CONTRACT DOCUMENTS AND
TECHNICAL SPECIFICATIONS
FOR

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION PROJECT PW2101

CITY OF LAWTON

COMANCHE COUNTY, OKLAHOMA

SET NO.: _____
DATE: March 12, 2024

PREPARED BY:
SCS ENGINEERS
1901 Central Drive, Suite 550
Bedford, Texas 76021
Certificate of Authorization Number: 1191
Certificate of Authorization Renewal Date: 06/30/2025

In Coordination with:

City of Lawton
Engineering Division
212 SW 9th Street
Lawton, Oklahoma 73501

CONTRACT DOCUMENTS

AND

TECHNICAL SPECIFICATIONS

FOR

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION
PROJECT PW2101

for

CITY OF LAWTON
COMANCHE COUNTY, OKLAHOMA

Prepared by:

Approved: March 12, 2024

SCS ENGINEERS
1901 Central Drive, Suite 550
Bedford, Texas 76021
(817) 571-2288
CA Number: 1191, CA Renewal Date: 06/30/2025

In Coordination with:

City of Lawton
Engineering Division
212 SW 9th Street
Lawton, Oklahoma 73501
(580) 581-3385

_____
Stan Booker, Mayor

_____
John Ratliff, City Manager

Sandeep Saraf, P.E.
Engineer of Record
SCS Engineers

Joseph Painter, P.E.
Director of Engineering
City Engineer

Notice to Bidders

Public Construction Contract

Date of Notice:	Date Documents Available:
March 13, 2024	**March 13, 2024**

SUBMISSION LOCATION & TIME: BY 2:00 P.M. April 10, 2024

City Clerk, New City Hall 212 SW 9th Street Lawton, OK 73501 Phone: 580.581.3305

Bid Opening: Date: Wednesday, April 10, 2024 Time: 2:00 p.m.

Location: 212 SW 9th Street, Lawton OK 3rd Floor Conference Room, New City Hall

Project Title: LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101

Bid Instructions: Bids timely filed with the City Clerk shall be publicly opened and read aloud at the time and location specified as bids above. Bids received more than ninety six (96) hours, excluding Saturdays, Sundays and holidays, before the time set for opening of bids, as well received after the time set for opening of bids, will not be considered and will be returned unopened. Within sixty (60) days from the bid opening date, the successful bidder shall execute a written contract embodying all provisions of the bidding documents.

For Technical Information, contact: **Sandeep Saraf – ssaraf@scsengineers.com** **Brett DeVries – bdevries@scsengineers.com**
Phone Number: (407) 923-7013 **Phone Number: (763) 442-5417**

Description of Work: Construction of Landfill Cells 6 & 7 that include installation of composite liner system, leachate collection system, access road, electrical, and stormwater system.

Time for Project Completion:	*Wage Rates:
260 Calendar Days	**YES**

Plans, Specs & Bidding Document Available at:	SCS Engineers	Deposit for Plans & Specs:
(Documents will be available in digital format through email)	**1901 Central Drive, Suite 550** **Bedford, TX 76021**	**N/A – digital format (email)**
8:00 a.m. to 5:00 p.m. Monday through Friday	**Phone: 817.571.2288**	

Prebid Conference

Location:		Attendance Mandatory?
212 SW 9th Street **Lawton, Oklahoma** **(3rd Floor Conference Room, New City Hall)**	**Time: 1:30 p.m.** **Date: March 20, 2024**	**NO**

***Bid Bond*:** A cashier's check, a certified check, or a surety bond in the amount of five percent (5%) of the bid shall accompany the sealed proposal of each bidder. Deposits will be returned to the unsuccessful bidders. Deposits will be returned to successful bidder upon execution of contract documents.

Prime contractors must provide adequate previous similar project experience, and verifiable references, that exhibits the prime's ability to self-perform and execute this project within the contract requirements as set forth in the plans and specifications. The City of Lawton reserves the right to reject any and all bids based on prior project experience or lack thereof.

*Bids shall also be made in accordance with the prevailing hourly rate of wages for this locality and project as determined by the Commission of Labor and filed with the Secretary of State, a copy of which is on file with the City Clerk, in accordance with the provisions of 40 O.S. 1971, 196.1-196.12, which prevailing hourly rate of wages is made a part of this notice by reference as though fully set forth herein.

THE CITY COUNCIL OF THE CITY OF LAWTON RESERVES THE RIGHT TO REJECT ANY OR ALL BIDS.
CITY OF LAWTON, OKLAHOMA By: Donalynn Blazek-Scherler, City Clerk

CONTRACT DOCUMENTS AND
TECHNICAL SPECIFICATIONS
FOR CONSTRUCTION OF

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION
PROJECT PW2101

CITY OF LAWTON
COMANCHE COUNTY, OKLAHOMA

CONTENTS

SOLICITATION FOR BIDS

NOTICE is hereby given that the CITY OF LAWTON, OKLAHOMA, will receive sealed bids at the Office of the City Clerk, City Hall, 212 SW 9th St, Lawton, Oklahoma, 73501, until 2:00 o'clock P.M., Local Time, on the **10th** day of **April, 2024**, for the construction of

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101

1. Bid Requirements.

   a. Bids shall be made in accordance and fully comply with

Solicitation for Bids	Requirements for Bidders
Bidder's Proposal	Plans and Specifications

   and other bidding documents on file and available for examination at the Office of the City Clerk in City Hall. These documents are made a part of this notice as though fully set forth herein.

   b. Bids may require compliance with the prevailing hourly rate of wages for this locality and project as determined by the Commission of Labor and filed with the Secretary of State, a copy of which is on file with the City Clerk, in accordance with the provisions of 40 Oklahoma Statute 1991, 196.1-196.14, which prevailing hourly rate of wages is made a part of this solicitation by reference as though fully set forth herein.

   c. A cashier's check, a certified check, or a surety bond in the amount of five percent (5%) of the bid shall accompany the sealed proposal of each bidder. Such deposits will be returned to the unsuccessful bidders.

2. Filing of Bids.

   a. Bids received more than ninety-six (96) hours before the time set for opening of bids, (excluding Saturdays, Sundays, and holidays), and bids received after the time set for opening of bids will not be considered and will be returned unopened.

   b. Bids timely filed with the City Clerk shall be publicly opened and read aloud in the Auditorium at City Hall immediately after the closing time above stated. No bidder may withdraw a bid within sixty (60) days after the actual date of the opening thereof. Within sixty (60) days from the bid date, the owner may award a contract to the successful bidder or reject any or all bids for the project.

3. Obtaining Documents.

   Complete sets of the Plans, Specifications and all other bidding documents may be obtained from SCS Engineers, in digital format through email.

Call 407-923-7013 or email ssaraf@scsengineers.com or bdevries@scsengineers.com

4. A **NON-MANDATORY PRE-Bid Conference** will be held at **212 SW 9th Street**, Lawton, Oklahoma at **1:30 p.m.**, Local Time, on **March 20, 2024**.

5. The City Council of the City of Lawton reserves the right to reject any or all bids.

For the CITY OF LAWTON, OKLAHOMA

_____

BY: Donalynn Blazek-Scherler, City Clerk

INFORMATION FOR BIDDERS

1. Receipt and Opening of Bids

The City of Lawton (herein called the "Owner") invites bids on the forms attached hereto, all blanks of which must be appropriately filled in. Bids will be received by the Owner at the Office of the City Clerk until 2:00 o'clock, P.M., Local Time on **April 10, 2024,** and then at 2:00 will be publicly opened and read aloud at the 3rd Floor Conference Room, New City Hall, at 212 SW 9th Street, Lawton, Oklahoma. The envelopes containing the bids must be sealed, addressed to the City Clerk, 212 SW 9th Street, Lawton, Oklahoma, 73501, and designated as bid for the

LANDFILL ELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101

The Owner may consider informal any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No bidder may withdraw a bid within sixty (60) days after the actual date of the opening thereof.

2. Preparation of Bid

Each bid must be submitted on the prescribed forms. All blanks and spaces for bid prices must be filled in, in ink or typewritten, in both words and figures, and the foregoing certifications must be fully completed and executed when submitted.

Bids and affidavits must be filed in sealed envelopes within the time limit for receiving proposals, as stated in the SOLICITATION FOR BIDS. Bid envelopes shall legibly bear the word "PROPOSAL" with the name of the Project. If forwarded by mail, the sealed envelope containing the bid **must** be enclosed in another envelope addressed as specified in the g. The original copy shall be filed with the CITY OF LAWTON in the CITY CLERK's office in the LAWTON CITY HALL. All blank spaces in the proposal forms shall be correctly filled-in and the bidder shall state the prices, typewritten or written in ink, both in words and numerals, for which he proposes to do the work contemplated or furnish the materials required. All prices shall be distinctly legible.

3. Method of Bidding

The Owner invites the following bid(s): **UNIT PRICE**

4. Bid Surety

Each bid must be accompanied by cash, certified check of the bidder, or a bid bond prepared on the form of bid bond attached hereto, duly executed by the bidder as principal and having as surety thereon a surety company approved by the Owner, in the amount of five percent (5%) of the bid. Such cash, checks, or bid bonds will be returned promptly after the Owner and the accepted bidder have executed the contract, or, if no award has been made within 60 days after the opening of bids,

upon demand of the bidder at any time thereafter, so long as he has not been notified of the acceptance of his bid.

Proposals will not be considered unless the original filed with the City is accompanied by the described Bid Surety made payable to the City of Lawton. The proposal guaranty is required as evidence of good faith and as a guarantee that, if awarded the contract, the bidder will execute the contract and furnish the required bonds.

The successful bidder, upon his failure or refusal to execute and deliver the contract and bonds required within ten (10) days after he has received notice of the acceptance of his bid, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the security deposited with his bid.

5. Telegraphic Modification

Any bidder may modify his bid by telegraphic communication at any time prior to the scheduled closing time for receipt of bids, provided such telegraphic communication is received by the Owner prior to the closing time; and, provided further, the Owner is satisfied that a written confirmation of the telegraphic modification over the signature of the bidder was mailed prior to the closing time. The telegraphic communication should not reveal the bid price but should provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed bid is opened. If written confirmation is not received within two (2) days from the closing time, no consideration will be given to the telegraphic modification.

6. Qualification/Disqualification of Bidders

The Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out contract requirements and complete the work contemplated therein. Conditional bids will not be accepted.

Bidders will be disqualified and their proposals not considered for any of the following specific reasons (These reasons are not all inclusive):

1. Where more than one proposal for an individual firm, partnership, or corporation is filed under the same or different names; and where such proposals are not identical in every respect

2. Reason for believing that collusion exists among the bidders

3. Reasonable grounds for believing that the bidder holds interest in more than one proposal for the work contemplated or materials to be furnished

4. Incomplete work that, in the judgment of the City, will hinder or prevent the prompt commencement or completion of this project

5. Prime contractors must provide adequate previous similar project experience, and verifiable references, that exhibits the prime's ability to self-perform and execute this project within the contract requirements as set forth in the plans and specifications. The City of Lawton reserves the right to reject any and all bids based on prior project experience or lack thereof.

6. Contractor shall provide evidence of the ability to adequately staff projects such that 2 project sites are actively moving at all times.

7. Power of Attorney

Attorneys-in-fact who sign bid bonds or contract bonds must submit with each bond a certified and effectively dated copy of their power of attorney.

If the proposal is submitted by an individual, his name must be signed by him or his duly authorized agent and his post office address given. If the proposal is submitted by a firm or partnership, the name and post office address of each member of the firm must be given with the proposal signed by a duly authorized member of the firm or partnership. If the proposal is made by a company or corporation, the state in which the company or corporation is chartered and business address must be given; and the proposal must be signed by a duly authorized official or agent. Powers of Attorney, authorizing agents, or others to sign proposals must be properly certified and on file with the City Clerk.

8. Time of Completion and Liquidated Damages

The Contractor hereby agrees to commence work under the Contract on a date specified in a written "Notice to Proceed" of the Owner, and to fully complete the project within **(260) consecutive calendar days**. The Contractor further agrees to pay as liquidated damages, the sum of **Two Thousand Dollars and 00/100 ($2000.00) for each consecutive calendar day** thereafter as provided in the Contract and General Conditions.

9. Rejection of Proposals

The City reserves the right to reject any or all proposals submitted, all of which are subject to this reservation. Proposals shall be rejected for any of the following specified reasons
(These reasons are not all inclusive):

1. Proposals received after the time limit stated in the solicitation

2. Proposal prices obviously unbalanced

3. Proposals that are incomplete insofar as the Non-Collusion Affidavit, required signatures, or containing any irregularities of substance

10. Notice of Award

The Owner will make every reasonable attempt to award the contract within ten (10) days of the bid opening date, but reserves the right to examine all the bids in their entirety and to take whatever time may be required, in the best interest of the Owner, to accomplish a complete and fair bid analysis.

11. Method of Award - Lowest Responsible Bidder

Award of contract will be made by the City Council, upon recommendation of the City Engineer, to the lowest responsible bidder submitting a responsive bid and meeting the requirements of the City. The Owner may reject all bids or may award the contract with any selected alternatives based upon available funding.

12. Cancellation of Award

The City reserves the right to cancel the award of any contract at any time before the execution of said contract without liability against the City.

13. Obligation of Bidder

At the time of the opening of bids, each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the plans and contract documents (including all addenda). The failure or omission of any bidder to examine any form, instrument, or document shall not relieve any bidder from any obligation in respect of his bid.

Each bidder must inform himself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of his obligation to furnish all material and labor necessary to carry out the provisions of the contract. Insofar as possible, the contractor must employ methods or means that will not cause any interruption of or interference with the work of any other contractor.

All bidders, by submittal of a proposal, represent that they have examined the site prior to submittal and are fully informed regarding facilities and conditions affecting work, costs, risks, and obligations to be met, regardless of any omissions of the specifications.

Any neglect or failure on the part of the bidder to obtain reliable information regarding the conditions to be encountered shall not relieve the successful bidder from any risks or liabilities or from the responsibility for the completion and acceptance of the project.

13. Pre-Bid Conference

A Non-**Mandatory Pre-Bid Conference** will be held at **212 SW 9th Street**, Lawton, OK, at **1:30 p.m.** on **March 20, 2024.**

15. Addenda and Interpretations

No interpretation of the means of the plans, specifications, or other pre-bid documents will be made to any bidder orally.

Each written request for such interpretation should be addressed to the City Engineer at 212 SW 9th Street, Lawton, Oklahoma, 73501. To be given consideration, each such request must be received at least five (5) days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, if issued, will be mailed by certified mail with return receipt requested to all plan holders (at the respective addresses furnished for such purposes) for the opening of bids. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his bid as submitted. All addenda so listed shall become part of the contract documents.

16. Security for Faithful Performance

The Contractor shall deliver the executed contract and all required surety bonds within ten (10) days upon receipt of the contract from the Owner. With the execution and delivery of the Contract, the Contractor shall furnish and file with the City in the amounts herein required, the surety bonds listed below. The surety on such bonds shall be a duly authorized surety company satisfactory to the Owner.

A. A good and sufficient Performance Bond in an amount equal to one hundred percent (100%) of the approximate total amount of the Contract, guaranteeing the full and faithful execution of the work and performance of the Contract and for the protection of the City and all property owners interested against any improper execution of the work or the use of inferior materials.

B. A good and sufficient Statutory Bond in an amount equal to one hundred percent (100%) of the approximate total amount of the Contract, guaranteeing payment for all labor, materials, and equipment used in the construction of the project.

C. A good and sufficient Maintenance Bond in an amount equal to one hundred percent (100%) of the total amount of the Contract, guaranteeing the maintenance in good condition of such project for a period of two (2) years from and after the time of its completion and acceptance by the City.

No surety will be accepted who is in default or delinquent on any bond or who holds interest in any litigation against the City. All bonds shall be made on forms furnished by the City and shall be executed by surety companies licensed to do business in the State of Oklahoma and shall conform to the requirements as set forth herein. Each Bond shall be executed by the Contractor and the Surety.

Should any surety on the Contract be determined unsatisfactory at any time by the City, notice will be given to the Contractor to that effect; and the Contractor shall forthwith substitute a new Surety

or Sureties satisfactory to the City. No payment will be made under the Contract until the new Surety or Sureties, as required, have qualified and have been accepted by the City. The Contract shall not be operative nor shall any payments be due until approval of the bonds has been made by the City.

17. Laws and Regulations

The bidder's attention is directed to the fact that all applicable state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout and they will be deemed to be included in the contract the same as though herein written out in full.

18. Sales Tax Exemption

Pursuant to Oklahoma Statutes, Title 68, 1356(I0), Contractors and Subcontractors shall be exempted from the tax levied on the sale of tangible personal property or services necessary for the completion of this construction contract. Any Contractor or Subcontractor making purchases for this contract on behalf of the City of Lawton shall certify, in writing, on the copy of the invoice or sales ticket to be retained by the vendor, that the purchases are made for and on behalf of the City of Lawton.

Contractors and Subcontractors shall request a written Sales Tax Exemption by contacting the Engineering Division, City of Lawton, 212 SW 9th Street, Lawton, Oklahoma, 73501, Ph. (580) 581-3385, who will issue such exemption on an individual project basis. It shall be the Contractor's and Subcontractor's responsibility to secure the Sales Tax Exemption and failure to do so will not lessen their liability for payment of the sales tax.

Two Tax Commission interpretations of the Oklahoma statutes Title 68, 1356(I0) are listed below to avoid contention among the City of Lawton, its contractors, and the Tax Commission:

> "*Exemptions apply to materials permanently incorporated into the project, but not to concrete forms nor to other tools."*
>
> *"The same reasoning precludes exceptions being applied to rental items."*

The Contractor shall certify that purchases are made for or are on behalf of the City of Lawton. Persons who make wrongful or erroneous certification(s) shall be guilty of a misdemeanor and shall be punished as provided in the statutes.

19. Safety Standards and Accident Prevention

With respect to all work performed under this contract, the Contractor shall:

1. Comply with the safety standard provisions of applicable laws, building and construction codes, and the "Manual of Accident Prevention in Construction" published by the Associated General Contractors of America, the requirements of

the Occupational Safety and Health Act of 1970 (Public Law 91-596), and the requirements of Title 29 of the Code of Federal Regulations.

2. Exercise every precaution at all times for the prevention of accidents and the protection of persons (including employees) and property.

3. Maintain as required by OSHA standards, all required articles necessary for giving first aid to the injured.

20. Access to Site

Access to the site is illustrated on the location map. It shall be the Contractor's responsibility to determine restrictions, if any, as to loads, bridge and road clearances, channel depths, and private property limitations that may influence access to the site.

21. Notice of Special Conditions

Attention is particularly called to those parts of the contract documents and specifications which deal with the following:

a. Time for Completion and Liquidated Damages
b. Wage rates and Insurance Requirements
c. Inspection and Testing of Materials
d. Stated allowances

22. Payments to Contractor

The Owner will make progress payments to the Contractor no more than once per month upon request of the Contractor. Pay requests take approximately 3-4 weeks to process.

Such payment will be made on the basis of an agreed estimate of work performed since the previous pay request, provided that the Contractor and the City Engineer shall have previously come to an agreement as to the amount of the request prior to submission.

The City shall retain 5% of the amount of each estimate until the project is complete.

CONTRACTOR'S CHECKLIST OF REQUIRED ITEMS

		Completed*
1.	Bid Proposal	_____
2.	Bid Bond	_____
3.	Anti-Collusion Affidavit	_____
4.	Business Relationships Affidavit	_____
5.	Experience and Capability Questionnaire	_____

*Check when filled out, signed, and included with submission of bid packet.

BID PROPOSAL

Date: April 10, 2024

The Honorable Mayor and City Council
City of Lawton
212 SW 9th Street
Lawton, Oklahoma 73501

RE: Proposal of _____ (hereinafter called "Bidder") a corporation/partnership/individual (strike out inapplicable term) organized and existing under the laws of the State of _____.

Gentlemen:

The Bidder, in compliance with your invitation for bids for the construction of

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101

having examined the Plans and Specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding construction of the proposed project (including availability of material and labor), hereby proposes to furnish all labor, materials, and supplies to construct the project in accordance with the Contract Documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the Contract Documents, of which this Proposal will be made a part.

Bidder hereby agrees to commence work under this contract on a date to be specified in written "Notice to Proceed" of the Owner and to fully complete the project within **Four Hundred Eighty (260) consecutive calendar days** thereafter as stipulated in the Specifications. Bidder further agrees to pay as liquidated damages the sum of **Two Thousand and 00/00 Dollars ($2000.00) for each consecutive calendar day** thereafter that the Contract is not completed as provided in the General Conditions.

Bidder acknowledges receipt of the following Addenda: _____

_____

Bidder agrees to perform all of the construction work described in the Specifications and shown on the Drawings for the following **UNIT PRICES**:

BID SCHEDULE
LANDFILL CELLS 6 AND 7 LINER CONSTRUCTIONPROJECT PW2101

BID PROPOSAL FORM

PAY QUANTITIES

BASE BID PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
		BASE BID			
1	MOBILIZATION AND DEMOBILIZATION (SHALL NOT EXCEED 5% OF TOTAL CONTRACT)	LSUM	1		
2	LAYOUT OF WORK AND SURVEYS	LSUM	1		
3	CLEARING AND GRUBBING	AC	8.5		
4	STORMWATER AND SEDIMENT CONTROL	LSUM	1		
5	EXCAVATION – CELLS 6 AND 8 LINER SUBGRADE, PERIMETER DRAINAGE, AND ACCESS ROADS	CY	459,450		
6	LINER TIE-IN (CELLS 4 AND 5)	LF	1,840		
7	GENERAL FILL – CELLS 6 AND 7 LINER SUBGRADE, STORMWATER POND BERM, AND ACCESS RAMP/TURNAROUND PAD	CY	36,200		
8	2-FOOT COMPACTED CLAY LINER	CY	61,000		
9	1-FOOT PROTECTIVE COVER	CY	31,000		
10	LINER TERMINATION BERM	LF	1,850		
11	60-MIL HDPE GEOMEMBRANE (TEXTURED BOTH SIDES)	SF	817,000		
12	250-MIL GEOCOMPOSITE (DOUBLE-SIDED)	SF	817,000		
13	LEACHATE COLLECTION SYSTEM – DRAINAGE AGGREGATE, NON-WOVEN GEOTEXTILE	LF	1,650		
14	8-INCH DIAMETER HDPE SDR 11 PERFORATED AND SOLID LEACHATE COLLECTION AND CLEANOUT RISER PIPING	LF	1,840		
15	18-INCH DIAMETER HDPE SDR 9 PERFORATED AND SOLID LEACHATE COLLECTION AND SUMP RISER PIPING	LF	100		
16	3-INCH (SDR 11) X 6-INCH (SDR 17) DIAMETER HDPE LEACHATE FORCEMAIN	LF	975		
17	LEACHATE COLLECTION SUMP (DRAINAGE AGGREGATE, NON-WOVEN GEOTEXTILE, HDPE GEOMEMBRANE RUBSHEET)	LSUM	1		
18	REINFORCED CONCRETE SUMP/CLEANOUT RISER HEADWALL	LSUM	1		
19	LEACHATE PUMP, CONTROL PANEL, DISCHARGE PIPE, AND CONNECTION TO FORCEMAIN PIPE	LSUM	1		
20	ELECTRICAL TIE-IN TO JUNCTION BOX AT CELL 4, NEW ELECTRICAL	LSUM	1		

	CONDUIT FROM CELL 4 TO CELL 6, AND NEW ELECTRICAL JUNCTION BOX AT CELL 6				
21	ROAD SURFACE COMPLETION (WOVEN GEOTEXTILE AND 12-INCH ROAD BASE)	SY	5,075		
22	RIP RAP (D50 = 9 INCH) AND 12-OZ/SY NON-WOVEN GEOTEXTILE	SY	1,210		
23	36-INCH DIAMETER CMP	LF	400		
24	4-FOOT ORANGE SAFETY FENCE (BELOW ACCESS RAMP AND TURNAROUND PAD)	LF	680		
25	SEED, MULCH, AND FERTILIZER (AREAS DISTURBED OUTSIDE LIMITS OF CONSTRUCTION)	LSUM	1		
26	PIPE AND VALVE ANCHOR	EA	800		
27	8-FOOT TALL CHAIN LINK FENCE	LF	1,600		
				BASE BID TOTAL:	

BID ALTERNATE PAYMENT ITEM (REPLACED BASE BID PAYMENT ITEM 9)					
BA-1	1-FOOT PROTECTIVE COVER (IMPORTED FROM OFF-SITE BORROW SOURCE WITH K ≥ 1.3 X 10^{-5} CM/SEC)	CY	31,000		
				SUBTOTAL BID ALTERNATE BA-1 ITEM:	

BASE BID TOTAL AMOUNT BID:	
TOTAL AMOUNT BASE BID IN WORDS:	

BASE BID + BID ALTERNATE BA-1 ITEMS TOTAL AMOUNT BID:	
TOTAL AMOUNT BASE BID + BID ALTERNATE BA-1 ITEM IN WORDS:	

Amounts are to be shown in both words and figures. In case of any discrepancy, the amount shown in words will govern.

The above unit prices shall include all costs for labor, materials, overhead, profit, insurance, etc., to cover the finished work of the several kinds called for.

Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informality in the bidding.

The Bidder agrees that this bid shall be good and may not be withdrawn for a period of sixty (60) calendar days after the scheduled closing time for receiving bids.

Upon receipt of written notice of acceptance of this bid, Bidder will execute the formal Contract attached within ten (10) days and deliver all bonds as required by the General Conditions. The bid security attached in the sum of

_____ DOLLARS ($_____) is to become the property of the Owner in the event the Contract and Bonds are not executed within the time set forth above, as liquidated damages for the delay and additional expense to the Owner caused thereby.

RESPECTFULLY SUBMITTED,

By: _____

Title: _____

Address: _____

_____

(AFFIX SEAL-if bid is by a corporation)

BID BOND

(replaces HUD Form 4328-E [2/66, formerly CFA-238-F)

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,

_____ as Principal, and
(full name and address)

_____ as Surety is hereby
(full name and address)

held and firmly bound unto the CITY OF LAWTON, as OWNER, in the penal sum of

_____ DOLLARS

($_____) for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that whereas the Principal has submitted to the CITY OF LAWTON a certain bid, attached hereto and whereby made a part hereof to enter into a contract in writing, for the construction of

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION
PROJECT PW2101

NOW, THEREFORE,

a. If said bid shall be rejected, or in the alternate,

b. If said bid shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said Bid) and shall furnish a bond for his faithful performance of said Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid,

then this obligation (bid bond) shall be void. Otherwise the same shall remain in force and effect. It is expressly understood and agreed that the liability for the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, stipulates and agrees that the obligations for said Surety and its bond shall in no way be impaired or affected by an extension of time within which the Owner may accept such Bid. Surety hereby waives notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers.

Signed this _____ day of _____, 2024

Principal

_____
(Name of Contractor)

By:

_____
(Name and Title)

Surety

_____

By:

_____
(Attorney in Fact) (AFFIX SEAL)

ATTEST:

_____ (AFFIX SEAL)
(Name and Title)

ANTICOLLUSION AFFIDAVIT

The following affidavit is submitted by Bidder as a part of this bid and proposal:

STATE OF OKLAHOMA }
COMANCHE COUNTY }

The undersigned deponent, of lawful age, being duly sworn, upon his oath, deposes and says that:

- he has lawful authority to execute the within and foregoing proposal;
- he has executed the same by subscribing his name hereto under oath for and on behalf of said bidder;
- bidder has not, directly or indirectly, entered into an agreement; expressed or implied, with any bidder(s) having as its object controlling of the price or amount of such bid(s), the limiting of the bids or the bidders, the parceling or farming out to any bidder(s) or other persons of any part of the contract or any part of the subject matter of the bid(s) or of the profits thereof; and
- he has not and will not divulge the sealed bid to any person whomsoever, except those having a partnership or other financial interest with him in said bid(s) until after the said sealed bid(s) are opened.

Deponent further states that:

- the bidder has not been a party to any collusion among bidders or prospective bidders in any restraint of freedom of competition by agreement to bid at a fixed price, or to refrain from bidding;
- the bidder has not been a party to any collusion with any City official or employee as to quantity, quality, or price in the prospective contract, or any other terms of said prospective contract;
- the bidder has not been in any discussions between bidders and any City official concerning exchange of money or other thing of value for special consideration in the letting of a contract;
- the bidder has not paid, given, or donated or agreed to pay, give, or donate to any officer or employee of the CITY OF LAWTON any money or other thing of value, either directly or indirectly, in the procuring of the award of contract pursuant to this bid.

SIGNED: _____
(Name of Bidder)
BY: _____

Title: _____

Subscribed and sworn to before me this _____ day of _____, 2024.

_____
Notary Public

My Commission Expires: _____

BUSINESS RELATIONSHIPS AFFIDAVIT

STATE OF OKLAHOMA }

COMANCHE COUNTY }

_____, of lawful age, being first duly sworn, on oath says that he Is the agent authorized by the bidder to submit the attached bid. Affidavit further states that the nature of any partnership, joint venture, or other business relationship presently in effect or which existed within one (1) year prior to the date of this statement with the architect, engineer, of other party to the project is as follows:

_____

_____

Affiant further states that any such business relationship presently in effect or which existed within one (1) year prior to the date of this statement between any officer or director of the bidding company and any officer or director of the architectural or engineering firm or other party to the project is as follows:

_____

_____

_____

Affiant further states that the names of all persons having any such business relationships and the positions they hold with their respective companies or firms are as follows:

_____

_____

(If none of the business relationships hereinabove mentioned exist, affiant should so state.)

Signed: _____
By: _____
Title: _____

Subscribed and sworn to before me this _____ day of _____, 2024.

_____
Notary Public

My Commission Expires:
_____

EXPERIENCE AND CAPABILITY QUESTIONNAIRE

_____, 2024

The Honorable Mayor and City Council
City of Lawton
212 SW 9th Street
Lawton, Oklahoma 73501

Gentlemen:

Re: **LANDFILLCELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101**

The following information is submitted to verify the prime contractors previous similar project experience, and verifiable references, that exhibits the prime's ability to self-perform and execute this project within the contract requirements as set forth in the plans and specifications. The City of Lawton reserves the right to reject any and all bids based on prior project experience or lack thereof.

1. How many years experience as a general contractor have you had in construction similar to the project upon which the attached proposal is submitted?

   _____

2. If you have constructed similar projects, list at least three contracts, giving name and location of each project, amount and date of contract, and the owner or agency for whom the work was performed (list only prime contracts).

   _____

   _____

   _____

3. What is the largest project you have ever undertaken as the Prime Contractor? Give location, amount, and date of contract, type of construction, etc.

   _____

   _____

4. Have you ever failed to complete a contract or been involved in litigation regarding the acceptance of final settlement for work performed? _____ If the answer is "Yes", explain fully.

   _____

5. If you are the successful bidder on this project, do you propose to sublet or assign the project or any part thereof to some other contractor?

   _____

6. Is your organization an established business, with construction equipment and personnel ready to start work on this project if you are the successful bidder?

_____

7. List all the projects that you have under contract this date, upon which final acceptance has not been made, giving the following information:

CONTRACT NO. 1
Name of Project _____
Owner _____ Location _____
Amount of Contract _____ Date of Contract _____
Time Allowed for Construction _____
Percent of Time Elapsed _____
Percent of Work Actually Accomplished _____
Has there been any litigation? _____
If answer to above question is "Yes", explain fully:
_____
_____
_____

CONTRACT NO. 2
Name of Project _____
Owner _____ Location _____
Amount of Contract _____ Date of Contract _____
Time Allowed for Construction _____
Percent of Time Elapsed _____
Percent of Work Actually Accomplished _____
Has there been any litigation? _____
If answer to above question is "Yes", explain fully:
_____
_____
_____

CONTRACT NO. 3
Name of Project _____
Owner _____ Location _____
Amount of Contract _____ Date of Contract _____
Time Allowed for Construction _____
Percent of Time Elapsed _____
Percent of Work Actually Accomplished _____
Has there been any litigation? _____
If answer to above question is "Yes", explain fully:
_____
_____
_____

CONTRACT NO. 4
Name of Project _____

Owner _____ Location _____
Amount of Contract _____ Date of Contract _____
Time Allowed for Construction _____
Percent of Time Elapsed _____
Percent of Work Actually Accomplished _____
Has there been any litigation? _____
If answer to above question is "Yes", explain fully:
_____
_____

(Attach additional sheets if required)

8. We submit the following list of major construction equipment now owned by us and available for the work that may be awarded, which is in operating condition and good state of repair.

No.	Item	Type	Size or Capacity	Present Value

_____
Firm Name

_____
Agent Signature

_____
Title

STATE OF OKLAHOMA }
COUNTY OF COMANCHE }

_____, of legal age, being first duly sworn, upon his oath deposes and says that he executed the above questionnaire on behalf of the Bidder therein named; and that he had lawful authority to do so, and that the information contained therein is true and correct to the best of his knowledge and belief; that he has truthfully answered the questions set forth, and that he has not knowing withheld any information which might affect his status as bidder.

Subscribed and sworn to before me this _____ day of _____, 2024.

_____
Notary Public

My Commission Expires: _____

C O N T R A C T

THIS CONTRACT made and entered into this ___ day of _____, 2024, by and between CITY OF LAWTON, Oklahoma, a Municipal Corporation, acting by and through the Mayor and City Council, party of the first part, hereinafter referred to as "CITY", and _____, party of the second part, hereinafter referred to as "CONTRACTOR".

W I T N E S S E T H:

WHEREAS, the CITY has caused to be prepared in accordance with law, certain Contract Documents and Technical Specifications (including Plans) for the work hereinafter described, and has caused a Solicitation for Bids to be given and advertised as required by law, and has received sealed proposals for the furnishing of all labor and materials for

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101
and

WHEREAS, the Contractor in response to said Solicitation for Bids submitted to the CITY in the manner and at the time specified a sealed proposal in accordance with the terms and provisions of said Contract Documents and Technical Specifications, Plans and Addenda(s) associated with this project; and

WHEREAS, the CITY, in the manner provided by law, has publicly opened, examined, and canvassed all the proposals submitted and has determined and declared the above named Contractor to be the best responsive bidder on the above described project; and

WHEREAS, the City, has duly awarded this Contract (Alternate A, Base Bid + Alternate A Items) to said Contractor for the sum specified in the Contractor's proposal, to wit:

_____
_____(_____). Said proposal of _____is incorporated by reference into this contract.

NOW, THEREFORE, for and in consideration of the mutual agreements and covenants herein contained, the parties to this Contract have agreed, and hereby agree, as follows:

1. The Contractor shall, in a good and first-class workmanlike manner, at his own cost and expense, furnish all labor and materials, tools, and equipment required to perform and complete said work in strict accordance with this Contract, the Contract Documents and Technical Specifications and all applicable Plans and Addenda, all of which are on file in the office of the City Engineer, City Hall, Lawton, OK, 73501, and hereby incorporated by reference and made a part of this Contract as if the same were each herein set out at length.

2. The CITY will make progress payments to the Contractor no more than once per month upon request of the Contractor.

Such payment will be made on the basis of an agreed estimate of work performed since the previous pay request, provided that the Contractor and the City Engineer shall have previously come to an agreement as to the amount of the request prior to submission.

The City shall retain five percent (5%) of the amount of each estimate until the project is complete. This retainage shall not be released until final acceptance of project by the City Council.

Each monthly estimate for payment must contain or have attached an affidavit for payment, as set forth in the Contract Documents and Technical Specifications.

On completion of the work, but prior to the acceptance by the CITY, it shall be the duty of the City Engineer, or his authorized designee, to determine that said work has been completed and fully performed in accordance with said Contract Documents and Technical Specifications and all applicable Plans and Addenda; and upon making such determination said official shall make his final certificate to the CITY.

The Contractor hereby agrees to commence work under this Contract on a date to be specified in a written "Work Order" of the CITY and to fully complete the project within **Four Hundred Eighty (260) consecutive calendar days**. The Contractor further agrees to pay as liquidated damages, the sum of **Two Thousand Dollars and 00/100 ($2000.00) for each consecutive calendar day** thereafter as provided in Paragraph 18 of the General Conditions section of the Contact Documents and Technical Specifications.

The Contractor shall furnish proof that all claims and obligations incurred by him in connection with the performance of said work have been fully paid and settled; said information shall be in the form of an affidavit constituting the Contractor's Release to City as set forth in the Contract Documents and Technical Specifications; thereupon, the final estimate (including any retained amounts) will be approved and paid.

3. Discrimination. The Contractor agrees in connection with the performance of work under this contract as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, national origin, disability, or ancestry. Such actions shall include, but not be limited to the following: employment, upgrading, demotion or transfer, recruiting or recruitment, advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training, (including apprenticeship.) The Contractor and subcontractor shall agree to post in a conspicuous place available to employees and applicants for employment, notice to be provided by the City Clerk of the City of Lawton setting forth provisions of this section.

b. The Contractor agrees to include this non-discrimination clause in any subcontracts connected with the performance of this Contract.

c. In the event of the Contractor's non-compliance with the above non-discrimination clause, this Contract may be terminated by the CITY. The Contractor may also be declared by the CITY to be ineligible for future contracts with the CITY until satisfactory proof of intent to comply shall be made by the Contractor.

4. Use of Subcontractors. The Contractor shall actively solicit bids for the subcontracting of goods or services from qualified minority businesses. At the request of the CITY, the Contractor shall furnish evidence of compliance with this requirement of minority solicitation. The Contractor further agrees to consider the grant of subcontracts to minority bidders on the basis of substantially equal proposals in the light most favorable to said minority businesses.

5. Entire Contract. This Contract and all the documents incorporated by reference contain the entire understanding and agreement of the parties upon the subject matter hereof. There is no agreement, oral or otherwise, which is not set forth in writing hereto or attached. This Contract includes the following items: this Contract, the Contract Documents and Technical Specifications, all applicable Plans and Addenda and the Contractor's Proposal.

6. Modification and Termination. This Contract cannot be modified or terminated except in writing signed by both parties or as otherwise provided herein.

7. Assignment. This Contract shall not be assigned without the written consent of the CITY.

8. Bankruptcy. If the Contractor becomes bankrupt or insolvent, or if a petition in bankruptcy is filed against the Contractor, or if a receiver is appointed for the Contractor, the CITY shall have the right to terminate this Contract upon written notice to the Contractor without prejudice to any claim for damages or any other right of the CITY under this Contract to the time of such termination.

9. Variables in Cost. The parties hereto assume and understand that the variables in Contractor's cost of performance may fluctuate; consequently, the parties hereto agree that any fluctuations in Contractor's costs will in no way alter the Contractor's obligations under this Contract nor excuse performance or delay on his part.

10. Venue. This Contract shall be governed by the laws of the State of Oklahoma.

11. <u>This Contract requires proper signature and acceptance by the Contractor and approval by the Lawton City Council before it becomes effective.</u>

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed, in three (3) originals, the day and year first above written.

(FOR CORPORATIONS ONLY)

_____
Name of Corporation

By _____

Title _____

ATTEST:

_____

Title _____
(AFFIX SEAL)

(FOR PARTNERSHIPS AND PROPRIETORSHIPS)

_____
Name of Partnership or Proprietorship
By _____
Title _____

COUNTY OF COMANCHE }
STATE OF OKLAHOMA }

Before me the undersigned, a Notary Public in and for said state, on this _____ day of _____, 2024, personally appeared _____, a member of the partnership/proprietorship _____ to me known to be the identical person who executed the within and foregoing instrument on behalf of said partnership/proprietorship and acknowledged to me that _____ (he/she) executed the same as _____ (his/her) free and voluntary act and deed, and for the free and voluntary act and deed of said partnership/proprietorship, for the uses and purposes therein set forth.

_____
Notary Public

My Commission Expires_____

CITY OF LAWTON, OKLAHOMA
A Municipal Corporation

_____
Stan Booker, MAYOR

ATTEST:

_____
Donalynn Blazek-Scherler, CITY CLERK

APPROVED as to form and legality this _____ day of _____, 2024.

_____
Tim Wilson, INTERIM CITY ATTORNEY

I, Joe Don Dunham, Finance Director of the City of Lawton, Oklahoma, do hereby certify that I have entered the amount for this encumbrance against appropriate Account No._____ for _$_____ , and after charging account title **LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101** with this encumbrance there is an unencumbered balance in said account of $_____.

Dated this _____ day of_____, 2024.

_____
Joe Don Dunham, FINANCE DIRECTOR

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS that

_____ as Principal, and
(full name and address)

_____ as Surety, a
(full name and address)

corporation organized under the laws of the State of_____, and authorized to transact business in the State of Oklahoma, are hereby held and firmly bound unto the CITY OF LAWTON, as OWNER, in the penal sum

of _____ DOLLARS ($_____) for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, trustees, successors, and assigns, firmly by these presents.

The condition of this obligation is such that WHEREAS, said Principal entered into a written contract with the CITY OF LAWTON, OKLAHOMA, dated on the _____ day of _____, 2024, for

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101

all in compliance with the plans and specifications therefore, made a part of said Contract and on file in the Office of the City Clerk, City of Lawton, City Hall, 212 SW 9th St, Lawton, Oklahoma 73501.

NOW, THEREFORE, if said Principal shall

(1) in all particulars, well, truly and faithfully perform and abide by said Contract, each and every covenant, and part thereof and shall fulfill all obligations resting upon said Principal by the terms of said Contract and said specifications; and

(2) if said Principal shall promptly pay, or cause to be paid, all labor, materials and/or repairs and all bills for labor performed on said work, whether by subcontract or otherwise.

then this obligation shall be null and void. **Otherwise** said obligation shall be and remain in full force and effect.

It is further expressly agreed and understood by the parties hereto that no changes or alterations in said Contract and no deviations from the plan or mode or procedure herein fixed shall have the effect of releasing the sureties, or any of them, from the obligation of this bond.

IN WITNESS WHEREOF, the said Principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers, and the said Surety has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its attorney-in-fact, duly authorized to do so, the day and year above written.

Dated this _____ day of _____, 2024.

Principal: Surety:

_____ _____
(Name of Contractor)

By: _____ By: _____
(Name & Title) Attorney-in-Fact (Affix Seal)

(FOR CORPORATIONS ONLY)

ATTEST:

_____
(Name & Title) (Affix Seal)

(FOR PARTNERSHIPS AND PROPRIETORSHIPS)

Notarized on this _____ day of _____, 2024

Notary: _____ My commission expires: _____

STATUTORY BOND

KNOW ALL MEN BY THESE PRESENTS that

_____ as Principal, and
(full name and address)

_____ as Surety, a
(full name and address)

corporation organized under the laws of the State of _____, and authorized to transact business in the State of Oklahoma, are hereby held and firmly bound unto the CITY OF LAWTON, as OWNER, in the penal sum of

_____ DOLLARS
($_____) in lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves and each of us, our heirs, executors, administrators, trustees, successors, and assigns, jointly and severally, firmly by these presents.

The condition of this obligation is such that WHEREAS, said Principal entered into a written Contract with the CITY OF LAWTON, OKLAHOMA, dated on the _____ day of _____, 2024, for

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101

all in compliance with the plans and specifications therefore, made a part of said Contract and on file in the Office of the City Clerk, City Hall, 212 SW 9th St, Lawton, Oklahoma 73501.

NOW, THEREFORE, if said Principal shall fail or neglect to pay all indebtedness incurred by said Principal or subcontractors of said Principal who perform work in the performance of such contract, for labor and materials and repairs to and parts for equipment used and consumed in the performance of said Contract within thirty (30) days after the same becomes due and payable, the person, firm, or corporation entitled thereto may sue and recover on this bond, the amount so due and unpaid. It is further expressly agreed and understood by the parties hereto that no changes or alterations in said Contract and no deviations from the plan or mode of procedure herein fixed shall have the effect of releasing the sureties, or any of them, from the obligations of this bond.

IN WITNESS WHEREOF, said Principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers, and the said Surety has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its attorney-in-fact, duly authorized so to do, the year and day first above written.

Dated this _____ day of _____, 2024.

Principal: Surety:

_____ _____
(Name of Contractor)

By: _____ By: _____
(Name & Title) Attorney-in-Fact (Affix Seal)

(FOR CORPORATIONS ONLY)

ATTEST:

_____
(Name & Title) (Affix Seal)

(FOR PARTNERSHIPS AND PROPRIETORSHIPS)

Notarized on this _____ day of _____, 2024

Notary: _____ My commission expires: _____

MAINTENANCE BOND

KNOW ALL MEN BY THESE PRESENTS that

_____ as Principal, and
(full name and address)

_____ as Surety, a
(full name and address)

corporation organized under the laws of the State of _____, and authorized to transact business in the State of Oklahoma, are hereby held and firmly bound unto the CITY OF LAWTON, as OWNER, in the penal sum of

_____ DOLLARS ($_____) in lawful money of the United States of America, said sum being equal to One Hundred Percent (100%) of the Contract price, for two (2) years after completion and acceptance of the project, payment of which, well and truly to be made, we bind ourselves and each of us, our heirs, executors, administrators, trustees, successors, and assigns, jointly and severally, firmly by these presents.

The condition of this obligation is such that WHEREAS, said Principal entered into a written contract with the CITY OF LAWTON, OKLAHOMA, dated on the _____ day of _____, 2024, for

LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101

all in compliance with the plans and specifications therefore, made a part of this contract and file in the Office of the City Clerk of the City of Lawton, City Hall, 212 SW 9th St, Lawton, Oklahoma, 73501.

NOW, THEREFORE, if said Principal shall pay or cause to be paid to the CITY OF LAWTON, OKLAHOMA all damage, loss and expense which may result by reason of defective materials and/or workmanship in connection with said work for a period of TWO (2) years, from and after acceptance of said project by the CITY OF LAWTON and if Principal shall pay or cause to be paid all labor and materials, including the prime contractor and all subcontractors; and if Principal shall save and hold the CITY OF LAWTON harmless from any failure whatsoever of said Principal, then this obligation shall be null and void, otherwise to be and remain in full force and effect.

It is further expressly agreed and understood by the parties hereto that no changes or alterations in said Contract and no deviations from the plan or mode of procedure herein fixed shall have the effect of releasing the sureties, or any of them, from the obligations of the bond.

IN WITNESS WHEREOF, the said Principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers, and the surety has

caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its attorney-in-fact, duly authorized to do so, the day and year first above written.

Dated this _____ day of _____, 2024.

Principal: Surety:

_____ _____
(Name of Contractor)

By: _____ By: _____
(Name & Title) Attorney-in-Fact (Affix Seal)

(FOR CORPORATIONS ONLY)

ATTEST:

_____
(Name & Title) (Affix Seal)

(FOR PARTNERSHIPS AND PROPRIETORSHIPS)

Notarized on this _____ day of _____, 2024

Notary: _____ My commission expires: _____

General Conditions Contents

CITY OF LAWTON
GENERAL CONDITIONS

1. Contract and Contract Documents

The Plans, Specifications, and Addenda, shall form part of this Contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light on the interpretation of the provisions to which they refer.

2. Definitions

The following terms as used in this contract are respectively defined as follows:

a. "Contractor": A person, firm or corporation with whom the contract is made by the Owner.

b. "Subcontractor": A person, firm or corporation supplying labor and materials or only labor for work at the site of the project for, and under separate contract or agreements with, the Contractor.

c. "Work on (at) the project": Work to be performed at the location of the project, including the transportation of materials and supplies to or from the location of the project by employees of the Contractor or any Subcontractor.

d. "Engineer": The term engineer shall apply to the City Engineer or his duly designated representative, to include consultants hired by the Owner to provide advice, assistance or direction concerning the contract.

e. "Owner": The term Owner shall apply to the City of Lawton, A Municipal Corporation, also referred to as the "CITY."

3. Additional Instructions and Detail Drawings

The Contractor will be furnished additional instructions and detailed drawings as necessary to carry out the work included in the contract. The additional drawings and instructions thus supplied to the Contractor will coordinate with the Contract Documents and will be so prepared that they can be reasonably interpreted as part thereof. The Contractor shall carry out the work in accordance with the additional detail drawings and instructions. The Contractor and the Engineer will prepare jointly: (a) a schedule, fixing the dates at which special detail drawings will be required; such drawings, if any, to be furnished by the Engineer in accordance with said scheduled; and (b) a schedule fixing the respective dates for the submission of shop drawings, the beginning of manufacture, testing and installation

of materials, supplies and equipment, and the completion of the various parts of the work; each such schedule to be subject to change from time to time in accordance with the progress of the work.

4. Shop or Setting Drawings

The Contractor shall submit promptly to the Engineer six copies of each shop or setting drawing prepared in accordance with the schedule predetermined as aforesaid. After examination of such drawings by the Engineer and the return thereof, the Contractor shall make such corrections to the drawings as have been indicated and shall furnish the Engineer with two corrected copies. If requested by the Engineer, the Contractor must furnish additional copies. Regardless of corrections made in or approval given to such drawings by the Engineer, the Contractor will nevertheless be responsible for the accuracy of such drawings and for their conformity to the Plans and Specifications, unless he notifies the Engineer in writing of any deviations at the time he furnishes such drawings.

5. Materials, Services, and Facilities

a. It is understood that except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete, and deliver the work within the specified time.

b. Any work necessary to be performed after regular hours, on Sundays or Legal Holidays, shall be performed without additional expense to the Owner.

6. Contractor's Title to Materials

No materials or supplies for the work shall be purchased by the Contractor or by any Subcontractor subject to any chattel mortgage or under a conditional sale contract, or other agreement by which an interest is retained by the seller. The Contractor warrants that he has good title to all materials and supplies used by him in the work, free from all liens, claims or encumbrances.

7. Inspection and Testing of Materials

a. All materials and equipment used in the construction of the project shall be subject to adequate inspection and testing in accordance with accepted standards. The laboratory or inspection agency shall be selected by the Owner. The Owner will pay for all laboratory inspection service direct, and not as a part of the contract.

b. Materials of construction, particularly those upon which the strength and durability of the structure may depend, shall be subject to inspection and testing to establish conformance with specifications and suitability for uses intended.

8. "Or Equal" Clause

Whenever a material, article, or piece of equipment is identified on the plans or in the specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, etc., it is intended merely to establish a standard. Any material, article, or equipment of other manufacturers and vendors which will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or equipment so proposed is, in the opinion of the Engineer, of equal substance and function. The proposed substitution shall not be purchased or installed by the contractor without the Engineer's written approval.

9. Patents

a. The Contractor shall hold and save the Owner and its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

b. License or Royalty Fees. License and/or royalty fees for the use of a process that is authorized by the Owner of the project must be reasonable, and paid to the holder of the patent, or his authorized licensee, direct by the Owner and not by or through the Contractor.

c. If the Contractor uses any design, device or materials covered by letters, patents or copyrights, he shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device or material. It is mutually agreed and understood, that, without exception, the contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his Sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this contract, and shall indemnify the Owner for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after completion of the work.

10. Surveys, Permits, and Regulations

a. Unless otherwise expressly provided for in the Specifications, the Contractor shall be responsible for all surveying and construction staking for the project and the Owner shall furnish to the Contractor all survey control points necessary as indicated in project drawings.

b. The Contractor shall procure and pay all permits, licenses and approvals necessary for the execution of his contract.

c. The Contractor shall comply with all laws, ordinances, rules, orders, and regulations relating to performance of the work, the protection of adjacent property, and the maintenance of passageways, guard fences or other protective facilities.

11. Contractor's Obligations

a. The Contractor shall and will, in good workmanlike manner, do and perform all work and furnish all supplies and materials, machinery, equipment, facilities and means, except as herein otherwise expressly specified, necessary or proper to perform and complete all the work required by this contract, within the time herein specified, in accordance with the provisions of this contract and said specifications and in accordance with the plans and drawings covered by this contract any and all supplemental plans and drawings. He shall furnish, erect, maintain, and remove such construction plant and such temporary works as may be required.

b. The Contractor shall observe, comply with, and be subject to all terms, conditions, requirements, and limitations of the contract and specifications, and shall do, carry on, and complete the entire work to the satisfaction of the Architect/Engineer and the Owner.

12. Weather Conditions

In the event of suspension of work, or during inclement weather, or whenever the Engineer shall direct, the Contractor will, and will cause his subcontractors to protect carefully his and their work and materials against damage or injury from the weather. If, in the opinion of the Engineer, any work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any of his Subcontractors so to protect his work, such materials shall be removed and replaced at the expense of the Contractor.

13. Protection of Work and Property- (Emergency)

a. The Contractor shall at all times safely guard the Owner's property from damage in connection with this contract. He shall at all times safely guard and protect his own work, and that of adjacent property from damage. The Contractor shall replace or make good any such damage, loss or injury unless such be caused directly by errors contained in the contract or by the Owner, or his duly authorized representatives.

b. In case of emergency which threatens loss or injury of property, and/or safety of life the Contractor will be allowed to act, without previous instructions from the Engineer, in a diligent manner. He shall notify the Engineer immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall be promptly submitted to the Engineer for approval.

c. Where the Contractor has not taken action but has notified the Engineer of an emergency threatening injury to persons or damage to the work or any adjoining property, he shall act as instructed or authorized by the Engineer.

d. The amount of reimbursement claimed by the Contractor on account of any emergency action shall be determined in the manner provided in Paragraph 22 of the General Conditions.

14. Inspection

The authorized representatives and agents of the Owner shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records.

15. Reports, Records, and Data

The Contractor shall submit to the Owner such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the Owner may request concerning work performed or to be performed under this Contract.

16. Superintendence by Contractor

At the site of the work, the Contractor shall employ a construction superintendent or foreman who shall have full authority to act for the Contractor. It is understood that such representative shall be one who can be continued in that capacity for the particular job involved unless he ceases to be on the Contractor's payroll.

17. Extras

Without invalidating the contract, the Owner may order extra work or make changes by altering, adding to or deducting from the work, the contract sum being adjusted accordingly, and the consent of the Surety being first obtained where necessary or desirable. All the work of the kind bid upon shall be paid for at the price stipulated in the proposal; and no claims for any extra work or materials shall be allowed unless the work is ordered in writing by the Owner and the price is stated in such order.

18. Time for Completion and Liquidated Damages

a. It is hereby understood and mutually agreed, by and between the Contractor and the Owner, that the date of beginning and the time for completion as specified in the contract of the work to be done hereunder are **ESSENTIAL CONDITIONS** of this contract; and it is further understood and agreed that the work embraced in this contract shall be commenced on a date to be specified in the "Notice to Proceed".

b. The Contractor agrees that said work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will ensure full completion thereof within

the time specified. It is expressly understood and agreed, by and between the Contractor and the Owner, that the time for the completion of the work described herein is a reasonable time for the completion of the same; taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

c. If the said Contractor shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the Owner, then the Contractor hereby agrees, as a part consideration for the awarding of this contract, to pay to the Owner the amount specified in the contract, **not as a penalty but as liquidated damages for such breach of contract** as hereinafter set forth, for each and every consecutive calendar day that the Contractor shall be in default after the time stipulated in the contract for completing the work.

d. The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain; and said amount is agreed to be the amount of the damages which the Owner would sustain and shall be retained from time to time by the Owner from current periodical estimates.

e. It is agreed that time is of the essence of each and every portion of this contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever. Where, under the contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this contract.

f. The Contractor shall not be charged with liquidated damages or any excess cost when the Owner determines that the Contractor is without fault and the Contractor's reasons for the time extension are acceptable to the Owner.

g. The Contractor shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due to:

(1) To any preference, priority, or allocation order duly issued by the Owner;

(2) To unforeseeable cause beyond the control and without the fault or the negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and severe weather occurring prior to the original completion date. Except that in the case of severe weather the original completion date as set out in the contract shall be adjusted for severe weather occurring prior to the date originally specified in the contract as the date on which all work pursuant the terms of the contract is to be completed. The revised date, adjusted as described, will be known as the adjusted completion date. There shall be no further

adjustment or adjustments to the adjusted completion date, for any reason, once the adjusted completion date has been determined. All conditions of the contract must be satisfied by the Contractor on or before the original completion date or adjusted completion date, whichever is applicable. If all contract requirements have not been met by the original completion date or adjusted completion date, if applicable, liquidated damages, regardless of weather conditions, shall apply for all subsequent days until the actual completion of the contract terms by the contractor.

(3) To any delays of Subcontractors or suppliers occasioned by any of the causes specified in subsections (1) and (2) of this article;

h. Provided, that the Contractor shall, within ten (10) days from the beginning of delay as set forth in (g) above, unless the Owner shall grant a further period of time prior to the date of final settlement of the contract, notify the Owner, in writing, of the causes of delay. The Owner shall ascertain the facts and extent of the delay and notify the Contractor within a reasonable time of its decision in the matter.

19. Correction of Work

All work, materials, (whether incorporated in the work or not), all processes of manufacture, and all methods of construction shall be at all times and places subject to the inspection of the Engineer who shall be the final judge of the quality and suitability of the work, materials, processes of manufacture, and methods of construction for the purposes for which they are used. Should they fail to meet his approval, they shall be forthwith reconstructed, made good, replaced and/or corrected, as the case may be, by the Contractor at his own expense. Rejected material shall immediately be removed from the site. If, in the opinion of the Engineer, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the work injured or not performed in accordance with the Contract Documents, payment to be paid to the Contractor hereunder shall be reduced by such amount as in the judgment of the Engineer shall be equitable.

20. Subsurface Conditions Found Different

Should the Contractor encounter subsurface and/or latent conditions at the site materially differing from those shown on the Plans or indicated in the Specifications, he shall immediately give notice to the Engineer of such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions, and if he finds that they materially differ from those shown on the Plans or indicated in the Specifications, he will at once make such changes in the Plans and/or Specifications as he may find necessary. Any increase or decrease of cost resulting from such changes shall be adjusted in the manner provided in Paragraph 22 of the General Conditions.

21. Claims for Extra Cost

No claim for extra costs or cost shall be allowed unless the same was done in pursuance of a written order of the Engineer approved by the Owner, as aforesaid, and the claim presented with the first estimate after the changed or extra work is done. When work is performed under the terms of subparagraph 22(b) of the General Conditions, the Contractor shall furnish satisfactory bills, payrolls and vouchers covering all items of cost and when requested by the Owner, give the Owner access to accounts relating thereto.

22. Changes in Work

No changes in the work covered by the approved Contract Documents shall be made without having prior written approval of the Owner. Charges or credits for the work covered by the approved change shall be determined by one or more, or a combination of the following methods:

a. Unit bid prices previously approved.

b. The actual cost of:

(1) Labor, including foreman,
(2) Materials entering permanently into the work,
(3) The ownership or rental cost of construction plant and equipment during the time of use on the extra work,
(4) Power and consumable supplies for the operation of power equipment,
(5) Insurance,
(6) Social Security and old age and unemployment contributions.

To the cost under b., there shall be added a fixed fee to be agreed upon but not to exceed fifteen percent (15%) of the actual cost of the work. The fee shall be compensation to cover the cost of supervision, overhead, bond, profit and any other general expenses.

23. Right of Owner to Terminate Contract

In the event that any of the provisions of this contract are violated by the Contractor, or by any of his subcontractors, the Owner may serve written notice upon the Contractor and the Surety of its intention to terminate the contract. Such notices shall contain the reasons for such intention to terminate the contract, and unless within ten (10) days after the serving of such notice upon the Contractor, such violation or delay shall cease and satisfactory arrangement of correction be made, the contract shall, upon the expiration of said ten (10) days, cease and terminate. In the event of any such termination, the Owner shall immediately serve notice thereof upon the Surety and the Contractor; and the Surety shall have the right to take over and perform the contract. If the Surety does not commence performance thereof within ten (10) days from the date of the mailing to such Surety of notice of termination, the Owner may take over the work and prosecute the same to completion by contract at the expense of the Contractor. The Contractor and his Surety

shall be liable to the Owner for any excess cost occasioned the Owner thereby; and in such event, the Owner may take possession of and utilize in completing the work, such materials, appliances, and plant as may be on the site of the work and necessary therefore.

24. Construction Schedule and Periodic Estimates

Immediately after execution and delivery of the contract, and before the first partial payment is made, the Contractor shall deliver to the Owner as estimated construction progress schedule in form satisfactory to the Owner, showing the proposed dates of commencement and completion of each of the various subdivisions of work required under the Contract Documents and the anticipated amount of each monthly payment that will become due the Contractor in accordance with the progress schedule. The Contractor shall also furnish on forms to be supplied by the Owner, (a) a detailed estimate giving a complete breakdown of the contract price, and (b) periodic itemized estimates of work done for the purpose of making partial payments thereon. The costs employed in making up any of these schedules will be used only for determining the basis of partial payments and will not be considered as fixing a basis for additions to or deductions from the contract price.

25. Payments to Contractor

a. At the request of the Contractor and no more than once per month, the Owner shall make a progress payment to the Contractor on the basis of a duly certified and approved estimate of the work performed during the preceding calendar month under this contract. To ensure the proper performance of this contract, the City shall retain 5% of the amount of each estimate. On completion and acceptance of each separate building, public work, or other division of the contract, on which the price is stated separately in the contract, payment may be made in full, including retained percentages thereon, less authorized deductions.

b. In preparing estimates, the material delivered on the site and preparatory work done may be taken into consideration.

c. All material and work covered by partial payments made shall thereupon become the sole property of the Owner. This provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and work upon which payments have been made or the restoration of any damaged work, or as a waiver of the right of the Owner to require the fulfillment of all the terms of the contract.

d. The Owner reserves the right to withhold certain amounts and make application thereof. Specifically, the Contractor agrees that he will indemnify and save the Owner harmless from all claims growing out of the lawful demands of subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this contract. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all

obligations of the nature hereinabove designated have been paid, discharged, or waived. If the Contractor fails to do so, then the Owner may, after having served written notice on the said Contractor, pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of this contract. In no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor or his Surety. In paying any unpaid bills of the Contractor, the Owner shall be deemed the agent of the Contractor, and any payment so made by the Owner shall be considered as a payment made under the contract by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

26. Acceptance of Final Payment Constitutes Release

The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor for all things done or furnished in connection with this work and for every act and neglect of the Owner and other relating to or arising out of this work. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations under this contract or the Performance and Payment Bond.

27. Payments by Contractor

The Contractor shall pay,

a. for all transportation and utility services not later than the 20th day of the calendar month following that in which services are rendered,

b. for all materials, tools, and other expendable equipment to the extent of ninety percent (90%) of the cost thereof, not later than the 20th day of the calendar month following that in which said materials, tools, equipment are delivered at the site of the project, and the balance of the cost thereof, not later than the 30th day following the completion of that part of the work in or on which such materials, tools, and equipment are incorporated or used, and

c. to each of his subcontractors, not later than the 5th day following each payment to the Contractor the respective amounts allowed the Contractor on account of the work performed by his subcontractors to the extent of each subcontractor's interest therein.

28. Insurance

The Contractor shall not commence work under this contract until he has obtained all the insurance required under this paragraph and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his

subcontract until the insurance required of the subcontractor has been so obtained and approved.

a. Worker's Compensation Insurance. The Contractor shall procure and shall maintain during the life of this contract Worker's Compensation Insurance as required by the State of Oklahoma for all of his employees to be engaged in work at the site of the project under this contract, and in case of any such work sublet, the Contractor shall require the subcontractor similarly to provide Worker's Compensation Insurance for all of the latter's employees to be engaged in such work unless such employees are covered by the protection afforded by the Contractor's Worker's Compensation Insurance. In case any class of employees engaged in hazardous work on the project under this contract is not protected under the Worker's Compensation Statute, the Contractor shall provide and shall cause each subcontractor to provide adequate employer's liability insurance for the protection of such of his employees as are not otherwise protected.

b. Contractor's General Liability and Property Damage Insurance and Vehicle Liability Insurance. The Contractor shall procure and shall maintain during the life of this contract, Contractor's General Liability Insurance, Contractor's Property Damage Insurance, and Vehicle Liability Insurance as follows:

Comprehensive General Liability and Bodily Injury:

Bodily Injury	$ 125,000.00 per person per occurrence
Property Damage	$ 100,000.00 each occurrence
Combined Single Limit	$1,000,000.00 per occurrence combined limit

Comprehensive Automobile:

Liability, Bodily Injury	$125,000.00 per person per occurrence
Property Damage	$100,000.00 each occurrence
Combined Limit	$1,000,000.00 per occurrence combined limit

c. Subcontractor's Public Liability and Property Damage Insurance and Vehicle Liability Insurance. The Contractor shall either,

(1) require each of his subcontractors to procure, and to maintain during the life of his subcontract, Subcontractor's Public Liability Insurance of the type and in the amounts specified in subparagraph (b) hereof, or

(2) ensure the activities of his subcontractors in his own policy, specified in subparagraph (b) hereof.

d. Scope of Insurance and Special Hazards. The insurance required under subparagraphs b. and c. hereof shall provide adequate protection for the Contractor and his subcontractors, respectively, against damage claims which may arise from operations under this contract, whether such operations be by the insured or by anyone directly or indirectly employed by him, and also against any of the special hazards which may be encountered in the performance of this contract.

e. Builder's Risk Insurance (Fire and Extended Coverage). Until the project is completed and accepted by the Owner, the Contractor (at the Owner's option) is required to maintain Builder's Risk Insurance (fire and extended coverage) on a one hundred percent (100%) completed value basis on the insurable portion of the project for the benefit of the Owner, the Contractor, and subcontractors as their interests may appear. This provision shall not release the Contractor from his obligation to complete, according to the plans and specifications, the project covered by the contract, and the Contractor and his Surety shall be obligated to full performance of the Contractor's undertaking.

f. Proof of Carriage of Insurance. The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and date of expiration of policies. Such certificates shall also contain substantially the following statement: "The insurance covered by this certification will not be canceled or materially altered, except after ten (10) days written notice has been received by the Owner."

29. Contract Security

The Contractor shall furnish a Performance Bond in an amount at least equal to one hundred percent (100%) of the contract price as security for the faithful performance of this contract and also a Statutory Bond in an amount not less than one hundred percent (100%) of the contract price or in a penal sum not less than that prescribed by State, territorial or local law, as security for the payment of all persons performing labor on the project under this contract and furnishing materials in connection with this contract. The Performance Bond and the Statutory Bond may be in one or in separate instruments in accordance with local law.

30. Additional or Substitute Bond

If at any time the Owner for justifiable cause shall become dissatisfied with any surety or sureties, then upon the Performance or Statutory Bonds, the Contractor shall within five (5) days after notice from the Owner to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished such an acceptable bond to the Owner.

31. Assignments

The Contractor shall not assign the whole or any part of this contractor or any moneys due or to become due hereunder without written consent of the Owner. In case the Contractor assigns all or any part of any monies due or to become due under this contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor

shall be subject to prior claims of all persons, firms and corporations of services rendered or materials supplied for the performance of the work called for in this contract.

32. Mutual Responsibility of Contractors

If, through acts of neglect on the part of the Contractor, any other contractor or any subcontractor shall suffer loss or damage on the work, the Contractor agrees to settle with such other Contractor or subcontractor by agreement or arbitration if such other Contractor or subcontractors will so settle. If such other Contractor or subcontractor shall assert any claim against the Owner on account of any damage alleged to have been sustained, the Owner shall notify the Contractor, who shall indemnify and save harmless the Owner against any such claim.

33. Separate Contract

The Contractor shall coordinate his operations with those of other contractors. Cooperation will be required in the arrangement for the storage of materials and in the detailed execution of the work. The Contractor, including his subcontractors, shall keep informed of the progress and the detail work of other Contractors and shall notify the Engineer immediately of lack of progress or defective workmanship on the part of other Contractors. Failure of a Contractor to keep informed of the work progressing on the site and failure to give notice of lack of progress or defective workmanship by others shall be construed as acceptance by him of the status of the work as being satisfactory for proper coordination with his own work.

34. Subcontracting

a. The Contractor may utilize the services of specialty subcontractors on those parts of the work that, under normal contracting practices, is performed by specialty subcontractors.

b. The Contractor shall not award any work to any subcontractor without prior written approval of the Owner. Approval will not be given until the Contractor submits to the Owner a written statement concerning the proposed award to the subcontractor, which statement shall contain such information as the Owner may require.

c. The Contractor shall be as fully responsible to the Owner for the acts and omissions of his subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions or persons directly employed by him.

d. The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the General Conditions and other contract documents insofar as applicable to the work of subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provisions of the contract documents.

e. Nothing contained in this contract shall create any contractual relation between any subcontractor and the Owner.

35. Engineer's Authority

a. The Engineer shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials which are to be paid for under this contract and shall decide all questions which may arise in relation to said work and the construction thereof. The Engineer's estimates and decisions shall be final and conclusive, except as herein otherwise expressly provided. In case any question shall arise between the parties hereto relative to said contract or specifications, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such questions.

b. The Engineer shall decide the meaning and intent of any portion of the specifications and of any plans or drawings where the same may be found obscure or be in dispute. Any differences or conflicts in regard to their work that may arise between the Contractor under this contract and other contractors performing work for the Owner shall be adjusted and determined by the Engineer. Any work performed on areas which have been identified as obscure or in dispute but for which a determination has not been made by the Engineer, shall be at the sole risk of the Contractor.

36. Use of Premises and Removal of Debris

The Contractor expressly undertakes at his own expense:

a. to take every precaution against injuries to persons or damage to property;

b. to store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the work as will not unduly interfere with the progress of his work or the work of any other contractors;

c. to place upon the work or any part thereof only such loads as are consistent with the safety of that portion of the work;

d. to frequently clean up all refuse, rubbish, scrap materials, and debris caused by his operations, to the end that at all times the site of the work shall present a neat, orderly and workmanlike appearance;

e. before final payment to remove all surplus material, false-work, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations, and to put the site in a neat orderly condition;

f. to effect all cutting, fitting or patching of his work required to make the same to conform to the plans and specifications and, except with the consent of the Engineer, not to cut or otherwise alter the work of any other Contractor.

37. Quantities of Estimate

Wherever the estimated quantities of work to be done and materials to be furnished under this contract are shown in any of the documents including the proposal, they are given for use in comparing bids and the right is especially reserved as herein otherwise specifically limited, to increase or diminish them as may be deemed reasonably necessary or desirable by the Owner to complete the work contemplated by this contract, and such increase or diminution shall in no way vitiate this contract, nor shall any such increase or diminution give cause for claims or liability for damages.

38. Lands and Rights-of-Way

Prior to the start of construction, the Owner shall obtain all lands and rights-of-way necessary for the carrying out and completion of work to be performed under this contract.

39. General Guaranty

Neither the final certificate of payment nor any provision in the Contract Documents, nor partial or entire occupancy of the premises by the Owner, shall constitute an acceptance of work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship. The Contractor shall remedy any defects in the work and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from the date of final acceptance of the work unless a longer period is specified. The Owner will give notice of observed defects with reasonable promptness.

40. Conflicts, Measurements and Discrepancies

a. Before undertaking each part of the work, the Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. The Contractor shall promptly report in writing to Engineer any conflict, error or discrepancy which the Contractor may discover and shall obtain a written interpretation or clarification from the Engineer before proceeding with any work affected thereby; however, the Contractor shall not be liable to the Owner or Engineer for failure to report any conflict, error or discrepancy in the Contract Documents, unless the Contractor had actual knowledge thereof or should reasonably have known thereof.

b. Any work performed which is governed by conflicting details, dimensions, or specifications and is performed without clarification by the Engineer shall be at the sole risk of the Contractor.

c. No extra charge or compensation in excess of actual quantities required will be allowed because of differences between actual dimensions and the dimensions shown on the drawings.

41. Notice and Service Thereof

Any notice to any Contractor from the Owner relative to any part of this contract shall be in writing and considered delivered and the service thereof completed, when said notice is posted, by certified or registered mail, to the said Contractor at his last given address, or delivered in person to said Contractor or his authorized representative on the work.

42. Provisions Required by Law Deemed Inserted

Each and every provision of law and clause required by law to be inserted in this contract shall be deemed to be inserted herein and the contract shall be read and enforced as though it were included herein. If, through mistake or otherwise any such provision is not inserted or is not correctly inserted, then upon the application of either party the contract shall forthwith be physically amended to make such insertion or correction.

43. Protection of Lives and Health

The Contractor shall exercise proper precaution at all times for the protection of persons and property and shall be responsible for all damages to persons or property, either on or off the site, which occur as a result of his prosecution of the work. The safety provisions of applicable laws and building and health regulations described in Chapter XIII, Bureau of Labor Standards, Department of Labor, Safety and Health Regulations for Construction, shall be observed and the Contractor shall take or cause to be taken, such additional safety and health measures as the Owner may determine to be reasonably necessary.

44. Subcontracts

The Contractor will insert in any subcontracts, any Federal Labor Standards Provisions which may be contained herein and such other clauses as the Owner and the Department of Housing and Urban Development may, by instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts which they may enter into, together with a clause requiring this insertion in any further subcontracts that may in turn be made.

45. Equal Employment Opportunity

During the performance of this contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because or race, religion, sex, color, disability or national origin. The Contractor will take affirmative action to ensure that applicants are employed and

that employees are treated during employment without regard to their race, religion, sex, color or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, (including apprenticeship). The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided of this nondiscrimination clause.

b. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, religion, sex, color, disability or national origin.

c. The Contractor will send to each labor union or representative or workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the labor union or worker's representative of the Contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

e. The Contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the Department of Housing and Urban Development and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

f. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be terminated or suspended in whole or in part and the Contractor may be declared ineligible for further CITY contracts or Federally-assisted construction contracts, in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 or September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

g. The Contractor will include the provisions of paragraph (a) through (f) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Department of Housing and Urban

Development may direct as means of enforcing such provisions including sanctions for noncompliance; provided, however, that in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Department of Housing and Urban Development, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

46. Prohibited Interests

No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or any part hereof. No officer, employee, architect, attorney, engineer or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

47. Use and Occupancy Prior to Acceptance by Owner

The Contractor agrees to the use and occupancy of a portion or unit of the project before formal acceptance by the Owner, provided the Owner:

a. Secures written consent of the Contractor except in the event, in the opinion of the Engineer, the Contractor is chargeable with unwarranted delay in final clean-up of punch list items or other contract requirements, and

b. Secures endorsement from the insurance carrier and consent of the surety permitting occupancy of the building or use of the project during the remaining period of construction, or,

c. When the project consists of more than one building, and one of the buildings is occupied, secures permanent fire and extended coverage insurance, including a permit to complete construction. Consent of the surety must also be obtained.

48. Photographs of the Project

If required by the Owner, the Contractor shall furnish photographs of the project, in the quantities and as described in the Special Provisions.

49. Suspension of Work

Should the Owner be prevented or enjoined from proceeding with work either before or after the start of construction by reason of any litigation or other reason beyond the control of the Owner, the Contractor shall not be entitled to make or assert claim for damage by reason of said delay; but time for completion of the work will be extended to such reasonable time as the Owner may determine will compensate for time lost by such delay with such determination to be set forth in writing.

50. Labor Provisions

a. Minimum Wages

All laborers and mechanics employed upon the work covered by this Contract shall be paid unconditionally and not less often than once each week, and without subsequent deduction or rebate of any account (except such payroll deductions as are made mandatory by law and such other payroll deductions as are permitted by the applicable regulations issued by the Secretary of Labor, United States Department of Labor, pursuant to the Anti-Kickback Act hereinafter identified), the full amount due at time of payment computed at wage rates not less than those contained in the wage determination decision of said Secretary of Labor (a copy of which is attached and herein incorporated by reference),regardless of any contractual relationship which may be alleged to exist between the Contractor or any subcontractor and such laborers and mechanics. All laborers and mechanics employed upon such work shall be paid in cash, except that payment may be by check if the employer provides or secures satisfactory facilities approved by the Owner for the cashing of the same without cost or expense to the employee. For the purpose of this clause, contributions made or costs reasonably anticipated under Section 1 (b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of Section 5.5(a)(1)(iv) of Title 29, Code of Federal Regulations. Also for the purpose of this clause, regular contributions made or costs incurred for more than a weekly period under plans, funds, or programs, but covering the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

b. Underpayment of Wages or Salaries

In case of underpayment of wages by the Contractor or by any subcontractors to laborers or mechanics employed by the Contractor or subcontractor upon the work covered by this Contract, the Owner in addition to such other rights as may be afforded it under this Contractor, shall withhold from the Contractor, out of any payments due the Contractor, so much thereof as the Owner may consider necessary to pay such laborers or mechanics the full amount of wages required by this Contract. The amount so withheld may be disbursed by the Owner, for and on account of the Contractor or the subcontractor (as may be appropriate), to the respective laborers or mechanics to whom the same is due or on their behalf prescribed in the applicable wage determination.

c. Anticipated Costs of Fringe Benefits

If the Contractor does not make payments to a trustee or other third person, he may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing fringe benefits under a plan or program of a type expressly listed in the wage determination decision of the Secretary of Labor which is part of this Contract; provided, however, the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program. A copy of findings made by the Secretary of Labor in respect to fringe benefits being provided by the Contractor must be submitted to the Owner with the first payroll filed by the Contractor subsequent to receipt of the findings.

d. Overtime Compensation Required by Contract Works Hours and Safety Standards Act (76 Stat. 357-360: Title 40 U.S.C., Sections 327-332).

1. Overtime Requirements. No Contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics, including watchmen and guards, which he is employed on such work to work in excess of 40 hours in such work week unless such laborer or mechanic receives compensation at a rate not less than one and one-half times his basic rate of pay for all hours worked in excess of 40 hours in such work week.

2. Violation/Liability for Unpaid Wages Liquidated Damages. In the event of any violation of the clause set forth in paragraph (1), the Contractor and any subcontractor responsible therefor shall be liable to any affected employee for his unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic employed in violations of the clause set forth in paragraph (1), in the sum of $10 for each calendar day on which such employee was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in paragraph (1).

3. Withholding for Liquidated Damages. The Owner shall withhold or cause to be withheld, from any monies payment on account of work performed by the Contractor or subcontractor, such sums as may administratively be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for liquidated damages as provided the clause set forth in paragraph (2).

4. Subcontracts. The Contractor shall insert in any subcontracts the clauses set forth in paragraphs (1), (2), and (3) of this Section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontractors which they may enter into, together with a clause requiring this insertion in any further subcontracts that may in turn be made.

e. Employment of Apprentices/Trainees

1. Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen in any craft classification shall not be greater than the ratio permitted to the contractor as to his entire work force under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not a trainee as defined in subdivision (2) of this subparagraph or is not registered or otherwise employed as stated above, shall be paid the wage rates determined by the Secretary of Labor for the classification of work he actually performed. The Contractor or subcontractor will be required to furnish to the contracting officer or a representative of the Wage-Hour Division of the U.S. Department of Labor written evidence of the registration of his program and apprentices as well as the appropriate ratios and wage rates (expressed in percentages of the journeyman hourly rates), for the areas of construction prior to using any apprentices on the contract work. The wage rate paid apprentices shall be not less than the appropriate percentage of the journeyman's rate contained in the applicable wage determination.

2. Trainees. Except as provided in 29 CFR 5.15, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidence by formal certification, by the U.S. Department of Labor, Manpower Administration, Bureau of Apprentice and Training. The ratio of trainees to journeymen shall not be greater than permitted under the plan approved by the Bureau of Apprenticeship and Training. Every trainee must be paid at not less than the rate specified in the approved program for his level of progress. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Bureau of Apprenticeship

and Training shall be paid not less than the wage rate determined by the Secretary of Labor for the classification of work he actually performed. The Contractor or subcontractor will be required to furnish the contracting officer or a representative of the Wage-Hour Division of the U.S. Department of Labor written evidence of the certification of his program, the registration of the trainees, and the ratios and wage rates prescribed in that program. In the event the Bureau of Apprenticeship and Training withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

3. Equal Employment Opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

f. Employment of Certain Persons Prohibited

No person under the age of sixteen or no person who, at the time, is serving sentence in a penal or correctional institution shall be employed on the work covered by this Contract.

g. Regulations Pursuant to So-Called "Anti-Kickback Act"

The Contractor shall comply with the applicable regulations (a copy of which is attached and herein incorporated by reference) of the Secretary of Labor, United States Department of Labor, made pursuant to the so-called "Anti-Kickback Act" of June 13, 1934 (48 Stat. 948: 62 Stat. 862; Title 18 U.S.C., Section 874; and Title 40 U.S.C., Section 276c), and any amendments or modifications thereof, shall cause appropriate provisions to be inserted in subcontracts to insure compliance therewith by all subcontractors subject thereto, and shall be responsible for the submission of affidavits required by subcontractors thereunder, except as said Secretary of labor may specifically provide for reasonable limitations, variations, tolerances, and exemptions from the requirement thereof.

h. Employment of Laborers or Mechanics Not Listed in Aforesaid Wage Determination Decision

Any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the Contract will be classified or reclassified comfortably to the wage determination by the Owner, and a report of the action taken shall be submitted by the Owner, through the Secretary of Housing and Urban Development, to the Secretary of Labor, United States Department of Labor. In the event the interested parties cannot agree on the proper classification or reclassification of a particular class of laborers and mechanics to be used, the question accompanied by the recommendation of the Owner shall be referred,

through the Secretary of Housing and Urban Development, to the Secretary of Labor for final determination.

i. Fringe Benefits Not Expressed as Hourly Wages Rates

The Owner shall require, whenever the minimum wage rate prescribed in the Contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly wage rate and the Contractor is obligated to pay cash equivalent of such a fringe benefit, an hourly cash equivalent thereof to be established. In the event the interested parties cannot agree upon a cash equivalent of the fringe benefit, the questions, accompanied by the recommendation of the Owner, shall be referred, through the Secretary of Housing and Urban Development, to the Secretary of Labor for determination.

j. Posting Wage Determination Decisions and Authorized Wage Deductions

The applicable wage poster of the Secretary of Labor, United States Department of Labor, and the applicable wage determination decisions of said Secretary of Labor with respect to the various classification of laborers and mechanics employed and to be employed upon the work covered by this Contract, and a statement showing all deductions, if any, in accordance with the provisions of this Contract, to be made from wages actually earned by persons so employed or to be employed in such classifications, shall be posted at appropriate conspicuous points at the site of the work.

k. Complaints, Proceedings, or Testimony by Employees

No laborer or mechanic to whom the wage, salary, or other labor standards provisions of this Contract are applicable shall be discharged or in any other manner discriminated against by the Contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this Contractor to his employer.

l. Claims and Disputes Pertaining to Wages

Claims and disputes pertaining to wage rates or to classifications of laborers and mechanics employed upon the work covered by this Contractor shall be promptly reported by the Contractor in writing to the Owner for referral by the latter through the Secretary of Housing and Urban Development to the Secretary of Labor, United States Department of Labor, whose decision shall be final with respect thereto.

m. Questions Concerning Certain Federal Statutes and Regulations

All questions arising under this Contract which relate to the application or interpretation of (a) the aforesaid Anti-Kickback Act, (b) the Contract Work Hours

and Safety Standards Act, (c) the aforesaid Davis-Bacon Act, (d) the regulations issued by the Secretary of Labor, United States Department of Labor, pursuant to said Acts, or (e) the labor standards provisions of any other pertinent Federal statute, shall be referred, through the Owner and the Secretary of Housing and Urban Development, to the Secretary of Labor, United States Department of Labor, for said Secretary's appropriate ruling or interpretation which shall be authoritative and may be relied upon for the purposes of this Contract.

n. Payrolls and Basic Payroll Records of Contractor and Subcontractors

The Contractor and each subcontractor shall prepare his payroll on forms satisfactory to and in accordance with instructions to be furnished by the Owner. The Contractor shall submit weekly to the Local Public Agency or Public Body two certified copies of all payrolls of the Contractor and of the subcontractors, it being understood that the Contractor shall be responsible for the submission of copies of payrolls of all subcontractors. Each such payroll shall contain the "Weekly Statement of Compliance" set forth in Section 3.3 of Title 29, Code of Federal Regulations. The payrolls and basic payroll records of the Contractor and each subcontractor covering all laborers and mechanics employed upon the work covered by this Contract shall be maintained during the course of the work and preserved for a period of three (3) years thereafter. Such payroll and basic payroll records shall contain the name and address of each such employee, his correct classification, rate of pay (including rates of contributions or costs anticipated of the types described in Section l(b)(2) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. In addition, whenever the Secretary of Labor has found under Section 5.5(a)(1)(iv) of Title 29, Code of Federal Regulations, that the wages of any laborer or mechanic includes the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section l(b)(2)(B) of the Davis Bacon Act, the Contractor or subcontractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. The Contractor and each subcontractor shall make his employment records with respect to persons employed by him upon the work covered by this Contract available for inspection by authorized representatives of the Secretary of Housing and Urban Development, the Owner, and the United States Department of Labor. Such representative shall be permitted to interview employees of the Contractor or of any subcontractor during working hours on the job.

o. Specific Coverage of Certain Types of Work by Employees

The transporting of materials and supplies to or from the site of the Project to which this Contract pertains by the employees of the Contractor or of any subcontractor, and the manufacturing or furnishing of materials, articles, supplies, or equipment

on the site of the Project to which this Contract pertains by persons employed by the Contractor or by any subcontractor, shall, for the purposes of this Contract, and without limiting the generality of the foregoing provisions of this Contract, be deemed to be work to which these, Federal Labor Standards Provisions are applicable.

p. Provisions to be Included in Certain Subcontracts

The Contractor shall include or cause to be included in each subcontract covering any of the work covered by this Contract, provisions which are consistent with any Labor Standards Provisions, included herein and also a clause requiring the subcontractors to include such provisions in any lower tier subcontracts which they may enter into, together with a clause requiring such insertion in any further subcontracts that may in turn be made.

q. Ineligible Subcontractors

The Contractor shall not subcontract any part of the work covered by this Contract or permit subcontracted work to be further subcontracted without the Owner's prior written approval of the subcontractor. The Owner will not approve any subcontractor for work covered by this Contract who is at the time ineligible under the provisions of any applicable regulations issued by the Secretary of Labor, United States Department of labor or the Secretary of Housing and Urban Development, to receive an award of such subcontract.

1. Breach of Foregoing Federal Labor Standards Provisions

In addition to the clauses for termination of this Contract as herein elsewhere set forth, the Owner reserves the right to terminate this Contract if the Contractor or any subcontractor whose subcontract covers any of the work covered by this Contract shall breach any of these Federal Labor Standards Provisions. A breach of these Federal Labor Standards Provisions may also be grounds for debarment as provided by the applicable regulations issued by the Secretary of Labor, United States Department of Labor.

r. Employment Practices

The Contractor shall, to the greatest extent practicable, follow hiring and employment practices for work on the project that will provide new job opportunities for the unemployed and underemployed. This clause shall be inserted in each construction subcontract.

s. Contract Termination; Debarment

A breach of Section 45 and the Federal Labor Standards Provisions may be grounds for termination of the Contractor, and for debarment as provided in 29 CFR 5.6.

51. Sales Tax Exemption

Pursuant to Oklahoma Statutes, Title 68, 1356(I0), Contractors and Subcontractors shall be exempted from the tax levied on the sale of tangible personal property or services necessary for the completion of this construction contract. Any Contractor or Subcontractor making purchases for this contract on behalf of the City of Lawton shall certify, in writing, on the copy of the invoice or sales ticket to be retained by the vendor, that the purchases are made for and on behalf of the City of Lawton.

Contractors and Subcontractors shall request a written Sales Tax Exemption by contacting the Engineering Division, City of Lawton, at 103 S.W. 4th Street, Lawton, Oklahoma, 73501 (580-581-3385) who will issue such exemption on an individual project basis. It shall be the Contractor's and Subcontractor's responsibility to secure the Sales Tax Exemption and failure to do so will not lessen their liability for payment of the sales tax.

