.5 GREEN GRAY, FIRM. 20.5–40.5 DARK GRAY, VERY FIRM SANDSTONE STREAK 27.5–30.5' WET SHALE 27.5–31.5'.		J–4	
	12				J–5	
					J–6	
	16				J–7	
	20				J–8	
	24				J–9	
	28				J–10	
					J–12	
	36				J–13	
717.9	40		BOTTOM OF HOLE @ 40.5'			

HOLE NO. 93

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 534879.00 2605316.70		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 93		13. TOTAL NO OF OVER- DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/16/87	
		16. DATE HOLE STARTED 03/16/87	COMPLETED 03/16/87
7. THICKNESS OF OVERBURDEN 5.0		17. ELEVATION TOP OF HOLE 758.0	
8. DEPTH DRILLED INTO ROCK 0.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 40.9		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
758.0	0		CLAY (CL) (0.0 – 5.0) 0.0–2.0 TAN, MOIST. 2.0–5.0 TAN GREEN, DRY.		J–1	MOVED OR HOLE 6" AUGER 0.0'–40.9'
					J–2	HOLE OPEN TO 38.6' DRY
	4					RAIN 1900 HOURS
753.0			TOP OF ROCK			SAMPLE DEPTH J–1 0.0– 2.0 J–2 2.0– 5.0 J–3 5.0– 8.5 J–4 8.5– 12.0 J–5 12.0– 15.0 J–6 15.0– 18.5 J–7 18.5– 22.0 J–8 22.0– 25.0 J–9 25.0– 28.5 J–10 28.5– 32.0 J–11 32.0– 35.0 J–12 35.0– 38.0 J–13 38.0– 40.9
			SHALE (SH) (5.0 – 40.9) SHALE, TAN GREEN, MOD FIRM, DRY 5.0–15.0 DARK GRAY, DRY, FIRM 15.0–40.9 FIRMER BELOW 32.0'		J–3	
	8					
					J–4	
	12					
					J–5	
	16					
					J–6	
	20					
					J–7	
	24					
					J–8	
	28					
					J–9	
					J–10	
					J–11	
	36					
					J–12	
718.0	40		BOTTOM OF HOLE @ 40.9'		J–13	

HOLE NO. 94

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 534329.80 2605364.10		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 94		13. TOTAL NO OF OVER– DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 03/17/87	COMPLETED 03/17/87
7. THICKNESS OF OVERBURDEN 6.0		17. ELEVATION TOP OF HOLE 763.2	
8. DEPTH DRILLED INTO ROCK 34.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 40.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 6.0) CLAY, BROWN MOIST 0.0–2.5' CLAY, TAN DRY 2.5–6.0 %PASS LL PL PI #200 CLASS 59 24 35 97.8 CH		J–1	RAINING W/THUNDERSTORMS 3–17–87 – RAINING UNTIL 0915 HOUR WATER LEVELS HOLE DEP REM TIME 93 38.62' DRY 1030HR 98 13.80 W.L. 1045HR TOP OF RISER SET UP OR HOLE 6" AUGER 0.0–40.0' CLEANED OUT HOLE OPEN TO 39.32
	4				J–2	
757.2			TOP OF ROCK			
			SHALE (SH) (6.0 – 9.0) SHALE, TAN GREEN, WEATHERED, MOD. FIRM. 6.0–9.0'		J–3	
	8					
754.2						
			SHALE (SH) (9.0 – 15.5) SHALE, GREEN TAN, MOD. FIRM – FIRM DRY W/IRON CONCRETIONS 9.0–15.5' LL PL PI %PASSING CLASS 52 22 30 97.6 SH		J–4	SAMPLE DEPTH J–1 0.0– 2.5 J–2 2.5– 6.0 J–3 6.0– 9.0 J–4 9.0– 12.0 J–5 12.0– 15.5 J–6 15.5– 18.5 J–7 18.5– 22.0 J–8 22.0– 25.5 J–9 25.5– 29.0 J–10 29.0– 31.5 J–11 31.5– 35.0 J–12 35.0– 38.0 J–13 38.0– 40.0
	12				J–5	
747.7						
	16		SHALE (SH) (15.5 – 22.0) SHALE, GREEN GRAY, FIRM DRY 15.5–22.0' LL PL PI %PASS CLASS 43 21 22 97.4 SH		J–6	
	20				J–7	
741.2						
			SHALE (SH) (22.0 – 40.0) SHALE, DARK GRAY, DRY, VERY FIRM 22.0–40.0 LL PL PI % PASS CLASS 43.0 21 22 96.8 SH S.S. STREAK AT 38.6'		J–8	
	24					
					J–9	
	28					
					J–10	
	36				J–12	
					J–13	
723.2	40		BOTTOM OF HOLE @ 40.0'			

HOLE NO. 96

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS

1. PROJECT	LANDFILL SITING (SECTION 30)
2. LOCATION (Coordinates or Station)	534336.60 2605804.30
3. DRILLING AGENCY	TULSA DISTRICT
4. HOLE NO. (As shown on drawing title and file number)	96
5. NAME OF DRILLER	WYATT
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	2.5
8. DEPTH DRILLED INTO ROCK	37.5
9. TOTAL DEPTH OF HOLE	40.0
10. SIZE AND TYPE OF BIT	5.5" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO OF OVER–	DISTURBED 14 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 03/16/87 COMPLETED 03/16/87
17. ELEVATION TOP OF HOLE	751.2
18. TOTAL CORE RECOVERY FOR BORING	0.0 %
19. SIGNATURE OF INSPECTOR	FLAMING

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
748.7			CLAY (CL) (0.0 – 2.5) CLAY (CL–GM) BROWN, MOIST–WET 0.0.2.5' TOP OF ROCK		J–1	HOLE# DEP. REM. TIME 97 37.21 DRY 0802 98 38.2 DRY 108 50.02 DRY 110 37.17 DRY 109 51.12 DRY 188 38.52 MUD 0831 MOVED OVER HOLE 6" AUGER 0.0–40.0'
	4		SHALE (SH) (2.5 – 15.5) SHALE, GREEN TAN, WEATHERED MOIST 2.5–5.5' SHALE,TAN GREEN,DRY,MOD. FIRM 5.5–15.5		J–2	
					J–3	HIT H20 AT 30.0' OPEN TO 39.0' W.L 20.0' AT 1035 HOUR
	8					
					J–4	6" AUGER 0.0–40.0' HIT H20 AT 30.0' OPEN TO 39.0' W.L 20.0' AT 1035 HR. SET PIEZO. BACK FILLED W/SAND TO 12.0' 1/2 BUCKET OF PELLETS TO 10.5' 4.39' STICKUP
	12					
735.7					J–5	
	16		SHALE (SH) (15.5 – 29.6) SHALE, DARK GRAY, DRY, FIRM W/ORANGE IRON CONCRETIONS DOWN TO 24.5'		J–6	SAMPLE DEPTH J–1 0.0– 2.5 J–2 2.5– 5.5 J–3 5.5– 8.5 J–4 8.5– 12.0 J–5 12.0– 15.5 J–6 15.5– 18.5 J–7 18.5– 21.5 J–8 21.5– 24.5 J–9 24.5– 28.0 J–10 28.0– 30.0 J–11 30.0– 32.5 J–12 32.5– 36.0 J–13 36.0– 39.0 J–14 39.0– 40.0
	20				J–7	
					J–8	
	24					
					J–9	
	28					
721.6					J–10	
			SANDSTONE (SS) (29.6 – 40.0) SANDSTONE 29.6–30.0 SOURCE H20		J–11	
	36					
					J–13	
711.2	40		BOTTOM OF HOLE AT 40.0'		J–14	

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. 96

HOLE NO. 97

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5"AUGER	
2. LOCATION (Coordinates or Station) 533972.20	2605117.70	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number)	97	13. TOTAL NO OF OVER–	DISTURBED 13 / UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	DRY 3/16/87
7. THICKNESS OF OVERBURDEN	7.0	16. DATE HOLE STARTED 03/13/87 COMPLETED 03/13/87	
8. DEPTH DRILLED INTO ROCK	34.5	17. ELEVATION TOP OF HOLE	771.3
9. TOTAL DEPTH OF HOLE	41.5	18. TOTAL CORE RECOVERY FOR BORING	0.0 %
		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	4		CLAY (CL) (0.0 – 7.0) CLAY (CL), ORANGE–BROWN, MOIST 0.0–1.5' CLAY (CL–CH) MOIST, GREEN TAN FEW GRAVEL 1.5–7.0'		J–1 J–2 J–3	MOVED OVER HOLE 6" AUGER 0.0–41.5' CLEANED OUT HOLE HOLE OPEN TO 37.2'
764.3			TOP OF ROCK			
	8		SHALE (SH) (7.0 – 30.0) SHALE TAN GREEN, DRY WEATHERED MOD. FIRM 7.0–30.0'		J–4	
	12		FIRMER BELOW 14.0'		J–5	
	16				J–6	
	20				J–7	
	24				J–8	
	28				J–9	
741.3					J–10	
	36		SHALE (SH) (30.0 – 41.5) SHALE DARK GRAY VERY FIRM		J–12	
731.3	41.5		BOTTOM OF HOLE AT 41.5		J–13	

SAMPLE	DEPTH
J–1	0.0– 1.5
J–2	1.5– 4.5
J–3	4.5– 7.0
J–4	7.0– 10.5
J–5	10.5– 14.0
J–6	14.0– 17.5
J–7	17.5– 21.0
J–8	21.0– 24.5
J–9	24.5– 28.0
J–10	28.0– 30.0
J–11	30.0– 33.5
J–12	33.5– 36.0
J–13	36.0– 41.5

HOLE NO. 98

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS

1. PROJECT	LANDFILL SITING (SECTION 30)	10. SIZE AND TYPE OF BIT	5.5"AUGER
2. LOCATION (Coordinates or Stations)	535845.30 2605168.00	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
3. DRILLING AGENCY	TULSA DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	98	13. TOTAL NO OF OVER– DISTURBED 13	UNDISTURBED
5. NAME OF DRILLER	WYATT	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	DRY 3/16/87
7. THICKNESS OF OVERBURDEN	7.5	16. DATE HOLE STARTED 03/12/87	COMPLETED 03/12/87
8. DEPTH DRILLED INTO ROCK	33.5	17. ELEVATION TOP OF HOLE	770.9
9. TOTAL DEPTH OF HOLE	41.0	18. TOTAL CORE RECOVERY FOR BORING	0.0 %
		19. SIGNATURE OF INSPECTOR	FLAMING

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 7.5) CLAY (CL–ML) BROWN MOIST–WET 0.0–1.5' CLAY (CL–CH) BROWN MOIST 1.5–7.5'		J–1	MOVED OVER HOLE 6" AUGER 0.0'–41.0' CLEANED OUT HOLE HOLE OPEN TO 38.2' DRY
	4				J–2	SAMPLE DEPTH J–1 0.0– 1.5 J–2 1.5– 4.5 J–3 4.5– 7.5 J–4 7.5– 11.0 J–5 11.0– 14.0 J–6 14.0– 17.5 J–7 17.5– 21.0 J–8 21.0– 24.0 J–9 24.0– 27.5 J–10 27.5– 31.0 J–11 31.0– 34.5 J–12 34.5– 38.0 J–13 38.0– 41.0
763.4			TOP OF ROCK		J–3	
	8		SHALE (SH) (7.5 – 41.0) SHALE TAN GREEN, MOD. FIRM, WEATHERED DRY. 7.5–21.0'		J–4	
	12		SHALE, DARK GRAY, VERY FIRM 21.0–41.0'		J–5	WL 3–16–87, 0800, 38.2 DRY
	16				J–6	
	20				J–7	
	24				J–8	
	28				J–9	
	36				J–10	
					J–12	
730.9	40		BOTTOM OF HOLE AT 41.0'		J–13	

HOLE NO. 104

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 533545.90 2604416.90		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 104		13. TOTAL NO OF OVER– DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/9/87	
		16. DATE HOLE STARTED 03/03/87	COMPLETED 03/04/87
7. THICKNESS OF OVERBURDEN 7.5		17. ELEVATION TOP OF HOLE 778.1	
8. DEPTH DRILLED INTO ROCK 33.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 41.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 7.5) MODERATELY SOFT, MOIST, MINOR SAND, LOW PLASTICITY. AT 2.4' CLAY IS STIFF, TAN–GREEN.		J–1	AUGERED 0.0–41.0, DID NOT SAMPLE 38.8–41.0'. HOLE DRY. SET PIEZOMETER. MEASURED WATER LEVEL ON 9 MAR 87, DRY.
	4				J–2	SAMPLE DEPTH J–1 0.0– 2.4 J–2 2.4– 5.5 J–3 5.5– 7.5 J–4 7.5– 11.0 J–5 11.0– 14.0 J–6 14.0– 17.5 J–7 17.5– 20.0 J–8 20.0– 23.0 J–9 23.0– 26.5 J–10 26.5– 30.0 J–11 30.0– 33.0 J–12 33.0– 36.0 J–13 36.0– 38.8
770.6					J–3	
	8		SHALE (SH) (7.5 – 41.0) SOFT, WEATHERED, BLOCKY, TAN–GREEN. GREEN–GRAY AT 14.0'.		J–4	
	12		MODERATELY SOFT, SILTY, DARK GRAY BELOW 20.0'. VERY SILTY AT 34.0'.		J–5	
	16				J–6	
					J–7	
	20				J–8	
	24				J–9	
	28				J–10	
					J–12	
	36				J–13	
737.1	40		BOTTOM OF HOLE AT 41.0'.			

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. 104

DRILLING LOG

DIVISION: SOUTHWEST
INSTALLATION: McALESTER
SHEET 1 OF 1 SHEETS

1. PROJECT	LANDFILL SITING (SECTION 30)
2. LOCATION (Coordinates or Station)	533554.60 2604416.90
3. DRILLING AGENCY	TULSA DISTRICT
4. HOLE NO. (As shown on drawing title and file number)	104A
5. NAME OF DRILLER	WYATT
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	7.5
8. DEPTH DRILLED INTO ROCK	13.7
9. TOTAL DEPTH OF HOLE	21.2
10. SIZE AND TYPE OF BIT	5.5" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO OF OVER—	DISTURBED 0 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY (9 MAR 87)
16. DATE HOLE	STARTED 03/03/87 COMPLETED 03/04/87
17. ELEVATION TOP OF HOLE	778.1
18. TOTAL CORE RECOVERY FOR BORING	0.0 %
19. SIGNATURE OF INSPECTOR	FLAMING

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		DID NOT COLLECT SAMPLES FOR HOLE. SEE LOG TO HOLE 104 FOR DESCRIPTION OF MATERIAL.			AUGERED 0.0–21.2'. SET PIEZOMETER IN DRY HOLE. HOLE DRY ON 9 MARCH 1987.
	4					
	8					
	12					
	16					
756.9	20		BOTTOM OF HOLE			
	24					
	28					
	36					
	40					

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PROJECT: LANDFILL SITING (SECTION 30) HOLE NO. 104A

HOLE NO. 105

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 533335.10 2605354.70		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 105		13. TOTAL NO OF OVER-- DISTURBED 15	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 26.4'(16 MAR87)	
		16. DATE HOLE STARTED 03/04/87	COMPLETED 03/05/87
7. THICKNESS OF OVERBURDEN 5.5		17. ELEVATION TOP OF HOLE 769.0	
8. DEPTH DRILLED INTO ROCK 43.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 49.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
763.5	4		CLAY (CL) (0.0 – 5.5) SOFT, LOW PLASTICITY, MOIST, BROWN. STIFF, DAMP, MODERATE TO HIGH PLASTICITY, TAN–GREEN BELOW 2.5'.		J–1 J–2	AUGERED 0.0–49.0'. HIT WATER AT 32.0'. SET PIEZOMETER. MEASURED WATER IN PIEZOMETER AT 26.4' ON 16 MARCH 1987.
	8		SHALE (SH) (5.5 – 49.0) SOFT, WEATHERED, BLOCKY, SILTY TAN–GREEN. GRAY–GREEN BELOW 12.0'. MODERATE SOFT, GRAY TO DARK GRAY BELOW 18.5'.VERY SILTY, WET 32.0–32.4'.		J–3	
	12				J–4	
	16				J–5	
	20				J–6	
	24				J–7	
	28				J–8	
					J–9	
					J–10	
					J–11	
	36				J–12	
729.0	40				J–13	

