EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3555036

TIER III PERMIT MODIFICATION
LANDFILL EXPANSION

VOLUME 4 OF 4

Prepared for

Waste Management of Oklahoma, Inc.

June 2015
Revised January 2016

Revised May 2016

LICENSED PROFESSIONAL ENGINEER
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5/31/16

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WCG Project No. 0086-356-11-42-04

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CONTENTS

CONTENTS (Continued)

EAST OAK RECYCLING AND DISPOSAL FACILITY
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APPENDIX L

LEACHATE COLLECTION SYSTEM DESIGN

Prepared for

Waste Management of Oklahoma, Inc.

June 2015
Revised January 2016

Revised May 2016

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WCG Project No. 0086-356-11-40-08

CONTENTS

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6.5.15

LIST OF APPENDICES

1 INTRODUCTION

This Leachate Collection System Design provides the design and operation details of the proposed leachate collection system for the East Oak Recycling and Disposal Facility (East Oak RDF). In accordance with OAC 252:515-13-31, the leachate collection system is designed to:

1. Maintain 1 foot or less of head above the top of the liner;
2. Drain leachate toward the perimeter of the disposal area; and
3. Provide at least a 5-foot separation above the highest measured groundwater elevation and the top of the liner.

Consistent with OAC 252:515-13, this appendix provides the design information for the leachate collection system. The layout for the liner and leachate collection systems are presented in Appendix L-1.

2 LEACHATE GENERATION

2.1 Generation Process

The capacity of solid waste to absorb moisture is known as field capacity. When the field capacity is exceeded, leachate is generated. However, leachate may also flow within the landfill through preferential pathways; therefore some downward flow of leachate will occur before the field capacity of waste is reached. The quantity of leachate produced depends upon the climate, site topography, type of cover, construction and landfilling procedures, and waste characteristics.

These factors, not including climate, will be controlled or modified to reduce the infiltration and the moisture content of solid waste, thereby reducing the quantity of leachate generated. The site will be graded with temporary and permanent drainage features to provide run-on/runoff controls for stormwater. Water that comes in contact with solid waste, leachate, or gas condensate will be considered contaminated water. Contaminated water will be kept to a minimum using temporary run-on and runoff control berms, detention areas, or operational methods (grading) and will be treated as leachate. Surface water will be managed throughout the active life of the landfill to minimize infiltration into the filled areas and to minimize contact with solid waste. Also, intermediate cover will be graded and maintained to promote runoff and prevent ponding.

2.2 Leachate Generation Modeling

The Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.07, was used to estimate the amount of leachate that will be generated at the East Oak RDF. The HELP model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of landfills. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, runoff, infiltration, percolation, soil-moisture storage, recirculation, evapotranspiration, and lateral drainage.

Leachate generation was evaluated for both active and closed landfill conditions. An explanation of the assumed conditions, methodologies, models, and printouts of the results are included in Appendix L-2. Consistent with OAC 252:515-13-31, the leachate collection system will maintain less than 12 inches of head on the liner in all cases.

2.3 Excavation Plan Design

As shown in Table 2-1 and on the Top of Liner Plan included in Appendix L-1, the top of liner grades are designed to maintain a 5-foot minimum separation between the established highest measured groundwater elevations beneath the site and the top of liner elevations.

Table 2-1
Difference Between Top of Liner Grades and Highest Measured Groundwater

Phase	Top of Liner Elevation in Sump (ft-msl)	Highest Measured Groundwater Elevation (ft-msl)	Depth Above Groundwater (ft)
XIII	1145.2	1140.0	5.2
XIV	1145.9	1140.8	5.1
XV	1146.5	1141.1	5.4
XVI	1146.0	1140.9	5.1
XVII	1146.1	1140.8	5.3

3 PROPOSED LEACHATE COLLECTION SYSTEM

3.1 System Layout

The leachate collection system layout and details are presented in Appendix L-1. The design includes a 12-inch-thick sand layer overlain by either an additional 12-inch-thick sand layer or a 12-inch-thick layer of tire chips. The tire chips layer option is available for the floor grades only. The 12-inch sand layer(s) will have a hydraulic conductivity of $k \geq 1x10^{-3}$ cm/s. The leachate collection layer will convey the leachate to leachate collection pipes, which will be bedded in granular media filled drains. Through the collection pipes, leachate will be conveyed to sumps and pumped out for disposal. The bottom elevation (top of the composite liner in sumps) of the sumps is designed to be the lowest point of the leachate collection system. Consistent with the requirements in OAC 252:515-11-3(a), the bottom elevation of the sumps will be at least 5 feet above the groundwater surface elevation.

3.2 Leachate Collection Layer/Protective Cover Material

The leachate collection layer will be placed directly over the liner system to collect and transfer leachate to leachate collection system pipes and sumps. The leachate collection layer will consist of a 12-inch-thick sand layer with a hydraulic conductivity of $k \geq 1x10^{-3}$ cm/s placed above a geotextile. The facility will have two options to utilize for protective cover: a 12-inch-thick layer of sand ($k \geq 1x10^{-3}$ cm/s) or a 12-inch-thick layer of tire chips (floor grades only) as shown on Figure L-1-5 in Appendix L-1.

3.3 Drainage Aggregate Around Leachate Collection Pipes

The coarse aggregate selected for placement around the leachate collection pipes will consist of normal or lightweight materials that comply with the project specifications. The drainage aggregate shall meet the permeability specified in Section 5 of Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing. Refer to Appendix L-3 for pipe perforation calculations.

The drainage aggregate will be wrapped by a geotextile to maintain separation of the free-draining material from the adjacent fine-grained materials. The geotextile will be inert to commonly encountered chemicals, hydrocarbons, and mildew, and will be rot resistant. Geotextile calculations are presented in Appendix L-5.

3.4 Leachate Collection Piping

The liner and leachate collection system layer will slope to drain toward the leachate collection drains, which will contain a perforated pipe surrounded by drainage aggregate. The leachate collection pipes will direct the leachate to sumps at the perimeter of the disposal area. The leachate collection pipe will be HDPE SDR 17 or equivalent. A cleanout riser will be provided at the end of the leachate collection pipes to allow cleaning as necessary. Leachate collection pipe design calculations are provided in Appendix L-3.

3.5 Leachate Sumps

The leachate collection sumps and pumps for the undeveloped area have been sized to limit maximum head above the liner system to 12 inches and provide a reasonable pump cycle time. The leachate sumps will be 2-feet deep with minimum dimensions of 27 by 27 feet at the landfill floor and 15 by 15 feet at the sump base and will store over 900 gallons of leachate. The sumps will be backfilled with drainage stone meeting the permeability specified in Section 5 of Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing. Existing sumps in Phases V and VI will be converted to vertical sumps.

Submersible pumps located in the 18-inch-diameter sidewall or vertical riser pipes will empty the sumps. The pumps will be operated either manually or automatically by pressure transducers. Control levels for automatic sump pumps will be set to maintain typical sump liquid levels at or below the floor of the landfill. The depth of leachate in the sumps will be monitored by the pressure transducers, which will be calibrated to provide direct read-out of the leachate level in the sumps. Sump volume calculations are presented in Appendix L-4.

3.6 Temporary Leachate Storage Sump

If needed, leachate may be conveyed to a temporary sump. Temporary leachate storage sumps will be constructed as necessary as the site develops. Plans for these temporary facilities will be submitted and approved by the ODEQ prior to initiation of construction.

3.7 System Cleanouts

The leachate collection system has been designed such that the leachate collection piping can be cleaned out periodically in accordance with OAC 252:515-13-34. Cleanouts are provided on the sump ends of the leachate collection pipes. In accordance with ODEQ regulations, the pipes will be cleaned out initially after protective cover has been placed over them, again after the placement of the first lift of waste, and once per year thereafter.

3.8 Leachate Storage

The leachate collected in the leachate sumps may be pumped from the sumps and recirculated to the landfill working face or pumped to the on-site leachate tanks via a 3-inch-diameter solid wall SDR 11 HDPE pipe contained within a 6-inch-diameter, solid wall SDR 17 HDPE pipe to provide secondary containment. Leachate will be discharged from the leachate tanks to the Oklahoma City (OKC) publicly owned treatment works (POTW) in accordance with Industrial Permit No. 2865. A copy of Industrial Permit No. 2865 is included in Appendix L-8. The site previously utilized leachate storage ponds for storage prior to discharging to the OKC POTW; however the leachate storage ponds were decommissioned in 2014.

The existing leachate tanks sit on a 8-inch thick concrete pad surrounded by a 8-inch thick, 53.5-foot long x 40-foot wide x 6-foot deep, concrete containment structure. The containment structure provides 96,000 gallons of capacity. The largest tank in the containment structure is 63,300 gallons.

4 DOCUMENTATION REQUIREMENTS

4.1 Construction Quality Assurance/Quality Control Plan (QA/QC)

The construction QA/QC plan (Appendix K) was developed for the leachate collection system and the other components of the liner system in accordance with OAC 252:515-11-4.

4.2 Construction Report

Details of the leachate collection system as required by OAC 252:515-13-35 will be provided in the LIT report. Upon completion of each phase's construction, an LIT Report will be submitted to the ODEQ.

4.3 Performance Evaluation

Quarterly reports providing leachate volume collected, treated, and/or disposed of as well as the results of any monitoring program will be submitted to the ODEQ.

4.4 Corrective Action

In the event that the leachate collection system fails to perform as designed, a corrective action plan will be submitted to the ODEQ within 90 days in accordance with OAC 252:515-13-2. The corrective action plan will be implemented within 30 days of receiving approval of the plan from the ODEQ.

5 LEACHATE AND CONTAMINATED WATER DISPOSAL

Submersible pumps will pump leachate from the leachate collection sumps to the on-site leachate tank via a forcemain. The forcemain will generally be located within the waste fill area; therefore, secondary containment will not be needed when in this area. The proposed piping will consist of a 3-inch-diameter HDPE SDR 11 contained within a 6-inch-diameter HDPE SDR 17 pipe to provide secondary containment when the forcemain is located outside the waste fill area. The carrier pipe will provide leak detection and containment. If the leachate forcemain is placed within the waste fill area, and in the final cover, the forcemain pipe will be placed a minimum of 18 inches below the top of the vegetation layer. After placement, any disturbed soil in the vegetation layer and vegetation support layer that occurs will be repaired in accordance with the Alternative Final Cover Quality Assurance/Quality Control Plan found in Appendix J. Forcemain placement above and in the final cover will require dual containment. The location of the existing and proposed leachate piping and the existing leachate storage tanks are shown in Appendix L-1, Figure L-1-4. Details of the connection between the 18-inch riser and piping are also presented in Appendix L-1.

Leachate and contaminated water will be disposed of by one of the following methods.

1. Directly discharged to the OKC POTW.
2. Recirculated at the working face, as needed to stabilize waste and facilitate compaction. The recirculation of leachate will be performed following the procedures set for in the Leachate Recirculation System Operating Plan (Section 6).

Sampling and analysis of the leachate will be limited to the disposal facility's requirements.

Contaminated water that collects will be pumped into tanker trucks and transported to a properly permitted privately-owned treatment facility or a public-owned treatment works (POTW) for treatment or may be recirculated at the working face. Contaminated water may also be transported to the leachate storage tanks for conveyance to the POTW provided that the contaminated water meets applicable pretreatment standards and permit requirements.

6 LEACHATE RECIRCULATION SYSTEM OPERATING PLAN

6.1 Introduction

The main purpose of recirculating leachate at the East Oak RDF is to facilitate waste compaction by providing for the opportunity to create a uniform moisture content throughout the waste at the working face. The additional moisture will help stabilize the waste mass by providing for increased compaction of the waste.

This Leachate Recirculation System Operating Plan will establish the procedures and requirements for recirculating leachate in accordance with ODEQ guidelines (i.e., ODEQ 252:515-13-53 and the Guidance Document on Leachate Recirculation as shown in Appendix L-6) and previous discussions with the ODEQ concerning leachate recirculation. This plan will serve as a guide for the East Oak RDF for managing the recirculation of leachate over the composite lined phases at the East Oak RDF.

6.2 System Description and Operating Procedures

In accordance with ODEQ guidelines, recirculation of leachate will only occur over areas of the landfill that have been lined with ODEQ approved Subtitle D composite liner systems. The following are three typical scenarios for recirculation areas.

- **Scenario 1.** From the pre-Subtitle D/Subtitle D tie-in a 1(H):1(V) offset will be used to determine the Subtitle D area that leachate recirculation operations will take place over.
- **Scenario 2.** An 18-inch-thick compacted clay barrier will be constructed to prevent recirculated leachate from entering pre-Subtitle D areas. The barrier will have a hydraulic conductivity no greater than $1x10^{-5}$ cm/s and constructed consistent with the QA/QC plan. Berms will be used to divert stormwater run-on and to contain any stormwater that may contact waste at the active face. The design of the containment and diversion berms is detailed in Appendix L-7.
- **Scenario 3.** From a combination of Items 1 and 2 discussed above, the landfill could place the 18-inch-thick compacted clay barrier over the pre-Subtitle D area up the slope enough and show that a 1(H):1(V) offset places the leachate recirculation over the Subtitle D area.

The leachate generated from the landfill will be recirculated to the landfill working face and excess quantities of leachate will be directed to the leachate storage facilities. The leachate recirculation schedule is that 100 percent of the leachate generated daily can be recirculated once a 10-foot-thick lift of waste is in place. As discussed in Appendix L-2, the HELP Model was used to evaluate the ability of the leachate collection system to maintain less than 12 inches of head on the liner during leachate recirculation. As shown in Appendix L-2, even at 100 percent recirculation, the leachate collection system produces less than 12 inches of head on the liner.

The leachate collection system layout and details are presented in Appendix L-1. The design includes a 12-inch-thick sand layer overlain by either an additional 12-inch-thick sand layer or a 12-inch-thick layer of tire chips (tire chips on floor grades only). An 8-oz/sy geotextile will underlie the 12-inch leachate collection layer.

The leachate collected in the leachate collection sump will be pumped into the leachate storage facilities. The leachate storage area is detailed in Section 3.8. Leachate will be recirculated using the following typical methods:

- Surface Spraying – Distributing leachate from a water truck using a spray bar or hose to distribute leachate back to the working face. Another option of surface spraying at the working face would be a water-reel, pump, and accessories for distributing leachate to the working face.
- Horizontal Trenches – Trenches placed in the waste fill at regular vertical intervals and backfilled with permeable materials (sand, aggregate, shredded tires, crushed glass, etc.) provides a method for distributing leachate in a uniform manner. Perforated piping is generally included in the trench to facilitate the flow of leachate.
- Drip Irrigation Tubing – This would consist of small diameter (typically 0.5") plastic tubing originally developed for irrigating food crops in arid environments. It allows a highly controlled application of moisture. The tubing can either be laid on the surface or be buried at shallow depths.
- Vertical Irrigation Wells – This method would consist of small-diameter wells installed vertically into the landfill surface to distribute liquid uniformly within each well's zone of influence.

6.3 Application Rate

The following performance standards will govern the application rate of leachate recirculation.

- The rate of application will not exceed the moisture holding capacity of the landfill. For example, the application rate will be applied so that no seeps or ponding is observed in the vicinity of the recirculation area.
- Leachate recirculation will not occur immediately before, during, or immediately after rainfall events, or during freezing temperatures that could affect the holding capacity of the waste.
- The application rate shall not result in a release of pollutants in surface runoff.

- The recirculation of leachate will be accomplished in a manner that does not create a health risk to employees, the public, adjacent property owners or their property (e.g., application should not occur during high winds, or if an additional odor occurs due to the recirculation event).
- Leachate may be recirculated in the phase after a 10-foot-thick waste column is in place. This is consistent with the HELP analysis included in Appendix L-2.

6.4 Leachate Sampling Requirements and Procedures

In accordance with the site's industrial permit, East Oak RDF currently samples leachate semi-annually. Analytical results are submitted to OKC and are available to ODEQ upon request. The site currently reports leachate quantities to ODEQ on a quarterly basis. Logs and analytical results will be maintained in the Site Operating Record.

If methane is detected at levels above regulatory limits or a statistically significant change is noted during a groundwater sampling event, the leachate recirculation will cease until the source is determined to be not associated with the landfill, unless otherwise approved by the ODEQ.

6.5 System Assessment

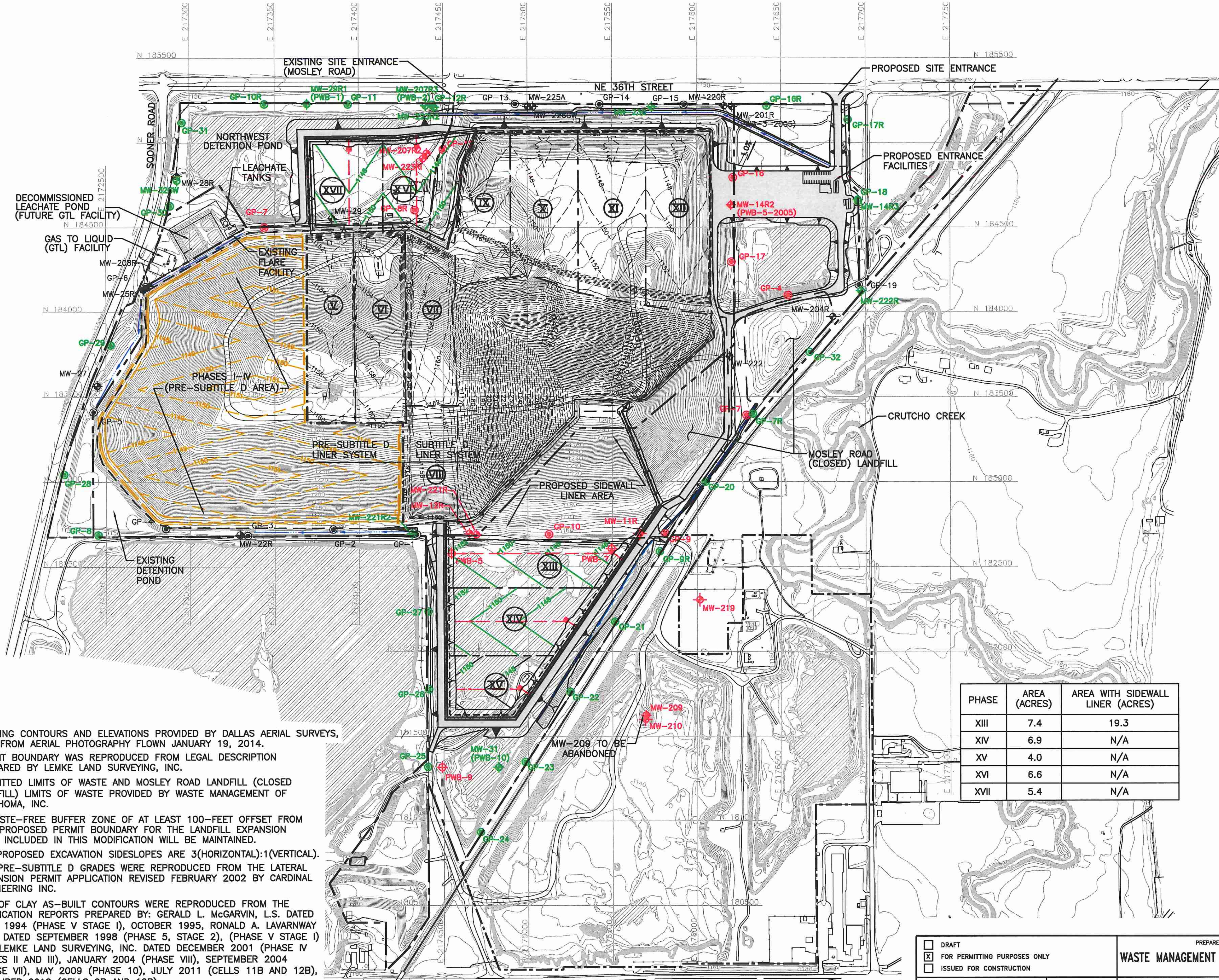
The site will be periodically inspected to verify that no known leachate springs or seeps have occurred and that leachate has not commingled with stormwater runoff that has been discharged from the site as a direct result of the operation of the leachate recirculation system. This inspection will also include an evaluation of the operating procedures to verify compliance with ODEQ guidelines.

If the site chooses to recirculate, in addition to the periodic inspections discussed above, an annual assessment will be submitted to ODEQ to document the performance of the recirculation system. The annual assessment will include an estimate of the volume of leachate recirculated and a summary of the analytical results. In addition, the overall performance of recirculation practices will be documented in the annual assessment.

APPENDIX L-1

FIGURES

CONTENTS



LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
- N 183000 STATE PLANE GRID COORDINATE
- 1160 EXISTING CONTOUR
- 1150 PROPOSED EXCAVATION CONTOUR
- 1150 APPROXIMATE PRE-SUBTITLE D CONTOUR (SEE NOTE 6)
- 1240 TOP OF CLAY AS-BUILT CONTOUR (SEE NOTE 7)
- LEACHATE COLLECTION PIPE
- LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE-SUBTITLE D/ SUBTITLE D LINER LOCATION
- X PHASE DESIGNATION
- MW-27 EXISTING GROUNDWATER MONITORING WELL (TO REMAIN)
- MW-29 EXISTING GROUNDWATER MONITORING WELL (TO BE ABANDONED)
- MW-31 PROPOSED GROUNDWATER MONITORING WELL
- GP-15 EXISTING LANDFILL GAS PROBE (TO REMAIN)
- GP-16 EXISTING LANDFILL GAS PROBE (TO BE ABANDONED)
- GP-18 PROPOSED LANDFILL GAS PROBE
- PWB-7 EXISTING GROUNDWATER PIEZOMETER (TO BE ABANDONED)

PHASE	AREA (ACRES)	AREA WITH SIDEWALL LINER (ACRES)
XIII	7.4	19.3
XIV	6.9	N/A
XV	4.0	N/A
XVI	6.6	N/A
XVII	5.4	N/A

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. A WASTE-FREE BUFFER ZONE OF AT LEAST 100-FEET OFFSET FROM THE PROPOSED PERMIT BOUNDARY FOR THE LANDFILL EXPANSION AREA INCLUDED IN THIS MODIFICATION WILL BE MAINTAINED.
5. ALL PROPOSED EXCAVATION SIDESLOPES ARE 3(HORIZONTAL):1(VERTICAL).
6. THE PRE-SUBTITLE D GRADES WERE REPRODUCED FROM THE LATERAL EXPANSION PERMIT APPLICATION REVISED FEBRUARY 2002 BY CARDINAL ENGINEERING INC.
7. TOP OF CLAY AS-BUILT CONTOURS WERE REPRODUCED FROM THE VERIFICATION REPORTS PREPARED BY: GERALD L. McGARVIN, L.S. DATED JUNE 1994 (PHASE V STAGE I), OCTOBER 1995, RONALD A. LAVARNWAY RPLS DATED SEPTEMBER 1998 (PHASE 5, STAGE 2), (PHASE V STAGE I) AND LEMKE LAND SURVEYING, INC. DATED DECEMBER 2001 (PHASE IV STAGES II AND III), JANUARY 2004 (PHASE VIII), SEPTEMBER 2004 (PHASE VII), MAY 2009 (PHASE 10), JULY 2011 (CELLS 11B AND 12B), NOVEMBER 2012 (CELLS 9B AND 10B).

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- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION

DATE: 06/2015
FILE: 0086-356-11
CAD: FIG L-1-1-EXCAVATION PLAN.DWG

DRAWN BY: VRS
DESIGN BY: RSF
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION
1	01/2016	REVISED PROBE/WELL LAYOUT
2	05/2016	REVISED PROBE/WELL LAYOUT

Weaver Consultants Group
CA 3804 PE-06/30/2017

TIER III PERMIT MODIFICATION EXCAVATION PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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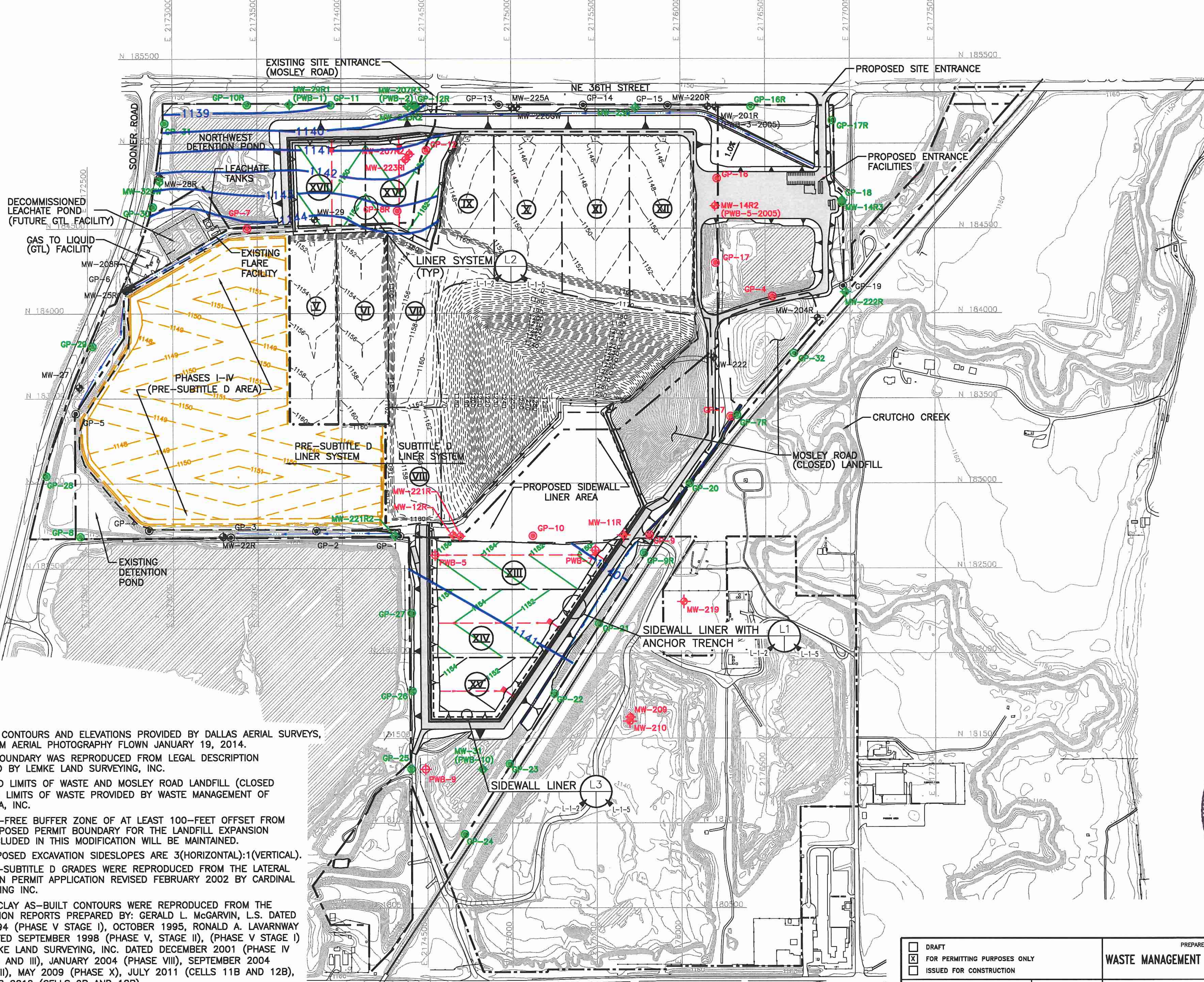
FIGURE L-1-1



0 300 600
SCALE IN FEET

LEGEND

PROPERTY BOUNDARY
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY
PERMITTED LIMITS OF WASTE
PROPOSED LIMITS OF WASTE
MOSLEY ROAD LANDFILL LIMITS OF WASTE
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1180 EXISTING CONTOUR
1152 PROPOSED TOP OF LINER CONTOUR
1150 APPROXIMATE PRE–SUBTITLE D CONTOUR (SEE NOTE 6)
1240 TOP OF CLAY AS–BUILT CONTOUR (SEE NOTE 7)
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LEACHATE SUMP
LEACHATE CLEANOUT RISER
PROPOSED DRAINAGE CHANNEL
1140 HIGHEST MEASURED GROUNDWATER ELEVATION CONTOUR IN FT–MSL (SEE NOTE 8)
APPROXIMATE PRE–SUBTITLE D/ SUBTITLE D LINER LOCATION
X PHASE DESIGNATION
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MW–29 EXISTING GROUNDWATER MONITORING WELL (TO BE ABANDONED)
MW–207R3 PROPOSED GROUNDWATER MONITORING WELL
GP–15 EXISTING LANDFILL GAS PROBE (TO REMAIN)
GP–16 EXISTING LANDFILL GAS PROBE (TO BE ABANDONED)
GP–18 PROPOSED LANDFILL GAS PROBE
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8. HIGHEST MEASURED GROUNDWATER ELEVATIONS FROM GROUNDWATER LEVEL MEASUREMENTS TAKEN FROM JUNE 2014 TO MAY 2015.

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PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

DATE: 06/2015
FILE: 0086–356–11
CAD: FIG L–1–2 TOP OF LINER.DWG

DRAWN BY: SRF
DESIGN BY: MDM
REVIEWED BY: JVQ

REVISIONS

NO.	DATE	DESCRIPTION
1	01/2016	REVISED PROBE/WELL LAYOUT
2	05/2016	REVISED PROBE/WELL LAYOUT

Weaver Consultants Group
CA 3804 PE – 06/30/2017

TIER III PERMIT MODIFICATION
TOP OF LINER PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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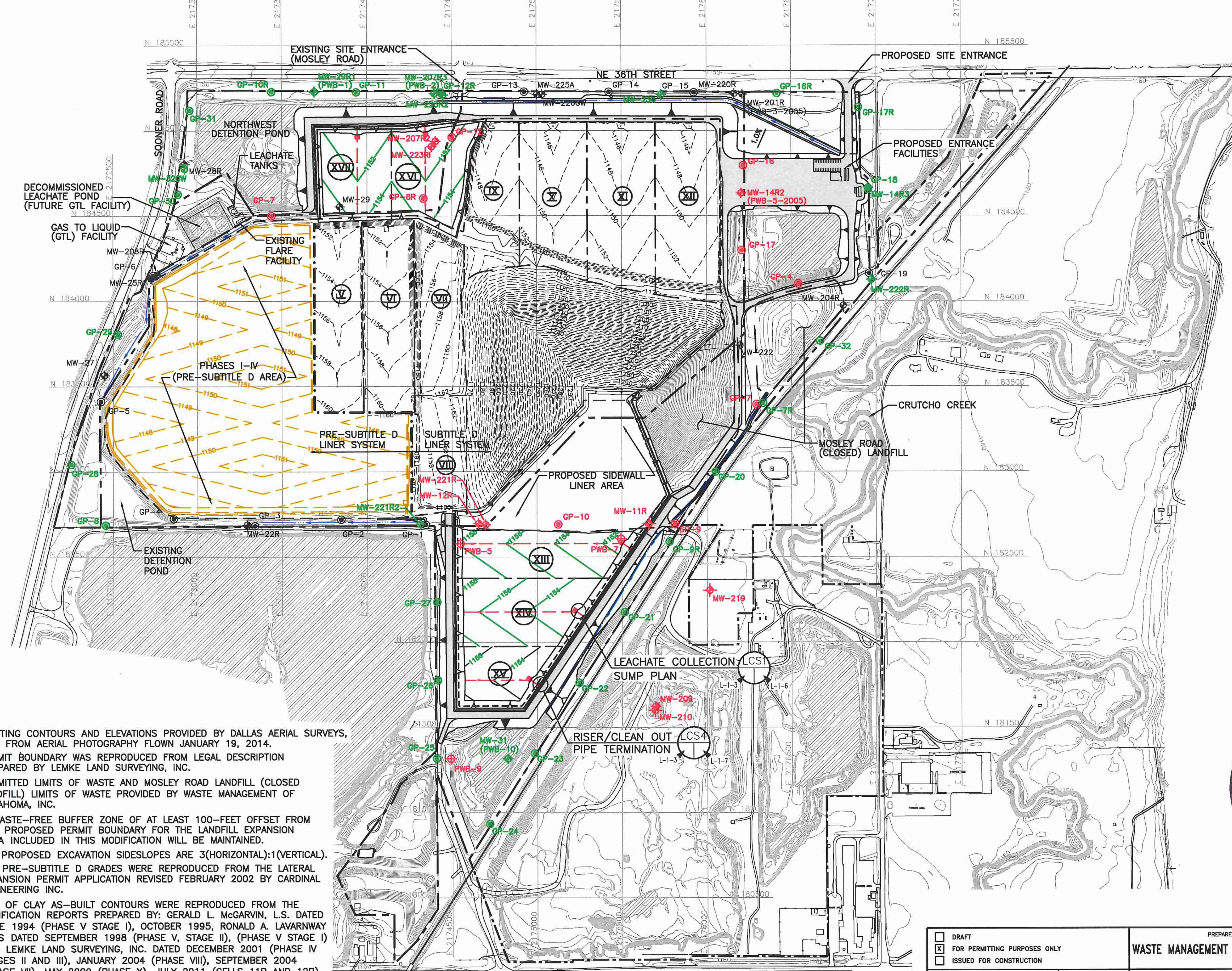
FIGURE L–1–2

O:\0086\356\EXPANSION 2013\APPENDIX L\FIG L–1–2–TOP OF LINER PLAN.dwg, rmorris, 1:2



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5. ALL PROPOSED EXCAVATION SIDESLOPES ARE 3(HORIZONTAL):1(VERTICAL).
6. THE PRE–SUBTITLE D GRADES WERE REPRODUCED FROM THE LATERAL EXPANSION PERMIT APPLICATION REVISED FEBRUARY 2002 BY CARDINAL ENGINEERING INC.
7. TOP OF CLAY AS–BUILT CONTOURS WERE REPRODUCED FROM THE VERIFICATION REPORTS PREPARED BY: GERALD L. McGARVIN, L.S. DATED JUNE 1994 (PHASE V STAGE I), OCTOBER 1995, RONALD A. LAVARNWAY RPLS DATED SEPTEMBER 1998 (PHASE V, STAGE II), (PHASE V STAGE I) AND LEMKE LAND SURVEYING, INC. DATED DECEMBER 2001 (PHASE IV STAGES II AND III), JANUARY 2004 (PHASE VIII), SEPTEMBER 2004 (PHASE VII), MAY 2009 (PHASE X), JULY 2011 (CELLS 11B AND 12B), NOVEMBER 2012 (CELLS 9B AND 10B).

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
- N 183000 — STATE PLANE GRID COORDINATE
- 1180 — EXISTING CONTOUR
- 1152 — PROPOSED TOP OF PROTECTIVE COVER CONTOUR
- 1150 — APPROXIMATE PRE–SUBTITLE D CONTOUR (SEE NOTE 5)
- 1240 — TOP OF CLAY AS–BUILT CONTOUR (SEE NOTE 6)
- LEACHATE COLLECTION PIPE
- LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE–SUBTITLE D/ SUBTITLE D LINER LOCATION
- X — PHASE DESIGNATION
- MW–201R — EXISTING GROUNDWATER MONITORING WELL (TO REMAIN)
- MW–29 — EXISTING GROUNDWATER MONITORING WELL (TO BE ABANDONED)
- MW–207R3 — PROPOSED GROUNDWATER MONITORING WELL
- GP–15 — EXISTING LANDFILL GAS PROBE (TO REMAIN)
- GP–16 — EXISTING LANDFILL GAS PROBE (TO BE ABANDONED)
- GP–18 — PROPOSED LANDFILL GAS PROBE
- PWB–7 — EXISTING GROUNDWATER PIEZOMETER (TO BE ABANDONED)

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DATE: 06/2015
FILE: 0086-356-11
CAD: FIG L-1-3 TOPC.DWG

DRAWN BY: SRF
DESIGN BY: MDM
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION
1	01/2016	REVISED PROBE/WELL LAYOUT
2	05/2016	REVISED PROBE/WELL LAYOUT

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TIER III PERMIT MODIFICATION TOP OF PROTECTIVE COVER PLAN

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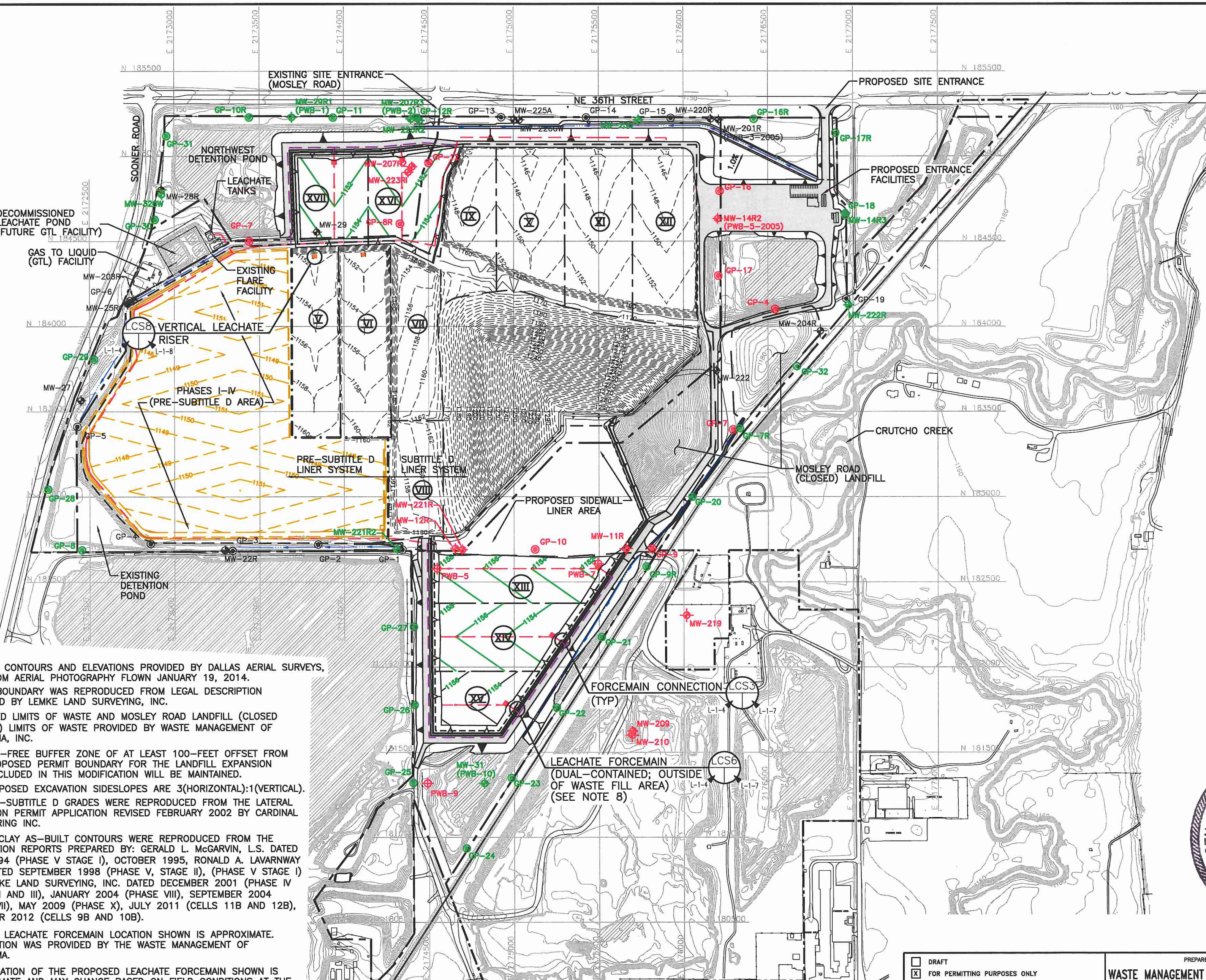
FIGURE L-1-3

O:\0086\356\EXPANSION 2013\APPENDIX L\FIG L-1-3-TOP OF PROTECTIVE COVER PLAN.dwg, rmorris, 1:2



NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. A WASTE-FREE BUFFER ZONE OF AT LEAST 100-FEET OFFSET FROM THE PROPOSED PERMIT BOUNDARY FOR THE LANDFILL EXPANSION AREA INCLUDED IN THIS MODIFICATION WILL BE MAINTAINED.
5. ALL PROPOSED EXCAVATION SIDESLOPES ARE 3(HORIZONTAL):1(VERTICAL).
6. THE PRE-SUBTITLE D GRADES WERE REPRODUCED FROM THE LATERAL EXPANSION PERMIT APPLICATION REVISED FEBRUARY 2002 BY CARDINAL ENGINEERING INC.
7. TOP OF CLAY AS-BUILT CONTOURS WERE REPRODUCED FROM THE VERIFICATION REPORTS PREPARED BY: GERALD L. McGARVIN, L.S. DATED JUNE 1994 (PHASE V STAGE I), OCTOBER 1995, RONALD A. LAVARNWAY RPLS DATED SEPTEMBER 1998 (PHASE V, STAGE II), (PHASE V STAGE I) AND LEMKE LAND SURVEYING, INC. DATED DECEMBER 2001 (PHASE IV STAGES II AND III), JANUARY 2004 (PHASE VIII), SEPTEMBER 2004 (PHASE VII), MAY 2009 (PHASE X), JULY 2011 (CELLS 11B AND 12B), NOVEMBER 2012 (CELLS 9B AND 10B).
8. EXISTING LEACHATE FORCEMAIN LOCATION SHOWN IS APPROXIMATE. INFORMATION WAS PROVIDED BY THE WASTE MANAGEMENT OF OKLAHOMA.
9. THE LOCATION OF THE PROPOSED LEACHATE FORCEMAIN SHOWN IS APPROXIMATE AND MAY CHANGE BASED ON FIELD CONDITIONS AT THE TIME OF CONSTRUCTION. IF THE PROPOSED LEACHATE FORCEMAIN IS PLACED WITHIN THE WASTE FILL AREA, SECONDARY CONTAINMENT WILL NOT BE NEEDED. SEE DETAIL LCS7 ON FIGURE L-1-7 FOR FORCEMAIN LOCATED WITHIN THE WASTE FILL AREA.

0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
- N 183000 STATE PLANE GRID COORDINATE
- 1180 EXISTING CONTOUR
- 1182 PROPOSED TOP OF PROTECTIVE COVER CONTOUR
- 1150 APPROXIMATE PRE-SUBTITLE D CONTOUR (SEE NOTE 6)
- 1240 TOP OF CLAY AS-BUILT CONTOUR (SEE NOTE 7)
- LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE FORCEMAIN (SEE NOTE 9)
- EXISTING LEACHATE FORCEMAIN (SEE NOTE 8)
- LEACHATE SUMP
- EXISTING LCS SUMP TO BE CONVERTED TO A VERTICAL SUMP
- LEACHATE CLEANOUT RISER
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE-SUBTITLE D/ SUBTITLE D LINER LOCATION
- X PHASE DESIGNATION
- MW-201R EXISTING GROUNDWATER MONITORING WELL (TO REMAIN)
- MW-29 EXISTING GROUNDWATER MONITORING WELL (TO BE ABANDONED)
- MW-207R3 PROPOSED GROUNDWATER MONITORING WELL
- GP-15 EXISTING LANDFILL GAS PROBE (TO REMAIN)
- GP-16 EXISTING LANDFILL GAS PROBE (TO BE ADANDONED)
- GP-18 PROPOSED LANDFILL GAS PROBE
- PWB-7 EXISTING GROUNDWATER PIEZOMETER (TO BE ABANDONED)

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DATE: 08/2015 FILE: 0086-356-11 CAD: FIG L-1-4 LEACHATE PLAN.DWG	DRAWN BY: SRF DESIGN BY: MDM REVIEWED BY: JVQ	EAST OAK RDF OKLAHOMA COUNTY, OKLAHOMA

REVISIONS

NO.	DATE	DESCRIPTION
1	01/2016	REVISED PROBE/WELL LAYOUT
2	05/2016	REVISED PROBE/WELL LAYOUT

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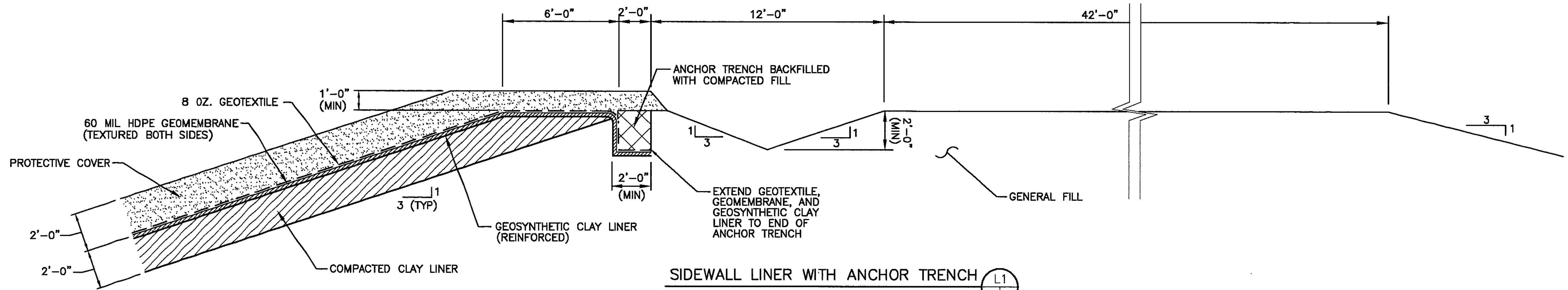
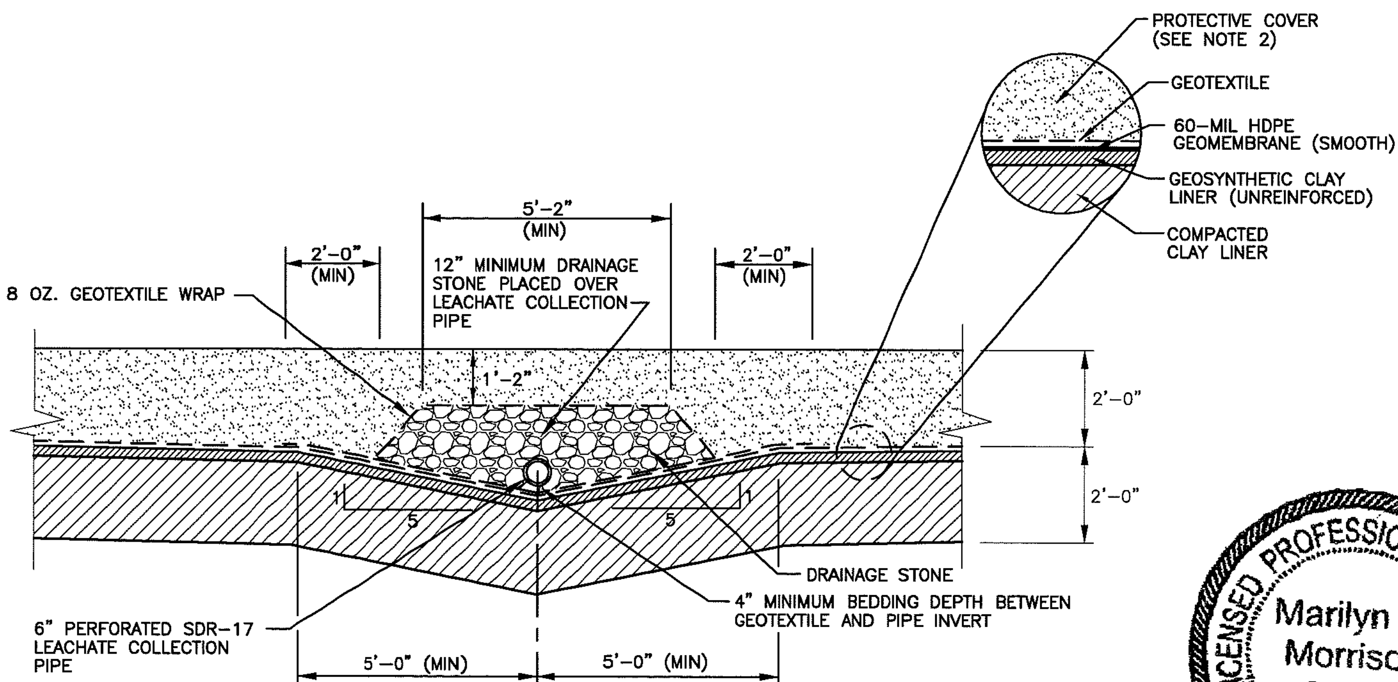
FIGURE L-1-4

O:\0086\356\EXPANSION 2013\APPENDIX L\FIG L-1-4-LEACHATE FORCEMAIN PLAN.dwg, rmorris, 1:2



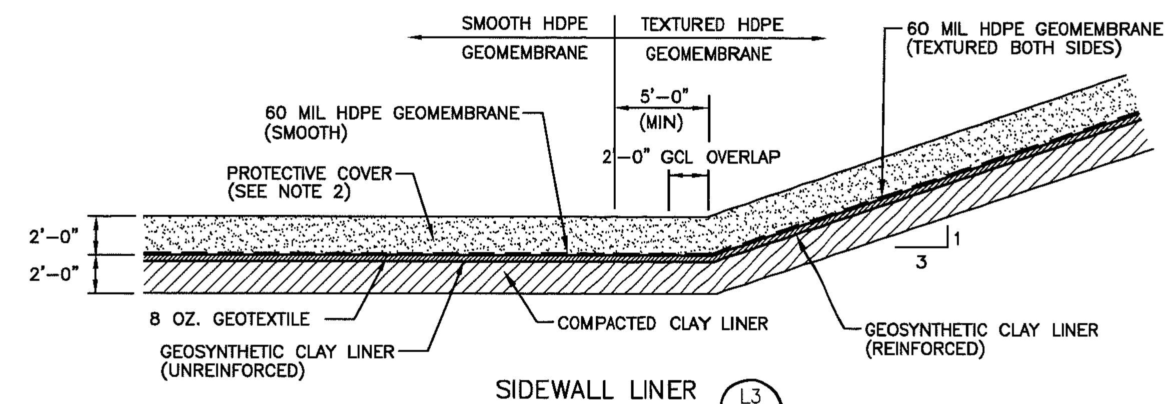
SIDEWALL LINER WITH ANCHOR TRENCH L1 L-1-2 L-1-5

6 3 0 SCALE IN FEET



LINER SYSTEM (TYP) L2 L-1-2 L-1-5

0 2 4 SCALE IN FEET



SIDEWALL LINER L3 L-1-2 L-1-5

0 5 10 SCALE IN FEET

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NOTE:

1. MATERIAL PROPERTIES AND QA/QC REQUIREMENTS FOR EACH OF THE LINER COMPONENTS ARE SPECIFIED IN APPENDIX K.
2. AN ALTERNATIVE PROTECTIVE COVER OPTION INCLUDES REPLACING THE TOP 1-FOOT OF MATERIAL WITH TIRE CHIPS FOR FLOOR GRADES ONLY. TIRE CHIPS ARE NOT ALLOWED ON 3:1 SIDESLOPES OR SIDEWALL LINER AREAS. SEE APPENDIX L FOR MORE INFORMATION.

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DATE: 06/2015
FILE: 0086-356-11
CAD: FIG L-1-5 LINER DTLS.DWG

DRAWN BY: JDW
DESIGN BY: MDM
REVIEWED BY: JVQ

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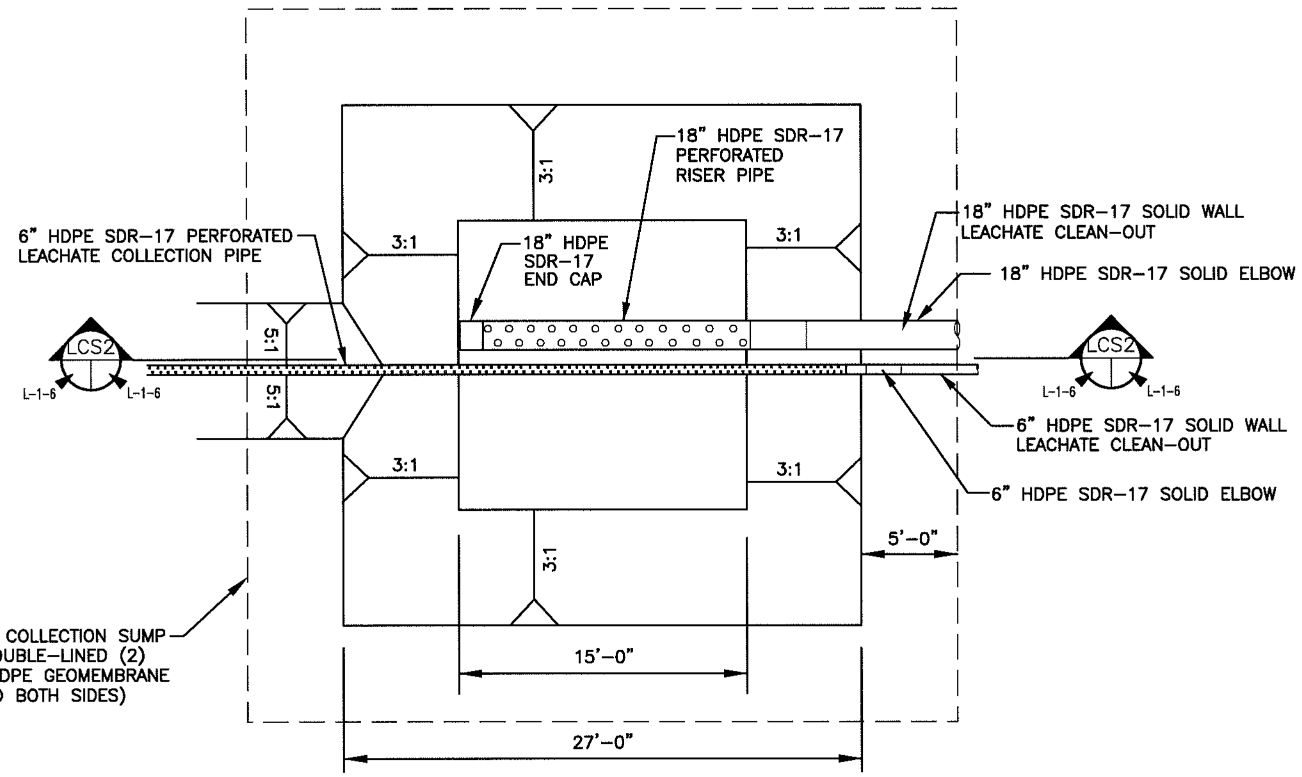
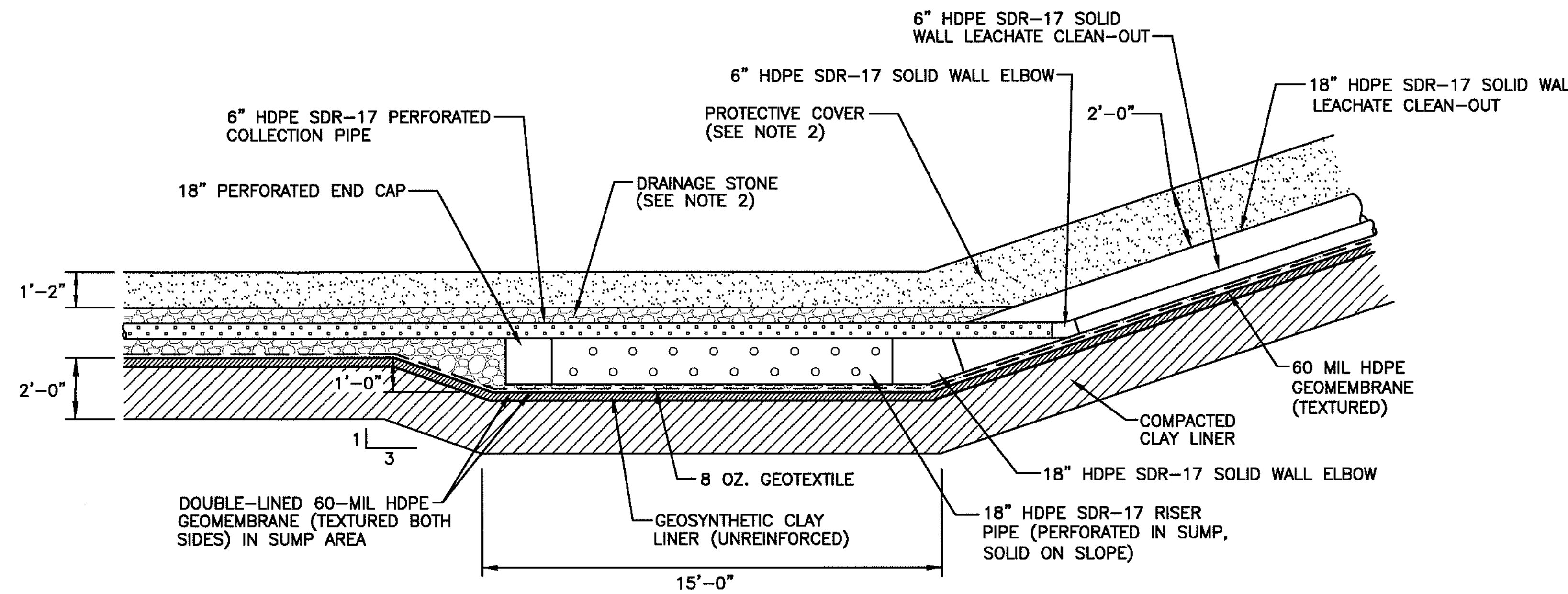
FIGURE L-1-5

O:\0086\356\EXPANSION 2013\APPENDIX L\FIG L-1-5-LINER-DTLS.dwg, uacholonu, 1:2



LEACHATE COLLECTION SUMP PLAN (LCS1, L-1-3, L-1-6)

0 5 10
SCALE IN FEET



TYPICAL LEACHATE SUMP SECTION (LCS2, L-1-6, L-1-6)

0 3 6
SCALE IN FEET

NOTES:

1. MATERIAL PROPERTIES AND QA/QC REQUIREMENTS FOR EACH OF THE LINER COMPONENTS ARE SPECIFIED IN APPENDIX K.
2. AN ALTERNATIVE PROTECTIVE COVER OPTION INCLUDES REPLACING THE TOP 1-FOOT OF MATERIAL WITH TIRE CHIPS FOR FLOOR GRADES ONLY. TIRE CHIPS ARE NOT ALLOWED ON 3:1 SIDESLOPES OR SIDEWALL LINER AREAS. SEE APPENDIX L FOR MORE INFORMATION.

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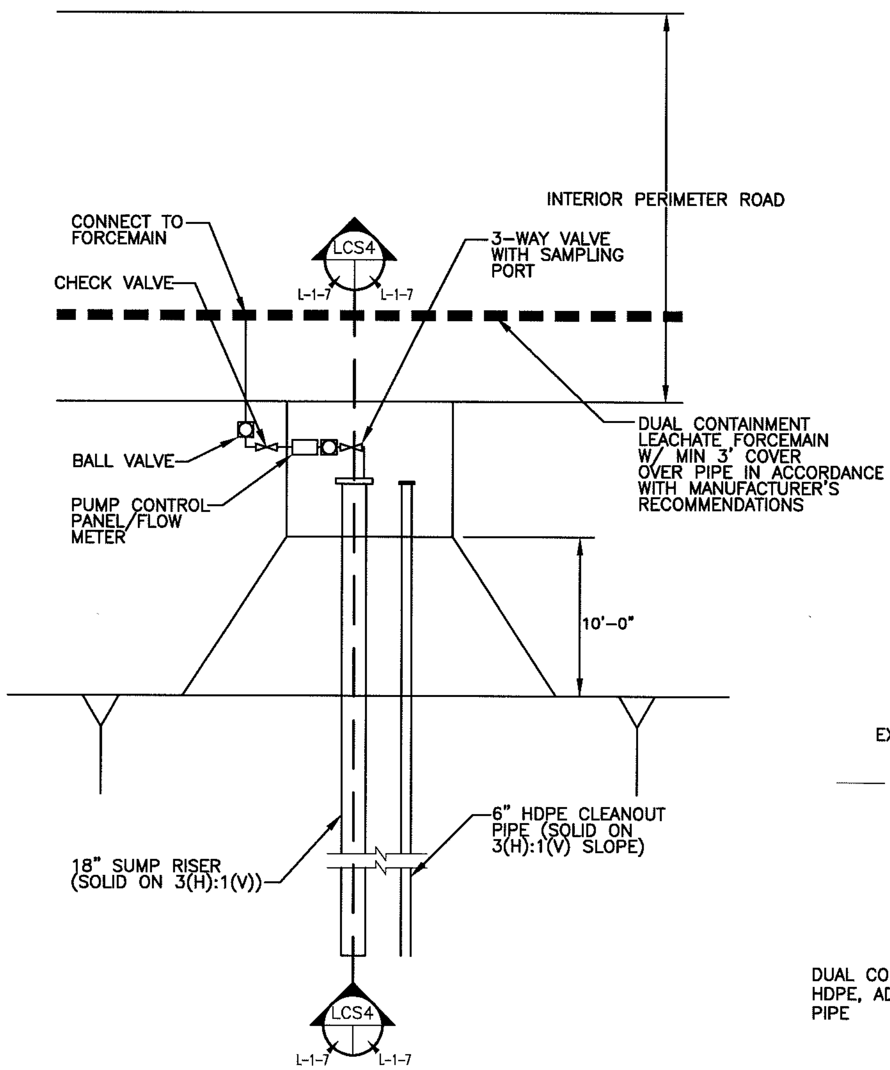
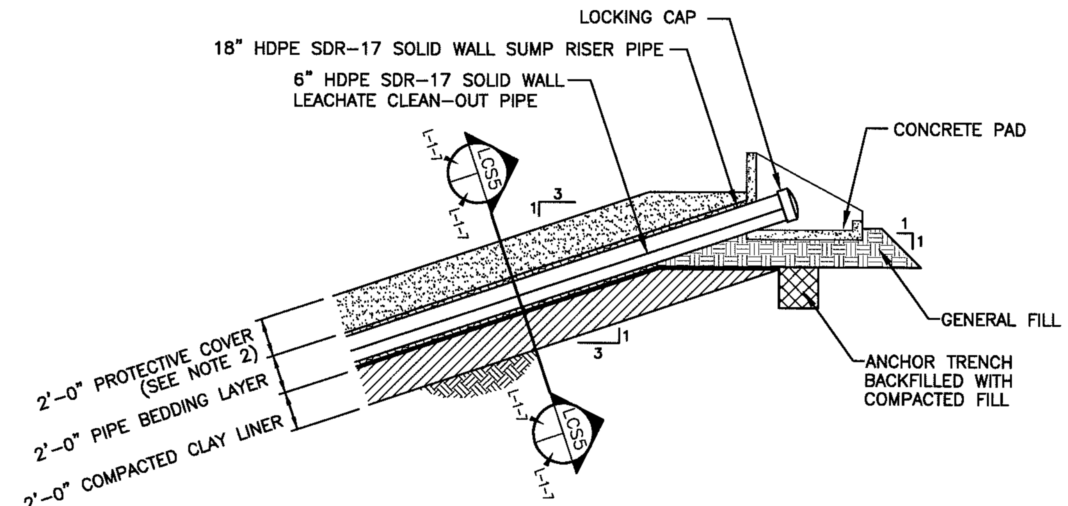
DATE: 06/2015 FILE: 0086-356-11 CAD: FIG L-1-6 LEACH DTLS.DWG	DRAWN BY: JDW DESIGN BY: MDM REVIEWED BY: JVQ	REVISIONS NO. / DATE / DESCRIPTION	
Weaver Consultants Group CA 3804 PE - 06/30/2015			WWW.WCGRP.COM — FIGURE L-1-6

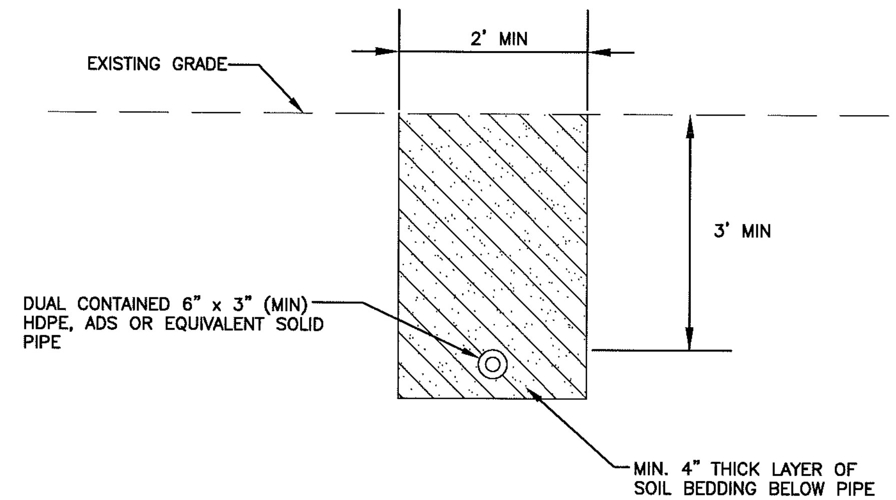
G:\0086\356\EXPANSION 2013\APPENDIX L\FIG L-1-6-LEACHATE-DTLS.dwg, uacholonu, 1:2



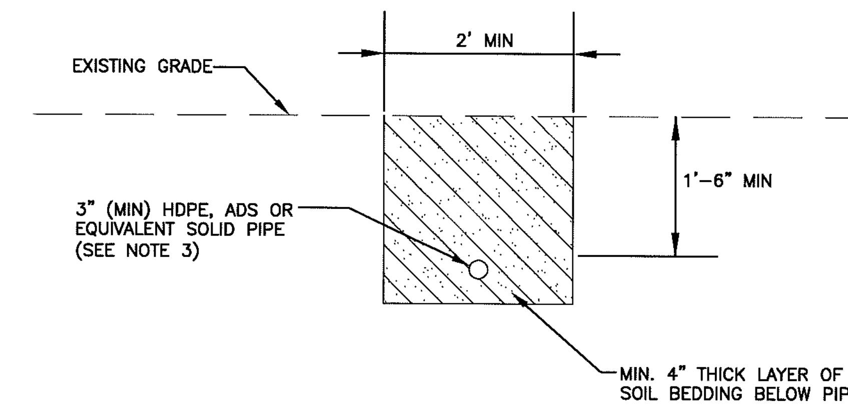
FORCEMAIN CONNECTION (LCS3, L-1-4, L-1-7)
NTS



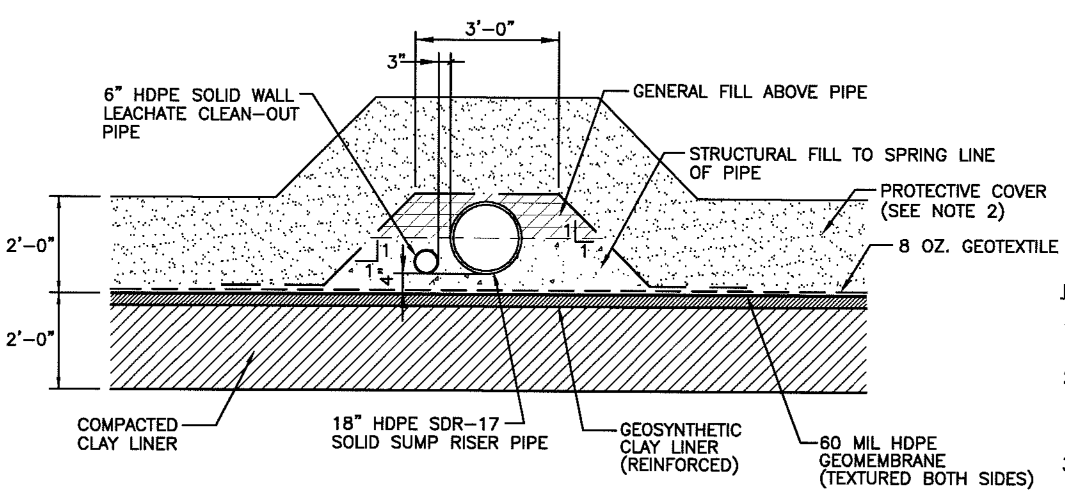
RISER/CLEANOUT PIPE TERMINATION (LCS4, L-1-3,L-1-7, L-1-7)
0 5 10
SCALE IN FEET



LEACHATE FORCEMAIN (DUAL-CONTAINED; OUTSIDE OF WASTE FILL AREA) (LCS6, L-1-4, L-1-7)
NTS



LEACHATE FORCEMAIN (SINGLE CONTAINED; INSIDE OF WASTE FILL AREA) (LCS7, L-1-7, L-1-7)
NTS



RISER/CLEANOUT PIPE SIDEWALL SECTION (LCS5, L-1-7, L-1-7)
0 2 4
SCALE IN FEET

NOTES:

1. MATERIAL PROPERTIES AND QA/QC REQUIREMENTS FOR EACH OF THE LINER COMPONENTS ARE SPECIFIED IN APPENDIX K.
2. AN ALTERNATIVE PROTECTIVE COVER OPTION INCLUDES REPLACING THE TOP 1-FOOT OF MATERIAL WITH TIRE CHIPS FOR FLOOR GRADES ONLY. TIRE CHIPS ARE NOT ALLOWED ON 3:1 SIDESLOPES OR SIDEWALL LINER AREAS. SEE APPENDIX L FOR MORE INFORMATION.
3. IF THE LEACHATE FORCEMAIN IS PLACED WITHIN THE WASTE FILL AREA AND IN THE FINAL COVER, THE FORCEMAIN PIPE WILL BE PLACED A MINIMUM OF 18 INCHES BELOW THE TOP OF THE EROSION LAYER. AFTER PLACEMENT, ANY DISTURBED SOIL IN THE VEGETATION LAYER AND VEGETATION SUPPORT LAYER THAT OCCURS WILL BE REPAIRED IN ACCORDANCE WITH THE ALTERNATIVE FINAL COVER QUALITY ASSURANCE/QUALITY CONTROL PLAN FOUND IN APPENDIX I-4. FORCEMAIN PLACEMENT ABOVE AND IN THE FINAL COVER WILL REQUIRE A DUAL CONTAINED 6"x3" (MIN) HDPE, ADS OR EQUIVALENT SOLID PIPE.

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DATE: 06/2015	DRAWN BY: VRS
FILE: 0086-356-11	DESIGN BY: RSF
CAD: FIG L-1-7-LEACH-DTLS.dwg	REVIEWED BY: JVQ

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TIER III PERMIT MODIFICATION LINER AND LEACHATE COLLECTION SYSTEM DETAILS

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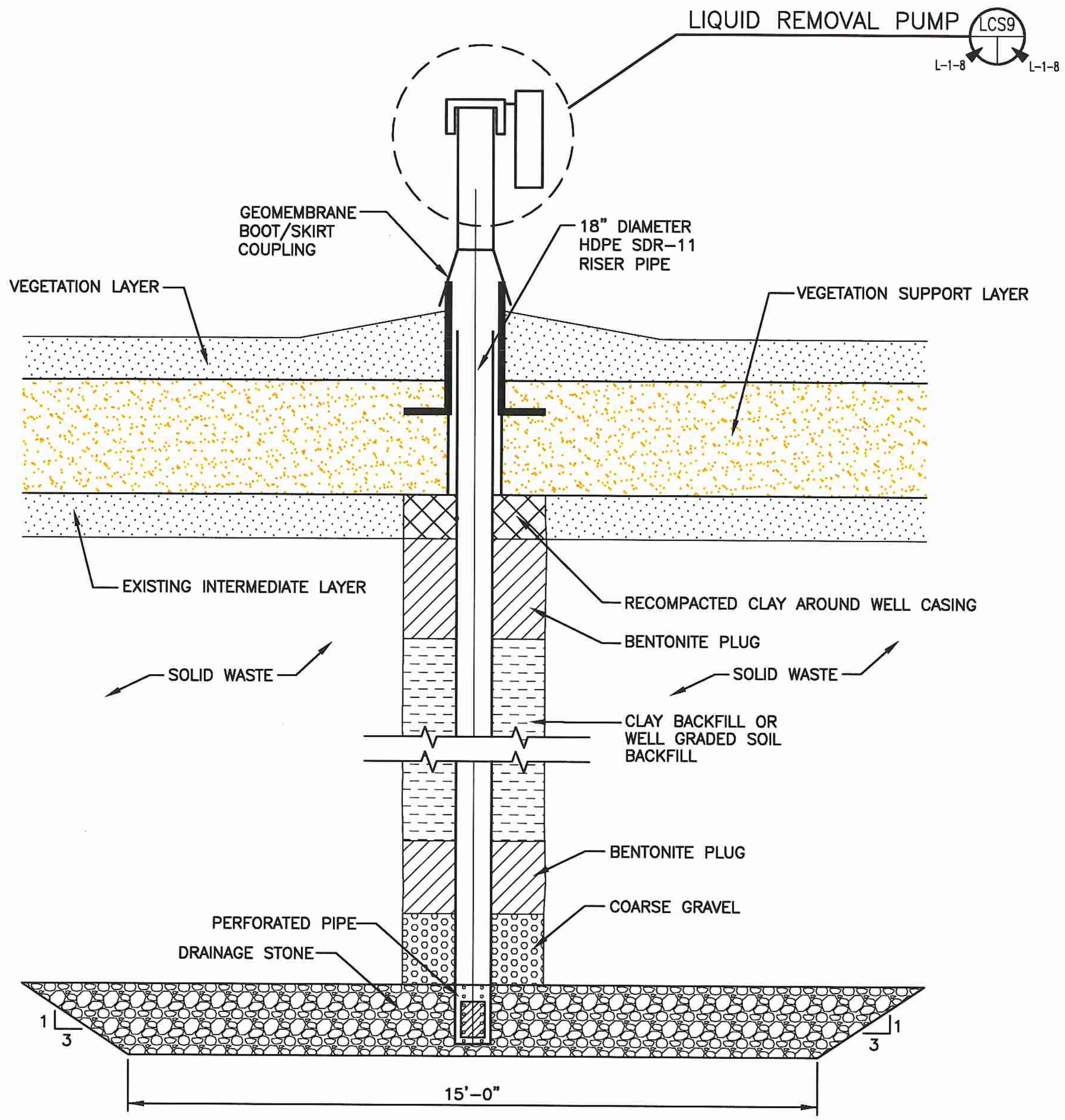
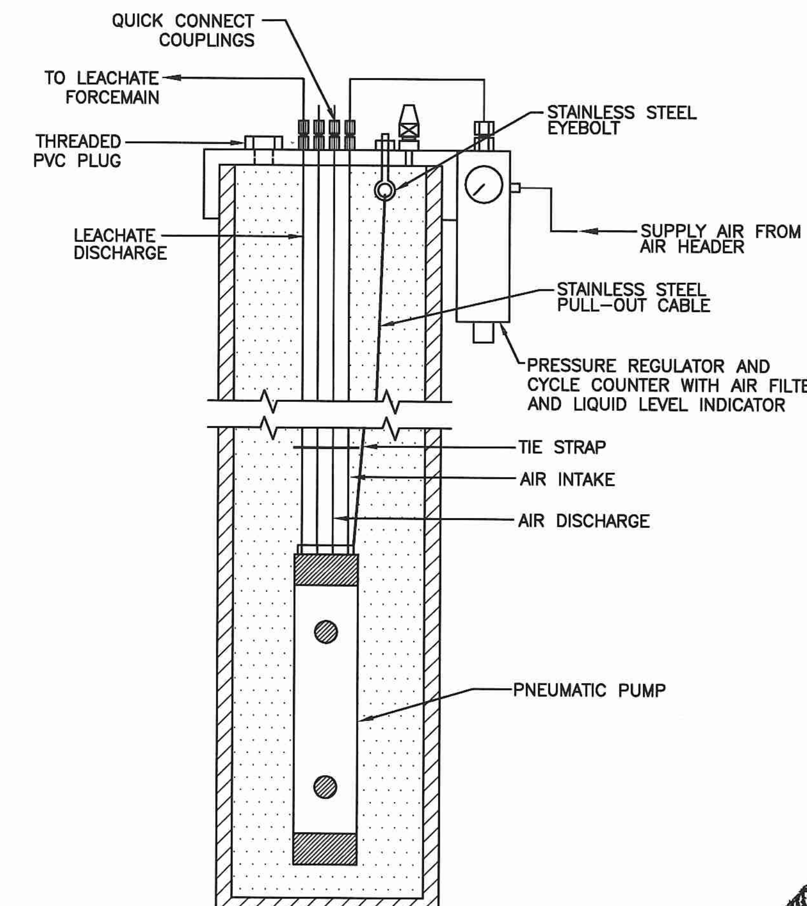
FIGURE L-1-7

G:\0086\356\EXPANSION 2013\APPENDIX L\FIG L-1-7-LEACHATE-DTLS.dwg, uacholonu, 1:2



VERTICAL LEACHATE RISER
NTS
LCS8
L-1-4 L-1-8



LIQUID REMOVAL PUMP
NTS
LCS9
L-1-8 L-1-8

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DATE: 06/2015 FILE: 0086-356-11 CAD: FIG L-1-8 SUMP DTLS.DWG DRAWN BY: SRF DESIGN BY: MDM REVIEWED BY: JVQ	REVISIONS NO. / DATE / DESCRIPTION	EAST OAK RDF OKLAHOMA COUNTY, OKLAHOMA
Weaver Consultants Group CA 3804 PE – 06/30/2015		WWW.WCGRP.COM FIGURE L-1-8

O:\0086\356\EXPANSION 2013\APPENDIX L\FIG L-1-8-VERTICAL SUMP-DTLS.dwg, uacholonu, 1:2

APPENDIX L-2

LEACHATE GENERATION MODEL

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Includes pages L-2-1 through L-2-58

CONTENTS

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6.5.15

LEACHATE GENERATION MODEL

1.1 HELP Model

The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07, was used to estimate the quantity of leachate that will be generated during the active life and postclosure period of the East Oak RDF. The HELP Model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of the landfill. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, runoff, infiltration, percolation, soil moisture storage, evapotranspiration, and lateral drainage.

1.2 Model Setup

The site was modeled using 1-acre unit areas for the following stages of landfill development for the liner system and leachate collection layer/protective cover material system:

- Working face with 10 feet of waste (pages L-2-5 through L-2-13)
- 50 feet of waste with cover soils (pages L-2-14 through L-2-23)
- 100 feet of waste with cover soils (pages L-2-24 through L-2-33)
- 150 feet of waste with cover soils (pages L-2-34 through L-2-43)
- 205 feet of waste with cover soils (pages L-2-44 through L-2-53)
- 205 feet of waste with final cover (pages L-2-54 through L-2-63)

To provide for a conservative demonstration, the active stage was modeled for 1 year with initial moisture contents initialized by the HELP program to steady-state moisture conditions. The interim stages with 50, 100, 150, and 205 feet of waste were modeled for various timeframes depending on expected conditions. The closed landfill condition was modeled for 30 years. The HELP Model suggested the evaporative zone depth and leaf area index for OKC. In addition, the HELP Model calculated the Soil Conservation Service (SCS) runoff curve numbers based on soil data and expected ground cover, surface slope, and slope length.

1.3 Climate Data Input

The HELP model synthetically generated precipitation data by using normal mean monthly precipitation data from the NOAA for OKC Will Rogers World Airport weather station. The average annual precipitation over the modeled 30-year period was 34.78 inches. The HELP model also synthetically generated temperature and solar radiation data using program defaults for OKC.

1.4 Landfill Profile

The landfill profiles for the active and closed stages of the landfill development are presented in the attached HELP Model summary sheet (page L-2-4). The profiles presented below represent the alternative composite liner system and the alternative final cover system. The liner system and final cover drawings are presented in Volume 1.

1.4.1 Alternative Composite Liner System

The alternative composite liner consists of a 24-inch clay layer overlain by a geosynthetic clay liner (GCL) and a 60-mil high-density polyethylene (HDPE) geomembrane. The 24-inch-thick clay layer will have a hydraulic conductivity of 1×10^{-7} cm/s. The GCL will have a hydraulic conductivity of 5×10^{-9} cm/s. Default characteristics from the HELP model were selected for the 0.25-inch GCL. The geomembrane liner was modeled for good installation quality, 1 defect per acre, and a pinhole density of 0.5 holes/acre.

1.4.2 Leachate Collection Layer/Protective Cover Material System

The leachate collection layer consists of 12-inch-thick sand layer ($k \geq 1 \times 10^{-3}$ cm/s). An 8-oz/sy geotextile will be placed beneath the 12-inch-thick leachate collection layer. The protective cover material modeled in HELP was 12 inches of sand ($k \geq 1 \times 10^{-3}$ cm/s).

1.4.3 Waste Layers

Waste layers of 10, 50, 100, 150, and 205 feet were used to represent the active and interim stages of landfill development. The default characteristics were selected from HELP to represent municipal solid waste.

1.4.4 Cover Soils

The cover soils consist of a 6-inch-thick layer of soil placed over the waste. Default soil characteristics from the HELP Version 3.07 table were selected to represent the available onsite soils.

1.4.5 Final Cover

The alternative final cover system consists of a 12-inch-thick vegetation layer capable of sustaining growth of vegetation, and a 24-inch-thick vegetation support layer.

1.5 HELP Model Output

The HELP summary table and output files for the active and closed stages of landfill development for the alternative composite liner design and alternative final cover system are presented on pages L-2-4 through L-2-63.

		ACTIVE (10 FT WASTE)	INTERIM (50 FT WASTE)	INTERIM (100 FT WASTE)	INTERIM (150 FT WASTE)	INTERIM (205 FT WASTE)	CLOSED (205 FT WASTE)
GENERAL	Case No.	1	2	3	4	5	6
INFORMATION	No. of Years	1	10	15	10	5	30
	Ground Cover	BARE	FAIR	FAIR	FAIR	FAIR	GOOD
	SCS Runoff Curve No.	96.9	90.4	90.4	90.4	90.4	80.4
	Model Area (acre)	1	1	1	1	1	1
	Runoff Area (%)	70	85	85	85	85	100
	Maximum Leaf Area Index	0.0	2.0	2.0	2.0	2.0	3.5
	Evaporative Zone Depth (inch)	6	6	6	6	6	12
VEGETATIVE TOPSOIL	Thickness (in)						12
LAYER	Porosity (vol/vol)						0.4000
(Texture = 0)	Field Capacity (vol/vol)						0.3660
	Wilting Point (vol/vol)						0.2880
	Init. Moisture Content (vol/vol)						0.2880
	Hyd. Conductivity (cm/s)						5.0E-07
VEGETATIVE SUPPORT	Thickness (in)						24
LAYER	Porosity (vol/vol)						0.4640
(Texture = 0)	Field Capacity (vol/vol)						0.3100
	Wilting Point (vol/vol)						0.1870
	Init. Moisture Content (vol/vol)						0.3100
	Hyd. Conductivity (cm/s)						2.0E-05
Cover	Thickness (in)	6	6	6	6	6	12
Soils	Porosity (vol/vol)	0.4450	0.4450	0.4450	0.4450	0.4450	0.4450
(Texture = 26)	Field Capacity (vol/vol)	0.3930	0.3930	0.3930	0.3930	0.3930	0.3930
	Wilting Point (vol/vol)	0.2770	0.2770	0.2770	0.2770	0.2770	0.2770
	Init. Moisture Content (vol/vol)	0.2770	0.3259	0.3575	0.3259	0.2770	0.3930
	Hyd. Conductivity (cm/s)	1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.9E-06
WASTE	Thickness (in)	120	600	1200	1800	2460	2460
(Texture = 18)	Porosity (vol/vol)	0.6710	0.6710	0.6710	0.6710	0.6710	0.6710
	Field Capacity (vol/vol)	0.2920	0.2920	0.2920	0.2920	0.2920	0.2920
	Wilting Point (vol/vol)	0.0770	0.0770	0.0770	0.0770	0.0770	0.0770
	Init. Moisture Content (vol/vol)	0.2920	0.2920	0.2920	0.2920	0.2920	0.2920
	Hyd. Conductivity (cm/s)	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03
PROTECTIVE	Thickness (in)	12	12	12	12	12	12
COVER	Porosity (vol/vol)	0.4370	0.4370	0.4370	0.4370	0.4370	0.4370
(Texture = 0)	Field Capacity (vol/vol)	0.0620	0.0620	0.0620	0.0620	0.0620	0.0620
	Wilting Point (vol/vol)	0.0240	0.0240	0.0240	0.0240	0.0240	0.0240
	Init. Moisture Content (vol/vol)	0.0621	0.0631	0.0630	0.0631	0.0633	0.0620
	Hyd. Conductivity (cm/s)	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03
GRANULAR	Thickness (in)	12	12	12	12	12	12
DRAINAGE COLLECTION	Porosity (vol/vol)	0.4370	0.4370	0.4370	0.4370	0.4370	0.4370
LAYER	Field Capacity (vol/vol)	0.0620	0.0620	0.0620	0.0620	0.0620	0.0620
(Texture = 0)	Wilting Point (vol/vol)	0.0240	0.0240	0.0240	0.0240	0.0240	0.0240
	Init. Moisture Content (vol/vol)	0.0621	0.0621	0.0621	0.0621	0.0621	0.0620
	Hyd. Conductivity (cm/s)	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03
	Slope (%)	1.0	1.0	1.0	1.0	1.0	1.0
	Slope Length (ft)	290	290	290	290	290	290
FLEXIBLE	Thickness (in)	0.06	0.06	0.06	0.06	0.06	0.06
MEMBRANE	Hyd. Conductivity (cm/s)	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13
LINER	Pinhole Density (holes/acre)	0.5	0.5	0.5	0.5	0.5	0.5
(Texture = 35)	Install. Defects (holes/acre)	1	1	1	1	1	1
	Placement Quality	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
GEOSYNTHETIC	Thickness (in)	0.25	0.25	0.25	0.25	0.25	0.25
CLAY LINER	Porosity (vol/vol)	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
(Texture = 0)	Field Capacity (vol/vol)	0.7470	0.7470	0.7470	0.7470	0.7470	0.7470
	Wilting Point (vol/vol)	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
	Init. Moisture Content (vol/vol)	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
	Hyd. Conductivity (cm/s)	5.0E-09	5.0E-09	5.0E-09	5.0E-09	5.0E-09	5.0E-09
COMPACTED	Thickness (in)	24	24	24	24	24	24
CLAY LINER	Porosity (vol/vol)	0.4270	0.4270	0.4270	0.4270	0.4270	0.4270
(Texture = 16)	Field Capacity (vol/vol)	0.4180	0.4180	0.4180	0.4180	0.4180	0.4180
	Wilting Point (vol/vol)	0.3670	0.3670	0.3670	0.3670	0.3670	0.3670
	Init. Moisture Content (vol/vol)	0.4180	0.4180	0.4180	0.4180	0.4180	0.4180
	Hyd. Conductivity (cm/s)	1.0E-07	1.0E-07	1.0E-07	1.0E-07	1.0E-07	1.0E-07
PRECIPITATION	Average Annual (in)	51.90	37.85	35.93	37.85	38.89	34.78
RUNOFF	Average Annual (in)	33.06	19.29	18.14	19.29	20.05	27.26
EVAPOTRANSPIRATION	Average Annual (in)	18.84	18.39	17.70	18.39	18.70	7.52
LATERAL	Average Annual (cf/year)	0.989	133.322	151.609	133.326	8.962	0.492
DRAINAGE COLLECTED[1]	Peak Daily (cf/day)	0.003	1.287	1.411	1.288	0.120	0.002
LATERAL	Average Annual (cf/year)		133.322	151.609	133.326	8.962	
DRAINAGE RECIRCULATED	Peak Daily (in)		1.287	1.411	1.288	0.120	
HEAD ON LINER	Average Annual (in)	0.004	0.514	0.585	0.514	0.035	0.002
	Peak Daily (in)	0.009	3.014	3.270	3.014	0.325	0.006
PERCOLATION	Average Annual (cf/yr)	0.000	0.157	0.180	0.157	0.016	0.009
THROUGH GCL	Average Annual (m/yr)	2.10E-10	1.10E-06	1.26E-06	1.10E-06	1.12E-07	6.30E-08

[1]Drainage collected includes actual leachate pumped by the leachate pumps (i.e., the total of the collected and recirculated leachate).