Until the City of Lawton accepts the improvements, purchases for carrying out the contract for construction of this project shall be exempt from sales taxes as provided in the cited statute. Two Tax Commission interpretations of the Oklahoma statutes Title 68 Sec 1356(I0) are listed below to avoid contention among the City of Lawton, its contractors, and the Tax Commission.

"Exemptions apply to materials incorporated into the project, but not to concrete forms nor to other tools"

"The same reasoning precludes exemptions being applied to rental items"

The Contractor shall certify that purchases are made for or are on behalf of the City of Lawton. Persons who make wrongful or erroneous certifications) shall be guilty of a misdemeanor and shall be punished as provided in the statutes.

52. Special Equal Opportunity Provisions

A. <u>Activities and Contracts Not Subject to Executive Order 11246, as Amended.</u>

(Applicable to Federally assisted construction contracts and related subcontracts under $10,000.)

During the performance of this contract, the Contractor agrees as follows:

(1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin. The Contractor shall take affirmative action to ensure that applicants for employment are employed, and that employees are treated during

employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation; and selection of training, including apprenticeship.

(2) The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices to be provided by Contracting Officer setting forth the provisions of this nondiscrimination clause. The Contractor shall state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(3) Contractors shall incorporate foregoing requirements in all subcontracts.

B. Contracts Subject to Executive Order 11246, as Amended.

(Applicable to Federally assisted construction contracts and related subcontracts exceeding $10,000.)

During the performance of this contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of thins nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(3) The Contractor shall send to each labor union or representatives of works with which he has a collective bargaining agreement or other contract or understanding, notice to be provided by the Contract Compliance Officer advising the said labor union or worker's representatives of the Contractor's commitment under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Contractor shall comply with all provisions of Executive Order 11246 of September 24, 1965, and the rules, regulations and relevant orders of the Secretary of Labor.

(5) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records and accounts by the Department and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

(6) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract, or with any of such rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part, and the Contractor may be declared ineligible for further Government contracts or federally assisted construction contract procedures authorized in Executive Order 11246, of September 24, 1965, or by rule, regulation, order of the Secretary of Labor, or as otherwise provided by law.

(7) The Contractor will include the portion of the sentence immediately preceding Paragraph (1) and the provisions of Paragraph (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Department may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Department, the Contractor may request the United States to enter into such litigation to protect the interest of the United States.

C. "Section 3 Compliance in the Provision of Training, Employment and Business Opportunities.

During the performance of this contract, the contractor agrees as follows:

(1) The Contractor agrees to comply with the requirements of Section 3 of the Housing and Urban Development Act of 1968 (12 U.S.C. 1701 u.), as amended, the HUD regulations issued pursuant thereto at 24 CFR Part 135, and any applicable rules and orders of HUD issued thereunder.

(2) The "Section 3 clause" set forth in 24 CFR 135.20(b) shall form part of this contract, as set forth in Paragraph 1 of the General Conditions, "Contract and Contract Documents".

(3) Contractor shall incorporate the "Section 3 clause" shown below and the foregoing requirements in all subcontracts.

Section 3 Clause as Set Forth in CFR 135.20(b)

a. The work to be performed under this contract is on a project assisted under a program providing direct Federal financial assistance from the Department of Housing and Urban Development and is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u. Section 3 requires that to the greatest extent feasible, opportunities for training and employment be given lower income residents of the project area and contracts for work in connection with the project be awarded to business concerns that are located in, or owned in substantial part by persons residing in the area of the project.

b. The parties to this contract will comply with the provisions of said Section 3 and the regulations issued pursuant thereto by the Secretary of Housing and Urban Development set forth in 24 CFR 135.20, and all applicable rules and orders of the Department issued thereunder prior to the execution of this contract. The parties to this contract certify and agree that they are under no contractual or other disability that would prevent them from complying with these requirements.

c. The Contractor will send to each labor organization or representative of workers with whom he has a collective bargaining agreement or other contract or understanding. If any, a notice advising the said labor organization or workers' representative of his commitments under this Section 3 clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment or training.

d. The Contractor will include this Section 3 clause in every subcontract for work in connection with the project and will, at the direction of the applicant for or recipient of Federal financial assistance, take appropriate action pursuant to the subcontract upon a finding that the subcontractor is in violation of regulations issued by the Secretary of Housing and Urban Development, 24 CFR 135.20. The Contractor will not subcontract with any subcontractor where it has notice or knowledge that the latter has been found in violation of regulations under 24 CFR 135.20 and will not let any subcontract unless the subcontractor has first provided it with a preliminary statement of ability to comply with the requirements of these regulations.

e. Compliance with the provisions of Section 3, the regulations set forth in 24 CFR 135.20, and all applicable rules and regulations of the Department issued thereunder prior to the execution of the contract shall be a condition of the Federal financial assistance provided to the project, binding upon the

applicant or recipient for such assistance. Failure to fulfill these requirements shall subject the applicant or recipient, its contractor and subcontractors, its successors, and assigns to these sanctions specified by the grant or loan agreement or contract through which Federal assistance is provided, and to such sanctions as are specified by 24 CFR 135.20.

53. Certification of Compliance with Air and Water Acts

(Applicable to Federally assisted construction contracts and related subcontracts exceeding $100,000.)

Compliance with Air and Water Acts

During the performance of this contract, the contractor and all subcontractors shall comply with the requirements of the Clean Air Act, as amended, 42 USC 1857 et. seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et. seq., and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part 14, as amended.

In addition to the foregoing instruments, all nonexempt contractors and subcontractors shall furnish to the Owner, the following:

(1) A stipulation by the contractor or subcontractor, that any facility to be utilized in the performance of any nonexempt contract or subcontract, is not listed on the List of Violating Facilities issued by the Environmental Protection Agency (EPA) pursuant to 40 CFR 15.20.

(2) Agreement by the Contractor to comply with all the requirements of Section 114 of the Clean Air Act, as amended (42 USC 1857c-8) and Section 308 of the Federal Water Pollution Control Act, as amended (33 USC 1318) relating to inspection, monitoring, entry reports and information, as will as all other requirements specified in said Section 114 and Section 308, and all requirements specified in said Section 114 and Section 308, and all regulations and guidelines issued thereunder.

(3) A stipulation that as a condition for the award of the contract, prompt notice will be given of any notification received from the Director, Office of Federal Activities, EPA, indicating that a facility, utilized, or to be utilized for the contract, is under consideration to be listed on the EPA List of Violating Facilities.

(4) Agreement by the Contractor that he will include, or cause to be included, the criteria and requirements in Paragraph (1) through (4) of this section in every non exempt subcontract and requiring that the Contractor will take such action as the Government may direct as a means of enforcing such provisions.

54. Employment of Handicapped Persons

Where possible, employment of handicapped persons is encouraged.

55. Employment of Female Persons

Where possible, employment of female persons is encouraged.

56. Employment of Veterans

The contractor agrees to provide certification that special consideration with existing applicable collective bargaining agreements and practices, shall be given to the employment on the project of qualified disabled veterans as defined in 38 USC 2011(1), and to qualified Vietnam-Era veterans, as defined in 38 USC 2011(2)(A).

WORK ORDER

TO: _____

From: City of Lawton

Re: **CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101**

Date:_____

You are hereby notified that all contract documents have been entered and accepted in relation to the contract entered into on the _____ day of _____, 2024, by and between the City of Lawton and _____ that work may now be commenced in accordance with said contract.

Authorized by:

_____

Effective Date: _____

AFFIDAVIT FOR PAYMENTS FOR $25,000 OR MORE
CITY OF LAWTON, OKLAHOMA

STATE OF OKLAHOMA }
COUNTY OF COMANCHE }

The undersigned (architect, contractor, supplier or engineer), of lawful age, being first duly sworn, on oath says that this invoice or claim is true and correct. Affiant further states that the (work, services or materials) as shown by this invoice or claim have been (completed or supplied) in accordance with the plans, specifications, orders or requests furnished the affiant. Affiant further states that (s)he has made no payment directly or indirectly to any elected official, officer or employee of the State of Oklahoma, any county or local subdivision of the state, of money or any other thing of value to obtain payment.

_____
(Architect, Contractor, Engineer or Supplier)

Subscribed and sworn to before me this _____ day of _____, 2024.

_____
Notary Public

My Commission Expires:

_____

_____
(Architect)

Subscribed and sworn to before me this _____ day of _____, 2024.

_____
Notary Public

My Commission Expires:

_____

Note: Copy of this Affidavit must be attached to any invoice submitted by an Architect, Contractor, Engineer or Supplier of material for $25,000 or more.

PAYMENT CERTIFICATE

TO: City of Lawton

Re: **LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101**

I, _____ of
Name of Authorized Agent and Designation

_____ do hereby affirm that all claims and Company obligations incurred by me or in my behalf in connection with the performance of the above mentioned project have been fully paid and settled.

_____
Authorized Representative

_____
Name of Company

STATE OF OKLAHOMA }
COUNTY OF COMANCHE}

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this ___ day of _____, 2024, personally appeared _____, (name) to me known to be the identical person who signed the name of _____, (corporation/proprietorship/authorized agent name) an Oklahoma corporation, to the within and foregoing instrument as its _____, (president/owner) and acknowledged to me that he executed the same as his free and voluntary act and deed and as the free and voluntary act and deed of said Corporation/Company for uses and purposes therein set forth.

Witness my hand and seal the day and year last above written.

_____
Notary Public

My Commission Expires:_____

CONTRACTOR'S RELEASE TO CITY

TO: City of Lawton

Re: **LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101**

This is to certify that _____, by acceptance of this final payment, hereby releases the owner, City of Lawton, from all claims and all liabilities to the City of Lawton for all things done or furnished in connection with work on this project and further releases said City of Lawton from liabilities arising from any act of the owner or his agent arising in connection with this project. This release in no way operates to release the contractor or his Surety from any obligations under this contract or the bond tendered pursuant thereto.

_____
Name of Corporation

_____
Authorized Agent

STATE OF OKLAHOMA }
COUNTY OF COMANCHE}

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this ___ day of _____, 2024, personally appeared _____, (name) to me known to be the identical person who signed the name of _____, (business/proprietorship/authorized agent name), an Oklahoma corporation/proprietorship, to the within and foregoing instrument as its _____ (president/owner), and acknowledged to me that he executed the same as his free and voluntary act and deed and as the free and voluntary act and deed of said Corporation/ Company for uses and purposes therein set forth.

Witness my hand and seal the day and year last above written.

_____
Notary Public

My Commission Expires:_____

SUBCONTRACTOR'S

WAIVER AND RELEASE OF LIEN
UPON FINAL PAYMENT

The undersigned subcontractor or material/equipment supplier, in consideration of the final payment in the amount of $_____, hereby waives and releases its lien, and right to claim a lien for labor, services, or materials furnished to _____ (contractor) on the job of **LANDFILL CELLS 6 AND 7 LINER CONSTRUCTION, PROJECT PW2101** for the City of Lawton, Comanche County, Oklahoma.

The said subcontractor or material/equipment supplier has been fully satisfied and paid any and all claims for labor and materials/equipment insofar as they pertain to the "Project" in question.

In further consideration of the payment made and set forth, the undersigned certifies that all of its subcontracts or material/equipment suppliers and employees on the project have already been paid and the undersigned agrees to indemnify and hold completely harmless _____ (contractor) in the event of any claims hereafter made alleging non-payment by such subcontractors or material/equipment suppliers or employees.

Date: _____

_____
Subcontractor/Supplier

By: _____ (Print Name)

_____ (Signature) _____ (Title)

State of _____ County of _____

Subscribed and sworn to before me on this _____ day of _____, 2024

_____ My commissions expires: _____
Notary Public

My commission number: _____

TECHNICAL SPECIFICATIONS

Lawton Sanitary Landfill
8902 SW 11th Street,
Oklahoma 73501
Permit No. 3516015

Technical Specifications
Landfill Cells 6 and 7 Project #PW2101

City of Lawton Public Works Administration
2202 SW 3rd Street
Lawton, OK 73501
(580) 581-3385

SCS ENGINEERS

16222084.00 | July 2023

1901 Central Drive, Suite 550
Bedford, TX 76021
817-571-2288

Landfill Cells 6 and 7 Liner Construction
Technical Specifications
Table of Contents

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section describes the following items related to the Work:

1. Project site location and access;
2. Scope of work;
3. Construction sequence;
4. Existing site conditions; and
5. Access to Work.

B. The individual technical specifications provided herein supplement the requirements specified in the Contract Documents. If the requirements of this section and the Contract Documents conflict, the Contractor shall adhere to the more stringent requirement as determined by the Owner and Engineer.

C. The definitions, authorities, duties, and responsibilities below apply to the technical specifications provided herein:

1. Owner – City of Lawton Engineering Division
2. Contractor – A person, firm or corporation with whom the contract is made by the Owner.
   a. The Contractor shall become familiar with the project conditions. The Contractor is responsible for controlling all aspects of Work, including construction, quality of materials, and construction on the jobsite according to the technical specifications.
   b. Quality Assurance inspections by the Engineer or Construction Quality Assurance (CQA) Consultant and visits by other representatives of the Owner shall not relieve the Contractor from complying with the requirements of the Contract.
3. Engineer – The term Engineer shall apply to consultants (Design Engineer) hired by the Owner (i.e. Stearns, Conrad and Schmidt Consulting Engineers, Inc. d/b/a SCS Engineers), who will perform inspections or provide guidance, information, or direction concerning the project.
   a. All work shall be done to the satisfaction of the Engineer. Engineer shall make decisions on all questions which arise as to quality and acceptability of materials furnished and work performed, rate of progress of the Work, interpretation of the construction plans and technical specifications, acceptable fulfillment of the contract, compensation, mutual rights between contractors under these specifications, and the suspension of Work. Engineer shall determine the amount and quality of the Work performed and materials furnished and Engineer's decisions and estimates shall be final.
4. CQA Consultant – References to CQA Consultant throughout the technical specifications shall be defined as either Certifying Engineer or on-site CQA Monitor who is a representative of the Certifying Engineer.

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. The Contractor shall receive and accept the compensation provided in the Contract Documents as full payment for furnishing all labor, equipment, materials, and incidentals for performing all construction necessary to complete the Work, as described in the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

B. The prices included in the Bid Schedule/Proposal shall include all costs for labor, equipment, materials, taxes, freight, permits, handling and tests required to perform the Work as specified in the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

C. The Contractor shall field verify all quantities and dimensions shown on the Construction Plans or contained in the Bid Schedule/Proposal and immediately notify the City and Engineer of any discrepancies.

D. The Contract shall note the following bid alternate that may be selected by the City. Measurement and payment for this bid alternate is described in Part 3.2 of this Section, and includes the following Work:

1. 1-foot Protective Cover (Imported from off-site borrow sources with $k \geq 1.3 \times 10^{-5}$ cm/sec).

E. The Contractor shall note that all area quantities (square feet, square yard, etc.) are based on horizontal projections of the area (i.e., not surface area). Measurement and payment for such items will be based on installed quantities within the specified horizontal areas or limits, which will be verified from as-built surveys (see Section 01052) of the completed Work, as specified in this Section. As such, measurement and payment will not be made on surface area.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 MEASUREMENT AND PAYMENT – PRIMARY BID

Item No. 1 – Mobilization and Demobilization

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment.

1. Payment for this item will be at the contract lump sum price, and shall constitute full compensation for all material, labor, equipment, and Work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications. Payment shall cover all Work for mobilization and demobilization in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

2. Mobilization includes, but is not limited to, movement of personnel, equipment, supplies and incidentals to the Site; obtaining, all permits, insurance, and bonds; and any other pre-construction

expenses necessary for the start of the Work. No price adjustments will be made for this item due to changes in the Work.

3. Demobilization includes removal from the Site of all materials, resources, equipment, temporary support facilities, utilities, and all remaining construction debris at the completion of the Work, and includes release of liens and other incidentals as specified for project closeout.

4. Progress payments shall be based on the percentage of mobilization and demobilization completed at the time of invoicing. The total amount quoted for mobilization and demobilization in the Bid Schedule/Proposal **shall not exceed 5 percent of the total base bid**. No separate payment will be made for demobilization. All costs will be considered to be included in the lump sum price quoted for "Mobilization and Demobilization" in the Bid Schedule/Proposal.

Item No. 2 – Layout of Work and Surveys

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment.

1. Payment for this item will be at the contract lump sum price. Payment will constitute full compensation for labor, equipment, tools and incidentals necessary to complete the Work specified in Construction Plans, Construction QA/QC Plan, and Technical Specifications.

2. No additional payment will be allowed for surveying associated with incremental material quantity increases, except for increased material quantities associated with Work clearly not included in the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 3 – Clearing and Grubbing

A. Measurement. The Work required for this item will measured on an acre (AC) basis.

B. Payment.

1. Payment will constitute full compensation for labor, equipment, tools and incidentals necessary to complete this item in accordance with **Section 02110 – Clearing and Grubbing within and out outside** construction areas, including within cell, drainage channels, ponds, stockpile areas, and equipment laydown/storage area, etc. Payment for this item shall also include the loading and transport of removed of topsoil and vegetation to locations depicted on the Construction Plans.

2. No additional payment will be allowed for clearing and grubbing associated with incremental material quantity increases, except for increased material quantities associated with Work clearly not included in the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 4 – Stormwater and Sediment Control Plan and Implementation

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment. Payment for this item will be at the contract lump sum price. Payment shall constituent full compensation for all labor, materials, tools, and Work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications, including but not necessarily limited to, providing and maintaining proper equipment, pumps, and facilities for stormwater control **at all times for removal of surface water <u>prior</u> to construction and during construction from entering the cell and areas of construction**; construction and maintaining diversions berms upslope of construction for stormwater control; supplying, installing, and maintaining silt fences down-gradient of soil disturbances (excavations, stockpiles, etc.); and general conformance to the site's Storm Water Pollution Prevention Plan at all times for management and control of

stormwater and sediment associated with protection the Work. No additional payments shall be made for time beyond the Contractor's completion date, unless extension is due to actions that are responsibility of the Owner. Any damage to the Work from surface water entering the limits of construction or sediment being discharged from the site due to Contractor's performance of work shall be at the Contractor's expense.

Item No. 5 – Excavation – Cells 6 and 7 Liner Subgrade, Perimeter Drainage, and Access Roads

A. Measurement.

1. Measurement for this item shall be on a cubic yard (CY) basis. Excavation quantities shall be measured for in-place soil volume excavated, based on a comparison of existing contours prior to construction, as represented on **Drawing No. 2 – Existing Conditions** of the Construction Plans or subsequent surveys and as-built surveys of the completed subgrade prepared by the Owner's surveyor, consistent with Construction Plans, Construction QA/QC Plan, and Technical Specifications.

2. Subsequent surveys shall be of sufficient accuracy to allow the Owner's Surveyor and/or Engineer to calculate pay volumes for this item within plus or minus 5 percent.

B. Payment. Payment for this item will be at the contract unit price per cubic yard (CY). Payment shall constitute full compensation for all labor, equipment, tools, and work incidentals thereto, necessary to complete this item in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications, related to excavation of Cells 6 & 7, and access ramp/road subgrade; surface/subgrade preparation; and protection of subgrade. Payment for this item shall also include the loading and transport of excavated material to approved stockpile areas or utilized as general fill, as depicted on the Construction Plans. Any excavation below subgrade levels caused by the Contractor shall be at the Contractor's expense. **Contractor shall note that removal of topsoil (assumed to be 6") associated with clearing and grubbing shall be measured and paid under the Clearing and Grubbing bid item.**

Item No. 6 – Liner Tie-in (Cells 4 and 5)

A. Measurement. Measurement for this item shall be on a linear foot (LF) basis to complete the liner tie-in to existing **Cells 4 and 5**.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF). Payment shall constituent full compensation for all labor, materials, tools, and Work incidental thereto, necessary to complete this item in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications**,** including but not necessarily limited to, excavation to locate and expose existing liner (comprised of 2-foot of protective cover overlying geocomposite, 2-feet of compacted clay liner, and geomembrane), disposal of soil and/or waste at the landfill working face (if necessary), management of leachate (if necessary), grading, placement of 6 inches of soil over exposed waste daily (if necessary), etc. Placement of compacted clay liner, geomembrane, geocomposite, and protective cover for liner tie-in will be paid at the unit rate for the respective materials, as specified in this Section.

Item No. 7 – General Fill – Cells 6 and 7 Liner Subgrade, Stormwater Pond Berm, and Access Ramp/Turnaround Pad

A. Measurement.

1. Measurement for this item shall be on a cubic yard (CY) basis for placement of General Fill required for construction of the Cells 6 and 7 liner subgrade, stormwater pond berm, and access ramp/turnaround pad, and areas within which topsoil has been removed during clearing and grubbing (base bid item no. 3). General Fill quantities shall be measured for in-place volumes, based on of existing contours prior to construction, as represented on **Drawing No. 2 – Existing**

Conditions of the Construction Plans or subsequent surveys and as-built surveys of the completed subgrade prepared by the Owner's surveyor, consistent with Technical Specifications.

2. The Contractor is responsible for developing final grades for the access ramp/turnaround pad, and riser pipes soil cover consistent with the Construction Plans to within -0.2 ft to +0.2 ft consistent with Technical Specifications.

3. Subsequent as-built surveys (see Technical Specifications), prepared by Owner's Surveyor, shall be of sufficient accuracy to allow the Engineer to calculate soil volumes for this item within plus or minus 5 percent.

B. Payment. Payment for this item will be at the contract unit price per cubic yard (CY). Payment will include all Work required to place, moisture condition, compact, and grade General Fill, as specified in Construction Plans, Construction QA/QC Plan, and Technical Specifications. Payment shall constitute full compensation for all materials, labor, equipment, tools and Work incidental thereto, necessary to complete this item in accordance with the Technical Specifications, including but not limited to, Work to excavate from within Cells 6 and 7 footprint, load, haul, and place General Fill; surface/subgrade preparation, grading, and protection; and moisture control.

Item No. 8 – 2-foot Compacted Clay Liner

A. Measurement. Measurement for this item shall be on an in-place cubic yard (CY) basis of certified 2-foot compacted clay liner, as delineated by the liner limits of Cells 6 & 7, which will be based on certification surveys of the prepared subgrade and top of compacted clay liner performed by the Owner's surveyor.

B. Payment. Payment for this item will be at the contract unit price per cubic yard (CY). Payment will include all Work to excavate from within Cells 6 and 7 footprint or load, haul, and transport from onsite soil stockpile (as needed), compact, moisture condition, fine grade, and place the compacted clay liner to the tolerances provided in the Technical Specifications, including the liner tie-in as shown on the Construction Plans. Payment shall constitute full compensation for all materials, labor, equipment, tools and work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications. No additional payment will be provided for clay liner thicknesses in excess of 2-foot or areas that do not meet project requirements and need to be reworked and retested.

Item No. 9 – 1-foot Protective Cover

A. Measurement. Measurement for this item shall be on an in-place cubic yard (CY) basis of certified 1-foot protective cover, as delineated by the liner limits of Cells 6 & 7, which will be based on surveys of the completed installation performed by the Owner's surveyor.

B. Payment. Payment for this item will be at the contract unit price per cubic yard (CY). Payment will include all Work to excavate from within Cells 6 and 7 footprint or load, haul, and transport from onsite soil stockpile (as needed) and place the protective cover, including extending past the liner limits for liner tie-in or termination, as shown on the Construction Plans. Payment shall constitute full compensation for all materials, labor, equipment, tools and work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications. No additional payment will be provided for protective cover thicknesses in excess of 1-foot or areas that do not meet project requirements and need to be reworked and retested. Note that if suitable material for the protective cover cannot be obtained from the onsite soil stockpile; then installation of the protective cover shall be measured and paid in accordance with Bid Alternate – BA-1 – 1-foot Sand Protective Cover (imported)

Item No. 10 – Liner Termination Berm

A. Measurement. Measurement for this item shall be on a linear foot (LF) basis, of liner termination (see Liner Termination – 1 and Liner Termination – 2 details), as depicted on the Construction Plans, which will be based on surveys of the completed installation performed by the Owner's surveyor.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF). Payment shall constitute full compensation for all materials, labor, and equipment necessary to install the Liner Termination – 1 and Liner Termination – 2 details in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications, including installation of the anchor trench, compacted clay and protective cover runout, and plywood, as shown on the Construction Plans; and the geosynthetics components are free of damage and defects (i.e., holes, tears, etc.) at the time of project completion. No additional payment will be provided for damage or wrinkles to the geosynthetics as deemed unacceptable by the CQA Monitor, which shall be repaired at the expenses of the Contractor.

Item No. 11 – 60-mil HDPE Geomembrane (Textured Both Sides)

A. Measurement. Measurement for this item shall be on an installed square foot (SF) basis (excluding seams, overlaps, and wastage) of textured 60-mil HDPE geomembrane, as delineated by the Limits of Liner for Cell 6 and 7, which will be based on surveys of the completed installation performed the City's surveyor.

B. Payment. Payment for this item shall be at the contract unit price per square foot (SF), as delineated by the LIT limit of Cell 6 and 7. Payment shall include all Work to furnish, deploy, install, weld, and test textured 60-mil HDPE geomembrane, as specified in Construction Plans, Construction QA/QC Plan, and Technical Specifications, and shown on the Construction Plans. Payment shall constitute full compensation for materials, labor, equipment, tools, testing, seams and seaming, wastage, and run-out past the LIT limit for liner tie-in, and Work incidental thereto, necessary to complete this item in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications. No additional payment will be provided for damage or wrinkles to the geosynthetics as deemed unacceptable by the CQA Monitor, which shall be repaired at the expenses of the Contractor.

Item No. 12 – 250-mil Geocomposite (Double-Sided)

A. Measurement. Measurement for this item shall be on an installed square foot (SF) basis (excluding overlaps and wastage) of double-sided 250-mil geocomposite, as delineated by the LIT limit of Cell 6 and 7, which will be based on surveys of the completed installation performed by the Owner's surveyor.

B. Payment. Payment for this item shall be at the contract unit price per square foot (SF), as delineated by the LIT limit of Cell 6 and 7. Payment shall include all Work to furnish, deploy, install, and seam the geocomposite in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications and shown on the Construction Plans. Payment shall constitute full compensation for materials, labor, equipment, tools, testing, seams and seaming, wastage, run-out past the LIT limit for liner tie-in, and Work incidental thereto, necessary to complete this item in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications. No additional payment will be provided for damage or wrinkles to the geosynthetics as deemed unacceptable by the CQA Monitor, which shall be repaired at the expenses of the Contractor.

Item No. 13 – Leachate Collection Trench (Drainage Aggregate and Non-Woven Geotextile)

A. Measurement. Measurement for this item shall be on a linear foot (LF) basis, of certified leachate collection trench, as depicted on the Construction Plans, which will be based on survey of the length of completed trench installation (i.e., including drainage aggregate, and non-woven geotextile) performed by the Owner's surveyor.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF), which will be based on survey of the length of completed trench installation performed by the City's surveyor. Payment shall include all Work to furnish and install drainage aggregate; and furnish, deploy, install, and seam non-woven geotextile. Payment shall constitute full compensation for all materials, labor, equipment, tools, seaming, wastage, and Work incidental thereto, necessary to complete this item in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 14 – 8-inch Diameter SDR 11 HDPE Perforated and Solid Leachate Collection and Cleanout Riser Piping

A. Measurement. Measurement for this item shall be on a linear foot (LF) basis, of 8-inch diameter SDR 11 HDPE perforated and solid pipe within the leachate collection system, as depicted on the Construction Plans, which will be based on survey of the length of completed pipe installation performed by the Owner's surveyor.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF), which will be based on survey of the length of completed pipe installation performed by the Owner's surveyor. Payment shall constitute full compensation for all materials, labor, equipment, tools and work incidental thereto, including furnish, install, and connect fittings and perforated piping for the leachate collection trench and cleanout riser pipe, necessary to complete this item in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 15 – 18-inch Diameter SDR 9 HDPE Perforated and Solid Leachate Sump Riser Piping

A. Measurement. Measurement for this item shall be on a linear foot (LF) basis, of 18-inch diameter SDR 9 perforated and solid pipe within the leachate collection system, as depicted on the Construction Plans, which will be based on survey of the length of completed pipe installation performed by the Owner's surveyor.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF), which will be based on survey of the length of completed pipe installation performed by the Owner's surveyor. Payment shall constitute full compensation for all materials, labor, equipment, tools and work incidental thereto, necessary to complete this item in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 16 – 3-inch (SDR 11) x 6-inch (SDR 17) Diameter HDPE Leachate Forcemain

A. Measurement. Measurement for this item shall be on an installed linear foot (LF) basis of 3-inch (SDR 11) x 6-inch (SDR 17) diameter HDPE leachate forcemain (dual-contained) piping, as measured by the Owner's Surveyor.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF), which will be based on survey of completed 3inch (SDR 11) x 6-inch (SDR 17) diameter HDPE leachate forcemain (dual-contained) piping performed by the Owner's surveyor. Payment will include fittings, piping, and connections. Payment includes excavation, trenching, clean soil backfill, and soil compaction; and fittings, joining materials, witness pipes, and accessories required for the installation of piping, including connections to proposed piping, performance testing, witness pipes, and incidentals. Payment shall constitute full compensation for all materials, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Construction Plans and Technical Specifications.

Item No. 17 – Leachate Collection Sump (Drainage Aggregate, Non-Woven Geotextile, and HDPE Geomembrane Rubsheet)

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment. Payment for this item shall be at a lump sum (LS) basis. Payment will include drainage aggregate, non-woven geotextile, and HDPE geomembrane rubsheet **(excluding 8-inch HDPE SDR 11 leachate cleanout pipe and 18-inch HDPE SDR 9 leachate sump riser pipe)** as depicted on the Construction Plans. Payment shall constitute full compensation for all materials, labor, equipment, tools, welding, storage, handling, protection, repair and Work incidental thereto, necessary to complete this item as shown on the Construction Plans and in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications. **Contractor shall note, 8-inch HDPE solid pipe, and 18-inch HDPE perforated and solid pipe shall be measured and paid under their respective bid items**.

Item No. 18 – Reinforced Concrete Sump/Cleanout Riser Headwall

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment. Payment for this item shall be at a lump sum (LS) basis. Payment will include reinforced concrete sump headwall as depicted in the Construction Plans. Payment shall constitute full compensation for all materials, labor, equipment, tools, rebar, storage, handling, protection, repair (if necessary) and Work incidental thereto, necessary to complete this item as shown on the Construction Plans and in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 19 – Leachate Pump, Control Panel, Discharge Pipe, and Connection to Forcemain Pipe

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment. Payment for this item shall be at a lump sum (LS) basis. Payment will include furnish and installation of submersible leachate pump and controls, including installation and connection of electrical; and pipe, fittings, and valves (HDPE/SS) for the discharge pipe connections to the pump and terminations, as depicted in the Construction Plans. Payment shall constitute full compensation for all materials, labor, equipment, tools, welding, storage, handling, protection, repair and Work incidental thereto, necessary to complete this item as shown on the Construction Plans and in accordance with Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 20 – Electrical Tie-in to Junction Box at Cell 4, New Electrical Conduit from Cell 4 to Cell 6, and New Electrical Junction Box at Cell 6

A. Measurement. Measurement. The Work required for this item will not be measured for payment.

B. Payment. Payment for this item shall be at a lump sum (LS) basis. Payment will include fittings, joining materials, and accessories required for the installation of conduit/piping and electrical lines at existing junction box at Cell 4. Payment shall include all work association with installation of conduit/piping from Cell 4 to Cell 6; installation of new junction box at Cell 6; connection to leachate pump and controls; excavation, trenching, clean soil backfill, and soil compaction; and incidentals. Payment shall constitute full compensation for all materials, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Construction Plans and in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 21 – Road Surface Completion (Woven Geotextile and 12-inch Road Base)

A. Measurement. Measurement for this item shall be on an in-place square yard (SY) basis of 12-inch thick road base installed over woven geotextile (i.e., surface completion), as depicted on the Construction Plans, which will be based on surveys of the completed installation performed by the Owner's surveyor.

B. Payment. Payment for this item will be at the contract unit price per square yard (SY), which will be based on surveys of the installed surface completion performed by the Owner's surveyor. Payment shall include all Work to procure and install road base; and to deploy, install, and seam woven geotextile. Payment shall constitute full compensation for all materials, labor, equipment, tools, seaming, wastage,

and Work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 22 – Rip Rap (D_{50} = 9 in.) and 12 oz/sy Non-Woven Geotextile

A. Measurement. Measurement for this item shall be on an in-place square yard (SY) basis of Rip Rap installed over non-woven geotextile, as depicted on the Construction Plans, which will be based on surveys of the completed installation performed by the Owner's surveyor.

B. Payment. Payment for this item shall be at the contract unit price per square yard (SY) of Rip Rap and non-woven geotextile separation layer installed as depicted in the Construction Plans. Payment shall constitute full compensation for all materials, labor, equipment, tools and work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 23 – 36-inch Diameter CMP

A. Measurement. Measurement for this item shall be on installed linear foot (LF) basis of 24-inch diameter CMP, as measured by the Owner's Surveyor.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF). Payment shall include all Work to furnish, deploy, and install 36-inch diameter CMP, as specified on the Construction Plans. Payment shall constitute full compensation for materials, labor, equipment, tools, and Work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications. **Contractor shall note, General Fill and/or Excavation associated with this bid item will be measured and paid under their respective bid items.**

Item No. 24 – 4-Foot Orange Safety Fence (Below Access Ramp and Turnaround Pad)

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment. Payment for this item shall be at a lump sum (LS) basis. Payment shall constitute full compensation for all labor, equipment, tools, and work incidentals thereto, necessary to complete this item in accordance with Construction Plans, related to placement of approximately 700 LF of orange safety fence.

Item No. 25 – Seed, Mulch, and Fertilizer (Areas Disturbed Outside Limits of Construction)

A. Measurement. The Work required for this item will not be measured for payment.

B. Payment. Payment for this item shall be at a lump sum (LS) basis. Payment includes seed, fertilizer, wood cellulose fiber mulch (only in areas disturbed outside limits of construction as shown on the construction plans), placement of materials using a hydro mulcher or equivalent equipment, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

Item No. 26 – Pipe and Valve Anchor

A. Measurement. Measurement for this item shall be on an each unit basis.

B. Payment. Payment includes installation of HDPE valves, fittings, PVC and HDPE piping, unistrut pipe clamps, concrete and rebar, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance

with the Construction Plans, Construction QA/QC Plan, and Technical Specifications and as shown on the Construction Plans.

Item No. 27 – 8-Foot Tall Chain Link Fence

A. Measurement. Measurement for this item shall be on installed linear foot (LF) basis of 8-foot tall chain link fence, as measured by the Owner's Surveyor.

B. Payment. Payment for this item shall be at the contract unit price per linear foot (LF). Payment shall include all Work to furnish, deploy, and install 8-foot tall chain link fence, as specified on the Construction Plans. Payment shall constitute full compensation for materials, labor, equipment, tools, and Work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications.

3.2 MEASUREMENT AND PAYMENT – BID ALTERNATE

Item No. BA-1 –1-foot Protective Cover (Imported from off-site borrow sources with $k \geq 1.3 \times 10^{-5}$ cm/sec)

A. Measurement. Measurement for this item shall be on an in-place cubic yard (CY) basis of certified 1-foot protective cover obtained from off-site source(s), as delineated by the liner limits of Cells 6 & 7, which will be based on surveys of the completed installation performed by the Owner's surveyor.

B. Payment. Payment for this item will be at the contract unit price per cubic yard (CY). Payment will include all Work to furnish material from offsite source and place the protective cover, including extending past the liner limits for liner tie-in or termination, as shown on the Construction Plans. Payment shall constitute full compensation for all materials, labor, equipment, tools and work incidental thereto, necessary to complete this item in accordance with the Construction Plans, Construction QA/QC Plan, and Technical Specifications. No additional payment will be provided for protective cover thicknesses in excess of 1-foot or areas that do not meet project requirements and need to be reworked and retested.

END OF SECTION

a. The CQA Monitor, designated by and acting under the direction of the Owner and/or Certifying Engineer, shall have the authority to inspect all work done and all materials furnished. Such inspection may extend to all or any part of the Work and to the preparation, fabrication or manufacture of the materials to be used or Work performed. The CQA Monitor is authorized to call to the attention of the Contractor any failure of the Work or materials to conform to the Construction Plans, Technical Specifications, and Contract Documents, and shall have the authority to reject materials or Work until any situation at issue can be referred to and decided by the Certifying Engineer. These inspections are for assurance on behalf of the Owner and do not relieve the Contractor from the responsibility of controlling the quality of Work or materials furnished under this Contract.

b. The CQA Monitor shall not act as foreman, perform other duties for the Contractor, or interfere with the management of the Contractor's Work. Any advice that the CQA Monitor may give the Contractor shall not be construed as binding the Owner/Certifying Engineer in any way nor waiving any of the terms of the Contract.

1.2 PROJECT LOCATION AND ACCESS

A. Project Location: The Site (also referred to in the Contract Documents as Project Site) is the City of Lawton Landfill (referred herein as Landfill or Facility). The Site is located at 8902 SW 11th St, Lawton, OK 73501.

B. Access: Access to the work areas for equipment and materials is via the landfill's existing site entrance, as depicted on the Construction Plans.

1. Contractor shall coordinate with the Owner on completion of the daily sign-in/out form. The sign-in/out form shall include the names of all personnel present on-site, including but not limited to the Contractor, Sub-Contractor, and/or CQA personnel.

2. Prior to conducting Work, all personnel present on-site, including but not limited to the Contractor, Sub-Contractor, and/or CQA personnel shall complete the site’s health and safety training.

3. The Contractor and their subcontractors, vendors, and suppliers shall not interfere with landfill operations and shall obey traffic safety signs at all times.

4. The Contractor and their subcontractors, vendors, and suppliers shall not interfere with other Contractors’ operations that may be working at the Site.

1.3 SCOPE OF WORK

A. General: The Work included in the contract includes, but is not limited to, the following:

1. Earthwork to prepare the liner subgrade; cell floor and sideslope liner systems, comprised of a 2-foot compacted clay liner and 60-mil double-sided textured geomembrane;

2. Leachate collection system, comprised of leachate collection sump and piping, drainage aggregate, geocomposite, and non-woven geotextile;

3. Liner protective cover soil;

4. Concrete sump/cleanout riser retaining wall;

5. Leachate pump, controls, and electrical;

6. Leachate forcemain;

7. Stormwater drainage features around the liner system, comprised of downchute, berms, rip rap, corrugated metal pipe (CMP), low water crossing, and other associated items;

8. Access road, ramp, and turnaround pad;

9. Other appurtenances specified in the Construction Plans and Technical Specifications;

10. One add alternate related to the following:

    a. Furnishing and Placement of 1-foot Protective Cover ($k \geq 1.3 \times 10^{-5}$ cm/sec) obtained from Off-site Borrow Source;

B. The Work is more fully detailed in the Technical Specifications and Construction Plans included herein.

1. The above description of the Work is for general information only, and does not limit the responsibility of the Contractor to accomplish the Work in strict accordance with the Contract Documents, Construction Plans and these Technical Specifications.

2. Environmental Observations: The Work shall be performed in strict accordance with the applicable requirements of the state and local agencies having jurisdiction, and in accordance with the requirements of the Contract Documents and these Technical Specifications.

3. The Contractor shall note that other construction projects or operations may be occurring onsite. As such, Contractor shall use appropriate coordination concerning daily activities during construction to avoid interference with other Contractors or landfill operations. If it is necessary in the course of operating the landfill for the Contractor to move its equipment and/or materials, he shall do so promptly and place that equipment and/or materials in an area that does not interfere with landfill operations.

4. Construction Quality Assurance (CQA). Owner will provide on-site inspection and quality assurance during construction. Quality control procedures will involve scheduled checking of soil placement testing and construction observation of the material and equipment components.

1.4 CONSTRUCTION SEQUENCE, MEETINGS, AND SCHEDULE

A. The Contractor shall provide a detailed construction schedule describing the construction sequence for the project, as described in Section 01200 – Construction Meetings and Schedule. The construction sequence detailed in the construction schedule shall be prepared to limit the interference with landfill operations, as approved by the Owner and Engineer.

B. Meetings will be conducted between the Owner, Engineer, CQA Consultant, and Contractor prior to commencement of construction, at least weekly during construction of the project, and other times as requested by the Owner, as specified in Section 01200 - Construction Meetings and Schedule. The intent of these meetings is to review and discuss specification requirements for that particular sequence of construction.

C. At least once per month the Contractor shall present an updated construction schedule outlining and detailing the equipment, personnel, and materials required, including source, transportation, handling, and placement of proposed materials. The Contractor shall cooperate fully and coordinate his activities with other activities and Owner staff to ensure adequate notification and suitable access for the Work.

1.5 EXISTING SITE CONDITIONS

A. The Contractor is advised that the construction of this project at the landfill may entail working in, on, and adjacent to buried solid wastes and refuse. As buried organic materials decompose anaerobically, they generate landfill gas (LFG). This LFG (or biogas) normally consists of about 45 percent carbon dioxide

(CO_2), 55 percent methane (CH_4) and other gases, depending on the composition of the buried materials. Occasionally hydrogen sulfide (H_2S) or other toxic gases have been encountered at some landfills even though the site was not classified as a hazardous waste disposal site.

B. This Landfill is permitted for the disposal of "nonhazardous solid waste." Notwithstanding the above, the Owner cannot guarantee that toxic or hazardous materials or vapors will not be encountered by the Contractor during the performance of this project.

C. Owner will continue the disposal of waste within the active Landfill area. Owner will continue the use of the access road that runs through the construction area. Therefore, the access road must be kept open and the Contractor is to furnish flagmen and/or all weather bypass lanes when necessary.

1.6 ACCESS TO WORK

A. The authorized representatives of the following agencies will also have the right of access to inspect the Work covered by these Contract Documents during the performance of this Contract:

1. Owner or representative thereof.

2. Oklahoma Department of Environmental Quality (DEQ).

3. Other Local, State, and Federal Agencies.

B. These inspections will be performed in the presence of the Owner, Engineer, and/or CQA Consultant.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01200

CONSTRUCTION MEETINGS AND SCHEDULES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for the pre-construction, weekly progress, and daily progress meetings.

B. Requirements for Contractor’s construction schedule.

1.2 PRE-CONSTRUCTION MEETING

A. A pre-construction meeting will be held at the landfill scalehouse building.

B. Attendance:

1. Contractor's Office Representative.

2. Contractor's On-site Field Superintendent.

3. Any Subcontractors or Supplier's representatives whom Contractor may desire to invite, or Owner or Engineer may request, including the Geosynthetics Installer’s Superintendent.

4. Construction quality assurance (CQA) Representatives.

5. Owner's Representatives, including Engineer.

C. A suggested format would include, but not be limited to, the following subjects:

1. Presentation of a proposed construction progress schedule and initial submittals as required by the Contract Documents.

2. Discussion of sequence of Work, and specific topics of interest to the Contractor, Owner, and Engineer.

3. Required bonds and insurance certifications prior to Notice-to-Proceed.

4. Time for completion and liquidated damages.

5. Procedures for handling submittals.

6. Direction of correspondence, and coordinating responsibility between Contractor, Geosynthetics Installer, Engineer, and Owner.

7. Requirement for a weekly progress meetings for all involved.

8. Quality control, quality assurance, and laboratory testing of construction materials.

9. Applications for payment, and progress payment procedures.

10. Change Order procedures.

11. Owner's landfill regulations.

D. The meeting will be documented by the Engineer or the Owner's CQA Monitor. Copies of the minutes and relevant documents will be provided to all parties.

1.3 PROGRESS MEETINGS

A. The Owner will schedule and administer weekly progress meetings and such additional meetings as required, or as requested by the Owner. Meetings will be held via teleconference.

B. Attendance at these progress meetings is the same as specified in **Part 1.2.B** of this Section. On-site attendance by at least one Contractor representative is mandatory at all progress meetings.

C. Meeting requirements:

1. The Owner or the Engineer, at the Owner's discretion, will administer the following general requirements for progress meetings:

a. Prepare agenda for meetings.

b. Make physical arrangements for meetings.

c. Preside at meetings.

d. Record significant proceedings and decisions of meeting.

e. Reproduce and distribute copies of meeting record within seven days after each meeting to participants in meeting and to parties affected by decisions made at meeting.

D. Suggested Agenda:

1. Review and approval of record of previous meeting.

2. Review of work progress since previous meeting.

3. Field observations, problems, and conflicts.

4. Problems which impede work schedule.

5. Corrective measures and procedures to regain projected schedule.

6. Revisions to Construction Progress Schedule.

7. Coordination of schedules between Subcontractors.

8. Review submittal schedules; expedite as required.

9. Maintenance of quality and safety standards.

10. Pending changes and substitutions.

11. Review proposed changes for effect on construction schedule and completion date, and on other contracts of projects.

12. Review of drawings and specifications that govern the next week of Work.

13. Review of bid item quantities relative to original estimates.

E. The Contractor shall submit pay requests by the 28th of each month.

1.4 DAILY PROGRESS MEETINGS

A. An informal progress meeting will be held daily before the start of work. At a minimum, this meeting will be attended by the CQA Monitor, Subcontractors, and Contractor. The purpose of this meeting is to:

1. Review scheduled Work activities.

2. Discuss problems and resolutions.

3. Review test data.

4. Discuss the Contractor's personnel and equipment assignments for the day.

5. Review the previous day's activities and accomplishments.

B. This meeting will be documented by the Contractor. Copies of the minutes and relevant documents will be provided to all parties.

C. The Landfill Manager or other Owner Representatives may attend this meeting at their discretion.

1.5 CONSTRUCTION SCHEDULE

A. Contractor’s construction schedule shall be prepared in accordance with the General Terms and Conditions, as incorporated into these Contract Documents.

B. If, at any time during the project, Contractor fails to complete an activity or milestone by its latest scheduled completion date, Contractor must revise the construction schedule and submit a written statement as to how and when Contractor will reorganize work force or construction sequencing to maintain the currently scheduled contract completion date. The revised construction schedule and written statement shall be submitted to Owner at the next scheduled bi-monthly progress meeting.

C. Whenever it becomes apparent from progress evaluation and updated schedule data that milestone completion dates and/or contract completion dates will not be met, some or all of the following actions must be taken:

1. Increase construction staffing in such quantities and crafts to substantially eliminate backlog of work.

2. Increase number of working hours per shift, shifts per work day, work days per week, or amount of construction equipment, or combination of foregoing to substantially eliminate backlog of work.

3. Reschedule work items to achieve concurrence of accomplishment.

D. Under no circumstances will addition of equipment or construction forces, increasing working hours or any other method, manner or procedure to return to current Construction Progress Schedule be considered justification for contract modification or treated as an acceleration.

E. Liquidated damages will be assessed as set forth the Contract Documents.

F. The Contractor's initial construction schedule shall be based upon the notice-to-proceed date and be submitted to the Owner and Engineer as described in **Section 01300**. Contractor shall update and submit the construction schedule at least monthly or when requested by the Owner or Engineer.

G. Provide details for scheduled activities over the month following the current day of the schedule.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. The word "submittals" shall be interpreted to include Construction Plans, product data, manuals, certifications, test reports, materials, samples, charts, brochures, warranties, record drawings, and other items furnished by Contractor for approval, information, and/or other purposes, as specified in the individual Technical Specifications.

B. Electronically transmit each submittal to Owner and Engineer, unless otherwise noted in the individual technical specifications. Indicate on each submittal whether it is an original submittal or a re-submittal. Once the submittal is deemed satisfactory by the Engineer, the submittal will be electronically returned to the Contractor stamped as “Approved,” “Approved as Noted,” or “Rejected.” Approval of the submittal by the Engineer does not relieve the Contractor of the responsibility of supplying materials that comply with the Technical Specifications and/or Construction Plans.

C. Identify Work, Subcontractor or supplier, pertinent drawing sheet and detail number(s), and Technical Specification section number, as appropriate. Apply Contractor’s stamp, signature or initials certifying the review, verification of products, field dimensions, and coordination of information in accordance with the Technical Specification and/or Construction Plans.

D. Deliver submittals to Owner and Engineer according to submittal schedule described herein and individual Technical Specification sections. Schedule submittals to expedite review by the Owner and Engineer and delivery in the timeframe specified.

E. Allow seven (7) days of review time for each submittal or re-submittal.

F. Identify variations from Contract Documents, Technical Specifications, Construction Plans, and product or system limitations, which may be detrimental to successful performance of the completed Work.

G. Contractor shall distribute copies of reviewed submittals, as appropriate, to subcontractors, vendors, and suppliers, and shall instruct said parties to promptly report any inability to comply with provisions.

H. Submittals containing errors or omissions or deemed unsatisfactory will be returned to Contractor stamped “Revise and Resubmit.” The Engineer will provide one (1) copy to the Contractor with the necessary corrections and changes indicated. If revisions and resubmittals are required, identify all changes made since previous submission. The Contractor shall review and resubmit as required by the Engineer until acceptance is obtained.

1.2 MANUFACTURERS INSTRUCTIONS AND PRODUCT DATA

A. When specified in individual Technical Specification sections, submit manufacturer’s printed instructions for delivery, storage, assembly, installation, adjusting, and finishing.

B. When specified submit manufacturer’s product data describing material properties specified in the individual Technical Specifications.

C. Identify conflicts between manufacturer’s instructions and material properties and Technical Specifications or Construction Plans.

1.3 MANUFACTURERS / SUPPLIERS CERTIFICATES

A. Where specified in individual Technical Specification sections, submit manufacturer's certificates for Engineer review.

B. Demonstrate that material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications, as appropriate.

C. Certificates may be recent or previous tests results on material or product, but must be acceptable to Engineer.

1.4 MATERIAL TESTING

A. Where specified in individual Technical Specification sections, submit testing results to Engineer for review.

B. Demonstrate that material conforms to or exceeds specified tests. Submit supporting reference data, affidavits, and certifications, as appropriate. Submittal shall include date of test, test method, result of test, mitigation of failing test, etc.

1.5 SUBMITTAL DUE TIMES

A. The tables below list the submittals required by the Technical Specifications. Any submittal required to be submitted by the Contractor, but which is not listed in tables, shall be submitted in accordance with the applicable requirements of this Technical Specification.

B. Division 1 – General Requirements

Specification Reference Section	Submittal Requirement	Submittal Due Time
01010	Sign-In/Out Form	Daily to Owner
01190	Health and Safety Plan	See Note 1
01200	Initial Construction Schedule	See Note 1
01200	Construction Schedule Updates	Monthly.
01500	Field Office Location, if applicable	7 days following Contract Award
01560	Storm Water Pollution Prevention Plan	See Note 1
01600	Product Substitutions	15 days following Contract Award.

Note:

1. The Contractor shall provide these submittals for review and/or approval within 14 days following award of the contract or prior to commencement of construction, whichever occurs first.

C. Division 2 – Site Work

Specification Reference Section	Submittal Requirement	Submittal Due Time
02231	Drainage Aggregate Source/Sample (See Note 1)	Following notice-to-proceed.
02231	Rip Rap Source/Test Results	15 days prior to delivery to Site.
02231	Coarse Aggregate Source/Gradation	15 days prior to delivery to Site.
02777	Woven Geotextile Product Data	30 days prior to procurement.
02777	Woven Geotextile Manufacturer's Qualifications	30 days prior to procurement.
02777	Woven Geotextile Certification	15 days prior to delivery to Site.
02278	Non-Woven Geotextile Product Data	30 days prior to procurement.

02778	Non-Woven Geotextile Manufacturer's Qualifications	30 days prior to procurement.
02278	Non-Woven MQC Testing Certifications	15 days prior to delivery to Site.
02922	Geomembrane Product Data	30 days prior to procurement.
02922	Geomembrane Manufacturer's Qualifications	30 days prior to procurement.
02922	Geomembrane Installer's Qualifications	30 days prior to procurement.
02922	Geomembrane MQC/MQA Program	30 days prior to procurement.
02922	Geomembrane MQC Testing Certifications	15 days prior to delivery to Site.
02922	Geomembrane Panel Layout and Deployment Plan	15 days prior to delivery to Site.
02922	Geomembrane Warranty	Within 15-Days of completing Work.
02922	Geomembrane Nondestructive Seam Test Results	Following completed tests.
02930	Geocomposite Product Data	30 days prior to procurement.
02930	Geocomposite Manufacturer's Qualifications	30 days prior to procurement.
02930	Geocomposite Installer's Qualifications	30 days prior to procurement.
02930	Geocomposite MQC/MQA Program	30 days prior to procurement.
02930	Geocomposite MQC Testing Certifications	15 days prior to delivery to Site.

Notes:

1. Contractor shall identify the aggregate source(s) to the Owner's CQA Consultant and ship (at the Contractor's expense) necessary samples and sample size to the geotechnical testing laboratory selected by the Owner's CQA Consultant.

D. Division 3 – Concrete

Specification Reference Section	Submittal Requirement	Submittal Due Time
03300	Product Data for Cement Materials	15 days prior to delivery to Site.
03300	Mix Design Test Data for 28-Day Strength	15 days prior to delivery to Site.
03300	Concrete Mix Design	15 days prior to delivery to Site.

C. Division 11 – Pumps

Specification Reference Section	Submittal Requirement	Submittal Due Time
11300	Leachate Pump, Fittings, Valves, and Appurtenances Product Data, Shop Drawings, and Pump Curve	15 days prior to delivery to Site.
11300	Underdrain Pump, Fittings, Valves, and Appurtenances Product Data, Shop Drawings, and Pump Curve	15 days prior to delivery to Site.
11300	Pump Operations and Maintenance Manual	Within 15-Days of completing Work.
11300	Pump Warranty	Within 15-Days of completing Work.

D. Division 15 – Mechanical

Specification Reference Section	Submittal Requirement	Submittal Due Time
15400	Leachate Forcemain Pipe Product Data	15 days prior to delivery to Site.
15400	Leachate Forcemain Cleanout Product Data	15 days prior to delivery to Site.
15400	Leachate Forcemain Isolation Valve Product Data	15 days prior to delivery to Site.
15400	HDPE Pipe Pressure Test	15 days prior to delivery to Site.
15400	HDPE Pipe and Fittings Product Data	15 days prior to delivery to Site.
15400	Leachate Collection Pipe Certification	15 days prior to delivery to Site.
15400	Ductile Iron Back-up Ring Product Data	15 days prior to delivery to Site.
15400	Gasket Product Data	15 days prior to delivery to Site.
15400	Bolts, Nuts, and Washers Product Data	15 days prior to delivery to Site.
15400	Pipe Insulation Product Data Sheet	15 days prior to delivery to Site.

E. Division 16 – Electrical

Specification Reference Section	Submittal Requirement	Submittal Due Time
16010	Shop Drawings	15 days prior to delivery to Site.
15400	As-Built Electrical Drawings	15 days following electrical installation

F. Construction Plans

Specification Reference Section	Submittal Requirement	Submittal Due Time
Construction Plans	CMP Pipe Product Data	15 days prior to delivery to Site.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION

SECTION 01400

QUALITY CONTROL AND QUALITY ASSURANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction Quality Assurance (CQA) Monitor's responsibilities for quality assurance (QA) and quality control (QC) testing.

1. All QC and QA testing will be performed by a third party CQA Monitor.

2. The Owner will contract a third party CQA Monitor and Laboratory to perform QA/QC testing for the project.

B. Contractor's responsibilities for QA and QC testing.

1.2 RELATED SECTIONS

A. Section 01300 — Submittals

B. **Exhibit 1 –** QA/QC Plan for Liner and Leachate Collection System Installation and Testing

1.3 DEFINITIONS

A. **Construction Quality Assurance (CQA) –** CQA includes observations, evaluations, and testing of materials and workmanship necessary to assess and document that construction has been performed consistent with the Contract Documents. Specifically, CQA testing is the testing of materials for acceptance of the completed Work.

B. **Construction Quality Control (CQC) –** CQC includes testing to provide a means to measure the characteristics of an item or service to comply with the requirements of the Contract Documents. Typically, CQC actions will be performed by the Contractor or the manufacturers, vendors, or suppliers, unless otherwise specified in the individual Technical Specifications. All quality control testing shall be performed during construction, but prior to installation or placement of the materials. In no instance shall CQC field or laboratory testing be undertaken after completion of the Work.

1.4 CQA MONITOR'S RESPONSIBILITIES

A. The Owner's CQA Monitor will perform QC testing and QA testing for materials identified as the Owner's CQA Monitors responsibilities, including for General Fill, as specified in **Section 02210**; aggregate, as specified in **Section 02231**; protective cover, as specified in **Section 02256**, if necessary; woven geotextiles, as specified in **Section 02777**, if necessary; non-woven geotextiles, as specified in **Section 02778**, if necessary; and geomembrane, as specified in **Section 02922**. Additionally, all other QC/QA testing required in the Contract Documents will be performed by the Owner's CQA Monitor, unless otherwise specified as the Contractor's responsibility in the individual specifications.

B. Quality control and quality assurance testing by Owner's CQA Monitor is not to be considered as a replacement for quality control testing or any other testing required to be performed by the Contractor or a manufacturer producing materials for Contractor.

C. The Owner's CQA Monitor and cost for tests performed by the Owner's CQA Monitor will be contracted directly to Owner.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. QA/QC supervised by the Owner CQA Monitor

1. The Contractor shall provide adequate notice to the Owner's CQA Monitor prior to any Work requiring QA testing to prevent delays in Construction due to testing requirements.

2. The Contractor shall coordinate and assist the Owner's CQA Monitor in the collection of necessary samples (specified for testing by the Owner's CQA Monitor), including providing the equipment, labor, and material necessary for collection of said samples, under the direction and supervision of the Owner's CQA Monitor or Engineer.

3. Testing performed by the Owner's CQA Monitor does not relieve the Contractor of the responsibility to install, construct, or achieve the desired QA test results as specified for the Work in the Contract Documents.

   a. The Owner will bear the cost of the initial QA test. If the initial QA test fails, the City will bear the cost of one additional QA test.

   b. If a third QA test is necessary, the Contractor will be responsible for incurring the cost of the additional test by the Owner's CQA Monitor.

B. QA/QC Testing at the Expense of the Contractor

1. Contractor shall assume full responsibility for all quality assurance and quality control testing, specifically delegated as the Contractor's responsibility in the individual technical specifications.

2. Contractor shall submit the name, address, and qualifications, together with the scope of proposed services, of the proposed testing firm(s) and personnel conducting quality assurance and quality control testing for the project. Information shall be submitted to Owner and Engineer for approval at least seven (7) days prior to the scheduled commencement of any work requiring such testing.

3. Within 24 hours, unless otherwise specified, after completion of testing performed by or for Contractor, submit test results to the Owner and Engineer. Identify test reports with the information specified for samples in **Section 01300 – Submittals** and additionally, the name and address of the organization performing the test(s), and the date of the tests.

4. All expenses related to testing required by the Contractor shall be included in the respective unit rate for installation, construction, placement, or completion of the tested item. No separate measurement and payment will be made for quality control and quality assurance testing.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction facilities required for the construction of the Work specified under the **Section 01010 – Summary of Work** and as specified in these Contract Documents. All construction facilities will be in coordination with and approved by the Owner.

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 01560 – Environmental Protection and Special Controls

C. Section 01600 – Material and Equipment

1.3 DEFINITION

A. Construction facilities include furnishing of all equipment, materials, tools, accessories, incidentals, labor, and performing all Work for the installation of equipment and for construction of facilities, including their maintenance, operation, and removal, if required, at the completion of the Work under the Contract.

B. Construction facilities include, but are not be limited to, the following temporary offices, utilities, equipment, materials, facilities, areas, and services:

1. Field Office
2. Parking Areas
3. Temporary Roads
4. Storage of Materials and Equipment
5. Construction Equipment
6. Temporary Sanitary Facilities
7. Temporary Electric Power
8. Temporary Water
9. First Aid Facilities
10. Security

1.4 CONSTRUCTION FACILITIES

A. GENERAL REQUIREMENTS

1. Contractor is responsible for furnishing, installing, constructing, operating, maintaining, removing and disposing of the construction related facilities, as specified in this specification, and as required by the Owner for the completion of the Work under the Contract.

2. Locate and maintain construction facilities in a clean, safe and sanitary condition at all times until completion of the Contract.

3. The requirements specified herein are in addition to any requirements specified elsewhere in the Contract Documents. Construction facilities must meet the requirements for all-weather service.

4. Minimize land disturbances related to the construction facilities to the greatest extent possible and restore land to the extent reasonable and practical, to its original contours by grading to provide positive drainage, and by seeding the area to match with existing vegetation, or as specified elsewhere.

5. Design and construct utilities to provide uninterrupted service.

6. Construct/install, maintain and operate construction facilities in accordance with the applicable Federal, State, and Local laws, rules, and regulations.

B. FIELD OFFICE

1. Contractor is not required to have a field office. However, Contractor shall note, the Owner will <u>not</u> provide office space for Contractor's staff.

2. At the Contractor's discretion, a field office may be established on the property, provided the location of the office has been approved by the Owner.

3. If the Contractor elects to have a field office, the proposed location of the Contractor's office will be submitted to the Owner for approval within seven (7) calendar days of Contract Award.

C. PARKING AREAS

1. The Owner will provide parking area for maintenance and delivery vehicles, the CQA Monitor, and Contractor's Representatives, and other authorized visitors. Contractor shall coordinate with the Owner regarding areas acceptable for temporary parking. Contractor shall not allow vehicles, equipment, or materials to be stored at a location or in a manner that interferes with ongoing landfilling activities.

D. TEMPORARY ROADS

1. Temporary roads may be constructed by Contractor, at no additional cost to the Owner, for convenience of Contractor in the performance of the Work under the Contract.

2. All temporary road construction must be coordinated with the Owner, and approved by the Owner prior to construction of said roads.

3. As necessary, coordinate all road construction activities with local utilities, fire and police departments.

4. Keep erosion to a minimum and maintain suitable grades and radii of curves to facilitate ease of movement of vehicles and equipment.

5. Furnish and install longitudinal and cross drainage facilities including, but not limited to, the ditches, structures, pipes and the like.

6. Clean equipment so mud or dirt is not carried onto public roads. Clean any mud or dirt transported by equipment onto paved roads both on site and off site.

7. Maintain roads, stockpiles, and staging areas by watering during all operating hours and when directed by Owner.

8. Provide erosion and sedimentation control consistent with Section 01560 – Environmental Protection and Special Controls.

E. STORAGE OF MATERIALS AND EQUIPMENT

1. Make arrangements for storage areas for materials and equipment, as specified in Section 01600 – Material and Equipment. Locations and configurations of such facilities are subject to the acceptance of the Owner. Security of all stored materials (paid and unpaid) and equipment is the sole responsibility of the Contractor.

2. Confine all operations, including storage of materials, to Owner-approved area. Contractor is liable for any and all damage caused during such use of property of the Owner or others.

3. Store materials in accordance with manufacturer's instructions when applicable.

4. Store construction materials and equipment within boundaries of designated areas. Storage of gasoline or similar fuels must conform to state and local regulations and be limited to the areas approved for this purpose by the Owner.

F. CONSTRUCTION EQUIPMENT

1. Erect, equip, and maintain all construction equipment in accordance with all applicable statutes, laws, ordinances, rules, and regulations or other authority having jurisdiction.

2. Construction equipment and temporary work must conform to all the requirements of State, County, and Local authorities, OSHA, and underwriters which pertain to operation, safety, and fire hazard. Furnish and install all items necessary for conformity with such requirements, whether or not called for under separate sections of these specifications.

G. TEMPORARY SANITARY FACILITIES

1. Provide temporary sanitary facilities for use by all employees and persons engaged in the Work, including Subcontractors, their employees, and authorized visitors from the commencement of the Project through Project completion. Maintain these facilities in a clean and sanitary condition at all times.

2. Sanitary facilities include enclosed chemical toilets and washing facilities. These facilities must meet the requirements of local public health standards. Open pit or trench latrines are not permitted.

3. Locate sanitary facilities as approved by the Owner, and maintain in a sanitary condition during the entire course of the Work. At a minimum, all sanitary facilities shall be emptied at least once per week.

4. Do not use restrooms within existing or Owner occupied buildings.

H. TEMPORARY ELECTRIC POWER

1. Provide and maintain during the course and progress of the Work all electrical power and wiring requirements to facilitate the Work of all trades and services associated with the Work. Make arrangements with the applicable serving utility company or provide generators and pay all charges for providing and maintaining electrical service including usage costs at the site unless otherwise approved by the Owner. Furnish all temporary wiring, feeders, and connections.

2. Routing of temporary conductors, including welding leads, must not create a safety hazard nor interfere with operation and maintenance of existing facilities.

3. Install all temporary wiring in accordance with the applicable requirements of the local electrical code.

4. Provide power and lighting to field office, and for Work as required, at no extra cost to the Owner.

I. TEMPORARY WATER

1. On-site water source, identified in the Construction Plans, will be used for construction.

J. FIRST AID FACILITIES

1. Provide first aid equipment and supplies to serve all Contractor personnel and CQA Monitor at the Site.

K. SECURITY

1. Make all necessary provisions and be responsible for the security of the Work and the site until final inspection and acceptance of the Work unless otherwise approved by the Owner. Any on-site materials or equipment lost or stolen during construction of Work shall be replaced at no additional cost to the Owner.

L. SHUT-DOWN TIME OF SERVICES

1. Do not disconnect or shut down any part of existing utilities and services, except as approved by the Owner.

M. MAINTENANCE

1. Maintain all construction facilities, utilities, temporary roads, services to office, and the like in good working condition as required by the Owner during the term of the Contract.

1.5 REMOVAL OF CONSTRUCTION FACILITIES

A. Upon completion of the Work, or prior thereto, when so required by Engineer:

1. Repair damage to roads to their original condition caused by or resulting from the Contractor's Work.

2. Remove and dispose of all construction facilities including office trailers and other facilities; utilities; roads and benches; construction equipment; informational and identification signs, framing, supports, and foundations; and sanitation facilities. Similarly, return all areas utilized for temporary facilities to their near original, natural state, or as otherwise indicated or directed.

B. Restore temporary roads built for Contractor's convenience to near original conditions to the extent practicable unless otherwise approved by the Engineer.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01560

ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Specifications for controlling the pollution of land, air, and water, as described herein.

B. Disposal of solid waste materials.

C. Special controls, include the protection of structures including, groundwater wells, landfill gas probes, landfill gas collection system components (i.e., extraction wells, piping, and condensate management system), if any; utilities including leachate forcemain, wind fence, electrical, etc.; and other landfill appurtenances in the vicinity of the Work from damage.

1.2 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 02210 – Excavation, Backfill, Fill, and Grading

C. Section 02270 – Soil Erosion and Sediment Controls

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 ENVIRONMENTAL PROTECTION

A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations.

B. No hazardous materials are allowed to be stored at the construction site. Environmental protection measures shall include, but are not limited to, the requirements for land, air, and water, as described in **Part 3.1.C. through Part 3.1.H**.

C. Land Protection:

1. Except for any Work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition. Contractor shall confine his construction activities to areas defined for Work within the Contract Documents.

2. Manage and control all Work area, soil stockpiles, embankments, and other land disturbances, storage areas, and access routes to prevent sediment from entering nearby water or land adjacent to the Work.

3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover, as necessary or as directed by the Owner.

4. Unless earthwork is immediately surfaced, protect all side slopes and backslopes immediately upon completion of final grading.

5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.

6. Except for areas designated by the Contract Documents to be cleared and grubbed, the Contractor shall not deface, injure or destroy trees and vegetation, nor remove, cut, or disturb them without approval of the Owner/Engineer. Any damage caused by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense.

D. Drainage and Erosion Protection:

1. It is the Contractor's responsibility to prevent erosion and sedimentation as a result of performance of the Work. Therefore, the Contractor shall utilize methods necessary to effectively prevent erosion and control sedimentation in accordance with Section 02270 – Soil Erosion and Sediment Control.

2. The Contractor shall provide adequate drainage or protection of the Work from surface water run-on or ponding, at the expense of the Contractor.

a. No separate measurement or compensation will be paid for subdrains, pumps, or other methods of draining.

b. The Contractor shall be entirely responsible for adequately draining and pumping surface water from the Work. In the event the Contractor fails to provide adequate surface water protection (i.e., erosion, ponding, etc.), which results in damage to the Work, the Contractor shall repair the Work at the expense of the Contractor.

E. Control of Chemical Waste:

1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.

2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides from entering drainage ways.

3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other waste waters to enter a drainage way(s) or stream.

F. Control of Dust:

1. The control of dust shall mean that no construction activity shall take place without applying all such reasonable measures as may be required to prevent particulate matter from becoming airborne so that it remains visible beyond the limits of construction. Reasonable measures may include road surfacing and application of water.

2. Utilize methods and practices of construction to eliminate dust in full observance of agency regulations.

3. The Engineer and/or the Owner will determine the effectiveness of the dust control program and may request the Contractor to provide additional measures, at no additional cost to the Owner.

G. Burning: Do not burn material on the site.

H. Control of Noise: Control noise by fitting equipment with appropriate mufflers.

3.2 SOLID WASTE DISPOSAL

A. Collect solid waste generated from construction activities on a daily basis, including degradable solid waste, non-degradable solid waste, trees, branches, brush, or wood wastes from clearing and grubbing operations, and dispose of said waste as described below, at no additional cost to the Owner.

B. Dispose of degradable solid waste at the working face of the landfill. Contractor shall coordinate with the Owner (Landfill Manager) regarding acceptable time of day for disposal of waste at the working face (**note: working face hours at the landfill are Monday through Saturday, 8:00 AM to 5:00 PM**). Additionally, prior to disposal of material at the landfill, the Contractor shall notify the Owner (Landfill Manager).

C. Dispose of trees, branches, or untreated wood waste from clearing and grubbing operations, if necessary for performance of work, at wood waste locations or Landfill working face as directed by the Owner.

D. Dispose of non-degradable, non-hazardous solid waste at the Landfill working face or to an alternate site approved by the Owner and regulatory agencies.

E. Contractor will not be charged a tipping fee for solid waste generated during construction activities at the Owner's Landfill. Contractor will be required to drive waste-containing vehicles over the Landfill scales for the Owner to record the weight of the waste.

3.3 SPECIAL CONTROLS

A. Protect existing structures including, groundwater wells, landfill gas probes, landfill gas collection system components; utilities including, but not limited to, leachate forcemain, electrical, etc.; and other landfill appurtenances in the vicinity of the Work from damage.

1. The Contractor is cautioned of the potential hazards of landfill gas, as specified under **Section 01190 – Health and Safety**.

2. Locate and mark all existing structures, such as groundwater wells, landfill gas probes, landfill gas collection system components; utilities including, but not limited to, leachate forcemain, electrical, etc.; and other landfill appurtenances in the vicinity of the Work.

3. Notify the Owner and Engineer immediately of any structures or utilities that interfere with the completion of the Work.

4. Inform employees of existing structures and utilities and the importance of protecting these from damage.

5. Protect all structures and utilities located in the vicinity of the Work from damage.

6. Repair or replace any damage to existing structures or utilities caused by Work performed under this contract at no cost to the Owner. The Owner reserves the right to select replacement of structures or utilities as a result of damage, and selection of Contractor or Subcontractor to perform such replacement work.

B. Protection of existing easements, rights-of-way, utilities, and other structures.

1. Prior to beginning Work, locate easements, right-of-ways, utilities and other structures (i.e. gas monitoring probes, electrical lines, culverts, and/or discharge structures, etc.) that are adjacent to or cross the Work area, and provide temporary markers designating these facilities. **All utility locations shown on the Construction Plans are approximate unless otherwise indicated. For underground utility locations, contact OKIE811 prior to excavations.**

2. Protect permanent and temporary markers, and replace if moved or lost during construction.

C. The Owner shall not be liable for any costs, injury, damage or loss associated with disturbance, impact, or damage to facilities or structures, regardless of whether the locations of said facilities or structures were properly or completely identified, or whether markers identifying such facilities were installed or maintained by Contractor.

1. Provide all necessary measures to protect structures, facilities, utilities and/or service lines from disturbance, impact, or damage.

2. Any Contractor-caused damage to facilities, structures, utilities and/or service lines, shown or not shown on the Construction Plans, shall be repaired or replaced at no cost to the Owner and shall be accomplished by the Contractor or Subcontractor approved by the Owner. The Owner reserves the right to select replacement of structures or utilities as a result of damage, and selection of Contractor or Subcontractor to perform such replacement work.

3.4 CONSTRUCTION SIGNAGE, BARRICADES, AND TRAFFIC CONTROL

A. The Contractor shall be responsible for furnishing all labor, material, equipment and incidental items needed to provide adequate construction signage, barricades, traffic control devices and other related items for the project area during the construction period.

B. **The Contractor shall provide a flagman in locations directed by the Owner to direct traffic when execution of Work is being performed in such areas or when performing road crossings, if applicable. When using a flagman, the Contractor shall coordinate with the Owner at least 48 hours prior to initiating any traffic control changes or road crossings**.

C. The work for construction signage, barricades, and traffic control shall be considered an incidental item and the cost of this item is to be included in other pay items.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products

B. Product Delivery

C. Product Storage, Handling, and Protection

D. Product Options and Substitutions

1.2 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01500 – Construction Facilities

1.3 PRODUCTS

A. Products: Means newly manufactured material, machinery, components, equipment, fixtures, and systems forming the work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

1.4 PRODUCT DELIVERY

A. Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.

B. Deliver products or equipment in manufacturer’s original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.

C. Clearly and fully mark and identify as to manufacturer, item, and installation location.

D. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.

E. Follow manufacturer’s instructions for storage and handling.

F. Products and/or equipment delivery schedule, and storage location(s) shall be coordinated with the Owner prior to delivery.

1.5 STORAGE, PROTECTION, AND HANDLING

A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible.

B. Store sensitive products in a weather-resistant and climate controlled enclosure. For exterior storage of fabricated products, place on sloped supports above ground.

C. Protect equipment from exposure to elements. Store pumps, motors, electrical equipment, and other equipment having anti-friction or sleeve bearings in weather-tight storage building, which are maintained at a temperature of at least 50 degrees Fahrenheit. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

D. Provide off-site storage and protection when site does not permit on-site storage or protection.

E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

F. Store loose granular materials on solid flat surfaces in a well-drained area, as practical.

G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

H. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions. Repair or replace protective cover as required.

I. Handle products or equipment in accordance with manufacturer's recommendations and instructions.

1.6 PRODUCT OPTIONS AND SUBSTITUTIONS

A. The Contract is based on standards of quality established in the Contract Documents.

1. In agreeing to the terms and conditions of the Contract, the Contractor has accepted a responsibility to verify that the specified products will be available and to place orders for all required materials in such a timely manner as is needed to meet the agreed construction schedule.

2. Neither the Owner nor the Engineer has agreed to the substitution of materials or methods called for in the Contract Documents, except as they may specifically otherwise state in writing.

B. Materials and/or methods specified by name:

1. Where materials and/or methods are specified by naming one single manufacturer and/or model number, without stating that equal products will be considered, only the material and/or method named is approved for incorporation into the Work.

2. Should the Contractor demonstrate to the approval of the Engineer that a specified material or method was ordered in a timely manner and will not be available in time for incorporation into this Work, the Contractor shall submit to the Engineer such data on proposed substitute materials and/or methods as are needed to help the Engineer determine suitability of the proposed substitution.

C. Where materials and/or methods are specified by name and/or model number, followed by the phrase "or equal," or approved equal," or "or equal as approved by the Engineer," or "Engineer approved substitute," or similar wording in the Contract Documents, the Contractor shall adhere to the following procedures when requesting a product substitution:

1. The material and/or method specified by name establishes the required standard of quality.

2. Materials and/or methods proposed by the Contractor to be used in lieu of materials and/or methods so specified by name must in all ways be equal or exceed the qualities of the named materials and/or methods.

3. The Contractor shall demonstrate through submittal of product data sheet(s), certification(s), calculations, conformance testing, etc. that the material being proposed meets or exceed the qualities or properties of the named materials or methods.

4. Do not assume that the materials, equipment, or methods will be approved as equal unless the item has been specifically so approved in writing for this Work by the Engineer.

5. The Owner shall not be responsible for any incremental costs associated with rejection of a requested “or equal,” or approved equal,” or "or equal as approved by the Engineer," or “Engineer approved substitute,” or similar wording for product or service, regardless of reason for rejection. The decision of the Owner shall be final.

D. The following products do not require further approval except for interface within the Work:

1. Products specified by reference to standard specifications such as ASTM and similar standards.

2. Products specified by manufacturer's name and catalog model number.

E. Delays in construction arising by virtue of the non-availability of a specified material and/or method will not be considered by the Owner as justifying of the agreed Time of Completion.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish labor, materials, and equipment necessary to perform site clearing and grubbing as needed to perform the Work.

B. Site clearing and grubbing includes, but is not limited to:

1. Protection of trees outside of clearing limits.

2. Removal of trees, shrubs, and other vegetation within limits of construction.

1.2 RELATED SECTIONS

A. Section 01560 – Environmental Protection and Special Controls

B. Section 02210 – Excavation, Backfill, Fill, and Grading

C. Section 02270 – Soil Erosion and Sediment Control

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

A. Prior to commencement of clearing, grubbing, or other earthwork operations, the Contractor shall have required erosion and sediment controls inplace in accordance with **Section 02270**.

3.2 CLEARING

A. Clearing consists of the cutting, removal, and satisfactorily disposing of all trees, shrubs, and other vegetation within the limits of construction necessary for the completion of Work.

B. With the Owner's or Engineer's approval, trees and brush outside the clearing limits, but within the immediate vicinity of the work and landfill property boundary, may be removed if such trees or brush interfere with or slow the progress of construction operations.

C. Clearing consists of removal flush with the ground surface.

D. Repair and maintain erosion control devices during construction in order to always assure their efficiency.

3.3 GRUBBING

A. Grubbing consists of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated limits of construction to a minimum depth of 6 inches below the original surface level of the ground.

B. Fill depressions made by grubbing with suitable material and compacted to make the surface conform with the original adjacent surface of the ground, unless further excavation is indicated.

C. Complete grubbing at least 200 feet in advance of clearing operations.

3.4 REMOVAL/DISPOSAL OF DEBRIS

A. Contractor shall dispose of all material from clearing and grubbing operations, including trees, brush, wood waste, and yard waste, consistent with **Section 01560 – Environmental and Special Controls, Part 3.2**.

B. Contractor may cut, trim, saw, or otherwise dress felled timber within the limits of the Owner's property, provided all timber and waste materials are disposed of consistent with with **Section 01560 – Environmental and Special Controls, Part 3.2**.

END OF SECTION

SECTION 02210

EXCAVATION, BACKFILL, FILL, AND GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes specifications for performance of excavation, backfill, fill, and grading for completion of **Cells 6 and 7 Liner Construction** subgrade, drainage channels, and access ramp, and other specified embankments, as shown on the Construction Plans.

B. Contractor shall furnish all labor, materials, and equipment for performance of the excavation, backfill, fill, and grading, as specified in this Section and shown on the Construction Plans.

1.2 RELATED SECTIONS

A. Section 01190 – Health and Safety

B. Section 01560 – Environmental Protection and Special Controls

C. Section 02250 – Compacted Clay Layer

D. Attachment A – QA/QC Plan for Liner and Leachate Collection System Installation and Testing

E. Attachment B – Geotechnical Information

F. Attachment C – Soil Sample Test Results

1.3 REFERENCES

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

B. ASTM D698 - Standard Test Method for Moisture Density Relationship of Soils and Soil Aggregate Mixtures Using 5.5 lb. Hammer/12-Inch Drop

C. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D. ASTM D2922 - Standard Test Method for Density of Soil in Place by the Nuclear Gauge

E. ASTM D3017 - Test Method for Water Content of Soil and Rock In-place by Nuclear Methods

F. ASTM D4318 - Test Method For Liquid Limit, Plastic Limit, and Plasticity Index of Soils

PART 2 PRODUCTS

2.1 MATERIALS

A. **Topsoil:** Natural, friable soils that produce heavy growths of crops, grass, or other vegetation and is generally the soil layer found from undisturbed area of the site at the surface to a depth of 6 to 12 inches. Topsoil for placement on graded areas shall be relatively free from root balls, stones, and other materials that may hinder grading, planting, and maintenance operations, and shall be relatively free from objectionable weed seeds and toxic substances.

B. **General Fill:** Clayey soil free from chemical contamination, construction material, organics, debris, frozen material, organic matter, or unsuitable material. General Fill shall be obtained from on-site excavations, borrow areas, or stockpiles, as directed by Owner, and tested prior to use at the frequencies specified in **Part 3.10.D** of this Section.

PART 3 EXECUTION

3.1 INSPECTION OF SITE

A. Prior to beginning excavation, backfill, or fill placement activities, Contractor shall perform their layout of Work survey, and verify topography shown on the Construction Plans.

B. If the surveyed topography or existing conditions are substantially different from topography shown on the Construction Plans, immediately notify the Engineer, including providing a copy of the site plan with survey control points transcribed onto plan sheet to the Engineer.

C. Consistent with **Section 01560 – Environmental Protection and Special Controls**, Contractor is responsible for identifying existing structures, utilities, including leachate forcemain and manholes, and other landfill appurtenances (i.e., benchmarks, etc.) within the vicinity of Work. Contractor is responsible for protection of structures, utilities, and other landfill appurtenances and in the event of damage to said features; Contractor will repair or replace them at the expense of Contractor.

3.2 SURFACE/SUBGRADE PREPARATION

A. Preparation of the compacted clay liner subgrade shall be performed consistent with the Construction Plans, QA/QC Plan, as well as the requirements specified herein. Where conflicts between the Construction Plans, QA/QC Plan, and this specification exist, Contractor shall adhere to the more stringent requirements, unless otherwise directed by the Owner's CQA Monitor.

B. During preparation of the subgrade, the Contractor shall proof-roll all subgrade surfaces with heavy rubber tired construction equipment to identify areas that contain pumping or yielding soils. In the event that areas with pumping/yielding soils are encountered, Contractor shall immediately notify the Engineer and Owner's CQA Monitor. Following inspection of the identified areas the Engineer or Owner's CQA Monitor will designate those areas requiring repair. Pumping/yielding soils shall be repaired consistent with the procedures set forth in **Part 3.3.F** of this Section.

C. Contractor shall coordinate with Owner's surveyor to perform a certification survey of the prepared subgrade, consistent with **Section 01052 – Layout of Work and Surveys**, prior to placement of overlying compacted clay liner. The subgrade shall be verified for tolerance, in accordance with **Part 3.6** of this Section and the **QA/QC Plan**.

D. Prior to installation of the compacted clay liner, the CQA Monitor shall inspect the compacted clay liner subgrade and provide written certification that the subgrade is suitable for placement of the compacted clay liner, consistent with **Section 02250 – Compacted Clay Liner**.

E. Prior to placement of backfill or General Fill, the subgrade shall be scarified and moisture conditioned, if applicable, consistent with **Part 3.7** of this Section.

3.3 EXCAVATION

A. Contractor shall perform excavation in accordance with the submitted health and safety plan, including but not limited to, performance of trench safety systems.

B. Existing areas that require excavation or engineered fill placement or areas designated as stockpile locations will be stripped of 12 inches (min.) of topsoil, debris, and vegetation prior to construction activities. Topsoil will be placed in a designated area approved by the Owner.

C. Excavate to the lines and grades as indicated on the Construction Plans.

D. Contractor shall excavate near adjacent cell to uncover the existing liner of **Cells 4 and 5,** for tie-in to the **Cells 6 and 7** liner system, as shown in the Construction Plans. The Owner's CQA Monitor will approve the location and length of exposure of the existing liner prior to constructing the liner tie-in and placement of materials for the **Cells 6 and 7** liner. Contractor shall note that a mixture of municipal solid waste (MSW) and soil could be encountered near the liner tie-in location. It is unknown whether this soil/MSW mixture will be encountered, and if encountered, the quantity of this mixture that maybe encountered. **Contractor shall note, payment for uncovering the liner materials of adjacent cells for tie-in to Cells 6 and 7 liner and removal of MSW, if necessary, shall be made in accordance with the provisions of Section 01025 – Measurement and Payment (Bid Item 6).**

1. Soil/MSW mixture, if encountered, shall be excavated under the direct supervision of the Owner's CQA Monitor. Contractor shall dispose of soil/MSW mixture at the landfill working face under the direction of the Owner.

2. Contractor is required to place 6 inches of soil cover over exposed MSW by the end of each day of operation consistent with regulatory requirements.

3. Contractor shall grade internal slopes at the liner tie-ins to slopes less than or equal to the slopes indicated in the Construction Plans, unless otherwise approved by Engineer. Under no circumstances shall Contractor develop slopes greater than 1H:1V.

4. Contractor shall be prepared to manage, control, and contain any leachate or leachate seeps that may be encountered at the liner tie-in to **Cells 4 and 5**. The means and methods to manage, control, and contain leachate, if encountered, will be the Contractor's responsibility. If leachate is encountered, suggested means and methods for managing, controlling, and containing leachate may include berms to control and prevent leachate from entering the excavation, packing the slope with soil to plug leachate seeps, excavation of temporary sumps within the waste mass for pumping, etc. Execution of this work shall be performed at no additional cost to the Owner.

E. Stockpile excavated material in separate stockpiles based on material type (e.g., topsoil, clay and weathered shale, and shale). Contractor will be responsible for visual classification of soil as it is excavated and directing stockpiling operations. Contractor shall stockpile segregated soil at the locations indicated in the Construction Plans or as directed by the Owner.

F. **Repair of Pumping and Yielding Subgrade:** At the discretion of the Owner's CQA consultant, areas subject to pumping or yielding will be undercut to firm material and refilled with General Fill. In the event that seams or layers of clayey or silty sands are encountered in the near surface excavations, Contractor shall undercut and replace the silty or clayey sands with clay material to provide a suitable foundation, if necessary. No additional compensation will be paid to Contractor for addressing pumping or yielding foundation soils.

3.4 CONTROL OF SURFACE WATER AND GROUNDWATER CONSTRUCTION

A. Water that enters excavations that contain refuse shall be considered landfill leachate and shall not be discharged to the ground or by other means that are typical for stormwater. Management of landfill leachate is the responsibility of the Contractor as described in **Part 3.3.D.4** of this section.

B. Contractor shall be aware that groundwater may be encountered in excavations outside the limits of waste.

1. Excavations may encounter perched groundwater within the weathered or unweathered soil formations present at the site. In the event groundwater is encountered, the Contractor shall be required to provide sufficient temporary groundwater control during construction to facilitate adequate compaction of foundation soils.

2. If groundwater is encountered the Contractor shall immediately notify Owner, Engineer, and Owner's CQA Monitor of groundwater impacts when encountered, and Contractor shall submit for approval the proposed method for temporary groundwater control so that the construction schedule is not impacted.

3. To facilitate control of groundwater during and after construction, an underdrain system will be constructed. Underdrain system is comprised of a pumping system, and underdrain collection trench and sump filled with drainage aggregate and wrapped in non-woven geotextile. Installation of temporary dewatering systems, if necessary, in excess of cutting temporary ditches or sumps, as required by Part 3.4.E, shall be paid using the allowance following approval of costs by Owner and Engineer of any such dewatering system that may need to be installed.

C. Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove surface water or groundwater from entering excavations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations or dewater excavations. Contractor shall keep such excavations dry so as to obtain a satisfactory foundation condition for all Work.

D. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottom and soil changes detrimental to stability of subgrades and foundations. Subgrade soils which become soft, loose, "quick," or otherwise unsatisfactory for support as a result of inadequate dewatering or other construction methods shall be removed and replaced by suitable material as required by Engineer at Contractor's expense. The bottom of excavations shall be firm and without standing water prior to placement of overlying geosynthetics.

E. Contractor shall establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rainwater and groundwater removed from excavations to collecting or runoff areas.

F. Discharge of Surface Water or Groundwater:

1. Water conveyed away or removed from excavations, which has not contacted refuse materials, shall be discharged to areas as approved by the Owner and Engineer.