SAMPLE	DEPTH
J–1	0.0– 2.5
J–2	2.5– 5.5
J–3	5.5– 8.5
J–4	8.5– 12.0
J–5	12.0– 15.5
J–6	15.5– 18.5
J–7	18.5– 22.0
J–8	22.0– 25.0
J–9	25.0– 28.5
J–10	28.5– 32.0
J–11	32.0– 35.0
J–12	35.0– 38.0
J–13	38.0– 41.5
J–14	41.5– 45.0
J–15	45.0– 49.0

DRILLING LOG	DIVISION: SOUTHWEST	INSTALLATION: McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT: LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT: 5.5" AUGER	
2. LOCATION (Coordinates or Station): 533335.10 2605354.70		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number): 105		13. TOTAL NO OF OVER– DISTURBED: 15 UNDISTURBED: 0	
5. NAME OF DRILLER: WYATT		14. TOTAL NUMBER CORE BOXES: 0	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: 26.4'(16 MAR87)	
7. THICKNESS OF OVERBURDEN: 5.5		16. DATE HOLE STARTED: 03/04/87 COMPLETED: 03/05/87	
8. DEPTH DRILLED INTO ROCK: 43.5		17. ELEVATION TOP OF HOLE: 769.0	
9. TOTAL DEPTH OF HOLE: 49.0		18. TOTAL CORE RECOVERY FOR BORING: 0.0 %	
		19. SIGNATURE OF INSPECTOR: FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SHALE (SH) (5.5 – 49.0) SOFT, WEATHERED, BLOCKY, SILTY TAN–GREEN. GRAY–GREEN BELOW 12.0'. MODERATE SOFT, GRAY TO DARK GRAY BELOW 18.5'.VERY SILTY, WET 32.0–32.4'.		J–13	
	44				J–14	
	48				J–15	
720.0			BOTTOM OF HOLE			
	52					
	56					
	60					
	64					
	68					
	76					
	80					

HOLE NO. 105A

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 533333.80 2805365.40		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 105A		13. TOTAL NO OF OVER– DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY (16 MAR 87)	
		16. DATE HOLE STARTED 03/05/87	COMPLETED 03/06/87
		17. ELEVATION TOP OF HOLE 768.9	
7. THICKNESS OF OVERBURDEN 5.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
8. DEPTH DRILLED INTO ROCK 19.5		19. SIGNATURE OF INSPECTOR FLAMING	
9. TOTAL DEPTH OF HOLE 25.0			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			DID NOT SAMPLE HOLE. SEE LOG OF HOLE 105 FOR DESCRIPTION OF SOIL AND ROCK MATERIAL.			AUGERED 0.0–25.0'. HOLE DRY. SET PIEZOMETER.
743.9	4, 8, 12, 16, 20, 24, 28, 36, 40					

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. 105A

DRILLING LOG

DIVISION: SOUTHWEST

INSTALLATION: McALESTER

SHEET 1 OF 1 SHEETS

1. PROJECT: LANDFILL SITING (SECTION 30)
2. LOCATION (Coordinates or Station): 533345.00 2605861.00
3. DRILLING AGENCY: TULSA DISTRICT
4. HOLE NO. (As shown on drawing title and file number): 105B
5. NAME OF DRILLER: WYATT
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 0.0
8. DEPTH DRILLED INTO ROCK: 0.0
9. TOTAL DEPTH OF HOLE: 25.4
10. SIZE AND TYPE OF BIT: 8" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. TOTAL NO OF OVER– DISTURBED: 0 UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: DRY (14MAR88)
16. DATE HOLE STARTED: 03/14/88 COMPLETED: 03/14/88
17. ELEVATION TOP OF HOLE: 768.8
18. TOTAL CORE RECOVERY FOR BORING: 0.0 %
19. SIGNATURE OF INSPECTOR: BOWEN

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		AUGERED TO 25.4'. NO SAMPLES TAKEN OR DESCRIPTION OF SOIL OR ROCK MATERIAL AVAILABLE.			NO WATER ENCOUNTERED IN HOLE. SET 2" PIEZOMETER
	4					
	8					
	12					
	16					
	20					
	24		BOTTOM OF HOLE			
	28					

HOLE NO. 106

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 533645.80 2605860.10		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 106		13. TOTAL NO OF OVER– DISTURBED 14	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 03/05/87	COMPLETED 03/05/87
7. THICKNESS OF OVERBURDEN 7.0		17. ELEVATION TOP OF HOLE 767.9	
8. DEPTH DRILLED INTO ROCK 35.6		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 42.6		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
760.9	4		CLAY (CL) (0.0 – 7.0) CLAY(CL–ML)BROWN MOIST, WET 0.0–1.0 CLAY(CL–CH) TAN GREEN, DRY, MOD. FIRM 1.0–7.0' TOP OF ROCK		J–1 J–2 J–3	6" AUGER 0.0'–29.4' W.L. 27.45 AT 1000 HR HIT WATER APRROX 27.0' 6" AUGER 29.4'–42.1' W.L. 37.4' 1130 HR HOLE OPEN TO 40.5' PIEZ. W.L.=9 MARCH 87 25.74 TOP WATER
744.4	8 12 16 20		SHALE (SH) (7.0 – 23.5) SHALE, TAN, WEATHERED, MOD. FIRM 7.0–14.0 SHALE, GREEN GRAY, FIRM, DRY 14.0–23.5		J–4 J–5 J–6 J–7 J–8	
727.9	24 28 36 40		SHALE (SH) (23.5 – 42.6) SHALE, DARK GRAY, VERY FIRM, DRY SOME IRON CONCRETIONS, ORANGE. SANDSTONE STREAK 35.0',35.3', 41.5'–42.0'. BOTTOM OF HOLE 42.1'		J–9 J–10 J–12 J–13 J–14	

SAMPLE	DEPTH
J–1	0.0– 1.0
J–2	1.0– 4.0
J–3	4.0– 7.0
J–4	7.0– 10.5
J–5	10.5– 14.0
J–6	14.0– 16.0
J–7	16.0– 20.5
J–8	20.5– 23.5
J–9	24.0– 27.0
J–10	27.0– 30.0
J–11	30.0– 33.0
J–12	33.0– 36.5
J–13	36.5– 39.0
J–14	39.0– 42.1

HOLE NO. 107

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 536685.20 2605210.40		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 107		13. TOTAL NO OF OVER– DISTURBED 16	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/9/87	
		16. DATE HOLE STARTED 03/09/87	COMPLETED 03/09/87
7. THICKNESS OF OVERBURDEN 7.0		17. ELEVATION TOP OF HOLE 779.9	
8. DEPTH DRILLED INTO ROCK 45.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 52.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 7.0) CLAY(CL–ML) BROWN MOIST, WET 0.0–1.0 CLAY(CL–CH) MOIST, TAN GREEN 1.0–4.0 CLAY(CL–CH) TAN GREEN, DRY 4.0–7.0		J–1 J–2 J–3	6" AUGER 0.0–52.0' 147' E. OF N. SIDE OF PON HOLE TAPED AT 49.92' WL 3–9–87, 49.92 DRY 3–10–87 49.72 CAVINGS SAMPLE DEPTH J–1 0.0– 1.0 J–2 1.0– 4.0 J–3 4.0– 7.0 J–4 7.0– 10.5 J–5 10.5– 13.5 J–6 13.5– 17.0 J–7 17.0– 20.0 J–8 20.0– 23.5 J–9 23.5– 27.5 J–10 27.5– 30.5 J–11 30.5– 33.5 J–12 33.5– 37.0 J–13 37.0– 40.5 J–14 40.5– 44.0 J–15 44.0– 48.0 J–16 48.0– 52.0
772.9	4					
	8		SHALE (SH) (7.0 – 30.5) SHALE TAN GREEN, WEATHERED, MOD. FIRM DRY 7.0–17.0 SHALE, GREEN GRAY, FIRM, DRY 17.0–30.5' NUMEROUS IRON CONCRETIONS		J–4	
	12				J–5	
	16				J–6	
					J–7	
	20				J–8	
	24				J–9	
	28				J–10	
749.4			SHALE (SH) (30.5 – 52.0) SHALE DARK GRAY VERY FIRM			
	36				J–12	
					J–13	
739.9	40					

HOLE NO. 107

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 538685.20 2605210.40		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 107		13. TOTAL NO OF OVER-- DISTURBED 16	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/9/87	
7. THICKNESS OF OVERBURDEN 7.0		16. DATE HOLE STARTED 03/09/87	COMPLETED 03/09/87
8. DEPTH DRILLED INTO ROCK 45.0		17. ELEVATION TOP OF HOLE 779.9	
9. TOTAL DEPTH OF HOLE 52.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SHALE (SH) (30.5 – 52.0) SHALE, DARK GRAY, VERY FIRM DRY 30.5–52.0'		J–14	
	44				J–15	
	48				J–16	
727.9	52		BOTTOM OF HOLE AT 52.0'			
	56					
	60					
	64					
	68					
	76					
	80					

HOLE NO. 108

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Stations) 535347.50 2805216.20		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 108		13. TOTAL NO OF OVER— DISTURBED 17	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/16/87	
7. THICKNESS OF OVERBURDEN 7.5		16. DATE HOLE STARTED 03/10/87	COMPLETED 03/11/87
8. DEPTH DRILLED INTO ROCK 54.5		17. ELEVATION TOP OF HOLE 764.5	
9. TOTAL DEPTH OF HOLE 52.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
757.0	4		CLAY (CL) (0.0 – 7.5) SOFT, LOW PLASTICITY, MOIST, BROWN. AT 1.3' MODERATE TO HIGH PLASTICITY, MOIST, TAN–GREEN. DRY TO DAMP BELOW 4.3'.		J–1 J–2 J–3	6" AUGER 0.0–52.0' W.L. 16 MARCH 52' DEEP DRY SAMPLE DEPTH J–1 0.0– 1.3 J–2 1.3– 4.3 J–3 4.3– 7.5 J–4 7.5– 10.5 J–5 10.5– 13.5 J–6 13.5– 17.0 J–7 17.0– 20.0 J–8 20.0– 23.5 J–9 23.5– 26.0 J–10 26.0– 30.0 J–11 30.0– 33.0 J–12 33.0– 36.5 J–13 36.5– 39.5 J–14 39.5– 42.5 J–15 42.5– 45.5 J–16 45.5– 49.0 J–17 49.0– 52.0
741.0	8 12 16 20		SHALE (SH) (7.5 – 23.5) SOFT, WEATHERED, TAN–GREEN, DRY. SOME IRONSTONE NODULES.		J–4 J–5 J–6 J–7 J–8	
724.5	24 28 36 40		SHALE (SH) (23.5 – 52.0) MODERATELY SOFT, BLOCKY, DARK GRAY.		J–9 J–10 J–12 J–13 J–14	

HOLE NO. 108

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 535347.50 2805216.20		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 108		13. TOTAL NO OF OVER— DISTURBED 17	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/16/87	
		16. DATE HOLE STARTED 03/10/87	COMPLETED 03/11/87
7. THICKNESS OF OVERBURDEN 7.5		17. ELEVATION TOP OF HOLE 764.5	
8. DEPTH DRILLED INTO ROCK 54.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 52.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SHALE (SH) (23.5 – 52.0) MODERATELY SOFT, BLOCKY, DARK GRAY.		J–14	
	44				J–15	
					J–16	
	48				J–17	
712.5	52		BOTTOM OF HOLE			
	56					
	60					
	64					
	68					
	76					
	80					

HOLE NO. 109

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 535028.80 2605675.20		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 109		13. TOTAL NO OF OVER– DISTURBED 16	UNDISTURBED
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/16/87	
		16. DATE HOLE STARTED 03/11/87	COMPLETED 03/11/87
7. THICKNESS OF OVERBURDEN 7.2		17. ELEVATION TOP OF HOLE 764.5	
8. DEPTH DRILLED INTO ROCK 0.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 52.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Descriptions) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 8.0) CLAY (CL–ML) BROWN MOIST WET 0.0–1.2 CLAY (CL–CH) TAN GREEN, MOIST, 1.2'–7.2 LL PL PI %PASS CLASS 51 22 29 92.2 CL		J–1 J–2	6" AUGER 0.0–52.0' WL 3–16–87 51.12 DEEP – DRY SAMPLE DEPTH J–1 0.0– 1.2 J–2 1.2– 4.2 J–3 4.2– 7.2 J–4 7.2– 10.0 J–5 10.0– 13.7 J–6 13.7– 17.0 J–7 17.0– 20.0 J–8 20.0– 23.5 J–9 23.5– 28.0 J–10 26.0– 29.5 J–11 29.5– 33.0 J–12 33.0– 36.5 J–13 36.5– 40.0 J–14 40.0– 43.5 J–15 43.5– 47.5 J–16 47.5– 52.0
	4				J–3	
756.5	8		TOP OF ROCK			
			SHALE (SH) (8.0 – 20.0) SHALE, GREEN GRAY, DRY, MOD. FIRM 8.0–20.0' LL PL PI %PASS CLASS 56 23 33 99.6 SH IRON NODUALS 13.7–20.0'		J–4	
	12				J–5	
	16				J–6	
744.5	20				J–7	
			SHALE (SH) (20.0 – 40.0) SHALE, DARK GRAY, FIRM LL PL PI %PASS CLASS 58 23 35 98.8 SH LL PL PI %PASS CLASS 38 19 19 99.1 SH		J–8	
	24				J–9	
	28				J–10	
	36				J–11 J–12	
724.5	40				J–13	

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. 109

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 535028.80 2605675.20		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 109		13. TOTAL NO OF OVER– DISTURBED 16	UNDISTURBED
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 3/16/87	
7. THICKNESS OF OVERBURDEN 7.2		16. DATE HOLE STARTED 03/11/87	COMPLETED 03/11/87
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 764.5	
9. TOTAL DEPTH OF HOLE 52.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO. J-16	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
724.5	b	c	d	e		g
			SHALE (SH) 20.0–52.0' SHALE, DARK GRAY, VERY FIRM S.S. STREAK 48.0 AND 49.0'		J-14	
	44				J-15	
	48				J-16	
712.5	52		BOTTOM OF HOLE 52.0'			
	56					
	60					
	64					
	68					
	76					
	80					

HOLE NO. 110

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5"ø AUGER	
2. LOCATION (Coordinates or Station) 535011.10 2605264.10		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 110		13. TOTAL NO OF OVER– DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 03/12/87	COMPLETED 03/12/87
7. THICKNESS OF OVERBURDEN 4.5		17. ELEVATION TOP OF HOLE 767.2	
8. DEPTH DRILLED INTO ROCK 34.7		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 39.2		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 4.5) CLAY(CL–ML)BROWN, WET–MOIST 0.0–1.5' CLAY (CL–CH) TAN GREEN MOIST–DRY 1.5–4.5'		J–1	MOVED OVER HOLE 6" AUGER 0.0–39.7' CLEANED OUT HOLE HOLE OPEN TO 37.3'
					J–2	SAMPLE DEPTH J–1 0.0– 1.5 J–2 1.5– 4.5 J–3 4.5– 7.5 J–4 7.5– 11.0 J–5 11.0– 14.0 J–6 14.0– 17.5 J–7 17.5– 21.0 J–8 21.0– 24.0 J–9 24.0– 27.5 J–10 27.5– 31.0 J–11 31.0– 34.5 J–12 34.5– 37.5 J–13 37.5– 39.2
762.7	4		TOP OF ROCK			
			SHALE (SH) (4.5 – 39.2) SHALE, DRY, GREEN-TAN, MOD. FIRM 4.5–11.0' SHALE, GREEN TAN, FIRM SOME IRON CONCRETIONS 11.0–31.0 SHALE, DARK GRAY, DRY, VERY FIRM 31.0–39.2'.		J–3	
	8				J–4	
	12				J–5	
	16				J–6	
					J–7	
	20				J–8	
	24				J–9	
	28				J–10	
	36				J–12	
					J–13	
728.0	40		BOTTOM OF HOLE AT 39.2'			

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. 110

HOLE NO. 111

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS

1. PROJECT	LANDFILL SITING (SECTION 20)
2. LOCATION (Coordinates or Station)	534012.40 2604849.50
3. DRILLING AGENCY	TULSA DISTRICT
4. HOLE NO. (As shown on drawing title and file number)	111
5. NAME OF DRILLER	WYATT
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	6.0
8. DEPTH DRILLED INTO ROCK	35.4
9. TOTAL DEPTH OF HOLE	41.0
10. SIZE AND TYPE OF BIT	5.5" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO OF OVER—	DISTURBED 13 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 03/19/87 COMPLETED 03/19/87
17. ELEVATION TOP OF HOLE	766.3
18. TOTAL CORE RECOVERY FOR BORING	0.0 %
19. SIGNATURE OF INSPECTOR	FLAMING