ACTIVE CASE (10 FT WASTE)
HELP MODEL OUTPUT

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**                  USAE WATERWAYS EXPERIMENT STATION                       **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
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PRECIPITATION DATA FILE:     C:\HELP 307\EOAK\2014\AC\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP 307\EOAK\2014\AC\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP 307\EOAK\2014\AC\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP 307\EOAK\2014\AC\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP 307\EOAK\2014\AC\DATA10.D10
OUTPUT DATA FILE:            C:\HELP 307\EOAK\2014\AC\AC.OUT


TIME:  15:13     DATE:   3/ 2/2014


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     TITLE:  EAST OAK LF - SOIL LCS - ACTIVE, 10 FT WASTE

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  26
           THICKNESS                    =        6.00   INCHES
           POROSITY                     =        0.4450 VOL/VOL
           FIELD CAPACITY               =        0.3930 VOL/VOL
           WILTING POINT                =        0.2770 VOL/VOL
           INITIAL SOIL WATER CONTENT   =        0.2770 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.190000003000E-05 CM/SEC


                                  LAYER  2
                                  --------
```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	120.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0620 VOL/VOL
WILTING POINT	=	0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0621 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0620 VOL/VOL
WILTING POINT	=	0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0621 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC
SLOPE	=	1.00 PERCENT
DRAINAGE LENGTH	=	290.0 FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	0.50 HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999997000E-08	CM/SEC

LAYER 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4180	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #25 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 200. FEET.

SCS RUNOFF CURVE NUMBER	=	96.90	
FRACTION OF AREA ALLOWING RUNOFF	=	70.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.662	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.670	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.662	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	48.411	INCHES
TOTAL INITIAL WATER	=	48.411	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
OKLAHOMA CITY OKLAHOMA

STATION LATITUDE	=	35.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	86
END OF GROWING SEASON (JULIAN DATE)	=	310
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	66.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.39	1.58	3.06	3.07	4.65	4.93
2.93	3.28	4.06	3.71	1.98	1.88

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.90	40.80	49.10	60.20	68.40	77.00
82.10	81.10	73.30	62.30	48.80	39.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA
AND STATION LATITUDE = 35.40 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 23 THROUGH 23

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.36	3.04	3.86	8.15	8.48	3.85
	4.13	6.75	2.16	2.73	2.75	2.64

STD. DEVIATIONS	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

RUNOFF

TOTALS	2.222	1.681	2.386	5.737	5.427	2.241
	2.406	4.494	1.416	1.863	1.644	1.543
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

EVAPOTRANSPIRATION

TOTALS	0.719	1.430	1.703	2.531	2.692	1.775
	1.886	2.288	0.744	0.867	1.106	1.097
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0028	0.0030	0.0032	0.0034	0.0035	0.0037
	0.0039	0.0041	0.0043	0.0045	0.0046	0.0048
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 23 THROUGH 23

	INCHES		CU. FEET	PERCENT
PRECIPITATION	51.90	(0.000)	188397.0	100.00
RUNOFF	33.062	(0.0000)	120013.25	63.702
EVAPOTRANSPIRATION	18.838	(0.0000)	68381.63	36.297
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00027	(0.00000)	0.989	0.00053
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000	(0.00000)	0.010	0.00001
AVERAGE HEAD ON TOP OF LAYER 5	0.004	(0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.000	(0.0000)	1.09	0.001

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PEAK DAILY VALUES FOR YEARS 23 THROUGH 23

	(INCHES)	(CU. FT.)
PRECIPITATION	3.27	11870.100
RUNOFF	2.719	9869.4248
DRAINAGE COLLECTED FROM LAYER 4	0.00000	0.00347
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 5	0.005	
MAXIMUM HEAD ON TOP OF LAYER 5	0.009	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	26.6 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
SNOW WATER	0.74	2687.3430
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3388	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2770	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 23

LAYER	(INCHES)	(VOL/VOL)
1	1.6620	0.2770
2	35.0399	0.2920
3	0.7447	0.0621
4	0.7458	0.0622
5	0.0000	0.0000
6	0.1875	0.7500
7	10.0315	0.4180
SNOW WATER	0.000	

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****

INTERIM CASE (50 FT WASTE)
HELP MODEL OUTPUT

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP 307\EOAK\2014\50\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP 307\EOAK\2014\50\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP 307\EOAK\2014\50\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP 307\EOAK\2014\50\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP 307\EOAK\2014\50\DATA10.D10
OUTPUT DATA FILE:            C:\HELP 307\EOAK\2014\50\50.OUT


TIME:  15:13     DATE:   3/ 2/2014


******************************************************************************

     TITLE:  EAST OAK LF - SOIL LCS - INTERIM, 50 FT WASTE

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  26
           THICKNESS                  =       6.00   INCHES
           POROSITY                   =       0.4450 VOL/VOL
           FIELD CAPACITY             =       0.3930 VOL/VOL
           WILTING POINT              =       0.2770 VOL/VOL
           INITIAL SOIL WATER CONTENT =       0.3259 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =   0.190000003000E-05 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

```
              TYPE 1 - VERTICAL PERCOLATION LAYER
                   MATERIAL TEXTURE NUMBER  18
   THICKNESS                    =    600.00    INCHES
   POROSITY                     =      0.6710 VOL/VOL
   FIELD CAPACITY               =      0.2920 VOL/VOL
   WILTING POINT                =      0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT   =      0.2920 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 4
         IS RECIRCULATED INTO THIS LAYER.
```

LAYER 3

```
              TYPE 1 - VERTICAL PERCOLATION LAYER
                   MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =     12.00    INCHES
   POROSITY                     =      0.4370 VOL/VOL
   FIELD CAPACITY               =      0.0620 VOL/VOL
   WILTING POINT                =      0.0240 VOL/VOL
   INITIAL SOIL WATER CONTENT   =      0.0631 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

LAYER 4

```
                TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =     12.00    INCHES
   POROSITY                     =      0.4370 VOL/VOL
   FIELD CAPACITY               =      0.0620 VOL/VOL
   WILTING POINT                =      0.0240 VOL/VOL
   INITIAL SOIL WATER CONTENT   =      0.0621 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
   SLOPE                        =      1.00    PERCENT
   DRAINAGE LENGTH              =    290.0     FEET
NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS
         LAYER IS RECIRCULATED INTO LAYER #  2.
```

LAYER 5

```
                TYPE 4 - FLEXIBLE MEMBRANE LINER
                   MATERIAL TEXTURE NUMBER  35
   THICKNESS                    =      0.06    INCHES
   POROSITY                     =      0.0000 VOL/VOL
   FIELD CAPACITY               =      0.0000 VOL/VOL
   WILTING POINT                =      0.0000 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =       0.50    HOLES/ACRE
FML INSTALLATION DEFECTS    =       1.00    HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  6
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =       0.25    INCHES
POROSITY                    =       0.7500 VOL/VOL
FIELD CAPACITY              =       0.7470 VOL/VOL
WILTING POINT               =       0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =       0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC


                        LAYER  7
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                   =      24.00    INCHES
POROSITY                    =       0.4270 VOL/VOL
FIELD CAPACITY              =       0.4180 VOL/VOL
WILTING POINT               =       0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =       0.4180 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #26 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
          AND A SLOPE LENGTH OF  200. FEET.

SCS RUNOFF CURVE NUMBER            =     90.40
FRACTION OF AREA ALLOWING RUNOFF   =     85.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =      6.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      1.956  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      2.670  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      1.662  INCHES
INITIAL SNOW WATER                 =      0.114  INCHES
INITIAL WATER IN LAYER MATERIALS   =    188.877  INCHES
TOTAL INITIAL WATER                =    188.991  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
OKLAHOMA CITY OKLAHOMA

STATION LATITUDE	=	35.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	86
END OF GROWING SEASON (JULIAN DATE)	=	310
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	66.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.39	1.58	3.06	3.07	4.65	4.93
2.93	3.28	4.06	3.71	1.98	1.88

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.90	40.80	49.10	60.20	68.40	77.00
82.10	81.10	73.30	62.30	48.80	39.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA
AND STATION LATITUDE = 35.40 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 20 THROUGH 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.75	2.05	4.31	3.69	4.31	5.71
	2.59	3.60	2.67	3.93	1.48	1.78
STD. DEVIATIONS	0.89	1.20	1.80	2.34	2.48	2.08
	1.29	1.74	1.32	2.07	1.31	1.60
RUNOFF						
TOTALS	0.674	0.746	2.374	2.025	2.265	2.842
	1.161	1.753	1.295	2.623	0.662	0.864
STD. DEVIATIONS	0.636	0.564	1.278	1.496	1.597	1.280
	0.773	1.114	0.908	1.674	0.875	1.080
EVAPOTRANSPIRATION						
TOTALS	1.052	1.323	1.888	1.701	2.080	2.764
	1.620	1.753	1.376	1.294	0.775	0.762
STD. DEVIATIONS	0.291	0.667	0.772	0.897	0.839	0.894
	0.663	0.766	0.624	0.462	0.499	0.493
LATERAL DRAINAGE RECIRCULATED INTO LAYER 2						
TOTALS	0.0025	0.0023	0.0027	0.0028	0.0031	0.0031
	0.0033	0.0033	0.0033	0.0035	0.0034	0.0035
STD. DEVIATIONS	0.0024	0.0022	0.0025	0.0027	0.0030	0.0030
	0.0032	0.0033	0.0032	0.0034	0.0033	0.0035
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE RECIRCULATED FROM LAYER 4						
TOTALS	0.0025	0.0023	0.0027	0.0028	0.0031	0.0031
	0.0033	0.0033	0.0033	0.0035	0.0034	0.0035
STD. DEVIATIONS	0.0024	0.0022	0.0025	0.0027	0.0030	0.0030
	0.0032	0.0033	0.0032	0.0034	0.0033	0.0035
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.4105	0.4195	0.4420	0.4801	0.5062	0.5252
	0.5399	0.5520	0.5617	0.5699	0.5769	0.5838
STD. DEVIATIONS	0.4033	0.4012	0.4121	0.4572	0.4901	0.5133
	0.5305	0.5437	0.5538	0.5618	0.5682	0.5725

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 20 THROUGH 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.85 (7.459)	137410.0	100.00
RUNOFF	19.285 (4.6088)	70004.11	50.945
EVAPOTRANSPIRATION	18.389 (2.8867)	66751.80	48.579
DRAINAGE RECIRCULATED INTO LAYER 2	0.03673 (0.03521)	133.322	0.09702
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00000 (0.00000)	0.000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.03673 (0.03521)	133.322	0.09702
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00004 (0.00004)	0.157	0.00011
AVERAGE HEAD ON TOP OF LAYER 5	0.514 (0.493)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.169 (0.3575)	612.75	0.446

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PEAK DAILY VALUES FOR YEARS 20 THROUGH 29

	(INCHES)	(CU. FT.)
PRECIPITATION	5.76	20908.801
RUNOFF	5.111	18553.0430
DRAINAGE RECIRCULATED INTO LAYER 2	0.00035	1.28717
DRAINAGE COLLECTED FROM LAYER 4	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.00035	1.28717
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00159
AVERAGE HEAD ON TOP OF LAYER 5	1.814	
MAXIMUM HEAD ON TOP OF LAYER 5	3.014	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	49.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
SNOW WATER	1.83	6634.7612
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4369	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2770	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 29

LAYER	(INCHES)	(VOL/VOL)
1	2.4674	0.4112
2	175.1999	0.2920
3	1.3676	0.1140
4	1.4244	0.1187
5	0.0000	0.0000
6	0.1875	0.7500
7	10.0320	0.4180
SNOW WATER	0.000	

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INTERIM CASE (100 FT WASTE)
HELP MODEL OUTPUT

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******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP 307\EOAK\2014\100\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP 307\EOAK\2014\100\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP 307\EOAK\2014\100\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP 307\EOAK\2014\100\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP 307\EOAK\2014\100\DATA10.D10
OUTPUT DATA FILE:            C:\HELP 307\EOAK\2014\100\100.OUT


TIME:  15:14     DATE:   3/ 2/2014


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     TITLE:  EAST OAK LF - SOIL LCS - INTERIM, 100 FT WASTE

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  26
           THICKNESS                 =       6.00   INCHES
           POROSITY                  =       0.4450 VOL/VOL
           FIELD CAPACITY            =       0.3930 VOL/VOL
           WILTING POINT             =       0.2770 VOL/VOL
           INITIAL SOIL WATER CONTENT  =     0.3575 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.190000003000E-05 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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                          LAYER  2
                          --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  18
   THICKNESS                    =    1200.00    INCHES
   POROSITY                     =       0.6710 VOL/VOL
   FIELD CAPACITY               =       0.2920 VOL/VOL
   WILTING POINT                =       0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.2920 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
 NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 4
          IS RECIRCULATED INTO THIS LAYER.


                          LAYER  3
                          --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =      12.00    INCHES
   POROSITY                     =       0.4370 VOL/VOL
   FIELD CAPACITY               =       0.0620 VOL/VOL
   WILTING POINT                =       0.0240 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.0630 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                          LAYER  4
                          --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =      12.00    INCHES
   POROSITY                     =       0.4370 VOL/VOL
   FIELD CAPACITY               =       0.0620 VOL/VOL
   WILTING POINT                =       0.0240 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.0621 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
   SLOPE                        =       1.00    PERCENT
   DRAINAGE LENGTH              =     290.0     FEET
 NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS
          LAYER IS RECIRCULATED INTO LAYER #  2.


                          LAYER  5
                          --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
   THICKNESS                    =       0.06    INCHES
   POROSITY                     =       0.0000 VOL/VOL
   FIELD CAPACITY               =       0.0000 VOL/VOL
   WILTING POINT                =       0.0000 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT   =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =       0.50   HOLES/ACRE
FML INSTALLATION DEFECTS     =       1.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                          LAYER  6
                          --------

                 TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER   0
THICKNESS                    =       0.25   INCHES
POROSITY                     =       0.7500 VOL/VOL
FIELD CAPACITY               =       0.7470 VOL/VOL
WILTING POINT                =       0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC


                          LAYER  7
                          --------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER  16
THICKNESS                    =      24.00   INCHES
POROSITY                     =       0.4270 VOL/VOL
FIELD CAPACITY               =       0.4180 VOL/VOL
WILTING POINT                =       0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.4180 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


            GENERAL DESIGN AND EVAPORATIVE ZONE DATA
            ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #26 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
          AND A SLOPE LENGTH OF  200. FEET.

SCS RUNOFF CURVE NUMBER              =      90.40
FRACTION OF AREA ALLOWING RUNOFF     =      85.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =       1.000  ACRES
EVAPORATIVE ZONE DEPTH               =       6.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =       2.145  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =       2.670  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =       1.662  INCHES
INITIAL SNOW WATER                   =       0.007  INCHES
INITIAL WATER IN LAYER MATERIALS     =     364.265  INCHES
TOTAL INITIAL WATER                  =     364.272  INCHES
TOTAL SUBSURFACE INFLOW              =       0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
OKLAHOMA CITY OKLAHOMA

STATION LATITUDE	=	35.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	86
END OF GROWING SEASON (JULIAN DATE)	=	310
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	66.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.39	1.58	3.06	3.07	4.65	4.93
2.93	3.28	4.06	3.71	1.98	1.88

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.90	40.80	49.10	60.20	68.40	77.00
82.10	81.10	73.30	62.30	48.80	39.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA
AND STATION LATITUDE = 35.40 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 16 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.49	1.91	4.08	3.30	4.25	4.84
	2.77	3.72	2.87	3.30	1.69	1.71
STD. DEVIATIONS	0.82	1.16	1.69	2.04	3.01	2.35
	1.21	1.90	1.75	2.00	1.32	1.39
RUNOFF						
TOTALS	0.524	0.616	2.225	1.744	2.335	2.391
	1.319	1.843	1.442	2.103	0.845	0.753
STD. DEVIATIONS	0.538	0.520	1.264	1.330	2.306	1.334
	0.817	1.198	1.223	1.655	0.909	0.916
EVAPOTRANSPIRATION						
TOTALS	1.048	1.223	1.962	1.564	1.915	2.411
	1.563	1.829	1.369	1.179	0.890	0.741
STD. DEVIATIONS	0.243	0.631	0.671	0.776	0.746	1.023
	0.614	0.835	0.650	0.480	0.472	0.443
LATERAL DRAINAGE RECIRCULATED INTO LAYER 2						
TOTALS	0.0031	0.0029	0.0032	0.0033	0.0035	0.0035
	0.0036	0.0037	0.0036	0.0038	0.0037	0.0039
STD. DEVIATIONS	0.0034	0.0031	0.0034	0.0035	0.0037	0.0036
	0.0038	0.0039	0.0038	0.0039	0.0038	0.0040
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE RECIRCULATED FROM LAYER 4						
TOTALS	0.0031	0.0029	0.0032	0.0033	0.0035	0.0035
	0.0036	0.0037	0.0036	0.0038	0.0037	0.0039
STD. DEVIATIONS	0.0034	0.0031	0.0034	0.0035	0.0037	0.0036
	0.0038	0.0039	0.0038	0.0039	0.0038	0.0040
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.5128	0.5201	0.5333	0.5563	0.5749	0.5897
	0.6015	0.6114	0.6196	0.6265	0.6325	0.6384
STD. DEVIATIONS	0.5619	0.5633	0.5686	0.5894	0.6068	0.6203
	0.6307	0.6391	0.6456	0.6509	0.6551	0.6580

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 16 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.93 (7.114)	130425.9	100.00
RUNOFF	18.141 (4.7239)	65850.17	50.489
EVAPOTRANSPIRATION	17.695 (2.5685)	64234.13	49.250
DRAINAGE RECIRCULATED INTO LAYER 2	0.04177 (0.04378)	151.609	0.11624
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00000 (0.00000)	0.000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.04177 (0.04378)	151.609	0.11624
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00005 (0.00005)	0.180	0.00014
AVERAGE HEAD ON TOP OF LAYER 5	0.585 (0.613)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00003 (0.00012)	0.112	0.00009
CHANGE IN WATER STORAGE	0.094 (0.3459)	339.67	0.260

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PEAK DAILY VALUES FOR YEARS 16 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.76	20908.801
RUNOFF	5.108	18540.4824
DRAINAGE RECIRCULATED INTO LAYER 2	0.00039	1.41145
DRAINAGE COLLECTED FROM LAYER 4	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.00039	1.41145
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00176
AVERAGE HEAD ON TOP OF LAYER 5	1.989	
MAXIMUM HEAD ON TOP OF LAYER 5	3.270	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	51.6 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000464	1.68313
SNOW WATER	2.65	9621.7861

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4353
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2770

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	2.2072	0.3679
2	350.3999	0.2920
3	1.3591	0.1133
4	1.4900	0.1242
5	0.0000	0.0000
6	0.1875	0.7500
7	10.0318	0.4180
SNOW WATER	0.000	

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INTERIM CASE (150 FT WASTE)
HELP MODEL OUTPUT

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\HELP 307\EOAK\2014\150\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP 307\EOAK\2014\150\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP 307\EOAK\2014\150\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP 307\EOAK\2014\150\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP 307\EOAK\2014\150\DATA10.D10
OUTPUT DATA FILE:            C:\HELP 307\EOAK\2014\150\150.OUT


TIME:  15:14      DATE:   3/ 2/2014


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     TITLE:  EAST OAK LF - SOIL LCS - INTERIM, 150 FT WASTE

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER  26
           THICKNESS                    =       6.00   INCHES
           POROSITY                     =       0.4450 VOL/VOL
           FIELD CAPACITY               =       0.3930 VOL/VOL
           WILTING POINT                =       0.2770 VOL/VOL
           INITIAL SOIL WATER CONTENT   =       0.3259 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.190000003000E-05 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1800.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 4 IS RECIRCULATED INTO THIS LAYER.

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0631	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0621	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	290.0	FEET

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS LAYER IS RECIRCULATED INTO LAYER # 2.

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL

```
INITIAL SOIL WATER CONTENT  =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =       0.50   HOLES/ACRE
FML INSTALLATION DEFECTS    =       1.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  6
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =       0.25   INCHES
POROSITY                    =       0.7500 VOL/VOL
FIELD CAPACITY              =       0.7470 VOL/VOL
WILTING POINT               =       0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =       0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC


                        LAYER  7
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                   =      24.00   INCHES
POROSITY                    =       0.4270 VOL/VOL
FIELD CAPACITY              =       0.4180 VOL/VOL
WILTING POINT               =       0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =       0.4180 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #26 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
          AND A SLOPE LENGTH OF  200. FEET.

SCS RUNOFF CURVE NUMBER            =      90.40
FRACTION OF AREA ALLOWING RUNOFF   =      85.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =       1.000  ACRES
EVAPORATIVE ZONE DEPTH             =       6.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =       1.956  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =       2.670  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =       1.662  INCHES
INITIAL SNOW WATER                 =       0.114  INCHES
INITIAL WATER IN LAYER MATERIALS   =     539.277  INCHES
TOTAL INITIAL WATER                =     539.391  INCHES
TOTAL SUBSURFACE INFLOW            =       0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
OKLAHOMA CITY OKLAHOMA

STATION LATITUDE	=	35.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	86
END OF GROWING SEASON (JULIAN DATE)	=	310
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	66.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.39	1.58	3.06	3.07	4.65	4.93
2.93	3.28	4.06	3.71	1.98	1.88

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.90	40.80	49.10	60.20	68.40	77.00
82.10	81.10	73.30	62.30	48.80	39.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA
AND STATION LATITUDE = 35.40 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 20 THROUGH 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.75	2.05	4.31	3.69	4.31	5.71
	2.59	3.60	2.67	3.93	1.48	1.78
STD. DEVIATIONS	0.89	1.20	1.80	2.34	2.48	2.08
	1.29	1.74	1.32	2.07	1.31	1.60
RUNOFF						
TOTALS	0.674	0.746	2.374	2.025	2.265	2.842
	1.161	1.753	1.295	2.623	0.662	0.864
STD. DEVIATIONS	0.636	0.564	1.278	1.496	1.597	1.280
	0.773	1.114	0.908	1.674	0.875	1.080
EVAPOTRANSPIRATION						
TOTALS	1.052	1.323	1.888	1.701	2.080	2.764
	1.620	1.753	1.376	1.294	0.775	0.762
STD. DEVIATIONS	0.291	0.667	0.772	0.897	0.839	0.894
	0.663	0.766	0.624	0.462	0.499	0.493
LATERAL DRAINAGE RECIRCULATED INTO LAYER 2						
TOTALS	0.0025	0.0023	0.0027	0.0028	0.0031	0.0031
	0.0033	0.0033	0.0033	0.0035	0.0034	0.0035
STD. DEVIATIONS	0.0024	0.0022	0.0025	0.0027	0.0030	0.0030
	0.0032	0.0033	0.0032	0.0034	0.0033	0.0035
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE RECIRCULATED FROM LAYER 4						
TOTALS	0.0025	0.0023	0.0027	0.0028	0.0031	0.0031
	0.0033	0.0033	0.0033	0.0035	0.0034	0.0035
STD. DEVIATIONS	0.0024	0.0022	0.0025	0.0027	0.0030	0.0030
	0.0032	0.0033	0.0032	0.0034	0.0033	0.0035
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.4105	0.4195	0.4420	0.4801	0.5062	0.5252
	0.5399	0.5520	0.5617	0.5699	0.5769	0.5838
STD. DEVIATIONS	0.4033	0.4011	0.4121	0.4572	0.4901	0.5133
	0.5305	0.5437	0.5538	0.5618	0.5682	0.5725

****

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 20 THROUGH 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.85 (7.459)	137410.0	100.00
RUNOFF	19.285 (4.6088)	70004.11	50.945
EVAPOTRANSPIRATION	18.389 (2.8867)	66751.80	48.579
DRAINAGE RECIRCULATED INTO LAYER 2	0.03673 (0.03521)	133.326	0.09703
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00000 (0.00000)	0.000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.03673 (0.03521)	133.326	0.09703
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00004 (0.00004)	0.157	0.00011
AVERAGE HEAD ON TOP OF LAYER 5	0.514 (0.493)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.169 (0.3576)	612.75	0.446

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PEAK DAILY VALUES FOR YEARS 20 THROUGH 29

	(INCHES)	(CU. FT.)
PRECIPITATION	5.76	20908.801
RUNOFF	5.111	18553.0430
DRAINAGE RECIRCULATED INTO LAYER 2	0.00035	1.28717
DRAINAGE COLLECTED FROM LAYER 4	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.00035	1.28717
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00159
AVERAGE HEAD ON TOP OF LAYER 5	1.814	
MAXIMUM HEAD ON TOP OF LAYER 5	3.014	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	49.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
SNOW WATER	1.83	6634.7612

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4369
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2770

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 29

LAYER	(INCHES)	(VOL/VOL)
1	2.4674	0.4112
2	525.6000	0.2920
3	1.3676	0.1140
4	1.4244	0.1187
5	0.0000	0.0000
6	0.1875	0.7500
7	10.0320	0.4180
SNOW WATER	0.000	

****
****

INTERIM CASE (205 FT WASTE)
HELP MODEL OUTPUT

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP 307\EOAK\2014\205\DATA4.D4
TEMPERATURE DATA FILE:        C:\HELP 307\EOAK\2014\205\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\HELP 307\EOAK\2014\205\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP 307\EOAK\2014\205\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP 307\EOAK\2014\205\DATA10.D10
OUTPUT DATA FILE:             C:\HELP 307\EOAK\2014\205\205.OUT


TIME:  15:14      DATE:   3/ 2/2014


******************************************************************************

     TITLE:  EAST OAK LF - SOIL LCS - INTERIM, 205 FT WASTE

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  26
           THICKNESS                   =       6.00   INCHES
           POROSITY                    =       0.4450 VOL/VOL
           FIELD CAPACITY              =       0.3930 VOL/VOL
           WILTING POINT               =       0.2770 VOL/VOL
           INITIAL SOIL WATER CONTENT  =       0.2770 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.190000003000E-05 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

```
THICKNESS                    =    2460.00    INCHES
POROSITY                     =       0.6710 VOL/VOL
FIELD CAPACITY               =       0.2920 VOL/VOL
WILTING POINT                =       0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 4
IS RECIRCULATED INTO THIS LAYER.

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

```
THICKNESS                    =      12.00    INCHES
POROSITY                     =       0.4370 VOL/VOL
FIELD CAPACITY               =       0.0620 VOL/VOL
WILTING POINT                =       0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0633 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

```
THICKNESS                    =      12.00    INCHES
POROSITY                     =       0.4370 VOL/VOL
FIELD CAPACITY               =       0.0620 VOL/VOL
WILTING POINT                =       0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0621 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
SLOPE                        =       1.00    PERCENT
DRAINAGE LENGTH              =     290.0     FEET
```

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS
LAYER IS RECIRCULATED INTO LAYER # 2.

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

```
THICKNESS                    =       0.06    INCHES
POROSITY                     =       0.0000 VOL/VOL
FIELD CAPACITY               =       0.0000 VOL/VOL
WILTING POINT                =       0.0000 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =        0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =        0.50   HOLES/ACRE
FML INSTALLATION DEFECTS    =        1.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                         LAYER  6
                         --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =        0.25   INCHES
POROSITY                    =        0.7500 VOL/VOL
FIELD CAPACITY              =        0.7470 VOL/VOL
WILTING POINT               =        0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =        0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC


                         LAYER  7
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                   =       24.00   INCHES
POROSITY                    =        0.4270 VOL/VOL
FIELD CAPACITY              =        0.4180 VOL/VOL
WILTING POINT               =        0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =        0.4180 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC


        GENERAL DESIGN AND EVAPORATIVE ZONE DATA
        ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #26 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
         AND A SLOPE LENGTH OF  200. FEET.

SCS RUNOFF CURVE NUMBER            =      90.40
FRACTION OF AREA ALLOWING RUNOFF   =      85.0     PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =       1.000   ACRES
EVAPORATIVE ZONE DEPTH             =       6.0     INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =       1.662   INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =       2.670   INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =       1.662   INCHES
INITIAL SNOW WATER                 =       0.000   INCHES
INITIAL WATER IN LAYER MATERIALS   =     731.706   INCHES
TOTAL INITIAL WATER                =     731.706   INCHES
TOTAL SUBSURFACE INFLOW            =       0.00    INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
OKLAHOMA CITY OKLAHOMA

STATION LATITUDE	=	35.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	86
END OF GROWING SEASON (JULIAN DATE)	=	310
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	66.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.39	1.58	3.06	3.07	4.65	4.93
2.93	3.28	4.06	3.71	1.98	1.88

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.90	40.80	49.10	60.20	68.40	77.00
82.10	81.10	73.30	62.30	48.80	39.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA
AND STATION LATITUDE = 35.40 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 25 THROUGH 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.63	1.95	4.51	4.19	3.22	6.77
	1.77	3.47	3.45	4.79	1.58	1.56
STD. DEVIATIONS	0.41	1.52	1.15	1.49	2.22	2.37
	0.97	1.40	1.16	2.04	1.67	1.95
RUNOFF						
TOTALS	0.541	0.830	2.387	2.178	1.407	3.780
	0.762	1.618	1.822	3.134	0.822	0.763
STD. DEVIATIONS	0.355	0.991	0.873	1.048	1.371	1.374
	0.608	0.998	0.931	1.534	1.153	1.477
EVAPOTRANSPIRATION						
TOTALS	1.046	1.182	2.106	1.942	1.919	2.806
	1.210	1.746	1.583	1.643	0.850	0.663
STD. DEVIATIONS	0.162	0.567	0.527	0.545	0.847	1.007
	0.635	0.448	0.629	0.256	0.598	0.533
LATERAL DRAINAGE RECIRCULATED INTO LAYER 2						
TOTALS	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE RECIRCULATED FROM LAYER 4						
TOTALS	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0195	0.0202	0.0215	0.0254	0.0294	0.0331
	0.0366	0.0399	0.0430	0.0458	0.0485	0.0510
STD. DEVIATIONS	0.0193	0.0198	0.0212	0.0270	0.0331	0.0388
	0.0441	0.0492	0.0537	0.0579	0.0618	0.0655

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 25 THROUGH 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.89 (5.044)	141178.0	100.00
RUNOFF	20.045 (4.5511)	72764.42	51.541
EVAPOTRANSPIRATION	18.696 (0.9003)	67868.09	48.073
DRAINAGE RECIRCULATED INTO LAYER 2	0.00247 (0.00291)	8.962	0.00635
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00000 (0.00000)	0.000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.00247 (0.00291)	8.962	0.00635
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (0.00000)	0.016	0.00001
AVERAGE HEAD ON TOP OF LAYER 5	0.035 (0.041)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.150 (0.1719)	545.39	0.386

****

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PEAK DAILY VALUES FOR YEARS 25 THROUGH 29

	(INCHES)	(CU. FT.)
PRECIPITATION	3.23	11724.900
RUNOFF	2.683	9739.0342
DRAINAGE RECIRCULATED INTO LAYER 2	0.00003	0.11967
DRAINAGE COLLECTED FROM LAYER 4	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.00003	0.11967
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00013
AVERAGE HEAD ON TOP OF LAYER 5	0.169	
MAXIMUM HEAD ON TOP OF LAYER 5	0.325	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	10.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
SNOW WATER	2.21	8015.3472

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4414
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2770

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 29

LAYER	(INCHES)	(VOL/VOL)
1	1.9751	0.3292
2	718.3199	0.2920
3	1.1355	0.0946
4	0.8073	0.0673
5	0.0000	0.0000
6	0.1875	0.7500
7	10.0316	0.4180
SNOW WATER	0.000	

****
****

CLOSED CASE (205 FT WASTE)
HELP MODEL OUTPUT

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP 307\EOAK\2014\CL\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP 307\EOAK\2014\CL\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP 307\EOAK\2014\CL\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP 307\EOAK\2014\CL\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP 307\EOAK\2014\CL\DATA10.D10
OUTPUT DATA FILE:            C:\HELP 307\EOAK\2014\CL\CL.OUT


TIME:  15:12     DATE:   3/ 2/2014


******************************************************************************

     TITLE:  EAST OAK LF - SOIL LCS - CLOSED, 205 FT WASTE

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     12.00   INCHES
           POROSITY                   =      0.4000 VOL/VOL
           FIELD CAPACITY             =      0.3660 VOL/VOL
           WILTING POINT              =      0.2880 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2880 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.499999999000E-06 CM/SEC


                                  LAYER  2
                                  --------
```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4640 VOL/VOL
FIELD CAPACITY	=	0.3100 VOL/VOL
WILTING POINT	=	0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3100 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999995000E-04 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 26