2. Dispose of water by procedures approved by the Engineer in such a manner as to cause no inconvenience to Owner or others involved in Work at the Site.

3.5 GENERAL FILL PLACEMENT

A. All General Fill shall be compacted to 95 percent (standard Proctor) of the maximum dry density in accordance with ASTM D698.

B. Placement and compaction of General Fill shall be performed, as specified below:

1. Deposit and spread soil in relatively uniform, horizontal lifts, no greater than 8 inches in thickness (uncompacted). Compact each lift with a minimum 3 complete passes (back and forth) of compaction equipment, to a minimum 95 percent of the maximum dry density. Additional passes may be required if quality assurance testing does not verify that adequate compaction is being achieved.

2. Prior to placement of successive lifts, scarify the surface of previously compacted lifts or subgrade using tracks of dozer, a disk, or other methods acceptable to the Engineer or Owner's CQA Monitor. Placement methods shall be such that smooth interfaces between successive lifts are not created. Moisten condition surface if dried prior to placement of successive lifts.

3. Unless otherwise specified, compact all General Fill at a moisture content within plus 4 percent or 0 percent of optimum moisture content as determined by ASTM D698, unless otherwise allowed by the Engineer.

3.6 GRADING

A. Uniformly grade areas within limits of Work, including adjacent transition areas.

B. Grade and compact with uniform levels and grades consistent with the construction plans and surrounding topography to provide adequate drainage.

C. After the completion of fill and backfill placement, all areas intersecting with or adjacent to the line of Work shall be left free, clean, and in good order.

D. Construct subgrade or finished grades to the tolerances specified in **Table 02210-1**.

TABLE 02210-1 – FINISHED GRADE TOLERANCES

SURFACE	TOLERANCE
Top of Prepared Subgrade	0 to +0.2 ft
Top of Compacted Clay Liner	0 to +0.2 ft
Top of Protective Cover	0 to +0.2 ft
Berms, Interim Sideslopes, and Access Road and Turnaround Pad	0 to +0.2 ft
Embankments and Fill Areas Outside Cell Boundary	0 to +0.2 ft
Anchor Trench Subgrade	0 to +0.2 ft

3.7 MOISTURE CONTROL

A. Where subgrade, backfill or fill material must be moisture conditioned before compaction, uniformly apply water at a rate sufficient to moisten the soil, while preventing free water from ponding on surface.

B. Moisture condition using methods which will distribute the added moisture uniformly through the soil lift or subgrade. For excessively wet soils, reduce moisture using methods which effectively promote aeration and drying of the fill material or subgrade.

C. During placement operations, keep surfaces from drying by addition of water. Protect compacted soils from excessive drying or cracking by addition of water.

D. Remove, replace, scarify, or dry fill that is too wet to achieve specified relative compaction. Prevent free water from appearing on surface during, or subsequent to, compaction operations.

E. If fill for subgrade is removed due to excessive moisture, stockpile in an area outside of the fill area and allow it to dry. Assist drying by disking, harrowing, pulverizing or other methods until moisture content is reduced to an acceptable level

F. No additional compensation shall be given to Contractor for re-working of areas that require re-compaction, moisture-conditioning, or other efforts to achieve minimum compaction and moisture content.

3.8 PROTECTION OF SUBGRADES AND FILL SURFACES

A. Protect final-graded areas from traffic and erosion. Repair settlement or erosion that occurs prior to acceptance. Repair shall include regrading and compacting to re-establish finished surfaces to specified tolerances.

B. Keep fill areas and excavations shaped and drained, with drainage directed for discharge to areas with adequate silt fencing and erosion control. Maintain ditches and drains to effectively drain at all times.

C. Do not allow water to accumulate in excavations. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate dewatering or other construction methods shall be removed and replaced with General Fill, as required by the Engineer at the Contractor's expense. The bottom of excavations shall be firm and without standing water before placing additional materials. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations and fill surfaces.

D. Do not allow equipment traffic or other operations to disturb the final grades. Do not store or stockpile materials on finished grades.

3.9 STRUCTURE FOUNDATIONS (IF APPLICABLE)

A. Provide firm, competent, and unyielding foundation for structures (i.e., sump access retaining wall).

B. Excavate or place engineered fill to specified elevation and level off to provide firm pad upon which to pour or place structure or overlying materials. General fill placed beneath structures shall be compacted to 100 percent (standard Proctor) of the maximum dry density in accordance with ASTM D698.

C. In the event pumping or yielding soils are encountered at structure foundation elevation, over-excavate a minimum of 2 feet from structure foundation and backfill with General Fill consistent with the procedures specified in **Part 3.5** of this Section, with exception engineered fill placed beneath structures shall be compacted to 100 percent (standard Proctor) of the maximum dry density in accordance with ASTM D698.

D. Prior to placing or pouring concrete structures, notify Engineer to allow an inspection of foundation conditions prior to pouring. Notify Engineer a minimum of 48 hours prior to pouring or placing structure.

E. Do not fill against structures until concrete has reached 28-day compressive strength, unless filling is approved by Engineer. Bring fill up evenly, in a manner that does not damage or shove structure. Do not strike structure with compaction equipment.

3.10 QUALITY CONTROL / QUALITY ASSURANCE TESTING

A. Quality control and quality assurance testing for General Fill will be performed by the Owner's CQA Monitor and Laboratory subcontracted by the Owner.

B. Contractor shall be responsible for coordinating with Owner's CQA Monitor regarding collection of samples and testing of General Fill. Owner or Owner's CQA Monitor shall not be responsible for failure of Contractor to coordinate collection of samples or coordinate Owner's CQA Monitor inspections, or for Contractor not coordinating sampling and testing to coincide with construction scheduling and sequencing.

C. Contractor shall work with the Owner's CQA Monitor to identify soils from onsite, excavations, borrow areas, or on-site soil stockpiles meeting the requirements for use as General Fill.

D. The Owner's CQA Monitor shall provide Standard Proctor and moisture for General Fill at the following frequencies:

TABLE 02210-2 – SOIL PROPERTY FREQUENCIES

TEST	METHOD USED	GENERAL FILL FREQUENCY
Unified Soil Classification	ASTM D2487	1 per soil type/minimum 1 per borrow source
Sieve Analysis	ASTM D422 and D1140	
Atterberg Limits	ASTM D4318	

Moisture/Density Relationship	ASTM D698	
In-place Moisture and Density	ASTM D6938	1 per 10,000 square feet per compacted lift

The above tests shall be performed at the specified frequency of borrow material, but at least once per borrow source, or for each material change in soil property. If a conspicuous change in soil color and soil type occurs within a borrow source, each soil type shall be tested. It is the Contractor's responsibility to inform the Owner's CQA Monitor of the change in soil type and the need for testing.

E. The Contactor shall work with the Owner's CQA Monitor to identify off-site borrow areas, if required, and coordinating with the Owner's CQA Monitor for the required testing of borrow soils prior to delivering soils on site. Borrow soils from off-site sources may not be delivered to the site prior to testing being performed, and copies of results provided to the Engineer. For off-site borrow sources, Engineer may ask for additional testing if soils may be contaminated.

F. A minimum of one in-situ field density test (ASTM D6938) per 10,000 square feet, per compacted lift of General Fill shall be performed by the Owner's CQA Monitor to verify the compaction requirements specified in **Part 3.5** of this Section. A minimum of 3 compaction tests will be required per 6-inch-thick compacted lift for engineered fill.

G. Contractor shall be responsible for coordinating all testing, and confirming that all tests are passing prior to placing successive lifts of soil.

END OF SECTION

SECTION 02231

AGGREGATE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install the following aggregate types at the locations designated herein and as shown on the Construction Plans:

1. Drainage aggregate: Installed around leachate collection pipes and within leachate collection system sump, as shown in the Construction Plans.

2. Road base aggregate: 12-inch thick layer, used for access roads and turnaround pad, as shown in the Construction Plans.

3. Rip Rap: Installed in the stormwater channel, as depicted in the Construction Plans.

1.2 RELATED SECTIONS

A. Section 02210 – Excavation, Backfill, Fill, and Grading

B. Section 02256 – Protective Cover

C. Section 02778 – Non-Woven Geotextile

D. Section 02779 – Woven Geotextile

1.3 SUBMITTALS

A. It is the Contractor's responsibility to identify the source(s) of aggregate consistent with these specifications, and provide said source(s) to Engineer and the Owner's CQA Monitor following award of Contract. The Contractor will collect the necessary samples to perform source quality control tests for each aggregate type, as specified in **Part 2**.

B. Certification from the aggregate source(s) indicating all aggregate supplied for the Work is consistent with the materials sampled for source quality control testing.

1.4 REFERENCES

A. ASTM C127 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

B. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

C. ASTM D448 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction

D. ASTM D3042 – Standard Test Method for Insoluble Residue in Carbonate Aggregates

E. JLT-S-105-89 – Degradation of Landfill Drainage Materials Due to Carbonate Content

PART 2 PRODUCTS

2.1 DRAINAGE AGGREGATE

A. Drainage aggregate shall be free of organics, foreign objects, or other deleterious materials; and shall conform to a gradation of 100% passing sieve opening of 2 inches and 0 to 5% passing ½ inch sieve opening in accordance with ASTM C136.

B. The aggregate shall have a calcium carbonate content loss of less than 15 percent (in accordance with the J&L method (JLT-S-105-89) or ASTM D3042 modified to use a solution of hydrochloric acid having a pH of 5).

2.2 ROAD BASE AGGREGATE

A. Road base aggregate shall conform to the gradation of ODOT Type C, Aggregate, set forth in Section 703, Table 703:1 of the Oklahoma Department of Transportation (ODOT) Standard Specifications for Highway Construction.

B. Aggregate shall be crushed rock free of recycled concrete, contaminated soil and other deleterious materials.

C. Aggregate shall be produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source.

D. Base aggregate shall conform to the following gradation:

Sieve Size (inches)	Percent Retained
1-3/4	0-10
7/8	10-35
3/8	30-50
No. 4	45-65
No. 40	70-85

2.3 RIP RAP

A. Rip Rap shall be installed within the stormwater channel and at the inlet of the stormwater pond, as depicted in the Construction Plans and conform to the requirements of ODOT Standard Specifications for Highway Construction, Stone for Plain Riprap (Type I), set forth in Section 713.

B. The Work shall include Rip Rap installed at the locations shown in the Construction Plans. Rip Rap shall consist of aggregate material with the following properties:

1) Dmin = 6 inches, D50 = 9 inches, and Dmax = 12 inches

C. Rip Rap shall be durable natural stone, either quarried, crushed, or processed, with a minimum bulk relative density (specific gravity) of 2.25, as determined by ASTM D6473. Loss of soundness (by freeze and thaw test), shall not exceed 15 percent after 20 cycles when tested in accordance with U.S. Army Corps of Engineers test method CRD-C 144.

2.4 QUALITY CONTROL

A. The Contractor shall be responsible for collecting and shipping aggregate samples to the Owner's third party CQA laboratory to perform source quality control testing for each type of aggregate using the test methods indicated in Table 02231-1.

B. The drainage aggregate shall be tested for gradation and calcium carbonate at the supply source at a minimum of 1 test per 5,000 cubic yards or 1 test per lined area or cell (if less than 5,000 cubic yards required).

C. The road base aggregate shall be tested for gradation at the supply source at least once per aggregate

source.

D. Quality control testing provided in Table 2231-1 will be performed for each aggregate.

E. All source quality control tests shall be performed at least once per aggregate source.

F. Owner and Engineer reserve the right to require additional quality control tests of aggregate if material delivered to site is materially different in gradation or composition than the specified material. Failing tests will be paid by the Contractor. Contractor will be required to remove and replace any aggregate placed that is representative of a failing test. Replacing non-conforming aggregate shall be at Contractor's expense.

Table 02231-1 - Quality Control Tests

Aggregate	Test Type	Test Method	Frequency of Testing
Drainage Aggregate	Gradation	ASTM C136	1 per 5,000 cubic yards
	Calcium Carbonate	ASTM D3042 Modified or JLT-S-105-89	1 per 5,000 cubic yards

PART 3 EXECUTION

3.1 INSTALLATION – DRAINAGE AGGREGATE

A. Place aggregate within the leachate collection system and sump to lines, grades and dimensions shown on the Construction Plans.

B. Around the leachate collection pipes, place aggregate only where underlying drainage geocomposite and non-woven geotextile is completed and has been approved by Owner's CQA Monitor.

C. Around the leachate collection pipes, place aggregate in a manner that does not shift, wrinkle, or damage the underlying geosynthetic layers or piping, as applicable.

D. Place using low ground pressure equipment by spreading in front of the spreading equipment while maintaining a minimum of 12 inches of soil between the spreading equipment and the installed geosynthetics. Under no circumstances shall the construction equipment be allowed to come in direct contact with the installed geosynthetics.

E. Place using the following equipment guidelines and minimum soil thickness below equipment:

Equipment Ground Pressure (psi)	Minimum Soil Thickness (inches)
< 5	10
5 – 8	18
8 – 16	24
> 16	36

3.2 INSTALLATION – ROAD BASE AGGREGATE

A. A 12-inch-thick layer of road base aggregate shall be placed over the prepared subgrade and woven geotextile for the access road and turnaround pad, as shown on the Construction Plans.

B. Aggregate shall be placed in two 6-inch uniform lifts prior to rolling. Prior to final compaction bring material to required moisture content by sprinkling or other appropriate means.

C. Compact aggregate using an approved roller (as specified in Section 301.03B of the ODOT *Standard Specifications for Highway Construction*). Begin rolling longitudinally at the sides of the road and proceed towards the center, overlapping successive trips by a least ½ the width of the roller unit. The Contractor shall perform a minimum of 3 successive trips with roller unit. One trip is defined as back and forth over the area with the roller unit. Additionally, trips with the roller may be required at the discretion of the CQA Monitor or Engineer. Correct irregularities, depressions, and weak spots.

D. After completing compaction, clip, skin, or tight-blade the surface with a maintainer or subgrade trimmer to a depth of approximately ¼ inch. Remove loosened material (may be pushed to shoulder). Roll with a pneumatic tire roller until smooth surface is attained. Add moisture as required.

3.3 INSTALLATION – RIP RAP

A. Rip Rap shall be placed over the non-woven geotextile in a single lift to achieve the specified thickness, as shown on the Construction Plans, using procedures that do not cause excessive shoving, tearing, or wrinkling of the geotextile.

B. Rip Rap shall be placed in such a manner to produce a reasonably well graded mass, with a minimum amount of voids and with the larger rock evenly distributed throughout the mass. The Rip Rap shall be thoroughly moistened and any excess fines shall be sluiced to the underside of the stone blanket.

C. No method of placing the rock that will cause segregation will be allowed. Hand placing or rearranging of individual rock may be necessary to obtain the specified results.

END OF SECTION

SECTION 02250

COMPACTED CLAY LAYER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction of the 2-foot-thick compacted clay liner of the liner system.

1.2 RELATED SECTIONS

A. Section 01400 – Quality Control and Quality Assurance

B. Section 02210 – Excavation, Backfill, Fill, and Grading

C. Attachment A – QA/QC Plan for Liner and Leachate Collection System Installation and Testing

1.3 REFERENCES

A. Refer to Table 02250-1 regarding testing references.

1.4 QUALITY ASSURANCE

A. The Contractor shall coordinate testing of compacted clay liner soils as set forth in the applicable reference Specifications and as required herein.

B. All testing described in this Section shall be performed by a third-party CQA Monitor and qualified geotechnical testing laboratory (GTL), in accordance to the methods and frequencies set forth in **Table 02250-1**. Unless otherwise described herein, all testing described in this Section (including sampling costs, sample equipment, delivery of samples to laboratory, etc.) shall be paid by the Owner's CQA Monitor.

C. The Owner's CQA Monitor will observe compacted clay liner installation and construction and certify that construction is in accordance with Technical Specifications, Construction Drawings, and CQA Plan.

D. Contractor shall be responsible for coordinating with CQA Monitor regarding sample frequencies and collection, that the requirements set forth in **Table 02250-1** are met. Owner or CQA Monitor shall not be responsible for failure of Contractor to coordinate collection of samples or coordinate CQA Monitor inspections, or for Contractor not coordinating sampling and testing to coincide with construction scheduling and sequencing.

E. Contractor shall coordinate with CQA Monitor that CQA Monitor is on-site full time during compacted clay liner construction.

F. Contractor is responsible for protection of the compacted clay liner during construction and prior to contract close-out from damage associated with weather elements (i.e., desiccation, saturation, etc.) and installation defects, and all other damage related to Contractors work on the Project.

PART 2 PRODUCTS

2.1 SOIL FOR COMPACTED CLAY LINER

A. Obtained from material excavated within Phase 4A-1 footprint or from onsite soil stockpile as directed by Owner.

B. Classified according to the United Soil Classification System (USCS) as ML-CL, MH, CH, or CL using test method ASTM D 2487, ASTM D 4318 for liquid limit (LL), plasticity index (PI), and ASTM D 422 percent passing the No. 200 sieve. Soil for the compacted clay liner must achieve an installed permeability of $1x10^{-7}$ cm/s or less; a liquid limit (LL) of 24 or greater; a plasticity index (PI) of 15 or greater; percent passing the No. 200 sieve of 30 percent or greater; and percent passing the No. 4 sieve of less than or equal to 20 percent. The final lift of the clay liner shall not contain rock or other deleterious materials that can cause damage to the overlying geomembrane. Alternate soil classifications may be acceptable with supporting geotechnical testing results, at the discretion of the CQA Monitor.

C. Reasonably free of calcareous concentrations and nodules, stones, refuse, roots, or other deleterious substances. Upper 6 to 12 inches of topsoil shall be stripped from borrow area prior to borrowing compacted clay liner soil in accordance with **Section 02210 – Excavation, Backfill, Fill, and Grading**.

D. Contractor shall be responsible for demonstrating the acceptability of soils obtained from excavated material. In the event of failing tests, Contractor shall work with Owner to identify other on-site borrow areas from which soils meeting these specifications can be obtained.

PART 3 EXECUTION

3.1 PRE-CONSTRUCTION TESTING

A. During excavation within the borrow area, Contractor shall identify and segregate any soil layers or seams identified as not suitable for clay liner construction (e.g., sand, silty sand, or sandy clay seams). Clay soils suitable for layer construction will be segregated from unsuitable soils. Soil stockpiles, excavation, or other location(s) identified as suitable for clay liner construction shall be tested in accordance with **Table 02250-1**.

B. Representative samples of stockpiled borrow soil will be obtained by the CQA Monitor for testing. Contractor shall provide any equipment necessary for obtaining samples (i.e., backhoe). Testing will be performed in accordance with **Table 02250-1**. Moisture-density relations for the soil shall be developed by ASTM D698. Using the results of the testing, remolded samples of the clay soil will be prepared at 95% of maximum dry density (by ASTM D 698), 0 to 4% wet of optimum. The remolded samples then shall be subjected to permeability testing in accordance with ASTM D5084. Acceptable borrow material shall exhibit a permeability value no greater than 1.0×10^{-7} cm/sec.

1. Permeability tests shall be performed on samples remolded in the laboratory from on-site borrow material at a frequency of one test per one moisture-density relationship.

2. If results of the permeability testing program show the permeability is higher than 1.0×10^{-7} cm/sec or that the material may not consistently satisfy the specifications, the CQA Monitor will decide whether to require retesting of the material at a greater degree-of-compaction; obtain additional representative samples from the proposed borrow source; or identify and test another borrow material. The CQA Monitor has the authority to reject any proposed borrow material that is believed to not be suitable for clay liner construction based upon the results of the site inspection and/or preconstruction geotechnical testing.

3. If either the LL or PI varies by 10 or more points when compared against the moisture density curve used for that soil borrow source, that borrow source is considered a separate soil borrow source and a new test series including moisture/density, compaction relationship, sieve analysis, and coefficient of permeability should be determined.

3.2 FIELD DENSITY TESTING DURING CONSTRUCTION

A. As the clay liner is placed and compacted, each 6-inch lift (compacted) shall be tested by the CQA Monitor at the frequency shown in **Table 02250-1** to confirm the material has been compacted to a

minimum of 95% of the maximum dry density (or higher, if required based on pre-construction permeability test results, as determined by ASTM D 698) has been achieved. The moisture content shall range from 0 to 4% wet of optimum. Lift thickness and the initial (before compaction) moisture content of the delivered material shall be monitored by the CQA Monitor to assure conformance with the requirements specified herein.

B. Each lift of material shall be tested and approved by the CQA Monitor to determine the compacted dry density and moisture content before subsequent lifts are placed. Field moisture-density tests shall be performed with a method and at the frequency specified in **Table 02250-1.**

3.3 LABORATORY PERMEABILITY TESTING DURING CONSTRUCTION

A. Permeability tests will be conducted on undisturbed samples of constructed clay liner obtained at random locations designated by the CQA Monitor. The Contractor shall assist in sampling using a hydraulic jack to press Shelby tubes into the constructed clay liner at locations designated by the CQA Monitor. Minimum testing frequency shall be as designated in **Table 02250-1**. The Contractor shall assist the CQA Monitor to properly extract, seal, store (as necessary), and transport the collected Shelby tube samples to the laboratory.

B. If the results of clay liner testing by the laboratory for a given Shelby tube sample indicate an in-place permeability greater than 1.0×10^{-7} cm/s, the procedures described in Part 3.4.D – Failing Permeability Test will be implemented. Upon reworking the isolated area of clay liner, an additional representative Shelby tube shall be collected and tested as directed by the CQA Monitor to verify acceptable in-situ permeability of the reworked acre(s).

C. If the permeability results do not prove to be acceptable, the procedure of reworking the clay liner shall be repeated until further Shelby tube testing results yield acceptable compacted permeability values. All holes or perforations in the clay liner resulting from Shelby tube sample collection shall be backfilled by the Contractor with a soil-bentonite mix as directed by the CQA Monitor.

3.4 PROCEDURES FOR ADDRESSING FAILING CQA TESTS

A. Contractor shall rework or repair areas with failing tests at no additional cost to Owner. Contractor shall schedule work to allow reworking of sampled areas in the event of failing test results. Proceeding with subsequent lift placement ahead of receipt of passing results will be at the Contractor's own risk, and shall not constitute justification for additional compensation or delays in completion of Work.

B. Failing Field Density Tests

1. In the event a test indicates field density less than specified, the Contractor will be required to moisture condition (either dry or moisten, if needed) the soil, and then re-compact and retest the soil. The entire 10,000 square foot area represented by the failing test will be required to be reworked.

2. Alternately, the Contractor may perform a minimum of 3 additional field density tests spaced no less than 20 feet in a circular pattern surrounding the original failed test, and, if all tests pass field density, the rework area will be limited to the area inside of the circle formed by the passing tests. If one or more of the additional field tests fail, the entire 10,000 square foot area represented by the failed test will require reworking.

3. In the event of a second failed field density test, the CQA Monitor will be immediately notified, and a field decision made by the CQA Monitor regarding conducting a second rework of the area (as described above) or alternately, requiring that an additional Proctor test be performed on the soils comprising the failed test area. If an additional Proctor test is required, the CQA Monitor will direct the contractor to either obtain soil samples from the failed area, or alternately, from the borrow source from which the failing soils were obtained. Reworking and retesting of the soils will not

occur until after the additional laboratory testing has been completed, and the new Proctor test information submitted to the CQA Monitor.

4. The results of both passing and failing tests will be recorded, and reported within a Liner Evaluation Report (LER) prepared for the construction.

C. Failing Gradation or Atterberg Limits Tests

1. In the event of a failing test, additional test samples will be obtained at a minimum of 3 locations, spaced no less than 20 feet in a circular pattern surrounding the original failed test.

2. If passing results are obtained for the additional test samples, the area defined by the passing tests will be removed, replaced, and retested. If one or more of the additional tests fail, a new sample will be obtained 30 feet (minimum) from the original failed test (along a line radiating from the original failed test through the failing additional test(s)), and in 10-foot (minimum) increments thereafter, until passing test results are obtained. The area requiring removal and replacement ultimately will be defined by passing test results. After removal and replacement, one additional passing test in the approximate center of the reworked area will be required.

D. Failing Permeability Tests

1. In the event of a failing permeability test, the CQA Monitor shall immediately notify the Contractor and the area represented by the failed test will be identified.

2. Prior to requiring additional permeability sampling and testing, a field density test will be performed at the location of the failed test. If a failing field density test is obtained, the failed area will be defined as described in Section 3.4.1, above, except that additional field density testing will be performed until passing tests are obtained. After reworking and achieving passing field density tests, a new permeability sample will be obtained for testing.

3. If passing field density tests are obtained at the location of the failed permeability test location, additional Atterberg limits and gradation test samples will be obtained at a minimum of 3 locations, spaced no less than 20 feet in a circular pattern surrounding the original failed test. If passing results are obtained for the additional test samples (Atterberg limits and gradation tests), the area defined by the passing tests will be removed and replaced. If one or more of the additional tests fail, a new sample will be obtained 30 feet (minimum) from the original failed test (along a line radiating from the original failed test through the failing additional test(s)), and in 10-foot (minimum) increments thereafter, until passing test results are obtained. Passing Atterberg limits and gradation test results will be used to define the area requiring removal and replacement. After removal and replacement, a new permeability sample will be obtained and tested, and a passing test obtained prior to approval of the reworked area.

3.5 MOISTURE CONDITIONING CLAY LINER SOILS

A. Prior to moisture conditioning soils (increasing moisture content by addition of water), soil clod sizes shall be reduced by disking, pulverizing, or other method of breaking clods, as acceptable to the CQA Monitor.

B. After applying water, soil will be mixed and stockpiled to allow adequate time for hydration to occur.

C. Water used for hydrating must be clean and will not have come into contact with waste or other objectionable material.

3.6 CLAY LINER SOIL PLACEMENT

A. The compacted clay liner shall be construct in compacted lifts not exceeding 6 inches. Construct the lift layer as a single monolithic section unless otherwise approved in writing by CQA Monitor.

B. Scarify, blend, and compact individual lifts together to prevent smooth surfaces between lifts. Placement and compaction methods shall result in continuous, uniform clay liner free of smooth interfaces, cracks, construction joints, or other deleterious features.

C. Meet specified relative compaction and moisture content in each lift before placing subsequent lifts.

D. Construct tie-ins and terminations as shown on the Construction Plans.

E. Do not place clay liner when temperature is below 30° F.

3.7 COMPACTION OF CLAY LAYER

A. Compact each lift with either pad/tamping foot roller or prong-feet (sheepsfoot) roller for each lift regardless of relative compaction. The compaction equipment must have operating weight and characteristics for kneading and compacting soil consistent with the specified compaction requirements. Use of bulldozers, pneumatic rollers, rubber-tired equipment, or flat wheel rollers as the compaction equipment is not allowed. Compaction equipment should make a sufficient number of passes across a lift for remolding of the clay by kneading action. The number of equipment passes may vary depending on the soil material and the results of the field CQA tests. Pad/tamping foot length shall be greater than the clay soil lift thickness, to allow complete penetration of the lift during compaction.

B. Prevent desiccation and crusting of the lift surface. If desiccation or crusting occurs before placement of the subsequent lift, moisture condition surface by spraying with water and scarifying to depth of desiccation prior to placing subsequent lift.

C. Compact clay liner to a minimum of 95 percent of the maximum dry density and at a moisture content 0 to 4% wet of optimum as determined by ASTM D 698.

D. Compact to meet a permeability less than or equal to $1x10^{-7}$ cm/sec.

E. The compacted clay liner thickness shall be a minimum of 2 feet. **Thickness of the clay liner on slopes greater than 5H:1V shall be 2.1 feet.**

F. The as-built thickness of the clay liner will be verified by survey methods (**see Section 01052 – Layout of Work and Survey**).

1. Compacted clay liner subgrade surface shall be surveyed on the pre-established 100-foot certification grid prior to the placement of <u>any</u> clay liner soils.

2. Upon completion of the clay liner, and prior to the installation of the geomembrane, survey shall be completed of the top of the clay liner on the same pre-established certification grid to confirm the specified thickness has been achieved.

3. The top of the compacted clay liner shall be graded to the specified grades, slopes, and thickness with a **tolerance of 0 feet to +0.2 feet**.

4. The certification survey shall be performed by a surveyor registered in the State of Oklahoma and under the employ of the Owner.

3.8 LINER TIE-INS AND TERMINATIONS

A. Tie-in to the existing compacted clay liner at existing **Cells 4 and 5** shall be achieved by scarifying the existing compacted clay liner and placing the new clay liner on the scarified surface.

B. Tie-in to existing compacted clay liner at existing **Cells 4 and 5** shall be achieved by the following:

1. The edge of the previously installed liner will be uncovered, exposed, and cut back on a slope so that the entire existing liner edge is tied to new construction without superimposed construction joints.

2. The surface of the existing liner will be scarified (roughened) prior to subsequent soil placement, to further reduce the possibility of construction joints.

3. The length of the tie-in area should be at least 5 feet per foot thickness of liner.

4. Liners will not be constructed by "butting" the entire thickness of a new liner segment next to the previously constructed section of liner.

3.9 PROTECTION

A. During construction, adequately wet/moisten finished lifts or sections of the compacted clay liner with water as needed to prevent drying and desiccation.

B. Contractor shall protect the top of compacted clay liner surface prior to placement of geomembrane from desiccation or excessive moisture from weather elements. Any repair required for overly wet (pumping soils), desiccated, or eroded clay layer surface shall be performed at the expense of the Contractor.

Table 02250-1 Standard Tests for Compacted Clay Layer Soils

SOIL TEST CATEGORY	TYPE OF TEST	STANDARD METHOD USED	FREQUENCY OF TESTING
Quality Control Testing of Soil Borrow Materials	Unified Soil Classification	ASTM D2487	Continual during placement
	Sieve Analysis	ASTM D422 or D1140	1 per 10,000 cy per material type
	Atterberg Limits	ASTM D4318	
	Moisture/Density Relationship	ASTM D698	
	Hydraulic Conductivity	ASTM D5084 (1)(2)	
Constructed Compacted Clay Liner	Field Moisture/Density Test	ASTM D698	3 per acre per 6-inch lift (2)
	Conventional Oven Drying Method for Moisture-Density Relationship	ASTM D2216	Performed once every 10 samples selected for nuclear density method of moisture-density test
	Sieve Analysis	ASTM D422 or D1140	1 per 10,000 cy per material type
	Atterberg Limits	ASTM D4318	
	Hydraulic Conductivity (3)(4)	ASTM D2434 or D5084	2 per acre for 12 inches on floor liner; 1 per acre for top 12 inches of sidewall liner
	Thickness (5)	Survey	100-foot square grid with a minimum of 2 reference points

1. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.
2. A minimum of three tests must be conducted for each 6-inch lift, regardless of area.
3. Hydraulic Conductivity tests will be run using tap water or a 0.05N solution of $CaSO_4$. Distilled water will not be allowed.
4. Testing will be conducted on undisturbed samples collected by Shelby tubes in accordance with ASTM D1587.
5. Minimum thickness shall be 2.1 feet on 3H: 1V sideslopes.

END OF SECTION

SECTION 02256

PROTECTIVE COVER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction of soil protective cover layer over geocomposite consistent with this Technical Specification and shown on the Construction Plans.

1.2 RELATED SECTIONS

A. Section 01400 – Quality Control and Quality Assurance

B. Section 02210 – Excavation, Backfill, Fill and Grading

C. Section 02930 – Geocomposite

D. **Attachment A – QA/QC Plan for Liner and Leachate Collection System Installation and Testing**

1.3 REFERENCES

A. ASTM D1140 Standard Test Method for Amount of Material in Soils Finer Than the No. 200 Sieve

B. ASTM D2487 Classification of Soils for Engineering Purposes

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

1.4 QUALITY ASSURANCE

A. The Contractor shall coordinate testing of protective cover soils as set forth in the applicable reference Specifications and as required herein.

B. All testing described in this Section shall be performed by a third-party CQA Monitor and qualified geotechnical testing laboratory (GTL), in accordance to the methods and frequencies set forth in Table 02256-1. Unless otherwise described herein, all testing described in this Section (including sampling costs, sample equipment, delivery of samples to laboratory, etc.) shall be paid by the Owner's CQA Monitor.

C. The Owner's CQA Monitor will observe protective cover soil installation and construction and certify that construction is in accordance with Technical Specifications, Construction Drawings, and CQA Plan.

D. Contractor shall be responsible for coordinating with CQA Monitor regarding sample frequencies and collection, that the requirements set forth in Table 02256-1 are met. Owner or CQA Monitor shall not be responsible for failure of Contractor to coordinate collection of samples or coordinate CQA Monitor inspections, or for Contractor not coordinating sampling and testing to coincide with construction scheduling and sequencing.

E. Contractor shall coordinate with CQA Monitor that CQA Monitor is on-site full time during protective cover soil construction.

F. Contractor is responsible for protection of the protective cover soil during construction and prior to contract close-out from damage associated with weather elements and installation defects, and all other damage related to Contractors work on the Project.

PART 2 PRODUCTS

2.1 SOIL FOR PROTECTIVE COVER

A. Consisting of on-site or off-site soils with a **hydraulic conductivity ≥ 1.3 x 10^{-5} cm/sec.**

B. Consisting of on-site soils that are free of calcareous concentrations and nodules, refuse, organics, angular rocks, foreign objects, or other deleterious materials which might damage the underlying geocomposite and compacted clay liner during placement.

C. The lower 6 inches of protective cover shall be free of rock particles greater than 2 inches in size, and the upper 6 inches of protective cover shall be free of rock particles greater than 4 inches in size. Under no circumstances shall the protective cover have angular rock that could damage the underlying geocomposite and compacted clay liner.

PART 3 EXECUTION

3.1 PRE-CONSTRUCTION TESTING

A. During excavation within the borrow area, Contractor shall identify and segregate any soil layers or seams identified as not suitable for compacted clay liner construction (e.g., sand, silty sand, or sandy clay seams). Soils suitable for protective cover layer construction will be segregated from unsuitable soils. Soil stockpiles, excavation, or other location(s) identified as suitable for protective cover construction shall be tested for hydraulic conductivity in accordance with **Table 02256-1**.

B. Representative samples of stockpiled borrow soil will be obtained by the CQA Monitor for testing. Contractor shall provide any equipment necessary for obtaining samples (i.e., backhoe). Testing will be performed in accordance with **Table 02256-1**. Acceptable borrow material shall exhibit a **hydraulic conductivity ≥ 1.3 x 10^{-5} cm/sec**.

C. If off-site borrow source is selected for protective cover, Contractor shall send a 5-gallon bucket of the sample to the GTL for hydraulic conductivity testing in accordance with **Table 02256-1 prior to shipping the material to the site**. Contractor shall take responsibility of material that is shipped to the site without Engineer's approval.

3.2 LABORATORY PERMEABILITY TESTING DURING CONSTRUCTION

A. Permeability tests will be conducted on on-site or off-site protective cover soil samples obtained at random locations designated by the CQA Monitor. Minimum testing frequency shall be as designated in **Table 02256-1**.

3.3 PLACEMENT

A. Place to a minimum thickness of 1 feet over the geocomposite to a thickness tolerance of 0 to +0.2 feet. **Contractor shall note that to achieve the minimum thickness of 1 feet on the sideslope, the vertical thickness of the protective cover shall be a minimum of 1.1 feet, as measured by the conformance survey.**

B. Place only where underlying geocomposite installation has been completed and approved by CQA Monitor.

C. Place using low ground pressure equipment by spreading in front of the spreading equipment while maintaining a minimum of 12 inches of soil between the spreading equipment and the installed geosynthetics. Under no circumstances allow the construction equipment to come in direct contact with the installed geosynthetics.

D. Place using the following guidelines:

Equipment Ground Pressure (psi)	Minimum Lift Thickness (inches)
< 5	12
5 – 8	18
8 – 16	24
> 16	36

E. Place protective cover soils in a manner that does not shift, wrinkle, or damage the underlying geosynthetic layers. Contractor shall document protective cover placement methods. Protective cover shall be placed in an up-slope direction on sideslopes so that stress imparted to the geosynthetics is minimized.

F. A greater thickness of protective cover shall be provided in access lanes or roadways used by Contractor for delivery or staging of protective cover soils, and for turning areas. Drivers will be directed to proceed with caution when on the overlying soil to prevent spinning of tires or sharp turns.

3.2 QUALITY CONTROL / QUALITY ASSURANCE

A. Verify the Owner's CQA Monitor is on-site at all times during the placement of the Protective Cover.

B. At the discretion of the Owner's CQA Monitor, a soil classification and/or gradation may be performed for the protective cover material. If a soil classification is necessary, the Contractor shall coordinate with the Owner's CQA Monitor for said testing of the protective cover material.

C. Owner's CQA Monitor will verify that survey control staking is performed prior to protective cover placement, that survey control stakes are removed following placement of protective cover, and that survey control stakes do not damage the underlying geosynthetics.

D. Contractor shall coordinate with Owner's surveyor to perform a certification survey, consistent with **Section 01052 – Layout of Work and Surveys**, following completion of placement operations. The thickness of the protective cover shall be verified at a minimum of two (2) survey points on a 100-foot grid, as specified in **Section 01052**. A minimum of 2 survey points shall be used for all constructed areas regardless of size.

Table 02256-1 Standard Tests for Protective Cover Soils

SOIL TEST CATEGORY	TYPE OF TEST	STANDARD METHOD USED	FREQUENCY OF TESTING
Pre-Construction Testing of On-site or Off-site Borrow Soil	Hydraulic Conductivity	ASTM D5084 (1)	1 per borrow source per material type
Construction Testing of On-site or Off-site Protective Cover Soil	Hydraulic Conductivity	ASTM D5084 (1)	1 per 1,600 cy per material type installed on the floor of the landfill cell
Thickness verification of Protective Cover Soil	Thickness (5)	Survey	100-foot square grid with a minimum of 2 reference points

1. Hydraulic Conductivity tests will be run using tap water or a 0.05N solution of $CaSO_4$. Distilled water will not be allowed.

END OF SECTION

SECTION 02270

SOIL EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provisions for soil erosion and sedimentation controls, specifically for areas disturbed by construction activities, including but not limited to, clearing and grubbing, excavation, backfill, fill, grading, stockpiling, etc., which has the potential to discharge to down-gradient or offsite water bodies.

B. Requirements contained herein will not be measured for payment, and as such should be performed at no additional cost to the Owner.

1.2 RELATED SECTIONS

A. Section 01560 – Environmental Protection and Special Controls

B. Section 02210 – Excavation, Backfill, Fill, and Grading

PART 2 PRODUCTS

2.1 MATERIALS

A. Best Management Practices (BMPs, Erosion and Sedimentation Controls):

1. It is the Contractor's responsibility to prevent erosion and sedimentation as a result of performance of the Work.

2. At a minimum silt fence (aka, sediment control fence) shall be installed for soil erosion and sedimentation control on the down-gradient side of soil stockpiles or land disturbances that have the potential to drain to down-gradient or offsite water bodies. **The Contractor shall note that this is consistent with Owner policy and alternates or substitutions will not be considered.**

3. In the event the above controls are not effectively controlling erosion and sedimentation, other best management practices shall be installed at no additional cost to the Owner.

PART 3 EXECUTION

3.1 GENERAL

A. Contractor shall prepare and submit a Storm Water Pollution Prevention Plan (SWPPP) in accordance with Section 01560 – Environmental Protection and Special Controls. Contractor shall perform construction and earthmoving actives in accordance with the approved SWPPP, including installation and maintenance of BMPs, inspections, and monitoring requirements. Contractor shall document and maintain files on compliance with the SWPPP (**provided in Exhibit 2**), and provide to Owner at Contract close-out (**see Section 01300 – Submittals**).

B. The provisions stated herein shall supplement the requirements of the Contractor's SWPPP. Where conflicts existing between this section and Site's SWPPP, the more stringent requirements shall apply.

3.2 PREPARATION

A. Prior to commencement of clearing and grubbing operations or other general earthwork:

1. Construct and install stabilized construction exit to prevent tracking of mud on the public roadways.

2. Install erosion and sedimentation controls, as noted in **Part 2.1** of this section, including the installation of silt fence in accordance with the manufacturer's recommendations.

3. Machine compact all berms, dikes and embankments, as necessary.

4. Install other erosion control features as necessary to control erosion and sedimentation, as directed by the Owner or Engineer, at no additional cost to Owner.

3.2 DURING CONSTRUCTION PERIOD

A. Maintain ditches, swales, berms, silt fences, stabilized construction exit, and other BMPs.

1. Inspect regularly and following rain events.

2. Based on regular inspections, repair or replace damaged or missing BMPs immediately following discovery of deficient items.

B. Do not disturb existing vegetation (grass and trees) to the extent possible.

3.3 NEAR COMPLETION OF CONSTRUCTION

A. Grade to finished or existing grades.

B. Fine grade and provide positive drainage for all remaining earthen areas.

C. Maintain and repair, as necessary, all installed erosion and sedimentation controls, as noted in **Part 2.1** of this section, and leave in-place, unless otherwise directed by the Owner, to prevent sedimentation from entering onsite drainage features or offsite water bodies.

END OF SECTION

SECTION 02271

SEED, MULCH, AND FERTILIZER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Placement of temporary seed **and/or** permanent seed, mulch and fertilizer, within areas disturbed during execution of Work, inside and outside of the limits of construction will require seed, mulch, and fertilizer.

B. Placement of seed and fertilizer below areas designated for erosion control blanket (ECB), as shown on the Construction Plans.

1.2 RELATED SECTIONS

A. Section 02210 – Excavation, Backfill, Fill, and Grading

B. Section 02270 – Soil Erosion and Sediment Control

C. Section 02272 – Erosion Control Blanket

1.3 SUBMITTALS

A. Contractor shall obtain the services of a third-party subcontractor with at least 5 years of experience in vegetation establishment in Oklahoma.

B. Contractor shall submit a certification from the supplier that the seed, mulch, and fertilizer comply with the applicable Oklahoma DOT (ODOT) standards indicated in **Part 2.1** of this Section. The certification shall also include the supply source for materials as well as:

1. Name, trademark, analysis, form, and coverage for fertilizer.

2. Name, type, germination, purity, germination test results with date of test for seed, and **application rate**.

3. Name, type, components and coverage for mulch.

1.4 REFERENCED STANDARDS

A. ODOT Standard Specifications for Highway Construction, 2019.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide seed meeting the requirements of the ODOT in accordance with Section 232, subsection 735.03, and Table 735:1 of the ODOT Standard Specifications. Contractor shall select seed that is capable of growing in warm and cold weather specific to Garvin County, OK.

B. Fertilizer. Fertilizer in accordance with Section 234, subsection 735.06A of the ODOT Standard Specifications, OK State University guidelines, and watering requirements.

C. Cellulose Fiber Mulch. Use only cellulose fiber mulches that are specified in Section 233, subsection 735.04 of the ODOT Standard Specifications. **Contractor shall not place mulch on areas to receive ECB.**

PART 3 EXECUTION

3.1 PREPARATION

A. Cultivate (scarify) areas to be seed and mulch to a depth of 4 inches.

B. Apply seed and mulch according to the methods and mixes provided for the specific soil type in Sections 232 and 233 of ODOT Standard Specifications.

C. Apply fertilizer consistent with Section 234 of ODOT Standard Specifications.

D. No heavy equipment shall be moved over seeded areas unless area is to be retilled and reseeded.

3.2 WATERING AND MAINTENANCE

A. Continue watering per supplier's recommendation, until established seed germination occurs and initial stand of grass is obtained. Repair any areas that are damaged, eroded, or do not germinate.

END OF SECTION

SECTION 02777

WOVEN GEOTEXTILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geotextile to stabilize and reinforce access road extensions and ramp base aggregate surface, as shown on the Construction Plans. The geotextile will provide both reinforcing and soil migration control of the underlying clayey soils.

B. Contractor shall furnish all labor, incidental materials, tools, supervision, transportation, and installation equipment necessary for the installation of woven geotextile, as specified herein, and as shown on the Construction Plans.

1.2 SUBMITTALS

A. Certification: Contractor shall provide to Engineer a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile. The Certification shall state that the furnished geotextile meets MARV requirements of the Specification as evaluated under the Manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the Manufacturer.

B. Contractor shall provide Manufacturer’s qualifications. Manufacturer shall be accredited through the following:

1. Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP)

2. American Association for Laboratory Accreditation (A2LA)

1.3 RELATED SECTIONS

A. Section 02210 – Excavation, Backfill, Fill, and Grading

B. Section 02231 – Aggregate

1.4 REFERENCES

A. AASHTO Standards:

1. M288-96 - Geotextile Specification for Highway Applications

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

1. D 123 - Standard Terminology Relating to Textiles

2. D 276 - Test Method for Identification of Fibers in Textiles

3. D 3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics

4. D 4354 - Practice for Sampling of Geosynthetics for Testing

5. D 4355 - Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light

and Water (Xenon-Arc Type Apparatus)

6. D 4439 - Terminology for Geotextiles

7. D 4491 - Test Methods for Water Permeability of Geotextiles by Permittivity

8. D 4533 - Test Method for Index Trapezoid Tearing Strength of Geotextiles

9. D 4595 - Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

10. D 4632 - Test Method for Grab Breaking Load and Elongation of Geotextiles

11. D 4751 - Test Method for Determining Apparent Opening Size of a Geotextile

12. D 4759 - Practice for Determining the Specification Conformance of Geosynthetics

13. D 4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

14. D 4873 - Guide for Identification, Storage, and Handling of Geotextiles

15. D 5141 - Test Method to Determine Filtering Efficiency and Flow Rate for Silt Fence Applications Using Site Specific Soils

C. Federal Highway Administration (FHWA) - Geosynthetic Design and Construction Guidelines, Publication No. FHWA HI-95-038, May 1995.

D. Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP).

1.5 DEFINITIONS

A. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Geotextiles labeling, shipment, and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.

C. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geotextile.

PART 2 PRODUCTS

2.1 APPROVED MATERIALS

A. An approved woven geotextile is Mirafi HP570 or approved substitute.

B. The geotextile shall be woven from high-tenacity long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

C. The geotextile shall meet the requirements of **Table 02777-1**. All numeric values in **Table 02777-1** except AOS represent MARV in the specified direction. Values for AOS represent maximum average roll values.

TABLE 02777-1
WOVEN GEOTEXTILE PROPERTIES

Mechanical Properties	**Test Method**	**Unit**	**Minimum Average Roll Value**	
			MD[1]	**CD[1]**
Ultimate Tensile Strength	ASTM D 4595	kN/m (lbs/ft)	70.0 (4800)	70.0 (4800)
Tensile Strength @ 5% Strain	ASTM D 4595	kN/m (lbs/ft)	35.0 (2400)	39.4 (2700)
			Minimum Roll Value	
Permittivity	ASTM D 4491	sec^{-1}	0.50	
			Maximum Opening Size	
Apparent Opening Size (AOS)	ASTM D 4751	mm (U.S. Sieve)	0.60 (30)	
			Minimum Test Value	
Ultraviolet Resistance (after 500 hrs.)	ASTM D 4355	% strength retained	80	

[1] MD - Machine, or roll, direction; CD - Cross machine direction

2.2 QUALITY CONTROL

A. Manufacturing Quality Control is the Contractor's responsibility. Testing shall be performed at a laboratory accredited by GAI-LAP and A2LA for tests required for the geotextile, at frequency meeting or exceeding ASTM D 4354.

B. Sewn Seam Strength shall be verified based on testing of either conformance samples obtained using Procedure A of ASTM D 4354, or based on manufacturer's certifications and testing of quality assurance samples obtained using Procedure B of ASTM D 4354. A lot size for conformance or quality assurance sampling shall be considered to be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

C. Ultraviolet Stability shall be verified by an independent laboratory on the geotextile or a geotextile of similar construction and yarn type, as the expense of the Manufacturer or Contractor.

PART 3 EXECUTION

3.1 PREPARATION

A. The location where the woven geotextile shall be installed shall be prepared by backfilling or filling the area to the design grade using General Fill for construction of road/ramp embankments, as shown on the Construction Plans.

B. Contractor shall place General Fill at the specified compaction rate, consistent with **Section 02210 – Excavation, Backfill, Fill, and Grading** prior to placement of geotextile for road/ramp embankments.

3.2 INSTALLATION

A. The geotextile shall be handled in such a manner as to ensure that it is not damaged in any way. Should the Contractor damage the geotextile to the extent that it is no longer usable as determined by these Specifications or by the Engineer, the Contractor shall replace the geotextile at no additional cost to the Owner.

B. The geotextile shall be installed to the lines and grades as shown on the Construction Plans following approval of the underlying materials.

C. The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. On curves, the geotextile may be folded or cut to conform to the curves. Adjacent geotextile rolls shall be overlapped a minimum of 24 inches, sewn or joined consistent with the manufacturer's recommendations. Sewing methods, pattern, and thread type shall be as recommended by manufacturer for subgrade improvement applications.

D. Prior to covering, the geotextile shall be inspected by the Engineer or CQA Consultant to ensure that the geotextile has not been damaged during installation. Damaged geotextiles, as identified by the Engineer or CQA Consultant, shall be repaired immediately. Cover the damaged area with a geotextile patch which extends an amount equal to the required overlap beyond the damaged area.

E. In the case of access road embankment construction, base aggregate shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed roadway base. A minimum fill thickness of 6 inches is required prior to operation of heavy equipment over the geotextile.

F. Sudden braking and sharp turning should be avoided. Heavy equipment should not be operated directly upon the geotextile. Turning of vehicles shall not be permitted on the first lift above the geotextile.

G. Any ruts occurring during construction shall be filled with additional base aggregate, and compacted to the specified density.

H. If placement of the fill material causes damage to the geotextile, the damaged area shall be repaired as previously described above. The placement procedure shall then be modified to eliminate further damage from taking place.

END OF SECTION

SECTION 02778

NON-WOVEN GEOTEXTILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-woven geotextile to provide separation and filtration for the following: (1) drainage aggregate in the leachate collection and underdrain dewatering trenches; and (2) drainage aggregate in the leachate collection and underdrain dewatering sumps in accordance with these Technical Specifications and as shown on the Construction Plans.

B. Contractor shall furnish all non-woven geotextile, labor, incidental materials, tools, supervision, transportation, and installation equipment necessary for the installation of non-woven geotextiles, as specified herein, and as shown on the Construction Plans.

C. Refer to **Section 02930 – Geocomposite** for properties related to non-woven geotextiles incorporated in the geocomposite drainage layer.

1.2 RELATED SECTIONS

A. Section 02210 – Excavation, Backfill, Fill, and Grading

B. Section 02231 – Aggregate

C. Section 02930 – Geocomposite

D. Attachment A – QA/QC Plan for Liner and Leachate Collection System Installation and Testing

1.3 SUBMITTALS

A. The Contractor shall submit the following for the non-woven geotextile to the Owner's Construction Quality Assurance (CQA) Monitor for approval at least 30 days prior to procurement of the the non-woven geotextile:

1. Material Prequalification: The Contractor shall submit the manufacturer's product data sheets for the geotextile demonstrating compliance with the material properties listed in **Table 02778-1**.

2. The Contractor shall provide the manufacturer's qualifications. The manufacturer shall be accredited through the following:

a. Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP)

b. American Association for Laboratory Accreditation (A2LA).

3. Submit a complete description of the non-woven manufacturer's formal Manufacturer Quality Assurance/Manufacturer Quality Control (MQA/MQC) program for manufacturing, fabricating, MQC testing, defects repair, handling, and shipping.

B. The Contractor shall submit the following for the non-woven geotextile to the Owner's CQA Monitor for approval at least 15 days prior to shipment of the the non-woven geotextile to the site:

1. Submit MQA/MQC certifications for each shipment of non-woveon geotextile. The certifications shall be signed by a responsible party employed by the manufacturer such as the MQA/MQC Manager, Production Manager, or Technical Services Manager. The certifications shall include:

a. Geotextile lot and roll numbers (with corresponding shipping information).

b. The results of MQC testing performed by the manufacturer. The minimum geotextile properties are specified in **Table 02778-1**. MQC testing shall be conducted at a minimum frequency of 1 per 100,000 square feet for the material properities specified in **Table 02278-1**, with the exception to UV resistance which shall be performed once per formulation.

2. Installation Instructions: Samples of the non-woven geotextile with a complete set of Specifications, and manufacturer's complete written instructions for storage, handling, installation, seaming, and overlap.

1.4 REFERENCES

A. ASTM D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles

B. ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

C. ASTM D4533, Standard Test Method for Index Trapezoidal Tearing Strength of Geotextiles

D. ASTM D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

E. ASTM D4491, Standard Test Method for Water Permeability of Geotextiles by Permittivity

F. ASTM D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile

G. ASTM D4354, Standard Practice for Sampling of Geosynthetics for Testing

H. ASTM D4759, Standard Practice for Determining the Specifications Conformance of Geosynthetics

I. ASTM D4873, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.5 DELIVERY, STORAGE, AND HANDLING

A. Geotextiles labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style name, lot number, roll number, and roll dimensions.

B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.

C. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geotextile.

PART 2 PRODUCT

2.1 GEOTEXTILE

A. The non-woven needle punched geotextile specified herein shall be made from polypropylene staple or continuous fiber. The geotextile shall be manufactured from first quality virgin polymer.

B. The geotextile shall be able to withstand direct exposure to ultraviolet radiation from sun for up to 15 days without any noticeable effect on index or performance properties.

C. 8 oz/sy geotextile shall be used for leachate collection trench and leachate collection sump and shall meet or exceed all material properties listed in **Table 02778-1**.

Table 02778-1
Minimum Average Roll Values (MARV) for Non-Woven Geotextiles

Tested Property	Units	Test Method	Required Value (Leachate Collection Pipe and Sump)
Mass per Unit Area	oz/yd^2	ASTM D 5261	8
Grab Tensile Strength	Lb	ASTM D 4632	320
Puncture Strength	Lb	ASTM D 4833	190
Apparent Opening Size	Sieve No.	ASTM D 4751	100
Water Flow Rate	gpm/ft^2	ASTM D 4491	60
UV Resistance	% (after 500 hrs)	ASTM D 4355	70

D. Refer to **Table 02930-2** for 8 oz/sy non-woven geotextile properties related to the geocomposite.

2.2 MANUFACTURER

A. All rolls of the geotextile shall be identified with permanent marking on the roll or packaging, with the manufacturers name, product identification, roll number and roll dimensions.

2.3 TRANSPORT

A. Transportation of the geotextile shall be the responsibility of the Contractor.

B. During shipment, the geotextile shall be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, or other damaging or deleterious conditions.

C. Upon delivery at the job site, the Contractor shall ensure that the geotextile rolls are handled and stored in accordance with the manufacturer's instructions to prevent damage, as specified in **Part 1.5** of this Section.

2.4 QUALITY CONTROL

A. The Owner or Engineer may elect to arrange conformance testing of the rolls delivered to the job site. For this purpose, the Owner's CQA Monitor or Engineer shall take a sample three feet (along roll length) by roll width according to ASTM D4354. The sample shall be properly marked, wrapped and sent to an independent laboratory for conformance testing.

B. Contractor shall be responsible for replacing any geotextile and associated work for geotextile not passing the requirements of these Specifications, at no additional cost to the Owner.

PART 3 EXECUTION

3.1 INSTALLATION

A. The geotextile shall be handled in such a manner as to ensure that it is not damaged in any way. Should the Contractor damage the geotextile to the extent that it is no longer usable as determined by these Specifications or by the Owner's CQA Monitor or Engineer, the Contractor shall replace the geotextile at no additional cost to the Owner.

B. The geotextile shall be installed to the lines and grades as shown on the Construction Plans following approval of the geocomposite installation.

C. The geotextile shall be rolled down the slope in such a manner as to continuously keep the geotextile in tension by self weight. The geotextile shall be securely anchored in an anchor trench where applicable, or by other approved or specified methods.

D. The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade. Geotextile shall be overlapped as follows:

1. Adjacent geotextile rolls shall be overlapped a minimum of 24 inches and seamed when installed beneath rip rap.

2. Geotextile installed for leachate collection and underdrain system components shall be completely wrapped all around, overlapped a minimum of 12 inches and seamed.

E. In the presence of wind, all geotextiles shall be weighted by sandbags or other approved equivalent. Such anchors shall be installed during placement and shall remain in place until replaced with cover material.

F. The Contractor shall take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geotextile, including all personnel working on the surface shall wear shoes that do not damage the materials, or engage in any other activity that may damage the materials, such as smoking. Should damage to such material occur due to the fault of the Contractor (including failure to protect the Work), the Contractor shall repair the damaged materials at no additional cost to the Owner and to the satisfaction of the Owner's CQA Monitor or Engineer.

G. During placement of the geotextile, care shall be taken not to entrap soil, stones or excessive moisture that could clog or damage the material, or hamper subsequent seaming of the geotextile as judged by the Engineer or Owner's CQA Monitor.

H. The geotextile shall be seamed using heat seaming or stitching methods as recommended by the manufacturer and approved by the Engineer.

1. Sewn seams shall be made using polymeric thread with chemical resistance equal to or exceeding that of the geotextile. All sewn seams shall be continuous. Seams shall be oriented down slopes perpendicular to grading contours unless otherwise specified.

2. For heat seaming, fusion welding techniques recommended by the manufacturer shall be used.

I. The Contractor shall not use heavy equipment to traffic above the geotextile without a minimum of 12-inches of cover or cover thickness recommended by the manufacturer.

J. Material overlying the geotextile shall be carefully placed to avoid wrinkling or damage to the geotextile.

END OF SECTION

SECTION 02922

GEOMEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The Work covered in this Section includes the manufacturing, fabrication, testing, supply and installation of high density polyethylene (HDPE) textured (both sides) geomembrane.

B. The Contractor shall furnish all labor, materials, transportation, handling, storage, supervision, tools, equipment and other incidentals necessary to install and test, including quality control and quality assurance as specified in Part 1.5 of this Section, the geomembrane as required by the Construction Plans and Technical Specifications.

1.2 RELATED SECTIONS

A. Section 02250 – Compacted Clay Liner

B. Section 02930 – Geocomposite

C. Attachment A – QA/QC Plan for Liner and Leachate Collection System Installation and Testing

1.3 SUBMITTALS

A. Contractor shall submit the following geomembrane manufacturing information to the Owner's Construction Quality Assurance (CQA) Consultant for approval at least 30 days prior to procurement of the geomembrane:

1. Material Prequalification: The Contractor shall submit the manufacturer's product data sheets for the geomembrane demonstrating compliance with the material properties (test methods and frequencies) described in GRI-GM13 for the properties described in Part 2.3 of this section.

2. Manufacturer's Qualifications - The Manufacturer must have documented experience totaling 10,000,000 ft^2 of the manufactured geomembrane for at least ten (10) completed facilities.

3. Manufacturer's Brochure: Submit complete manufacturer's specifications, descriptive drawings, and literature for the geomembrane, including the product identification and supplier of the polymer resin and recommended method for handling and storage of all materials prior to installation. Include information on plant size, equipment, personnel, number of shifts per day and capacity per shift.

4. Manufacturer Quality Assurance/Manufacturer Quality Control (MQA/MQC) Program: Submit a complete description of the geomembrane MQA/MQC program for manufacturing, fabricating, quality control testing, defects repair, handling, and shipping. The description shall include, but not be limited to, polymer resin supplier(s) and product identification; quality control test methods and frequencies; production sampling and testing; and documentation of changes, alterations, repairs, retests, and acceptance procedures.

B. Contractor shall submit the following information related to their Geosynthetic Installer's qualifications to the Owner's CQA Consultant for approval at least 30 days prior to procurement of the geomembrane:

1. Certification that the Geosynthetic Installer is approved and/or licensed by the geomembrane manufacturer.

2. List at least ten (10) completed facilities over a continuous five (5) year period totaling a minimum 4,000,000 ft^2, for which the Geosynthetic Installer has installed geomembrane, including thickness, amount, date(s) and intended usage.

3. The name or names of the field superintendents proposed for the project, and a list of completed projects for which the field superintendent(s) installed the selected geomembrane totaling a minimum of 4,000,000 ft^2.

4. The name or names of the Master Seamer(s) proposed for the project, and a list of completed projects for which the Master Seamer(s) installed the selected geomembrane totaling a minimum of 2,000,000 ft^2.

5. Construction Quality Assurance Program: Submit a complete description of the Geosynthetic Installer's formal quality assurance program for handling, installing, testing, and defect repair. The description shall include, but not be limited to installation testing, documentation of changes, alterations, repairs, retests, and acceptance procedures. The document shall include a complete description of seaming by extrusion welding and hot wedge welding. Testing methods, procedures, and frequencies, shall at a minimum, conform to the requirements set forth in this Section.

C. Contractor shall submit the following information for the geomembrane to the Owner's CQA Consultant for approval at least 15 days prior to shipment of the geomembrane to the site:

1. Certification from manufacturer that geomembrane is manufactured in strict accordance with the requirements set forth in GRI-GM13 and this technical specification. At a minimum, test methods and frequencies described in GRI-GM13 for the properties described in Part 2.3 of this section will be observed during the geomembrane manufacturing. Results of testing performed shall be provided for resin and geomembrane supplied to project.

2. The manufacturer shall provide certification that the geomembrane supplied to project was manufactured from the resin lot represented by the submitted resin quality control test.

3. Prior to shipment, the manufacturer shall provide a quality control certification signed by a qualified individual employed by the manufacturer that each geomembrane roll supplied to project meets specified properties measured using test methods indicated in this specification. The certification(s) shall contain the roll number(s), production date(s), and identification for each geomembrane roll supplied for project.

4. Panel Layout Drawing: Contractor or Geosynthetic Installer shall submit a panel layout drawing consistent with the SLQCP, Section 4.3.2. The panel layout drawing shall be drawn to scale, and shall indicate areas where horizontal seams will be utilized.

D. Manufacturing Plant Visit: At the request of the Owner, submit contact names, telephone numbers, addresses, and production schedule information for purposes of scheduling a Owner or Owner's representative plant visit during production, as specified in Part 2.1.

E. Submit geomembrane warranty, as specified in Part 1.6 of this Section.

1.4 REFERENCES

A. References as listed in Table 02922-1 and 02922-2.

B. References as listed in Geosynthetic Research Institute (GRI) Standard GM13 – Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

C. QA/QC Plan for the landfill, as provided in **Attachment A**.

D. When specifications between the above references differ, the more stringent requirements shall apply. Specifically, if the inconsistencies are found between this Section and the QA/QC Plan, the Owner's CQA Monitor and/or Engineer should be notified immediately.

1.5 QUALITY ASSURANCE AND QUALITY CONTROL

A. The Owner's CQA Monitor will observe geomembrane installation and construction and certify that construction is in accordance with Construction Plans, Technical Specifications, and QA/QC Plan (See **Attachment A**).

B. This Section includes a description of the test methods and frequencies for both Construction Quality Control (CQC) and CQA tests, including but not limited to the following:

1. Construction conformance testing, as specified in Part 3.2 of this Section, will be performed by the Owner's CQA Monitor, at the expense of the Owner.

2. Field trail seams, as specified in Part 3.7 of this Section, will be performed by the Geosynthetic Installer, at the expense of the Contractor.

3. Field nondestructive seam testing, as specified in Part 3.9, will be performed by the Geosynthetic Installer, at the expense of the Contractor.

4. Field destructive seam testing, as specified in Part 3.10, will be performed by the Owner's CQA Monitor, at the expense of the Owner.

C. The Geosynthetic Installer shall coordinate all required testing with Owner's CQA Monitor prior to performing sample collection or required field testing.

1.6 WARRANTY

A. Provide warranty against workmanship defects from the Contractor for a period of one (1) year following the date of final completion of the geomembrane installation. The warranty required herein shall be provided in addition to any other warranty required by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURING PLANT VISIT

A. If requested, the Manufacturer shall allow the Owner, Owner's CQA Consultant, Engineer, or designated alternates to visit the manufacturing plant for a project-specific visit. The designated visitor shall be allowed to review the manufacturing process, quality control, laboratory facilities and testing procedures as necessary to verify that:

1. Properties guaranteed by the Manufacturer meet all specifications;

2. Measurements of properties by the Manufacturer are properly documented and test methods used are acceptable;

3. Rolls of geomembrane are free of holes, blisters, or any sign of contamination by foreign matter;

4. Packaging and transportation procedures do not damage the geomembrane;

5. Roll packages are labeled to indicate the name of the manufacturer, the type of geomembrane, the roll thickness and the roll number; and

6. That extrusion rods and/or beads are derived from the same base resin type as the geomembrane.

2.2 GEOMEMBRANES

A. Single Source: All geomembrane sheets and extrudate material for the construction of the project shall be obtained from a single material supplier and manufacturer. It must be certified and warranted that the sheets and extrudate are compatible with one another. The Contractor shall provide manufacturer's warranties for the sheets and extrudate, as specified in Part 1.6 of this Section.

B. No more than six lots shall be used without written approval from the Owner's CQA Monitor.

2.3 MATERIAL PROPERTIES

A. Resin shall be a high density polyethylene meeting the property requirements set forth in Table 02922-1 and GRI-GM13.

TABLE 02922-1
EXTRUDATE RESIN PROPERTIES [1]

Property	Test Method	Units	Requirements
Specific Gravity/Density (compounded resin)	ASTM D 1505 / D 792	g/cc	> 0.932
Melt Flow Index	ASTM D 1238 (condition E)	g/10 min.	< 1.1

Note:
[1] Testing frequencies for the above properties shall at a minimum comply with testing frequencies specified in GRI-GM13 or the approved QA/QC Plan, whichever is more stringent. The manufacturer's quality control program shall describe the test methods and frequencies for each material property.

B. Extrudate shall be the same resin as the geomembrane. The manufacturer shall provide documentation and shall certify that the extrudate meets this requirement.

C. The geomembrane shall consist of new, first-quality products designed and manufactured in accordance with the requirements set forth in GRI-GM13.

D. Geomembrane shall be 60-mil HDPE meeting the property requirements set forth in Table 02922-2 and GRI-GM13.

TABLE 02922-2
GEOMEMBRANE PROPERTIES[1]

Property	Test Method	Requirements	Units
		Textured	
Sheet Thickness	ASTM D 5994	60	mils
Tensile Yield Strength	ASTM D 6693, Type IV	126	lbs/in
Tensile Break Strength	ASTM D 6693, Type IV	90	lbs/in
Elongation at Yield	ASTM D 6693, Type IV	12	%
Elongation at Break	ASTM D 6693, Type IV	100	%
Tear Resistance	ASTM D 1004	42	lbs
Puncture Resistance	ASTM D 4833	90	lbs
Stress Crack Resistance	Appendix of ASTM D 5397	300	Hours
Oxidative Induction	D 3895 (or D 5885)	100 (or 400)	Minutes
Carbon Black Content	ASTM D 1603	2-3	%
Carbon Black Dispersion	ASTM D 5596	See Note 2	Categories
Oven Aging @ 85°	ASTM D 5721 and D 3895 (or D 5885)	55 (or 80)	%

[1] Testing frequencies for the above properties shall at a minimum comply with testing frequencies specified in GRI-GM13. The manufacturer's quality control program shall describe the test methods and frequencies for each material property. Each material property requirement shall be considered the minimum average value unless otherwise specified in GRI-GM13.
[2] Carbon black dispersion (only near spherical agglomerates) shall be tested from 10 different views with a minimum of 9 in Categories 1 or 2 and 1 in Category 3.

PART 3 EXECUTION

3.1 DELIVERY, HANDLING, AND STORAGE

A. The Contractor and Geosynthetics Installer shall comply with the general handling and storage requirements specified in the QA/QC Plan, as well as the following requirements. Where the following requirements and the QA/QC Plan conflict, Contractor and Geosynthetics Installer shall adhere to the more stringent requirements.

1. Inspection upon Delivery - Upon delivery at the site the Geosynthetics Installer, in the presence of the Owner's CQA Monitor, shall conduct a visual inspection of rolls for defects and/or damage. This inspection shall be conducted without unrolling rolls unless, in the Geosynthetic Installer's or Owner's CQA Monitor's opinion, defects or damages are found or suspected. Defects or flaws in the materials shall be brought to the attention of the Owner's CQA Monitor. Rolls, or portions thereof, which have unacceptable flaws shall be recorded by the Owner's CQA Monitor and Geosynthetics Installer as rejected and shall be removed from the site. Rejected materials shall be replaced by the Contractor at no additional cost to the Owner. No time extension will be allowed in the case of rejected materials.

2. Handling - The Geosynthetic Installer's and Contractor's personnel shall handle the material with care, using appropriate equipment and taking necessary precautions necessary to prevent damage to geomembrane.

3. Storage - The Geosynthetic Installer and Contractor shall be responsible for ensuring that the stored materials are protected from rain, snow, ice, dirt, ultraviolet light, shock, theft, vandalism, passage of vehicles, and other sources of damage. The Contractor is responsible the clearing, grubbing, and grading necessary to prepare the storage area. Additionally, the Contractor shall

provide surface water control, access, and lighting necessary for adequate unloading of highway transport vehicles and access by construction equipment.

3.2 CONSTRUCTION CONFORMANCE TESTING

A. The Geosynthetic Installer shall take samples from the delivered lots at the specified frequency in the presence of the Owner's CQA Monitor. The Owner's CQA Monitor shall forward all samples to the CQA Laboratory for conformance testing. The cost for laboratory conformance testing shall be paid by the CQA Monitor.

B. The following conformance tests, as referenced in Table 02922-2, are required prior to geomembrane shipment:

1. Thickness [ASTM D 5994];

2. Specific Gravity/Density (ASTM D 1505);

3. Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes (ASTM D 6693);

4. Carbon Black Content (ASTM D 1603); and

5. Carbon Black Dispersion (ASTM D 5596).

C. Conformance Test (Part 3.2.B): Samples shall be taken across the entire width of the roll and shall not include the first three feet. Samples shall be three feet long by the roll width. Samples shall be taken at a rate of one per lot or one per 100,000 square feet, whichever is least.

D. Thickness measurements shall also be taken in the field at a rate of one measurement every five feet along the leading edge of each panel, as specified in the QA/QC Plan.

E. All conformance test results shall be reviewed and approved by the Owner's CQA Monitor prior to any placement. If a conformance test result fails the specifications, at least two additional conformance tests shall be performed on samples taken immediately from adjacent numbered rolls. If both additional conformance test results pass the specifications, the entire lot or 100,000 square feet shall be accepted except that roll from which the failed sample is taken. If any of the conformance test results fails for the two (minimum) additional samples, the entire lot or 100,000 square feet shall be rejected by the CQA Monitor.

3.3 GENERAL REQUIREMENTS

A. Installation shall be performed under the direction of a qualified field superintendent, employed by the Geosynthetic Installer, who shall remain on-site and be in charge throughout the entire geomembrane installation (including subgrade acceptance, geomembrane layout, panel placement, seaming, testing and repairs) and all other activities performed by the Geosynthetic Installer.

B. All personnel performing seaming operations shall be qualified by experience and by successfully passing trial seam tests and shall be approved by the Owner's CQA Monitor prior to installing the geomembrane.

C. Actual seaming shall be performed under the direction and supervision of a "Master Seamer" as described in Part 1.3.B of this Section. The Master Seamer must be on-site whenever installation and/or seaming are being performed.

D. Weather - The Geosynthetic Installer shall provide sufficient ballast and temporary anchorage to protect the material from wind damage or displacement. Additionally, the Geosynthetic Installer and

Contractor is responsible for protecting the material from damage due to other weather incidents at all times, including but not limited to rain, snow, ice, dirt and soil deposition, ultraviolet light, etc. Replacement or repair of weather-damaged geomembrane shall be at the Contractor's expense, as determined by the Owner and Owner's CQA Monitor.

3.4 INSTALLATION AND FIELD TESTING EQUIPMENT

A. Seaming Methods

1. Approved processes for field seaming are extrusion welding and fusion (wedge) welding. Solvent or adhesive welding is prohibited.

2. Proposed alternate processes shall be documented and submitted to the Owner's CQA Monitor and Engineer for approval prior to the equipment being delivered to site, and prior to geomembrane installation.

3. Only apparatus which have been specifically approved by make and model shall be used.

B. Welding Equipment

1. The Geosynthetic Installer shall provide welding equipment with gauges showing temperatures at the nozzle or barrel (extrusion welder) and at the wedge (fusion welder).

2. The fusion-welding apparatus must be automated, self-propelled devices, and shall be equipped with gauges giving the important temperatures and pressures. The welding apparatus shall be able to produce a "double hot wedge" with void for non-destructive seam testing.

3. Equipment shall be maintained in good working condition and in adequate number to avoid delaying work in the event of equipment failure or malfunction, and shall be supplied by a power source capable of providing constant voltage under a combined line load.

4. At least one spare operable seaming apparatus of each type used shall be maintained on-site. Equipment used for seaming shall be handled so as to avoid damaging the geomembrane.

C. Field Tensiometer

1. The Geosynthetic Installer shall provide a field tensiometer for on-site peel and shear testing of geomembrane seams. The tensiometer shall be calibrated prior to arrival at the site, capable of performing testing according to ASTM D 6392, and be accompanied by evidence of current valid calibration. The tensiometer shall be motor driven and have jaws capable of traveling at a maximum measured rate of 2 inches per minute, or as recommended by the current version of the applicable GRI guideline. The tensiometer shall be equipped with a gauge that measures the force exerted between the jaws in pounds and have a digital readout.

D. Punch Press

1. The Geosynthetic Installer shall provide a punch press for the on-site preparation of specimens for testing. The press shall be capable of cutting specimens in accordance with ASTM D 6392 or as recommended by the current version of the applicable GRI guideline.

3.5 PREPARATION

A. Prior to geomembrane panel deployment, the Geosynthetic Installer shall inspect the surface upon which the geomembrane will be placed. This surface shall be smooth, free of rocks, protrusions, sharp

objects, and deleterious material that could puncture or abrade the geomembrane. Edges of the geomembrane surface and grade breaks shall be rounded to preclude sharp corners.

B. Certification of Subgrade Acceptance

1. The Geosynthetic Installer shall be responsible for preparing the geomembrane surface, see Section 02250 – Compacted Clay Liner, upon which the geomembrane will be placed.

2. Prior to geomembrane installation the Geosynthetic Installer shall certify in writing that the surface upon which the geomembrane will be installed is acceptable. The Certificate of Acceptance shall be given by the Geosynthetic Installer to the Owner's CQA Monitor prior to commencement of geomembrane installation in the area under consideration.

3. After the Owner's CQA Consultant has approved the installed compacted clay liner, it shall be the Geosynthetic Installer's responsibility to indicate to the Owner's CQA Consultant changes in the compacted clay liner that require repair work. The Geosynthetic Installer and Owner's CQA Consultant shall ensure that the compacted clay liner is repaired prior to placement of geomembrane in that area.

C. Prior to geomembrane panel deployment, repair any damage to the compacted clay liner, which has occurred due to the Geosynthetic Installer's activities.

D. Geomembrane anchor trenches shall be constructed to the lines, grades, and dimensions shown on the Construction Plans. The anchor trench shall be backfilled with care as not to damage or stretch the geomembrane. When the anchor trench will be excavated in soil susceptible to desiccation, no more than the amount of trench required for geomembrane to be anchored in one day shall be excavated. The anchor trench shall be maintained clean and dry prior to backfilling.

3.6 PANEL PLACEMENT

A. Procedures for panel placement shall be in accordance with the QA/QC Plan (**Attachment A**).

3.7 FIELD SEAMING

A. Trial seam testing shall be performed for each of the events described in the QA/QC Plan (**Attachment A**).

B. Field seaming procedures shall also be performed in accordance with the QA/QC Plan (**Attachment A**).

C. All field seams shall meet or exceed the requirements of Part 3.10, related to destructive seam testing.

3.8 PROTECTION

A. The Geosynthetic Installer shall take precautions as necessary to protect the geomembrane, including but not limited to:

1. Providing a smooth insulating plate or fabric beneath hot welding apparatus before and after usage.

2. Providing additional protection over the geomembrane in heavily trafficked areas.

3. Protecting the geomembrane from ultraviolet exposure. The geomembrane shall not be left exposed (uncovered) to the elements for any period longer than 30 days unless otherwise approved by the Owner's CQA Monitor.

4. Positioning overlaps of panels to facilitate drainage prior to seaming.

5. Preventing damage to the geomembrane by scraping, scarring, scuffing, scratching, gouging, handling, trafficking, excessive heat, vibration, leakage of hydrocarbons or any other means.

6. Assuring that the prepared surface underlying the geomembrane has not deteriorated or changed significantly since acceptance, and is still acceptable at the time of geomembrane placement.

7. Assuring that the surfaces underlying the geomembrane are clean and free of debris.

8. Preventing personnel working on the geomembrane from smoking, wearing damaging shoes, or engaging in other activities which could damage the geomembrane.

9. Using methods to unroll the panels that do not cause scratches or crimps in the geomembrane and do not damage the underlying surfaces.

10. Using methods to place the panels that minimize wrinkles (especially differential wrinkles between adjacent panels). Temperature changes should be considered in scheduling of panel deployment and seaming to minimize shrinkage and expansion problems.

11. Adequately anchoring the geomembranes before and after deployment to prevent wind damage.

12. Minimizing direct contact with geomembrane; (i.e., protecting the geomembrane with geotextiles, extra geomembrane, or other suitable materials) in areas where excessive traffic may be expected.

13. Preventing all wheeled and tracked equipment from driving directly on the geomembrane.

14. Not allowing the geomembrane surface to be used as a work area for preparing patches, storing tools and supplies, etc.

15. Ensuring that sharp objects are not left on the surface of the geomembrane.

3.9 FIELD NONDESTRUCTIVE SEAM TESTING

A. The Geosynthetic Installer shall nondestructively test 100 percent of field seams over their entire length using the procedures specified in the QA/QC Plan (**Attachment A**).

B. Nondestructive testing shall be performed in the presence of the Owner's CQA Monitor and results shall be immediately provided to Owner's CQA Monitor following completion of the test.

C. Air pressure testing is only applicable to those processes which produce a double seam with an enclosed space, and shall follow GRI GM6, Pressurized Air Channel Test for Dual Seamed Geomembranes.

D. Testing shall be performed as the seaming work progresses, not at the completion of all field seaming.

3.10 DESTRUCTIVE SEAM TESTING

A. Destructive seam sampling and testing shall be performed in accordance with the procedures described in the QA/QC Plan (**Attachment A**).

B. Samples will be taken by the Geosynthetic Installers, in the presence of the Owner's CQA Monitor at the location selected by the Owner's CQA Monitor.

C. Independent laboratory testing must confirm the field test results. All laboratory samples must meet the passing criteria specified in QA/QC Plan (**Attachment A**). To be considered passing:

1. At least 4 of the 5 specimens tested in peel must fail in film tear bond (FTB);

2. At least 4 of the 5 specimens tested must meet the minimum specified value for peel and shear; and

3. The average value from all 5 specimens tested in peel and shear values must meet the minimum specified values for peel and shear.

D. All field-tested samples must be passing in both shear and peel for the required minimum values:

1. The shear strength minimum requirement is 95% of the manufacture's parent sheet strength, but not less than 120 lbs/in.

2. The peel strength minimum requirement is 62% of the manufacture's parent sheet strength, but not less than 78 lbs/in, and exhibit FTB.

3.11 DEFECTS AND REPAIRS

A. Identification

1. The entire geomembrane, including seams, shall be visually examined by the Owner's CQA Monitor for identification of visual defects, holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

2. The surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be swept or washed by the Geosynthetic Installer if dust, mud or other matter inhibits examination. All areas having defects and/or requiring repairs shall be repaired at no additional cost to the Owner.

3. Work shall not proceed with any materials which will cover locations which have been repaired until the Owner's CQA Monitor has re-examined the repaired area and applicable laboratory test results with passing values are available. Panels or portions of panels which, in the opinion of the Owner's CQA Monitor, are damaged beyond repair shall be removed from the site and replaced.

B. Repair Procedures

1. Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test shall be repaired. Several procedures exist for the repair of these areas, as specified in the QA/QC Plan (**Attachment A**). The final decision as to the appropriate repair procedure shall be agreed upon between the Owner's CQA Monitor and Geosynthetics Installer.

C. Verification of Repairs: Each repair shall be nondestructively tested. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. At the discretion of the Owner's CQA Monitor, large repairs may require destructive test sampling. In the case of failed tests, the repair shall be redone and retested until a passing test result is obtained. The Owner's CQA Monitor shall observe all non-destructive testing of repairs and shall record the identification of each repair, date, technician, and test outcome.

D. Wrinkles: When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the Owner's CQA Monitor shall indicate which wrinkles shall be cut and reseamed by the Geosynthetic Installer. The seam thus produced shall be tested in accordance with this Section. Wrinkle size shall be evaluated during the

time of day and under conditions similar to those expected when overlying protective cover/drainage layer material is to be placed. All wrinkles higher than they are wide (across their base) shall be removed by repair methods.

E. Bridging: The geomembrane shall be continuously supported on the accepted compacted clay liner surface. Bridging (unsupported geomembrane) is not permissible. Geosynthetic Installer shall take necessary steps to prevent bridging and repair or replace any geomembrane subsequently affected and repair the underlying compacted clay liner, as directed by the Owner's CQA Monitor.

END OF SECTION

SECTION 02930

GEOCOMPOSITE

PART 1 GENERAL

1.1 SUMMARY

A. The Work covered in this Section includes the manufacture, fabrication, testing, supply, and installation of the geocomposite component of the leachate collection system. **Geocomposite supplied for this project will consist of a non-woven geotextile heat bonded to both sides of a high density polyethylene geonet (i.e., double-sided geocomposite)**.

B. The work covered in this section includes the supply and installation of the 250-mil geocomposite for the leachate collection system (referred herein as the leachate collection geocomposite). Therefore, as specified in the Section 01025 – Measurement and Payment, the measurement and payment for the leachate collection geocomposite shall include manufacture, fabrication, testing, supply (including freight to the Site), and installation.

C. The Geosynthetic Contractor shall furnish all labor, materials, transportation, handling, storage, supervision, tools, incidentals and other equipment that may be necessary to install and test the geocomposite as specified by the Contract Documents. All testing specified in this section is quality control (QC) testing and is the Geosynthetic Contractor's responsibility.

1.2 RELATED SECTIONS

A. Section 02256 – Protective Cover

B. Section 02922 – Geomembrane

C. **Attachment A – QA/QC Plan for Liner and Leachate Collection System Installation and Testing**

1.3 SUBMITTALS

A. The Contractor shall submit the following product information to the CQA Consultant for approval at least 30 days (unless otherwise specified) prior to procurement of the product:

1. Material Prequalification: The Contractor shall submit the manufacturer's product data sheets for the geocomposite demonstrating compliance with the material properties listed in Table 02930-1 (HDPE Drainage Net), Table 02930-2 (Non-woven Geotextile), and Table 02930-3 (Geocomposite Properties).

2. Manufacturer's qualifications for the HDPE drainage net, non-woven geotextile, and geocomposite, as specified in Part 2.1.

3. Manufacturer's Brochure: Complete manufacturer's specifications, descriptive drawings, and literature for the geocomposite, including the product identification and suppliers of the polymer resin and recommended methods for handling and storage of all materials prior to installation. Describe the manufacturer's methodology to comply with the requirements specified for manufacturing quality control.

4. Manufacturer Quality Assurance/Manufacturer Quality Control (MQA/MQC) Program: Complete description of the MQA/MQC program for manufacturing, fabricating, handling, installing, and testing. The description shall include, but not be limited to, polymer resin supplier and product identification, acceptance testing, production testing, installation inspection, installation

techniques, repairs, and acceptance. The document shall include a complete description of methods for both roll end and roll side joining.

5. Installer's Qualifications: The name or names of the Geosynthetic Installer's field superintendent who will be proposed for the project and a list of completed facilities for which the field superintendent has installed geocomposite layer totaling a minimum of 2,000,000 square feet.

B. Contractor shall submit the following information for the geocomposite to the Authority's CQA Consultant for approval at least 15 days prior to shipment of the geocomposite to the site:

1. Manufacturer's Quality Control Testing (See Part 2.5 for tests and test frequencies): The manufacture shall test all supplied materials for the specified properties using the specified test methods described in Part 2.5.B – D. At a minimum, each material property shall be verified at least once per quantity supplied or at the specified frequencies listed in Part 2.5, whichever is greater.

2. The manufacturer must provide a certificate of compliance which states production dates for the geocomposite and that all material to be installed meets or exceeds the material properties specified in Table 02930-1 to 02930-3 and was manufactured using the same techniques, resin type, and formulation as that for which test results were submitted.

3. Suppliers and/or manufacturers shall also certify that HDPE drainage net and non-woven geotextile are compatible with one another when bonded to form the geocomposite.

4. Protection from Wind and Weather: Submit plans to protect the geocomposite from wind, dirt, and extended direct sunlight exposure.

5. Installation Instructions: Samples of the geocomposite with a complete set of specifications, and manufacturer's complete written instructions for storage, handling, installation, and joining.

B. Factory Visit: Upon request, arrange with the geocomposite manufacturer to allow the Authority or Authority's Representative to visit the manufacturing plant during the manufacture of material for this project, for the purpose of observing the manufacturing process and quality control procedures. Submit contact names, telephone numbers, addressed, and production schedule information.

1.4 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only. Where the test method references are not the most recently published methods, the recently published methods shall supersede the methods listed below.

1. ASTM D 413 - Rubber Property - Adhesion to Flexible Substrate

2. ASTM D 1238 - Flow Rates of Thermoplastics by Extrusion Plastometer

3. ASTM D 1505 - Density of Plastics by the Density-Gradient Technique

4. ASTM D 1603 - Carbon Black in Olefin Plastics

5. ASTM D 3786 - Hydraulic Bursting Strength of Knitted Goods and Non-woven Fabrics: Diaphragm Bursting Strength Tester Method

6. ASTM D 4491 - Water Permeability of Geotextiles by Permittivity

7. ASTM D 4533 - Trapezoid Tearing Strength of Geotextiles

8. ASTM D 4632 - Grab Breaking Load and Elongation of Geotextiles

9. ASTM D 4716 - Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products

10. ASTM D 4751 - Determining the Apparent Opening Size of a Geotextile

11. ASTM D 4833 - Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

12. ASTM D 5199 - Measuring Nominal Thickness of Geotextiles and Geomembranes

13. ASTM D 5261 - Measuring Mass per Unit Area of Geotextiles

14. ASTM D 5321 - Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

15. ASTM F 904 - Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials

PART 2 PRODUCTS

2.1 MANUFACTURER'S QUALIFICATIONS

A. Manufacturer shall have manufactured a minimum of 5,000,000 square feet of geocomposite.

B. Single Source

1. All HDPE drainage net used for construction of the geocomposite must be obtained from a single material supplier or manufacturer.

2. All non-woven geotextile fused to the HDPE drainage net and used for the construction must be obtained from a single material supplier.

3. All fusion of HDPE drainage net to non-woven geotextile must be accomplished by a single material supplier or manufacturer.

4. Suppliers and/or manufacturers shall certify that the HDPE drainage net and non-woven geotextile will be compatible with one another.

2.2 HDPE DRAINAGE NET

A. The HDPE drainage net component of the geocomposite shall be manufactured by extruding strands of material into a counter-rotating die to form a three dimensional structure to provide planar water flow.

B. HDPE drainage net shall meet the requirements of Table 02930-1, HDPE Drainage Net Properties.

C. The HDPE drainage net shall consist of new, first-quality products designed and manufactured specifically for the intended purpose designated in the Technical Specifications and shown on the Construction Plans, as satisfactorily demonstrated by prior use. The HDPE drainage net shall contain stabilizers to prevent ultraviolet light degradation. The HDPE drainage net shall be unmodified HDPE containing no plasticizer, fillers, chemical additives, reclaimed polymers, or extenders. Carbon black shall be added to the resin for ultraviolet resistance. The only other allowable compound elements shall be anti-oxidants and heat stabilizers, of which up to 1 percent total, as required for manufacturing, may be added.