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 6.0) CLAY (CL-CH) LT BROWN,MOIST 0.0–2.5' CLAY(CL-CH)TAN GREEN MOIST–DRY 2.5–6.0'		J-1	SET UP ON HOLE 6" AUGER 0.0–41.0' CLEANED OUT HOLE HOLE OPEN TO 40.12'
	4				J-2	SAMPLE DEPTH J-1 0.0– 2.5 J-2 2.5– 6.0 J-3 6.0– 9.0 J-4 9.0– 12.5 J-5 12.5– 16.0 J-6 16.0– 19.0 J-7 19.0– 22.0 J-8 22.0– 25.0 J-9 25.0– 28.5 J-10 28.5– 32.0 J-11 32.0– 35.0 J-12 35.0– 38.5 J-13 38.5– 41.0
760.3			TOP OF ROCK			
			SHALE (SH) (6.0 – 16.0) SHALE, TAN GREEN, MOD. FIRM WEATERED, DRY 6.0–16.0' SHALE, GREEN TAN, FIRM, DRY		J-3	
	8					
	12				J-4	
					J-5	
750.3	16					
			SHALE (SH) (16.0 – 22.0) SHALE, GREEN TAN, FIRM DRY 16.0–22.0'		J-6	
	20				J-7	
744.3						
			SHALE (SH) (22.0 – 41.0) SHALE DARK GRAY 22.0–41.0'		J-8	
	24				J-9	
	28				J-10	
	36				J-12	
			BOTTOM OF HOLE AT 41.0' 1		J-13	
726.3	40					

HOLE NO. 112

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Stations) 534326.70 2604822.50		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 112		13. TOTAL NO OF OVER— DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY (3 APR 87)	
		16. DATE HOLE STARTED 03/19/87	COMPLETED 03/19/87
7. THICKNESS OF OVERBURDEN 5.0		17. ELEVATION TOP OF HOLE 769.4	
8. DEPTH DRILLED INTO ROCK 36.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 41.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
764.4	4		CLAY (CL) (0.0 – 5.0) SOFT, LOW TO MEDIUM PLASTICITY MOIST TO WET, BROWN. MODERATE TO HIGH PLASTICITY, TAN–GREEN BELOW 1.5'.		J–1 J–2	6" AUGER 0.0–41.0'. CLEANED OUT HOLE, HOLE OPEN TO 40.3' DRY. MEASURED HOLE 3 APRIL 87 DRY. SAMPLE DEPTH J–1 0.0– 1.5 J–2 1.5– 5.0 J–3 5.0– 8.0 J–4 8.0– 11.5 J–5 11.5– 15.0 J–6 15.0– 18.5 J–7 18.5– 22.0 J–8 22.0– 25.0 J–9 25.0– 28.5 J–10 28.5– 32.0 J–11 32.0– 35.5 J–12 35.5– 38.5 J–13 38.5– 41.0
744.4	8 12 16 20 24		SHALE (SH) (5.0 – 25.0) SOFT, WEATHERED, BLOCKY, SILTY TAN–GREEN.		J–3 J–4 J–5 J–6 J–7 J–8	
729.4	28 36 40		SHALE (SH) (25.0 – 41.0) MODERATELY SOFT, SILTY, BLOCKY DARK GRAY. VERY SILTY AT 40.0'. BOTTOM OF HOLE AT 41.0'.		J–9 J–10 J–11 J–12 J–13	

HOLE NO. 113

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 1333.00 450.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 113		13. TOTAL NO OF OVER– DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 03/20/87	COMPLETED 03/20/87
7. THICKNESS OF OVERBURDEN 5.0		17. ELEVATION TOP OF HOLE 770.0	
8. DEPTH DRILLED INTO ROCK 35.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 40.5		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 5.0) CLAY (CL–ML) BROWN, MOIST AND WET 0.0–1.5' CLAY(CL–CH)TAN GREEN, MOIST DRY 1.5–5.0 LL PL PI %PASS CLASS 58 25 33 95.6 CH		J–1	SETUP ON HOLE 6" AUGER 0.0–40.5' HOLE OPEN TO 38.6' SAMPLE DEPTH J–1 0.0– 1.5 J–2 1.5– 5.0 J–3 5.0– 8.0 J–4 8.0– 11.5 J–5 11.5– 15.0 J–6 15.0– 18.0 J–7 18.0– 21.0 J–8 21.0– 24.5 J–9 24.5– 28.0 J–10 28.0– 31.5 J–11 31.5– 35.0 J–12 35.0– 38.5 J–13 38.5– 40.5
	4				J–2	
765.0			TOP OF ROCK			
			SHALE (SH) (5.0 – 18.0) SHALE, TAN GREEN, WEATHERED, MOD FIRM, DRY 5.0–18.0' LL PL PI %PASS CLASS 51 23 28 98.4 SH		J–3	
	8					
					J–4	
	12				J–5	
					J–6	
	16					
752.0						
			SHALE (SH) (18.0 – 24.5) SHALE, GREEN TAN, DRY FIRM 18.0–24.5' LL PL PI %PASS CLASS 54 23 31 98.7 SH		J–7	
	20				J–8	
	24					
745.5						
			SHALE (SH) (24.5 – 40.5) SHALE, DARK GRAY, DRY, VERY FIRM 24.5–40.5 LL PL PI %PASS CLASS 49 22 27 96.4 SH		J–9	
	28				J–10	
					J–11	
	36				J–12	
730.0	40		BOTTOM OF HOLE		J–13	

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. 113

HOLE NO. 114

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 534751.20 2605734.70		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 114		13. TOTAL NO OF OVER– DISTURBED 13	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 03/23/87	COMPLETED 03/23/87
7. THICKNESS OF OVERBURDEN 5.0		17. ELEVATION TOP OF HOLE 758.3	
8. DEPTH DRILLED INTO ROCK 36.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 41.5		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 5.0) CLAY(CL) BROWN MOIST 0.0–2.0' CLAY (CL–CH) TAN GREEN,MOIST 2.0–5.0'		J–1	6" AUGER 0.0–41.5' W.L.37.6' SET 3.0'SCREEN AND 38.8' PVC PIPE W/3.0 STICKUP AND 0.9'.
					J–2	
	4		TOP OF ROCK			SAMPLE DEPTH J–1 0.0– 2.0 J–2 2.0– 5.0 J–3 5.0– 8.0 J–4 8.0– 11.5 J–5 11.5– 15.0 J–6 15.0– 18.0 J–7 18.0– 21.5 J–8 21.5– 25.0 J–9 25.0– 28.0 J–10 28.0– 31.5 J–11 31.5– 34.5 J–12 34.5– 38.0 J–13 38.0– 41.5
753.3			SHALE (SH) (5.0 – 25.0) SHALE, TAN GREEN,MOD.FIRM DRY 5.0–15.0' SHALE, GREEN TAN, DRY, FIRM 15.0–25.0'		J–3	
	8					
					J–4	
	12				J–5	
	16				J–6	
	20				J–7	
					J–8	
	24					
733.3			SHALE (SH) (25.0 – 41.5) SHALE, DARK GRAY, DRY, VERY FIRM 25.0–41.5' S.S. 32.5',35.6',38.0'		J–9	
	28				J–10	
	36				J–12	
718.3	40		BOTTOM OF HOLE AT 41.5'		J–13	

DRILLING LOG

DIVISION: SOUTHWEST

INSTALLATION: McALESTER

SHEET 1 OF 1 SHEETS

1. PROJECT: LANDFILL SITING (SECTION 30)
2. LOCATION (Coordinates or Station): 534323.40 2604398.30
3. DRILLING AGENCY: TULSA DISTRICT
4. HOLE NO. (As shown on drawing title and file number): 115
5. NAME OF DRILLER: WYATT
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 5.5
8. DEPTH DRILLED INTO ROCK: 36.0
9. TOTAL DEPTH OF HOLE: 41.5
10. SIZE AND TYPE OF BIT: 5.5" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. TOTAL NO OF OVER– DISTURBED: 13 UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 03/24/87 COMPLETED: 03/24/87
17. ELEVATION TOP OF HOLE: 772.0
18. TOTAL CORE RECOVERY FOR BORING: 0.0 %
19. SIGNATURE OF INSPECTOR: FLAMING

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 5.5) CLAY(CL–GM)BROWN MOIST–WET 0.0–1.5' CLAY(CL–CH) TAN GREEN, MOIST 1.5–5.5'		J–1	MOVED ON HOLE PULLED MAINTENANCE 6" AUGER 0.0–40.5–41.5' HOLE OPEN TO 34.1' CLEANED OUT HOLE HOLE OPEN TO 38.5' DRY
	4				J–2	
768.5			TOP OF ROCK			
			SHALE (SH) (5.5 – 19.0) SHALE, TAN GREEN, DRY MOD.FIRM 5.5–19.0		J–3	
	8					
					J–4	
	12					
					J–5	
	16					
753.0					J–6	
	20		SHALE (SH) (19.0 – 25.5) SHALE, GREEN TAN, FIRM DRY		J–7	
	24				J–8	
746.5						
			SHALE (SH) (25.5 – 41.5) SHALE, DARK GRAY, VERY FIRM, DRY		J–9	
	28		S.S. 37.6'			
					J–10	
	36				J–12	
732.0	40		BOTTOM OF HOLE AT 41.5'		J–13	

SAMPLE	DEPTH
J–1	0.0– 1.5
J–2	1.5– 5.5
J–3	5.5– 8.5
J–4	8.5– 12.0
J–5	12.0– 15.5
J–6	15.5– 19.0
J–7	19.0– 22.0
J–8	22.0– 25.5
J–9	25.5– 28.5
J–10	28.5– 32.0
J–11	32.0– 35.0
J–12	35.0– 38.0
J–13	38.0– 41.5

HOLE NO. 116

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGER	
2. LOCATION (Coordinates or Station) 533976.50 2604399.40		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 116		13. TOTAL NO OF OVER– DISTURBED 16	UNDISTURBED
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 04/01/87	COMPLETED 04/01/87
7. THICKNESS OF OVERBURDEN 7.5		17. ELEVATION TOP OF HOLE 773.4	
8. DEPTH DRILLED INTO ROCK 43.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 51.0		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 7.5) CLAY (CL–ML) BROWN, MOIST 0.0–1.0' CLAY (CL–CH) TAN, MOIST 1.0–4.0' CLAY (CL–CH) TAN, DRY 4.0–7.5'		J–1	DOWN 30 MIN. PACKING HYDRALIC CYLINDER MOVED ON HOLE 6" AUGER 0.0–51.0' HOLE OPEN 47.4' NO H20 ENCOUNTERED
	4				J–2	
					J–3	SAMPLE DEPTH J–1 0.0– 1.0 J–2 1.0– 4.0 J–3 4.0– 7.5 J–4 7.5– 10.5 J–5 10.5– 14.0 J–6 14.0– 17.0 J–7 17.0– 20.5 J–8 20.5– 23.5 J–9 23.5– 26.5 J–10 26.5– 29.5 J–11 29.5– 30.0 J–12 30.0– 36.0 J–13 36.0– 40.0 J–14 40.0– 43.0 J–15 43.0– 46.5 J–16 46.5– 51.0
765.9			TOP OF ROCK			
	8		SHALE (SH) (7.5 – 20.5) SHALE, TAN GREEN, DRY, MOD. FIRM. 7.5–14.0' SHALE, GREEN TAN, DRY, MOD. FIRM 14.0–20.5'		J–4	
	12				J–5	
	16				J–6	
					J–7	
752.9	20					
			SHALE (SH) (20.5 – 51.0) SHALE, DARK GRAY, FIRM 20.5–51.0 SANDSTONE STREAK 22.0',25,5', AND 31.0', AND 35.6' SANDSTONE AT 45.0',48.0',50.0' AND 50.8'.		J–8	
	24				J–9	
	28				J–10	
					J–11	
	36				J–13	
733.4	40					

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 2 OF 2 SHEETS

1. PROJECT	LANDFILL SITING (SECTION 30)
2. LOCATION (Coordinates or Station)	533976.50 2604399.40
3. DRILLING AGENCY	CORPS OF ENGR.
4. HOLE NO. (As shown on drawing title and file number)	116
5. NAME OF DRILLER	WYATT
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	7.5
8. DEPTH DRILLED INTO ROCK	43.5
9. TOTAL DEPTH OF HOLE	51.0
10. SIZE AND TYPE OF BIT	5.5" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO OF OVER— DISTURBED	16 UNDISTURBED
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE STARTED	04/01/87 COMPLETED 04/01/87
17. ELEVATION TOP OF HOLE	773.4
18. TOTAL CORE RECOVERY FOR BORING	0.0 %
19. SIGNATURE OF INSPECTOR	FLAMING

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. J-15	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SHALE (SH) (20.5 – 51.0) SHALE, DARK GRAY, FIRM 20.5–51.0 SANDSTONE STREAK 22.0',25.5', AND 31.0', AND 35.6' SANDSTONE AT 45.0',48.0',50.0' AND 50.8'.		J-14	
	44				J-15	
	48				J-16	
722.4			BOTTOM OF HOLE 51.0'			
	52					
	56					
	60					
	64					
	68					
	76					
	80					

HOLE NO. 117

DRILLING LOG	DIVISION: SOUTHWEST	INSTALLATION: McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT: LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT: 6"AG,4"CB	
2. LOCATION (Coordinates or Station): 534643.30 2604391.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number): 117		13. TOTAL NO OF OVER— DISTURBED: 5	UNDISTURBED: 6
5. NAME OF DRILLER: WYATT		14. TOTAL NUMBER CORE BOXES: 12	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: 710.4' 4/15/87	
		16. DATE HOLE: STARTED 03/25/87	COMPLETED 03/30/87
7. THICKNESS OF OVERBURDEN: 7.5		17. ELEVATION TOP OF HOLE: 773.5	
8. DEPTH DRILLED INTO ROCK: 93.4		18. TOTAL CORE RECOVERY FOR BORING: 97.9 %	
9. TOTAL DEPTH OF HOLE: 100.9		19. SIGNATURE OF INSPECTOR: FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
772.0			SILT (ML) (0.0 – 1.5) SOFT, MOIST TO WET, BROWN, V. CLAYEY.		J–1	AUGERED 0.0–10.0', SET CASING AND CORED WITH 4" CARBLOY BIT. ENCOUNTERED WATER AT 80.6'.WATER LEVEL AT 88.9'ON 30MAR87. DRILLED USING AIR. REAMED OUT HOLE WITH A 7 7/8"BIT TO 100'AND SET MONITORING WELL ON 5AUG87. CARTON SAMPLES 1. 19.6–20.0' 2. 26.2–26.9' 3. 26.9–27.3' 4. 36.1–37.3' 5. 51.2–52.4' 6. 92.5–93.8'
	5		CLAY (CL) (1.5 – 7.5) MODERATE SOFT, MOIST, LIGHT BROWN, HIGH PLASTICITY, AT 3.5'BECOMES TAN–GREEN.		J–2	
					J–3	
766.0					J–4	
			SHALE (SH) (7.5 – 27.4) MODERATELY SOFT, BLOCKY TO POORLY FISSILE, FRACTURED, WEATHERED WITH SOME IRON STAINS ON FRACTURED SURFACES. YELLOWISH–GRAY. CALCAREOUS. GRAY–BLACK BELOW 14.7'.		J–5	
	10			100.0	BOX 1	
	15			100.0		
	20				BOX 2	
				94.0		
	25				BOX 3	
746.1						
			SHALE (SH) (27.4 – 56.5) MODERATELY SOFT, SLIGHTLY SILTY, CALCAREOUS, ZONE OF LARGE CEMENTED SILTSTONE NODULES 30.7–39.7' AND 43.4 TO 56.9'. MINOR FRACTURES AT 41.3 TO 43.9'.			
	30			100.0		
	35				BOX 4	
	45				BOX 5	
723.5	50				BOX 6	

SAMPLE	DEPTH
J–1	0.0– 1.5
J–2	1.5– 3.5
J–3	3.5– 6.0
J–4	6.0– 7.5
J–5	7.5– 10.0
BOX 1	10.0– 17.0
BOX 2	17.0– 23.7
BOX 3	23.7– 32.7
BOX 4	32.7– 40.9
BOX 5	40.9– 48.7
BOX 6	48.7– 56.5
BOX 7	56.5– 64.5
BOX 9	64.5– 79.2
BOX 10	79.2– 86.3
BOX 11	86.3– 94.8
BOX 12	94.8–100.9