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4450 VOL/VOL
FIELD CAPACITY	=	0.3930 VOL/VOL
WILTING POINT	=	0.2770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3930 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.190000003000E-05 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	2460.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0620 VOL/VOL
WILTING POINT	=	0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0620 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 6

```
              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     12.00    INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.0620 VOL/VOL
WILTING POINT                =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0620 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
SLOPE                        =      1.00    PERCENT
DRAINAGE LENGTH              =    290.0     FEET


                         LAYER  7
                         --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06    INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      0.50    HOLES/ACRE
FML INSTALLATION DEFECTS     =      1.00    HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  8
                         --------

                TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.25    INCHES
POROSITY                     =      0.7500 VOL/VOL
FIELD CAPACITY               =      0.7470 VOL/VOL
WILTING POINT                =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC


                         LAYER  9
                         --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  16
THICKNESS                    =     24.00    INCHES
POROSITY                     =      0.4270 VOL/VOL
FIELD CAPACITY               =      0.4180 VOL/VOL
WILTING POINT                =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.4180 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 400. FEET.

SCS RUNOFF CURVE NUMBER	=	80.40	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.456	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.800	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	3.456	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	745.639	INCHES
TOTAL INITIAL WATER	=	745.639	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM OKLAHOMA CITY OKLAHOMA

STATION LATITUDE	=	35.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	86
END OF GROWING SEASON (JULIAN DATE)	=	310
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	66.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.39	1.58	3.06	3.07	4.65	4.93
2.93	3.28	4.06	3.71	1.98	1.88

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.90	40.80	49.10	60.20	68.40	77.00
82.10	81.10	73.30	62.30	48.80	39.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OKLAHOMA CITY OKLAHOMA
AND STATION LATITUDE = 35.40 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.44	1.87	3.65	3.29	4.65	4.57
	2.56	3.21	2.94	3.25	1.81	1.55
STD. DEVIATIONS	0.84	1.23	1.64	2.00	3.09	2.25
	1.65	2.18	1.70	1.98	1.36	1.19
RUNOFF						
TOTALS	0.955	1.346	2.923	2.614	3.709	3.552
	1.889	2.480	2.331	2.815	1.407	1.238
STD. DEVIATIONS	0.707	1.032	1.473	1.721	2.732	1.851
	1.343	1.807	1.546	1.858	1.247	1.089
EVAPOTRANSPIRATION						
TOTALS	0.436	0.581	0.759	0.672	0.946	1.013
	0.683	0.731	0.602	0.432	0.334	0.334
STD. DEVIATIONS	0.214	0.256	0.278	0.322	0.432	0.474
	0.378	0.406	0.263	0.196	0.189	0.197
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 8						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0018	0.0018	0.0018	0.0019	0.0019	0.0019
	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019
STD. DEVIATIONS	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.78 (6.686)	126267.2	100.00
RUNOFF	27.260 (5.8394)	98953.42	78.368
EVAPOTRANSPIRATION	7.523 (1.1147)	27306.85	21.626
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00014 (0.00002)	0.492	0.00039
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000 (0.00000)	0.009	0.00001
AVERAGE HEAD ON TOP OF LAYER 7	0.002 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.002 (0.1029)	6.35	0.005

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.76	20908.801
RUNOFF	5.639	20468.8223
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00185
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 7	0.003	
MAXIMUM HEAD ON TOP OF LAYER 7	0.006	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00000
SNOW WATER	2.22	8062.0308

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3181

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2880

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	3.5081	0.2923
2	7.4399	0.3100
3	4.7160	0.3930
4	718.3199	0.2920
5	0.7440	0.0620
6	0.7448	0.0621
7	0.0000	0.0000
8	0.1875	0.7500
9	10.0316	0.4180
SNOW WATER	0.000	

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APPENDIX L-3

LEACHATE COLLECTION PIPE DESIGN

LICENSED PROFESSIONAL ENGINEER
Marilyn D.
Morrison
23833
OKLAHOMA

6.5.15

Includes pages L-3-1 through L-3-30

CONTENTS

LICENSED PROFESSIONAL ENGINEER
Marilyn D.
Morrison
23833
OKLAHOMA

6-5-15

REQUIRED: Size the leachate collection system pipe.

METHOD:

A. Use leachate production rates determined from the HELP model analysis to size the leachate collection pipes.

B. Determine required hole size (perforations) based on characteristics of the surrounding drainage media.

REFERENCES:

1. Bass, J., *Avoiding Failure of Leachate Collection and Cap Drainage Systems*, Pollution Technology Review No. 138, Noyles Data Corporation, 1986.

2. Texas Natural Resource Conservation Commission, *Leachate Collection System Handbook*, 30 TAC 330.201, 1993.

SOLUTION:

A. Estimate the average daily flow rate:

The following table summarizes the fill conditions that are likely to be present and have the greatest contribution of leachate into the LCS. The average flow rate (lateral drainage in the LCS layer) is shown for each condition. All flow rates are cubic feet per year per acre (cfy/ac) and gallons per day per acre (gpd/ac).

From the HELP models (Appendix L-2):

CONDITION	AVERAGE cfy/ac	AVERAGE gpd/ac
Active, 10' Waste	1	0.0
Interim, 50' Waste	133	2.7
Interim, 100' Waste	152	3.1
Interim, 150' Waste	133	2.7
Interim, 205' Waste	9	0.2
Closed, 205' Waste	0.5	0.0

The largest area draining to one pipe is 19.3 acres (pipe located in Phase XIII, which receives leachate from the sidewall liner).

The maximum leachate production is predicted to occur assuming the following scenario:

Active, 10' Waste	1.5	ac
Interim, 50' Waste	3.3	ac
Interim, 100' Waste	4.2	ac
Interim, 150' Waste	5.4	ac
Interim, 205' Waste	3.4	ac
Closed, 205' Waste	1.5	ac

CONDITION	AREA ac	AVERAGE gpd/ac	AVERAGE gpd	AVERAGE cfs
Active, 10' Waste	1.5	0.0	0.0	0.00000
Interim, 50' Waste	3.3	2.7	9.0	0.00001
Interim, 100' Waste	4.2	3.1	13.1	0.00002
Interim, 150' Waste	5.4	2.7	14.7	0.00002
Interim, 205' Waste	3.4	0.2	0.6	0.00000
Closed, 205' Waste	1.5	0.0	0.0	0.00000
Total	19.3		37.5	0.00006

Apply Factor of Safety of 1.5:		
Total	56.2	0.00009

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40-08
PIPE CAPACITY

Determination of flow capacity (Q_{full}) for a 6 inch perforated pipe:

$$Q_{full} = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Where:

A = Cross-sectional area of pipe, with d representing the inside diameter in feet

R = Hydraulic radius of pipe in feet under full flow conditions

From Pipe Structural Stability Calculations (presented later in this appendix):

Standard dimension ratio (SDR) = 17

ID = 5.845 in
= 0.487 ft

$$A = \frac{\Pi \times d^2}{4}$$ A = 0.186 sq ft

$$R = \frac{d}{4}$$ R = 0.122 ft

S = Design slope of pipe — S = 0.007 ft/ft

n = Manning's number — n = 0.015

Q_{full} =	0.37943	cfs

Compare Q_{max} and Q_{full}:

Q_{full} =	0.37943	cfs	>>	Q_{max} =	0.00009	cfs

Conclusion:

An SDR 17 pipe with an outer diameter of 6 inches exceeds flow capacity requirements. Because the minimum recommended size of pipe for use is 6 inches, a perforated SDR 17 HDPE pipe will be used in the leachate collection trenches.

B. Perforation configuration

Pipe perforations must allow free passage of leachate and also prevent migration of drainage media into collection pipes. Therefore, size of perforations depends on media particle size. Two perforations alternatives are tested below:

For leachate collection pipes with slotted perforations:

$$\frac{D_{85} \text{ of Filter}}{\text{Slot Width}} > 2.0$$

Where: D_{85} = Particle size for which 85% of all particles are smaller than

Assume: Drainage media is an ASTM 448 size number 467 aggregate

D_{85} = 25 mm
= 0.984 in

Standard slot width: d = 0.125 in

Compare the sizes of D_{85} and slot width:

$$\frac{D_{85} \text{ of Filter}}{\text{Slot Width}} = 7.9 > 2.0 \quad \text{(acceptable)}$$

For leachate collection pipes with circular holes:

$$\frac{D_{85} \text{ of Filter}}{\text{Hole Diameter}} > 1.7$$

Where: D_{85} = Particle size for which 85% of all particles are smaller than

Assume: Drainage media is an ASTM 448 size number 467 aggregate

D_{85} = 25 mm
= 0.984 in

Standard hole diameter d = 0.5 in

Compare the sizes of D_{85} and hole diameter:

$$\frac{D_{85} \text{ of Filter}}{\text{Hole Diameter}} = 2.0 > 1.7 \quad \text{(acceptable)}$$

In Addition:

A minimum open area of 1 square inch per foot of drainage pipe is recommended by the U.S. Soil Conservation Service and the U.S. Bureau of Reclamation.

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40-08
PIPE STRUCTURAL STABILITY
6-INCH LEACHATE COLLECTION PIPE

REQUIRED: Analyze structural stability of the leachate collection system pipes.

A. 6-inch-diameter HDPE perforated leachate collection pipe
B. 18-inch-diameter HDPE solid-wall sidewall riser

METHOD:

1. Determine the critical load under the following two conditions:

   a. Construction loading
   b. Overburden loading

2. Use the critical loading pressure to analyze pipe stability under the following three possible failure conditions:

   a. Wall crushing
   b. Wall buckling
   c. Ring deflection

REFERENCES

1. Bass, J., *Avoiding Failure of Leachate Collection and Cap Drainage Systems* , Pollution Technology Review No. 138, Noyles Data Corporation, 1986.

2. Texas Natural Resource Conservation Commission, *Leachate Collection* System Handbook, 30 TAC 330.201, 1993.

3. Phillips 66 Driscopipe, *System Design* , 1991.

4. Landfill Design Series, *Leachate Gas Management Systems Design, Volume 5, Leachate Management and Storage* , Appendix A, 1993.

5. Caterpillar Tractor Company, *Caterpillar Performance Handbook,* Edition 27, October 1996.

6. Qian, Koerner, and Gray, *Geotechnical Aspects of Landfill Design and Construction.* Prentice-Hall, 2002.

SOLUTION: **A. Structural stability of 6-inch-diameter SDR 17 perforated leachate collection pipe:**

A.1.a. Maximum Construction Loading

Assume: CAT 637E Series II scraper with an even load distribution

Loaded weight =	190,500	lb	(From Ref. 5, Page 9-3)
Tire pressure =	80	psi	(From Ref. 5, Section 12)
Number of tires =	4		

For a circular tire imprint:

$$F = \frac{\text{Loaded Weight}}{\text{Number of Tires}}$$

Where: F = Force exerted by one tire (lb)

F =	47,625	lb

Determine area of contact for circular tire imprint:

$$r = (F/\pi p)^{1/2}$$

Where:
- r = Radius of contact (in)
- F = Force exerted by one tire (lb)
- p = Tire pressure (psi)

r =	13.8	in

Use Boussinesq's solution to find the stress at a point below a uniformly loaded circular area:

$$y = p\,(1 - ((r/z)^2+1)^{-3/2})$$

Where:
- y = Change in vertical stress (psi)
- p = Tire pressure (psi)
- r = Radius of contact (in)
- z = Protective cover thickness (in)

z = 26 in

y =	24.8	psi

Assume only one wheel load on pipe and add 50% for impact loading:

$P_L = 1.5y$

Where: P_L = Maximum live load (psi)

$P_L =$	37.2	psi

$P_D = (zw)/1728$

Where: P_D = Maximum dead load (psi)
z = Protective cover thickness (in)
w = Unit weight of protective cover (pcf)

z = 26 in
w = 118 pcf

$P_D =$	1.78	psi

$P_T = P_L + P_D$

Where: P_T = Maximum construction load (psi)

$P_T =$	38.9	psi

A.1.b. Overburden loading (postclosure load)

For maximum fill load on pipe:

2.2	ft prot. cover/grvl @	118	pcf =	259.6	psf
4	ft final & int. cover @	118	pcf =	472	psf
205	ft solid waste @	60	pcf =	12,300	psf
			S =	13,032	psf

$P_T =$	90.5	psi

Determine critical loading condition:

Construction loading:	$P_T =$	38.9	psi
Overburden loading:	$P_T =$	90.5	psi

Overburden loading is most critical to the structural stability of the pipe and will be used to determine the design pipe stress.

A.1.b.1. Determine Design Stress:

A.1.b.1.a. Adjust critical stress to account for loss of strength in the pipe due to perforations:

$$P_{DES1} = 12P_T / (12 - l_p)$$

Where:

l_p	= Cumulative length of perforations per foot of pipe
P_T	= Critical pipe stress (psi)
P_{DES1}	= Pipe stress adjusted for loss of strength (psi)

6	holes / foot
0.5	in / hole

$\boxed{l_p = 3.0 \text{ in/ft}}$

From determination of critical loading:

$P_T =$ 90.5 psi

$\boxed{P_{DES1} = 120.7 \text{ psi}}$

A.1.b.1.b. Adjust pipe stress determined above to account for effects of soil arching:

The design pipe stress is estimated by accounting for the soil structure interaction between the buried leachate collection pipe and its backfill to obtain a realistic loading condition on the pipe.

A.1.b.1.b.1. For the burial conditions shown on Figure 1 (page L-3-27), the pipe may be classified as a positive projecting conduit.

A.1.b.1.b.2. Because the pipe is flexible and will deflect in the vertical plane as shown on Figure 2 (page L-3-28), the pipe will experience a reduction in loading due to soil arching. Soil arching is present when the soil column over the pipe settles and creates shear stresses in the surrounding soil. Those shear stresses will support the soil column, thereby reducing the load experienced by the pipe (see Figure 3, page L-3-28).

A.1.b.1.b.3. The load on the pipe will be estimated using Marston's Formula:

$$W_c = \gamma C_c B_c^{\,2} \tag{1}$$

$$C_c = \frac{e^{\pm 2k\mu(H_e/B_c)} - 1}{\pm 2k\mu} + \left(\frac{H}{B_c} - \frac{H_e}{B_c}\right)e^{\pm 2k\mu(H_e/B_c)} \tag{2}$$

Where:
- W_c = Load per unit length of conduit (lb/ft)
- g = Unit weight of soil above conduit (pcf)
- B_c = Outer diameter of conduit (ft)
- H = Height of fill above conduit (ft)
- H_e = Height of plane of equal settlement above critical plane (ft)
- k = Lateral pressure ratio (earth pressure coefficient)
- m = tan f
- f = Angle of internal friction of pipe-zone backfill (PZB) (degrees)

$$H_e = \pm r_{sd}\, p\left(\frac{H}{B_c}\right) \tag{3}$$

Where:
- r_{sd} = Settlement ratio
- p = Ratio of the conduit projection above the compacted soil liner to its diameter

$$r_{sd} = \frac{(S_m + S_g) - (S_f + dc)}{S_m} \tag{4}$$

Where:
- S_m = Compression deformation of soil column adjacent to conduit
- S_g = Settlement of natural ground adjacent to conduit
- S_f = Settlement of conduit into foundation material
- dc = Vertical deflection of the conduit

It is assumed that for a leachate collection pipe S_g and S_f are equivalent. The equation settlement ratio, therefore, reduces to the following:

$$r_{sd} = \frac{S_m - dc}{S_m} \tag{5}$$

Since the PZB is much stiffer than the pipe, dc is larger than S_m implying that r_{sd} will be negative. Because r_{sd} is negative, the pipe is categorized as an incomplete ditch as specified by Marston. Note that in the above equations, where a "+" and a "-" signs are used together, the upper sign corresponds to a positive r_{sd} and a the lower sign to a negative r_{sd}.

A.1.b.1.b.4. Load analysis solution by trial and error

Step 1: Assume a value for the settlement ratio, r_{sd}.

r_{sd} = -0.12

Step 2: Calculate S_m based on the estimated vertical stress at the level of the pipe and the deformation modulus E of the PZB.

$S_m = P_{DES1} D / E_s$

Where:
- P_{DES1} = Pipe stress adjusted for loss of strength (psi)
- D = Outside Pipe diameter (in)
- E_s = PZB soil modulus (psi)

P_{DES1} =	120.7	psi
D =	6.0	in
E_s =	3,000	psi

S_m =	0.241	in

Step 3: Calculate dc using Equation (5):

$dc = S_m (1 - r_{sd})$

dc =	0.270	in

Step 4: Use the Iowa Formula (provided below) to calculate W_c.

$$W_c = \frac{dc}{(DL)k}\left(\frac{EI}{r^3} + 0.061E'\right)$$

Where:
- DL = Deflection lag factor
- k = Bedding factor
- E = Young's modulus for pipe material (psi)
- I = Moment of inertia for pipe wall = $t^3/12$ (in^4/in)
- r = Pipe radius (in)
- E' = Modulus of soil reaction (psi)

DL =	1.5	(refer to page 306 of Ref. 6)
k =	0.1	(refer to page 307 of Ref. 6)
E =	32,000	psi (refer to Chart 25 on page L-3-29 using P_{DES1} above)
t =	0.390	in (refer to page L-3-30)
I =	0.005	in^4/in
r =	2.61	in
E' =	3,000	psi

W_c =	311	lb/in

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Step 5: Calculate C_c using Equation 1 (page L-3-9):

$$C_c = \frac{W_c}{\gamma B_c^{\ 2}}$$

Composite unit weight for waste and soil:

2.2	ft protective cover @	118	pcf =	259.6	psf
4	ft final & inter. cover @	118	pcf =	472	psf
205	ft solid waste @	60	pcf =	12,300	psf
			Σ =	13,032	psf

$\gamma =$ 44.0 pcf (weighted average based on above table)
$B_c =$ 6 in

$C_c =$ 339.3 (unitless)

Step 6: Solve for He/Bc using Equation 2 (page L-3-9) in an iterative manner:

H = 211 ft
$H/B_c =$ 422.4

Assume: $H_e/B_c =$ 0.85

kμ = 0.13
$e^{-2km(He/Bc)}-1 =$ -0.20
-2km = -0.26
$(H/B_c - H_e/B_c) =$ 421.6
$e^{-2km(He/Bc)} =$ 0.80

Left-hand-side of equation (LHS) = 339
Right-hand-side of equation (RHS) = 339

Step 7: Substitute H_e/B_c into equation given below to determine if proper value for r_{sd} was used.

$$\left[\frac{1}{2k\mu} \pm \left(\frac{H}{B_c} - \frac{H_e}{B_c}\right) \pm \frac{r_{sd}\,p}{3}\right] \frac{e^{\pm 2k\mu(H_e/B_c)} - 1}{\pm 2k\mu} \pm \frac{1}{2}\left(\frac{H_e}{B_c}\right)^2$$

$$\pm \frac{r_{sd}\,p}{3}\left(\frac{H}{B_c} - \frac{H_e}{B_c}\right) e^{\pm 2k\mu(H_e/B_c)} - \frac{1}{2k\mu}\left(\frac{H_e}{B_c}\right) \mp \left(\frac{H}{B_c}\right)\left(\frac{H_e}{B_c}\right) = \pm r_{sd}\,p\left(\frac{H}{B_c}\right)$$

Because r_{sd} is negative for the incomplete ditch condition, the lower signs in the above equation are used.

p =	1
km =	0.13
H/B_c =	422.4
H_e/B_c =	0.845
r_{sd} =	-0.12
LHS =	50
RHS =	50

If LHS is not approximately equal to RHS, adjust value for r_{sd} in Step 1 and repeat solution procedure.

A.1.b.1.b.5. Once the solutions to the above equations are determined, the design pipe stress may be calculated and the deflection of the pipe determined.

$P_{DES2} = W_c / D$

Where: P_{DES2} = Load on pipe adjusted to account for effects of soil arching (psi)

W_c =	311	lb/in
D =	6.000	in

P_{DES2} =	52	psi

A summary table for the structural stability analyses presented below is provided on page L-3-15 for the 6-inch-diameter leachate collection pipe. A pipe will be selected from this table for use in the collection system based on the calculated factors of safety for each possible failure condition. An example calculation is provided below that outlines the procedures used to determine the factors of safety for all pipe SDR sizes shown in the summary table.

A.2. Example pipe structural stability calculations:

SDR = Standard dimension ratio	=	17	
S_Y = compressive yield strength	=	1,500	psi (Ref. 3, page 37)
RD_{all} = allowable ring deflection	=	4.2	% (Ref. 3, page 38)

A.2.a. Wall crushing (Ref 3)

$S_A = P_{DES2}\,(SDR - 1) / 2$ FS $= S_Y / S_A$

Where:
- S_A = Actual compressive stress (psi)
- SDR = Standard dimension ratio
- P_{DES2} = Load pipe adjusted to account for effects of soil arching (psi)
- S_Y = Compressive yield strength (psi)
- FS = Factor of safety against wall crushing

P_{DES2} = 52 psi

S_A =	415.0	psi
FS =	3.6	

Compare calculated and suggested factor of safety:	3.6	> 1.0

A.2.b. Wall buckling (Ref 3)

$P_{cb} = 0.8\,(E'\,(2.32E / SDR^3))^{1/2}$ FS $= P_{cb} / P_{DES2}$

Where:
- P_{cb} = Critical buckling pressure at top of pipe (psi)
- E' = Soil modulus (psi)
- E = Stress/time dependent tensile modulus for design loading conditions (psi)
- P_{DES2} = Load pipe adjusted to account for effects of soil arching (psi)
- FS = Factor of safety against wall buckling

E' = 3,000 psi
E = 21,500 psi (refer to Chart 25 on page L-3-29 using S_A above)
P_{DES2} = 52 psi

P_{cb} =	139.6	psi
FS =	2.7	

Compare calculated and suggested factor of safety:	2.7	> 1.0

A.2.c. Ring deflection (Ref 3)

$E_S = P_{DES2} / E'$

Where:
- E_S = Soil strain (%)
- P_{DES2} = Load pipe adjusted to account for effects of soil arching (psi)
- E' = Soil modulus (psi)

P_{DES2} = 52 psi
E' = 3,000 psi

E_S = 1.7 %

Ring deflection for buried HDPE pipe is conservatively the same (no more than) the vertical compression of the soil envelope around the pipe. Therefore, assumed actual ring deflection (RD_{act}) is equal to soil strain.

RD_{act} = 1.7 %

Allowable ring deflection, RD_{all} = 4.2 %

$RD_{act} < RD_{all}$, design is acceptable

Note: An additional factor of safety is inherent to the design of the leachate collection system due to the presence of a gravel envelope surrounding the leachate collection pipe. The gravel layer will transmit leachate in the event that the leachate collection pipe becomes plugged or crushed.

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Adjusted load to account for soil arching = 52 psi

	Wall Crushing			Wall Buckling				Ring Deflection			
SDR	S_Y	S_A	FS_{WC}	E^2	E'	P_{cb}	FS_{WB}	RD_{all}	E'	RD_{act}	FS_{RD}
32.5	1,500	817.0	1.8	13,000	3,000	41.1	0.8	8.1	3,000	1.7	4.7
26.0	1,500	648.4	2.3	16,000	3,000	63.7	1.2	6.5	3,000	1.7	3.8
21.0	1,500	518.7	2.9	18,500	3,000	94.3	1.8	5.2	3,000	1.7	3.0
19.0	1,500	466.9	3.2	20,000	3,000	114.0	2.2	4.7	3,000	1.7	2.7
17.0	1,500	415.0	3.6	21,500	3,000	139.6	2.7	4.2	3,000	1.7	2.4
15.5	1,500	376.1	4.0	22,500	3,000	164.1	3.2	3.9	3,000	1.7	2.3
13.5	1,500	324.5	4.6	23,500	3,000	206.0	4.0	3.4	3,000	1.7	2.0
11.0 [1]	1,500	259.4	5.8	26,000	3,000	295.0	5.7	2.7	3,000	1.7	1.6

denotes standard size

[1] Select 6-inch-diameter HDPE SDR 17 pipe for use in the leachate collection system based on the calculated factors of safety.

[2] Values for the modulus of elasticity were selected from the attached chart (page L-3-29), Reference 3, using the calculated stress in the pipe wall (S_A under the wall crushing heading in the above table) for a 50 year duration (maximum loading is the overburden load on the pipe).

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18-INCH RISER PIPE

REQUIRED: Analyze structural stability of the leachate collection system pipes.

B. 18-inch-diameter HDPE solid-wall sidewall riser

METHOD:

1. Determine the critical load under the following two conditions:

   a. Construction loading
   b. Overburden loading

2. Use the critical loading pressure to analyze pipe stability under the following three possible failure conditions:

   a. Wall crushing
   b. Wall buckling
   c. Ring deflection

REFERENCES

1. Bass, J., *Avoiding Failure of Leachate Collection and Cap Drainage Systems*, Pollution Technology Review No. 138, Noyles Data Corporation, 1986.

2. Texas Natural Resource Conservation Commission, *Leachate Collection* System Handbook, 30 TAC 330.201, 1993.

3. Phillips 66 Driscopipe, *System Design*, 1991.

4. Landfill Design Series, *Leachate Gas Management Systems Design, Volume 5, Leachate Management and Storage*, Appendix A, 1993.

5. Caterpillar Tractor Company, *Caterpillar Performance Handbook,* Edition 27, October 1996.

6. Qian, Koerner, and Gray, *Geotechnical Aspects of Landfill Design and Construction.* Prentice-Hall, 2002.

SOLUTION: **B. Structural stability of 18-inch-diameter HDPE SDR 17 perforated leachate collection pipe:**

B.1.a. Maximum construction loading

Assume: CAT 637E Series II scraper with an even load distribution

Loaded weight =	190,500	lb	(From Ref. 5, Page 9-3)
Tire pressure =	80	psi	(From Ref. 5, Section 12)
Number of tires =	4		

For a circular tire imprint:

$$F = \frac{\text{Loaded Weight}}{\text{Number of Tires}}$$

Where: F = Force exerted by one tire (lb)

F =	47,625	lb

Determine area of contact for circular tire imprint:

$$r = (F/\pi p)^{1/2}$$

Where:
r = Radius of contact (in)
F = Force exerted by one tire (lb)
p = Tire pressure (psi)

r =	13.8	in

Use Boussinesq's solution to find the stress at a point below a uniformly loaded circular area:

$$y = p\,(1 - ((r/z)^2+1)^{-3/2})$$

Where:
y = Change in vertical stress (psi)
p = Tire pressure (psi)
r = Radius of contact (in)
z = Gravel and protective cover thickness (in)

z = 48 in

y =	8.9	psi

Assume only one wheel load on pipe and add 50% for impact loading:

$P_L = 1.5y$

Where: P_L = Maximum live load (psi)

P_L =	13.4	psi

$P_D = (zw)/1728$

Where: P_D = Maximum dead load (psi)
z = Gravel and protective cover thickness (in)
w = Unit weight of gravel and protective cover (pcf)

z = 48 in
w = 118 pcf

P_D =	3.28	psi

$P_T = P_L + P_D$

Where: P_T = Maximum construction load (psi)

P_T =	16.7	psi

B.1.b. Overburden loading (postclosure load)

For maximum fill load on pipe:

4	ft prot. cover & grvl @	118	pcf =	472	psf
4	ft final & int. cover @	118	pcf =	472	psf
205	ft solid waste @	60	pcf =	12,300	psf
			Σ =	13,244	psf

P_T =	92.0	psi

Determine critical loading condition:

Construction loading:	P_T =	16.7	psi
Overburden loading:	P_T =	92.0	psi

Overburden loading is most critical to the structural stability of the pipe and will be used to determine the design pipe stress.

B.1.b.1. Determine Design Stress:

B.1.b.1.a. Adjust critical stress to account for loss of strength in the pipe due to perforations:

$P_{DES1} = 12P_T / (12 - l_p)$

Where: l_p = Cumulative length of perforations per foot of pipe

P_T = Critical pipe stress (psi)

P_{DES1} = Pipe stress adjusted for loss of strength (psi)

6 holes / foot

0.5 in / hole

l_p =	3.0	in/ft

From determination of critical loading:

P_T = 92.0 psi

P_{DES1} =	122.6	psi

B.1.b.1.b. Adjust pipe stress determined above to account for effects of soil arching:

The design pipe stress is estimated by accounting for the soil structure interaction between the buried leachate collection pipe and its backfill to obtain a realistic loading condition on the pipe.

B.1.b.1.b.1. For the burial conditions shown on Figure 1 (page L-3-27), the pipe may be classified as a positive projecting conduit.

B.1.b.1.b.2. Because the pipe is flexible and will deflect in the vertical plane as shown on Figure 2 (page L-3-28), the pipe will experience a reduction in loading due to soil arching. Soil arching is present when the soil column over the pipe settles and creates shear stresses in the surrounding soil. Those shear stresses will support the soil column, thereby reducing the load experienced by the pipe (see Figure 3, page L-3-28).

B.1.b.1.b.3. The load on the pipe will be estimated using Marston's Formula:

$$W_c = \gamma C_c B_c^{\,2} \tag{1}$$

$$C_c = \frac{e^{\pm 2k\mu(H_e/B_c)} - 1}{\pm 2k\mu} + \left(\frac{H}{B_c} - \frac{H_e}{B_c}\right) e^{\pm 2k\mu(H_e/B_c)} \tag{2}$$

Where:
- W_c = Load per unit length of conduit (lb/ft)
- γ = Unit weight of soil above conduit (pcf)
- B_c = Outer diameter of conduit (ft)
- H = Height of fill above conduit (ft)
- H_e = Height of plane of equal settlement above critical plane (ft)
- k = Lateral pressure ratio (earth pressure coefficient)
- μ = tan ϕ
- ϕ = Angle of internal friction of pipe-zone backfill (PZB) (degrees)

$$H_e = \pm r_{sd} \, p \left(\frac{H}{B_c}\right) \tag{3}$$

Where:
- r_{sd} = Settlement ratio
- p = Ratio of the conduit projection above the compacted soil liner to its diameter

$$r_{sd} = \frac{(S_m + S_g) - (S_f + dc)}{S_m} \tag{4}$$

Where:
- S_m = Compression deformation of soil column adjacent to conduit
- S_g = Settlement of natural ground adjacent to conduit
- S_f = Settlement of conduit into foundation material
- dc = Vertical deflection of the conduit

It is assumed that for a leachate collection pipe S_g and S_f are equivalent. The equation settlement ratio, therefore, reduces to the following:

$$r_{sd} = \frac{S_m - dc}{S_m} \tag{5}$$

Since the PZB is much stiffer than the pipe, dc is larger than S_m implying that r_{sd} will be negative. Because r_{sd} is negative, the pipe is categorized as an incomplete ditch as specified by Marston. Note that in the above equations, where a "+" and a "-" signs are used together, the upper sign corresponds to a positive r_{sd} and a the lower sign to a negative r_{sd}.

B.1.b.1.b.4. Load analysis solution by trial and error

Step 1: Assume a value for the settlement ratio, r_{sd}.

r_{sd} = -0.08

Step 2: Calculate S_m based on the estimated vertical stress at the level of the pipe and the deformation modulus E of the PZB.

$S_m = P_{DES1} D / E_s$

Where:
P_{DES1} = Pipe stress adjusted for loss of strength (psi)
D = Outside Pipe diameter (in)
E_s = PZB soil modulus (psi)

P_{DES1} =	122.6	psi
D =	18	in
E_s =	3,000	psi

S_m =	0.736	in

Step 3: Calculate dc using Equation (5):

$dc = S_m (1 - r_{sd})$

dc =	0.791	in

Step 4: Use the Iowa Formula (provided below) to calculate W_c.

$$W_c = \frac{dc}{(DL)k}\left(\frac{EI}{r^3} + 0.061E'\right)$$

Where:
DL = Deflection lag factor
k = Bedding factor
E = Young's modulus for pipe material (psi)
I = Moment of inertia for pipe wall = $t^3/12$ (in^4/in)
r = Pipe radius (in)
E' = Modulus of soil reaction (psi)

DL =	1.5	(refer to page 306 of reference 6)
k =	0.1	(refer to page 307 of reference 6)
E =	32,000	psi (refer to Chart 25 on page L-3-29 using P_{DES1} above)
t =	1.059	in (refer to page L-3-30)
I =	0.099	in^4/in
r =	7.9	
E' =	3,000	

W_c =	998	lb/in

Step 5: Calculate C_c using Equation 1 (page L-3-20):

$$C_c = \frac{W_c}{\gamma B_c^2}$$

Composite unit weight for waste and soil:

4	ft prot. Cover & grvl @	118	pcf =	472	psf
4	ft final & int.cover @	118	pcf =	472	psf
205	ft solid waste @	60	pcf =	12,300	psf
			Total =	13,244	psf

γ = 44.7 pcf (weighted average based on above table)
B_c = 18 in

C_c =	119.0	(unitless)

Step 6: Solve for He/Bc using Equation 2 (page L-3-20) in an iterative manner:

H = 213 ft
H/B_c = 142.0

Assume: H_e/B_c = 0.64

kμ = 0.14 (Ref 4)
$e^{-2k\mu(He/Bc)}-1$ = -0.16
-2kμ = -0.28
$(H/B_c - H_e/B_c)$ 141.4
$e^{-2k\mu(He/Bc)}$ = 0.84

Left-hand-side of equation (LHS) = 119
Right-hand-side of equation (RHS) = 119

Step 7: Substitute H_e/B_c into equation given below to determine if proper valuefor r_{sd} was used.

$$\left[\frac{1}{2k\mu} \pm \left(\frac{H}{B_c} - \frac{H_e}{B_c}\right) \pm \frac{r_{sd}\,p}{3}\right] \frac{e^{\pm 2k\mu(H_e/B_c)} - 1}{\pm 2k\mu} \pm \frac{1}{2}\left(\frac{H_e}{B_c}\right)^2$$
$$\pm \frac{r_{sd}\,p}{3}\left(\frac{H}{B_c} - \frac{H_e}{B_c}\right) e^{\pm 2k\mu(H_e/B_c)} - \frac{1}{2k\mu}\left(\frac{H_e}{B_c}\right) \mp \left(\frac{H}{B_c}\right)\left(\frac{H_e}{B_c}\right) = \pm r_{sd}\,p\left(\frac{H}{B_c}\right)$$

Because r_{sd} is negative for the incomplete ditch condition, the lower signs in the above equation are used.

p =	1
kμ =	0.14
H/B_c =	142.0
H_e/B_c =	0.635
r_{sd} =	-0.08
LHS =	11
RHS =	11

If LHS is not approximately equal to RHS, adjust value for r_{sd} in Step 1 and repeat solution procedure.

B.1.b.1.b.. Once the solutions to the above equations are determined, the design pipe stress may be calculated and the deflection of the pipe determined.

P_{DES2} $= W_c / D$

Where: P_{DES2} = Load on pipe adjusted to account for effects of soil arching (psi)

W_c =	998	lb/in
D =	18.0	in

P_{DES2} =	55	psi

A summary table for the structural stability analyses presented below is provided on page L-3-26 for the 18-inch-diameter leachate riser pipe.
A pipe will be selected from this table for use in the collection system based on the calculated factors of safety for each possible failure condition. An example calculation is provided below that outlines the procedures used to determine the factors of safety for all pipe SDR sizes shown in the summary table.

B.2. Example pipe structural stability calculations:

SDR = Standard dimension ratio	=	17	
S_Y = compressive yield strength	=	1,500	psi (Ref. 3, page 37)
RD_{all} = allowable ring deflection	=	4.2	% (see Ref. 3, page 38)

B.2.a. Wall crushing (Ref 3)

$S_A = P_{DES2}\,(SDR - 1) / 2$ FS $= S_Y / S_A$

Where:
- S_A = Actual compressive stress (psi)
- SDR = Standard dimension ratio
- P_{DES2} = Load pipe adjusted to account for effects of soil arching (psi)
- S_Y = Compressive yield strength (psi)
- FS = Factor of safety against wall crushing

P_{DES2} = 55 psi

S_A =	443.7	psi
FS =	3.4	

Compare calculated and suggested factor of safety:	3.4	> 1.0

B.2.b. Wall buckling (Ref 3)

$P_{cb} = 0.8\,(E'\,(2.32E / SDR^3))^{1/2}$ FS $= P_{cb} / P_{DES2}$

Where:
- P_{cb} = Critical buckling pressure at top of pipe (psi)
- E' = Soil modulus (psi)
- E = Stress/time dependent tensile modulus for design loading conditions (psi)
- P_{DES2} = Pipe stress adjusted to account for effects of soil arching (psi)
- FS = Factor of safety against wall buckling

E' =	3,000	psi
E =	20,500	psi (see Chart 25 on page L-3-29 using S_A above)
P_{DES2} =	55	psi

P_{cb} =	136.3	psi
FS =	2.5	

Compare calculated and suggested factor of safety:	2.5	> 1.0

B.2.c. Ring deflection (Ref 3)

$E_S = P_{DES2} / E'$

Where:
E_S = Soil strain (%)
P_{DES2} = Pipe stress adjusted to account for effects of soil arching (psi)
E' = Soil modulus (psi)

P_{DES2} = 55 psi
E' = 3,000 psi

E_S =	1.8	%

Ring deflection for buried HDPE pipe is conservatively the same (no more than) the vertical compression of the soil envelope around the pipe. Therefore, assumed actual ring deflection (RD_{act}) is equal to soil strain.

RD_{act} = 1.8 %

Allowable ring deflection, RD_{all} = 4.20 %

$RD_{act} < RD_{all}$, design is acceptable

Note: An additional factor of safety is inherent to the design of the leachate collection system due to the presence of a gravel envelope surrounding the leachate collection pipe. The gravel layer will transmit leachate in the event that the leachate collection pipe becomes plugged or crushed.

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18-INCH RISER PIPE

Adjusted load to account for soil arching = 55 psi

SDR	Wall Crushing			Wall Buckling				Ring Deflection			
	S_Y	S_A	FS_{WC}	E^2	E'	P_{cb}	FS_{WB}	RD_{all}	E'	RD_{act}	FS_{RD}
32.5	1,500	873.5	1.7	13,000	3,000	41.1	0.7	8.1	3,000	1.8	4.4
26.0	1,500	693.3	2.2	15,000	3,000	61.7	1.1	6.5	3,000	1.8	3.5
21.0	1,500	554.6	2.7	18,000	3,000	93.0	1.7	5.2	3,000	1.8	2.8
19.0	1,500	499.2	3.0	19,000	3,000	111.1	2.0	4.7	3,000	1.8	2.5
17.0 [1]	1,500	443.7	3.4	20,500	3,000	136.3	2.5	4.2	3,000	1.8	2.3
15.5	1,500	402.1	3.7	22,000	3,000	162.2	2.9	3.9	3,000	1.8	2.1
13.5	1,500	346.9	4.3	23,000	3,000	203.8	3.7	3.4	3,000	1.8	1.8
11.0	1,500	277.3	5.4	25,500	3,000	292.1	5.3	2.7	3,000	1.8	1.5

denotes standard size

[1] Select 18-inch-diameter HDPE SDR 17.0 pipe for use in the leachate collection system based on the calculated factors of safety.

[2] Values for the modulus of elasticity were selected from the attached chart (page L-3-29), Reference 3, using the calculated stress in the pipe wall (S_A under the wall crushing heading in the above table) for a 50 year duration (maximum loading is the overburden load on the pipe).

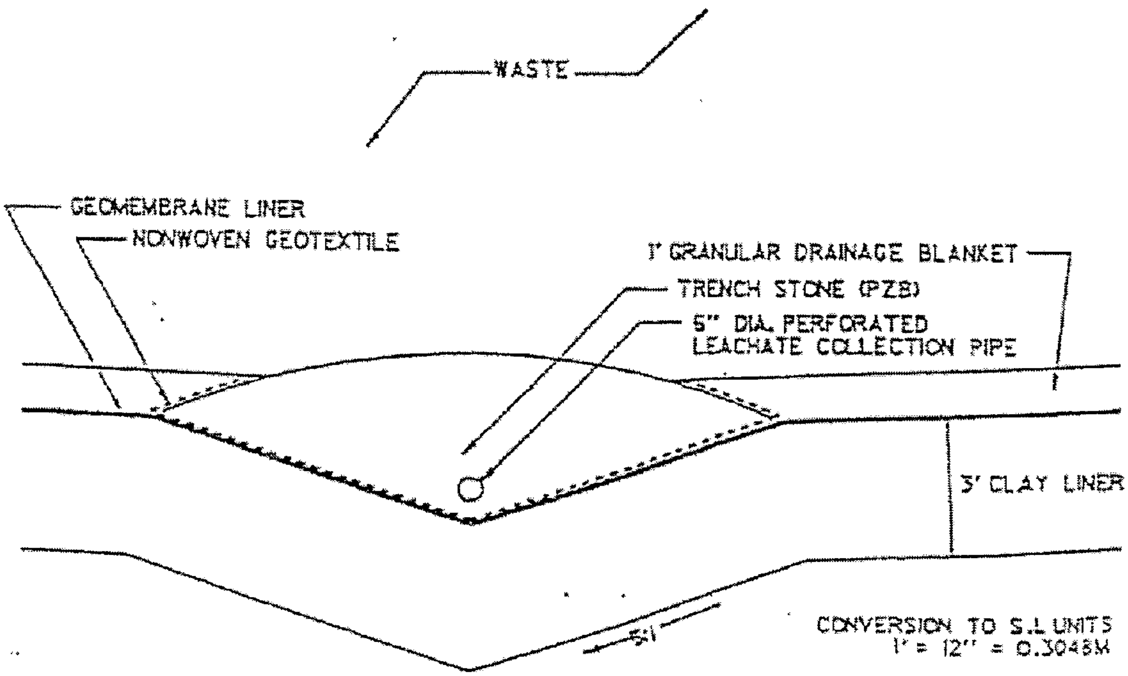


FIGURE 1: TYPICAL V-SHAPED TRENCH FOR LANDFILLS WITH COMPOSITE LINERS

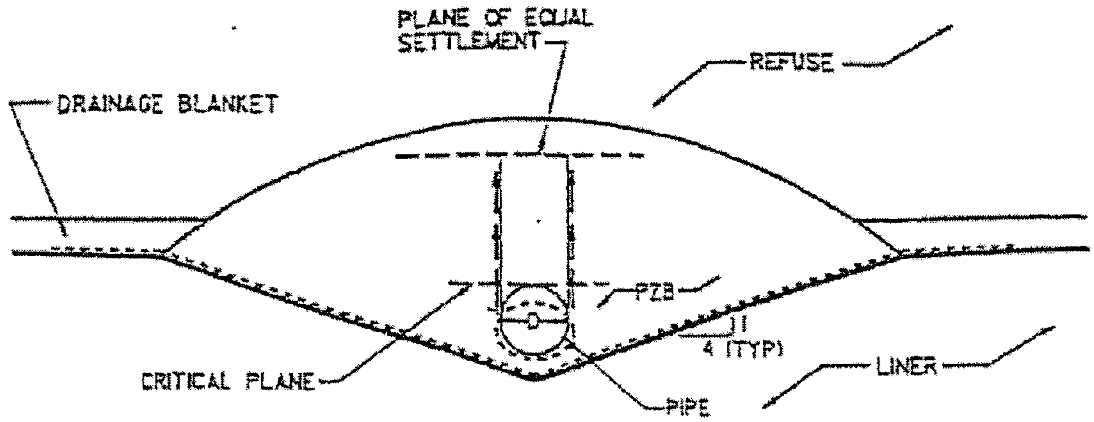


FIGURE 2: SETTLEMENT OF LEACHATE PIPE INDUCING SHEAR STRESSES IN PZB

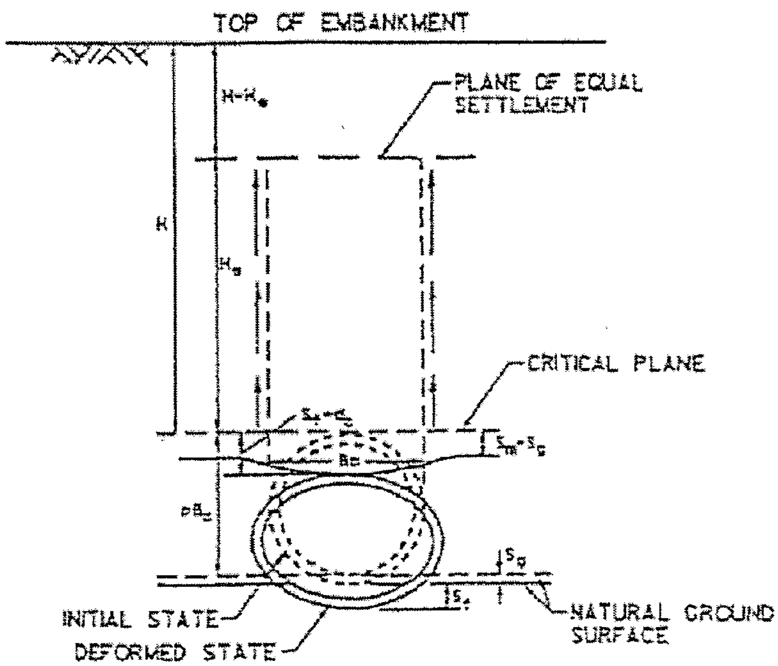
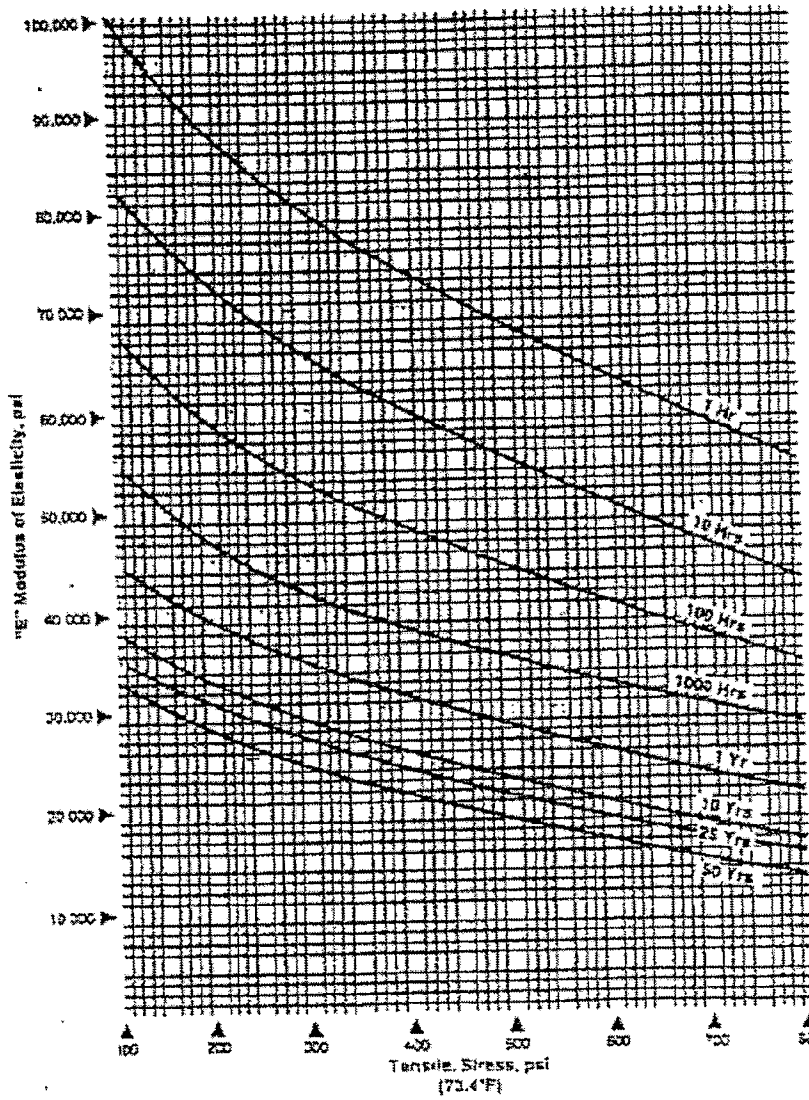


FIGURE 3: CASE OF AN INCOMPLETE DITCH CONDITION FOR A POSITIVE PROJECTING CONDUIT

Chart 25

Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

3. Phillips 66 Driscopipe, "System Design", 1991

3/4" (1.050 OD)

SDR 11	160 psi	0.12 lbs./ft.	0.860 ID	.095 wall

1" (1.315 OD)

SDR 11	160 psi	0.19 lbs./ft.	1.075 ID	.120 wall

1-1/4" (1.660 OD)

SDR 11	160 psi	0.31 lbs./ft.	1.358 ID	.151 wall

1-1/2" (1.900 OD)

SDR 11	160 psi	0.41 lbs./ft.	1.554 ID	.173 wall

2" (2.375 OD)

SDR 7	267 psi	0.94 lbs/ft	1.697 ID	.339 wall
SDR 9	200 psi	0.76	1.847	.264
SDR 11 ●	**160 psi**	**0.64**	**1.943**	**.216**
SDR 13.5	128 psi	0.53	2.023	.176
SDR 15.5	110 psi	0.47	2.069	.153
SDR 17	100 psi	0.43	2.095	.140

3" (3.500 OD)

SDR 7	267 psi	2.05 lbs./ft.	2.500 ID	.500 wall
SDR 9	200 psi	1.66	2.722	.389
SDR 11 ●	**160 psi**	**1.39**	**2.864**	**.318**
SDR 13.5	128 psi	1.15	2.982	.259
SDR 15.5	110 psi	1.02	3.048	.226
SDR 17 ●	**100 psi**	**0.93**	**3.088**	**.206**
SDR 19	89 psi	0.84	3.132	.184
SDR 21	80 psi	0.77	3.166	.167
SDR 26	64 psi	0.62	3.230	.135
SDR 32.5	51 psi	0.50	3.284	.108

4" (4.500 OD)

SDR 7	267 psi	3.39 lbs/ft.	3.214 ID	.643 wall
SDR 9	200 psi	2.74	3.500	.500
SDR 11 ●	**160 psi**	**2.29**	**3.682**	**.409**
SDR 13.3	128 psi	1.90	3.834	.333
SDR 15.5 ●	**110 psi**	**1.68**	**3.020**	**.290**
SDR 17 ●	**100 psi**	**1.54**	**3.970**	**.265**
SDR 19	89 psi	1.39	4.026	.237
SDR 21	80 psi	1.26	4.072	.214
SDR 26 ●	**64 psi**	**1.03**	**4.154**	**.173**
SDR 32.5	51 psi	0.83	4.224	.138

5-3/8" (5.375 OD)

SDR 17	100 psi	2.20 lbs./ft.	4.743 ID	.316 wall
SDR 21	80 psi	1.80	4.863	.256
SDR 26	64 psi	1.47	4.961	.207
SDR 32.5	51 psi	1.18	5.045	.165

5" (5.563 OD)

SDR 7	267 psi	5.17 lbs/ft.	3.973 ID	.795 wall
SDR 9	200 psi	4.18	4.327	.618
SDR 11	160 psi	3.51	4.551	.506
SDR 13.5	128 psi	2.91	4.739	.412
SDR 15.5	110 psi	2.57	4.845	.359
SDR 17	100 psi	2.35	4.909	.327
SDR 19	89 psi	2.12	4.977	.293
SDR 21	80 psi	1.93	5.033	.265
SDR 26	64 psi	1.57	5.135	.214
SDR 32.5	51 psi	1.27	5.221	.171

6" (6.625 OD)

SDR 7	267 psi	7.33 lbs./ft.	4.733 ID	.946 wall
SDR 9	200 psi	5.93	5.153	.736
SDR 11 ●	**160 psi**	**4.97**	**5.421**	**.602**
SDR 13.5	128 psi	4.13	5.643	.491
SDR 15.5	110 psi	3.63	5.771	.427
SDR 17 ●	**100 psi**	**3.34**	**5.845**	**.390**
SDR 19	89 psi	3.01	5.927	.349
SDR 21 ●	**80 psi**	**2.73**	**5.995**	**.315**
SDR 26 ●	**64 psi**	**2.23**	**6.115**	**.255**
SDR 32.5 ●	**51 psi**	**1.80**	**6.217**	**.204**

7" (7.125 OD)

SDR 7	267 psi	8.49 lbs./ft.	5.089 ID	1.018 wall
SDR 9	200 psi	6.86	5.541	.792
SDR 11	160 psi	5.75	5.829	.648
SDR 13.5	128 psi	4.78	6.069	.528
SDR 15.5	110 psi	4.21	6.205	.460
SDR 17	100 psi	3.86	6.287	.419
SDR 19	89 psi	3.48	6.375	.375
SDR 21	80 psi	3.16	6.445	.340
SDR 26 ●	**64 psi**	**2.58**	**6.577**	**.274**
SDR 32.5	51 psi	2.08	6.685	.220

8" (8.625 OD)

SDR 7	267 psi	12.43 lbs.ft.	6.161 ID	1.232 wall
SDR 9	200 psi	10.05	6.709	.958
SDR 11 ●	**160 psi**	**8.42**	**7.057**	**.784**
SDR 13.5	128 psi	7.00	7.347	.639
SDR 15.5	110 psi	6.16	7.513	.556
SDR 17 ●	**100 psi**	**5.65**	**7.611**	**.507**
SDR 19	89 psi	5.10	7.717	.454
SDR 21 ●	**80 psi**	**4.64**	**7.803**	**.411**
SDR 26 ●	**64 psi**	**3.79**	**7.961**	**.332**
SDR 32.5 ●	**51 psi**	**3.05**	**8.095**	**.265**

● denotes standard sizes

APPENDIX L-4

LEACHATE SUMP DESIGN

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Includes pages L-4-1 through L-4-4

REQUIRED: Evaluate the size of the leachate collection sumps and storage tanks.

METHOD:

A. Determine the flow rate into the sump using the leachate production rates from HELP model and the sump drainage area shown in Appendix L-1.
B. Determine the geometry of the sump and its storage capacity.
C. Assume pump size and determine the average pump cycle time.

REFERENCES:

1. Texas Natural Resource Conservation Commission, *Leachate Collection System Handbook*, 30 TAC 330.201, 1993.
2. Phillips 66 Driscopipe, *System Design*, 1991.
3. Heisler, Sanford I., P.E., Wiley Engineer's Desk Reference, John Wiley & Sons, Inc., New York, 1998.

SOLUTION: **A. Determine the flow rate into the sump using the leachate production rates from HELP model and the sump drainage area shown in Appendix L-1.**

The following table summarizes the fill conditions that are likely to be present and have the greatest contribution of leachate into the LCS and sump. The average flow rates (lateral drainage in the LCS layer) are shown for each condition. Flow rates are cubic feet per year per acre (cfy/ac) and gallons per day per acre (gpd/ac).

From the HELP model (Appendix L-2):

CONDITION	AVERAGE[1] cfy/ac	AVERAGE gpd/ac
Active, 10' Waste	1	0.0
Interim, 50' Waste	133	2.7
Interim, 100' Waste	152	3.1
Interim, 150' Waste	133	2.7
Interim 205' Waste	9	0.2
Closed, 205' Waste	0.5	0.0

The largest area draining to one sump is 19.3 acres (sump receives leachate from the sidewall and Phase XIII).

Condition	Rate	Active		Inactive		Closed	
	(gpd/ac)	area (ac)	rate (gpd)	area (ac)	rate (gpd)	area (ac)	rate (gpd)
Active, 10' Waste	0.0	1.5	0.0	0.0	0.0	0.0	0.0
Interim, 50' Waste	2.7	4.2	11.4	0.0	0.0	0.0	0.0
Interim, 100' Waste	3.1	6.0	18.7	0.0	0.0	0.0	0.0
Interim, 150' Waste	2.7	4.2	11.4	0.0	0.0	0.0	0.0
Interim 205' Waste	0.2	1.9	0.4	19.7	3.6	0.0	0.0
Closed, 205' Waste	0.0	1.5	0.0	0.0	0.0	19.3	0.2
Total Area		19.3	42.0	19.7	3.6	19.3	0.2
with 1.5 F.S.			63.0		5.5		0.3

B. Determine the geometry of the sump and its storage capacity.

Assumed porosity of drainage stone: P = 0.35

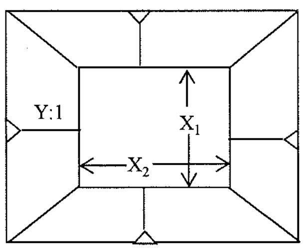
$V_{REQ} = V_C / P$

Condition	V_C (gpd)	V_C (cf/d)	V_{REQ} (cf/d)
Active	63.0	8.4	24.1
Inactive with Intermediate Cover	5.5	0.7	2.1
Closed	0.3	0.0	0.1

Total sump volume:

$$V_{TOT} = 1/3\left(A_1 + A_2 + \sqrt{(A_1 \cdot A_2)}\right)h$$ (Ref. 3, page 17)

Where:
A_1 = Area of bottom of sump
A_2 = Area of top of sump
h = Depth of sump



Y = Slope of sump side walls
$A_1 = X_1 * X_2$
$A_2 = (X_1 + 2(h*Y))*(X_2 + 2(h*Y))$

X_1 =	15	ft		A_1=	225	sf
X_2 =	15	ft		A_2=	729	sf
Y =	3					
h =	2	ft				

V_{TOT} = 906.0 cu ft

Compute the number of days storage provided for the following:

$$\text{STORAGE (Detention Time)} = \frac{V_{TOT}}{V_{REQ}}$$

Condition	V_{REQ} (cf/d)	V_{TOT} (cf)	Storage (d)
Active	24.1	906.0	37.7
Inactive with Intermediate Cover	2.1	906.0	435.2
Closed	0.1	906.0	7996.0

C. Assume pump size and determine the average pump cycle time.

Submersible pump capacity = 10 gpm

Phase	Production (gpd)	Average Pump Time (min/day)	Average Pump Time (hr/day)
Active	63	6	0.1
Inactive with Intermediate Cover	5	1	0.0
Closed	0	0	0.0

Production rate includes a factor of safety of 1.5.

Note: The size of the sump will be the same for all phases. The sump calculations are based on the largest phase size as well as the constructability of the sump. Should a different size of sump be used due to a smaller phase size, these calculations should be revised.

APPENDIX L-5

GEOTEXTILE DESIGN

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Includes pages L-5-1 through L-5-11

REQUIRED: Determine geotextile properties for the following:

A. Geotextile around granular drainage material.
B. Geotextile underlying the leachate collection/protective cover layer.

METHOD: Design geotextiles and determine material property requirements.

REFERENCES:

1. Standard Speficitiaon for *Geotextile Specification for Highway Applications.* AASHTO Designation: M 288-06. FHWA NHI-07-092, Appendix D, September 2007.
2. Koerner, R.M., *Designing With Geosynthetics*, Fifth Edition, 2005.
3. AASHTO Designation: M288-06.
4. GRI White Paper #4, *Reduction Factors (RFs) Used in Geosynthetic Design,* Feb. 3, 2005, revised Mar. 1, 2007.

SOLUTION: **A. Geotextile Around Granular Drainage Material**

The design calculations assume the leachate collection/protective cover layer will consist of one of the following:

Hydraulic conductivity greater than or equal to $1x10^{-3}$ cm/s and percent fines (passing #200 sieve) more than 20 percent.

If the leachate collection/protective cover layer material contains less than 20 percent fines, these geotextile calculations will be revised.

Retention:

Based on Chart 1 - "Soil Retention Criteria" (shown on page L-5-8) the apparent opening size (O_{95}) may be determined.

$O_{95} <$ 0.4755 mm For leachate collection/protective cover layer materials

Permeability:

The required permeability is determined by comparing the permeability of the overlying waste material ($1.0x10^{-3}$ cm/s) and the leachate collection/protective cover layer material ($1.0x10^{-3}$ cm/s) with the permeability of the geotextile after the appropriate reduction factors are applied to the laboratory permeability of the geotextile.

Minimum Laboratory Permeability Specified (k_{ult}) = 0.2 cm/s

To determine the allowable permeability (k_{allow}) of the geotextile, the following reduction factors are used:

Table 2 - Reduction Factors[1]

RF_{SCB} = Reduction factor for soil clogging and blinding	2.0
RF_{CR} = Reduction factor for creep reduction of void space	2.0
RF_{IN} = Reduction factor for adjacent materials intruding into void spaces	1.2
RF_{CC} = Reduction factor for chemical clogging	1.5
RF_{BC} = Reduction factor for biological clogging	2.0
Overall Reduction Factor (ORF) =	14.4

[1] Reduction factors obtained from Ref. 4.

$k_{allow} = k_{ult}$ / ORF = (0.2 cm/s) / 14.4

$\boxed{k_{allow} = 1.4\text{E-}02 \text{ cm/s}}$

$k_{allow} \gg k_{\text{leachate collection/protective cover}}$ (1.0×10^{-3} cm/s).

The predicted permeability of the geotextile is greater than the surrounding materials (i.e., waste and leachate collection/protective cover). The chimney drain geotextile will not impede the flow of leachate into the LCS pipe. Therefore, no head will develop on the chimney drain geotextile.

Specification: Chimney drain geotextile permeability shall be equal to or greater than 0.2 cm/s as determined by ASTM D 4491.

Clogging:

For geotextile filters where retention is important, use smallest O_{95} that meets the geotextile permeability requirement.

Survivability:

Based on Table 4, provided on page L-5-10, Class 2 geotextile was selected based on the subgrade condition and type of equipment that would be used to at the site. Assuming Class 2 geotextile, Table 1, "Geotextile Strength Property Requirements", provided on page L-5-11, was used to obtain the physical properites required.

Durability:

Chemical compatibility with leachate was considered during the selection process for the specific leachate.

Summary of required properties for geotextile (around granular drainage material):

Apparent opening size	<	0.4755	mm
Grab tensile strength	>	157	lb
Sewn seam strength	>	142	lb
Puncture strength	>	309	lb
Tear strenght	>	56	lb
Permeability	>=	0.20	cm/s

B. Geotextile Underlying the Leachate Collection/Protective Cover Layer.

The design calculations assume the leachate collection/protective cover layer will consist of one of the following:

Hydraulic conductivity greater than or equal to 1×10^{-3} cm/s and percent fines (passing #200 sieve) more than 20 percent.

If the leachate collection/protective cover layer material contains less than 20 percent fines, these geotextile calculations will be revised.

Retention:

Based on Chart 1 - "Soil Retention Criteria" (shown on page L-5-8) the apparent opening size (O95) may be determined.

$O_{95} <$ 0.4755 mm — For granular media layer materials

Permeability:

The required permeability is determined by comparing the permeability of the leachate collection/protective cover (1.0×10^{-3} cm/s) with the permeability of the geotextile after the appropriate reduction factors are applied to the laboratory permeability of the geotextile.

Minimum Laboratory Permeability Specified (k_{ult}) = 0.2 cm/s

To determine the allowable permeability (k_{allow}) of the geotextile, the following reduction factors are used:

Table 2 - Reduction Factors[1]

RF_{SCB} = Reduction factor for soil clogging and blinding	2.0
RF_{CR} = Reduction factor for creep reduction of void space	2.0
RF_{IN} = Reduction factor for adjacent materials intruding into void spaces	1.2
RF_{CC} = Reduction factor for chemical clogging	1.5
RF_{BC} = Reduction factor for biological clogging	2.0
Overall Reduction Factor (ORF) =	14.4

[1] Reduction factors obtained from Ref. 4.

$$k_{allow} = k_{ult} / ORF = (0.2 \text{ cm/s}) / 14.4$$

$$\boxed{k_{allow} = 1.4\text{E-02} \text{ cm/s}}$$

$k_{allow} >> k_{leachate\ collection/protective\ cover}$ ($1.0\text{x}10^{-3}$ cm/s).

Specification: Geotextile component permeability shall be equal to or greater than 0.2 cm/s as determined by ASTM D 4491.

Clogging:

For geotextile filters where retention is important, use smallest O_{95} that meets the geotextile permeability requirement.

Survivability:

Based on Table 4, provided on page L-5-10, Class 2 geotextile was selected based on the subgrade condition and type of equipment that would be used to at the site. Assuming Class 2 geotextile, Table 1, "Geotextile Strength Property Requirements", provided on page L-5-11, was used to obtain the physical properites required.

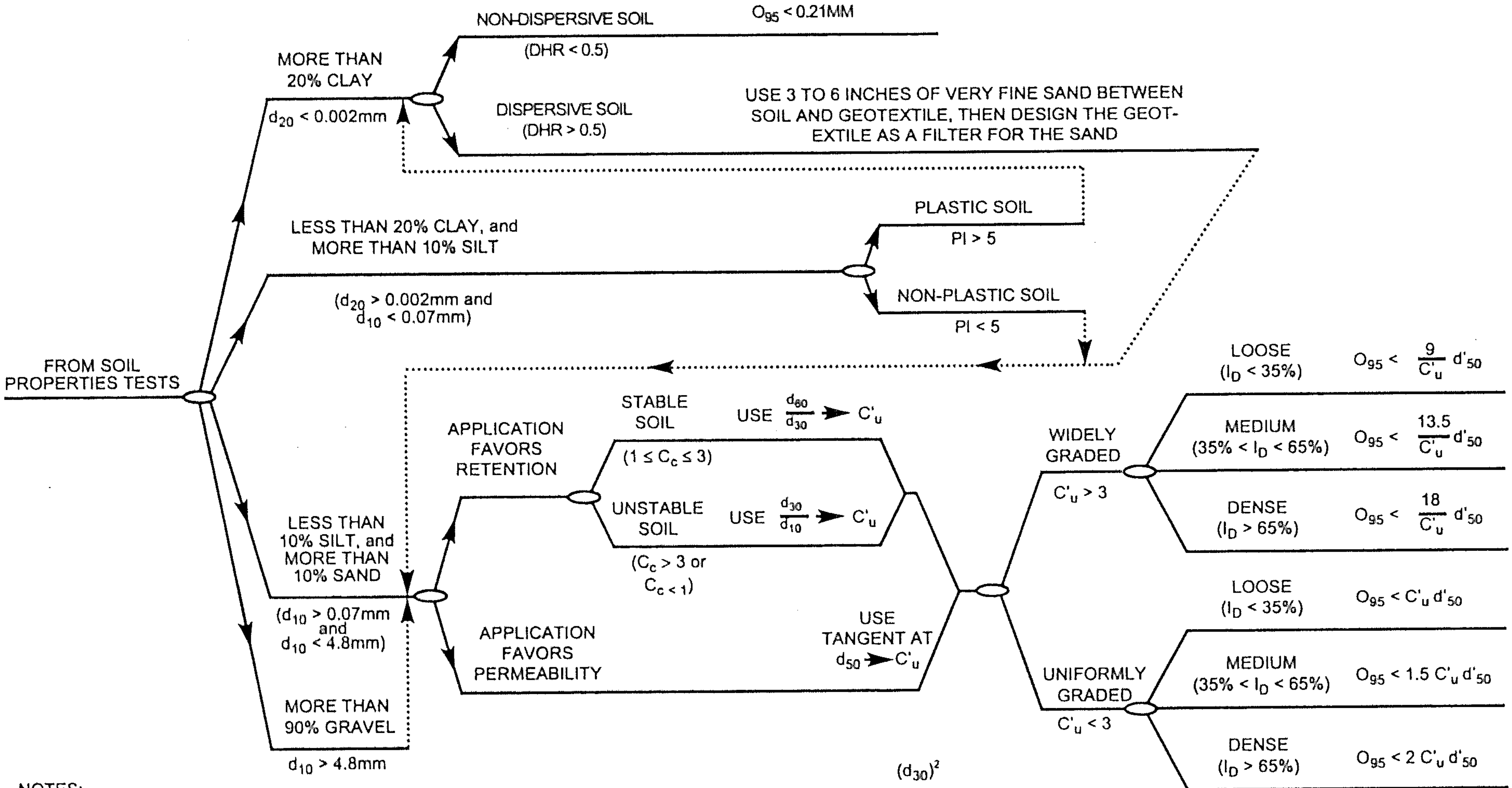
Durability:

Chemical compatibility with leachate will be considered during the selection process for the specific geotextile.

Summary of required properties for geotextile (underlying the leachate collection/protective cover layer).

Apparent opening size	$<$	0.4755	mm
Grab tensile strength	$>$	157	lb
Sewn seam strength	$>$	142	lb
Puncture strength	$>$	309	lb
Tear strenght	$>$	56	lb
Permeability	$>=$	0.20	cm/s

Chart 1. Soil Retention Criteria of Steady-State Flow Conditions



NOTES:

d_x = particle diameter of which size *x* percent is smaller

$C'_u = \sqrt{\frac{d'_{100}}{d'_0}}$ where: d'_{100} and d'_0 are the extremeties of a straight line drawn through the particle-size distribution, as directed above and d'_{50} is the midpoint of this line

$$C_c = \frac{(d_{30})^2}{d_{60} \times d_{10}}$$

I_D = relative density of the soil
PI = plasticity index of the soil
DHR = double-hydrometer ratio of the soil
O_{95} = geotextile opening size

Table 1. Typical Hydraulic Gradients[a]

Drainage Applications	Typical Hydraulic Gradient
Channel Lining	1.0
Standard Dewatering Trench	1.0
Vertical Wall Drain	1.5
Pavement Edge Drain	1.0
Landfill LCDRS	1.5
Landfill LCRS	1.5
Landfill SWCRS	1.5
Shoreline Protection	
Current Exposure	1.0[b]
Wave Exposure	10[b]
Dams	10[b]
Liquid Impoundments	10[b]

[a] *Table developed after Giroud, 1988.*
[b] *Critical applications may require designing with higher gradients than those given.*

Table 4 – Required Degree of Survivability as a Function of Subgrade Conditions, Construction Equipment, and Lift Thickness (Class 1, 2, and 3 properties are given in Table 1; Class 1 + properties are higher than Class 1, but not defined at this time and if used must be specified by the purchaser)[a]

	Low-ground pressure equipment ≤ 25 kPa (3.6 psi)	Medium ground-pressure equipment > 25 to ≤ 50 kPa (>3.6 to ≤ 7.3 psi)	High ground-pressure equipment > 50 kPa (> 7.3 psi)
Subgrade has been cleared of all obstacles except grass, weeds, leaves, and fine wood debris. Surface is smooth and level so that any shallow depressions and humps do not exceed 450 mm (18 in.) in depth or height. All larger depressions are filled. Alternatively, a smooth working table may be placed.	Low (Class 3)	Moderate (Class 2)	High (Class 1)
Subgrade has been cleared of obstacles larger than small to moderate-sized tree limbs and rocks. Tree trunks and stumps should be removed or covered with a partial working table. Depressions and humps should not exceed 450 mm (18 in.) in depth or height. Larger depressions should be filled.	Moderate (Class 2)	High (Class 1)	Very high (Class 1+)
Minimal site preparation is required. Trees may be felled, delimbed, and left in place. Stumps should be cut to project not more than ± 150 mm (± 6 in.) above subgrade. Geotextile may be draped directly over the tree trunks, stumps, large depressions and humps, holes, stream channels, and large boulders. Items should be removed only I f placing the geotextile and cover material over them will distort the finished road surface.	High (Class 1)	Very high (Class 1+)	Not recommended

[a] Recommendations are for 150 to 300 mm (6 to 12 in.) initial lift thickness. For other initial lift thicknesses:

300 to 450 (12 to 18 in.): reduce survivability requirement by one level;

450 to 600 mm (18 to 24 in.): reduce survivability requirement two levels;

> 600 mm ((24 in.): reduce survivability requirement three levels

For special construction techniques such as prerutting, increase the geotextile survivability requirement one level. Placement of excessive initial cover material thickness may cause bearing failure of the soft subgrade.

Stabilization Requirements:

8.3.5 *Description* – This specification is applicable to the use of a geotextile in wet, saturated conditions to provide the coincident functions of separation and filtration. In some installations, the geotextile can also provide the function of reinforcement. Stabilization is applicable to pavement structures constructed over soils with a California Bearing Ratio between one and three (1<CBR<3) (shear strength between approximately 30 kPa and 90 kPa).

Table 1 – Geotextile Strength Property Requirements

	Test Methods	Units	Geotextile Class[a,b]					
			Class 1		Class 2		Class 3	
			Elongation < 50%[c]	Elongation ≥ 50%[c]	Elongation < 50%[c]	Elongation ≥ 50%[c]	Elongation < 50%[c]	Elongation ≥ 50%[c]
Grab strength	ASTM D 4632	N	1400	900	1100	700	800	500
Sewn seam strength[d]	ASTM D 4632	N	1260	810	990	630	720	450
Tear strength	ASTM D 4533	N	500	350	400[e]	250	300	180
Puncture strength	ASTM D 6241	N	2750	1925	2200	1375	1650	990
Permittivity	ASTM D 4491	sec^{-1}	Minimum property values for permittivity, AOS, and UV stability are based on geotextile application. Refer to Table 2 subsurface drainage, Table 3 and Table 4 for separation, Table 5 for stabilization, and Table 6 for permanent erosion control.					
Apparent opening size	ASTM D 4751	mm						
Ultraviolet stability (retained strength)	ASTM D 4355	%						

[a] Required geotextile class is designated in Tables 2, 3, 4, 5, or 6 for the indicated application. The severity of installation conditions for the application generally dictate the required geotextile class. Class 1 is specified for more severe or harsh installation conditions where there is a greater potential for geotextile damage, and Classes 2 and 3 are specified for less severe conditions.

[b] All numeric values represent MARV in the weaker principal direction. (See Section 8.1.2)

[c] As measured in accordance with ASTM D 4632.

[d] When sewn seams are required. Refer to Appendix for overlap seam requirements.

[e] The required MARV tear strength for woven monofilament geotextiles is 250 N.

8.2 *Subsurface Drainage Requirements:*

8.2.1 *Description* – This specification is applicable to placing a geotextile against a soil to allow for long-term passage of water into a subsurface drain system retaining the *in situ* soil. The primary function of the geotextile in subsurface drainage applications is filtration. Geotextile filtration properties are a function of the *in situ* soil gradation, plasticity, and hydraulic conditions.

APPENDIX L-6

ODEQ LEACHATE RECIRCULATION GUIDANCE

DEQ Guidance on Leachate Recirculation

Regulatory Reference: OAC 252:515-13-53

Applicability. MSWLFs where leachate is intended to be recirculated.

Purpose. To identify the minimum requirements for plans to recirculate landfill leachate over areas with a composite liner and leachate collection system.

Technical Discussion. As a minimum, a leachate recirculation plans must include the following components.

Location where leachate will be recirculated
Leachate may be recirculated only over areas of the landfill with a composite liner and leachate collection system. If recirculation will take place near the interface between a composite-lined cell and a clay-lined cell, a barrier must be constructed at the interface to prevent leachate from filtering into the clay-lined area.

The plan must include a map of the landfill showing locations where recirculation is proposed and design criteria for the interface, if one is required.

Leachate collection system design
The plan must include supporting assumptions, drawings, and calculations to demonstrate the leachate collection system will be able to handle the additional volume of liquid and still maintain no more than one-foot of head above the liner.[1]

In developing recirculation plans, DEQ believes the following, at a minimum, should be thoroughly considered and discussed:

- specific design of the drainage layer;[2]
- the potential for plugging of the drainage layer;
- the potential for chemical reaction of the leachate with the drainage layer material;
- long-term permeability of the drainage layer; and
- a method to verify excessive head is not collecting above the liner.

Routine testing program
The recirculation plan must include a routine testing program to monitor changes to leachate composition. A testing program must be established prior to beginning recirculation and submitted as part of the recirculation plan. As a minimum, leachate must be tested for the constituents identified in OAC 252:515-9-31(d)(1)(A) and (B). The plan must also include a sampling protocol that addresses the method and number of samples necessary to ensure a representative sample of the leachate volume is collected.

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[1] Considerations may include HELP model output, pipe slopes and diameter, drainage layer permeability, etc.
[2] For instance, some materials, such as geotextile, may be incompatible with recirculation due to plugging problems.

Sampling must initially be performed quarterly and sample results submitted to the DEQ. After four quarterly samples have been collected, the DEQ may consider requests to reduce sampling frequency.

Standards for leachate recirculation
Application rates must take into consideration the hydraulic conductivity of the waste and any cover present, waste compaction, surface grade, time of year, and weather conditions. Using these considerations, the recirculation plan must include a comprehensive discussion of how the following will be met.

- During leachate application, exposure to landfill employees and customers must be minimized.
- Leachate must be prevented from discharging from the landfill.
- Leachate application must be at a low flow rate with uniform distribution over the proposed recirculation area.[3]
- Leachate application must not exceed holding capacity of the soils so as to cause ponding or runoff.[4]
- Leachate application must not occur during periods of high winds, freezing temperatures, or during or immediately after rainfall events.
- Adequate leachate storage must be available to store leachate when it is not being applied.[5]
- Procedures must be implemented to annually assess the performance of the leachate collection system to determine if any adverse effects from the added volume of leachate have occurred.

Recordkeeping
Owner/operators must keep records of the amount of leachate recirculated, locations of recirculation, and leachate testing results.

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[3] Acceptable application methods may include surface spraying, drip irrigation tubing, pipes within the waste mass, etc.
[4] DEQ recommends owner/operators consult with their local extension agent to assist with determining appropriate application rates.
[5] Leachate storage is subject to the requirements of OAC 252:515-13-52.

APPENDIX L-7

CONTAINMENT AND DIVERSION BERM CALCULATIONS

LICENSED PROFESSIONAL ENGINEER
Marilyn D.
Morrison
23833
OKLAHOMA

6-5-15

Includes pages L-7-1 through L-7-10

CONTENTS

CONTAINMENT AND DIVERSION BERM CALCULATIONS

A contaminated water run-off containment berm may be maintained down-slope from the active disposal area to contain any water running off or seeping out of the working face. Additional methods of containment include detention areas or operational methods (grading). Water contained is considered contaminated and will largely be absorbed into the landfill and collected by the leachate containment system. If excessive quantities of such water interfere with disposal operations, the leachate or contaminated water will be removed and handled in accordance with Section 5.

Stormwater run-on from drainage areas onto active landfill areas will be prevented by constructing a diversion berm or detention area, or by operational methods (grading). Run-off will be routed to bypass the active areas of the landfill. Containment berm calculations for run-off volumes of various working face areas are presented on pages L-7-2 through L-7-5 and L-7-7. In addition, diversion berm calculations for run-on volumes of various drainage areas are presented on pages L-7-6 and L-7-8.

A typical berm configuration at the working face is shown in Sheet L-7-9. A containment and diversion berm will be maintained and relocated as necessary to ensure that the berms are always ahead of the disposal operations and the diversion berm is advanced along the intermediate cover as it is applied. These berms will be compacted and of adequate crest width so that they are not destroyed by equipment driving over them.

REQUIRED:

1. Determine the height of the contaminated water berm required at the working face.
2. Determine the height of the diversion berm required for run-on control of the working face.

PROCEDURE: **Containment Berm Calculations**

1. Determine the 25-year, 24-hour rainfall.
2. Calculate the volume of water captured behind the containment berm for 25-year, 24-hour rainfall event.
3. Determine the height of the containment berm for a non-sloping water storage area.
4. Determine the height of the berm for a sloping water storage area.

Diversion Berm Calculations

1. Determine the 25-year frequency runoff flow rates for the diversion berm run-on drainage areas by the Rational Method.
2. Calculate the capacity of the diversion berm at various slopes and determine the required height of the diversion berm.

REFERENCES:

1. U.S. Weather Bureau, "Technical Paper No. 40," 1963.
2. State of Oklahoma Department of Transportation, Drainage Design Manual, Revised: Feb. 1988.
3. Dodson and Associates, Inc., *ProHec-1 Program Documentation*, 1993.

SOLUTION: **Containment Berm Calculations**

1. Determine the 25-year, 24-hour rainfall.

Based on Reference 3, the 25-year, 24-hour rainfall depth for Oklahoma County is:

$R \approx$ 6.8 in (see page L-7-10)

2. Calculate the volume of water captured behind the containment berm for 25-year, 24-hour rainfall event.

$$V_R = CAR$$

Where:

V_R = Storage volume, cf			
C = Runoff coefficient	=	0.5	
A = Drainage area	=	varies	ac
R = 25-year, 24-hour rainfall depth	=	6.8	in

The storage volume required for varying drainage areas are shown on the attached table.

3. Determine the height of the containment berm for a non-sloping water storage area.

$$H = \frac{V_R}{A_{stor}}$$

Where: A_{stor} = Storage area (sf)

Example Calculation:

Variables:	S_o =	0.00	%	R =	6.8	in
	A_{stor} =	0.25	ac	C =	0.5	
	A =	0.50	ac	W =	100	ft
Volume:	V_R =	6,171	cf			
Height:	H =	0.6	ft			

Values for height of the containment berm (H) are listed on Sheet L-7-9 for several storage areas.

4. Determine the height of the berm for a sloping water storage area.

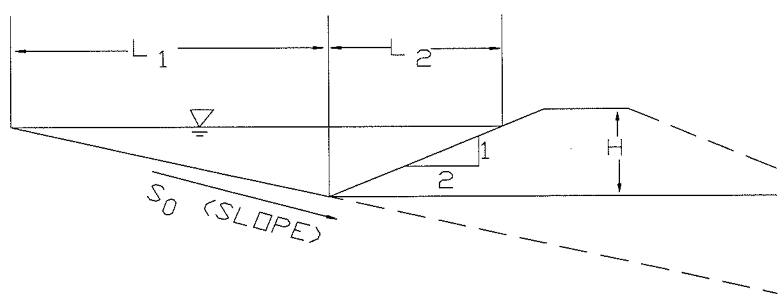
The volume contained by the berm is equal to the cross-sectional storage area multiplied by the width of the berm. The computed volume must be greater than the volume found in Step 3.

$$V_C = A_s W$$

Where: A_s = Cross-sectional storage area (sf)
W = Width (ft)

The minimum width of the downstream berm is 100 feet.

Figure 1. Cross Section of Berm and Storage Area



$$A_s = \frac{(L_1 + L_2)H}{2}$$

Where: $L_1 = \dfrac{H}{S_o}$ (ft)

$L_2 = 2H$ (ft)
S_o = Slope of active cell (ft/ft)

Example calculations:

1% sloping area

Variables:						
	S_o =	1.00	%	R =	6.8	in
	A_{stor} =	0.25	ac	C =	0.5	
	A =	0.50	ac	W =	100	ft

Height: An iterative process is used to determine the height of the berm required to meet the storage volume requirement for a non-sloping storage area.

H = 1.1 ft

Check to ensure that the above berm height is adequate:

L_1 =	110.00	ft
L_2 =	2.20	ft
A_s =	61.71	sf
V_C =	6,171	cf

V_C is larger than V_R; berm has adequate height. See Sheet L-7-7 and Sheet L-7-9 for summary.

2% sloping area

Variables:						
	S_o =	2.00	%	R =	6.8	in
	A_{stor} =	0.25	ac	C =	0.5	
	A =	0.50	ac	W =	100	ft

Height: An iterative process is used to determine the height of the berm required to meet the storage volume requirement for a non-sloping storage area.

H = 1.6 ft

Check to ensure that the above berm height is adequate:

L_1 =	80.00	ft
L_2 =	3.20	ft
A_s =	66.56	sf
V_C =	6,656	cf

V_C is larger than V_R; berm has adequate height. See Sheet L-7-7 and Sheet L-7-9 for summary.

Diversion Berm Calculations

1. Determine the 25-year frequency runoff flow rates for the diversion berm run-on drainage areas by the Rational Method.

From Reference 2 for Oklahoma County:

$Q = C\,I\,A$

C =	0.5	(intermediate cover)
I =	7.23	intensity, in/hr (see calculation below)
A =	varies	drainage area, ac

$$I = \frac{b}{(t_c + d)^e}$$

b =	95
d =	15
e =	0.8

t_c is assumed to be 10 min. for all cases

I = 7.23 in/hr

<u>Diversion Berm Flow Rate Summary</u>

Area (ac)	Flow Rate (cfs)
0.5	1.8
1	3.6
1.5	5.4
2	7.2
2.5	9.0
3	10.9

2. Calculate the capacity of the diversion berm at various slopes and determine the required height of the diversion berm.

- As shown on Sheet L-7-9, several swales were analyzed to determine the adequacy of the swale configuration.
- Hydraulic calculations are summarized on page L-7-8.

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40-08
CONTAINMENT / DIVERSION BERM CALCULATIONS

Drainage Area	Storage Area	Volume Required		Slope	Berm Height	Cross Sectional Area	Width	Water Surface Area	Volume Provided		L_1[1]	L_2[1]
(ac)	(ac)	(cf)		(%)	(ft)	(sf)	(ft)	(ac)	(cf)		(ft)	(ft)
				0	0.6							
0.5	0.25	6,171		1	1.1	61.71	100	0.258	6,171		110.0	2.2
				2	1.6	66.56	100	0.191	6,656		80.0	3.2
				0	0.6							
1.0	0.50	12,342		1	1.6	130.56	100	0.375	13,056		160.0	3.2
				2	2.2	125.84	100	0.263	12,584		110.0	4.4
				0	0.6							
2.0	1.00	24,684		1	2.2	246.84	100	0.515	24,684		220.0	4.4
				2	3.1	249.86	100	0.370	24,986		155.0	6.2
				0	0.6							
4.0	2.00	49,368		1	3.2	522.24	100	0.749	52,224		320.0	6.4
				2	4.4	503.36	100	0.525	50,336		220.0	8.8

[1] L_1 and L_2 are shown on Sheet L-7-4.

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40-08
CONTAINMENT / DIVERSION BERM CALCULATIONS

For 20H:1V Diversion Berm Area Slope

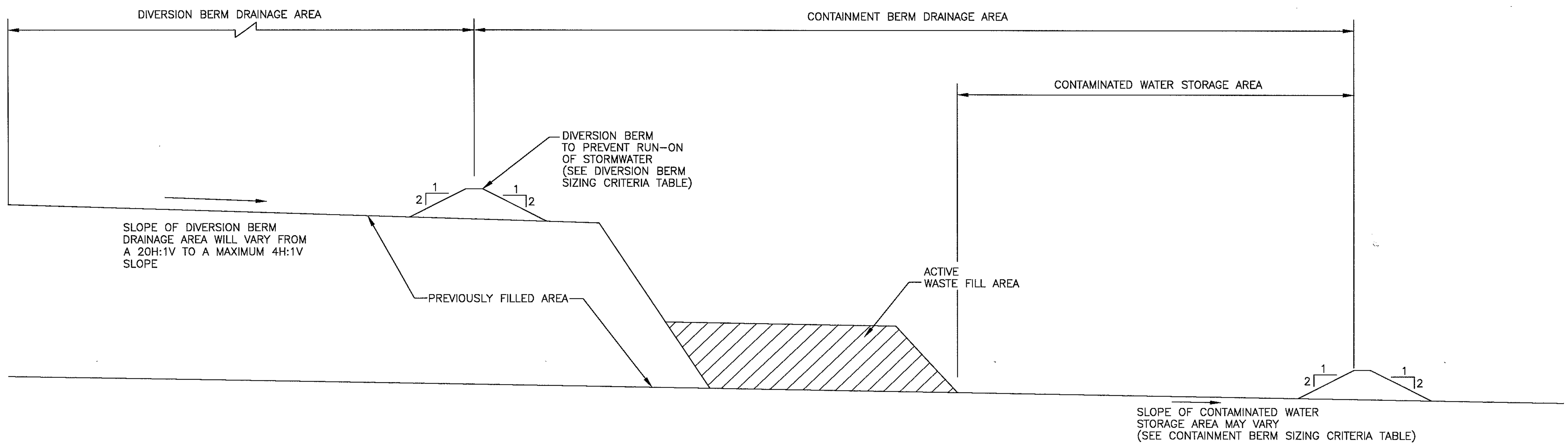
Drainage Area	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)
0.5	1.8	0.02	0.03	2	20	0	0.29	1.94	0.895	0.06	0.35	0.93
1	3.6	0.02	0.03	2	20	0	0.38	2.30	0.933	0.08	0.46	1.57
1.5	5.4	0.02	0.03	2	20	0	0.44	2.54	0.957	0.10	0.54	2.12
2	7.2	0.02	0.03	2	20	0	0.49	2.73	0.973	0.12	0.61	2.64
2.5	9.0	0.02	0.03	2	20	0	0.53	2.89	0.986	0.13	0.66	3.12
3	10.9	0.02	0.03	2	20	0	0.57	3.03	0.998	0.14	0.71	3.60

Note: Calculations were performed using the HYDROCALC Hydraulics for Windows developed by Dodson and Associates (Version 1.2a, 1996).

For 4H:1V Diversion Berm Area Slope

Drainage Area	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sf)
0.5	1.8	0.02	0.03	2	4	0	0.48	2.61	0.940	0.11	0.59	0.69
1	3.6	0.02	0.03	2	4	0	0.62	3.10	0.980	0.15	0.77	1.16
1.5	5.4	0.02	0.03	2	4	0	0.72	3.43	1.005	0.18	0.91	1.57
2	7.2	0.02	0.03	2	4	0	0.81	3.67	1.018	0.21	1.02	1.96
2.5	9.0	0.02	0.03	2	4	0	0.88	3.89	1.033	0.23	1.11	2.32
3	10.9	0.02	0.03	2	4	0	0.94	4.09	1.051	0.26	1.20	2.66

Note: Calculations were performed using the HYDROCALC Hydraulics for Windows developed by Dodson and Associates (Version 1.2a, 1996).



CONTAINMENT BERM SIZING CRITERIA *

CONTAINMENT BERM DRAINAGE AREA (ACRES)	CONTAMINATED WATER STORAGE AREA (ACRES)	FLOOR SLOPE OF CONTAMINATED WATER STORAGE AREA	REQUIRED MINIMUM HEIGHT OF CONTAINMENT BERM (FT)
0.5	0.25	0 % 1 % 2 %	0.6 1.1 1.6
1.0	0.5	0 % 1 % 2 %	0.6 1.6 2.2
2.0	1.0	0 % 1 % 2 %	0.6 2.2 3.1
3.0	1.5	0 % 1 % 2 %	0.6 3.2 4.4

* CONTAINMENT BERM WILL BE SIZED USING THE ABOVE TABLE AS A GUIDELINE TO CONTAIN STORMWATER FROM THE 25 YEAR, 24 HOUR STORM EVENT. SUPPORTING CALCULATIONS ARE INCLUDED ON PAGES L-7-2 THROUGH L-7-5. NOTE THAT THE CRITERIA SET FORTH IN THE ABOVE TABLE IS BASED ON A MINIMUM DOWNSLOPE CONTAINMENT BERM LENGTH OF 100 FEET.

DIVERSION BERM SIZING CRITERIA *

DIVERSION BERM DRAINAGE AREA (ACRES)	MINIMUM 5%			MAXIMUM 25%		
	FLOW RATE (CFS)	FLOW DEPTH (FT)	REQUIRED MINIMUM DIVERSION BERM HEIGHT (FT)	FLOW RATE (CFS)	FLOW DEPTH (FT)	REQUIRED MINIMUM DIVERSION BERM HEIGHT (FT)
0.5	1.8	0.29	1.29	1.8	0.48	1.48
1	3.6	0.38	1.38	3.6	0.62	1.62
1.5	5.4	0.44	1.44	5.4	0.72	1.72
2	7.2	0.49	1.49	7.2	0.81	1.81
2.5	9.0	0.53	1.53	9.0	0.88	1.88
3	10.9	0.57	1.57	10.9	0.94	1.94

* DIVERSION BERM WILL BE SIZED USING THE ABOVE TABLE AS A GUIDELINE TO CONTAIN STORMWATER FROM THE 25 YEAR. SUPPORTING CALCULATIONS ARE INCLUDED ON PAGE L-7-6.

LICENSED PROFESSIONAL ENGINEER
Marilyn D. Morrison
23833
OKLAHOMA
6-5-15

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 06/2015
FILE: 0086-356-11
CAD: FIG L-7-9 LEACH DTLS.DWG

DRAWN BY: SRF
DESIGN BY: MDM
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
CA 3804 PE - 06/30/2015

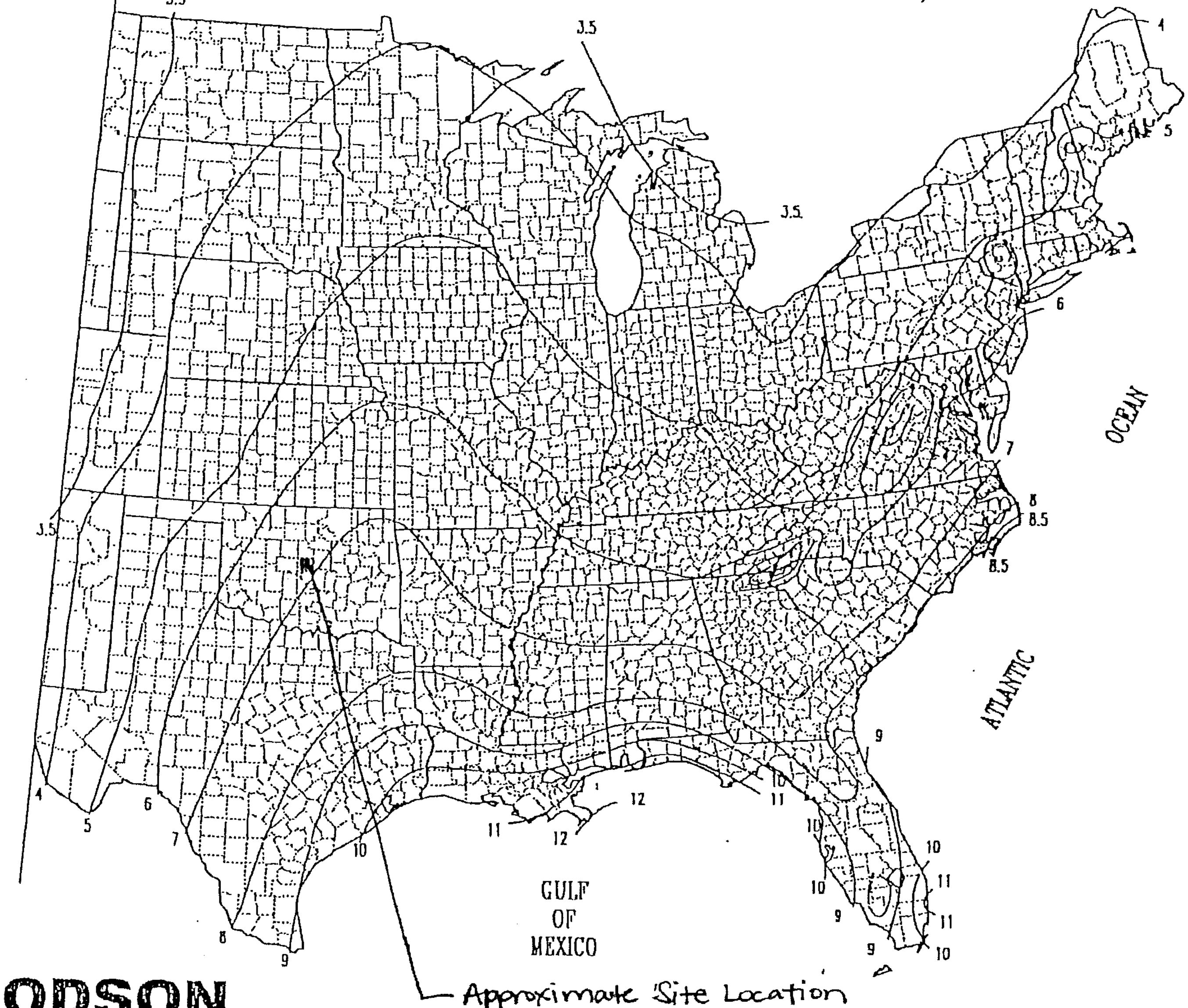
TIER III PERMIT MODIFICATION CONTAINMENT AND DIVERSION BERM PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM

FIGURE L-7-9

25-YEAR 24-HOUR RAINFALL (INCHES)



DODSON
& ASSOCIATES, INC.
Hydrologists and Civil Engineers

APPENDIX L-8

Industrial Permit No. 2865

The City of
OKLAHOMA CITY
DEPARTMENT OF WATER & WASTEWATER UTILITIES

December 15, 2015

Dear Permit Holder,

As you are aware your Industrial Waste Discharge Permit expires December 31, 2015. We greatly appreciate your time and effort in completing your renewal application.

Presently the City of Oklahoma City is in the process of developing new local discharge limits for commercial facilities that discharge to the City of Oklahoma City sanitary sewer system. This Oklahoma Department of Environmental Quality required procedure occurs every 5 years. The process ensures that each wastewater treatment plant can treat the wastewater it receives. Once the analytical part of the process is completed these local discharge limits must be approved by the Oklahoma Department of Environmental Quality and the City of Oklahoma City Council.

The development of the new local limits has taken longer than anticipated so permit reissuance is not anticipated until early 2016. Your present permit remains in effect until you receive the new permit. Thank you for your patience regarding this matter.

Sincerely,

Perry Soltani, P.E., Superintendent
Wastewater Quality Division

pc:

Marsha Slaughter, Utilities Director
Laura Yates, Assistant Municipal Counselor
Ken Meadows, Pretreatment Supervisor,
Jerry Gates, Pretreatment Coordinator
Roshini Nambiar, ODEQ Pretreatment Coordinator

Wastewater Quality Division, 420 W. Main, Suite 500,
Oklahoma City, OK 73102• 405/297-3810 • FAX 405/297-1616

The City of
OKLAHOMA CITY
Utilities Department

CERTIFIED MAIL

May 18, 2011

RE: Issuance of your Industrial User Permit

Dear Permittee:

We wish to inform you that your Industrial User Permit is issued in accordance with the previsions of the Industrial Pretreatment Ordinance, which is codified as Chapter 47 of the Oklahoma City Code. Your Industrial User Permit includes all conditions required by the Industrial Pretreatment Ordinance.

The enclosed Industrial User Permit covers the wastewater discharge from your facility into the City sanitary sewer system. All discharges from this facility, actions, and reports relating thereto shall be in accordance with the terms and conditions of this permit. Non-compliance with any term or condition of this permit shall constitute a violation of The City of Oklahoma City Pretreatment Ordinance. Compliance with this permit does not relieve the Permittee of its obligations to comply with any or all applicable pretreatment regulations, standards, or requirements under local, state, and federal laws, including any such regulations, standards, requirements, or laws that may become effective during the term of this permit. Part 2 of the Permit contains your **Monitoring Requirements** and Part 3 contains your **Reporting Requirements**.

This Permit, dated January 1, 2011, shall expire on December 31, 2015. If the Permittee wishes to continue to discharge after the expiration date of this permit, a request must be submitted for a permit renewal in accordance with the requirements of the Oklahoma City Code, Chapter 47, Section 47-307, a minimum of 30 days prior to the expiration date. The annual fee for your Industrial Discharge Permit will be billed on your water account. The attached permit becomes effective May 1, 2011.

Please note that the permit includes new EPA regulations referred to as streamlining. New Local Discharge Limits are also included. These changes are delineated in bold print.

If you wish to appeal or challenge any conditions imposed in this permit, a petition shall be filed for modification or reissuance of this permit in accordance with the requirements of the Oklahoma City Code, Chapter 47, Section 47-303, within 30 days of your receipt of this correspondence. Pursuant to this Code, Section 47-303(1) states failure to petition for reconsideration of the permit within the allotted time is deemed a waiver by the Permittee of his right to challenge the terms of this permit.

If you need information regarding conditions of the permit, please contact the Oklahoma City Pretreatment Section at (405) 297-3805.

Sincerely,

Perry Soltani, P.E., Superintendent
Wastewater Quality Division

Enclosure: Industrial User Discharge Permit

pc: Marsha Slaughter, Utilities Director
Craig Keith, Assistant Municipal Counselor

Wastewater Quality Division, 420 West Main, Suite 500
Oklahoma City, OK 73102 • 405/297-3810 • FAX 405/297-1616

The City of
OKLAHOMA CITY
Department of Water & Wastewater Utilities

PERMIT No.: 2865

INDUSTRIAL WASTEWATER DISCHARGE PERMIT
INDUSTRIAL USER

In accordance with Chapter 47, of the Oklahoma City Code, establishing industrial pretreatment and sewer user requirements as required by City, State, and Federal Statutes and Regulations, an Industrial Wastewater Discharge Permit is Hereby Granted To:

PERMITTEE: EAST OAK RECYCLING AND DISPOSAL FACILITY

ADDRESS: 3201 Mosley Road

Oklahoma City, OK 73121 SIC Code: 4953

This permit authorizes EAST OAK RECYCLING AND DISPOSAL FACILITY to discharge industrial wastewater with constituents whose concentrations are regulated by the Oklahoma City Code, Chapter 47, to the Oklahoma City sanitary sewerage collection and treatment system in a manner that complies with all applicable provision of City, State, and Federal laws regulating discharge limits on industrial wastewater. The Permittee shall pay all applicable fees and charges when billed by the City.

This permit is granted in accordance with the application filed on December 31st, 2009, in the office of the Director of Water & Wastewater Utilities, 420 West Main, Suite 500, and in conformity with plans, specifications and other data submitted to the City of Oklahoma City in support of the above application, all of which are filed with and considered as part of this permit, together with the attached conditions and requirements. Permit was modified on June 25, 2008

Effective this 1st day of January, 2011

To Expire this 31st day of December, 2015

Permitting Authority

CITY OF OKLAHOMA CITY WATER & WASTEWATER UTILITIES DEPARTMENT

Name:

Title: Utilities Director

TABLE OF CONTENTS

PART 1 - EFFLUENT LIMITATIONS

During the effective period of this Permit, the Permittee is authorized to discharge process wastewater, which shall be regulated by Chapter 47 of the Oklahoma City Code, to the POTW from the Outfall(s) listed below.

A. DESCRIPTION OF OUTFALLS:

OUTFALL	DESCRIPTIONS
001	Outfall 001 shall consist of leachate from a non-hazardous solid waste landfill facility.

B. PERMITTEE'S DISCHARGE LIMITS

1. Oklahoma City Local Limits shall be applied at Outfall 001, a point prior to mixing with waste from any other facility and prior entering the POTW. During the effective period of this Permit, the discharge from Outfall 001 shall not exceed the following effluent limitations:

PARAMETER	PEAK DAY MAXIMUM (mg/l)	MONTHLY AVERAGE (mg/l)
Arsenic (T)	0.70	0.35
Cadmium (T)	0.14	0.07
Chromium (T)	3.90	1.95
Copper (T)	**3.04**	**1.52**
Cyanide (T)	0.42	0.21
Lead (T)	**1.80**	**0.90**
Mercury (T)	**0.03**	**0.015**
Molybdenum (T)	1.58	0.79
Nickel (T)	7.96	3.98
Selenium (T)	**0.10**	**0.05**
Silver (T)	**1.46**	**0.73**
Zinc (T)	4.34	2.17
BOD	*	*
Suspended Solids	*	*
Non-polar or Saturated Based Oil & Grease	100	100
Polar or Non-saturated Based Oil & Grease	200	200
Flow	To Be Reported	---

*The Director shall set limits for Biochemical Oxygen Demand (BOD) and Suspended Solids (TSS). At the present, a BOD and TSS limit has not been set, however, there is a surcharge for BOD above 250 mg/L and TSS above 300 mg/L. See Item 2 on Page 22 for details.

2. Prohibited Discharges

(a) No industrial user shall introduce or cause to be introduced into the POTW any pollutant or wastewater which causes pass-through or interference. Furthermore, no industrial user may contribute the following substances to the POTW:

1. Pollutants which create a fire or explosive hazard in the municipal wastewater collection system and POTW, including, but not limited to, waste streams with a closed-cup flashpoint of less than 140°F (60°C) using the test methods specified in 40 CFR 261.21, as amended.

2. Any wastewater having a pH less than 5.0 or more than 10.5, or otherwise causing corrosive structural damage to the POTW or equipment, or endangering City personnel.

3. Solid or viscous substances in amounts which will cause obstruction of the flow in the POTW resulting in interference, but in no case solids greater than one-half (½) inch in any dimension.

4. Any wastewater containing pollutants, including oxygen demanding pollutants (BOD, etc.), release in a discharge at a flow rate and/or pollutant concentration which, either singly or by interaction with other pollutants, will cause interference with either the POTW; or any wastewater treatment or sludge process, or which will constitute a hazard to humans or animals.

5. Any wastewater having a temperature greater than 104°F (40°C), or which will inhibit biological activity in the treatment plant resulting in interference, but in no case wastewater which causes the temperature at the introduction into the treatment plant to exceed 104°F (40°C).

6. Any discharge of nonpolar or saturated oil, nonbiodegradable cutting oil, or products of mineral oil origin which is greater than 100 mg/l or in amounts that will cause interference or pass through.

7. Any pollutants which result in the presence of toxic gases, vapors or fumes within the POTW in a quantity that may cause acute worker health and safety problems.

8. Any trucked or hauled pollutants, except as discharge points designated by The City in accordance with 40 CFR 403.5(b)(8).

9. Any wastewater containing toxic pollutant in sufficient quantity, either singly or by interaction with other substances, to injure or interfere with any wastewater treatment process, constitute a hazard to humans or animals, create a toxic effect in the receiving water of the municipal wastewater collection and/or treatment system.

10. Any noxious or malodorous liquids, gases, solids or other wastewater which, either singly or by interaction with other wastes, are sufficient to create a public nuisances, a hazard to life, or to prevent entry into the sewers for maintenance and repair.

11. Any wastewater which imparts color which cannot be removed by the treatment process such as, but no limited to, dye wastes and vegetable tanning solutions.

12. Any wastewater containing any radioactive wastes or isotopes except as specifically approved by the Director, in compliance with applicable state or federal regulations.

13. Stormwater, surface water, groundwater, artesian well water, roof runoff, subsurface drainage, condensate, deionized water, noncontact cooling water, and unpolluted industrial wastewater, unless specifically authorized by the Director.

14. Any sludges, screenings, or other residues from the pretreatment of industrial wastes.

15. Any medical wastes, except as specifically authorized by the Director in a wastewater discharge Permit.

16. Any wastewater causing the treatment plant's effluent to fail a toxicity test.

17. Any wastes containing detergents, surface active agents, or other substance which may cause excessive foaming in the POTW.

18. Any discharge of polar or nonsaturated fats, oils or greases which is greater than 200 mg/l or in amounts that will cause interference or obstruction of the POTW.

19. Any substance which causes a hazard to human life or creates a public nuisance.

20. Any garbage from categorical or non-categorical users that has not been properly shredded. The installation and operation of any garbage grinder or garbage disposal equipped with a motor of three-fourths horsepower or grater shall be subject to review and approval of the Director.

(b) At no time shall any two readings on an explosion hazard meter at any point of discharge into the POTW, or at any point in the POTW, be more than five percent nor any single reading over ten percent of the lower explosive limit (LEL) of the meter.

(c) When the Director determines that a user is contributing to the municipal wastewater collection and treatment system any of the above enumerated substances in such amounts as to interfere with the operation of the municipal wastewater collection and treatment system, the Director shall:

(1) Advise the user of the impact of the contribution on the municipal wastewater collection and treatment system; and

(2) Inform said user has two days to correct the interference with the municipal wastewater collection and treatment system.

(d) Wastes prohibited by Chapter 47, Section 47-211 shall not be processed or stored in such a manner that the wastes could be discharged to the POTW. All floor drains located in process or materials storage areas must discharge to the industrial user's pretreatment facility before connecting with the POTW or have spill control measures approved by the Director installed and operational.

(e) All discharges shall comply with all other applicable laws, regulations, standard, and requirements contained in Chapter 47 of the Oklahoma City Code and any applicable state and federal pretreatment laws, regulations, standards or requirements that may become effective during the term of this Permit.

C. DILUTION

No industrial user shall ever increase the use of process water, or in any way attempt to dilute a discharge, as a partial or complete substitute for adequate treatment to achieve compliance with a discharge limitation unless expressly authorized by an applicable pretreatment standard or requirement. The Director may impose mass limitations on industrial users which are using dilution to meet applicable pretreatment standards or requirements, or in other cases when the imposition of mass limitation is appropriate.

PART 2 - MONITORING REQUIREMENTS

1. The Permittee's normal workday is established as 6:00 AM - 5:30 PM, Monday – Friday and 8:00 AM - 2:00 PM Saturday. Self-Monitoring samples shall be taken at Outfall 001, described on Page 8, during a normal workday.

2. At least once every 6 months (1/6 mo), during the reporting periods of May through October and November through April, the Permittee shall analyze Outfall 001 for the following pollutants and report the average daily flow for a minimum of 4 months during each 6 months reporting period.

Pollutant	Frequency	Type
pH	1/6 mo.	Grab
Oil & Grease*	1/6 mo.	"
B.O.D.	1/6 mo.	Composite
Suspended Solids (TSS)	1/6 mo.	"
Molybdenum (T)	1/6 mo.	"
E.P.A. Priority Pollutants Listed in 40 CFR, Part 122, Appendix D, Table II & Table III.	1/6 mo.	E.P.A. Methodology Refer to 40 CFR Part 136.
Flow	Daily	N/A

*Non-polar or Saturated and Polar or Non-saturated.

3. The Permittee shall notify the Permitting Authority, in writing, at least 3 days prior to taking compliance samples. If the Permittee takes compliance samples, it shall be under the direction of a Permitting Authority approved wastewater laboratory. The Permittee's compliance samples shall be analyzed by a Permitting Authority approved wastewater laboratory. Compliance sampling and analysis shall be performed in accordance with U.S. Environmental Protection Agency Regulations.

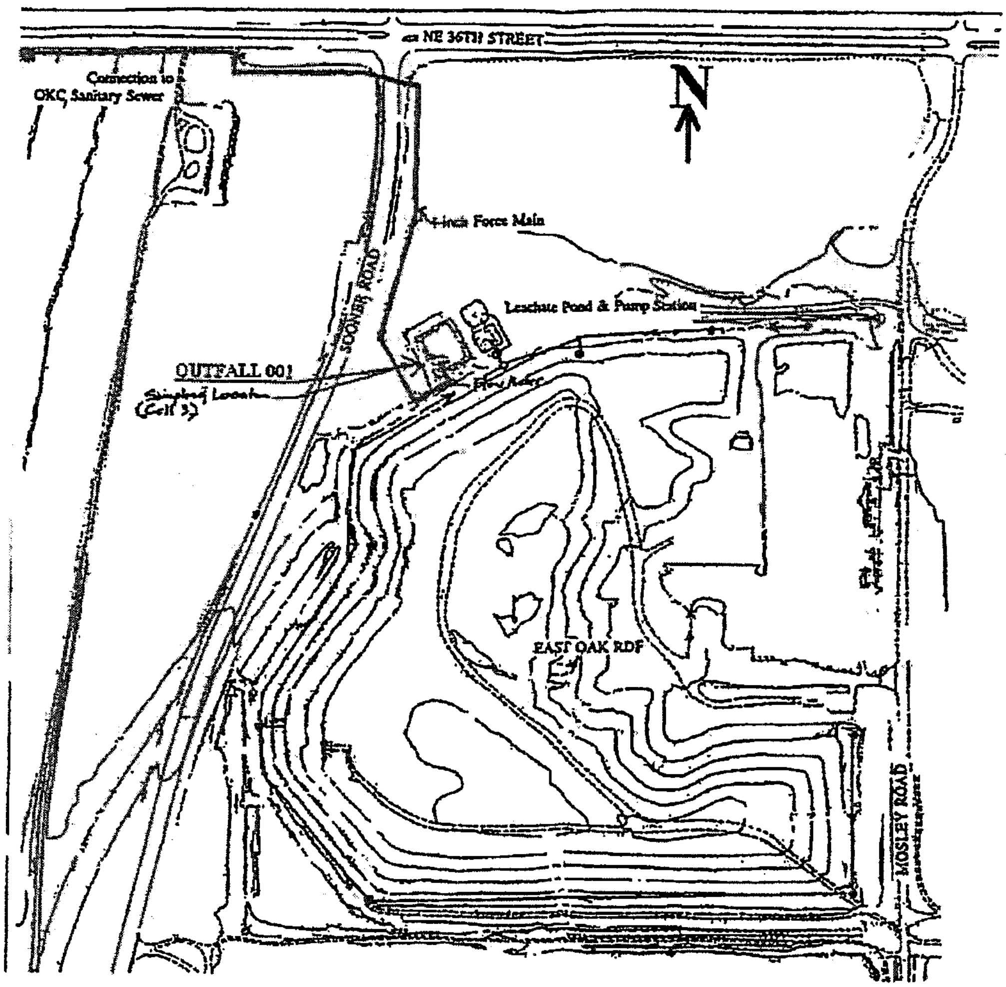
4. The Permittee's Self-Monitoring samples shall be an instantaneous grab sample. An instantaneous grab sample is used to determine compliance on batch discharges. The Permittee shall split samples when directed by the Permitting Authority.

5. The Permitting Authority's compliance samples shall an instantaneous grab sample. An instantaneous grab sample is used to determine compliance on batch discharges. The Permitting Authority shall use grab samples to determine compliance with Chapter 47 of the Oklahoma City Code.

6. The Permittee shall self-monitor for any pollutant to show compliance with Chapter 47 of the Oklahoma City Code when directed to do so by the Permitting Authority.

7. Sampling Location

Description: Outfall 001: Wastewater compliance samples shall be taken at Outfall 001 from Cell #3, the final leachate storage/treatment pond, and/or holding tanks, located northwest of the landfill just east of N. Sooner Road and south of NE 36th Street. See drawing below.



PART 3 - REPORTING REQUIREMENTS

1. A. Outfall 001 - The Permittee shall submit Self-Monitoring Reports at least twice a year (2/yr), during the months of May and November, for the pollutants listed in Part 2 on Page 7. The Permittee shall also submit the average daily flow for a minimum of 4 months during each 6 months reporting period.

2. The Permittee shall self-monitor and submit a Self-Monitoring Report for any pollutant to show compliance with Chapter 47 of the Oklahoma City Code when directed to do so by the Permitting Authority.

3. Each Self-Monitoring Report shall contain:

   A. A valid Chain-Of-Custody: The Chain-Of-Custody shall contain the facility name and address, Outfall number and description of sampling location as described on Page 8, name(s) and signature(s) of the person(s) who collected the sample and any other person(s) who handles the sample, the date(s) and time(s) of sample collection, date and time of pH analysis, type of sample, type of container used, and preservatives used.

   B. A valid Laboratory Report: The Laboratory Report shall contain the name and address of the reporting laboratory, Outfall number, sample type and pollutant (s) analyzed, name(s) of the analyst, date and time of analysis, methodology used, detection limit used, Quality Assurance/Quality Control Report, and signature of Laboratory Supervisor.

   C. A Certification Statement: All reports required under this Permit shall have the Certification Statement listed under Signatory Requirements on Page 18 of this Permit and signed by an individual who meets Signatory Requirements outlined under Signatory Requirements.

4. When the Permittee's Self-Monitoring shows a violation, the Permittee shall notify the City within 24 hours after becoming aware of the violation. Within 30 days after becoming aware of the violation, the Permittee shall resample for the pollutant in violation and report the results to the City.

5. The Permittee shall contact the City's Industrial Waste Pretreatment Section at 297-3805 regarding monitoring and reporting requirements.

PART 4 - COMPLIANCE SCHEDULE

The Permittee shall meet the following schedule in the designated time period. No later than 14 days following each completion date in the schedule and the final date of compliance, a Progress Report shall be submitted to the Permitting Authority, advising the Permitting Authority whether the increment has been completed and if not, the date on which the increment will be completed, the reason for the delay, and steps being taken to return to the schedule.

	Increments of Progress	Commencement Date	Completion Date
1.			
2.			
3.			
4.			
5.			
6.			
7.			

PART 5 - SPECIAL CONDITIONS

A - ADDITIONAL/SPECIAL MONITORING REQUIREMENTS

1. The Permittee shall comply with any additional or special monitoring required by the City and report the results to the Permitting Authority.
2. All measurements, test, and analysis of the characteristics of waters and waste to which reference is made in this Permit shall be determined in accordance with the procedures set forth in Section 47-340 and Section 47-341 and shall be determined at the control manhole provided or upon suitable samples taken at said control manhole.
3. The time of collection of Permittee's sampling shall be at the sole discretion of the City, but at least once every six months (1/6 mo.) for the purpose of determining the industrial wastewater contribution to the City's sewerage system. **All analytical results must be reported to the Permitting authority.**

B - SPECIAL AGREEMENTS

1. The City reserves the right to enter into special agreements with Industrial Users setting out special terms under which they may discharge to the City.
2. If any waters or waste are discharged, or proposed to be discharged to the public sewers that, in the judgment of the Director, may have a deleterious effect upon the wastewater works, process, equipment, or receiving waters, or otherwise create a hazard to life or constitute a health hazard or public nuisance, the Director may:
   a) Reject the waste;
   b) Require pretreatment to an acceptable condition for discharge to the public sewer;
   c) Require control over the quantities and rates of discharge; and/or
   d) Require a variance agreement to treat such waste; said agreement shall remain in effect for a period of one year and shall be renewable at the discretion of the Director.
3. If the Director permits the pretreatment or equalization of waste flows, the design and installation of the plant and equipment shall be subject to the review and approval of the Director and subject to the requirements of all applicable codes, ordinances, and laws.

C - WAIVERS AND VARIANCES