2.3 NON-WOVEN GEOTEXTILE

A. Non-woven geotextile shall meet the physical property requirements set forth in Table 02930-2.

2.4 GEOCOMPOSITE

A. **Double-Sided geocomposite**: Geocomposite comprised of three layers, including a lower non-woven geotextile, a middle HDPE drainage net, and an upper non-woven geotextile. The lower and upper geotextiles shall be heat-bonded to the middle HDPE drainage net. Double-sided geocomposite shall be installed at the locations indicated on the Construction Plans.

B. The geocomposite shall be fabricated by heat bonding the non-woven geotextile to one or both sides of the HDPE drainage net. No burn through of non-woven geotextiles will be permitted. No glue or adhesive shall be permitted. The bond between the geotextile and the HDPE drainage net shall meet the requirements of Table 02930-3, Geocomposite Properties.

C. Geocomposite shall be supplied in rolls, marked or tagged with the following information:

1. Manufacturer's name;
2. Product identification;
3. Lot number;
4. Roll number; and
5. Roll dimensions.

D. The geocomposite shall be supplied as a continuous sheet with no factory seams. During installation, the roll length shall be maximized to provide the largest manageable roll for the fewest field seams. Rolls shall be wound on a core which shall be stable enough to support the rolls during handling and shipping.

2.5 MANUFACTURING QUALITY CONTROL TESTING

A. At a minimum, the properties listed in Tables 02930-1, 02930-2, and 02930-3 for HDPE resin and drainage net, non-woven geotextile, and geocomposite, respectively, shall be tested using the specified test methods.

1. HDPE resin shall be tested at a frequency of one test per resin batch for compliance with Table 02930-1, HDPE Drainage Net Properties. One batch is defined as one rail car load of resin. The finished rolls of the HDPE drainage net shall be identified by a roll number corresponding to the resin batch used. The following minimum test frequencies shall be observed:

Property	Test Method	Minimum Frequency
Polymer Density, resin	ASTM D 1505	1 per batch
Polymer Melt Index	ASTM D 1238	1 per batch

2. HDPE drainage net shall be tested during manufacturing for compliance with Table 02930-1, HDPE Drainage Net Properties. The following minimum test frequencies shall be observed:

Property	Test Method	Minimum Frequency
Polymer Density, resin (plus Carbon Black)	ASTM D 1505	1/100,000 sf
Property	**Test Method**	**Minimum Frequency**
Mass per Unit Area	ASTM D 5261	1/40,000 sf
Thickness	ASTM D 5199	1/40,000 sf

3. Non-Woven Geotextile shall be tested during manufacturing for the compliance with Table 02930-2, Non-woven Geotextile Properties, at a minimum frequency of 1 per 100,000 square feet, with the exception to the UV resistance which shall be performed at once per formulation.

4. Geocomposite shall be tested during manufacturing for compliance with Table 02930-3, Geocomposite Properties, at a minimum frequency of 1 per 100,000 square feet. The transmissivity may be performed specifically for the project or may be certified as meeting or exceeding the requirements based on historical test data provided by the manufacturer.

B. Material Properties for geocomposite supplied and/or installed for the leachate collection system are described in Tables 02930-1, 02930-2, and 02930-3. Material property values are minimum average roll values (MARV), which exception to the Polymer Melt Index, which is a maximum allowable value.

TABLE 02930-1
HDPE DRAINAGE NET PROPERTIES

Property	Unit	Test Method	Specified Values
Polymer Density, Resin	g/cm^3	ASTM D 1505	0.932
Polymer Density, Resin plus Carbon Black	g/cm^3	ASTM D 1505	0.940
Polymer Melt Index	g/10 min.	ASTM D 1238	1.0
Carbon Black	Percent	ASTM D 1603/4218	2-3
Nominal Thickness	Mils	ASTM D 5199	250
Tensile Strength (machine direction)	lbs/in	ASTM D 5035	50 +/- 10

TABLE 02930-2
NON-WOVEN GEOTEXTILE

Property	Unit	Test Method	Specified Values
Mass per Area	oz/yd^2	ASTM D 5261	8
Grab Tensile Strength	Lbs	ASTM D 4632	220
Puncture Strength	Lbs	ASTM D 4833	120
Apparent Opening Size	Sieve No.	ASTM D 4751	80
Water Flow Rate	gpm/ft^2	ASTM D 4491	95
UV Resistance	% (after 500 hrs)	ASTM D 4355	70

TABLE 02930-3
GEOCOMPOSITE PROPERTIES

Property	Unit	Test Method	Specified Values
Ply Adhesion	lb/in	ASTM F 904	1
Transmissivity[1]	m^2/sec	ASTM D 4716	6.4×10^{-4}

Notes:
1. Gradient of 0.02 and normal load of 6,000 psf for a seat time of 15 minutes.

PART 3 EXECUTION

3.1 ROLL JOINING METHODS

A. Table 02930-4, Geocomposite Joining Methods, summarizes acceptable roll joining methods.

1. Lap Seams: The bottom layer of non-woven geotextile shall be lap seamed. Lap seaming is accomplished by overlapping adjacent non-woven geotextile a minimum of 6 inches.

2. Nylon Ties: Geocomposite layers shall be overlapped and fastened with nylon ties. Nylon ties shall be yellow or white in color to facilitate inspection.

3. Machine Sewn Seams: Sewing shall be accomplished with a chain-stitching sewing machine. The thread shall be polymeric thread which complies with non-woven geotextile manufacturer's recommendations and is a color which contrasts with the color of the non-woven geotextile. The seam shall be placed a minimum of 4 inches from the non-woven geotextile edges. The finished seam shall be folded to one side ("J" seam) and be secured with a double row of stitches.

3.2 ROLL JOINING REQUIREMENTS

A. The minimum requirements for joining rolls are specified in Table 02930-4, Geocomposite Joining Methods.

1. Roll Ends: At roll ends the material shall be overlapped a minimum of 12 inches. Roll ends shall be shingled; the uphill roll end shall be overlapped 12 inches over the downhill roll end. At roll ends, the HDPE drainage net shall be tied every 12 inches on centers at a minimum. The bottom layer of non-woven geotextile shall be overlapped a minimum of 6 inches. The upper layer of non-woven geotextile shall be machine sewn.

2. Adjacent Roll Sides: At roll sides the material shall be overlapped a minimum of 4 inches. The bottom non-woven geotextile shall be lap seamed. The HDPE drainage net shall be overlapped and tied a minimum of 5 feet on center. The upper layer of non-woven geotextile shall be machine sewn.

TABLE 02930-4
GEOCOMPOSITE JOINING METHODS

Location	Layer	Joining Method	Min. Overlap (in)	Tying Frequency (ft)
Roll End	Upper geotextile	machine sewing	4	N/A
	Geonet	nylon ties	12	1’ on center
	Lower geotextile	overlap	6	N/A
Roll Side	Upper geotextile	machine sewing	4	N/A
	Geonet	nylon ties	4	5’ on center
	Lower geotextile	overlap	6	N/A
Repair of Minor damage	Upper geotextile	machine sewing	4	N/A
	Geonet	N/A	N/A	N/A

3.3 INSTALLATION

A. The Geocomposite shall be installed in accordance with the manufacturer's recommendations and as specified herein. In case of a conflict between requirements, the more stringent shall apply.

B. The CQA Monitor shall be onsite at all times during installation of the geocomposite.

C. Both geocomposite and the underlying geomembrane shall be clean, dry, and free of dirt and dust during installation. If dirt, dust, or water is present, the Contractor shall clean the work area. Geocomposite which is wet, dirty or muddy shall be discarded and shall not be installed.

D. Geocomposite shall be rolled down the slope in such a manner as to continually keep the material in tension. If necessary, the material shall be positioned by hand after unrolling to minimize wrinkles. The material shall not be unrolled horizontally (i.e., across the slope).

E. The Contractor shall provide sufficient ballast and temporary anchorage to protect the material from wind damage or displacement. The Contractor is responsible for protecting the material from damage due to weather at all times.

F. Personnel walking on the material shall not engage in activities or wear footwear that could damage the material. Smoking shall not be permitted on or near the geosynthetics.

G. Vehicular traffic shall not be permitted on the geosynthetics. Equipment shall not damage the material by handling, trafficking, or leakage of hydrocarbons. The surface shall not be used as a work area for preparing patches, storing tools and supplies, or other uses.

H. The material shall be installed to avoid bridging.

I. In corners, where overlaps between rolls are staggered, an extra roll shall be installed from the top to the bottom of the slope to provide a smooth, protected surface.

J. Geocomposite shall be protected from direct sunlight or precipitation prior to installation. After installation this material shall have minimal exposure to direct sunlight and shall be completely protected from direct sunlight within 30 days of installation. Material which is exposed to direct sunlight for 30 days or more shall be replaced at the Contractor's expense.

K. It is the Contractor's responsibility to provide all labor and materials for protection of the geocomposite during the period of time prior to installation of overlying materials. The Contractor's protection method is subject to the approval of the CQA Monitor.

3.4 REPAIRS

A. Damaged, soiled, or delaminated geocomposite shall be removed and discarded.

B. Minor Damage: Minor damage is defined as a defect or hole in the material that is smaller than 2 inches in its lesser dimension. Minor damage may be repaired by snipping out any protruding drainage net and machine sewing a non-woven geotextile patch over the hole. The patch shall be a minimum of 12 inches larger than the damaged area in all directions.

C. Major Damage: Major damage is defined as a defect or hole in the material that is 2 inches or larger in its lesser dimension. Major damage shall be repaired by replacing the entire geocomposite panel width.

END OF SECTION

SECTION 03300

CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section specifies cast-in place concrete, including formwork, reinforcement, mix design, placement procedures, and finishes.

B. Cast-in-place concrete will be required for the concrete sump/clean-out riser retaining wall, as shown on the Construction Plans.

1.2 RELATED SECTIONS

A. Section 02210 – Excavation, Backfill, Fill, and Grading

B. Section 02231 – Aggregate

1.3 SUBMITTALS

A. Submit the following product data:

1. Product data for proprietary materials and items described in Part 2, and others if requested by Owner or Engineer, including but not limited to the following:

   a. Chemical and physical properties for the materials incorporated into the mix, including but not limited to the cement, fly ash, gravel and sand gradations, and admixtures. This product data should also include the applicable ASTM standards used by the manufacturer to perform their quality control test.

   b. Test data from the manufacturer demonstrating 28-day break strength of 4,000 psi consistent with ASTM C 150.

2. Submit concrete mix designs to Engineer at least 15 days prior to incorporating into Work.

B. Each truckload of ready-mix concrete shall have a truck ticket, listing at a minimum, the following:

1. Mix identification and cement content

2. Type of admixtures, if any

3. Time loaded

4. Water quantity, in gallons or pounds

5. Name of ready-mix plant

6. Invoice number

7. Date and truck number

8. Weight of fly ash, if any

C. Truck tickets shall be maintained by Contractor, and a copy submitted to Owner and Engineer.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces.

B. Form Release Agent: Provide commercial formulation form release agent with a maximum volatile organic compound (VOC) concentration of 350 mg/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed, epoxy coated reinforcement Bar of a size indicated on the Construction Plans.

B. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

C. All reinforcement shall be free of any material, which would reduce bonding with concrete.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I with a 28-day break strength of 4,000 psi unless otherwise shown in the Construction Plans.

B. Water: Potable.

2.4 RELATED MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf.

2.5 DESIGN MIX

A. For plant-mix concrete, submit a mix design from a concrete supplier that has previously provided concrete to similar projects.

B. Aggregates: Aggregates shall conform to ASTM C 33. Maximum size of the coarse aggregate shall be 3/4 inch. Fine aggregates shall be natural materials, not manufactured sand.

C. For site-mix concrete to be batch-mixed at site, provide mix design and laboratory testing of mix demonstrating mix characteristics are consistent with requirements of this Section. Use of batch-mixed concrete that has not been confirmation tested by independent laboratory is at Contractor's risk.

D. Design concrete mix for cast-in-place concrete with following characteristics:

1. 4,000 psi (minimum), 28-day compressive strength.

2. Air content between 2 and 4 percent by volume.

E. Slump Limits: Not more than 4 inches prior to introduction of superplasticizers.

F. Use water reducing admixtures or high-range water-reducing admixtures (superplasticizers) in concrete, as required, for placement and workability.

G. Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Owner or Engineer may request additional laboratory test data, which shall be provided by Contractor at no additional cost to Owner.

2.6 CONCRETE MIXING

A. Job-Site Mixing: Mix concrete materials in appropriate drum-type batch machine mixer. For mixers of 1 cubic yard or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than 1 cubic yard, increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cubic yard.

1. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Plant-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 FORMS

A. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes

B. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove wood chips, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.2 PLACING REINFORCEMENT AND SMOOTH DOWELS

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chair runners, bolster spacers and hangers, as approved by Engineer.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.3 JOINTS

A. Construction Joints: If needed, locate and install construction joints so as to take the place of a control joint. Construction joints shall be provided with keyways to resist shear. Keyways placed in the construction joint shall be 1-1/2 inches deep and centered in the exposed edge of the slab. Bulkheads designed and accepted for this purpose may be used on the slabs. Continue reinforcement across construction joints except as indicated otherwise; however, do not continue reinforcement through sides of strip placement. All exposed reinforcement steel shall be cleaned of concrete spillage, before concrete placement operations resume. Additionally, the surface of the concrete shall be cut or chipped to remove all laitance and exposed aggregate. A bonding agent shall be used on existing concrete that is to be joined to the fresh concrete. A spacer ¼-inch wide by approximately 2-inches deep shall be installed at top of the construction joint. After curing the spacer shall be removed and the exposed joint shall be epoxy filled.

B. Contraction Joints: Contraction joints shall be provided at the low-water crossing at the locations indicated in the Construction Plans. Contraction joints shall be saw cuts 5/8-inch deep by 1/4-inch wide and then filled with self-leveling joint seal.

3.4 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, non-residual, low-VOC, form-coating compound before placing reinforcement. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces where fresh concrete will be placed. Apply according to manufacturer's instructions.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete", and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficient1y to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms:

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no further than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set.At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

3. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.

4. Bring surfaces to correct level with a straight edge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows.

5. Maintain reinforcing in proper position on chairs during concrete placement.

E. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

F. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

G. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

4. Use water-reducing-retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineer.

H. Forming of pipeline trenches is not required. Excavated trench walls shall serve as forms for the pipeline encasement pour (if applicable).

3.6 CONCRETE CURING AND PROTECTION

A. General:Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material.

B. Immediately after the finish operation has been completed and marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with Section 90-7.01 A, Water Method, of the Caltrans Standard Specifications or other appropriate methods. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour during the curing period.

C. Curing and protection of pipeline encasement will not be required, except that Contractor shall protect concrete-filled trench from soil or other deleterious materials being shoved into fresh concrete.

D. Where concrete is to be buried, it shall be allowed to cure a minimum of 24 hours prior to covering with soil.

3.7 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of walls and similar parts of the work, maybe removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

3.8 CONCRETE SURFACE REPAIRS

A. Repairing Unformed Surfaces: Test unformed surfaces, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spelling, popouts, honeycombs, rock pockets, and other objectionable conditions.

2. Correct high and low areas in unformed surfaces by grinding after concrete has cured at least 14 days, as approved by the Engineer.

END OF SECTION

SECTION 11300

PUMPING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install submersible pumping systems for the leachate sump pump and underdrain sump pump, as specified herein.

B. Installer shall furnish all labor, materials, tools, equipment, and incidentals thereto for the installation of the pumping systems consistent with this specification.

C. Providing electrical connections for pump, controls, break-out boxes, breaker boxes, etc. consistent with **Section 16010 - Electrical**.

1.2 REFERENCES

A. American National Standard Institute (ANSI)

B. American Society for Testing and Materials (ASTM)

C. Hydraulic Institute (HI) Standards for Centrifugal, Rotary and Reciprocating Pumps

D. National Electrical Manufacturers Association (NEMA):

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

2. ICS 6, Enclosures for Industrial Controls and Systems

E. National Fire Protection Association (NFPA):

1. 70, National Electrical Code (NEC) UL label requirement

F. Underwriters Laboratories, Inc. (UL) 508 & 698a

G. National Fire Protection Association (NFPA 70): Requirement for SCCR (Short Circuit Current Rating) labeling of control panels. NOTE: Article 409 of the 2005 National Electrical Code (NFPA 70) requires industrial control panels to be marked with a short circuit current rating. As specified in the National Electric Code, UL508A-2001 Supplement SB, the Standard of Safety for Industrial Control Equipment

1.3 SUBMITTALS

A. Shop Drawings depicting the following:

1. Connections from pump to discharge piping and connections to the discharge pipe terminations, including leachate pumping location (leachate line) and the proposed earthen channel (underdrain line), including all piping, valves, fittings, etc.;

2. All necessary electrical connections for control panels, break-out boxes, breaker boxes, etc., consistent with **Section 16010 – Electrical**, including connections to Owner provided electrical service, as described in **Part 3.1.A**; and

3. All shop drawings shall be provided in plan view with sufficient details to demonstrate compliance

with this specification and the Contract Documents.

B. Operation and Maintenance Manuals.

C. Warranty, as specified in **Part 2.7** of this Section.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers or Suppliers are acceptable:

1. EPG Companies 800-443-7426

2. The Reich Company, Inc. (area EPG distributor) 713-724-5837

3. Engineer approved equals, submitted in accordance with **Section 01600 – Material and Equipment** by providing full & detailed equipment submittals. Submittals must include manufacturer's UL ID number and a copy of manufacturer's SCCR (Short Circuit Current Rating) label.

2.2 MATERIALS

A. Furnish unit component meeting or exceeding the following material specifications:

1. Pump case: 304 Stainless Steel
2. Motor housing: Franklin Submersible, 304 Stainless Steel fitted with E-Glide™ impeller seal rings
3. Impeller: 304 Stainless Steel
4. Shaft: Stainless Steel, ANSI Series 300 or 400
5. Wear ring: E-Glide™
6. Bearings: E-Glide™
7. O-rings: Viton
8. Bolts and nuts: Stainless Steel
9. Seal metal parts: Stainless Steel

2.3 EQUIPMENT

A. Performance Requirements:

1. Submersible Leachate Pump
   a. Design condition: 20 gpm at 60 ft total dynamic head (TDH)
   b. Nameplate horsepower: ¾ HP
   c. Drive type: constant speed
   d. Pump-on level: 18 inches
   e. Pump-off level: 6 inches
   f. Motor lead length: 200'

2.4 ACCESSORIES

A. Wheeled Sump Drainers

1. One (1) pump shall be EPG Series 5 SurePump™ WSDPT5-3 with 200-foot 12 AWG motor leads installed in a patented 300 series stainless steel, wheeled, sump drainer for use in 18-inch HDPE riser pipes, with a constant diameter, set on a 3H:1V slope. No plastic or HDPE housings will be accepted.

2. The sump drainers shall be supplied as sealed units which draw all liquid past the motor.

3. Vent valves shall be provided to assist with the evacuation of air from the sump drainers.

4. The pumps shall be designed to allow easy removal of unit, should removal be required.

5. Provide 200 feet of 300 Series stainless steel retrieval cable, complete with stainless steel clamps and associated hardware with leachate pump, respectively.

6. Submersible level sensor mounts with an easy to remove protective housing shall be located at the center bottom of each sump drainer for liquid level monitoring and pump control.

B. Discharge Pipes and Fittings

1. The leachate pump discharge pipe located within the leachate riser pipe shall be 1.5-inch diameter HDPE SDR 11 and be at least 100 feet in length. Contractor shall transition this discharge pipe to 2-inch diameter HDPE SDR 11 outside of the 18-inch riser pipe at the EPG Discharge Adapters at the top of the riser pipe.

2. The 2-inch HDPE leachate discharge pipe shall connect the leachate pump to the proposed leachate forcemain, as shown on the Construction Plans.

3. HDPE pipe supplied for the leachate and underdrain pump systems shall comply the specifications provided in **Section 15400 – HDPE Pipe and Fittings**.

4. Contractor shall install 2-inch diameter stainless steel back-flow preventers (EPG CVSE200 check valves), horizontally, immediately adjacent to the 1.5-inch EPG Discharge Adapters, on the outside of the sump riser, using 2” x 1.5” stainless steel adapters, 2” stainless steel nipples on the up-gradient end of the check valve (sump riser side) and 2” stainless steel camlock assemblies on the other side of the check valve, as shown on the Construction Plans.

5. 2-inch diameter stainless steel ball valves (EPG BV200SS) shall be installed down-gradient of the check valve (specified above) using 2-inch stainless steel pipe (camlock on check valve side and threaded on ball valve side), and 2-inch threaded stainless/HDPE transition on the down-gradient side of the ball valve, as shown on the Construction Plans.

6. Fittings provided should be suitable for intended use.

7. Provide 1.5” EPG 300 Series stainless steel NW right angle slip fit taper lock discharge adapter (NW1.5SS-C) with Viton O-ring seals. To be installed near top of riser to allow easy connection and separation of pump discharge piping from forcemain pipe. Discharge adapter to be designed for gas tight seal to risers.

C. Control Panel

1. The control panel shall be supplied by the same manufacturer as the pump. It shall be tested with the pump prior to shipment to insure compatibility and will provide level control, pump operation, and motor protection for both pumping systems.

2. Control panel power shall be able to operate both leachate and underdrain pump motors (¾ HP, 230V single-phase, grounded) and shall include individual level master control meters with simulators, elapsed time meters, and top level high alarm lights.

3. Control panel power shall be 230V, single phase, and built and listed under UL 508 & 698A with an attached detailed UL label and an attached detailed SCCR label from the manufacturer in

compliance with Article 409 of the 2005 National Electric Code (NFPA 70). Control panel manufacturer's UL identification number must be provided to engineer with submittals.

4. Control panel shall be EPG Model L975PT to control one (1) pump separately and consist of NEMA 4X stainless steel enclosure with a rain guard and lockable outer door.

5. The control panel door shall open a minimum of 180 degrees.

6. The inner door shall be painted steel. The inner door shall contain cut outs for the mounted equipment and operator accessible equipment and provide protection of personnel from live internal wiring.

7. Operator accessible components mounted on the dead front door shall include the following:

   a. "Hand-Off-Auto" (HOA) selector switch Hand-Off-Auto switch to allow manual or automatic operation and shall be heavy duty, oil tight, NEMA 4 rated. The hand position shall be momentary with a spring return.

   b. POWER ON indicating light (amber) shall indicate power on to system and shall be LED, heavy duty, oil tight and NEMA 4 rated.

   c. RUN indicating light (green) shall indicate energization of motor circuit and shall be LED, heavy duty, oil tight and NEMA 4 rated.

   d. OVERLOAD indicating light (red) shall indicate motor not running due to overload condition and shall be LED, heavy duty, oil tight and NEMA 4 rated.

   e. Digital read out level indicator

   f. Main disconnect switch

   g. Load fuses

   h. Fused type control switch

8. The back plate shall consist of 12 gauge sheet steel and finished with a primer coat and two coats of baked-on white enamel. All hardware mounted to the subpanel shall be accomplished with machine thread tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified by labels.

9. The panel power distribution shall include all necessary components and shall be completely wired with standard copper conductors rated at 90 degrees C.

10. Control wiring shall be a minimum of 16 gauge and installed in Panduit type wiring trays.

11. Individual fuses shall be provided for main power, pumps and control circuits.

12. A control transformer shall be used to provide the 120VAC power for control circuits. Provide primary and secondary fusing for the circuit.

13. Surge protection and voltage protection shall be provided.

14. Two (2) transducer simulators, to check transducer operation for both leachate and underdrain pumps, shall be provided.

15. A thermostat controlled heater shall be provided to control the inside temperature below the dew

point and alleviate the buildup of condensate in the control enclosure.

16. A corrosion inhibitor shall be provided within the enclosure.

17. A top-mounted, rotating, red visual high level alarm beacon, which shall be weatherproof, shall be provided for the leachate pumping system. Light shall be Federal Signal Model 225. Provide high level contact closure for wiring to the alarm dialer.

18. One (1) inner door mounted alarm lights shall be provided.

19. A 120V duplex GFCI outlet for remote mount shall be provided.

D. Level Control

1. A panel mounted controller digital readout display for the leachate system shall provide level indication of the sump. The pump "ON-OFF-HIGH LEVEL" selection shall be through setpoint current relays located on inner door. The digital controller shall be equipped with a "HIGH-HIGH" shutdown feature which will lock out the pump if the level exceeds 150 inches.

2. A level simulator shall be mounted on the inner door and shall be a built-in test circuit design to simulate 4-20 mA loads to assist in level setup and troubleshooting.

3. A submersible transducer, with adequate range of operation & a 4-20MA output signal, shall be provided with a vented and chemical resistant cable for the leachate pump. The transducer shall be all 316 stainless steel with stainless steel diaphragm and Viton seals, and shall be mounted in the center axis of the pump carriage at the suction end. Static accuracy rating shall be no less than 1.0%. Transmitter circuit must be protected by intrinsically safe barriers.

4. A filter dryer with pressure compensation diaphragm shall be provided to be mounted in the level junction box to prevent moisture in the level sensor vent tube. Unit shall extend the operating life of the desiccant filter.

E. Break Out Junction Boxes

1. Separate and individual breakout boxes for power leads and level sensor leads shall be provided for installation near the top of the riser pipe.

2. Breakout boxes to be NEMA 4X fiberglass and include proper sized cord restraint and ½" conduit gas-tight seal fitting.

2.5 FABRICATON

A. General

1. Provide pumps capable of handling primary landfill leachate.

2. Design pump to allow for removal without entering the wet well and without removal of bolts, nuts or other fastenings.

B. Impeller

1. Provide closed impeller in accordance with Hydraulic Institute Standards.

2. Provide wear ring as necessary to assure efficient sealing between volute and impeller.

C. Shaft

1. Design pump shaft of sufficient size to transmit full driver output.

2. Use shaft which is accurately machined and constructed with sufficient materials.

D. Bearings

1. Support shaft on upper and lower and between end stage with E-Glide™ product lubricated bearings.

E. Motors

1. Provide motors of totally submersible design, constructed with epoxy encapsulated windings and Kingsbury type thrust bearings, rated for continuous duty operation.

2. Motors for leachate pump shall be ¾ HP, 230V single-phase, grounded.

F. Control Panel

1. Compliance with UL, NEMA and SCCR requirements must be demonstrated by the attachment of detailed labeling to the panel by the manufacturer.

2.6 SOURCE QUALITY CONTROL

A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:

1. Check impeller, motor rating, and electrical connections for compliance with Specification.

2. Test motor and cable insulation for moisture content or insulation defects.

3. Run pump for a minimum of 15 minutes submerged.

4. After operational Test No. 3, perform insulation Test No. 2 again.

B. Provide written certification of testing to Owner or Engineer.

2.7 EQUIPMENT WARRANTY

A. Wheeled Sump Drainers, Control Panel, and accessories manufactured by single manufacturer (i.e., EPG or Engineer-approved equal) and installed as a complete and integrated system by a factory trained installer will be warranted for a period of thirty (30) months from date of manufacture, but not less than twenty four (24) months after installation and final acceptance.

PART 3 EXECUTION

3.1 INSTALLATION

A. Factory Authorized Installation

1. Pumping system shall be installed and started up by a factory trained installer or subcontractor authorized to perform the installation. Contractor shall be responsible for all coordination and scheduling of pumping system installer to meet project schedules.

2. Installer shall provide all electrical connections, wiring, and components necessary for proper installation of pumps, controls, and appurtenances in accordance with applicable local codes and requirements.

3. In accordance with **Part 1.3** of this Section, Contractor shall provide shop drawings for all electrical connections.

4. The Contractor will provide the electrical service, including meter and disconnect, required for the pumping systems within 250 feet of the pump control panel at the expense of the Owner. It is the Contractor's responsibility to make all necessary electrical connections from the Owner provided service to the control panel and make all necessary connections in accordance with the requirements of the pump system manufacturer, National Electrical Code, and **Section 16010**.

B. System Ground

1. Factory trained installer shall ground system, measuring impedance to ground, to less than or equal to 1.0 Ohms using 780 Series Ground Resistance Tester, Model #61-781, as manufactured by Ideal Industries, Inc., Sycamore, IL.

END OF SECTION

SECTION 15400

HDPE PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of High Density Polyethylene (HDPE) pipe and fittings including, but is not necessarily limited to, the following locations:

1. 1.5-inch diameter solid leachate pump discharge pipe (SDR 11)

2. 3-inch diameter (SDR 11) by 6-inch diameter (SDR 17) dual-contained solid leachate discharge pipe

3. 8-inch diameter perforated leachate collection pipe (SDR 11).

4. 8-inch diameter solid leachate clean-out riser pipe (SDR 11).

5. 18-inch diameter perforated leachate sump collection pipe (SDR 9).

6. 18-inch diameter solid leachate sump riser pipe (SDR 9).

B. Contractor shall furnish all labor, materials, tools, equipment and services for the installation of all HDPE pipe and fittings, in accordance with the Construction Plans and Technical Specifications.

1.2 RELATED SECTIONS

1. Section 01600 – Materials and Equipment

2. Section 02210 – Excavation and Backfill

3. Section 02231 – Aggregate

4. Section 02778 – Non-Woven Geotextile

1.3 SUBMITTALS

A. The pipe manufacturer shall provide certifications and product data sheets indicating that the HDPE pipe and fittings conform to this technical specification and that samples of the production pipe from which the furnished materials were obtained have been tested in accordance with ASTM D-2837. The minimum hydrostatic design basis shall be 1600 psi at 73.4 °F and 800 psi at 140°F.

1.4 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM D638 - Test Method for Tensile Properties of Plastics.

2. ASTM D696 - Linear Thermal Expansion Coefficient.

3. ASTM D746 - Brittleness Temp.

4. ASTM D790 - Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and

Electrical Insulating Materials.

5. ASTM D1238 - Test Method for Flow Rates of Thermal Plastics by Extrusion Plastometer.

6. ASTM D1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.

7. ASTM D1505 - Text Method for Density of Plastics by the Density Gradient Technique.

8. ASTM D1525 - Vicat Softening Temp.

9. ASTM D1599 - Test Method for Short Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.

10. ASTM D1603 - Carbon Black in Olefin Plastics.

11. ASTM D1693 - Test Method for Environmental Stress Cracking of Ethylene Plastics.

12. ASTM D2122 - Method for Determining Dimensions of Thermal Plastic Pipe and Fittings.

13. ASTM D2837 - Method for Obtaining Hydrostatic Design Basis for Thermal Plastic Pipe Materials.

14. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

15. ASTM D3350 - Specification for Polyethylene Plastic Pipe and Fittings Materials.

16. ASTM D4218 - Test Method for Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

17. ASTM F714 - Standard Specification for Polyethylene Plastic Pipe Based on Outside Diameter.

18. ASTM F1248 - Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.

19. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Construction Plans and this technical specifications, the following Manufacturers and/or Suppliers are acceptable:

1. Pipe and Fittings:

a. Performance Pipe

b. ISCO Industries, Inc.

d. Improved Piping Products

e. Engineer approved substitute.

B. Submit request for substitutions in accordance with Section 01600 – Materials and Equipment.

2.2 PIPE AND APPURTENANCES

A. Materials:

1. The HDPE pipe and fittings shall be manufactured from new, high performance, high molecular weight high density polyethylene resin conforming to ASTM D1248 (Type III, Class C, Category 5, Grade P34), ASTM D3350 (e.g., Cell Classification PE345454C or 445474C), and having a material designation of PE3608 or PE4710.

2. Pipe and fittings shall be butt fusible at 440°F or 500°F.

3. Pipe shall be manufactured in accordance with ASTM F714.

   a. All 1.5-inch diameter pipe installed for leachate pump discharge, as shown on construction plans, shall be SDR 11.

   b. The leachate pump discharge pipe shall be dual-contained: 3-inch diameter (SDR 11) by 6-inch diameter (SDR 17).

   c. All 8-inch diameter perforated leachate collection and clean-out riser pipes shall be SDR 11. Perforated piping shall be perforated as shown on the Construction Plans.

   d. The 18-inch leachate sump pipe shall be perforated as shown on the Construction Plans. Above the floor of the respective sumps, the leachate sump riser pipes shall be solid wall. All 18-inch pipes shall be SDR 9.

4. Fittings shall be manufactured in accordance with ASTM D3261. Except as indicated on Construction Plans, fittings shall be butt fusion type, meeting the requirements of ASTM D3261 and this specification. All fittings shall be pressure rated to match the system piping to which they are fused. At the point of fusion, the outside diameter and minimum wall thickness specifications of ASTM F714 for the same size of pipe. The sideslope riser fittings shall be factory fabricated and shall have a smooth interior surface.

5. All exposed collection line ends will be fitted with a snugly fitting slip cap at the end of each day and at all temporary liner terminations. End caps shall be of similar material and construction as collection pipes and supplied by the same manufacturer for this purpose.

6. All elbows shall be “long sweep” with 3-foot minimum radius.

B. Requirements:

1. Workmanship: Exterior and interior surfaces shall be smooth with no sharp projections. The surfaces shall be free of foreign inclusions and major surface defects. Polyethylene pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties. The product function shall be considered when judging external defects.

2.3 FLANGES CONNECTIONS

A. Flange connections for HDPE pipe shall performed using convoluted ductile iron back-up rings with a minimum thickness of 1-inch. Back-up rings shall be finished with red oxide primer.

B. Studs, bolts, nuts, and washers for flanges shall be zinc or cadmium-plated steel. Below-grade flanges shall be wrapped in 5-mil polyethylene sheeting, following installation and prior to backfilling, to prevent corrosion.

2.4 VALVES

A. General

1. All valves shall be complete with all necessary operators, actuators, handwheels, chain wheels, extension stems, floor stands, worm and gear operators, operating nuts, chains, wrenches, and other accessories or appurtenances which are required for the proper completion of the Work. Operators, actuators, and other accessories shall be sized and furnished by the valve supplier and factory mounted.

2. All valves shall have the name of the manufacturer and sizes cast on the body or bonnet or shown on a permanently attached plate raised in letters.

3. All valves and operators shall be constructed of materials that are compatible with landfill gas, and have been used on other landfill gas applications by Contractor. Valve seals shall be manufactured of nitrile or other material resistant to landfill gas. Valves shall have all safety features required by OSHA.

4. Unless otherwise shown, valves shall be the same size as the adjoining pipe.

B. HDPE Valves

1. HDPE isolation valves at the leachate cleanout/collection riser shall be shall be HDPE black full-port ball valves with valve handles as depicted on the Construction Plans.

2.5 PIPE WARNING TAPE

A. Warning tape shall be a metallic locator/warning tape imprinted with the words “Caution Leachate Line Buried Below,” as supplied by Terra Tape (1-800-231-6074) or Engineer-approved substitute.

2.6 PIPE INSULATION

A. In locations specified in the Construction Plans, pipe insulation shall be installed. Pipe insulation shall be in accordance with the Construction Plans and installed in accordance with Manufacturer’s requirements.

PART 3 EXECUTION

3.1 HANDLING AND PLACEMENT

A. The Contractor shall comply with the HDPE pipe Manufacturer's recommendations for handling, storing, and installing HDPE pipes and fittings.

B. The Contractor shall exercise care when transporting, handling and placing HDPE pipe and fittings, such that they will not be cut, kinked, twisted, or otherwise damaged.

C. All pipe, fittings, and valves shall be kept clean and free from dirt and debris.

D. Ropes, fabric or rubber-protected slings and straps shall be used when handling HDPE pipe. Slings, straps, etc. shall not be positioned at butt-fused joints. Chains, cables or hooks shall not be inserted into the pipe ends as a means of handling pipe.

E. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Under no circumstances shall pipe or fittings be dropped into trenches, or dragged over sharp and cutting objects.

F. HDPE pipe shall be stored on clean level ground, free of sharp objects which could damage the pipe. Stacking shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

G. The maximum allowable depth of cuts, gouges or scratches on the exterior surface of HDPE pipe or fittings is 10 percent of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges and scratches. Sections of pipe with excessive cuts, gouges or scratches shall be removed and the ends of the pipe rejoined at no cost to GFL.

H. Whenever pipe laying is not actively in progress, the open end of pipe that has been placed shall be closed using a watertight plug.

3.2 JOINING

A. Only two methods shall be utilized to join HDPE pipe: heat fusion and mechanical joining.

1. Mechanical Joining shall be accomplished with HDPE flange adapters, neoprene gaskets, and ductile iron back-up flanges and zinc or cadmium-plated steel studs, bolts, nuts, and washers, as specified in **Part 2.3** of this section. Mechanical joining shall be used only where shown on the Construction Plans or approved by Engineer.

2. Heat Fusion joints shall be made in accordance with manufacturer's step by step procedures and recommendations using approved equipment in accordance with ASTM F2620. Heat fusion shall be performed by a qualified person specifically trained to operate fusion equipment. Pipe fusion equipment shall be of the size and nature to adequately weld all pipe sizes and fittings necessary to complete the project. Heat fusion shall be performed outside of the trench whenever practical. Before heat fusing pipe, each length shall be inspected for the presence of dirt, sand, mud, shavings, and other debris. Any foreign material shall be completely removed. At the end of each day, all open ends of fused pipe shall be capped or otherwise covered to prevent entry by animals or debris.

3.3 INSTALLATION

A. All HDPE pipe and fittings shall be installed in accordance with the manufacturer's instructions.

B. The Contractor shall carefully examine all pipe and fittings for cracks, damage or defects before installation. Defective materials shall be immediately removed from the site and replaced at no cost to Owner.

C. The interior of all pipe and fittings shall be inspected, and any foreign material shall be completely removed from the pipe interior before fusing pipe, as specified in **Part 3.2.A.2** of this section.

D. All pipe and fittings shall be laid or placed to the lines and grades with bedding and backfill, as shown on the Construction Plans.

E. No pipe shall be placed in a trench or covered until the CQA Consultant has inspected and approved the pipe and pipe joints. CQA Consultant and Contractor shall visually inspect each pipe joint for proper installation in accordance with manufactured recommendations.

3.4 PIPE SUPPORTS

A. Construct a pipe support structure to provide support for the leachate sump and leachate clean-out riser pipes, as shown on the Construction Plans

B. Provide additional supports as required to support piping such that its weight is not supported by pumps or equipment, or as specified in the Construction Plans.

3.5 HDPE PIPE AND VALVE TESTING

A. All HDPE piping installed for the leachate forcemain and underdrain discharge pipe shall be subjected to a pneumatic pressure test, as described herein to detect any leaks in the piping. Contractor shall furnish all necessary equipment and materials, and make all taps in the pipe, as required, for testing.

B. The Contractor shall accept the responsibility for locating, uncovering (if previously backfilled), and repairing any leaks detected during testing at no additional cost to the Owner.

C. The test should be performed during a period when the pipe will be out of direct sunlight when possible; i.e., early morning, late evening, or cloudy days. This will minimize the pressure changes which will occur during temperature fluctuations.

D. The Owner and CQA Consultant shall be notified prior to commencement of the testing procedure and shall be present during all tests.

E. All HDPE SDR 11 pipe for the leachate forcemain and underdrain discharge pipe shall be subject to an air test pressure of 4 psig for 30 minutes and then 100 psig for 30 minutes for a total pressure test period of no less than one hour. All HDPE SDR 17 pipe for the leachate forcemain shall be subject to an air test pressure of 10 psig for a period of no less than one hour. The pressure test will begin once the pipe has been pressurized to the required pressure. During the pressure test, no loss of pressure shall be observed for passing test.

F. Any section of pipe which falls to meet the stipulated pressure test shall be checked by the Contractor and corrective measures taken. The test shall then be repeated, at no additional cost to the Owner. Pipe installation will not be accepted unless and until it meets the pressure test requirements.

G. The following steps shall be performed for failing the pressure test described in this Part.

1. The pipe and all fusions shall be inspected for cracks, pinholes, or perforations.

2. All blocked risers and capped ends shall be inspected for leaks.

3. Leaks shall be located and/or verified by applying a soapy water solution and observing soap bubble formation.

H. All pipe and fused joint leaks shall be repaired by cutting out the leaking area and refusing the pipe.

I. After all leaks are repaired, a retest shall be performed in accordance with this Section.

J. Records shall be made of each pipe segment pneumatically tested. These records shall include: date of test, description and identification of pipe tested, test pressure, remarks regarding leaks or repairs made on leaks, and certification by contractor.

END OF SECTION

SECTION 16010

ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Basic requirements for electrical work and requirements for underground distribution for the electrical connections for the leachate pumping system (pump and controls), as specified in Section 11301.

B. Install and wire all equipment, including pre-purchased equipment, and perform all tests necessary to assure conformance to the Construction Plans and Technical Specifications and ensure that equipment is ready and safe for energization.

1.2 RELATED SECTIONS

A. Construction Plans Use and Interpretation:

1. Construction Plans indicate the location and arrangement of the leachate pumping systems. The Contractor will provide the electrical service, including meter and disconnect, required for the pumping systems within 250 feet of the pump control panel at the expense of the Contractor. It is the Contractor's responsibility to make all necessary electrical connections from the Owner provided service to the control panel and make all necessary connections in accordance with the requirements of the pump system manufacturer, National Electrical Code, Construction Plans, and this Section.

2. Field measurements shall take precedence over dimensioned drawings.

3. Installation of all electrical systems and equipment is subject to review and approval of shop drawings and field coordination drawings, as specified in Part 1.3 of this Section.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings prior to purchase or fabrication of electrical equipment. Shop drawings shall indicate type and gauge of wire, connections, component protection, etc.

2. Prior to submittals of shop drawings, coordinate electrical equipment, particularly the leachate and underdrain pumping systems motor control equipment, control panel, and instrumentation, with all applicable equipment and systems interfacing with that equipment.

3. For each product, clearly identify manufacturer by name and technical information to be used, including:

a. Product descriptive bulletin.

b. Electrical data pertinent to the Project and necessary to assure compliance with Technical Specifications.

c. Equipment dimensions, where applicable.

d. Evidence that the products submitted meet the requirements of the standards referenced.

4. When general data sheets are provided as part of the submittal, specifically identify the products to be used on this Project.

5. Ensure that all submittals clearly indicate the equipment is UL of ETL listed or is constructed utilizing UL or ETL listed or UL recognized components. Where a UL standard has not been established clearly identify that no UL standard exists for that equipment.

B. Contractor shall provide as-built drawings depicting the type and gauge of wire, underground and above ground wiring and conduit, control panels, junction boxes, etc.

1.4 QUALITY ASSURANCE

A. Referenced Standards:

1. American Iron and Steel Institute (AISI):

a. Steel Products Manual - Stainless and Heat Resisting Steel.

2. American National Standards Institute (ANSI):

a. C2, National Electrical Safety Code.

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

a. A36, Specification for Structural Steel.

b. A153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

4. Factory Mutual System (FM):

a. A Guide to Equipment, Materials and Services.

5. Institute of Electrical and Electronics Engineers (IEEE):

a. 141, Recommended Practice for Electrical Power Distribution for Industrial Plants.

b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

6. National Electrical Manufacturers Association (NEMA):

a. ICS 6, Enclosures for Industrial Controls and Systems.

7. National Fire Protection Association (NFPA):

a. 70, National Electrical Code (NEC).

8. Underwriters Laboratories, Inc. (UL):

a. 508, Safety Industrial Control Equipment.

b. 698, Industrial Control Equipment for use in Hazardous Locations.

B. When a specific code or standard has not been cited, the applicable codes and standards of the following code-making authorities and standards organizations shall apply

1. American Association of State Highway and Transportation Officials (AASHTO).

2. American Iron and Steel Institute (AISI).

3. American National Standard Institute (ANSI).

4. American Society for Testing and Materials (ASTM).

5. ETL Testing Laboratories, Inc. (ETL).

6. Insulated Cable Engineers Association (ICEA).

7. Institute of Electrical and Electronic Engineers (IEEE).

8. Illuminating Engineering Society of North America (IES).

9. Instrument Society of America (ISA).

10. Lightning Protection Institute (LPI).

11. National Electrical Manufacturers Association (NEMA).

12. National Fire Protection Association (NFPA).

13. Occupational, Health and Safety Administration (OSHA).

14. Underwriters Laboratories Inc. (UL).

C. In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, drawings and specifications, or within either document itself the more stringent condition shall govern.

1.5 AREA CLASSIFICATIONS

A. Area surrounding the pump control panel shall be considered corrosive. The area adjacent to the electrical service source shall be considered wet.

1.6 SYSTEM DESCRIPTION

A. Provide functioning systems in compliance with manufacturer's instructions, performance requirements specified, and modifications resulting from reviewed shop drawings and field coordinated drawings.

B. Coordinate installation of the electric service and metering with the serving utility, if necessary.

1.7 DELIVERY, STORAGE, AND HANDLING

A. See Section 01600.

B. Ensure that equipment is not used as steps, ladders, scaffolds, platforms, or for storage either inside or on top of enclosures.

C. Protect nameplates on electrical equipment to prevent defacing.

D. Repair, restore or replace damaged, corroded and rejected items at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. All equipment of a similar type shall be by one manufacturer unless otherwise noted in the Specifications.

B. Warning Tape:

1. W. H. Brady Company.

2. Seton Nameplate Company.

C. Nameplates:

1. W H Brady Company.

2. Seton Nameplate Company.

2.2 MATERIALS

A. Trade names and catalog numbers shall be used when specified to establish quality standards and basics of design.

1. Other listed manufacturers in the applicable specification sections with equal equipment may be acceptable.

2. If no other manufacturer is listed, then manufacturers of equal equipment may be acceptable.

B. Where UL test procedures have been established for the product type, electrical equipment shall be approved by UL or ETL and shall be provided with the UL or ETL label.

C. Structural Steel Supports:

1. Galvanized steel: ASTM A36.

a. PVC coated in Class I and in corrosive areas.

2. Stainless steel: AISI Type 316.

D. Warning Tape:

1. Approved manufacturers and catalog numbers:

a. W J Brady Company, Catalog S-1Q, #91296.

2. Material: Polyethylene.

3. Thickness: 3.5 mils.

4. Tensile strength: 1,750 psi.

5. Size: 6 IN wide (minimum).

6. Legend: Preprinted and permanently imbedded:

a. Message continuously printed.

E. Equipment Nameplates:

1. Phenolic or thermoplastic laminate 1/16 IN thick with holes for screw mounting.

2. 3/16 IN high lettering, unless otherwise indicated.

3. Engrave letters through top surface into contrasting color core:

a. Colors: Black top surface, white core, unless otherwise indicated.

4. Stainless steel self-tapping screws.

5. Size as required for the legend.

F. Warning Signs:

1. For mounting on equipment such as MCC's, control panels, etc., and containing specific messages such as "Danger, 120 V AC from external sources in this cubicle":

a. Plastic laminate 1/16 IN thick with holes for screw mounting.

b. 3/4 IN high letters for the words "WARNING," "DANGER," and "CAUTION"; all other lettering 3/16 IN high unless otherwise indicated.

c. Engrave letters through top surface into contrasting color core:

i. Colors: Red for "DANGER" and "WARNING" signs; yellow for "CAUTION" signs.

d. Stainless steel self-tapping screws.

e. Size as required for the legend.

2.3 FABRICATION

A. When equipment is shop fabricated for the Project, the electrical devices and enclosures utilized shall be UL or ETL listed and labeled or shall be UL recognized.

B. Shop or Factory Finishes:

1. See **Section 11300**.

2. Interiors of other painted equipment shall be either white or light gray.

PART 3 EXECUTION

3.1 INSTALLATION

A. Make arrangements for and pay for all permits, licenses, and inspections.

B. Equipment shall be installed in accordance with the requirements of the NEC, National Electrical Safety Code, and local applicable codes and ordinances.

C. Enclosures for Use with Electrical Equipment:

1. NEMA 4X: Use in all corrosive locations.

2. Exceptions:

a. As otherwise indicated on the Drawings.

3. Standards:

a. NEMA ICS Enclosures for Industrial Controls and Systems.

b. UL 508, Safety Industrial Control Equipment.

D. Coordinate the installation of electrical equipment with other trades.

1. Arrange for the building in of equipment during structure construction.

2. Where equipment cannot be built-in during construction, arrange for sleeves, box- outs, openings, etc., as required to allow installation of equipment after structure construction is complete.

E. Verify that equipment will fit support layouts indicated.

F. Equipment Dimensions and Clearances:

1. Do not use equipment that exceeds the indicated dimensions.

a. Except as approved in writing by the Engineer.

2. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

G. Install equipment in accordance with the manufacturer's instructions.

H. Equipment Access:

1. Install equipment so it is readily accessible for operation and maintenance.

2. Equipment shall not be blocked or concealed.

3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.

I. Equipment shall be installed plumbed, square and true with the building construction and shall be securely fastened.

J. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

K. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete.

L. Provide all necessary anchoring devices and supports.

1. Use supports as detailed on the Construction Drawings and as specified.

a. Where not detailed on the Construction Drawings or specified, use supports and anchoring devices rated for the equipment load and as recommended by the manufacturer.

2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.

3. Hardware shall be malleable type, corrosion resistant and shall be supported by heavily plated machine screws or brass, bronze or stainless steel bolts.

4. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

M. Provide concrete foundations or pads required for electrical equipment as indicated or specified.

N. To avoid interference with structural members and equipment of other trades, it may be necessary to adjust the intended location of electrical equipment. Unless specifically dimensioned or detailed, the Contractor may, at his discretion, make minor adjustments in equipment location without obtaining the Engineer's approval.

O. Provide tagging of electrical equipment in accordance with the following:

1. Tagging materials:

a. Phenolic or thermoplastic name plates (Type E):

i. Approved manufacturers:

a.) W H Brady Co.

b.) Seton Nameplate Co.

ii. Size: As required for the text.

iii. Thickness: 1/16 IN.

iv. Fabrication: Three layers laminated.

v. Contrasting top and center laminations.

vi. Legend engraved through top lamination into center lamination.

b. Pressure sensitive vinyl cloth markers (Type F):

i. Approved manufacturers:

a.) W. H. Brady Co.

b.) Set Nameplate Co.

ii. Material: Self-sticking vinyl.

iii. Size: As required by text.

2. Equipment to be tagged:

a. Enclosures for electrical, equipment, e.g., safety switches, control panels, etc., that have a name and number as shown on the Construction Drawings.

i. Tag type: E.

ii. Legend: Name and number of enclosure as indicated on the Construction Drawings.

iii. Letters: 1 IN black letters on white background.

iv. Mount with stainless steel screws.

b. Nameplate for elements or components within or surface mounted on enclosures for electrical, and I&C equipment including switches, instruments, etc.:

i. Tag type: E.

ii. Legend: name and number of each element or component as indicated on the Construction Drawings.

iii. Letters: 1/2 IN high letters for element or component names and 114 IN high letters for element or component number. White letters with black background.

iv. Mount with stainless steel screws.

c. Electrical wires, cables and conduit carrying 600 V or less:

i. Legend: Wire, cable or conduit number as shown on Construction Drawings, on each end of each wire, cable or conduit.

ii. Letters: Minimum 114 IN high yellow letters on standard background.

iii. Tag type: F.

P. Provide Danger, Caution and Safety Instructional Signs in accordance with the following:

1. Fiberglass reinforced plastic signs (Type D):

a. Approved manufacturers:

i. W H Brady Co.

ii. Seton Nameplate Co.

b. Material: Fiberglass reinforced plastic.

c. Size:

i. Surface:

a.) As required by legend.

b.) Minimum size, 7 x 10 IN or as indicated in the schedule.

ii. Thickness: 0.10 IN.

d. Fabrication:

i. Rounded corners.

ii. Drilled holes in corners with grommets.

e. Mount with stainless steel screws.

2. Letters:

a. 2 IN for words “DANGER,” “CAUTION” or “SAFETY FIRST.”

b. 3/4 IN for other text except as indicated in the schedule below.

3. Danger signs:

a. White background.

b. White letters for word “DANGER” placed on standard red oval with black panel.

c. Additional letters: Black.

d. Additional text: As indicated in schedule below.

4. Caution signs:

a. Yellow background.

b. Yellow letters for word “CAUTION” placed on black panel.

c. Additional letters: Black.

d. Additional text: As indicated in schedule below.

5. Warning signs:

a. Orange background.

b. Orange letters for word “WARNING” placed on black panel.

c. Additional letters: Black.

d. Additional text: As indicated in schedule below.

6. Safety instruction signs:

a. White background.

b. White letters for words “SAFETY FIRST” placed on green panel.

c. Additional letters: Black.

d. Additional text: As indicated in schedule below.

7. Schedule of hazard and safety signs:

TYPE AND SIZE	LEGEND	LOCATION
D 7 x 10	DANGER HIGH VOLTAGE (define voltage, ex. 480 V AC) KEEP OUT AUTHORIZED PERSONNEL ONLY	All locations where voltages above 120 V AC or 50 V DC exist
D 10 x 14	CAUTION THIS EQUIPMENT STARTS BY REMOTE CONTROL	Near equipment capable of being remotely or automatically started

Q. Device Mounting Schedule:

1. Dimensions are to center of item unless otherwise indicated.

2. Mounting heights as indicated below:
   a. Circuit breakers: 54 IN.

   b. As indicated on the drawings.

R. Perform excavation and backfill in accordance with Section 02210.

S. Underground Conduits:

1. Direct-buried conduit:

a. Provide conduit directly buried in earth.

b. For circuits 600 V and below, install so that top of conduit at any point, is not less than the minimum depths established by the NEC (Table 300-5 and exceptions).

i. Rigid PVC conduit: 18 IN.

ii. Under areas subject to vehicular traffic:

a.) All applications: 24 IN.

iii. Unless otherwise detailed on the Drawings.

2. All underground conduits shall comply with the following:

a. Minimum grade shall be 4 IN per 100 FT or as detailed on the Drawings.

b. During construction and after conduit installation is complete, plug the ends of all conduits.

c. Provide conduit supports and separators of concrete, plastic, or other suitable nonmetallic, non-decaying material designed for that purpose.

d. Make conduit joints watertight and in accordance with manufacturer's recommendations.

i. Make plastic conduit joints by uniformly brushing a plastic solvent cement on inside of plastic coupling fitting and outside of conduit ends. Slip conduit and fitting together with a quick one-quarter turn twist to set joint tightly.

e. Accomplish changes in direction of runs exceeding a total of 5 degrees by long sweep bends having a minimum radius of 25 FT.

i. Sweep bends shall be made with RGS conduit and may be made up of one or more curved or straight sections or combinations thereof.

f. Furnish manufactured bends at end of runs.

i. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN and larger trade size.

g. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.

h. Transition from PVC to RGS conduit a minimum of 5 FT prior to entering a structure or going above ground.

i. Unless otherwise indicated on the Drawings.

i. After the conduit run has been completed, pull a standard flexible mandrel having a length of not less than 12 IN and a diameter approximately 1/4 IN less than the inside diameter of the conduit through each conduit. Then pull a brush with stiff bristles through each conduit to remove any foreign material left in conduit.

j. Pneumatic rodding may be used to draw in lead wire.

i. Install a heavy nylon cord free of kinks and splices in all unused new ducts.

ii. Extend cord 3 FT beyond ends of conduit.

3. Warning tape:

a. Place warning tape in trench directly over direct-buried conduit.

i. 6 IN below finished grade where conduit is 12 IN or more below finished grade.

ii. 3 IN below finished grade where conduit is less than 12 IN below finished grade.

b. Provide warning tape as follows:

i. Electrical trenches or directly buried conduit:

a.) Legend: CAUTION CAUTION CAUTION (1st line), BURIED ELECTRIC LINE (2nd line).

b.) Letters: 1-1/4 IN minimum.

c.) Interval: Continuous.

d.) Color: Red and black letters.

3.2 FIELD QUALITY CONTROL

A. Make all penetrations of electrical work through walls and roofs water and weather- tight.

B. Equipment furnished under this Contract for use on future work and all concealed equipment, including conduits, shall be dimensioned, on the record drawings, from visible and permanent building features.

C. After installation, all equipment shall be tested as recommended by the manufacturer.

D. Verify all components are operational.

E. Perform ground-fault performance testing as required by NEC Article 230-95(c).

F. Test Equipment Interface:

1. Verify systems coordination and operation.

G. Set all adjustable trip protective devices as required for system protection and coordination.

H. Verify all system and equipment ground continuity.

I. Adjust installed equipment for proper operation of all electrical and mechanical components.

J. Replace equipment and systems found inoperative or defective and re-test.

1. If equipment or system fails re-test, replace it with products which conform with Contract Documents.

2. Continue remedial measures and re-tests until satisfactory results are obtained.

3. Remedial measures and re-tests will be done at no cost to the Owner.

K. At Completion of Installation:

1. Test to ensure all equipment is free of short circuits and improper grounds.

2. Test to ensure all equipment is operational.

3.3 CLEANING

A. Clean dirt and debris from all surfaces.

B. Apply touch-up paint as required to repair scratches, etc.

C. Replace nameplates damaged during installation.

D. Thoroughly vacuum the interior of all enclosures to remove dirt and debris.

3.4 DEMONSTRATION

A. Demonstrate equipment.

END OF SECTION

ATTACHMENT A

QUALITY ASSURANCE/QUALITY CONTROL PLAN FOR LINER AND LEACHATE COLLECTION SYSTEM INSTALLATION AND TESTING

Appendix B
Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing

Lawton Sanitary Landfill

8902 SW 11th Street,
Lawton, OK 73501

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City of Lawton Public Works Administration
2202 SW 3rd Street,
Lawton, OK 73501
580-581-3385

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April 2023
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Certification

This QA/QC Plan for liner and LCS installation and testing has been prepared in accordance with good engineering practice, including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality, as defined in the applicable sections of Oklahoma Administrative Code (OAC) 252:515-11 and 13, related to the QA/QC for installed liner and LCS components.

Prepared by:

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Senior Project Manager
SCS Engineers

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this Quality Assurance/Quality Control (QA/QC Plan) is to describe the quality assurance procedures to be used during construction of the liner and leachate collection components at the City of Lawton Landfill (landfill) in accordance with OAC 252:515-11 and 13 as promulgated by the Oklahoma Department of Environmental Quality (DEQ) and the EPA Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities (EPA/600/R-93182, September 1993). The primary goals of the quality assurance program are to:

- Determine if proper construction techniques, materials, and procedures are used;
- Determine if the intent of the construction documents and project design reports are met; and
- Identify construction problems and provide a mechanism for resolution.

Upon completion of construction, information generated through the quality assurance program will be used to prepare a Liner Installation and Testing (LIT) Report.

This QA/QC Plan addresses the testing methods and frequency requirements set forth in OAC 252:515-11-6. Consistent with OAC 252:515-11-2(b) and (c), the landfill will have the following composite liner design options for both the floor and sideslopes, from top to bottom:

<u>Composite Bottom Liner Option No. 1</u>

- 2-foot-thick soil protective cover comprised of onsite soils ($k \geq 1.3x10^{-5}$ cm/sec);
- 250-mil double-sided geocomposite (non-woven geotextile on both sides of geonet);
- 60-mil high density polyethylene (HDPE) geomembrane liner (textured on both sides);
- 24-inch-thick compacted clay liner (CCL, $k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

<u>Composite Bottom Liner Option No. 2</u>

- 2-foot-thick soil protective cover ($k \geq 1.0x10^{-3}$ cm/sec);
- 60-mil HDPE geomembrane liner (textured on both sides);
- 12-inch-thick CCL ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

<u>Composite Bottom Liner Option No. 3</u>

- 5-foot-thick select waste, as defined in Section 1.2.20;
- 1-foot-thick soil protective cover comprised of onsite soils ($k \geq 1.3x10^{-5}$ cm/sec);
- 250-mil double-sided geocomposite (non-woven geotextile on both sides of geonet);
- 60-mil HDPE geomembrane liner (textured on both sides);
- 24-inch-thick CCL ($k \leq 1x10^{-7}$ cm/sec); and
- Prepared subgrade (excavation grade).

This QA/QC Plan, which will be followed during the installation and testing of the bottom liner and outlines materials selection and evaluation, laboratory test requirements, field test requirements and treatment of problems for the components described above. This QA/QC Plan also includes reporting requirements for the LIT Report for the construction quality assurance of soil liner, geomembrane liner, and LCS components of the bottom liner system.

1.2 DEFINITIONS

Whenever the terms listed below are used, the intent and meaning shall be interpreted as indicated.

1.2.1 ASTM

This means the American Society for Testing and Materials.

1.2.2 Construction Quality Assurance (CQA)

A planned system of activities that provides the owner and permitting agency assurance that the facility will be constructed as specified in the design (EPA, 1993). CQA includes observations and evaluations of materials and workmanship necessary to assess and document that construction has been performed consistent with the applicable contract and permit documents. CQA refers to measures taken by the CQA professional of record and/or CQA monitor to assess if the bottom and sideslope liner systems construction has been in compliance with the permit drawings and this QA/QC Plan for the site.

1.2.3 CQA Professional of Record (POR)

The POR is an authorized representative of the owner and has responsibility for construction quality assurance reporting and confirming that the facility was constructed in general accordance with construction drawings and specifications approved by the permitting agency. The POR is identified as the “Engineer” in the project specifications. The POR must be registered as a Professional Engineer in the State of Oklahoma. The POR may also be known in applicable regulations and guidelines as the CQA Engineer, Resident Project Representative, or Geotechnical Professional (GP).

1.2.4 CQA Monitors

These are representatives of the POR who work under direct supervision of the POR. The CQA Monitor is responsible for quality assurance monitoring and performing on-site tests and observations. Any references to monitoring, testing, or observations to be performed by the GP should be interpreted to mean the POR or CQA Monitor working under the POR’s direction.

1.2.5 Construction Quality Control (CQC)

These actions provide a means to measure the characteristics of an item, material, or service to comply with the requirements of the contract or permit documents. CQC actions will be performed by the Contractor or manufacturer of materials. All quality control testing shall be performed prior to or during construction of the liner. In no instance shall quality control field or laboratory testing be undertaken after completion of liner construction.

1.2.6 Contract Documents

These are the official set of documents provided by the Owner. The documents include bidding requirements, contract forms, contract conditions, technical specifications, construction plans, addenda, and contract modifications.

1.2.7 Technical Specifications (or Specifications)

These are the qualitative requirements for products, materials, and workmanship upon which the construction contract is based.

1.2.8 Contractor

This is the person or persons, firm, partnership, corporation, or any combination, who as an independent contractor, has entered into a contract with the Owner.

1.2.9 Design Engineer

These individuals or firms are responsible for the design and preparation of the project construction drawings and technical specifications; also referred to as "designer" or "engineer."

1.2.10 Earthwork

This is a construction activity involving the use of soil materials as defined in the technical specifications.

1.2.11 Geomembrane Liner

This is an essentially impermeable synthetic lining material, 60-mil high-density polyethylene (HDPE), also referred to as flexible membrane liner (FML), geomembrane, membrane, liner, or sheet, used as a solid or liquid barrier.

1.2.12 Geosynthetics Contractor

This individual is also referred to as the "Contractor," and is the person or firm responsible for geosynthetic construction and/or installation. This definition applies to any person installing geomembrane, geotextile, geocomposite, or other geosynthetic materials, even if not their primary function.

1.2.13 Nonconformance

A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of nonconformance include, but are not limited to, physical defects, test failures, and inadequate documentation.

1.2.14 Operator

The organization that will operate the landfill disposal unit.

1.2.15 Operator's Representative

This is the person that is an official representative of the operator responsible for planning, organizing, and controlling the construction activities.

1.2.16 Panel

A unit area of the geomembrane which will be seamed in the field or in the fabricator's plant.

1.2.17 Procedure

A document that specifies or describes how an activity is to be performed.

1.2.18 Project Documents

Contractor submittals, construction drawings, record drawings, specifications, shop drawings, construction quality control and quality assurance plans, safety plan, and project schedule.

1.2.19 Record Drawings

Drawings recording the constructed dimensions, details, and coordinates of the project (also referred to as "as-builts").

1.2.20 Select Waste

Select waste shall be free from C&D waste, lumber, rock larger than 2-inch diameter, loads containing structural or scrap metal, fencing material, utility poles, large bulky items, or any other material that may puncture the liner.

1.2.21 Surveyor

The individual or firm responsible for grade staking to establish required elevations to construct the project in accordance with the drawings and specifications.

1.2.22 Testing

Verification that materials meet specified requirements by subjecting that material to a set of physical, chemical, environmental, or operating conditions.

1.2.23 Testing Laboratory

A laboratory capable of conducting the tests required by this QA/QC Plan and the specifications. Testing may be done by the same laboratory or by a separate soils testing laboratory and a geosynthetics testing laboratory.

1.2.24 USCS

Unified Soil Classification System (ASTM D2487).

1.3 MEETINGS

To facilitate construction and to define construction goals and activities, coordination between the Design Engineer, Owner, Operator, POR, CQA Monitor, and Contractor is essential. To meet this objective, meetings will be held prior to and throughout the construction process.

In accordance with OAC 252:515-11-5, DEQ will be notified at least 48 hours in advance of the pre-construction meeting and at least two weeks before liner system construction begins. The pre-construction meeting notification will (1) define the area to be constructed and (2) include the names of the contractors and the QA and QC officials. The notification will also include pre-construction tests information identified in OAC 252:515-11-32(a).

Additionally, in accordance with OAC 252:515-11-56(b), DEQ will be notified at least 48 hours before installation of the FML.

2.0 CONSTRUCTION QUALITY ASSURANCE FOR EARTHWORK

2.1 INTRODUCTION

The overall goal of the earthwork quality assurance program is to assure that proper construction techniques and procedures are used and that the project is built in accordance with the project construction drawings and specifications. Another function of the quality assurance program is to identify problems that may occur during construction and to verify that these problems are avoided or corrected before construction is completed.

Construction must be conducted consistent with the project construction drawings and specifications. To monitor conformance, a quality assurance testing program will be implemented that includes:

- A review of the contractor's quality control submittals,
- Material evaluation,
- Construction testing, and
- Construction observation.

Activities will be conducted in accordance with this manual, and the project construction drawings and specifications.

The following paragraphs describe general construction procedures to be used for various earthwork components of liner construction at the landfill. The earthwork construction specifications will be developed based on the material and construction procedures outlined in this section of the QA/QC Plan for each specific component of liner construction.

2.2 SUBGRADE

Subgrade refers to a surface that is exposed after stripping topsoil or excavating to establish the grade directly beneath the bottom liner system. The prepared subgrade must conform to the Excavation Plan of the construction drawings.

Prior to beginning liner construction, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The subgrade will be proof-rolled with heavy, rubber-tired construction equipment to detect areas subject to pumping caused by excessively wet soils or surface water. If soils subject to pumping cannot be disked, dried, or stabilized, these areas will be undercut to firm material and refilled with general fill, as defined in Section 2.2.2.

In accordance with OAC 252:515-11-34, the upper 6 inches of the subgrade will be compacted to a minimum of 90 percent of the maximum dry density as determined by the Standard Proctor (ASTM D 698), unless the subgrade is part of the perimeter berm.

Perimeter berm soils (general fill) will placed in uniform lifts which do not exceed 9 inches in loose thickness (6-inch compacted lifts) and compacted to at least 95 percent of standard Proctor (ASTM D698) density at a moisture content ranging from -2% to +4% of optimum (as determined by ASTM D698). Testing frequencies for subgrade construction quality assurance is provided in Table 2-1 consistent with the requirements of OAC 252:515-11.

Based on visual evaluations, the CQA Monitor will determine whether additional physical testing methods are necessary to evaluate the excavated or prepared subgrade or subgrade areas where fill is placed. Testing might include shallow test holes, test trenches, density, and moisture testing. Additional proof-rolling may also be required. The CQA Monitor or POR will approve the prepared subgrade prior to the placement of soil liner or general fill. Approval will be based on a review of test information, if applicable, and CQA monitoring of the subgrade preparation.

In accordance with OAC 252:515-11-37, the subgrade shall be surveyed on a 100-foot grid to provide verification of liner thickness with a minimum of two reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the subgrade surface.

2.3 GENERAL FILL

General fill material (which may also be referred to as structural or engineered fill) will be used in the establishment of proper subgrade elevations and in the construction of perimeter embankments. General fill will be placed in uniform lifts which do not exceed 9 inches in loose thickness (6-inch compacted lifts) and compacted to at least 95 percent of standard Proctor (ASTM D698) density at a moisture content ranging from -2% to +4% of optimum (as determined by ASTM D698).

For quality control purposes a standard Proctor test will be required at a minimum of at least once per borrow source, and at least one per visual change in soil type or classification (as judged by the POR or CQA Monitor based on visual observation).

Testing frequencies for general fill construction quality assurance is provided in Table 2-1 consistent with the requirements of OAC 252:515-11-32.

Table 2-1. Subgrade/General Fill Testing Schedule

Test	Method Used	Frequency
Soil Classification: USCS	ASTM D2487	1 per soil type/ minimum 1 per borrow source
Sieve Analysis	ASTM D422 or D1140	
Atterberg Limits	ASTM D4318	
Moisture/Density Relationship	ASTM D698	
Moisture/Density of Soil In-Place	ASTM D6938	1 per 10,000 ft^2 per 6-inch lift
Thickness Verification	Survey	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the general fill

2.3.1 Construction Procedures

The following guidelines apply during placement of the general fill:

- Verify subgrade is scarified and re-compacted to design requirements;
- Verify removal and stockpiling of oversized material;
- Verify that source of material is suitable for general fill (see Table 2-1);

- Test compaction and moisture content at required frequencies;
- Verify that completed grades meet slope requirements; and
- Verify that final grading meets tolerance requirements.

2.4 SOIL LINER

Construction of the soil liner will begin after excavation, embankment construction, subgrade preparation, and grading to excavation grades has been completed. For this landfill, the soil liner constructed for all waste disposal cells will be a 2-foot thick compacted soil (clay) liner, as described in Section 1.1.

In accordance with OAC 252:515-11-33, soil for the soil liner will achieve an installed permeability of $1x10^{-7}$ cm/s or less; a liquid limit (LL) of 24 or greater; a plasticity index (PI) of 15 or greater; percent passing the No. 200 sieve of 30 percent or greater; and 100 percent passing the 1-inch sieve (i.e., no particles greater than 1 inch in size) with no more than 10 percent rocks by weight. The final lift of the soil liner will not contain rock or other deleterious materials that can cause damage to the overlying geomembrane.

2.4.1 Pre-Construction Testing

In accordance with OAC 252:515-32, pre-construction testing for soil liner will be performed at a frequency of 1 per 10,000 cy per material type, as summarized in Table 2-2.

For each soil sample, correlations will be developed based on moisture-density tests and permeability tests (performed on soil samples at a calculated density) to demonstrate that the soils will have the required permeability at the specified level of compaction. Soil density test results will be reported as a percentage of the maximum dry density at the corresponding optimum moisture content. Correlation testing will be provided to POR and CQA Monitor for use in the field during soil liner construction.

Table 2-2. Soil Liner Pre-Construction Testing Schedule

Test	Method Used	Frequency
Soil Classifications: USCS	ASTM D2487	1 per 10,000 cy per material type
Sieve Analysis	ASTM D422 or D1140	
Atterberg Limits	ASTM D4318	
Moisture/Density Relationship	ASTM D698	
Hydraulic Conductivity (1)	ASTM D5084 (2)(3)	

1. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.
2. Testing procedures in Appendix VII of the Corps of Engineers Manual EM 1110-2-1906, November 30, 1970, Laboratory Soils Testing, may be used as an alternative method.
3. Permeability tests will be conducted with tap water or 0.05N solution of CaSO4. Distilled water will not be allowed.

2.4.2 Construction Testing

Construction quality assurance for the soil liner will consist of both laboratory and field testing. The minimum frequencies and test methods for testing of soil liner during construction are presented on Table 2-3. The POR or CQA Monitor will be on-site during all liner installation construction activities. Laboratory testing will be performed by an independent geotechnical laboratory.

All quality assurance testing of soil liners will be performed during the construction of the liner. In no instance will any quality assurance field or laboratory testing be undertaken after completion of liner construction, except for that testing which is required of the final constructed lift, confirmation of liner thickness, or cover material thickness. All soil testing and evaluation of the soil liner will be complete prior to installing the geomembrane and leachate collection system on the area under evaluation.

Table 2-3. Soil Liner Construction Testing Schedule

Test	Method	Minimum Frequency
Moisture/Density of Soil In-Place	ASTM D6938	3 per acre per 6-inch lift
Sieve Analysis	ASTM D422 or D1140	1 per 100,000 ft^2 per 6-inch lift
Atterberg Limits	ASTM D4318	
Hydraulic Conductivity	ASTM D5084 (1)(2)	2 per acre for top 12 inches of floor liner; 1 per acre for top 12 inches of sidewall liner
Thickness	Survey	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the liner surface

1. Permeability tests will be run using tap water or a 0.05N solution of $CaSO_4$. Distilled water will not be allowed.
2. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.

2.4.3 Thickness Verification

The thickness (minimum 2-foot) of constructed soil liner will be verified by surveying methods. As described in Table 2-3, thickness verification will be performed for every 100-foot square grid with a minimum of 2 reference points. All elevation calculations necessary for thickness verification will be included in the FCCR submittal.

2.4.4 Construction Procedures

2.4.4.1 General Requirements

The following guidelines apply during placement of the soil liner:

- The excavation grade surface should be scarified (roughened) prior to placing the first lift of the soil liner, thus providing adequate bonding between the liner and underlying foundation soils. The CQA Monitor will inspect the adequacy of the scarification and compaction effort in providing good lift bonding (i.e., no smooth interface between lifts) during the initial stages of liner installation.

- Bottom and sideslope soil liners will be constructed in compacted lifts not exceeding 6 inches. The top of each subsequent lift should be scarified (roughened) to a shallow depth prior to the spreading and compaction of successive lifts, thereby providing bonding between the lifts.

- The soil liners will not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed roller. The soil liner will be compacted with a pad-footed or prong-footed roller only. The maximum clod size of the compacted liner soils will be approximately one inch in diameter. In all cases soil clods will be reduced to the smallest size necessary to achieve the coefficient of permeability reported by the testing laboratory and to destroy any macrostructure evidenced after the compaction of the clods under density-controlled conditions.

- No loose lift will be thicker than the pads of the compactor so that complete bonding with the top of the previous lift is achieved. The soil liner lifts will be compacted by a minimum 3 passes (back and forth) of the compaction equipment.

- The soil liner material will consist of relatively homogeneous cohesive materials, which are free of debris, rock greater than 1 inch in diameter, plant materials, frozen materials, foreign objects, organics, and other deleterious materials. The soil liner material will be placed in maximum 9-inch loose lifts to produce a compacted lift thickness of approximately 6 inches. The material will be compacted to a minimum of 95 percent of the maximum dry density as determined by standard Proctor (ASTM D 698), at a moisture content ranging from 0% to +4% above optimum moisture content, in order to achieve a permeability of less than or equal to $1x10^{-7}$ cm/s.

- Water will be applied as necessary to the material and worked evenly into the material with the compaction equipment. Water used for the soil liner must be clean and not contaminated by waste or any objectionable material. Storm water collected on-site may be utilized if it has not come into contact with solid waste.

- Soil liner construction will not be conducted in adverse weather conditions (heavy rain, freezing temperatures, etc.).

- Although not anticipated since design grades are not this steep, equipment and safety limitations prohibit finished grades with slopes greater than 3H:1V if the liner is constructed parallel to the surface. Compaction equipment placing sideslope liners on slopes steeper than 3H:1V results in reduced stability of compaction equipment, and reduction in compaction efficiency.

- The surface of the soil liner will be sealed by smooth drumming when construction is to be shut down for more than 24 hours to mitigate the effects of desiccation and wetting from rainfall events. Additionally, smooth drum rolling to seal the surface will be required on a routine basis during the summer months at the end of each day's liner construction to reduce desiccation.

- Any liner perforations required for obtaining laboratory samples will be repaired by backfilling the hole with bentonite chips or 50/50 powdered/granulated bentonite/soil/sand mixture hand-tamped into place. If the hole is in the upper lift of soil liner, the upper 2 inches will be backfilled by clayey liner soil which will be hand-tamped sufficiently to blend the backfill into the adjacent soil liner lift.

- Soil liner construction will be conducted in a systematic and timely manner, such that the soil liner is not left exposed for an extended period of time. The Contractor will be required to maintain any exposed soil liner in a condition acceptable to the CQA Monitor through the

completion and approval of the soil liner, and during placement of the geomembrane over the soil liner.

- The soil liner will be prevented from losing moisture prior to placement of the geomembrane. Preserving the moisture content of the soil liner will be dependent on the earthwork contractor's means and methods and is subject to the POR approval. The POR will provide daily certification that the liner is of uniform grade with no ruts, meets the minimum moisture content requirements, and the surface is free of debris, rock greater than 1 inch in diameter, plant materials, frozen materials, foreign objects, and other deleterious materials.

- The top of the soil liner will be surveyed on a 100-foot grid with a minimum of two reference points to provide verification of liner thickness.

2.4.4.2 Liner Tie-ins

The leading 10 to 20 feet of the liner will <u>not</u> be covered with waste, but instead will be protected to facilitate tie-in with subsequent phase liners. Liners will not be constructed by “butting” the entire thickness of a new liner segment next to the previously constructed section of liner. Soil liner tie-ins will be performed using the following procedures:

- The edge of the previously installed liner will be uncovered, exposed, and cut back on a slope so that the entire existing liner edge is tied to new construction without superimposed construction joints.

- The surface of the existing liner will be scarified (roughened) prior to subsequent soil placement, to further reduce the possibility of construction joints.

The length of the tie-in area will be at least 5 feet per foot thickness of liner.

2.4.4.3 Hydrating Liner Soil

Prior to attempting to hydrate (moisture condition by wetting) clayey soils, clod sizes will be reduced by disking, pulverizing, or other method of breaking clods as acceptable to the POR or CQA Monitor. The number of passes required for adequate clod size reduction will be determined in the field between the Contractor and POR, based on soil condition, equipment used, and equipment operation. After applying water, the soil will be mixed and stockpiled, if necessary, to allow adequate time for hydration to occur. The amount of moisture conditioning and time of hydration will be determined in the field by the POR. Water used in hydrating liner soils must be clean and will not have come into contact with waste or any objectionable material.

2.4.5 Procedures for Addressing Failing Tests

2.4.5.1 Failing Field Density Tests

As described in Table 2-3, field density tests will be performed at a frequency of 3 per acre per 6-inch lift. In the event a test indicates field density less than specified, the Contractor will be required to moisture condition (either dry or moisten, if needed) the soil, and then re-compact and retest the soil. The entire area represented by the failing test will be required to be reworked.

Alternately, the contractor may perform a minimum of 3 additional field density tests spaced no less than 20 feet in a circular pattern surrounding the original failed test, and, if all tests pass field density, the rework area will be limited to the area inside of the circle formed by the passing tests. If one or more of the additional field tests fail, the entire area represented by the failed test will require reworking.

In the event of a second failed field density test, the POR will be immediately notified, and a field decision made by the POR regarding conducting a second rework of the area (as described above) or alternately, requiring that an additional Proctor test be performed on the soils comprising the failed test area. If an additional Proctor test is required, the POR will direct the contractor to either obtain soil samples from the failed area, or alternately, from the borrow source from which the failing soils were obtained. Reworking and retesting of the soils will not occur until after the additional laboratory testing has been completed, and the new Proctor test information submitted to the POR or CQA Monitor.

The results of both passing and failing tests will be recorded, and reported within the LIT.

2.4.5.2 Failing Permeability Tests

As described in Table 2-3, hydraulic conductivity tests will be performed at a frequency of 2 per acre for top 12 inches of floor liner and 1 per acre for top 12 inches of sideslope liner. In the event of a failing permeability test, the POR will immediately be notified, and the failing laboratory results provided to the POR.

Prior to requiring additional permeability sampling and testing, a field density test will be performed at the location of the failed test. If a failing field density test is obtained, the failed area will be defined as described in Section 2.4.1, above, except that additional field density testing will be performed until passing tests are obtained. After reworking and achieving passing field density tests, a new permeability sample will be obtained for testing.

If passing field density tests are obtained at the location of the failed permeability test location, additional Atterberg limits and gradation test samples will be obtained at a minimum of 3 locations, spaced no less than 20 feet in a circular pattern surrounding the original failed test. If passing results are obtained for the additional test samples, the area defined by the passing tests will be removed and replaced. If one or more of the additional tests fail, a new sample will be obtained 30 feet (minimum) from the original failed test (along a line radiating from the original failed test through the failing additional test(s)), and in 10-foot (minimum) increments thereafter, until passing test results are obtained. After removal and replacement, a new permeability sample will be obtained and tested, and a passing test obtained prior to approval of the reworked area.

2.5 PROTECTIVE COVER

As discussed in Section 1.1, the protective cover material will consist of either a 24-inch thick layer of soil or a 1-foot thick layer of soil. When composite liner Options 1 and 3 are utilized, protective cover will comprise of on-site soils that will meet a hydraulic conductivity of 1.3×10^{-5} cm/sec or greater. When composite bottom liner Option 2 is utilized, protective cover will meet a hydraulic conductivity of 1×10^{-3} cm/sec or greater. The soils will be tested by ASTM D5084 method, at a frequency of 1 every 1,600 cy when placed on the floor of the landfill cell. No testing will be performed on material that is placed on the landfill sideslope.

Protective soils will be placed without any compaction requirement, consistent with DEQ's guidance document. If select waste is utilized as a protective cover layer (composite bottom liner Option 3), it will contain no C&D waste, lumber, rock larger than 2-inch diameter, loads containing structural or scrap metal, fencing material, utility poles, large bulky items, or any other material that may puncture the liner. Landfill personnel or Contractor will remove any nonconforming waste while placing the first 5-foot lift of waste. The select waste will be placed or rolled into position on the drainage layer and will not be dumped or pushed across the top of the protective cover layer. The select waste will be placed in one lift with a dozer and left uncompacted. Within 10 days of the completion of the first 5-foot lift of select waste, a signed letter from the landfill owner or operator that no nonconforming waste was placed in the first lift will be sent to the DEQ. This letter will include survey elevations documenting that the minimum 5-foot layer of select waste has been achieved.

The protective cover material will consist of soil materials that have not previously come in contact with solid waste and do not contain materials detrimental to the underlying geosynthetics. During placement of the protective cover soil, a minimum of 36 inches of soil will be maintained between the haul trucks and the installed geosynthetics. The protective cover soil will be placed using low ground pressure equipment and in a manner which will prevent abrasion of the underlying geosynthetics by pushing the material across the geosynthetics. A minimum of 12 inches of soil will be maintained between the spreading equipment and the installed geosynthetics. Under no circumstances will the construction equipment come in direct contact with the installed geosynthetics.

The thickness of the protective soil layer will be verified with surveying procedures. Thickness will be determined using the same 100 foot grid used for the liner thickness verification with a minimum of two reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the protective cover surface. The test results for the drainage layer will be included in the LIT Report.

During construction, the CQA Monitor will:

- Verify that grade control construction staking is performed prior to work;
- Verify that underlying geosynthetics installations are not damaged during placement operations. Mark damaged geosynthetics and verify that damage is repaired;
- Verify that protective soils have been placed without any compaction.
- Monitor haul road thickness over geosynthetics installations and verify that equipment hauling and materials placement meet equipment specifications; and
- Verify corrective action measures as determined by the verification survey. (The POR will coordinate with the project surveyor to perform a thickness verification survey of the drainage layer materials upon completion of placement operations.)

2.6 DRAINAGE AGGREGATE

Granular drainage material around the leachate collection pipes (i.e., chimney drains), and within and above the leachate collection sumps will consist of durable particles of crushed stone, natural gravel, or lightweight aggregate free of silt, clay, or other unsuitable materials. River rock or rounded particles are not suitable as leachate pipe bedding. The aggregate shall have a loss of mass due to calcium carbonate of less than 15 percent (in accordance with J&L Test Designation S-105-89 or ASTM D3042 modified to use a solution of hydrochloric acid having a pH of 5).

Drainage aggregate will be placed using low ground pressure equipment, as specified in Table 2-4 of this Appendix. Drainage aggregate will be placed by spreading in front of the placement equipment with a minimum lift thickness of 12 inches separating the equipment and the underlying geosynthetics.

Table 2-4. Equipment Requirements for Leachate Collection Layer Construction

Equipment Ground Pressure	Minimum Lift Thickness (inches)
≤ 5	10
5 - 8	18
8 - 16	24
> 16	36

The drainage aggregate will meet the following gradation:

Sieve Size Square Opening	Percent Passing
2 inches	100
½ inch	0 – 5

Drainage aggregate of this gradation will meet a minimum permeability requirement of $1x10^{-2}$ cm/s, therefore no permeability testing is required.

2.6.1 Testing

The drainage aggregate shall be tested for gradation and calcium carbonate, in accordance with ASTM C136 and J&L Test Designation S-105-89 or ASTM D3042 modified, respectively, at the supply source at a minimum of 1 test per 5,000 cubic yards or 1 test per lined area or phase (if less than 5,000 cubic yards required). The physical characteristics of the aggregate shall be evaluated through visual inspection and laboratory classification testing before construction and visual inspection during construction. The drainage aggregate may be tested during construction at the discretion of the CQA Monitor. The test results for the drainage aggregate used in the leachate collection system will be included in the LIT.

2.6.2 Installation

The drainage aggregate will be placed on top of the geocomposite that overlies the geomembrane using low ground pressure equipment as outlined in Table 2-4. The drainage aggregate shall be placed by spreading a minimum of 12 inches of material in front of the spreading equipment. Under no circumstances shall the construction equipment come in direct contact with the installed geosynthetics.

During construction, the CQA Monitor will:

- Verify that underlying geosynthetic installations are not damaged during placement operations, or mark damaged geosynthetics and verify that damage is repaired; and
- Monitor haul road thickness over geosynthetics installations and verify that equipment hauling and materials placement meets equipment specifications.

2.7 SUMMARY OF EARTHWORK TESTING SCHEDULE

A summary of testing schedule for subgrade/general fill, soil liner, protective cover, and drainage aggregate is provided in Table 2-5.

Table 2-5. Minimum Earthwork Construction Testing Schedule

Test (ASTM No.)	Subgrade/General Fill	Soil Liner	Protective Cover	Leachate Collection (Aggregate)	5-foot Select Waste
Moisture/Density Relationship (Pre-construction, D698)	1 per soil type/ minimum 1 per borrow source	1/10,000 cy per material type	NA	NA	NA
Moisture/Density of Soil In-Place (D6938)	1 per 10,000 ft^2 per 6-inch lift	3 per acre per 6-inch lift	NA	NA	NA
Visual Classification (D2487 and D2488)	NA	Continual during placement	NA	Continual during placement	NA
Atterberg Limits (Pre-construction D4318)	1 per soil type/ minimum 1 per borrow source	1/10,000 cy per material type	NA	NA	NA
Gradation (D422 or D1140 or C136 [for aggregate])	1 per soil type/ minimum 1 per borrow source	1/10,000 cy per material type	NA	1/5,000 cy	NA
Hydraulic Conductivity (Pre-construction, D2434 or D5084) (1)(2)	NA	1/10,000 cy per material type	1 per soil type/ minimum 1 per borrow source	N/A	NA
Hydraulic Conductivity In-Place (D2434 or D5084)(1)(2)	NA	2 per acre for top 12 inches of floor liner; 1 per acre for top 12 inches of sidewall liner	1/1,600 cy per material type installed on the floor of a landfill cell	N/A	NA
Carbonate Content (J&L Test Designation S-105-89 or D3042)	NA	NA	NA	1/5,000 cy	NA
Thickness Verification	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the subgrade/general fill surface	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the liner surface	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the protective cover surface	NA	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.2 feet on the top of the select waste

1. Permeability tests will be run using tap water or a 0.05N solution of $CaSO_4$. Distilled water will not be allowed.
2. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.