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 6"AG,4"CB	
2. LOCATION (Coordinates or Station) 534843.30 2604391.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 117		13. TOTAL NO OF OVER– DISTURBED 5	UNDISTURBED 6
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 12	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 710.4' 4/15/87	
		16. DATE HOLE STARTED 03/25/87	COMPLETED 03/30/87
7. THICKNESS OF OVERBURDEN 7.5		17. ELEVATION TOP OF HOLE 773.5	
8. DEPTH DRILLED INTO ROCK 93.4		18. TOTAL CORE RECOVERY FOR BORING 97.9 %	
9. TOTAL DEPTH OF HOLE 100.9		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY g	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) e
717.0	55		SHALE (SH) (27.4 – 56.5) MODERATELY SOFT, SLIGHTLY SILTY, CALCAREOUS, ZONE OF LARGE CEMENTED SILTSTONE NODULES 30.7–39.7' AND 43.4 TO 56.9'. MINOR FRACTURES AT 41.3 TO 43.9'.	100.0	BOX 6	
	60		SHALE (SH) (56.5 – 86.3) MODERATELY SOFT, CALCAREOUS, SILTY, VERY FOSSILIFEROUS TO 86.3' BRACHIOPODA AND PYRITIZED PLANT STEMS. ZONE OF FRACTURES WITH SLICKENSIDES 70.2–77.7'.	69.0	BOX 7	
				100.0		
	65					
	70			100.0	BOX 9	
	75					
	80			100.0		
				100.0	BOX 10	
687.2	85					
	95		SHALE (SH) (86.3 – 100.9) MODERATELY SOFT, MINOR SILT, CALCAREOUS, FRACTURES AT 93.9' AND 98.3'.		BOX 12	
672.6	100		BOTTOM OF HOLE AT 100.9'.	100.0		

DRILLING LOG

DIVISION	SOUTHWEST
INSTALLATION	McALESTER
SHEET	1 OF 2 SHEETS
1. PROJECT	LANDFILL SITING (SECTION 30)
2. LOCATION (Coordinates or Station)	533340.30 2604900.70
3. DRILLING AGENCY	CORPS OF ENGR.
4. HOLE NO. (As shown on drawing title and file number)	118
5. NAME OF DRILLER	WYATT
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	7.0
8. DEPTH DRILLED INTO ROCK	93.0
9. TOTAL DEPTH OF HOLE	100.0
10. SIZE AND TYPE OF BIT	6" AG,4"CB
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO OF OVER—	DISTURBED 4 UNDISTURBED 3
14. TOTAL NUMBER CORE BOXES	11
15. ELEVATION GROUND WATER	714.3 15APR87
16. DATE HOLE	STARTED 03/30/87 COMPLETED 04/01/87
17. ELEVATION TOP OF HOLE	771.3
18. TOTAL CORE RECOVERY FOR BORING	91.0 %
19. SIGNATURE OF INSPECTOR	FLAMING

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
768.8	0		CLAY (CL) (0.0 – 2.5) SOFT, MOIST, BROWN.		J-1	AUGERED 0.0–10.0'.CORED WITH AIR 10.0–100.0',USED 4" CARBLOY BIT. MEASURED WATER LEVEL AT 56.92' ON 15 APRIL 1987. ENCOUNTERED WATER AT 46'.
	5		CLAY (CL) (2.5 – 7.0) MODERATELY STIFF, DAMP, MEDIUM TO HIGH PLASTICITY, TAN–GREEN.		J-2	
764.3					J-3	SAMPLES CARTON SAMPLES 1. 44.2–45.2' 2. 70.0–71.3' 3. 85.4–86.7'
			SHALE (SH) (7.0 – 28.4) SOFT TO MODERATELY SOFT, GRAY–BROWN, WEATHERED WITH IRON OXIDE STAIN, SILTY, FRACTURES WITH SLICKENSIDES, CALCAREOUS, BLOCKY.		J-4	
	10			87.0	BOX 1	SAMPLE DEPTH J-1 0.0– 2.5 J-2 2.5– 5.8 J-3 5.8– 7.0 J-4 7.0– 10.0 BOX 1 10.0– 18.6 BOX 2 18.6– 31.9 BOX 3 31.9– 39.5 BOX 4 39.5– 47.6 BOX 5 47.6– 54.8 BOX 6 54.8– 61.8 BOX 7 61.8– 69.2 BOX 8 69.2– 76.5 BOX 9 76.5– 84.7 BOX 10 84.7– 92.8 BOX 11 92.8–100.0
	15					
	20			38.0	BOX 2	
	25					
742.9						
	30		SHALE (SH) (28.4 – 47.8) MODERATELY SOFT, BROWN–GRAY TO GRAY–BLACK. SILTY, BLOCKY MINOR WEATHERING TO 35.6'. FRACTURES 28.4–35.6'. POORLY CEMENTED SILTSTONE NODULES 35.3–43.2'.	93.0		
	35				BOX 3	
				100.0		
				100.0	BOX 4	
	45					
723.5			SHALE (SH) (47.8 – 84.7) MODERATELY SOFT, GRAY–BLACK, SILTY, FOSSILIFEROUS WITH BRACHIOPODA AND PYRITIZED PLANT SILTSTONE NODULES 52.5–58.2'. GRADES TO SILTSTONE 83.4–84.7'			
721.3	50			100.0	BOX 5	

HOLE NO. 118

DRILLING LOG	DIVISION: SOUTHWEST	INSTALLATION: McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT: LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT: 6" AG,4"CB	
2. LOCATION (Coordinates or Station): 533340.30 2604900.70		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number): 118		13. TOTAL NO OF OVER– DISTURBED: 4	UNDISTURBED: 3
5. NAME OF DRILLER: WYATT		14. TOTAL NUMBER CORE BOXES: 11	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: 714.3 15APR87	
		16. DATE HOLE STARTED: 03/30/87	COMPLETED: 04/01/87
7. THICKNESS OF OVERBURDEN: 7.0		17. ELEVATION TOP OF HOLE: 771.3	
8. DEPTH DRILLED INTO ROCK: 93.0		18. TOTAL CORE RECOVERY FOR BORING: 91.0 %	
9. TOTAL DEPTH OF HOLE: 100.0		19. SIGNATURE OF INSPECTOR: FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	55		SHALE (SH) (47.8 – 84.7) MODERATELY SOFT, GRAY–BLACK, SILTY, FOSSILIFEROUS WITH BRACHIOPODA AND PYRITIZED PLANTS. SILTSTONE NODULES 52.5–58.2'. GRADES TO SILTSTONE 83.4–84.7'	100.0	BOX 5	
	60			100.0	BOX 6	
	65				BOX 7	
	70			100.0		
	75			100.0	BOX 8	
	80			100.0	BOX 9	
686.8	85		SILTSTONE (SI) (84.7 – 90.0) MODERATELY SOFT, SHALY, GRAY, CALCAREOUS, GRADES TO A SANDSTONE AT 90.0'.		BOX 10	
679.5			SANDSTONE (SS) (90.0 – 91.8) FINE TO MEDIUM GRAINED, MODERATELY HARD, LIGHT GRAY, NO BEDDING FEATURES.			
	95		SHALE (SH) (91.8 – 100.0) MODERATELY SOFT, GRAY–BROWN, BLOCKY, SLIGHTY CALCAREOUS, MINOR FRACTURES WITH SLICKEN-SIDES.	100.0	BOX 11	
671.3	100		BOTTOM OF HOLE			

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PROJECT: LANDFILL SITING (SECTION 30) HOLE NO. 118

HOLE NO. 119

DRILLING LOG	DIVISION: SOUTHWEST	INSTALLATION: McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT: LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT: 5.5" AUGE	
2. LOCATION (Coordinates or Station): 534007.20 / 2606290.10		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number): 119		13. TOTAL NO OF OVER– DISTURBED: 16 UNDISTURBED: 0	
5. NAME OF DRILLER: WYATT		14. TOTAL NUMBER CORE BOXES: 0	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE: STARTED 04/02/87 COMPLETED 04/02/87	
		17. ELEVATION TOP OF HOLE: 761.7	
7. THICKNESS OF OVERBURDEN: 10.0		18. TOTAL CORE RECOVERY FOR BORING: 0.0 %	
8. DEPTH DRILLED INTO ROCK: 40.2		19. SIGNATURE OF INSPECTOR: FLAMING	
9. TOTAL DEPTH OF HOLE: 50.2			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			CLAY (CL) (0.0 – 10.0) CLAY(CL–CH) BROWN, MOIST 0.0–1.0' CLAY(CL–CH) TAN GREEN, MOIST 1.0–4.5' CLAY(CL–CH) TANK GREEN DRY 4.5–10.0'		J–1 J–2 J–3 J–4	MOVED ON HOLE 6" AUGER 0.0–38.0' HIT WATER ABOUT 35.0' W.L. @ 28.7 AT 1300 HRS 6"AUGER 0.0–50.2 HOLE OPEN TO 48.5'
	4					
	8					
751.7			TOP OF ROCK			
			SHALE (SH) (10.0 – 22.5) SHALE, TAN GREEN,DRY, MOD. FIRM 10.0'15.5' SHALE, GREEN TAN, MOD. FIRM – FIRM. 15.5–22.5'		J–5 J–6 J–7 J–8	
	12					
	16					
	20					
739.2						
			SHALE (SH) (22.5 – 40.0) SHALE, DARK GRAY, FIRM 22.5 – 40.0 S.S STREAK 23.5', 30.0, 35.0'		J–9 J–10 J–11 J–12 J–13 J–14	
	24					
	28					
	36					
721.7	40					

SAMPLE	DEPTH
J–1	0.0– 1.0
J–2	1.0– 4.5
J–3	4.5– 7.5
J–4	7.5– 10.0
J–5	10.0– 13.0
J–6	13.0– 15.5
J–7	15.5– 19.0
J–8	19.0– 22.5
J–9	22.5– 26.0
J–10	26.0– 29.0
J–11	29.0– 32.5
J–12	32.5– 35.5
J–13	35.5– 39.0
J–14	39.0– 43.0
J–15	43.0– 46.5
J–16	46.5– 50.2

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGE	
2. LOCATION (Coordinates or Stations) 534007.20	2606290.10	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 119		13. TOTAL NO OF OVER– DISTURBED 16	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 04/02/87	COMPLETED 04/02/87
7. THICKNESS OF OVERBURDEN 10.0		17. ELEVATION TOP OF HOLE 761.7	
8. DEPTH DRILLED INTO ROCK 40.2		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 50.2		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
721.7	b	g	d	e	f	g
			SHALE (SH) (22.5 – 50.2) SHALE, DARK GRAY, FIRM S.S STREAK 23.5', 30.0, 35.0'		J–14 J–15 J–16	
711.5			BOTTOM OF HOLE 50.2'			

44
48
52
56
60
64
68
76
80

HOLE NO. 120

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGE	
2. LOCATION (Coordinates or Station) 533652.40 2606285.70		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 120		13. TOTAL NO OF OVER– DISTURBED 12	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 04/02/87	COMPLETED 04/02/87
7. THICKNESS OF OVERBURDEN 7.0		17. ELEVATION TOP OF HOLE 762.5	
8. DEPTH DRILLED INTO ROCK 33.5		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 40.5		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
761.5			SILT (ML) (0.0 – 1.0) SILT(ML-GM) BROWN,MOIST,WET		J–1	MOVED ON HOLE 6" AUGER 0.0–40.5' HOLE OPEN TO 37.5' MAKING WATER
			CLAY (CL) (1.0 – 4.0) CLAY(CL–CH), TAN GREEN, DRY		J–2	
758.5	4		CLAY (CL) (4.0 – 7.0) CLAY (CL–CH), TAN GREEN, DRY 4.0–7.0'		J–3	
755.5			TOP OF ROCK			
	8		SHALE (SH) (7.0 – 28.0) SHALE, TAN GREEN, MOD. FIRM 7.0–17.5' SHALE,GREEN TAN,MOD FIRM–FIRM 17.5–28.0'		J–4	
	12				J–5	
	16				J–6	
					J–7	
	20					
					J–8	
	24				J–9	
734.5	28		SHALE (SH) (28.0 – 40.5) SHALE, DARK GRAY, FIRM 28.0–40.5'. S.S. 38.5'		J–10	
					J–11	
	36					
					J–12	
722.5	40		BOTTOM OF HOLE			

SAMPLE	DEPTH
J–1	0.0– 1.0
J–2	1.0– 4.0
J–3	4.0– 7.0
J–4	7.0– 10.5
J–5	10.5– 14.0
J–6	14.0– 17.5
J–7	17.5– 21.0
J–8	21.0– 24.5
J–9	24.5– 28.0
J–10	28.0– 31.5
J–11	31.5– 35.5
J–12	35.5– 40.5

HOLE NO. 121

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 5.5" AUGE	
2. LOCATION (Coordinates or Station) 534025.80 2605873.10		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 121		13. TOTAL NO OF OVER– DISTURBED 12	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 04/01/87	COMPLETED 04/01/87
7. THICKNESS OF OVERBURDEN 6.0		17. ELEVATION TOP OF HOLE 761.9	
8. DEPTH DRILLED INTO ROCK 31.7		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 37.7		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
755.9	4		CLAY (CL) (0.0 – 6.0) CLAY(CL–CH) LT BROWN GREEN, MOIST LL PL PI %PASS CLASS 56 22 34 88.2 CH MOIST DRY 3.0–6.0' TOP OF ROCK		J–1 J–2	MOVED ON HOLE 6" AUGER 0.0–37.7'. CHANGED AUGER TEETH AT 37.5'. STOPPED HOLE TO KEEP FROM TEARING UP AUGER BIT SAMPLE DEPTH J–1 0.0– 3.0 J–2 3.0– 6.0 J–3 6.0– 9.0 J–4 9.0– 12.5 J–5 12.5– 15.5 J–6 15.5– 19.0 J–7 19.0– 22.0 J–8 22.0– 25.0 J–9 25.0– 28.5 J–10 28.5– 31.5 J–11 31.5– 34.5 J–12 34.5– 37.7
746.4	8 12		SHALE (SH) (6.0 – 15.5) SHALE, TAN GREEN, MOD. FIRM. 6.0–15.5'. LL PL PI %PASS CLASS 55 22 33 99.4 SH		J–3 J–4 J–5	
739.9	16 20		SHALE (SH) (15.5 – 22.0) SHALE,GREEN TAN, MOD.FIRM–FIRM LL PL PI %PASS CLASS 48 22 26 98.2 SH		J–6 J–7	
724.2	24 28 36		SHALE (SH) (22.0 – 37.7) SHALE, DARK GRAY, FIRM LL PL PI % PASS CLASS 48 22 26 97.9 SH SANDSTONE 30.5',35.5',37.5'.		J–8 J–9 J–10 J–11 J–12	
	40		BOTTOM OF HOLE 37.7'			

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. 121

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 6" AUGER	
2. LOCATION (Coordinates or Stations) 534309.20 2606244.50		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 122		13. TOTAL NO OF OVER- DISTURBED 17	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 18.87' 14APR87	
		16. DATE HOLE STARTED 04/08/87	COMPLETED 04/08/87
7. THICKNESS OF OVERBURDEN 8.5		17. ELEVATION TOP OF HOLE 760.1	
8. DEPTH DRILLED INTO ROCK 44.2		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 52.7		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
760.1			CLAY (CL) (0.0 – 1.5) SOFT, SILTY, MOIST, BROWN.		J-1	AUGERED 0.0–52.7'. ENCOUNTERED WATER AT 35.0' MEASURED WATER LEVEL AT 18.87' ON 14 APRIL 1987.
758.6			CLAY (CL) (1.5 – 8.5) MODERATELY STIFF, MOIST, LOW PLASTICITY, TAN–GREEN.		J-2	
	4					
					J-3	
751.6	8		SHALE (SH) (8.5 – 52.7) MODERATELY SOFT, BLOCKY, SILTY TAN–GREEN, WEATHERED. BECOMES DARK GRAY AT 21.0. VERY SILTY AT 26.8', 29.5', 32.0', 37.0', AND 41.0'.		J-4	
	12				J-5	
					J-6	
	16					
					J-7	
	20					
					J-8	
	24					
					J-9	
	28					
					J-10	
	36				J-12	
					J-13	
720.1	40					

SAMPLE	DEPTH
J-1	0.0– 1.5
J-2	1.5– 5.0
J-3	5.0– 8.5
J-4	8.5– 11.5
J-5	11.5– 14.5
J-6	14.5– 17.5
J-7	17.5– 21.0
J-8	21.0– 24.5
J-9	24.5– 27.5
J-10	27.5– 30.5
J-11	30.5– 33.5
J-12	33.5– 37.0
J-13	37.0– 40.0
J-14	40.0– 43.5
J-15	43.5– 46.5
J-16	46.5– 49.0
J-17	49.0– 52.7

HOLE NO. 122

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 2 OF 2 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 6" AUGER	
2. LOCATION (Coordinates or Station) 534309.20 2606244.50		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY CORPS OF ENGR.		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 122		13. TOTAL NO OF OVER— DISTURBED 17	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 18.87' 14APR87	
		16. DATE HOLE STARTED 04/08/87	COMPLETED 04/08/87
7. THICKNESS OF OVERBURDEN 8.5		17. ELEVATION TOP OF HOLE 760.1	
8. DEPTH DRILLED INTO ROCK 44.2		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
9. TOTAL DEPTH OF HOLE 52.7		19. SIGNATURE OF INSPECTOR FLAMING	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. J-16	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SHALE (SH) (8.5 - 52.7) MODERATELY SOFT, BLOCKY, SILTY TAN-GREEN, WEATHERED. BECOMES DARK GRAY AT 21.0. VERY SILTY AT 26.8', 29.5', 32.0', 37.0', AND 41.0'.		J-14	
	44				J-15	
	48				J-16	
					J-17	
707.4	52		BOTTOM OF HOLE			
	56					
	60					
	64					
	68					
	76					
	80					

HOLE NO. MW123

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 7 7/8 RB	
2. LOCATION (Coordinates or Station) 535897.00 2605109.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) MW123		13. TOTAL NO OF OVER– DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 43.4 24 AUG 87	
7. THICKNESS OF OVERBURDEN 5.0		16. DATE HOLE STARTED 08/04/87	COMPLETED 08/05/87
8. DEPTH DRILLED INTO ROCK 75.0		17. ELEVATION TOP OF HOLE 768.2	
9. TOTAL DEPTH OF HOLE 80.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
		19. SIGNATURE OF INSPECTOR BOWEN	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV–ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			ROCKBIT HOLE WITH AIR. ENCOUNTERED WATER AT 68.0'.			ROCKBIT HOLE TO 80.0'. HOLE WAS NOT LOGGED. OVERBURDEN IS APPROXIMATELY 5.0'. SET 4"PVC MONITORING WELL SEE SCHEMETIC FOR DETAILS.