An Industrial User may submit to the Director a written request for a waiver or variance of specific pollutant limitations. All requests will be evaluated by the Director and, on a case-by-case basis, a determination will be made within sixty (60) days of receipt of the request. The Industrial User must meet any and all specific pollutant limitations unless and until the Director expressly and explicitly grants written approval and establishes a new or different specific pollutant limitation, which grant, waiver, or variance may be subject to other or additional requirements, conditions, or limitations. The Director may deny any request for a waiver in whole or in part. The issuance of a waiver is merely a revocable grant to permission and does not create any right in the Industrial User or any obligation upon the City. The determinations of the Director are not subject to appeal. The following conditions shall apply to all waivers granted:

1. Waiver of applicable Federal Categorical Pretreatment Standards or the pollutants outlined in paragraph 47-214 (a) is prohibited.
2. Capacity at the Wastewater Treatment Facility must be available for the pollutant(s).
3. The duration of the waiver will be specified and shall in no event exceed five years. Application for renewal of the waiver must be made at least 60 days before expiration.
4. Any violation of the Industrial Waste Discharge Permit or Special Use Authorization conditions may result in the immediate revocation of the waiver.
5. The waiver will be issued to a specific user for a specific operation. A waiver shall not be reassigned, transferred, or sold to a new owner, new user, different premises, or a new or changed operation without the approval of the Director.

6. Notwithstanding the language in any individual permit or any individual waiver, all permit waivers are subject to revocation or modification by the Director subsequent to any periodic review of the technically based local limits.

7. The Industrial User will bear the cost of any testing or evaluation deemed necessary by the Director in evaluating any waiver or the impact of any waiver or class of waivers upon the POTW.

D - REOPENER CLAUSE

The Director may require the user to reapply or amend its Permit under the following conditions.

1. This Permit may be reopened and modified to incorporate any new or revised requirement in a National Categorical Pretreatment Standard.

2. This Permit may be reopened and modified to incorporate any new or revised requirements resulting from the City of Oklahoma City reevaluating any local limit approved by the State or U.S. EPA.

3. This Permit may be reopened and modified to incorporate any applicable new or revised requirements developed by the City, State, or U.S. EPA.

4. This Permit may be reopened and modified to permit changes or increases in discharge, as determined by the Director.

PART 6 - STANDARD CONDITIONS

A - GENERAL CONDITIONS

1. DUTY TO COMPLY

a) It shall be unlawful for any significant industrial user to discharge wastewater into The City's POTW without first obtaining a wastewater discharge Permit from the Director. Any violation of the terms and conditions of a wastewater discharge Permit shall be deemed a violation of Chapter 47 and subjects the wastewater discharge Permittee to the fines, imprisonment and sanctions set forth herein. Obtaining a wastewater discharge Permit does not relieve a Permittee of its obligation to comply with all Federal, State and local pretreatment standards or requirements or with any other requirements of Federal, State and local law.

b) All categorical and noncategorical users who claim no process discharge, total recycling of categorical and/or non-categorical waste or the separate disposal of all categorical and/or noncategorical waste are hereby required to obtain a Permit for Potential to Discharge. Provided however, that should the Director determine that the categorical or noncategorical user is discharging categorical or noncategorical waste into the POTW then the Permit for Potential to Discharge shall be revoked and the user shall be required to obtain the appropriate Permit and meet the applicable requirements of Chapter 47.

2. DUTY TO MITIGATE

Whenever deemed necessary, the Director may require industrial users to restrict their discharge peak flow periods, designated that certain wastewater be discharged only into specific sewers, relocate and/or consolidate points of discharge, separate sewage waste streams from industrial waste streams, and other conditions as may be necessary to protect the POTW and determine the industrial user's compliance with the requirement of Chapter 47.

3. PERMIT MODIFICATION

The Director may modify the wastewater discharge Permit for good cause, including, but not limited to, the following:

a) To incorporate any new or revised federal, state or local pretreatment standards or requirements.

b) To address significant alterations or additions to the industrial user's operation, processes, or wastewater volume or character since the time of wastewater discharge Permit issuance.

c) A change in the POTW that requires either a temporary or permanent reduction or elimination of the authorized discharge.

d) Information indicating that the Permitted discharge poses a threat to The City's POTW, City personnel, or the receiving water.

e) Violation of any terms or conditions of the wastewater discharge Permit.

f) Misrepresentations or failure to fully disclose all relevant facts in the wastewater discharge Permit application or in any required reporting.

g) Revision of or a grant of variance from categorical pretreatment standards pursuant to 40 CFR 403.13 as amended.

h) To correct typographical or other errors in the wastewater discharge Permit.

i) To reflect a transfer of the facility ownership and/or operations to a new owner/operator.

The filing of a request by the Permittee for a wastewater discharge Permit modification does not stay any wastewater discharge Permit condition.

4. PERMIT REVOCATION

Wastewater discharge Permits may be revoked for the following reasons:

a) Failure to notify The City of significant changes to the wastewater character prior to discharge.

b) Failure to provide prior notification to The City of changed condition pursuant to Article VI.

c) Misrepresentation or failure to fully disclose all relevant facts in the wastewater discharge Permit application.

d) Falsifying self-monitoring equipment.

e) Tampering with monitoring equipment.

f) Refusing to allow The City timely access to the facility premises and records.

g) Failure to meet effluent limitations.

h) Failure to pay fines.

i) Failure to pay sewer charges.

j) Failure to meet compliance schedules.

k) Failure to complete a wastewater survey or the wastewater discharge Permit application.

l) Failure to provide advance notice of the transfer of a Permitted facility.

m) Violation of any pretreatment standard or requirement, or any term, of the wastewater discharge Permit or the provisions of Chapter 47.

Wastewater discharge Permits shall be voidable upon non-use, cessation of operations, or transfer of business ownership without prior approval of the Director of a Permit transfer. All wastewater discharge Permits are void upon the issuance of a new wastewater discharge Permit.

5. PERMIT TERMINATION

A. In addition to those provisions in Section 47-306 of the Oklahoma City Code, Chapter 47, any user that violates the restrictions, prohibitions, requirements, conditions, wastewater discharge Permits, or orders issued pursuant to Chapter 47 is subject to discharge termination. Additionally, any user that violates the following is subject to termination of discharge:

a) Violation of wastewater discharge Permit conditions.

b) Failure to accurately report the wastewater constituents and characteristics of its discharge.

c) Failure to report significant changes in operations of wastewater volume, constituents and characteristics prior to discharge.

d) Refusal of reasonable access to the user's premises for the purpose of inspection, monitoring and sampling.

e) Violation of the pretreatment standards in the Oklahoma City Code, Chapter 47 (Revised 2002).

B. Such user will be notified of the proposed termination of its discharge and be offered an opportunity to show cause why the purposed action should not be taken.

6. PERMIT APPEALS

Any person, including the industrial users, may petition the Director, or his designated representative, to reconsider the terms of a wastewater discharge Permit within 30 days of its issuance.

a) Failure to submit a timely petition for review shall be deemed to be a waiver of the administrative appeal.

b) In its petition, the appealing party must indicate the wastewater discharge Permit provision objected to, the reasons for this objection and the alternative conditions, if any, it seeks to place in the wastewater discharge Permit.

c) The effectiveness of the wastewater discharge Permit shall not be stayed pending the appeal.

d) If the Director, or his designated representative, fails to act within 45 days, a request for reconsideration shall be deemed to be denied. Decisions not to reconsider a wastewater discharge Permit, not to issue a wastewater discharge Permit, or not to modify a wastewater discharge Permit, shall be considered final administrative action for purposes of judicial review.

e) Aggrieved parties who have exhausted their administrative remedies may seek judicial review of the final administrative wastewater discharge Permit decision by filing a complaint with the District Court for Oklahoma County within appropriate State statute of limitations.

7. PERMIT TRANSFER

A. Wastewater discharge Permits are issued to a specific user for a specific operation. A wastewater Discharge Permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation without the approval of the Director. Changes in operation or processing which result in a change in the Permit conditions, limitations, or requirements will require a new Permit, and the existing Permit will not be reassigned. Any succeeding owner or user shall comply with the terms and conditions of the existing Permit.

B. Wastewater discharge Permits may be reassigned or transferred to a new owner and/or operator only if the Permittee gives at least 30 days advance notice to the Director; the Permit premises have not changed; the processes and operations at the premises have not changed; and the Director approves the wastewater discharge Permit transfer. The notice to the Director must include a written certification by the new owner and/or operator which:

a) States that the new owner and/or operator has no immediate intent to change the facility's operations and processes.

b) Identifies the specific date on which the transfer is to occur.

c) Acknowledges full responsibility for complying with the existing wastewater discharge Permit.

C. Failure to provide advance notice of a transfer renders the wastewater discharge Permit voidable on the date of the facility transfer.

8. WASTEWATER DISCHARGE PERMIT REISSUANCE

A significant industrial user shall apply for wastewater discharger Permit reissuance a minimum of 30 days prior to the expiration of the industrial user's existing Permit.

9. COMPLIANCE WITH APPLICABLE PRETREATMENT STANDARDS AND REQUIREMENTS

Compliance with this Permit does not relieve the Permittee from its obligations regarding compliance with: the provisions of chapter 47 of the Code, any and all applicable orders, rules, regulations and permits issued pursuant to chapter 47 of the Code; and any orders, rules, regulations, and requirements of City, State, and Federal Permits, orders, laws, requirements, rules, and regulations including any such standards or requirements that may become effective during the term of this Permit.

B. - OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. PRETREATMENT FACILITIES

Industrial users shall provide necessary wastewater treatment as required to comply with Chapter 47 and shall achieve compliance with all categorical pretreatment standards, local limits, and the prohibitions set out Section 47-211 and Federal Categorical Pretreatment Standards within the time to limitations as specified in Chapter 47 and by the Federal Pretreatment Regulations. Any facilities required to pretreat wastewater to a level acceptable to the City shall be provided, operated, and maintained at the user's expense. Detailed plans showing the pretreatment facilities and operation procedures shall be submitted to the City for review, and shall be acceptable to The City before construction of the facility. The review of such plans and operating procedures will in no way relieve the user from the responsibility of modifying the facility as necessary to produce an effluent acceptable to the City under the provisions of Chapter 47. Any subsequent changes in the pretreatment facilities or method of operation shall be reported to and be acceptable to the City prior to the user's initiation of the changes.

2. ADDITIONAL PRETREATMENT MEASURES

a) Whenever deemed necessary, the Director may require industrial users to restrict their discharge peak flow periods, designate that certain wastewater be discharged only into specific sewers, relocate and/or consolidated points of discharge, separate sewage waste streams from industrial waste streams, and other conditions as may be necessary to protect the POTW and determine the industrial user's compliance with the requirements of Chapter 47.

b) Grease, oil and sand interceptors shall be provided by the user when, in the opinion of the Director, the interceptors are necessary for the proper handing of wastewater containing excessive amounts of grease and oil, or sand; except that such interceptors shall not be required for residential users. All interceptor units shall be of type and capacity approved by the Director and shall be so located to be easily accessible for cleaning and inspection. Interceptors may be periodically inspected by the Director. Interceptors shall be cleaned and repaired regularly, and, as otherwise needed, by the user at the owner's expense.

3. BYPASS OF TREATMENT FACILITIES

A. (1) "Bypass" means the intentional diversions of wastewater streams from any portion of an industrial user's treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which cause the facilities to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delay in production.

B. An industrial user may allow any bypass to occur which does not cause pretreatment standards or requirements to be violated, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provision of paragraphs C and D of this section.

C. (1) If an industrial user knows in advance of the need for a bypass, it shall submit prior notice to the City, at least ten days before the date of the bypass if possible.

(2) An industrial user shall submit oral notice of an unanticipated bypass that exceeds applicable pretreatment standards to the City within 24 hours from the time it becomes aware of the bypass. A written submission shall also be provided within five days of the time the industrial user becomes aware of the bypass. The written submission shall contain a description of the bypass and its cause; the duration of the bypass, including exact dates and times, and, if the bypass has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate and prevent reoccurrence of the bypass. The City may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

D. (1) Bypass is prohibited, and the City may take enforcement action against an industrial user for a bypass, unless:

(i) Bypass was unavoidable to prevent loss of life, personal injury or severe property damage.

(ii) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime.

(iii) The industrial user submitted notices as required under paragraph C of this section.

(2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that the industrial user will meet the three (3) conditions listed in paragraph D (1) of this section.

4. REMOVE SUBSTANCES

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in accordance with section 405 of the Clean Water Act and Subtitles C and D of the Resource Conservation and Recovery Act.

C. - MONITORING AND RECORDS

1. CONTROL MANHOLES

Where required by the City Engineer or the Director, the owner of any property serviced by a building sewer carrying industrial waste shall install a suitable control manhole together with such necessary meters and other appurtenances in the building sewer to facilitate observation, sampling, and measurement of the wastes. Such manhole shall be accessible and safely located and shall be constructed in accordance with plans approved by the City Engineer or the Director. The manhole shall be installed by the owner, at his expense, and shall be maintained by him so as to be safe and accessible at all times.

2. REPRESENTATIVE SAMPLING

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this Permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water or substance. All equipment used for sampling and analysis must be routinely calibrated, inspected and maintained to ensure their accuracy. Monitoring points shall not be changed without notification to and the approval of the City of Oklahoma City.

3. FLOW MEASUREMENTS

If flow measurement is required by this Permit, the appropriate flow measurement devices and methods consistent with approved scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The device shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10 percent from true discharge rates throughout the range of expected discharge volumes.

4. ANALYTICAL METHODS TO DEMONSTRATE COMPLIANCE

All sampling and analysis required by this Permit shall be performed in accordance with the techniques prescribed in 40 CFR Part 136 and amendments thereto, otherwise approved by EPA, or as specified in this Permit.

5. ADDITIONAL MONITORING BY THE PERMITTEE

If the Permittee monitors any pollutant more frequently than required by this Permit, using test procedures identified Section C.3; the results of this monitoring shall be included in the Permittee's self-monitoring reports.

6. INSPECTION, SAMPLING, AND ENTRY

The Permittee shall allow the Director of Water and Wastewater Utilities, or any authorized representative acting in his behalf and upon the presentation of credentials and other documents as may be required by law, to:

a) Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Permit;

b) Have access to and copy, at reasonable times, records that must be kept under this Permit;

c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit;

d) Sample or monitor, for the purposes of assuring Permit compliance, any substances or parameters at any location; and

e) Inspect production, manufacturing, fabricating, or storage area where pollutants, regulated under the Permit, could originate, be stored, or be discharged to the sewer system.

7. RETENTION OF RECORDS

a) The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this Permit, and records of all data used to complete the application for this Permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the City of Oklahoma City at any time.

b) All records that pertain to matters that are the subject of special orders or any other enforcement or litigation activities brought by The City of Oklahoma City shall be retained and preserved by the Permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

8. RECORD CONTENTS

Records of sampling and analysis shall include but not be limited to:

a) The date, exact place, time, and methods of sampling or measurements, and sample preservation techniques or procedures;

b) Who performed the sampling or measurements;

c) The date(s) analysis were performed;

d) Who performed the analysis;

e) The analytical techniques or methods used; and

f) The results of such analysis.

9. FALSIFYING INFORMATION

Knowingly making any false statement on any report or other document required by this Permit or knowingly rendering any monitoring device or method that is inaccurate, is a crime and may result in the imposition of criminal sanctions and/or civil penalties.

D. - ADDITIONAL REPORTING REQUIREMENTS

1. PLANNED CHANGES

The Permittee shall give notice to the City of Oklahoma City 30 days prior to any facility expansion, production increase, or process modifications which results in new or substantially increased discharges or a change in the nature of the discharge.

2. ANTICIPATED NONCOMPLIANCE

The Permittee shall give at least ten days advance notice, if possible, to the City of Oklahoma City of any planned changes in the Permitted facility or activity which may result in noncompliance with Permit requirements.

3. DATE OF SUBMITTAL

Written reports will be deemed to have been submitted on the date postmarked. For reports which are not mailed, postage prepaid, into a mail facility serviced by the U.S. Postal Service, the date of receipt of the report shall govern.

4. DUTY TO PROVIDE INFORMATION

The Permittee shall furnish to the City of Oklahoma City any information which the City of Oklahoma City may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit, or to determine compliance with his Permit. The Permittee shall also, upon request, furnish to the City of Oklahoma City copies of any records required to be kept by this Permit.

5. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the City of Oklahoma City must contain the following certification statement and be signed as required in Sections (a), (b), (c) or (d) below:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those person directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

a) By a responsible corporate officer, if the industrial user submitting the reports is a corporation. For the purpose of this paragraph, a responsible corporate officer means:

(i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy - or decision-making functions for the corporation, or;

(ii) The manager of one or more manufacturing, production, or operation facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

b) By a general partner or proprietor if the Industrial User submitting the reports is a partnership or sole proprietorship respectively.

c) The principal executive officer or director having responsibility for the overall operation of the discharging facility if the Industrial User submitting the reports is a Federal, State, or local governmental entity, or their agents.

d) By a duly authorized representative of the individual designated in paragraph (a), (b), or (c) of this section if:

(i) The authorization is made in writing by the individual described in paragraph (a), (b), or (c);

(ii) The authorization specifies either an individual or a position having responsibility for the overall operation of the facility from which the industrial discharge originates, such as the position of plant manager, operator of a well, or a well field superintendent, or a position of equivalent responsibility, or having overall responsibility for environmental matter for the company; and

(iii) The written authorization is submitted to the City.

e) If an authorization under paragraph (b) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, or overall responsibility for the environmental matters for the company, a new authorization satisfying the requirements of paragraph (d) of this section must be submitted to the City prior to or together with any reports to be signed by an authorized representative.

6. ACCIDENTAL DISCHARGE/SLUG LOAD/SLUG CONTROL PLANS

a) **Following evaluation, if determined by the POTW to be necessary,** each user shall provide facilities which the City deems adequate to protect the municipal wastewater collection and treatment system from accidental discharge of prohibited materials or substances regulated by Chapter 47. Facilities to prevent accidental discharge of prohibited materials shall be provided and maintained at the owner's expense. Detailed plans showing facilities and operating procedures to provide this protection shall be submitted to the City for review, and shall be approved by the City before construction of the facility. **Additional Significant Industrial Users must be evaluated within one year of being designated a significant industrial user.**

b) In case of an accidental discharge, discharge of a non-routine episodic nature, a non-customary batch discharge, or a slug load, it is the responsibility of the User to immediately telephone the Director of the discharge weekdays at 405-297-3805 or night time and weekends at 405-297-0334, after 5 p.m. Monday - Friday, on weekends, and holidays at 405-297-2255. The notification shall include date, time, and location of discharge, type of waste, concentration and volume, and corrective actions. **Users are required to notify the POTW immediately of any changes at its facility affecting potential for a Slug Discharge.**

c) A written follow-up report of the accidental discharge shall be filed by the Permittee with the Director of Water and Wastewater Utilities within five days. The report shall specify:

1. Description of the accidental discharge and the cause(s) thereof; and
2. Duration of the accidental discharge, including exact dates and times of the discharge, and if not corrected, the anticipated time the discharge is expected to continue; and

3. All steps taken or to be taken to reduce, eliminate and prevent similar future occurrence.

d) A notice shall be permanently posted on the user's bulletin board or other prominent and accessible place advising employees whom to call in the event of a dangerous discharge. The Permittee shall ensure that all employees who may cause or suffer such a dangerous discharge to occur are advised of the emergency notification procedures.

7. OPERATING UPSETS

Any Permittee that experiences an upset in operations that places the Permittee in a temporary state of noncompliance with the provisions of either this Permit or with any provision of Chapter 47 of the Oklahoma City Code shall inform the City of Oklahoma City within 24 hours of becoming aware of the upset weekdays at 405-297-3805 or night time and weekends at 405-297-0334, after 5 p.m. Monday - Friday, on weekends, and holidays at 405-297-2255.

A written follow-up report of the upset shall be filed by the Permittee with the Director of Water and Wastewater Utilities within five days. The report shall specify:

a) Description of the upset, the cause(s) thereof and the upset's impact on the Permittee's compliance status;

b) Duration of noncompliance, including exact dates and times of noncompliance, and if not corrected, the anticipated time the noncompliance is expected to continue; and

c) All steps taken or to be taken to reduce, eliminate and prevent recurrence of such an upset.

The report must also demonstrate that the treatment facility was being operated in a prudent and workmanlike manner.

8. ANNUAL PUBLICATION

The City shall published annually, **a newspaper of general circulation that provides meaningful public notice within the jurisdiction(s) served by the POTW**, a list of all industrial users which, during the previous twelve (12) month, were in significant noncompliance with applicable pretreatment standards and requirements. Accordingly, the Permittee is appraised that noncompliance with this Permit may lead to an enforcement action and may result in publication of its name in an appropriate newspaper in accordance with Chapter 47, Section 47-411, Revised 2002. The term "significant noncompliance" shall mean:

a) Chronic violations of wastewater discharge limits, defined here as those in which 66 percent or more of wastewater measurements taken during a six-month period exceed the daily maximum limit or average limit for the same pollutant parameter **(by any magnitude) a numeric Pretreatment Standard or requirement, including instantaneous limits, as defined by 40 CFR 403.3 (l).**

b) Technical review criteria (TRC) violations, defined here as those in which 33 percent or more of wastewater measurements taken for each pollutant parameter during a six-month period equal or exceed the product of the **numeric Pretreatment Standard or Requirement, including instantaneous limits, as defined by 40 CFR 403.3(l)** multiplied by the applicable criteria (1.4 for BOD, TSS, fats, oils and grease, and 1.2 for all other pollutants except pH).

c) Any other violation of a Pretreatment **Standard or Requirement as defined by 40 CFR 403.3 (l) (daily maximum, long-term average, instantaneous limit, or narrative standard)** the City **(POTW)** believes has caused, alone or in combination with other discharges, interference or pass-through (including endangering the health of City personnel or the general public.

d) Any discharge of pollutants that has caused imminent endangerment to the public or to the environment, or has resulted in the City's exercise of its emergency authority to halt or prevent such discharge.

e) Failure to meet, within 90 days of the scheduled date, a compliance schedule milestone contained in a wastewater discharge Permit or enforcement order for starting construction, completing construction, or attaining final compliance.

f) Failure to provide, within 30 days after the due date, any required reports, including the baseline monitoring report, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules.

g) Failure to accurately report noncompliance.

h) Any other violation(s), **which may include a violation of Best Management Practices**, the City (POTW) determines will adversely affect the operation or implementations of the local pretreatment program.

9. CIVIL AND CRIMINAL LIABILITY

Nothing in this Permit shall be constructed to relieve the Permittee from civil and/or criminal penalties for noncompliance under the Oklahoma City Code, Chapter 47, Section 47-62 and Section 47-63 or State or Federal laws or regulations.

10. PENALTIES FOR VIOLATIONS OF PERMIT CONDITIONS

a) Any user who is found to have violated or failed to comply with any permit provision, order of the Director, any provision of this chapter, or with any order, rule, regulation or permit issued hereunder, and any user or person who has introduced into the POTW any substance which causes personal injury or property damage, or knowingly made any false statements, representations, or certifications in any application, record, report, plan or other documentation filed or required to be maintained, pursuant to this chapter, wastewater discharge permit or order; and any user or person who falsifies, tampers with or knowingly renders inaccurate any monitoring device or method required under this chapter, shall be guilty of an offense against the City. Each and every day on which a violation or failure shall occur or continue shall be deemed a separate and distinct offense. In addition to the penalties provided herein, the City may recover reasonable attorneys' fees, court costs, court reporters' fees and other expenses of litigation by appropriate suit at law or in equity against the person found to have violated or failed to comply with this chapter or any order, rule, regulation or permit issued hereunder. The issuance or collection of an administrative fee or charge or the assessment or collection of costs, as may also be provided for in this Code, shall not be a bar to or be a prerequisite for taking any other administrative or criminal action against the user or person.

b) Any person violating any provision of this chapter shall, upon conviction, be guilty of a Class "a" offense. Any person violating any provision of this chapter knowingly and willfully shall, upon conviction, be guilty of a Class "b" offense. For any second or subsequent offense and upon proof of conviction, said person shall be guilty of a Class "b" offense.

11. RECOVERY OF COSTS INCURRED

a) The City may recover reasonable attorneys' fees, court costs, reporters' fees and other expenses of litigation by appropriate suit at law or in equity against any person for the enforcement of permit requirements, enforcement of the Code, for an action to enjoin a breach of a permit or enforcement of the Code, or for the prevention or cessation of a discharge of wastewater into the City's POTW or upon any land or into any waters within the City.

b) In determining the amount of civil liability, the City may allege all relevant circumstances including, but not limited to, the extent of harm caused by the violation, the magnitude and duration, any economic benefit gained through the user's violations, corrective actions by the user, the compliance history of the user, and any other factor as justice requires.

E. CHARGES AND FEES FOR THE TREATMENT OF INDUSTRIAL WASTE

1. The sewer user charge effective October 1, 2010 shall be $3.37 per thousand (1,000) gallons of wastewater as determined from the meter records of the Water Utilities Department. Non-residential accounts shall have said user charge applied to total water consumption or to the effluent from the establishment, if an approved metering system is installed.

2. The surcharge for industrial users shall be calculated and imposed according to the following schedule:

   The surcharge for each milligram per liter (mg/l) of B.O.D. in excess of two hundred and fifty milligrams per liter (250 mg/l), effective October 1, 2010, shall be $2.88 per one (1) million gallons. The surcharge for each milligram per liter (mg/l) of Total Suspended Solids in excess of three hundred milligrams per liter (300 mg/l), effective October 1, 2010, shall be $2.02 per one (1) million gallons of wastewater as determined from the meter records of the Water Utilities Department.

3. Schedule of Fees

Item	Schedule of Fees	Annual Cost
A.	Categorical Pollutant Discharge Permit (New)	$500.00
B.	Categorical Pollutant Discharge Permit (Renewal or Existing Modified)	250.00
C.	Non-Categorical Pollutant Discharge Permit (New)	50.00
D.	Non-Categorical Pollutant Discharge Permit (Renewal or Existing Modified)	25.00
E.	Filing Appeals	100.00
F.	Categorical Pollutant Potential to Discharge Permit (New)	250.00
G.	Categorical Pollutant Potential to Discharge Permit (Renewal or Existing Modified)	125.00
H.	Non-Categorical Pollutant Potential to Discharge Permit (New)	50.00
I.	Non-Categorical Pollutant Potential to Discharge Permit (Renewal or Existing Modified)	25.00
J.	Private Water/Sewer Meter Inspection (Verification/ Reverification)	50.00
K.	Emergency Industrial Waste Disposal Inspection	50.00
L.	Requested Categorical Pretreatment Facility Inspection	50.00
M.	Duplication of an approved Permit	10.00
N.	Change of Name/Permittee Due to Change in Ownership (With no Change in Operation)	25.00
O.	Reproduction of Federal Regulations/ Other Requested Material	0.25 each one-sided Page (8-1/2 x 11or 8-1/2 x 14)
P.	Non-significant categorical industrial user permit (new)	250.00
Q.	Non-significant categorical industrial user permit (renewal or modified)	125.00

4. The City may adopt additional Charges and Fees that the City deems necessary to carry out the Requirement of the Pretreatment Program.

EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3555036

APPENDIX M

ALTERNATIVE LINER SYSTEM DESIGN

Prepared for

Waste Management of Oklahoma, Inc.

June 2015
Revised January 2016

Revised May 2016

LICENSED PROFESSIONAL ENGINEER
Marilyn D.
Morrison
23833
OKLAHOMA

5-31-16

Prepared by

Weaver Consultants Group, LLC
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0086-356-11-40-08

CONTENTS

INTRODUCTION

The purpose of this appendix is to demonstrate that the proposed liner system design exceeds the requirements of OAC 252:515-11-2(c). The proposed composite liner system at the site includes the addition of a geosynthetic clay liner (GCL) to the Oklahoma Department of Environmental Quality (ODEQ) standard Subtitle D liner system set forth in OAC 252:515-11-2(b).

Typical details of the liner system are provided in Appendix M-1. The MULTIMED modeling included in Appendix M-2 demonstrates that the Maximum Concentration Levels (MCLs) of the Appendix B constituents referenced in OAC 252:515-11-2(c) will not be exceeded at the relevant point of compliance (POC). This demonstration is made by calculating the Dilution Attention Factor (DAF). The DAF must be higher than 260 to ensure that the constituents of concern will not exceed the MCLs at the point of compliance. The lowest calculated DAF of 8,643 is over 33 times higher than the minimum required DAF of 260. Numerous conservative assumptions were made for the liner system design demonstration. A summary of these assumptions and the results of the liner system design demonstration are provided in Tables 1-1 and 1-2.

Table 1-1
Major Assumptions Used to Determine Model Input Parameters

Input Parameters	Assumption	Actual Site Condition
Unsaturated Zone Thickness	0	The unsaturated zone above the groundwater table is variable in thickness but is always greater than 5 feet (by rule). The attenuating effects of this zone have been conservatively ignored in this demonstration.
Organic Carbon Content	0	Organic carbon was assumed to be 0, although most subsurface formations are at least partly carbonaceous. The attenuating effects of carbon absorption have been conservatively ignored in this model.
Model Source Type	Steady State	A potential leachate release would typically be released as a pulse, not a steady-state continuous source.
Biodegradation	No biodegradation	Biodegradation is active in hydrogeologic environments.
Chemical Decay	No chemical decay	Chemical decay will occur with most contaminants.

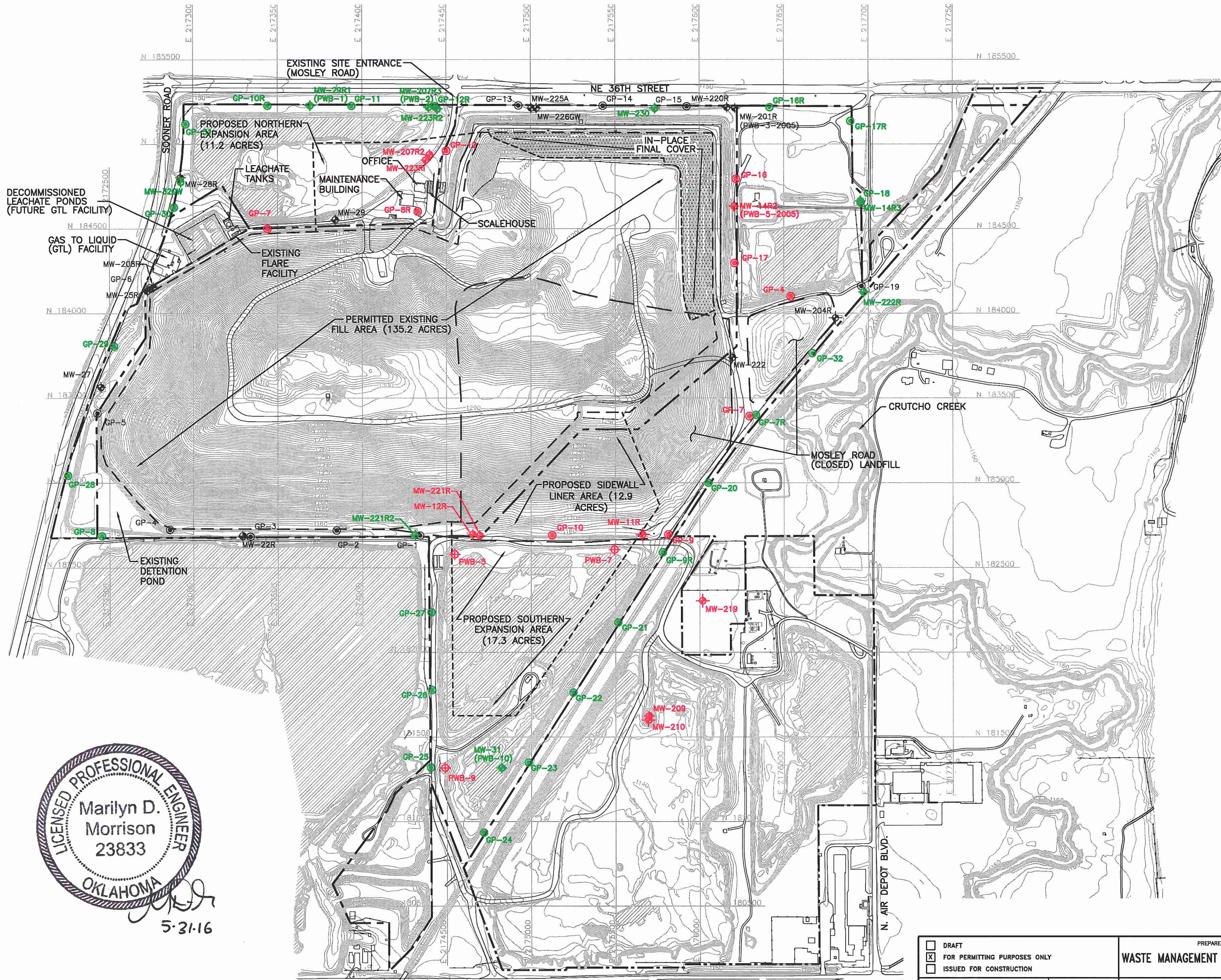
Table 1-2
Liner System Design Results

Modeling Condition	Concentration at POC (mg/L)	Minimum Required DAF[1]	DAF[1]
Interim Condition (100 ft)	$0.1157\text{x}10^{-3}$	260	8,643
Interim Condition (150 ft)	$0.1010\text{x}10^{-3}$	260	9,901

[1] The lowest calculated Dilution Attention Factor (DAF) is 8,643. The results demonstrate that the proposed alternative liner system meets ODEQ requirements. The DAF calculated is in excess of the 260 minimum criterion (refer to Appendix M-2 for more information). The actual DAF is expected to be higher than the DAF predicted by this modeling investigation because the model input were conservatively estimated as discussed in Table 1-1.

APPENDIX M-1

FIGURES



0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- N 183000 — STATE PLANE GRID COORDINATE
- 1180 — EXISTING CONTOUR
- MW-27 — EXISTING GROUNDWATER MONITORING WELL (TO REMAIN)
- MW-29 — EXISTING GROUNDWATER MONITORING WELL (TO BE ABANDONED)
- MW-31 — PROPOSED GROUNDWATER MONITORING WELL
- GP-15 — EXISTING LANDFILL GAS PROBE (TO REMAIN)
- GP-16 — EXISTING LANDFILL GAS PROBE (TO BE ABANDONED)
- GP-18 — PROPOSED LANDFILL GAS PROBE
- PWB-7 — EXISTING GROUNDWATER PIEZOMETER (TO BE ABANDONED)
- IN-PLACE FINAL COVER

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. A WASTE-FREE BUFFER ZONE OF AT LEAST 100-FEET OFFSET FROM THE PROPOSED PERMIT BOUNDARY TO THE PROPOSED LIMITS OF WASTE INCLUDED IN THIS MODIFICATION WILL BE MAINTAINED.
5. REFER TO SECTION 2.5 FOR WETLAND INFORMATION.
6. IN-PLACE FINAL COVER AREA REPRODUCED FROM LEMKE LAND SURVEYING, INC. VERIFICATION SURVEY DATED JULY 2013 (FINAL COVER AREA 1).

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O:\0086\356\EXPANSION 2013\APPENDIX M\FIG M-1-1-SITE PLAN.dwg, rmorris, 1:2

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FILE: 0086-356-11	DESIGN BY: MDM
CAD: FIG M-1-1-SITE PLAN.DWG	REVIEWED BY: JVQ

Weaver Consultants Group
CA 3804 PE – 06/30/2017

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

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2	05/2016	REVISED PROBE/WELL LAYOUT

TIER III PERMIT MODIFICATION SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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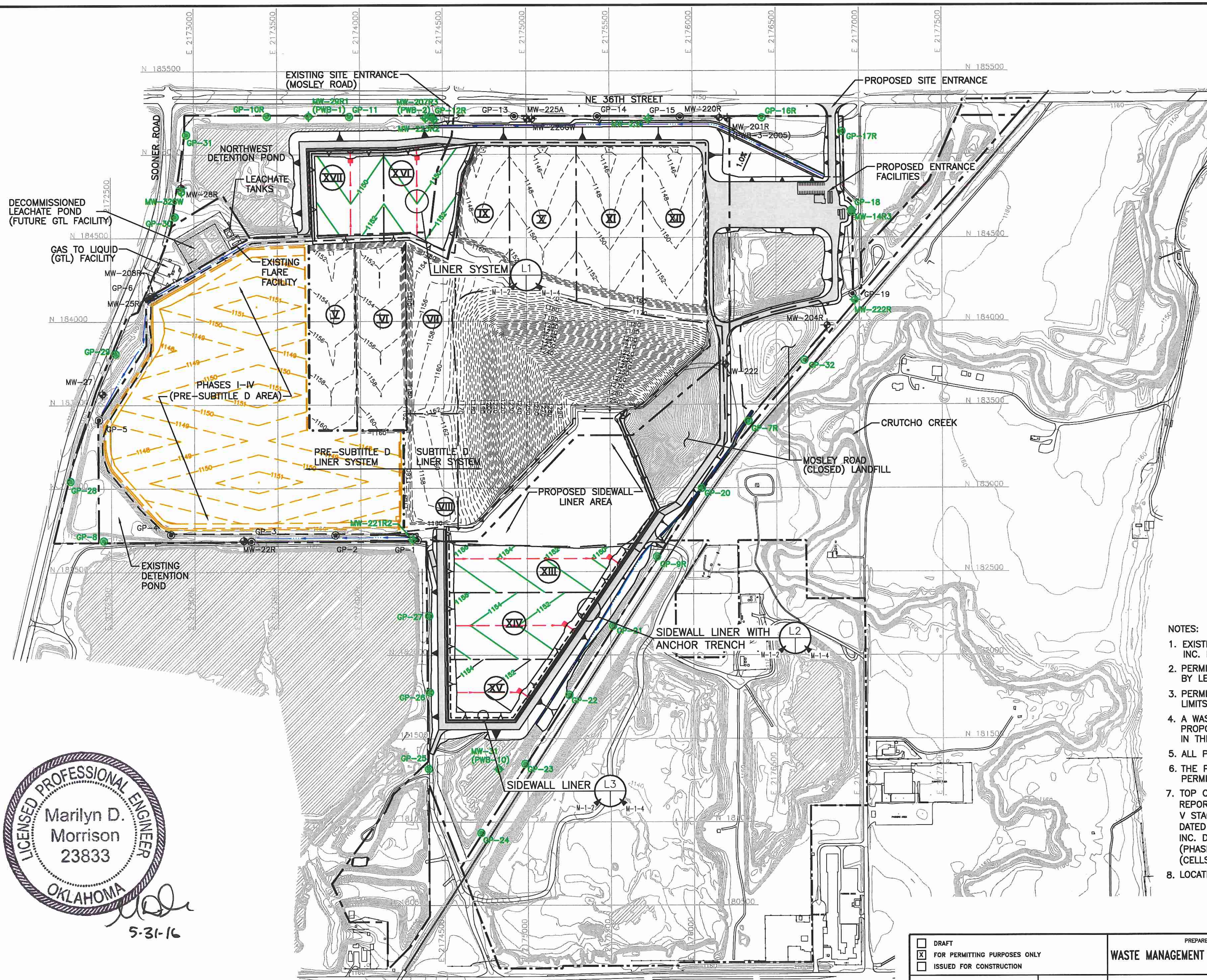
FIGURE M-1-1



0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
- N 183000 STATE PLANE GRID COORDINATE
- 1180 EXISTING CONTOUR
- 1152 PROPOSED TOP OF LINER CONTOUR
- 1150 APPROXIMATE PRE-SUBTITLE D CONTOUR (SEE NOTE 6)
- 1240 TOP OF CLAY AS-BUILT CONTOUR (SEE NOTE 7)
- LEACHATE COLLECTION PIPE
- LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE-SUBTITLE D/SUBTITLE D LINER LOCATION
- X PHASE DESIGNATION
- MW-27 EXISTING GROUNDWATER MONITORING WELL (TO REMAIN)
- MW-31 PROPOSED GROUNDWATER MONITORING WELL
- GP-15 EXISTING LANDFILL GAS PROBE (TO REMAIN)
- GP-18 PROPOSED LANDFILL GAS PROBE

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5. ALL PROPOSED EXCAVATION SIDESLOPES ARE 3(HORIZONTAL):1(VERTICAL).
6. THE PRE-SUBTITLE D GRADES WERE REPRODUCED FROM THE LATERAL EXPANSION PERMIT APPLICATION REVISED FEBRUARY 2002 BY CARDINAL ENGINEERING INC.
7. TOP OF CLAY AS-BUILT CONTOURS WERE REPRODUCED FROM THE VERIFICATION REPORTS PREPARED BY: GERALD L. McGARVIN, L.S. DATED JUNE 1994 (PHASE V STAGE I), OCTOBER 1995 (PHASE V STAGE I), RONALD A. LAVARNWAY RPLS DATED SEPTEMBER 1998 (PHASE V, STAGE II), AND LEMKE LAND SURVEYING, INC. DATED DECEMBER 2001 (PHASE IV STAGES II AND III), JANUARY 2004 (PHASE VIII), SEPTEMBER 2004 (PHASE VII), MAY 2009 (PHASE X), JULY 2011 (CELLS 11B AND 12B), NOVEMBER 2012 (CELLS 9B AND 10B).
8. LOCATION AND DEPTH OF BOREHOLES CAN BE FOUND IN APPENDIX E.

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OKLAHOMA
5-31-16

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DRAWN BY: VRS
DESIGN BY: MDM
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

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2	05/2016	REVISED PROBE/WELL LAYOUT

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TIER III PERMIT MODIFICATION TOP OF LINER PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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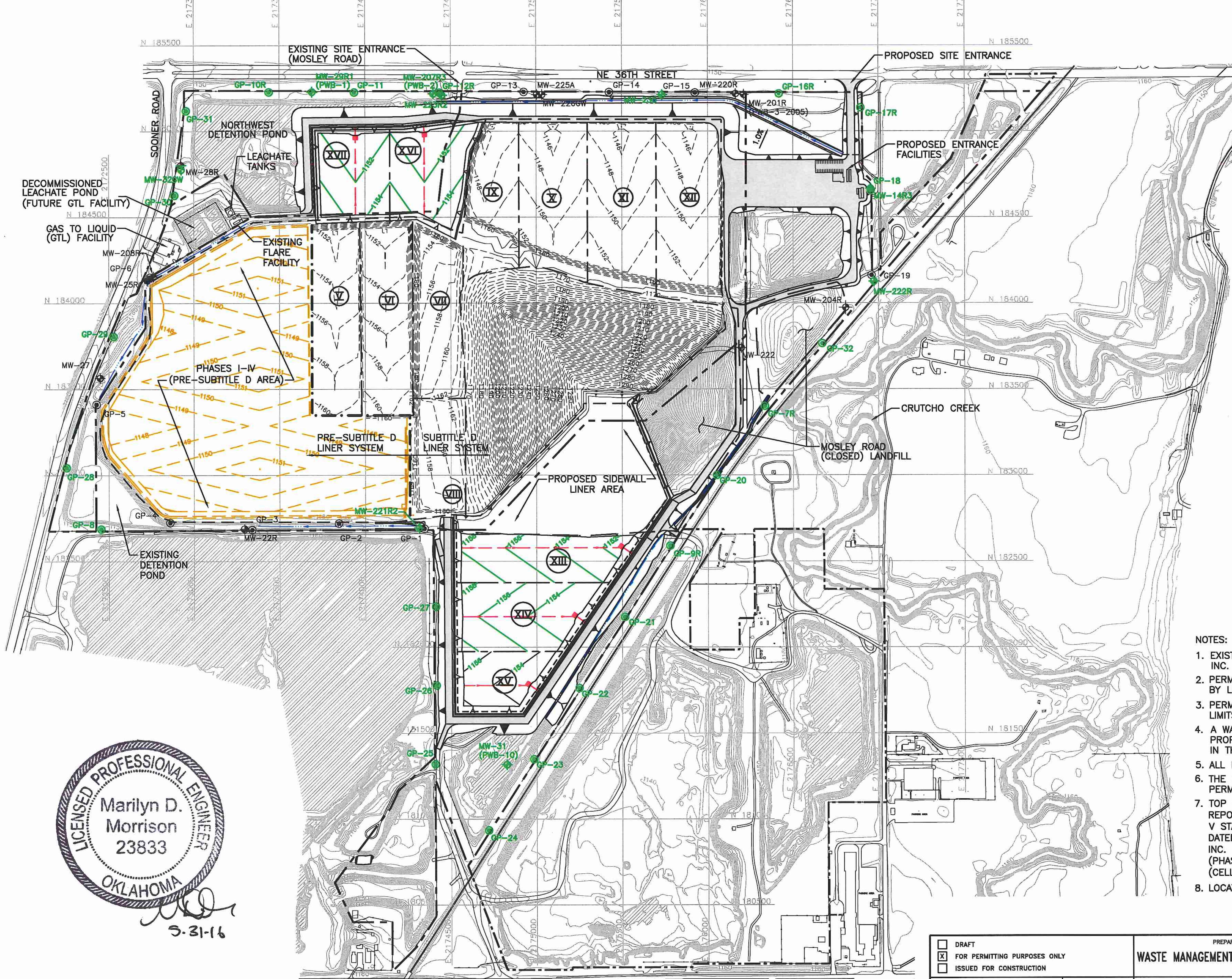
FIGURE M-1-2

O:\0086\356\EXPANSION 2013\APPENDIX M\FIG M-1-2-TOP OF LINER PLAN.dwg, rmorris, 1:2



0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
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- 1180 — EXISTING CONTOUR
- 1152 — PROPOSED TOP OF PROTECTIVE COVER CONTOUR
- 1150 — APPROXIMATE PRE-SUBTITLE D CONTOUR (SEE NOTE 5)
- 1240 — TOP OF CLAY AS-BUILT CONTOUR (SEE NOTE 6)
- LEACHATE COLLECTION PIPE
- LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE-SUBTITLE D/ SUBTITLE D LINER LOCATION
- X — PHASE DESIGNATION
- MW-27 — EXISTING GROUNDWATER MONITORING WELL (TO REMAIN)
- MW-30 — PROPOSED GROUNDWATER MONITORING WELL
- GP-15 — EXISTING LANDFILL GAS PROBE (TO REMAIN)
- GP-18 — PROPOSED LANDFILL GAS PROBE

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☐ ISSUED FOR CONSTRUCTION

DATE: 08/2015
FILE: 0086-356-11
CAD: FIG M-1-3-LEACHATE PLAN.DWG

DRAWN BY: VRS
DESIGN BY: MDM
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

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TIER III PERMIT MODIFICATION
TOP OF LEACHATE COLLECTION LAYER PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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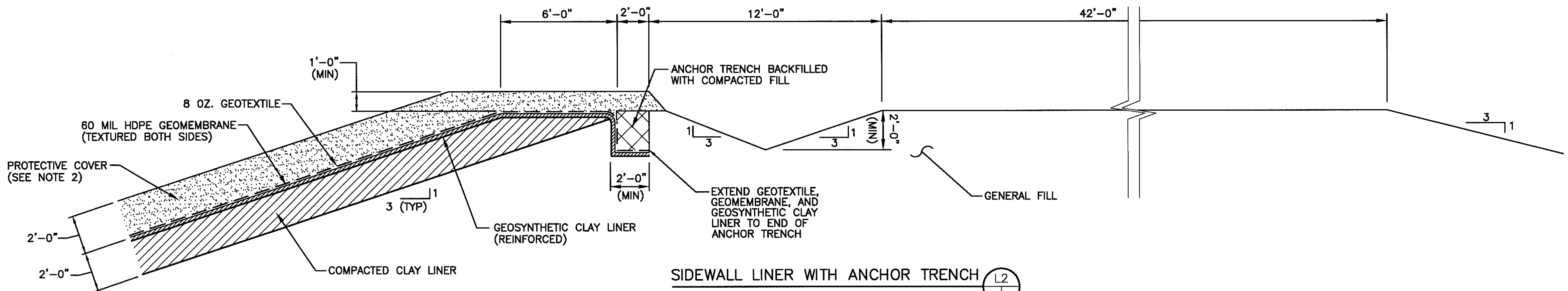
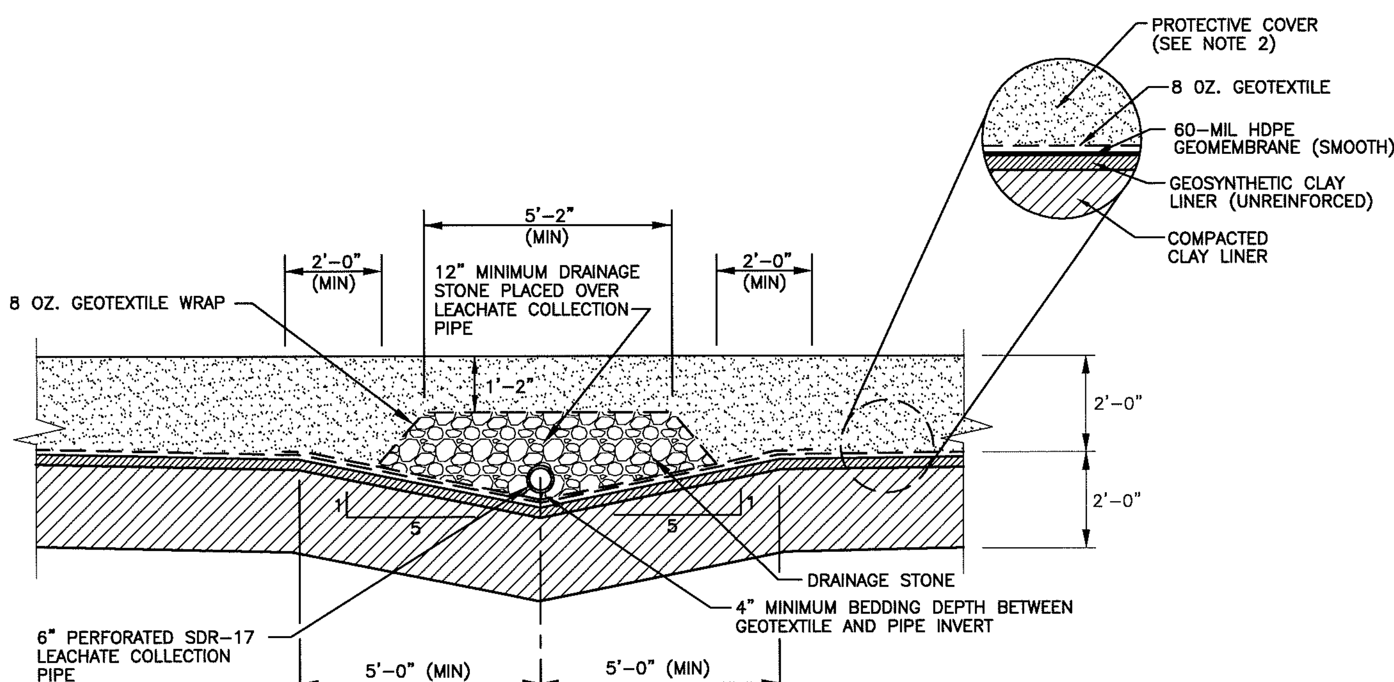
FIGURE M-1-3

O:\0086\356\EXPANSION 2013\APPENDIX M\FIG M-1-3-TOP OF LEACHATE LAYER PLAN.dwg, rmorris, 1:2



SIDEWALL LINER WITH ANCHOR TRENCH L2 M-1-2 M-1-4

0 3 6 SCALE IN FEET

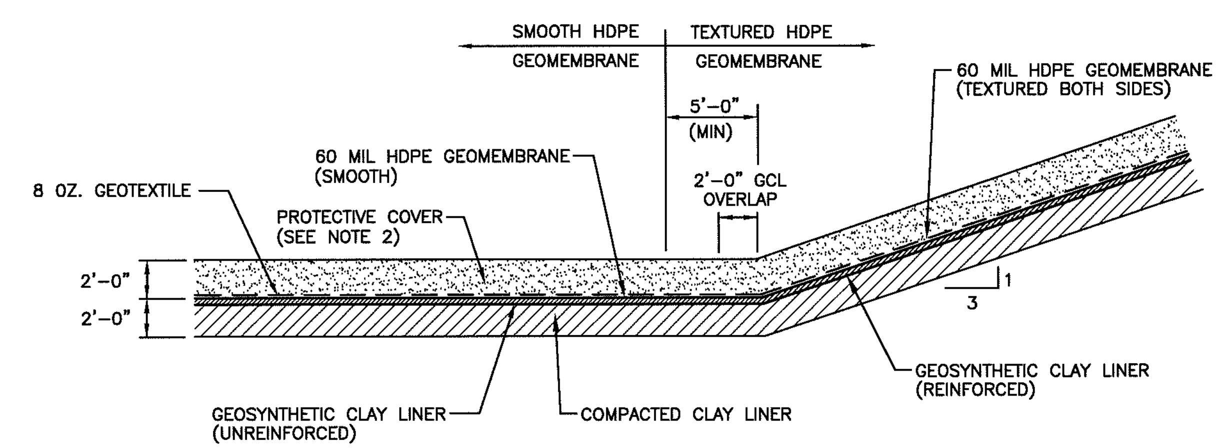


LINER SYSTEM L1 M-1-2 M-1-4

0 2 4 SCALE IN FEET

NOTE:

1. MATERIAL PROPERTIES AND QA/QC REQUIREMENTS FOR EACH OF THE LINER COMPONENTS ARE SPECIFIED IN APPENDIX K.
2. AN ALTERNATIVE PROTECTIVE COVER OPTION INCLUDES REPLACING THE TOP 1-FOOT OF MATERIAL WITH TIRE CHIPS FOR FLOOR GRADES ONLY. TIRE CHIPS ARE NOT ALLOWED ON 3:1 SIDESLOPES OR SIDEWALL LINER AREAS. SEE APPENDIX L FOR MORE INFORMATION.



SIDEWALL LINER L3 M-1-2 M-1-4

0 5 10 SCALE IN FEET

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OKLAHOMA
6-5-15

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DATE: 06/2015 FILE: 0086-356-11 CAD: FIG M-1-4-LINER DTLS.DWG	DRAWN BY: VRS DESIGN BY: MDM REVIEWED BY: JVQ	REVISIONS			EAST OAK RDF OKLAHOMA COUNTY, OKLAHOMA
		NO.	DATE	DESCRIPTION	
Weaver Consultants Group CA 3804 PE – 06/30/2015					WWW.WCGRP.COM — FIGURE M-1-4

O:\0086\356\EXPANSION 2013\APPENDIX M\FIG M-1-4-LINER DETAILS.dwg, uacbolonu, 1:2

APPENDIX M-2

MULTIMED MODELING

CONTENTS

1 INTRODUCTION

This liner system design demonstration has been prepared to demonstrate that the proposed liner system design exceeds the requirements of OAC 252:515-11-2(c) for the lateral expansion area.

The demonstrations included in this appendix were conducted using the MULTIMED Exposure Assessment (MULTIMED) computer model. The MULTIMED modeling demonstrates that the Maximum Concentration Levels (MCLs) of the Appendix B constituents referenced in OAC 252:515-11-2(c) will not be exceeded at the relevant point of compliance (POC). This demonstration is shown by calculating the Dilution Attention Factor (DAF). The DAF must be higher than 260 to ensure that the constituents of concern will not exceed MCLs at the point of compliance. The lowest calculated DAF of 8,643 is over 33 times higher than the minimum required DAF of 260. Numerous conservative assumptions were made for the liner system design demonstration. These assumptions and the results of the liner system design demonstration are discussed in the following sections.

2 LINER SYSTEM DESIGN DEMONSTRATION METHODS

2.1 Demonstration Methodology

The demonstrations were conducted by showing that the proposed liner system design options would not allow Appendix B concentrations values shown on Table 2-1 to be exceeded at the relevant point of compliance. This is done by modeling a Dilution Attenuation Factor (DAF), defined as the initial input leachate concentration, Co, divided by the concentration at the point of compliance, Cp:

$$DAF = \frac{Co}{Cp}$$

The required DAF for each Appendix B constituent is found by dividing the input leachate concentration by the Appendix B MCLs. The input leachate concentrations are based on recommended input concentrations from USEPA's "Draft Background Summary of Data on Municipal Solid Waste Landfill Leachate Characteristics: July 1988," and the Toxicity Characteristic Leaching Procedure (TCLP) in 40 CFR 261.62. The greater of the two values for each constituent were used as the recommended input concentration. Table 2-1 lists these data.

A single simulation can account for all 24 Appendix B constituents by assuming the constituents act as conservative tracers that do not experience carbon absorption, or chemical or biological decay. This very conservative assumption discounts natural physical processes that normally act to reduce chemical concentrations. The dilution required to meet ODEQ standards is a function of both the expected input leachate concentration and the Appendix B MCLs. Table 2-1 data show that trichloroethylene is the most critical constituent because it has the highest DAF. In other words, trichloroethylene requires the most dilution in order to comply with Appendix B MCLs. If the input leachate concentration is assumed to be 1, then the DAF at the POC becomes the reciprocal of the output concentration calculated by MULTIMED. The reciprocal of the MULTIMED result must then equal or exceed the most critical DAF to meet ODEQ requirements.

Table 2-1
ODEQ Appendix B Leachate Input Concentrations

Constituent	MCL (mg/L)	Recommended Input Concentration (mg/L)	Minimum Dilution Attenuation Factor
Arsenic	0.05	5.0	100.0
Barium	1.0	100.0	100.0
Benzene	0.005	0.814	163.0
Cadmium	0.01	1.0	100.0
Carbon tetrachloride	0.005	0.5	100.0
Chromium (hexavalent)	0.05	5.0	100.0
2,4-Dichlorophenoxy acetic acid	0.1	10.0	100.0
1,4-Dichlorobenzene	0.075	7.5	100.0
1,2-Dichloroehane	0.005	0.5	100.0
1,1-Dichloroethylene	0.007	0.7	100.0
Endrin	0.0002	0.05	250.0
Fluoride	4.0		
Lindane	0.004	0.4	100.0
Lead	0.05	5.0	100.0
Mercury	0.002	0.2	100.0
Methoxychlor	0.1	Data Not Available	100.0
Nitrate	10.0	Data Not Available	Data Not Available
Selenium	0.01	1.0	100.0
Silver	0.05	5.0	100.0
Toxaphene	0.005	0.5	100.0
1,1,1-Trichloromethane	0.2	Data Not Available	Data Not Available
Trichloroethylene	0.005	1.3	260.0
2,4,5-Trichlorophenoxy acetic acid	0.01	1.0	100.0
Vinyl Chloride	0.002	0.2	100.0

2.2 Estimating Percolation Through Liner

The rates of percolation through the liner were estimated using the Hydrologic Evaluation of Landfill Performance (HELP) model. These demonstrations are provided in Appendix L-2.

2.3 MULTIMED Model

MULTIMED Model Version 1.01 was used to assess contaminate fate and transport between the landfill base and the POC. MULTIMED was developed by the Athens Environmental Research Laboratory for the EPA. MULTIMED estimates the capacity of the hydrogeologic system modeled to dilute and attenuate contaminant concentrations. The model can be used to simulate the fate and transport processes in both the unsaturated and the saturated subsurface environments. In this application, only the saturated environment was modeled.

2.4 Landfill Configuration Analyzed

Two interim landfill configurations were modeled for the proposed liner system design using the percolation rates estimated by using the HELP model. These two cases represent the cases with the highest percolation through the liner system calculated by HELP. For the first interim condition, it is assumed that the landfill will have 100 feet of waste over the entire modeled area for a 15-year period. For the second interim condition, it is assumed that the landfill will have 150 feet of waste over the entire modeled area for a 10-year period. Additional input parameter assumptions are discussed in Section 3. Liner details can be found in Appendix M-1. The leachate percolation rates are the rates through the geosynthetic clay liner. All HELP modeling (leachate percolation) information is included in Appendix L-2. Typical profiles of both interim conditions modeled are illustrated on Figures M-2-2 and M-2-3.

2.5 Site Geology and Hydrogeology

The geology and hydrogeology information used was obtained from Appendix E – Subsurface Investigation. Site-specific data was used as much as possible. Other values were obtained by selecting default values provided by the MULTIMED documentation.

3 MODEL INPUT PARAMETERS

Leachate percolation information is included in Appendix L-2. MULTIMED information is presented in Appendix M-2-2. In general, environmentally conservative assumptions were made in determining the percolation rate and the dilution attenuation factor (DAF). A list of the major assumptions used in this demonstration is presented in Table 3-1. In addition, the table shows actual site conditions to provide a comparison with the assumptions made for modeling purposes. The criteria used to develop the percolation rate were selected to maximize the percolation. As a result, the DAF calculated for the landfill would be significantly larger if less conservative assumptions were used to develop the input parameters.

By making the assumptions listed in Table 3-1, a single MULTIMED simulation accounts for all 24 constituents identified by the EPA as requiring landfill design protection criteria because the constituent concentration at the POC is independent of chemical-specific properties. The model result is then expressed in terms of DAF, which is defined as the ratio of the input concentration to the concentration at the POC. MULTIMED can be used to find the DAF by using an input concentration of 1.0 mg/L. The DAF is the reciprocal of the resulting concentration at the POC. The POC for this study is shown on Figure M-2-1.

The required minimum DAFs for the 24 EPA constituents are given in Table 2-1. The largest DAF listed is 260. Therefore, if MULTIMED modeling results in a DAF higher than 260 for a generic chemical that is conservatively modeled with no carbon absorption, no chemical or biological decay, it can be concluded that the proposed liner system design is acceptable. The actual DAF for a specific chemical would be higher than the result calculated by MULTIMED under these circumstances, since real-world physical processes of carbon absorption, would act to reduce chemical concentrations at the POC to less than those predicted by MULTIMED.

Table 3-1
Major Assumptions Used to Determine Model Input Parameters

Input Parameters	Assumption	Actual Site Condition
Unsaturated Zone Thickness	0	The unsaturated zone above the groundwater table is variable in thickness but is always greater than 5 feet (by rule). The attenuating effects of this zone have been conservatively ignored in this demonstration.
Organic Carbon Content	0	Organic carbon was assumed to be 0, although most subsurface formations are at least partly carbonaceous. The attenuating effects of carbon absorption have been conservatively ignored in this model.
Model Source Type	Steady State	A potential leachate release would typically be released as a pulse, not a steady-state continuous source.
Biodegradation	No biodegradation	Biodegradation is active in hydrogeologic environments.
Chemical Decay	No chemical decay	Chemical decay will occur with most contaminants.

4 RESULTS

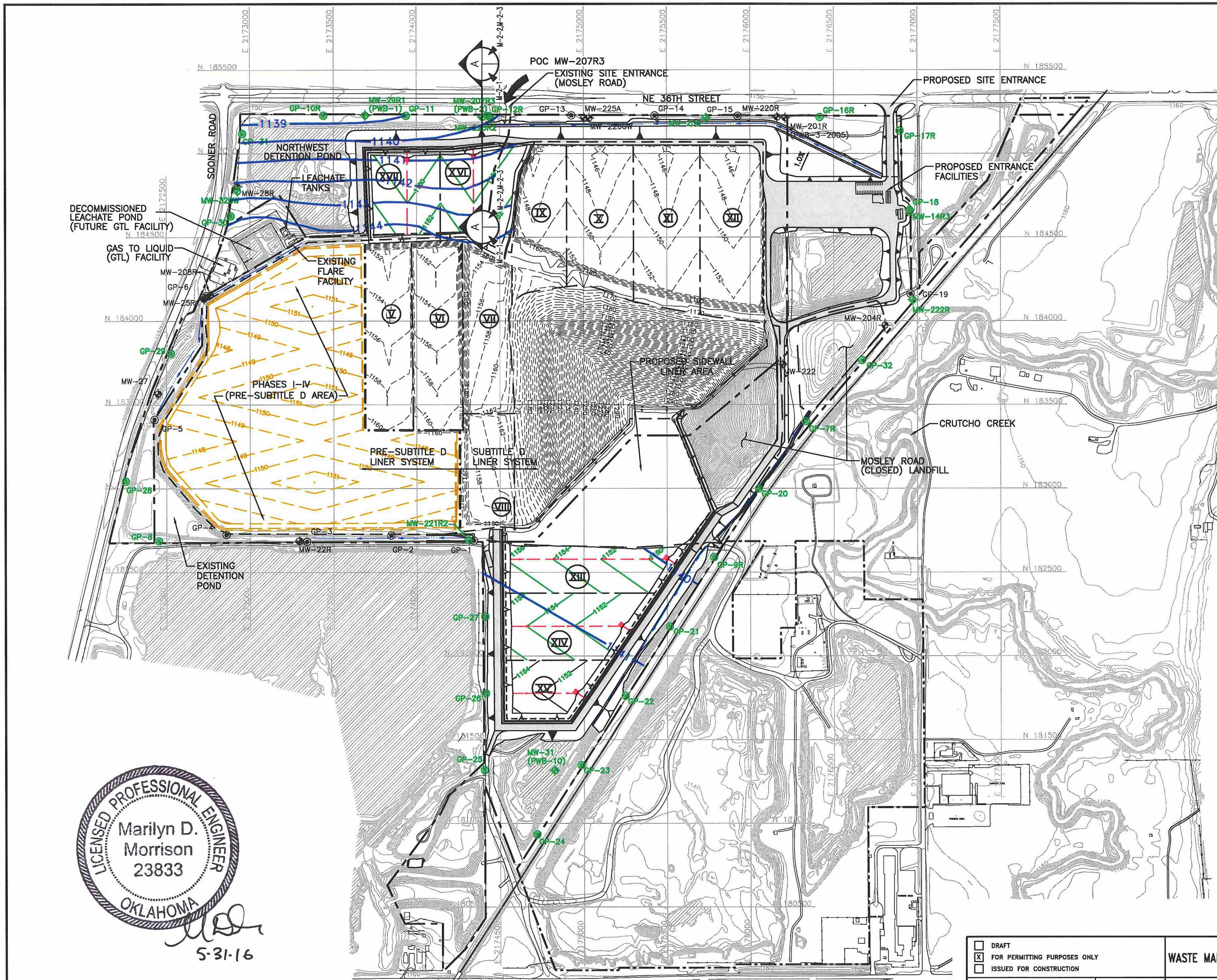
Modeling was used to evaluate the design of the proposed liner system design by estimating constituent concentrations at the POC for landfill configurations that yield the highest percolation rate for both liner system options. The constituent concentrations at the base of the landfill liner and at the POC were used to calculate the DAF. Per DEQ guidance information, the Appendix B MCLs must not be exceeded. This is equivalent to demonstrating a DAF of more than 260.

Modeling Condition	Concentration at POC (mg/L)	DAF
Interim Condition (100 ft)	0.1157×10^{-3}	8,643
Interim Condition (150 ft)	0.1010×10^{-3}	9,901

The lowest calculated DAF is 8,643. The results demonstrate that the proposed liner system exceeds the requirements of OAC 252:515-11-2(c) because the DAF calculated is in excess of the 260 minimum criterion. The actual DAF is expected to be higher than the DAF predicted by this modeling investigation because the model input parameters were conservatively estimated as discussed in previous sections of this report.

APPENDIX M-2-1

LINER SYSTEM DESIGN DEMONSTRATION FIGURES



N
0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
- N 183000 STATE PLANE GRID COORDINATE
- 1180 EXISTING CONTOUR
- 1152 PROPOSED TOP OF LINER CONTOUR
- 1150 APPROXIMATE PRE-SUBTITLE D CONTOUR (SEE NOTE 6)
- 1240 TOP OF CLAY AS-BUILT CONTOUR (SEE NOTE 7)
- LEACHATE COLLECTION PIPE
- LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- 1140 HIGHEST MEASURED GROUNDWATER ELEVATION CONTOUR IN FT-MSL (SEE NOTE 8)
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE-SUBTITLE D/ SUBTITLE D LINER LOCATION
- X PHASE DESIGNATION
- MW-27 EXISTING GROUNDWATER MONITORING WELL (TO REMAIN)
- MW-31 PROPOSED GROUNDWATER MONITORING WELL
- GP-15 EXISTING LANDFILL GAS PROBE (TO REMAIN)
- GP-18 PROPOSED LANDFILL GAS PROBE

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. A WASTE-FREE BUFFER ZONE OF AT LEAST 100-FEET OFFSET FROM THE PROPOSED PERMIT BOUNDARY FOR THE LANDFILL EXPANSION AREA INCLUDED IN THIS MODIFICATION WILL BE MAINTAINED.
5. ALL PROPOSED EXCAVATION SIDESLOPES ARE 3(HORIZONTAL):1(VERTICAL).
6. THE PRE-SUBTITLE D GRADES WERE REPRODUCED FROM THE LATERAL EXPANSION PERMIT APPLICATION REVISED FEBRUARY 2002 BY CARDINAL ENGINEERING INC.
7. TOP OF CLAY AS-BUILT CONTOURS WERE REPRODUCED FROM THE VERIFICATION REPORTS PREPARED BY: GERALD L. McGARVIN, L.S. DATED JUNE 1994 (PHASE V STAGE I), OCTOBER 1995 (PHASE V STAGE I), RONALD A. LAVARNWAY RPLS DATED SEPTEMBER 1998 (PHASE 5, STAGE 2), AND LEMKE LAND SURVEYING, INC. DATED DECEMBER 2001 (PHASE IV STAGES II AND III), JANUARY 2004 (PHASE VIII), SEPTEMBER 2004 (PHASE VII), MAY 2009 (PHASE 10), JULY 2011 (CELLS 11B AND 12B), NOVEMBER 2012 (CELLS 9B AND 10B).
8. LOCATION AND DEPTH OF BOREHOLES CAN BE FOUND IN APPENDIX E.

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5-31-16

O:\0086\356\EXPANSION 2013\APPENDIX M\FIG M-2-1-TOP OF LINER PLAN.dwg, rmorris, 1:2

☐	DRAFT
☒	FOR PERMITTING PURPOSES ONLY
☐	ISSUED FOR CONSTRUCTION

DATE: 06/2015
FILE: 0086-356-11
CAD: FIG M-2-1-TOP OF LINER.DWG

DRAWN BY: VRS
DESIGN BY: MDM
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION
1	01/2016	REVISED PROBE/WELL LAYOUT
2	05/2016	REVISED PROBE/WELL LAYOUT

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TIER III PERMIT MODIFICATION
TOP OF LINER PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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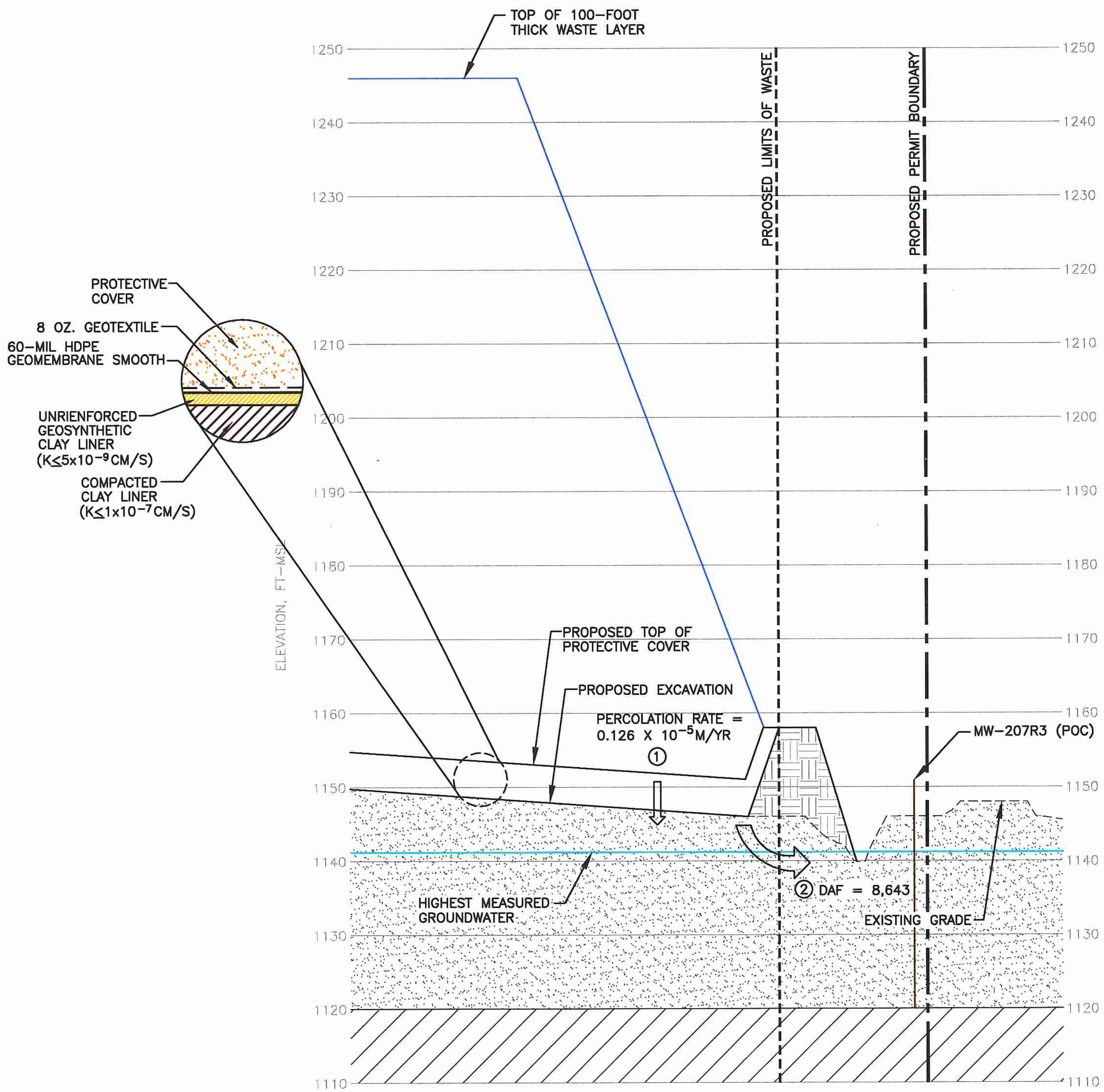
FIGURE M-2-1

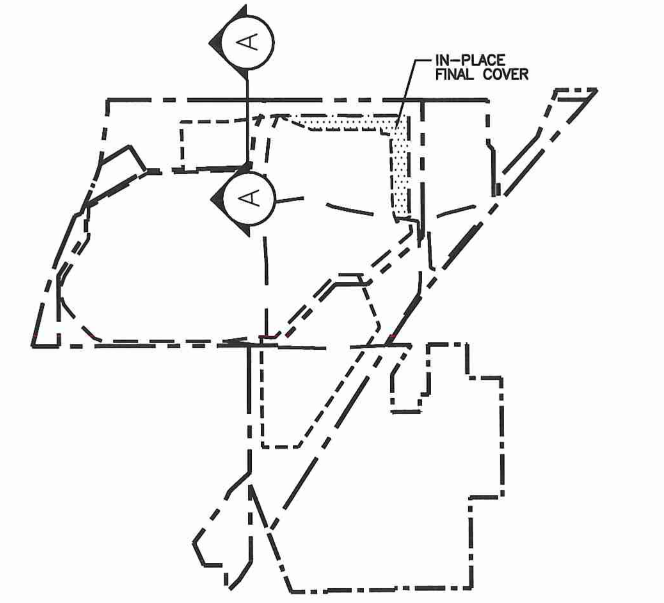


MULTIMED INFORMATION	
AVERAGE AQUIFER THICKNESS	3.0 M (10 FT)
HYDRAULIC CONDUCTIVITY	797.0 M/YR (2.53 X 10^{-3} CM/S)
HYDRAULIC GRADIENT	0.00093
DISTANCE TO POINT OF COMPLIANCE	55.5 M (182.1 FT)

SECTION A
(EXAGGERATED VERTICAL SCALE) A

0 100 200
HORIZONTAL SCALE IN FEET

0 10 20
VERTICAL SCALE IN FEET



KEY MAP
(NTS)

LEGEND

PROPERTY BOUNDARY
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY
PERMITTED LIMITS OF WASTE
PROPOSED LIMITS OF WASTE
MOSLEY ROAD LANDFILL LIMITS OF WASTE
EXISTING GRADE
HIGHEST MEASURED GROUNDWATER
SURFACE SAND UNIT
LOWER CONSOLIDATED UNIT
FILL MATERIAL

DEMONSTRATION PROCEDURE

1 CALCULATE PERCOLATION RATE USING HELP.
2 CALCULATE DILUTION ATTENUATION FACTOR (DAF) USING MULTIMED.

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. SEE TABLE 3-1 FOR DISCUSSION OF ASSUMPTIONS.
3. GEOLOGY SHOWN REPRESENTS MODEL CONDITIONS, NOT ACTUAL SITE CONDITIONS.
4. SEE APPENDICES L-2 AND M-2-2 FOR HELP AND MULTIMED MODELING DEMONSTRATION CALCULATIONS.

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CAD: FIG M-2-2-SECTION.DWG

DRAWN BY: VRS
DESIGN BY: MDM
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS		
NO.	DATE	DESCRIPTION

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CA 3804 PE - 06/30/2015

TIER III PERMIT MODIFICATION
TYPICAL PROFILE
INTERIM CONDITION (100 FOOT OF WASTE)

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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FIGURE M-2-2

O:\0086\356\EXPANSION 2013\APPENDIX M\FIG M-2-2-100 FT SECTION.dwg, uacholonu, 1:2

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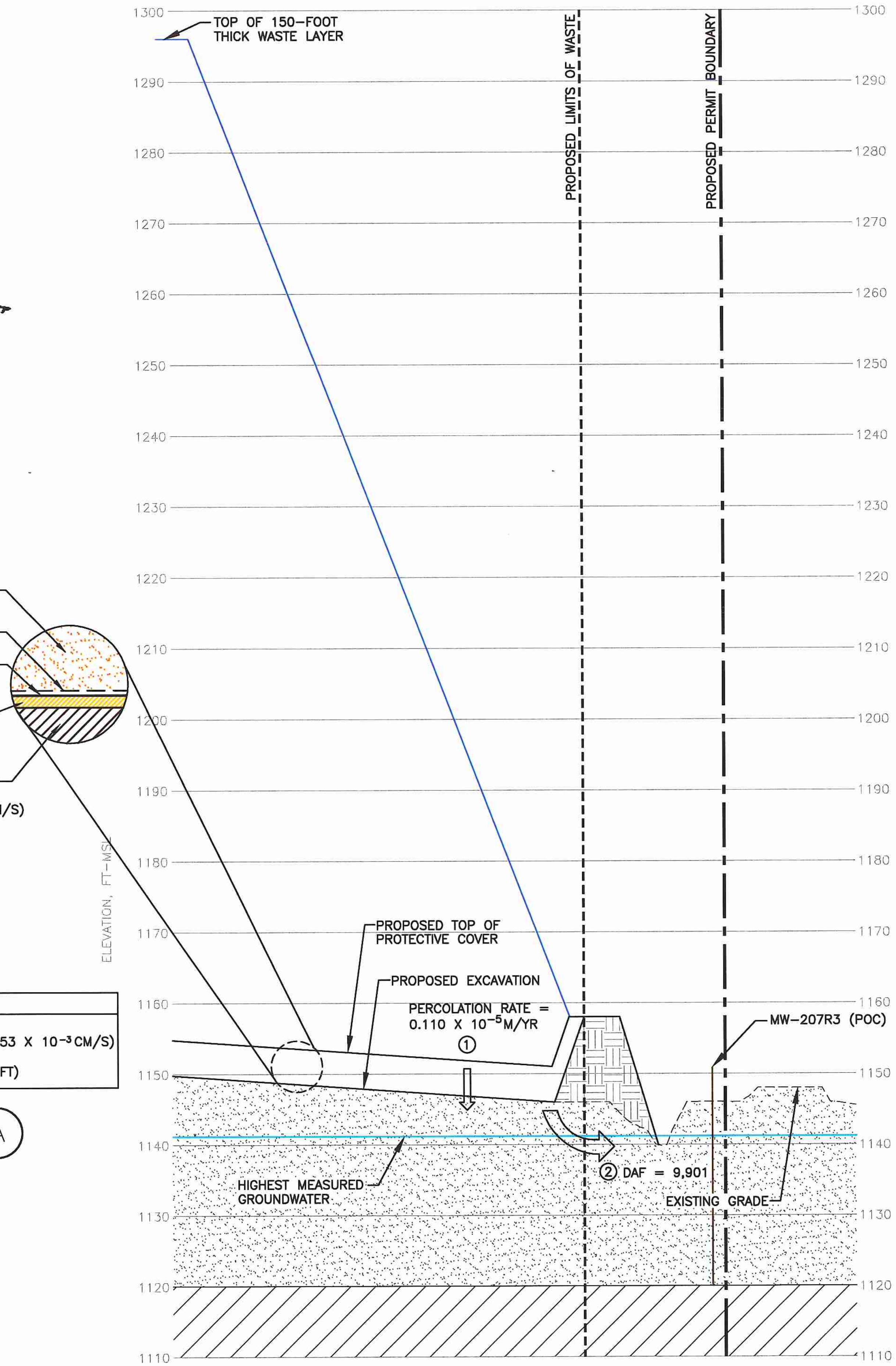
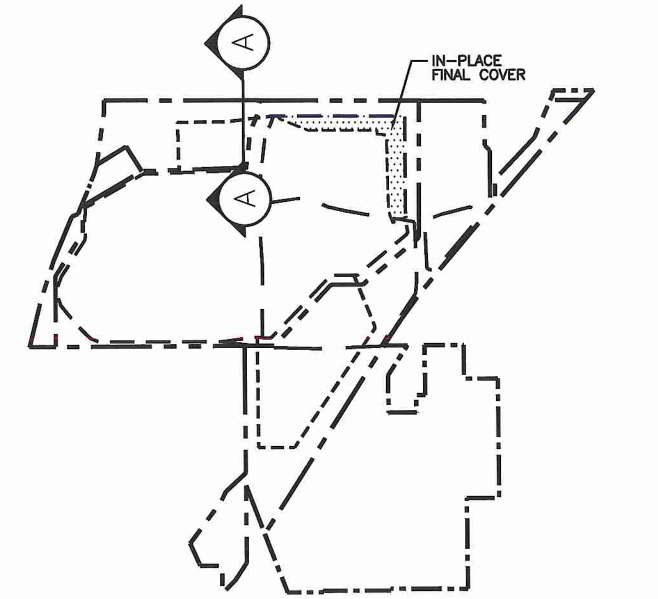


MULTIMED INFORMATION	
AVERAGE AQUIFER THICKNESS	3.0 M (10 FT)
HYDRAULIC CONDUCTIVITY	797.0 M/YR (2.53 X 10^{-3}CM/S)
HYDRAULIC GRADIENT	0.00093
DISTANCE TO POINT OF COMPLIANCE	55.5 M (182.1 FT)

SECTION A
(EXAGGERATED VERTICAL SCALE) (A)

0 100 200
HORIZONTAL SCALE IN FEET

0 10 20
VERTICAL SCALE IN FEET



KEY MAP
(NTS)

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- EXISTING GRADE
- HIGHEST MEASURED GROUNDWATER
- SURFACE SAND UNIT
- LOWER CONSOLIDATED UNIT
- FILL MATERIAL

DEMONSTRATION PROCEDURE

① CALCULATE PERCOLATION RATE USING HELP.
② CALCULATE DILUTION ATTENUATION FACTOR (DAF) USING MULTIMED.

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. SEE TABLE 3-1 FOR DISCUSSION OF ASSUMPTIONS.
3. GEOLOGY SHOWN REPRESENTS MODEL CONDITIONS, NOT ACTUAL SITE CONDITIONS.
4. SEE APPENDICES L-2 AND M-2-2 FOR HELP AND MULTIMED MODELING DEMONSTRATION CALCULATIONS.

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DATE: 06/2015
FILE: 0086-356-11
CAD: FIG M-2-3-SECTION.DWG

DRAWN BY: VRS
DESIGN BY: MDM
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
CA 3804 PE – 06/30/2015

TIER III PERMIT MODIFICATION
TYPICAL PROFILE
INTERIM CONDITION (150 FOOT OF WASTE)

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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FIGURE M-2-3

O:\0086\356\EXPANSION 2013\APPENDIX M\FIG M-2-3-150 FT SECTION.dwg, uacholonu, 1:2

APPENDIX M-2-2

MODELING PARAMETERS
AND
MULTIMED PROGRAM OUTPUT

LINER SYSTEM DESIGN DEMONSTRATION
MODELING PARAMETERS

Chemical Modeling Parameters

As detailed in Section 2.1, chemical decay was not modeled for the purposes of this demonstration. Such processes would, in fact, act to naturally reduce chemical concentrations, but these processes were conservatively disregarded. All chemical decay process constants were set to zero in the MULTIMED model in order to deactivate those portions of the model.

Source Modeling Data

Source data are listed in Table 1 of this appendix. The estimated leakage through the liner calculation is provided in Appendix L-2.

Unsaturated Zone Modeling Data

The unsaturated zone was not modeled as part of this alternative liner design demonstration. The attenuating effects of the unsaturated zone were conservatively disregarded.

Aquifer Modeling Data

Aquifer data is listed in Table 2 of this appendix.

Table 1
Source-Specific Modeling Data

Variable Name		Units	Value	Comments
Infiltration Rate	Interim 100 ft	m/yr	0.126×10^{-5}	Calculated using HELP Model (Appendix L-2)
	Interim 150 ft	m/yr	0.110×10^{-5}	Calculated using HELP Model (Appendix L-2)
Area of Waste Disposal Unit		m^2	359,766	88.9 acres (area of alternative liner)
Spread of Contaminant Source		m		Derived by MULTIMED
Recharge Rate		m/yr	0.093	Diluting effects of rainfall were conservatively assumed to be 10% of the average annual rainfall (10% of average annual rainfall = 3.652 inches or 0.093 m).
Initial Concentration at Landfill		mg/l	1.0	Set at 1.0 to find DAF
Length Scale of Facility		m		Derived by MULTIMED
Width Scale of Facility		m		Derived by MULTIMED

Table 2
Aquifer-Specific Modeling Data

Variable Name	Units	Value	Comments
Particle Diameter	cm	--	Not used when user specifies porosity
Aquifer Porosity	Unitless	0.35	From Appendix E, Subsurface Investigation
Bulk Density	g/cc	1.73	From Ref. 1, Table 6-11, p. 99, Bulk density for various geologic materials
Aquifer Thickness	m	3.0	From Appendix E, Subsurface Investigation (monitor well screen interval is 10 ft)
Mixing Zone Depth	m		Derived by MULTIMED
Hydraulic Conductivity	m/yr	797.0	From Appendix E, Subsurface Investigation (2.53×10^{-3} cm/s).
Groundwater Seepage Velocity	m/yr		Derived by MULTIMED
Retardation Coefficient	Unitless		Derived by MULTIMED
Longitudinal Dispersivity	m		Derived by MULTIMED
Transversal Dispersivity	m		Derived by MULTIMED
Vertical Dispersivity	m		Derived by MULTIMED
Organic Carbon Content	%	0	Conservative assumption.
Hydraulic Gradient	m	0.00093	From Appendix E, Subsurface Investigation
Receptor Distance From Site	m	55.5	This distance was measured from the edge of waste to the downgradient POC well, MW-207R3 (182.1 ft or 55.5 m).
Z-Distance From Water Table	m	0	Assume water table at bottom of liner. To be conservative the attenuating effect of an unsaturated zone is not considered.

1. Sharp-Hansen, S., Travers, C., Hummel, P., and Allison, T., 1990. *A Subtitle D Landfill Application Manual For The Multimedia Exposure Model (MULTIMED)*, U.S. Environmental Protection Agency, 470 p.

MULTIMED OUTPUT FILES

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

1
Run options
--- -------
EAST OAK RDF LINER SYSTEM DESIGN

INTERIM CASE 100 FT
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00

Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.126E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.930E-01	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.400E-02	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.350	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.73	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	3.00	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	797.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.930E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	20.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.00	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-05	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	55.5	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1157E-03

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

1

Run options

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EAST OAK RDF LINER SYSTEM DESIGN
INTERIM CASE 150 FT
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

1
1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.110E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.930E-01	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.400E-02	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.350	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.73	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	3.00	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	797.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.930E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	20.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.00	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-05	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	55.5	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1010E-03

EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3555036

APPENDIX N

GEOTECHNICAL ASSESSMENT

Prepared for

Waste Management of Oklahoma, Inc.

June 2015

LICENSED PROFESSIONAL ENGINEER
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WBC Project No. 0086-356-11-40-08

CONTENTS

CONTENTS (Continued)

TABLES

1 INTRODUCTION

The purpose of this report is to present the geotechnical analysis and design for the expansion of the East Oak Recycling and Disposal Facility. This report addresses the geotechnical testing information that has been compiled for the site, a stability analysis, and a settlement, heave, and strain analysis. Recommendations for construction of the various landfill components including the liner and final cover systems are also provided.

2 SUMMARY OF LABORATORY TESTING

2.1 General

Western Technologies, Ltd. (Western, 1984), Shepherd Engineering and Testing Company, Inc. (SETCO, 1985), Golder Associates, Inc. (Golder, 1991), Rust Environmental and Infrastructure, Inc. (Rust, 1993), and Weaver Boos Consultants, LLC–Southwest (WBC, 2005 and 2014) conducted laboratory tests on samples recovered from borings completed to evaluate physical and engineering properties of the different strata for geotechnical investigation. Laboratory tests were performed in general accordance with ASTM and U.S. Army Corps of Engineers procedures. The following laboratory tests were performed on selected soil samples recovered during geotechnical investigations.

Table 2-1
Geotechnical Test Methods Performed

Test	Test Method
Hydraulic Conductivity	ASTM D5084 and EM-1110-2-1906, Appendix VII
Soil Classification	ASTM D2487
Particle Size	ASTM D422
Percent Passing 200 Sieve	ASTM D1140
Atterburg Limits	ASTM D4318
Moisture Content	ASTM D2216 (Oven Drying) or ASTM D4643 (Microwave Drying)
Moisture/Density	ASTM D698 (Standard Proctor) or ASTM D1557 (Modified Proctor)
Direct Shear (Consolidated Drained)	ASTM D3080
Unconfined Compressive Strength	ASTM D2938

Copies of the boring logs from previous site investigations are included in Appendix E – Subsurface Investigation and Groundwater Study. Results from geotechnical tests, including material classification, strength tests, and laboratory hydraulic conductivity tests, are summarized and included in Appendix N-1. In-situ hydraulic conductivity testing information is provided in Appendix E – Subsurface Investigation and Groundwater Study.

2.2 Material Properties

The subsurface materials encountered at the site are discussed in detail in Appendix E – Subsurface Investigation and Groundwater Study. In general, the subsurface at the site is characterized by the following two units.

- Alluvium
- Garber-Wellington

The results of laboratory tests performed on soil samples recovered from the site are summarized in Table 2-2. These test results were reviewed with the boring log information and compared to literature values to develop generalized soil properties used in the geotechnical design and analyses included in this appendix.

2.3 Conclusion of Lab Testing

Classification testing along with unit weight, moisture content, and sieve analysis results were used to support field observations during subsurface explorations. Testing results were also used to support the subsurface characterization which includes an uppermost unconfined unit (Alluvium) underlain by another unconfined unit (Garber-Wellington) that exist across the site. Additionally, soil strength parameters from literature were conservatively selected for similar materials for analysis purposes if site specific material data were not available.

Table 2-2
Typical Properties of On-Site Material

Laboratory Test[1]	Test Method	Typical Values [2,3]		Number of Tests	
		Alluvium	Garber-Wellington	Alluvium	Garber-Wellington
Liquid Limit (LL)	ASTM D4318	38	30	23	5
Plastic Limit (PL)	ASTM D4318	18	17	23	5
Plasticity Index (PI)	ASTM D4318	20	13	23	5
% Passing No. 200 Sieve	ASTM D1140	41	45	40	5
Natural Moisture Content, %	ASTM D2216	18	13	75	27
Dry Unit Weight, pcf		101	122	6	25
Vertical Hydraulic conductivity (cm/s)	EL-1110-2-1906 Appendix VII/ASTM D5084	–	7.6E-05	–	14
Unconfined Compression (tsf)	ASTM D2166	2	35.3	8	8

1 Laboratory test results were obtained from site subsurface investigations. Laboratory test data from site subsurface investigations are presented in Appendix N-1.
2 Values listed are averages of the data for each soil layer.
3 Refer to Appendix E for information regarding geologic unit and primary lithology.
4 Refer to Appendix E for in-situ hydraulic conductivity information.

3 PERMIT REQUIREMENTS AND CONSTRUCTION RECOMMENDATIONS

3.1 General

This section contains permit requirements and construction recommendations for landfill excavation, soil liner construction, leachate collection layer placement, cover soils, final cover construction, and perimeter berm construction.

3.2 Material Requirements

Construction of the landfill will require clay or clayey soils which can be compacted to have an in-place hydraulic conductivity of $1x10^{-7}$ cm/s or less for the soil liner portion of the composite liner system. An alternative final cover will be placed over the entire site including pre-Subtitle D areas. Soil will also be required for the leachate collection layer and protective cover on the liner, operational cover (daily and intermediate), the erosion layer component of the final cover, berm construction, and other miscellaneous general fill. Typical material requirements are summarized in Table 3-1. Testing requirements and construction quality control and quality assurance for soil liner material is detailed in Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing. Testing requirements and construction quality control and quality assurance for final cover system soils are detailed in Appendix J – Alternative Final Cover System Design. Liner and leachate collection system details (Drawings 19 through 23), and final cover details (Drawings 24 through 26) are included in Volume 1.

Table 3-1
Typical Soil Requirements for Landfill Construction

Landfill Component	Soil Description	Classification	Test Parameters				Material Source[1]
			LL	PI	% - 200	Hydraulic Conductivity cm/s	
Vegetation Layer	Clayey sand, sandy clay, or clay	SC, CL, SM	Suitable to support plant growth				On Site
Vegetation Support Layer	Homogeneous clay, silty clay, sandy clay, or clayey sand	CL, CH, ML, SM, or SC					On Site
Protective Cover	sand or sand with silt and clay	SP-SM, SP, SP-SC, SW, SM or SM-SC				$1x10^{-3}$ min	On Site
Leachate Collection Layer	Sand, gravelly sand, or gravel	SW, SP, GW, GP				$1x10^{-3}$ min	On Site
Soil Liner	clayey sand, sandy clay, or clay	SC, CL, CH	24 min	10 min	30 min	$1x10^{-7}$ max	On Site
Operational Cover (Daily Cover, Intermediate Cover and Soil Barrier Layer)	sand, clayey sand, sandy clay, or clay	SP, SC, CL, CH	--	--	--	--	On Site
Earth Fill: Perimeter Berm & Subgrade Preparation	Homogeneous clay, silty clay, sandy clay, or clayey sand	CL, CH, ML, SM, or SC	--	--	--	--	On Site

[1] Offsite material may also be used.

3.3 Landfill Excavation

The landfill will be founded primarily in the Alluvium Unit. Landfill base grades will be excavated in a manner that will achieve reasonable segregation of liner quality material from the topsoil. Materials will be stockpiled separately, according to construction material properties outlined in Table 3-1 and visual observation during excavation.

Placement of general fill may be required below the composite liner since portions of the expansion area will have to be built up to reach the proposed excavation grades (i.e., proposed excavation grades are above existing grades). General fill placement procedures are included in Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing.

Excavation will be achieved with standard excavation equipment and no significantly hard materials are expected. Waste fill area excavation sideslopes (i.e., slopes that will be lined) will be graded no steeper than 3 horizontal to 1 vertical. Excavation cut slopes around the perimeter will require erosion protection if an extended period of time occurs between excavation and soil liner construction. Interim erosion protection can be accomplished by diverting most of the runoff water away from the slopes. "Track walking" with a bulldozer up and down the slopes will create the effect of "mini-dikes," which will reduce erosion.

Prior to beginning construction of the landfill components, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The soil liner subgrade area will be proof-rolled with heavy, rubber-tired construction equipment to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted earth fill. Preparation of the subgrade will result in a surface that is stable and that does not exhibit significant rutting from construction traffic. The prepared subgrade will be approved by a geotechnical professional and will be surveyed to verify grades.

3.4 Soil Liner Construction

The proposed liner system design (LSD) will be an alternative liner design in accordance with OAC 252:515-11-2(c). The composite liner details are depicted on Drawings 19 through 22 in Volume 1. The liner system configuration (from top to bottom) is a 60-mil geomembrane liner (FML), geosynthetic clay liner (GCL), and 24 inches of compacted clay. The following information is applicable to the compacted clay component of the LSD.

The bottom and sides of the landfill excavation will consist of a 24-inch-thick compacted soil liner. Adequate liner quality material may be available from proposed landfill excavations, on-site borrow sources, or off-site borrow sources to provide material for the constructed soil liners. Laboratory tests indicate that these materials are adequate to meet the compacted clay liner requirements listed in OAC 252:515-11-33. Laboratory tests of samples included in the LITs for previous phase constructions indicate that soils will achieve a hydraulic conductivity of less than $1x10^{-7}$ cm/s.

The following soil liner properties are included in Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing.

Table 3-2
Soil Liner Properties

Test	Specifications
In-Place Dry Density	95% of Maximum Standard Proctor (ASTM D 698) Dry Density or 90% of Maximum Modified Proctor (ASTM D 1557) Dry Density
In-Place Moisture Content	Standard Proctor or Modified Proctor Optimum Moisture Content or Greater
Hydraulic Conductivity	$1.0x10^{-7}$ cm/s or less
Plasticity Index	10 minimum
Liquid Limit, percent	24 minimum
Percent Passing No. 200 Mesh Sieve	30% minimum
Percent Retained No. 4 Mesh Sieve	20% maximum

Representative preliminary sampling will be performed on soils from landfill excavations, onsite borrow sources and/or offsite borrow sources to be used as soil liner material. Pre-construction tests will be performed at a frequency not less than one test series for every 10,000 cubic yards of soil to be used in soil liner construction, unless soil types are limited and easily distinguished. As soil is usually made available subsequent to excavation during soil liner construction, additional pre-construction samples should be taken and tests performed when soils vary, or when the initial pre-construction test results appear inappropriate or questionable. If and when the same borrow source is utilized for the soil supply of more than one soil liner area, results from previous tests may be used to supplement the pre-construction data. The soil liner construction and testing procedures are outlined in Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing.

3.5 Leachate Collection Layer

The leachate collection layer consists of a 12-inch-thick sand layer with a hydraulic conductivity of $1x10^{-3}$ cm/s or greater. The protective cover material will either be an additional 12-inch-thick sand layer ($k \geq 1x10^{-3}$ cm/s) or a 12-inch-thick layer of tire chips (floor grades only). Each phase will have a bottom slope toward an LCS trench (i.e., pipe enveloped in gravel and geotextile) that will collect drainage from the bottom and side slopes. The leachate collection system details are illustrated on Drawings 19 through 23

Volume 1. The construction procedures for the LCS are outlined in Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing. The material specifications for the LCS are provided in Appendix L – Leachate Collection System Design.

3.6 Operational Cover Soils

Operational cover soils include daily cover (6 inches thick minimum placed over the waste each day) and intermediate cover (12 inches thick minimum placed over waste in areas that will not receive additional fill for at least 6 months). All soils excavated at the site may be used for operational cover.

3.7 Protective Cover Soils

The leachate collection layer consists of a 12-inch-thick sand layer with a hydraulic conductivity of 1×10^{-3} cm/s or greater. The protective cover material will either be an additional 12-inch-thick sand layer ($k \geq 1 \times 10^{-3}$ cm/s) or a 12-inch-thick layer of tire chips (floor grades only). (see Appendix K – Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing).

3.8 Final Cover System Vegetation Support Layer Construction

The vegetation support layer will consist of a minimum 24-inch-thick soil layer that will extend along the top and sideslopes of the landfill. The vegetation layer material will consist of relatively homogeneous clay, silty clay, sandy clay, or clayey sand. Material used for the vegetation support layer shall classify as CL, CH, ML, SM, or SC according to the Unified Soil Classification System (USCS). The soil will be free of debris and rock greater than one inch in diameter. The vegetation support layer will be placed as a single lift and compacted to a density that is between 75 and 85 percent of the maximum dry density determined by Standard Proctor (ASTM D698) at a moisture content less than the optimum moisture content.

3.9 Final Cover System Vegetation Layer Construction

The vegetation layer will consist of a 12-inch-thick layer placed over the vegetation support layer. This vegetation layer consists of soil capable of supporting vegetative growth. The soil will be placed in one lift over the entire surface of the vegetation support layer and is compacted in place with a dozer. The surface of the vegetation layer should be graded to achieve the desired final grades and disked parallel to the proposed contours in preparation for seeding and to prevent excessive loss due to heavy rainfall.

3.10 Perimeter Embankment Construction

Perimeter embankments (berms) may be constructed to prevent surface water flow entering the landfill excavation. The embankment will have side slopes, in general, no steeper than 3 horizontal to 1 vertical (3H:1V) unless the slopes are stabilized with geogrid (or equivalent) reinforcement. Temporary containment and diversion berm information is included in Appendix L – Leachate Collection System Design.

Prior to beginning embankment fill, the subgrade area will be stripped to a depth sufficient to remove all topsoil and vegetation. Topsoil will be stockpiled for later use. The subgrade area will be proof-rolled with heavy, rubber-tired construction equipment to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted earth fill. The subgrade preparation will result in a subgrade surface that is stable and does not exhibit significant rutting from construction equipment traffic.

The embankments will be constructed of soils free of organic or other objectionable materials. The earth fill will be spread in maximum 9-inch-thick, loose, horizontal lifts and compacted to a minimum of 95 percent of standard Proctor maximum dry density, at a moisture content equal to or greater than the standard Proctor optimum moisture content. A minimum of one standard Proctor test (ASTM D698) will be performed on each representative soil used as earth fill material. Each lift will receive multiple passes with a heavy tamping roller. Qualified geotechnical personnel will provide moisture-density field-testing and monitoring during construction. As necessary, the outside face of all embankment construction will be vegetated to minimize erosion and desiccation.

4 SLOPE STABILITY ANALYSIS

4.1 General

XSTABL 5.2, a computer program developed to model general slope stability by the Simplified Bishop and Rankine Block Method, was used to analyze the stability of excavation, liner, interim fill, perimeter drainage structure, and final cover slopes. The composite liner system configuration of 24 inches of compacted clay, GCL, geomembrane liner, 12 inches of leachate collection layer, and 12 inches of protective cover, as shown on Drawings 19 through 22 in Volume 1, was utilized for modeling purposes. Circular failure surfaces using the Simplified Bishop method were generated for the stability analyses of the excavation, liner, interim fill, and the final configuration of the site. The Rankine Block method was used to analyze the stability of the interfaces of underlying soils and geosynthetics of the liner system by using block failure surfaces. The slope stability analysis is included in Appendix N-2A. In Appendix N-2B the stability of the liner system geosynthetic components was evaluated by using infinite slope stability analysis.

The stability of various critical sections was analyzed under short-term conditions (excavation and constructed liner) and long-term conditions (after liner construction). In addition, due to the potential of seismic impact at the project site (discussed in Section 2.11 of the Introduction Text in Volume 1), all sections were evaluated by a pseudo-static method using XSTABL to determine the minimum factor of safety (FS). The slope stability analyses are provided in Appendix N-2A.

4.2 Sections Selected for Analysis

Slope stability analyses were performed on critical sections to estimate the stability of the excavation, liner, interim fill, perimeter drainage structure, and final cover slopes. The geometry of the slope configurations analyzed was determined by reviewing the drawings included in Volume 1: the proposed excavation plan (Drawing 7), top of protective cover plan (Drawing 9), and the closure contour map (Drawing 10). The referenced drawings are included in Volume 1. The evaluation locations were selected to analyze critical slopes that include the landfill configuration as well as natural soils at the toe and below the landfill excavation slopes. The critical section locations were selected to represent the longest and steepest slopes for excavation and final landfill configurations. The interim fill slope was analyzed using an assumed geometry as discussed in Section 4.3. Figures showing the location of the cross sections are included in Appendix N-2A.

4.3 Configurations Analyzed

The excavation, liner, interim fill, and final landfill configurations were modeled to represent critical slope conditions, and the analysis was performed using circular and block failure surfaces. The maximum final fill slopes will be 4 horizontal to 1 vertical (4H:1V), while interim fill slopes, liner slopes, and excavation slopes could be as steep as 3H:1V. The excavation, liner, and interim fill slopes were analyzed with a slope angle of 3H:1V, and a 4H:1V final side slope was used to evaluate final cover. A copy of the excavation contour map and closure contour map showing the location of the cross sections selected for analysis are included in Appendix N-2A. Additionally, the configurations analyzed are graphically illustrated in Appendix N-2A. The interim condition was analyzed considering a 3H:1V slope with a horizontal length of 593 feet. If actual interim slopes longer than 593 feet are developed during site operations, an additional analysis will be completed at that time and maintained in the Site Operating Record.

4.4 Input Parameters

The cross sections for slope stability analysis were developed from the proposed excavation plan and the closure contour map (see Sheets N-2A-5 and N-2A-6 in Appendix N-2A). The soil parameters were selected based on a review of the boring logs and laboratory test results from the subsurface investigation studies at the site and upon engineering judgment and experience with similar materials. Laboratory testing should be performed again to confirm the design parameters if materials properties appear different at the time of construction.

As noted above, the East Oak Recycling and Disposal Facility lies within a seismic impact zone (see Appendix E); therefore, earthquake loads were evaluated for all sections using a pseudo-static method by assuming a horizontal loading coefficient of 0.155.

Waste strength parameters were derived from several references. MSW shear strength parameters reported in technical literature references vary, with friction angles as low as 10 degrees and as high as 53 degrees and cohesion values varying from 0 psf to 1400 psf. To provide for a conservative analysis, a cohesion of 288 psf and a friction angle of 35 degrees were selected.

Total and effective stress soil parameters were determined for use in the short and long-term static conditions, respectively, and the condition under seismic impact. Table 4-1 summarizes the strength parameters used for the stability analyses.

Table 4-1
Summary of Material Weight and Strength Properties for Landfill Slope Stability Analysis

Material Type	Moist Unit Weight (pcf)	Effective Stress Cohesion (psf)	Effective Stress Friction Angle (degrees)	Total Stress Cohesion (psf)	Total Stress Friction Angle (degrees)
General Fill – Perimeter Berm	116	250	30	1,000	0
General Fill – Liner Floor Area	116	0	30	0	30
Alluvium	119.2	0	25	0	25
Garber-Wellington	137.8	0	45	2,000	0
Vegetation Layer	112	0	25	170	16
Vegetation Support Layer	116	0	25	170	16
Waste	60	288	35	288	35
Drainage Layer	116	0	25	0	25
Textured Geomembrane and Reinforced GCL (Sideslope)	120	100	22	100	22
Smooth Geomembrane and Unreinforced GCL (Bottom Liner)	120	10	10	10	10

4.5 Results of Stability Analysis

4.5.1 Stability Analysis Using XSTABL

The results of the stability analyses using XSTABL computer program indicate that the proposed excavation, liner, interim fill, perimeter drainage structure, and final configuration slopes are stable under the conditions analyzed. Table 4-2 summarizes the results of the stability analyses for the landfill slopes and compares the calculated factor of safety to the recommended minimum factor of safety. The recommended minimum factors of safety for the conditions analyzed were determined using recommendations from the USACE Slope Stability, Engineering, and Design Manual (EM 1110-02-1902, October 31, 2008).

Loading Conditions	Recommended Minimum Factor of Safety
Permanent Long-Term	1.5
Short-Term (Excavation and Construction)	1.3
Seismic Loading	1.15

Computer-generated slope stability analysis output is included in Appendix N-2A. As shown in Table 4-2, the calculated factor of safety is above the recommended factor of safety.

Table 4-2
Summary of Slope Stability Analyses

Analyzed Section-Run	Failure Type	Minimum Factor of Safety				Factor of Safety Acceptable
		Static Condition		Seismic Condition[3]		
		Long-Term	Short-Term	Long-Term	Short-Term	
Recommended Minimum Factor of Safety		1.5[2]	1.3[2]	1.15[2]	1.15[2]	
Excavation Slope 1-1	Bishop-Circular	2.53	3.31	1.60	2.16	YES
Excavation Slope 2-1	Bishop-Circular	3.09	3.76	1.92	2.42	YES
Liner Slope 1-1	Bishop-Circular	3.32	3.95	2.04	2.50	YES
Liner Slope 2-1	Bishop-Circular	3.12	5.01	2.09	3.28	YES
Interim Slope 1-1	Bishop-Circular	2.27	2.30	1.45	1.46	YES
Final Cover Slope 1-1	Bishop-Circular	2.85	2.85	1.69	1.67	YES
Final Cover Slope 1-2	Rankine-Block	1.79	2.20	1.15	1.45	YES
Final Cover Slope 1-3	Rankine-Block	2.83	2.83	1.57	1.57	YES

[1] For excavation, liner, and interim slopes, run 1 represents the circular failure analysis. For final cover slopes, run 1 represents the circular failure analysis through the waste, run 2 represents the circular failure analysis at the perimeter structure, and run 3 represents the block failure analysis.
[2] Recommended minimum factor of safety provided in reference 3 on page N-2A-2.
[3] A horizontal loading coefficient of 0.155 was applied to each condition to represent seismic impact.

4.5.2 Infinite Slope Stability Analysis

Infinite slope stability analysis for the liner and final cover systems has been included in this design. The infinite liner stability analysis addresses anchor trench design, stability of cover and drainage material on anchored geosynthetics, and shear forces within the liner system. The infinite final cover slope stability analysis addresses the shear forces within the final cover system. These calculations are presented in Appendix N-2B and indicate the liner and final cover systems to be satisfactory using the assumed parameters.

5 SETTLEMENT, STRAIN, AND HEAVE ANALYSIS

5.1 General

This section addresses settlement, strain, and heave analyses for foundation and post construction settlement of the liner and final cover systems. Heave (swelling) of subgrade areas may occur when overburden pressure is removed with soil excavation. Foundation settlement and strain may occur when additional loading occurs in the form of liner material, waste placement, and final cover construction. Settlement and strain of the final cover system will occur due to consolidation within the solid waste.

5.2 Foundation Heave