3.0 CONSTRUCTION QUALITY ASSURANCE FOR GEOMEMBRANE

3.1 INTRODUCTION

This section describes CQA procedures for the installation of 60-mil HDPE geomembrane. The overall goal of the CQA procedures is to confirm (1) that proper materials, construction techniques and procedures are used; (2) that the Geosynthetic Contractor implements a quality control plan in accordance with this QA/QC Plan; and (3) that the project is built in accordance with this QA/QC Plan and the project construction plans and technical specifications. The quality assurance program is intended to identify and define problems that may occur during construction and to observe that these problems are avoided and/or corrected before construction is complete.

Conformance testing refers to material testing that takes place before material installation. Construction testing includes activities that occur during installation. Activities will be conducted in accordance with this manual, and the project construction drawings and specifications.

3.2 QUALITY CONTROL AND QUALITY ASSURANCE TESTING

CQC during installation of the geomembrane will be performed by the Geosynthetics Contractor. CQA during installation of geomembrane will be performed by the CQA Monitor to assure that the geomembrane is installed in accordance with this QA/QC Plan and the project construction plans and technical specifications. To monitor compliance, a quality assurance program will include the following:

- A review of the contractor's quality control submittals,
- Material evaluation (conformance testing),
- Construction testing, and
- Construction observation.

Conformance testing refers to activities that take place prior to material installation. Construction testing includes activities that occur during geosynthetic installation. All quality control/assurance monitoring and testing will be conducted in accordance with this QA/QC Plan and the project construction plans and technical specifications. The POR or CQA Monitor will be on-site, and observe all geomembrane installation and testing activities.

3.2.1 Manufacturer's Quality Control

Prior to the installation of the geomembrane, the manufacturer or installer will provide the POR with quality control certificates signed by a responsible party employed by the manufacturer. Each quality control certificate will include roll identification numbers, testing procedures, and results of quality control tests. The manufacturer's quality control tests will be performed in accordance with the test methods and frequencies provided in the most recent version of Geosynthetic Research Institute (GRI) standard GM-13. Additionally, testing for the geomembrane resin will be performed in accordance with the following:

- Specific Gravity/Density (ASTM D792 or D1505): 1 per batch and every resin lot; and

- Melt Flow Index (ASTM D1238): 1 per batch and every resin lot.

All geomembrane properties must meet the minimum values set forth in the most recent version of Geosynthetic Research Institute (GRI) standard GM-13. UV Resistance testing not required for HDPE that will be immediately covered.

3.2.2 Conformance Testing

Conformance testing refers to testing (by a third-party independent laboratory) performed after manufacture of the geomembrane to verify it meets the required specifications. Conformance testing methods and required frequencies are presented in Table 3-1.

Table 3-1. Geomembrane Conformance Testing Schedule

Test	Method	Minimum Frequency
Thickness	ASTM D5994	1 per 100,000 ft^2 and every resin lot
Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
Carbon black content	ASTM D1603	
Carbon black dispersion	ASTM D5596	
Tensile properties (1)	ASTM D638, Type IV	

1. 2-inch initial gauge length assumed for elongation at break at 2.0 in/min.

3.3 INSTALLATION

3.3.1 Delivery

Upon delivery of the geomembrane, the CQA Monitor will verify that:

- The geomembrane is delivered in rolls and not folded. Folded geomembrane is not acceptable because the highly crystalline structure of the geomembrane will be damaged if it is folded. Any evidence of folding or other shipping damage is cause for rejection of the material;
- Equipment used to unload and store the rolls does not damage the geomembrane;
- The geomembrane is stored in an acceptable location and in accordance with the specifications. The geomembrane is protected from puncture, dirt, grease, mud, mechanical abrasions, excessive heat, or other damage; and
- All manufacturing documentation required by the specifications has been received. Geomembrane that does not have proper manufacturer's documentation must be stored at a separate location until all documentation has been received, reviewed, and accepted.

3.3.2 Panel Placement

At the conclusion of soil liner construction, the geomembrane shall be installed by a third-party geosynthetics contractor. Prior to installation of the geomembrane, the subgrade (top of clay liner beneath geomembrane) shall be free of debris, roots, and angular or sharp rocks. The subgrade (top of clay liner beneath geomembrane) shall be of such compaction so as to provide a firm, unyielding

foundation sufficient for deployment vehicles to move about the construction area without rutting and pumping. The geomembrane installer will complete a Subgrade Acceptance Form for inclusion in the construction documentation report.

During placement, the CQA Monitor must maintain up-to-date logs documenting panel and roll numbers, seam numbers, test locations and results, repair locations and results, and nondestructive testing information. The CQA Monitor will review the contractor-prepared as-built (record) drawings, using the logs as reference.

Geomembrane panels shall be deployed and immediately assigned a number according to a panel numbering system. Panels shall be placed down the slope and not across it. Panels shall be physically identified in the field with a grease pencil (or equivalent) for reference during seaming and testing operations and project as-built records. Destructive and nondestructive test locations, as well as repair locations, shall be appropriately identified for documentation purposes. Panels will be deployed with a rubber-tired front loader and special roller bar to assist with unrolling the geomembrane panels at specified locations. Care shall be used in the deployment of geomembrane panels such that traffic is minimized and equipment does not damage the geomembrane or supporting subgrade surface. Sandbags or other approved loading shall be used as necessary to prevent uplift of panels by the wind or migration of storm water beneath the panels. Panels shall not be deployed in areas of standing water or on frozen subgrade. Damage done to panels during deployment shall be noted and repaired by patching and/or spot welding as approved by the POR. No more panels shall be deployed than can be seamed during that day. Steps shall be taken to prevent water from migrating under the geomembrane during and after deployment. Overlapping of the panels or completion of seaming for those panels deployed prior to the end of the work day shall be used as appropriate to minimize the potential for such occurrence. Additionally, temporary or permanent berms shall be constructed where necessary to redirect surface water away from the construction area.

During panel placement, the CQA Monitor should:

- Record panel numbers and dimensions on a panel/seam log;
- Observe the geomembrane surface as it is deployed and record all panel defects and repair of the defects. All repairs must be made in accordance with the specifications;
- Verify that equipment used does not damage the geomembrane during handling or equipment transit by contact with hydrocarbons, or by other means;
- Verify that the soil liner beneath the geomembrane has not been damaged since previous acceptance;
- Verify there are no stones, construction debris, or other items beneath the geomembrane that could cause damage to the geomembrane;
- Verify that the geomembrane is not dragged across an unprotected surface. If the geomembrane is dragged across an unprotected surface, the geomembrane must be inspected for scratches and repaired or rejected, if necessary;
- Record weather conditions, including temperature, wind, and humidity. The geomembrane must not be deployed in the presence of excess moisture (fog, dew, mist, etc.). In addition, geomembrane should only be seamed when the ambient air temperature is between 40°F

and 104°F, unless trial weld tests for the seaming demonstrate adequate results at other temperatures. The geomembrane should not be deployed during excessive winds that can lift and move the geomembrane panels;

- Verify that people working on the geomembrane do not smoke, wear shoes that could damage the liner, or engage in activities that could damage the liner;
- Verify that the method used to deploy the geomembrane minimizes wrinkles or fishmouths so that the geomembrane is anchored and ballasted to prevent movement by the wind. (The contractor is responsible for any damage resulting to or from windblown geomembrane);
- Verify that no more panels are deployed than can be seamed on the same day:
- Verify that no base T-seam is closer than 5 feet to the toe of the slope;
- Verify that field seams are minimized in corners and odd-shaped geometric locations; and
- Verify that field seaming will be performed by a hot shoe fusion welder, an extrusion welder, or an alternative method approved by the DEQ and POR prior to use in the field.

The CQA Monitor must inform both the contractor and the POR if any of the above conditions are not met.

3.3.3 Field Seaming

A seam numbering system must be agreed to by the CQA Monitor or POR and Contractor prior to the start of seaming operations. One procedure is to identify the seam by adjacent panels. For example, the seam located between Panels 306 and 401 would be Seam No. 306/401.

Trial seam testing will be performed for each of the following events:

- At the beginning of each seaming period per workday and for each seaming apparatus, including in the morning and immediately after each extended break throughout the day.
- After any major change in environmental condition, i.e., temperature, humidity, dust, etc.
- Any time the seaming apparatus is turned off for longer than 30 minutes.
- The contractor has the number of welding apparatuses and spare parts necessary to perform the work;

Both the welder and the welding apparatus must be tested for extrusion welding. Only the apparatus must be tested according to the above schedule for fusion welding. Each welder or seamer, whether extrusion or fusion welding, must be tested at least once daily.

Each trial seam shall be at least three (3) feet in length, and 1 foot wide. A minimum of four (4) adjoining 1-inch wide coupons will be die-cut from the test seam. Two field samples will be tested for shear, and two samples tested for peel. The apparatus used for field testing must have a current certificate of calibration issued by the appropriate state or federal agency.

If one of the test seams fails, the trial seam will be repeated and testing performed on the trial seam samples. If the second trial seam fails, two additional trial seams will be performed and tested. Trial seaming and retesting will continue until two consecutive passing test series (i.e., two consecutive trial seams) are achieved for the apparatus, and welder, if applicable (extrusion welding only).

The CQA Monitor must observe all trial welding operations, quantitative testing of each trial weld for peel and shear, and recording of the results on the trial weld form. It is important that the trial welds or seams be completed under conditions similar to those under which the panels will be welded.

CQA documentation of trial seam procedures shall include, at a minimum, the following:

- Documentation that trial seams are performed by each welder and welding apparatus prior to commencement of welding and prior to commencement of the second half of the workday, or after extended break periods throughout the day.

- The welder, the welding apparatus number, time, date, ambient air temperature, welding machine temperatures and trial seam number for each trial seam.

During geomembrane welding operations, the CQA Monitor must observe the following:

- Equipment used for welding will not damage the geomembrane;

- The extrusion welder is purged before beginning a weld until all the heat-degraded extrudate is removed (extrusion welding only);

- Seam grinding has been completed less than one hour before seam welding, and the upper sheet is beveled (extrusion welding only);

- Grind marks do not extend more than 1/4 inch from the edge of the weld;

- The ambient temperature is between 40°F and 104° F;

- The ends of old welds, more than five minutes old, are ground to expose new material before restarting a weld (extrusion welding only);

- The contact surfaces of the sheets are clean, free of dust, grease, dirt, debris, and moisture before welding;

- The weld is free of dust, rocks, and other debris;

- The seams are overlapped a minimum of 3 inches for extrusion and 4 inches for hot wedge welding, or in accordance with manufacturer's recommendations, whichever is more stringent;

- No solvents or adhesives are present in the seam area;

- The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing;

- The panels are welded in accordance with the plans and specifications; and

- There is no free moisture in the weld area.

3.4 SEAM TESTING

During seam testing, the CQA Monitor will perform the following tasks:

- Review technical specifications regarding test procedures.
- Observe that equipment operators are properly trained and qualified to perform their work.
- Observe that test equipment meets project technical specifications.
- Observe that the entire length of each seam is tested in accordance with the specifications.
- Observe that all testing is completed in accordance with the technical specifications.
- Identify the failed areas by marking the area with a waterproof marker compatible with the geomembrane, and inform the contractor of any required repairs, then record the repair area on the repair log.
- Observe that all repairs are completed and tested in accordance with the project specifications.
- Record all completed and tested repairs on the repair log.

For destructive samples, the CQA Monitor will select locations where seam samples will be cut for laboratory testing. Sample locations should not be disclosed to the Contractor prior to completion of the seam.

Destructive samples must be shipped to the third-party laboratory for seam testing. Test methods and required frequencies are presented in Section 3.3.6. The third-party laboratory must provide test results within 24 hours, in writing or via telephone, to the POR. Certified test results are to be provided within 5 days. The CQA Monitor must immediately notify the POR in the event of a calibration discrepancy or failed test results.

3.4.1 Non-Destructive Testing

Continuous, non-destructive testing will be performed on all seams by the installer. Air pressure testing on dual-track fusion welds and vacuum-box testing for extrusion welds are the only acceptable methods. All leaks must be isolated and repaired by the following procedures:

- Air-Pressure Testing (GRI GM6) - The ends of the air channel of the dual-track fusion weld must be sealed and pressured to approximately 30 psi, if possible. The air pump must then be shut off and the air pressure observed after five (5) minutes. A loss of less than 4 psi is acceptable if it is determined that the air channel is not blocked between the sealed ends. A loss of 4 psi or more indicates the presence of a seam leak that must then be isolated and repaired by following the procedures described under “Seam Failure Repairs and Retesting.” The POR or his/her qualified representatives must observe and record all pressure gauge readings.

- Vacuum-Box Testing (ASTM D4437) - A suction value of approximately 3 to 5 inches of gauge vacuum must be applied to all extrusion welded seams that can be tested in this manner. Examples of extrusion welded seams that do not easily lend themselves to vacuum testing would be around boots, appurtenances, etc. The seam must be observed for leaks at least ten seconds while subjected to this vacuum. The POR or CQA Monitor must observe 100 percent of this testing.

3.4.2 Destructive Testing

Destructive seam testing will be performed in accordance with ASTM D6392. Destructive samples shall be taken at a minimum of one location for every 500 linear feet of field seam. The total footage of individual repairs of leaks of more than 10 feet and individual repairs of more than 10 feet for failed seams must also be counted and destructively tested using the same frequency of testing described above. At a minimum, a destructive test must be done for each welding machine used for seaming or repairs. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam when necessary.

Field testing shall include at least two (2) peel test specimens (four (4) when possible for testing both tracks on dual-track fusion welded seams). Independent laboratory testing shall consist of five (5) shear test specimens and five (5) peel test specimens (10 when possible for both tracks of dual-track fusion welded seams). Destructive seam-testing locations shall be cap-stripped and the cap completely seamed by extrusion welding to the parent geomembrane. Capped sections shall be nondestructively tested. Additional destructive test samples may be taken if deemed necessary by the POR or CQA Monitor.

All field-tested specimens from a destructive test location must be passing in both shear and peel for the seam to be considered as passing. Field-tested specimens are determined as passing if the specimen tested in peel fails in film tear bond (FTB) and all test specimens meet the criteria listed in Table 3-2. Independent laboratory testing must confirm these field results. The minimum passing criteria for independent laboratory testing are all three of the following:

- 5 of 5 specimens tested in the peel mode must fail in FTB.
- 5 of 5 specimens from each peel and shear determination must meet the minimum specified values in Table 3-2.
- All 5 specimens for shear determination should meet the minimum percent elongation at break value in Table 3-2.
- The above criteria must be met by both tracks from each dual-track fusion welded seam before it is considered as passing.

Table 3-2. Geomembrane Seam Strength

Property	Qualifier	Unit	Value
Shear Strength Shear elongation at break	Min. Min.	lb/in %	120 50
Peel Strength: Fusion Extrusion	 Min Min.	 lb/in lb/in	 91 78

3.4.3 Seam Failure Delineation

In the event failing tests are obtained at a destructive test location, new destructive test samples will be obtained, a minimum of 10 feet in either direction of the failing test. If one, but not both, of the additional tests fail, further additional destructive testing will be required until passing tests are obtained at both ends of the original destructive test location. A cap will be required for the areas subject to destructive testing, and testing of the cap will be required as set forth in this QA/QC Plan. If more than two failing destructive test locations are observed for a single seam, the CQA Monitor will have the alternative of requiring the entire seam be removed, and a new seam welded.

3.5 REPAIRS AND RETESTING

All seam leaks and destructive test locations shall be repaired for a distance of at least six (6) inches on each side of the leak or destructive test location. At a minimum, these repairs shall be non-destructively retested in accordance with Section 3.4.1. Destructive testing shall be performed in accordance with Section 3.4.2, or at the discretion of the CQA Monitor.

3.6 REPAIRS

Any portion of the geomembrane with a detected flaw, or which fails a non-destructive or destructive test, or where destructive tests were cut, or where non-destructive tests left cuts or holes, must be repaired in accordance with the specifications. The CQA Monitor must locate and record all repairs on the repair sheet. Repair techniques include the following:

- Patching – used to repair large holes, tears, large panel defects, undispersed raw materials, contamination by foreign matter, and destructive sample locations;
- Extrusion – used to repair small defects in the panels and seams. In general, this procedure should be used for defects less than ½ inch in the largest dimension;
- Capping – used to repair failed welds or to cover seams where welds or bonded sections cannot be nondestructively tested (also used to cap T-seams where wedge-welding is used); and
- Removal – used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal must be patched or capped.

Repair procedures include the following:

- Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than 1 hour before the repair;
- Clean and dry all surfaces at the time of repair;
- Verify acceptance of the repair procedures, materials, and techniques by the CQA Monitor in advance of the specific repair; and
- Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of material to be patched and patches to a radius of at least 3 inches. Bevel the top edges of patches before extrusion welding.

3.6.1 Wrinkles

During placement of materials over the geomembrane, temperature changes or creep may cause wrinkles to develop in the geomembrane. Any wrinkles that can fold over must be allowed to contract by liner temperature reduction. In no case can material be placed over the geomembrane, which could result in the geomembrane folding. Panels that are being seamed together should be at approximately the same temperature and have approximately the same amount of wrinkling. The CQA Monitor must monitor geomembrane for wrinkles and notify the contractor if wrinkles are being covered with material. The CQA Monitor is then responsible for documenting corrective action to remove the wrinkles.

3.6.2 Folded Material

All folded geomembrane must be removed. Remnant folds evident after deployment of the roll which are due to manufacturing process are acceptable.

3.6.3 Bridging or Induced Tension

Bridging or Induced Tension: Bridging is defined as areas where the geomembrane is not in contact with the subgrade due to a void in the subgrade or the sheet is pulled in tension so as to span over depressions in the subgrade. Areas likely to promote bridging, i.e. trenches, toe of slopes, etc., shall be loaded with sandbags after deployment and after seaming. Induced tension is stress introduced into the geomembrane during installation or covering. These areas will likely result in bridging. Areas with excessive bridging shall be identified and repaired by either of the following methods:

- The geomembrane shall be cut, by the Contractor, so the tension is relieved and the geomembrane conforms to the subgrade contours. The cut geomembrane shall be repaired and tested according to the specifications regarding repairs and testing.
- The geomembrane shall be cut, by the Contractor, and subgrade material shall be added and placed, in accordance with the contract specifications, so as bring the geomembrane in contact with the subgrade. The cut geomembrane shall be repaired and tested according to the specifications regarding repairs and testing.

3.6.4 Geomembrane Anchor Trench

Anchor trenches shall be excavated by the project earthwork contractor to the lines and widths depicted on the approved permit or construction drawings prior to geomembrane placement. Sharp

bends and edges in the anchor trench shall be minimized to avoid potential stresses to the geomembrane. The geomembrane should be placed in the anchor trench to the dimensions shown on the construction drawings. Excess material must be removed before the anchor trench is backfilled. The geomembrane anchor trench is left open until panels are seamed together. Expansion and contraction of the geomembrane should be accounted for in the liner placement. The anchor trench should be filled at sundown or in the morning when temperatures are coolest to reduce bridging of the geomembrane.

3.7 GEOMEMBRANE ACCEPTANCE

The contractor retains all ownership and responsibility for the geomembrane until acceptance by the Owner. In the event the contractor is responsible for placing materials over the geomembrane, the contractor retains all ownership and responsibility for the geomembrane until all required documentation is complete and the cover material is placed. After panels are placed, seamed, tested successfully, and repairs made, the completed installation is walked by the Owner's and contractor's representatives. Any damage or defect found during this inspection is repaired properly by the installer. The installation is not accepted until it meets the requirements of both representatives. In addition, the geomembrane is accepted by the POR only when the following has been completed:

- The installation is finished;
- All seams have been inspected and verified to be acceptable;
- All required laboratory and field tests have been completed and reviewed;
- All required contractor-supplied documentation has been received and reviewed; and
- All record drawings have been received and reviewed by the CQA Monitor. The record drawings show the true panel dimensions, and the locations of seams, trenches, and repairs.
- Acceptance of the LIT by DEQ.

4.0 CONSTRUCTION QUALITY ASSURANCE FOR DRAINAGE GEOCOMPOSITE

4.1 INTRODUCTION

This section describes CQA procedures for the installation of drainage geocomposite in the leachate collection system. All quality control testing will be conducted in accordance with this QA/QC Plan and the project construction plans and technical specifications. The POR or CQA Monitor will be on-site, and observe all geocomposite installation.

The drainage geocomposite for the floor and sideslopes will consist of a geonet with geotextile heat-bonded to both sides (referred to as double-sided).

4.2 DELIVERY

Upon delivery, the CQA Monitor will observe the following:

- Unloading equipment does not damage the drainage geocomposite rolls.
- Drainage geocomposite rolls are wrapped in impermeable and opaque protection covers.
- Care is used when unloading the rolls.
- Each roll is marked or tagged with the manufacturer's name, lot number, roll number, and roll dimensions.
- The drainage geocomposite is protected from precipitation, mud, dirt, dust, puncture, cutting, impact forces, or any other damaging or deleterious conditions.

Any damaged rolls shall be rejected and removed from the site or stored at a location, separate from accepted rolls, designated by the Owner. All rolls which do not have proper manufacturer's documentation shall also be stored at a separate location until all documentation has been received and approved.

4.3 QUALITY CONTROL TESTING

The drainage geocomposite manufacturer (or supplier), will conduct quality control testing in accordance with the manufacturer's quality control program and certify that all materials delivered comply with technical specifications. The minimum frequencies and test methods for manufacturer's quality control testing for geocomposites are presented in Table 4-1. The material certifications shall be reviewed by the POR and approved for the project prior to acceptance of any of the material.

The geocomposite manufacturer also shall certify that geocomposite transmissivity meets or exceeds the transmissivity requirements set forth in the technical specifications. The manufacturer shall further certify that transmissivity results meet or exceed all requirements for the gradient and confining pressures listed in the technical specifications. If alternate gradient or confining pressures are used for the certification, the geocomposite manufacturer shall certify that the material meets or exceeds the technical specification requirements. However, even with the manufacturer's certification, the POR reserves the right to reject any materials not meeting the transmissivity requirements, including gradient and confining pressure requirements.

Table 4-1. Manufacturer's Testing Schedule for Geocomposite

Product	Test	Method	Minimum Frequency
Resin	Density	ASTM D1505 or D792	1 per batch and every resin lot
	Melt Flow Index	ASTM D1238	
Geonet	Density	ASTM D1505 or D792	1 per 100,000 ft^2 and every resin lot
	Mass/Area	ASTM D1603	
	Thickness	ASTM D5199	
Geotextile	Mass/Area	ASTM D5261	1 per 100,000 ft^2 and every resin lot
	Grab Tensile Strength	ASTM D4632	
	Trapezoidal Tear Strength	ASTM D4533	
	Apparent Opening Size	ASTM D4751	
	Permittivity	ASTM D4491	
Geocomposite	Transmissivity	ASTM D4716	One test per product type

Additionally, conformance testing will be performed for transmissivity (ASTM D4716) and ply adhesion (D413) by an independent third-party laboratory chosen by the POR. Conformance testing for these parameters will be performed at least once per product type and project.

4.4 INSTALLATION

4.4.1 Surface Preparation

Prior to geocomposite installation, the CQA Monitor must observe the following:

- All lines and grades have been verified by the Contractor.
- All debris, soil, dust and other materials shall be removed from the geomembrane surface being prepared prior to deployment of the overlying geocomposite.
- When placed over a geomembrane, the geomembrane installation, including all required documentation, has been completed.
- The supporting surface does not contain stones that could damage the geocomposite or the geomembrane.

4.4.2 Placement

During placement, the CQA Monitor must perform the following:

- Observe the geocomposite as it is deployed and record all defects and disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the specifications.
- Verify that equipment used to deploy the geocomposite does not damage the geocomposite or underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.

- Verify that people working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite or underlying geomembrane.

- Verify that the geocomposite is anchored to prevent movement by the wind (the contractor is responsible for any damage resulting to or from wind-blown geocomposite. Use sandbags, or equivalent, to prevent bridging).

- Verify that the geocomposite remains free of contaminants such as soil, grease, fuel, etc.

- Observe that the geocomposite is laid smooth and free of tension, stress, folds, wrinkles, or creases.

- Observe that on slopes the geocomposite is secured in the anchor trench and then rolled or lowered down the slope in a controlled fashion.

- Observe that adjacent rolls of geocomposite are overlapped, tied, and seamed in accordance with the manufacturer's recommendations and the specifications.

- Observe that the geonet components are tied at the specified interval with plastic fasteners. In the absence of other specifications, the adjoining geonet panels will be tied approximately every 5 feet along the roll length (edges) and every 1 foot along the roll width (ends).

- Observe that geotextile component is overlapped and either thermal bonded or sewn together.

- All seams should run parallel to the line of the slope. Seams shall be overlapped a minimum of four (4) inches. Seaming material shall be white or yellow for easy inspection. Metallic material shall not be allowed. The geotextile shall then be overlapped and sewn.

4.5 REPAIRS

Repair procedures include the following:

- Holes or tears in the drainage geocomposite will be repaired by placing a geocomposite patch extending 2 feet beyond the edges of the hole or tear.

- Secure patch to the originally installed geocomposite by tying every 6 inches.

- Where the hole or tear width across the roll is more than 50 percent of the roll width, the damaged area will be removed and replaced across the entire roll width.

5.0 CONSTRUCTION QUALITY ASSURANCE FOR NON-WOVEN GEOTEXTILE

5.1 INTRODUCTION

This section describes CQA procedures for the installation of geotextiles. All quality control testing will be conducted in accordance with this QA/QC Plan and the project construction plans and technical specifications. The POR or CQA Monitor will be on-site, and observe all geotextile installation.

5.2 DELIVERY

During delivery, the CQA monitor will observe the following:

- Equipment used to unload the rolls will not damage the geotextile;
- Rolls are wrapped in impermeable and opaque protection covers;
- All documentation required by the specifications has been received and reviewed for compliance with the specifications;
- Each roll is marked or tagged with the manufacturer's name, project identification, lot number, roll number, and roll dimensions;
- Materials are stored in a location that will protect the rolls from precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions; and
- Damaged rolls are rejected and removed from the site or stored at a location separate from accepted rolls.

5.3 QUALITY CONTROL TESTING

The geotextile manufacturer (or supplier), will conduct quality control testing and certify that the materials delivered to the site comply with project technical specifications and their minimum material specifications. The material certifications shall be reviewed by the POR and approved for the project prior to acceptance of any of the material. Testing will be conducted at a minimum frequency recommended by the manufacturer of the material.

Where optional procedures are noted in the test method, the technical specification requirements prevail unless reviewed and approved by the POR. The POR will review all test results and report any nonconformance.

5.4 INSTALLATION

5.4.1 Surface Preparation

Prior to geotextile installation, the CQA Monitor will observe the following:

- All lines and grades have been verified by the Contractor.

- All debris, soil, dust and other materials shall be removed from the surface being prepared for geotextile deployment.
- When placed over a geomembrane or geocomposite, the underlying material installation, including all required documentation, has been completed.
- The supporting surface does not contain stones that could damage the geotextile or the underlying geosynthetics.
- There are no excessively soft areas that could result in damage to the geotextile or the underlying geosynthetics.

5.4.2 Placement

During geotextile placement, the CQA Monitor will observe the following:

- Observe the geotextile as it is deployed, and record all defects and disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the technical specifications.
- Observe that equipment used does not damage the geotextile by handling, equipment transit, leakage of hydrocarbons, or other means.
- Observe that people working on the geotextile do not smoke, wear shoes that could damage the material, or engage in activities that could damage the material.
- Observe that the geotextile is securely anchored as applicable.
- Observe that the geotextiles are temporarily anchored as necessary to prevent movement by the wind.
- Observe that the panels are overlapped in accordance with the plans, specifications and manufacturer's recommendations.
- Examine the geotextile after installation to confirm that no potentially harmful foreign objects are present.
- Observe that seams (where required) are continuously sewn or thermal bonded in accordance with the manufacturer's recommendations and technical specifications.

The CQA Monitor must inform both the contractor and POR if the above conditions are not met.

5.5 REPAIRS

Repair procedures include:

- Patching - used to repair large holes, tears, large defects, and destructive sample locations; and

- Removal - used to replace areas with large defects where the preceding method is not appropriate.

Holes, tears, and defects must be repaired in the following manner. Soil or other material which may have penetrated the defect must be removed completely prior to repair. If located on a slope, the defect must be patched using the same type of material. On a sideslope, should any tear, hole, or defect exceed 10 percent of the width of the panel, the panel must be removed and replaced. If the defect is not located on a slope, the patch must be made using the same type of material and placed with a minimum of 24 inches overlap in all directions. All geotextile patches should be thermal bonded in place.

5.6 EQUIPMENT ON GEOSYNTHETIC MATERIAL

Construction equipment on the composite liner system will be minimized to reduce the potential for liner puncture. The CQA Monitor will verify that small equipment such as generators are placed on scrap liner material (rub sheet) above geosynthetic materials in the composite liner system. Aggregate drainage layers, drainage layer, and/or general fill that is placed on the geosynthetics will be placed using low ground pressure equipment. The CQA Monitor will verify that the geosynthetics are not displaced while the soil layers are being placed.

Unless otherwise specified by the POR, all lifts of leachate collection layer and/or general fill that is placed on the geosynthetics shall conform to the equipment guidelines presented in Table 2-4.

6.0 CONSTRUCTION QUALITY ASSURANCE FOR LEACHATE COLLECTION PIPING

6.1 INTRODUCTION

This section describes CQA procedures for the installation of pipe for the leachate collection system. The objective of the following requirements are (1) to assure that proper construction techniques and procedures are used, and (2) that the project is built in accordance with the construction plans and technical specifications. The pipe installed for the leachate collection system will comply with the size and material requirements indicated in Appendix G. To monitor compliance, a quality assurance program will be implemented that includes (1) a review of the contractor's quality control submittals and (2) construction monitoring.

6.2 DELIVERY

During delivery, the CQA Monitor will observe the following:

- That upon delivery, the pipe and pipe fittings are in compliance with the requirements of the technical specifications.

- That a pipe laydown area is designated in which the pipe and pipe fittings are protected from excessive heat, cold, construction traffic, hazardous chemicals, and solvents. If the pipe and pipe fittings are stored at a location where other construction materials are present, the CQA Monitor will observe that stacking or insertion of the other construction materials onto or into the pipe and pipe fitting is prohibited. The CQA Monitor will periodically examine the storage area to observe that the pipe fittings are undamaged, and have been adequately protected.

- That upon transporting pipe and fittings from the storage location to the construction site, the contractor will use pliable straps, slings, or rope to lift the pipe. Steel cables or chains will not be used to transport or lift the pipe.

- That the Contractor has provided provisions such that pipe greater than 20 feet in length will be lifted with at least two support points. The Contractor will not drop, impact, or bump into the pipe, particularly at the pipe ends. Pipe and fitting ends must be cleaned of all dirt, debris, oil, or any other contaminant which may prohibit making a sound joint.

Any damaged pipe must be rejected and removed from the site, or stored at a location separate from the accepted pipe designated by the Owner. All pipe that does not have proper manufacturer's documentation must also be stored at a separate location, until all documentation has been received and approved.

6.3 QUALITY CONTROL TESTING

Prior to the acceptance of the pipe, the pipe manufacturer will provide the CQA Monitor with a quality control certificate for each lot or batch of pipe provided. The quality control certificate will be signed by a responsible party employed by the pipe manufacturer, such as the quality control manager.

The quality control certificate will include:

- A description of the pipe delivered to the project, including but not limited to the strength classification, diameter, dimensional ratio, perforations, and production lot.

- Property data sheet including, at a minimum, all specified properties, measured using test methods indicated in the technical specifications.

- A list of quantities and descriptions of materials which comprise the pipe.

- A certification that property values given in the property data sheet are guaranteed by the pipe manufacturer.

The CQA Monitor will observe that the property values certified by the pipe manufacturer meet all of the technical specifications and that measurements of properties by the pipe manufacturer are properly documented and that the test methods used are acceptable.

6.4 INSTALLATION

6.4.1 Surface Preparation

Prior to pipe installation, the CQA Monitor will observe the following:

- All lines and grades have been verified by the Contractor and project surveyor.

- The pipe trenches are relatively free of deleterious material which may damage the pipe or underlying geomembrane or might clog the pipe.

- Pipe perforations for leachate collection system are drilled in the pipe prior to delivery to the site, or while in the staging or stockpile area, outside of the drainage trench where the pipe is to be laid. Drilling will not be allowed over the geomembrane. The pipe shall be cleaned of drill cutting (inside and out) prior to being placed in the leachate collection trench.

- Pipe perforations are drilled at the correct size and spacings according to the project construction plans and technical specifications.

6.4.2 Placement

During pipe and fitting installation, the CQA Monitor will:

- Observe all pipe, pipe fittings, and joints as the pipe is being laid. The CQA Monitor will observe that pipes and fittings are not broken, cracked, or otherwise damaged or unsatisfactory. Prior to fusing (if required), the pipe installer will provide for a fusion surface area which is clean and free of moisture, dust, dirt, debris of any kind, and foreign material. Prior to gluing (if required), the pipe and fittings are clean and dry.

- Observe that the pipe and fittings are being constructed in accordance with technical specifications, manufacturer's recommendations and accepted practices.

- Observe that the people and equipment utilized to install the pipe do not damage the pipe or any other component of the bottom liner system. No butt fusion welding equipment shall be allowed directly on the geomembrane, and no primer or glue shall be used directly over the

geomembrane. If butt fusion welding is performed within cell, a protective piece of geomembrane will be placed beneath welder.

- Observe placement of aggregate or protective cover over pipe.

Surveying shall include invert elevations to the nearest 0.01 foot at least every 25 feet along each collection pipe, at changes in grade, and at all connections to structures.

7.0 DOCUMENTATION

The quality assurance program depends on thorough monitoring and documentation of all construction activities during liner and leachate collection system installation. Therefore, the POR and CQA Monitor will document that all quality assurance requirements are addressed and satisfied. Documentation consists of daily record-keeping, testing and installation reports, nonconformance reports (if necessary), progress reports, design and specification revisions, and a LIT Report as required by OAC 252:515-11-6.

7.1 DAILY RECORD KEEPING

At a minimum, daily records consist of construction progress, daily construction reports, observation and test data sheets, and, as needed, nonconformance/corrective measure reports. All forms are copied to the POR for review.

7.1.1 Daily Record of Construction Progress

The daily field report will summarize ongoing construction and discussions with the contractor and will be prepared by the CQA Monitor. At a minimum, the report will include the following:

- Date, project name, project number, and location;
- A unique number for cross-referencing and document control;
- Weather data;
- A description of all ongoing construction for the day in the area of the CQA Monitor's responsibility;
- A brief description of tests and observations, identified as passing or failing, or, in the event of failure, a retest;
- Areas of nonconformance/corrective actions, if any, (nonconformance/corrective action form to be attached); and
- Name of CQA Monitor that prepared form.

7.1.2 Observation and Test Data Sheets

Observation and test data sheets should include the following information as appropriate for the form being used:

- Date, project name, and location;
- A unique number for cross-referencing and document control;
- Weather data, as applicable;
- A reduced-scale site plan showing sample and test locations;

- Test equipment calibrations, if applicable;
- A summary of test results identified as passing, failing, or, in the event of a failed test, retest;
- Completed calculations; and
- Name of CQA Monitor that prepared form.

7.2 PHOTOGRAPHS

Construction activities will be photographed. Photographs will be taken to document any significant problems encountered, corrective actions, and construction progress. The photographs are identified by number, location, time, date, and photographer. The photographer should document the subject of the photograph, either on the back of the picture or in a photograph log.

7.3 LINER INSTALLATION AND TESTING REPORT

At the completion of the project, the POR will submit a LIT Report documenting the construction of the composite liner system and leachate collections system to the DEQ for approval. The POR will provide an engineer's certification that the liner and leachate collection system were constructed in accordance with the approved construction drawings and specifications. QA/QC documentation will be included in the LIT Report.

The LIT Report shall be submitted to the DEQ at the conclusion of the composite liner and leachate collection system construction. The LIT Report shall be placed in the site operating record.

At a minimum, the LIT Report will contain:

- A summary of major construction activities;
- A summary of conformance test results;
- A summary of laboratory and field test results;
- Sampling and testing location drawings;
- A summary of repairs and their locations;
- A description of significant construction problems and the resolution of these problems;
- As-built drawings, calculations and other pertinent data to demonstrate compliance with DEQ requirements;
- Invert elevations to the nearest 0.01 foot at least every 25 feet along each leachate collection pipe, grade changes, and at all connections to structures;
- A map showing the locations of system components tied to at least two permanent monuments;
- The results of storage tank leak detection tests, if applicable;

- Any deviations from the approved construction plan made necessary by changes of circumstances;
- The method for phased tie-in of leachate collection pipes;
- Results of the initial leachate collection pipe clean out; and
- A statement of compliance with the construction documents and design intent, signed and sealed by a professional engineer registered in the State of Oklahoma.

ATTACHMENT B

GEOTECHNICAL INFORMATION

PERMIT MODIFICATION APPLICATION
VOLUME II
HYDROGEOLOGIC INVESTIGATION
FOR THE LAWTON SANITARY LANDFILL
CITY OF LAWTON, OKLAHOMA

JANUARY 2005

Project No. 32527

Burns & McDonnell Engineering Company, Inc.
Engineers-Geologist-Scientists
Kansas City, Missouri

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bgs	below ground surface
HAS	hollow stem auger
msl	mean sea level
MSWLF	Municipal Solid Waste Landfill
ODEQ	Oklahoma Department of Environmental Quality
OSDH	Oklahoma State Department of Health
PVC	polyvinyl chloride
Site	proposed landfill expansion

* * * * *

1.0 INTRODUCTION

1.1 PURPOSE

The following report has been prepared for the City of Lawton to present the findings of the hydrogeologic investigation for the proposed landfill lateral expansion. This investigation was performed to obtain appropriate subsurface characterization data necessary to obtain a Tier III modification to the existing permit for a lateral expansion of the City of Lawton Landfill. The Tier III modification has been prepared to enable the expansion of the permit boundary and to permit construction of disposal cells 4 and 5 which will overlap of the existing landfill.

1.2 OWNER/OPERATOR INFORMATION

City of Lawton Landfill
8902 SW 11th St.
Lawton, OK 73501
Y.S. Ramachandra
580-581-3385

1.3 PHYSICAL SETTING

The proposed landfill expansion (Site) consists of approximately 151 acres located in Section 31, Township 1 North, Range 11 West in Comanche County Oklahoma. Cells 4 and 5 are located in the northern 20 acres of the Site. The Site location is shown on Figure 1.

The Site is bordered on the east by Wolf Creek, and on the west by Old Highway 281, on the north by the existing Lawton Sanitary Landfill, and on the south by agricultural land. The local land use in the vicinity of the expansion and the existing landfill consists of farmland, limited residential, and a salvage yard. Access to the expansion and the existing landfill facility is via Old Highway 281.

1.3.1 Physiography

The City of Lawton and its vicinity are situated within the Permian Redbeds of the Central Lowlands province. To the northwest of Lawton and the Site are the rugged Wichita Mountains. Great smooth lowlands underlain by a thick mass of Permian age shale and sandstone are indicative of this area.

Surface elevations at the Site range from approximately 1050 to 1140 feet above mean sea level (msl). Surface drainage is generally to the east-southeast toward Wolf Creek.

1.4 REGIONAL GEOLOGY AND HYDROGEOLOGY

1.4.1 Geology

The Site is located in an area where bedrock is mantled by a thin layer of silty clay. These soil deposits were derived from the weathering of bedrock. The overburden deposits consist of low to high plasticity clays with moisture contents ranging from damp to moist, and consistencies from stiff to hard.

The uppermost bedrock underlying the Site is the Permian-age Garber Sandstone. This formation consists of fine-grained sandstone, siltstone, claystone, and mudstone conglomerate. The overall thickness of the Garber Claystone ranges from approximately 160 to 210 feet. The Garber is underlain by the Wellington Formation. The Wellington is a maroon shale approximately 130 feet in thickness (Havens, 1977). Figure 2 is of the surface geology in the area of the Site.

Structurally, the Site is situated on the southern limb of the Wichita-Criner Arch near the central axis of the Marietta Basin. To the northwest of the Site and the City of Lawton are the Wichita Mountains, a Pennsylvanian age uplift of Cambrian age igneous and metamorphic rocks that represents the division between the Anadarko and Hollis Basins. Figure 2 also indicates the geologic structure in the area of the Site.

1.4.2 Hydrogeology

Regionally, significant quantities of groundwater are present within the deep subsurface. The uppermost continuous regional groundwater aquifer beneath the Site, utilized as a drinking water supply source, is the Arbuckle-Timbered Hills aquifer. This aquifer lies approximately 1500 to 2000 feet below ground surface (bgs) (Havens, 1977). An alluvial aquifer, the East Cache aquifer, is present to the east of the Site. The depth to groundwater in the East Cache aquifer ranges from 20 to 30 feet bgs.

Zones of perched water have been identified beneath the existing landfill in the upper 130 feet of the Garber Sandstone formation. Previous hydrogeologic investigations at the Site have revealed that groundwater encountered in this shallow zone is very limited in quantity and extremely slow to recharge monitoring wells (Burns & McDonnell, 1995 and ZIA, 1996). Groundwater from the Garber Sandstone is not known to be a local drinking water supply source.

1.5 HISTORIC LAND USES

The Lawton Sanitary Landfill was issued Operating Permit No. 3516015M by the Oklahoma State Department of Health (OSDH) on November 2, 1971. The sanitary landfill was upgraded and a modification to the permit was issued by the OSDH on April 12, 1985. The existing solid waste disposal

area consists of approximately 133 acres. Solid waste has been placed in approximately 106 acres of the permitted landfill.

In November 1993, a permit modification for the landfill was submitted to Oklahoma Department of Environmental Quality (ODEQ) for approval. The modification called for a vertical expansion and redesign of 27 acres in the southwest corner of the permitted disposal area. The permit modification included a composite landfill liner, leachate management system, storm water management system, and final cap to meet the ODEQ Municipal Solid Waste Landfill (MSWLF) regulations. The application was approved and a permit addendum was issued on February 22, 1995 by ODEQ. A permit modification to construct the lined "subtitle D" cell was approved by the ODEQ on May 9, 1997. Subsequently, a vertical expansion permit was approved by the ODEQ on January 16, 2001 to raise the top elevation of the existing permitted landfill to 1207 feet above msl.

The solid waste received at the City of Lawton Sanitary Landfill consists primarily of municipal solid waste generated by Lawton, Oklahoma and nearby cities.

* * * * *

2.0 FIELD ACTIVITIES

This hydrogeologic investigation utilized a strategy that allowed for flexibility in approach while meeting the regulatory criteria for the proposed landfill expansion. The field activities were completed in accordance with the field procedures described in the Lawton Sanitary Landfill Expansion Work Plan (Burns & McDonnell, 2003) as approved by ODEQ.

2.1 SUBSURFACE INVESTIGATION

2.1.1 Drilling Locations

Forty soil and bedrock borings were drilled to characterize subsurface conditions beneath the Site (see Figure 3). Table 1 lists the boring depths and locations. The borings were advanced using a combination of one or more of the following methodologies:

- Hollow stem auger drilling (HSAs)
- Rotary drilling (air and/or water)
- Rock coring (air and/or water)

2.1.2 Geotechnical Borings

Twenty-three geotechnical borings (B-1 through B-23) were completed to aid in determining geologic and hydrogeologic conditions underlying the proposed landfill expansion area. The boring logs are located in Appendix A.

Geotechnical samples were collected continuously to total depth within the overburden using split spoon samplers, continuous split barrel samplers, and thin walled sampling tubes (Shelby Tubes). The soil samples were selected from specific borings and submitted to a geotechnical testing laboratory for testing and classification of materials to determine their usability for cell construction and daily cover (see Appendix B for test results).

2.1.3 Hydrogeological Borings/Piezometers

Seventeen borings were drilled to define the depth to groundwater and aid in the determination of the uppermost continuous water-bearing unit beneath the Site. The borings were drilled utilizing HSAs, rotary drilling, and rock coring techniques. The boring logs are located in Appendix A.

Twelve of the 17 borings were completed as piezometers. Nine borings were completed as permanent piezometers (PZ-1B, PZ-2B, PZ-4, PZ-5, PZ-6, PZ-7, PZ-8, PZ-9A, and PZ-10A) and three borings were completed as temporary piezometers (PZ-2C, PZ-10B and PZ-10C). PZ-10B was completed as a 1-inch

piezometer. A summary of the piezometer construction data is located in Table 2. Piezometer construction diagrams are located in Appendix C. The piezometers were constructed of 2-inch schedule 40 polyvinyl chloride (PVC) with 10 feet of machine slotted screen except for PZ-10B, which was constructed as a 1-inch piezometer. Piezometer risers were completed between 2 and 3 feet above the ground surface at each location. Permanent monitoring wells were completed in accordance with the guidelines contained in the "RCRA Ground-Water Monitoring: Technical Enforcement Guidance Document" (USEPA, 1986). The temporary piezometers are used for initial hydrogeologic characterizations and will be abandoned within an appropriate period of time. Temporary piezometer abandonment will only be completed as agreed with ODEQ.

Four (PZ-1A, PZ-2A, PZ-9A, and PZ-10) of the 17 borings were drilled using a combination of HSAs and rock coring techniques with air and/or water. Piezometers were not installed in the borings due to unfavorable conditions. The borings were drilled to a greater depth than needed for the piezometer construction to obtain additional subsurface information. The decision was made to abandon the boring and offset and drill one to the correct depth to ensure the integrity of the piezometer construction. These borings were abandoned with a bentonite grout from the total depth of the boring to ground surface. An adjacent boring was then drilled using air rotary methods to a predetermined depth and a piezometer was installed at that location.

One of the 17 borings, PZ-3, was planned to be converted into piezometer. This boring was drilled using air rotary methods to a depth of 200 feet bgs. No free groundwater was encountered in this boring, so a piezometer was not constructed. The boring was left open for approximately three weeks with no free groundwater accumulation. The boring was abandoned with a bentonite grout from the total depth to ground surface.

2.1.4 Geophysical Logging

In October 2003, downhole geophysical surveys were performed by Century Geophysical Corporation at PZ-1, PZ-2B, PZ-3, PZ-4, PZ-5, PZ-6, PZ-7, PZ-8, PZ-9, and PZ-10A. The geophysical logs and summary report are located in Appendix D.

2.1.5 Development

Development was performed on all newly installed piezometers in accordance with procedures described in the Work Plan (Burns & McDonnell, 2003). Development was performed to remove fine-grained material near the screen and improve the hydraulic connections between the piezometer and the water bearing zone. The piezometers were developed with disposable bailers. PZ-5 was not developed due to an

insufficient amount of water being present during the investigation. Development forms are located in Appendix E.

2.1.6 Groundwater Elevations

Groundwater elevations were collected monthly from November 2003 to October 2004 to determine the groundwater flow directions and potentiometric surface geometry at the Site. Water level elevations in piezometers completed for the proposed expansion are shown in Table 3. Groundwater level forms are located in Appendix F.

2.1.7 Field Permeability Testing

Slug tests were conducted on all newly installed piezometers excluding PZ-5. PZ-5 was dry at the time the slug tests were performed. A slug test was also performed on PZ-10C, which was constructed as a temporary piezometer.

A summary of the results is listed in Table 4. Field permeability testing information and the associated hydraulic conductivity calculations are presented in Appendix G.

2.1.8 Groundwater Sampling

Beginning in January 2005, selected monitoring wells/piezometers as proposed in Section 4.2 will be sampled on a quarterly basis (pending ODEQ approval) for one full year to determine background water quality prior to depositing waste at the Site. These wells will be sampled according to the Burns & McDonnell 2003 Work Plan which includes procedures for sample collection and analysis (Burns & McDonnell, 2003). A list of water quality parameters that will be analyzed when the background sampling takes place is presented in Table 5.

2.2 SURVEYING

Prior to field activities, a surveyor determined the positions of all subsurface drilling locations. The positions of all newly installed piezometers were determined by an Oklahoma licensed surveyor following the completion of the field activities.

All piezometer locations were surveyed horizontally to the nearest 0.1 foot using State Plane Coordinate System. The ground surface elevations of the locations were measured to the nearest 0.1 foot relative to msl. For all piezometers, a notch in the top of the riser pipe was surveyed to the nearest 0.01 foot relative to msl.

* * * * *

3.0 RESULTS OF INVESTIGATION

3.1 SITE GEOLOGY

Soil overburden and bedrock of the Permian-age Garber Sandstone formation was encountered during this investigation. The following subsections describe the geologic materials encountered during the investigation. Figure 3 shows the locations of geologic profile lines selected to illustrate the subsurface conditions at the Site. Figures 4, 5, and 6 are the geologic profiles prepared for this report. Boring logs are present in Appendix A.

3.1.1 Overburden

The overburden consists of brown to dark reddish brown silty clay. These soil deposits were derived from the weathering of bedrock at the Site. The soils generally are low to high plasticity clays with moisture contents ranging from damp to moist, and consistencies from stiff to hard.

3.1.2 Bedrock

The uppermost bedrock unit underlying the Site is the Garber Sandstone Formation. Bedrock as logged at the Site was chiefly a weak, reddish-brown claystone/siltstone with calcareous and sandy zones present in places. Weak grey shales and very fine to fine-grained sandstones occurring as thin beds were sparsely interbedded with the claystones.

3.2 SITE HYDROGEOLOGY

3.2.1 Groundwater Occurrence - September 13 through October 15, 2003

Free water was encountered while drilling in some borings. Other borings, at similar or deeper elevations, were observed to be dry at time intervals spanning only several weeks after the hole was drilled.

From September 13 through September 29, 2003, twenty-three geotechnical borings were drilled. The boreholes were left open to see if groundwater was present. The boreholes were checked for groundwater on September 30 (B-1 and B-2) and October 8 (the remaining boreholes) 2003. Depth to groundwater was measured where groundwater was present. Nine borings (B-1, B-2, B-8, B-12, B-15, B-18, B-19, B-20, and B-21) out of twenty-three had free water observed in the borehole (see Table 6).

Borehole PZ-3 was drilled with air rotary methods to an approximate depth of 200 ft bgs. The boring was left open for approximately three weeks and no free groundwater had accumulated in the boring prior to boring abandonment.

Water levels from the clusters of piezometers screened in separate depth intervals (PZ-2 cluster and PZ-10 cluster) yield different hydraulic head values, with the deeper water-bearing zone generally exhibiting lower hydraulic head values than the shallow water-bearing unit at each cluster. Both the PZ-2 and the PZ-10 well clusters indicate a head difference of approximately five feet between the shallow and deep screened intervals. Hydraulic head differences can be seen on the geologic cross sections in Figures 6 through 8.

Daily and thirty year mean precipitation data for the Lawton Municipal Airport in Lawton, Oklahoma is present in Appendix H.

3.2.2 Hydraulic Conductivity and Groundwater Velocity

Field permeability tests (slug tests) were performed on all piezometers, excluding Piezometer PZ-5 due to insufficient water. The data was analyzed using the Bouwer and Rice (1976) method. The results indicate hydraulic conductivities ranging from 1.01 x 10-7 cm/sec to 7.44 x 10-8 cm/sec in the Garber Sandstone Unit.

Permeability values from test results performed during this investigation indicate extremely low hydraulic conductivities (1.01 X 10– 7 cm/sec or less). These values are indicative of a geologic formation that can be characterized as an aquitard that restricts groundwater flow, rather than aquifer whose permeability values would typically be three to five orders of magnitude higher. Field permeability tests results for each piezometer are shown in Table 4. Graphs and calculations are located in Appendix E.

Maximum and minimum groundwater velocity for the Site as calculated was 4.2 x 10-2 feet per year and 1.9 x 10-3 feet per year. Using the conservative estimate this equates to a horizontal velocity of approximately 4.2 feet per hundred years. The calculation sheet for maximum and minimum groundwater velocity can be found in Appendix I.

The very low hydraulic conductivity observed in the Garber Sandstone complicates the interpretation on whether or not the data support a conclusion that the groundwater bearing unit is either laterally continuous or discontinuous. The Garber Sandstone is a water bearing unit but it exhibits the hydraulic conductivity of a confining unit or aquitard. Dry borings drilled during this investigation and other historical investigations can indicate a laterally discontinuous unit, however, this conclusion was based on borings left open and allowed to recharge for only several weeks at the most. As indicated in the groundwater piezometric data collected through October, 2004, borings may require several months or more to recharge and reach static equilibrium. The time required for the individual borings to recharge is indicated on the Figure 19 hydrograph.

3.2.3 Groundwater Flow - November 2003 to October 2004

Groundwater flow evaluations for the proposed landfill were made by contouring the water level data from the piezometers screened within the Garber Sandstone from November 2003 through October 2004. Field measurements are on groundwater level forms located in Appendix F. Figures 7 through 18 illustrate the groundwater elevation data in the piezometers for the November 2003 through October 2004 months. Figure 19 is a hydrograph of the 12 months of measurements for the 12 piezometers. The October 2004 piezometric map is considered the best representation of the piezometric surface beneath the proposed site. As indicated in Figure 19, piezometric maps developed prior to October 2004 include data from wells not fully recharged. Additional water level data is needed to confirm all wells have reached static equilibrium. Water level data obtained from this investigation is presented in Appendix F.

A continuous water level meter, a levelogger, was installed by City of Lawton personnel in Piezometer PZ-6 in November of 2003 for the evaluation of groundwater levels. In March of 2004, a barologger was added to the levelogger to compensate for the barometric pressure within the casing. Levelogger data was compared to actual water level measurements collected by City of Lawton personnel to determine the static elevation of groundwater based on levelogger hydraulic head data. Levelogger hydraulic head data did not produce a consistent elevation adjustment (based on direct groundwater elevation measurements) for the head data and therefore was not used. Levelogger data for January through October 2004 can be found in Appendix J.

Due to the extremely low hydraulic conductivity for the Garber Sandstone Formation, many of the piezometers were slow in reaching static water level as shown on the hydrograph in Figure 19. Piezometers PZ-2B, PZ-6, PZ-7, PZ-8, PZ-10A, and PZ-10B reached static within the first three months of installation; however, Piezometers PZ-4, PZ-5, PZ-9, and PZ-10C required between five to nine months to reach static equilibrium. Piezometers PZ-1 and PZ-2C are still rising after 12 months but appear to be at or close to static elevation. As of October 2004, groundwater levels in the piezometers ranged from 1078 to 1044 ft msl.

As shown on Figure 18, a groundwater trough is present at this Site running approximately from PZ-2B to PZ-10A. Groundwater to the northwest and southeast both flow toward the trough and then flow off site either to the north northeast or to the south southwest.

Water levels from the clusters of piezometers screened in separate depth intervals (PZ-2 cluster and PZ-10 cluster) yield different static water levels, with the deeper water-bearing zone exhibiting a lower static

level value than the shallow water-bearing unit at each cluster. The maximum static level difference found was 5.4 feet at the PZ-10 piezometer cluster as of October 2004.

* * * * *

4.0 CONCLUSIONS

4.1 DESIGN IMPACTS

The Site is suitable for construction and operation of the proposed horizontal landfill expansion. Data gathered during this hydrogeologic investigation indicate the Garber Sandstone Unit will serve as an excellent low permeability base underlying the proposed landfill liner.

Currently proposed top of liner elevations indicate vertical separation of five feet from the uppermost water bearing unit is not achieved in some areas of Cells 4 and 5, as well as the southern portion of the expanded boundary. The required vertical separation between the piezometric surface and the proposed landfill liner elevations can be achieved through an appropriate engineering solution. The extent of these areas will need to be further identified and a design evaluated based on cost implications, constructability, and ability to provide appropriate groundwater protection.

Groundwater evaluations for the proposed landfill were made by contouring the water level data from the piezometers screened within the Garber Sandstone during the months of November 2003 to October 2004. The October 2004 peizometric map is considered the best representation of the groundwater surface due to the fact that some of the piezometers required several months to recharge. Piezometers PZ-1 and PZ-2C may still require additional time to reach static equilibrium if they have not already.

4.2 PROPOSED MONITORING SYSTEM DESIGN

Based upon the groundwater levels collected in October 2004 the designation of the piezometers as upgradient versus downgradient is as follows:

PZ-1	Upgradient
PZ-2B & PZ-2C	Downgradient
PZ-4	Upgradient
PZ-5	Crossgradient
PZ-6	Crossgradient and upgradient
PZ-7	Crossgradient
PZ-8	Downgradient
PZ-9	Upgradient
PZ-10 Cluster	Downgradient

The following is the proposed monitoring system for groundwater sampling for Cells 4 and 5:

Upgradient Wells – PZ-1 and PZ-9 → see bre locat

Downgradient Wells – PZ-2B, PZ-2C, and PZ-6

Analytical groundwater samples from the proposed monitoring network for Cells 4 and 5 will be collected as detailed in the 2003 Burns & McDonnell Work Plan found in Appendix K (Burns & McDonnell, 2003). This data will be used to establish background water quality prior to placement of waste. A detailed Sampling and Analysis Plan for detection monitoring will be completed after background analysis. The collection of background groundwater samples and groundwater monitoring system expansion will be conducted at the appropriate time in the future as agreed with ODEQ.

Due to the extremely low hydraulic conductivity found at the Site, it is probable that there will be problems with adequate sample volume during groundwater sampling. Also, piezometric maps produced during quarterly sampling may not reflect static groundwater levels for all of the piezometers. Monitoring wells yielding non-representative groundwater elevation data (potentially still recharging due to sampling) should not be used in peizometric mapping.

4.3 FUTURE INVESTIGATIONS

The data collected during the hydrogeological field investigation are adequate to characterize the Site. At this time no additional subsurface investigations are planned.

* * * * *

5.0 REFERENCES

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* * * * *

TABLES

TABLE 1
BORING SUMMARY
LAWTON SANITARY LANDFILL
LAWTON, OKLAHOMA

Piezometer/ Boring	Ground Elevation (msl)	Boring Depth from GS (msl)	Total Depth Elevation from GS (msl)
B-1	1101.11	70.00	1031.11
B-2	1099.79	75.00	1024.79
B-3	1091.73	16.00	1075.73
B-4	1075.79	20.50	1055.29
B-5	1062.79	74.00	988.79
B-6	1097.84	78.00	1019.84
B-7	1093.66	20.00	1073.66
B-8	1065.22	61.00	1004.22
B-9	1092.35	62.00	1030.35
B-10	1095.60	80.00	1015.60
B-11	1091.33	77.00	1014.33
B-12	1092.08	68.00	1024.08
B-13	1079.60	56.00	1023.60
B-14	1087.33	78.00	1009.33
B-15	1075.76	56.00	1019.76
B-16	1090.81	66.00	1024.81
B-17	1082.11	56.00	1026.11
B-18	1087.46	83.00	1004.46
B-19	1085.12	75.00	1010.12
B-20	1071.85	57.00	1014.85
B-21	1073.85	49.00	1024.85
B-22	1066.50	30.00	1036.50
B-23	1070.14	30.00	1040.14
PZ-1A	1098.11	224.00	874.11
PZ-1	1098.11	65.19	1032.92
PZ-2A	1065.98	70.00	995.98
PZ-2B	1065.98	50.18	1015.80
PZ-2C	1065.98	65.43	1000.55
PZ-3	1091.54	200.00	891.54
PZ-4	1097.00	63.26	1033.74
PZ-5	1079.61	62.05	1017.56
PZ-6	1093.12	58.04	1035.08
PZ-7	1071.89	35.70	1036.19
PZ-8	1066.50	31.52	1034.98
PZ-9A	1084.98	100.00	984.98
PZ-9	1084.98	57.30	1027.68
PZ-10	1060.66	85.00	975.66
PZ-10A	1060.66	32.83	1027.83
PZ-10B	1060.66	17.00	1043.66
PZ-10C	1060.66	70.40	990.26

Notes:
GS = Ground Surface
msl=Mean Sea Level

TABLE 3
PIEZOMETER GROUNDWATER ELEVATION SUMMARY
CITY OF LAWTON LANDFILL
LAWTON, OKLAHOMA

	PZ-1	PZ-2B	PZ-2C	PZ-4	PZ-5	PZ-6	PZ-7	PZ-8	PZ-9	PZ-10A	PZ-10B	PZ-10C
Top of Casing Elevation	1101.62	1069.09	na	1099.68	1082.24	1095.75	1074.89	1068.89	1087.81	1063.07	na	na
Top of Ground Elevation	1098.11	1065.98	1065.98	1097	1079.61	1093.12	1071.89	1066.5	1084.98	1060.66	1060.66	1060.66
November 3, 2003	1053.4	1046.0	1003.1	1042.6	1022.6	1058.0	1058.0	1058.4	1032.0	1051.0	1051.2	1008.6
December 5, 2003	1057.8	1057.3	1006.8	1054.8	1027.1	1059.8	1065.0	1058.1	1042.8	1052.9	1050.5	1026.3
January 5, 2004	1059.2	1049.6	1011.4	1061.6	1038.0	1059.8	1066.3	1057.6	1054.5	1052.5	1049.8	1037.4
February 17, 2004	1062.6	1051.5	1021.3	1064.3	1048.0	1060.2	1066.5	1057.1	1064.5	1052.7	1049.4	1040.7
March 16, 2004	1065.1	1048.5	1030.5	1065.2	1052.1	1059.8	1067.3	1057.6	1066.5	1052.7	1051.0	1042.8
April 9, 2004	1068.2	1048.0	1034.9	1065.6	1054.3	1060.8	1067.1	1057.4	1067.1	1052.0	1051.2	1043.9
May 7, 2004	1070.5	1047.2	1038.2	1065.8	1055.6	1059.2*	1067.2	1057.2	1067.0	1051.0	1050.9	1044.6
June 4, 2004	1072.8	1046.6	1040.5	1065.8	1056.4	1059.0	1067.0	1057.2	1066.7	1050.0	1047.8	1044.9
July 8, 2004	1074.7	1046.6	1041.9	1066.0	1057.2	1059.0*	1067.6	1057.5	1066.7	1050.0	1047.9	1045.3
August 18, 2004	1076.4	1047.1	1043.1	1066.0	1057.8	1058.8	1066.5	1057.5	1066.9	1049.8	1048.3	1045.5
September 14, 2004	1077.4	1048.3	1043.8	1065.9	1057.9	1058.7	1066.5	1057.2	1067.0	1050.2	1047.9	1045.6
October 18, 2004	1078.3	1049.7	1044.5	1066.1	1058.4	1058.7	1067.3	1058.4	1067.6	1051.2	1048.4	1045.8

Note:

Groundwater levels gauged by City of Lawton personnel.

* - Water level determined from datalogger data. June 4, 2004 readings from datalogger and June 4 field level measurements were used to determine zero level of datalogger.

TABLE 2
PIEZOMETER CONSTRUCTION SUMMARY TABLE
LAWTON SANITARY LANDFILL
LAWTON, OKLAHOMA

Piezometer/Boring	Ground Elevation (msl)	Top PVC Elevation (msl)	Northing	Easting	Depth to Top of Screen from GS (feet)	Depth to Bottom of Screen from GS (feet)	Top of Screen Elevation (msl)	Bottom of Screen Elevation (msl)	Borehole Diameter (nominal) (inches)	Well Casing Diameter (inches)
PZ-1	1098.11	1101.62	432614.31	1847073.75	54.69	65.19	1043.42	1032.92	6	2
PZ-2B	1065.98	1069.09	432687.53	1849242.83	39.68	50.18	1026.30	1015.80	6	2
PZ-2C*	1065.98	NA	NA	NA	54.93	65.43	1011.05	1000.55	6	2
PZ-4	1097.00	1099.68	431502.26	1846792.69	52.76	63.26	1044.24	1033.74	6	2
PZ-5	1079.61	1082.24	431499.89	1849232.26	51.55	62.05	1028.06	1017.56	6	2
PZ-6	1093.12	1095.75	431280.77	1848061.02	47.54	58.04	1045.58	1035.08	6	2
PZ-7	1071.80	1074.89	430497.75	1846797.30	25.20	35.70	1046.60	1036.10	6	2
PZ-8	1066.50	1068.89	430342.96	1847750.00	21.02	31.52	1045.48	1034.98	6	2
PZ-9	1084.98	1087.81	430489.89	1849229.59	46.80	57.30	1038.18	1027.68	6	2
PZ-10A	1060.65	1063.07	429925.16	1848485.03	22.33	32.83	1038.32	1027.82	6	2
PZ-10B*	1060.65	NA	NA	NA	6.50	17.00	1054.15	1043.65	6	1
PZ-10C*	1060.65	NA	NA	NA	59.90	70.40	1000.75	990.25	6	2

*Temporary piezometer
msl - mean sea level
NA - Not Available

TABLE 4
HYDRAULIC CONDUCTIVITY VALUES SUMMARY
LAWTON SANITARY LANDFILL
LAWTON, OKLAHOMA

Piezometer ID	Test Date	Aquifer Model	Solution Method	Hydraulic Conductivity (K) (cm/sec)
PZ-1	10/09/03	Confined	Bouwer-Rice	4.73×10^{-8}
PZ-2b	10/09/03	Confined	Bouwer-Rice	4.85×10^{-8}
PZ-4	10/11/03	Confined	Bouwer-Rice	1.01×10^{-7}
PZ-6	10/09/03	Confined	Bouwer-Rice	7.44×10^{-8}
PZ-7	10/10/03	Confined	Bouwer-Rice	5.06×10^{-8}
PZ-8	10/10/03	Confined	Bouwer-Rice	2.04×10^{-8}
PZ-9	10/11/03	Confined	Bouwer-Rice	4.67×10^{-8}
PZ-10a	10/09/03	Confined	Bouwer-Rice	1.20×10^{-8}
PZ-10c	10/08/03	Confined	Bouwer-Rice	6.05×10^{-8}

TABLE 5
OKLAHOMA APPENDIX A AND INDICATOR PARAMETERS
LAWTON SANITARY LANDFILL
LAWTON, OKLAHOMA

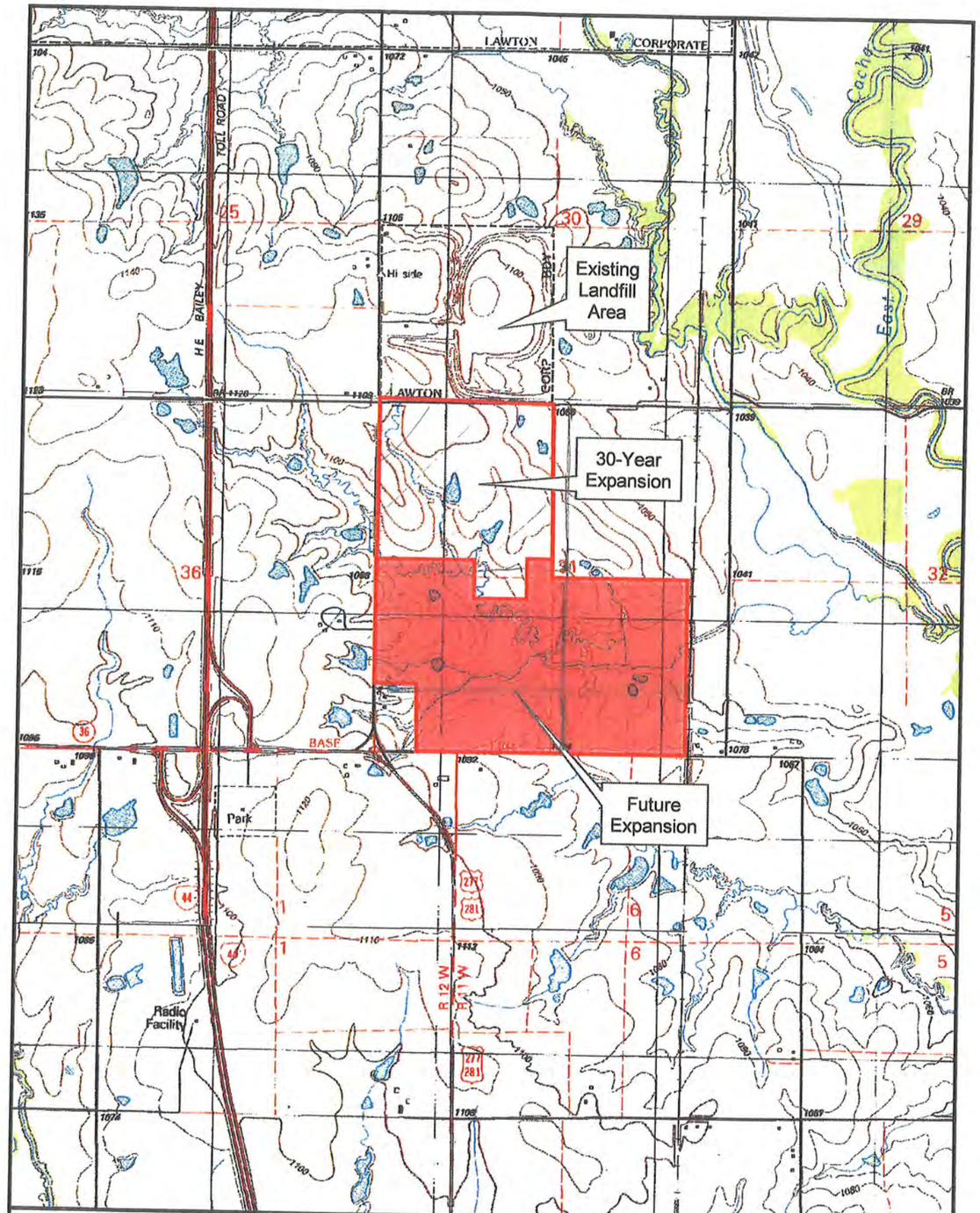
PARAMETER	ANALYTICAL METHOD	SAMPLE CONTAINER/PRESERVATIVE	HOLDING TIMES
INORGANIC CONSTITUENTS - WATER/METALS			
Antimony	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Arsenic	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Barium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Beryllium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Cadmium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Calcium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Chromium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Cobalt	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Copper	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Lead	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Magnesium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Nickel	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Potassium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Selenium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Silver	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Sodium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Thallium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Vanadium	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
Zinc	SW-846 6010	1 1L Plastic; HNO3 to pH<2	6 months
ORGANIC CONSTITUENTS - VOCs			
Acetone	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Acrylonitrile	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Benzene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Bromochloromethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Bromodichloromethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Bromoform	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Carbon disulfide	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Carbon tetrachloride	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Chlorobenzene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Chloroethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Chloroform	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Dibromochloromethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,2-Dibromo-3-chloropropane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,2-Dibromoethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
o-Dichlorobenzene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
p-Dichlorobenzene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
trans-1,4-Dichloro-2-butene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,1-Dichloroethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,2-Dichloroethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,1-Dichloroethylene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
cis-1,2-Dichloroethylene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
trans-1,2-Dichloroethylene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,2-Dichloropropane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days

TABLE 5 (continued)
OKLAHOMA APPENDIX A AND INDICATOR PARAMETERS

LAWTON SANITARY LANDFILL
LAWTON, OKLAHOMA

PARAMETER	ANALYTICAL METHOD	SAMPLE CONTAINER/PRESERVATIVE	HOLDING TIMES
ORGANIC CONSTITUENTS - VOCs (Continued)			
cis-1,3-Dichloropropene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
trans-1,3-Dichloropropene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Ethylbenzene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
2-Hexanone	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Methyl bromide	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Methyl chloride	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Methylene bromide	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Methylene chloride	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Methyl ethyl ketone	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Methyl iodide	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
4-Methyl-2-pentanone	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Styrene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,1,1,2-Tetrachloroethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,1,2,2-Tetrachloroethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Tetrachloroethylene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Toluene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,1,1-Trichloroethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,1,2-Trichloroethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Trichloroethylene	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Trichlorofluoromethane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
1,2,3-Trichloropropane	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Vinyl acetate	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Vinyl chloride	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
Xylenes	SW-846 8260	3 40mL Glass w/teflon septum; HCl; 4° C	14 days
INDICATOR PARAMETERS			
Bicarbonate-Alkalinity	EPA 310.1	1 100mL Plastic; 4° C	14 days
Carbonate-Alkalinity	EPA 310.1	1 100mL Plastic; 4° C	14 days
Chemical Oxygen Demand	EPA 410	1 50mL Plastic; 4° C; H2SO4	28 days
Chlorides (Cl)	SW-846 9056	1 50mL Plastic or Glass	28 days
Nitrate/Nitrite	EPA 353	1 100mL Plastic; 4° C; H2SO4	28 days
Sulfate	SW-846 9056	1 25 mL Plastic or Glass; 4° C	28 days
Specific Conductance	Field Method	NA	immediate
pH	Field Method	NA	immediate

FIGURES



Source: USGS 7.5' Series Topographic Maps
1991 Lawton, OK
1987 Geronimo, OK

2000 0 2000 Feet

N

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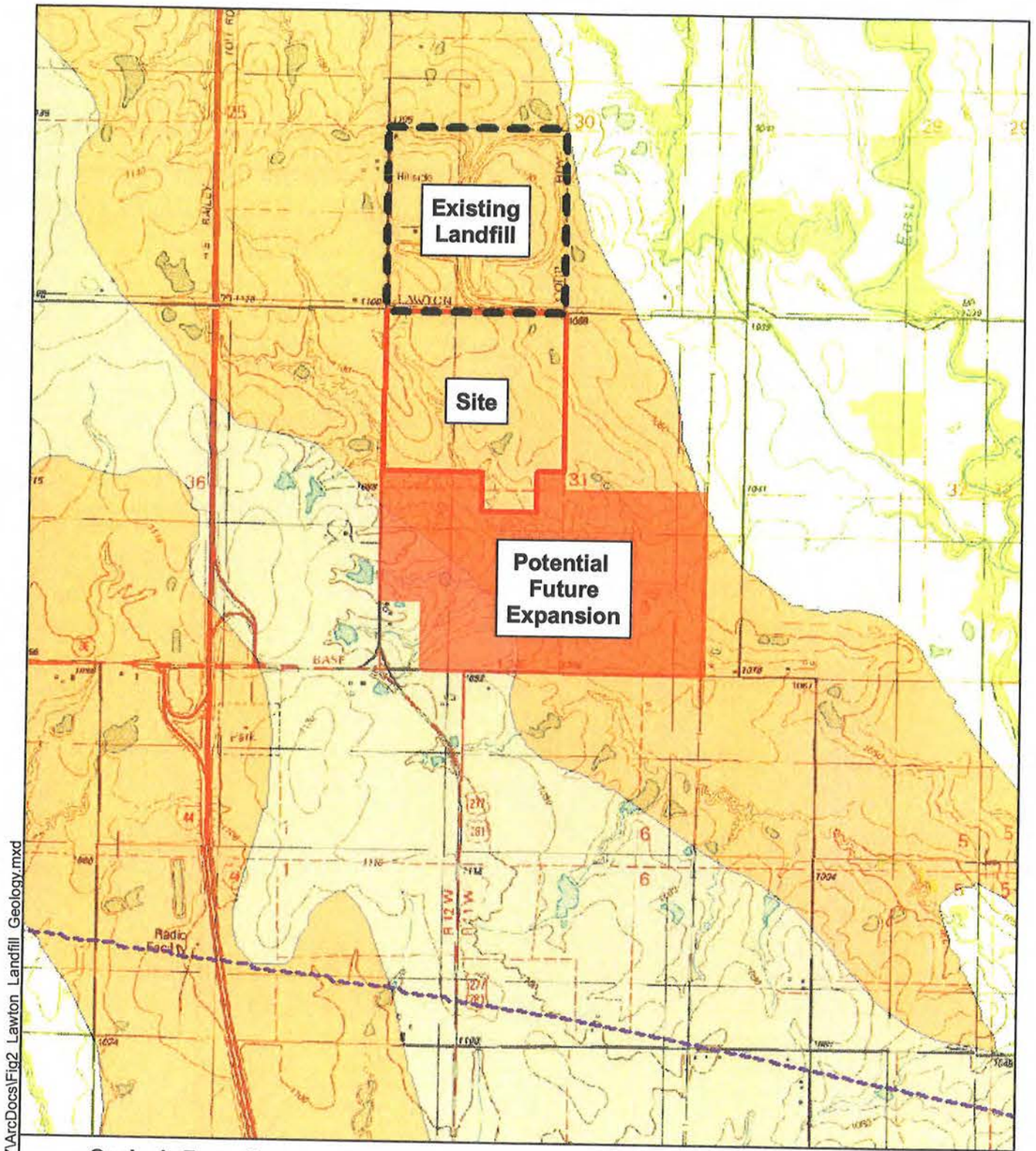
Figure 1
SITE LOCATION MAP



Geologic Formation

- Garber Group; Pg
- Hennessey Group; Phy
- Alluvium; Qal

- Anticline
- Syncline
- Monocline
- Fault Lines

NOTES:

Geologic Information From Havens, 1977.

Anticlines, Monoclines, and Fault Lines are not located inside the mapped area depicted hereon.

2,000 0 2,000

SCALE IN FEET

NORTH

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Figure 2

GEOLOGIC MAP WITH STRUCTURE OF SITE AND NEARBY AREA

\\Gissrv\Projects\wcdmaps\32527\ArcDocs\Fig2_Lawton_Landfill_Geology.mxd

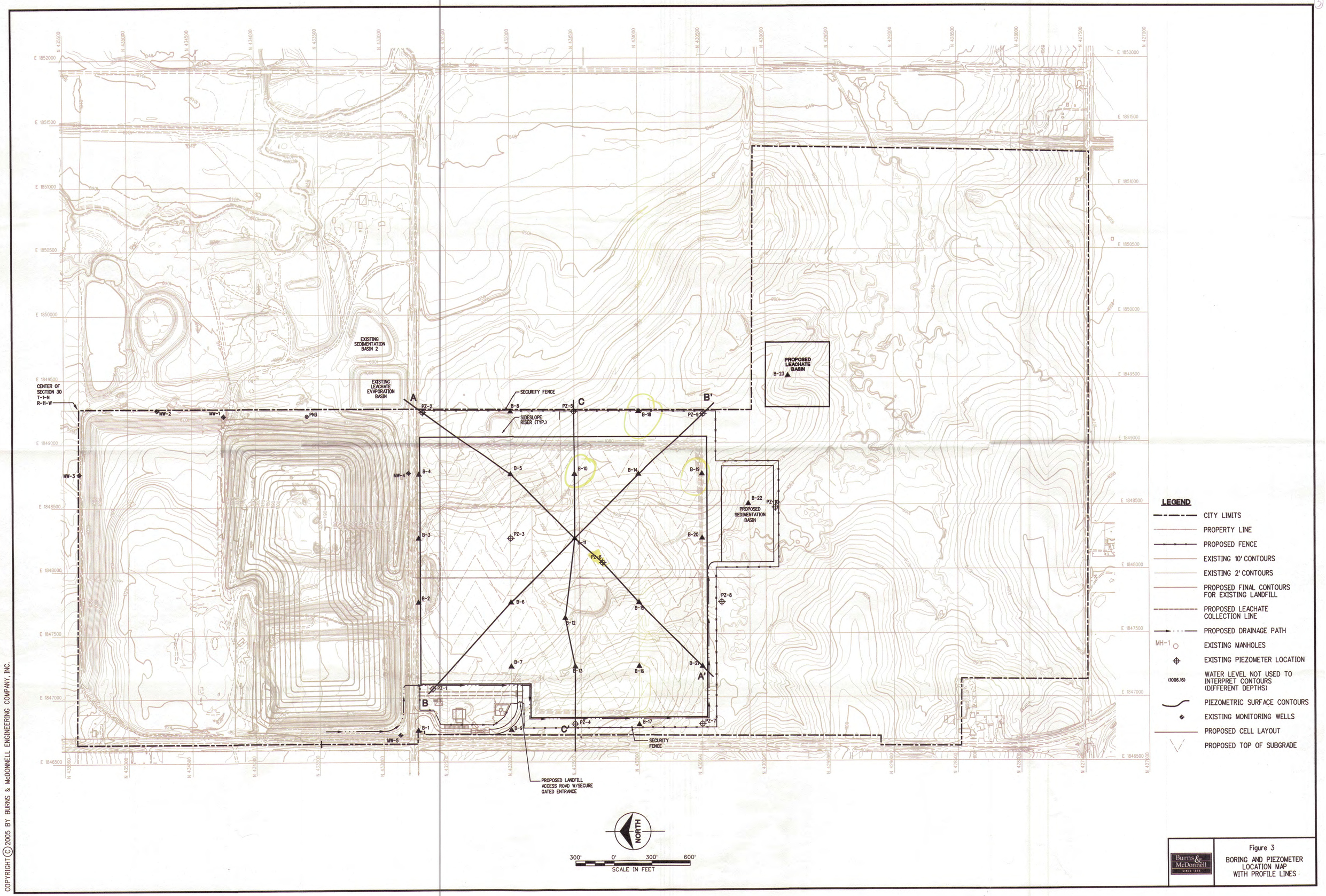
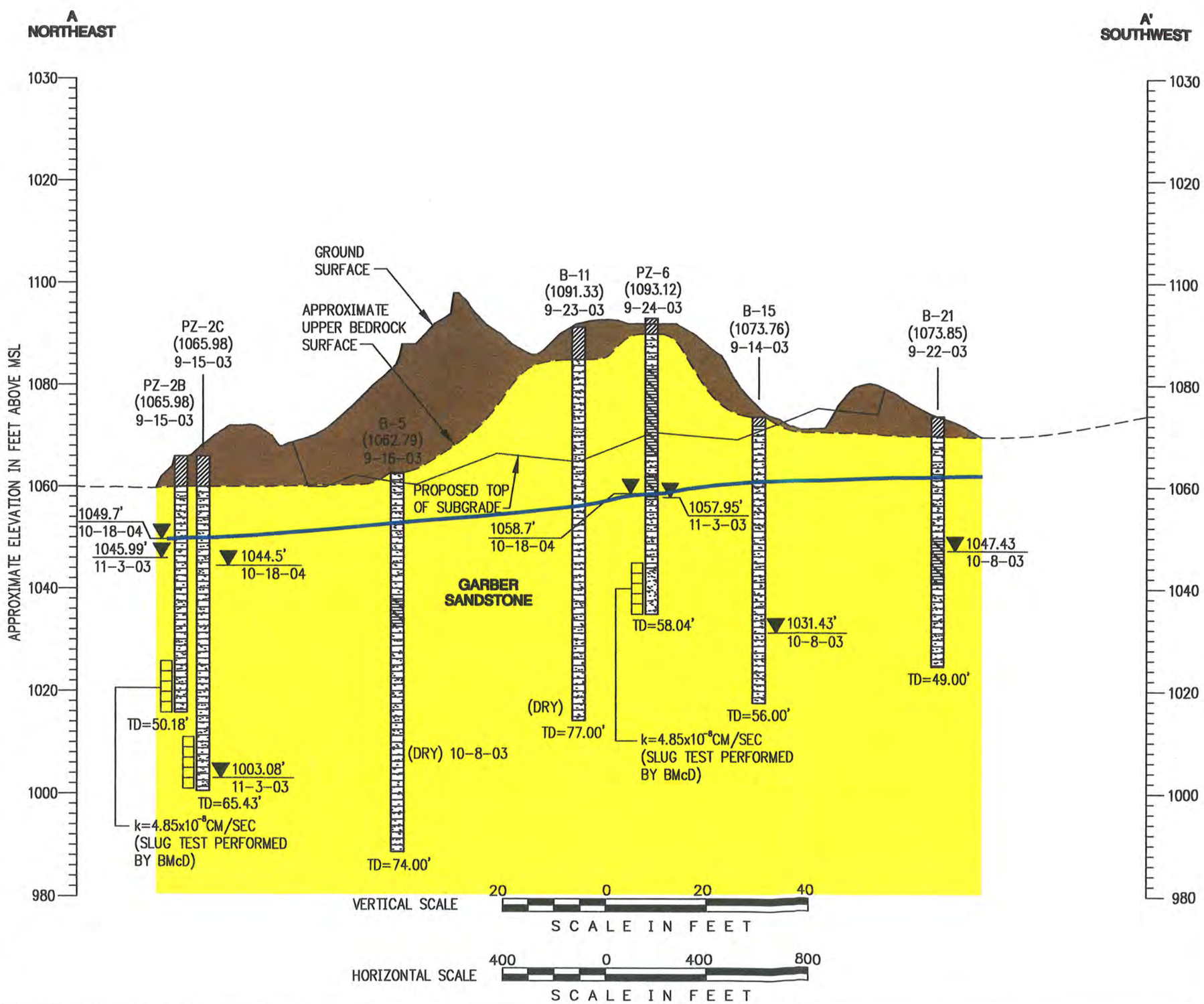


Figure 3
BORING AND PIEZOMETER LOCATION MAP WITH PROFILE LINES

Burns & McDonnell SINCE 1898

LAW-FG3.DGN / 1-05-2005 16:12 / SO K:\ENV\LAWTON OKLAHOMA\SITE\ 32527\CAD\LANDFILL EXPANSION\

K:\ENV\LAWTON OKLAHOMA\REF\WORK PLAN\061500
K:\ENV\LAWTON OKLAHOMA\REF\WORK PLAN\AEXPANO2C2.DGN\
K:\ENV\LAWTON OKLAHOMA\REF\WORK PLAN\0
K:\ENV\LAWTON OKLAHOMA\REF\WORK PLAN\ANNEXATION.DGN(CITY LIMITS) 0
K:\ENV\LAWTON OKLAHOMA\REF\WORK PLAN\WELLS.DGN\WEL



LEGEND

PZ-2	PIEZOMETER
▼	WATER LEVEL ELEVATION (MSL) ON DATE INDICATED
TD=	TOTAL DEPTH
	SCREENED INTERVAL
(DRY)	REPORTED TO BE DRY AT TIME OF ABANDONMENT
	SILTY CLAY
	CLAYSTONE
	SHALE
	SILTSTONE
	SANDSTONE
9-10-03	BORING COMPLETION DATE
	WATER LEVEL IN GARBER SANDSTONE ON OCTOBER 18, 2004.

NOTES:

1. GARBER SANDSTONE CONSISTS OF CLAYSTONE AND SILTSTONE THAT IS SHALEY IN PART WITH LENSES OF CEMENTED FINE-GRAINED SANDSTONE.
2. SURFACE TOPOGRAPHY IS APPROXIMATE.
3. CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT.
4. THE STRATIGRAPHIC SEQUENCE PRESENTED HEREIN REFLECT THE OBSERVATIONS OF PERSONNEL PRESENT DURING DRILLING AND SAMPLING OPERATIONS. THE MATERIAL CLASSIFICATIONS ARE BASED ON VISUAL CLASSIFICATION AND CONSTITUTE AN OPINION OF THE PERSONNEL MAKING THE OBSERVATION.
5. SLOPES APPEAR STEEPER BECAUSE OF HIGH VERTICAL EXAGGERATION.