10 20 30 40 50 60 70 90 100

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PROJECT LANDFILL SITING (SECTION 30) HOLE NO. MW123

HOLE NO. MW124

DRILLING LOG	DIVISION SOUTHWEST	INSTALLATION McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT 7 7/8 RB	
2. LOCATION (Coordinates or Stations) 533816.00 2604390.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) MW124		13. TOTAL NO OF OVER- DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER WYATT		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY 24 AUG 87	
7. THICKNESS OF OVERBURDEN 5.0		16. DATE HOLE STARTED 08/05/87	COMPLETED 08/06/87
8. DEPTH DRILLED INTO ROCK 75.0		17. ELEVATION TOP OF HOLE 775.0	
9. TOTAL DEPTH OF HOLE 80.0		18. TOTAL CORE RECOVERY FOR BORING 0.0 %	
		19. SIGNATURE OF INSPECTOR BOWEN	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		ROCKBIT HOLE WITH AIR. NO SAMPLES TAKEN. SOME WATER IN HOLE WHEN DRILLED. AFTER WELL INSTALLED, HOLE DIDN'T MAKE WATER.			ROCKBIT HOLE WITH AIR. DID NOT LOG HOLE. OVERBURDEN IS APPROXIMATELY 5.0'. INSTALLED 4"PVC WELL IN HOLE. SEE SCHEMATIC FOR DETAILS.
	10					
	20					
	30					
	40					
	50					
	60					
	70					
	90					
	100					

HOLE NO. MW125

DRILLING LOG	DIVISION: SOUTHWEST	INSTALLATION: McALESTER	SHEET 1 OF 1 SHEETS
1. PROJECT: LANDFILL SITING (SECTION 30)		10. SIZE AND TYPE OF BIT: 7 7/8 RB	
2. LOCATION (Coordinates or Station): 533342.00 2805880.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: TULSA DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number): MW125		13. TOTAL NO OF OVER– DISTURBED: 0	UNDISTURBED: 0
5. NAME OF DRILLER: WYATT		14. TOTAL NUMBER CORE BOXES: 0	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: 25.6 24 AUG 87	
7. THICKNESS OF OVERBURDEN: 5.0		16. DATE HOLE STARTED: 08/06/87	COMPLETED: 08/07/87
8. DEPTH DRILLED INTO ROCK: 35.0		17. ELEVATION TOP OF HOLE: 764.8	
9. TOTAL DEPTH OF HOLE: 40.0		18. TOTAL CORE RECOVERY FOR BORING: 0.0 %	
		19. SIGNATURE OF INSPECTOR: BOWEN	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			ROCKBIT HOLE WITH AIR. ENCOUNTERED WATER AT 29.0'.			ROCKBIT HOLE WITH AIR. DID NOT LOG HOLE. SET 4" PVC WELL IN HOLE.OVER-BURDEN IS APPROXIMATELY 5.0' DEEP.
	10					
	20					
	30					
724.8	40		BOTTOM OF HOLE			
	50					
	60					
	70					
	90					
	100					

DRILLING LOG

DIVISION: SOUTHWEST

INSTALLATION: McALESTER

SHEET 1 OF 1 SHEETS

1. PROJECT: LANDFILL SITING (SECTION 30)

2. LOCATION (Coordinates or Station): 533752.00 2804398.00

3. DRILLING AGENCY: US GEOL. SURVEY

4. HOLE NO. (As shown on drawing title and file number): MW126

5. NAME OF DRILLER:

6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.

7. THICKNESS OF OVERBURDEN: 0.0

8. DEPTH DRILLED INTO ROCK: 0.0

9. TOTAL DEPTH OF HOLE: 120.0

10. SIZE AND TYPE OF BIT: 5 5/8 RB

11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL

12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500

13. TOTAL NO OF OVER– DISTURBED: 0 UNDISTURBED: 0

14. TOTAL NUMBER CORE BOXES: 0

15. ELEVATION GROUND WATER: 49.0 (3/14/88)

16. DATE HOLE STARTED: 01/04/88 COMPLETED: 03/14/88

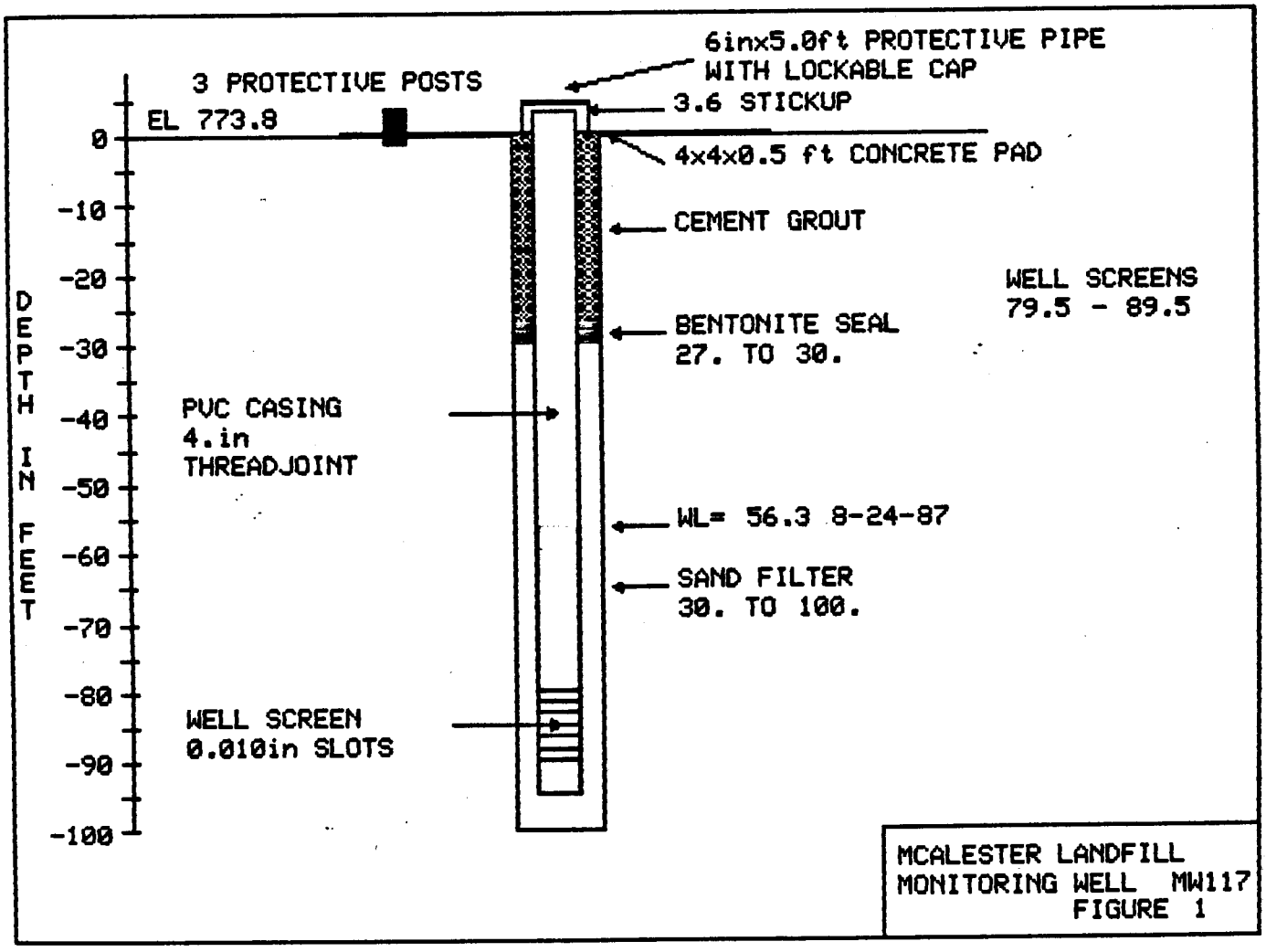
17. ELEVATION TOP OF HOLE: 774.9

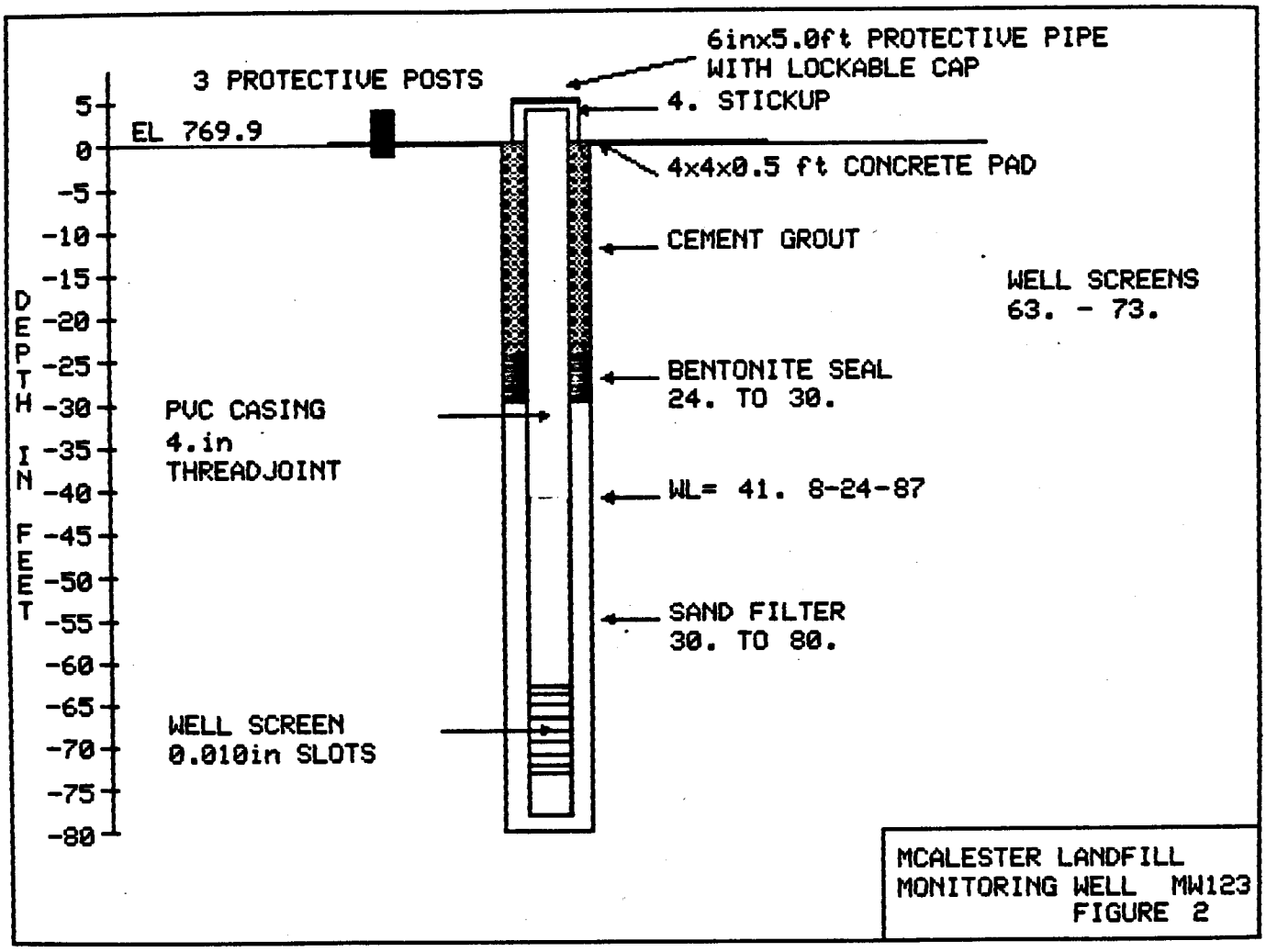
18. TOTAL CORE RECOVERY FOR BORING: 0.0 %

19. SIGNATURE OF INSPECTOR: MILES OVERTON

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			ROCKBIT HOLE TO 120.0'. NO SAMPLES TAKEN. NO DESCRIPTION OF SOIL OR ROCK MATERIAL AVAILABLE.			ROCKBIT HOLE TO 120.0'. HIT WATER AT 105.0'.

Appendix 12
Historical Monitoring Well Schematics


6inx5.0ft PROTECTIVE PIPE
WITH LOCKABLE CAP
3 PROTECTIVE POSTS
EL 773.8
3.6 STICKUP
4x4x0.5 ft CONCRETE PAD
CEMENT GROUT
WELL SCREENS
79.5 - 89.5
BENTONITE SEAL
27. TO 30.
PVC CASING
4.in
THREADJOINT
WL= 56.3 8-24-87
SAND FILTER
30. TO 100.
WELL SCREEN
0.010in SLOTS
DEPTH IN FEET
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
MCALESTER LANDFILL
MONITORING WELL MW117
FIGURE 1


6inx5.0ft PROTECTIVE PIPE
WITH LOCKABLE CAP
3 PROTECTIVE POSTS
4. STICKUP
EL 769.9
4x4x0.5 ft CONCRETE PAD
CEMENT GROUT
WELL SCREENS
63. - 73.
BENTONITE SEAL
24. TO 30.
PVC CASING
4.in
THREADJOINT
WL= 41. 8-24-87
SAND FILTER
30. TO 80.
WELL SCREEN
0.010in SLOTS
DEPTH IN FEET
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
MCALESTER LANDFILL
MONITORING WELL MW123
FIGURE 2

File DE
RW

REC'D MAY 24 2005

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

May 19, 2005

Darrell Elliott, Director
Environmental Management Office
U. S. Army Ammunition Plant
1 C Tree Road
McAlester, OK 74501-9002

Re: Groundwater – Replacement Well and Plugging Records
McAlester Army Ammunition Plant – New Landfill
Pittsburg Co., Permit No. 3561014

Dear Mr. Elliott:

The Land Protection Division of the Department of Environmental Quality (Department) is in receipt of McAlester Army Ammunition Plant Groundwater letter dated April 26, 2005 and received April 28, 2005.

You have supplied the Department with well drilling logs and a completion report for the new well MW-123A. The well was drilled in accordance with Oklahoma Water Resources Board (OWRB) regulations. The new replacement well will require two years quarterly background testing in accordance with OAC 252:515-9-2-31. Also supplied was the plugging record for MW-123.

If you have any questions or other comments, please contact Jim Cammack of my office at 405-702-5195.