Potential heave (rebound) due to excavation of overburden soils above the excavation base was estimated using the standard consolidation theory for soils. In order to estimate potential for heave, the load is decreased, instead of increasing the load on the soils, to correspond with the projected weight of excavated soil. Using a maximum excavation depth of approximately 12 feet (existing ground elevation minus bottom of excavation at a given location), a heave of approximately 0.3 feet was calculated. Where the excavation depth is less, heave will also be less and therefore negligible over much of the landfill area. The majority of the expansion area will have to be built up to reach the proposed excavation grades (i.e., proposed excavation grades are above existing grades); therefore foundation heave is expected to be negligible. These calculations are included on pages N-3A-9 to N-3A-10. Heave will occur soon after excavation (before and during liner construction) and will not adversely affect the performance of the liner system.

5.3 Foundation Settlement and Strain

In general, landfill foundation settlement occurs as the cohesive foundation soils consolidate due to the weight of the landfill. Although the foundation soils at the site primarily consist of non-cohesive soils, foundation settlement was predicted using standard consolidation theory for soils. The analysis was performed using literature values presented in Appendix N-3A. The settlement analysis is provided in Appendix N-3A. The settlement calculation was based on a maximum applied load of approximately 135.6 feet of solid waste with unit weight of 60 pcf and cover with an average unit weight of 120 pcf. A generalized soil profile based on average conditions from boring logs and typical soil conditions over the site was used for the analysis.

Based on the result of the settlement analysis, the subgrade consolidation will not exceed approximately 0.59 feet.

The settlement of the liner will be generally uniform and will not adversely affect the performance of the liner or leachate collection system.

Maximum strain for the liner system is calculated by using maximum settlement. This is within the strain values that liner system components (e.g., GCL, geocomposite, FML, compacted clay) can withstand (see Appendix N-3A). Soil liners can withstand the smallest average allowable tensile strain which is 0.5 percent for compacted clay. GCL and FML can withstand significantly more strain, as listed in Appendix N-3A. The final deflected shape of the liner will generally consist of gradual transitions with the differential settlement occurring over several hundred feet or more (horizontal projection). Based on the above discussion, it is concluded that settlement will not adversely affect the liner system or flow in the leachate collection system.

5.4 Final Cover Settlement and Strain

Landfill final cover settlement occurs due to settlement of foundation soils and the settlement of waste materials. In general, foundation settlement is insignificant in comparison to the settlement of deposited waste. Waste settlement consists of primary and secondary settlement.

Settlement of solid waste generally begins rapidly as the waste load is placed and continues to occur for long periods of time after the initial placement. Initially, municipal solid waste will undergo primary settlement due to its own weight, final cover, equipment, etc. Primary settlement occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. By the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

Secondary settlement continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay. Settlement analysis for the final cover system is presented in Appendix N-3B.

A strain analysis has been incorporated into the final cover settlement analysis presented in Appendix N-3B. The purpose of the settlement and strain analysis is to demonstrate that the final cover system will be stable as designed and maintain positive drainage. If it is considered that the waste settlement is uniform, then the sideslopes are expected to maintain positive drainage. Based on the estimates of settlement for the maximum waste thickness (where maximum waste settlement is expected to occur on the top deck of the landfill) and minimum waste thickness (where minimum settlement is expected to occur on the top deck of the landfill), the landfill final cover will be subject to a strain (0.641 percent). The performance of the final cover system will not be adversely affected by the minimal amount of strain initiated by settlement. A strain demonstration in Appendix N-3B shows that the top deck areas of the final cover will be stable and maintain positive drainage after settlement.

6 CONCLUSIONS AND RECOMMENDATIONS

- Based upon field exploration, laboratory testing, and engineering analysis, the soil and strata at the site are geotechnically suitable for continued development of a municipal solid waste landfill.
- All geotechnical engineering tests were performed in accordance with industry practice and recognized procedures (e.g., ASTM standards).
- Stability of the proposed landfill excavation slopes, constructed liner slopes, interim fill slopes, perimeter drainage structure slopes, and the final cover sideslopes are acceptable as designed (see Appendix N-2A).
- Stability of the liner and final cover system components is acceptable as designed (see Appendix N-2B).
- Foundation heave during excavation is expected to be negligible and is within the strain limits of the liner system (refer to Appendix N-3A).
- Foundation settlement after filling is expected to be negligible and within the strain limits of the liner system (refer to Appendix N-3A).
- Settlement of the final cover system will not adversely affect the final cover system components, and the final cover system will function as designed (refer to Appendix N-3B).

APPENDIX N-1

GEOTECHNICAL DATA SUMMARY

LICENSED PROFESSIONAL ENGINEER
SALMAN A.
BAIG
27485
OKLAHOMA

06-05-15

Includes pages N-1-1 through N-1-37

SUMMARY

The geotechnical and geological subsurface explorations that included geotechnical testing for the East Oak Recycling and Disposal Facility site were conducted in 1979, 1984, 1985, 1991, 1993, 2005, and 2014. The investigations include:

- A 1984 report prepared by Western Technologies, Ltd. (Western) describes the advancement of 8 borings and installation of five monitoring wells and three piezometers as part of a subsurface investigation for the second phase of filling at the Mosley Road II Landfill.
- A 1985 report prepared by Shepherd Engineering and Testing Company, Inc. (SETCO) describes the advancement of five borings and the installation of five piezometers to determine and analyze the in-situ soil characteristics of the site.
- A 1991 report prepared by Golder Associates, Inc. (Golder) describes remedial actions taken at the Mosley Road Landfill which included several borings advanced at the landfill to provide subsurface characterization information.
- A 1993 report prepared by Rust Environmental and Infrastructure, Inc. (Rust) describes four borings that were done as part of a geotechnical investigation to evaluate the foundation stability of the site.
- Ten borings were advanced in the WBC subsurface investigation conducted in November and December 2005.
- Ten borings were advanced in the WBC subsurface investigation conducted in May and June 2014.

A more detailed discussion of the previous site explorations are included in Appendix E – Subsurface Investigation and Groundwater Study. Logs of the borings are also contained in Appendix E, Appendix E-2. The geotechnical studies included geotechnical field and laboratory testing. The results are summarized in this appendix.

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
GEOTECHNICAL DATA SUMMARY - ALL MATERIALS

Boring No.	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Density (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity		Unconfined Compressive Strength (tsf)	Triaxial Shear		Pocket Penetrometer Test (tsf)
							3/8"	#4	#8	#40	#200						Vertical	Horiz.		C (psf)	Ø (Deg.)	
1984, Western Technologies																						
B-1	6.5-7.5	Sand, fine to medium, brown	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
B-1	23.5-24.5	Sand, fine to coarse, trace gravel, grey	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
B-1	33.5-34.5	Sand, fine to coarse, with gravel, grey	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
B-1	38-39	Sand, fine to coarse, with gravel, grey	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--
B-1	50-50.1	Sandstone, weathered	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--
B-2	17-18	Sand, silty, fine to medium, brown	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--
B-2	26-27	Sand, fine to coarse, trace silt, grey	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
B-2	41.5-42.5	Sandstone, weathered	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--
MW-1	2.5-3.5	Sand, fine, trace silt, brown	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	
MW-1	7.5-8.5	Sand, fine, trace silt, brown	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	
MW-1	12.5-13.5	Sand, silty, fine, light brown	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	
MW-1	17.5-18.5	Sand, silty, fine, light brown	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	
MW-1	23-24	Sand, fine to coarse, trace silt, brown	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	
MW-1	32.5-33.5	Sand, fine to coarse, trace gravel, grey	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	
MW-1	37.5-38.5	Sandstone	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	
MW-2	2.5-3.5	Sand, fine, trace silt, brown	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	
MW-2	8.0-9.0	Sand, silty, fine to medium, brown	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	
MW-2	12.0-13.0	Sand, silty, fine to medium, brown	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	

Prep By: SS
Date: 6/1/2015

EAST OAK RECYCLING AND DISPOSAL FACILITY
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GEOTECHNICAL DATA SUMMARY - ALL MATERIALS

Chkd By: SAB
Date: 6/1/2015

Boring No.	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Density (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity		Unconfined Compressive Strength (tsf)	Triaxial Shear		Pocket Penetrometer Test (tsf)
							3/8"	#4	#8	#40	#200						Vertical	Horiz.		C (psf)	Ø (Deg.)	
MW-2	17.0-18.0	Sand, silty, fine to medium, grey-brown	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	
MW-2	20.5-21.5	Sand, fine to coarse, grey	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	
MW-2	25.0-26.0	Sand, fine to coarse, grey	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	
MW-3	2.0-3.0	Sand, fine, trace silt, brown	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	
MW-3	14.0-15.0	Clay, sandy, silty, light brown	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	
MW-3	28.0-29.0	Sand, clayey, brown	--	--	--	--	--	--	--	--	--	33	--	--	--	--	--	--	--	--	--	
MW-3	31.5-32.5	Sand, silty, fine, grey	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	
MW-3	37.0-38.0	Sand, silty, fine, grey	--	--	--	--	--	--	--	--	--	27	--	--	--	--	--	--	--	--	--	
MW-3	42.5-43.5	Sand, silty, fine, grey, occasional clay seams	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	
MW-4	3.5-4.5	Sand, fine to medium, brown	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	
MW-4	12.5-13.5	Clay, silty, sandy, light brown	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	
MW-4	17.5-18.5	Clay, silty, trace sand, brown	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	
MW-4	22.5-23.5	Clay, silty, trace sand, brown	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	
MW-4	27.0-28.0	Sand, silty, fine, light brown	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	
MW-4	35.0-36.5	Sand, fine to coarse, grey	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	
MW-4	37.5-38.5	Sand, fine to coarse, grey	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	
MW-4	40.0-41.5	Sand, fine to coarse, grey	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	
MW-4	44.5-45.5	Sand, silty, medium to coarse, grey	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	
MW-5	2.0-3.0	Clay, silty, trace organics, dark brown	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	
MW-5	7.0-8.0	Sand, fine to medium, brown	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	

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EAST OAK RECYCLING AND DISPOSAL FACILITY
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GEOTECHNICAL DATA SUMMARY - ALL MATERIALS

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Date: 6/1/2015

Boring No.	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Density (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity		Unconfined Compressive Strength (tsf)	Triaxial Shear		Pocket Penetrometer Test (tsf)
							3/8"	#4	#8	#40	#200						Vertical	Horiz.		C (psf)	Ø (Deg.)	
MW-5	14.0-15.0	Sand, silty, fine, brown	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	
MW-5	20.0-21.5	Sand, fine to medium, trace silt, grey	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	
MW-5	25.0-26.5	Sand, fine to medium, trace silt, grey	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	
MW-5	30.0-31.5	Sand, medium to coarse, trace silt, grey		--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--
1985 Shepherd Engineering and Testing Co., Inc.																						
P-A	0.0-1.0	Sand, silty, fine, brown	--	--	--	--	--	--	--	--	--	18	15.0	--	--	--	--	--	--	--	--	
P-A	4.0-5.0	Sand, silty, fine, light brown-grey	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	
P-A	5.0-6.5	Clayey Silt, brown	--	--	--	--	--	--	--	--	--	26	95.0	--	--	--	--	--	--	--	--	
P-A	9.0-10.0	Sand, silty, fine, light brown-tan	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	
P-A	19.0-20.0	Sand, fine, light brown-tan	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	
P-B	4.0-5.0	Silty Sand, fine, light brown-grey	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	
P-B	14.0-15.0	Sand, fine, brown	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	
P-C	4.0-5.0	Silty Sand, fine, light brown-grey with silt layers	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	
P-C	9.0-10.0	Silty Sand, fine, light brown-grey with silt layers	--	--	--	--	--	--	--	--	--	26	101.0	--	--	--	--	--	--	--	--	
P-C	14.0-15.0	Silty Sand, fine, light brown-grey with silt layers	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	
P-D	0.0-1.0	Sandy Silt, brown	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	
P-D	12.0-13.0	Sand, fine, tan	--	--	--	--	--	--	--	--	--	11	101.0	--	--	--	--	--	--	--	--	
P-D	17.0-18.0	Sand, fine, tan	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	
P-E	14.0-15.0	Sand, fine, light brown-tan	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	
P-E	24.0-25.0	Clay, silty, brown and black layers	--	--	--	--	--	--	--	--	--	12	86.0	--	--	--	--	--	--	--	--	--
1990 Golder																						
BH-12R	0.0-2.0	Clayey Silt, dark yellowish brown	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8	--	--	--

EAST OAK RECYCLING AND DISPOSAL FACILITY
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							3/8"	#4	#8	#40	#200						Vertical	Horiz.		C (psf)	Ø (Deg.)	
BH-12R	25.0-26.0	Sand, little silt, moderate yellowish brown	SW	--	--	--	--	--	--	--	7	19	--	--	--	--	--	--				
BH-12R	26.0-27.0	Silty Clay, dark yellowish brown, with interbedded medium sand layers	--	39	13	26	--	--	--	--	--	33	--	--	--	--	--	--				
BH-13R	0.0-2.0	Clayey Silt, pale yellow brown	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.7			
BH-13R	4.5-6.5	Silty Clay, moderate brown	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.3			
BH-13R	9.5-11.0	Silty Clay, moderate brown	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0			
BH-14R	10.0-12.0	Clayey Silt, dark yellow brown	CH	76	19	57	--	--	--	--	86	38	--	--	--	--	--	--				
BH-14R	12.0-14.0	Clayey Silt, dark yellow brown	--	74	18	56	--	--	--	--	--	38	--	--	--	--	--	--				
BH-14R	20.0-22.0	Sand, some silt, trace clay, moderate yellowish brown	SM-SC	--	--	--	--	--	--	--	22	23	--	--	--	--	--	--				
BH-14R	35.0-37.0	Sand, trace gravel, dark yellowish brown, with 6" interbedded clayey silt	SW-SP	--	--	--	--	--	--	--	9	10	--	--	--	--	--	--				
BH-129	25.0-26.5	Sand, fine to coarse, trace silt, pale yellowish brown	SW-SP	--	--	--	--	--	--	--	3	19	--	--	--	--	--	--				
BH-130	8.0-9.5	Sand, fine to medium, trace gravel, trace silt, dark yellowish orange	SW-SP	--	--	--	--	--	--	--	5	19	--	--	--	--	--	--				
BH-201	19.0-21.0	Sand, fine, some silt, dark yellowish brown	SW-SP	--	--	--	--	--	--	--	6	16	--	--	--	--	--	--				
BH-207	15.0-17.0	Silty Clay, dark yellowish brown, top 6" of sample in sand	--	48	15	33	--	--	--	--	--	29	--	--	--	--	--	--				

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Boring No.	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Density (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity		Unconfined Compressive Strength (tsf)	Triaxial Shear		Pocket Penetrometer Test (tsf)
							3/8"	#4	#8	#40	#200						Vertical	Horiz.		C (psf)	Ø (Deg.)	
BH-207	20.0-22.0	Sand, fine to medium, some silt, greenish-grey	SM	--	--	--	--	--	--	--	14	20	--	--	--	--	--	--				
BH-211	5.0-7.0	Clay, trace silt, dark yellowish brown	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.8			
BH-211	10.0-12.0	Clay, trace silt, dark yellowish brown	CL	30	18	12	--	--	--	--	85	19	--	--	--	--	--	--				
BH-211	15.0-17.0	Silty Clay, moderate yellowish brown	--	66	19	47	--	--	--	--	--	22	--	--	--	--	--	--	2.5			
BH-211	30.0-32.0	Sand, fine, some silt, trace clay, moderate yellowish brown	SM-SC	--	--	--	--	--	--	--	13	21	--	--	--	--	--	--				
BH-211	40.0-42.0	Sand, fine to coarse, trace silt, trace gravel, pale yellowish brown	SW-SP	--	--	--	--	--	--	--	3	17	--	--	--	--	--	--				
BH-214	20.0-22.0	1' Sand, fine to medium, some silt, over 1' Clay, dark yellowish brown	SC	--	--	--	--	--	--	--	25	20	--	--	--	--	--	--	--	--	--	--
BH-214	25.0-27.0	Sand, coarse, some silt, trace gravel, dark yellowish brown	SM	--	--	--	--	--	--	--	19	17	--	--	--	--	--	--	--	--	--	--
1993-1995 RUST																						
TH-1-SD	5.0-6.5	Clayey Silt	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	0.2	--	--	--
TH-1-SD	12.5-14.0	Silty Clay	CL	34	19	15	--	--	--	--	96	--	--	--	--	--	--	--	--	--	--	--
TH-1-SD	21.5-23.0	Sandy Silt	ML	21	20	1	--	--	--	--	79	--	--	--	--	--	--	--	--	--	--	--
TH-1-SD	29.0-30.5	Silty Sand	SM	--	--	--	--	--	--	--	58	--	--	--	--	--	--	--	--	--	--	--
TH-2-SD	5.0-6.5	Clay	CH	71	28	43	--	--	--	--	96	24	--	--	--	--	--	--	--	--	--	--
TH-2-SD	12.5-14.0	Clay	--	57	20	37	--	--	--	--	--	42	--	--	--	--	--	--	0.2	--	--	--
TH-2-SD	14.0-15.5	Clay	--	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	--	--	--
TH-2-SD	23.0-24.5	Silty Clay	CL-ML	22	16	6	--	--	--	--	76	--	--	--	--	--	--	--	--	--	--	--

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
GEOTECHNICAL DATA SUMMARY - ALL MATERIALS

Boring No.	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Density (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity		Unconfined Compressive Strength (tsf)	Triaxial Shear		Pocket Penetrometer Test (tsf)
							3/8"	#4	#8	#40	#200						Vertical	Horiz.		C (psf)	Ø (Deg.)	
TH-2-SD	29.0-30.5	Silty Sand	SM	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--
TH-3-SD	14.0-15.5	Clayey Silt	ML	19	14	5	--	--	--	--	60	--	--	--	--	--	--	--	--	--	--	--
TH-3-SD	23.0-24.5	Sand	SM-SC	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--
TH-3-SD	29.0-30.5	Silty Sand	SM	14	12	2	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	5.0-6.5	Silty Sand	SM	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	12.5-14.0	Silty Sand	SM	--	--	--	--	--	--	--	5.0	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	23.0-24.5	Silty Sand	SM	14	11	3	--	--	--	--	39	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	29.5-31.0	Sand	--	44	14	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2005 Subsurface Investigation by Weaver Boos Consultants, LLC-Southwest Testing Laboratory: M.L. Testing																						
WB-2	28-29.5	Sand, gravelly	GW	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--
WB-2	34-36	Sandstone, silty, clayey	--	--	--	--	--	--	--	--	--	15	114.1	131.2	--	--	3.0E-04	--	40.0	--	--	>4.5
WB-4	18-19.5	Sand, gravelly	GW	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	0.0
WB-4	24-27.5	Shale, clayey, some sandy	--	--	--	--	--	--	--	--	--	6	134.2	142.3	--	--	8.5E-08	--	23.7	--	--	>4.5
WB-5	38.0	Sandstone	--	--	--	--	--	--	--	--	--	15	118.7	136.5	--	--	--	--	--	--	--	--
WB-7	19.0	Sandstone	--	--	--	--	--	--	--	--	--	17	119.3	139.6	--	--	--	--	--	--	--	>4.5
WB-7	28-30	Sandstone	SM-SC	27	22	5	--	--	--	--	21	15	110.6	127.2	--	--	2.4E-06	--	20.4	--	--	>4.5
WB-8	24.0	Sandstone, silty, clayey	--	--	--	--	--	--	--	--	--	3	113.3	116.7	--	--	--	--	--	--	--	>4.5
WB-8	32-34	Sandstone, silty, clayey	SM-SC	29	22	7	--	--	--	--	11	17	111.1	130.0	--	--	5.4E-04	--	37.9	--	--	>4.5
WB-9	24-26	Shale, sandy	CL	32	12	20	--	--	--	--	60	6	148.5	157.4	--	--	1.4E-06	--	--	--	--	4.0
WB-9	31.0	Shale, silty, sandy	CL	26	15	11	--	--	--	--	58	5	140.7	147.7	--	--	--	--	--	--	--	>4.5
WB-10	0.0	Clay, silty	CH	57	21	36	--	--	--	--	98	15	106.9	122.9	--	--	--	--	--	--	--	>4.5
WB-10	28-30	Sandstone, silty, clayey	--	--	--	--	--	--	--	--	--	12	117.4	131.5	--	--	2.0E-04	--	--	--	--	4.0
WB-10	35.0	Shale, clayey, sandy	CL	38	16	22	--	--	--	--	74	10	124.5	137.0	--	--	1.3E-08	--	--	--	--	>4.5
2014 Subsurface Investigation by Weaver Boos Consultants, LLC-Southwest Testing Laboratory: M.L. Testing																						
PWB-01	45-49	Siltstone, sandy	--	--	--	--	--	--	--	--	--	12	118.5	132.6	--	--	1.10E-05	--	49.7	--	--	>4.5
PWB-02	4.0	Silt, sandy	CL	33.0	17.0	16.0	--	--	--	--	56.0	--	--	--	--	--	--	--	--	--	--	--
PWB-02	45-50	Sandstone, silty	--	--	--	--	--	--	--	--	--	18	108.8	128.6	--	--	2.70E-07	--	--	--	--	>4.5
WB-03	0.0	Sand, silty	SM	18.0	17.0	1.0	--	--	--	--	20.0	--	--	--	--	--	--	--	--	--	--	--
WB-03	6.0	Silt, sandy	ML	26.0	24.0	2.0	--	--	--	--	66.0	--	--	--	--	--	--	--	--	--	--	--
WB-04	0.0	Silt, sandy	--	--	--	--	--	--	--	--	58.0	--	--	--	--	--	--	--	--	--	--	--

Prep By: SS
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Chkd By: SAB
Date: 6/1/2015

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
GEOTECHNICAL DATA SUMMARY - ALL MATERIALS

Boring No.	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Density (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity		Unconfined Compressive Strength (tsf)	Triaxial Shear		Pocket Penetrometer Test (tsf)
							3/8"	#4	#8	#40	#200						Vertical	Horiz.		C (psf)	Ø (Deg.)	
WB-04	2.0	Silt, sandy	--	--	--	--	--	--	--	--	67.0	--	--	--	--	--	--	--	--	--	--	--
WB-04	4.0	Sand, silty	--	--	--	--	--	--	--	--	45.0	--	--	--	--	--	--	--	--	--	--	--
PWB-05	30.0	Sandstone, silty	--	--	--	--	--	--	--	--	--	16	112.4	130.7	--	--	--	--	--	--	--	>4.5
WB-06	27.5	Sandstone	--	--	--	--	--	--	--	--	--	12	120.9	135.3	--	--	--	--	--	--	--	>4.5
WB-06	30.0	Sandstone	--	--	--	--	--	--	--	--	--	16	114.8	133.3	--	--	--	--	--	--	--	>4.5
PWB-07	22.5	Sandstone	--	--	--	--	--	--	--	--	--	7	149.8	159.8	--	--	--	--	49.6	--	--	>4.5
PWB-07	25-29	Sandstone	--	--	--	--	--	--	--	--	--	8	139.5	151.1	--	--	7.10E-07	--	12.0	--	--	>4.5
PWB-07	29-32	Sandstone, silty	--	--	--	--	--	--	--	--	--	13	124.7	140.3	--	--	4.70E-07	--	--	--	--	>4.5
WB-08	35-40	Sandstone	--	--	--	--	--	--	--	--	--	14	122.3	138.8	--	--	1.20E-05	--	--	--	--	>4.5
WB-08	60.0	Sandstone	--	--	--	--	--	--	--	--	--	16	111.7	130.0	--	--	--	--	--	--	--	>4.5
WB-08	80.0	Sandstone	--	--	--	--	--	--	--	--	--	15	119.6	137.2	--	--	--	--	--	--	--	>4.5
WB-08	95.0	Sandstone	--	--	--	--	--	--	--	--	--	15	117.0	134.9	--	--	--	--	--	--	--	>4.5
PWB-09	2.0	Clay, silty	CL-ML	29.0	22.0	7.0	--	--	--	--	75.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	6.0	Clay	CL	36.0	20.0	16.0	--	--	--	--	89.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	14.0	Clay, silty	CL-ML	28.0	22.0	6.0	--	--	--	--	82.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	22.0	Sand, silty	--	21.0	18.0	3.0	--	--	--	--	11.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	47.5-50	Siltstone	--	--	--	--	--	--	--	--	--	13	122.3	137.6	--	--	5.90E-08	--	--	--	--	>4.5
PWB-10	2.0	Sand	--	--	--	--	--	--	--	--	30.0	--	--	--	--	--	--	--	--	--	--	--
PWB-10	25-30	Sandstone	--	--	--	--	--	--	--	--	--	15	119.0	136.3	--	--	5.20E-07	--	49.3	--	--	>4.5

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EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
GEOTECHNICAL DATA SUMMARY
ALLUVIUM UNIT

Boring	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Unit Weight (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity (cm/s)		Unconfined Compressive Strength (tsf)	Triaxial Compression		Pocket Penetrometer Test (tsf)
							3/8"	#4	#10	#40	#200						Vertical	Horiz.		Cohesion (psf)	Friction Angle (deg)	
1984 Western Technologies																						
B-1	6.5-7.5	Sand	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
B-1	23.5-24.5	Sand with gravel	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
B-1	33.5-34.5	Sand with gravel	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
B-1	38-39	Sand with gravel	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--
B-2	17-18	Sand, Silty	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--
B-2	26-27	Sand with silt	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
MW-1	2.5-3.5	Sand with silt	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--
MW-1	7.5-8.5	Sand with silt	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--
MW-1	12.5-13.5	Sand, silty	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--
MW-1	17.5-18.5	Sand, silty	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
MW-1	23-24	Sand with silt	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--
MW-1	32.5-33.5	Sand with gravel	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--
MW-2	2.5-3.5	Sand with silt	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--
MW-2	8.0-9.0	Sand with silt	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
MW-2	12.0-13.0	Sand, silty	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--
MW-2	17.0-18.0	Sand, silty	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
MW-2	20.5-21.5	Sand	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
MW-2	25.0-26.0	Sand	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
MW-3	2.0-3.0	Sand with silt	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--
MW-3	14.0-15.0	Clay, sandy, silty	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
MW-3	28.0-29.0	Sand, clayey	--	--	--	--	--	--	--	--	--	33	--	--	--	--	--	--	--	--	--	--
MW-3	31.5-32.5	Sand, silty	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--
MW-3	37.0-38.0	Sand, silty	--	--	--	--	--	--	--	--	--	27	--	--	--	--	--	--	--	--	--	--
MW-3	42.5-43.5	Sand, silty	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
MW-4	3.5-4.5	Sand	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--
MW-4	12.5-13.5	Clay, sandy, silty	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--
MW-4	17.5-18.5	Clay, silty	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--
MW-4	22.5-23.5	Clay, silty	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--
MW-4	27.0-28.0	Sand, silty	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--
MW-4	35.0-36.5	Sand	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
MW-4	37.5-38.5	Sand	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--
MW-4	40.0-41.5	Sand	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--
MW-4	44.5-45.5	Sand, silty	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--
MW-5	2.0-3.0	Clay, silty	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--
MW-5	7.0-8.0	Sand	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--
MW-5	14.0-15.0	Sand, silty	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--
MW-5	20.0-21.5	Sand	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
MW-5	25.0-26.5	Sand with silt	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
MW-5	30.0-31.5	Sand with silt		--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--
1985 Shepherd Engineering and Testing Co., Inc.																						
P-A	0.0-1.0	Sand, Silty	--	--	--	--	--	--	--	--	--	18	115.0	135.5	--	--	--	--	--	--	--	--
P-A	4.0-5.0	Sand, silty	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--
P-A	5.0-6.5	Clayey Silt	--	--	--	--	--	--	--	--	--	26	95.0	119.8	--	--	--	--	--	--	--	--
P-A	9.0-10.0	Sand, silty	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--
P-A	19.0-20.0	Sand	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--

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EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
GEOTECHNICAL DATA SUMMARY
ALLUVIUM UNIT

Chkd By: SAB
Date: 6/1/2015

Boring	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Unit Weight (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity (cm/s)		Unconfined Compressive Strength (tsf)	Triaxial Compression		Pocket Penetrometer Test (tsf)
							3/8"	#4	#10	#40	#200						Vertical	Horiz.		Cohesion (psf)	Friction Angle (deg)	
P-B	4.0-5.0	Silty Sand	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--
P-B	14.0-15.0	Sand	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
P-C	4.0-5.0	Silty Sand	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--
P-C	9.0-10.0	Silty Sand	--	--	--	--	--	--	--	--	--	26	101.0	127.7	--	--	--	--	--	--	--	--
P-C	14.0-15.0	Silty Sand	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--
P-D	0.0-1.0	Sandy Silt	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--
P-D	12.0-13.0	Sand	--	--	--	--	--	--	--	--	--	11	101.0	112.3	--	--	--	--	--	--	--	--
P-D	17.0-18.0	Sand	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--
P-E	14.0-15.0	Sand	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--
P-E	24.0-25.0	Clay, silty	--	--	--	--	--	--	--	--	--	12	86.0	96.4	--	--	--	--	--	--	--	--
1990 Golder																						
BH-12R	0.0-2.0	Clayey Silt	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8	--	--	--
BH-12R	25.0-26.0	Sand with silt	SW	--	--	--	--	--	--	--	7	19	--	--	--	--	--	--	--	--	--	--
BH-12R	26.0-27.0	Silty Clay	--	39	13	26	--	--	--	--	--	33	--	--	--	--	--	--	--	--	--	--
BH-13R	0.0-2.0	Clayey Silt	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.7	--	--	--
BH-13R	4.5-6.5	Silty Clay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.3	--	--	--
BH-13R	9.5-11.0	Silty Clay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0	--	--	--
BH-14R	10.0-12.0	Clayey Silt	CH	76	19	57	--	--	--	--	86	38	--	--	--	--	--	--	--	--	--	--
BH-14R	12.0-14.0	Clayey Silt	--	74	18	56	--	--	--	--	--	38	--	--	--	--	--	--	--	--	--	--
BH-14R	20.0-22.0	Sand with silt	SM-SC	--	--	--	--	--	--	--	22	23	--	--	--	--	--	--	--	--	--	--
BH-14R	35.0-37.0	Sand with gravel	SW-SP	--	--	--	--	--	--	--	9	10	--	--	--	--	--	--	--	--	--	--
BH-129	25.0-26.5	Sand with gravel	SW-SP	--	--	--	--	--	--	--	3	19	--	--	--	--	--	--	--	--	--	--
BH-130	8.0-9.5	Sand with gravel	SW-SP	--	--	--	--	--	--	--	5	19	--	--	--	--	--	--	--	--	--	--
BH-201	19.0-21.0	Sand with silt	SW-SP	--	--	--	--	--	--	--	6	16	--	--	--	--	--	--	--	--	--	--
BH-207	15.0-17.0	Silty Clay	--	48	15	33	--	--	--	--	--	29	--	--	--	--	--	--	--	--	--	--
BH-207	20.0-22.0	Sand with silt	SM	--	--	--	--	--	--	--	14	20	--	--	--	--	--	--	--	--	--	--
BH-211	5.0-7.0	Clay with silt	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.8	--	--	--
BH-211	10.0-12.0	Clay with silt	CL	30	18	12	--	--	--	--	85	19	--	--	--	--	--	--	--	--	--	--
BH-211	15.0-17.0	Silty Clay	--	66	19	47	--	--	--	--	--	22	--	--	--	--	--	--	2.5	--	--	--
BH-211	30.0-32.0	Sand with silt	SM-SC	--	--	--	--	--	--	--	13	21	--	--	--	--	--	--	--	--	--	--
BH-211	40.0-42.0	Sand with gravel	SW-SP	--	--	--	--	--	--	--	3	17	--	--	--	--	--	--	--	--	--	--
BH-214	20.0-22.0	Sand, clayey	SC	--	--	--	--	--	--	--	25	20	--	--	--	--	--	--	--	--	--	--
BH-214	25.0-27.0	Sand with silt	SM	--	--	--	--	--	--	--	19	17	--	--	--	--	--	--	--	--	--	--
1993-1995 RUST																						
TH-1-SD	5.0-6.5	Clayey Silt	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	0.2	--	--	--
TH-1-SD	12.5-14.0	Silty Clay	CL	34	19	15	--	--	--	--	96	--	--	--	--	--	--	--	--	--	--	--
TH-1-SD	21.5-23.0	Sandy Silt	ML	21	20	1	--	--	--	--	79	--	--	--	--	--	--	--	--	--	--	--
TH-1-SD	29.0-30.5	Silty Sand	SM	--	--	--	--	--	--	--	58	--	--	--	--	--	--	--	--	--	--	--
TH-2-SD	5.0-6.5	Clay	CH	71	28	43	--	--	--	--	96	24	--	--	--	--	--	--	--	--	--	--
TH-2-SD	12.5-14.0	Clay	--	57	20	37	--	--	--	--	--	42	--	--	--	--	--	--	0.2	--	--	--
TH-2-SD	14.0-15.5	Clay	--	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	--	--	--
TH-2-SD	23.0-24.5	Silty Clay	CL-ML	22	16	6	--	--	--	--	76	--	--	--	--	--	--	--	--	--	--	--
TH-2-SD	29.0-30.5	Silty Sand	SM	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--
TH-3-SD	14.0-15.5	Clayey Silt	ML	19	14	5	--	--	--	--	60	--	--	--	--	--	--	--	--	--	--	--
TH-3-SD	23.0-24.5	Sand	SM-SC	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
GEOTECHNICAL DATA SUMMARY
ALLUVIUM UNIT

Boring	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Unit Weight (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity (cm/s)		Unconfined Compressive Strength (tsf)	Triaxial Compression		Pocket Penetrometer Test (tsf)
							3/8"	#4	#10	#40	#200						Vertical	Horiz.		Cohesion (psf)	Friction Angle (deg)	
TH-3-SD	29.0-30.5	Silty Sand	SM	14	12	2	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	5.0-6.5	Silty Sand	SM	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	12.5-14.0	Silty Sand	SM	--	--	--	--	--	--	--	5.0	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	23.0-24.5	Silty Sand	SM	14	11	3	--	--	--	--	39	--	--	--	--	--	--	--	--	--	--	--
TH-4-SD	29.5-31.0	Sand	--	44	14	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2005 Subsurface Investigation by Weaver Boos Consultants, LLC-Southwest Testing Laboratory: M.L. Testing																						
WB-2	28-29.5	Sand, gravelly	SW	--	--	--	--	--	--	52	8	--	--	--	--	--	--	--	--	--	--	--
WB-4	18-19.5	Sand, gravelly	SW	--	--	--	--	--	--	34	5	--	--	--	--	--	--	--	--	--	--	0.0
WB-10	0.0	Clay, silty	CH	57	21	36	--	--	--	--	98	15	106.9	122.9	--	--	--	--	--	--	--	4.5
2014 Subsurface Investigation by Weaver Boos Consultants, LLC-Southwest Testing Laboratory: M.L. Testing																						
PWB-02	4.0	Silt, sandy	CL	33.0	17.0	16.0	--	--	--	--	56.0	--	--	--	--	--	--	--	--	--	--	--
WB-03	0.0	Sand, silty	SM	18.0	17.0	1.0	--	--	--	--	20.0	--	--	--	--	--	--	--	--	--	--	--
WB-03	6.0	Silt, sandy	ML	26.0	24.0	2.0	--	--	--	--	66.0	--	--	--	--	--	--	--	--	--	--	--
WB-04	0.0	Silt, sandy	--	--	--	--	--	--	--	--	58.0	--	--	--	--	--	--	--	--	--	--	--
WB-04	2.0	Silt, sandy	--	--	--	--	--	--	--	--	67.0	--	--	--	--	--	--	--	--	--	--	--
WB-04	4.0	Sand, silty	--	--	--	--	--	--	--	--	45.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	2.0	Clay, silty	CL-ML	29.0	22.0	7.0	--	--	--	--	75.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	6.0	Clay	CL	36.0	20.0	16.0	--	--	--	--	89.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	14.0	Clay, silty	CL-ML	28.0	22.0	6.0	--	--	--	--	82.0	--	--	--	--	--	--	--	--	--	--	--
PWB-09	22.0	Sand, silty	--	21.0	18.0	3.0	--	--	--	--	11.0	--	--	--	--	--	--	--	--	--	--	--
PWB-10	2.0	Sand	--	--	--	--	--	--	--	--	30.0	--	--	--	--	--	--	--	--	--	--	--
			Average:	38	18	20	--	--	--	43	41	18	101	119	--	--	--	--	2.0	--	--	2.3
			Minimum:	14	11	1	--	--	--	34	3	3	86	96	--	--	--	--	0.2	--	--	0.0
			Maximum:	76	28	57	--	--	--	52	98	42	115	135	--	--	--	--	4.3	--	--	4.5
			Count:	23	23	23	--	--	--	2	40	75	6	6	--	--	--	--	8	--	--	2

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
GEOTECHNICAL DATA SUMMARY
GARBER WELLINGTON UNIT

Boring	Depth (ft)	Material Description	Soil Classification	LL	PL	PI	Sieve Analysis % Passing					Moisture Content %	Dry Unit Weight (pcf)	Moist Unit Weight (pcf)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Hydraulic Conductivity (cm/s)		Unconfined Compressive Strength (tsf)	Triaxial Compression		Pocket Penetrometer Test (tsf)
							3/8"	#4	#10	#40	#200						Vertical	Horiz.		Cohesion (psf)	Friction Angle (deg)	
1984, Western Technologies																						
B-1	50-50.1	Sandstone	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--
B-2	41.5-42.5	Sandstone	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--
2005 Subsurface Investigation by Weaver Boos Consultants, LLC-Southwest Testing Laboratory: M.L. Testing																						
WB-2	34-36	Sandstone, silty	--	--	--	--	--	--	--	--	--	15	114.1	131.2	--	--	3.0E-04	--	40.0	--	--	4.5
WB-4	24-27.5	Shale with sand	--	--	--	--	--	--	--	--	--	6	134.2	142.3	--	--	8.5E-08	--	23.7	--	--	4.5
WB-5	38.0	Sandstone	--	--	--	--	--	--	--	--	--	15	118.7	136.5	--	--	--	--	--	--	--	--
WB-7	19.0	Sandstone	--	--	--	--	--	--	--	--	--	17	119.3	139.6	--	--	--	--	--	--	--	4.5
WB-7	28-30	Sandstone, silty	SM-SC	27	22	5	--	--	--	--	21	15	110.6	127.2	--	--	2.4E-06	--	20.4	--	--	4.5
WB-8	24.0	Sandstone, silty	--	--	--	--	--	--	--	--	--	3	113.3	116.7	--	--	--	--	--	--	--	4.5
WB-8	32-34	Sandstone, silty	SM-SC	29	22	7	--	--	--	--	11	17	111.1	130.0	--	--	5.4E-04	--	37.9	--	--	4.5
WB-9	24-26	Shale, sandy	CL	32	12	20	--	--	--	--	60	6	148.5	157.4	--	--	1.4E-06	--	--	--	--	4.0
WB-9	31.0	Shale, silty, sandy	CL	26	15	11	--	--	--	--	58	5	140.7	147.7	--	--	--	--	--	--	--	4.5
WB-10	28-30	Sandstone, silty	--	--	--	--	--	--	--	--	--	12	117.4	131.5	--	--	2.0E-04	--	--	--	--	4.0
WB-10	35.0	Shale, sandy	CL	38	16	22	--	--	--	--	74	10	124.5	137.0	--	--	1.3E-08	--	--	--	--	4.5
2014 Subsurface Investigation by Weaver Boos Consultants, LLC-Southwest Testing Laboratory: M.L. Testing																						
PWB-01	45-49	Siltstone, sandy	--	--	--	--	--	--	--	--	--	12	118.5	132.6	--	--	1.10E-05	--	49.7	--	--	4.5
PWB-02	45-50	Sandstone, silty	--	--	--	--	--	--	--	--	--	18	108.8	128.6	--	--	2.70E-07	--	--	--	--	4.5
PWB-05	30.0	Sandstone, silty	--	--	--	--	--	--	--	--	--	16	112.4	130.7	--	--	--	--	--	--	--	4.5
WB-06	27.5	Sandstone	--	--	--	--	--	--	--	--	--	12	120.9	135.3	--	--	--	--	--	--	--	4.5
WB-06	30.0	Sandstone	--	--	--	--	--	--	--	--	--	16	114.8	133.3	--	--	--	--	--	--	--	4.5
PWB-07	22.5	Sandstone	--	--	--	--	--	--	--	--	--	7	149.8	159.8	--	--	--	--	49.6	--	--	4.5
PWB-07	25-29	Sandstone	--	--	--	--	--	--	--	--	--	8	139.5	151.1	--	--	7.10E-07	--	12.0	--	--	4.5
PWB-07	29-32	Sandstone, silty	--	--	--	--	--	--	--	--	--	13	124.7	140.3	--	--	4.70E-07	--	--	--	--	4.5
WB-08	35-40	Sandstone	--	--	--	--	--	--	--	--	--	14	122.3	138.8	--	--	1.20E-05	--	--	--	--	4.5
WB-08	60.0	Sandstone	--	--	--	--	--	--	--	--	--	16	111.7	130.0	--	--	--	--	--	--	--	4.5
WB-08	80.0	Sandstone	--	--	--	--	--	--	--	--	--	15	119.6	137.2	--	--	--	--	--	--	--	4.5
WB-08	95.0	Sandstone	--	--	--	--	--	--	--	--	--	15	117.0	134.9	--	--	--	--	--	--	--	4.5
PWB-09	47.5-50	Siltstone	--	--	--	--	--	--	--	--	--	13	122.3	137.6	--	--	5.90E-08	--	--	--	--	4.5
PWB-10	25-30	Sandstone	--	--	--	--	--	--	--	--	--	15	119.0	136.3	--	--	5.20E-07	--	49.3	--	--	4.5
			Average:	30	17	13	--	--	--	--	45	13	122	137	--	--	7.6E-05	--	35.3	--	--	4.5
			Minimum:	26	12	5	--	--	--	--	11	3	109	117	--	--	1.3E-08	--	12.0	--	--	4.0
			Maximum:	38	22	22	--	--	--	--	74	21	150	160	--	--	5.4E-04	--	49.7	--	--	4.5
			Count:	5	5	5	--	--	--	--	5	27	25	25	--	--	14	--	8	--	--	24

2014 WEAVER BOOS CONSULTANTS, LLC–SOUTHWEST LABORATORY TEST DATA

Sheet 1 of 1

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Percent Passing #40	Unconfined Compressive Strength (tsf)
PWB-01	45.0							11.9	118.5		49.7
PWB-02	4.0	33	17	16	0.075	56	CL				
PWB-02	45.0							18.2	108.8		
PWB-05	30.0							16.3	112.4		
PWB-07	22.5							6.7	149.8		49.6
PWB-07	25.0							8.3	139.5		12.0
PWB-07	29.0							12.5	124.7		
PWB-09	2.0	29	22	7	0.075	75	CL-ML				
PWB-09	6.0	36	20	16	0.075	89	CL				
PWB-09	14.0	28	22	6	0.075	82	CL-ML				
PWB-09	22.0	21	18	3	0.075	11					
PWB-09	47.5							12.5	122.3		
PWB-10	2.0				0.075	30					
PWB-10	25.0							14.5	119.0		49.3
WB-03	0.0	18	17	1	0.075	20	SM				
WB-03	6.0	26	24	2	0.075	66	ML				
WB-04	0.0				0.075	58					
WB-04	2.0				0.075	67					
WB-04	4.0				0.075	45					
WB-06	27.5							11.9	120.9		
WB-06	30.0							16.1	114.8		
WB-08	35.0							13.5	122.3		
WB-08	60.0							16.4	111.7		
WB-08	80.0							14.7	119.6		
WB-08	95.0							15.3	117.0		

US LAB SUMMARY EAST OAK EXPANSION.GPJ - 9/21/14

Telephone:
Fax:

Summary of Laboratory Results

Project: East Oak Expansion

Number: 0086-356-11-40-13

LAB DATA SHEET

Date: 9/18/14
JOB NAME: East Oak Expansion
Page ____ of ____
JOB NUMBER: 0086-356-11-40-13
Tech: MLT

Boring No.: PWB-2 Depth: 4-6 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL	49.23	40.83	15.14	51	25
PL	22.37	21.31	15.13	52	
-200	183.3	135.5	98.3	503	
MC					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — ☐ NONE ☐ · ☐ WEAK ☐ · ☐ STRONG ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Perm

Boring No.: PWB-2 Depth: 45-50 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200					
MC	95.6	83.2	15.17	88	
UDW	1.8	1.8	154.6		
Qu	Sample	to short			

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — ☐ NONE ☐ · ☐ WEAK ☐ · ☐ STRONG ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: WB-3 Depth: 0-2 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL	45.23	40.72	15.15	53	25
PL	29.43	27.38	15.11	54	
-200	205.3	183.1	96.4	DD	
MC					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — ☐ NONE ☐ · ☐ WEAK ☐ · ☐ STRONG ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: WB-3 Depth: 6-8 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL	38.48	33.65	14.84	55	25
PL	22.52	21.11	15.15	56	
-200	203.1	130.0	91.6	WW	
MC					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — ☐ NONE ☐ · ☐ WEAK ☐ · ☐ STRONG ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: WB-4 Depth: 0-2 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200	228.6	153.6	99.6	AA	
MC					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — ☐ NONE ☐ · ☐ WEAK ☐ · ☐ STRONG ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

LAB DATA SHEET

JOB NAME: East Oak Expansion

JOB NUMBER: 00816-356-11-40-13

Date: 9/18/14

Page ____ of ____

Tech: MLT

Boring No.: WB-4 Depth: 4-6 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
~~-200~~	198.5	153.7	98.3	up
MC				
UDW				
Qu				

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: WB-6 Depth: 27.5-30 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	86.2	78.6	15.0	89
~~UDW~~	1.7	1.95	180.4	
Qu				

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Perm

Boring No.: PWB-7 Depth: 29-32 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	80.1	72.9	15.1	84
~~UDW~~	3.2	1.95	351.7	
Qu				

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Perm

Boring No.: PWB-1 Depth: 45-49 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	92.3	84.1	15.4	86
~~UDW~~	5.15	1.95	535.4	
~~Qu~~	1500+	.040		

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

49.66 +5R

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: PWB-5 Depth: 30-34 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	83.9	74.3	15.5	77
~~UDW~~	3.9	1.95	399.7	
Qu				

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

LAB DATA SHEET

JOB NAME: East Oak Expansion

JOB NUMBER: 0086-356-11-40-13

Date: 9/18/14

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Tech: MLT

Boring No.: PWB-7 Depth: 25-29 Location: ____

Perm

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	92.3	86.4	15.7	86
~~UDW~~	4.1	1.95	485.6	
Qu	~~[illegible]~~ 363	~~[illegible]~~ .120		

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

Ring No.: ____

REACTION TO — HCl / Pheno.: ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

12.01 tsf

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: PWB-9 Depth: 47.5-50 Location: ____

Perm

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	82.7	75.2	15.3	90
~~UDW~~	2.4	2.0	272.3	
Qu				

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

Ring No.: ____

REACTION TO — HCl / Pheno.: ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: PWB-10 Depth: 25-30 Location: ____

Perm

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	75.2	67.6	15.2	91
~~UDW~~	4.7	1.95	502.0	
~~Qu~~	1500+	.070		

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

Ring No.: ____

REACTION TO — HCl / Pheno.: ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

49,30 tsf

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: WB-6 Depth: 30-32 Location: ____

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	99.5	87.8	15.2	75
~~UDW~~	3.5	1.95	345.7	
Qu				

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

Ring No.: ____

REACTION TO — HCl / Pheno.: ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: WB-8 Depth: 35-40 Location: ____

Perm

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.
LL				
PL				
-200				
~~MC~~	90.0	81.1	15.3	87
~~UDW~~	2.7	1.95	293.9	
Qu				

BLOWS: LL = ____ PL = ____ PI = ____ -200 = ____

Ring No.: ____

REACTION TO — HCl / Pheno.: ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: ____ Hand Penetrometer: ____ % Swell ____

LAB DATA SHEET

JOB NAME: East Oak Expansion

JOB NUMBER: 0086-356-11-40-13

Date: 9/18/14
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Tech: MLT

Boring No.: WB-8 Depth: 60-65 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200					
MC	75.5	67.0	15.2	79	
UDW	2.7	1.95	275.2		
Qu					

LL = PL = PI = -200 =

Ring No.:

REACTION TO: HCl / Pheno. — ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: Hand Penetrometer: % Swell

Boring No.: WB-8 Depth: 80-85 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200					
MC	92.1	82.2	15.0	92	
UDW	1.65	1.85	159.8		
Qu					

LL = PL = PI = -200 =

Ring No.:

REACTION TO: HCl / Pheno. — ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: Hand Penetrometer: % Swell

Boring No.: WB-8 Depth: 95-100 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200					
MC	90.6	80.6	15.1	86	
UDW	1.9	1.95	200.8		
Qu					

LL = PL = PI = -200 =

Ring No.:

REACTION TO: HCl / Pheno. — ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: Hand Penetrometer: % Swell

Boring No.: PWB-9 Depth: 2-4 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL	48.39	41.13	15.75	57	26
PL	22.98	21.58	15.27	58	
-200	191.8	116.3	91.7	B-3	
MC					
UDW					
Qu					

LL = PL = PI = -200 =

Ring No.:

REACTION TO: HCl / Pheno. — ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: Hand Penetrometer: % Swell

Boring No.: PWB-9 Depth: 6-8 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL	45.07	37.08	14.90	59	27
PL	22.33	21.15	15.27	60	
-200	159.8	101.2	93.9	B-2	
MC					
UDW					
Qu					

LL = PL = PI = -200 =

Ring No.:

REACTION TO: HCl / Pheno. — ☐ NONE ☐ / ☐ WEAK ☐ / ☐ STRONG ☐

Description: Hand Penetrometer: % Swell

LAB DATA SHEET

JOB NAME: East Oak Expansion

JOB NUMBER: 0086-356-11-40-13

Date: 9/18/14

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Tech: MLT

Boring No.: PWB-9 Depth: 14-15 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL	53.68	45.17	15.18	61	23
PL	25.17	22.95	12.69	62	
-200	197.0	114.1	95.9	Sal	
MC					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: PWB-9 Depth: 22-24 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL	51.45	45.17	15.18	63	25
PL	33.97	31.16	15.17	64	
-200	206.7	194.1	91.4	Feb	
MC					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: PWB-10 Depth: 2-4 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200	202.5	170.0	92.4	Apr	
MC					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: WB-4 Depth: 2-4 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200	179.9	119.0	89.0	II	
MC (wet)					
UDW					
Qu					

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

Boring No.: PWB-7 Depth: 22.5-25 Location:

	WET WEIGHT	DRY WEIGHT	TARE WEIGHT	TARE No.	BLOWS
LL					
PL					
-200					
MC	89.6	84.9	15.0	97	
UDW	4.55	1.95	570.4		
Qu	1500+	.040			

LL = ____ PL = ____ PI = ____ -200 = ____

REACTION TO: HCl / Pheno. — NONE ☐ ☐ WEAK ☐ ☐ STRONG ☐ ☐

49.61 tsf

Ring No.: ____

Description: ____ Hand Penetrometer: ____ % Swell ____

UNCONFINED COMPRESSION TEST WORKSHEET

PROJECT: East Oak Expansion
JOB NO.: 0086-356-11-4013
LOCATION:
DATE: 9/20/14
MATERIAL:
TECHNICIAN:
BORING NO.: PWB-1
DEPTH: 45-49
HEIGHT:
AVERAGE DIAMETER:

Ring Maxed Out

STRESS DIAL	LOAD	STRAIN DIAL	% STRAIN	STRESS, psi
	0	0.000		
	64	0.010		
	198	0.020		
	510	0.030		
	1500+	0.040		
		0.050		
		0.060		
		0.070		
		0.080		
		0.090		
		0.100		
		0.120		
		0.140		
		0.160		
		0.180		
		0.200		
		0.220		
		0.240		
		0.260		
		0.280		
		0.300		
		0.320		
		0.340		
		0.360		
		0.380		
		0.400		
		0.420		
		0.440		
		0.460		
		0.480		
		0.500		
		0.520		
		0.540		
		0.560		
		0.580		
		0.600		
		0.650		
		0.700		
		0.750		
		0.800		
		0.850		
		0.900		
		0.950		
		1.000		
		1.050		
		1.100		
		1.150		
		1.200		
		1.250		
		1.300		
		1.350		

TYPE OF FAILURE

- BULGE ☐
- VERTICAL SPLIT ☐
- ANGULAR ☐
- SLICKENSIDED ☐

SKETCH OF FAILURE

PROVING RING NO.: ______ STRAIN RATE: 1.52 mm/min OTHER: ______

UNCONFINED COMPRESSION TEST WORKSHEET

PROJECT: East Oak Expansion JOB NO.: 0086-356-11-40-13
LOCATION: DATE: 9/20/14
MATERIAL: TECHNICIAN:
BORING NO.: AWB-10 DEPTH: 25-30
HEIGHT: AVERAGE DIAMETER:

STRESS DIAL	LOAD	STRAIN DIAL	% STRAIN	STRESS, psi
	0	0.000		
	35	0.010		
	107	0.020		
	220	0.030		
	385	0.040		
	670	0.050		
	1210	0.060		
Ring maxed out	1500+	0.070		
		0.080		
		0.090		
		0.100		
		0.120		
		0.140		
		0.160		
		0.180		
		0.200		
		0.220		
		0.240		
		0.260		
		0.280		
		0.300		
		0.320		
		0.340		
		0.360		
		0.380		
		0.400		
		0.420		
		0.440		
		0.460		
		0.480		
		0.500		
		0.520		
		0.540		
		0.560		
		0.580		
		0.600		
		0.650		
		0.700		
		0.750		
		0.800		
		0.850		
		0.900		
		0.950		
		1.000		
		1.050		
		1.100		
		1.150		
		1.200		
		1.250		
		1.300		
		1.350		

TYPE OF FAILURE

- BULGE ☐
- VERTICAL SPLIT ☐
- ANGULAR ☐
- SLICKENSIDED ☐

SKETCH OF FAILURE

PROVING RING NO.: ______ STRAIN RATE: 1.52 mm/min OTHER: ______

UNCONFINED COMPRESSION TEST WORKSHEET

PROJECT: East Oak Expansion
LOCATION:
MATERIAL:
BORING NO.: PWB-7
HEIGHT:

JOB NO.: 00086-356-11-40-B
DATE: 9/20/14
TECHNICIAN:
DEPTH: 22.5-25
AVERAGE DIAMETER:

Ring maxed-out

STRESS DIAL	LOAD	STRAIN DIAL	% STRAIN	STRESS, psi
	0	0.000		
	75	0.010		
	210	0.020		
	600	0.030		
	1500 +	0.040		
		0.050		
		0.060		
		0.070		
		0.080		
		0.090		
		0.100		
		0.120		
		0.140		
		0.160		
		0.180		
		0.200		
		0.220		
		0.240		
		0.260		
		0.280		
		0.300		
		0.320		
		0.340		
		0.360		
		0.380		
		0.400		
		0.420		
		0.440		
		0.460		
		0.480		
		0.500		
		0.520		
		0.540		
		0.560		
		0.580		
		0.600		
		0.650		
		0.700		
		0.750		
		0.800		
		0.850		
		0.900		
		0.950		
		1.000		
		1.050		
		1.100		
		1.150		
		1.200		
		1.250		
		1.300		
		1.350		

TYPE OF FAILURE

- BULGE ☐
- VERTICAL SPLIT ☐
- ANGULAR ☐
- SLICKENSIDED ☐

SKETCH OF FAILURE

PROVING RING NO.: ______ STRAIN RATE: 1.52 mm/min OTHER: ______

UNCONFINED COMPRESSION TEST WORKSHEET

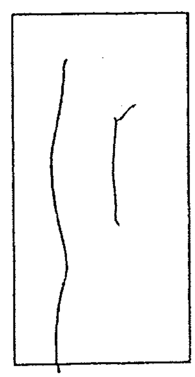
PROJECT: East Oak Expansion
JOB NO.: 0086-356-11-40-13
LOCATION:
DATE: 9/20/14
MATERIAL:
TECHNICIAN:
BORING NO.: PWB-7
DEPTH: 25-29
HEIGHT:
AVERAGE DIAMETER:

STRESS DIAL	LOAD	STRAIN DIAL	% STRAIN	STRESS, psi
	0	0.000		
	27	0.010		
	49	0.020		
	74	0.030		
	100	0.040		
	128	0.050		
	157	0.060		
	192	0.070		
	226	0.080		
	263	0.090		
	306	0.100		
	363	0.120		
		0.140		
		0.160		
		0.180		
		0.200		
		0.220		
		0.240		
		0.260		
		0.280		
		0.300		
		0.320		
		0.340		
		0.360		
		0.380		
		0.400		
		0.420		
		0.440		
		0.460		
		0.480		
		0.500		
		0.520		
		0.540		
		0.560		
		0.580		
		0.600		
		0.650		
		0.700		
		0.750		
		0.800		
		0.850		
		0.900		
		0.950		
		1.000		
		1.050		
		1.100		
		1.150		
		1.200		
		1.250		
		1.300		
		1.350		

TYPE OF FAILURE

- BULGE ☐
- VERTICAL SPLIT ☐
- ANGULAR ☐
- SLICKENSIDED ☐

SKETCH OF FAILURE



PROVING RING NO.: ______ STRAIN RATE: 1.52 mm/min OTHER: ______

CLIENT:

REPORT DATE: 9/23/2014

PROJECT NO.: 0086-356-11-40-13

PROJECT: East Oak Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET
FALLING HEAD, RISING TAILWATER - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Sandstone, red-brown
BORING/SAMPLE: PWB-1
PROCTOR #:
SAMPLE ORIENTATION: H ____ V ✓
Remold ____

LAB START DATE: 9/20/2014
LAB RPT. DATE: 9/23/2014
TECHNICIAN: MLT
DEPTH/LIFT: 45.0'-49.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.75 in
c. Sample Volume ($\pi b^2 / 4 * a$): 5.226 cu in

b. Avg. Diameter of Specimen: 1.95 in
d. Wet Unit Weight: [(e * 3.8095) / c)]: 132.6 pcf

INITIAL CONDITIONS

e. Wet Weight Soil: 181.9 gms
f. Wet Weight Soil + Tare: 281.5 gms
g. Dry Weight Soil + Tare: 258.0 gms
h. Tare Weight: 99.6 gms
i. Moisture Content [((f-g)/(g-h)]*100: 14.8 %
j. Unit Dry Weight [d/(1+(i/100))]: 115.5 pcf

FINAL CONDITIONS

k. Wet Weight Soil + Tare: 282.9 gms
l. Dry Weight Soil + Tare: 258.0 gms
m. Tare Weight: 99.6 gms
n. Moisture Content [((k-l)/(l-m)]*100: 15.7 %

B COEFFICIENT DETERMINATION						PRESSURE, psi			
Date	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow hs, in	Outflow hs, out
		10							
		10							
		10							
22-Sep	25	10	20	29.5	0.95	1	25	20	17

Date	Time	Dt sec	Inflow Vin, cc	Outflow Vout, cc	Din sec	Dout sec	Temp C	Rt	k @ 20C cm/sec
22-Sep	06:35		10	22					
22-Sep	06:37	120	14.3	17.6	4.3	4.4	22	0.953	3.6E-05
22-Sep	06:40	180	18.3	12.9	4.0	4.7	22	0.953	2.5E-05
22-Sep	06:42	120	21.4	9.5	3.1	3.4	22	0.953	3.0E-05
22-Sep	06:45	180	23.5	7.1	2.1	2.4	22	0.953	1.4E-05
22-Sep	06:48	180	25	5.2	1.5	1.9	22	0.953	1.1E-05

Test Method ASTM D 5084-90

Pipet Area = 0.820 sq cm
Pipet Volume, Vp = 25 cc
Pipet Length, Lp = 30.5 cm

HYDRAULIC CONDUCTIVITY WORKSHEET
Falling Head, Rising Tailwater Flexible Wall Permeameter

PROJECT: East Oak Expansion
JOB NO: 0086-356-11-40-13
LOCATION:
DATE: 9/20/14
MATERIAL: Sandstone Rd-br
TECHNICIAN: MLT
BORING/SAMPLE NO: PWB-1
DEPTH/LIFT: 45-49
SAMPLE ORIENTATION H V R (Circle One)
PERM FLUID USED: Tap Water
a. HEIGHT: 1.75 in
b. AVERAGE DIAMETER: 1.95 gms
c. VOLUME: (0.7854 * b ^ 2 * a) cu in
d. WET UNIT WEIGHT: [(e * 3.8095)/c] gms

INITIAL CONDITIONS		FINAL CONDITIONS	
e. Wet Wt. Soil:	181.9 gms	k. Wet Wt. Soil + tare:	282.9 gms
f. Wet Wt. Soil + tare:	gms	l. Dry Wt. Soil + tare:	258.8 gms
g. Dry Wt. Soil + tare:	gms	m. Tare Wt:	AA 99.6 gms
h. Tare Wt:	gms	n. Moisture Content [(k-l)/l-m)]*100	%
i. Moisture Content [(f-g)/(g-h)]*100	%	o. Unit Dry Wt. [d/(1 + (n/100))]	pcf
j. Unit Dry Wt. [d/(1 + (i/100))]	pcf		

B COEFFICIENT DETERMINATION						PRESSURE			
DATE	P3	DELTA PRESSURE	BACKPRESSURE BP	μ	B COEFFICIENT	TRIAL	P3 cp	INFLOW ip	OUTFLOW op
9/22	25	10	20	29.5	.95	7	25	20	17
		10							
		10							
		10							
		10							

DATE	CLOCK TIME	TIME SECONDS	INFLOW cc	OUTFLOW cc	TEMP °C	PERMEABILITY k, cm/sec
9/22/14	6:35		10.0	22.0		
9/22/14	6:37		14.7	17.6		
9/22/14	6:40		18.3	12.9		
9/22/14	6:42		21.4	9.5		
9/22/14	6:45		23.5	7.1		
9/22/14	6:48		25.0	5.2		

PROCTOR NO:

MDD:

OMC:

PERCENT COMPACTION:

SAMPLE CALCULATIONS

B COEFFICIENT = (μ - bp)/10
k = permeability, cm/sec

See Sample Calculation Sheet

Burette Height cm Burette Volume cc

EBS 86003.5 Revised 8/93

CLIENT:

REPORT DATE: 9/21/2014

PROJECT NO.: 0086-356-11-40-13

PROJECT: East Oak Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Sandstone, red
BORING/SAMPLE: PWB-2
PROCTOR #:
SAMPLE ORIENTATION: H ____ V ✓ Remold ____

LAB START DATE: 9/19/2014
LAB RPT. DATE: 9/21/2014
TECHNICIAN: MLT
DEPTH/LIFT: 45.0'-50.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.75 in
c. Sample Volume (π b^2 / 4 * a): 4.209 cu in

b. Avg. Diameter of Specimen: 1.75 in
d. Wet Unit Weight: [(e * 3.8095) / c)]: 138.9 pcf

INITIAL CONDITIONS

e. Wet Weight Soil: 153.5 gms
f. Wet Weight Soil + Tare: 245.7 gms
g. Dry Weight Soil + Tare: 219.7 gms
h. Tare Weight: 92.2 gms
i. Moisture Content [(f-g)/(g-h)]*100: 20.4 %
j. Unit Dry Weight [d/(1+(i/100))]: 115.4 pcf

FINAL CONDITIONS

k. Wet Weight Soil + Tare: 248.5 gms
l. Dry Weight Soil + Tare: 219.7 gms
m. Tare Weight: 92.2 gms
n. Moisture Content [(k-l)/(l-m)]*100: 22.6 %

B COEFFICIENT DETERMINATION						PRESSURE, psi			
Date	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow hs, in	Outflow hs, out
		10							
		10							
		10							
20-Sep	25	10	20	29.5	0.95	1	25	20	17

Date	Time	Dt sec	Inflow Vin, cc	Outflow Vout, cc	Din sec	Dout sec	Temp C	Rt	k @ 20C cm/sec
20-Sep	09:59		10	22					
20-Sep	10:10	660	11.9	20.1	1.9	1.9	22	0.953	3.5E-06
20-Sep	11:05	3300	14	18.3	2.1	1.8	22	0.953	7.4E-07
20-Sep	11:38	1980	15.6	17	1.6	1.3	22	0.953	9.3E-07
20-Sep	14:28	10200	17.8	14.1	2.2	2.9	22	0.953	3.3E-07
20-Sep	16:05	5820	19	12.9	1.2	1.2	22	0.953	2.7E-07

Test Method ASTM D 5084-90

Pipet Area = 0.820 sq cm
Pipet Volume, Vp = 25 cc
Pipet Length, Lp = 30.5 cm

HYDRAULIC CONDUCTIVITY WORKSHEET
Falling Head, Rising Tailwater Flexible Wall Permeameter

PROJECT: East Oak Expansion
JOB NO: 0086-356-11-40-13
LOCATION:
DATE:
MATERIAL: Sandstone Rd
TECHNICIAN: MLT
BORING/SAMPLE NO: PWB-2
DEPTH/LIFT: 45-50
SAMPLE ORIENTATION H V R (Circle One)
PERM FLUID USED: Tap water
a. HEIGHT: 1.75 in
b. AVERAGE DIAMETER: 1.75 gms
c. VOLUME: (0.7854 * b ^ 2 * a) cu in
d. WET UNIT WEIGHT: [(e * 3.8095)/c] gms

INITIAL CONDITIONS

e. Wet Wt. Soil: 153.5 gms
f. Wet Wt. Soil + tare: gms
g. Dry Wt. Soil + tare: gms
h. Tare Wt: gms
i. Moisture Content [(f-g)/(g-h)]*100 %
j. Unit Dry Wt. [d/(1 + (i/100))] pcf

FINAL CONDITIONS

k. Wet Wt. Soil + tare: 248.5 gms
l. Dry Wt. Soil + tare: 219.7 gms
m. Tare Wt: A5 92.2 gms
n. Moisture Content [(k-l)/(l-m)]*100 %
o. Unit Dry Wt. [d/(1 + (n/100))] pcf

B COEFFICIENT DETERMINATION						PRESSURE			
DATE	P3	DELTA PRESSURE	BACKPRESSURE BP	μ	B COEFFICIENT	TRIAL	P3 cp	INFLOW Ip	OUTFLOW op
9/20	25	10	20	29.5	.95	1	25	20	17
		10							
		10							
		10							
		10							

DATE	CLOCK TIME	TIME SECONDS	INFLOW cc	OUTFLOW cc	TEMP °C	PERMEABILITY k, cm/sec
9/20/14	9:59		10.0	22.0		
9/20/14	10:10		11.9	20.1		
9/20/14	11:05		14.0	18.3		
9/20/14	11:38		15.6	17.0		
9/20/14	14:28		17.8	14.1		
9/20/14	16:05		19.0	12.9		

PROCTOR NO:

MDD:

OMC:

PERCENT COMPACTION:

SAMPLE CALCULATIONS

B COEFFICIENT = (μ - bp)/10
k = permeability, cm/sec

See Sample Calculation Sheet

Burette Height cm
Burette Volume cc

EBS 86003.5 Revised 8/93

CLIENT:

REPORT DATE: 9/21/2014

PROJECT NO.: 0086-356-11-40-13

PROJECT: East Oak Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Sandstone, red
BORING/SAMPLE: PWB-7
PROCTOR #:
SAMPLE ORIENTATION: H ____ V ✓ Remold ____

LAB START DATE: 9/19/2014
LAB RPT. DATE: 9/21/2014
TECHNICIAN: MLT
DEPTH/LIFT: 25.0'-29.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 2.5 in
c. Sample Volume (π b^2 / 4 * a): 7.466 cu in

b. Avg. Diameter of Specimen: 1.95 in
d. Wet Unit Weight: [(e * 3.8095) / c)]: 151.2 pcf

INITIAL CONDITIONS

e. Wet Weight Soil: 296.4 gms
f. Wet Weight Soil + Tare: 387.7 gms
g. Dry Weight Soil + Tare: 364.6 gms
h. Tare Weight: 91.3 gms
i. Moisture Content [((f-g)/(g-h))*100: 8.5 %
j. Unit Dry Weight [d/(1+(i/100))]: 139.4 pcf

FINAL CONDITIONS

k. Wet Weight Soil + Tare: 390.0 gms
l. Dry Weight Soil + Tare: 364.6 gms
m. Tare Weight: 91.3 gms
n. Moisture Content [((k-l)/(l-m))*100: 9.3 %

B COEFFICIENT DETERMINATION						PRESSURE, psi			
Date	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow ha, in	Outflow ha, out
		10							
		10							
		10							
20-Sep	25	10	20	29.6	0.96	1	25	20	17

Date	Time	Dt sec	Inflow Vin, cc	Outflow Vout, cc	Din sec	Dout sec	Temp C	Rt	k @ 20C cm/sec
20-Sep	10:03		10	22					
20-Sep	10:25	1320	13	21.1	3.0	0.9	22	0.953	2.1E-06
20-Sep	11:05	2400	15.8	19.5	2.8	1.6	22	0.953	1.3E-06
20-Sep	11:38	1980	17.7	18.9	1.9	0.6	22	0.953	9.3E-07
20-Sep	14:28	10200	22.2	13.3	4.5	5.6	22	0.953	7.5E-07
20-Sep	16:05	5820	24.2	10.1	2.0	3.2	22	0.953	7.1E-07

Test Method ASTM D 5084-90

Pipet Area = 0.820 sq cm
Pipet Volume, Vp = 25 cc
Pipet Length, Lp = 30.5 cm

HYDRAULIC CONDUCTIVITY WORKSHEET
Falling Head, Rising Tailwater Flexible Wall Permeameter

PROJECT: East Oak Expansion
JOB NO: 0086-356-11-40-13
LOCATION:
DATE:
MATERIAL: Sand Stone Rd
TECHNICIAN: MLT
BORING/SAMPLE NO: PWB-7
DEPTH/LIFT: 25-29
SAMPLE ORIENTATION H (V) R (Circle One)
PERM FLUID USED: Tap Water
a. HEIGHT: 2.5 in
b. AVERAGE DIAMETER: 1.95 gms
c. VOLUME: (0.7854 * b ^ 2 * a) ______ cu in
d. WET UNIT WEIGHT: [(e * 3.8095)/c] ______ gms

INITIAL CONDITIONS

e. Wet Wt. Soil: 296.4 gms
f. Wet Wt. Soil + tare: ______ gms
g. Dry Wt. Soil + tare: ______ gms
h. Tare Wt: ______ gms
i. Moisture Content [(f-g)/(g-h)]*100 ______ %
j. Unit Dry Wt. [d/(1 + (i/100))] ______ pcf

FINAL CONDITIONS

k. Wet Wt. Soil + tare: 390.0 gms
l. Dry Wt. Soil + tare: 364.6 gms
m. Tare Wt: C1 91.3 gms
n. Moisture Content [(k-l)/(l-m)]*100 ______ %
o. Unit Dry Wt. [d/(1 + (n/100))] ______ pcf

B COEFFICIENT DETERMINATION

DATE	P3	DELTA PRESSURE	BACKPRESSURE BP	μ	B COEFFICIENT
9/20	25	10	20	29.6	.96
		10			
		10			
		10			
		10			

PRESSURE

TRIAL	P3 cp	INFLOW ip	OUTFLOW op
1	25	20	17

DATE	CLOCK TIME	TIME SECONDS	INFLOW cc	OUTFLOW cc	TEMP °C	PERMEABILITY k, cm/sec
9/20/14	10:03		10.0	22.0		
9/20/14	10:25		13.0	21.1		
9/20/14	11:05		15.8	19.5		
9/20/14	11:38		17.7	18.9		
9/20/14	14:28		22.2	13.3		
9/20/14	16:05		24.2	10.1		

PROCTOR NO: ______
MDD: ______
OMC: ______
PERCENT COMPACTION: ______

SAMPLE CALCULATIONS

B COEFFICIENT = (μ - bp)/10
k = permeability, cm/sec

See Sample Calculation Sheet

Burette Height ______ cm
Burette Volume ______ cc

EBS 86003.5 Revised 8/93

CLIENT:

REPORT DATE: 9/21/2014

PROJECT NO.: 0086-356-11-40-13

PROJECT: East Oak Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Sandstone, red
BORING/SAMPLE: PWB-7
PROCTOR # :
SAMPLE ORIENTATION: H ____ V ✓
Remold ____

LAB START DATE: 9/19/2014
LAB RPT. DATE: 9/21/2014
TECHNICIAN: MLT
DEPTH/LIFT: 29.0'-32.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.55 in
c. Sample Volume ($\pi b^2 / 4 * a$): 4.629 cu in

b. Avg. Diameter of Specimen: 1.95 in
d. Wet Unit Weight: [(e * 3.8095) / c)]: 131.1 pcf

INITIAL CONDITIONS

e. Wet Weight Soil: 159.3 gms
f. Wet Weight Soil + Tare: 249.8 gms
g. Dry Weight Soil + Tare: 234.5 gms
h. Tare Weight: 90.5 gms
i. Moisture Content [(f-g)/(g-h)]*100: 10.6 %
j. Unit Dry Weight [d/(1+(i/100))]: 118.5 pcf

FINAL CONDITIONS

k. Wet Weight Soil + Tare: 253.9 gms
l. Dry Weight Soil + Tare: 234.5 gms
m. Tare Weight: 90.5 gms
n. Moisture Content [(k-l)/(l-m)]*100: 13.5 %

B COEFFICIENT DETERMINATION						PRESSURE, psi			
Date	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow he, in	Outflow he, out
		10							
		10							
		10							
20-Sep	25	10	20	29.5	0.95	1	25	20	17

Date	Time	Dt sec	Inflow Vin, cc	Outflow Vout, cc	Din sec	Dout sec	Temp C	Rt	k @ 20C cm/sec
20-Sep	09:52		10	22					
20-Sep	10:10	1080	13.6	18.3	3.6	3.7	22	0.953	3.0E-06
20-Sep	11:05	3300	16.1	14.2	2.5	4.1	22	0.953	9.2E-07
20-Sep	11:38	1980	19	13.3	2.9	0.9	22	0.953	9.1E-07
20-Sep	14:28	10200	22.5	5.8	3.5	7.5	22	0.953	5.3E-07
20-Sep	16:05	5820	25	3	2.5	2.8	22	0.953	4.7E-07

Test Method ASTM D 5084-90

Pipet Area = 0.820 sq cm
Pipet Volume, Vp = 25 cc
Pipet Length, Lp = 30.5 cm

HYDRAULIC CONDUCTIVITY WORKSHEET
Falling Head, Rising Tailwater Flexible Wall Permeameter

PROJECT: East Oak Expansion
LOCATION:
MATERIAL: Sand Stone Rd
BORING/SAMPLE NO: PWB-7
SAMPLE ORIENTATION H (V) R (Circle One)
a. HEIGHT: 1.55 in
c. VOLUME: (0.7854 * b ^ 2 * a) cu in

JOB NO: 0086-356-11-40-13
DATE: 9/19/14
TECHNICIAN: MLT
DEPTH/LIFT: 29-32
PERM FLUID USED: Tap Water
b. AVERAGE DIAMETER: 1.95 gms
d. WET UNIT WEIGHT: [(e * 3.8095)/c] gms

INITIAL CONDITIONS

e. Wet Wt. Soil: 159.3 gms
f. Wet Wt. Soil + tare: gms
g. Dry Wt. Soil + tare: gms
h. Tare Wt: gms
i. Moisture Content [(f-g)/(g-h)]*100 %
j. Unit Dry Wt. [d/(1 + (i/100))] pcf

FINAL CONDITIONS

k. Wet Wt. Soil + tare: 253.9 gms
l. Dry Wt. Soil + tare: 234.5 gms
m. Tare Wt: 606 90.5 gms
n. Moisture Content [(k-l)/l-m)]*100 %
o. Unit Dry Wt. [d/(1 + (n/100))] pcf

B COEFFICIENT DETERMINATION

DATE	P3	DELTA PRESSURE	BACKPRESSURE BP	μ	B COEFFICIENT
9/20	25	10	20	29.5	.95
		10			
		10			
		10			
		10			

PRESSURE

TRIAL	P3 cp	INFLOW Ip	OUTFLOW op
1	25	20	17

DATE	CLOCK TIME	TIME SECONDS	INFLOW cc	OUTFLOW cc	TEMP °C	PERMEABILITY k, cm/sec
9/20/14	9:52		10.0	22.0		
9/20/14	10:10		13.6	18.3		
9/20/14	11:05		16.1	14.2		
9/20/14	11:38		19.0	13.3		
9/20/14	14:28		22.5	5.8		
9/20/14	16:05		25.0	3.0		

PROCTOR NO:

MDD:

OMC:

PERCENT COMPACTION:

SAMPLE CALCULATIONS

B COEFFICIENT = (μ - bp)/10
k = permeability, cm/sec

See Sample Calculation Sheet

Burette Height 30.5 cm Burette Volume 25 cc

EBS 86003.5 Revised 8/93

CLIENT:

REPORT DATE: 9/21/2014

PROJECT NO.: 0086-356-11-40-13

PROJECT: East Oak Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Clayey sandstone, red
BORING/SAMPLE: PWB-9
PROCTOR # :
SAMPLE ORIENTATION: H ____ V ✓
Remold ____

LAB START DATE: 9/19/2014
LAB RPT. DATE: 9/21/2014
TECHNICIAN: MLT
DEPTH/LIFT: 47.5'-50.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 2.35 in
c. Sample Volume ($\pi b^2 / 4 * a$): 7.018 cu in

b. Avg. Diameter of Specimen: 1.95 in
d. Wet Unit Weight: [(e * 3.8095) / c)]: 147.7 pcf

INITIAL CONDITIONS

e. Wet Weight Soil: 272.1 gms
f. Wet Weight Soil + Tare: 368.9 gms
g. Dry Weight Soil + Tare: 345.3 gms
h. Tare Weight: 96.8 gms
i. Moisture Content [(f-g)/(g-h)]*100: 9.5 %
j. Unit Dry Weight [d/(1+(i/100))]: 134.9 pcf

FINAL CONDITIONS

k. Wet Weight Soil + Tare: 372.9 gms
l. Dry Weight Soil + Tare: 345.3 gms
m. Tare Weight: 96.8 gms
n. Moisture Content [(k-l)/(l-m)]*100: 11.1 %

B COEFFICIENT DETERMINATION						PRESSURE, psi			
Date	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow hs, in	Outflow hs, out
		10							
		10							
		10							
20-Sep	25	10	20	29.5	0.95	1	25	20	17

Date	Time	Dt sec	Inflow Vin, cc	Outflow Vout, cc	Din sec	Dout sec	Temp C	Rt	k @ 20C cm/sec
20-Sep	09:26		15	22					
20-Sep	09:53	1620	15.2	21.8	0.2	0.2	22	0.953	1.7E-07
20-Sep	11:05	4320	15.6	21.4	0.4	0.4	22	0.953	1.3E-07
20-Sep	11:38	1980	15.7	21.3	0.1	0.1	22	0.953	6.8E-08
20-Sep	14:28	10200	16.4	20.8	0.7	0.5	22	0.953	8.0E-08
20-Sep	16:05	5820	16.6	20.5	0.2	0.3	22	0.953	5.9E-08

Test Method ASTM D 5084-90

Pipet Area = 0.820 sq cm
Pipet Volume, Vp = 25 cc
Pipet Length, Lp = 30.5 cm

HYDRAULIC CONDUCTIVITY WORKSHEET
Falling Head, Rising Tailwater Flexible Wall Permeameter

PROJECT: East Oak Expansion
JOB NO: 0086-356-11-40-13
LOCATION:
DATE: 9/19/14
MATERIAL: Clayey Sand Stone Rd
TECHNICIAN: MLT
BORING/SAMPLE NO: PWB-9
DEPTH/LIFT: 47.5-50
SAMPLE ORIENTATION H V R (Circle One)
PERM FLUID USED: Tap Water
a. HEIGHT: 2.35 in
b. AVERAGE DIAMETER: 1.95 gms
c. VOLUME: (0.7854 * b ^ 2 * a) ____ cu in
d. WET UNIT WEIGHT: [(e * 3.8095)/c] ____ gms

INITIAL CONDITIONS

e. Wet Wt. Soil: 272.1 gms
f. Wet Wt. Soil + tare: ____ gms
g. Dry Wt. Soil + tare: ____ gms
h. Tare Wt: ____ gms
i. Moisture Content [((f-g)/(g-h)]*100 ____ %
j. Unit Dry Wt. [d/(1 + (i/100))] ____ pcf

FINAL CONDITIONS

k. Wet Wt. Soil + tare: 372.9 gms
l. Dry Wt. Soil + tare: 345.3 gms
m. Tare Wt: C3 96.8 gms
n. Moisture Content [(k-l)/l-m)]*100 ____ %
o. Unit Dry Wt. [d/(1 + (n/100))] ____ pcf

B COEFFICIENT DETERMINATION						PRESSURE			
DATE	P3	DELTA PRESSURE	BACKPRESSURE BP	μ	B COEFFICIENT	TRIAL	P3 cp	INFLOW Ip	OUTFLOW op
9/20	25	10	20	24.5	.95	1	25	20	17
		10							
		10							
		10							
		10							

DATE	CLOCK TIME	TIME SECONDS	INFLOW cc	OUTFLOW cc	TEMP °C	PERMEABILITY k, cm/sec
9/20/14	9:26		15.0	22.6		
9/20/14	9:53		15.2	21.8		
9/20/14	11:05		15.6	21.4		
9/20/14	11:38		15.7	21.2		
9/20/14	14:28		16.4	20.8		
9/20/14	16:05		16.6	20.5		

PROCTOR NO:
MDD:
OMC:
PERCENT COMPACTION:

SAMPLE CALCULATIONS

B COEFFICIENT = (μ - bp)/10
k = permeability, cm/sec

See Sample Calculation Sheet

Burette Height 30.5 cm　Burette Volume 25 cc

EBS 86003.5 Revised 8/93

CLIENT:

REPORT DATE: 9/21/2014

PROJECT NO.: 0086-356-11-40-13

PROJECT: East Oak Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET
FALLING HEAD, RISING TAILWATER - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Sandstone, red
BORING/SAMPLE: PWB-10
PROCTOR # :
SAMPLE ORIENTATION: H ____ V ✓
Remold ____

LAB START DATE: 9/19/2014
LAB RPT. DATE: 9/21/2014
TECHNICIAN: MLT
DEPTH/LIFT: 25.0'-30.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 2.2 in
c. Sample Volume (π b^2 / 4 * a): 6.238 cu in

b. Avg. Diameter of Specimen: 1.9 in
d. Wet Unit Weight: [(e * 3.8095) / c)]: 136.7 pcf

INITIAL CONDITIONS

e. Wet Weight Soil: 223.8 gms
f. Wet Weight Soil + Tare: 317.0 gms
g. Dry Weight Soil + Tare: 292.2 gms
h. Tare Weight: 93.2 gms
i. Moisture Content [(f-g)/(g-h)]*100: 12.5 %
j. Unit Dry Weight [d/(1+(i/100))]: 121.5 pcf

FINAL CONDITIONS

k. Wet Weight Soil + Tare: 320.5 gms
l. Dry Weight Soil + Tare: 292.2 gms
m. Tare Weight: 93.2 gms
n. Moisture Content [(k-l)/(l-m)]*100: 14.2 %

B COEFFICIENT DETERMINATION						PRESSURE, psi			
Date	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow hs, in	Outflow hs, out
		10							
		10							
		10							
20-Sep	25	10	20	29.6	0.96	1	25	20	17

Date	Time	Dt sec	Inflow Vin, cc	Outflow Vout, cc	Din sec	Dout sec	Temp C	Rt	k @ 20C cm/sec
20-Sep	10:07		10	22					
20-Sep	10:25	1080	12.6	19.8	2.6	2.2	22	0.953	2.9E-06
20-Sep	11:05	2400	13.9	18	1.3	1.8	22	0.953	8.6E-07
20-Sep	11:38	1980	14.9	17.2	1.0	0.8	22	0.953	6.2E-07
20-Sep	14:28	10200	19.5	13.2	4.6	4.0	22	0.953	5.9E-07
20-Sep	16:05	5820	21.3	10.8	1.8	2.4	22	0.953	5.2E-07

Test Method ASTM D 5084-90

Pipet Area = 0.820 sq cm
Pipet Volume, Vp = 25 cc
Pipet Length, Lp = 30.5 cm

HYDRAULIC CONDUCTIVITY WORKSHEET
Falling Head, Rising Tailwater Flexible Wall Permeameter

PROJECT: East Oak Expansion JOB NO: 00816-356-11-40-13
LOCATION: ______ DATE: ______
MATERIAL: Sandstone Rd TECHNICIAN: MT
BORING/SAMPLE NO: PWB-10 DEPTH/LIFT: 25-30
SAMPLE ORIENTATION H V R (Circle One) PERM FLUID USED: Tap Water
a. HEIGHT: 2.2 in b. AVERAGE DIAMETER: 1.9 gms
c. VOLUME: (0.7854 * b ^ 2 * a) ______ cu in d. WET UNIT WEIGHT: [(e * 3.8095)/c] ______ gms

INITIAL CONDITIONS	FINAL CONDITIONS
e. Wet Wt. Soil: 223.8 gms	k. Wet Wt. Soil + tare: 320.5 gms
f. Wet Wt. Soil + tare: ______ gms	l. Dry Wt. Soil + tare: 292.2 gms
g. Dry Wt. Soil + tare: ______ gms	m. Tare Wt: TT 93.2 gms
h. Tare Wt: ______ gms	n. Moisture Content [(k-l)/l-m)]*100 ______ %
i. Moisture Content [(f-g)/(g-h)]*100 ______ %	o. Unit Dry Wt. [d/(1 + (n/100))] ______ pcf
j. Unit Dry Wt. [d/(1 + (i/100))] ______ pcf	

B COEFFICIENT DETERMINATION						PRESSURE			
DATE	P3	DELTA PRESSURE	BACKPRESSURE BP	μ	B COEFFICIENT	TRIAL	P3 cp	INFLOW ip	OUTFLOW op
9/30	25	10	20	29.6	.96	1	25	20	17
		10							
		10							
		10							
		10							

DATE	CLOCK TIME	TIME SECONDS	INFLOW cc	OUTFLOW cc	TEMP °C	PERMEABILITY k, cm/sec
9/20/14	10:07		10.0	22.0		
9/20/14	10:25		12.6	19.8		
9/20/14	11:05		13.9	18.0		
9/20/14	11:38		14.9	17.2		
9/20/14	14:28		19.5	13.2		
9/20/14	16:05		21.3	10.8		

PROCTOR NO: ______
MDD: ______
OMC: ______
PERCENT COMPACTION: ______

SAMPLE CALCULATIONS

B COEFFICIENT = (μ - bp)/10
k = permeability, cm/sec

See Sample Calculation Sheet

Burette Height ______ cm Burette Volume ______ cc

EBS 86003.5 Revised 8/93

CLIENT:

REPORT DATE: 9/23/2014

PROJECT NO.: 0086-356-11-40-13

PROJECT: East Oak Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Sandstone, red
BORING/SAMPLE: WB-8
PROCTOR # :
SAMPLE ORIENTATION: H ____ V ✓
Remold ____

LAB START DATE: 9/20/2014
LAB RPT. DATE: 9/23/2014
TECHNICIAN: MLT
DEPTH/LIFT: 35.0'-40.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.25 in
c. Sample Volume (π b^2 / 4 * a): 3.544 cu in

b. Avg. Diameter of Specimen: 1.9 in
d. Wet Unit Weight: [(e * 3.8095) / c)]: 146.9 pcf

INITIAL CONDITIONS

e. Wet Weight Soil: 136.7 gms
f. Wet Weight Soil + Tare: 228.0 gms
g. Dry Weight Soil + Tare: 210.8 gms
h. Tare Weight: 91.3 gms
i. Moisture Content [(f-g)/(g-h)]*100: 14.4 %
j. Unit Dry Weight [d/(1+(i/100))]: 128.4 pcf

FINAL CONDITIONS

k. Wet Weight Soil + Tare: 228.4 gms
l. Dry Weight Soil + Tare: 210.8 gms
m. Tare Weight: 91.3 gms
n. Moisture Content [(k-l)/(l-m)]*100: 14.7 %

B COEFFICIENT DETERMINATION						PRESSURE, psi			
Date	P3	Della Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow hs, in	Outflow hs, out
		10							
		10							
		10							
22-Sep	25	10	20	29.5	0.95	1	25	20	17

Date	Time	Dt sec	Inflow Vin, cc	Outflow Vout, cc	Din sec	Dout sec	Temp C	Rt	k @ 20C cm/sec
22-Sep	06:36		10	22					
22-Sep	06:37	60	14.1	19.3	4.1	2.7	22	0.953	4.2E-05
22-Sep	06:40	180	17.9	15.5	3.8	3.8	22	0.953	1.6E-05
22-Sep	06:42	120	20.2	12.9	2.3	2.6	22	0.953	1.6E-05
22-Sep	06:45	180	22.9	9.4	2.7	3.5	22	0.953	1.4E-05
22-Sep	06:48	180	25	6.3	2.1	3.1	22	0.953	1.2E-05

Test Method ASTM D 5084-90

Pipet Area = 0.820 sq cm
Pipet Volume, Vp = 25 cc
Pipet Length, Lp = 30.5 cm

HYDRAULIC CONDUCTIVITY WORKSHEET
Falling Head, Rising Tailwater Flexible Wall Permeameter

PROJECT: East Oak Expansion
LOCATION:
MATERIAL: Sandstone Rd
BORING/SAMPLE NO: WB-8
SAMPLE ORIENTATION H (V) R (Circle One)
a. HEIGHT: 1.25 in
c. VOLUME: (0.7854 * b ^ 2 * a) ______ cu in

JOB NO: 0086-356-11-40-13
DATE: 9/20/14
TECHNICIAN: MLT
DEPTH/LIFT: 35-40
PERM FLUID USED: Tap Water
b. AVERAGE DIAMETER: 1.9 gms
d. WET UNIT WEIGHT: [(e * 3.8095)/c] ______ gms

INITIAL CONDITIONS

e. Wet Wt. Soil: 136.7 gms
f. Wet Wt. Soil + tare: ______ gms
g. Dry Wt. Soil + tare: ______ gms
h. Tare Wt: ______ gms
i. Moisture Content [(f-g)/(g-h)]*100 ______ %
j. Unit Dry Wt. [d/(1 + (i/100))] ______ pcf

FINAL CONDITIONS

k. Wet Wt. Soil + tare: 228.4 gms
l. Dry Wt. Soil + tare: 210.8 gms
m. Tare Wt: Bin 91.3 gms
n. Moisture Content [(k-l)/(l-m)]*100 ______ %
o. Unit Dry Wt. [d/(1 + (n/100))] ______ pcf

B COEFFICIENT DETERMINATION

DATE	P3	DELTA PRESSURE	BACKPRESSURE BP	μ	B COEFFICIENT
9/22	25	10	20	24.5	.95
		10			
		10			
		10			
		10			

PRESSURE

TRIAL	P3 cp	INFLOW ip	OUTFLOW op
1	25	20	17

DATE	CLOCK TIME	TIME SECONDS	INFLOW cc	OUTFLOW cc	TEMP °C	PERMEABILITY k, cm/sec
9/22/14	6:36	≠	10.0	22.0		
9/22/14	6:37		14.1	19.3		
9/22/14	6:40		17.9	15.5		
9/22/14	6:42		20.2	12.9		
9/22/14	6:45		22.9	9.4		
9/22/14	6:48		25.0	6.5		

PROCTOR NO: ______
MDD: ______
OMC: ______
PERCENT COMPACTION: ______

SAMPLE CALCULATIONS

B COEFFICIENT = (μ - bp)/10
k = permeability, cm/sec

See Sample Calculation Sheet

Burette Height ______ cm
Burette Volume ______ cc

EBS 86003.5 Revised 8/93

APPENDIX N-2

SLOPE STABILITY ANALYSIS

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APPENDIX N-2A

STABILITY ANALYSIS USING XSTABL

LICENSED PROFESSIONAL ENGINEER
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06-05-15

Includes pages N-2A-1 through N-2A-163

Required: Evaluate the slope stability of the proposed landfill slopes for the undeveloped area and the stability of the liner/cover systems.

Given:

1. The slope stability analyses section locations are provided on Sheets N-2A-5 and N-2A-6.
2. As shown on page N-2B-3, the composite liner system consists of a 2-foot-thick compacted clay liner with a maximum permeability of $1x10^{-7}$ cm/s, a geosynthetic clay liner (GCL), and a 60-mil-thick HDPE Flexible Membrane Liner (FML) overlain by a geotextile separation layer, a 1-foot-thick leachate collection layer, and a 1-foot-thick protective cover layer.

Method:

A. Evaluate the stability of the proposed excavation slopes, liner slopes, interim slopes, and final cover slopes.

1. Determine the most critical excavation and liner, interim, and final cover slopes in the proposed design.
2. Select a soil profile for each critical section using available boring logs and geologic cross sections near each section.
3. Select material properties using unit weights and strength parameters. (Laboratory test summary is provided in Table 2-2 in Section 2 of Appendix N text and Appendix N-1).
4. Perform stability analyses.
   a. Analyze the excavation slopes using XSTABL 5.2 and the Simplified Bishop method of circular failure surfaces. Use undrained total stress parameters to model short-term static conditions during construction.
   b. Analyze the liner slopes using XSTABL 5.2 and both Simplified Bishop method of circular failure surfaces and Rankine method of block failure surfaces. Use undrained total stress parameters to model short-term static conditions during construction.
   c. Analyze the interim slopes using XSTABL 5.2 and both Simplified Bishop method of circular failure surfaces and Rankine method of block failure surfaces. Use undrained total stress parameters to model short-term static conditions during construction.
   d. Analyze the final cover slopes using XSTABL 5.2 and both Simplified Bishop method of circular failure surfaces and Rankine method of block failure surfaces. Use effective stress parameters to model long-term static conditions after construction.
   e. Based on the results of static slope stability analysis, analyze selected sections of the excavation, liner, interim, and final cover slopes using XSTABL 5.2 and either the Simplified Bishop method or Rankine method, as appropriate. Use undrained total stress parameters to model the seismic conditions.

B. Evaluate the stability of the proposed liner system by using infinite slope stability analysis.

1. Verify that the tensile stress in the liner system will be less than the yield stress by using Koerner's method (reference 5) for determination of shear stress in liner systems considering cohesion/ adhesion forces.
2. Provide anchor trench design considering pullout of the geomembrane.
3. Use Duncan and Buchianani's method for infinite stability analyses to evaluate the internal stability of the liner system.

C. Evaluate the stability of the proposed final cover system by using infinite slope stability analysis. The proposed final cover system will consist of (from bottom to top), a 1-foot-thick intermediate cover layer, a 2-foot-thick vegetation support layer, and a 1-foot-thick vegetation layer.

1. Use Duncan and Buchianani's method for infinite stability analyses to evaluate the internal stability of the final cover system.

References:

1. Bowles, Joseph E., *Foundation Analyses and Design*, 4th Ed., Mc-Graw-Hill, 1988.
2. Duncan, J.M. and Buchianani, A.L., *An Engineering Manual for Slope Stability Studies*, Department of Civil Engineering-University of California-Berkeley, 1975.
3. TRI, Interface Friction/Direct Shear Testing & Slope Stability Issues. Short Course, November 12-13, 1998.
4. US Army Corps of Engineers, *Slope Stability*, Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.
5. Koerner, Robert M., *Designing with Geosynthetics*, 3rd Ed., Prentice-Hall, Inc., 1994.
6. XSTABL 5.2 (computer program for slope stability analyses), Interactive Software Designs, Inc.
7. Day, Robert W., *Geotechnical Engineer's Portable Handbook*, McGraw-Hill, 2000.
8. Day, Robert W., *Foundation Engineering Handbook*, McGraw-Hill, 2006.
9. US Naval Facilities Design Manual DM-7.01, Soil Mechanics, September 1986.

Solution:

A. Slope stability analyses of the proposed slopes

1. The locations of the most critical sections selected for the stability analysis for the proposed slopes are shown on Sheets N-2A-5 and N-2A-6. Sections analyzed are shown with the most critical failure surface on Sheets N-2A-7 through N-2A-8 (excavation and liner slopes) and Sheets N-2A-9 and N-2A-10 (interim and final cover slopes).
2. The soil profile used for each analysis was based on boring log data from previous site investigations (see Appendix E, Appendix E-2) from the undeveloped area of the site and the geologic cross sections (Appendix E). A generalized soil profile is shown on Sheet N-2A-4.
3. A summary table of the assumed material weight and strength properties is provided on Sheet N-2A-11. The material weight and strength parameter determination for each material type was based on previous laboratory testing results (Atterburg limits, natural moisture contents, unit weight, percent finer than #200 sieve, and Standard Proctor) and engineering judgment based on previous experience with similar materials. Laboratory testing results from previous investigations are included in Appendix N-1.
4. The output from the slope stability analyses on the excavation, liner, interim, and final cover slopes is provided on Pages N-2A-12 through N-2A-188. A summary of the results of the slope stability analyses is provided on Sheet N-2A-11.

B. Infinite slope stability of the proposed liner system.

1. Verification that the tensile stress in the liner system will be less than yield stress is provided on Sheets N-2B-3 through N-2B-6.
2. Anchor trench design is provided on Sheets N-2B-6 and N-2B-7.
3. Infinite stability analyses to evaluate the internal stability of the liner system are provided on Sheets N-2B-8 through N-2B-11.

C. Infinite slope stability of the proposed final cover system.

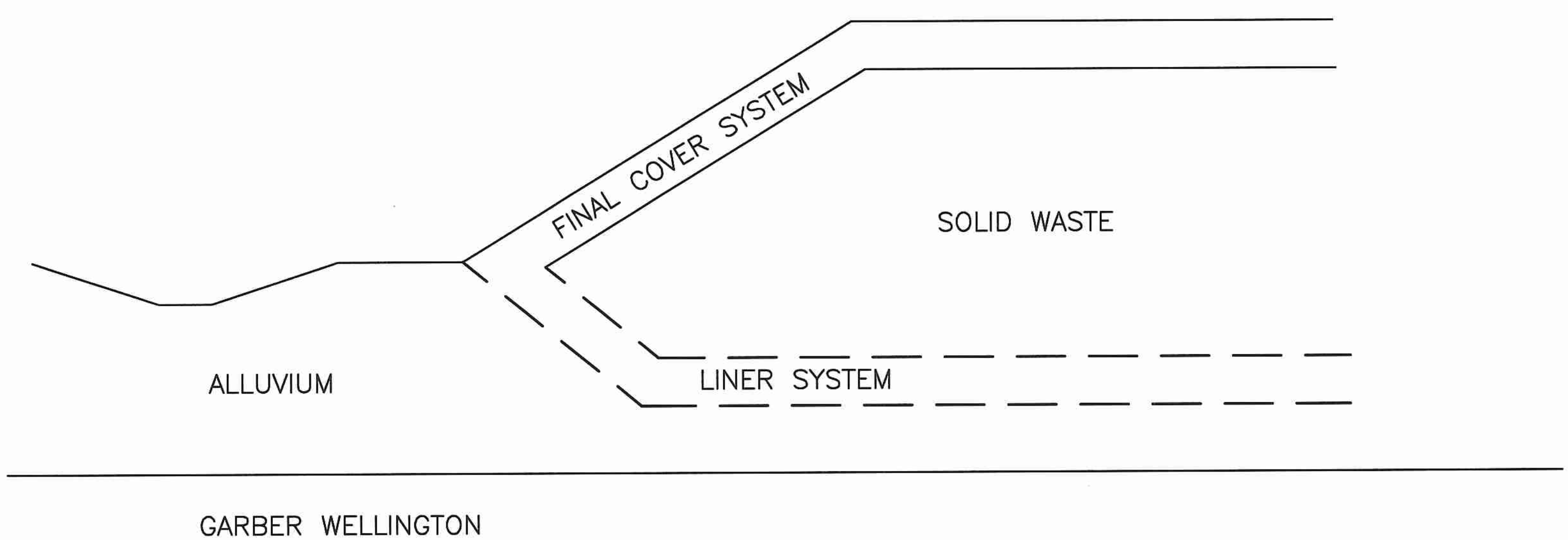
1. Infinite stability analyses to evaluate the internal stability of the cover system are provided on Sheets N-2B-12 through N-2B-14.

Conclusion: Based on the slope stability analyses provided in this appendix, the proposed critical slopes for the excavation, liner, interim, and final cover have adequate factors of safety to be considered stable. In addition, the infinite stability analysis demonstrates that the liner and final cover

Summary of Material Properties Used in the Slope Stability Analyses

Soil Description	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Effective Stress		Total Stress	
			Cohesion (psf)	Angle of Internal Friction (degrees)	Cohesion (psf)	Angle of Internal Friction (degrees)
General Fill - Perimeter Berm	116	118	250	30	1000	0
General Fill - Liner Floor Area	116	118	0	30	0	30
Surface Sand	119.2	119.2	0	25	0	25
Sandstone/Shale	137.8	139.8	0	45	2,000	0
Vegetation Layer	112	114	0	25	170	16
Vegetation Support Layer	116	118	0	25	170	16
Waste[1]	60	60	288	35	288	35
Drainage Layer	116	118	0	25	0	25
Sideslope Liner Textured Geomembrane and Reinforced GCL (sideslope)	120	125	100	22	100	22
Bottom Liner Smooth Geomembrane and Unreinforced GCL (bottom liner)	120	125	10	10	10	10

[1] Density of in-place solid waste (solid waste and operational soil cover).



(NOT TO SCALE)

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TIER III PERMIT MODIFICATION
SLOPE STABILITY ANALYSIS
GENERALIZED SOIL PROFILE
EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

Weaver Consultants Group
CA 3804 PE – 06/30/2015

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REVIEWED BY: JVQ	CAD: N-2A-4 PROFILE.DWG	SHEET N-2A-4

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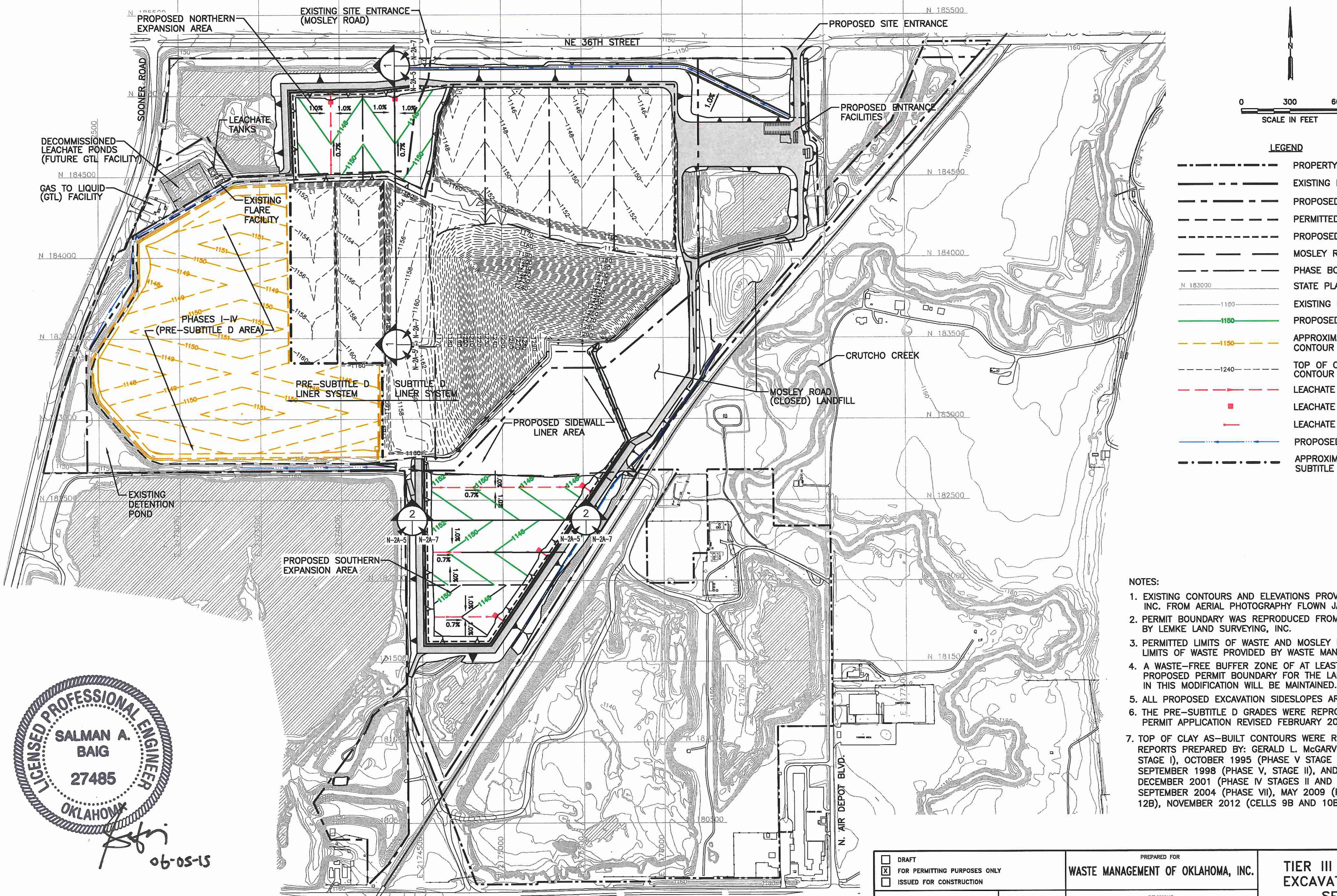

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
- N 183000 STATE PLANE GRID COORDINATE
- 1180 EXISTING CONTOUR
- 1150 PROPOSED EXCAVATION CONTOUR
- 1150 APPROXIMATE PRE–SUBTITLE D CONTOUR (SEE NOTE 6)
- 1240 TOP OF CLAY AS–BUILT CONTOUR (SEE NOTE 7)
- LEACHATE COLLECTION PIPE
- LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE–SUBTITLE D/ SUBTITLE D LINER LOCATION

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. A WASTE–FREE BUFFER ZONE OF AT LEAST 100–FEET OFFSET FROM THE PROPOSED PERMIT BOUNDARY FOR THE LANDFILL EXPANSION AREA INCLUDED IN THIS MODIFICATION WILL BE MAINTAINED.
5. ALL PROPOSED EXCAVATION SIDESLOPES ARE 3(HORIZONTAL):1(VERTICAL).
6. THE PRE–SUBTITLE D GRADES WERE REPRODUCED FROM THE LATERAL EXPANSION PERMIT APPLICATION REVISED FEBRUARY 2002 BY CARDINAL ENGINEERING INC.
7. TOP OF CLAY AS–BUILT CONTOURS WERE REPRODUCED FROM THE VERIFICATION REPORTS PREPARED BY: GERALD L. McGARVIN, L.S. DATED JUNE 1994 (PHASE V STAGE I), OCTOBER 1995 (PHASE V STAGE I), RONALD A. LAVARNWAY RPLS DATED SEPTEMBER 1998 (PHASE V, STAGE II), AND LEMKE LAND SURVEYING, INC. DATED DECEMBER 2001 (PHASE IV STAGES II AND III), JANUARY 2004 (PHASE VIII), SEPTEMBER 2004 (PHASE VII), MAY 2009 (PHASE X), JULY 2011 (CELLS 11B AND 12B), NOVEMBER 2012 (CELLS 9B AND 10B).

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DESIGN BY: RJS
REVIEWED BY: JVQ

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REVISIONS		
NO.	DATE	DESCRIPTION

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TIER III PERMIT MODIFICATION
EXCAVATION SLOPE STABILITY
SECTION LOCATION
EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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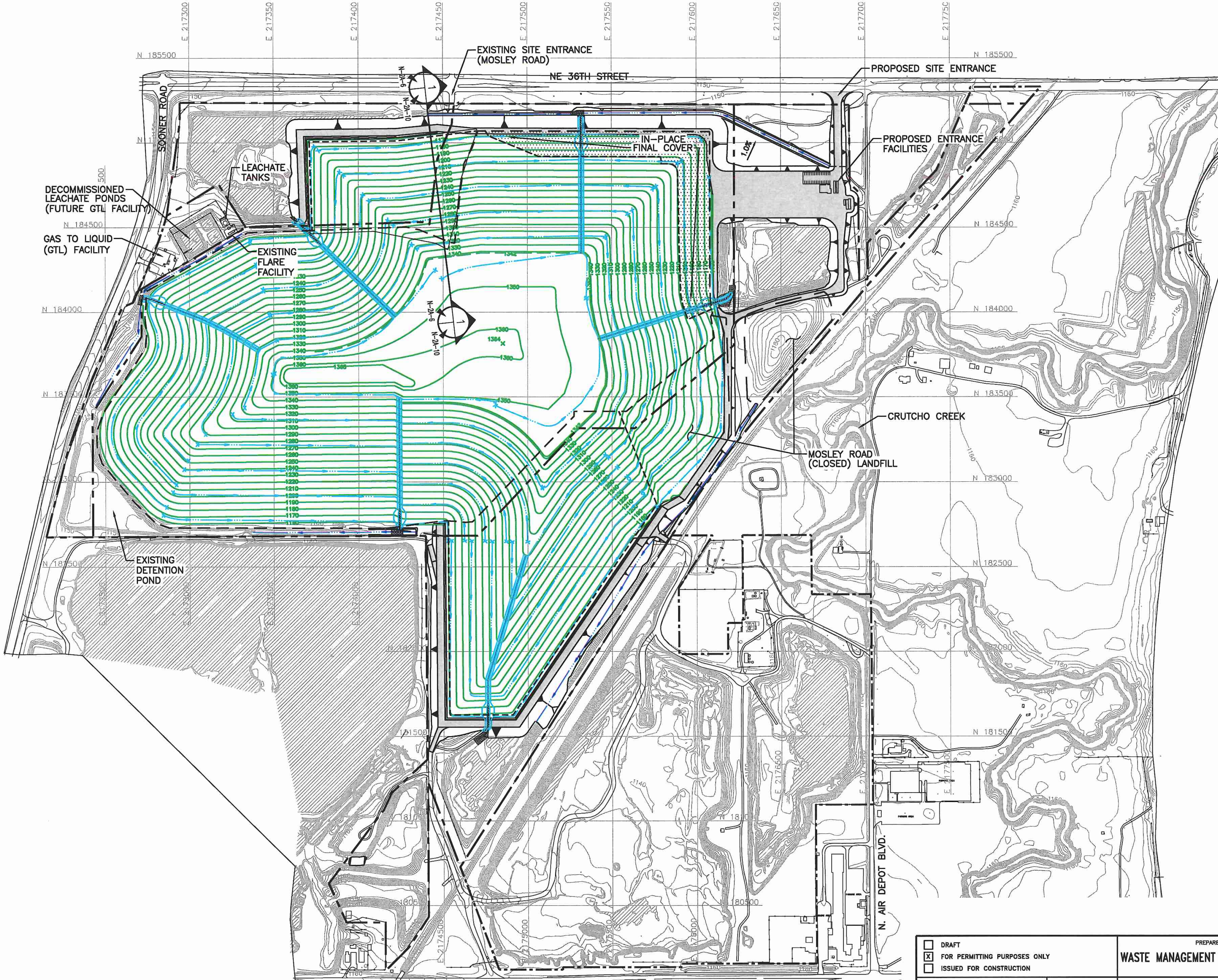
SHEET N–2A–5



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LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- N 183000 STATE PLANE GRID COORDINATE
- 1180 EXISTING CONTOUR
- 1280 PROPOSED FINAL COVER CONTOUR
- PROPOSED DRAINAGE CHANNEL
- PROPOSED DRAINAGE SWALE
- PROPOSED DRAINAGE CHUTE
- IN-PLACE FINAL COVER

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. IN-PLACE FINAL COVER LIMITS REPRODUCED FROM SOIL VERIFICATION SURVEY PREPARED BY LEMKE LAND SURVEYING, INC. DATED JUNE 2013.

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WASTE MANAGEMENT OF OKLAHOMA, INC.

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FINAL COVER SLOPE STABILITY SECTION LOCATIONS

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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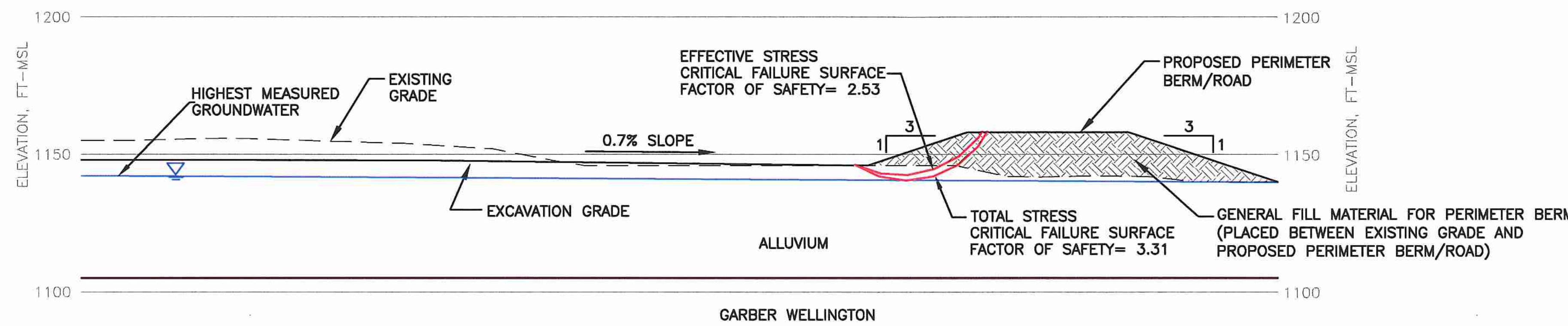

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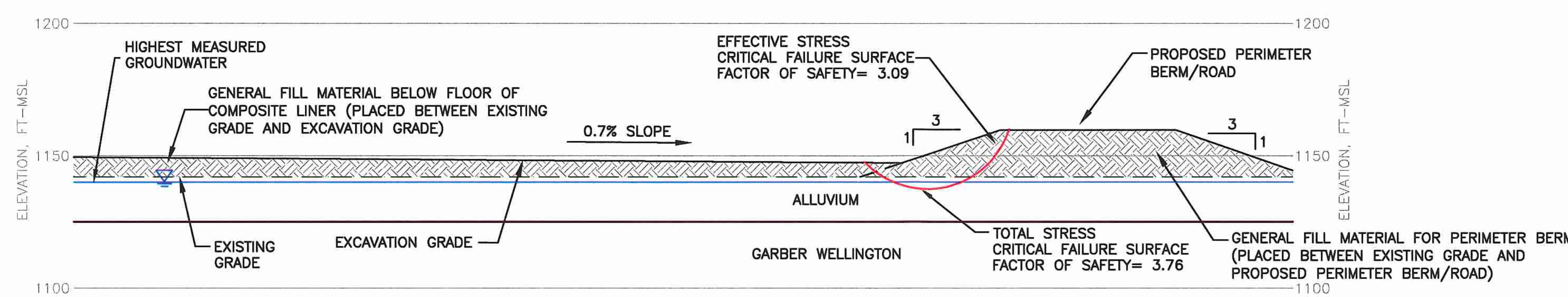

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EXCAVATION
SLOPE STABILITY SECTIONS
EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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CONSTRUCTED LINER SECTION 1
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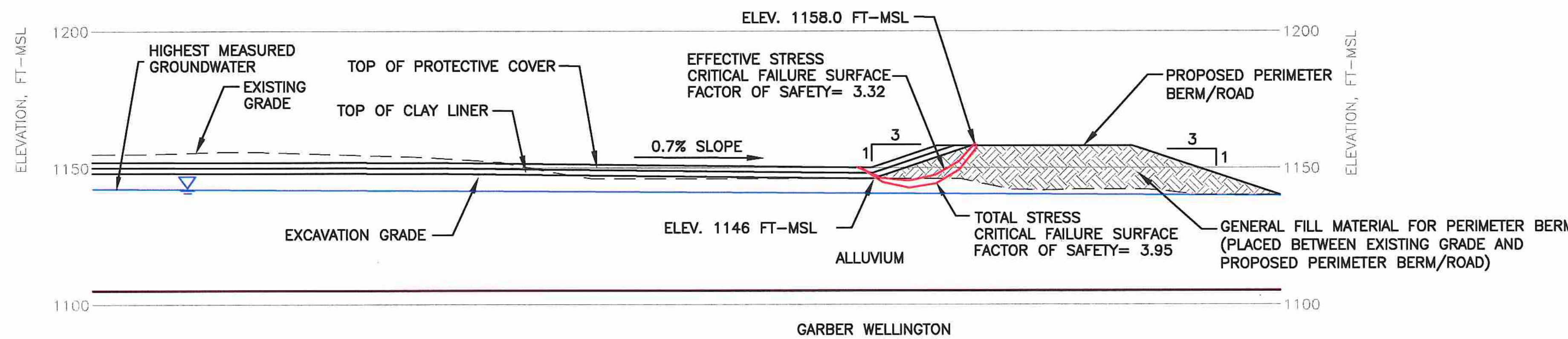

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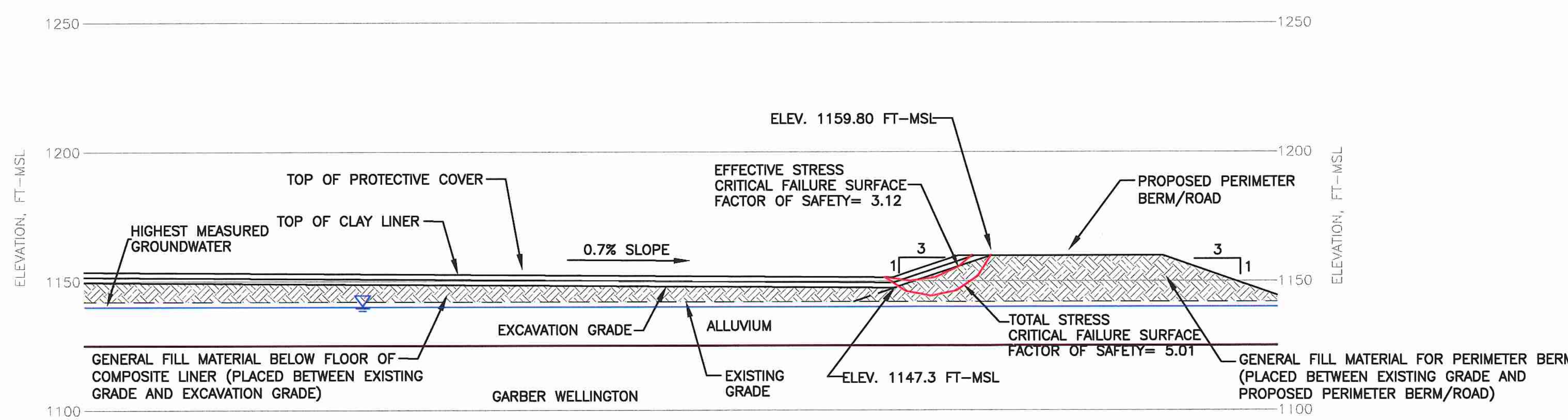

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CONSTRUCTED LINER
SLOPE STABILITY SECTIONS
EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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INTERIM SECTION
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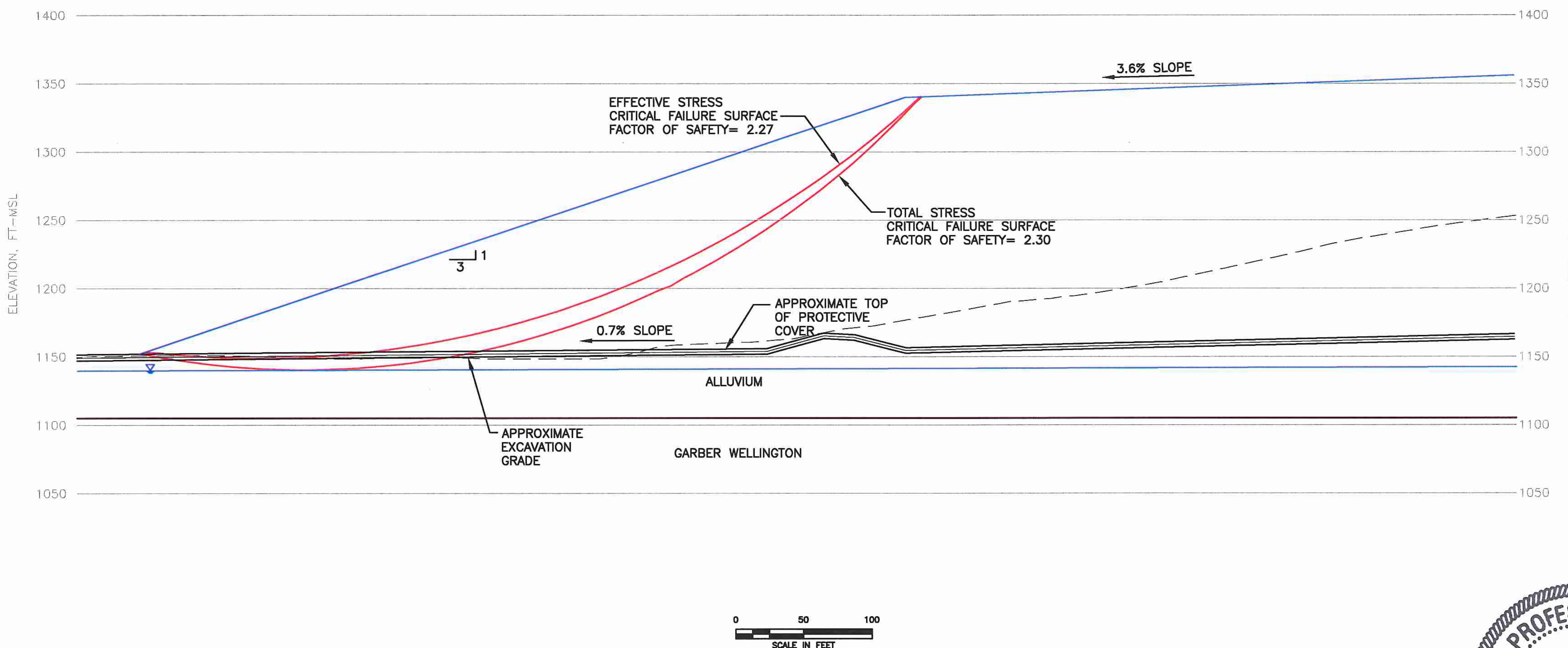

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DATE: 06/2015 FILE: 0086-356-11 CAD: N-2A-9-SLOPE-SEC.DWG	DRAWN BY: SRF DESIGN BY: SS REVIEWED BY: JVQ	REVISIONS NO. / DATE / DESCRIPTION	
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FINAL COVER SECTION
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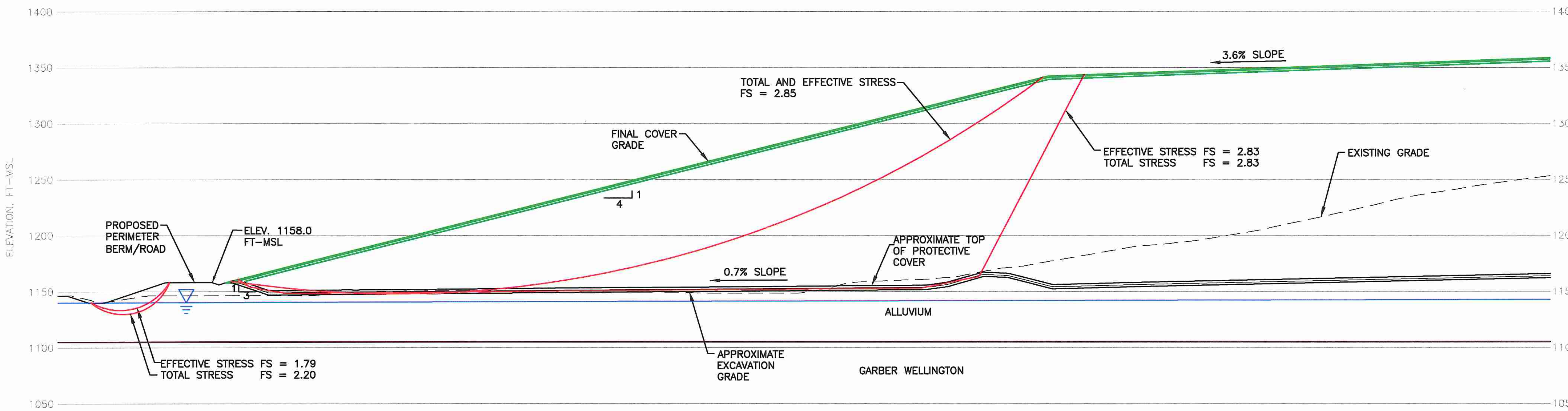

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DATE: 06/2015 FILE: 0086-356-11 CAD: N-2A-10-SLOPE-SEC.DWG	DRAWN BY: SRF DESIGN BY: SS REVIEWED BY: JVQ	REVISIONS NO. | DATE | DESCRIPTION	
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EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
SLOPE STABILITY ANALYSIS

Analyzed Section-Run[1]	Failure Type	Calculated Factor of Safety				Acceptable Factor of Safety
		Static Condition		Seismic Condition[3]		
Recommended Minimum Factor of Safety[2]		Long-Term	Short-Term	Long-Term	Short-Term	
		1.5	1.3	1.15	1.15	
Excavation Slope Sec-1	Bishop-Circular	2.53	3.31	1.60	2.16	YES
Excavation Slope Sec-2	Bishop-Circular	3.09	3.76	1.92	2.42	YES
Liner Slope Sec-1	Bishop-Circular	3.32	3.95	2.04	2.50	YES
Liner Slope Sec-2	Bishop-Circular	3.12	5.01	2.09	3.28	YES
Interim Slope Sec-1	Bishop-Circular	2.27	2.30	1.45	1.46	YES
Final Cover Run-1	Bishop-Circular	2.85	2.85	1.69	1.67	YES
Final Cover Run-2	Bishop-Circular	1.79	2.20	1.15	1.45	YES
Final Cover Run-3	Rankine-Block	2.83	2.83	1.57	1.57	YES

1. For excavation,liner, and interim slopes, run 1 represents the circular failure analysis. For final cover slopes, run 1 represents the circular failure analysis through the waste, run 2 represents the circular failure analysis at the perimeter structure, and run 3 represents the block failure analysis.
2. Recommended minimum factor of safety provided in reference 3 on page N-2A-2.
3. A horizontal loading coefficient of 0.155 was applied to each condition to represent seismic impact.

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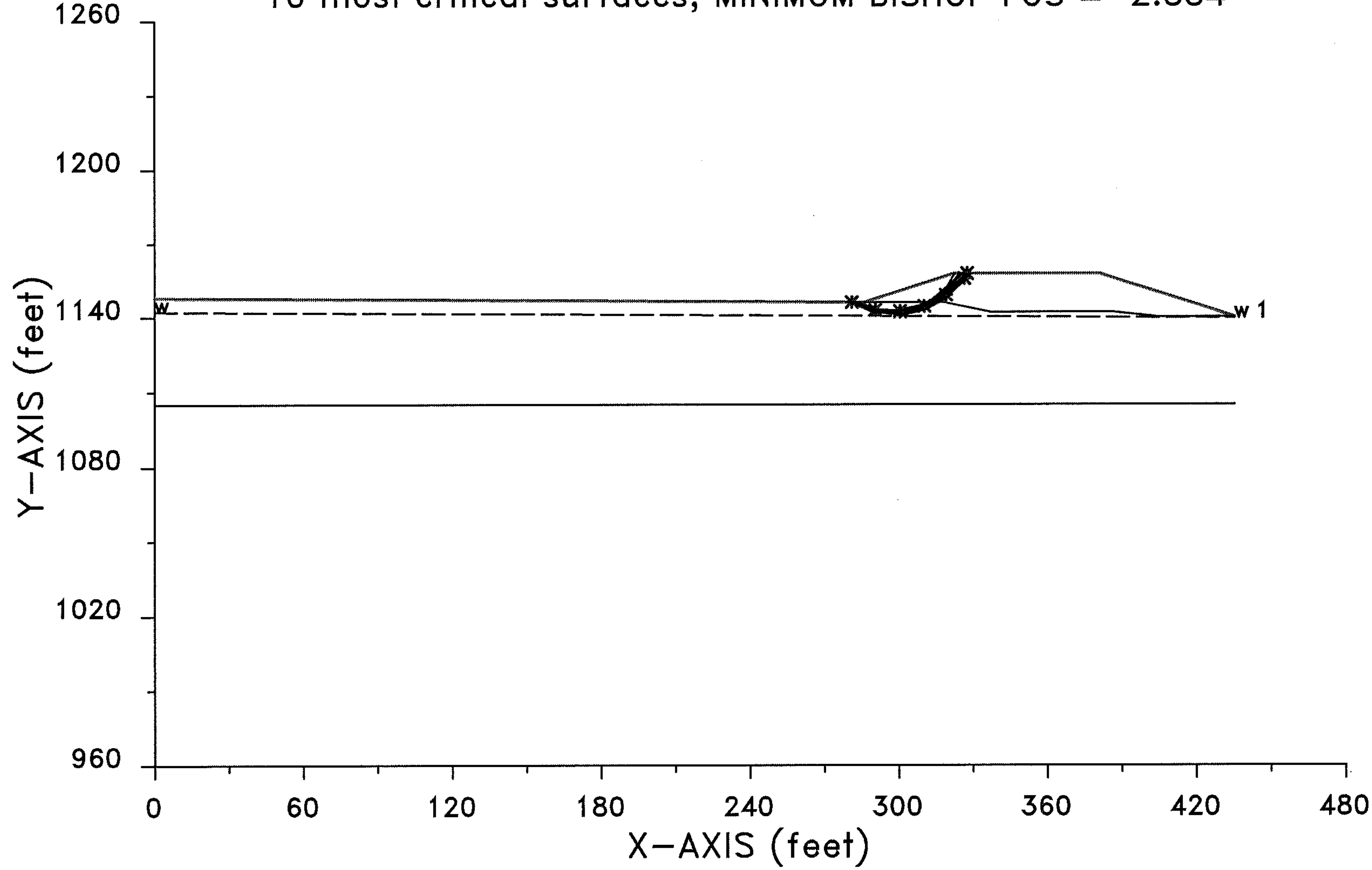
Excavation Section1 Effective

10 most critical surfaces, MINIMUM BISHOP FOS = 2.534



XSTABL File: EO_EXC1E 5-19-15 10:28

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*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*             using the                *
*          Method of Slices            *
*                                      *
*       Copyright (C) 1992 - 2013      *
*   Interactive Software Designs, Inc. *
*       Moscow, ID 83843, U.S.A.       *
*                                      *
*          All Rights Reserved         *
*                                      *
*  Ver. 5.209              96 - 2083   *
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Problem Description : Excavation Section1 Effective

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1148.0	286.1	1146.0	2
2	286.1	1146.0	322.2	1158.0	1
3	322.2	1158.0	380.9	1158.0	1
4	380.9	1158.0	435.3	1140.0	1

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	286.2	1146.0	317.8	1146.0	2
2	317.8	1146.0	336.9	1142.0	2
3	336.9	1142.0	386.4	1142.0	2
4	386.4	1142.0	404.5	1140.0	2
5	404.5	1140.0	435.3	1140.0	2
6	.0	1105.0	435.3	1105.0	3

ISOTROPIC Soil Parameters

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	119.2	119.2	.0	25.00	.000	.0	1
3	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 280.0 ft and x = 290.0 ft

Each surface terminates between x = 320.0 ft and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	281.11	1146.03
2	290.58	1142.83
3	300.57	1142.27
4	310.34	1144.41
5	319.18	1149.08
6	326.44	1155.95
7	327.68	1158.00

****   Simplified BISHOP FOS =   2.534   ****

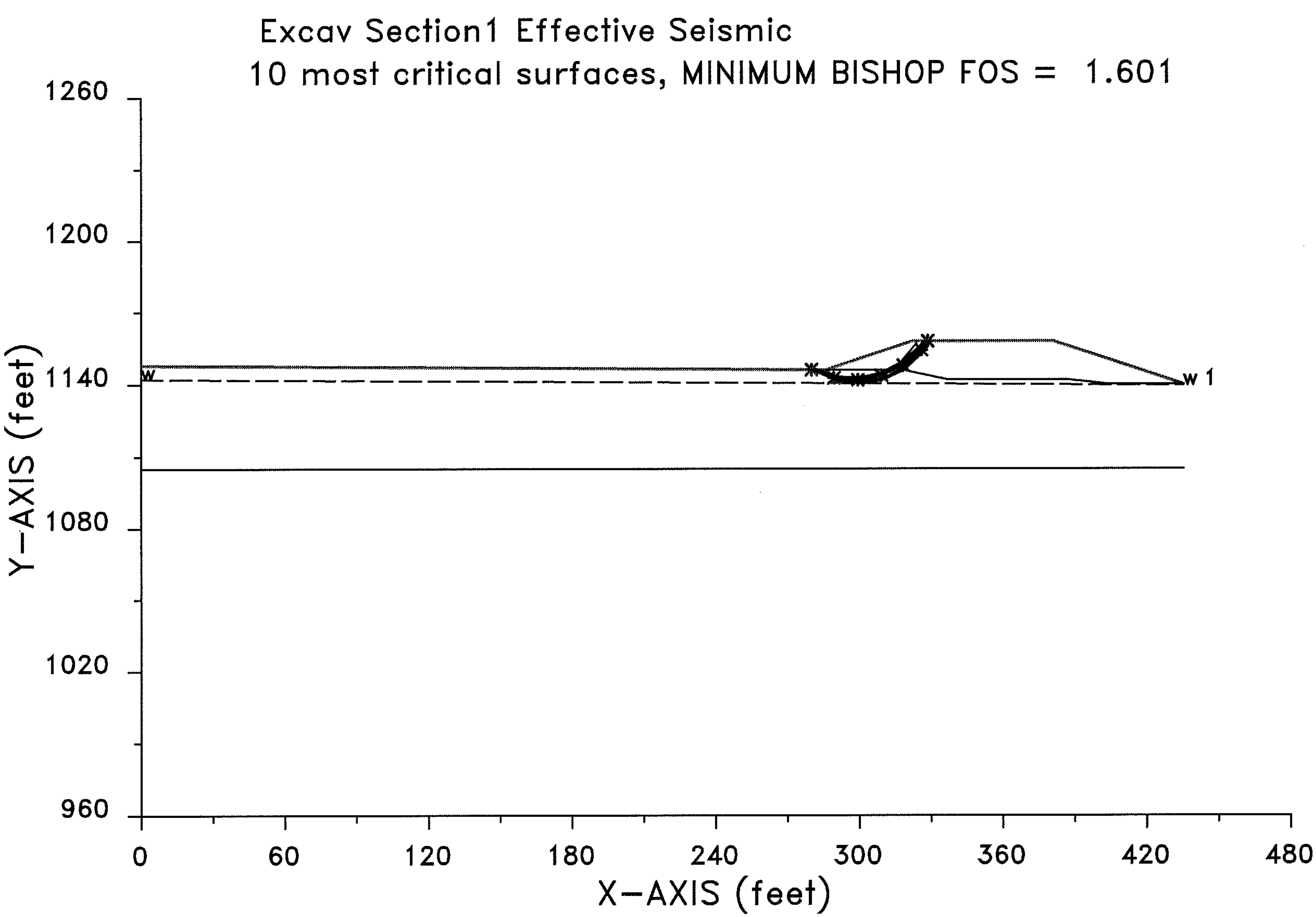
The following is a summary of the TEN most critical surfaces

Problem Description : Excavation Section1 Effective

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.534	297.62	1179.16	37.01	281.11	327.68	7.960E+05
2.	2.539	297.85	1179.53	37.44	281.11	328.14	8.238E+05
3.	2.541	296.14	1180.72	38.25	280.00	326.63	7.709E+05
4.	2.541	297.60	1180.35	38.56	280.00	328.62	8.864E+05
5.	2.541	296.67	1172.46	31.23	280.00	324.15	6.421E+05
6.	2.545	298.88	1175.52	33.35	283.33	327.24	6.942E+05
7.	2.554	297.73	1170.07	28.02	283.33	322.64	4.947E+05
8.	2.563	299.67	1172.15	31.41	282.22	327.36	7.532E+05
9.	2.565	298.49	1170.27	29.20	282.22	324.95	6.204E+05
10.	2.565	299.67	1171.88	30.58	283.33	326.82	6.812E+05

* * *   END OF FILE   * * *

EOEXC1ES 5-19-15 10:35



XSTABL File: EOEXC1ES   5-19-15   10:35

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2013      *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*           All Rights Reserved         *
*                                       *
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*****************************************
```