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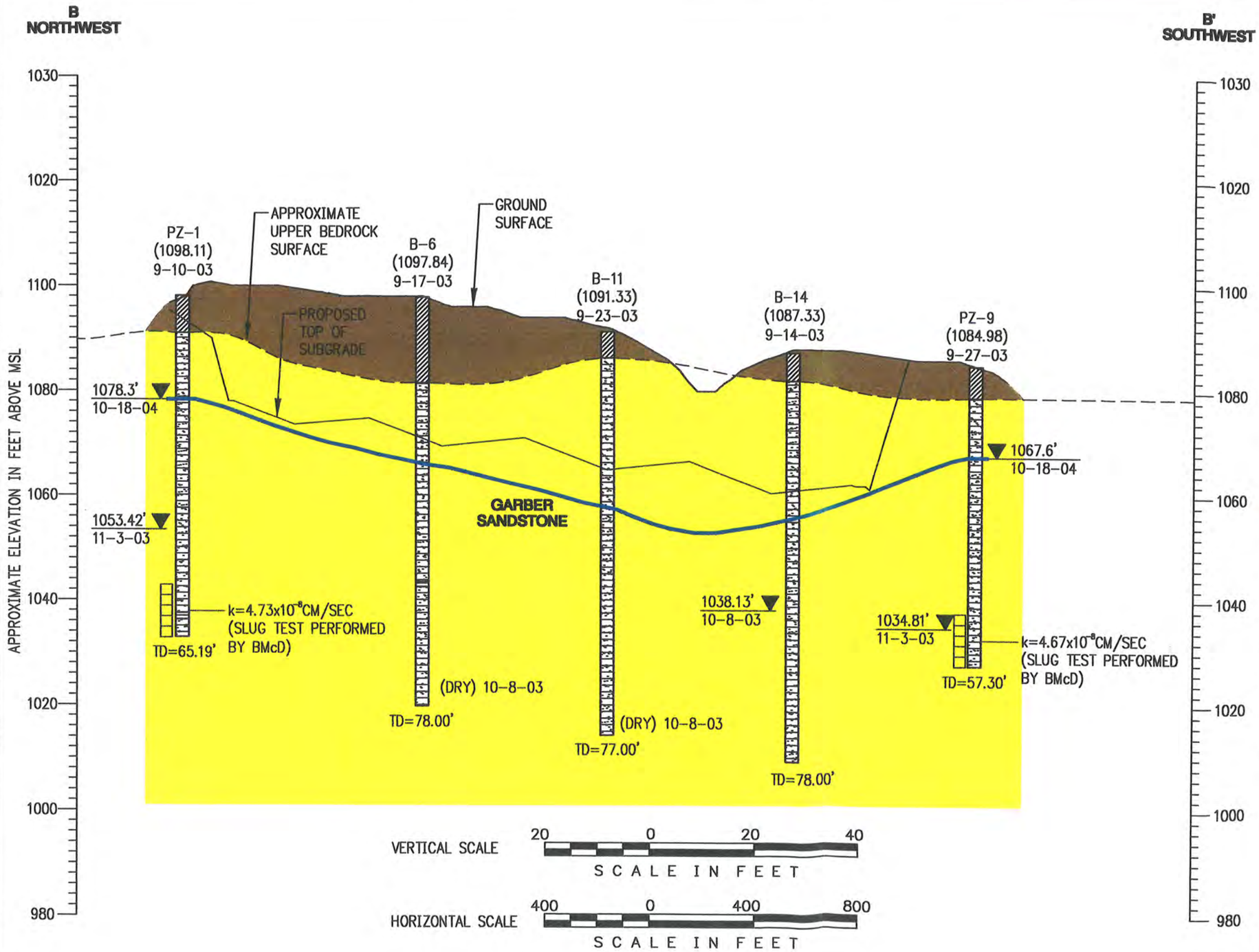
Figure 4
GEOLOGIC PROFILE
A-A'



LEGEND

PZ-2	PIEZOMETER
▼	WATER LEVEL ELEVATION (MSL) ON DATE INDICATED
TD=	TOTAL DEPTH
	SCREENED INTERVAL
(DRY)	REPORTED TO BE DRY AT TIME OF ABANDONMENT
	SILTY CLAY
	CLAYSTONE
	SHALE
9-22-03	BORING COMPLETION DATE
	WATER LEVEL IN GARBER SANDSTONE ON OCTOBER 18, 2004.

NOTES:

1. GARBER SANDSTONE CONSISTS OF CLAYSTONE AND SILTSTONE THAT IS SHALEY IN PART WITH LENSES OF CEMENTED FINE-GRAINED SANDSTONE.
2. SURFACE TOPOGRAPHY IS APPROXIMATE.
3. CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT.
4. THE STRATIGRAPHIC SEQUENCE PRESENTED HEREIN REFLECT THE OBSERVATIONS OF PERSONNEL PRESENT DURING DRILLING AND SAMPLING OPERATIONS. THE MATERIAL CLASSIFICATIONS ARE BASED ON VISUAL CLASSIFICATION AND CONSTITUTE AN OPINION OF THE PERSONNEL MAKING THE OBSERVATION.
5. SLOPES APPEAR STEEPER BECAUSE OF HIGH VERTICAL EXAGGERATION.

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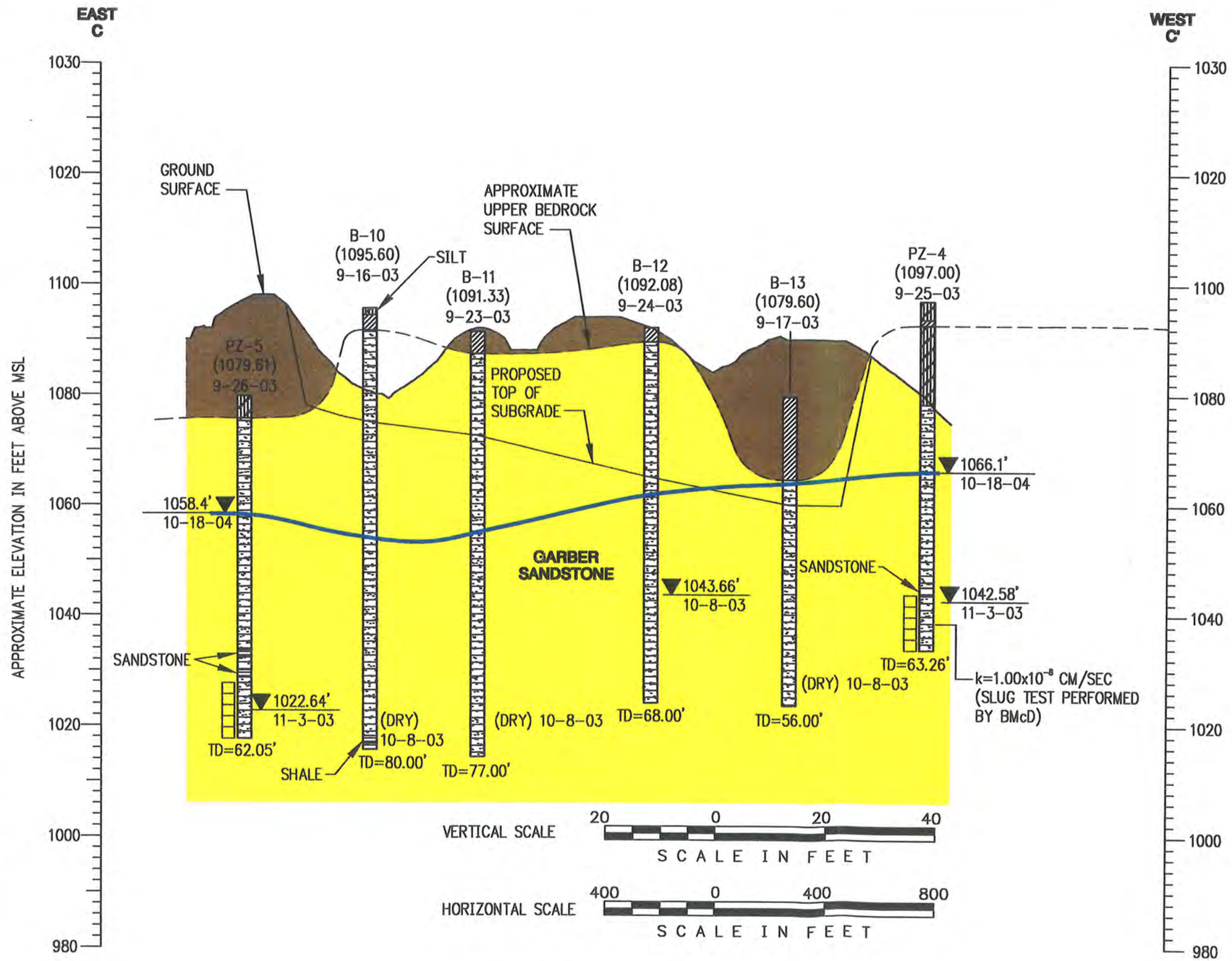
SINCE 1898

Figure 5

GEOLOGIC PROFILE
B-B'



LEGEND

PZ-2	PIEZOMETER
▼	WATER LEVEL ELEVATION (MSL) ON DATE INDICATED
TD=	TOTAL DEPTH
	SCREENED INTERVAL
(DRY)	REPORTED TO BE DRY AT TIME OF ABANDONMENT
	SILTY CLAY
	CLAYSTONE
	SHALE
	SILTSTONE
	SANDSTONE
9-16-03	BORING COMPLETION DATE
	WATER LEVEL IN GARBER SANDSTONE ON OCTOBER 18, 2004.

NOTES:

1. GARBER SANDSTONE CONSISTS OF CLAYSTONE AND SILTSTONE THAT IS SHALEY IN PART WITH LENSES OF CEMENTED FINE-GRAINED SANDSTONE.
2. SURFACE TOPOGRAPHY IS APPROXIMATE.
3. CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT.
4. THE STRATIGRAPHIC SEQUENCE PRESENTED HEREIN REFLECT THE OBSERVATIONS OF PERSONNEL PRESENT DURING DRILLING AND SAMPLING OPERATIONS. THE MATERIAL CLASSIFICATIONS ARE BASED ON VISUAL CLASSIFICATION AND CONSTITUTE AN OPINION OF THE PERSONNEL MAKING THE OBSERVATION.
5. SLOPES APPEAR STEEPER BECAUSE OF HIGH VERTICAL EXAGGERATION.

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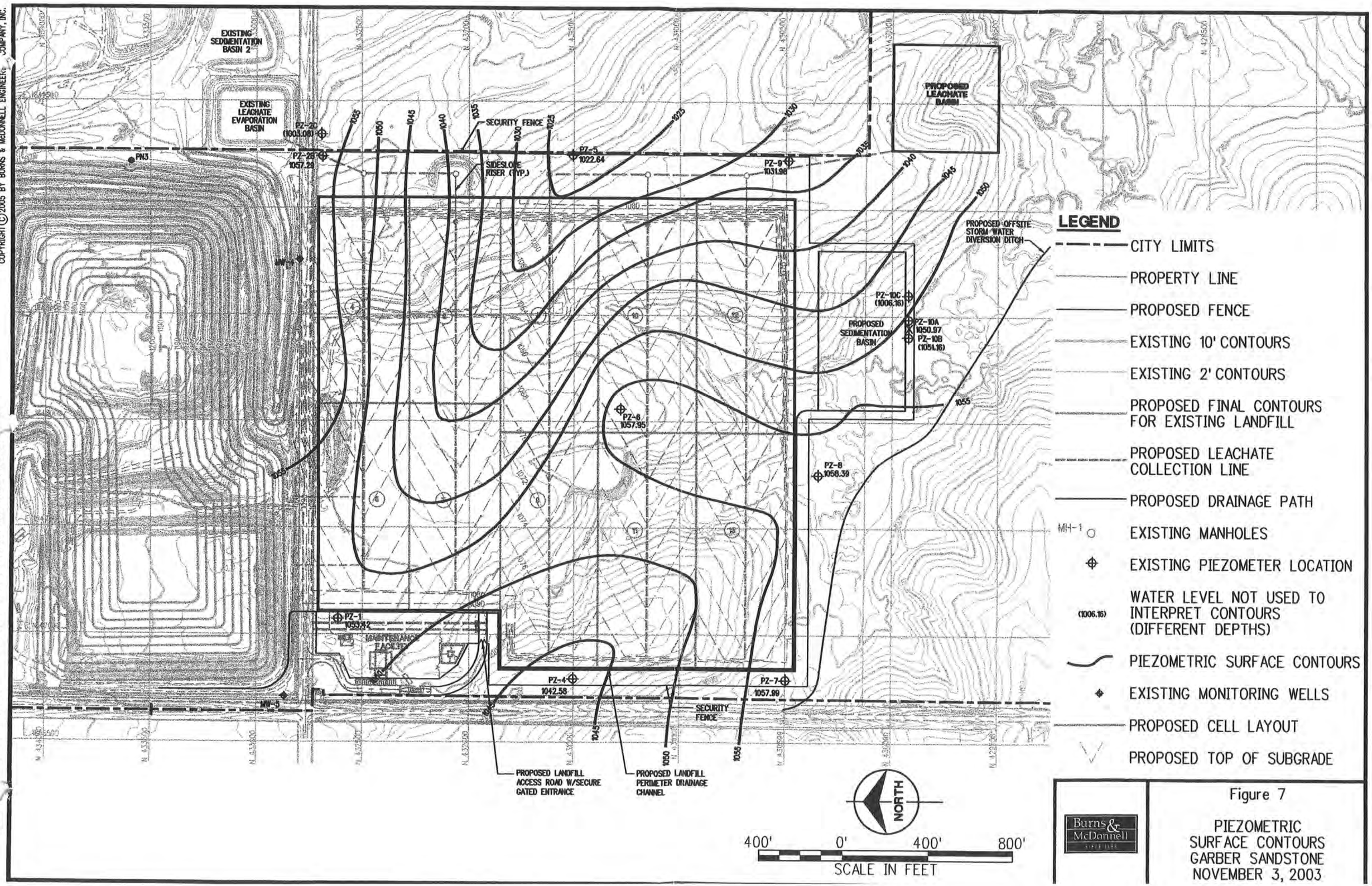
Figure 6

GEOLOGIC PROFILE C-C'



Burns & McDonnell

Figure 7

PIEZOMETRIC SURFACE CONTOURS GARBER SANDSTONE NOVEMBER 3, 2003

K:\ENV\LAWTON OKLAHOMA\SITE\ 32527\CAD\LANDFILL EXPANSION\EXPAN02C2.DGN
1-04-2005 11:21 / CJW

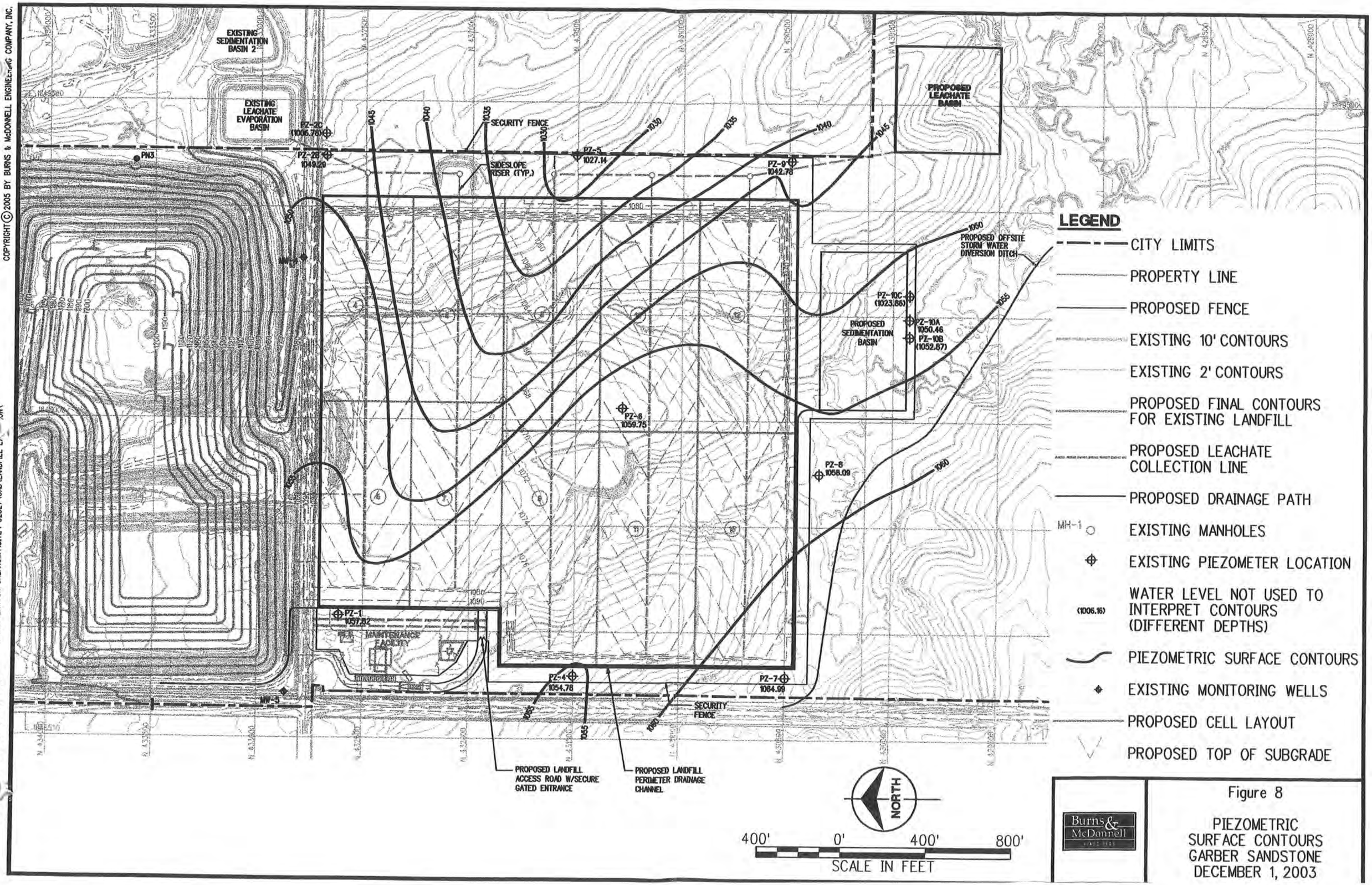


Figure 8

PIEZOMETRIC SURFACE CONTOURS GARBER SANDSTONE DECEMBER 1, 2003

K:\ENV\LAWTON OKLAHOMA\SITE\ 32527\CAD\LANDFILL EXPAN
LAW-FIGURE 8 / 1-04-2005 11:03 / CJW K:\ENV\LAWTON OKLAHOMA\SITE\ 32527\CAD\LANDFILL EXPAN02C2.DGN

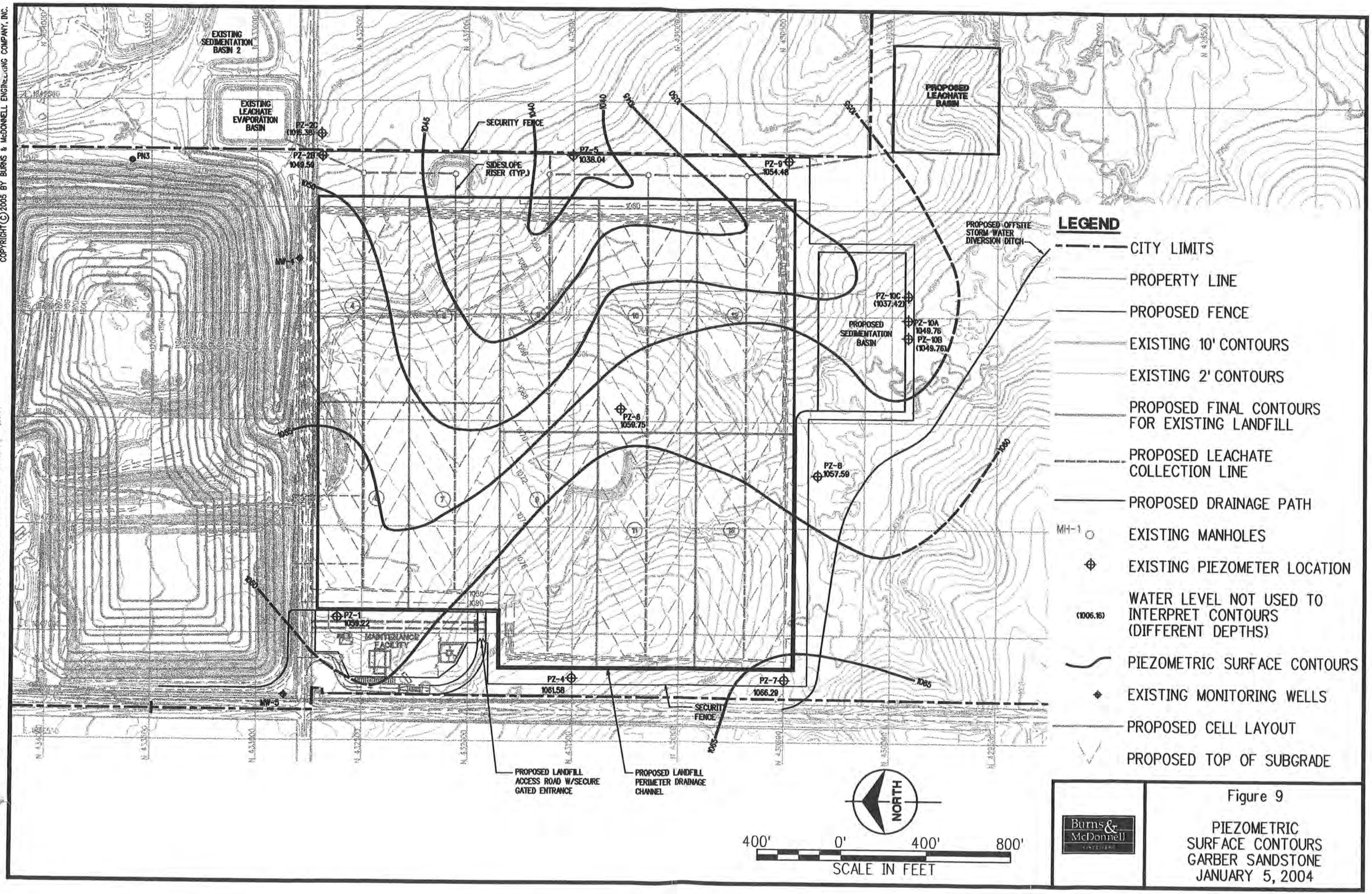
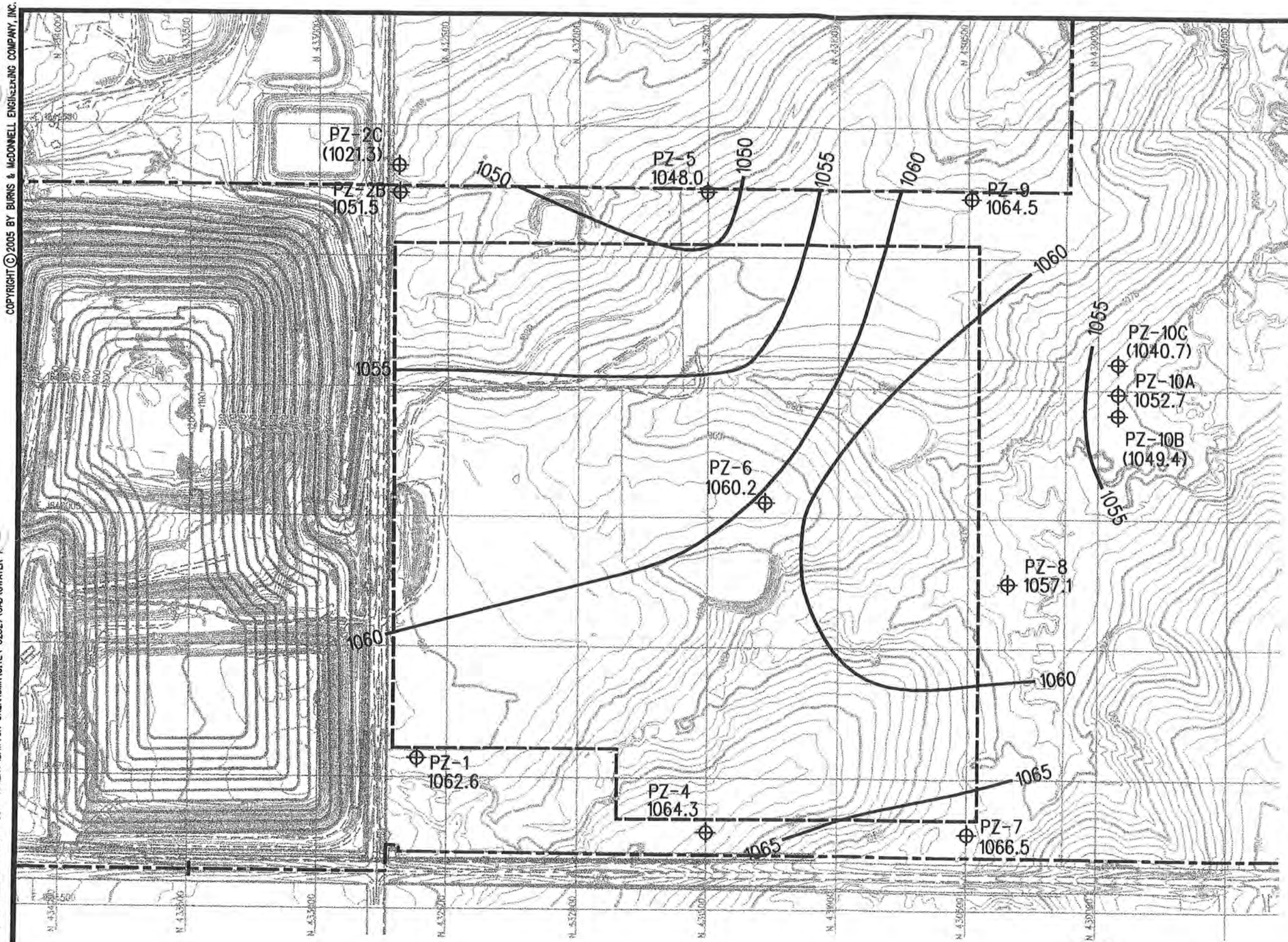


Figure 9

PIEZOMETRIC SURFACE CONTOURS GARBER SANDSTONE JANUARY 5, 2004

K:\ENV\LAWTON OKLAHOMA\SITE\ 32527\CAD\LANDFILL PLAN\ANNEX\LAWC001.DGN(BUILDING) DFF=1.3
LAWTON OKLAHOMA WORK PLAN\ANNEX / 7-04-2005 11:08 / CJW



LEGEND

- CITY LIMITS
- PROPOSED LANDFILL AREA
- EXISTING 10' CONTOURS
- EXISTING 2' CONTOURS
- EXISTING PIEZOMETER
- 1007.12 WATER LEVEL
- (1006.16) WATER LEVEL NOT USED TO INTERPRET CONTOURS (DIFFERENT DEPTH)
- PIEZOMETRIC SURFACE CONTOURS

NOTE

1. WATER LEVELS POTENTIALLY NOT AT EQUILIBRIUM.

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Figure 10

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
FEBRUARY 17, 2004

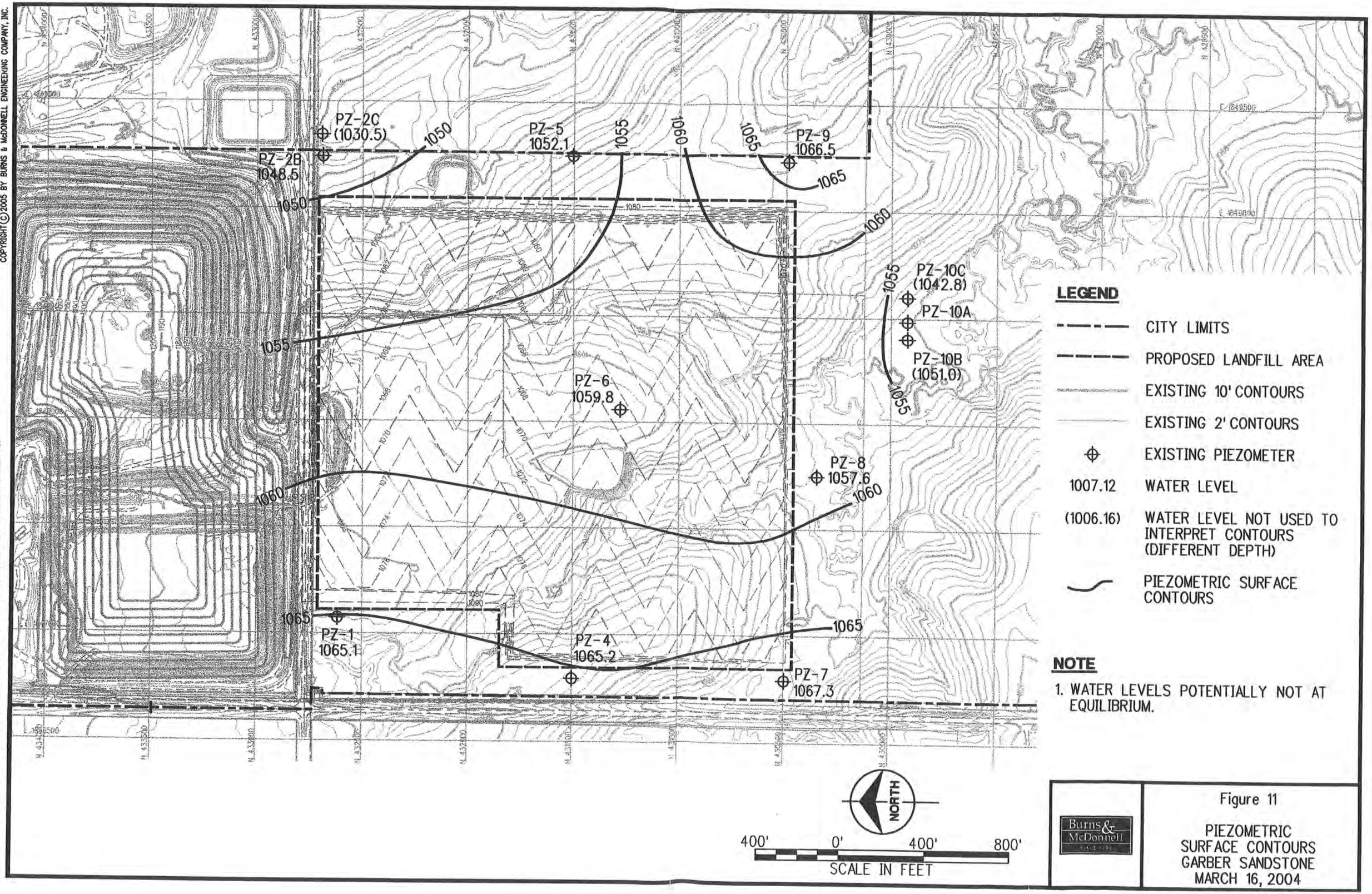


Figure 11

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
MARCH 16, 2004

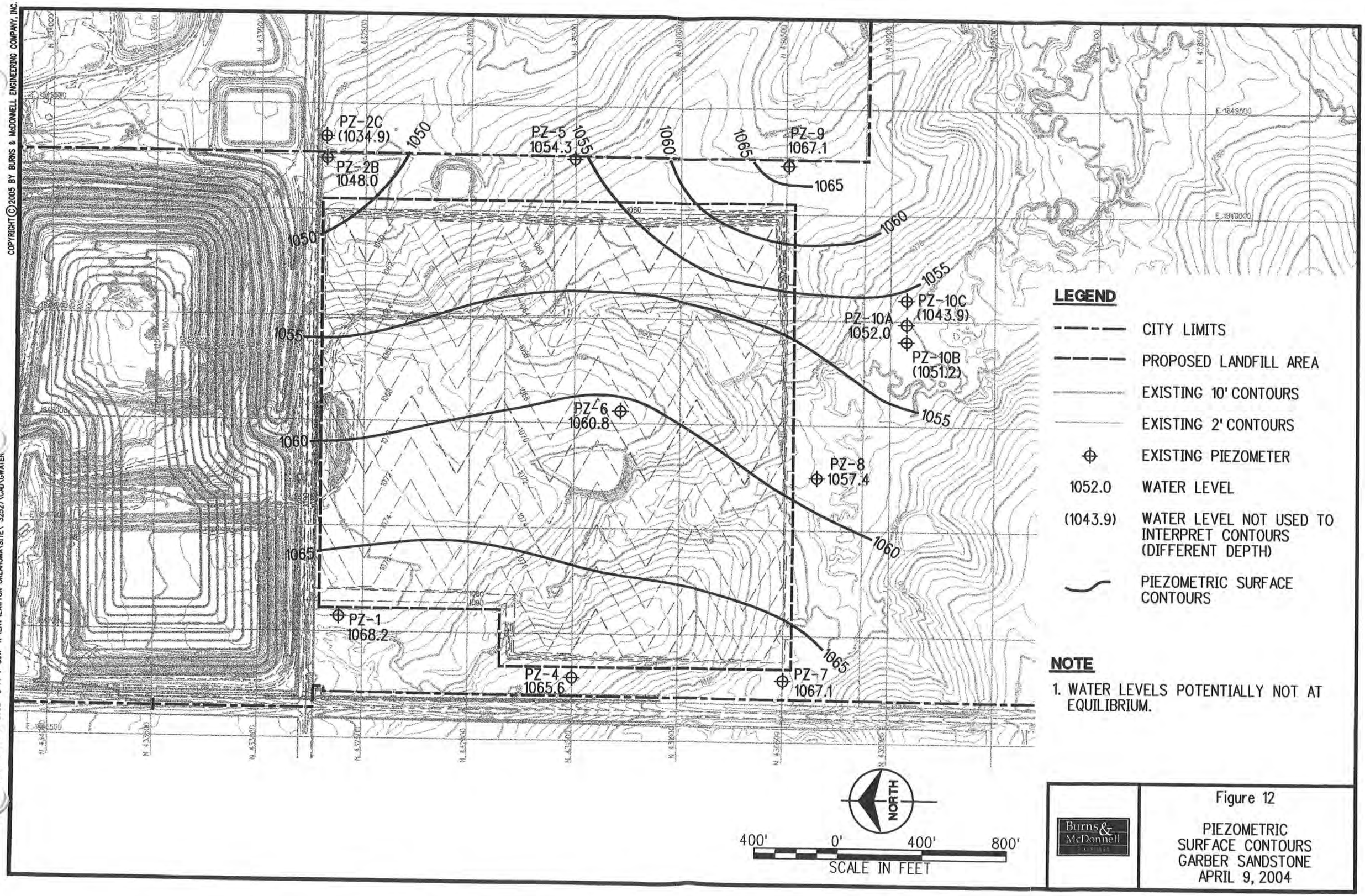
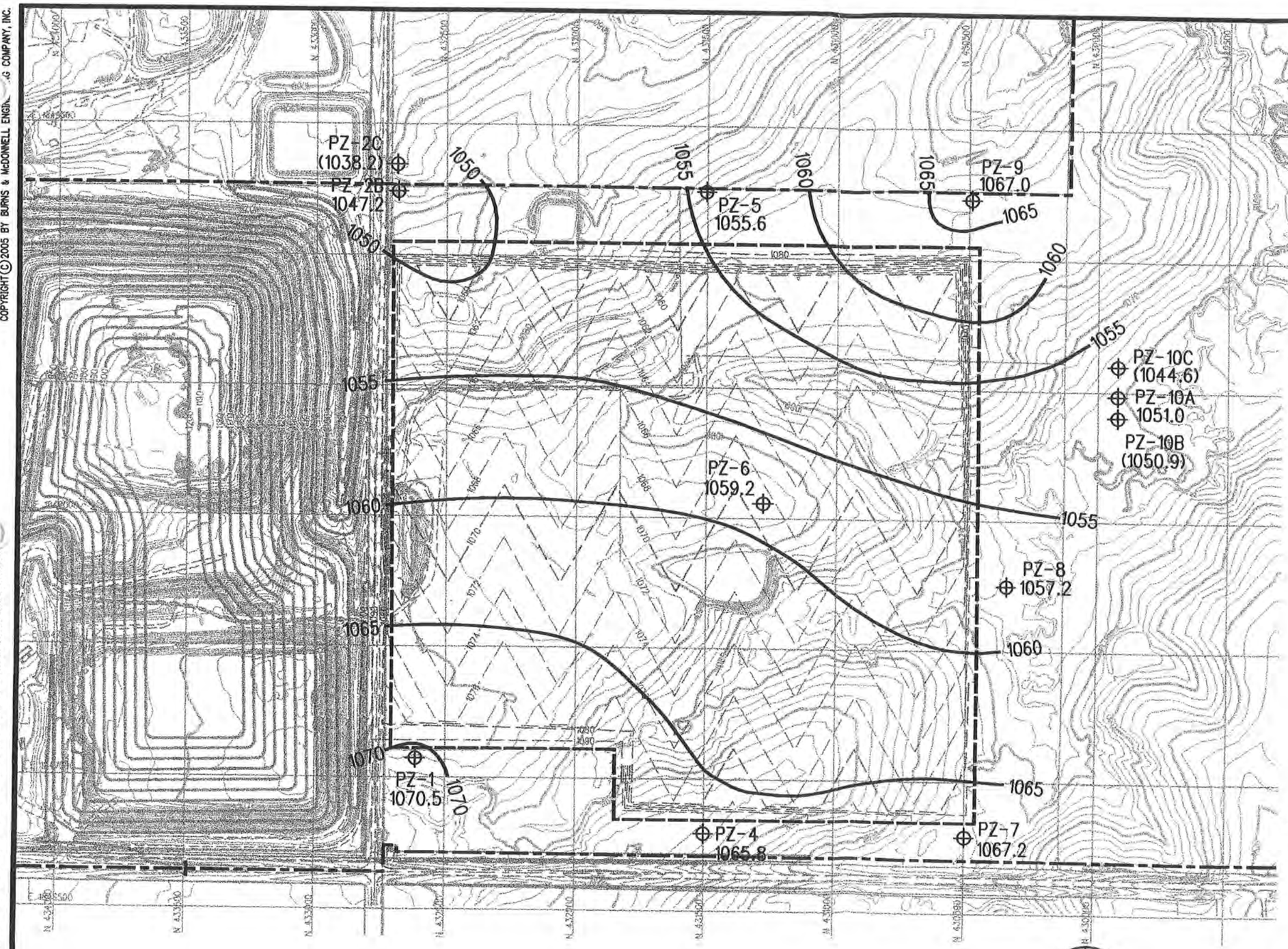


Figure 12

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
APRIL 9, 2004



LEGEND

— · — · —	CITY LIMITS
— — — —	PROPOSED LANDFILL AREA
	EXISTING 10' CONTOURS
	EXISTING 2' CONTOURS
⊕	EXISTING PIEZOMETER
1050.9	WATER LEVEL
(1044.6)	WATER LEVEL NOT USED TO INTERPRET CONTOURS (DIFFERENT DEPTH)
~	PIEZOMETRIC SURFACE CONTOURS

NOTE

1. WATER LEVELS POTENTIALLY NOT AT EQUILIBRIUM.

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Figure 13

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
MAY 7, 2004

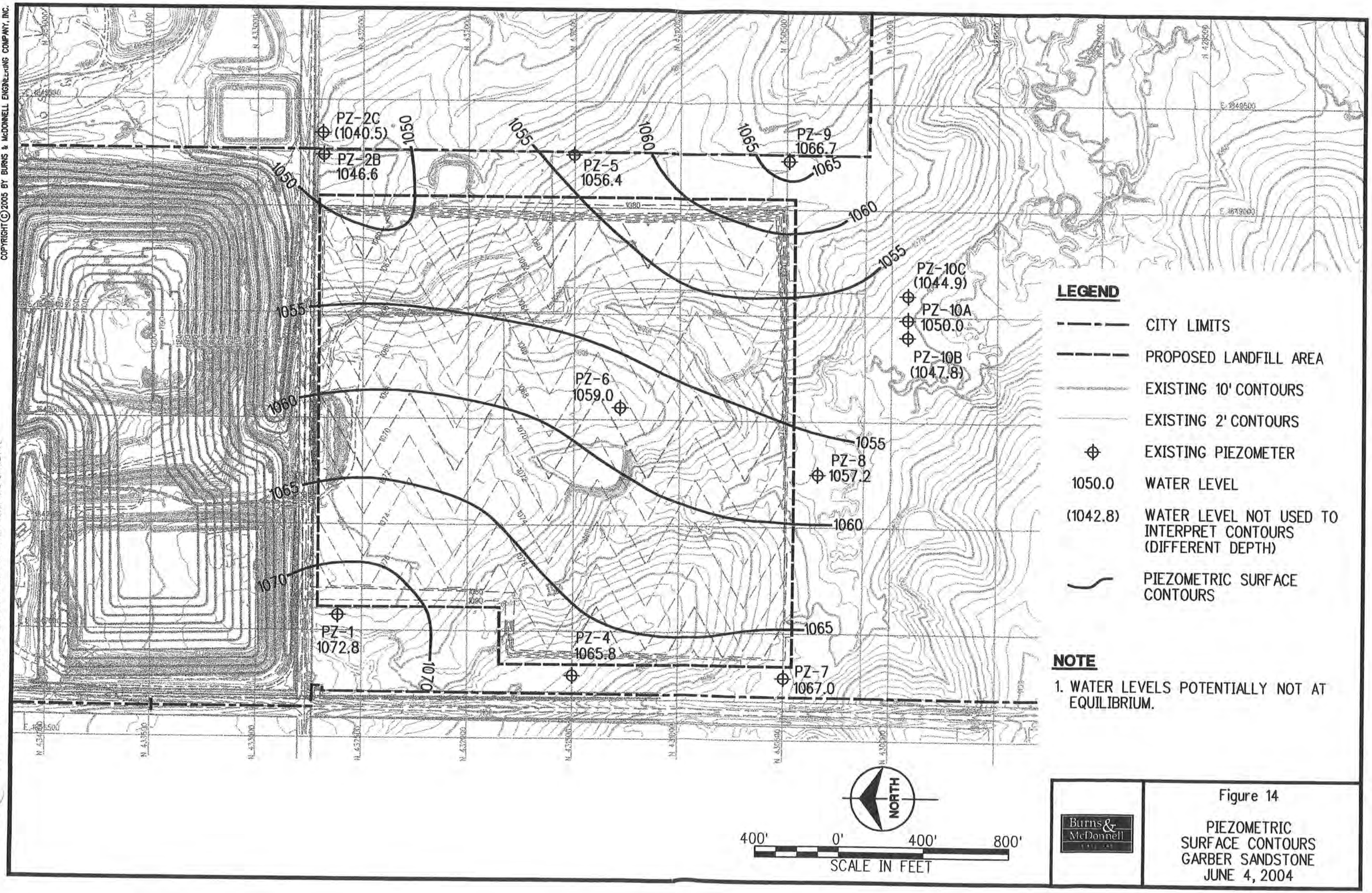
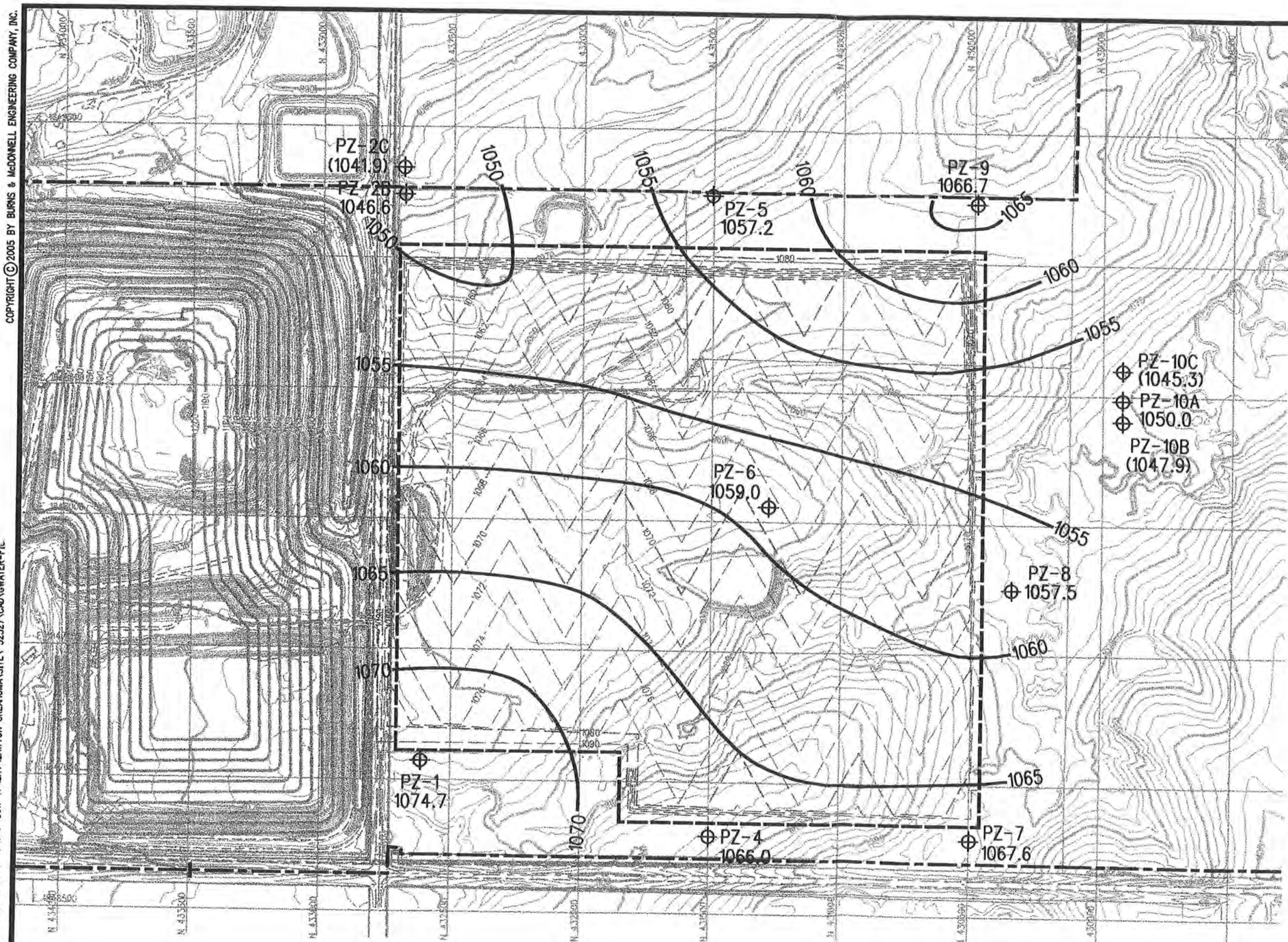


Figure 14

PIEZOMETRIC SURFACE CONTOURS GARBER SANDSTONE JUNE 4, 2004



LEGEND

- CITY LIMITS
- PROPOSED LANDFILL AREA
- EXISTING 10' CONTOURS
- EXISTING 2' CONTOURS
- EXISTING PIEZOMETER
- 1059.0 WATER LEVEL
- (1045.3) WATER LEVEL NOT USED TO INTERPRET CONTOURS (DIFFERENT DEPTH)
- PIEZOMETRIC SURFACE CONTOURS

NOTE

1. WATER LEVELS POTENTIALLY NOT AT EQUILIBRIUM.

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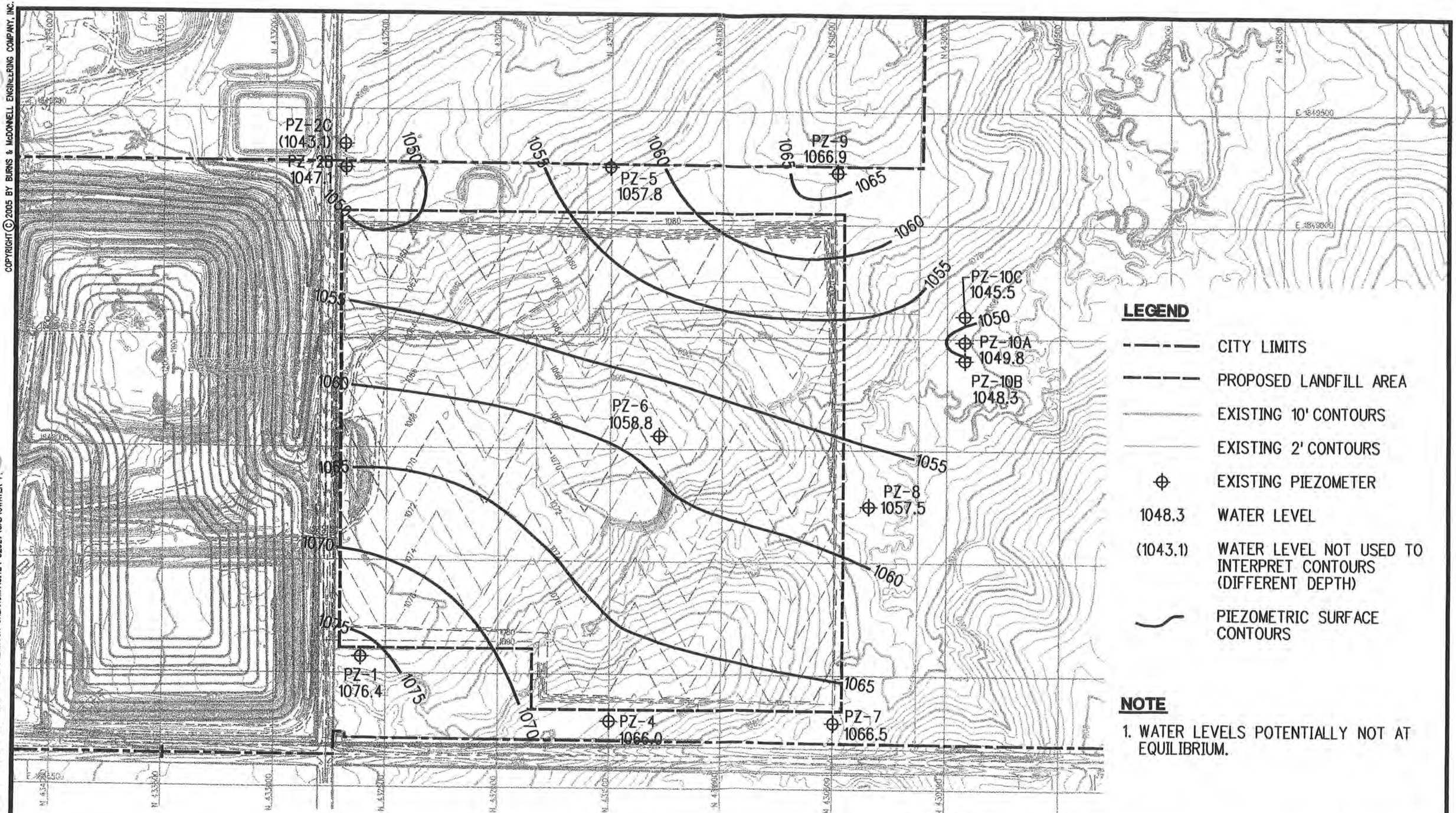
Figure 15

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
JULY 8, 2004



Burns & McDonnell

Figure 16

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
AUGUST 18, 2004

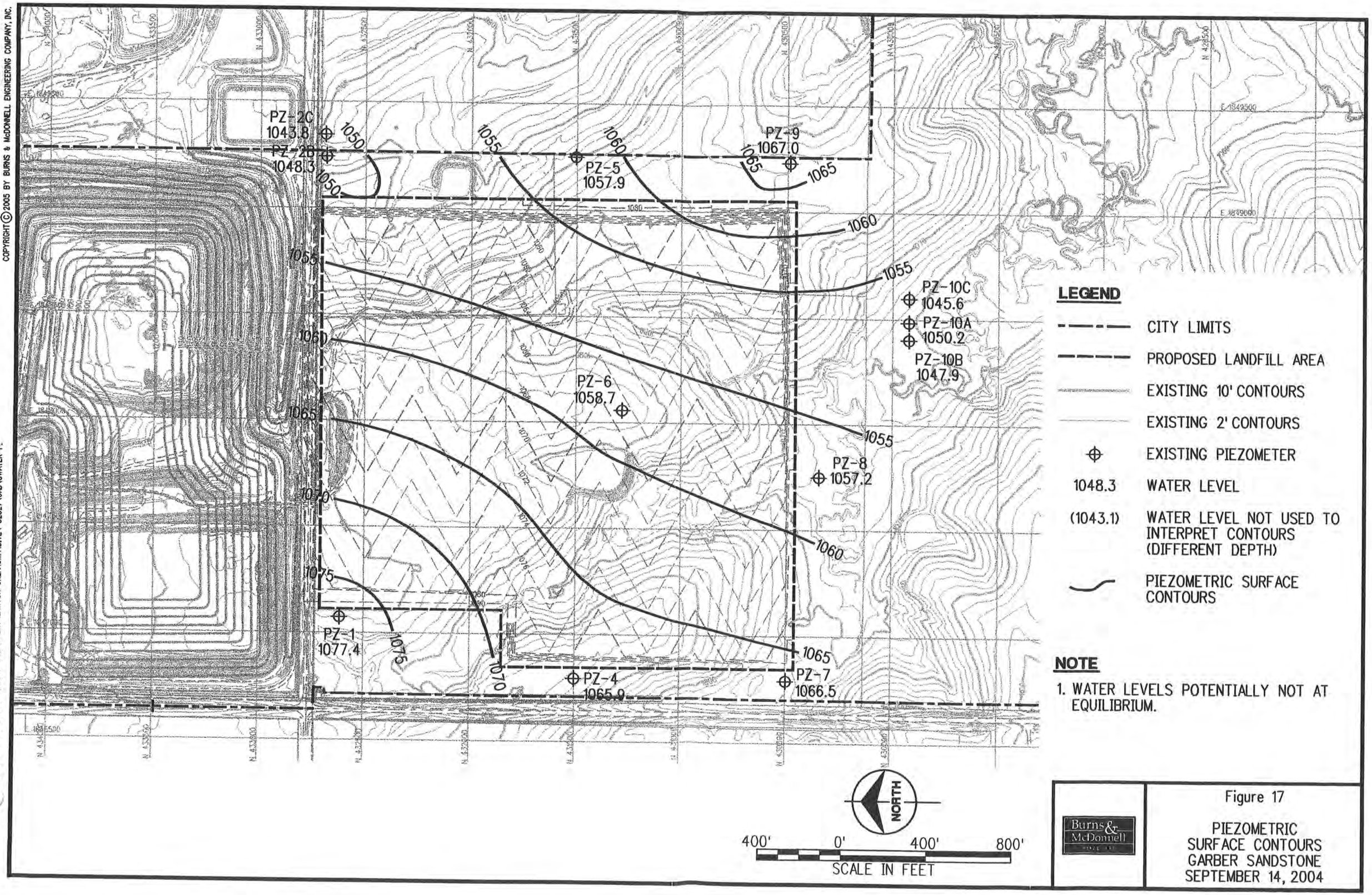


Figure 17

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
SEPTEMBER 14, 2004

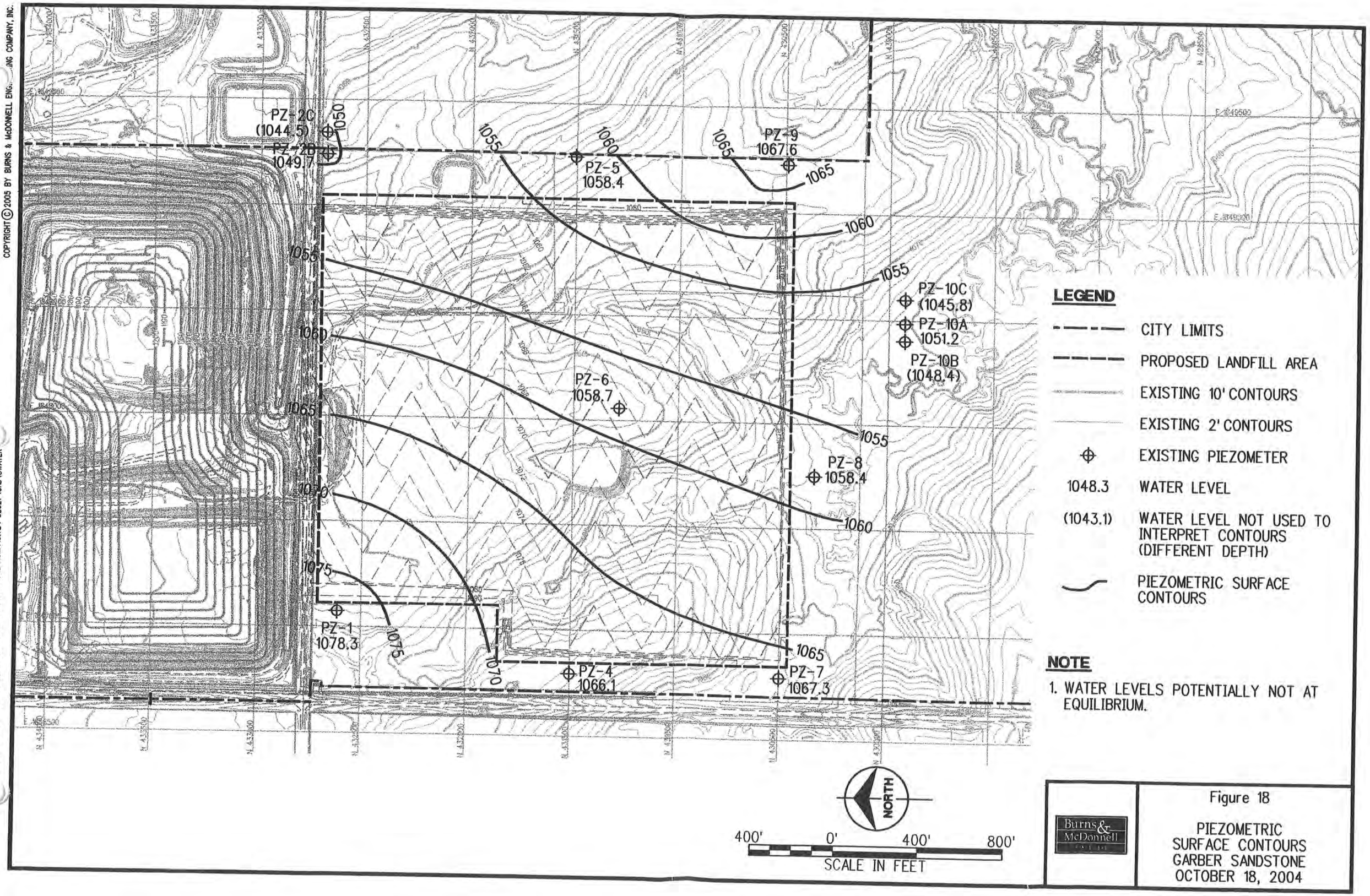
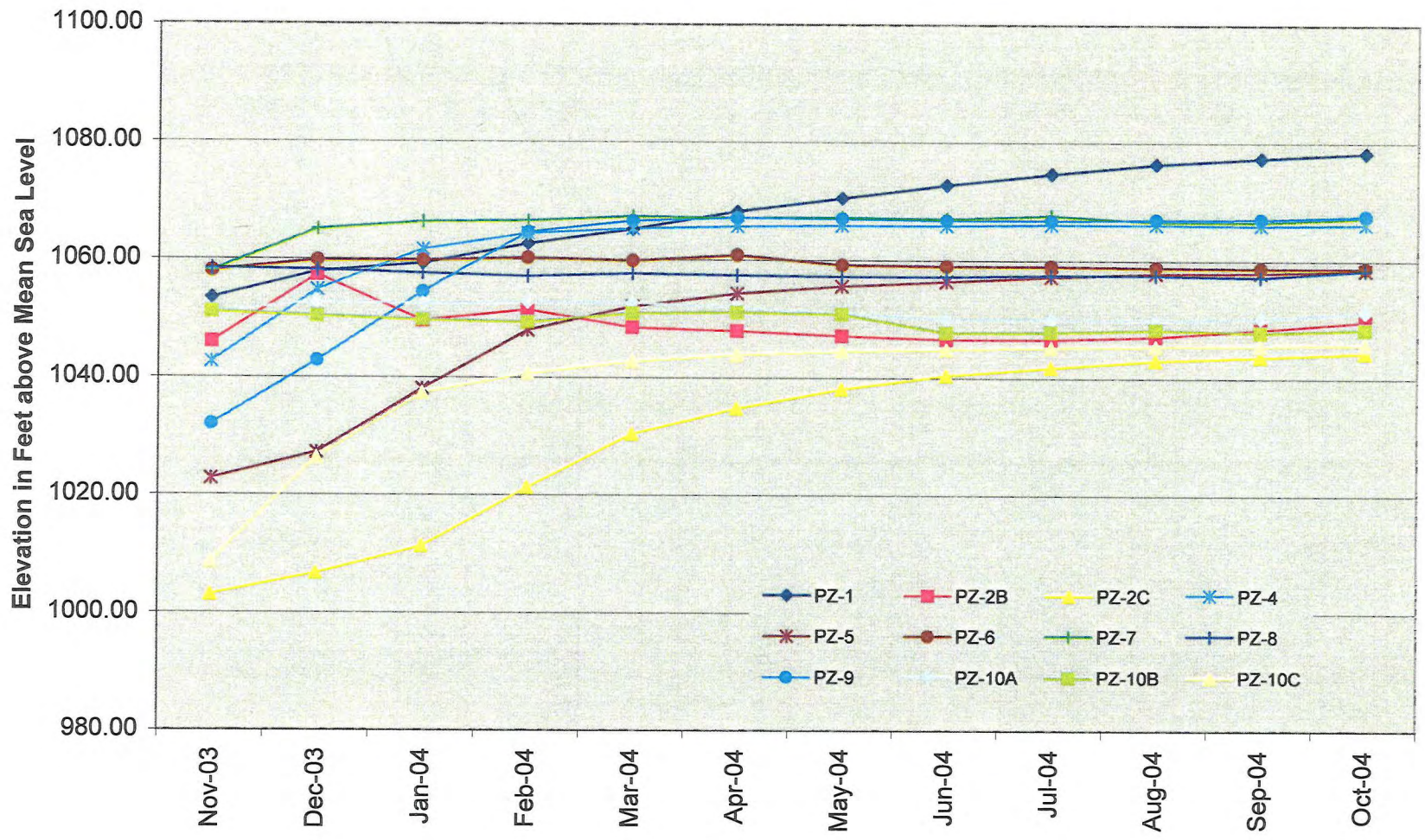


Figure 18

PIEZOMETRIC SURFACE CONTOURS
GARBER SANDSTONE
OCTOBER 18, 2004

Figure 19
HYDROGRAPH OF PIEZOMETERS
NOVEMBER 2003 THROUGH OCTOBER 2004
CITY OF LAWTON LANDFILL



APPENDIX A

Boring Logs

Drilling Log

Project Name	Boring Number
Lawton	PZ-1
Project No. 23693	Page 1 of 5
Ground Elevation 1,098.1 ft. / Location N 432614.313 E 1847073.754	Total Footage 65

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	5	60	NA	NA	58.9	9-29-03

Drilling Company Standard Testing	Drillers (s) John Lawson, Michael Mose
Drilling Rig Davey DK-5	Type of Penetration Test NA
Date 9-9-03 To 9-10-03	Field Observer (s) D.Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAY, with Silt, reddish brown (5YR4/4), dry to moist, stiff, organic matter, trace plasticity						NA	
1								
2								
3								
4								
5	**CLAYSTONE**, reddish brown (5YR4/4), with light olive gray mottles (5Y6/1), dry, very weak							
6								
7			NA	NA	No Sample			
8								
9								
10								
11								
12								
13								
14								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

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Drilling Log, continued

Boring Number	PZ-1
Project Name	Lawton
Page	2 of 5
Project Number	23693
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (5YR4/4), with light olive gray mottles (5Y6/1), dry, very weak						NA	
15								
16								
17								
18								
19								
20								
21								
22			NA	NA	No Sample			
23								
24								
25								
26								
27								
28								
29								
30								
31								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1
Page	3 of 5
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (5YR4/4), with light olive gray mottles (5Y6/1), moist, very weak, trace fine sand						NA	
32								
33								
34								
35	**CLAYSTONE**, some silt, trace calcareous, reddish brown (5YR4/4), some light gray mottles (5Y6/1), dry, very weak, friable							
36								
37								
38								
39			NA	NA	No Sample			
40	moisture increased, moderately calcareous, slightly weathered							
41								
42								
43								
44								
45								
46								
47								
48								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1
Page	4 of 5
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, moderately calcareous, dry, friable, moderate, weathered, very weak, reddish brown (5YR4/4)						NA	
49								
50								
51								
52								
53								
54								
55								
56			NA	NA	No Sample			
57								
58								
59								
60	**CLAYSTONE**, reddish brown (5YR4/4), wet, very weak							
	SHALE, grayish green (5GY6/1), dry, silty, moderately weathered, weak							
61	**CLAYSTONE**, reddish brown (5YR4/4), dry to trace moist, moderately weathered, weak							
62								
63								
64								
65								

Drilling Log, continued

Boring Number	PZ-1
Project Name Lawton	Page 5 of 5
Project Number 23693	Date 9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	Total Depth @ 65' bgs							
66								
67								
68								
69								
70								
71								
72								
73								
74								
75								
76								
77								
78								
79								
80								
81								
82								

Drilling Log

Project Name	Boring Number
Lawton	PZ-1A
Project No. 23693	Page 1 of 14
Ground Elevation 1,098.1 ft. / Location N 432616.38 E 1847073.4	Total Footage 224

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	5	219	15	NA	na	na

Drilling Company: Standard Testing	Drillers (s): John Lawson, Michael Mose
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-9-03 To: 9-10-03	Field Observer (s): C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAY, with Silt, reddish brown (5YR4/4), dry to moist, stiff, organic matter, trace plasticity		5/ 5/ 5		No Sample 1.15/ 1.5	SS-1	0741 Will start drilling with air rotary, 6" reamer bit. Will sample this boring to top of rock/split spoon refusal and then will log from cuttings
1							
2			NA		No Sample	NA	
3							
4							
5	**CLAYSTONE**, reddish brown (5YR4/4), with light olive gray mottles (5Y6/1), dry, very weak		9/ 8/ 12		0/ 1.5	SS-2	
6							
7				NA	No Sample	NA	
8			NA		No Sample		
9							
10			7/ 8/ 11		1.4/ 1.5	SS-3	
11							
12			NA		No Sample	NA	
13							
14							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

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Drilling Log, continued

Boring Number	PZ-1A
Project Name	Lawton
Page	2 of 14
Project Number	23693
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (5YR4/4), with light olive gray mottles (5Y6/1), dry, very weak		NA		No Sample	NA	
15			10/ 11/ 14		1.5/ 1.5	SS-4	
16			NA		No Sample	NA	
17							
18							
19							
20			11/ 14/ 18		1.5/ 1.5	SS-5	
21							
22			NA	NA	No Sample	NA	
23			NA		No Sample		
24							
25			24/ 34/ 50/5		1.5/ 1.5	SS-6	
26							
27			NA		No Sample	NA	
28							
29							
30			12/ 18/		1.5/ 1.5	SS-7	
31							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1A
Page	3 of 14
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (5YR4/4), with light olive gray mottles (5Y6/1), moist, very weak, trace fine sand		17			SS-7	
32						NA	
33			NA		No Sample		
34							
35	**CLAYSTONE**, some silt, trace calcareous, reddish brown (5YR4/4), some light gray mottles (5Y6/1), dry, very weak, friable		17/ 29/ 50/4		1.5/ 1.5	SS-8	
36							
37						NA	
38			NA		No Sample		
39				NA	No Sample		
40	moisture increased, moderately calcareous, slightly weathered		15/ 31/ 43		1.5/ 1.5	SS-9	
41							
42						NA	
43			NA		No Sample		
44							
45			16/ 19/ 25		1.5/ 1.5	SS-10	
46							
47			NA		No Sample	NA	
48							

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1A
Page	4 of 14
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, moderately calcareous, dry, friable, moderate, weathered, very weak, reddish brown (5YR4/4)						NA	
49			NA		No Sample			
50			22/ 50/3		0.7/ 0.7		SS-11	
51							NA	
52								
53			NA		No Sample			
54								
55			23/ 50/3		0.7/ 0.7		SS-12	some moisture in boring @ 55 ft bgs
56							NA	
57				NA	No Sample			
58			NA		No Sample			
59								
60	**CLAYSTONE**, reddish brown (5YR4/4), wet, very weak						SS-13	wet @ 60 ft bgs
61	**SHALE**, grayish green (5GY6/1), dry, silty, moderately weathered, weak		14/ 13/ 50/2		1.2/ 1.5			
62	**CLAYSTONE**, reddish brown (5YR4/4), dry to trace moist, moderately weathered, weak						NA	
63			NA		No Sample			
64								
65								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Boring Number	PZ-1A
Project Name	Lawton
Page	5 of 14
Project Number	23693
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (5YR4/4), dry to trace moist, moderately weathered, weak		21/ 50/5		0.7/ 0.9		SS-14	
66							NA	
67								
68			NA		No Sample			
69								
70	change from moderately weathered to weathered, friable, trace greenish gray (5G6/1), mottled		27/ 50/5		0.9/ 0.9		SS-15	
71							NA	
72								
73				NA	No Sample			
74								
75								hit sample refusal, will log from cuttings from 75 ft bgs to total depth
76			NA					
77								
78								
79								
80								
81								
82								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1A
Page	6 of 14
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (5YR4/4), dry to trace moisture, moderately weathered, weak						NA	
83								
84								
85								
86								
87								
88								
89								
90			NA	NA	No Sample			
91								
92								hard drilling from 92 to 93 ft bgs
93								
94								
95								
96								
97								
98								
99								

Drilling Log, continued

Boring Number	PZ-1A
Project Name	Lawton
Page	7 of 14
Project Number	23693
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (5YR4/4), dry to trace moisture, moderately weathered, weak						NA	
100								
101								
102								
103								
104								
105								
106								
107			NA	NA	No Sample			
108								
109								
110								
111								
112								
113								
114								
115								
116								

Drilling Log, continued

Boring Number	PZ-1A
Project Name Lawton	Page 8 of 14
Project Number 23693	Date 9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, grayish red (5R4/2), dry, trace calcareous, moderately weathered						NA	
117								
118								
119								
120								
121								
122								
123								
124			NA	NA	No Sample			
125								
126								
127								
128								
129								
130								
131								
132								
133								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1A
Page	9 of 14
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, grayish red (5R4/2), dry, trace calcareous, moderately weathered						NA	
134								
135								
136								
137								
138								
139								
140								
141			NA	NA	No Sample			
142								
143								
144								
145								
146								
147								
148								
149								
150								

Drilling Log, continued

Boring Number	PZ-1A
Project Name	Lawton
Page	10 of 14
Project Number	23693
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, trace calcareous						NA	hard drilling from 150.5 to 151
151								
152								
153								
154								
155								
156								
157								
158			NA	NA	No Sample			
159								
160								
161								
162								
163								
164								
165								
166								
167								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1A
Page	11 of 14
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, trace calcareous						NA	
168								hard drilling from 168 to 168.5 ft bgs
169								
170								
171								
172								
173								
174								
175								
			NA	NA	No Sample			
176								
177								
178								
179								
180								
181								
182								
183								
184								

Drilling Log, continued

Boring Number	PZ-1A
Project Name Lawton	Page 12 of 14
Project Number 23693	Date 9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, trace calcareous color change to pale reddish brown (10YR5/4) from 184' to 201'						NA	
185								
186								
187								
188								
189								
190								
191								
192			NA	NA	No Sample			
193								
194								
195								
196								
197								
198								
199								
200								
201								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-1A
Page	13 of 14
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, trace calcareous color change to grayish red (10YR4/2) from 201' to 224'						NA	
202								
203								
204								
205								
206								
207								
208								
209			NA	NA	No Sample			
210								
211								
212								
213								
214								
215								
216								
217								
218								

Drilling Log, continued

Boring Number	PZ-1A
Project Name	Lawton
Page	14 of 14
Project Number	23693
Date	9-9-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, trace calcareous						NA	
219								
220								
221			NA	NA	No Sample			
222								
223								
224								Total Depth @ 224' bgs. Going to offset 5' from this boring and drill new boring for piezometer installation. This boring was abandoned with a bentonite grout.
225								
226								
227								
228								
229								
230								
231								
232								
233								
234								
235								

Drilling Log

Project Name	Boring Number
Lawton	PZ-2A
Project No. 23693	Page 1 of 5
Ground Elevation 1,066.0 ft. / Location N 432709.19 E 1849250	Total Footage 70

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
see Remarks	3"	0	70	NA	7	19.3	9-29-03

Drilling Company Standard Testing	Drillers (s) Tim Fife, Chris Kelty
Drilling Rig CME Track Rig	Type of Penetration Test NA
Date 9-10-03 To 9-12-03	Field Observer (s) C.ROLLI

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10YR3/4), dry, slightly weathered (0-4'), moderately weathered and friable (4'-5'), some gray mottling (N5), dry to moist						CME 1 Box 1	Drilling Methods: HSA/HQ Rock Core w/Air & Water
1				NA	No Sample			
2				NA	Run#1 5/5			9/10/03 1030 start to auger, collect 5' samples with a split barrel sampler
3								
4								
5	from 5' to 10', weathered, friable, dry						CME 2 Box 2	
6								
7			NA	NA	5/5			
8								
9								
10							CME 3 Box 2	
11								
12	**CLAYSTONE**, dark reddish brown (10R3/4), dry, moderately weathered, gray mottling (N5), consistency increasing, less friable, weak			NA	5/5			
13								
14								

DRILLING LOG LAWTON.GPJ BURNS MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-2A
Page	2 of 5
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, gray mottling (N5), stiff to very stiff consistency, very weak					CME 3 Box 2	
15						CME 4 Box 2	
16							
17				NA	5/5		
18							
19							
20	weathered and friable from 20-24'					CME 5 Box 3	
21							
22			NA	NA	5/5		
23							
24	stiffer consistency @ 24' bgs						
25						CME 6 Box 3	
26							
27				NA	5/5		
28							
29							
30						CME 7 No Box	
31							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-2A
Page	3 of 5
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, friable, very weak						CME 7 No Box	
32				NA	5/ 5			
33								
34								
35	**CLAYSTONE**, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable						CR 1 Box 4	9/10/03 Refusal @ 35' bgs. Going to switch to rock core methods.
36								
37				66	3.7/ 5			9/12/03 0700, start core run from 35-40' bgs
38								
39			NA					
40	some moisture in sample from 40-43'						CR 2 Box 4	
41								
42				44	3.5/ 5			
43								
44								
45	**CLAYSTONE**, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable						CR 3 Box 5	run went to 44.5' bgs. Bit got plugged with mtrl due to some moisture in the borehole.
46	@ 46' calcareous nodule approx. .3'							0950, bit is continuing to get plugged off, will inject water per the state's approval
47				43	2.2/ 4.5			
48								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-2A
Page	4 of 5
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable					CR 3 Box 5	
49							
						CR 4 Box 5	
50							
51	may be wet @ 51' to 52' bgs			100	3.5/ 3.5		
52	sample becomes silty, friable						
53						CR 5 Box 6	
54							
55				80	4/ 4		
56			NA				
57						CR 6 Box 6	
58	**SANDSTONE**, greenish gray (5GY6/1), fresh, very weak, very fine grained			80	2.8/ 3		
59							
60	**CLAYSTONE**, dark reddish brown (10R3/4), fresh to slightly weathered, weak, some sandstone lenses, dry					CR 7 Box 6/7	
61							
62				74	5/ 5		
63							
64							
65							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/2/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-2A
Page	5 of 5
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), moderately weathered, some sandstone lenses, very weak, moist, some gray (N5) mottling, trace calcareous						CR 8 Box 7	
66								
67			NA	84	5/5			
68								
69								
70								9/12/03 stop drilling at 70 ft bgs
	Total Depth @ 70' bgs							
71								9/13/03 1030 going to blow hole dry and borehole set.
72								9/13/03 borehole is full of water. WL = 21.9' bgs @ 1335. Going to offset from this corehole and drill a new boring for piezometer installation. This corehole was plugged 9/29/03
73								
74								
75								
76								
77								
78								
79								
80								
81								
82								

Drilling Log

Project Name	Boring Number
Lawton	PZ-2B
Project No. 23693	Page 1 of 4
Ground Elevation 1,066.0 ft. / Location N 432687.525 E 1849242.833	Total Footage 50

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	0	50	NA	NA	26.32	9-29-03

Drilling Company Standard Testing	Drillers (s) John Lawson, Michael Mose
Drilling Rig Davey DK-5	Type of Penetration Test NA
Date 9-15-03 / To 9-15-03	Field Observer (s) D.Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10YR3/4), dry, slightly weathered (0-4'), moderately weathered and friable (4'-5'), some gray mottling (N5), dry to moist						NA	1612 Start drilling air rotary with reamer bit, will log from cuttings
1								
2								
3								
4								
5	from 5' to 10', weathered, friable, dry							
6								
7			NA	NA	No Sample			
8								
9								
10								
11								
12	**CLAYSTONE**, dark reddish brown (10R3/4), dry, moderately weathered, gray mottling (N5), consistency increasing, less friable, weak							
13								
14								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-2B
Page	2 of 4
Date	9-15-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, gray mottling (N5), stiff to very stiff consistency, very weak						NA	
15								
16								
17								
18								
19								
20	weathered and friable from 20-24'							
21								
22			NA	NA	No Sample			
23								
24	stiffer consistency @ 24' bgs							
25								
26								
27								
28								
29								
30								
31								

DRILLING LOG LAWTON.GPJ 3URNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-2B
Page	3 of 4
Date	9-15-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, friable, very weak						NA	
32								
33								
34								
35	**CLAYSTONE**, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable							
36								
37								
38								
39			NA	NA	No Sample			
40	some moisture in sample from 40-43'							
41								
42								
43								
44								
45	**CLAYSTONE**, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable							
46	@ 46' calcareous nodule approx. .3'							
47								
48								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-2B
Page	4 of 4
Date	9-15-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
49	**CLAYSTONE**, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable		NA	NA	No Sample		NA	
50	Total Depth @ 50 ft bgs							moisture in boring @ 49.5 ft bgs. End boring @ 1700, 9/14/03 9/15/03 0710, WL = 50.0 ft bgs 1257 WL = 49.07 ft bgs Going to set well: 4.5 bags sand for filter pack, 1 bag of bentonite chips
51								
52								
53								
54								
55								
56								
57								
58								
59								
60								
61								
62								
63								
64								
65								

Drilling Log

Project Name	Boring Number
Lawton	Temp PZ-2C
Project No. 23693	Page 1 of 5
Ground Elevation 1,066.0 ft. / Location	Total Footage 65

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	0	65	NA	NA	DRY	9-29-03

Drilling Company: Standard Testing	Drillers (s): John Lawson, Michael Mose
Drilling Rig: Davey DK-5	Type of Penetration Test: NA
Date: 9-15-03 To: 9-15-03	Field Observer (s): D.Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10YR3/4), dry, slightly weathered (0-4'), moderately weathered and friable (4'-5'), some gray mottling (N5), dry to moist						NA	0955 start drilling air rotary, will log from cutting
1								
2								
3								
4								
5	from 5' to 10', weathered, friable, dry							
6								
7			NA	NA	No Sample			
8								
9								
10								
11								
12	**CLAYSTONE**, dark reddish brown (10R3/4), dry, moderately weathered, gray mottling (N5), consistency increasing, less friable, weak							
13								
14								

Drilling Log, continued

Boring Number	Temp PZ-2C
Project Name	Lawton
Page	2 of 5
Project Number	23693
Date	9-15-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, gray mottling (N5), stiff to very stiff consistency, very weak						NA	
15								
16								
17								
18								
19								
20	weathered and friable from 20-24'							
21								
22			NA	NA	No Sample			
23								
24	stiffer consistency @ 24' bgs							
25								
26								
27								
28								
29								
30								
31								

DRILLING LOG LAWTON.GPJ 3URNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	Temp PZ-2C
Page	3 of 5
Date	9-15-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, moderately weathered, friable, very weak						NA	
32								
33								
34								
35	**CLAYSTONE**, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable							
36								
37								
38								
39			NA	NA	No Sample			
40	some moisture in sample from 40-43'							
41								
42								
43								
44								
45	**CLAYSTONE**, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable							
46	@ 46' calcareous nodule approx. .3'							
47								
48								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	**Temp PZ-2C**
Page	4 of 5
Date	9-15-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry to moist, moderately weathered, calcareous, weak, friable						NA	
49								
50								
51	may be wet @ 51' to 52' bgs							
52	sample becomes silty, friable							
53								
54								
55								
56			NA	NA	No Sample			
57								
58	**SANDSTONE**, greenish gray (5GY6/1), fresh, very weak, very fine grained							
59								
60	**CLAYSTONE**, dark reddish brown (10R3/4), fresh to slightly weathered, weak, some sandstone lenses, dry							
61								
62								
63								
64								
65								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	Temp PZ-2C
Page	5 of 5
Date	9-15-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	Total Depth @ 65 ft bgs							1058 stop drilling @ 65.5 ft bgs. Backfill 6" of sand 65-65.5 bgs, and set the well. 4 3/4 bags of sand for filter pack, 1 bag of bentonite chips. 2 - 5 ft screen pipe, 4 - 15' riser pipe
66								
67								
68								
69								
70								
71								
72								
73								
74								
75								
76								
77								
78								
79								
80								
81								
82								

Drilling Log

Project Name	Boring Number
Lawton	PZ-3
Project No. 23693	Page 1 of 13
Ground Elevation 1,091.5 ft. / Location N 432001.75 E 1848250	Total Footage 200

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	5	195	18	NA	DRY	9-30-03

Drilling Company: Standard Testing	Drillers (s): John Lawson, Michael Mose
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-10-03 To: 9-12-03	Field Observer (s): D.Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	**CLAYSTONE**, reddish brown (5YR4/4), dry to moist, stiff, trace plasticity		6/ 6/ 13		No Sample 1.5/ 1.5		SS-1	1710 start air rotary w/ reamer bit. Will sample boring to top of rock/split spoon to refusal and then will log from cuttings.
2							NA	
3			NA		No Sample			
4								
5	**CLAYSTONE**, reddish brown (2.5YR4/4) with light olive gray mottles (5YR6/2), damp, very weak							
6			5/ 7/ 10		1.5/ 1.5		SS-2	
7				NA	No Sample		NA	
8			NA		No Sample			
9								
10							SS-3	
11			7/ 8/ 8		1.5/ 1.5			
12							NA	
13			NA		No Sample			
14								

DRILLING LOG - LAWTON GPJ BURNS MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-3
Page	2 of 13
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4) with light olive gray mottles (5YR6/2), damp, very weak		NA		No Sample	NA	
15	**CLAYSTONE**, trace silt, trace calcareous, reddish brown (2.5YR4/4) with light olive gray mottles (5YR6/2), very weak, dry to damp		10/ 17/ 29		1.5/ 1.5	SS-4	
16							
17			NA		No Sample	NA	
18							
19							
20			12/ 50/5		0.9/ 0.9	SS-5	
21			NA		No Sample No Sample	NA	
22				NA			
23							
24							
25			12/ 29/ 50/5.5		1.5/ 1.5	SS-6	
26							
27					No Sample	NA	
28	**SHALE**, light olive gray (5Y5/2), silty, moderately weathered, dry						
29	**CLAYSTONE**, reddish brown (2.5YR4/4) with light olive gray mottles (5YR6/2), dry, friable, moderately weathered, very weak		NA				
30			/ 27/ 50/4		0.8/ 0.8	SS-7	
31							

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-3
Page	3 of 13
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4), some light gray mottles (5Y7/1), damp, very weak, trace calcareous					NA	
32							
33			NA		No Sample		
34							
35			21/ 50/4.5		0.9/ 0.9	SS-8	
36						NA	
37							
38			NA		No Sample		
39				NA	No Sample		slight moisture @ 39' bgs
40	**CLAYSTONE**, reddish brown (2.5YR4/4), some light olive gray mottles (5Y6/2), very weak, moist, slightly weathered, trace calcareous		18/ 50/5		0.9/ 0.9	SS-9	
41						NA	
42							
43			NA		No Sample		
44							
45	**CLAYSTONE**, silty, moderately calcareous, dry, friable, moderately weathered, very weak, reddish brown (2.5YR4/4)		29/ 50/3		0.7/ 0.7	SS-10	
46						NA	
47			NA		No Sample		
48							

Drilling Log, continued

Boring Number	PZ-3
Project Name	Lawton
Page	4 of 13
Project Number	23693
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, moderately calcareous, dry, friable, moderately weathered, very weak, reddish brown (2.5YR4/4)						NA	
49			NA		No Sample			
50			32/ 50/2		0.7/ 0.7		SS-11	
51							NA	
52			NA		No Sample			
53								
54								
55			28/ 50/3		0.8/ 0.8		SS-12	
56							NA	
				NA	No Sample			
57								
58			NA		No Sample			
59								
60			50/5		0.4/ 0.4		SS-13	
61							NA	
62			NA		No Sample			
63								
64								
65								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/2/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-3
Page	5 of 13
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4), dry to trace moisture, moderately weathered, weak						NA	0950 @ 65', going to log from cuttings
66								
67								
68								
69								
70								
71								
72								
73								
	SHALE, grayish green (10GY5/2), dry, silty, moderately weathered, dry, weak		NA	NA	No Sample			
74	**CLAYSTONE**, reddish brown (2.5YR4/4), dry to trace moisture, moderately weathered, weak							
75								
76								
77								
78								
79								
80								
81								
82								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-3
Page	6 of 13
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4), dry to trace moisture, moderately weathered, weak						NA	
83								
84								
85								
86								
87								
88								
89								
90			NA	NA	No Sample			
91								
92								
93								
94								
95								
96								
97								
98								
99								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-3
Page	7 of 13
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4), dry to trace moisture, moderately weathered, weak						NA	
100								
101								
102			NA		No Sample			
103								
104								
105			50/5		0.4/ 0.5		SS-14	some moisture @ 105' bgs
							NA	
106								
107				NA	No Sample			
108								
109								hard drilling from 109 to 110' bgs
110								
111			NA		No Sample			
112								
113								
114								
115								
116								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-3
Page	8 of 13
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4), dry to trace moisture, moderately weathered, weak						NA	
117								
118								
119								
120								
121								
122								
123								
124			NA	NA	No Sample			
125								
126								
127								
128								
129								
130								
131								
132								
133								

Drilling Log, continued

Boring Number	PZ-3
Project Name	Lawton
Page	9 of 13
Project Number	23693
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4), dry to trace moisture, moderately weathered, weak						NA	
134								
135								
136								
137								
138								
139								
140								
141			NA	NA	No Sample			
142								
143								
144								
145								
146								
147								
148								
149								hard drilling from 149 to 150' bgs
150								

Drilling Log, continued

Boring Number	PZ-3
Project Name	Lawton
Page	10 of 13
Project Number	23693
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, reddish brown (2.5YR4/4), dry to trace moisture, moderately weathered, weak		25/ 50/3		0.8/ 0.8		SS-15	moisture @ 150' bgs
151							NA	
152								
153								
154								
155			NA		No Sample			
156								
157								
158				NA	No Sample			
159								
160	**CLAYSTONE**, grayish red (10R4/2), dry, friable, calcareous, moderately weathered, weak		24/ 50/.35		0.9/ 0.9		SS-16	
161							NA	
162								
163								
164			NA		No Sample			
165								
166								
167								

Drilling Log, continued

Boring Number	PZ-3
Project Name	Lawton
Page	11 of 13
Project Number	23693
Date	9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, dark reddish brown (10R3/4), dry, friable, slightly calcareous, moderately weathered, weak						NA	
168								
169								
170								
171			NA		No Sample			
172								
173								
174								
175			25/ 50/.3	NA	0/ 0.0 No Sample		SS-17	
176							NA	
177								
178								
179								
180			NA		No Sample			moisture @ 179.5
181								
182								
183								
184								

Drilling Log, continued

Boring Number	PZ-3
Project Name Lawton	Page 12 of 13
Project Number 23693	Date 9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, grayish red (10R4/2), dry, trace calcareous, moderately weathered, weak						NA	
185								hard drilling @ 185' bgs.
186								
187								
188								
189			NA		No Sample			
190								
191								
192				NA	No Sample			
193								
194								
195	**CLAYSTONE**, grayish red (10R4/2), damp to wet, calcareous, moderately weathered, weak		27/ 50/.15		0.7/ 0.7		SS-18	moisture @ 195' bgs
196							NA	
197								
198			NA					
199								
200								no water accumulated in this boring as of 9/30/03. Boring
201	Total Depth @ 200' bgs							