Sincerely,

Saba Tahmassebi, Ph.D., P.E.
Chief Engineer
Land Protection Division

ST/jwc
File: Groundwater - Permit No. 3561014

DEPARTMENT OF THE ARMY
MCALESTER ARMY AMMUNITION PLANT
1 C-TREE ROAD
McAlester, Oklahoma 74501-9002

REPLY TO
ATTENTION OF:

April 26, 2005

Environmental Management Office

Mr. Saba Tahmassebi, Ph.D., PE
Chief Engineer, Land Protection Division
Oklahoma Department of Environmental Quality
P.O. Box 1677
Oklahoma City, Oklahoma 73101-1677

Dear Mr. Tahmassebi:

This letter is in response to the Oklahoma Department of Environmental Quality (ODEQ) October 1, 2004 letter to the McAlester Army Ammunition Plant (MCAAP), containing the subject "Groundwater-Replacement Well", for the New Landfill at MCAAP; Permit No. 3561014. This letter requested that drilling logs and completion reports be submitted to ODEQ for the new well (MW-123A) at the New Landfill.

MW-123 at the New Landfill was removed and MW-123A was successfully installed in the approved location according to Oklahoma Water Resources Board (OWRB) regulations (785:35-7-2). Quarterly monitoring will be conducted at MW-123A according to OAC 252:515-9-2-31 and the results will be submitted accordingly. Also mentioned in your letter, the legal description of the New Landfill permitted boundary needs to be corrected and this will be looked at closer and submitted to ODEQ at a later date.

Enclosed in this letter are the drilling logs and completion reports for the installation of the replacement well (MW-123A) at the New Landfill as requested.

If you have any questions or other comments, please contact Mr. Ryan Williams at 918-420-6551.

Sincerely,

Darrell L. Elliott

Darrell L. Elliott
Director, Environmental Management Office

Enclosures

Cf (w/enclosures): Mr. Jim Cammack, Solid Waste Permitting Unit, Land Protection Division, Oklahoma Department of Environmental Quality, P.O. Box 1677, Oklahoma City, Oklahoma 73101-1677

Mailed 4/27/05

Printed On Recycled Paper

Dsg/SJMMC-EM RW
Williams

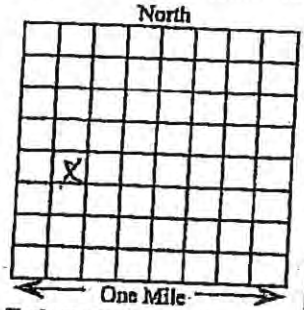
M:\200-1a2 WATER\GW\Cover Letter to ODEQ-New Landfill Drilling Logs and Completion Report (26 April 2005).doc

RECD APR 13 2005

PLUGGING REPORT FOR
Groundwater and Monitoring Wells

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location of Water Well or Boring



Each square is 10-acres
Please Plot Well Location

Section 29
Township 4 ☒ North ☐ South Range 13 ☐ WIM ☒ EIM ☐ ECM

Do Not Write In This Space
Well Record ID Number _____

*** After August 1, 2003 measured latitude and longitude may be substituted for the Legal Description**
Latitude _____ Longitude _____
Date collected (latitude and longitude), if different from date the well was drilled: _____
Method latitude and longitude was collected: ☐ GPS-uncorrected data, ☐ GPS-corrected data (WASS), ☐ GPS-corrected data (DGPS), ☐ GPS-corrected to base station

County Pittsburg Variance Request No. (if applicable) _____

WELL OWNER – NAME AND ADDRESS
Well Owner McAlester Army Ammunition Plant Phone 918 420 6591
Address/City/State MCAAP / McAlester / OK Zip 74501

TYPE OF WELL OR BORING BEING PLUGGED
☐ Groundwater Test Hole ☐ Groundwater well ☐ Geothermal/Heat Pump ☐ Geotechnical Boring ☒ Monitoring well

USE OF WELL BEFORE PLUGGING *Indicate the use of the well being plugged, to the best of your knowledge.
Use of well: Groundwater Monitoring

PLUGGING INFORMATION
Date Well or Boring Was Plugged: Nov. 17 2004 Total depth of well being plugged (feet): 85'

Was the well contaminated or was it plugged as though it was contaminated? ☐ Yes ☒ No

If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? ☐ Yes ☒ No

Backfilled with:
☐ Native Materials, ☐ Clean Washed Sand, ☐ Other Describe: _____
Backfilled from _____ feet to _____ feet

Grouted with:
☐ Cement Grout, ☐ Cement Grout/Bentonite, ☐ H.S. Bentonite Grout, ☐ Bentonite Pellets, ☐ Bentonite Granules/Chips
Grouted From 0 feet to 85 feet Was Grout Tremied? ☒ Yes ☐ No

Grouted with:
☐ Cement Grout, ☐ Cement Grout/Bentonite, ☐ H.S. Bentonite Grout, ☐ Bentonite Pellets, ☐ Bentonite Granules/Chips
Grouted From _____ feet to _____ feet

CERTIFICATION

The work described above was done under my supervision. This report is correct to the best of my knowledge.

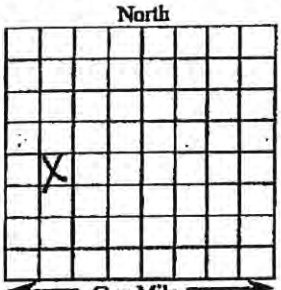
Firm Name _____ D/PC No. _____
Operator Name _____ OP No. _____
Signature _____ Date _____

MONITORING WELL COMPLETION REPORT

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location of Monitoring Well

North



Each square is 10-acres
Please Plot Well Location

Do Not Write In This Space
Well Record ID Number _____

Section 29
Township 4 ☒ North ☐ South Range 13 ☐ WIM ☒ EIM ☐ ECM

*** After August 1, 2003 a measured latitude and longitude may be substituted for the Legal Description**

Latitude _____ Longitude _____

Date collected (latitude and longitude), if different from date the well was drilled: _____
Method latitude and longitude was collected: ☐ GPS-uncorrected data, ☐ GPS-corrected data (WASS), ☐ GPS-corrected data (DGPS), ☐ GPS-corrected to base station

County Pittsburg Variance Request No. (if applicable) _____

WELL OWNER – NAME AND ADDRESS

Well Owner McAlester Army Ammunition Plant Phone (918)-420-6591
Address/City/State MCAAP / McAlester / OK Zip 74501-9002
Finding Location _____

TYPE OF WORK
☒ Monitoring Well

USE OF WELL
☐ Air Sparging ☐ Pump & Treat ☐ Site Assessment ☐ Unsaturated Zone ☐ Vapor Extraction ☐ Water Quality

NEW WELL CONSTRUCTION DATA
An application for a variance must be requested and obtained before any changes are made to the minimum construction standards for any well.

Date Well Was Completed 1-27-05
Hole Diameter 9.5 inches From 0 feet to 91 feet
Hole Diameter _____ inches From _____ feet to _____ feet

CASING INFORMATION: *Note: If surface casing is used please indicate that on the appropriate well casing information line.
1) Well Casing Material (check one): ☐ H.C. Steel ☒ P.V.C. ☐ Other
Well Casing Diameter (inches): 4 inches Well Casing From 3 feet to 80 feet
2) Well Casing Material (check one): ☐ H.C. Steel ☐ P.V.C. ☐ Other 3 above Ground Level
Well Casing Diameter (inches): _____ inches Well Casing From _____ feet to _____ feet

SCREEN OR PERFORATION INFORMATION:
Type of Screen: ☒ PVC ☐ H.C. Steel ☐ Stainless Steel ☐ Other
Type of Slots or Openings: ☐ Perforations ☒ Factory Slotted ☐ Hand Slotted or Perforated ☐ Other Describe: _____
Screened Interval: From 80 feet to 90 feet
From _____ feet to _____ feet
From _____ feet to _____ feet

FILTER PACK INFORMATION:
Filter Pack Material: ☐ Course Gravel ☐ Fine Gravel ☐ Course Sand ☐ Medium Sand ☒ Fine Sand ☐ Native Material
Filter Pack Interval: From 78 feet to 91 feet

WELL SEAL INFORMATION:
Type of Surface Seal: ☐ Cement Grout ☐ Cement Grout with Bentonite ☐ Other Describe: Concrete
Surface Seal Interval: From 0 feet to 1 feet

Annular Seal Material:
☒ Cement Grout ☐ Cement Grout/ Bentonite ☐ H.S. Bentonite Grout, ☐ Bentonite Pellets ☐ Bentonite Granules/Chips ☐ Other
Annular Seal Interval: From 1 feet to 75.5 feet

Filter Pack Seal Material:
☐ Cement Grout ☐ Cement Grout/ Bentonite ☐ H.S. Bentonite Grout ☐ Bentonite Pellets ☒ Bentonite Granules/Chips ☐ Other
Filter Pack Seal Interval: From 75.5 feet to 78 feet

TYPE OF COMPLETION: ☒ Above Ground with Casing Protection ☐ Flush Mounted ☐ Below Ground (connections between wells)
Was There a Cement Pad Installed Around the Well? ☒ Yes ☐ No
Size of Cement Pad if Installed: 4 feet by 4 feet

HYDROLOGIC DATA
Depth to water at time of drilling _____ Estimated yield of well _____ gpm First water zone _____ feet
Drawdown Pumping Test: Depth to water before start of test was _____ feet; Well was pumped/bailed at _____ gpm for _____ hours, which resulted in a drawdown depth to water of _____ feet.

LITHOLOGY DESCRIPTION

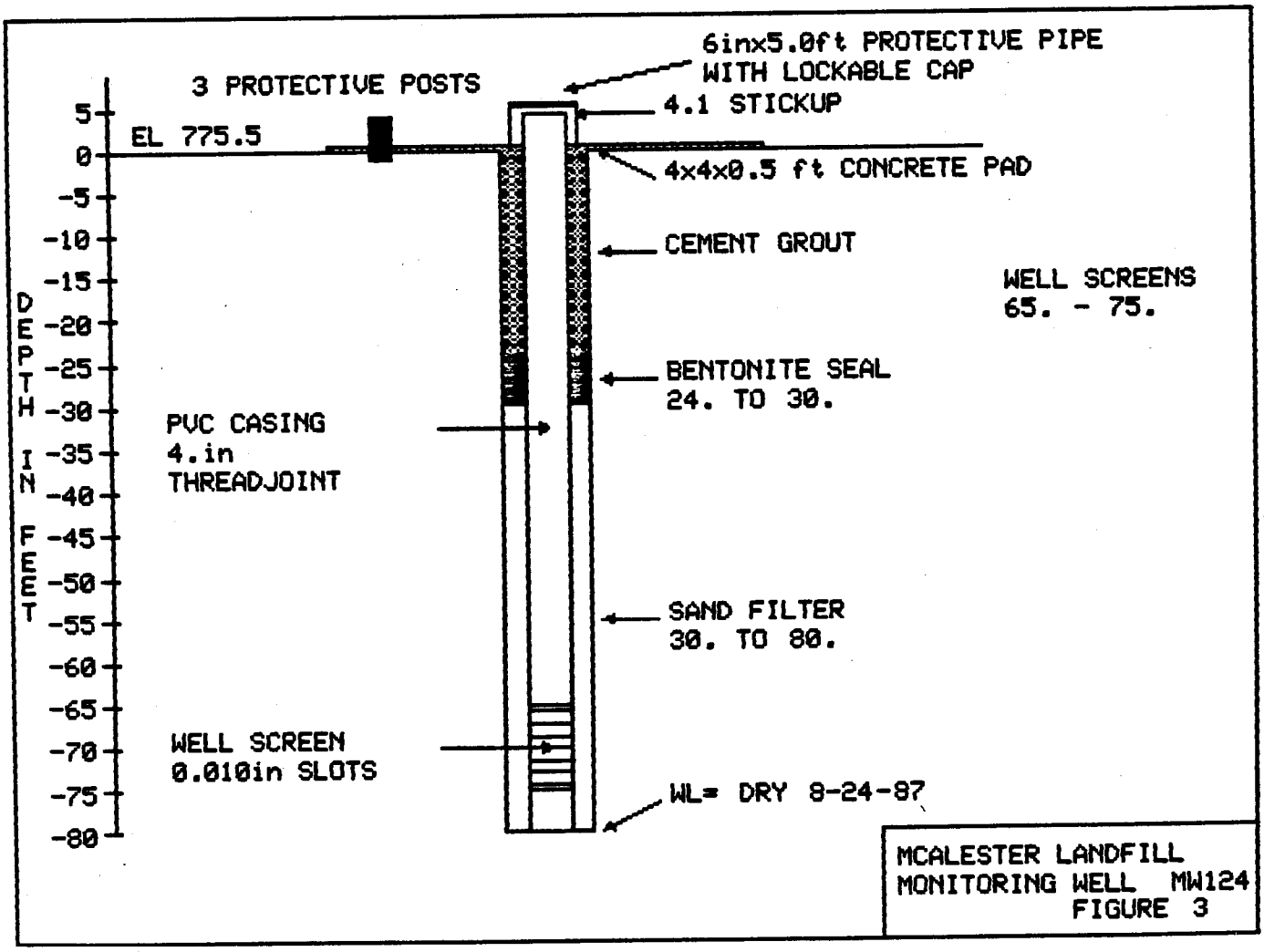
Note: If no lithology descriptions were made then, in the "Material" data field please indicate "no lithologic description obtained"

MATERIAL (Indicate with a check mark a zone that is saturated)	ENCOUNTERED FROM (Feet)	ENCOUNTERED TO (Feet)	MATERIAL (Indicate with a check mark a zone that is saturated)	ENCOUNTERED FROM (Feet)	ENCOUNTERED TO (Feet)
Fat clay yellow Brn	0	1.5			
Clayey Shale Light Olive Gray	1.5	35			
Silty Shale med. Dark gray	35	75			
Silty Dark Gray Shale	75	91			

CERTIFICATION

The work described above was done under my supervision. This report is correct to the best of my knowledge.

Firm Name Cherokee America Drilling D/PC No. 0060
Operator Name Tim Fite OP No. 0082
Signature Date 2-2-05


6inx5.0ft PROTECTIVE PIPE
WITH LOCKABLE CAP
3 PROTECTIVE POSTS
4.1 STICKUP
EL 775.5
4x4x0.5 ft CONCRETE PAD
CEMENT GROUT
WELL SCREENS
65. - 75.
BENTONITE SEAL
24. TO 30.
PVC CASING
4.in
THREADJOINT
SAND FILTER
30. TO 80.
WELL SCREEN
0.010in SLOTS
WL= DRY 8-24-87
DEPTH IN FEET
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
MCALESTER LANDFILL
MONITORING WELL MW124
FIGURE 3

File DE RW

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

KEN 200-102 Water Groundwater Landfill New

October 9, 2005

Darrell Elliott, Director
Environmental Management Office
U. S. Army Ammunition Plant
1 C Tree Road
McAlester, OK 74501-9002

REC'D SEP 19 2005

Re: Groundwater – Replacement Well – 124
McAlester Army Ammunition Plant – New Landfill
Pittsburg Co., Permit No. 3561014

Dear Mr. Elliott:

The Land Protection Division of the Department of Environmental Quality (Department) is in receipt of McAlester Army Ammunition Plant groundwater well replacement letter dated May 26, 2005 and received August 16, 2005.

This letter confirms our conversation on May 24, 2005 regarding MW-124. MW-124 has been determined to have a hole in the screen or pipe separation and must be replaced. The new well needs a new number, MW-124A. The new well is to be offset approximately 10 feet from the old MW-124.

The Department approves the new location. You will need to submit the actual well location, well drilling logs, and completion reports for the new well. The well is to be drilled in accordance with Oklahoma Water Resources Board (OWRB) regulations under the heading of OWRB 785:35-7-2 (Minimum Standards For Completing Monitoring Wells). The new replacement well will require two years quarterly background testing in accordance with OAC 252:515-9-31.

If you have any questions or other comments, please contact Jim Cammack of my office at 405-702-5195.

Sincerely,

Saba Tahmassebi, Ph.D., P.E.
Chief Engineer
Land Protection Division

ST/jwc
File: Groundwater - Permit No. 3561014

DEPARTMENT OF THE ARMY
MCALESTER ARMY AMMUNITION PLANT
1 C-TREE ROAD
McAlester, Oklahoma 74501-9002

REPLY TO
ATTENTION OF:

October 25, 2005

Environmental Management Office

Mr. Saba Tahmassebi, Ph.D., PE
Chief Engineer, Land Protection Division
Oklahoma Department of Environmental Quality
P.O. Box 1677
Oklahoma City, Oklahoma 73101-1677

Dear Mr. Tahmassebi:

This letter is in response to the Oklahoma Department of Environmental Quality (ODEQ) October 09, 2005 letter to the McAlester Army Ammunition Plant (MCAAP), containing the subject "Groundwater-Replacement Well-124", for the New Landfill at MCAAP; Permit No. 3561014. This letter requested that drilling logs and completion reports be submitted to ODEQ for the new well (MW-124A) at the New Landfill.