Problem Description : Excavation Section1 Effective Seismic

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1148.0	286.1	1146.0	2
2	286.1	1146.0	322.2	1158.0	1
3	322.2	1158.0	380.9	1158.0	1
4	380.9	1158.0	435.3	1140.0	1

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	286.2	1146.0	317.8	1146.0	2
2	317.8	1146.0	336.9	1142.0	2
3	336.9	1142.0	386.4	1142.0	2
4	386.4	1142.0	404.5	1140.0	2
5	404.5	1140.0	435.3	1140.0	2
6	.0	1105.0	435.3	1105.0	3

ISOTROPIC Soil Parameters

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	119.2	119.2	.0	25.00	.000	.0	1
3	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 280.0 ft
and x = 290.0 ft

Each surface terminates between x = 320.0 ft
and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
***********************************************************************
    -- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
***********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
***********************************************************************
```

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	280.00	1146.04
2	289.41	1142.67
3	299.38	1141.83
4	309.22	1143.59
5	318.29	1147.81
6	325.96	1154.23
7	328.62	1158.00

**** Simplified BISHOP FOS = 1.601 ****

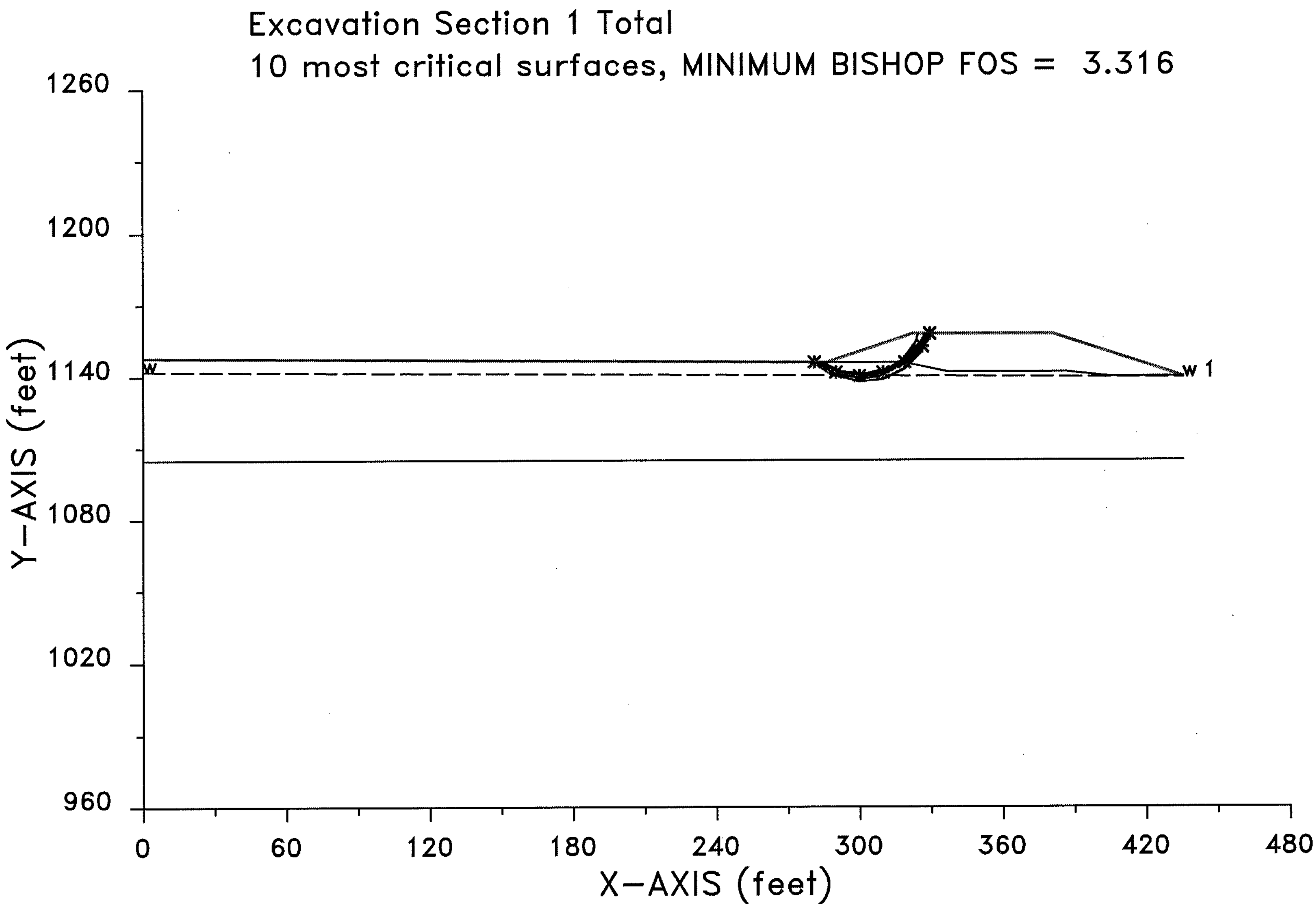
The following is a summary of the TEN most critical surfaces

Problem Description : Excavation Section1 Effective Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.601	297.60	1180.35	38.56	280.00	328.62	8.489E+05
2.	1.608	297.85	1179.53	37.44	281.11	328.14	7.886E+05
3.	1.609	297.62	1179.16	37.01	281.11	327.68	7.617E+05
4.	1.616	296.14	1180.72	38.25	280.00	326.63	7.372E+05
5.	1.620	300.21	1176.23	35.15	282.22	329.84	8.490E+05
6.	1.624	296.67	1172.46	31.23	280.00	324.15	6.141E+05
7.	1.625	300.07	1174.23	33.98	281.11	329.52	8.689E+05
8.	1.625	298.88	1175.52	33.35	283.33	327.24	6.641E+05
9.	1.628	298.54	1182.89	40.31	282.22	329.92	8.649E+05
10.	1.632	299.67	1172.15	31.41	282.22	327.36	7.222E+05

* * * END OF FILE * * *

EO_EXC1T 5-19-15 10:32



XSTABL File: EO_EXC1T   5-19-15   10:32

```
****************************************
*              X S T A B L             *
*                                      *
*        Slope Stability Analysis      *
*              using the               *
*           Method of Slices           *
*                                      *
*        Copyright (C) 1992 - 2013     *
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*        Moscow, ID 83843, U.S.A.      *
*                                      *
*          All Rights Reserved         *
*                                      *
*  Ver. 5.209               96 - 2083  *
****************************************
```

Problem Description : Excavation Section 1 Total

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1148.0	286.1	1146.0	2
2	286.1	1146.0	322.2	1158.0	1
3	322.2	1158.0	380.9	1158.0	1
4	380.9	1158.0	435.3	1140.0	1

7 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1148.0	286.2	1146.0	2
2	286.2	1146.0	317.8	1146.0	2
3	317.8	1146.0	336.9	1142.0	2
4	336.9	1142.0	386.4	1142.0	2
5	386.4	1142.0	404.5	1140.0	2
6	404.5	1140.0	435.3	1140.0	2
7	.0	1105.0	435.3	1105.0	3

ISOTROPIC Soil Parameters

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	119.2	119.2	.0	25.00	.000	.0	1
3	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 280.0 ft and x = 290.0 ft

Each surface terminates between x = 320.0 ft and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	281.11	1146.03
2	290.14	1141.74
3	300.03	1140.25
4	309.92	1141.71
5	318.96	1145.99
6	326.36	1152.71
7	329.52	1158.00

**** Simplified BISHOP FOS = 3.316 ****

The following is a summary of the TEN most critical surfaces

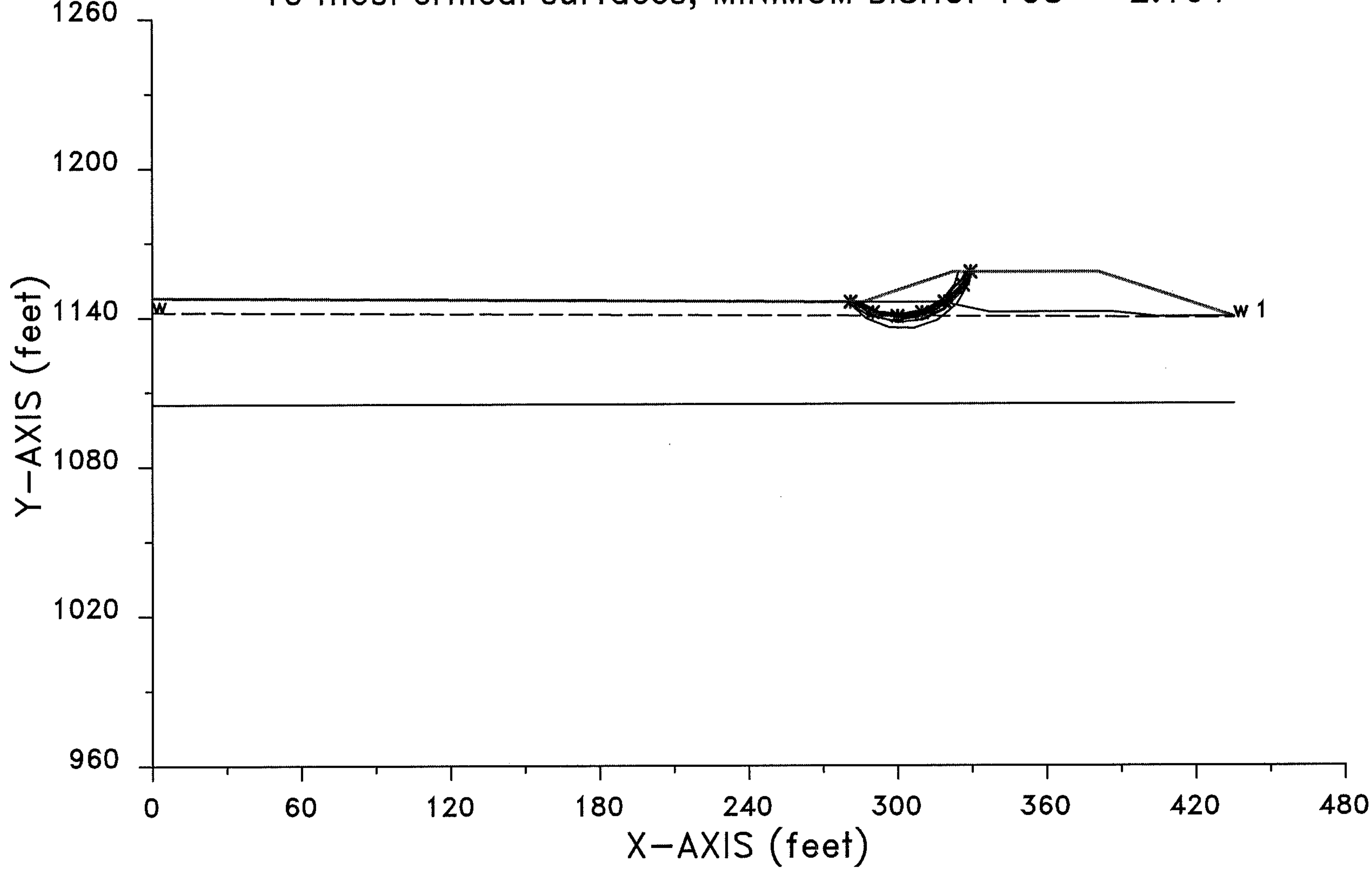
Problem Description : Excavation Section 1 Total

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	3.316	300.07	1174.23	33.98	281.11	329.52	1.162E+06
2.	3.365	300.21	1176.23	35.15	282.22	329.84	1.156E+06
3.	3.378	301.33	1172.32	31.87	283.33	329.38	1.071E+06
4.	3.389	299.67	1172.15	31.41	282.22	327.36	9.962E+05
5.	3.411	302.43	1166.55	28.80	282.22	329.71	1.125E+06
6.	3.415	298.92	1165.64	27.24	280.00	324.59	9.229E+05
7.	3.422	300.29	1173.26	32.09	283.33	328.23	1.011E+06
8.	3.428	302.39	1171.28	30.99	284.44	329.97	1.065E+06
9.	3.430	301.94	1165.32	27.59	282.22	328.18	1.044E+06
10.	3.438	299.04	1166.80	27.44	281.11	324.60	8.822E+05

* * * END OF FILE * * *

EOEXC1TS 5-19-15 10:37

Excavation Section 1 Total Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 2.164



XSTABL File: EOEXC1TS 5-19-15 10:37

```
****************************************
*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*             using the                *
*          Method of Slices            *
*                                      *
*       Copyright (C) 1992 - 2013      *
*   Interactive Software Designs, Inc. *
*       Moscow, ID 83843, U.S.A.       *
*                                      *
*         All Rights Reserved          *
*                                      *
*  Ver. 5.209                96 - 2083 *
****************************************
```

Problem Description : Excavation Section 1 Total Seismic

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1148.0	286.1	1146.0	2
2	286.1	1146.0	322.2	1158.0	1
3	322.2	1158.0	380.9	1158.0	1
4	380.9	1158.0	435.3	1140.0	1

7 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1148.0	286.2	1146.0	2
2	286.2	1146.0	317.8	1146.0	2
3	317.8	1146.0	336.9	1142.0	2
4	336.9	1142.0	386.4	1142.0	2
5	386.4	1142.0	404.5	1140.0	2
6	404.5	1140.0	435.3	1140.0	2
7	.0	1105.0	435.3	1105.0	3

ISOTROPIC Soil Parameters

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	119.2	119.2	.0	25.00	.000	.0	1
3	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 280.0 ft
and x = 290.0 ft

Each surface terminates between x = 320.0 ft
and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
***********************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
***********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
***********************************************************************
```

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	281.11	1146.03
2	290.14	1141.74
3	300.03	1140.25
4	309.92	1141.71
5	318.96	1145.99
6	326.36	1152.71
7	329.52	1158.00

****   Simplified BISHOP FOS =   2.164   ****

The following is a summary of the TEN most critical surfaces

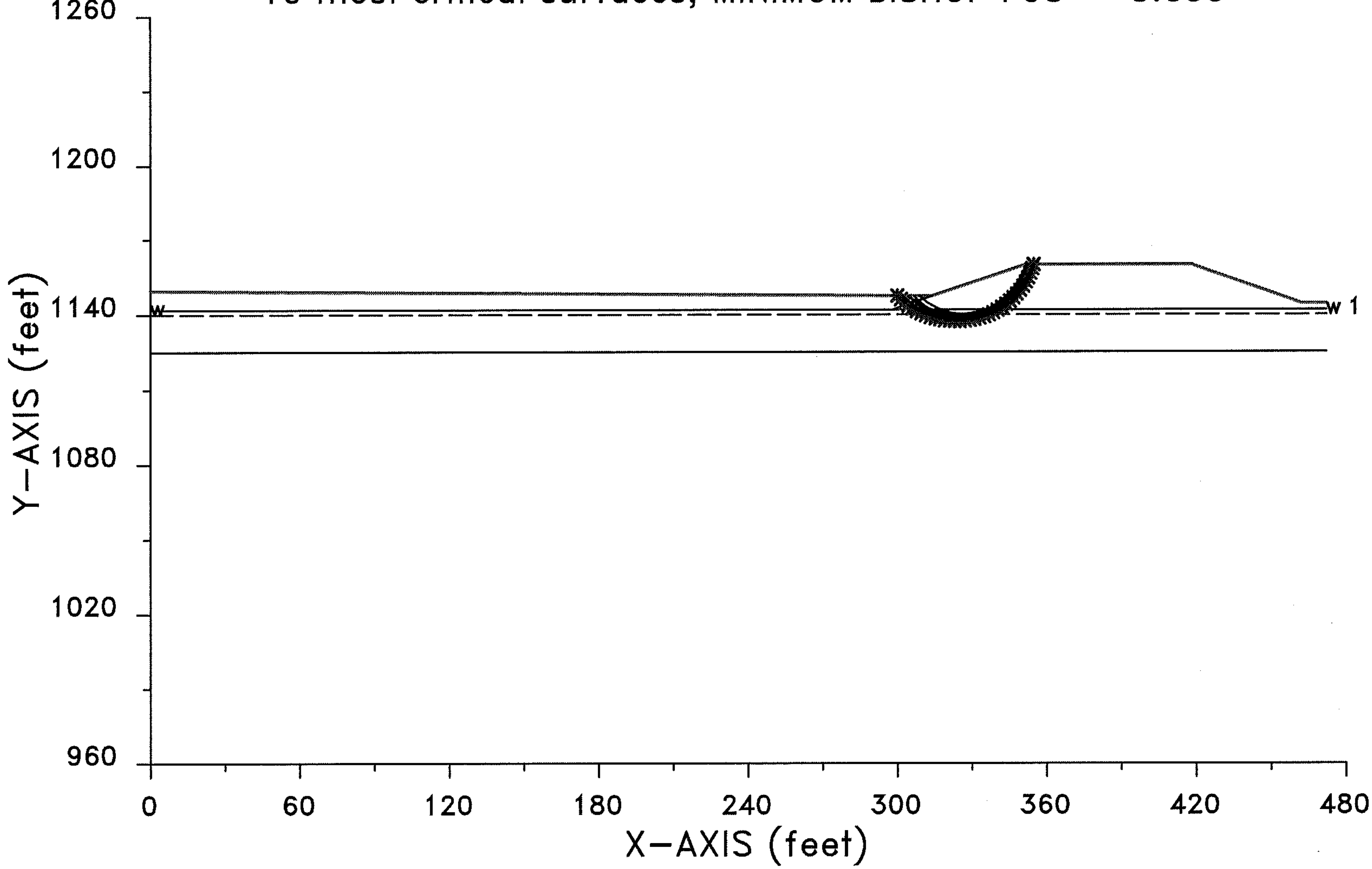
Problem Description : Excavation Section 1 Total Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.164	300.07	1174.23	33.98	281.11	329.52	1.158E+06
2.	2.198	300.21	1176.23	35.15	282.22	329.84	1.152E+06
3.	2.214	301.33	1172.32	31.87	283.33	329.38	1.067E+06
4.	2.223	302.43	1166.55	28.80	282.22	329.71	1.120E+06
5.	2.230	302.32	1163.39	28.27	280.00	329.63	1.255E+06
6.	2.239	302.39	1171.28	30.99	284.44	329.97	1.061E+06
7.	2.243	299.67	1172.15	31.41	282.22	327.36	9.925E+05
8.	2.249	301.94	1165.32	27.59	282.22	328.18	1.039E+06
9.	2.253	298.92	1165.64	27.24	280.00	324.59	9.182E+05
10.	2.254	302.79	1169.02	29.42	284.44	329.62	1.039E+06

* * * END OF FILE * * *

EO_EXC2E 5-22-15 10:59

Excavation Section 2 Effective
10 most critical surfaces, MINIMUM BISHOP FOS = 3.099



XSTABL File: EO_EXC2E   5-22-15   10:59

```
****************************************
*              X S T A B L             *
*                                      *
*        Slope Stability Analysis      *
*              using the               *
*           Method of Slices           *
*                                      *
*        Copyright (C) 1992 - 2013     *
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*        Moscow, ID 83843, U.S.A.      *
*                                      *
*           All Rights Reserved        *
*                                      *
*  Ver. 5.209                96 - 2083 *
****************************************
```

Problem Description : Excavation Section 2 Effective

SEGMENT BOUNDARY COORDINATES

5 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1149.5	314.0	1147.3	2
2	314.0	1147.3	351.5	1159.8	1
3	351.5	1159.8	418.0	1159.8	1
4	418.0	1159.8	462.2	1144.4	1
5	462.2	1144.4	472.2	1144.4	1

4 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1142.0	298.2	1142.0	3
2	298.2	1142.0	314.0	1147.3	1
3	298.2	1142.0	472.2	1142.0	3
4	.0	1125.0	472.2	1125.0	4

ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	116.0	118.0	.0	30.00	.000	.0	0
3	119.2	119.2	.0	25.00	.000	.0	1
4	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

```
**********************************
        PHREATIC SURFACE,
**********************************
```

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

```
  10 Surfaces initiate from each of  10 points equally spaced
along the ground surface between  x =    300.0 ft
                              and  x =    320.0 ft


Each surface terminates between   x =    345.0 ft
                             and   x =    355.0 ft
```

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

2.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
***********************************************************************
    -- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
***********************************************************************
```

Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.

```
***********************************************************************
```

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 35 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	300.00	1147.40
2	301.42	1145.99
3	302.93	1144.67
4	304.51	1143.45
5	306.16	1142.32
6	307.88	1141.30
7	309.66	1140.39
8	311.49	1139.59
9	313.37	1138.90
10	315.28	1138.32
11	317.23	1137.87
12	319.20	1137.53
13	321.19	1137.32
14	323.19	1137.22
15	325.19	1137.25
16	327.18	1137.40
17	329.16	1137.68
18	331.13	1138.07
19	333.06	1138.59
20	334.96	1139.22
21	336.81	1139.96
22	338.62	1140.82
23	340.37	1141.79
24	342.06	1142.86
25	343.68	1144.03
26	345.22	1145.30
27	346.69	1146.66
28	348.07	1148.11
29	349.35	1149.64
30	350.55	1151.25
31	351.64	1152.93
32	352.62	1154.67
33	353.50	1156.46
34	354.27	1158.31
35	354.78	1159.80

**** Simplified BISHOP FOS =   3.099 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Excavation Section 2 Effective

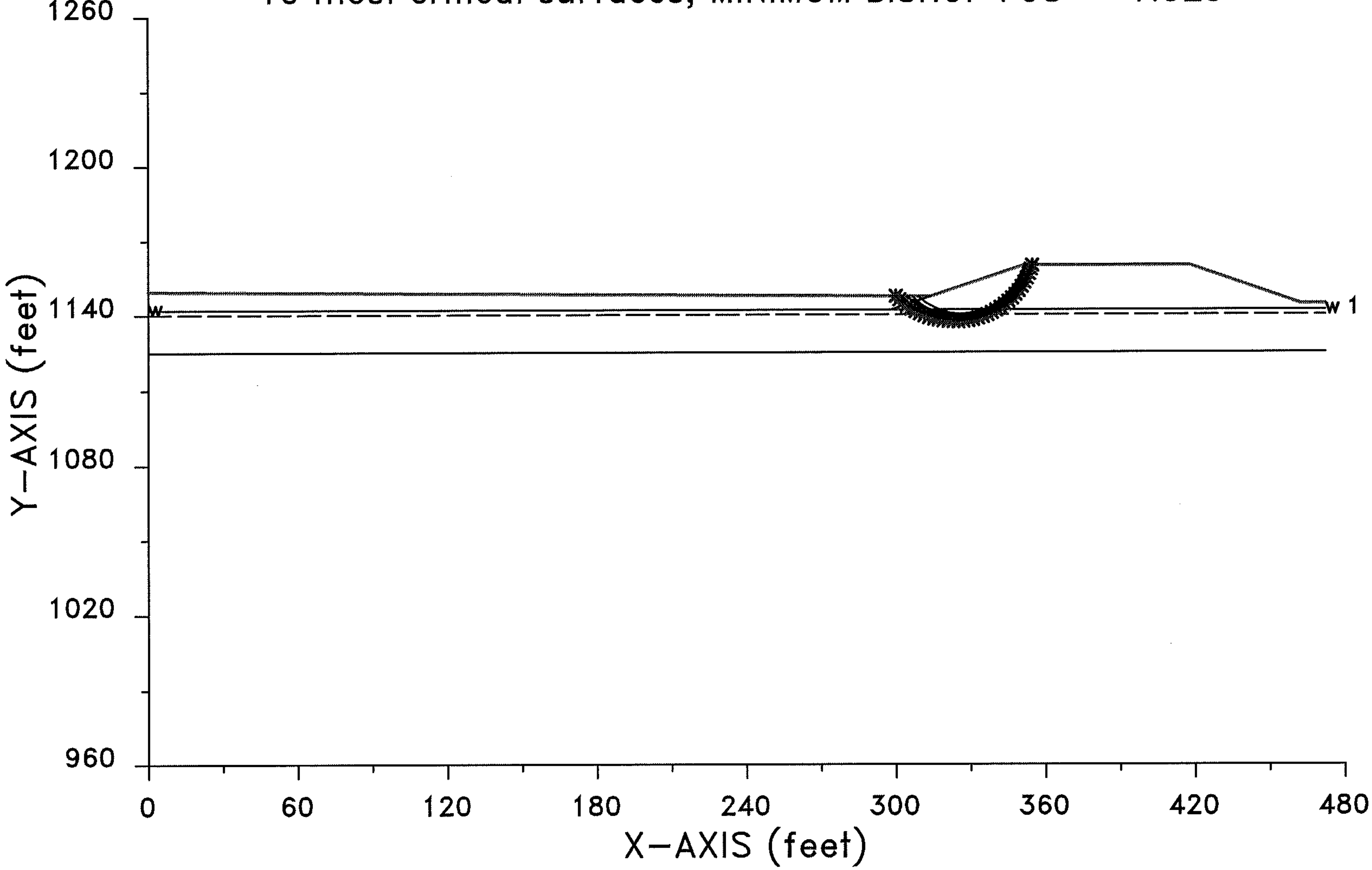
	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	3.099	323.69	1169.89	32.66	300.00	354.78	1.316E+06
2.	3.101	324.92	1168.70	31.14	302.22	354.76	1.230E+06
3.	3.104	324.53	1170.36	32.02	302.22	354.76	1.222E+06
4.	3.106	324.83	1168.58	30.99	302.22	354.58	1.217E+06
5.	3.152	327.46	1166.73	28.43	306.67	355.01	1.085E+06
6.	3.188	324.74	1172.52	32.32	304.44	354.41	1.128E+06
7.	3.208	324.91	1166.77	28.20	304.44	352.23	9.935E+05
8.	3.215	322.06	1170.44	31.91	300.00	352.18	1.134E+06
9.	3.240	327.75	1168.16	28.09	308.89	354.52	9.839E+05
10.	3.260	324.11	1168.34	28.75	304.44	351.60	9.508E+05

* * * END OF FILE * * *

EOEXC2ES 5-22-15 11:01

Excav Section 2 Effective Seismic

10 most critical surfaces, MINIMUM BISHOP FOS = 1.929



XSTABL File: EOEXC2ES 5-22-15 11:01

```
*****************************************
*              X S T A B L              *
*                                       *
*       Slope Stability Analysis        *
*              using the                *
*           Method of Slices            *
*                                       *
*       Copyright (C) 1992 - 2013       *
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*       Moscow, ID 83843, U.S.A.        *
*                                       *
*         All Rights Reserved           *
*                                       *
*  Ver. 5.209                96 - 2083  *
*****************************************
```

Problem Description : Excav Section 2 Effective Seismic

SEGMENT BOUNDARY COORDINATES

5 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1149.5	314.0	1147.3	2
2	314.0	1147.3	351.5	1159.8	1
3	351.5	1159.8	418.0	1159.8	1
4	418.0	1159.8	462.2	1144.4	1
5	462.2	1144.4	472.2	1144.4	1

4 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1142.0	298.2	1142.0	3
2	298.2	1142.0	314.0	1147.3	1
3	298.2	1142.0	472.2	1142.0	3
4	.0	1125.0	472.2	1125.0	4

ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	116.0	118.0	.0	30.00	.000	.0	0
3	119.2	119.2	.0	25.00	.000	.0	1
4	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

```
**********************************
        PHREATIC SURFACE,
**********************************
```

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced
along the ground surface between x = 300.0 ft
and x = 320.0 ft

Each surface terminates between x = 345.0 ft
and x = 355.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

2.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
***********************************************************************
    -- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
***********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
***********************************************************************
```

```
------------------------------------------------------------
USER SELECTED option to maintain strength greater than zero
------------------------------------------------------------
```

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 35 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	300.00	1147.40
2	301.42	1145.99
3	302.93	1144.67
4	304.51	1143.45
5	306.16	1142.32
6	307.88	1141.30
7	309.66	1140.39
8	311.49	1139.59
9	313.37	1138.90
10	315.28	1138.32
11	317.23	1137.87
12	319.20	1137.53
13	321.19	1137.32
14	323.19	1137.22
15	325.19	1137.25
16	327.18	1137.40
17	329.16	1137.68
18	331.13	1138.07
19	333.06	1138.59
20	334.96	1139.22
21	336.81	1139.96
22	338.62	1140.82
23	340.37	1141.79
24	342.06	1142.86
25	343.68	1144.03
26	345.22	1145.30
27	346.69	1146.66
28	348.07	1148.11
29	349.35	1149.64
30	350.55	1151.25
31	351.64	1152.93
32	352.62	1154.67
33	353.50	1156.46
34	354.27	1158.31
35	354.78	1159.80

**** Simplified BISHOP FOS = 1.929 ****

The following is a summary of the TEN most critical surfaces

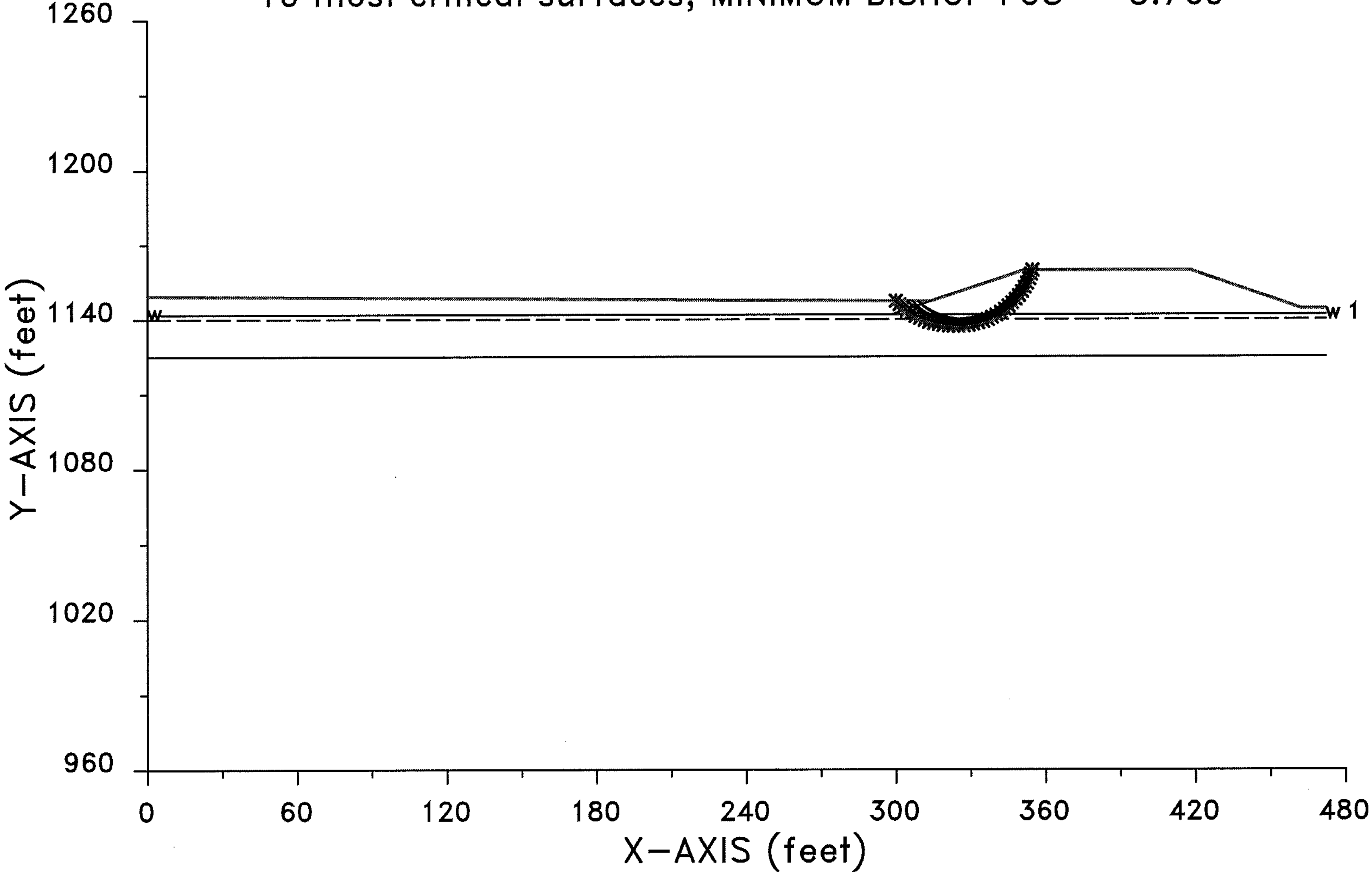
Problem Description : Excav Section 2 Effective Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.929	323.69	1169.89	32.66	300.00	354.78	1.274E+06
2.	1.957	324.92	1168.70	31.14	302.22	354.76	1.191E+06
3.	1.960	324.53	1170.36	32.02	302.22	354.76	1.184E+06
4.	1.960	324.83	1168.58	30.99	302.22	354.58	1.179E+06
5.	1.999	322.06	1170.44	31.91	300.00	352.18	1.098E+06
6.	2.037	327.46	1166.73	28.43	306.67	355.01	1.053E+06
7.	2.045	324.74	1172.52	32.32	304.44	354.41	1.095E+06
8.	2.053	324.91	1166.77	28.20	304.44	352.23	9.632E+05
9.	2.088	324.11	1168.34	28.75	304.44	351.60	9.219E+05
10.	2.118	327.75	1168.16	28.09	308.89	354.52	9.563E+05

* * * END OF FILE * * *

EO_EXC2T 5-22-15 11:00

Excavation Section 2 Total
10 most critical surfaces, MINIMUM BISHOP FOS = 3.769



XSTABL File: EO_EXC2T 5-22-15 11:00

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*              using the                *
*           Method of Slices            *
*                                       *
*       Copyright (C) 1992 - 2013       *
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*       Moscow, ID 83843, U.S.A.        *
*                                       *
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*                                       *
*  Ver. 5.209                96 - 2083  *
*****************************************
```

Problem Description : Excavation Section 2 Total

SEGMENT BOUNDARY COORDINATES

5 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1149.5	314.0	1147.3	2
2	314.0	1147.3	351.5	1159.8	1
3	351.5	1159.8	418.0	1159.8	1
4	418.0	1159.8	462.2	1144.4	1
5	462.2	1144.4	472.2	1144.4	1

4 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1142.0	298.2	1142.0	3
2	298.2	1142.0	314.0	1147.3	1
3	298.2	1142.0	472.2	1142.0	3
4	.0	1125.0	472.2	1125.0	4

ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	116.0	118.0	.0	30.00	.000	.0	0
3	119.2	119.2	.0	25.00	.000	.0	1
4	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 300.0 ft
and x = 320.0 ft

Each surface terminates between x = 345.0 ft
and x = 355.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

2.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 35 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	300.00	1147.40
2	301.42	1145.99
3	302.93	1144.67
4	304.51	1143.45
5	306.16	1142.32
6	307.88	1141.30
7	309.66	1140.39
8	311.49	1139.59
9	313.37	1138.90
10	315.28	1138.32
11	317.23	1137.87
12	319.20	1137.53
13	321.19	1137.32
14	323.19	1137.22
15	325.19	1137.25
16	327.18	1137.40
17	329.16	1137.68
18	331.13	1138.07
19	333.06	1138.59
20	334.96	1139.22
21	336.81	1139.96
22	338.62	1140.82
23	340.37	1141.79
24	342.06	1142.86
25	343.68	1144.03
26	345.22	1145.30
27	346.69	1146.66
28	348.07	1148.11
29	349.35	1149.64
30	350.55	1151.25
31	351.64	1152.93
32	352.62	1154.67
33	353.50	1156.46
34	354.27	1158.31
35	354.78	1159.80

**** Simplified BISHOP FOS = 3.769 ****

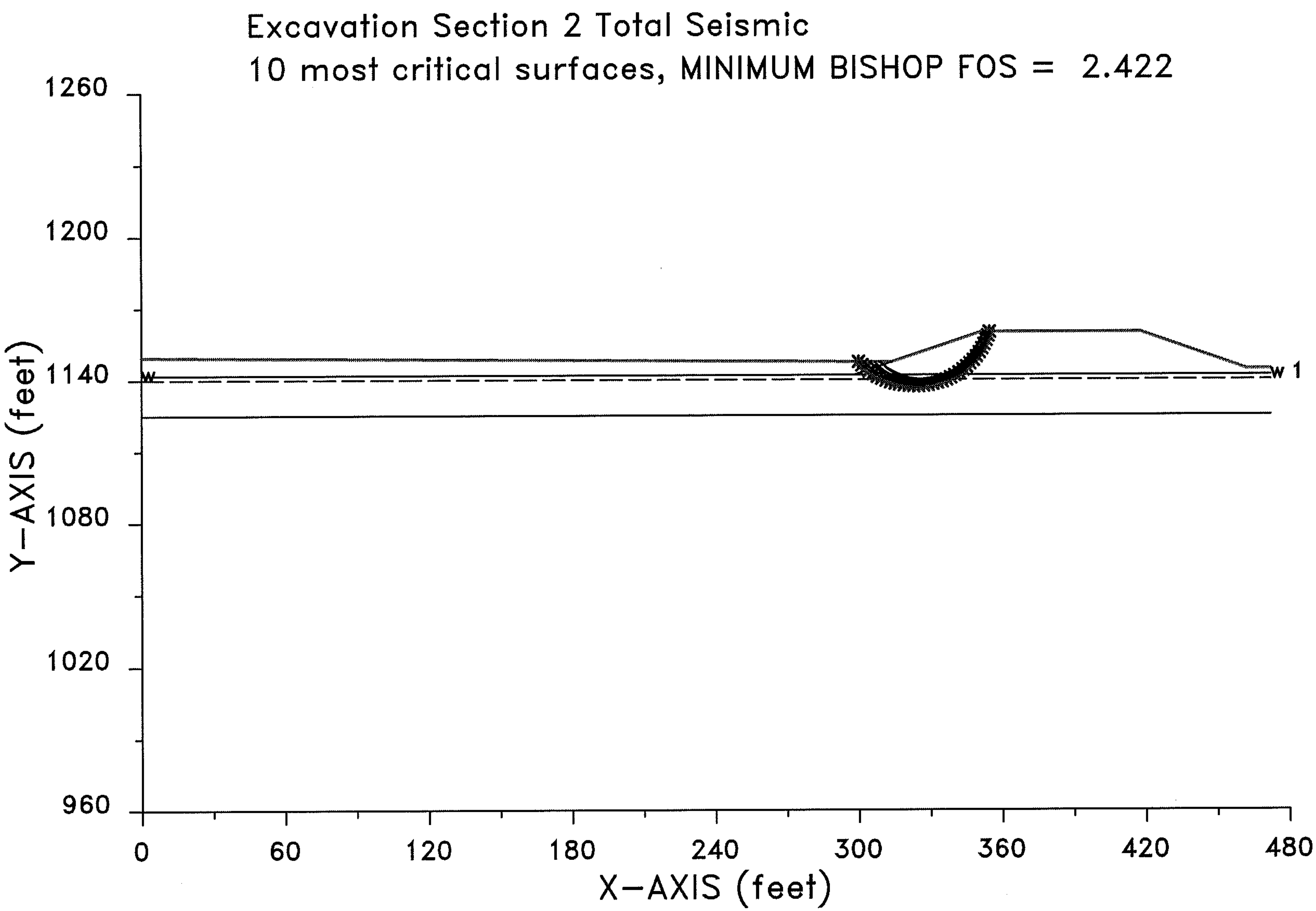
The following is a summary of the TEN most critical surfaces

Problem Description : Excavation Section 2 Total

	FOS (BISHOP)	Circle Center x-coord (ft)	y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	3.769	323.69	1169.89	32.66	300.00	354.78	1.600E+06
2.	3.811	324.92	1168.70	31.14	302.22	354.76	1.511E+06
3.	3.824	324.83	1168.58	30.99	302.22	354.58	1.498E+06
4.	3.872	324.53	1170.36	32.02	302.22	354.76	1.525E+06
5.	3.956	327.46	1166.73	28.43	306.67	355.01	1.361E+06
6.	4.116	322.06	1170.44	31.91	300.00	352.18	1.452E+06
7.	4.137	324.91	1166.77	28.20	304.44	352.23	1.281E+06
8.	4.224	324.74	1172.52	32.32	304.44	354.41	1.495E+06
9.	4.261	327.80	1164.96	25.85	308.89	353.13	1.182E+06
10.	4.266	327.75	1168.16	28.09	308.89	354.52	1.296E+06

* * * END OF FILE * * *

EOEXC2TS 5-22-15 11:05



XSTABL File: EOEXC2TS   5-22-15   11:05

```
****************************************
*             X S T A B L              *
*                                      *
*        Slope Stability Analysis      *
*               using the              *
*            Method of Slices          *
*                                      *
*        Copyright (C) 1992 - 2013     *
*   Interactive Software Designs, Inc. *
*        Moscow, ID 83843, U.S.A.      *
*                                      *
*          All Rights Reserved         *
*                                      *
*  Ver. 5.209               96 - 2083  *
****************************************
```

Problem Description : Excavation Section 2 Total Seismic

SEGMENT BOUNDARY COORDINATES

5 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1149.5	314.0	1147.3	2
2	314.0	1147.3	351.5	1159.8	1
3	351.5	1159.8	418.0	1159.8	1
4	418.0	1159.8	462.2	1144.4	1
5	462.2	1144.4	472.2	1144.4	1

4 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1142.0	298.2	1142.0	3
2	298.2	1142.0	314.0	1147.3	1
3	298.2	1142.0	472.2	1142.0	3
4	.0	1125.0	472.2	1125.0	4

ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	116.0	118.0	.0	30.00	.000	.0	0
3	119.2	119.2	.0	25.00	.000	.0	1
4	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced
along the ground surface between x = 300.0 ft
and x = 320.0 ft

Each surface terminates between x = 345.0 ft
and x = 355.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

2.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined
within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
***********************************************************************
    -- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
***********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
***********************************************************************
```

```
    ------------------------------------------------------------
    USER SELECTED option to maintain strength greater than zero
    ------------------------------------------------------------
```

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 35 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	300.00	1147.40
2	301.42	1145.99
3	302.93	1144.67
4	304.51	1143.45
5	306.16	1142.32
6	307.88	1141.30
7	309.66	1140.39
8	311.49	1139.59
9	313.37	1138.90
10	315.28	1138.32
11	317.23	1137.87
12	319.20	1137.53
13	321.19	1137.32
14	323.19	1137.22
15	325.19	1137.25
16	327.18	1137.40
17	329.16	1137.68
18	331.13	1138.07
19	333.06	1138.59
20	334.96	1139.22
21	336.81	1139.96
22	338.62	1140.82
23	340.37	1141.79
24	342.06	1142.86
25	343.68	1144.03
26	345.22	1145.30
27	346.69	1146.66
28	348.07	1148.11
29	349.35	1149.64
30	350.55	1151.25
31	351.64	1152.93
32	352.62	1154.67
33	353.50	1156.46
34	354.27	1158.31
35	354.78	1159.80

**** Simplified BISHOP FOS = 2.422 ****

The following is a summary of the TEN most critical surfaces

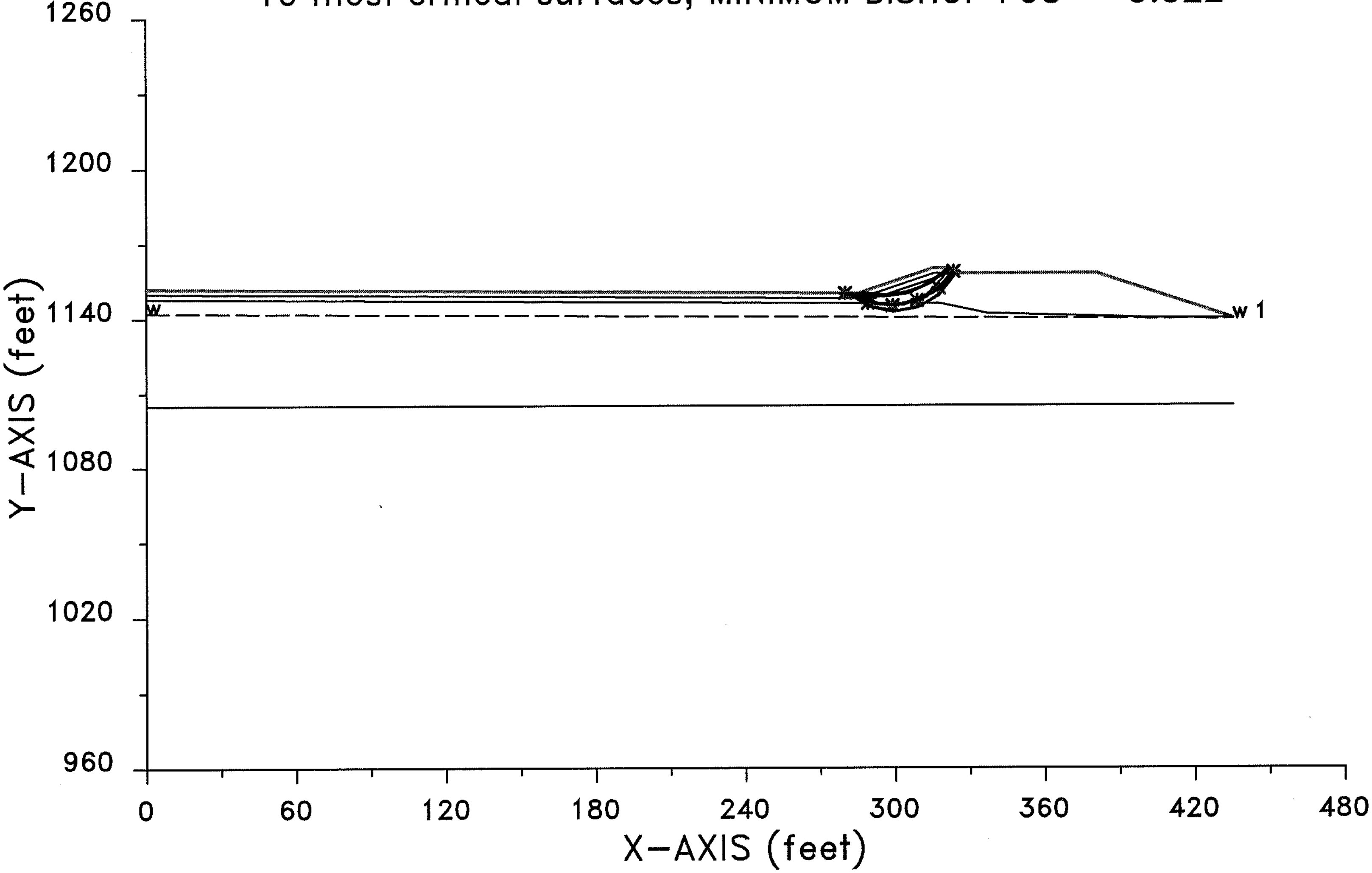
Problem Description : Excavation Section 2 Total Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.422	323.69	1169.89	32.66	300.00	354.78	1.600E+06
2.	2.481	324.92	1168.70	31.14	302.22	354.76	1.510E+06
3.	2.490	324.83	1168.58	30.99	302.22	354.58	1.497E+06
4.	2.524	324.53	1170.36	32.02	302.22	354.76	1.524E+06
5.	2.631	327.46	1166.73	28.43	306.67	355.01	1.361E+06
6.	2.645	322.06	1170.44	31.91	300.00	352.18	1.452E+06
7.	2.730	324.91	1166.77	28.20	304.44	352.23	1.281E+06
8.	2.792	324.74	1172.52	32.32	304.44	354.41	1.495E+06
9.	2.869	327.75	1168.16	28.09	308.89	354.52	1.295E+06
10.	2.870	327.80	1164.96	25.85	308.89	353.13	1.182E+06

* * * END OF FILE * * *

EO_1E 5-22-15 10:49

Liner Section1 Effective Stress
10 most critical surfaces, MINIMUM BISHOP FOS = 3.322



XSTABL File: EO_L1E   5-22-15   10:49

```
******************************************
*               X S T A B L              *
*                                        *
*        Slope Stability Analysis        *
*               using the                *
*            Method of Slices            *
*                                        *
*        Copyright (C) 1992 - 2013       *
*   Interactive Software Designs, Inc.   *
*        Moscow, ID 83843, U.S.A.        *
*                                        *
*          All Rights Reserved           *
*                                        *
*  Ver. 5.209                96 - 2083   *
******************************************
```

Problem Description : Liner Section1 Effective Stress

SEGMENT BOUNDARY COORDINATES

----

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1152.0	285.5	1150.0	2
2	285.5	1150.0	315.6	1160.0	2
3	315.6	1160.0	322.2	1160.0	2
4	322.2	1160.0	324.2	1158.0	2
5	324.2	1158.0	380.9	1158.0	1
6	380.9	1158.0	435.3	1140.0	1