Drilling Log, continued

Boring Number	PZ-3
Project Name Lawton	Page 13 of 13
Project Number 23693	Date 9-10-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
202								was abandoned with a bentonite grout from total depth to ground surface.
203								
204								
205								
206								
207								
208								
209								
210								
211								
212								
213								
214								
215								
216								
217								
218								

Drilling Log

Project Name	Boring Number
Lawton	PZ-4
Project No. 23693	Page 1 of 5
Ground Elevation 1,097.0 ft. / Location N 431502.26 E 1846792.69	Total Footage 65

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
see Remarks	6"	5	60	NA	3	DRY	9-29-03

Drilling Company: Standard Testing	Drillers (s): Tim Fife, Chris Kelty
Drilling Rig: CME Track Rig/Davey DK-5	Type of Penetration Test: NA
Date: 9-24-03 To: 9-25-03	Field Observer (s): C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SILT, some clay, very dark grayish brown (10YR3/2), dry to trace plasticity, stiff consistency, friable						CME-1 BOX 1	Drilling Methods: HSA/HQ Rock Core w/Air/Air Rotary
1					No Sample			
2					Run#1 5/ 5			
3								
4	**CLAY**, some silt, red (2.5YR4/2), moist, low to medium plasticity, stiff consistency							
5	**SILTSTONE**, with clay, moderate reddish brown (10R4/6), dry, friable, moderate greenish gray mottling (5GY6/1)						CME-2 No Box	
6								
7			NA		Run#2 0/ 5			
8								
9				NA				
10							CME-3 Box 1	
11								
12					Run#3 5/ 5			
13								
14								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Boring Number	PZ-4
Project Name	Lawton
Page	2 of 5
Project Number	23693
Date	9-24-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, some fine sand, some calcareous (limestone) fragments, increased grayish green mottling @ 15-17' bgs, dark reddish brown (10R4/6), dry, friable, very weak						CME-3 Box 1	
15							CME-4 Box 2	
16								
17					Run#4 5/ 5			
18								
19								
20							CME-5 Box 2	
21								
22			NA	NA	Run#5 5/ 5			
23								
24								
25							CME-6 Box 3	
26								
27					Run#6 5/ 5			
28								
29								
30							CME-7 Box 3	
31								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Boring Number	PZ-4
Project Name Lawton	Page 3 of 5
Project Number 23693	Date 9-24-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, dark reddish brown (10R4/6), dry, calcareous, greenish gray mottling (5GY6/1), grading from weathered to moderately weathered						CME-7 Box 3	
32					Run#7 5/ 5			
33								
34								
35				NA			CME-8 Box 4	
36								
37					Run#8 5/ 5			
38								
39			NA					
40							CR-1 Box 4	refusal @ 40' bgs, going to switch to coring
41	grading to moderately weathered to fresh, some fine sand							
42	calcareous vugs @ 41.8 to 42			RQD= 42%	Run#9 3.5/ 5			
43								
44								
45	greenish gray claystone increases @ 45' bgs **CLAYSTONE**, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), slightly weathered to fresh, very weak						CR-2 Box 5	
46								
47				RQD= 80%	Run#10 5/ 5			
48								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-4
Page	4 of 5
Date	9-24-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
49	**CLAYSTONE**, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), slightly weathered to fresh, very weak					CR-2 Box 5	
50						CR-3 Box 5	
51	**SANDSTONE**, interbedded with clay, greenish gray (5GY6/1)						
	CLAYSTONE, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), slightly weathered to fresh, very weak			RQD= 40%	Run#11 5/ 5		
52							
53							
54							
55						CR-4 Box 6	
56			NA				
57				RQD= 18%	Run#12 2/ 5		
58							
59							
60						CR-5 Box 6	
61							
62				RQD= 45%	Run#13 5/ 5		
63							
64							
65							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/2/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc

Drilling Log, continued

Boring Number	PZ-4
Project Name Lawton	Page 5 of 5
Project Number 23693	Date 9-24-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	Total Depth @ 65' bgs							TD @ 65 ft bgs, will move track rig off of location, and the air rig will set up to ream a 6" boring and install a piezometer.
66								
67								
68								
69								
70								
71								
72								
73								
74								
75								
76								
77								
78								
79								
80								
81								
82								

Drilling Log

Project Name	Boring Number
Lawton	PZ-5
Project No. 23693	Page 1 of 4
Ground Elevation 1,079.6 ft. / Location N 431499.89 E 1849232.26	Total Footage 63

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
see Remarks	6"	5	58	NA	7	DRY	9-29-03

Drilling Company: Standard Testing	Drillers (s): Tim Fife, Chris Kelty
Drilling Rig: CME Track Rig/Davey DK-5	Type of Penetration Test: NA
Date: 9-25-03 To: 9-26-03	Field Observer (s): C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	SILT, some clay, some fine to medium gravel, non plastic, moderately stiff, brown (10YR3/2), dry					CME-1 BOX 1	Drilling Methods: HSA/HQ Rock Core w/Air/Air Rotary
1					No Sample		9/25/03 1344 start to drill with HSA's and continuos sampler
2					Run#BOX 1 5/5		
3							
4							
5	**CLAYSTONE**, silty, calcareous gravel, moderately weathered, dark reddish brown (10R4/6), dry to slightly moist					CME-2 BOX 1	
6							
7			NA		Run#BOX 1 5/5		
8	greenish gray (5GY6/1) mottling begins @ 8' bgs, trace fine sand						
9				NA			
10	decrease in calcareous content @ 10' bgs					CME-3 BOX 2	
11							
12					Run#BOX 2 5/5		
13							
14							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-5
Page	2 of 4
Date	9-25-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, dry, weathered, friable, trace fine sand						CME-3 BOX 2	
15							CME-4 BOX 2	
16								
17					Run#BOX 2 5/ 5			
18								
19								
20							CME-5 BOX 3	
21								
22	**CLAYSTONE**, silty, dark reddish brown (10R4/6), some greenish gray mottling (5GY6/1), dry, weathered, friable		NA	NA	Run#BOX 3 5/ 5			
23								
24								
25							CME-6 BOX 3	
26								
27					Run#BOX 3 5/ 5			
28								
29								
30	increase in calcareous content (limestone nodules), trace fine sand						CME-7 BOX 4	
31								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-5
Page	3 of 4
Date	9-25-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
32					Run#BOX 4 5/ 5		CME-7 BOX 4	
33								
34				NA				
35							CME-8 BOX 4	
36					Run#BOX 4 3/ 3			
37								
38	**CLAYSTONE**, some silt, some fine sand, dark reddish brown (10R4/6), some calcareous gravel, some greeenish gray mottling (5GY6/1), moist, very weak, fresh						CR-1 BOX 5	1450 sampler refusal, will switch to HQ air core at 38 ft bgs
39			NA					
40	**CLAYSTONE**, some silt, some fine sand, greenish gray (5GY6/1), fresh, very weak			RQD= 77%	Run#BOX 5 4.1/ 5			
41								
42								
43							CR-2 BOX 5	
44								
45				RQD= 92%	Run#BOX 5 5/ 5			
46								
47	**SANDSTONE**, fine grained, interbedded with clay, fresh							
48								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-5
Page	4 of 4
Date	9-25-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, dark reddish brown (10YR4/6, moist, fresh						CR-3 BOX 6	
49								
	SANDSTONE,							
50	**CLAYSTONE**, some silt, some fine sand, dark reddish brown (10R4/6), trace greenish mottling (5GY6/1), moist, very weak, moderately weathered			RQD= 16%	Run#BOX 6 3.4/ 5			
51								
52								
53							CR-4 BOX 6	
54								
55			NA	RQD= 35%	Run#BOX 6 3.5/ 5			
56								
57								
58	**CLAYSTONE**, some silt, trace fine sand, dark reddish brown (10R4/6), moist, moderately weathered, greenish gray (5GY6/1) mottling						CR-5 BOX 7	
59								
60				RQD= 64%	Run#BOX 7 4.5/ 5			
61								
62								
63	Total Depth @ 63' bgs							TD @ 63 ft bgs. Track rig will move off of location and air rig will set up @ PZ-4 to ream hole with 6" bit and install piezometer.
64								
65								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name	Boring Number
Lawton	PZ-6
Project No. 23693	Page 1 of 4
Ground Elevation 1,093.1 ft. / Location N 431280.77 E 1848061.02	Total Footage 58.7

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
see Remarks	6"	3	55.7	NA	6	45.27	9-29-03

Drilling Company Standard Testing	Drillers (s) Tim Fife, Chris Kelty
Drilling Rig CME Track Rig/Davey DK-5	Type of Penetration Test NA
Date 9-22-03 To 9-24-03	Field Observer (s) C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1, 2	**SILT**, some clay, dark brown (10R3/3), dry, very soft, friable, organic material				No Sample		CME-1 BOX 1	Drilling Methods: HSA/HQ Rock Core w/Air/Air Rotary
3, 4, 5	**CLAYSTONE**, some silt, some organic material, calcareous nodules, grayish green (5GY5/1), dry, weak, weathered from 4-6', slightly weathered from 6-8', weathered 8-10, poorly cemented sandstone fragments				5/5			
6, 7, 8, 9			NA	NA	5/5		CME-2 BOX 2	
10, 11, 12, 13, 14	**SILTSTONE**, some clay, dark reddish brown (2.5YR3/4), dry, weathered, very weak, friable, some greenish gray (5GY5/1) mottling				5/5		CME-3 BOX 2	

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-6
Page	2 of 4
Date	9-22-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SILTSTONE, some clay, dark reddish brown (2.5YR3/4), dry, weathered, very weak, friable, some greenish gray (5GY5/1) mottling						CME-3 BOX 2	
15							CME-4 BOX 2	
16								
17					5/ 5			
18								
19								
20							CME-5 BOX 3	
21								
22			NA	NA	5/ 5			
23								
24								
25							CME-6 BOX 3	
26								
27	**CLAYSTONE**, some very fine grained sand, greenish gray (5GY5/1), calcareous, mosit, fresh				5/ 5			
28	**CLAYSTONE**, silty, dark reddish brown (2.5YR3/4), dry, weathered, friable, calcareous, some greenish gray mottling (5GY5/1), dry to slightly moist							
29								
30							CME-7 BOX 4	
31								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-6
Page	3 of 4
Date	9-22-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
32	**SILTSTONE**, some clay, dark reddish brown (2.5YR3/4), dry, friable, very weak, trace greenish gray mottling (5GY5/1)				5/ 5		CME-7 BOX 4	
33				NA				
34	grading to moderately weathered to fresh							
35	**CLAYSTONE**, some silt, some greenish gray mottling (5GY5/1), dark reddish brown (2.5YR3/4), dry to moist, moderately weathered to fresh, weak, trace calcareous, trace fine sand						CR-1 BOX 4	hit refusal, switch to rock core
36								
37				RQD= 60%	5/ 5			
38								
39			NA					
40							CR-2 BOX 5	
41								
42				RQD= 13%	2.2/ 5			
43								
44								
45							CR-3 BOX 5	
46				NA	2.1/ 2.5			
47								
48	**CLAYSTONE**, with fine sand, some silt, greenish gray (5GY6/1), moist, fresh, very weak, calcareous							9/22/03 1800 stop drill @ 47.5' bgs.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-6
Page	4 of 4
Date	9-22-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
						CR-4 BOX 5	moist soil at 47.5
	CLAYSTONE, with fine sand, some silt, dark reddish brown (2.5YR3/4), moist, moderately weathered						
49	**SANDSTONE**, with **CLAY**, some silt, dark reddish brown (10R3/4), fine grained, poorly cemented, weak, calcareous, vertical fracture from 49.2 to 50.2, trace greenish gray mottling (5GY5/1), moderately weathered						9/23/03 9/23/03 0723, checked wl at 47.5' bgs, no water
50				RQD= 68%	4.1/ 5		
51							
52							
53			NA			CR-5 BOX 6	
54							
55				RQD= 60%	4.4/ 5		
56							
57							
58	Total Depth @ 57.5' bgs			NA	No Sample	NA	stopped drilling @ 57.5 ft bgs, hit water @ 49' bgs in core sample. Going to pull off of hole and ream to set a piezometer. 9/24/03 0723 set up on boring to ream to 58 ft bgs and install piezometer
59							
60							
61							
62							
63							
64							
65							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log

Project Name	Boring Number
Lawton	PZ-7
Project No. 23693	Page 1 of 3
Ground Elevation 1,071.9 ft. / Location N 430497.75 E 1846797.3	Total Footage 35

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
see Remarks	6"	10	25	NA	3	33.48	9-29-03

Drilling Company Standard Testing	Drillers (s) Tim Fife, Chris Kelty
Drilling Rig CME Track Rig/Davey DK-5	Type of Penetration Test NA
Date 9-24-03 To 9-24-03	Field Observer (s) C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAY, some silt, dark reddish brown (2.5YR3/4), dry to moist, low to medium plasticity, soft consistency				No Sample		CME 1 BOX 1	Drilling Methods: HSA/HQ Rock Core w/Air/Air Rotary
1								
2					5/5			
3								
4								
5	**CLAY**, some silt, some fine to medium gravel, dark red (2.5YR3/6), moist, low to medium plasticity, some fine sand, soft consistency, some greenish gray (10GY6/1)						CME 2 BOX 1	
6								
7			NA	NA	5/5			
8	**CLAY**, some silt, trace fine gravel, trace fine sand, moderately greenish gray (10GY6/1) mottling, moist, soft consistency, moderately calcareous							
9								
10	**SILTSTONE**, some clay, dark reddish brown (2.5YR3/4), dry, weathered, friable, some greenish gray mottling (10GY6/1), trace calcareous						CME 3 BOX 2	
11								
12					5/5			
13								
14								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-7
Page	2 of 3
Date	9-24-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, (weathered shale), trace fine sand, dark reddish brown (2.5YR3/4), dry to slightly moist, some greenish gray mottling (10G6/1)						CME 3 BOX 2	
15							CME 4 BOX 2	
16								
17					5/ 5			
18								
19								
20							CR 1 BOX 3	hit refusal at 20 ft bgs, going to switch to air core.
21								
22			NA	NA	1.3/ 5			
23								
24								
25							CR 2 BOX 3	
26								
27					1/ 5			
28								
29	**SANDSTONE**, some interbedded greeenish gray clay, weathered, weak, fine grained **CLAYSTONE**, silty, (weathered shale), trace fine sand, dark reddish brown (2.5YR3/4), dry to slightly moist, some greenish gray mottling (10G6/1)							
30							CR 3 BOX 3	
31								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-7
Page	3 of 3
Date	9-24-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, (weathered shale), trace fine sand, dark reddish brown (2.5YR3/4), dry to slightly moist, some greenish gray mottling (10G6/1)						CR 3 BOX 3	
32					1.8/ 5			
33			NA	NA				
	SANDSTONE, some interbedded greeenish gray clay, weathered, weak, fine grained							
34								
	CLAYSTONE, silty, (weathered shale), trace fine sand, dark reddish brown (2.5YR3/4), dry to slightly moist, some greenish gray mottling (10G6/1)							
35	Total Depth @ 35' bgs							stop drill at 35' bgs, going to move to another location. The air rig will set up on this location and ream the borehole to 6", and set a piezometer
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								

Drilling Log

Project Name	Boring Number
Lawton	PZ-8
Project No. 23693	Page 1 of 3
Ground Elevation 1,066.5 ft. / Location N 430342.96 E 1847750	Total Footage 32

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	3	29	NA	NA	14.91	10-1-03

Drilling Company Standard Testing	Drillers (s) John Lawson, Michael Mose
Drilling Rig Davey DK-5	Type of Penetration Test NA
Date 9-29-03 To 9-29-03	Field Observer (s) D.Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAY, some silt and sand, trace to medium plasticity, brown (7.5YR4/3), dry to damp, stiff						NA	Start to air rotary, (6" reamer bit). Will log from cuttings
1								
2								
3	**CLAYSTONE**, some silt and sand, moderate reddish brown (10R4/6), damp to moist, high plasticity, fresh, weak							
4								
5								
6								
7			NA	NA	No Sample			
8								
9								
10								
11								
12								
13	**CLAYSTONE**, silty, trace sand, light olive gray (5Y6/1), dry, slightly weathered, weak, trace calcareous							
14								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Boring Number	PZ-8
Project Name	Lawton
Page	2 of 3
Project Number	23693
Date	9-29-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, trace silt, moderate reddish brown (10R4/6), trace greenish gray (5GY6/1), dry to damp, slightly weathered, weak, calcareous						NA	
15								
16	**CLAYSTONE**, silty, sandstone seams, greeenish gray (5G6/1), dry to damp, slightly weathered, weak, calcareous							
17								
18	**CLAYSTONE**, some sand and trace silt, moderate reddish brown (10R4/6), some light olive gray (5Y6/1), dry to damp, fresh to slightly weathered, weak, trace calcareous							
19								
20								
21								
22			NA	NA	No Sample			
23								
24								
25								
26								
27								
28								
29								
30								
31								

Drilling Log, continued

Boring Number	PZ-8
Project Name	Lawton
Page	3 of 3
Project Number	23693
Date	9-29-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
			NA	NA	No Sample		NA	
32								Total Depth @ 32 ft bgs
	Total Depth @ 32.0 ft bgs							
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								

Drilling Log

Project Name	Boring Number
Lawton	PZ-9
Project No. 23693	Page 1 of 4
Ground Elevation 1,085.0 ft. / Location N 430489.89 E 1849229.59	Total Footage 58

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	5	53	NA	NA	DRY	9-29-03

Drilling Company: Standard Testing	Drillers (s): John Lawson, Michael Mose
Drilling Rig: Davey DK-5	Type of Penetration Test: NA
Date: 9-26-03 To: 9-27-03	Field Observer (s): C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SILT, some clay, brown (10YR3/2), dry, trace fine gravel, low plasticity, organic material						NA	Start to air rotary with 6" reamer bit. Will log from cuttings
1								
2								
3								
4								
5								
6	**CLAYSTONE**, silty, calcareous, some fine gravel from 6-7' bgs, high plasticity, moist, mediume consistency, dark reddish brown (10R4/6)							
7			NA	NA	No Sample			
8								
9	some greenish gray (5GY6/1) mottling * 9'							
10	becomes dry and friable @ 10'							
11								
12								
13								
14								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Boring Number	PZ-9
Project Name	Lawton
Page	2 of 4
Project Number	23693
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, moderately calcareous, dark reddish brown (10R4/6), dry, soft consistency, weathered, some greenish gray (5GY6/1) mottling						NA	
15								
16								
17								
18								
19								
20								
21								
22			NA	NA	No Sample			
23								
24								
25								
26								
27								
28								
29								
30								
31								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-9
Page	3 of 4
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, moderately calcareous, dark reddish brown (10R4/6), dry, soft consistency, weathered, some greenish gray (5GY6/1) mottling						NA	
32								
33								
34								
35								
36								
37	**CLAYSTONE**, silty, moderately calcareous, trace fine sand, dark reddish brown (10R4/6), with greenish gray mottling (5GY6/1), moist, very weak, moderately weathered							
38								
39			NA	NA	No Sample			
40								
41								
42								
43								
44	decrease in gray mottling and not calcareous @ 44' bgs							
45								
46	**CLAYSTONE**, some silt, trace fine sand, greenish gray (5GY6/1), very weak							
47								
48								

Drilling Log, continued

Boring Number	PZ-9
Project Name Lawton	Page 4 of 4
Project Number 23693	Date 9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, dark reddish brown (10R4/6), moist, fresh, calcareous, moderately strong						NA	
49								
50								
51								
52								
53			NA	NA	No Sample			
54								
55								
56								
57								
58								Total Depth @ 58 ft bgs
	Total Depth @ 58' bgs							
59								
60								
61								
62								
63								
64								
65								

Drilling Log

Project Name	Boring Number
Lawton	PZ-9A
Project No. 23693	Page 1 of 7
Ground Elevation 1,085.0 ft. / Location N 430499.89 E 184223.62	Total Footage 100

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
see Remarks	3"	6	94	NA	10	DRY	9-29-03

Drilling Company: Standard Testing	Drillers (s): Tim Fife, Chris Kelty
Drilling Rig: CME Track Rig	Type of Penetration Test: NA
Date: 9-26-03 To: 9-27-03	Field Observer (s): C.ROLLI

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SILT, some clay, brown (10YR3/2), dry, trace fine gravel, low plasticity, organic material						CME 1 BOX 1	Drilling Methods: HSA/HQ Rock Core w/Air & Water
1					No Sample			
2					5/5			
3								
4								
5							CME 2 BOX 1	
6	**CLAYSTONE**, silty, calcareous, some fine gravel from 6-7' bgs, high plasticity, moist, mediume consistency, dark reddish brown (10R4/6)							
7			NA		5/5			
8								
9	some greenish gray (5GY6/1) mottling * 9'			NA				
10	becomes dry and friable @ 10'						CME 3 BOX 2	
11								
12					3.85/5			
13								
14								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 — Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-9A
Page	2 of 7
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, moderately calcareous, dark reddish brown (10R4/6), dry, soft consistency, weathered, some greenish gray (5GY6/1) mottling						CME 3 BOX 2	
15							CME 4 BOX 2	
16								
17					4/ 5			
18								
19								
20							CME 5 BOX 3	
21								
22			NA	NA	4.4/ 5			
23								
24								
25							CME 6 BOX 3	
26								
27					5/ 5			
28								
29								
30							CME 7 BOX 4	
31								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-9A
Page	3 of 7
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, silty, moderately calcareous, dark reddish brown (10R4/6), dry, soft consistency, weathered, some greenish gray (5GY6/1) mottling						CME 7 BOX 4	
32					5/ 5			
33								
34				NA				
35							CME 8 BOX 4	
36					2/ 2			
37	**CLAYSTONE**, silty, moderately calcareous, trace fine sand, dark reddish brown (10R4/6), with greenish gray mottling (5GY6/1), moist, very weak, moderately weathered						CR 1 BOX 5	Sampler refusal @ 37 ft bgs, going to switch to air core
38								
39			NA	RQD= 56%	4.3/ 5			
40								
41								
42							CR 2 BOX 5	
43								
44	decrease in gray mottling and not calcareous @ 44' bgs			RQD= 47%	4.3/ 5			
45								
46	**CLAYSTONE**, some silt, trace fine sand, greenish gray (5GY6/1), very weak							
47							CR 3 BOX 6	
48								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Boring Number	PZ-9A
Project Name	Lawton
Page	4 of 7
Project Number	23693
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, dark reddish brown (10R4/6), moist, fresh, calcareous, moderately strong						CR 3 BOX 6	
49				RQD= 53%	4.2/ 5			
50								
51								
52							CR 4 BOX 6	
53								
54				RQD= 85%	5/ 5			may be H2O at 54 ft bgs.
55								
56			NA					
57							CR 5 BOX 7	plugging off at 57 ft bgs. Going to have to ream the hole out in order to continue. Will inject water in order to continue to core to 100' bgs for DEQ reg's.
58								
59				RQD= 53%	3.1/ 5			1533 start to core with water @ 57' bgs
60	@ 60' bgs, increase in calcareous content							
61								
62							CR 6 BOX 7	
63								
64				RQD= 32%	2.7/ 5			
65								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Boring Number	PZ-9A
Project Name	Lawton
Page	5 of 7
Project Number	23693
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, dark reddish brown (10R4/6), moist, moderately weathered, calcareous						CR 6 BOX 7	
66								
67							CR 7 BOX 7	9/26/03 stop coring for the day 9/27/03 0811 start to core 0839 stop core, sample stuck, have to pull rods, core was plugged off and sample was reworked, so there was full recovery, but core in the box only reflects solid pieces.
68								
69				RQD= 43%	5/ 5			
70								
71								
72							CR 8 BOX 8	
73								
74			NA	RQD= 27%	2.9/ 5			
75								
76								
77	**CLAYSTONE**, with fine**SAND**, some silt, dark reddish brown (10R4/6), moist, weathered, very weak, some greenish gray mottling present from 77-89.5 bgs.						CR 9 BOX 8	
78								
79				RQD= 70%	5/ 5			
80								
81								
82								

Drilling Log, continued

Boring Number	PZ-9A
Project Name	Lawton
Page	6 of 7
Project Number	23693
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, with fine**SAND**, some silt, dark reddish brown (10R4/6), moist, weathered, very weak, some greenish gray mottling present from 77-89.5 bgs.						CR 10 BOX 9	
83								
84				RQD= 80%	5/ 5			
85								
86								
87							CR 11 BOX 9	
88								
89				RQD= 25%	2.5/ 5			
90	**SANDSTONE**, with **CLAY**, some silt, greenish gray (5GY6/1) to dark reddish brown (10R4/6), moderately weathered, poorly cemented, weak, wet		NA					
91	**CLAYSTONE**, with fine **SAND** and **SILT**, dark reddish brown (10R4/6), moderately weathered, wet, moderately strong							
92							CR 12 BOX 9	
93				RQD= 43%	3/ 3			
94	increased sand @ 94' bgs							
95							CR 13 BOX 10	
96								
97				RQD= 12%	2/ 5			
98								
99								

Drilling Log, continued

Boring Number	**PZ-9A**
Project Name	Lawton
Page	7 of 7
Project Number	23693
Date	9-26-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, with fine **SAND** and **SILT**, dark reddish brown (10R4/6), moderately weathered, wet, moderately strong		NA				CR 13 BOX 10	
100	Total Depth@ 100' bgs							Total Depth @ 100' bgs. Going to pull off of location, and will abandon corehole due to injection water. The air rig will offset a few feet and drill to total depth and install a piezometer.
101								
102								
103								
104								
105								
106								
107								
108								
109								
110								
111								
112								
113								
114								
115								
116								

Drilling Log

Project Name	Boring Number
Lawton	PZ-10
Project No. 23693	Page 1 of 6
Ground Elevation 1,060.7 ft. / Location N 429917.65 E 1848499.89	Total Footage 85

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
see Remarks	6"	25	60	NA	8	9.2	9-29-03

Drilling Company Standard Testing	Drillers (s) Tim Fife, Chris Kelty
Drilling Rig CME Track Rig	Type of Penetration Test NA
Date 9-28-03 To 9-28-03	Field Observer (s) C.ROLLI

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	SILT, some clay, brown (10R4/4), dry, low plasticity, trace fine grave, medium consistency					CME 1 Box 1	Drilling Methods: HSA/HQ Rock Core w/Air
1							
2					4.6/ 5		
3	**CLAY**, some silt, medium to high plasticity, brown (10R4/4), moist, stiff consistency						
4							
5						CME 2 BOX 1	
6							
7	**CLAY**, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs		NA		5/ 5		
8							
9				NA	NA		
10						CME 3 BOX 2	
11							
12					3.2/ 5		
13							
14							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	**PZ-10**
Page	2 of 6
Date	9-28-03

Depth	Description	Class	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
	CLAY, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs					CME 3 BOX 2	
15	**CLAY**, with **FINE SAND** and silt, dark reddish brown (10R4/6), with trace greenish gray mottling (5GY6/1), dry, friable					CME 4 BOX 2	
16							
17					5/ 5		
18	becoming stiff @ 18' bgs						
19				NA	NA		
20						CME 5 BOX 3	
21							
22			NA		5/ 5		
23							
24	grading into a weathered claystone						
25	**CLAYSTONE**, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, fresh to slightly weathered, moderately strong					CR 1 BOX 3	Refusal @ 25 ft bgs, start to core with air
26							
27				RQD= 39%	2.3/ 5		
28							
29							
30						CR 2 BOX 3	
31							

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring Number **PZ-10**
Project Number 23693	Page 3 of 6
	Date 9-28-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, fresh to slightly weathered, moderately strong						CR 2 BOX 3	
32				RQD= 14%	1/ 5			
33								
34								
35							CR 3 BOX 3	
36								
37				RQD= 12%	1.1/ 5			
38								
39			NA					
40							CR 4 BOX 4	
41								
42				RQD= 18%	2.9/ 5			
43								
44								
45	**SHALE**, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling						CR 5 BOX 4	
46								
47				RQD= 54%	5/ 5			
48								

Drilling Log, continued

Boring Number	PZ-10
Project Name	Lawton
Page	4 of 6
Project Number	23693
Date	9-28-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SHALE, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling						CR 5 BOX 4	
49								
50							CR 6 BOX 5	
51								
52				RQD= 33%	3.8/ 5			
53								
54								
55							CR 7 BOX 5	
56			NA					
57				RQD= 70%	5/ 5			
58								
59								
60							CR 8 BOX 6	
61								
62				RQD= 24%	2.8/ 5			
63								
64								
65								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-10
Page	5 of 6
Date	9-28-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SHALE, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling						CR 9 BOX 7	
66								
67				RQD= 33%	5/ 5			
68								
69								
70							CR 10 BOX 7	
71								
72				RQD= 60%	5/ 5			
73			NA					
74								
75							CR 11 BOX 7	
76								
77				RQD= 65%	5/ 5			
78								
79								
80	**CLAYSTONE**, some silt, some fine sand, dark reddish brown (10R4/6), calcareous, some greenish						CR 12 BOX 8	
81								
82								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-10
Page	6 of 6
Date	9-28-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
83 84	**CLAYSTONE**, some silt, some fine sand, dark reddish brown (10R4/6), calcareous, some greenish		NA	RQD= 20%	5/ 5		CR 12 BOX 8	
85 86 87 88 89 90 91 92 93 94 95 96 97 98 99	Total Depth @ 85 ft bgs							Total Depth @ 85 ft bgs 9/29/03 WL = 9.2 ft bgs We offset from this location to drill a new boring to install a piezometer so we wouldn't have to install through water. This corehole was abandoned with a bentonite grout.

Drilling Log

Project Name	Boring Number
Lawton	PZ-10A
Project No. 23693	Page 1 of 6
Ground Elevation 1,098.1 ft. / Location N 429925.162 E 1848485.028	Total Footage 86

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	25	61	NA	NA	6.29	10-1-03

Drilling Company Standard Testing	Drillers (s) John Lawson, Michael Mose
Drilling Rig Davey DK-5	Type of Penetration Test NA
Date 9-30-03 To 9-30-03	Field Observer (s) C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SILT, some clay, brown (10R4/4), dry, low plasticity, trace fine grave, medium consistency						NA	9/29/03 start drilling @ 1310, drill with 6" air rotary reamer bit, going to log from cuttings
3	**CLAY**, some silt, medium to high plasticity, brown (10R4/4), moist, stiff consistency							
7	**CLAY**, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs		NA	NA	No Sample			

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 — Waste Consultants, Inc.

Drilling Log, continued

Boring Number	**PZ-10A**
Project Name	Lawton
Page	2 of 6
Project Number	23693
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAY, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs						NA	
15	**CLAY**, with **FINE SAND** and silt, dark reddish brown (10R4/6), with trace greenish gray mottling (5GY6/1), dry, friable							
16								
17								
18	becoming stiff @ 18' bgs							
19								
20								
21								
22			NA	NA	No Sample			
23								
24	grading into a weathered claystone							
25	**CLAYSTONE**, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, fresh to slightly weathered, moderately strong							
26								
27								
28								
29								
30								
31								

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-10A
Page	3 of 6
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, fresh to slightly weathered, moderately strong						NA	
32								
33								
34								
35								
36								
37								
38								
39			NA	NA	No Sample			
40								
41								
42								
43								
44								
45	**SHALE**, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling							
46								
47								
48								

Drilling Log, continued

Boring Number	PZ-10A
Project Name Lawton	Page 4 of 6
Project Number 23693	Date 9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SHALE, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling						NA	
49								
50								
51								
52								
53								
54								
55								
56			NA	NA	No Sample			
57								
58								
59								
60								H2O noticed in borehole @ 60' bgs
61								
62								
63								
64								
65								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-10A
Page	5 of 6
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SHALE, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling						NA	
66								
67								
68								
69								
70								
71								
72								
73			NA	NA	No Sample			
74								
75								
76								
77								
78								
79								
80	**CLAYSTONE**, some silt, some fine sand, dark reddish brown (10R4/6), calcareous, some greenish							
81								
82								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	PZ-10A
Page	6 of 6
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, dark reddish brown (10R4/6), calcareous, some greenish		NA	NA	No Sample		NA	
83								
84								
85	Total Depth @ 85 ft bgs							
86								9/29/03 Total Depth @ 86 ft bgs. Going to backfill the boring with bentonite chips to 72 ft bgs, so we can install a piezometer tommorow. 9/30/03, 0758 Grout swelled to 62 ft bgs, wl @ 8.9 ft bgs. 9/30/03, boring collapsed on top of bentonite grout to 57 ft bgs from 62 ft bgs. Going to back fill the boring and set a piezometer. 1450, backfilled the boring with bentonite chips from 57 ft bgs to 46 ft bgs. Added sand from 46 ft bgs to 33 ft bgs installed piezometer screen from approx. 33 ft bgs to 23 ft bgs. Installed filter pack from 33 ft bgs to 20 ft bgs, bentonite chips from 20 ft bgs to 16 ft bgs and bentonite grout from 16 ft bgs to 3 ft bgs.
87								
88								
89								
90								
91								
92								
93								
94								
95								
96								
97								
98								
99								

Drilling Log

Project Name	Boring Number
Lawton	Temp PZ-10B
Project No. 23693	Page 1 of 2
Ground Elevation 1,098.1 ft. / Location	Total Footage 17

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	17	0	NA	NA	8.88	10-1-03

Drilling Company: Standard Testing	Drillers (s): John Lawson, Michael Mose
Drilling Rig: Davey DK-5	Type of Penetration Test: NA
Date: 9-29-03 To: 9-30-03	Field Observer (s): C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SILT, some clay, brown (10R4/4), dry, low plasticity, trace fine grave, medium consistency						NA	log from cuttings
3	**CLAY**, some silt, medium to high plasticity, brown (10R4/4), moist, stiff consistency							
7	**CLAY**, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs		NA	NA	No Sample			

1 2 3 4 5 6 7 8 9 10 11 12 13 14

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/2/03

Burns & McDonnell SINCE 1898 | Waste Consultants, Inc.

Drilling Log, continued

Boring Number	**Temp PZ-10B**
Project Name	Lawton
Page	2 of 2
Project Number	23693
Date	9-29-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAY, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs						NA	
15	**CLAY**, with **FINE SAND** and silt, dark reddish brown (10R4/6), with trace greenish gray mottling (5GY6/1), dry, friable		NA	NA	No Sample			
16								
17	Total Deth @ 17 ft bgs							installed a 1" piezometer in the boring. Screened fro 7-17 ft bgs.
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

Drilling Log

Project Name	Boring Number
Lawton	Temp PZ-10C
Project No. 23693	Page 1 of 6
Ground Elevation 1,098.1 ft. / Location	Total Footage 70

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	25	45	NA	NA	67.21	10-1-03

Drilling Company Standard Testing	Drillers (s) John Lawson, Michael Mose
Drilling Rig Davey DK-5	Type of Penetration Test NA
Date 9-30-03 / To 9-30-03	Field Observer (s) C.Rolli, D. Pollock

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SILT, some clay, brown (10R4/4), dry, low plasticity, trace fine grave, medium consistency						NA	log from cuttings
3	**CLAY**, some silt, medium to high plasticity, brown (10R4/4), moist, stiff consistency							
7	**CLAY**, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs		NA	NA	No Sample			

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

DRILLING LOG LAWTON.GPJ BURNS_MO.GDT 12/22/03

Burns & McDonnell SINCE 1898 — Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	Temp PZ-10C
Page	2 of 6
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAY, with **FINE GRAVEL**, dark reddish brown (10R4/6), moist, soft consistency, medium plasticity, gravel abundant, from 7-7.5' bgs						NA	
15	**CLAY**, with **FINE SAND** and silt, dark reddish brown (10R4/6), with trace greenish gray mottling (5GY6/1), dry, friable							
16								
17								
18	becoming stiff @ 18' bgs							
19								
20								
21								
22			NA	NA	No Sample			
23								
24	grading into a weathered claystone							
25	**CLAYSTONE**, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, fresh to slightly weathered, moderately strong							
26								
27								
28								
29								
30								
31								

Drilling Log, continued

Boring Number	**Temp PZ-10C**
Project Name	Lawton
Page	3 of 6
Project Number	23693
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, calcareous, dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, fresh to slightly weathered, moderately strong						NA	
32								
33								
34								
35								
36								
37								
38								
39			NA	NA	No Sample			
40								
41								
42								
43								
44								
45	**SHALE**, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling							
46								
47								
48								

Drilling Log, continued

Project Name	Lawton
Project Number	23693
Boring Number	Temp PZ-10C
Page	4 of 6
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SHALE, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling						NA	
49								
50								
51								
52								
53								
54								
55								
56			NA	NA	No Sample			
57								
58								
59								
60								
61								
62								
63								
64								
65								

Drilling Log, continued

Boring Number	**Temp PZ-10C**
Project Name	Lawton
Page	5 of 6
Project Number	23693
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	SHALE, some silt, some fine sand, argillaceous, trace calcareous, grayish red (5R4/2), dry, fresh, moderately strong, some greenish gray (5GY6/1) mottling						NA	
66								
67			NA	NA	No Sample			
68								
69								
70								Total Depth @ 70.5 ft bgs. Installed temporary 2" piezometer screen from 70.4 to 60.4 ft bgs. Did not installed a permanent completion at this location. Will monitor the water level, and abandon accordingly.
71								
72								
73								
74								
75								
76								
77								
78								
79								
80	**CLAYSTONE**, some silt, some fine sand, dark reddish brown (10R4/6), calcareous, some greenish							
81								
82								

Drilling Log, continued

Boring Number	**Temp PZ-10C**
Project Name	Lawton
Page	6 of 6
Project Number	23693
Date	9-30-03

Depth	Description	Class	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	CLAYSTONE, some silt, some fine sand, dark reddish brown (10R4/6), calcareous, some greenish							
83								
84								
85								
	Total Depth @ 85 ft bgs							
86								
87								
88								
89								
90								
91								
92								
93								
94								
95								
96								
97								
98								
99								

Drilling Log

Project Name: Lawton			Boring Number: BH-1 offset 28'E & 5'S
Project No.: 23693			Page: 1 of 5
Ground Elevation: 1101.11	Location: 432729.45 N 1846745.61 E		Total Footage: 70.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	4.0'	70.0'	[illegible]	0	See Remarks	NA

Drilling Co.: Standard Testing, Inc.		Driller (s): John Lawson & Michael Moas	
Drilling Rig: Davey DK-5		Type of Penetration Test: SPT	
Date: 9-27-03	To: 9-27-03	Field Observer (s): Darin Pollock	

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	clay, some sand, trace silt & gravel, medium to high plasticity, reddish brown (2.5YR 4/4) mottled dark brown (10YR 3/3), damp, stiff	CLCH Fill	5/5/8	NA	1.30/1.50	1	SS-1	Start 1125
1–2	clay, some sand, medium to high plasticity, brown (10YR 4/3), damp to moist, stiff	CLCH Possible Fill	NA	NA	NR	2	NS	
3–4						3, 4		
5	Claystone, some sand & silt, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), damp to moist, fresh, weak, trace calcareous		6/11/19	NA	1.5/1.5	5, 6	SS-2	stopped drilling 1135
7						7		Start drilling @ 1140
8–9						8, 9	—	
10						10		
11						11		stopped drilling @ 1143
12			NA	NA	1.5/1.5	12	ST-1	Shelby tube refusal @ 12.5
13						13		Start drilling @ 1148
14						14		

Burns & McDonnell Waste Consultants, Inc.

01/11/1994 Form WCI-DB2-1

Drilling Log, continued

Boring No.	BH-1 offset 28'E + 5'S
Project Name	Lawton
Page	2 of 5
Project No	23693
Date	9-27-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Depth	Sample or Box No.	Remarks
4						14		1315 Drillers setting soil diverter pipe
5						15		
6	claystone, some sand, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), damp to moist, fresh, weak, trace calcareous					16		
7						17		
8						18		
19						19		
20	trace silt		22/32/47	NA	1.45/1.50	20	SS-3	Stopped drilling @ 1329
21						21		
22						22		Start drilling @ 1336
23						23		
24						24		
25			28/50-5.5"	NA	.96/.96	25	SS-4	Stopped drilling @ 1342
26	claystone, some sand lenses & trace silt, moderate reddish brown (10R 4/6) Some greenish gray (5GY 6/1), dry,					26		Start drilling 1420
27	fresh to slightly weathered, weak					27		
28						28		
29						29		
30	trace calcareous		30/50-5"	NA	.90/.90	30	SS-5	Stopped drilling @ 1426
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-1
Project No. 23693	Page 3 of 5
	Date 9-27-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32	claystone, some sand, dark reddish brown (10R 3/4) trace greenish gray (5GY 6/1) mottles, dry, slightly weathered, weak					32		Start drilling @ 1436
33						33		
34						34		
35	claystone, silty, greenish gray (5GY 6/1), damp, slightly weathered, weak, trace calcareous		30/50-5"	NA	.90/.90	35	SS-6	Stopped drilling @ 1440
36						36		
37						37		Start drilling @ 1447
38						38		
39	claystone, some sand lenses, + silt, dark reddish brown (10R 3/4) some greenish gray (5GY 6/1) mottling, dry, slightly weathered, weak, trace calcareous					39		
40			26/50-5.5	NA	.96/.96	40	SS-7	Stopped drilling @ 1453
41						41		
42						42		Start drilling @ 1503
43						43		
44						44		
45	slightly to moderately weathered		50-5.5"	NA	.46/.46	45	SS-8	Stopped drilling @ 1507
46						46		
47	claystone, silty, trace fine sand, light olive gray (5Y 4/1), dry, moderately weathered, weak trace calcareous					47		Started drilling @ 1518
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Boring No. BH-1
Page 4 of 5
Date 9-27-03

Project Name Lawton
Project No. 23693

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		
49			NA	NA	NR	49	NS	
50	claystone, trace sand lenses, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), dry, moderately weathered, friable, weak, trace calcareous		50-4.5'	NA	40/40	50	SS-9	Stopped drilling @ 1523
51						51		Start drilling @ 1533
52			NA	NA	NR	52	NS	
53						53		
54						54		
55			50-5.0'	NA	40/40	55	SS-10	Stopped drilling @ 1538
56	claystone, w/ sandstone seams, dark reddish brown (10R 3/4) trace greenish gray (5GY 6/1), dry, moderately weathered, friable, weak, calcareous					56		Logged from cuttings
57			NA	NA	NR	57	NS	
58						58		
59						59		
60						60		Moisture observed in cuttings @ 60' bgs
61	claystone, some silt, moderate reddish brown (10R 4/6) trace greenish gray (5GY 4/1), dry, slightly to moderately weathered, weak					61		
62						62		
63						63		
64						64		
65						65		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Boring No. BH-1
Project Name Lanton
Page 5 of 5
Project No. 23693
Date 9-27-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65						65		Logged from cuttings
66						66		
	same as above							
67						67		
68						68		
69						69		
70						70		
								TD-70' End Boring @1625

Drilling Log

Project Name: Lawton			Boring Number: BH-2
Project No.: 23693			Page: 1 of 4
Ground Elevation: 1099.79	Location: 432723.95N 1847748.50E		Total Footage: 75.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
HSA	4"	14'	75.0'	12-SS	0	See Remarks	NA

Drilling Co.: Standard Testing	Driller (s): Tim Fife, Chris Kelly
Drilling Rig:	Type of Penetration Test: Split-Spoon
Date: 9-13-03 To: 9-13-03	Field Observer (s): CRolli

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	CLAY, some silt, dark reddish brown (2.5YR3/4), dry to moist, stiff consistency, low to medium plasticity		4/6/8		1.5/1.5		SS-1	1355 start to drill
2								
3								
4								
5			5/10/14		1.5/1.5		SS-2	
6	Some gray mottling (@ 6.5', organic material present (5YR4/1)							
7								
8								
9								
10	increase in silt, decrease in moisture.		6/10/14		1.5/1.5		SS-3	
11	@ 11.5 - trace fine sands present.							
12								
13								
14								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B2
Page	2 of
Date	9-13-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14	CLAYSTONE, darkreddish brown (2.5YR3/4), some silt, trace fine sand, trace calcareous, some gray mottling (N5), dry, very weak, moderately weathered							
15			11/17/24		1.5/1.5		SS-4	
16								
17								
18								
19								
20	CLAYSTONE, with silt, dark reddish brown (2.5YR3/4), dry, friable, trace gray (N5) mottling, very weak weathered.		13/24/31		1.5/1.5		SS-5	
21								
22								
23								
24								
25	CLAYSTONE, silty, dark reddish brown (2.5YR3/4), some greenish gray mottling (10GY4/1), dry, friable, weathered, trace fine sand, trace calcareous.		20/50-5 3/4"		.95/.95		SS-6	
26								
27								
28								
29								
30			30/50-3"		0.7/0.7		SS-7	
31								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B2
Page	3 of
Date	9-13-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31	CLAYSTONE, silty, dark reddish brown (2.5YR 3/4), some greenish gray mottling (10GY 6/1), dry, friable, weathered, trace [illegible]							
32								
33								9-13-03 stop drilling @ 35' due to mechanical problems
34								
35								9-14-03 1400 start to push split spoon @ 35' bgs.
36			28/50-5.5"		.95/.95"		SS-6	
37								
38								
39								
40	some moisture @ top of sample		28/50-4.5"		.875/.875		SS-9 1440	
41								
42								
43								
44								
45	trace calcareous.		28/50-5.5"				SS-10 1626	Moisture on outside of the sampler.
46								
47								@ 47-48.5 - sandstone?
48								harder drilling

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B2
Page	4 of
Date	9-14-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48	CLAYSTONE, silty, trace calcareous, dark reddish brown (2.5YR 3/4), dry to trace moisture, fresh to moderately weathered, stiff consistency, trace gray mottling (N5)							hard drilling (USCS)
49								
50			42/50-3"		.75/.75		SS-11 1653	
51								
52								
53								
54								
55			50-4"				SS-12 1727	Split spoon refusal will log from cuttings.
56								
57								
58								
59								
60							G-2 (Grab)	9-14-03 stop @ 60' bgs 9-15-03 0700 start @ 60' bgs.
61								
62								
63								
64								[illegible] drilling
65								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

	Boring No. B2
Project Name	Page 4 of 4
Project No.	Date 9-15-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65	CLAYSTONE, silty, trace calcareous, dark reddish brown (2.5YR3/4), dry to trace moisture, fresh to moderately weathered, stiff consistency, trace flaky cuttings (1.5)						C2 (6-16.6)	drilled w/ HSA's log from cuttings
66							65-70	
67			NA	NA	NA			
68								
69								
70								
71							C3 (1.06) 70-75	
72			NA	NA	NA			
73								
74								
75							0935	9-15-03 Stop drilling 75' for day due to equipment problems.
76							C4 (1.06)	
77			NA	NA	NA		75-80	
78								
79								
80								
81								

Drilling Log

Project Name	Lawton	Boring Number	B3
Project No.	23693	Page	1 of 2
Ground Elevation	1091.73	Location	432720.45N 1848248.50E
Total Footage	16'		

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
HSA	6"	5	11	3-SS 1-ST	NA	NA	NA

Drilling Co.	Standard Testing	Driller (s)	Tim Fite, Chris Kelty
Drilling Rig.	CME Track Rig	Type of Penetration Test	SPT
Date 9-29-03	To 9-29-03	Field Observer (s)	Craig

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	CLAY, some silt, brown (10YR4/3), dry, friable		6/8/9		1.5/1.5		SS-1	
2								
3								
4								
5	CLAYSTONE, some silt, calcareous dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, dry stiff consistency		NA	NA	2/2		ST-1 B3 0930	
6								
7								
8								
9								
10								
11			NA	NA	NA		SS-2	
12								
13								
14								

Burns & McDonnell Waste Consultants, Inc.

01/11/2004

Form WCI-OP3-1

Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B3
Page	2 of 2
Date	10-8-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14	CLAYSTONE, some silt, calcareous dark reddish brown (10R4/6), with greenish gray (5GY6/1) mottling, dry, stiff consistency							
15								
16			NA	NA	NA		SS-3	
17								Refusal @ 16' bgs.
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton			Boring Number: B4
Project No.: 23693			Page: 1 of 2
Ground Elevation: 1075.79	Location: 432716.95N 1848748.50E		Total Footage: 20.5'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
HSA	6"	14	NA	6 (5-SS, 1-ST)	NA	NA	NA

Drilling Co.: Standard Testing		Driller (s): Tim Fife, Chris Kelty	
Drilling Rig: CME Truck Rig		Type of Penetration Test: SPT	
Date: 9-29-03	To: 9-29-03	Field Observer (s): C. Rell	

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	CLAY, some silt, brown (10R 4/6), dry, low plasticity.		5/5/10		1.5/1.5		SS-1	
2								
3								
4								
5	CLAY, some silt, some organic mottling, moist, medium plasticity, hard consistency tough.		5/11/16		1.5/1.5		SS-2	
6								
7							ST-1	
8					1.5/2			
9								
10	increased moisture @ 10'-11.5' bgs		5/7/10		1.5/1.5		SS-3	
11								
12								
13								
14	grading into a Claystone @ 14'							

Burns & McDonnell Waste Consultants, Inc.

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Form WCI-OP3-1

Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B4
Page	2 of 2
Date	9-29-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14	CLAYSTONE, silty, dark reddish brown (10R 3/6), dry,							
15			10/40/50-5"		1.4/1.4		SS4	
16								
17								
18								
19								
20			NA		0.5/0.5		SS-5	
21								TD @ 20.5' bgs.
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton						Boring Number: B-5	
Project No.: 23603						Page: 1 of 5	
Ground Elevation: 1062.79		Location: 432000.00N 1848748.50E				Total Footage: 74.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	5.5"	5.0'	74.0'	14-SS	0	See Remarks	NA
Drilling Co.: Standard Testing, Inc.				Driller (s): John Lawson & Michael Moes			
Drilling Rig: Davey DK-5				Type of Penetration Test: SPT			
Date: 9-16-03	To: 9-16-03			Field Observer (s): Devin Pollock			

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	claystone, silty, trace fine sand, moderate reddish brown (10R 4/6), trace greenish gray (5GY 6/1), dry to damp, very weak		5/13/20	NA	1.50/1.50	1	SS-1	
2–4			NA	NA	NR	2, 3, 4	NS	
5						5		
6	claystone, some silt and sand lenses, moderate reddish brown (10R 4/6), dry, fresh to slightly weathered, weak, trace calcareous		15/25/36	NA	1.50/1.50	6	SS-2	Stopped hammering, split spoon @ 6.5' There is a hair line fracture in the hammer where it beats down on split spoon. Drillers will have to weld hammer
7–9			NA	NA	NR	7, 8, 9	NS	Resume drilling @ 1425
10						10		
11	claystone, trace sand lenses, moderate reddish brown (10R 4/6), trace light olive gray (5Y 6/1), slightly weathered, weak		11/23/50-5"	NA	1.40/1.40	11	SS-3	Sample taken @ 1434
12–13			NA	NA	NR	12, 13	NS	
14						14		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-5
Project No. 23693	Page 2 of 5
	Date 9-15-05

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14			NA	NA	NR	14	NS	
15	claystone, weak, reddish brown (10R 3/4), trace lime, olive gray (5Y 4/2), slightly weathered, weak, dry to damp		17/50 5.5"	NA	13/.92	15		sample taken @ 1445
16						16		
17			NA	NA	NR	17	NS	
18						18		
19						19		
20			17/50 2"	NA	1.0/1.0	20	SS-5	sample taken @ 1456
21						21		
22						22		
23			NA	NA	NR	23	NS	
24	claystone, silty, greenish gray (5G 4/1), dry to damp, moderately weathered, weak					24		
25			29/50 2"	NA	.67/.67	25	SS-6	sample taken @ 1510
26	siltstone, trace sand, coarse, dark reddish brown (10R 3/4), dry, slightly weathered, weak, trace calcareous					26		
27						27		
28			NA	NA	NR	28	NS	
29						29		
30			50/5.5"	NA	.46/.46	30	SS-7	sample taken @ 1523
31			NA	NA	NR	31	NS	

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-5
Project No. 23693	Page 3 of 5
	Date 9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32						32		
			NA	NA	NR		NS	
33						33		
34	Claystone, some silt & trace sandstone lenses, moderate reddish brown (10R 4/6), trace light olive gray (5Y 6/1) mottles, slightly to moderately weathered, dry, trace calcareous					34		
35			22/50-5"	NA	1.90/.92	35	SS-8	Sample taken @ 1533
36						36		
37						37		
38						38		
39						39		
40			16/50-5"	NA	1.90/.92	40	SS-9	Sample taken @ 1546
41						41		Stopped drilling @ 1548
42	Claystone, moderate reddish brown (10R 4/6) some light olive gray (5Y 6/1) mottles, dry, moderately weathered, weak					42		Resumed drilling @ 1605
43						43		
44						44		
45			26/50-4.5"	NA	1.87/.97	45	SS-10	Sample taken @ 1614
46						46		
47						47		
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-5
Project No. 22693	Page 4 of 5
	Date 9-15-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
48							
49	Same as above						
50							
51	claystone, silty, greenish gray (5G 6/1), and moderate reddish brown (10R 4/6), dry, moderately weathered, weak		50/5.5"	NA	.49/.49	SS-11	Sample taken @ 1620
52							
53							
54	claystone, some silt, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), dry, moderately weathered, friable, weak						
55			50-5.5'	NA	.46/.46	SS-12	sample taken @ 1632
56							
57							
58							
59							
60	same as above		50-5"	NA	.40/.40	SS-13	Sample taken @ 1636
61							
62							
63							
64							
65							

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-5
Project No. 23693	Page 5 of 5
	Date 9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65			50-5"	NA	140/140	65	3S-14	
66						66		Logged from cuttings
67	Claystone, silty, moderate reddish brown (10R4/6) trace light olive gray (5Y6/1), dry, moderately weathered, friable, weak, trace calcareous					67		
68						68		
69						69		
70						70		
71						71		
72						72		
73						73		
74						74		TD-74' End Boring @ 1700

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton						Boring Number: B-6	
Project No.: 23693						Page: 1 of 5	
Ground Elevation: 1097.84		Location: 432000.00N 1847748.50E				Total Footage: 78.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	5.0'	78.0'	15-SS	0	NA	NA

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lawson & Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: Split Spoon
Date: 9-17-03 To: 9-17-03	Field Observer (s): C. Kelsi

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	CLAY, some silt, dry, low plasticity, brown (7.5YR 4/2).		7/6/7		1.5/1.5		SS-1	9-16-03 0745 start to drill & rotary.
2								
3								
4								
5	CLAY, some silt, some organic matter, dark brown (7.5YR 3/4) and [illegible]		5/8/11		1.5/1.5		SS-2	
6								
7								
8								
9								
10	[illegible]		3/4/6		1.5/1.5		SS-3	
11								
12								
13								
14								

Burns & McDonnell Waste Consultants, Inc.

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Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B6
Page	2 of
Date	9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14	CLAYSTONE, [illegible]							
	[illegible] weak, [illegible] (115)							
15	(2.5YR 5/6) [illegible] gray [illegible]		7/19/30		1.5/1.5		SS-4	
16							0819	
17								
18								
19								
20	SILTSTONE, [illegible]		9/16/22		1.5/1.5		SS-5	
21							0830	
22								
23								
24								
25	[illegible] consolidated.		24/39/[illegible]		1.35/1.35		SS-6	
26								
27								
28								
29								
30	[illegible]		12/26/47		1.5/1.5		SS-7 0900	
31								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lowlin
Project No.	[illegible]
Boring No.	B6
Page	3 of
Date	9-16-93

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31	CLAYSTONE, [illegible] trace [illegible] (10YR4/1)		17/50/50/7		1.5/1.3		SS 7	
32	@32.5 color changed to brown [illegible] (10YR4/2)							
33								
34	color reverted to dark [illegible] brown 2.5YR4/6							
35	trace [illegible]		27/30/50-4.5		1.3/1.35		SS-8 0908	
36								
37								
38								
39								
40			27/50-4.0		0.8/0.8		SS-9	
41								
42								
43								
44								
45	inc. [illegible]		35/50-4.5		0.8/0.8		SS-10 0930	
46								
47								
48								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project No.	21693
Boring No.	B6
Page	4 of
Date	9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48	CLAYSTONE, silty, trace calcareous, moist, very weak, dark reddish brown (2.5YR 3/6), gray mottling (N4/1),							
49								
50	CLAY, some silt, greenish gray (10GY 6/1) moist, very weak,		50-5.5"		.45/.45		SS-11 1006	
51								
52								
53	CLAYSTONE some silt, dark reddish brown (7.5YR 3/4), moist, very thinly very weak, friable, dry							
54								
55			30/50-2.5"		6.7/6.7		SS12 1009	
56								
57								
58								
59								
60								I @ 60'10" top [illegible]
61			19/50-4.5"		6.8/6.8		SS-13 1018	
62								
63								
64								
65								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B6
Project No. 236-3	Page 5 of 5
	Date 9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65	CLAYSTONE, dark reddish brown (2.5YR 2/4) [illegible]		50/6"		0.3/0.5		SS-14 1025	
66	[illegible] (10GY 6/1) fresh [illegible] [illegible]							
67								
68								
69								
70								
			35/504.5				SS-15	1028
71								
72								
73								
74								
75								
76								
77								
78								TD [illegible]

Drilling Log

Project Name: Lawton			Boring Number: B7
Project No.: 23673			Page: 1 of 2
Ground Elevation: 1072	Location: 432000.00N 1847248.50 E		Total Footage: 20.0

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
HSA	6"	10'	10'		NA	NA	NA

Drilling Co.: Standard		Driller (s): Tim Fife, Chris Kelty	
Drilling Rig: CME Track Rig.		Type of Penetration Test: Standard Penetration	
Date: 9-29-03	To: 9-29-03	Field Observer (s): CRL	

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	CLAY, some silt, brown (10YR4/3), dry, low plasticity, stiff consistency		4/3/4	NA	/1.5		SS-1	9-29-03 0755 start to HSA
2								
3								
4								
5	CLAY, some silt, trace calcareous, reddish brown (5YR4/4), dry, stiff consistency		12/19/33	NA	1.5/1.5		SS-2	
6								
7								
8								
9								
10	CLAYSTONE, some silt, dark reddish brown (10R4/6) with greenish gray mottling (5GY6/1), dry, stiff consistency		9/18/28				SS-3	
11								
12								
13								
14								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B7
Page	2 of 2
Date	9-29-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14	CLAYSTONE, some silt, dark reddish brown (10R4/6) with greenish gray mottling (5GY6/1), dry, stiff consistency							
15			50/6"		.5/.5		SS-4	
16								
17								
18								
19								
20			50/3"		.25/.25		SS-5	
21								Refusal @ 20' bgs
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton						Boring Number: B-8	
Project No.: 23693						Page: 1 of 4	
Ground Elevation: 1065.22		Location: 432000.00 N 1849248.50 E				Total Footage: 61.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	6.0'	61.0'	9-SS/2-ST	0	See Remarks	
Drilling Co.: Standard					Driller (s): John Lawson & Michael Moes		
Drilling Rig: Davey DK-5					Type of Penetration Test: SPT		
Date: 9-22-03	To: 9-23-03				Field Observer (s): Devin Pollock		

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, some silt, trace sand, roots, medium to high plasticity, dark yellowish brown (10yr 3/4), damp, stiff		3/6/5	NA	1.20/1.50	1	SS-1	1705 start drilling
2						2		
3			NA	NA	NR	3	NS	
4	clay, some sand, high plasticity, reddish brown (2.5yr 4/4), damp to moist, stiff					4		
5						5		
6						6		
7	claystone, some sand, moderate reddish brown (10R 4/6), damp to slightly moist, fresh weak		NA	NA	2/2	7	ST-1	Sample taken @1718
8						8		
9						9		
10			NA	NA	NR	10	NA	
11						11		
12						12		
13						13		
14			NA	NA	1.50/1.50	14	ST-2	Sample taken @1735

Burns & McDonnell | Waste Consultants, Inc.

Drilling Log, continued

Boring No. B-8
Project Name Lawton
Page 2 of 4
Project No. 23693
Date 9-23-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14			NA	NA	1.5/1.5	14	ST-2	Shelby tube refusal @ 14.5' bgs
15						15		1800 stopped drilling (9-22-03) 0740 Resume drilling (9-23-03)
16						16		
17						17		
18	claystone, some silt, moderate reddish brown (10R 4/6) some light olive gray (5Y 6/1), damp, fresh, very weak, trace calcareous					18		
19						19		
20			10/25/32	NA	1.5/1.5	20	SS-2	Sample taken @ 0750
21						21		
22						22		
23						23		
24						24		
25			10/25/48	NA	1.5/1.5	25	SS-3	Sample taken @ 0900
26	claystone, moderate reddish brown (10R 4/6) some greenish gray mottles (5G 6/1), dry to damp, fresh, weak					26		
27						27		
28						28		
29						29		
30			11/50-5"	NA	.80/.90	30	SS-4	Sample taken @ 0817
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-8
Project No. 23693	Page 3 of 4
	Date 9-23-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32	claystone, some silt, moderate reddish brown (10R 4/6) trace greenish gray (5G 6/1) mottles, dry, fresh to slightly weathered, weak		NA	NA	NR	32	NS	
33						33		
34						34		
35			25/50-5"	NA	.90/.90	35	SS-5	Sample taken @ 0825
36	claystone, some sand lenses, moderate reddish brown (10R 4/3) trace greenish gray (5G 6/1) mottles, dry to slightly damp, slightly weathered, weak		NA	NA	NR	36	NS	
37						37		
38						38		
39						39		
40			19/50-5.5	NA	.96/.96	40	SS-6	Sample taken @ 0836
41	claystone, some silt, greenish gray (5G 6/1), damp, slightly to moderately weathered, weak					41		
42						42		
43			NA	NA	NR	43	NS	
44	claystone, trace sand, moderate reddish brown (10R 4/6) w/ greenish gray (5G 6/1) mottling, slightly weathered, weak, trace calcareous, dry					44		
45			26/50-5"	NA	.90/.90	45	SS-7	Sample taken @ 0845
46						46		
47			NA	NA	NR	47	NS	
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-8
Project No. 23693	Page 4 of 4
	Date 9-23-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		
49			NA	NA	NA	49	NS	
50	claystone, trace silt, moderate reddish brown (10R 4/6) some greenish gray (5G 6/1) mottles, dry, slightly weathered, weak		33/50-5.5	NA	.96/.96	50	SS-8	
51						51		
52						52		
53			NA	NA	NR	53	NS	
54						54		
55						55		
56	claystone, some silt, greenish gray (5G 6/1), dry to slightly damp, slightly weathered, weak		50-5"	NA	.40/.40	56	SS-9	
57						57		Logged from cuttings from 55-61' bgs
58	claystone, moderate reddish brown (10R 4/6) trace greenish gray (5G 6/1) mottles, dry, slightly to moderately weathered, weak, trace calcareous		NA	NA	NR	58	NS	
59						59		
60						60		
61						61		
								TD-61.0' End Boring @ 0932

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton			Boring Number: BH-9
Project No.: 23693			Page: 1 of 4
Ground Elevation: 1092.35	Location: 432000.00N 1846748.50E		Total Footage: 62.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	5.0'	62.0'	7-SS 1-ST	NA	NA	NA

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lawson & Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-28-03 To: 9-28-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	Topsoil							
1	Clay, some silt & sand, trace gravel, trace to med low plasticity, dk yellowish brown (10yr 4/4), dry to damp, stiff		5/7/8	NA		1	SS-1	1130 start
2						2		Start drilling @ 1135
3			NA	NA	NR	3	NS	
4						4		
5						5		stopped drilling @ 1138
6	Claystone, silty, some sand, dark reddish brown (10R 3/5) trace greenish gray (5GY 6/1), damp to moist, fresh weak, calcareous		NA	NA	1.75/1.75	6	ST-1	1200 Lunch Resume activities @ 1324
7						7		start drilling 1340
8			NA	NA	NR	8	NS	
9						9		
10	dry					10		stopped drilling @ 1343
11			10/17/28	NA		11	SS-2	
12						12		start drilling @ 1347
13			NA	NA	NR	13	NS	
14						14		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name	Lanton
Project No.	23693
Boring No.	BH-9
Page	2 of 4
Date	9-28-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14			NA	NA	NR	14	NS	
15	claystone, some silt, moderate reddish brown (10R4/6) trace greenish gray (5GY6/1), damp, fresh, weak, trace calcareous		18/50-.5.5	NA	.96/.96	15	SS-3	Stopped drilling @ 1351
16						16		Drillers are setting soil diverter pipe @1400
17			NA	NA	NR	17	NS	Started drilling @ 1310
18						18		
19						19		
20	grading to dark reddish brown (10R3/4)		25/50-.5.5	NA	.96/.96	20	SS-4	Stopped drilling @ 1314
21						21		Start drilling @ 1322
22			NA	NA	NR	22	NS	
23						23		
24						24		
25			22/50-.5.5	NA	.96/.96	25	SS-5	Stopped drilling @ 1325
26	claystone, some silt & sand lenses, dark reddish brown (10R3/4) trace greenish gray (5GY6/1), dry, fresh to slightly weathered, weak, calcareous					26		Start drilling @ 1433
27						27		
28			NA	NA	NR	28	NS	
29						29		
30			31/50-.5.5	NA	.96/.96	30	SS-6	Stopped drilling @ 1437 Resume drilling @ 1446
31						31		

Burns & McDonnell Waste Consultants, Inc

Drilling Log, continued

Project Name Lawton	Boring No. BH-9
Project No. 23693	Page 3 of 4
	Date 9-28-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32	claystone, some silt, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry, slightly weathered, weak, trace calcareous		NA	NA	NR	32	NS	
33						33		
34						34		
35			22/50-5.5"	NA	.96/.96 ~~NR~~	35	SS-7	Stopped drilling @ 1451 1455 Rig is down (9-2
36						36		0940 start (9-29-0: drilling
37						37		
38						38		
39						39		
40	trace sandstone lenses, moderately weathered					40		Log from Cuttings 0920 @ 40' bgs
41						41		
42						42		
43						43		
44						44		Hard drilling @ 44' bgs
45						45		
46						46		
47						47		
48						48		

Drilling Log, continued

Project Name Lawton	Boring No. BH-9
Project No. 23193	Page 4 of 4
	Date 9-28-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		Log from cuttings
49						49		
	claystone, silty & some sand, moderate							
50	reddish brown (10R4/6) some greenish					50		0942 @ 50' bgs
	gray (5GY6/1) mottling, dry, moderately							
51	weathered, friable, weak, calcareous					51		
52						52		
53						53		
54						54		
55	grading to dark reddish brown					55		0945 @ 55' bgs
	(10R3/4), trace calcareous							stopped drilling @
56						56		0948
								start drilling @
57						57		0952
58						58		
59						59		
60						60		
61						61		
62						62		TD - 62.0' bgs
								End Boring @
								1000

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lanton			Boring Number: B-10
Project No.: 23693			Page: 1 of 5
Ground Elevation: 1095.60'	Location: 431500.00 N 1848748.50 E		Total Footage: 80.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	4.0'	80.0'	16-SS	0	See Remarks	NA

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lanson & Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-15-03 To 9-16-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
1	Silt, trace clay, & sand, non-plastic, brown (7.5yr 4/6), dry to damp, soft		2/5/8	NA	1.5/1.50	SS-1	1515 start drilling Air Rotary w/ Reimer Bit. Will air rotary and take split spoons every 5' down to refusal and then will log from cuttings.
2–3	clay, some silt, trace sand, medium to high plasticity, dark brown (10yr 3/3), damp, stiff		NA	NA	NR	NS	
4–5	claystone, some sand & gravel, moderate reddish brown (10R 4/6), dry, very weak (Fill)	possible Fill					1520 sample taken
6			5/7/6	NA	1.5/1.50	SS-2	
7–8–9	claystone, trace sand, moderate reddish brown (10R 4/6), damp to moist, very weak, fresh		NA	NA	NR	NS	
10			6/12/17	NA	1.5/1.5	SS-3	1528 sample taken
11–12–13–14	claystone, trace silt, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), damp, fresh, very weak		NA	NA	NR	NS	

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Drilling Log, continued

Boring No. B-10
Project Name Lawton
Page 2 of 5
Project No. 23693
Date

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14			NA	NA	NR	14	NS	1535 Stopped drilling placing soil diverter pipe on drill rods sample taken @ 1556
15	claystone, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), damp, fresh, weak		4/11/15	NA	.65/1.5	15	SS-4	
16						16		
17						17		
18			NA	NA	NR	18	NS	
19						19		
20			29/50-5.5	NA	1.0/1.0	20	SS-5	sample taken @ 1604
21						21		
22						22		
23			NA	NA	NR	23	NS	
24						24		
25			14/18/22	NA	1.50/1.50	25	SS-6	sample taken @ 1619
26	claystone, trace silty sand lenses, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), damp, fresh to slightly weathered, weak, trace calcareous					26		
27						27		
28			NA	NA	NR	28	NS	
29						29		
30	same as below		15/50-5.5	NA	1.0/1.0	30	SS-7	Stopped drilling @ 1634 Sample taken @ 1645
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-10
Project No. 23693	Page 3 of 5
	Date 9-15-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32	claystone, some silt, trace sand, moderate reddish brown (10R 4/6), dry, slightly weathered, weak, trace calcareous		NA	NA	NR	32	NS	
33						33		
34						34		
35			10/31/47	NA	1.50/1.50	35	SS-8	Sample taken @ 1700
36						36		
37						37		
38			NA	NA	NR	38	NS	
39						39		
40	same as above and trace light olive gray mottles (5Y 6/1), dry to damp		24/35/50 5"	NA	1.40/1.40	40	SS-9	Sample taken @ 1711
41						41		
42						42		
43			NA	NA	NR	43	NS	
44	moist					44		Moisture in boring, approximately @ 45' bgs
45						45		▽ Sample taken @ 1728
46	claystone, trace sandstone lenses, moderate reddish brown (10R 4/6), dry, moderately weathered, friable, weak		24/31/38	NA	1.5/1.50	46	SS-10	
47			NA	NA	NR	47	NS	
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-10
Project No. 23193	Page 4 of 5
	Date 9-15-03 / 9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48	same as above		NA	NA	NR	48	NS	
49	claystone, some silt, greenish gray (5GY 6/1), damp, moderately weathered, weak					49		
50	claystone, moderate reddish brown (10R 4/6), some light olive gray (5Y 6/1), dry, moderately weathered, friable, weak		11/50-5"	NA	.90/.90	50	SS-11	Sample taken @ 1045 (9-15-03)
51						51		
52			NA	NA	NR	52	NS	
53						53		
54						54		
55	claystone, silty, grayish red (10R 4/2), trace light olive gray (5Y 6/1), dry to damp, moderately weathered, weak		33/50-2"	NA	.70/.70	55	SS-12	Sample taken @ 0738. Moisture in boring @ 55' bgs
56						56		
57			NA	NA	NR	57	NS	
58						58		
59						59		
60			23/50-5.5"	NA	1.0/1.0	60	SS-13	Sample taken @ 0756. Moisture in boring @ 60' bgs
61						61		
62			NA	NA	NR	62	NS	
63						63		
64						64		
65						65		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-10
Project No. 23693	Page 5 of 5
	Date 9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65			22/50-4"	NA	.80/.80	65	SS-14	observed moisture on split spoon and laminar 0828
66	claystone, some silt and sand lenses, moderate reddish brown (10R 4/6) trace					66		
67	light olive gray mottles (5Y 6/1) dry to damp moderately weathered, weak		NA	NA	NR	67	NS	
68						68		
69						69		
70			30/50-4.5"	NA	.90/.90	70	SS-15	stopped drilling @ 0858
71						71		Resumed drilling & pounding split spoon @ 0907
72						72		
73			NA	NA	NR	73	NS	
74						74		
75	dry, friable.		28/50-5"	NA	.92/.92	75	SS-16	sample taken @ 0925
76						76		
77						77		
78	shale, silty, greenish gray (5G 6/1), dry, moderately weathered, weak		NA	NA	NR	78	NS	
79	claystone, some silt & sand, moderate reddish brown (10R 4/6), dry, moderately weathered, friable, weak					79		
80						80		TD-80' End Boring @ 0935

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton			Boring Number: B-11
Project No.: 23693			Page: 1 of 5
Ground Elevation: 1091.33'	Location: 431500.00N 1848248.50E		Total Footage: 77.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	6.0	77.0	10-SS 2-ST	0	Dry	NA

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lawson & Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-23-03 To: 9-23-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, trace organics, some silt, trace sand & gravel, medium to high plasticity, dark brown (10yr 3/3), damp, stiff		4/6/7	NA	1.20/1.50	1	SS-1	Start @ 1145
2			NA	NA	NR	2	NS	
3						3		Stopped drilling @ 1152
4	clay, trace silt, some sand, high plasticity, reddish brown (2.5yr 4/4), damp to moist, stiff		NA	NA	2/2	4	ST-1	Sample taken @ 1158
5						5		Resume drilling @ 1317
6			NA	NA	NR	6	NS	
7	claystone, some silt & sand, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry to damp, fresh, weak					7		
8			NA	NA	1.1/1.1	8	ST-2	Stopped drilling @ 1325
9						9		Sample taken @ 1330
10						10		Shelby tube refusal @ 9.1' bgs (SS-8-9.1')
11						11		Resume drilling @ 1332
12						12		
13						13		
14						14		

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Form WCI-OP3-1

Drilling Log, continued

Project Name Lawton	Boring No. B-11
Project No. 23693	Page 2 of 5
	Date 9-23-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14						14		
15	Claystone, some silt, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), damp, fresh, weak, trace calcareous		15/50-5.5"	NA	.96/.96	15	SS-2	1346 sample taken
16						16		Start drilling @ 1350
17						17		
18						18		
19						19		
20			19/50-5"	NA	.90/.90	20	SS-3	stopped drilling @ 1355 Drillers are setting diverter pipe, 1417 start pounding spoon
21						21		
22						22		start drilling @ 1428
23						23		
24						24		
25			50-5.5"	NA	.46/.46	25	SS-4	stopped drilling @ 1432
26	Claystone, some silt, & sandstone lenses, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry, fresh weak, calcareous					26		sample taken @ 1435 start drilling @ 1437 to 30' bgs
27						27		
28						28		
29						29		
30			19/50-5"	NA	.90/.90	30	SS-5	stopped drilling @ 1440 sample taken @ 1446
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Boring No. B-11
Project Name Lawton
Page 3 of 5
Project No. 23693
Date 9-23-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		1445 start drilling
32						32		
33	claystone, some silt, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), dry, fresh, weak, trace calcareous		NA	NA	NR	33	NS	
34						34		
35						35		stopped drilling @ 1452
			18/50-5.5"	NA	19.5/19.5		SS-6	sample taken @ 1458
36						36		start drilling @ 1502
37						37		
38			NA	NA	NR	38	NS	
39						39		
40						40		stopped drilling @ 1506
			15/24/37	NA	1.50/1.50		SS-7	sample taken @ 1510
41	claystone, some silt & sand lenses, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1) dry to slightly damp, fresh to slightly weathered, weak					41		
42						42		start drilling @ 1525
43			NA	NA	NR	43	NS	
44						44		
45	same as above but trace greenish gray (5GY 6/1) mottles					45		stopped drilling @ 1528
			33/50-5"	NA	.90/.90		SS-8	sample taken @ 1530
46								
47			NA	NA	NR	47	NS	
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-11
Project No. 23693	Page 4 of 5
	Date 9-23-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		
49						49		
50	Claystone, some silt, trace sand, dark reddish brown (10R3/4) trace greenish gray (5GY6/1), dry, slightly weathered, weak, trace calcareous		50-5.5"	NA	.46/.46	50	SS-9	sample taken @ 1540
51						51		start drilling @1544
52						52		
53						53		
54						54		stopped drilling @1549
55			50-5"	NA	.40/.40	55	SS-10	sample taken @1557
56						56		Resume drilling @1645- log from cuttings
57						57		
58						58		
59						59		
60						60		
61						61		
62						62		@62.5' to 63' grey cuttings
63						63		
64						64		
65						65		

Drilling Log, continued

Project Name Lawton	Boring No. B-11
Project No. 23693	Page 5 of 5
	Date 9-23-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65	CLAYSTONE, some silt, trace sand, dark reddish brown (10R3/4), trace greenish gray (5G 7/1), dry, slightly weathered, weak, type calcareous					65		log from cuttings
66						66		
67						67		
68						68		
69						69		
70						70		
71						71		
72						72		
73						73		
74						74		
75						75		
76						76		
77						77		1714
								TD-77' End Boring @

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Drilling Log

Project Name: Lawton			Boring Number: B-12
Project No.: 23693			Page: 1 of 5
Ground Elevation: 1092.08'	Location: 431576.76 N 1847627.65 E		Total Footage: 68.0

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	3.0'	68.0	11-SS 2-ST	0	Dry	NA

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lawson and Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-24-03 To 9-24-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, some silt, medium to high plasticity, dk yellowish brown (10yr 4/4), dry to damp, stiff		7/12/10	NA	1.5/1.5	1	SS-1	Start @ 1023 push split spoon
2			NA	NA	NR	2	NS	Start drilling @ 1025
3						3		
4						4		stopped drilling @ 1030
5	claystone, some silt, moderate reddish brown (10R 4/6), damp, fresh, very weak		NA	NA	1.60/1.60	5	ST-1	Sample taken @ 1033
6						6		start drilling @ 1038
7						7		
8			NA	NA	NR	8	NS	
9						9		
10						10		
11	claystone, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), damp, fresh, weak		NA	NA	.80/.80	11	ST-2	stopped drilling @ 1049 Sample taken @ 1049
12						12		start drilling @ 1058
13			NA	NA	NA	13	NS	
14						14		

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Drilling Log, continued

Project Name Lawton	Boring No. B-12
Project No. 23693	Page 2 of 5
	Date 9-24-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14						14		
15	Claystone, some silt, trace sand, moderate reddish brown (10R 4/6) some light olive gray (5Y 6/1) mottling, dry to damp, weak, calcareous		7/20/29	NA	1.5/1.5	15		stopped drilling @ 1102
16						16	SS-2	Sample taken @ 1106
17						17		1108 Drillers setting diverter pipe. Resume drilling @ 1118
18						18		
19						19		
20						20		stopped drilling @ 1124
21			17/32/41	NA	1.30/1.50	21	SS-3	Sample taken @ 1128
22						22		start drilling @ 1130
23						23		
24						24		
25						25		stopped drilling @ 1133
26	Claystone, some silt, trace sandstone lenses, dark reddish brown (10R 3/4) trace greenish gray (5GY 6/1) mottling, fresh to slightly weathered, dry to damp, weak		15/40/49	NA	1.4/1.5	26	SS-4	start drilling @ 1138
27						27		
28						28		
29						29		
30						30		stopped drilling @ 1142
31			16/34/36	NA	1.5/1.5	31	SS-5	

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-12
Project No. 23693	Page 3 of 5
	Date 9-24-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31			14/34/d	NA	1.5/1.5	31	SS-5	
32	claystone, some silt, dark reddish brown (10R 3/4) some greenish gray (5GY 6/1) mottling, slightly weathered, dry, weak		NA			32		Resume drilling @ 1325
33						33		
34						34		
35			15/36/50 4.5	NA	1.40/1.40	35	SS-6	stopped drilling @ 1329
36						36		
37	claystone, some silt, trace sand, moderate reddish brown (10R 4/6) some greenish gray (5GY 4/1) mottling, slightly weathered, dry to damp, weak, trace calcareous					37		Resume drilling @1339
38						38		
39						39		
40			16/50-5"	NA	.90/.90	40	SS-7	stopped drilling @ 1344
41						41		Resume drilling @1348
42						42		
43						43		
44						44		
45	dry		36/50-5.5"	NA	.96/.96	45	SS-8	stopped drilling 1353
46						46		start drilling @ 1404
47						47		
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-12
Project No. 23693	Page 4 of 5
	Date 9-24-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		
49						49		stopped drilling @1408
50	Claystone, some silt, w/ sandstone seams, moderate reddish brown (10R 4/6) damp, moderately weathered, calcareous		50-4.5"	NA	.49/.40	50	SS-9	▽ moisture in boring @50' bgs
51						51		Resumed drilling @1412
52						52		
53								
54						54		
55			33/50-5	NA	.90/.90	55	SS-10	stopped drilling @1416
56	Claystone, some silt, trace sand, dark reddish brown (10R 3/4) some greenish gray (5GY 6/1) mottles, dry, moderately weathered, friable, weak, calcareous					56		Resumed drilling @1429
57						57		
58						58		
59						59		
60			50-5.5	NA	.46/.46	60	SS-11	Stopped drilling @1440
61						61		Resume drilling @1520
62						62		
63						63		
64						64		
65						65		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-12
Project No. 23693	Page 5 of 5
	Date 9-24-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65						65		
66	claystone, some silt, + sand lenses, grayish red (5R 4/2) trace greenish gray (5GY 6/1), dry, moderately weathered, friable, weak, trace calcareous					66		Logged from cuttings (60.5 - 68' bgs)
67						67		
68						68		TD - 68' End Boring @ 1525

Drilling Log

Project Name LAWTON						Boring Number B13	
Project No. 23693						Page 1 of 4	
Ground Elevation 1079.60		Location 431500.00 N 1847250.00 E				Total Footage 56.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary		14	56	11-SS	NA	See Remarks	NA

Drilling Co. Standard Testing		Driller (s) [illegible]	
Drilling Rig. Davey DK-5		Type of Penetration Test Split-Spoon	
Date 9-17-03	To 9-17-03	Field Observer (s) [illegible]	

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	[illegible]		3/3/6		1/1.5		SS-1	1223 start to drill
2								
3								
4								
5	[illegible]		3/11/14		19/1.5		SS-2	
6								
7								
8								
9								
10	[illegible]		5/14/13		15/3		[illegible]	
11								
12								
13								
14								

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Drilling Log, continued

Project Name	[illegible]
Project No.	[illegible]
Boring No.	B13
Page	2 of
Date	9-16-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14	[illegible]							
15	[illegible]		11/24/23		15/15		SS-4 1245	
16								
17								
18								
[illegible]								
[illegible]			24/50-5"		[illegible]/[illegible]		SS-5	
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]			43/50-5"		[illegible]/[illegible]		SS-6	
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]	[illegible] 30' bgs.		31/50-4"		[illegible]/0.5		SS-7 1324	

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Drilling Log, continued

Project Name	Lautan
Project No.	22.93
Boring No.	B13
Page	3 of 4
Date	9-16-93

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
30	CLAY [illegible] (10YR6/1), [illegible]							
35	[illegible] (2.5Y4/3), [illegible]							
35	becoming firm, less mottled, stronger consistency		28/50-3"		.7/.7		SS8 1338	≥? maybe some [illegible] sample
40			17/50-5"		0.9/0.9		SS-9 1400	
45			26/50-5"		0.9/0.9		SS-10	1420 @ 45'- hit moisture zone maybe @ 25' - [illegible] Swirt @ 35' [illegible] plugging [illegible] [illegible] sample @ 45' - auger will [illegible]

Drilling Log, continued

	Boring No.
Project Name	Page of
Project No.	Date

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
45								
52								
							SS11	
62								
70								
								Total Depth @ 56' bgs.