MW-124 at the New Landfill was removed and MW-124A was successfully installed in the approved location according to Oklahoma Water Resources Board (OWRB) regulations (785:35-7-2). Quarterly monitoring will be conducted at MW-124A according to OAC 252:515-9-2-31 and the results will be submitted accordingly.

Enclosed in this letter are the well drilling logs and completion reports for the installation of the replacement well (MW-124A) as requested. In addition, the survey information of MW-124A is also enclosed.

If you have any questions or other comments, please contact Mr. Ryan Williams at 918-420-6551.

Sincerely,

Darrell L. Elliott

Darrell L. Elliott
Director, Environmental Management Office

Enclosures

Cf (w/enclosures): Mr. Jim Cammack, Solid Waste Permitting Unit, Land Protection Division, Oklahoma Department of Environmental Quality, P.O. Box 1677, Oklahoma City, Oklahoma 73101-1677

Dsg/SJMMC-EM RW
Williams

M:\Common Files\200-1a2 WATER\GW\Cover Letter to ODEQ-New Landfill Drilling Logs and Completion Report MW-124A (24 Oct 2005).doc

mailed 10/26/05

Printed On Recycled Paper

F16c DE RW

REC'D DEC 0 8 2005

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

November 29, 2005

Darrell Elliott, Director
Environmental Management Office
U. S. Army Ammunition Plant
1 C Tree Road
McAlester, OK 74501-9002

Re: Groundwater – Replacement Well – 124A
McAlester Army Ammunition Plant – New Landfill
Pittsburg Co., Permit No. 3561014

Dear Mr. Elliott:

The Land Protection Division of the Department of Environmental Quality (Department) is in receipt of McAlester Army Ammunition Plant groundwater well drilling logs for replacement well and completion reports for MW-124A. Your letter is dated October 25, 2005 and was received October 31, 2005.

Old well MW-124 was properly plugged and abandoned on July 21, 2005 at a total depth of 80 feet. The new MW-124A is complete, with the monitoring well completion report, and drilling logs of this well.

If you have any questions or other comments, please contact Jim Cammack of my office at 405-702-5195.

Sincerely,

Saba Tahmassebi, Ph.D., P.E.
Chief Engineer
Land Protection Division

ST/jwc
File: Groundwater - Permit No. 3561014

200-102 Water-Groundwater-Boring logs-Landfill '05

File DR.

REC'D OCT 17 2005

LEMKE LAND SURVEYING, Inc.

3625 W. Main, Suite 109 - Norman, OK 73072
Ph (405) 366-8541 FAX (405) 366-8540 E-mail robbyj@lemke-ls.com
C.A. No. 2054 (expires 6/30/06)

MONITORING WELL 124-A
McAlester Army Ammunition Plant, Oklahoma
for CRC & ASSOCIATES, INC.

NORTHING	EASTING	ELEVATION	DESCRIPTION
533,879.85	2,572,806.95	780.35	MW-124-A TOP CASING
533,879.64	2,572,806.93	779.95	MW-124-A TOP NOTCH/6in PVC
533,879.53	2,572,805.50	777.30	MW-124-A CORP BRASS CAP
		777.10	MW-124-A GROUND
533,272.49	2,572,775.94	783.06	B ASHLAND
533,375.99	2,576,520.90	770.98	B8CY58

HORIZONTAL DATUM: NAD83, OKLAHOMA STATE PLANE SOUTH ZONE
VERTICAL DATUM: NGVD29
McAAP CONTROL MONUMENTS: 'B8CY58' & 'B ASHLAND'

Date of Survey: 8 August 2005
Crew: Courange / Scott

REGISTERED PROFESSIONAL LAND SURVEYOR
ROBBY L. JOHNSON
1539
OKLAHOMA

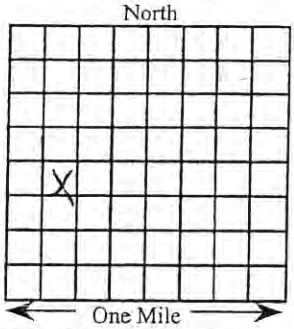
Robby L. Johnson
Oklahoma Registered Land Surveyor # 1539

CONSTRUCTION AND PLUGGING REPORT FOR
Groundwater Test Holes or Geotechnical Borings

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location

North



Each square is 10-acres

Please Plot Well Location

Do Not Write In This Space
Well Record ID Number _____

Section 29

Township 4 ☒ North ☐ South Range 13 ☐ WIM ☒ EIM ☐ ECM

*** After August 1, 2003 a measured latitude and longitude may be substituted for the Legal Description**

Latitude _____ Longitude _____

Date collected (latitude and longitude), if different from date the well was drilled: _____

Method latitude and longitude was collected: ☐ GPS-uncorrected data, ☐ GPS-corrected data (WASS), ☐ GPS-corrected data (DGPS), ☐ GPS-corrected to base station

County Pittsburg Variance Request No. (if applicable) _____

* Number of borings represented on this log which are within the same 10 acre-tract and with the same general depths and lithologies? _____

WELL OWNER – NAME AND ADDRESS

Well Owner McAlester Army Ammunition Plant Phone (918) 420-6591

Address/City/State _____ ZIP _____

Finding Location _____

TYPE OF WORK

☐ Geotechnical Boring ☐ Groundwater Test Hole ☒ monitoring well

NEW BORING OR WELL CONSTRUCTION DATA

An application for a variance must be requested and obtained before any changes are made to the minimum construction standards for any well.

Date Well or Boring was Completed _____

Hole Diameter _____ inches Boring Drilled From _____ feet to _____ feet

HYDROLOGIC DATA

Depth to water at time of drilling _____ Estimated yield of well _____ gpm. First water zone _____ feet

PLUGGING INFORMATION

Date Well or Boring Was Plugged: 7-21-05 Total depth well was plugged (feet): 80

Was the well contaminated or was it plugged as though it was contaminated? ☒ Yes ☐ No

If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? ☒ Yes ☐ No

Backfilled with: ☐ Native materials, ☐ Clean washed sand, ☐ Other Describe: _____

Backfilled from _____ feet to _____ feet

Grouted with: ☐ Cement grout, ☒ Cement grout/bentonite, ☐ H.S. bentonite grout, ☐ Bentonite pellets, ☐ Bentonite granules/chips

Grouted From 80 feet to 3 feet Was Grout Tremied? ☒ Yes ☐ No

Grouted with: ☐ Cement grout, ☐ Cement grout/bentonite, ☐ H.S. bentonite grout, ☐ Bentonite pellets, ☐ Bentonite granules/chips

Grouted From _____ feet to _____ feet

11 — 11 OP.#

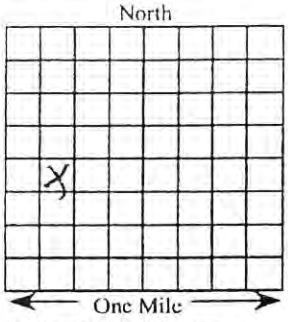
MONITORING WELL COMPLETION REPORT

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Do Not Write In This Space
Well Record ID Number _____

Legal Location of Monitoring Well

North



Each square is 10-acres
Please Plot Well Location

Section 29
Township 4 ☒ North ☐ South Range 13 ☐ WIM ☒ EIM ☐ ECM

*** After August 1, 2003 a measured latitude and longitude may be substituted for the Legal Description**

Latitude _____ Longitude _____

Date collected (latitude and longitude), if different from date the well was drilled: _____
Method latitude and longitude was collected: ☐ GPS-uncorrected data, ☐ GPS-corrected data (WASS), ☐ GPS-corrected data (DGPS), ☐ GPS-corrected to base station

County Pittsburg Variance Request No. (if applicable) _____

WELL OWNER – NAME AND ADDRESS

Well Owner McAlester Army Ammunition Plant Phone (918) 420-6591
Address/City/State MCAAP/McAlester, ok Zip 74501
Finding Location New Landfill MW-124-A

TYPE OF WORK
☒ Monitoring Well

USE OF WELL
☐ Air Sparging ☐ Pump & Treat ☐ Site Assessment ☐ Unsaturated Zone ☐ Vapor Extraction ☐ Water Quality

NEW WELL CONSTRUCTION DATA
An application for a variance must be requested and obtained before any changes are made to the minimum construction standards for any well.

Date Well Was Completed 7-26-05
Hole Diameter 10 inches From 0 feet to 80 feet
Hole Diameter _____ inches From _____ feet to _____ feet

CASING INFORMATION: ***Note:** If surface casing is used please indicate that on the appropriate well casing information line.
1) Well Casing Material (check one): ☐ H.C. Steel ☒ P.V.C. ☐ Other
Well Casing Diameter (inches): 4 inches Well Casing From 70 feet to 0 feet
2) Well Casing Material (check one): ☐ H.C. Steel ☐ P.V.C. ☐ Other
Well Casing Diameter (inches): _____ inches Well Casing From _____ feet to _____ feet

SCREEN OR PERFORATION INFORMATION:
Type of Screen: ☒ PVC ☐ H.C. Steel ☐ Stainless Steel ☐ Other
Type of Slots or Openings: ☐ Perforations ☒ Factory Slotted ☐ Hand Slotted or Perforated ☐ Other Describe: _____
Screened Interval: From 80 feet to 70 feet
From _____ feet to _____ feet
From _____ feet to _____ feet

FILTER PACK INFORMATION:
Filter Pack Material: ☐ Coarse Gravel ☐ Fine Gravel ☐ Coarse Sand ☐ Medium Sand ☒ Fine Sand ☐ Native Material
Filter Pack Interval: From 80 feet to 68 feet

WELL SEAL INFORMATION:

Type of Surface Seal: ☒ Cement Grout ☐ Cement Grout with Bentonite ☐ Other Describe: _____

Surface Seal Interval: From 1 feet to 0 feet w/ 4x4 Pad

Annular Seal Material:

☒ Cement Grout ☐ Cement Grout/ Bentonite ☐ H.S. Bentonite Grout, ☐ Bentonite Pellets ☐ Bentonite Granules/Chips ☐ Other

Annular Seal Interval: From 60 feet to 1 feet

Filter Pack Seal Material:

☐ Cement Grout ☐ Cement Grout/ Bentonite ☐ H.S. Bentonite Grout ☐ Bentonite Pellets ☐ Bentonite Granules/Chips ☐ Other

Filter Pack Seal Interval: From 68 feet to 60 feet

TYPE OF COMPLETION: ☒ Above Ground with Casing Protection ☐ Flush Mounted ☐ Below Ground (connections between wells)

Was There a Cement Pad Installed Around the Well? ☒ Yes ☐ No

Size of Cement Pad if Installed: 4 feet by 4 feet

HYDROLOGIC DATA

Depth to water at time of drilling 59 ft Estimated yield of well UNK gpm First water zone _____ feet

Drawdown Pumping Test: Depth to water before start of test was _____ feet; Well was pumped/bailed at _____ gpm for _____ hours, which resulted in a drawdown depth to water of _____ feet.

LITHOLOGY DESCRIPTION

Note: If no lithology descriptions were made then, in the "Material" data field please indicate "no lithologic description obtained"

MATERIAL (indicate with a check mark a zone that is saturated)	ENCOUNTERED FROM (Feet)	ENCOUNTERED TO (Feet)	MATERIAL (indicate with a check mark a zone that is saturated)	ENCOUNTERED FROM (Feet)	ENCOUNTERED TO (Feet)
Grass	0	.6			
Gravel	.6	3			
Top Soil	3	6			
Shale Tan	6	48			
Gray Shale	48	80			

CERTIFICATION

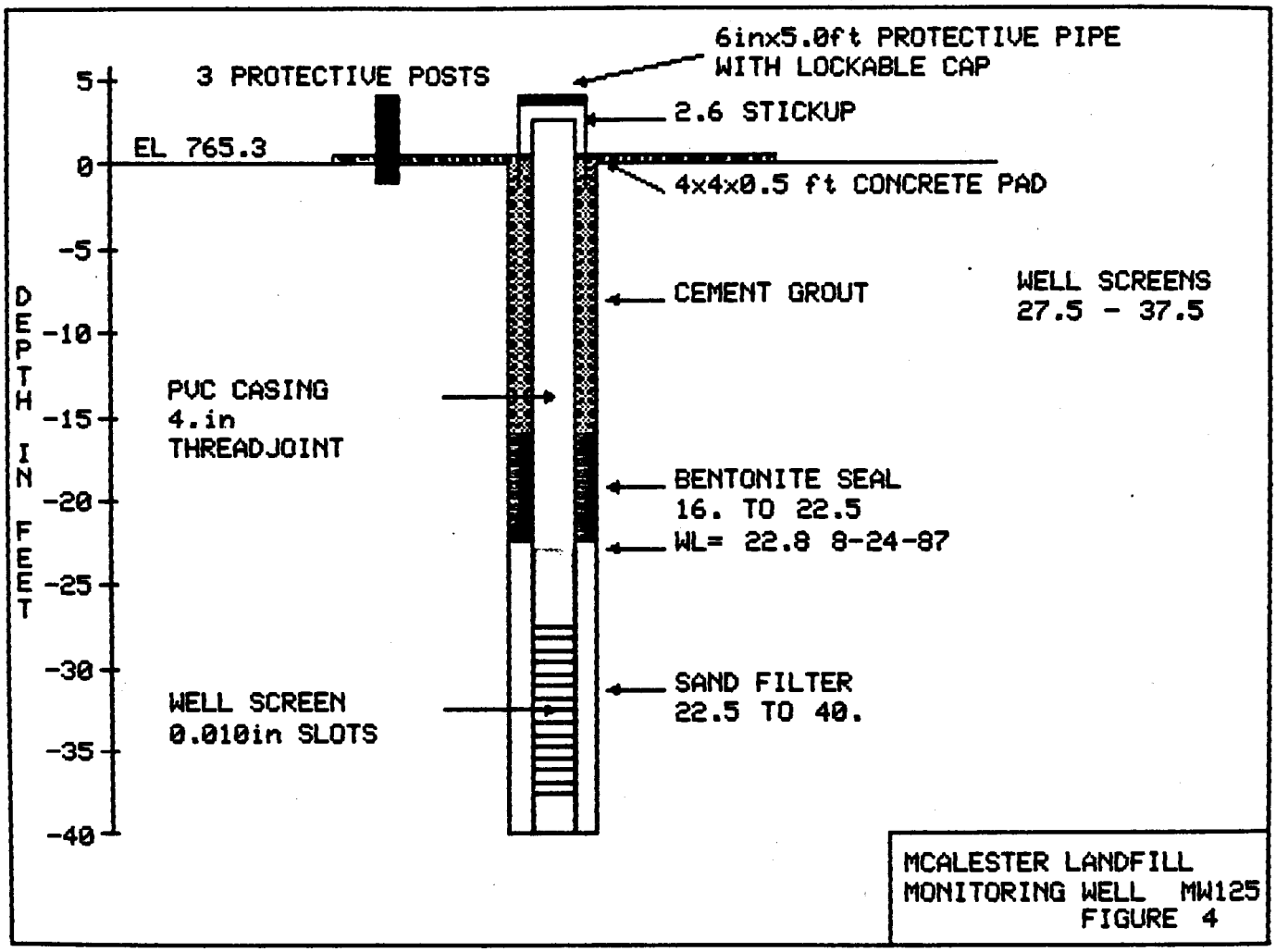
The work described above was done under my supervision. This report is correct to the best of my knowledge.