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1150.0	285.8	1148.0	3
2	285.8	1148.0	315.9	1158.0	3
3	315.9	1158.0	322.2	1158.0	3
4	.0	1148.0	286.1	1146.0	4
5	286.1	1146.0	322.2	1158.0	1
6	322.2	1158.0	324.2	1158.0	1
7	286.1	1146.0	317.8	1146.0	4
8	317.8	1146.0	336.9	1142.0	4
9	336.9	1142.0	404.5	1140.0	4
10	404.5	1140.0	435.3	1140.0	4
11	.0	1105.0	435.3	1105.0	5

ISOTROPIC Soil Parameters

----

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 280.0 ft
and x = 290.0 ft

Each surface terminates between x = 320.0 ft
and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
***********************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
***********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
***********************************************************************
```

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 6 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	280.00	1150.04
2	289.17	1146.04
3	299.12	1145.05
4	308.89	1147.15
5	317.56	1152.14
6	323.51	1158.69

**** Simplified BISHOP FOS =   3.322   ****

The following is a summary of the TEN most critical surfaces

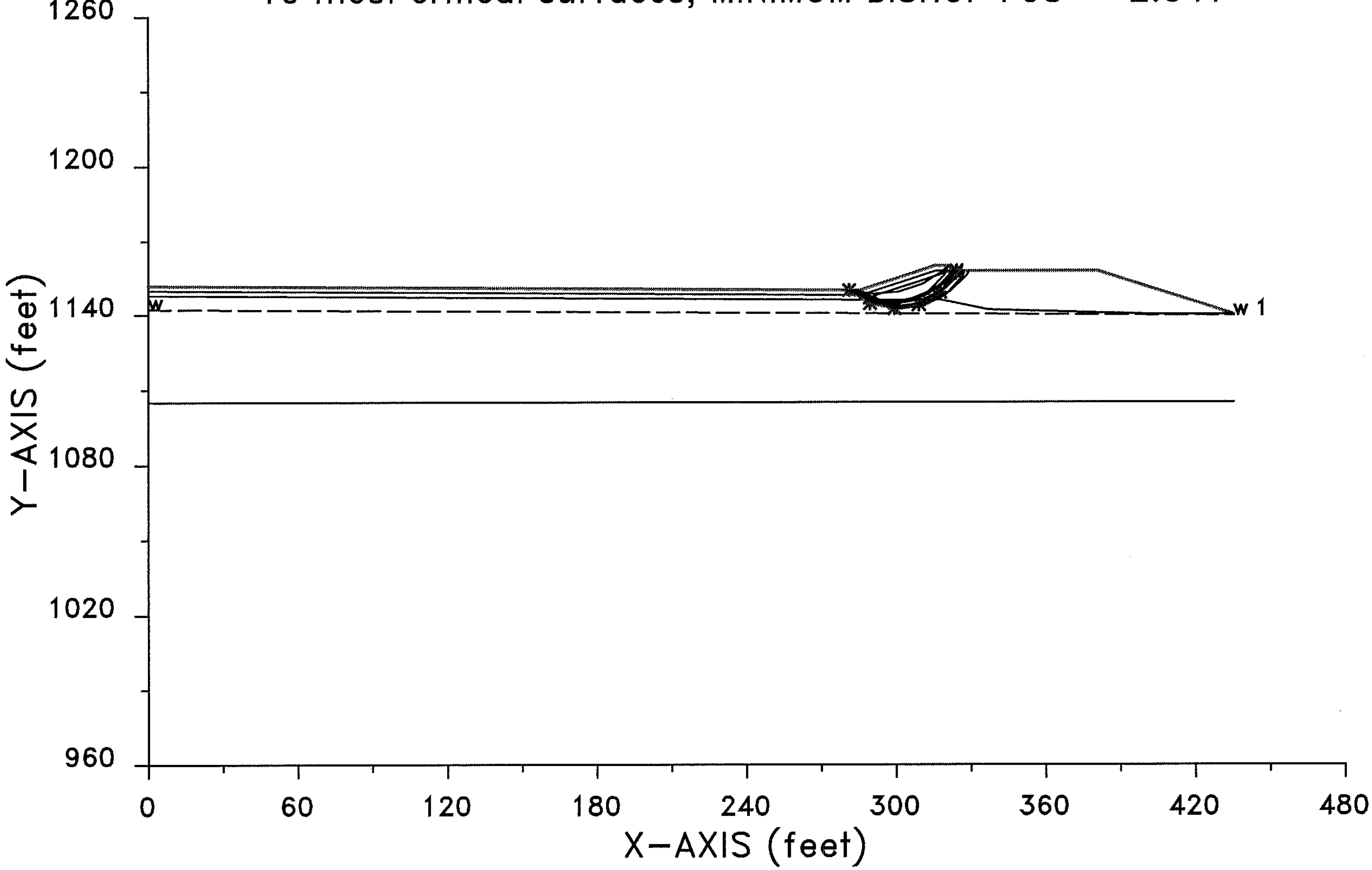
Problem Description : Liner Section1 Effective Stress

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	3.322	297.32	1177.26	32.26	280.00	323.51	8.242E+05
2.	3.323	299.94	1169.48	27.07	281.11	324.25	7.873E+05
3.	3.353	300.33	1169.79	26.81	282.22	324.29	7.491E+05
4.	3.375	292.35	1190.67	42.16	281.11	320.92	6.681E+05
5.	3.411	299.10	1169.23	24.18	284.44	320.91	5.520E+05
6.	3.442	299.02	1175.45	30.47	282.22	323.83	7.889E+05
7.	3.491	299.89	1171.68	26.61	284.44	322.91	6.599E+05
8.	3.517	292.21	1193.45	45.10	280.00	322.04	7.934E+05
9.	3.559	295.69	1183.84	35.31	285.56	321.62	6.051E+05
10.	3.601	295.61	1188.95	39.59	286.67	322.27	6.128E+05

* * * END OF FILE * * *

EO_L1ES 5-22-15 10:50

Liner Section1 Effective Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 2.041



XSTABL File: EO_L1ES 5-22-15 10:50

```
****************************************
*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*              using the               *
*           Method of Slices           *
*                                      *
*       Copyright (C) 1992 - 2013      *
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*        Moscow, ID 83843, U.S.A.      *
*                                      *
*          All Rights Reserved         *
*                                      *
*  Ver. 5.209              96 - 2083   *
****************************************
```

Problem Description : Liner Section1 Effective Seismic

SEGMENT BOUNDARY COORDINATES
----

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1152.0	285.5	1150.0	2
2	285.5	1150.0	315.6	1160.0	2
3	315.6	1160.0	322.2	1160.0	2
4	322.2	1160.0	324.2	1158.0	2
5	324.2	1158.0	380.9	1158.0	1
6	380.9	1158.0	435.3	1140.0	1

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1150.0	285.8	1148.0	3
2	285.8	1148.0	315.9	1158.0	3
3	315.9	1158.0	322.2	1158.0	3
4	.0	1148.0	286.1	1146.0	4
5	286.1	1146.0	322.2	1158.0	1
6	322.2	1158.0	324.2	1158.0	1
7	286.1	1146.0	317.8	1146.0	4
8	317.8	1146.0	336.9	1142.0	4
9	336.9	1142.0	404.5	1140.0	4
10	404.5	1140.0	435.3	1140.0	4
11	.0	1105.0	435.3	1105.0	5

ISOTROPIC Soil Parameters
----

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced
along the ground surface between x = 280.0 ft
and x = 290.0 ft

Each surface terminates between x = 320.0 ft
and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	281.11	1150.03
2	289.46	1144.52
3	299.23	1142.42
4	309.11	1144.01
5	317.73	1149.08
6	323.92	1156.93
7	324.25	1158.00

**** Simplified BISHOP FOS = 2.041 ****

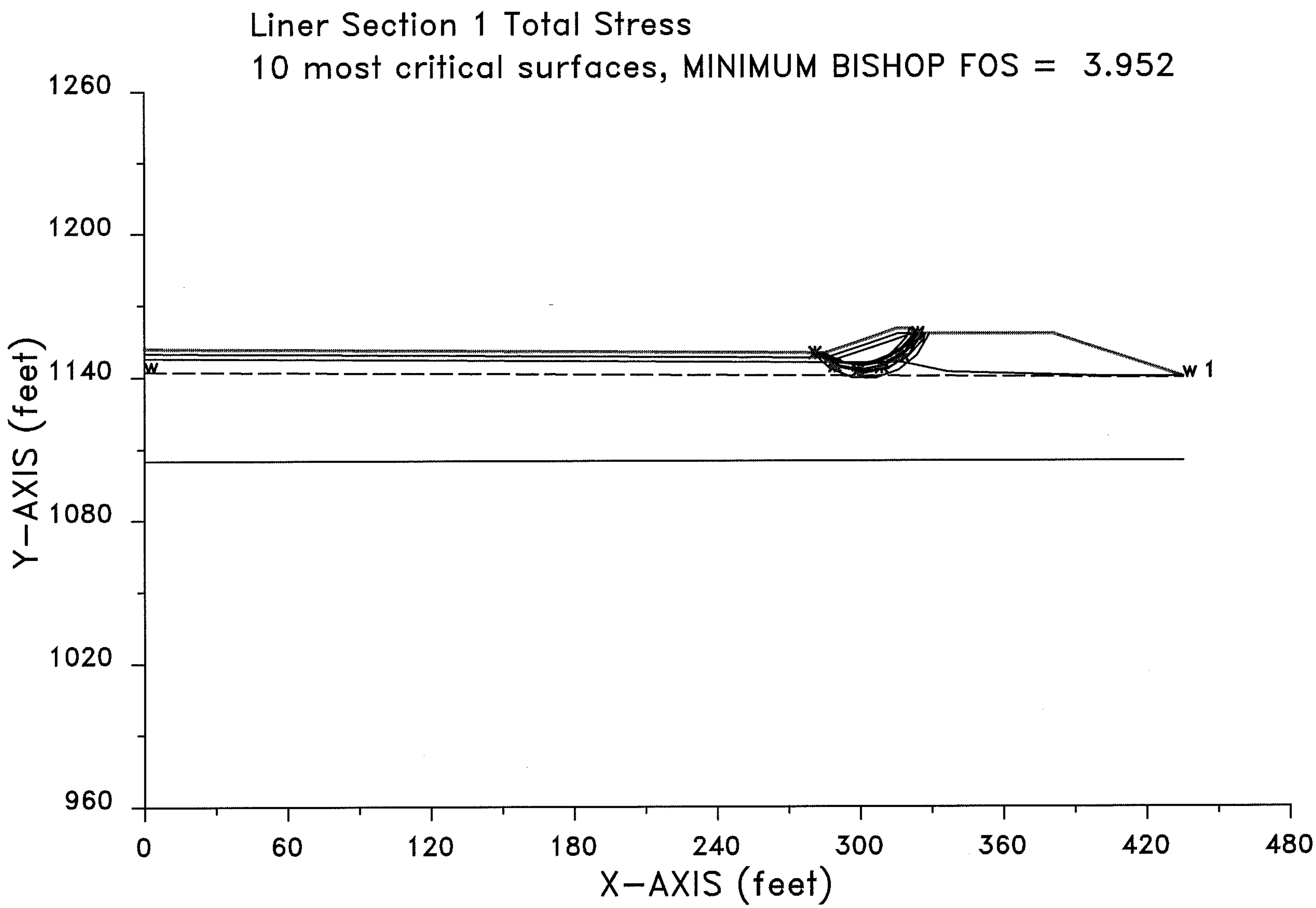
The following is a summary of the TEN most critical surfaces

Problem Description : Liner Section1 Effective Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.041	299.94	1169.48	27.07	281.11	324.25	7.628E+05
2.	2.063	300.33	1169.79	26.81	282.22	324.29	7.259E+05
3.	2.064	297.32	1177.26	32.26	280.00	323.51	7.986E+05
4.	2.128	299.02	1175.45	30.47	282.22	323.83	7.657E+05
5.	2.147	300.46	1177.86	33.28	282.22	327.14	9.046E+05
6.	2.176	292.35	1190.67	42.16	281.11	320.92	6.510E+05
7.	2.190	299.10	1169.23	24.18	284.44	320.91	5.360E+05
8.	2.198	299.89	1171.68	26.61	284.44	322.91	6.410E+05
9.	2.208	302.75	1175.83	32.30	283.33	329.36	9.640E+05
10.	2.214	302.71	1170.10	27.91	283.33	327.50	8.566E+05

* * * END OF FILE * * *

EO_L1T 5-22-15 10:49



XSTABL File: EO_L1T   5-22-15   10:49

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2013      *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.209                 96 - 2083 *
*****************************************
```

Problem Description : Liner Section 1 Total Stress

SEGMENT BOUNDARY COORDINATES

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1152.0	285.5	1150.0	2
2	285.5	1150.0	315.6	1160.0	2
3	315.6	1160.0	322.2	1160.0	2
4	322.2	1160.0	324.2	1158.0	2
5	324.2	1158.0	380.9	1158.0	1
6	380.9	1158.0	435.3	1140.0	1

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1150.0	285.8	1148.0	3
2	285.8	1148.0	315.9	1158.0	3
3	315.9	1158.0	322.2	1158.0	3
4	.0	1148.0	286.1	1146.0	4
5	286.1	1146.0	322.2	1158.0	1
6	322.2	1158.0	324.2	1158.0	1
7	286.1	1146.0	317.8	1146.0	4
8	317.8	1146.0	336.9	1142.0	4
9	336.9	1142.0	404.5	1140.0	4
10	404.5	1140.0	435.3	1140.0	4
11	.0	1105.0	435.3	1105.0	5

ISOTROPIC Soil Parameters

5 Soil unit(s) specified

Soil   Unit Weight   Cohesion   Friction   Pore Pressure   Water

Unit No.	Moist (pcf)	Sat. (pcf)	Intercept (psf)	Angle (deg)	Parameter Ru	Constant (psf)	Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 280.0 ft and x = 290.0 ft

Each surface terminates between x = 320.0 ft and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
*********************************************************************
   --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
*********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
*********************************************************************
```

```
-----------------------------------------------------------
USER SELECTED option to maintain strength greater than zero
-----------------------------------------------------------
```

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	281.11	1150.03
2	289.46	1144.52
3	299.23	1142.42
4	309.11	1144.01
5	317.73	1149.08
6	323.92	1156.93
7	324.25	1158.00

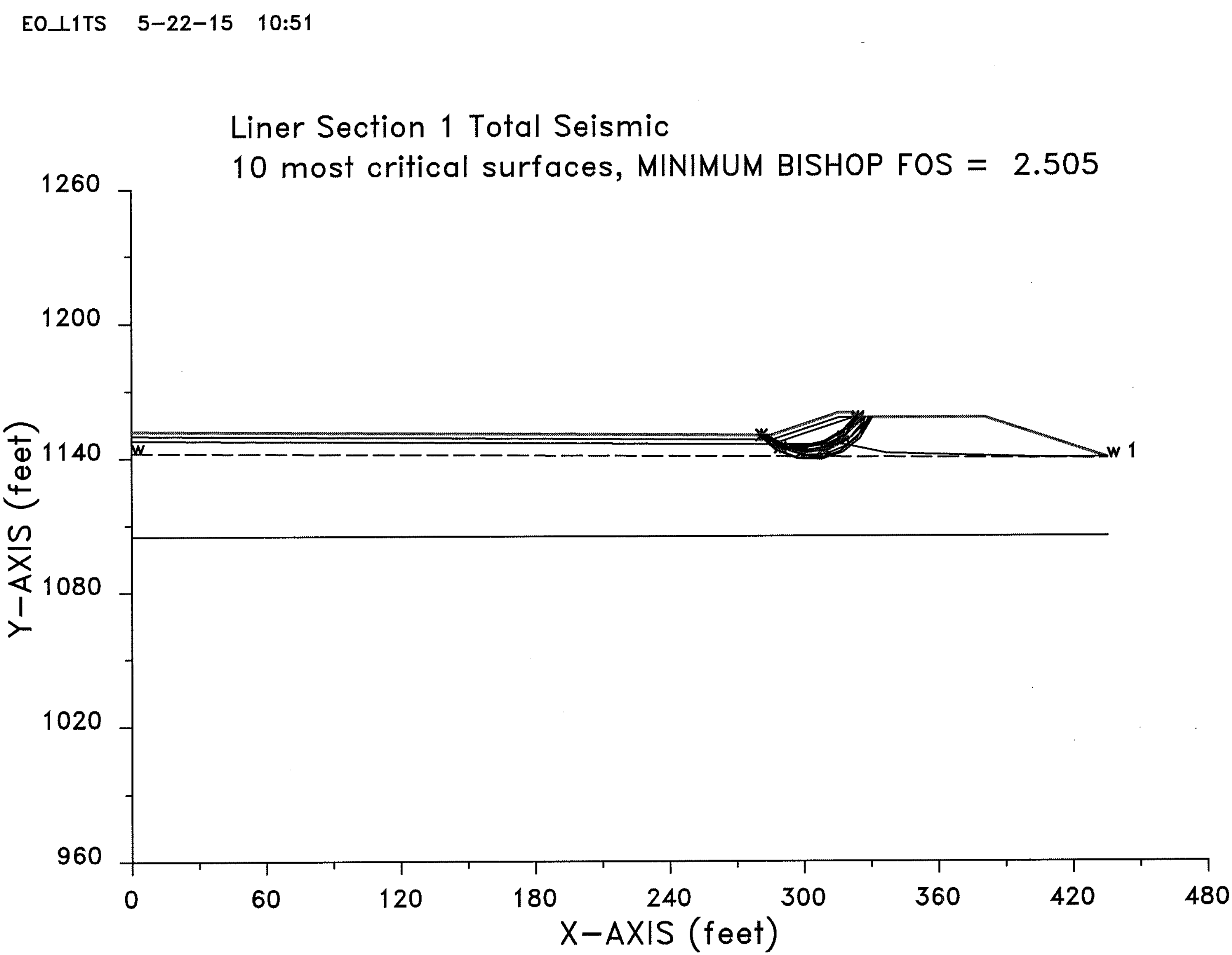
**** Simplified BISHOP FOS =   3.952   ****

The following is a summary of the TEN most critical surfaces

Problem Description : Liner Section 1 Total Stress

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	3.952	299.94	1169.48	27.07	281.11	324.25	9.362E+05
2.	4.045	300.33	1169.79	26.81	282.22	324.29	9.037E+05
3.	4.251	297.32	1177.26	32.26	280.00	323.51	1.055E+06
4.	4.355	299.02	1175.45	30.47	282.22	323.83	9.980E+05
5.	4.397	299.10	1169.23	24.18	284.44	320.91	7.115E+05
6.	4.464	299.89	1171.68	26.61	284.44	322.91	8.438E+05
7.	4.511	302.71	1170.10	27.91	283.33	327.50	1.050E+06
8.	4.538	300.46	1177.86	33.28	282.22	327.14	1.161E+06
9.	4.554	302.88	1165.74	24.24	284.44	325.70	9.046E+05
10.	4.583	302.32	1167.39	28.28	280.00	328.95	1.284E+06

* * * END OF FILE * * *



EO_L1TS 5-22-15 10:51
Liner Section 1 Total Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 2.505
1260
1200
1140
1080
1020
960
Y-AXIS (feet)
0
60
120
180
240
300
360
420
480
X-AXIS (feet)
w
w 1

XSTABL File: EO_L1TS   5-22-15   10:51

```
****************************************
*              X S T A B L             *
*                                      *
*        Slope Stability Analysis      *
*              using the               *
*           Method of Slices           *
*                                      *
*        Copyright (C) 1992 - 2013     *
*   Interactive Software Designs, Inc. *
*        Moscow, ID 83843, U.S.A.      *
*                                      *
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*                                      *
*  Ver. 5.209                96 - 2083 *
****************************************
```

Problem Description : Liner Section 1 Total Seismic

SEGMENT BOUNDARY COORDINATES

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1152.0	285.5	1150.0	2
2	285.5	1150.0	315.6	1160.0	2
3	315.6	1160.0	322.2	1160.0	2
4	322.2	1160.0	324.2	1158.0	2
5	324.2	1158.0	380.9	1158.0	1
6	380.9	1158.0	435.3	1140.0	1

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1150.0	285.8	1148.0	3
2	285.8	1148.0	315.9	1158.0	3
3	315.9	1158.0	322.2	1158.0	3
4	.0	1148.0	286.1	1146.0	4
5	286.1	1146.0	322.2	1158.0	1
6	322.2	1158.0	324.2	1158.0	1
7	286.1	1146.0	317.8	1146.0	4
8	317.8	1146.0	336.9	1142.0	4
9	336.9	1142.0	404.5	1140.0	4
10	404.5	1140.0	435.3	1140.0	4
11	.0	1105.0	435.3	1105.0	5

ISOTROPIC Soil Parameters

5 Soil unit(s) specified

Soil   Unit Weight   Cohesion Friction   Pore Pressure   Water

Unit No.	Moist (pcf)	Sat. (pcf)	Intercept (psf)	Angle (deg)	Parameter Ru	Constant (psf)	Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1142.20
2	435.30	1139.60

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced
along the ground surface between x = 280.0 ft
and x = 290.0 ft

Each surface terminates between x = 320.0 ft
and x = 330.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined
within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	281.11	1150.03
2	289.46	1144.52
3	299.23	1142.42
4	309.11	1144.01
5	317.73	1149.08
6	323.92	1156.93
7	324.25	1158.00

**** Simplified BISHOP FOS = 2.505 ****

The following is a summary of the TEN most critical surfaces

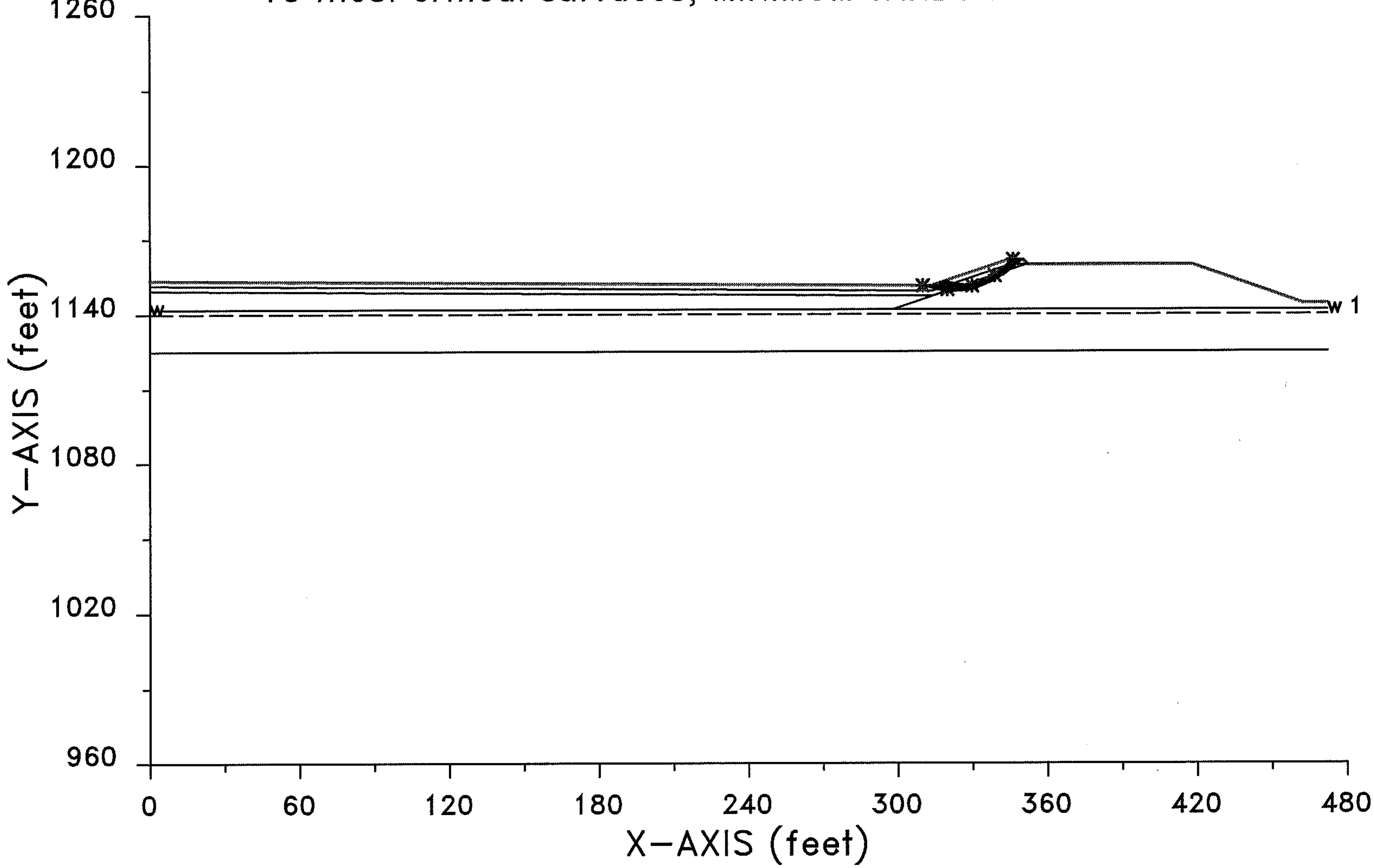
Problem Description : Liner Section 1 Total Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.505	299.94	1169.48	27.07	281.11	324.25	9.363E+05
2.	2.569	300.33	1169.79	26.81	282.22	324.29	9.039E+05
3.	2.712	302.32	1167.39	28.28	280.00	328.95	1.283E+06
4.	2.713	302.71	1170.10	27.91	283.33	327.50	1.050E+06
5.	2.727	297.32	1177.26	32.26	280.00	323.51	1.055E+06
6.	2.741	303.50	1169.85	29.08	282.22	329.65	1.224E+06
7.	2.757	300.46	1177.86	33.28	282.22	327.14	1.161E+06
8.	2.760	302.75	1175.83	32.30	283.33	329.36	1.205E+06
9.	2.776	299.02	1175.45	30.47	282.22	323.83	9.986E+05
10.	2.808	303.68	1167.36	28.46	281.11	330.41	1.337E+06

* * * END OF FILE * * *

EO_L2E 5-22-15 10:52

Liner Section 2 Effective Stress
10 most critical surfaces, MINIMUM JANBU FOS = 3.126



XSTABL File: EO_L2E   5-22-15   10:52

```
****************************************
*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*              using the               *
*           Method of Slices           *
*                                      *
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****************************************
```

Problem Description : Liner Section 2 Effective Stress

SEGMENT BOUNDARY COORDINATES

---

7 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1153.5	313.4	1151.3	2
2	313.4	1151.3	344.8	1161.8	2
3	344.8	1161.8	350.1	1161.8	2
4	350.1	1161.8	352.1	1159.8	2
5	352.1	1159.8	418.0	1159.8	1
6	418.0	1159.8	462.2	1144.4	1
7	462.2	1144.4	472.2	1144.4	1

10 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.5	313.7	1149.3	3
2	313.7	1149.3	345.2	1159.8	3
3	345.2	1159.8	351.5	1159.8	3
4	.0	1149.5	314.0	1147.3	4
5	314.0	1147.3	351.5	1159.8	1
6	351.5	1159.8	352.1	1159.8	1
7	.0	1142.0	298.2	1142.0	5
8	298.2	1142.0	314.0	1147.3	1
9	298.2	1142.0	472.2	1142.0	5
10	.0	1125.0	472.2	1125.0	6

ISOTROPIC Soil Parameters

---

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	116.0	118.0	.0	30.00	.000	.0	0
5	119.2	119.2	.0	25.00	.000	.0	1
6	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 310.0 ft
and x = 320.0 ft

Each surface terminates between x = 345.0 ft
and x = 355.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

```
**********************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
**********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
**********************************************************************
```

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 5 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	310.00	1151.32
2	319.89	1149.82
3	329.79	1151.20
4	338.89	1155.36
5	346.25	1161.80

** Corrected JANBU FOS = 3.126 ** (Fo factor = 1.059)

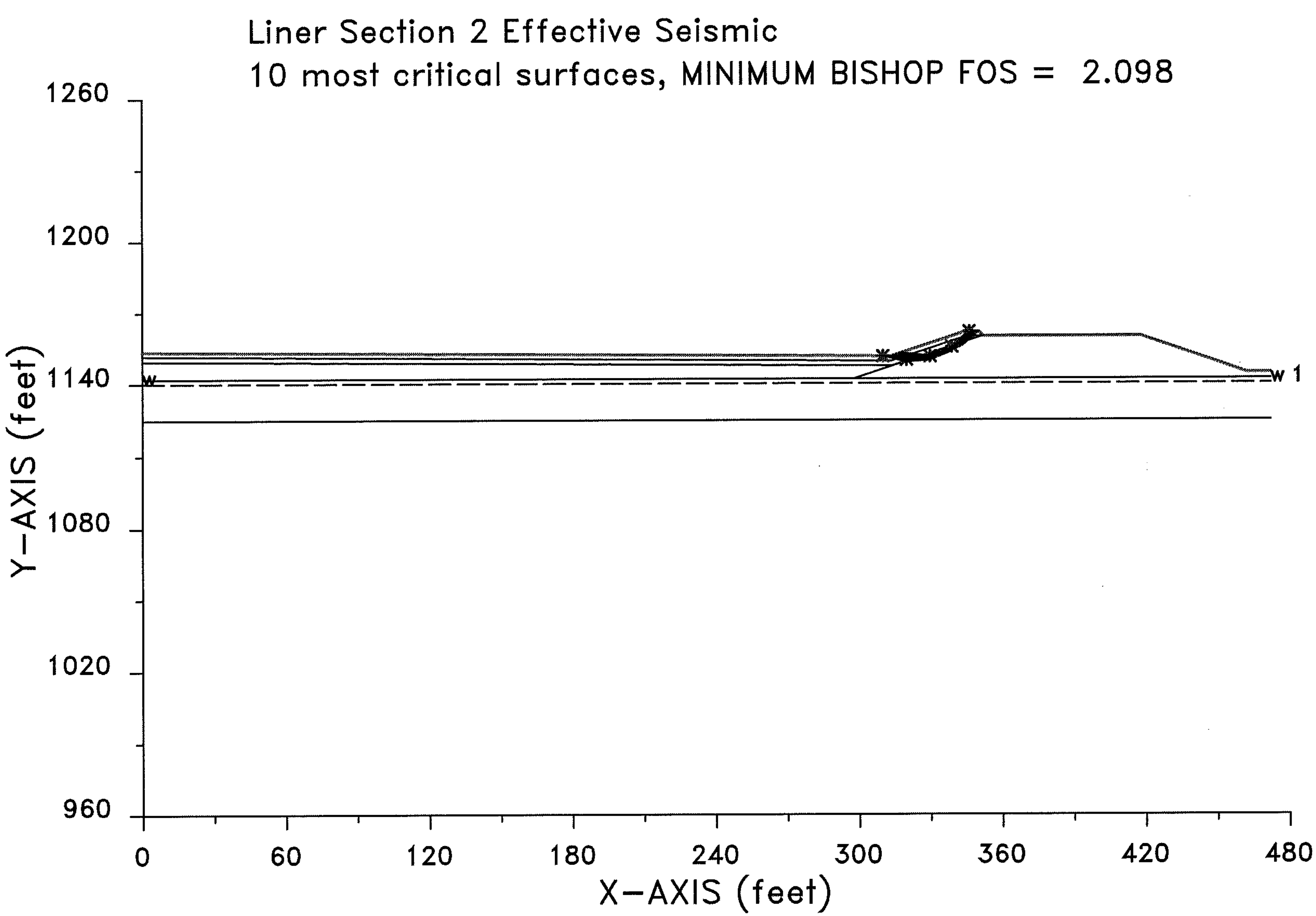
The following is a summary of the TEN most critical surfaces

Problem Description : Liner Section 2 Effective Stress

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	3.126	1.059	310.00	346.25	1.298E+04
2.	3.200	1.059	310.00	347.26	1.460E+04
3.	3.228	1.059	317.78	347.24	1.102E+04
4.	3.241	1.065	313.33	345.42	1.386E+04
5.	3.252	1.058	314.44	347.49	1.348E+04
6.	3.314	1.068	313.33	345.45	1.502E+04
7.	3.331	1.059	316.67	348.27	1.288E+04
8.	3.341	1.067	310.00	347.74	1.865E+04
9.	3.369	1.056	313.33	350.05	1.653E+04
10.	3.382	1.069	318.89	346.10	1.170E+04

* * * END OF FILE * * *

EO_L2ES 5-22-15 10:55



XSTABL File: EO_L2ES   5-22-15   10:55

```
****************************************
*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*             using the                *
*          Method of Slices            *
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****************************************
```

Problem Description : Liner Section 2 Effective Seismic

SEGMENT BOUNDARY COORDINATES

7 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1153.5	313.4	1151.3	2
2	313.4	1151.3	344.8	1161.8	2
3	344.8	1161.8	350.1	1161.8	2
4	350.1	1161.8	352.1	1159.8	2
5	352.1	1159.8	418.0	1159.8	1
6	418.0	1159.8	462.2	1144.4	1
7	462.2	1144.4	472.2	1144.4	1

10 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.7	313.7	1149.3	3
2	313.7	1149.3	345.2	1159.8	3
3	345.2	1159.8	351.5	1159.8	3
4	.0	1149.5	314.0	1147.3	4
5	314.0	1147.3	351.5	1159.8	1
6	351.5	1159.8	352.1	1159.8	1
7	.0	1142.0	298.2	1142.0	5
8	298.2	1142.0	314.0	1147.3	1
9	298.2	1142.0	472.2	1142.0	5
10	.0	1125.0	472.2	1125.0	6

ISOTROPIC Soil Parameters

6 Soil unit(s) specified

Soil   Unit Weight   Cohesion   Friction   Pore Pressure   Water

Unit No.	Moist (pcf)	Sat. (pcf)	Intercept (psf)	Angle (deg)	Parameter Ru	Constant (psf)	Surface No.
1	116.0	118.0	250.0	30.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	116.0	118.0	.0	30.00	.000	.0	0
5	119.2	119.2	.0	25.00	.000	.0	1
6	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced
along the ground surface between x = 310.0 ft
and x = 320.0 ft

Each surface terminates between x = 345.0 ft
and x = 355.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 5 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	310.00	1151.32
2	319.89	1149.82
3	329.79	1151.20
4	338.89	1155.36
5	346.25	1161.80

**** Simplified BISHOP FOS = 2.098 ****

The following is a summary of the TEN most critical surfaces

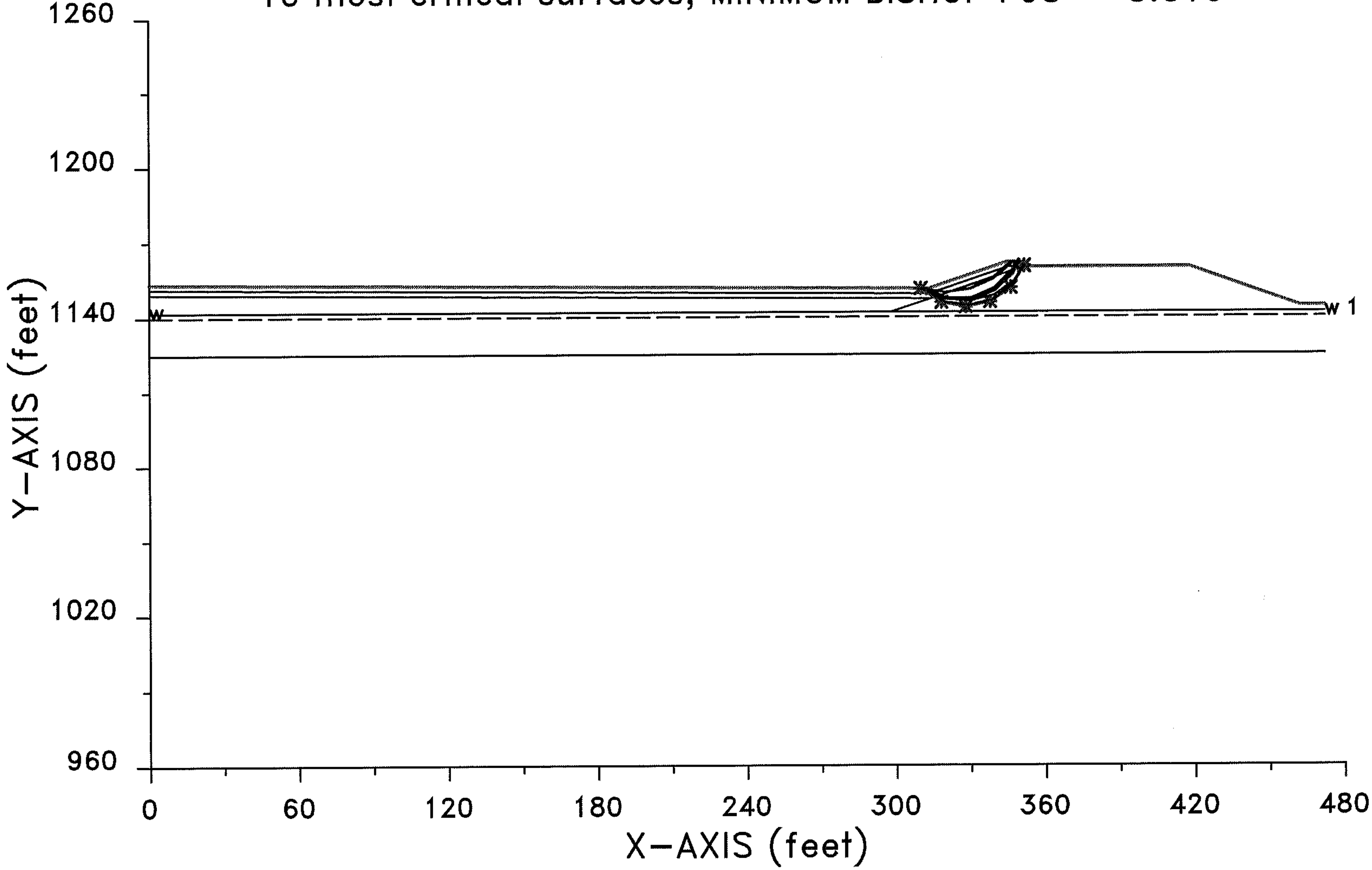
Problem Description : Liner Section 2 Effective Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.098	320.09	1184.45	34.63	310.00	346.25	4.394E+05
2.	2.133	320.66	1185.29	35.60	310.00	347.26	5.081E+05
3.	2.176	326.00	1179.60	28.07	317.78	347.24	3.029E+05
4.	2.185	323.04	1183.66	33.14	314.44	347.49	4.370E+05
5.	2.214	322.88	1187.36	37.30	313.33	350.05	6.029E+05
6.	2.221	325.35	1182.33	31.18	316.67	348.27	3.931E+05
7.	2.233	322.68	1178.13	28.41	313.33	345.42	3.859E+05
8.	2.258	322.49	1180.37	31.62	310.00	347.74	5.777E+05
9.	2.264	324.47	1184.55	34.39	314.44	350.10	5.651E+05
10.	2.306	323.25	1176.39	26.98	313.33	345.45	3.977E+05

* * * END OF FILE * * *

EO_L2T 5-22-15 10:53

Liner Section 2 Total Stress
10 most critical surfaces, MINIMUM BISHOP FOS = 5.016



XSTABL File: EO_L2T   5-22-15   10:53

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*              using the                *
*           Method of Slices            *
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*****************************************
```

Problem Description : Liner Section 2 Total Stress

SEGMENT BOUNDARY COORDINATES

7 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1153.5	313.4	1151.3	2
2	313.4	1151.3	344.8	1161.8	2
3	344.8	1161.8	350.1	1161.8	2
4	350.1	1161.8	352.1	1159.8	2
5	352.1	1159.8	418.0	1159.8	1
6	418.0	1159.8	462.2	1144.4	1
7	462.2	1144.4	472.2	1144.4	1

10 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.5	313.7	1149.3	3
2	313.7	1149.3	345.2	1159.8	3
3	345.2	1159.8	351.5	1159.8	3
4	.0	1149.5	314.0	1147.3	4
5	314.0	1147.3	351.5	1159.8	1
6	351.5	1159.8	352.1	1159.8	1
7	.0	1142.0	298.2	1142.0	5
8	298.2	1142.0	314.0	1147.3	1
9	298.2	1142.0	472.2	1142.0	5
10	.0	1125.0	472.2	1125.0	6

ISOTROPIC Soil Parameters

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	116.0	118.0	.0	30.00	.000	.0	0
5	119.2	119.2	.0	25.00	.000	.0	1
6	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 310.0 ft
and x = 320.0 ft

Each surface terminates between x = 345.0 ft
and x = 355.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	310.00	1151.32
2	318.35	1145.82
3	328.17	1143.95
4	337.95	1146.03
5	346.18	1151.71
6	351.58	1160.13
7	351.61	1160.29

**** Simplified BISHOP FOS = 5.016 ****

The following is a summary of the TEN most critical surfaces

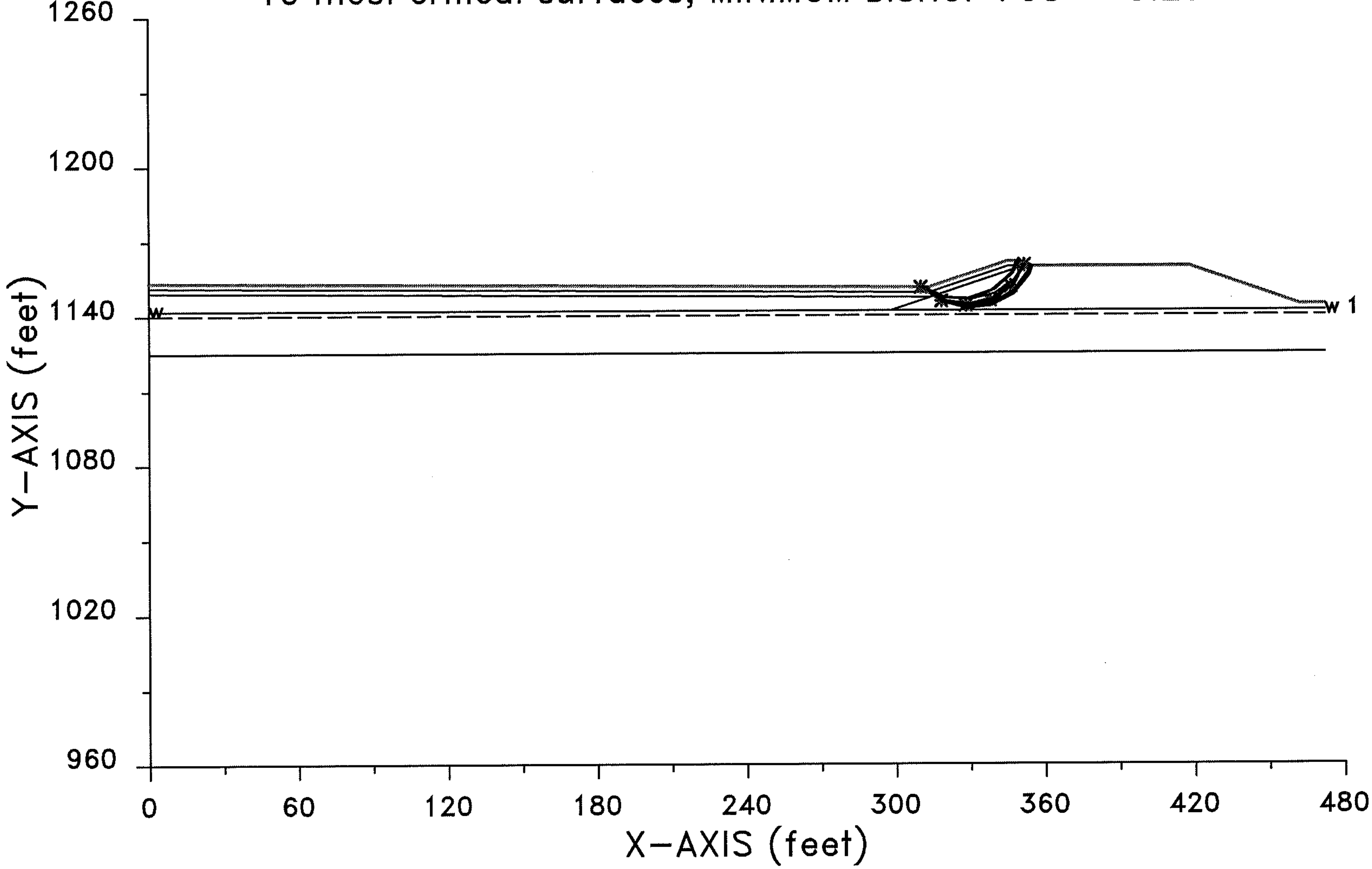
Problem Description : Liner Section 2 Total Stress

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	5.016	327.90	1169.38	25.42	310.00	351.61	1.120E+06
2.	5.057	325.23	1173.75	27.11	310.00	349.05	9.706E+05
3.	5.069	328.26	1169.54	25.03	311.11	351.35	1.057E+06
4.	5.070	326.26	1173.06	26.50	311.11	349.74	9.657E+05
5.	5.102	326.13	1170.73	24.55	311.11	348.44	8.808E+05
6.	5.116	320.09	1184.45	34.63	310.00	346.25	7.270E+05
7.	5.148	325.22	1173.20	26.04	311.11	348.14	8.727E+05
8.	5.168	320.66	1185.29	35.60	310.00	347.26	8.324E+05
9.	5.184	326.53	1170.51	23.95	312.22	348.32	8.338E+05
10.	5.210	327.62	1175.37	29.17	311.11	351.94	1.181E+06

* * * END OF FILE * * *

EO_L2TS 5-22-15 10:56

Liner Section 2 Total Stress Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 3.280



XSTABL File: EO_L2TS   5-22-15   10:56

```
****************************************
*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*              using the               *
*           Method of Slices           *
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****************************************
```

Problem Description : Liner Section 2 Total Stress Seismic

SEGMENT BOUNDARY COORDINATES

7 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1153.5	313.4	1151.3	2
2	313.4	1151.3	344.8	1161.8	2
3	344.8	1161.8	350.1	1161.8	2
4	350.1	1161.8	352.1	1159.8	2
5	352.1	1159.8	418.0	1159.8	1
6	418.0	1159.8	462.2	1144.4	1
7	462.2	1144.4	472.2	1144.4	1

10 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.5	313.7	1149.3	3
2	313.7	1149.3	345.2	1159.8	3
3	345.2	1159.8	351.5	1159.8	3
4	.0	1149.5	314.0	1147.3	4
5	314.0	1147.3	351.5	1159.8	1
6	351.5	1159.8	352.1	1159.8	1
7	.0	1142.0	298.2	1142.0	5
8	298.2	1142.0	314.0	1147.3	1
9	298.2	1142.0	472.2	1142.0	5
10	.0	1125.0	472.2	1125.0	6

ISOTROPIC Soil Parameters

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	116.0	118.0	1000.0	.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	100.0	22.00	.000	.0	0
4	116.0	118.0	.0	30.00	.000	.0	0
5	119.2	119.2	.0	25.00	.000	.0	1
6	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	472.20	1140.00

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced
along the ground surface between x = 310.0 ft
and x = 320.0 ft

Each surface terminates between x = 345.0 ft
and x = 355.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined
within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

****

-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)

****

Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.

****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	310.00	1151.32
2	318.35	1145.82
3	328.17	1143.95
4	337.95	1146.03
5	346.18	1151.71
6	351.58	1160.13
7	351.61	1160.29

**** Simplified BISHOP FOS = 3.280 ****

The following is a summary of the TEN most critical surfaces

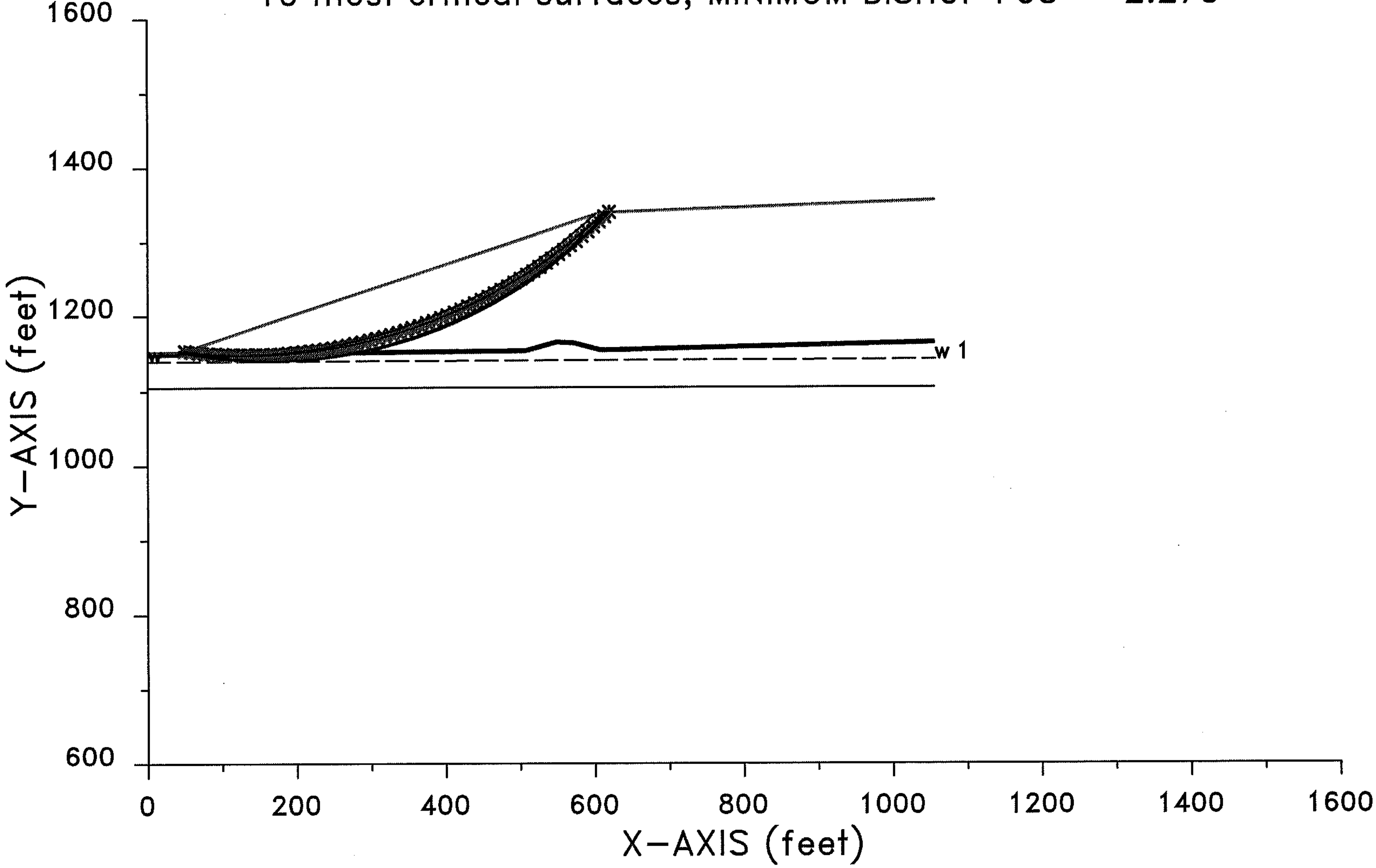
Problem Description : Liner Section 2 Total Stress Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	3.280	327.90	1169.38	25.42	310.00	351.61	1.120E+06
2.	3.318	328.26	1169.54	25.03	311.11	351.35	1.057E+06
3.	3.325	330.27	1170.31	26.98	311.11	354.74	1.279E+06
4.	3.329	329.91	1169.30	26.01	311.11	353.82	1.216E+06
5.	3.340	330.73	1168.95	26.38	311.11	355.00	1.289E+06
6.	3.361	327.62	1175.37	29.17	311.11	351.94	1.182E+06
7.	3.371	325.23	1173.75	27.11	310.00	349.05	9.704E+05
8.	3.371	326.26	1173.06	26.50	311.11	349.74	9.656E+05
9.	3.409	329.45	1167.64	23.74	312.22	351.71	1.032E+06
10.	3.412	326.13	1170.73	24.55	311.11	348.44	8.806E+05

* * * END OF FILE * * *

EO_INT-E 5-22-15 14:10

Interim Sec – Effective Stress
10 most critical surfaces, MINIMUM BISHOP FOS = 2.275



XSTABL File: EO_INT-E   5-22-15   14:10

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*           Method of Slices            *
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Problem Description : Interim Sec - Effective Stress

SEGMENT BOUNDARY COORDINATES

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.5	45.2	1151.9	2
2	45.2	1151.9	608.0	1339.6	1
3	608.0	1339.6	1055.3	1355.8	1

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	45.2	1151.9	506.9	1155.7	2
2	506.9	1155.7	548.0	1167.1	2
3	548.0	1167.1	571.0	1166.0	2
4	571.0	1166.0	608.5	1156.5	2
5	608.5	1156.5	1055.3	1166.4	2
6	.0	1149.0	507.2	1153.7	3
7	507.2	1153.7	548.3	1165.1	3
8	548.3	1165.1	570.7	1164.0	3
9	570.7	1164.0	608.3	1154.5	3
10	608.3	1154.5	1055.4	1164.4	3
11	.0	1147.0	507.4	1151.7	4
12	507.4	1151.7	548.5	1163.1	4
13	548.5	1163.1	570.4	1162.0	4
14	570.4	1162.0	608.1	1152.5	4
15	608.1	1152.5	1055.4	1162.4	4
16	.0	1105.0	1055.4	1105.0	5

ISOTROPIC Soil Parameters

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	60.0	60.0	288.0	35.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	10.0	10.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1056.90	1142.20

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 40.0 ft
and x = 50.0 ft

Each surface terminates between x = 600.0 ft
and x = 620.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1140.0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 63 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	50.00	1153.50
2	59.94	1152.39
3	69.89	1151.42
4	79.86	1150.58
5	89.83	1149.89
6	99.82	1149.34
7	109.81	1148.93
8	119.80	1148.65
9	129.80	1148.52
10	139.80	1148.53
11	149.80	1148.68
12	159.80	1148.97
13	169.79	1149.40
14	179.77	1149.98
15	189.75	1150.69
16	199.71	1151.54
17	209.66	1152.53
18	219.60	1153.66
19	229.52	1154.94
20	239.42	1156.35
21	249.29	1157.90
22	259.15	1159.58
23	268.98	1161.41
24	278.79	1163.38
25	288.56	1165.48
26	298.31	1167.72
27	308.02	1170.10
28	317.70	1172.61
29	327.35	1175.26
30	336.95	1178.04
31	346.52	1180.96
32	356.04	1184.01
33	365.52	1187.20
34	374.95	1190.52
35	384.33	1193.97
36	393.67	1197.55
37	402.96	1201.27
38	412.19	1205.11
39	421.36	1209.09
40	430.48	1213.19
41	439.54	1217.42
42	448.55	1221.78
43	457.48	1226.26
44	466.36	1230.87
45	475.17	1235.60
46	483.91	1240.46

47	492.58	1245.44
48	501.18	1250.54
49	509.71	1255.76
50	518.17	1261.10
51	526.55	1266.55
52	534.85	1272.13
53	543.07	1277.82
54	551.21	1283.63
55	559.27	1289.55
56	567.25	1295.58
57	575.14	1301.73
58	582.94	1307.98
59	590.65	1314.35
60	598.27	1320.82
61	605.81	1327.40
62	613.24	1334.08
63	619.67	1340.02

**** Simplified BISHOP FOS = 2.275 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Interim Sec - Effective Stress

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.275	134.08	1859.45	710.94	50.00	619.67	8.008E+08
2.	2.281	135.32	1840.08	691.86	50.00	613.07	7.644E+08
3.	2.293	114.05	1869.72	721.55	41.11	600.84	7.334E+08
4.	2.298	166.52	1753.41	612.85	46.67	619.12	8.160E+08
5.	2.298	164.06	1761.50	620.89	45.56	619.75	8.255E+08
6.	2.298	169.41	1742.39	602.04	47.78	616.97	7.999E+08
7.	2.298	168.07	1743.08	603.04	46.67	616.64	8.022E+08
8.	2.298	172.82	1741.70	600.88	50.00	619.70	8.053E+08
9.	2.299	161.99	1759.80	618.83	45.56	616.52	8.073E+08
10.	2.299	170.81	1740.63	599.43	50.00	616.50	7.883E+08

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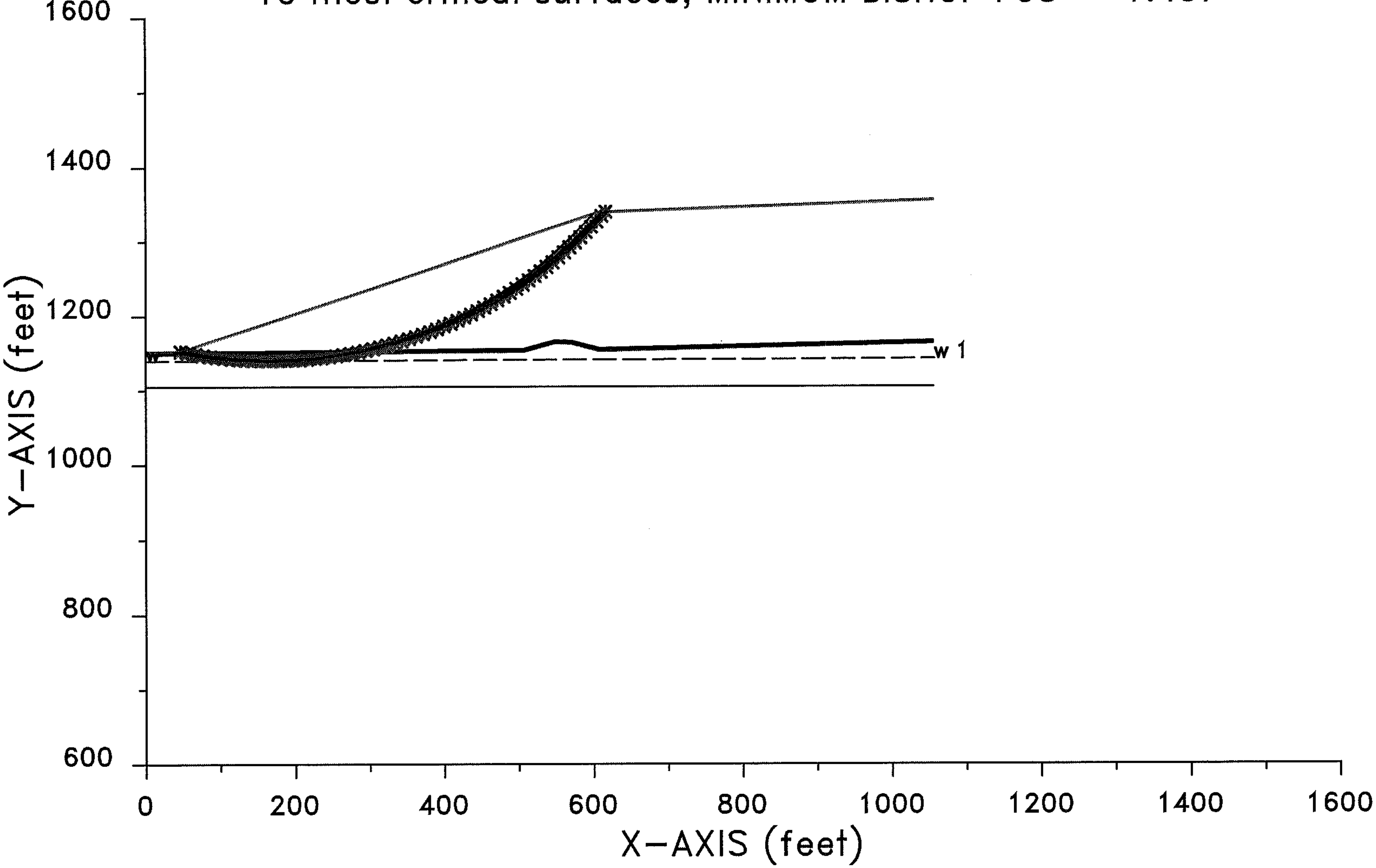
Interim Effective Stress Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 1.457



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****************************************
*              X S T A B L             *
*                                      *
*        Slope Stability Analysis      *
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Problem Description : Interim Effective Stress Seismic

SEGMENT BOUNDARY COORDINATES

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.5	45.2	1151.9	2
2	45.2	1151.9	608.2	1339.6	1
3	608.2	1339.6	1055.3	1355.8	1

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	45.2	1151.9	506.9	1155.7	2
2	506.9	1155.7	548.0	1167.1	2
3	548.0	1167.1	571.0	1166.0	2
4	571.0	1166.0	608.5	1156.5	2
5	608.5	1156.5	1055.3	1166.4	2
6	.0	1149.6	507.2	1153.7	3
7	507.2	1153.7	548.3	1165.1	3
8	548.3	1165.1	570.7	1164.0	3
9	570.7	1164.0	608.3	1154.5	3
10	608.3	1154.5	1055.4	1164.4	3
11	.0	1147.6	507.4	1151.7	4
12	507.4	1151.7	548.5	1163.1	4
13	548.5	1163.1	570.4	1162.0	4
14	570.4	1162.0	608.1	1152.5	4
15	608.1	1152.5	1055.4	1162.4	4
16	.0	1105.0	1055.4	1105.0	5

ISOTROPIC Soil Parameters

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	60.0	60.0	288.0	35.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	120.0	125.0	10.0	10.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1056.90	1142.20

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 40.0 ft
and x = 50.0 ft

Each surface terminates between x = 600.0 ft
and x = 620.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1140.0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 64 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	46.67	1152.39
2	56.48	1150.46
3	66.32	1148.69
4	76.19	1147.08
5	86.09	1145.64
6	96.00	1144.36
7	105.94	1143.25
8	115.90	1142.30
9	125.87	1141.52
10	135.85	1140.90
11	145.84	1140.45
12	155.83	1140.16
13	165.83	1140.04
14	175.83	1140.09
15	185.83	1140.30
16	195.82	1140.67
17	205.81	1141.22
18	215.78	1141.92
19	225.75	1142.80
20	235.69	1143.84
21	245.62	1145.04
22	255.52	1146.40
23	265.41	1147.94
24	275.26	1149.63
25	285.09	1151.49
26	294.88	1153.51
27	304.64	1155.69
28	314.36	1158.03
29	324.04	1160.54
30	333.68	1163.20
31	343.27	1166.03
32	352.82	1169.01
33	362.31	1172.15
34	371.75	1175.45
35	381.14	1178.90
36	390.47	1182.51

37	399.73	1186.27
38	408.93	1190.19
39	418.07	1194.26
40	427.13	1198.48
41	436.13	1202.84
42	445.05	1207.36
43	453.90	1212.02
44	462.66	1216.83
45	471.35	1221.79
46	479.95	1226.89
47	488.47	1232.13
48	496.90	1237.51
49	505.24	1243.03
50	513.48	1248.68
51	521.64	1254.48
52	529.69	1260.40
53	537.64	1266.46
54	545.50	1272.65
55	553.25	1278.97
56	560.89	1285.42
57	568.43	1292.00
58	575.85	1298.69
59	583.17	1305.51
60	590.37	1312.45
61	597.45	1319.51
62	604.42	1326.69
63	611.26	1333.98
64	616.65	1339.91

**** Simplified BISHOP FOS = 1.457 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Interim Effective Stress Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.457	168.07	1743.09	603.05	46.67	616.65	7.613E+08
2.	1.459	160.77	1757.40	617.25	41.11	615.36	7.679E+08
3.	1.459	169.41	1742.39	602.05	47.78	616.98	7.592E+08
4.	1.459	166.61	1753.85	613.31	46.67	619.12	7.750E+08
5.	1.459	164.06	1761.50	620.89	45.56	619.75	7.834E+08
6.	1.459	161.85	1748.52	608.07	44.44	612.18	7.451E+08
7.	1.460	159.99	1730.93	590.91	42.22	600.45	6.994E+08
8.	1.460	172.82	1741.70	600.88	50.00	619.70	7.644E+08
9.	1.461	161.99	1759.80	618.83	45.56	616.54	7.662E+08
10.	1.462	162.76	1748.06	606.87	46.67	611.52	7.355E+08

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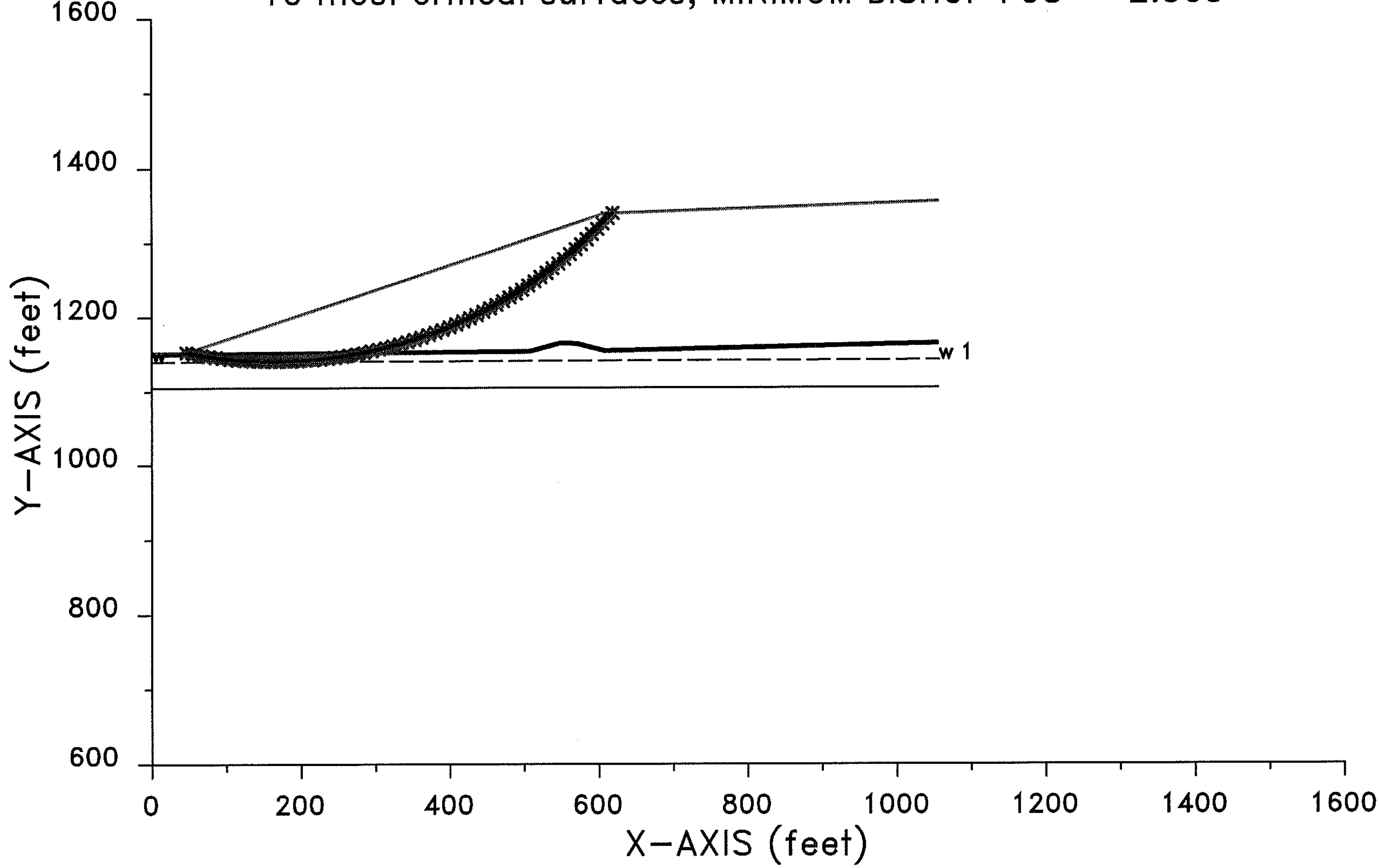
Interim Sec – Total Stress
10 most critical surfaces, MINIMUM BISHOP FOS = 2.303



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*                                      *
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*               using the              *
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****************************************
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Problem Description : Interim Sec - Total Stress

SEGMENT BOUNDARY COORDINATES

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.5	45.2	1151.9	2
2	45.2	1151.9	608.0	1339.6	1
3	608.0	1339.6	1055.3	1355.8	1

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	45.2	1151.9	506.9	1155.7	2
2	506.9	1155.7	548.0	1167.1	2
3	548.0	1167.1	571.0	1166.0	2
4	571.0	1166.0	608.5	1156.5	2
5	608.5	1156.5	1055.3	1166.4	2
6	.0	1149.6	507.2	1153.7	3
7	507.2	1153.7	548.3	1165.1	3
8	548.3	1165.1	570.7	1164.0	3
9	570.7	1164.0	608.3	1154.5	3
10	608.3	1154.5	1055.4	1164.4	3
11	.0	1147.6	507.4	1151.7	4
12	507.4	1151.7	548.5	1163.1	4
13	548.5	1163.1	570.4	1162.0	4
14	570.4	1162.0	608.1	1152.5	4
15	608.1	1152.5	1055.4	1162.4	4
16	.0	1105.0	1055.4	1105.0	5

ISOTROPIC Soil Parameters

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	60.0	60.0	288.0	35.00	.000	.0	0
2	116.0	118.0	100.0	25.00	.000	.0	0
3	120.0	125.0	10.0	10.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1056.90	1142.20

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 40.0 ft
and x = 50.0 ft

Each surface terminates between x = 600.0 ft
and x = 620.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1140.0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit :=   -45.0 degrees
Upper angular limit :=   -5.0 degrees

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 64 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	46.67	1152.39
2	56.49	1150.51
3	66.34	1148.80
4	76.22	1147.24
5	86.12	1145.85
6	96.05	1144.62
7	105.99	1143.55
8	115.95	1142.64
9	125.92	1141.90
10	135.90	1141.32
11	145.89	1140.90
12	155.89	1140.64
13	165.89	1140.55
14	175.89	1140.62
15	185.89	1140.85
16	195.88	1141.25
17	205.86	1141.81
18	215.84	1142.53
19	225.80	1143.42
20	235.74	1144.46
21	245.67	1145.67
22	255.58	1147.04
23	265.46	1148.58
24	275.31	1150.27
25	285.14	1152.12
26	294.93	1154.14
27	304.70	1156.31
28	314.42	1158.64
29	324.11	1161.13
30	333.75	1163.78
31	343.35	1166.59
32	352.90	1169.55
33	362.40	1172.66
34	371.85	1175.94
35	381.25	1179.36
36	390.58	1182.94
37	399.86	1186.67
38	409.08	1190.55
39	418.23	1194.58
40	427.32	1198.76
41	436.33	1203.08
42	445.28	1207.56
43	454.14	1212.17
44	462.94	1216.94
45	471.65	1221.84
46	480.29	1226.89
47	488.84	1232.07

48	497.30	1237.40
49	505.68	1242.86
50	513.96	1248.46
51	522.16	1254.19
52	530.25	1260.06
53	538.26	1266.06
54	546.16	1272.18
55	553.96	1278.44
56	561.66	1284.82
57	569.26	1291.32
58	576.74	1297.95
59	584.12	1304.70
60	591.39	1311.57
61	598.54	1318.56
62	605.58	1325.66
63	612.50	1332.88
64	619.12	1340.00

**** Simplified BISHOP FOS = 2.303 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Interim Sec - Total Stress

	FOS (BISHOP)	Circle Center x-coord (ft)	y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.303	166.52	1753.41	612.85	46.67	619.12	8.180E+08
2.	2.304	168.07	1743.08	603.04	46.67	616.64	8.041E+08
3.	2.304	164.06	1761.50	620.89	45.56	619.75	8.276E+08
4.	2.304	169.41	1742.39	602.04	47.78	616.97	8.019E+08
5.	2.304	172.82	1741.70	600.88	50.00	619.70	8.073E+08
6.	2.305	161.99	1759.80	618.83	45.56	616.52	8.094E+08
7.	2.305	170.81	1740.63	599.43	50.00	616.50	7.903E+08
8.	2.305	161.84	1748.51	608.06	44.44	612.15	7.871E+08
9.	2.306	160.77	1757.40	617.25	41.11	615.34	8.111E+08
10.	2.306	158.68	1763.49	622.18	44.44	614.26	7.997E+08

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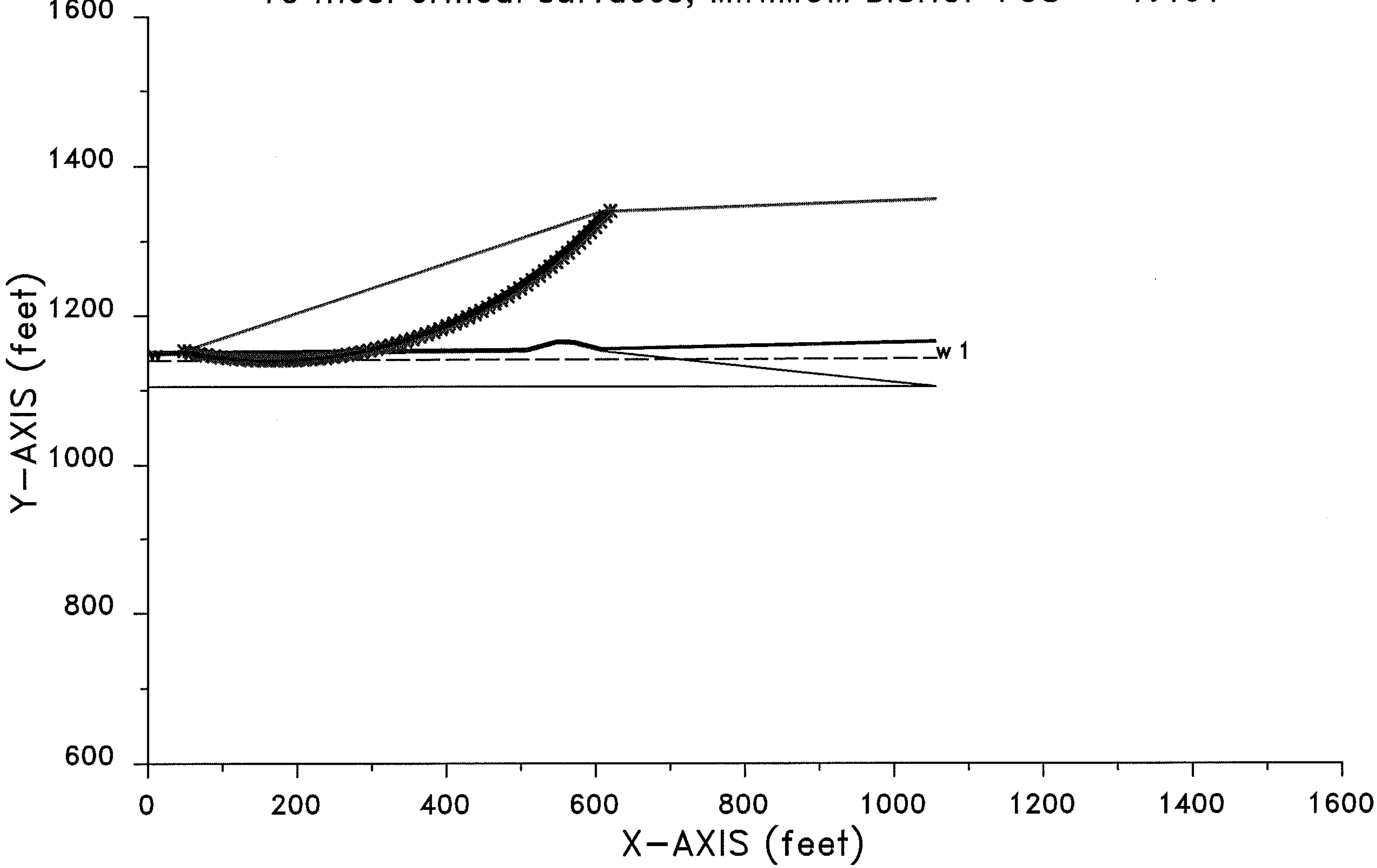
Interim Sec – Total Stress Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 1.461



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*             Method of Slices          *
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*  Ver. 5.209               96 - 2083   *
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Problem Description : Interim Sec - Total Stress Seismic

SEGMENT BOUNDARY COORDINATES

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1151.5	45.2	1151.9	2
2	45.2	1151.9	608.2	1339.6	1
3	608.2	1339.6	1055.3	1355.8	1

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	45.2	1151.9	506.9	1155.7	2
2	506.9	1155.7	548.0	1167.1	2
3	548.0	1167.1	571.0	1166.0	2
4	571.0	1166.0	608.5	1156.5	2
5	608.5	1156.5	1055.3	1166.4	2
6	.0	1149.6	507.2	1153.7	3
7	507.2	1153.7	548.3	1165.1	3
8	548.3	1165.1	570.7	1164.0	3
9	570.7	1164.0	608.3	1154.5	3
10	608.3	1154.5	1055.4	1164.4	3
11	.0	1147.6	507.4	1151.7	4
12	507.4	1151.7	548.5	1163.1	4
13	548.5	1163.1	570.4	1162.0	4
14	570.4	1162.0	608.1	1152.5	4
15	608.1	1152.5	1055.4	1105.0	4
16	.0	1105.0	1055.4	1105.0	5

ISOTROPIC Soil Parameters

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	60.0	60.0	288.0	35.00	.000	.0	0
2	116.0	118.0	100.0	25.00	.000	.0	0
3	120.0	125.0	10.0	10.00	.000	.0	0
4	119.2	119.2	.0	25.00	.000	.0	1
5	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	1056.90	1142.60

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced
along the ground surface between x = 35.0 ft
and x = 50.0 ft

Each surface terminates between x = 600.0 ft
and x = 620.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = 1140.0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 64 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	48.33	1152.94
2	58.14	1150.98
3	67.98	1149.18
4	77.84	1147.55
5	87.73	1146.07
6	97.65	1144.77
7	107.58	1143.62
8	117.53	1142.65
9	127.50	1141.83
10	137.48	1141.19
11	147.47	1140.70
12	157.46	1140.39
13	167.46	1140.24
14	177.46	1140.25
15	187.46	1140.44
16	197.45	1140.78
17	207.44	1141.30
18	217.42	1141.98
19	227.38	1142.82
20	237.33	1143.83
21	247.26	1145.01
22	257.17	1146.35
23	267.06	1147.85
24	276.92	1149.52
25	286.75	1151.35
26	296.55	1153.34
27	306.31	1155.50
28	316.04	1157.81
29	325.73	1160.29
30	335.37	1162.93
31	344.97	1165.73
32	354.53	1168.69
33	364.03	1171.81
34	373.48	1175.08
35	382.87	1178.51
36	392.21	1182.09
37	401.48	1185.83
38	410.69	1189.72
39	419.84	1193.77
40	428.91	1197.97

41	437.92	1202.31
42	446.85	1206.81
43	455.71	1211.45
44	464.49	1216.24
45	473.19	1221.17
46	481.80	1226.25
47	490.33	1231.47
48	498.77	1236.83
49	507.13	1242.33
50	515.39	1247.97
51	523.55	1253.74
52	531.62	1259.65
53	539.59	1265.69
54	547.45	1271.86
55	555.22	1278.17
56	562.88	1284.60
57	570.43	1291.15
58	577.87	1297.84
59	585.19	1304.64
60	592.41	1311.56
61	599.51	1318.61
62	606.49	1325.77
63	613.35	1333.04
64	619.71	1340.02

**** Simplified BISHOP FOS = 1.461 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Interim Sec - Total Stress Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.461	171.50	1742.90	602.68	48.33	619.71	7.723E+08
2.	1.461	174.93	1727.72	587.65	50.00	616.36	7.482E+08
3.	1.461	162.36	1764.20	623.78	43.33	619.74	7.890E+08
4.	1.462	158.31	1758.76	618.66	38.33	613.61	7.646E+08
5.	1.462	162.20	1758.90	618.21	45.00	616.93	7.709E+08
6.	1.462	169.49	1741.82	601.21	48.33	616.51	7.559E+08
7.	1.462	159.92	1753.02	612.67	41.67	612.19	7.516E+08
8.	1.463	160.37	1762.94	622.17	43.33	616.56	7.723E+08
9.	1.463	156.11	1751.52	611.47	36.67	607.79	7.374E+08
10.	1.464	163.69	1740.58	599.72	46.67	609.94	7.279E+08

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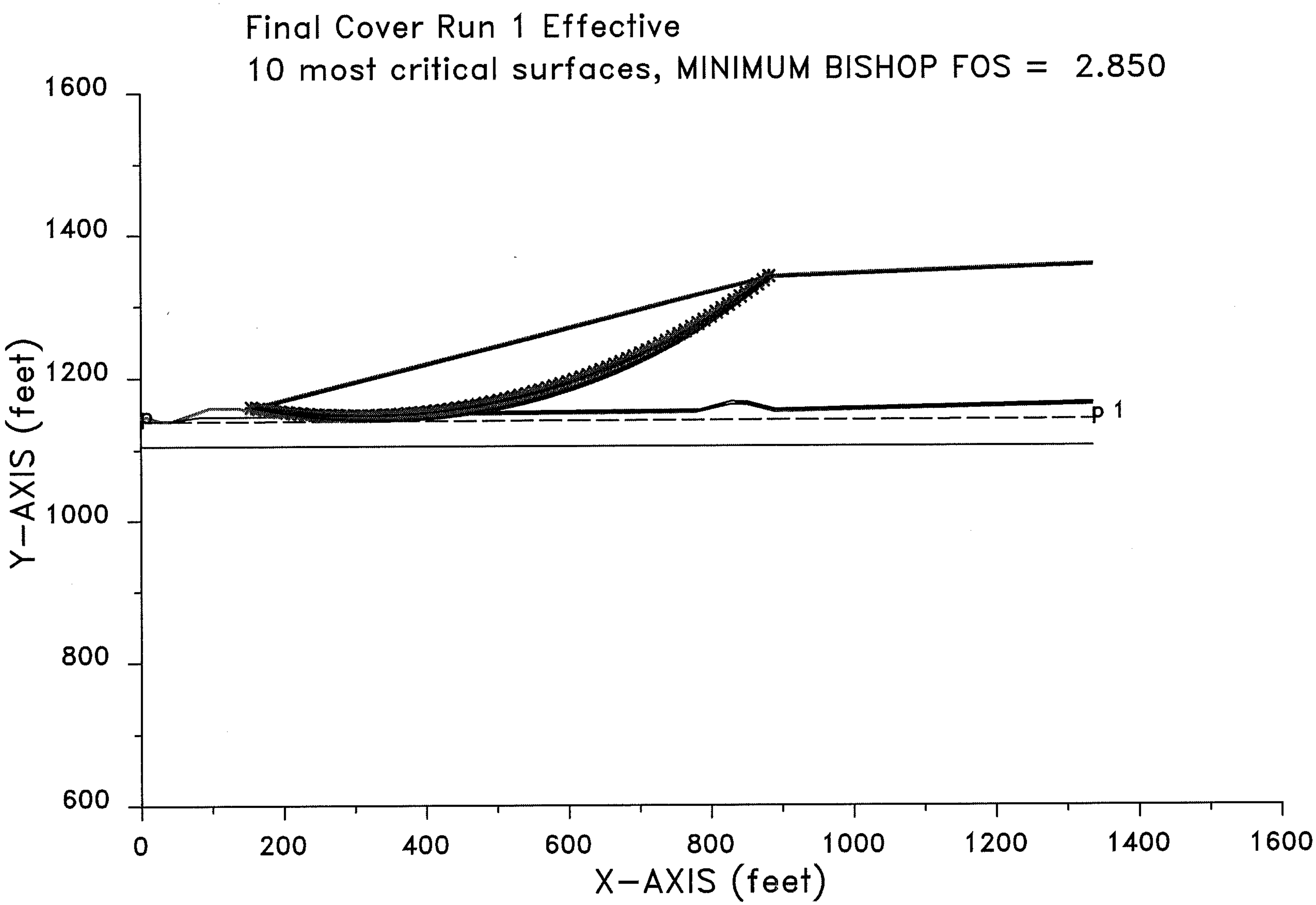

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*              X S T A B L              *
*                                       *
*       Slope Stability Analysis        *
*              using the                *
*           Method of Slices            *
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Problem Description : Final Cover Run 1 Effective

SEGMENT BOUNDARY COORDINATES

---

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters
----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	.0	25.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	116.0	118.0	250.0	30.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 155.0 ft
and x = 165.0 ft

Each surface terminates between x = 880.0 ft
and x = 890.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1140.0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 78 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.00	1159.20
2	164.89	1157.71
3	174.79	1156.33
4	184.71	1155.05
5	194.64	1153.88
6	204.58	1152.80
7	214.54	1151.83
8	224.50	1150.97
9	234.47	1150.20
10	244.45	1149.54
11	254.43	1148.99
12	264.42	1148.53
13	274.42	1148.18
14	284.41	1147.94
15	294.41	1147.80
16	304.41	1147.76
17	314.41	1147.82
18	324.41	1147.99
19	334.41	1148.27
20	344.40	1148.64
21	354.39	1149.12
22	364.37	1149.71
23	374.35	1150.40

24	384.32	1151.19
25	394.28	1152.08
26	404.23	1153.08
27	414.17	1154.18
28	424.09	1155.38
29	434.01	1156.69
30	443.91	1158.10
31	453.79	1159.61
32	463.66	1161.23
33	473.51	1162.94
34	483.35	1164.76
35	493.16	1166.68
36	502.95	1168.71
37	512.72	1170.83
38	522.47	1173.06
39	532.20	1175.38
40	541.90	1177.81
41	551.57	1180.34
42	561.22	1182.96
43	570.84	1185.69
44	580.44	1188.52
45	590.00	1191.45
46	599.53	1194.47
47	609.03	1197.60
48	618.49	1200.82
49	627.93	1204.14
50	637.32	1207.56
51	646.69	1211.08
52	656.01	1214.69
53	665.30	1218.40
54	674.54	1222.21
55	683.75	1226.11
56	692.92	1230.10
57	702.04	1234.19
58	711.13	1238.38
59	720.16	1242.66
60	729.16	1247.03
61	738.10	1251.50
62	747.00	1256.06
63	755.86	1260.71
64	764.66	1265.45
65	773.41	1270.29
66	782.12	1275.21
67	790.77	1280.23
68	799.37	1285.33
69	807.91	1290.52
70	816.41	1295.81
71	824.84	1301.17
72	833.22	1306.63
73	841.55	1312.17
74	849.81	1317.80
75	858.02	1323.52
76	866.16	1329.32
77	874.25	1335.20
78	881.97	1340.94

**** Simplified BISHOP FOS = 2.850 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 1 Effective

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.850	303.10	2111.76	964.00	155.00	881.97	1.530E+09
2.	2.888	317.57	2082.07	934.30	161.67	887.45	1.545E+09
3.	2.902	335.75	2001.25	860.72	156.11	888.89	1.593E+09
4.	2.903	318.50	2070.88	922.51	163.89	882.89	1.505E+09
5.	2.904	303.98	2105.63	958.08	155.00	881.39	1.553E+09
6.	2.904	336.97	1980.35	840.05	157.22	881.31	1.532E+09
7.	2.904	337.25	1999.44	858.77	157.22	889.86	1.594E+09
8.	2.905	328.26	2013.63	871.82	155.00	883.29	1.560E+09
9.	2.906	315.21	2097.68	949.31	161.67	889.78	1.575E+09
10.	2.908	342.79	1981.00	840.41	160.56	888.57	1.563E+09