Drilling Log

Project Name: Lawton			Boring Number: B-14
Project No.: 23693			Page: 1 of 5
Ground Elevation: 1087.33	Location: 431000.00N 1848748.50E		Total Footage: 78'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6"	5.2	78.0'	16-SS 2-GS	NA	NA	NA

Drilling Co.: Standard Testing Inc.	Driller (s): John Lawson & Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-13-03 To 9-14-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	silt, some clay, trace silt, trace to medium plasticity, dk brown (10yr 3/3), damp, stiff			NA			G-1	1600 start drilling
1			NA	NA	NR	1	NS	
2	clay, some silt, high plasticity, reddish brown (2.5yr 4/4), damp, stiff		3/6/10	NA	1.50/1.50	2	SS-1	1605 sample taken
3			NA	NA	NR	3	NS	
4	clay, some silt and sand, trace gravel, reddish brown (2.5yr 4/4), damp to moist, stiff		4/10/13	NA		4	SS-2	1610 sample taken
5						5		
6	clay stone, some silt, trace sand, moderate reddish brown (10R 4/6), trace light olive gray mottles (5y 5/2), damp to moist, fresh, very weak		NA	NA	NR	6	NS	
7						7		
8						8		
9			NA	NA	2/2	9	G-2	
10						10		
11			6/10/22	NA	1.50/1.50	11	SS-3	
12						12		
13						13		
14						14		

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Drilling Log, continued

Project Name Lawton	Boring No. B-14
Project No. 23693	Page 2 of 5
	Date

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14	Claystone, moderate reddish brown (10YR 4/6), some light olive gray mottles (5Y 6/1), damp to moist, fresh, very weak, trace calcareous					14		
15			11/18/36	NA	1.50/1.50	15	SS-4	
16						16		
17						17		
18						18		
19						19		
20			21/50-5"	NA	.90/.90	20	SS-5	start drilling @ 0735
21						21		
22						22		
23						23		
24						24		
25			18/30/33	NA	1.50/1.5	25	SS-6	sample taken @ 0742
26						26		
27	Claystone, some silt, light olive gray (5Y 6/1), damp to moist, fresh, very weak					27		
28						28		
29	Claystone, moderate reddish brown (10R 4/6), trace light olive gray mottles (5Y 6/1), damp to moist, fresh, very weak, trace calc.					29		
30			11/19/39	NA	1.50/1.50	30	SS-7	sample taken @ 0800
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-14
Project No. 23693	Page 3 of 5
	Date 9-14-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31			11/19/39	NA	1.50/1.50	31	SS-7	
32						32		
33	Claystone, silty, moderately reddish brown (10R 4/6), some light olive gray (5Y 6/1), dry to damp, fresh to slightly weathered, weak, trace calcareous					33		
34						34		
35			20/26/50 4.5"	NA	1.3/1.5	35	SS-8	Sampled about 0830
36						36		
37						37		
38						38		
39						39		
40	Same as above but slightly to moderately weathered		24/50-5"	NA	.90/.90	40	SS-9	Sampled about 0845
41						41		
42						42		
43						43		
44						44		
45	Claystone, moderately reddish brown (10R 4/6), trace light olive gray (5Y 6/1), dry, slightly weathered, weak		24/50-5"	NA	[illegible]	45	[illegible]	
46						46		
47						47		
48						48		

Drilling Log, continued

	Boring No. B-14
Project Name Lawton	Page 4 of 5
Project No. 23693	Date 9-14-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		
49						49		
50	claystone, silty, trace fine sand, greenish gray (5GY 6/1), dry to damp, moderately weathered, very weak		50-3.5"	NA	30/30	50	SS-11	sample taken @ 1015, penetration in boring @ 50' bgs
51						51		
52						52		
53						53		
54						54		
55	claystone, silty, some fine sand lenses, moderately reddish brown (10R 4/6) some light olive gray (5Y 6/1), dry, moderately weathered, weak		30/50-5"	NA	.90/.90	55	SS-12	sample taken @ 1027
56						56		
57						57		
58						58		
59						59		
60	claystone, silty, light olive gray (5Y 6/1), dry, moderately weathered, very weak		21/50-4"	NA	.80/.80	60	SS-13	sample taken @ 1042
61						61		
62	claystone, trace sand lenses, moderately reddish brown (10R 4/6), some light olive gray mottles (5Y 6/1), dry moderately weathered, friable, weak					62		
63						63		
64						64		
65						65		

Drilling Log, continued

Project Name Lawton	Boring No. B-14
Project No. 23693	Page 5 of 5
	Date 9-14-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
65	claystone, trace sand lenses, moderately reddish brown (10R 4/6), some light olive gray (5Y 6/1), dry, moderately weathered, friable, weak		26/50-5"	NA	90/.90	SS-14	Sample taken @ 1054
66							
67							
68							
69							
70	claystone, moderately reddish brown (10R 4/6), trace light olive gray (5Y 6/1), dry, moderately		25/50-4.5"	NA	90/.90	SS-15	Sample Taken @ 1109
71							
72							
73							
74							1115 Hard drilling from 74.0' bgs
75	claystone, silty, trace fine sand, moderately reddish brown (10R 4/6), dry, moderately weathered, friable, weak		50-5.5"	NA	50/.50	SS-16	Sample Taken @ 1122
76							
77							
78							TD - 78.0' bgs End Boring @ 1126

Drilling Log

Project Name: Lawton						Boring Number: B-15	
Project No.: 23693						Page: 1 of 4	
Ground Elevation: 1075.76		Location: 431000.00N 1847748.50E				Total Footage: 56.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	2.0'	56.0'	10-SS 2-GS	0	See Remarks	NA
Drilling Co.: Standard testing, Inc.					Driller (s):		
Drilling Rig: Davey DK-5					Type of Penetration Test: SPT		
Date: 9-14-03		To: 9-14-03			Field Observer (s): Devin Pollock		

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, trace silt & sand, high plasticity, reddish brown (2.5YR 4/4), damp to moist		4/5/10	NA	1.5/1.5	1	SS-1	1305 start drilling
2–4	claystone, silty, moderate reddish brown (10R 4/6) some light olive gray (5Y 6/1), dry to damp, fresh, very weak		NA	NA	NR	2–4	NS	
5–6	claystone, trace sand lenses, moderate reddish brown (10R 4/6), trace light olive gray (5Y 6/1), damp, fresh, very weak, trace gravel		8/13/15	NA	1.5/1.5	5–6	SS-2	1314
6–7	claystone, trace silt, light olive gray (5Y 6/1), damp, fresh, very weak, calcareous							
7–9	claystone, trace silt, moderate reddish brown (10R 4/6), trace olive gray (5Y 6/1). damp, fresh, very weak, trace calcareous		NA	NA	NR	7–9	NS	
10–11			10/15/22	NA	1.5/1.5	10–11	SS-3	1320
12–14						12–14		

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Drilling Log, continued

Project Name Lawton	Boring No. B-15
Project No. 23693	Page 2 of 4
	Date 9-14-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
14							
15	claystone, trace sand lenses, silty, moderately [illegible] brown (10R [illegible]) + trace light olive gray [illegible] damp, fresh, very weak		12/30/37	NA	1.5/1.5	SS-4	1330 Sample taken
16							
17							
18			NA	NA	NR	NS	
19							
20			11/20/26	NA	1.5/1.5	SS-5	1338 Sample taken
21							
22							
23			NA	NA	NR	NS	
24							
25	claystone, silty, moderate reddish brown (10R 4/1) trace light olive gray (5Y 6/1), dry to damp, fresh to slightly weathered, weak		21/50-5.5	NA	1.0/1.0	SS-6	1346 Sample taken
26							
27							
28			NA	NA	NR	NS	
29							
30	same but becoming moderately weathered + trace calcareous		50-5.5'	NA	.40/.40	SS-7	1400 Sample taken
31							

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-15
Project No. 22409	Page 3 of 4
	Date 9-14-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
31							
32							
33	Claystone, moderate reddish brown (10R4/6), trace light olive gray (5Y6/1), dry, moderately weathered friable, weak		NA	NA	NR	NS	
34							
35			32/50-3.5"	NA	.80/.80	SS-8	Sample taken @ 1413
36							
37							
38			NA	NA	NR	NS	Stopped drilling @ 1425 (38'bgs) Resume drilling @ 1458
39							
40			30/50-5"	NA	.90/.90	SS-9	Sample taken @ 1505
41	Claystone, silty, dark reddish brown (10R3/4), trace light olive gray (5Y6/1), dry, moderately weathered, friable, weak, trace calcareous						
42							
43							
44							
45	Some sand lenses		15/50-5.5"	NA	1.0/1.0	SS-10	Sample taken @ 1516
46							
47							
48							

Drilling Log, continued

Project Name Lanton	Boring No. B-15
Project No. 23693	Page 4 of 4
	Date 9-14-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		
49	same as above					49		
50						50		1527 Stopped drilling @ 50' cable came unspooled
51	claystone, silty, greenish gray (5G 6/1), dry, moderately weathered, weak		NA	NA	2/2	51	GS-1	1532 Resumed drilling. 1538 cable came unspooled again.
52						52		
53	claystone, silty, some sand lenses moderate reddish brown (10R 4/6), dry to damp moderately weathered, weak		NA	NA	NR	53	NS	with Grab Samples from cuttings 50-52 and 54-56' bgs
54						54		
55			NA	NA	2/2	55	GS-2	
56						56		
								TD - 56.0' End Boring @ 1549

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton						Boring Number: BH-1b	
Project No.: 23693						Page: 1 of 5	
Ground Elevation: 1090.81		Location: 431000.00N 1847248.50E				Total Footage: 66.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0'	4.5'	66.0'	12-SS 1-ST	0	NA	NA
Drilling Co.: Standard Testing Inc.				Driller (s): John Lawson & Michael Moss			
Drilling Rig: Davey DK-5				Type of Penetration Test: SPT			
Date: 9-26-03	To: 9-27-03			Field Observer (s): Devin Pollock			

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	clay, some silt, medium to high plasticity, brown (10yr 4/3), dry to damp, stiff		3/4/6	NA			SS-1	start 1607
1	clay, some sand & silt, high plasticity, reddish brown (2.5yr 4/4), dry to damp, stiff					1		
2						2		
3						3		
4						4		
5						5		stopped drilling @ 1610
6	claystone, some silt & sand lenses, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), damp, fresh weak, slightly calcareous		11/21/39	NA	1.4/1.5	6	SS-2	Start drilling 1619
7						7		
8						8		
9						9		
10			NA	NA	1.80/1.80	10	ST-2	stopped drilling @ 1622 Shelby tube refusal @ 10.8' bgs
11						11		
12						12		Start drilling @ 1635
13						13		
14						14		

Burns & McDonnell | Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-16
Project No. 23693	Page 2 of 5
	Date 9-26-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
14							
15	claystone, some sand, trace silt, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry to damp, fresh, weak		21/50/5.5"	NA	.96/.96	SS-3	stopped drilling @ 1638
16							1650 Drillers are setting soil diverter pipe
17							
18							1700 Resume drilling
19							
20			15/30/50-5"	NA	1.40/1.40	SS-4	1703 Stopped drilling
21							
22							Start drilling @ 1714
23							
24							
25			50-5.5"	NA	.46/.46	SS-5	Stopped drilling @ 1718
26	claystone, trace silt, moderate reddish brown, dry to damp, fresh to slightly weathered, weak						Start drilling @ 1724
27							
28							
29							
30	trace greenish gray (5GY 6/1)		50-5.5"	NA	.46/.46	SS-6	Stopped drilling @ 1727
31							Start drilling @ 1738

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-1b
Project No. 23693	Page 3 of 5
	Date 9-26-03 - 9-27-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32						32		
33	Claystone, trace silt, some sand, moderate reddish brown (10R 4/6), dry, slightly weathered, weak, trace calcareous					33		
34						34		
35			50-5.5"	NA	.46/.46	35	SS-7	stopped drilling @ 1746 (9-26-03)
36						36		Start drilling @ 0723 (9-27-03)
37						37		
38						38		
39						39		
40			50-5"	NA	.40/.40	40	SS-8	stopped drilling @ 0728
41	Claystone, some silt & sandstone seams, moderate reddish brown (10R 4/6), dry, slightly to moderately weathered, weak, calcareous					41		Start drilling @ 0735
42						42		
43						43		
44						44		
45			50-5.5"	NA	.46/.46	45	SS-9	stopped drilling @ 0739
46						46		Start drilling 0755
47						47		
48						48		

Drilling Log, continued

Project Name Lanton	Boring No. BH-16
Project No. 23693	Page 4 of 5
	Date 9-27 03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
48							
49							
50	claystone, some silt, trace sand, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry, moderately weathered, friable, weak, trace calcareous		22/50-5"	NA	.90/.90	SS-10	stopped drilling @ 0802 ▽ moisture in boring @ 50' bgs
51							0815 Rig is down
52							Resume drilling @ 1017
53							
54							
55			50-5"	NA	.40/.40	SS-11	1021 stopped drilling
56	claystone, trace sand, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), dry, slightly weathered, weak						start drilling @ 1028
57							
58							
59							
60	slightly to moderately weathered		50-5.5"	NA	.46/.46	SS-12	stopped drilling @ 1034
61							
62							Logged from cuttings
63	claystone, silty, trace fine sand, light olive gray (5Y 6/1), dry to damp, moderately weathered, weak						
64							
65							

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-16
Project No. 23693	Page 5 of 5
	Date 9-27-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65	claystone, some silt, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry, moderately weathered, weak					65		Logged from Cuttings
66						66		
								TD-66.0'
								End Boring @ 1050

Drilling Log

Project Name: Lawton			Boring Number: B-17
Project No.: 23693			Page: 1 of 4
Ground Elevation: 1082.11	Location: 431000.00N 1846788.37E		Total Footage: 56.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	5.0'	56.0'	10-SS 2-ST	0	See Remarks	

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lawson and Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-22-03 To 9-23-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, trace silt & sand, high plasticity, reddish brown (2.5yr 4/4), damp, stiff consistency		4/6/5	NA		1	SS-1	1305 start drilling
2–4			NA	NA	NR	2–4	NS	
5						5		stop drilling @ 1333
6	claystone, some silt, & trace sand, moderate reddish brown (10R 4/6), dry to damp, fresh, weak		6/17/22	NA	1.5/1.5	6	SS-2	sample taken @ 1337
7						7		start drilling @ 1340
8			NA	NA	NR	8	NS	
9						9		
10			18/28/30	NA	1.5/1.5	10	SS-3	sample taken @ 1347
11	claystone, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), damp, fresh, weak		NA	NA	NR	11	NS	
12			NA	NA	1.0/1.0	12	ST-1	sample taken @ 1358
13			NA	NA	NR	13	NS	pushed shelby tube to 13' refusal
14						14		

Burns & McDonnell Waste Consultants, Inc.

Form WCI OB2-1

Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	B-17
Page	2 of 4
Date	9-22-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14						14		
15	Claystone, trace sand, moderate reddish brown (10R 4/6) trace light olive gray (5Y 5/1), dry to damp, fresh, weak		NA	NA	NR	15	NS	
16			NA	NA	.5/2	16	ST-2	stopped drilling @ 1408. Drillers placing filter tab pipe in bore hole
17						17		Shelby tube sample taken @ 1440
18			NA	NA	NR	18	NS	Shelby pushed to 16.5' @ refusal
19						19		
20	Claystone, some silt, greenish gray (5GY 6/1), dry to damp, moderately weathered, weak		13/50-5"	NA	.92/.92	20	SS-4	sample taken @ 1448
21						21		
22						22		
23	Claystone, trace silt, moderate reddish brown (10R 4/6) some light olive gray (5Y 6/1), dry, fresh to slightly weathered, weak, trace calcareous		NA	NA	NR	23	NS	
24						24		
25			22/50-4.5"	NA	.87/.87	25	SS-5	Sample taken @ 1502
26						26		
27						27		
28			NA	NA	NR	28	NS	
29						29		
30			23/50-4.5"	NA	.87/.87	30	SS-6	moisture in boring 30.5' bgs Sample taken @ 1510
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Boring No. B-17
Project Name Lawton
Page 3 of 4
Project No. 23693
Date 9-22-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32	Same as above		NA	NA	NR	32	NS	
33						33		
34						34		
35			35/50-3"	NA	.75/.75	35	SS-7	Sample taken @ 1521
36	Siltstone, trace sandstone lenses, dark reddish brown (10R 3/4) trace light olive gray (5Y 5/1), dry to damp, slightly to moderately weathered, weak, trace calcareous		NA	NA	NR	36	NS	
37						37		
38						38		
39						39		
40			21/50-5"	NA	.92/.92	40	SS-8	Sample taken @1529
41	Claystone, trace sand lenses, moderate reddish brown (10R 3/4) trace light olive gray (5Y 5/1), dry, moderately weathered, friable, weak		NA	NA	NR	41	NS	
42						42		
43						43		
44						44		
45			31/50-4.5"	NA	.87/.87	45	SS-9	Sample taken @ 1540
46						46		
47			NA	NA	NR	47	NS	
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-17
Project No. 23693	Page 4 of 4
	Date 9-22-93

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48	same as above					48		
49			NA	NA	NR	49	NS	
50			36/50-5"	NA	.92/.92	50	SS-10	sample taken @ 1549
51						51		
52	claystone, some sand lenses, dark reddish brown (10R 3/4) trace light olive gray (5Y 6/1), dry, moderately weathered, friable, weak, trace calcareous					52		
53			NA	NA	NR	53	NS	51-56 log from cuttings
54						54		
55						55		
56						56		TD - 56.0' End Boring @ 1600

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton			Boring Number: B-18
Project No.: 23693			Page: 1 of 5
Ground Elevation: 1087.46	Location: 431000.00N 1849248.50E		Total Footage: 83.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	5.3'	83.0'	17-SS 2-GS	NA	NA	NA

Drilling Co.	Standard Testing, Inc.	Driller (s)	John Lawson and Michael Moes
Drilling Rig.	Davey DK-5	Type of Penetration Test	SPT
Date 9-13-03	To 9-13-03	Field Observer (s)	Devin Pollack

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	Silt, trace clay and sand, slightly plastic, yellowish brown (10yr5/4), dry to damp, soft	ML	NA	NA	.50/.50		GS-1	
1			NA	NA	NR	1	NA	
2	clay, trace silt, medium to high plasticity, dark brown (10yr3/3), damp stiff (fill material)	CLCH	4/3/5	NA	1.5/1.5	2	SS-1	
3			NA	NA	NR	3	NA	
4	clay, some sand & trace gravel, some silt, high plasticity, reddish brown (5yr4/4), damp, stiff	CH	6/12/34	NA	.70/1.50	4	SS-2	Hit a rock at 4' bgs
5						5		
6			NA	NA	NR	6	NS	
7						7		
8						8		
9	Claystone, silty, moderate reddish brown (10y4/6), trace olive gray mottles (5y6/2), damp, very weak, trace calcareous		NA	NA	2/2	9	GS-2	
10						10		
11			4/6/10/9	NA	1.5/1.5	11	SS-3	
12						12		
13			NA	NA	NR	13	NA	
14						14		

Burns & McDonnell | Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-18
Project No. 23693	Page 2 of 5
	Date 9-13-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14			NA	NA	NR	14	NS	
15	claystone, moderate reddish brown (10R 4/6), some light olive gray mottles (5Y 6/2), dry to damp, fresh, very weak		8/25/45	NA	1.5/1.5	15	SS-4	
16						16		
17						17		
18			NA	NA	NR	18	NS	
19						19		
20			9/50-5.5"	NA	1.0/1.0	20	SS-5	
21						21		
22			NA	NA	NR	22	NS	
23						23		
24						24		
25			16/50-5.5"	NA	1.0/1.0	25	SS-6	
26	claystone, trace silt, moderate reddish brown (10R 4/6) with light olive gray mottles (5Y 6/2), dry, slightly weathered, very weak					26		
27			NA	NA	NR	27	NS	
28						28		
29						29		
30			36/50-2"	NA	.70/.70	30	SS-7	
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-18
Project No. 23693	Page 3 of 5
	Date 9-13-05

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31	claystone, moderate reddish brown (10R 4/6) some light olive gray mottles (5Y 5/2), damp, slightly weathered, weak					31		
32	shale, pale olive (10Y 6/2), silty moderately weathered, dry, weak					32		
33						33		
34						34		
35	Claystone, moderate reddish brown (10R 4/6) trace light olive gray mottles (5Y 5/2), moderately weathered, dry to damp, trace calcareous		50-4.5"	NA	.40/.40	35	SS-8	Sample taken @ 1128
36						36		
37						37		
38						38		
39						39		
40			31/50-4.5"	NA	.90/.90	40	SS-9	1130 @ 40' bgs Sample taken @ 1137
41						41		
42						42		
43						43		
44						44		
45			21/50-5"	NA	.90/.90	45	SS-10	1142 @ 45.0' bgs 1145 Sample taken
46						46		
47						47		
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-18
Project No. 23693	Page 4 of 5
	Date 9-13-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
49						49		
50	Siltstone, trace sand lenses, greenish gray (5GY 5/1), dry to damp, moderately weathered, weak, trace calcareous		28/50-4.5"	NA	.90/.90	50	SS-11	Sample taken @ 1315
51						51		
52						52		
53			NA	NA	NR	53	NS	
54	claystone, some silt, moderate reddish brown (10R 4/6) some light olive gray mottles (5Y 6/1), damp to moist, moderately weathered, very weak, calcareous					54		
55			31/50-5"	NA	.90/.90	55	SS-12	1330 sample taken Moisture in boring @ 55'-35
56						56		
57						57		
58						58		
59						59		
60			26/50-4.5"	NA	.90/.90	60	SS-13	1343 sample taken
61						61		
62	claystone, trace fine sand, moderate reddish brown (10R 4/6), trace light olive gray mottles (5Y 6/1), dry, moderately weathered, friable, very weak					62		
63						63		
64						64		
65						65		
66			13/50-5"	NA	.90/.90	66	SS-14	

Drilling Log, continued

Project Name Lawton	Boring No. B-18
Project No. 23693	Page 5 of 5
	Date 9-13-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
66						66		
67						67		
68						68		
69	Claystone, moderate reddish brown (10R 4/6) some light olive gray mottles (5Y 6/1), dry, moderately weathered, friable, weak					69		
70			50/5.5"	NA	.50/.50	70	SS-15	
71						71		
72						72		
73						73		
74						74		
75			50/5"	NA	.40/.40	75	SS-16	
76	Shale, silty, greenish gray (5G 6/1), moderately weathered, weak					76		
77						77		
78	Siltstone, trace sand lenses, moderate reddish brown (10R 4/6), dry to damp, slightly weathered, weak					78		
79						79		
80			50/5"	NA	.40/.40	80	SS-17	Moisture in boring @ 80' 5g S Sample taken @ 1514
81						81		
82						82		
83						83		1521 Boring Completed

EOB @ 83'

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton			Boring Number: BH-19
Project No.: 23693			Page: 1 of 5
Ground Elevation: 1085.12	Location: 430500.00N 1848748.50E		Total Footage: 75.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	7.0'	75.0'	12-SS 2-ST	0	NA	NA

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lawson and Michael Yocs
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-25-03 To: 9-25-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
	silt, trace clay + sand, non-plastic, brown (10yr 4/3), dry, medium		5/6/8	NA	1.3/1.5	1	SS-1	0810 start
1	clay, some silt, trace sand + gravel, dark brown (10yr 3/3), dry to damp, stiff							
2						2		
3			NA	NA	NR	3	NS	
4	clay, some sand, trace silt, high plasticity, reddish brown (2.5yr 4/4), damp to moist, stiff					4		
5						5		stopped drilling @ 0815
6			NA	NA	2/2	6	ST-1	
7						7		start drilling @ 0840
8						8		
9			NA	NA	NR	9	NS	
10	claystone, some silt, trace sand, moderate reddish brown (10R 4/6), damp, fresh, weak					10		
11						11		stopped drilling @ 0845
12			NA	NA	1.1/1.1	12	ST-2	Shelby tube refusal @ 12.1'
13						13		start drilling @ 0855
14			NA	NA	NR	14	NS	

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-19
Project No. 23693	Page 2 of 5
	Date 9-25-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14			NA	NA	NR	14	NS	
15	claystone, some sand, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), damp, fresh, weak, trace calcareous		20/50-5.5"	NA	.96/.96	15	SS-2	Stopped drilling @ 0902
16						16		0908 Drillers are setting soil diverter pipe
17						17		0920 Start drilling
18			NA	NA	NR	18	NS	
19						19		
20			35/50-3"	NA	.75/.75	20	SS-3	0923 stopped drilling
21	claystone, some silt, trace sand lenses, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry to damp, fresh, weak					21		start drilling @ 0938
22						22		
23			NA	NA	NR	23	NS	
24						24		
25			19/28/50-3"	NA	1.25/1.25	25	SS-4	stopped drilling @ 0952
26						26		start drilling @ 0947
27						27		
28			NA	NA	NR	28	NS	
29						29		
30			24/50-5"	NA	.90/.90	30	SS-5	stopped drilling @ 0952
31						31		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-19
Project No. 23693	Page 3 of 5
	Date 9-25-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31	claystone, trace sand, silty, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), dry to damp, slightly weathered, weak, trace calcareous		NA	NA	NR	31	NS	Resumed drilling @ 0958
32						32		
33						33		
34						34		stopped drilling @ 1005
35	some greenish gray (5GY 6/1) mottling, calcareous, damp to slightly moist		15/50-5"	NA	.90/.90	35	SS-6	▽ Moisture @ 35' bgs
36			NA	NA	NR	36	NS	Start drilling 1040
37						37		
38						38		
39						39		
40	dry to damp		26/50-5"	NA	.90/.90	40	SS-7	stopped drilling @ 1044
41			NA	NA	NR	41	NS	Start drilling @ 1052
42						42		
43	claystone, silty, greenish gray (5G 6/1), dry, slightly weathered, weak trace calcareous					43		
44						44		
45	claystone, some silt, trace sand lenses, dark reddish brown (10R 3/4) trace greenish gray (5G 6/1), dry, moderately weathered, friable, weak		50-5"	NA	.40/.40	45	SS-8	stopped drilling @ 1059
46			NA	NA	NR	46	NS	Start drilling @ 1105
47						47		
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-19
Project No. 23693	Page 4 of 5
	Date 9-25-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
48							
49			NA	NA	NR	NS	
50	claystone, some silt, trace sand lenses, dark reddish brown (10R 3/4) trace greenish gray (5G 6/1), dry, moderately weathered, friable, weak		50-5"	NA	40/40	SS-9	stopped drilling @ 1110
51							start drilling @ 1114
52			NA	NA	NR	NS	
53							
54	claystone, silty, greenish gray (5G 4/1), dry, moderately weathered, weak						stopped drilling @ 1118
55	claystone, some sand, trace silt, moderate reddish brown (10R 4/6) w/ greenish gray (5G 5/1) mottles, dry, friable, moderately weathered, weak		50-5.5"	NA	.46/.46	SS-10	▽ - moisture @ 55' bgs
56							start drilling @ 1122
57			NA	NA	NR	NS	
58							
59							
60	claystone, silty, some sand, greenish gray (5G 4/1), dry, moderately weathered, weak		31/50-5"	NA	.90/.90	SS-11	stopped drilling @ 1128
61	claystone, trace sand + silt, moderate reddish brown (10R 4/6) trace greenish gray (5G 6/1) mottles, dry to slightly damp, moderately weathered, weak						Resume drilling @ 1133
62			NA	NA	NR	NS	
63							
64							
65							

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH19
Project No. 23693	Page 5 of 5
	Date 9-25-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
65	claystone, some silt, trace sand, dark reddish brown (10R 3/4) trace light olive gray (5Y 6/1), dry, moderately weathered, weak		50-5.5"	NA	.46/.46	65	SS-12	Stopped drilling @ 1137
66						66		Resumed drilling @
67						67		Logged from cuttings
68						68		
69			NA	NA	NR	69	NS	
70						70		
71						71		
72						72		
73						73		
74						74		
75						75		
								TD-75' End Boring @ 1335

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lawton						Boring Number: BH-20	
Project No.: 23603						Page: 1 of 4	
Ground Elevation: 1071.85		Location: 430500.00N 1848248.50E				Total Footage: 57.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	2.5	57.0'	10-SS 1-ST	0	NA	NA
Drilling Co.: Standard Testing, Inc.				Driller (s): John Lawson & Michael Moss			
Drilling Rig: Davey DK-5				Type of Penetration Test: SPT			
Date: 9-25-03	To: 9-26-03			Field Observer (s): [illegible]			

Depth	Topsoil / Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, some silt, trace sand, medium to high plasticity, brown (7.5YR 4/3), dry to damp, stiff		4/7/6	NA	1.20/1.50	1	SS-1	1730 start hammering spoon (0-1.5')
2						2		Start drilling @1735
3						3		
4			NA	NA	NR	4	NS	
5	claystone, some silt, trace sand, moderate reddish brown (10R 4/6), damp, fresh weak					5		
6						6		stopped drilling @1739
7			NA	NA	1.50/1.50	7	ST-1	
8						8		started drilling @ 1745
9						9		
10						10		stopped drilling @ 1747 (9-25-03)
11	claystone, some sand, trace silt, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/2), dry, fresh to slightly weathered, weak, trace calcareous		11/50/50	[illegible]	1.50/1.50	11	SS-2	start drilling @ (9-26-03)
12						12		Resume drilling @ 0721
13						13		
14						14		

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Drilling Log, continued

Project Name Lawton	Boring No. BH-20
Project No. 23695	Page 2 of 4
	Date 9-26-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
14							
15			20/50-5.5	NA	.96/1.96	SS-3	stopped drilling @ 0733
16	claystone, trace sand lenses, moderate reddish brown (10R 4/6) some greenish gray (5GY 4/1) mottles, damp, fresh weak						Drillers are setting soil diverter pipe
17							start drilling @ 0748
18							
19							
20	trace calcareous		19/33/46	NA	1.50/1.50	SS-4	stopped drilling @ 0758
21							
22							start drilling @ 0807
23							
24							
25	slightly weathered		20/34/46	NA	1.40/1.50	SS-5	stopped drilling @ 0815
26							
27							start drilling @ 0828
28							
29							
30			50-5.5"	NA	.46/.46	SS-6	stopped drilling @ 0832
31							

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-20
Project No. 23693	Page 3 of 4
	Date 9-26-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		Start drilling 0835
32	claystone, some sand, dark reddish brown (10R 3/4) trace greenish gray (5GY 6/1) mottles dry, slightly weathered, weak					32		
33						33		
34						34		
35	sandstone lenses		50-5"	NA	.40/.40	35	SS-7	stopped drilling @ 0837
36						36		Resume drilling @ 0840
37						37		
38						38		
39						39		stopped drilling @ 0844
40			50-5"	NA	.40/.40	40	SS-8	▽ - moisture in boring @ 40' bgs
41	claystone, some silt & sand, moderate reddish brown (10R 4/6) w/ greenish gray (5GY 6/1) mottles, dry, moderately weathered, friable, weak, trace calcareous					41		Start drilling @ 0848
42						42		
43						43		
44						44		
45	slightly weathered		50-5.5"	NA	.46/.46	45	SS-9	stopped drilling @ 0851
46						46		Start drilling @ 0855
47						47		
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. BH-20
Project No. 23695	Page 4 of 4
	Date 9-26-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48						48		
49						49		
50	Claystone, some sand, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), dry, moderately weathered, friable, weak		50-5"	NA	.40/.40	50	SS-10	Stopped drilling @ [illegible]
51						51		[illegible]
52						52		
53						53		[illegible]
54	Claystone, some sand, + silt, greenish gray (5GY 6/1), dry, moderately weathered, trace calcareous					54		
55						55		
56	Claystone, some sand, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), dry, moderately weathered, friable, weak					56		
57						57		TD-57' End Boring @ 0911

Drilling Log

Project Name: Lawton			Boring Number: B-21
Project No.: 23693			Page: 1 of 4
Ground Elevation: 1073.85	Location: 430500.00 N 1847250.00 E		Total Footage: 49.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	3.0'	49.0'	8-SS 2-ST	0	See Remarks	

Drilling Co.: Standard Testing, Inc.	Driller (s): John Lawson and Michael Moes
Drilling Rig: Davey DK-5	Type of Penetration Test: SPT
Date: 9-22-03 To: 9-22-03	Field Observer (s): Devin Pollock

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, trace silt & sand, + gravel, high plasticity, dark brown (7.5 yr 3/4), damp, stiff		4/7/7	NA	1.30/1.50	1	SS-1	0903 Start drilling. Sample taken @ 0905
2			NA	NA	NR	2	NS	
3						3		
4	claystone, silty, trace sand, moderate reddish brown (10R 4/6), trace light olive gray (5Y 5/2), damp, fresh, v. v. weak		NA	NA	2/2	4	ST-1	Sample taken @ 0916
5						5		
6			NA	NA	NR	6	NS	
7						7		
8						8		
9			NA	NA	1.85/2	9	ST-2	Sample taken @ 0932
10						10		
11						11		
12			NA	NA	NR	12	NS	
13						13		
14						14		

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Drilling Log, continued

Project Name Lawton	Boring No. B-21
Project No. 23693	Page 2 of 4
	Date 9-22-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.	Sample or Box No.	Remarks
14			NA	NA	NR	NS	
15	claystone, some silt, trace sand lenses, moderate reddish brown (10R 4/6) some light olive gray (5Y 6/1), dry & damp, fresh, trace calcareous, weak		6/16/22	NA	1.4/1.5	SS-2	sample taken @ 0950
16							0957 placing diverter pipe in borehole
17							1003 Resume drilling
18			NA	NA	NR	NS	
19							
20			11/25/50-4.5"	NA	1.38/1.38	SS-3	sample taken @ 1011
21	claystone, silty, greenish gray (5GY 6/1), dry, weak (highly weathered shale)						
22	claystone, trace silt, moderate reddish brown (10R 4/2), trace light olive gray (5Y 6/1), dry,						
23			NA	NA	NR	NS	
24							
25	Siltstone, some sand lenses, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), dry, fresh to slightly weathered, weak, trace calcareous		30/50-2"	NA	.67/.67	SS-4	Sample taken @ 1020
26							
27							
28			NA	NA	NR	NS	
29							
30			50-5.5"	NA	.46/.46	SS-5	Sample taken @ 1028
31			NA	NA	NR	NS	

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-21
Project No. 23693	Page 3 of 4
	Date 9-22-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
31						31		
32						32		
33	claystone, some silt, moderate reddish brown (10R4/6), some light olive gray (5Y6/1), dry, slightly weathered, trace calcareous, weak		NA	NA	NR	33	NS	
34						34		
35			21/50-5.5"	NA	196/.96	35	SS-6	sample taken @ 1039
36						36		
37						37		
38			NA	NA	NR	38	NS	
39						39		
40			23/50-5"	NA	192/.92	40	SS-7	sample taken @ 1050
41								
42	claystone, trace silt & sand, dark reddish brown (10R3/4) trace light olive gray (5Y6/1), damp to slightly moist, moderately weathered, weak					42		
43			NA	NA	NR	43	NS	
44						44		
45			29/50-4.5"	NA	187/.87	45	SS-8	sample taken @ 1059
46	claystone, silty trace sand, greenish gray (5GY6/1), damp, slightly to moderately weathered, weak					46		
47			NA	NA	NR	47	NS	
48						48		

Burns & McDonnell Waste Consultants, Inc.

Drilling Log, continued

Project Name Lawton	Boring No. B-21
Project No. 23693	Page 4 of 4
	Date 9-22-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
48	claystone, trace sand & silt, dark reddish brown (10R3/4), dry, moderately weathered, friable, weak		NA	NA	NR	48	NS	
49						49		End Boring @ 1106 TD - 49.0'

Burns & McDonnell Waste Consultants, Inc.

Drilling Log

Project Name: Lanton						Boring Number: BH-23	
Project No.: 23693						Page: 1 of 2	
Ground Elevation: 1070.14		Location: 429825.61N 1849519.24 E				Total Footage: 30.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	4.0'	30.0	4-SS 1-ST	0	NA	NA
Drilling Co.: Standard Testing Inc.					Driller (s): John Lamson & Michael Moes		
Drilling Rig: Davey DK-5					Type of Penetration Test: SPT		
Date: 9-26-03		To: 9-26-03			Field Observer (s): Devin Pollock		

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, some silt, trace sand, high plasticity, reddish brown (2.5YR 4/4) dry to damp, stiff		2/5/5	NA	1.20/1.5	1	SS-1	1420 start
2						2		
3						3		
4			NA	NA	NR	4	NS	
5						5		
6	claystone, some silt, trace sand, moderate reddish brown (10R 4/6) trace greenish gray (5GY 6/1), damp, fresh, weak					6		
7						7		
8			NA	NA	.75/.75	8	ST-1	Stopped drilling @ 1432 Had shelby tube refusal @ 8.75' bgs
9						9		Resumed drilling @ 1436
10						10		
11			NA	NA	NR	11	NS	
12						12		
13						13		
14						14		

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Drilling Log, continued

Project Name	Lawton
Project No.	23693
Boring No.	BH-23
Page	2 of 2
Date	9-26-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14			NA	NA	NR	14	NS	
15	claystone, some silt, trace sand lenses, moderate reddish brown (10R4/6) trace greenish gray (5GY6/1), damp, fresh to slightly weathered weak, trace calcareous		21/50-5"	NA	90/.90	15	SS-2	stopped drilling @ 1442
16						16		start drilling @ 1451
17						17		
18			NA	NA	NR	18	NS	
19						19		
20			50-5.5"	NA	46/.46	20	SS-3	stopped drilling @ 1455
21						21		start drilling @ 1459
22			NA	NA	NR	22	NS	
23						23		
24						24		
25			50-5"	NA	40/.40	25	SS-4	stopped drilling @ 1503
26	claystone, some sand lenses, a trace silt, dark reddish brown (10R3/4), trace greenish gray (5GY 6/1) mottling, dry, slightly to moderately weathered, weak					26		
27			NA	NA	NR	27	NS	
28						28		
29						29		
30						30		TD-30' End Boring @ 1512

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Drilling Log

Project Name: Lawton						Boring Number: BH-22	
Project No.: 23693						Page: 1 of 2	
Ground Elevation: 1066.50'		Location: 430143.86 N 1848512.42				Total Footage: 30.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. Of Samples	No. Core Boxes	Depth to Water	Date Measured
Air Rotary	6.0"	6.5'	30.0'	4-SS1-ST	0	NA	NA
Drilling Co.: Standard Testing, Inc.				Driller (s): John Lawson & Michael Moes			
Drilling Rig: Davey DK-5				Type of Penetration Test: SPT			
Date: 9-25-03	To: 9-25-03			Field Observer (s): Darin Pollock			

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
1	clay, some silt, trace sand, medium to high plasticity, reddish brown (5yr 4/4), damp, stiff	CLCH	4/4/5	NA	1.2/1.5	1	SS-1	start 1603
2						2		start drilling @ 1608
3	clay, some sand, high plasticity, reddish brown (2.5yr 4/4), damp, stiff	CH				3		
4			NA	NA	NR	4	NS	
5						5		
6						6		
7						7		
8						8		
9	claystone, some silt, trace sand, moderate reddish brown (10R 4/6), fresh, very weak					9		stopped drilling @ 1614
10			NA	NA	1.50/1.50	10	ST-1	start drilling @ 1620
11						11		
12			NA	NA	NR	12	NS	
13						13		
14						14		

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Drilling Log, continued

Project Name Larton	Boring No. BH-22
Project No. 23693	Page 2 of 2
	Date 9-25-03

Depth	Description	Class.	Blow Count	Field Strength	Recov.		Sample or Box No.	Remarks
14						14		stopped drilling @ 1625
	Claystone, some sand, trace silt, moderate reddish brown (10R 4/6) some greenish gray (5GY 6/1), damp to slightly moist, fresh, weak, trace calcareous		NA	NA	NR		NS	
15			13/18/25	NA	1.50/1.50	15	SS-2	
16						16		
								start drilling @ 1634
17						17		
18			NA	NA	NR	18	NS	
19						19		
20			22/50-5.5"	NA	.96/.96	20	SS-3	stopped drilling @ 1639
	Claystone, trace sand lenses, moderate reddish brown (10R 4/6) trace light olive gray (5Y 6/1), dry to damp, fresh, weak							
21						21		start drilling @ 1644
22						22		
23			NA	NA	NR	23	NS	
24						24		
25	Some sand lenses, ± slightly weathered		50-5"	NA	.40/.40	25	SS-4	stopped drilling @ 1648
26						26		start drilling 1650
27			NA	NA	NR	27	NS	
28						28		
29						29		
30						30		TD - 30.0' End Boring @ 1655

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ATTACHMENT C

SOIL SAMPLE TEST RESULTS

CQA Testing Laboratory

Lab ID: 05091

Laboratory Test Result Summary Sheet

Bulk Samples

Client: SCS Engineers
Project: City of Lawton Landfill

Project No.: 2315
Location: Oklahoma

Sample Number and Location					ASTM D2216	ASTM D4318			ASTM D422 or D6913/ D7928				ASTM D1140	ASTM D2487	ASTM D698, Method B		ASTM D5084	Recompacted Specimen Data				
					Moisture	Atterberg Limits			Grain-size Analysis					USCS	Laboratory Compaction, *uncorrected*		Hydraulic	Wet	Dry	%	%	%
Sample Number	Coordinates North	East	Elev. (ft)	Foot No.	Content (%)	LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	P-200 (%)	Group Symbol	MDD (pcf)	OMC (%)	Conductivity cm/sec	Dens (pcf)	Dens (pcf)	MC	MDD	Sat. Initial
SS-1					13.5	44	21	23	0.7	11.1			88.2	CL, lean clay,			2.6E-006	102.9	91.2	12.8		39.9
SS-1																	2.1E-005	94.1	83.2	13.1		33.9
SS-2					20.4	49	22	27	0.1	3.2			96.7	CL, lean clay,	104.9	20.9	5.6E-008	120.5	99.7	20.9	95.0	79.6
SS-3					14.9	47	22	25	0.0	1.4			98.6	CL, lean clay,	110.5	18.0	8.3E-008	123.9	105.0	18.0	95.0	78.0
SS-3																	2.2E-006	109.5	96.0	14.1	86.9	49.2
SS-4					16.2	47	21	26	0.5	10.4			89.1	CL, lean clay,	111.1	17.2	9.3E-008	123.7	105.6	17.2	95.0	75.6
				Minimum	13.5	44	21	23	0.0	1.4	0.0	0.0	88.2				5.6E-008	94.1	83.2	12.8		33.9
				Maximum	20.4	49	22	27	0.7	11.1	0.0	0.0	98.6				2.1E-005	123.9	105.6	20.9		79.6
				Average:	16.2	47	22	25	0.3	6.5	0.0	0.0	93.1				4.3E-006	112.4	96.8	16.0		59.4

Remarks:
Moist Method, ASTM D422
Clay content reported at 0.005mm

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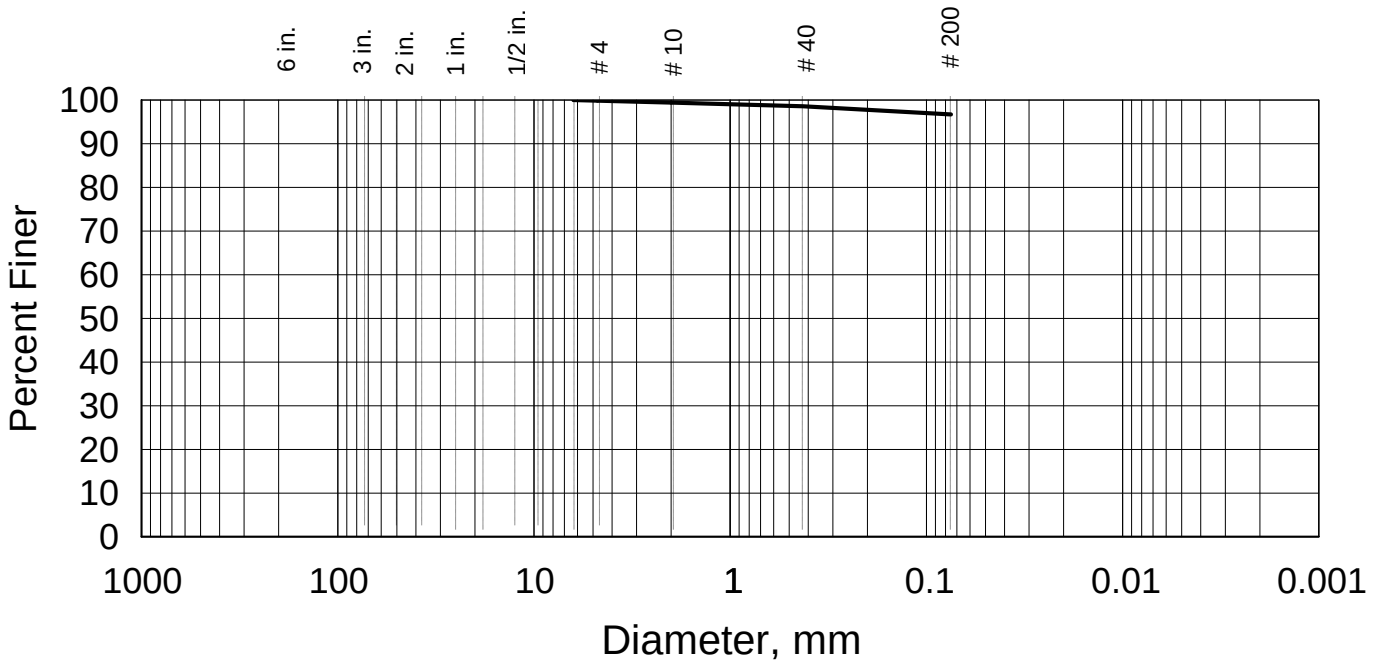
CQA Testing Laboratory Lab ID: 05091

Particle Distribution Test Result



Proj. Name:	City of Lawton Landfill	**Gravel, %**	**Sand, %**	**Silt, %**	**Clay, %**	**LL**	**PI**
Project No.: 2315		0.1	3.2	0.0	0.0	49	27
Report Date 06.13.2023	Log-in Date 06.07.2023	**Description and Classification**					
Project Loc. Oklahoma		Red/Brown	CL, lean clay,				
		Standard Sieve Sizes - Percent Passing					
Sample Identification - Location - Type		6 "		2.5 "		3/8 "	
SS-2	Bulk Sample	5 "		2 "		1/4 "	100.0
Remarks:	**NMC, %** **20.4**	4.5 "		1- 1/2 "		# 4	99.9
Moist Method, ASTM D422	Bulk	4 "		1 "		# 10	99.4
Sample split on # 40 sieve	Sample wt., kg	3.5 "		3/4 "		# 40	98.6
Clay content reported at 0.005mm	15.70	3 "		1/2 "		# 200	96.7

Hygroscopic Moisture Content Data		Hydrometer Specimen Wet wt.	0.00	**Traceability Items**		
WS+t	0.00	Hydrometer Specimen Dry wt.	ERR	Balance ID	1	2
DS+T	0.00	Assumed Gs	2.75	Therm ID	58981	NA
Tare wt	0.00	Percent <#40 based on complete specimen	98.60	Flask ID	1	NA
Moist Ratio	ERR	Calculated biased weight	ERR	Bulb ID	1	152H
		Composite Correction at 20 deg C	-6	Sol Mix, ml	125	NA
		Meniscus Correction only	1	Tested By	JMB	BMG

Hydrometer Reading Data			Temp.	Corrected			Effective	Diameter, mm	Percent
Time, min.	Readings	Temp.	Correction, Ct	Reading, Rc	K	Rm	depth		finer
2	0	0		-6		1	16.13	0.0000	
5	0	0		-6		1	16.13	0.0000	
15	0	0		-6		1	16.13	0.0000	
30	0	0		-6		1	16.13	0.0000	
120	0	0		-6		1	16.13	0.0000	
240	0	0		-6		1	16.13	0.0000	
600	0	0		-6		1	16.13	0.0000	

Page ID SS-2 Grain-size

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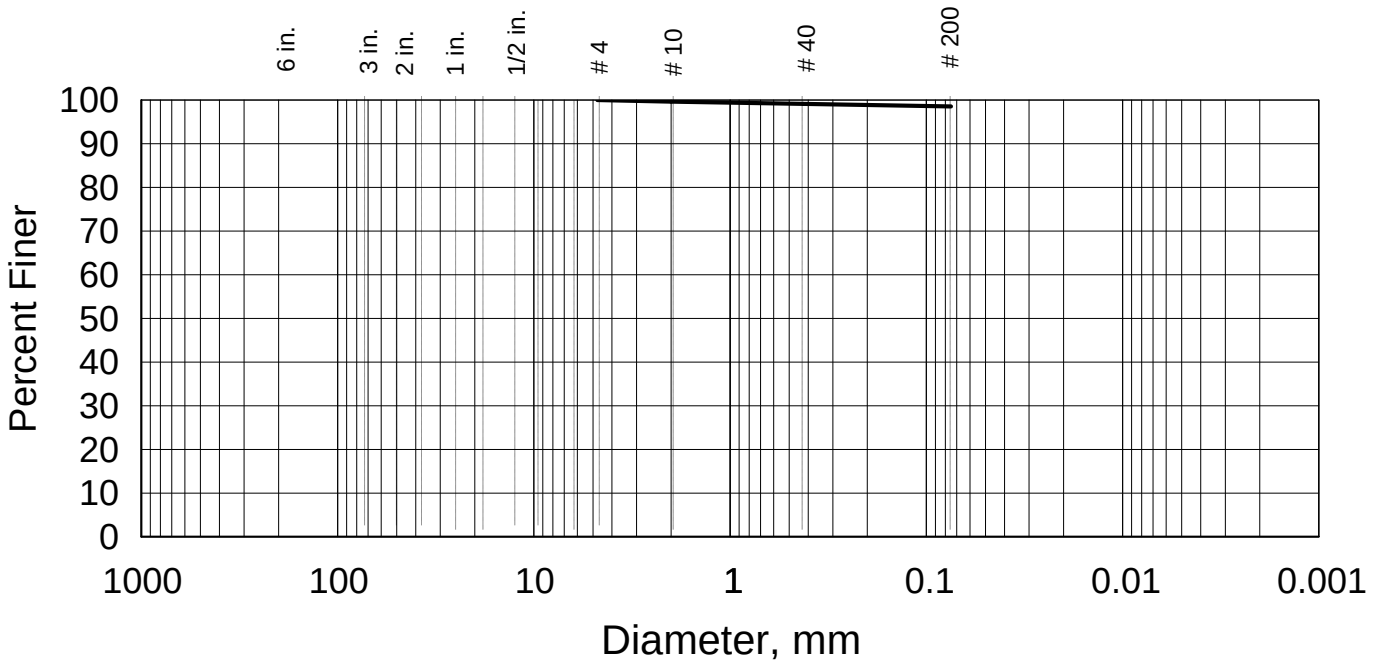
CQA Testing Laboratory Lab ID: 05091

Particle Distribution Test Result



Proj. Name:	City of Lawton Landfill	**Gravel, %**	**Sand, %**	**Silt, %**	**Clay, %**	**LL**	**PI**
Project No.: 2315		0.0	1.4	0.0	0.0	47	25
Report Date 06.13.2023	Log-in Date 06.07.2023	**Description and Classification**					
Project Loc. Oklahoma		Orange/Browr	CL, lean clay,				
		Standard Sieve Sizes - Percent Passing					
Sample Identification - Location - Type		6 "		2.5 "		3/8 "	
SS-3	Bulk Sample	5 "		2 "		1/4 "	
Remarks:	**NMC, %** **14.9**	4.5 "		1- 1/2 "		# 4	100.0
Moist Method, ASTM D422	Bulk	4 "		1 "		# 10	99.7
Sample split on # 40 sieve	Sample wt., kg	3.5 "		3/4 "		# 40	99.1
Clay content reported at 0.005mm	16.90	3 "		1/2 "		# 200	98.6

Hygroscopic Moisture Content Data		Hydrometer Specimen Wet wt.	0.00	**Traceability Items**		
WS+t	0.00	Hydrometer Specimen Dry wt.	ERR	Balance ID	1	2
DS+T	0.00	Assumed Gs	2.75	Therm ID	58981	NA
Tare wt	0.00	Percent <#40 based on complete specimen	99.14	Flask ID	1	NA
Moist Ratio	ERR	Calculated biased weight	ERR	Bulb ID	1	152H
		Composite Correction at 20 deg C	-6	Sol Mix, ml	125	NA
		Meniscus Correction only	1	Tested By	JMB	BMG

Hydrometer Reading Data			Temp.	Corrected			Effective	Diameter, mm	Percent
Time, min.	Readings	Temp.	Correction, Ct	Reading, Rc	K	Rm	depth		finer
2	0	0		-6		1	16.13	0.0000	
5	0	0		-6		1	16.13	0.0000	
15	0	0		-6		1	16.13	0.0000	
30	0	0		-6		1	16.13	0.0000	
120	0	0		-6		1	16.13	0.0000	
240	0	0		-6		1	16.13	0.0000	
600	0	0		-6		1	16.13	0.0000	

Page ID SS-3 Grain-size

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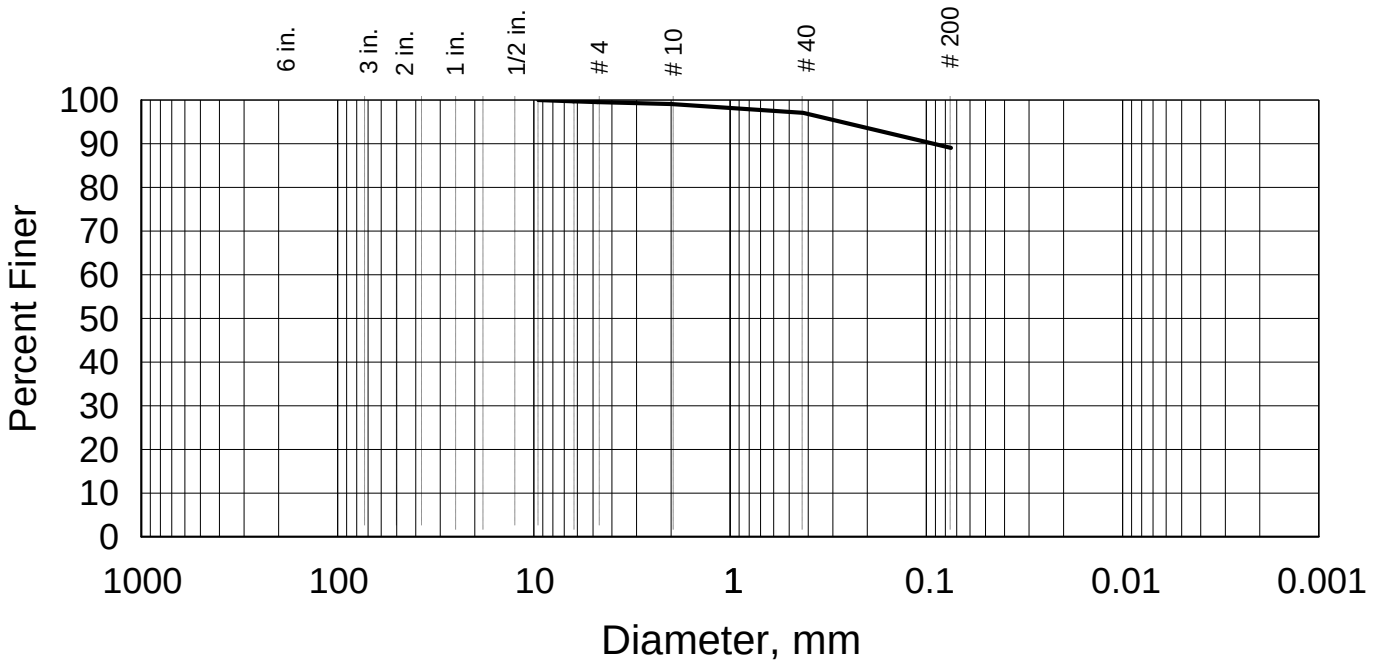
CQA Testing Laboratory Lab ID: 05091

Particle Distribution Test Result



Proj. Name:	City of Lawton Landfill	**Gravel, %**	**Sand, %**	**Silt, %**	**Clay, %**	**LL**	**PI**
Project No.: 2315		0.5	10.4	0.0	0.0	47	26
Report Date 06.13.2023	Log-in Date 06.07.2023	**Description and Classification**					
Project Loc. Oklahoma		Orange/Browr	CL, lean clay,				
		Standard Sieve Sizes - Percent Passing					
Sample Identification - Location - Type		6 "		2.5 "		3/8 "	100.0
SS-4	Bulk Sample	5 "		2 "		1/4 "	99.7
Remarks:	**NMC, %** **16.2**	4.5 "		1- 1/2 "		# 4	99.5
Moist Method, ASTM D422	Bulk	4 "		1 "		# 10	99.1
Sample split on # 40 sieve	Sample wt., kg	3.5 "		3/4 "		# 40	97.1
Clay content reported at 0.005mm	15.30	3 "		1/2 "		# 200	89.1

Hygroscopic Moisture Content Data		Hydrometer Specimen Wet wt.	0.00	**Traceability Items**		
WS+t	0.00	Hydrometer Specimen Dry wt.	ERR	Balance ID	1	2
DS+T	0.00	Assumed Gs	2.75	Therm ID	58981	NA
Tare wt	0.00	Percent <#40 based on complete specimen	97.08	Flask ID	1	NA
Moist Ratio	ERR	Calculated biased weight	ERR	Bulb ID	1	152H
		Composite Correction at 20 deg C	-6	Sol Mix, ml	125	NA
		Meniscus Correction only	1	Tested By	JMB	BMG

Hydrometer Reading Data			Temp.	Corrected			Effective	Diameter, mm	Percent
Time, min.	Readings	Temp.	Correction, Ct	Reading, Rc	K	Rm	depth		finer
2	0	0		-6		1	16.13	0.0000	
5	0	0		-6		1	16.13	0.0000	
15	0	0		-6		1	16.13	0.0000	
30	0	0		-6		1	16.13	0.0000	
120	0	0		-6		1	16.13	0.0000	
240	0	0		-6		1	16.13	0.0000	
600	0	0		-6		1	16.13	0.0000	

Page ID SS-4 Grain-size

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CQA Testing Laboratory

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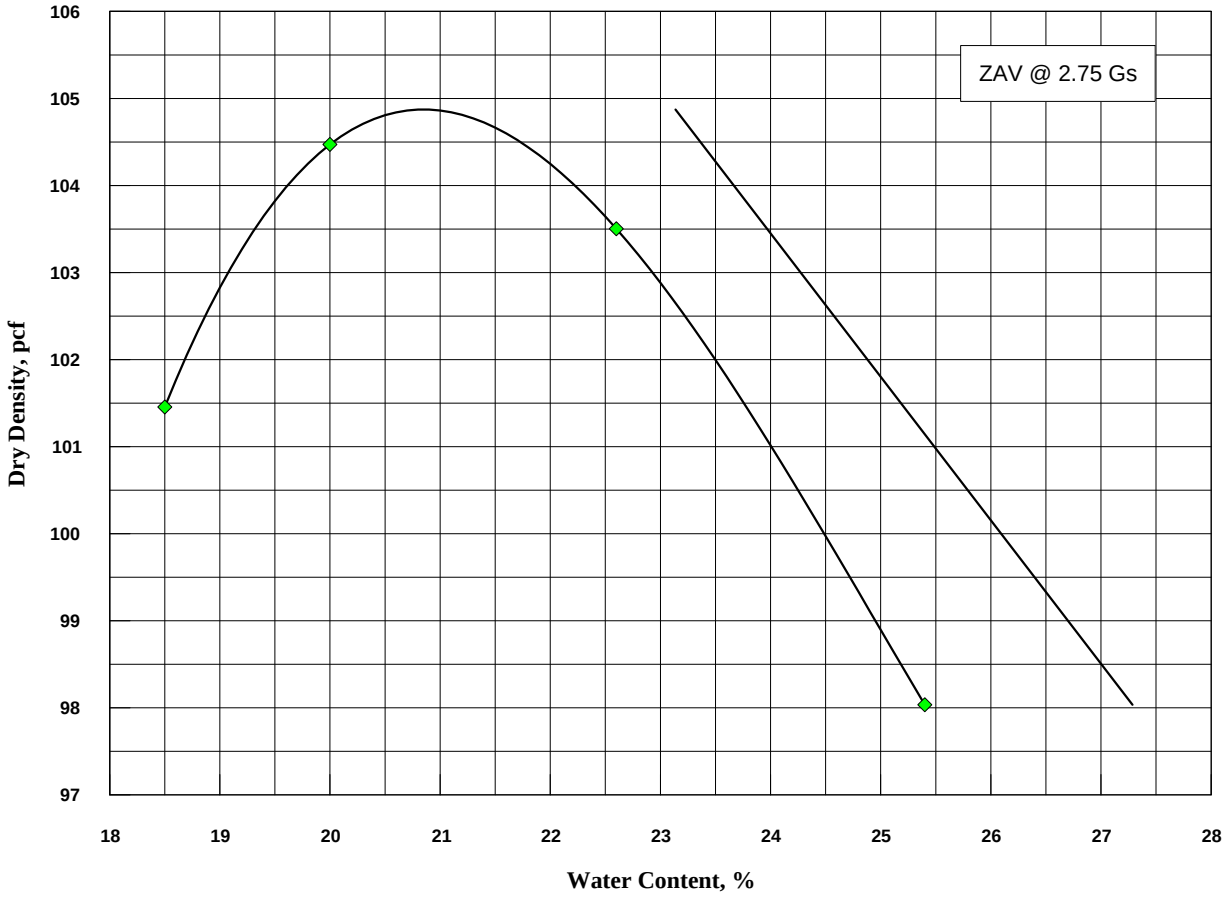
Lab ID: 05091

Laboratory Compaction Test
ASTM D698, Standard Compaction Test, Mechanical Rammer
Method B, Moist Method



Report Date:	06.20.2023	**Received Date:**	06.07.2023	**Ran by:**	JMB	**Checked by:**	BMG
Max. Dry Density, pcf:	**104.9**			**OMC, %:**	**20.9**		
Corrected for Oversize:	**N/A**			**Corrected:**	**N/A**		

Project: City of Lawton Landfill **Client:** SCS Engineers

Project Number: 2315 **Sample Location:** SS-2

Sample Description: Red/Brown CL, lean clay, sandy

LL	PL	PI	NMC
49	22	27	20.4

Gravel, %	Sand, %	Clay, %	P-200
N/A	3.2	N/A	96.8

Traceability Items

Balance ID	Hammer ID	Mold ID	Other
1	1S	A	
2	**Page ID**	**SS-2**	**Compaction**

CQA Testing Laboratory

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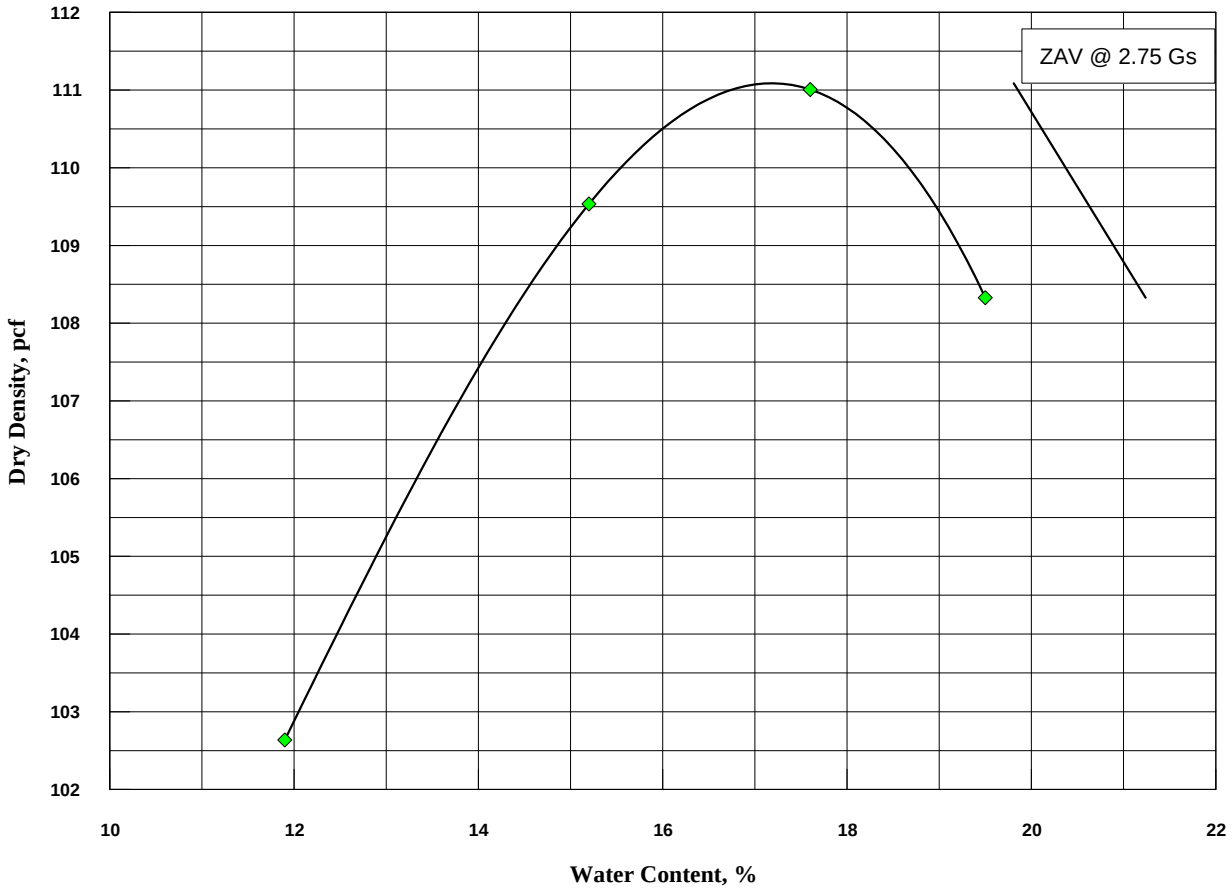
Lab ID: 05091

Laboratory Compaction Test
ASTM D698, Standard Compaction Test, Mechanical Rammer
Method B, Moist Method



Report Date:	06.20.2023	**Received Date:**	06.07.2023	**Ran by:**	JMB	**Checked by:**	BMG
Max. Dry Density, pcf:	**111.1**			**OMC, %:**	**17.2**		
Corrected for Oversize:	**N/A**			**Corrected:**	**N/A**		

Project: City of Lawton Landfill **Client:** SCS Engineers

Project Number: 2315 **Sample Location:** SS-4

Sample Description: Orange/Brown CL, lean clay, with sand

LL	PL	PI	NMC
47	21	26	16.2

Gravel, %	Sand, %	Clay, %	P-200
N/A	10.4	N/A	89.6

Traceability Items

Balance ID	Hammer ID	Mold ID	Other
1	1S	A	
2	**Page ID**	**SS-4**	**Compaction**

CQA Testing Laboratory

Lab ID: 05091

Results of Falling Head Permeability, ASTM D5084
Recompacted Specimen

Project Number:	**2315**	**Specimen Received Date:**	**06.07.2023**	**Test Date:**	**06.23.2023**
Project Name:	**City of Lawton Landfill**	**Specimen Loaded into Cell:**	**06.20.2023**	**Tested By:**	**JMB**
Client:	**SCS Engineers**			**Reviewed By:**	**BMG**

Sample Id.	**SS-2**	**Location:**	**N/A**	**Elevation:**	**N/A**
	Before Testing		**After Testing**		
Specimen Condition:	**good**		**good**		

Special Selection or Preparation if Any:
Recompacted Specimen

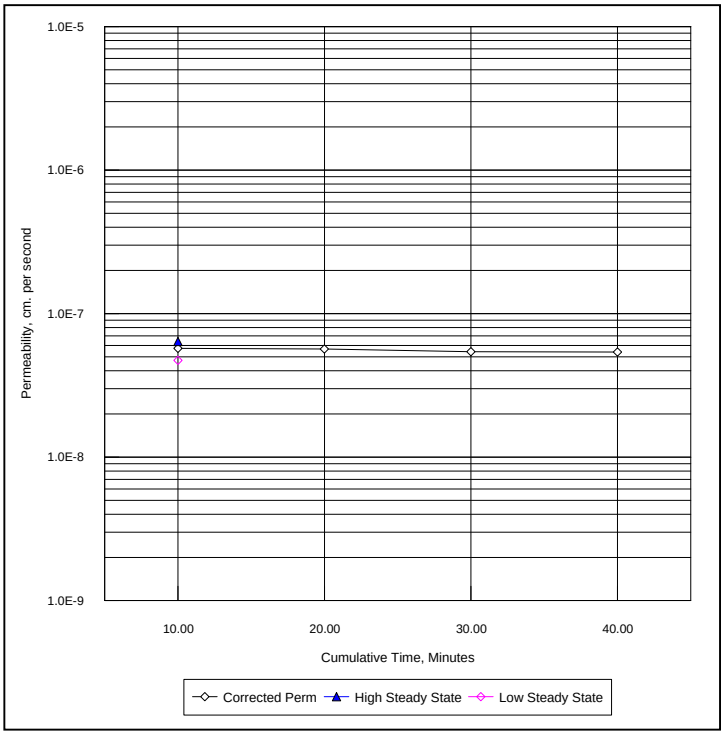
Permeant: **D/A Water**

Specimen Data	**Initial**	**Final**	**Compaction Data**		**Proctor**	**Target**	**Difference**
Moisture Content, (%)	20.9	25.3	Maximum Dry Density, pcf		104.9	99.7	0.0
Percent Saturation	79.6	97.4	Optimum Moisture Content, (%)		20.9	20.9	0.0
Wet Mass Density, (pcf)	120.5	125.4	**Percent Compacted:**	95.0		95.0	0.0
Dry Mass Density, (pcf)	99.7	100.1					
Height of Solids, (in)	1.741	1.742	**Test Pressures During Test**				
Void Ratio	0.723	0.716	Backpressure, psi		50		
Calculated Porosity, (%)	41.95	41.71	Effective Confining Stress, psi		3		

Specimen Dimensions		**Initial**	**Final**
Specimen Height, cm		7.62	7.59
Specimen Diameter, cm		10.16	10.16
Specimen Area, cm^2		81.06	81.02
Specimen Mass		**Initial**	**Final**
Initial Wet Mass, gms		1192.3	1235.7
Specific Gravity (Assumed):		2.75	
Traceability Items			
Caliper ID	2	**Cell ID**	T-1
Balance ID	1	**CV Hg ID**	1
Thermo ID	2		
Constants During Testing and Equipment			
Inflow Buret, (cm ^2, ain)			0.7671
Outflow Buret, (cm ^2, aout)			0.0314
Specific Gravity, (GHg - Gw) = (13.56 - 1)			12.56
Manometer, M1, (ain*aout/ain+aout)			0.0302
Manometer, M2, (1+[aout/ain])			1.041
Sample, S=(Sample Length/ Sample Area)			0.0940
Test Constant, C=(M1*S/G)			**0.000226**

	Test	**Data**	
Elapsed Time (Minutes)	Cumulative Time (Minutes)	Permeability, k (cm/sec) (Uncorrected)	Corrected k For 20 c (cm/sec)
0	0.00		
10	10.00	5.8E-008	5.7E-008
10	20.00	5.8E-008	5.7E-008
10	30.00	5.5E-008	5.4E-008
10	40.00	5.5E-008	5.4E-008

Average Permeability, Corrected k:		**5.6E-008**
	15% of Average	8.3E-009
	High Steady State Limit:	6.4E-008
	Low Steady State Limit:	4.7E-008



		Trial	**Flow**	**Readings**					**Test Fluid**
Date	**Clock Time**	**Elapsed**	**Inflow**	**Outflow**	**Gradient**	**Out/Inflow**	**Z out**	**T**	**Temp, c**
	(hh+mm/60)	**t, sec.**			**During Test**	**Ratio**			
06.23.2023	6.0000	0	1.000	15.500	25.803			0.072	21
06.23.2023	6.1667	600	1.082	13.500	22.098	1.000	2.000	0.084	21
06.23.2023	6.3333	600	1.151	11.800	18.949	1.000	1.700	0.098	21
06.23.2023	6.5000	600	1.209	10.400	16.356	1.000	1.400	0.113	21
06.23.2023	6.6667	600	1.258	9.200	14.133	1.000	1.200	0.131	21

Initial Gradient;	30.00
Height of Mercury in Center Column, cm:	16.86
Unmeasured Flow, cm:	1.36

Remarks: k = C/t ln [1-(Zout T)] and Corrected k for temp @ 20 C = k x (-0.02452 x temp. + 1.495)

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CQA Testing Laboratory

Lab ID: 05091

Results of Falling Head Permeability, ASTM D5084
Recompacted Specimen

Project Number:	**2315**	**Specimen Received Date:**	**06.07.2023**	**Test Date:**	**06.26.2023**
Project Name:	**City of Lawton Landfill**	**Specimen Loaded into Cell:**	**06.24.2023**	**Tested By:**	**JMB**
Client:	**SCS Engineers**			**Reviewed By:**	**BMG**

Sample Id.	**SS-3**	**Location:**	**N/A**	**Elevation:**	**N/A**
	Before Testing		**After Testing**		
Specimen Condition:	**good**		**good**		

Special Selection or Preparation if Any:
Recompacted Specimen

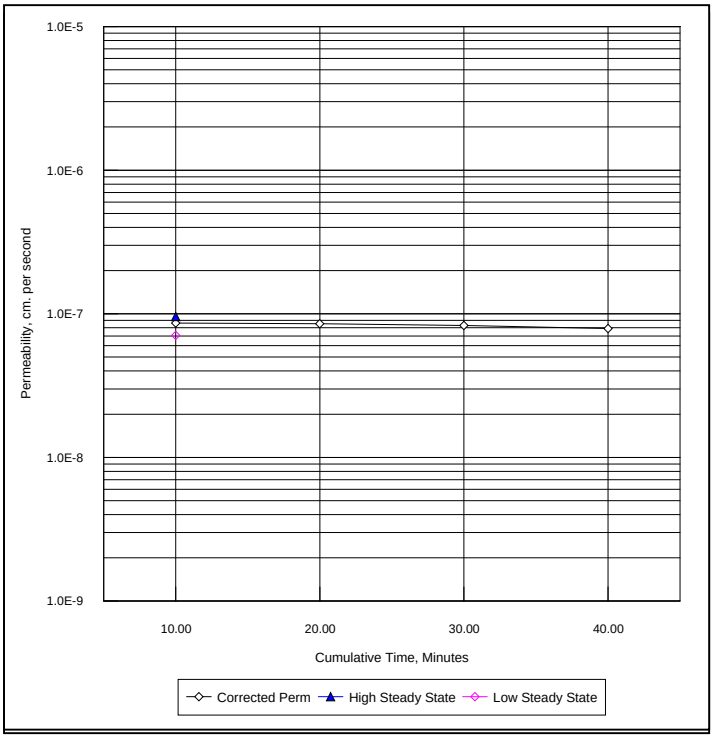
Permeant: **D/A Water**

Specimen Data	**Initial**	**Final**	**Compaction Data**		**Proctor**	**Target**	**Difference**
Moisture Content, (%)	18.0	21.7	Maximum Dry Density, pcf		110.5	105.0	0.0
Percent Saturation	78.0	99.5	Optimum Moisture Content, (%)		18.0	18.0	0.0
Wet Mass Density, (pcf)	123.9	130.6	**Percent Compacted:**	95.0		95.0	0.0
Dry Mass Density, (pcf)	105.0	107.3					
Height of Solids, (in)	1.834	1.863	**Test Pressures During Test**				
Void Ratio	0.635	0.600	Backpressure, psi		50		
Calculated Porosity, (%)	38.85	37.50	Effective Confining Stress, psi		3		

Specimen Dimensions		**Initial**	**Final**
Specimen Height, cm		7.62	7.57
Specimen Diameter, cm		10.16	10.08
Specimen Area, cm^2		81.06	79.81
Specimen Mass		**Initial**	**Final**
Initial Wet Mass, gms		1225.83	1263.9
Specific Gravity (Assumed):		2.75	
Traceability Items			
Caliper ID	2	**Cell ID**	T-4
Balance ID	1	**CV Hg ID**	3
Thermo ID	2		
Constants During Testing and Equipment			
Inflow Buret, (cm ^2, ain)			0.7671
Outflow Buret, (cm ^2, aout)			0.0314
Specific Gravity, (GHg - Gw) = (13.56 - 1)			12.56
Manometer, M1, (ain*aout/ain+aout)			0.0302
Manometer, M2, (1+[aout/ain])			1.041
Sample, S=(Sample Length/ Sample Area)			0.0940
Test Constant, C=(M1*S/G)			**0.000226**

	Test	**Data**	
Elapsed Time (Minutes)	Cumulative Time (Minutes)	Permeability, k (cm/sec) (Uncorrected)	Corrected k For 20 c (cm/sec)
0	0.00		
10	10.00	8.8E-008	8.6E-008
10	20.00	8.7E-008	8.5E-008
10	30.00	8.5E-008	8.3E-008
10	40.00	8.1E-008	7.9E-008

Average Permeability, Corrected k:		**8.3E-008**
	15% of Average	1.3E-008
	High Steady State Limit:	9.6E-008
	Low Steady State Limit:	7.1E-008



		Trial	**Flow**	**Readings**					**Test Fluid**
Date	**Clock Time**	**Elapsed**	**Inflow**	**Outflow**	**Gradient**	**Out/Inflow**	**Z out**	**T**	**Temp, c**
	(hh+mm/60)	**t, sec.**			**During Test**	**Ratio**			
06.26.2023	6.0000	0	1.000	15.000	24.913			0.074	21
06.26.2023	6.1667	600	1.115	12.200	19.727	1.000	2.800	0.094	21
06.26.2023	6.3333	600	1.205	10.000	15.652	1.000	2.200	0.118	21
06.26.2023	6.5000	600	1.274	8.300	12.503	1.000	1.700	0.148	21
06.26.2023	6.6667	600	1.327	7.000	10.094	1.000	1.300	0.184	21

Initial Gradient;	30.00
Height of Mercury in Center Column, cm:	16.86
Unmeasured Flow, cm:	1.86

Remarks: k = C/t ln [1-(Zout T)] and Corrected k for temp @ 20 C = k x (-0.02452 x temp. + 1.495)

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CQA Testing Laboratory

Lab ID: 05091

Results of Falling Head Permeability, ASTM D5084
Recompacted Specimen

Project Number:	**2315**	**Specimen Received Date:**	**06.07.2023**	**Test Date:**	**06.23.2023**
Project Name:	**City of Lawton Landfill**	**Specimen Loaded into Cell:**	**06.20.2023**	**Tested By:**	**JMB**
Client:	**SCS Engineers**			**Reviewed By:**	**BMG**

Sample Id.	**SS-4**	**Location:**	**N/A**	**Elevation:**	**N/A**
	Before Testing		**After Testing**		
Specimen Condition:	**good**		**good**		

Special Selection or Preparation if Any:
Recompacted Specimen

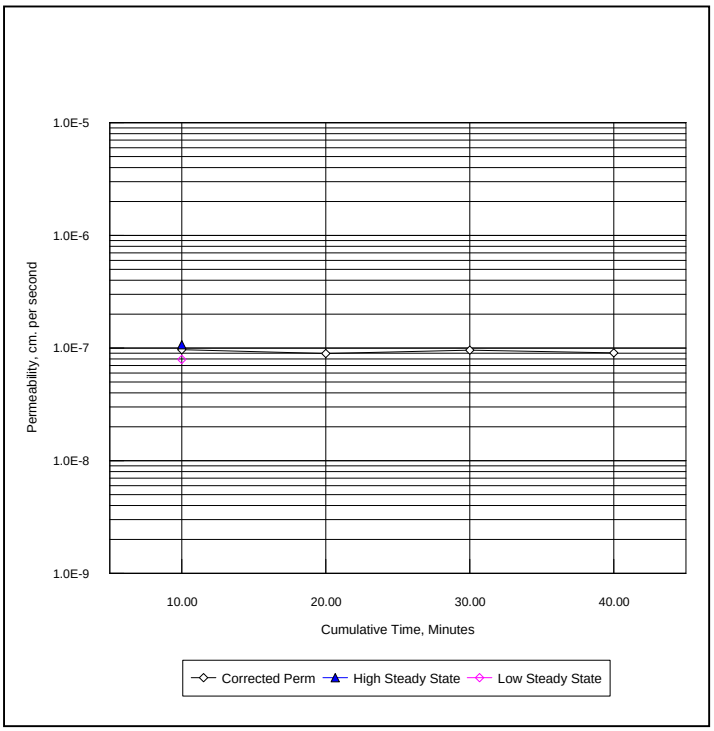
Permeant: **D/A Water**

Specimen Data	**Initial**	**Final**	**Compaction Data**		**Proctor**	**Target**	**Difference**
Moisture Content, (%)	17.2	22.2	Maximum Dry Density, pcf		111.1	105.5	0.0
Percent Saturation	75.6	98.4	Optimum Moisture Content, (%)		17.2	17.2	0.0
Wet Mass Density, (pcf)	123.7	129.4	**Percent Compacted:**	95.0		95.0	0.0
Dry Mass Density, (pcf)	105.6	105.9					
Height of Solids, (in)	1.844	1.851	**Test Pressures During Test**				
Void Ratio	0.627	0.621	Backpressure, psi		50		
Calculated Porosity, (%)	38.52	38.30	Effective Confining Stress, psi		3		

Specimen Dimensions		**Initial**	**Final**
Specimen Height, cm		7.62	7.62
Specimen Diameter, cm		10.16	10.14
Specimen Area, cm^2		81.06	80.77
Specimen Mass		**Initial**	**Final**
Initial Wet Mass, gms		1224.13	1276.2
Specific Gravity (Assumed):		2.75	
Traceability Items			
Caliper ID	2	**Cell ID**	T-2
Balance ID	1	**CV Hg ID**	2
Thermo ID	2		
Constants During Testing and Equipment			
Inflow Buret, (cm ^2, ain)			0.7671
Outflow Buret, (cm ^2, aout)			0.0314
Specific Gravity, (GHg - Gw) = (13.56 - 1)			12.56
Manometer, M1, (ain*aout/ain+aout)			0.0302
Manometer, M2, (1+[aout/ain])			1.041
Sample, S=(Sample Length/ Sample Area)			0.0940
Test Constant, C=(M1*S/G)			**0.000226**

	Test	**Data**	
Elapsed Time (Minutes)	Cumulative Time (Minutes)	Permeability, k (cm/sec) (Uncorrected)	Corrected k For 20 c (cm/sec)
0	0.00		
10	10.00	9.9E-008	9.7E-008
10	20.00	9.1E-008	9.0E-008
10	30.00	9.8E-008	9.6E-008
10	40.00	9.2E-008	9.1E-008

Average Permeability, Corrected k:		**9.3E-008**
	15% of Average	1.4E-008
	High Steady State Limit:	1.1E-007
	Low Steady State Limit:	7.9E-008



		Trial	**Flow**	**Readings**					**Test Fluid**
Date	**Clock Time**	**Elapsed**	**Inflow**	**Outflow**	**Gradient**	**Out/Inflow**	**Z out**	**T**	**Temp, c**
	(hh+mm/60)	**t, sec.**			**During Test**	**Ratio**			
06.23.2023	6.0167	0	1.200	12.500	20.109			0.092	21
06.23.2023	6.1833	600	1.302	10.000	15.478	1.000	2.500	0.120	21
06.23.2023	6.3500	600	1.376	8.200	12.143	1.000	1.800	0.153	21
06.23.2023	6.5167	600	1.437	6.700	9.365	1.000	1.500	0.198	21
06.23.2023	6.6833	600	1.482	5.600	7.327	1.000	1.100	0.253	21

Initial Gradient;	30.00
Height of Mercury in Center Column, cm:	16.86
Unmeasured Flow, cm:	4.36

Remarks: k = C/t ln [1-(Zout T)] and Corrected k for temp @ 20 C = k x (-0.02452 x temp. + 1.495)

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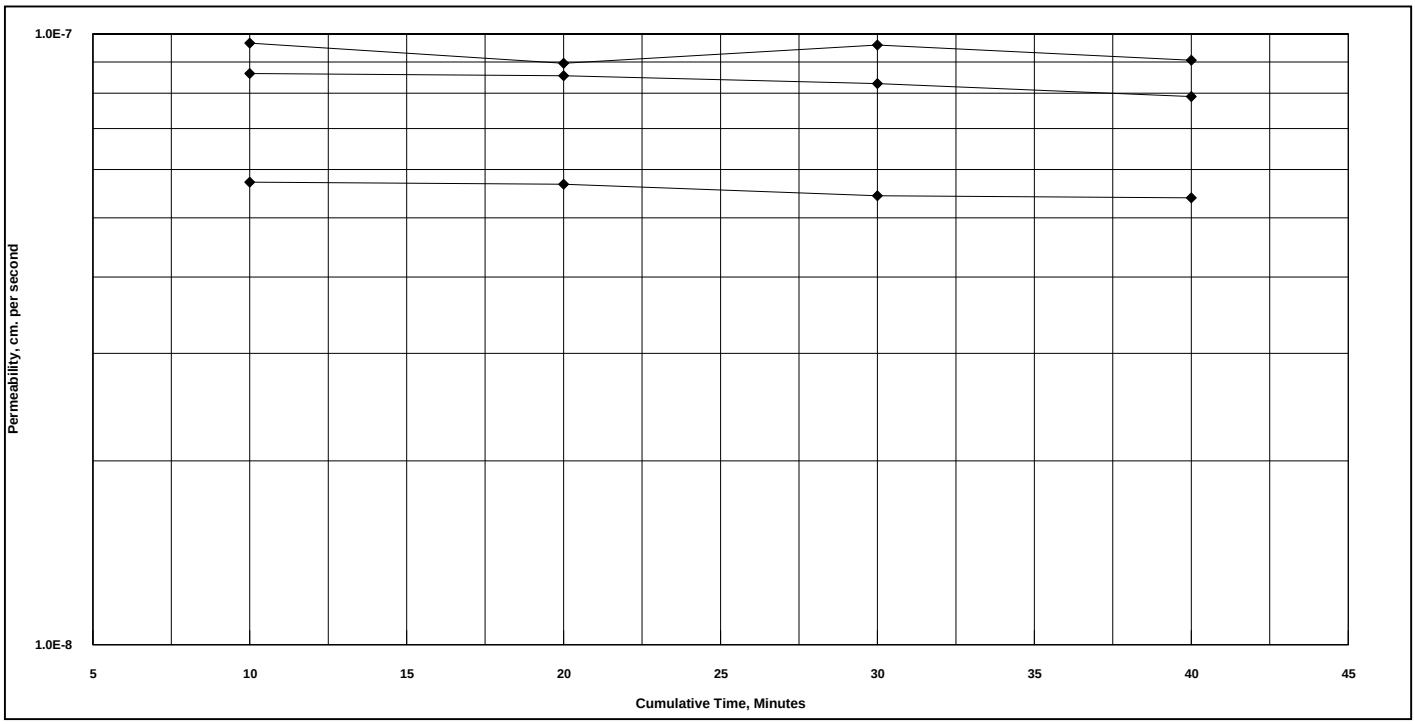
CQA Testing Laboratory

Lab ID: 05091

ASTM D5084
Permeability Test Summary Sheet



Project Name: City of Lawton Landfill **Sample Type:** **Bulk Sample**
Project Number: 2315
Client: SCS Engineers

Project Test Number	Date of Testing	Sample Number	Moisture Content, %	Initial Saturation, %	Final Saturation, %	Percent Lab Compacted	Wet Density (pcf)	Dry Density (pcf)	Average K @ 20 C
1	06.23.2023	SS-2	20.9	79.6	97.4	95.0	120.5	99.7	5.6E-008
2	06.23.2023	SS-4	17.2	75.6	98.4	95.0	123.7	105.6	9.3E-008
3	06.26.2023	SS-3	18.0	78.0	99.5	95.0	123.9	105.0	8.3E-008

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CQA Testing Laboratory

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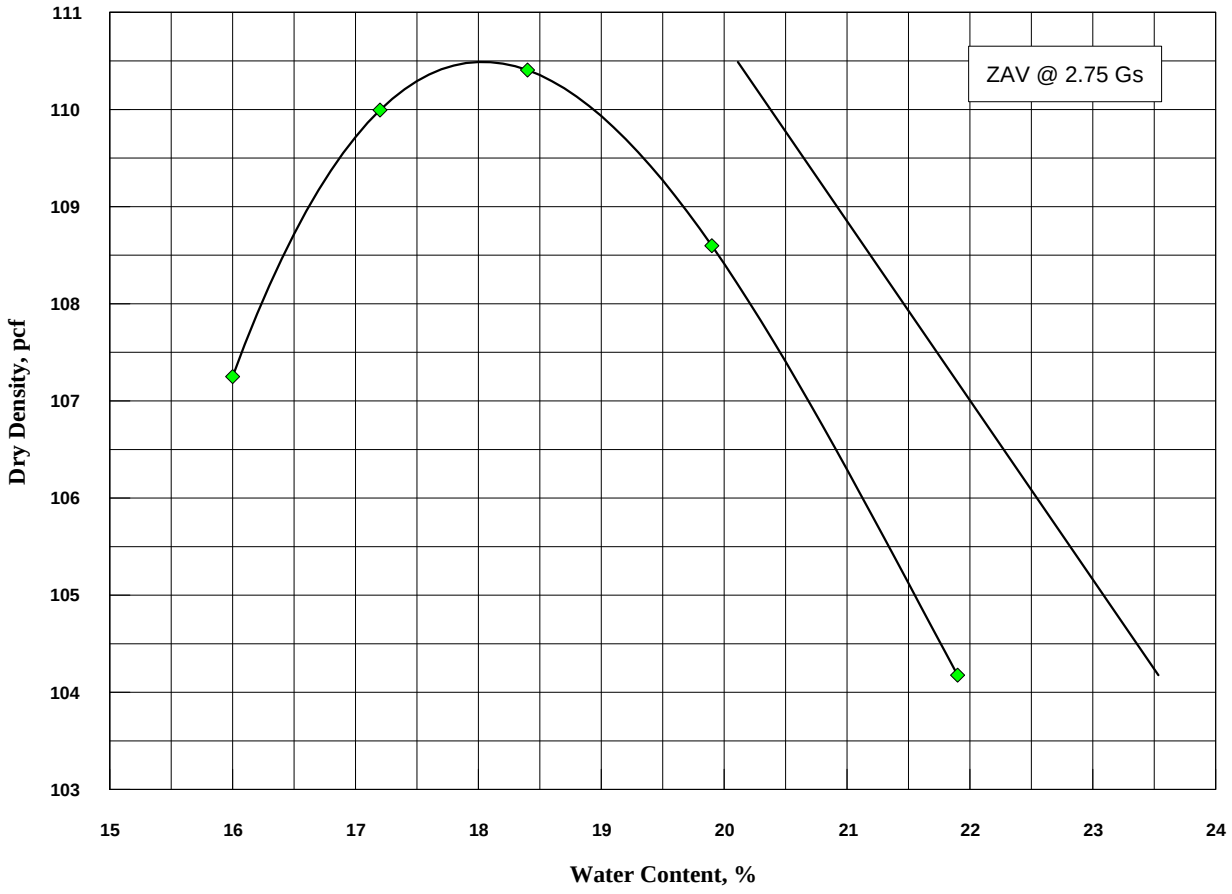
Lab ID: 05091

Laboratory Compaction Test
ASTM D698, Standard Compaction Test, Mechanical Rammer
Method B, Moist Method



Report Date:	06.24.2023	**Received Date:**	06.20.2023	**Ran by:**	JMB	**Checked by:**	BMG
Max. Dry Density, pcf:	**110.5**			**OMC, %:**	**18.0**		
Corrected for Oversize:	**N/A**			**Corrected:**	**N/A**		

Project: City of Lawton Landfill **Client:** SCS Engineers

Project Number: 2315 **Sample Location:** SS-3

Sample Description: Orange/Brown CL, lean clay,

LL	PL	PI	NMC
47	22	25	14.9

Gravel, %	Sand, %	Clay, %	P-200
N/A	1.4	N/A	98.6

Traceability Items

Balance ID	Hammer ID	Mold ID	Other
1	1S	A	
2	**Page ID**	**SS-3**	**Compaction**