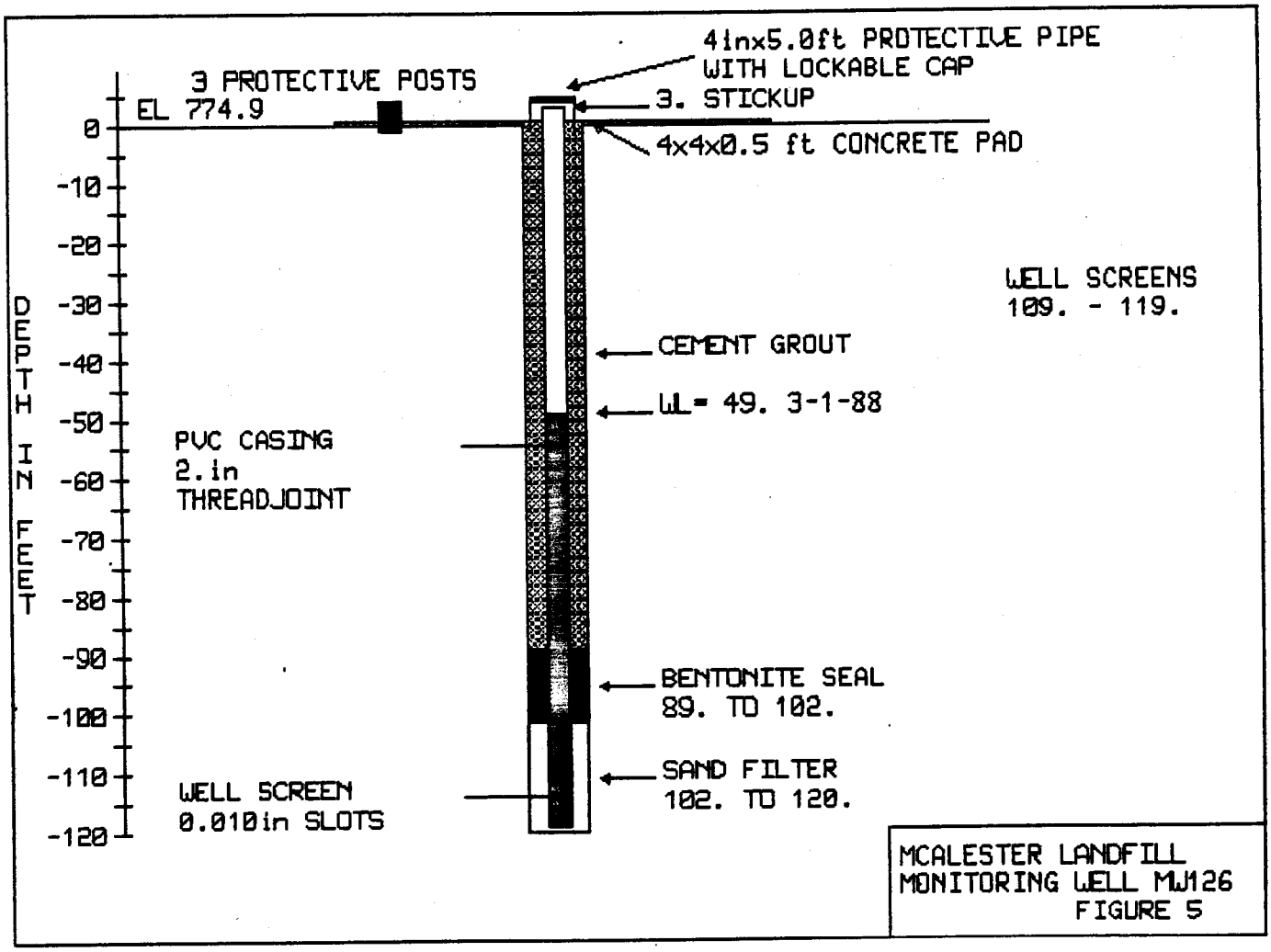
Firm Name Cherokee America Drilling D/PC No. 0060

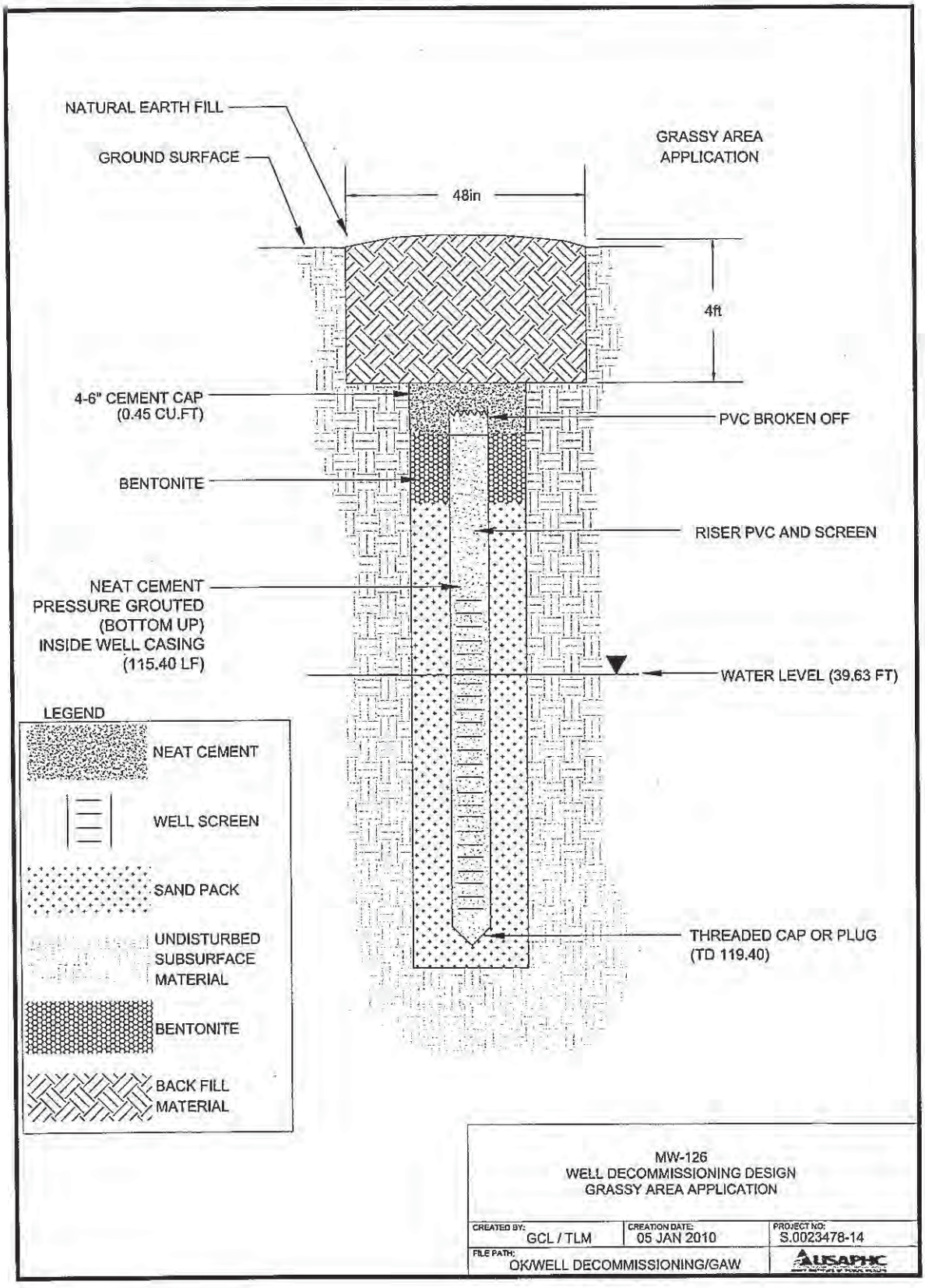
Operator Name Steven Waldrop OP No. 1190

Steven Waldrop Date 7-26-05

Signature


6inx5.0ft PROTECTIVE PIPE
WITH LOCKABLE CAP
3 PROTECTIVE POSTS
2.6 STICKUP
EL 765.3
4x4x0.5 ft CONCRETE PAD
CEMENT GROUT
WELL SCREENS
27.5 - 37.5
PVC CASING
4.in
THREADJOINT
BENTONITE SEAL
16. TO 22.5
WL= 22.8 8-24-87
SAND FILTER
22.5 TO 40.
WELL SCREEN
0.010in SLOTS
DEPTH IN FEET
5
0
-5
-10
-15
-20
-25
-30
-35
-40
MCALESTER LANDFILL
MONITORING WELL MW125
FIGURE 4


4inx5.0ft PROTECTIVE PIPE
WITH LOCKABLE CAP
3 PROTECTIVE POSTS
EL 774.9
3. STICKUP
4x4x0.5 ft CONCRETE PAD
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
DEPTH IN FEET
WELL SCREENS
109. - 119.
CEMENT GROUT
WL= 49. 3-1-88
PVC CASING
2.in
THREADJOINT
BENTONITE SEAL
89. TO 102.
SAND FILTER
102. TO 120.
WELL SCREEN
0.010in SLOTS
MCALESTER LANDFILL
MONITORING WELL MW126
FIGURE 5


NATURAL EARTH FILL
GROUND SURFACE
GRASSY AREA
APPLICATION
48in
4ft
4-6" CEMENT CAP
(0.45 CU.FT)
PVC BROKEN OFF
BENTONITE
RISER PVC AND SCREEN
NEAT CEMENT
PRESSURE GROUTED
(BOTTOM UP)
INSIDE WELL CASING
(115.40 LF)
WATER LEVEL (39.63 FT)
THREADED CAP OR PLUG
(TD 119.40)
LEGEND
NEAT CEMENT
WELL SCREEN
SAND PACK
UNDISTURBED
SUBSURFACE
MATERIAL
BENTONITE
BACK FILL
MATERIAL
MW-126
WELL DECOMMISSIONING DESIGN
GRASSY AREA APPLICATION
CREATED BY:
GCL / TLM
CREATION DATE:
05 JAN 2010
PROJECT NO:
S.0023478-14
FILE PATH:
OK/WELL DECOMMISSIONING/GAW
USAPHC

U.S. ARMY INSTITUTE OF PUBLIC HEALTH
BORING and WELL CONSTRUCTION LOG

McAlester AAP, McAlester, Oklahoma
Ground Water Consultation, New Active Landfill
August 2013

BORING / MONITORING WELL INSTALLATION LOG

JOB NO S.0013291-13 Boring/Well No. MW-LF-1 Depth of Hole 95′ Sheet 1 Of 1
Geologist JAM Sample Method Drill Cuttings Hole Diameter 4" Drill Rig Mobile B80
Driller RH Drilling Method Auger/Air Started 11Aug13 Completed 17Aug13

WELL MATERIALS INVENTORY

Well Casing Type PVC In. Dia. 4" Pack Type & Size Sand No.2 Seal Type Bent.
Install Method Auger/Air Protective Casing ____ Y ____ N Protective Casing Type
Well Screen PVC In. Dia. 4" Screen Slot Size 0.010" Grout Type Cement
Amount of Pack 70-95′ Amount of Seal 67-70′ Amount of Grout 6-67′

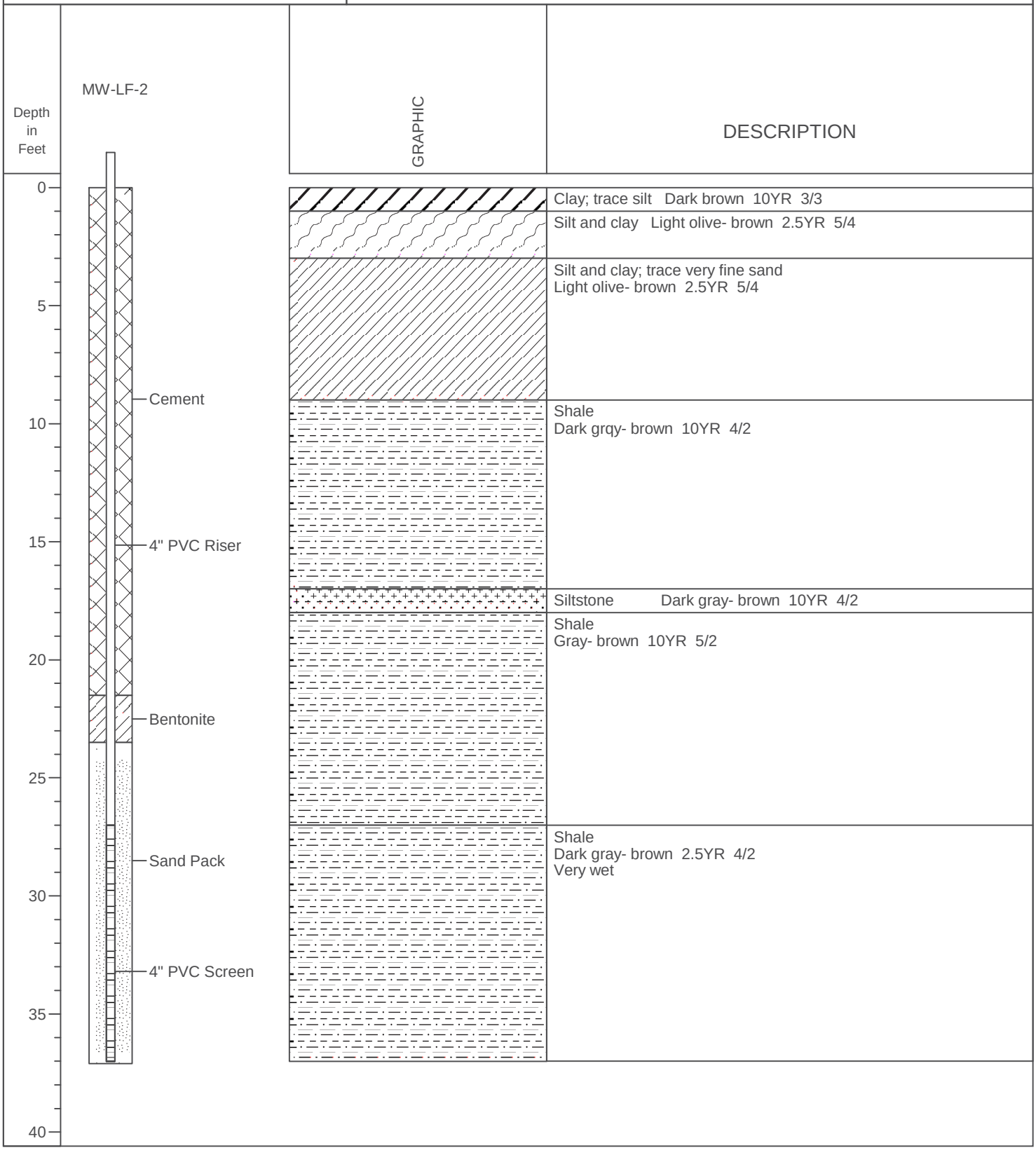
Depth (Ft.)	Sample No.	REC %	Lithologic Description / USCS Classification	Well Diagram / Comments
0-2′			Sand very fine and Silt; little clay; yellow-brown 10 YR 5/4	
2-6′			Sand very fine to fine; little silt; trace clay; yellow-brown 10YR 5/6 and light brown-gray 10 YR 6/6	
6-9′			Silt; trace sand very fine; trace sand very fine; gray-brown 10YR 5/2	
9-13′			Shale; dark gray-brown 10YR 4/2; soft	
13-19′			Shale; dark gray 10YR 4/1 and gray-brown 10YR 5/2; very soft	
19-95′			Shale; dark gray-brown 10YR 4/2; soft; moist 78-95′	

USAPHC
ARMY INSTITUTE OF PUBLIC HEALTH

MW-LF-2

McAlester Army Ammunition Plant
Ground Water Consultation
Landfill Area
S.0031692
February 2015

Date	: 5 February 2015
Drill Rig	: B-80
Drill Method	: Air Rotary
Drill Crew	: Hoover, Maners, Farro
Geologist	: J. Maio



04-23-2015

Appendix 13
Common MCAAP NHIW Waste Stream

The following is a list of common items that are deposited in the MCAAP NHIW Landfill.

- Empty Cans, Pails, Brushes, Cups (Previously containing Paint, Thinner, Mil-C-450, Oil, Grease, Coolant, Hydraulic Fluid, Empty Epoxy Polyamide with lids off)
- Empty 55 gallon drums (previously containing Oil, Grease, Coolant, Hydraulic Fluid)
- Empty Cardboard boxes and liners previously Containing explosive
- Empty cardboard tubes and end caps from Renovation processes
- Grit Dust
- Empty Aluminum powder bags
- Non-reactive activated carbon from waste water treatment processes
- Cutting sand from Machine Shop
- Water Plant lagoon sludge
- Ash from Fire training due to burning of untreated wood
- Digester Sludge
- Car wash sludge
- Cement Dust/Residue Drums Waste from Baghouse or Cement mix waste
- Desiccant, Labels, tags, markers, paper, tapes, earplugs, wipes, items contaminated with K-70 grease, molykote, waste asphalt and Items contaminated with only asphalt, unserviceable plug caps, sandpaper, Empty 5 minute epoxy containers, Used (dry) Roofing Felt, gloves contaminated with only dirt, empty containers of Loctite ,dryersheets touch up pens, damaged fiber tubes, tissue, rags/bear tex pads, crocus cloth, dirt/rust (dry), empty silicone tubes; Items contaminated with Compound, Molykote 55, Cutting Oil and Locktite. Items contaminated with Cement, Filters from Parts, vermiculite, and items contaminated with cement and sealing compound, and unserviceable plug, inert plastic items including plastic banding, electrical tape, flashbulbs, fiberglass insert of yaw screen
- Items that contain asbestos
- Asbestos