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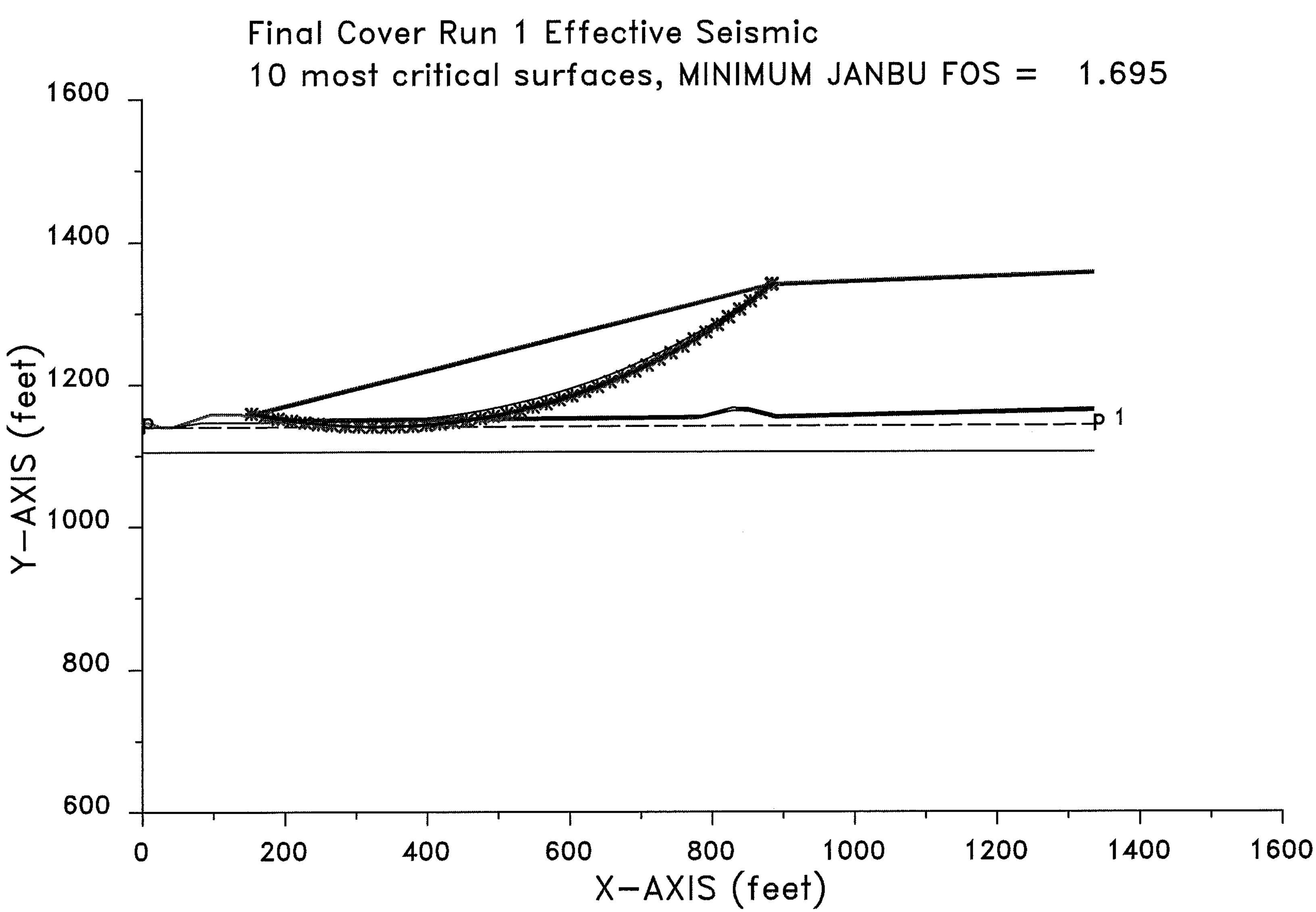

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*                                       *
*        Slope Stability Analysis       *
*              using the                *
*           Method of Slices            *
*                                       *
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*                                       *
*  Ver. 5.209                96 - 2083  *
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Problem Description : Final Cover Run 1 Effective Seismic

SEGMENT BOUNDARY COORDINATES

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters
----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	.0	25.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	116.0	118.0	250.0	30.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A horizontal earthquake loading coefficient of .155 has been assigned

A vertical earthquake loading coefficient of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 150.0 ft
and x = 160.0 ft

Each surface terminates between x = 880.0 ft
and x = 890.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1140.0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

19.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 43 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	153.33	1158.78
2	171.96	1155.04
3	190.67	1151.71
4	209.44	1148.80
5	228.28	1146.30
6	247.16	1144.22
7	266.09	1142.56
8	285.05	1141.31
9	304.03	1140.49

10	323.03	1140.08
11	342.03	1140.10
12	361.02	1140.54
13	380.00	1141.39
14	398.96	1142.67
15	417.88	1144.36
16	436.77	1146.47
17	455.60	1149.00
18	474.37	1151.95
19	493.07	1155.31
20	511.69	1159.08
21	530.22	1163.26
22	548.66	1167.85
23	566.99	1172.85
24	585.21	1178.25
25	603.30	1184.06
26	621.26	1190.26
27	639.08	1196.86
28	656.74	1203.85
29	674.25	1211.23
30	691.59	1218.99
31	708.76	1227.14
32	725.74	1235.66
33	742.53	1244.56
34	759.11	1253.83
35	775.49	1263.46
36	791.65	1273.45
37	807.59	1283.79
38	823.29	1294.49
39	838.76	1305.53
40	853.97	1316.91
41	868.93	1328.62
42	883.63	1340.66
43	884.77	1341.64

** Corrected JANBU FOS = 1.695 ** (Fo factor = 1.048)

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 1 Effective Seismic

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	1.695	1.048	153.33	884.77	1.746E+06
2.	1.695	1.048	152.22	886.04	1.738E+06
3.	1.696	1.048	152.22	884.13	1.726E+06
4.	1.697	1.048	154.44	889.94	1.778E+06
5.	1.699	1.047	151.11	887.82	1.733E+06
6.	1.700	1.049	155.56	880.82	1.736E+06
7.	1.701	1.049	156.67	886.84	1.768E+06
8.	1.702	1.047	152.22	889.95	1.744E+06
9.	1.703	1.043	155.56	886.51	1.534E+06
10.	1.703	1.049	158.89	881.20	1.754E+06

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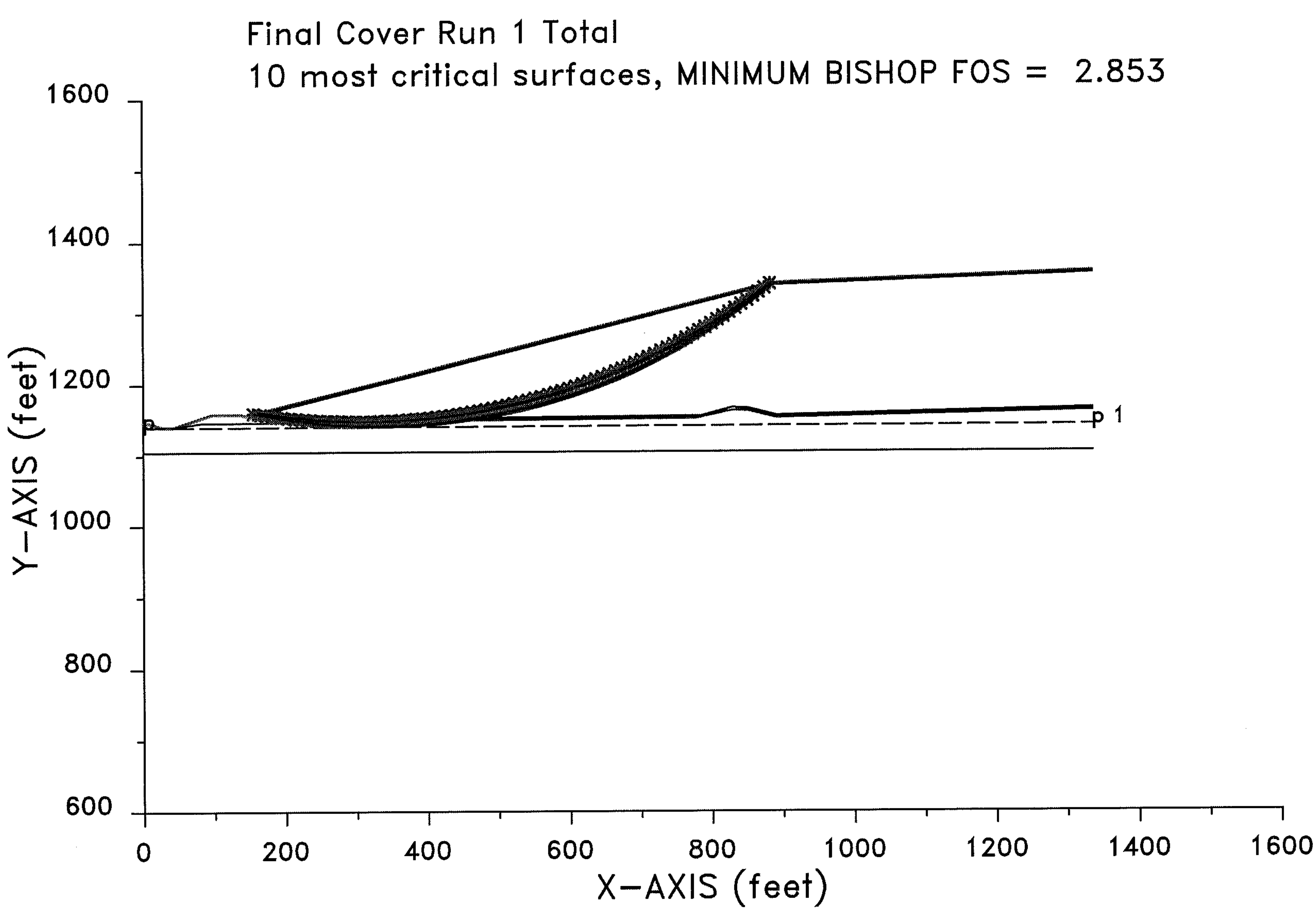

XSTABL File: EO_FC-1T 5-19-15 17:29

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 ******************************************
 *             X S T A B L                *
 *                                        *
 *        Slope Stability Analysis        *
 *               using the                *
 *           Method of Slices             *
 *                                        *
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Problem Description : Final Cover Run 1 Total

SEGMENT BOUNDARY COORDINATES
----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters
----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	170.0	16.00	.000	.0	0
2	116.0	118.0	120.0	16.00	.000	.0	0
3	116.0	118.0	1000.0	.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 155.0 ft and x = 165.0 ft

Each surface terminates between x = 880.0 ft and x = 890.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1140.0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 78 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.00	1159.20
2	164.89	1157.71
3	174.79	1156.33
4	184.71	1155.05
5	194.64	1153.88
6	204.58	1152.80
7	214.54	1151.83
8	224.50	1150.97
9	234.47	1150.20
10	244.45	1149.54
11	254.43	1148.99
12	264.42	1148.53
13	274.42	1148.18
14	284.41	1147.94
15	294.41	1147.80
16	304.41	1147.76
17	314.41	1147.82
18	324.41	1147.99
19	334.41	1148.27
20	344.40	1148.64
21	354.39	1149.12
22	364.37	1149.71
23	374.35	1150.40
24	384.32	1151.19

25	394.28	1152.08
26	404.23	1153.08
27	414.17	1154.18
28	424.09	1155.38
29	434.01	1156.69
30	443.91	1158.10
31	453.79	1159.61
32	463.66	1161.23
33	473.51	1162.94
34	483.35	1164.76
35	493.16	1166.68
36	502.95	1168.71
37	512.72	1170.83
38	522.47	1173.06
39	532.20	1175.38
40	541.90	1177.81
41	551.57	1180.34
42	561.22	1182.96
43	570.84	1185.69
44	580.44	1188.52
45	590.00	1191.45
46	599.53	1194.47
47	609.03	1197.60
48	618.49	1200.82
49	627.93	1204.14
50	637.32	1207.56
51	646.69	1211.08
52	656.01	1214.69
53	665.30	1218.40
54	674.54	1222.21
55	683.75	1226.11
56	692.92	1230.10
57	702.04	1234.19
58	711.13	1238.38
59	720.16	1242.66
60	729.16	1247.03
61	738.10	1251.50
62	747.00	1256.06
63	755.86	1260.71
64	764.66	1265.45
65	773.41	1270.29
66	782.12	1275.21
67	790.77	1280.23
68	799.37	1285.33
69	807.91	1290.52
70	816.41	1295.81
71	824.84	1301.17
72	833.22	1306.63
73	841.55	1312.17
74	849.81	1317.80
75	858.02	1323.52
76	866.16	1329.32
77	874.25	1335.20
78	881.97	1340.94

**** Simplified BISHOP FOS = 2.853 ****
The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 1 Total

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.853	303.10	2111.76	964.00	155.00	881.97	1.531E+09
2.	2.891	317.57	2082.07	934.30	161.67	887.45	1.546E+09
3.	2.900	335.75	2001.25	860.72	156.11	888.89	1.592E+09
4.	2.904	336.97	1980.35	840.05	157.22	881.31	1.532E+09
5.	2.904	337.25	1999.44	858.77	157.22	889.86	1.594E+09
6.	2.905	328.26	2013.63	871.82	155.00	883.29	1.560E+09
7.	2.906	318.50	2070.88	922.51	163.89	882.89	1.507E+09
8.	2.907	303.98	2105.63	958.08	155.00	881.39	1.555E+09
9.	2.908	315.21	2097.68	949.31	161.67	889.78	1.576E+09
10.	2.910	342.79	1981.00	840.41	160.56	888.57	1.564E+09

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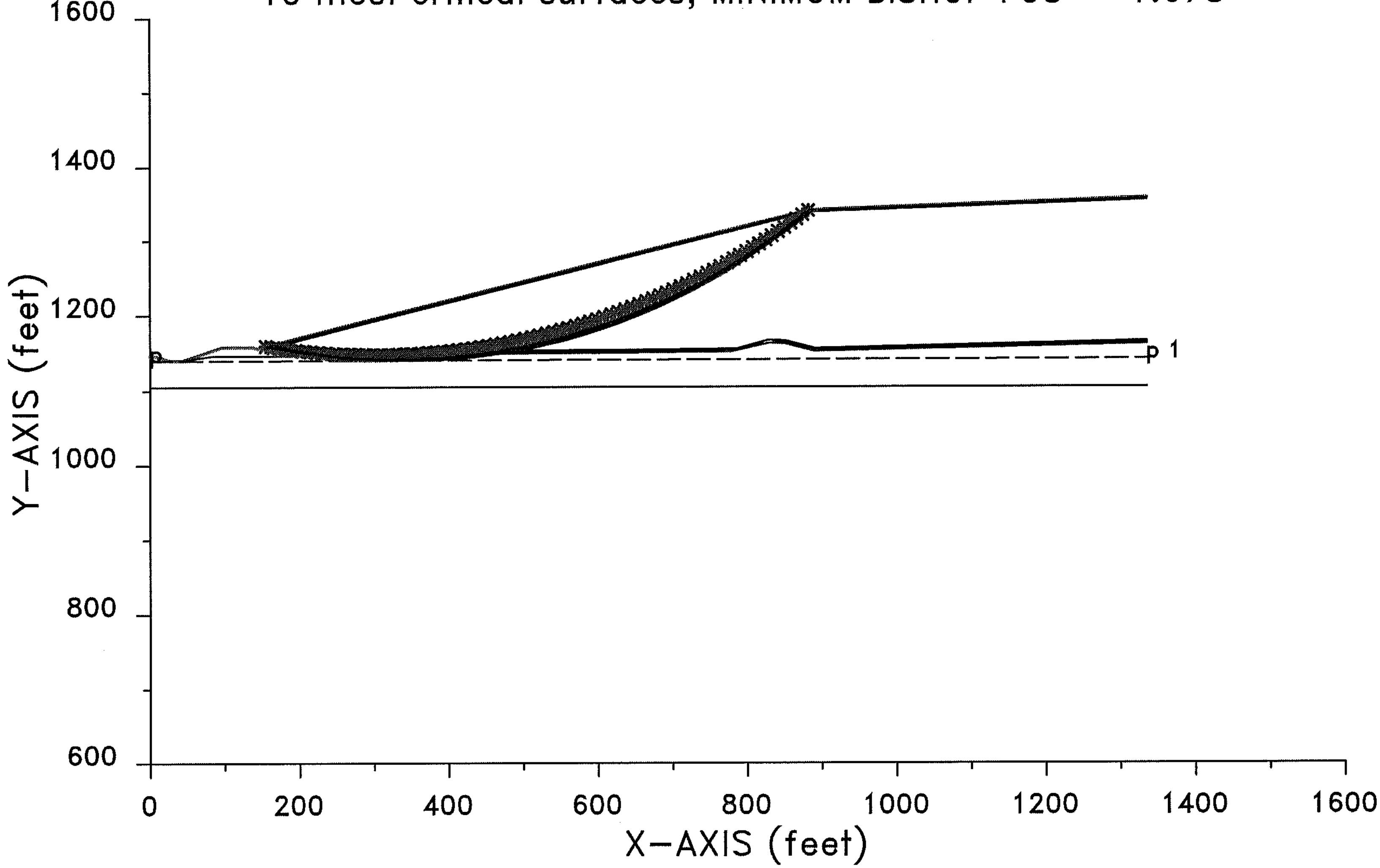
Final Cover Run 1 Total Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 1.678



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*              X S T A B L             *
*                                      *
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Problem Description : Final Cover Run 1 Total Seismic

SEGMENT BOUNDARY COORDINATES

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters
----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	170.0	16.00	.000	.0	0
2	116.0	118.0	120.0	16.00	.000	.0	0
3	116.0	118.0	1000.0	.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced along the ground surface between x = 155.0 ft and x = 165.0 ft

Each surface terminates between x = 880.0 ft and x = 890.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1140.0 ft

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 78 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.00	1159.20
2	164.89	1157.71
3	174.79	1156.33
4	184.71	1155.05
5	194.64	1153.88
6	204.58	1152.80
7	214.54	1151.83
8	224.50	1150.97
9	234.47	1150.20
10	244.45	1149.54
11	254.43	1148.99
12	264.42	1148.53
13	274.42	1148.18
14	284.41	1147.94
15	294.41	1147.80
16	304.41	1147.76

17	314.41	1147.82
18	324.41	1147.99
19	334.41	1148.27
20	344.40	1148.64
21	354.39	1149.12
22	364.37	1149.71
23	374.35	1150.40
24	384.32	1151.19
25	394.28	1152.08
26	404.23	1153.08
27	414.17	1154.18
28	424.09	1155.38
29	434.01	1156.69
30	443.91	1158.10
31	453.79	1159.61
32	463.66	1161.23
33	473.51	1162.94
34	483.35	1164.76
35	493.16	1166.68
36	502.95	1168.71
37	512.72	1170.83
38	522.47	1173.06
39	532.20	1175.38
40	541.90	1177.81
41	551.57	1180.34
42	561.22	1182.96
43	570.84	1185.69
44	580.44	1188.52
45	590.00	1191.45
46	599.53	1194.47
47	609.03	1197.60
48	618.49	1200.82
49	627.93	1204.14
50	637.32	1207.56
51	646.69	1211.08
52	656.01	1214.69
53	665.30	1218.40
54	674.54	1222.21
55	683.75	1226.11
56	692.92	1230.10
57	702.04	1234.19
58	711.13	1238.38
59	720.16	1242.66
60	729.16	1247.03
61	738.10	1251.50
62	747.00	1256.06
63	755.86	1260.71
64	764.66	1265.45
65	773.41	1270.29
66	782.12	1275.21
67	790.77	1280.23
68	799.37	1285.33
69	807.91	1290.52
70	816.41	1295.81
71	824.84	1301.17
72	833.22	1306.63
73	841.55	1312.17
74	849.81	1317.80
75	858.02	1323.52
76	866.16	1329.32
77	874.25	1335.20
78	881.97	1340.94

**** Simplified BISHOP FOS = 1.678 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 1 Total Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.678	303.10	2111.76	964.00	155.00	881.97	1.466E+09
2.	1.686	335.75	2001.25	860.72	156.11	888.89	1.526E+09
3.	1.687	336.97	1980.35	840.05	157.22	881.31	1.468E+09
4.	1.689	337.25	1999.44	858.77	157.22	889.86	1.528E+09
5.	1.692	349.24	1955.57	815.49	163.89	886.66	1.462E+09
6.	1.692	328.26	2013.63	871.82	155.00	883.29	1.495E+09
7.	1.693	342.79	1981.00	840.41	160.56	888.57	1.500E+09
8.	1.695	339.05	1991.47	850.35	159.44	888.48	1.506E+09
9.	1.696	345.14	1968.48	827.67	162.78	885.98	1.467E+09
10.	1.702	332.75	2001.15	859.01	158.33	882.69	1.477E+09

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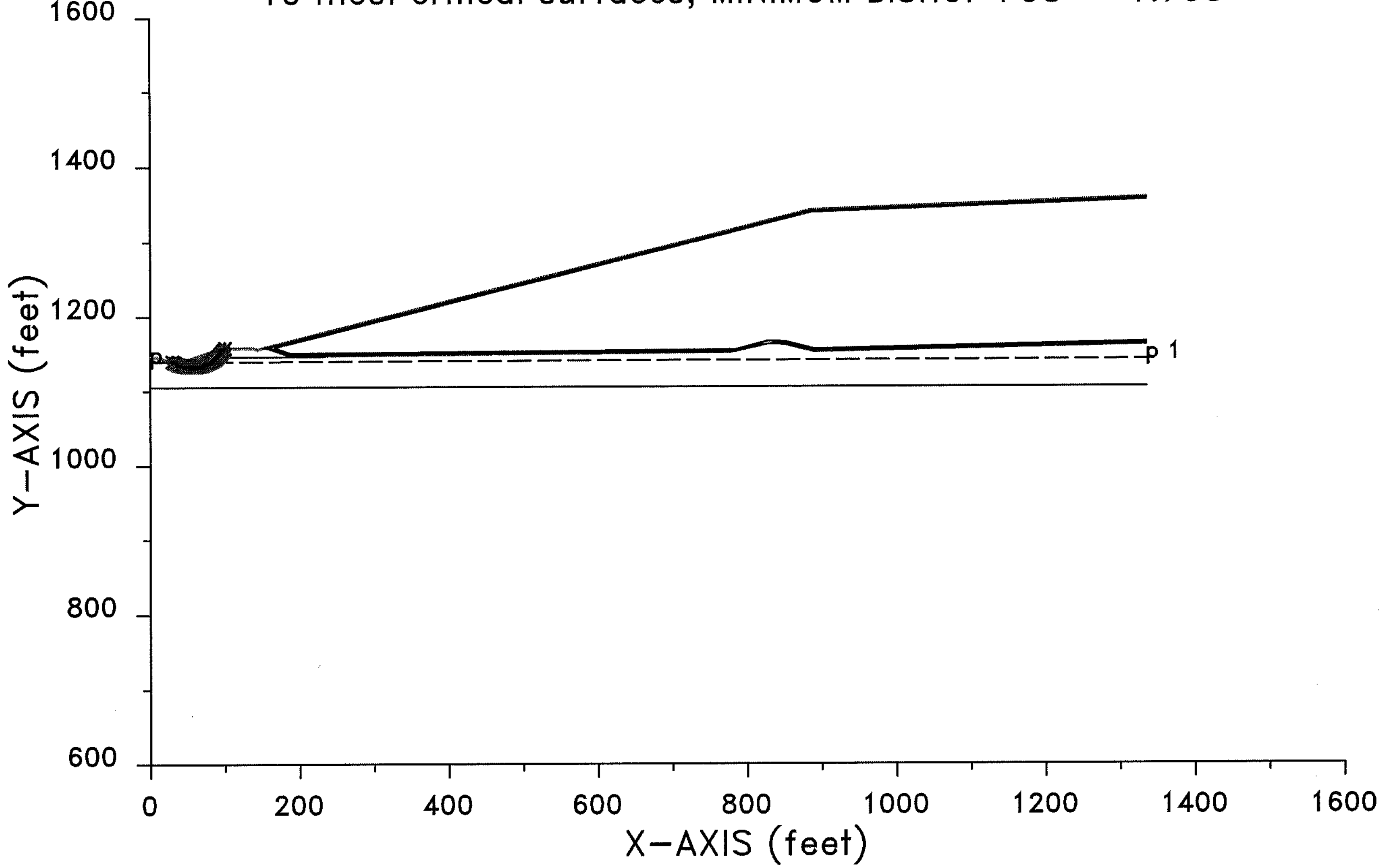
Final Cover Run 2 Effective
10 most critical surfaces, MINIMUM BISHOP FOS = 1.795



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Problem Description : Final Cover Run 2 Effective

SEGMENT BOUNDARY COORDINATES

----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6

16	829.0	1163.1	850.8	1164.0	6
17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters
----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	.0	25.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	116.0	118.0	250.0	30.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

```
  10 Surfaces initiate from each of  10 points equally spaced
along the ground surface between  x =      27.0 ft
                              and  x =      32.0 ft


Each surface terminates between   x =      90.0 ft
                             and   x =     100.0 ft


Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =        .0 ft


* * * * *  DEFAULT SEGMENT LENGTH SELECTED BY XSTABL  * * * * *

    2.0 ft line segments define each trial failure surface.


---------------------
ANGULAR RESTRICTIONS
---------------------

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=    -5.0 degrees

************************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
************************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
************************************************************************

------------------------------------------------------------
USER SELECTED option to maintain strength greater than zero
------------------------------------------------------------



Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *


  The most critical circular failure surface
  is specified by 42 coordinate points
```

Point No.	x-surf (ft)	y-surf (ft)
1	29.78	1140.00
2	31.53	1139.03
3	33.32	1138.14
4	35.14	1137.31
5	36.99	1136.56
6	38.87	1135.87

7	40.77	1135.26
8	42.70	1134.72
9	44.65	1134.26
10	46.61	1133.88
11	48.58	1133.56
12	50.57	1133.33
13	52.56	1133.17
14	54.56	1133.09
15	56.56	1133.09
16	58.56	1133.17
17	60.56	1133.32
18	62.54	1133.55
19	64.52	1133.85
20	66.48	1134.24
21	68.43	1134.69
22	70.36	1135.23
23	72.26	1135.83
24	74.14	1136.51
25	76.00	1137.26
26	77.82	1138.09
27	79.61	1138.98
28	81.36	1139.94
29	83.08	1140.97
30	84.75	1142.06
31	86.38	1143.22
32	87.97	1144.44
33	89.51	1145.72
34	90.99	1147.06
35	92.43	1148.45
36	93.80	1149.90
37	95.13	1151.40
38	96.39	1152.95
39	97.59	1154.55
40	98.73	1156.20
41	99.80	1157.88
42	99.87	1158.00

**** Simplified BISHOP FOS = 1.795 ****

The following is a summary of the TEN most critical surfaces

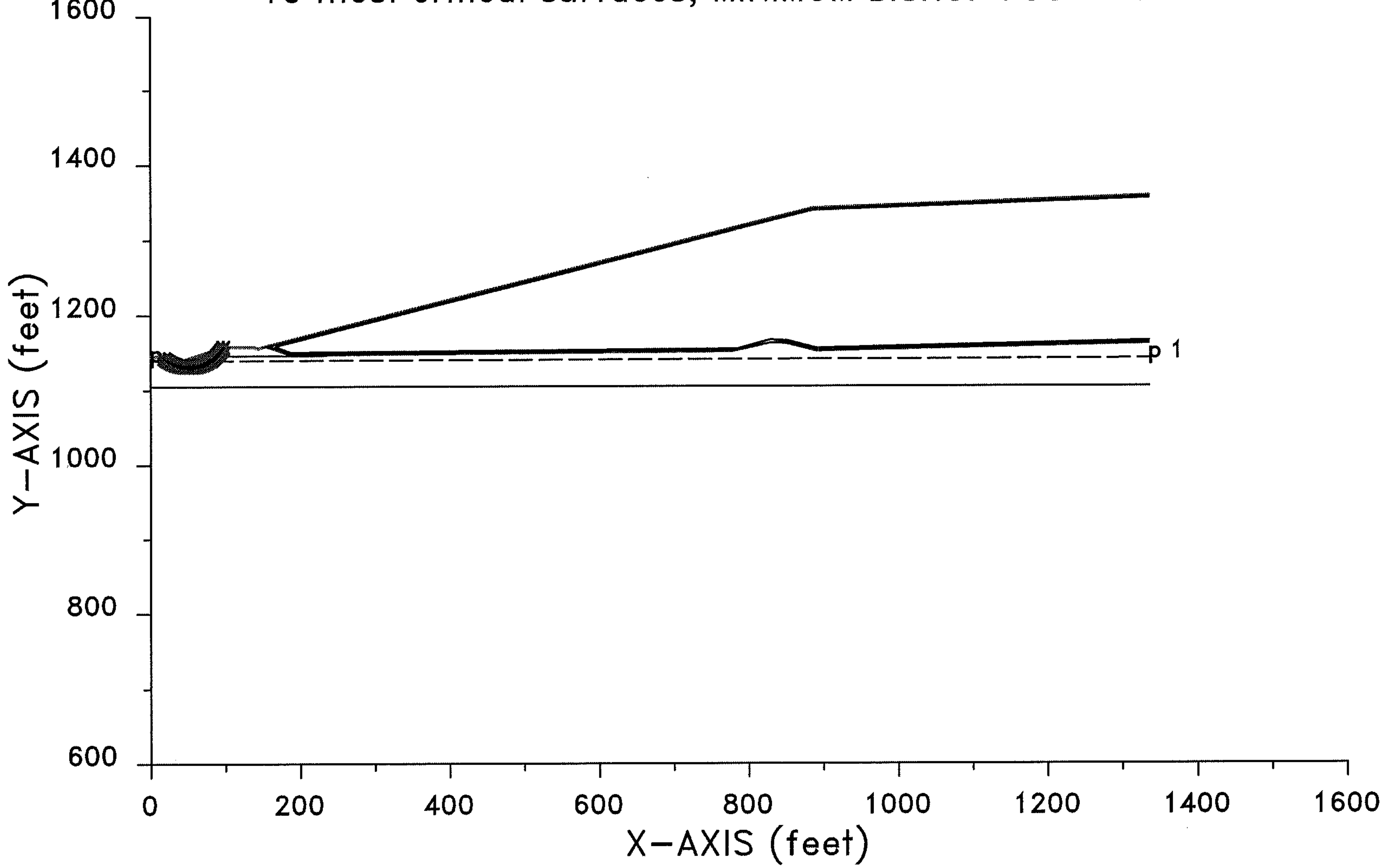
Problem Description : Final Cover Run 2 Effective

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.795	55.60	1184.80	51.71	29.78	99.87	1.773E+06
2.	1.802	53.15	1188.43	55.01	27.00	98.95	1.789E+06
3.	1.803	57.01	1178.11	46.52	30.33	98.95	1.704E+06
4.	1.806	55.55	1185.90	51.59	32.00	98.95	1.603E+06
5.	1.806	56.20	1178.47	47.63	28.11	99.18	1.828E+06
6.	1.810	53.06	1191.25	57.24	27.56	99.61	1.829E+06
7.	1.812	55.37	1176.94	45.91	28.11	97.15	1.650E+06
8.	1.813	53.23	1191.74	57.51	28.11	99.88	1.828E+06
9.	1.813	56.47	1175.35	43.31	31.44	96.12	1.431E+06
10.	1.813	53.10	1178.52	46.23	27.56	94.13	1.409E+06

* * * END OF FILE * * *

EO_FC2ES 5-20-15 14:21

Final Cover Run 2 Effective Seismic
10 most critical surfaces, MINIMUM BISHOP FOS = 1.155



XSTABL File: EO_FC2ES 5-20-15 14:21

```
****************************************
*              X S T A B L             *
*                                      *
*        Slope Stability Analysis      *
*              using the               *
*           Method of Slices           *
*                                      *
*        Copyright (C) 1992 - 2013     *
*   Interactive Software Designs, Inc. *
*        Moscow, ID 83843, U.S.A.      *
*                                      *
*           All Rights Reserved        *
*                                      *
*  Ver. 5.209               96 - 2083  *
****************************************
```

Problem Description : Final Cover Run 2 Effective Seismic

SEGMENT BOUNDARY COORDINATES

----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6
16	829.0	1163.1	850.8	1164.0	6
17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6

19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters

----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	.0	25.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	116.0	118.0	250.0	30.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****

PIEZOMETRIC SURFACE

****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned
A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

```
  10 Surfaces initiate from each of  10 points equally spaced
along the ground surface between  x =      16.0 ft
                             and  x =      18.0 ft


Each surface terminates between   x =      95.0 ft
                            and   x =      98.0 ft


Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =       .0 ft


* * * * *  DEFAULT SEGMENT LENGTH SELECTED BY XSTABL  * * * * *

    2.0 ft line segments define each trial failure surface.

---------------------
ANGULAR RESTRICTIONS
---------------------

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=    -5.0 degrees

************************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
************************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
************************************************************************

 ------------------------------------------------------------
 USER SELECTED option to maintain strength greater than zero
 ------------------------------------------------------------

 Factors of safety have been calculated by the :

 * * * * *   SIMPLIFIED BISHOP METHOD   * * * * *


  The most critical circular failure surface
  is specified by 47 coordinate points
```

Point No.	x-surf (ft)	y-surf (ft)
1	18.00	1143.02
2	19.60	1141.82
3	21.24	1140.68
4	22.93	1139.60
5	24.65	1138.58
6	26.41	1137.64
7	28.21	1136.75
8	30.03	1135.94
9	31.89	1135.19
10	33.77	1134.51

11	35.68	1133.91
12	37.60	1133.37
13	39.55	1132.91
14	41.51	1132.52
15	43.49	1132.21
16	45.47	1131.96
17	47.46	1131.80
18	49.46	1131.70
19	51.46	1131.68
20	53.46	1131.74
21	55.46	1131.87
22	57.45	1132.07
23	59.43	1132.35
24	61.40	1132.71
25	63.35	1133.13
26	65.29	1133.63
27	67.20	1134.20
28	69.10	1134.84
29	70.97	1135.55
30	72.81	1136.33
31	74.62	1137.18
32	76.40	1138.10
33	78.14	1139.08
34	79.85	1140.12
35	81.51	1141.23
36	83.13	1142.40
37	84.71	1143.63
38	86.24	1144.92
39	87.72	1146.26
40	89.15	1147.66
41	90.53	1149.11
42	91.85	1150.61
43	93.12	1152.16
44	94.32	1153.76
45	95.47	1155.40
46	96.55	1157.08
47	97.10	1158.00

**** Simplified BISHOP FOS = 1.155 ****

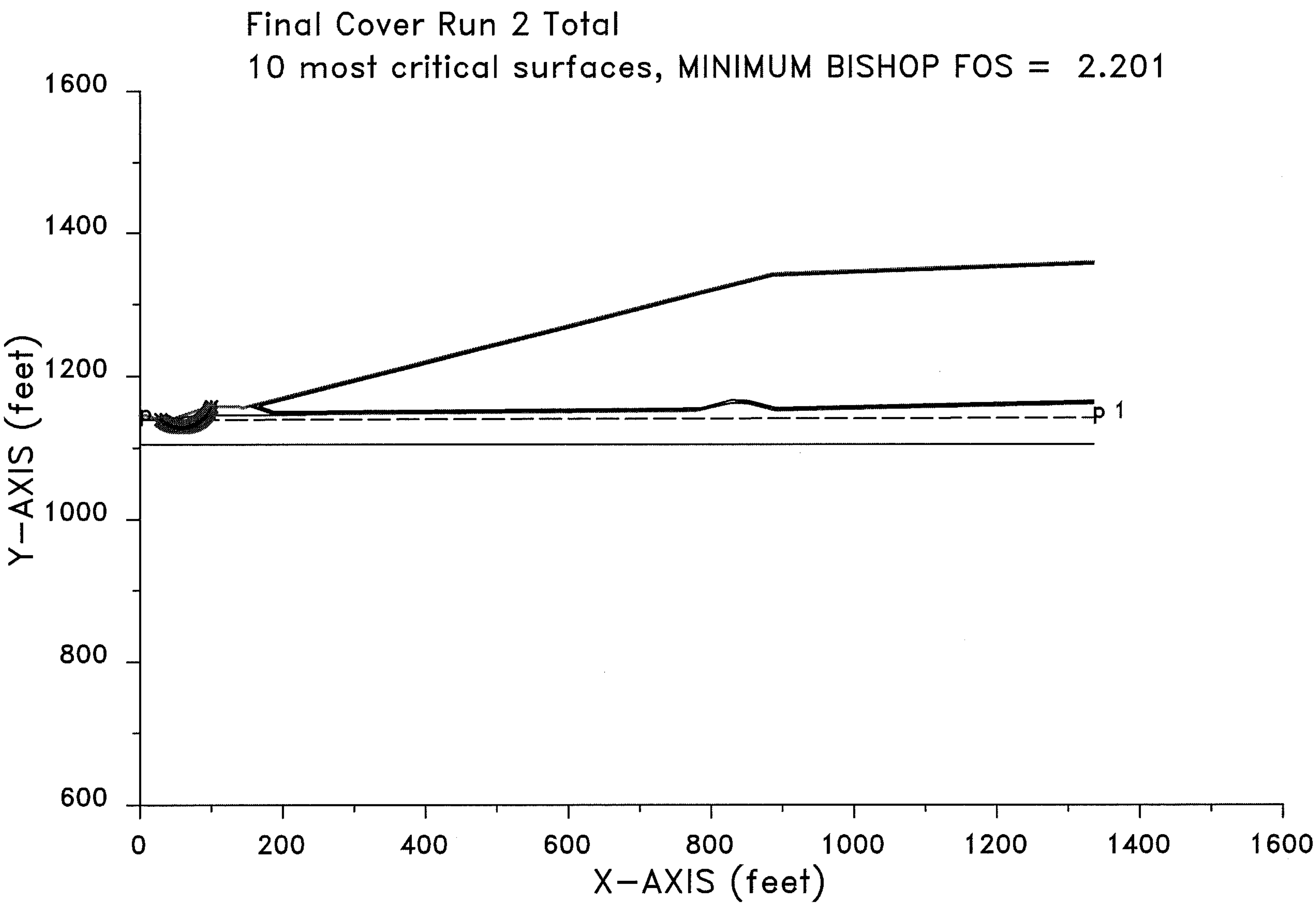
The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 2 Effective Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.155	51.00	1185.33	53.66	18.00	97.10	1.780E+06
2.	1.157	51.66	1183.79	52.96	17.78	97.88	1.897E+06
3.	1.159	50.45	1185.75	53.65	18.00	96.41	1.698E+06
4.	1.161	50.06	1192.51	59.09	17.56	97.96	1.788E+06
5.	1.161	50.38	1186.42	54.30	17.56	96.67	1.732E+06
6.	1.161	50.84	1183.46	52.09	18.00	96.24	1.722E+06
7.	1.162	51.06	1184.62	53.39	17.33	97.35	1.843E+06
8.	1.164	52.26	1181.09	51.22	18.00	98.01	1.952E+06
9.	1.165	50.87	1185.45	54.08	16.89	97.44	1.858E+06
10.	1.165	51.24	1182.60	51.86	17.56	96.91	1.825E+06

* * * END OF FILE * * *

EO_FC-2T 5-19-15 17:47



XSTABL File: EO_FC-2T 5-19-15 17:47

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*              using the                *
*           Method of Slices            *
*                                       *
*        Copyright (C) 1992 - 2013      *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*           All Rights Reserved         *
*                                       *
*  Ver. 5.209              96 - 2083    *
*****************************************
```

Problem Description : Final Cover Run 2 Total

SEGMENT BOUNDARY COORDINATES
----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters
----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	170.0	16.00	.000	.0	0
2	116.0	118.0	120.0	16.00	.000	.0	0
3	116.0	118.0	1000.0	.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

100 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 10 points equally spaced

```
along the ground surface between  x =     27.0 ft
                             and  x =     32.0 ft


Each surface terminates between   x =     90.0 ft
                            and   x =    100.0 ft


Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =       .0 ft



* * * * *  DEFAULT SEGMENT LENGTH SELECTED BY XSTABL  * * * * *

    2.0 ft line segments define each trial failure surface.


---------------------
ANGULAR RESTRICTIONS
---------------------

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=    -5.0 degrees

***********************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
***********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
***********************************************************************

    ------------------------------------------------------------
    USER SELECTED option to maintain strength greater than zero
    ------------------------------------------------------------


    Factors of safety have been calculated by the :

    * * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

      The most critical circular failure surface
      is specified by 44 coordinate points
```

Point No.	x-surf (ft)	y-surf (ft)
1	29.22	1140.00
2	30.79	1138.75
3	32.40	1137.58
4	34.07	1136.47
5	35.79	1135.44
6	37.55	1134.49
7	39.35	1133.62
8	41.18	1132.83
9	43.05	1132.12
10	44.95	1131.49

11	46.88	1130.95
12	48.82	1130.50
13	50.79	1130.13
14	52.77	1129.85
15	54.76	1129.66
16	56.76	1129.55
17	58.76	1129.54
18	60.76	1129.61
19	62.75	1129.77
20	64.73	1130.02
21	66.71	1130.36
22	68.66	1130.78
23	70.59	1131.29
24	72.50	1131.89
25	74.38	1132.57
26	76.23	1133.33
27	78.04	1134.18
28	79.82	1135.10
29	81.55	1136.11
30	83.23	1137.18
31	84.87	1138.33
32	86.45	1139.56
33	87.98	1140.85
34	89.45	1142.21
35	90.85	1143.63
36	92.20	1145.11
37	93.47	1146.65
38	94.68	1148.25
39	95.81	1149.90
40	96.87	1151.59
41	97.85	1153.34
42	98.76	1155.12
43	99.58	1156.94
44	100.00	1158.00

**** Simplified BISHOP FOS = 2.201 ****

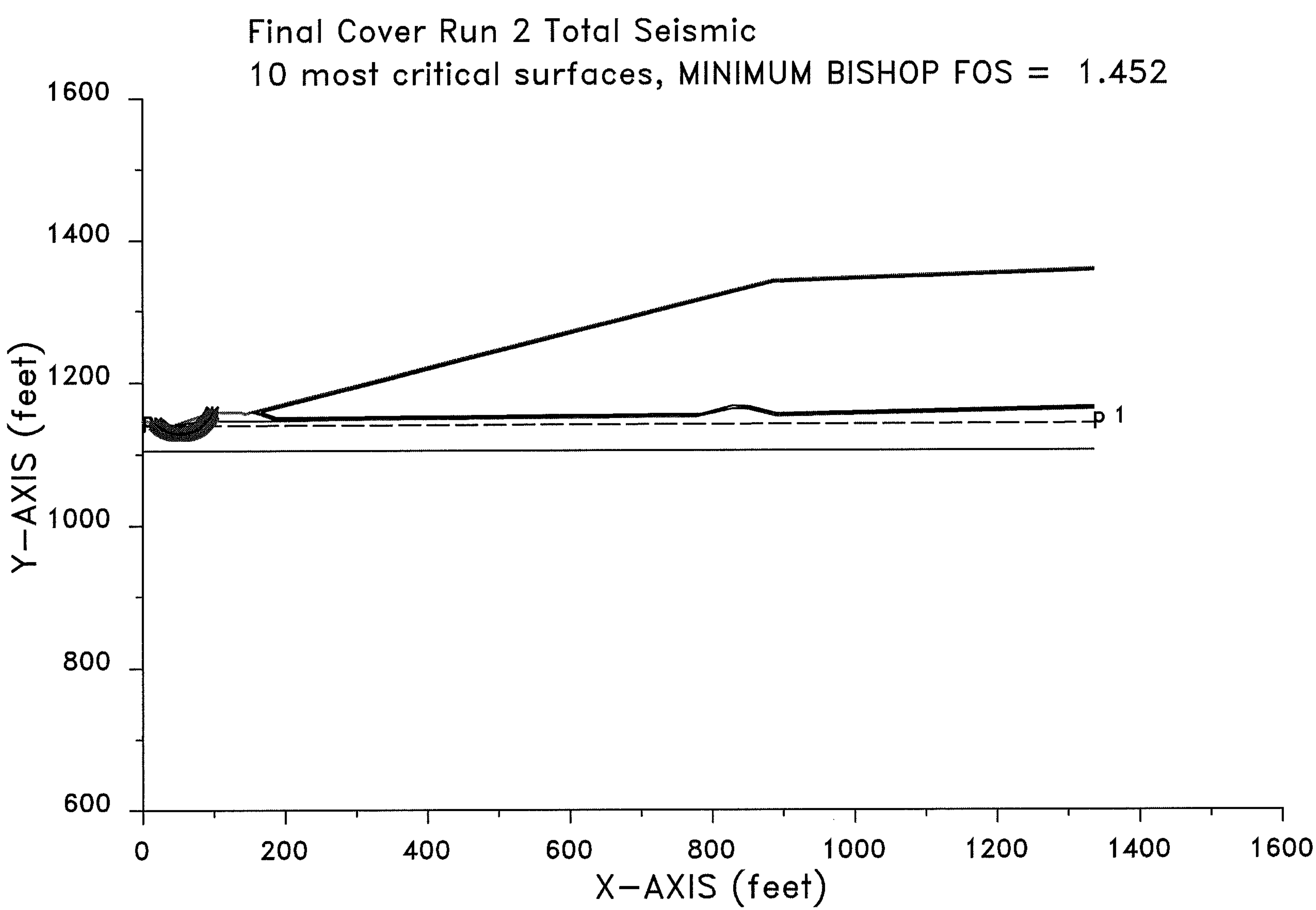
The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 2 Total

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.201	58.11	1174.62	45.09	29.22	100.00	2.279E+06
2.	2.204	56.32	1177.23	47.05	27.56	99.31	2.282E+06
3.	2.211	58.19	1175.25	44.93	30.33	99.71	2.188E+06
4.	2.213	57.90	1176.82	46.00	30.33	99.80	2.195E+06
5.	2.215	56.20	1178.47	47.63	28.11	99.18	2.241E+06
6.	2.219	58.28	1170.93	43.59	27.56	99.89	2.409E+06
7.	2.220	58.95	1174.34	43.99	31.44	99.80	2.146E+06
8.	2.223	58.27	1172.42	43.16	29.78	98.95	2.166E+06
9.	2.224	58.47	1170.41	43.37	27.56	100.02	2.431E+06
10.	2.225	58.45	1175.68	44.75	31.44	99.53	2.119E+06

* * * END OF FILE * * *

EO_FC2TS 5-20-15 14:22



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*               X S T A B L             *
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*              using the                *
*           Method of Slices            *
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Problem Description : Final Cover Run 2 Total Seismic

SEGMENT BOUNDARY COORDINATES
----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	7
2	9.0	1146.0	27.1	1140.0	7
3	27.1	1140.0	42.1	1140.0	7
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	6
14	188.9	1148.8	778.5	1153.6	6
15	778.5	1153.6	829.0	1163.1	6
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	7
23	82.3	1146.4	230.7	1146.4	7
24	230.7	1146.4	236.8	1147.2	7
25	236.8	1147.2	778.0	1151.4	7
26	778.0	1151.4	829.0	1163.1	7
27	829.0	1163.1	850.5	1162.0	7
28	850.5	1162.0	890.0	1152.0	7
29	890.0	1152.0	1335.4	1161.9	7
30	.0	1105.0	1335.4	1105.0	8

ISOTROPIC Soil Parameters

----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	170.0	16.00	.000	.0	0
2	116.0	118.0	120.0	16.00	.000	.0	0
3	116.0	118.0	1000.0	.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	119.2	119.2	.0	25.00	.000	.0	1
8	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****

PIEZOMETRIC SURFACE

****

Point No.	x-water (ft)	y-water (ft)
1	.00	1139.60
2	1335.40	1142.20

A horizontal earthquake loading coefficient of .155 has been assigned

A vertical earthquake loading coefficient of .000 has been assigned

```
A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.


  100 trial surfaces will be generated and analyzed.


  10 Surfaces initiate from each of  10 points equally spaced
along the ground surface between  x =      16.0 ft
                             and  x =      18.0 ft


Each surface terminates between   x =      95.0 ft
                            and   x =      98.0 ft


Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =       .0 ft


* * * * *  DEFAULT SEGMENT LENGTH SELECTED BY XSTABL  * * * * *

    2.0 ft line segments define each trial failure surface.


---------------------
ANGULAR RESTRICTIONS
---------------------

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=    -5.0 degrees


***********************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
***********************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
***********************************************************************

    ------------------------------------------------------------
    USER SELECTED option to maintain strength greater than zero
    ------------------------------------------------------------


    Factors of safety have been calculated by the :

    * * * * *   SIMPLIFIED BISHOP METHOD   * * * * *
```

The most critical circular failure surface
is specified by 50 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	18.00	1143.02
2	19.42	1141.60
3	20.89	1140.25
4	22.41	1138.96
5	23.99	1137.73
6	25.62	1136.57
7	27.29	1135.47
8	29.01	1134.45
9	30.77	1133.50
10	32.57	1132.62
11	34.40	1131.81
12	36.26	1131.09
13	38.15	1130.43
14	40.07	1129.86
15	42.01	1129.37
16	43.96	1128.96
17	45.94	1128.63
18	47.92	1128.38
19	49.91	1128.21
20	51.91	1128.12
21	53.91	1128.12
22	55.91	1128.20
23	57.90	1128.36
24	59.89	1128.60
25	61.86	1128.93
26	63.82	1129.33
27	65.76	1129.82
28	67.68	1130.38
29	69.57	1131.03
30	71.44	1131.75
31	73.27	1132.55
32	75.07	1133.42
33	76.83	1134.37
34	78.55	1135.39
35	80.23	1136.48
36	81.86	1137.63
37	83.45	1138.85
38	84.98	1140.14
39	86.45	1141.49
40	87.87	1142.90
41	89.23	1144.36
42	90.53	1145.89
43	91.77	1147.46
44	92.94	1149.08
45	94.04	1150.75
46	95.07	1152.46
47	96.03	1154.22
48	96.92	1156.01
49	97.73	1157.84
50	97.80	1158.00

**** Simplified BISHOP FOS =   1.452   ****

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 2 Total Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.452	52.98	1176.62	48.50	18.00	97.80	2.489E+06
2.	1.452	52.73	1177.83	49.28	17.78	97.91	2.490E+06
3.	1.452	52.86	1177.23	49.06	17.56	97.99	2.525E+06
4.	1.455	52.78	1177.27	49.13	17.33	97.95	2.533E+06
5.	1.455	52.80	1177.02	48.87	17.56	97.82	2.510E+06
6.	1.457	52.63	1177.66	49.19	17.56	97.71	2.487E+06
7.	1.457	52.40	1179.08	50.14	17.33	97.92	2.496E+06
8.	1.458	52.76	1176.67	48.49	17.78	97.56	2.474E+06
9.	1.458	52.35	1179.52	50.23	17.78	97.77	2.451E+06
10.	1.458	52.26	1181.09	51.22	18.00	98.01	2.446E+06

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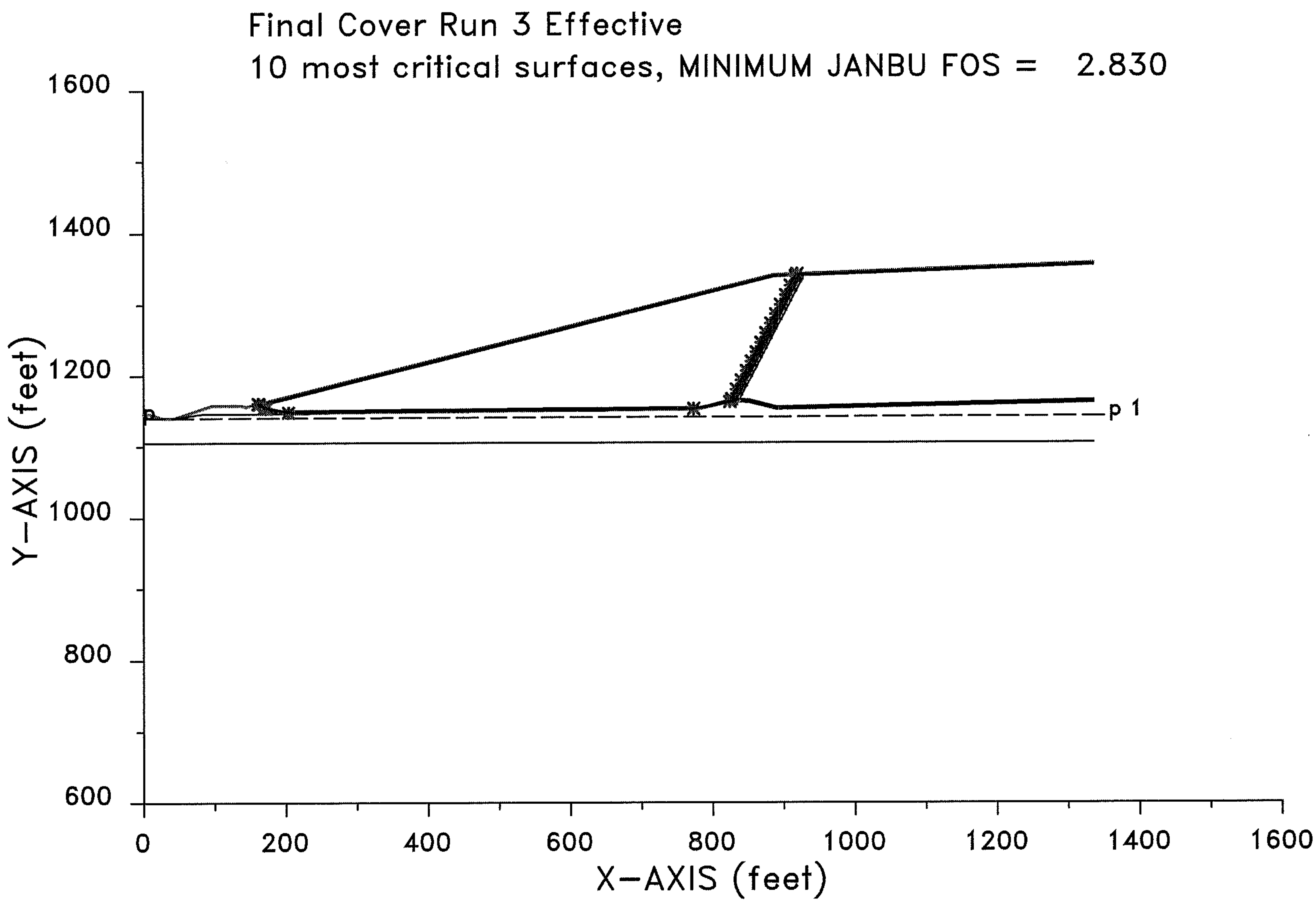

XSTABL File: EO_FC-3E 5-20-15 8:45

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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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*  Ver. 5.209              96 - 2083    *
*****************************************
```

Problem Description : Final Cover Run 3 Effective

SEGMENT BOUNDARY COORDINATES

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	8
2	9.0	1146.0	27.1	1140.0	8
3	27.1	1140.0	42.1	1140.0	8
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	7
14	188.9	1148.8	778.5	1153.6	7
15	778.5	1153.6	829.0	1163.1	7
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	8
23	82.3	1146.4	230.7	1146.4	8
24	230.7	1146.4	236.8	1147.2	8
25	236.8	1147.2	778.0	1151.4	8
26	778.0	1151.4	829.0	1163.1	8
27	829.0	1163.1	850.5	1162.0	8
28	850.5	1162.0	890.0	1152.0	8
29	890.0	1152.0	1335.4	1161.9	8
30	.0	1105.0	1335.4	1105.0	9

ISOTROPIC Soil Parameters

----

9 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	112.0	114.0	.0	25.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	116.0	118.0	250.0	30.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	120.0	125.0	100.0	22.00	.000	.0	0
8	119.2	119.2	.0	25.00	.000	.0	1
9	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****

PIEZOMETRIC SURFACE

****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	1358.00	1142.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

4 boxes specified for generation of central block base

Length of line segments for active and passive portions of sliding block is 15.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	168.2	1155.7	174.4	1153.6	2.1
2	202.6	1148.9	212.6	1149.0	2.0
3	746.0	1153.4	776.1	1153.6	2.0
4	821.9	1163.2	838.1	1164.6	1.9

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 24 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	161.16	1160.74
2	162.32	1160.00
3	170.11	1155.04
4	171.68	1153.98
5	203.82	1148.11
6	773.44	1152.84
7	824.36	1162.88
8	826.81	1166.71
9	833.73	1180.02
10	840.66	1193.33
11	847.58	1206.63
12	854.51	1219.94
13	861.44	1233.24
14	868.36	1246.55
15	875.29	1259.85
16	882.21	1273.16
17	889.14	1286.46
18	896.07	1299.77
19	902.99	1313.07
20	909.92	1326.38
21	916.85	1339.68
22	917.07	1340.11
23	918.38	1342.16
24	919.03	1343.19

** Corrected JANBU FOS = 2.830 ** (Fo factor = 1.071)

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 3 Effective

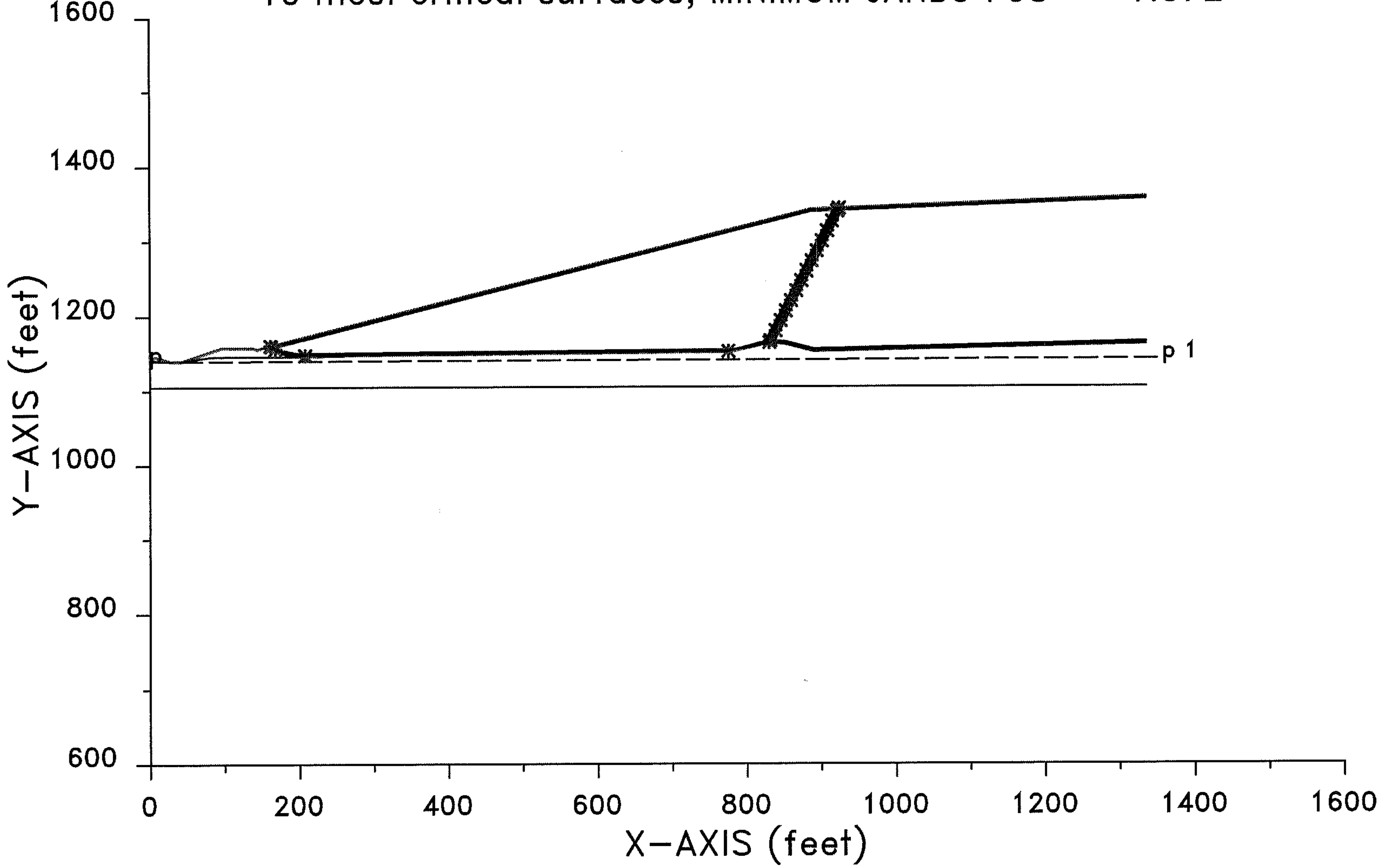
	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.830	1.071	161.16	919.03	2.182E+06
2.	2.831	1.071	161.40	924.41	2.214E+06
3.	2.833	1.071	160.07	921.82	2.198E+06
4.	2.842	1.070	162.23	930.64	2.246E+06
5.	2.843	1.071	162.99	917.82	2.183E+06
6.	2.845	1.071	160.00	926.67	2.222E+06
7.	2.847	1.071	162.71	920.82	2.195E+06
8.	2.848	1.071	160.77	924.58	2.227E+06
9.	2.850	1.071	162.23	918.69	2.194E+06
10.	2.855	1.071	162.43	924.65	2.219E+06

* * * END OF FILE * * *

EO_FC3ES 5-20-15 8:43

Final Cover Run 3 Effective Seismic

10 most critical surfaces, MINIMUM JANBU FOS = 1.572



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*  Ver. 5.209              96 - 2083   *
****************************************
```

Problem Description : Final Cover Run 3 Effective Seismic

SEGMENT BOUNDARY COORDINATES
----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	8
2	9.0	1146.0	27.1	1140.0	8
3	27.1	1140.0	42.1	1140.0	8
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	7
14	188.9	1148.8	778.5	1153.6	7
15	778.5	1153.6	829.0	1163.1	7
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	8
23	82.3	1146.4	230.7	1146.4	8
24	230.7	1146.4	236.8	1147.2	8
25	236.8	1147.2	778.0	1151.4	8
26	778.0	1151.4	829.0	1163.1	8
27	829.0	1163.1	850.5	1162.0	8
28	850.5	1162.0	890.0	1152.0	8
29	890.0	1152.0	1335.4	1161.9	8
30	.0	1105.0	1335.4	1105.0	9

ISOTROPIC Soil Parameters
----

9 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	.0	25.00	.000	.0	0
2	116.0	118.0	.0	25.00	.000	.0	0
3	116.0	118.0	250.0	30.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	120.0	125.0	100.0	22.00	.000	.0	0
8	119.2	119.2	.0	25.00	.000	.0	1
9	137.8	139.8	.0	45.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	1358.00	1142.60

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

4 boxes specified for generation of central block base

Length of line segments for active and passive portions of sliding block is 15.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	168.2	1155.7	174.4	1153.6	2.1
2	202.6	1148.9	212.6	1149.0	2.0
3	746.0	1153.4	776.1	1153.6	2.0
4	821.9	1163.2	838.1	1164.6	1.9

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 23 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	161.40	1160.80
2	162.55	1160.06
3	168.29	1156.41
4	208.13	1147.99
5	775.70	1152.65
6	830.62	1164.45
7	832.19	1166.91
8	839.11	1180.21

9	846.04	1193.52
10	852.96	1206.82
11	859.89	1220.13
12	866.82	1233.43
13	873.74	1246.74
14	880.67	1260.04
15	887.60	1273.35
16	894.52	1286.66
17	901.45	1299.96
18	908.37	1313.27
19	915.30	1326.57
20	922.23	1339.88
21	922.45	1340.30
22	923.76	1342.36
23	924.41	1343.39

** Corrected JANBU FOS = 1.572 ** (Fo factor = 1.071)

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 3 Effective Seismic

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	1.572	1.071	161.40	924.41	2.096E+06
2.	1.573	1.071	161.16	919.03	2.065E+06
3.	1.575	1.070	162.23	930.64	2.126E+06
4.	1.575	1.071	160.07	921.82	2.080E+06
5.	1.580	1.071	160.00	926.67	2.103E+06
6.	1.582	1.071	160.77	924.58	2.109E+06
7.	1.583	1.071	162.99	917.82	2.067E+06
8.	1.587	1.071	162.71	920.82	2.079E+06
9.	1.588	1.071	162.23	918.69	2.077E+06
10.	1.588	1.071	162.43	924.65	2.101E+06

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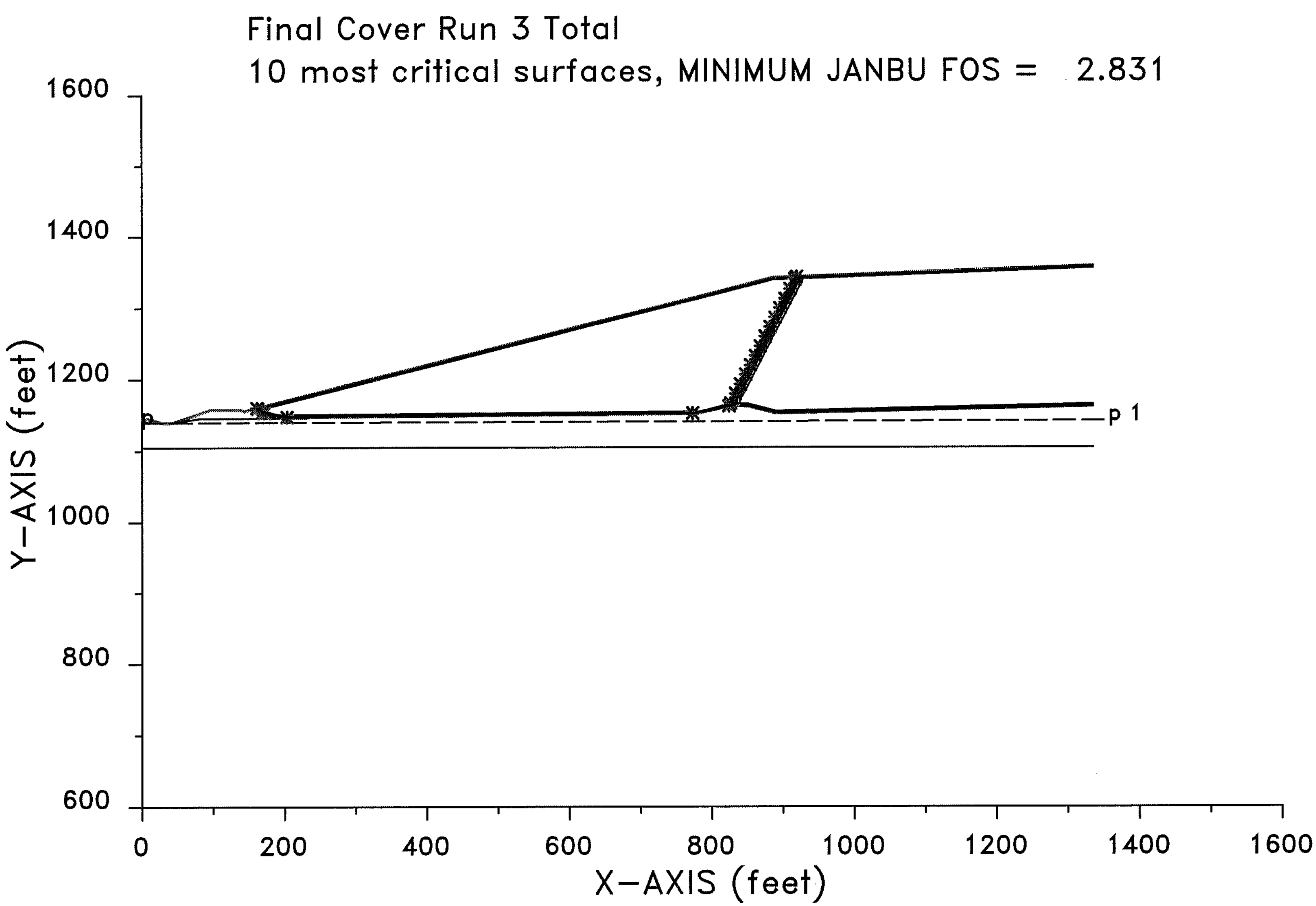

XSTABL File: EO_FC-3T 5-20-15 8:52

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****************************************
*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*              using the               *
*           Method of Slices           *
*                                      *
*       Copyright (C) 1992 - 2013      *
*   Interactive Software Designs, Inc. *
*       Moscow, ID 83843, U.S.A.       *
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Problem Description : Final Cover Run 3 Total

SEGMENT BOUNDARY COORDINATES

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	8
2	9.0	1146.0	27.1	1140.0	8
3	27.1	1140.0	42.1	1140.0	8
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	7
14	188.9	1148.8	778.5	1153.6	7
15	778.5	1153.6	829.0	1163.1	7
16	829.0	1163.1	850.8	1164.0	6

17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	8
23	82.3	1146.4	230.7	1146.4	8
24	230.7	1146.4	236.8	1147.2	8
25	236.8	1147.2	778.0	1151.4	8
26	778.0	1151.4	829.0	1163.1	8
27	829.0	1163.1	850.5	1162.0	8
28	850.5	1162.0	890.0	1152.0	8
29	890.0	1152.0	1335.4	1161.9	8
30	.0	1105.0	1335.4	1105.0	9

ISOTROPIC Soil Parameters
----

9 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	170.0	16.00	.000	.0	0
2	116.0	118.0	120.0	16.00	.000	.0	0
3	116.0	118.0	1000.0	.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	120.0	125.0	100.0	22.00	.000	.0	0
8	119.2	119.2	.0	25.00	.000	.0	1
9	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	1358.00	1142.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

4 boxes specified for generation of central block base

Length of line segments for active and passive portions of sliding block is 15.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	168.2	1155.7	174.4	1153.6	2.1
2	202.6	1148.9	212.6	1149.0	2.0
3	746.0	1153.4	776.1	1153.6	2.0
4	821.9	1163.2	838.1	1164.6	1.9

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 24 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	161.30	1160.77
2	162.32	1160.00
3	170.11	1155.04
4	171.68	1153.98
5	203.82	1148.11
6	773.44	1152.84
7	824.36	1162.88
8	826.81	1166.71
9	833.73	1180.02
10	840.66	1193.33
11	847.58	1206.63
12	854.51	1219.94
13	861.44	1233.24
14	868.36	1246.55
15	875.29	1259.85
16	882.21	1273.16
17	889.14	1286.46
18	896.07	1299.77
19	902.99	1313.07
20	909.92	1326.38
21	916.85	1339.68
22	917.07	1340.11
23	918.62	1342.17
24	919.40	1343.20

** Corrected JANBU FOS = 2.831 ** (Fo factor = 1.071)

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 3 Total

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.831	1.071	161.30	919.40	2.183E+06
2.	2.832	1.071	161.53	924.78	2.215E+06
3.	2.834	1.071	160.21	922.19	2.199E+06
4.	2.843	1.070	162.76	931.01	2.246E+06
5.	2.845	1.071	163.48	918.19	2.184E+06
6.	2.846	1.071	160.13	927.04	2.223E+06
7.	2.849	1.071	163.22	921.19	2.196E+06
8.	2.850	1.071	160.90	924.95	2.228E+06
9.	2.852	1.071	162.76	919.06	2.195E+06
10.	2.856	1.071	162.95	925.02	2.220E+06

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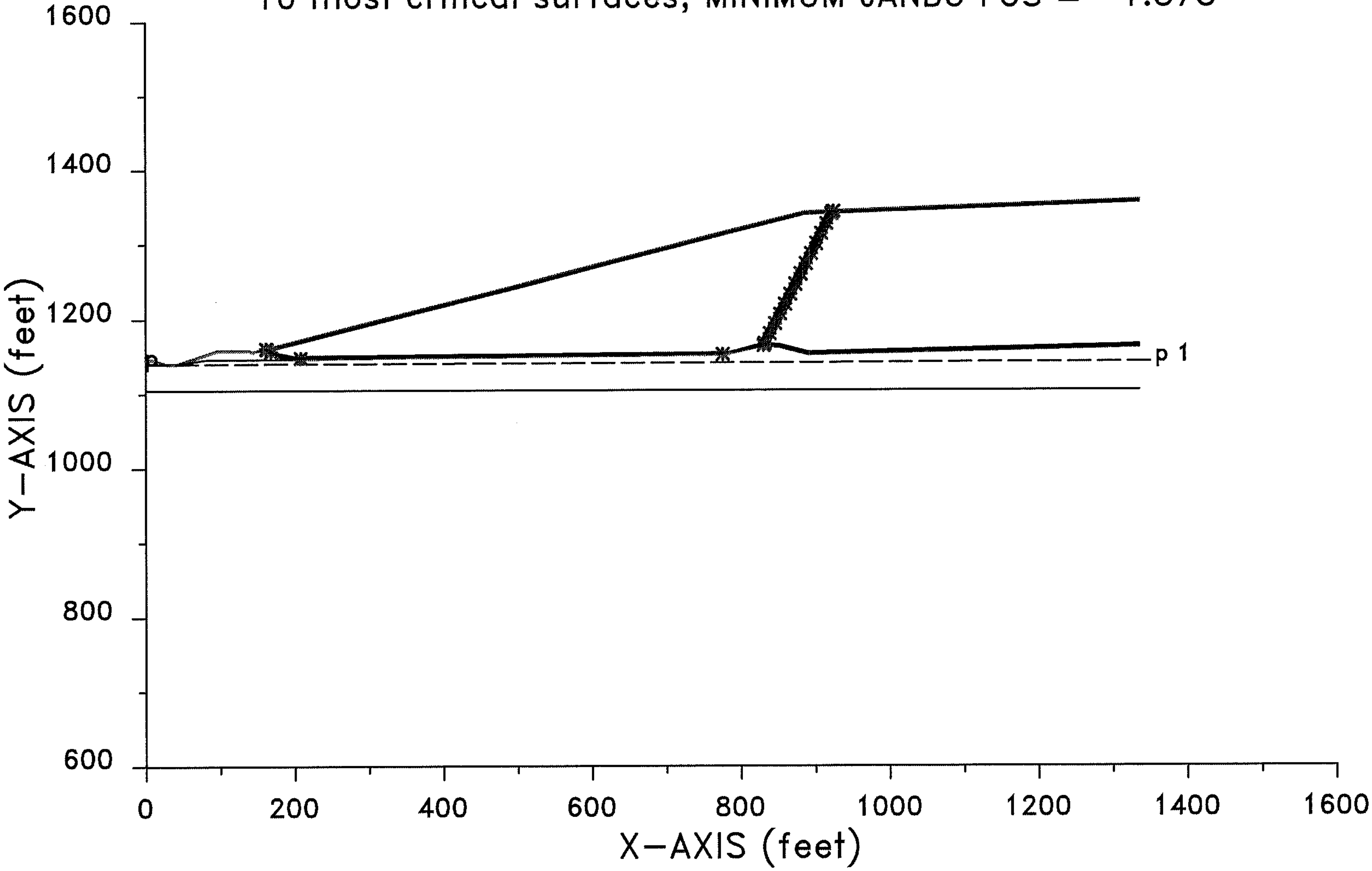
Final Cover Run 3 Total Seismic
10 most critical surfaces, MINIMUM JANBU FOS = 1.573



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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*              using the                *
*           Method of Slices            *
*                                       *
*        Copyright (C) 1992 - 2013      *
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*                                       *
*  Ver. 5.209                96 - 2083  *
*****************************************
```

Problem Description : Final Cover Run 3 Total Seismic

SEGMENT BOUNDARY COORDINATES

----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	1146.0	9.0	1146.0	8
2	9.0	1146.0	27.1	1140.0	8
3	27.1	1140.0	42.1	1140.0	8
4	42.1	1140.0	96.2	1158.0	3
5	96.2	1158.0	138.2	1158.0	3
6	138.2	1158.0	144.2	1156.0	3
7	144.2	1156.0	150.2	1158.0	3
8	150.2	1158.0	886.2	1342.0	1
9	886.2	1342.0	1335.4	1358.3	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	154.3	1158.0	886.3	1341.0	2
2	886.3	1341.0	1335.4	1357.3	2
3	166.7	1158.0	168.3	1159.4	4
4	168.3	1159.4	886.6	1339.0	4
5	886.6	1339.0	1335.4	1355.3	4
6	166.7	1158.0	168.0	1158.0	5
7	168.0	1158.0	187.9	1150.8	5
8	187.9	1150.8	785.1	1155.2	5
9	785.1	1155.2	828.2	1167.1	5
10	828.2	1167.1	851.1	1166.0	5
11	851.1	1166.0	890.4	1156.0	5
12	890.4	1156.0	1335.4	1165.9	5
13	161.2	1158.0	188.9	1148.8	7
14	188.9	1148.8	778.5	1153.6	7
15	778.5	1153.6	829.0	1163.1	7

16	829.0	1163.1	850.8	1164.0	6
17	850.8	1164.0	890.2	1154.0	6
18	890.2	1154.0	1335.4	1163.9	6
19	150.2	1158.0	155.2	1158.0	3
20	155.2	1158.0	188.9	1146.8	3
21	188.9	1146.8	236.8	1147.2	3
22	43.5	1140.5	82.3	1146.4	8
23	82.3	1146.4	230.7	1146.4	8
24	230.7	1146.4	236.8	1147.2	8
25	236.8	1147.2	778.0	1151.4	8
26	778.0	1151.4	829.0	1163.1	8
27	829.0	1163.1	850.5	1162.0	8
28	850.5	1162.0	890.0	1152.0	8
29	890.0	1152.0	1335.4	1161.9	8
30	.0	1105.0	1335.4	1105.0	9

ISOTROPIC Soil Parameters
----

9 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	112.0	114.0	170.0	16.00	.000	.0	0
2	116.0	118.0	120.0	16.00	.000	.0	0
3	116.0	118.0	1000.0	.00	.000	.0	0
4	60.0	60.0	288.0	35.00	.000	.0	0
5	116.0	118.0	.0	25.00	.000	.0	0
6	120.0	125.0	10.0	10.00	.000	.0	0
7	120.0	125.0	100.0	22.00	.000	.0	0
8	119.2	119.2	.0	25.00	.000	.0	1
9	137.8	139.8	2000.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PIEZOMETRIC SURFACE
****

Point No.	x-water (ft)	y-water (ft)
1	.00	1140.00
2	1358.00	1142.60

A horizontal earthquake loading coefficient
of .155 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

4 boxes specified for generation of central block base

Length of line segments for active and passive portions of sliding block is 15.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	168.2	1155.7	174.4	1153.6	2.1
2	202.6	1148.9	212.6	1149.0	2.0
3	746.0	1153.4	776.1	1153.6	2.0
4	821.9	1163.2	838.1	1164.6	1.9

****

-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)

****

Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.

****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 23 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	161.53	1160.83
2	162.55	1160.06
3	168.29	1156.41
4	208.13	1147.99

5	775.70	1152.65
6	830.62	1164.45
7	832.19	1166.91
8	839.11	1180.21
9	846.04	1193.52
10	852.96	1206.82
11	859.89	1220.13
12	866.82	1233.43
13	873.74	1246.74
14	880.67	1260.04
15	887.60	1273.35
16	894.52	1286.66
17	901.45	1299.96
18	908.37	1313.27
19	915.30	1326.57
20	922.23	1339.88
21	922.45	1340.30
22	924.01	1342.37
23	924.78	1343.40

** Corrected JANBU FOS = 1.573 ** (Fo factor = 1.071)

The following is a summary of the TEN most critical surfaces

Problem Description : Final Cover Run 3 Total Seismic

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	1.573	1.071	161.53	924.78	2.097E+06
2.	1.574	1.071	161.30	919.40	2.066E+06
3.	1.576	1.070	162.76	931.01	2.127E+06
4.	1.576	1.071	160.21	922.19	2.081E+06
5.	1.581	1.071	160.13	927.04	2.104E+06
6.	1.583	1.071	160.90	924.95	2.109E+06
7.	1.584	1.071	163.48	918.19	2.068E+06
8.	1.588	1.071	163.22	921.19	2.080E+06
9.	1.589	1.071	162.76	919.06	2.078E+06
10.	1.589	1.071	162.95	925.02	2.102E+06

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APPENDIX N-2B

INFINITE SLOPE STABILITY ANALYSIS

LICENSED PROFESSIONAL ENGINEER
SALMAN A.
BAIG
27485
OKLAHOMA

06-05-15

Includes pages N-2B-1 through N-2B-14

INFINITE SLOPE STABILITY ANALYSIS FOR LINER AND FINAL COVER SYSTEMS

Infinite slope stability analysis has been developed for the interfaces of the liner and final cover system components. The facility will have an alternate liner and an evapotranspiration monolithic soil only final cover. The liner and final cover system will be stable as designed considering that the lowest factor of safety has been calculated as 1.8 for the geotextile/geomembrane interface of the liner system and 2.1 for the vegetation support layer/waste interface of the final cover system.

Required:

A. Infinite slope stability of the composite liner system.

1. Verify that tensile stress in composite liner system is less than yield stress for the composite liner system.
2. Verify anchor trench design is adequate for pullout of geosynthetics.
3. Use infinite slope stability analysis to verify stability for the composite liner system.

Note:

1. As shown on page N-2B-3, the composite liner system consists of a 2-foot-thick compacted clay liner with a maximum permeability of $1x10^{-7}$ cm/s, a geosynthetic clay liner (GCL), and a 60-mil-thick HDPE Flexible Membrane Liner (FML) overlain by a geotextile separation layer, a 1-foot-thick leachate collection layer, and a 1-foot-thick protective cover layer.

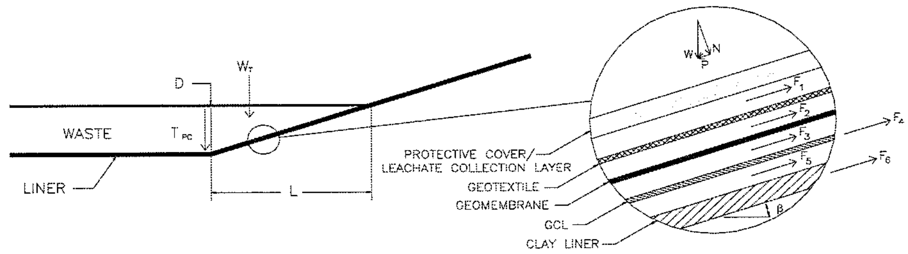
2. The leachate collection layer and protective cover layer will be analyzed as one 2-foot-thick soil layer.

Method:

1. Use Koerner's method for determination of shear stress in a composite liner system with the addition of cohesion/adhesion forces.
2. Use Koerner's method for anchor trench design.
3. Use Duncan and Buchignani's method for infinite stability analysis.

References:

1. Koerner, Robert M., *Designing with Geosynthetics*, 3rd Edition, Prentice-Hall Inc., 1994.
2. Duncan, J.M. and Buchignani, A. L., *An Engineering Manual for Slope Stability Studies*, Department of Civil Engineering - University of California-Berkeley, 1975.
3. TRI, Interface Friction/Direct Shear Testing & Slope Stability Issues Short Course, November 12-13, 1998, Austin, Texas.
4. US Army Corps of Engineers, *Slope Stability*, Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.
5. Koerner, Robert M., *Analysis and Design of Veneer Cover Soils*, 1998 Sixth International Conference of Geosynthetics.
6. Cetco Lining Technologies, Laboratory Data Reports, Bentomat Direct Shear Testing Summary, Summary of Bentomat Direct Shear Test Data Internal, Revised 08/02



Definition of terms/variables:

W_E = Weight of equipment, lb (used per foot of slope width)

Assume a Caterpillar D8T WH Track-Type Tractor

Operation Weight =	85,150	lb
Number of Tracks =	2	
Track Width =	1.84	ft

W_W = Weight of solid waste, lb (used per foot of slope width)

W_{LC} = Weight of leachate collection layer, lb (used per foot of slope width)

W_T = Combined weight of equipment, solid waste, and leachate collection layer, lb (per foot of slope width)

T_{LC}= Friction force on edge of leachate collection layer, lb/ft

W = Net force of equipment, waste, and leachate collection layer on the composite liner system, lb/ft

N = W cos(β) - normal force on the composite liner system, lb/ft

P = W sin(β) - shearing force on the composite liner system, lb/ft

β = slope angle, deg

F_1 = Resistance of Protective Cover/Leachate Collection Layer-Geotextile Interface

F_2 = Resistance of Geotextile-Geomembrane Interface

F_3 = Resistance of Geomembrane-GCL Interface

F_4 = Resistance of GCL Internal Interface

F_5 = Resistance of GCL-Clay Liner Interface

F_6 = Resistance of Clay Liner Internal Interface

$F_1 = (N * TAN(\Delta'_1)) + (a'_1 * L / COS (\beta))$

$F_2 = (N * TAN(\Delta'_2)) + (a'_2 * L / COS (\beta))$

$F_3 = (N * TAN(\Delta'_3)) +(a'_3 * L / COS (\beta))$

$F_4 = (N * TAN(\phi'_4))+(c'_4 * L / COS (\beta))$

$F_5 = (N * TAN(\Delta'_5)) +(a'_5 * L / COS (\beta))$

$F_6 = (N * TAN(\phi'_6))+(c'_6 * L / COS (\beta))$

Δ'_1 = Interface Friction Angle between Protective Cover/Leachate Collection Layer-Geotextile

a'_1 = Adhesion between Protective Cover/Leachate Collection Layer-Geotextile

Δ'_2 = Interface Friction Angle between Geotextile-Geomembrane

a'_2 = Adhesion between Geotextile-Geomembrane

Δ'_3 = Interface Friction Angle between Geomembrane-GCL

a'_3 = Adhesion between Geomembrane-GCL

ϕ'_4 = Internal Friction Angle of GCL

c'_4 = Cohesion of GCL

Δ'_5 = Interface Friction Angle between GCL-Clay Liner

a'_5 = Adhesion between GCL-Clay Liner

ϕ'_6 = Internal Friction Angle of Clay Liner

c'_6 = Cohesion of Clay Liner

γ_{was} = Unit weight of solid waste (including daily cover), pcf
D_{was} = Individual lift height, ft
ϕ_{was} = Internal friction angle of waste, deg
γ_{lc} = Unit weight of leachate collection layer, pcf
D_{lc} = Leachate collection layer height, ft
ϕ_{lc} = Internal friction angle of leachate collection layer, deg
L = Horizontal length of lift, ft

Parameters:

β =	18.43	deg
Δ'_1 =	31	deg
a'_1 =	61	lb/sf
Δ'_2 =	26	deg
a'_2 =	26	lb/sf
Δ'_3 =	22	deg
a'_3 =	100	lb/sf
ϕ'_4 =	45	deg
c'_4 =	100	lb/sf

Δ'_5 =	22	deg
a'_5 =	100	lb/sf
ϕ'_6 =	25	deg
c'_6 =	0	lb/sf
γ_{was} =	60	pcf
D_{was} =	10	ft
ϕ_{was} =	35	deg
L =	30	ft

Note: Interface friction angles are selected conservatively from laboratory testing of similar material/interfaces and from engineering judgment and knowledge of materials.

Calculations:

Weight of Equipment

$$W_E = \frac{\frac{\text{Operational Weight}}{\text{Number of tracks}}}{\text{Width of Track}} \qquad W_E = 23{,}139 \text{ lb / ft}$$

Weight of Solid Waste

$$W_W = \frac{D_{was} \times L \times \gamma_{was}}{2} \qquad W_W = 9{,}000 \text{ lb / ft}$$

Combined Weight of Equipment, Solid Waste, and Leachate Collection Layer, lb

$$W_T = W_E + W_W \qquad W_T = 32{,}139 \text{ lb / ft}$$

Friction Force on Edge of Waste

$$T_W = k_o \times \sigma_v \times \tan \phi'_{was} \times D$$

where: $k_o = 1 - \sin \phi'_{was}$

$$\sigma_v = \frac{D \times \gamma_{was}}{2}$$

$T_W =$ 896 lb / ft

Net Force of Leachate Collection Layer on the Composite Liner System

$W = W_T - T_W$

$W =$ 31,243 lb / ft

$N =$ 29,640 lb / ft

$P_{sideslope} =$ 9,880 lb / ft

Resistance of Protective Cover/Leachate Collection Layer-Geotextile Interface = F_1 = 19,738 lb / ft

$P_{sideslope} < F_1$ Therefore, the protective cover/leachate collection layer is table and a driving force equal to P is transferred to the next interface.

Resistance of Geotextile-Geomembrane Interface = F_2 = 15,278 lb / ft

$P_{sideslope} < F_2$ Therefore, the geotextile layer is stable and a driving force equal to P is transferred to the next interface.

Resistance of Geomembrane-GCL Interface = F_3 = 15,137 lb / ft

$P_{sideslope} < F_3$ Therefore, the geomembrane is stable and a driving force equal to P is transferred to the next interface.

Resistance of GCL Internal Interface = F_4 = 32,802 lb / ft

$P_{sideslope} < F_4$ Therefore, the GCL is internally stable and a driving force equal to P is transferred to the next interface.

Resistance of GCL-Clay Liner Interface = F_5 = 22,516 lb / ft

$P_{sideslope} < F_5$ Therefore, the GCL is stable and a driving force equal to P is transferred to the next interface.

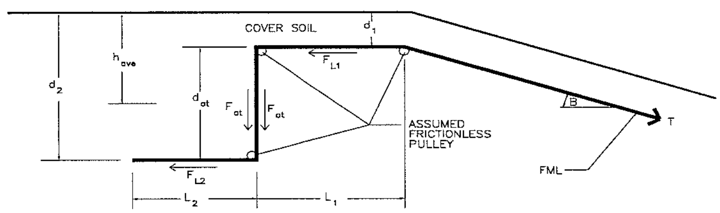
Resistance of Clay Liner Internal Interface = F_6 = 13,821 lb / ft

$P_{sideslope} < F_6$ Therefore, the clay liner internally is stable and a driving force equal to P is transferred to the next interface.

The Actual Tensile Force on the Composite Liner System (T_{act}) = 0 lb / ft

2. Anchor Trench Design

Force Diagram for Composite Liner System



$T =$ $F_{L1} + F_{L2} + F_{at}$

Where T is the tensile force necessary for pullout

$F_{L1} = (q_1 \tan\phi')(L_1)$

$q_1 =$ Surcharge pressure $= d_1 \times \gamma_{soil}$
$d_1 =$ Depth of soil, ft
$\gamma_{soil} =$ Unit weight of soil, pcf
$\phi' =$ Interface friction angle, degrees
$L_1 =$ Length of runout, ft

$F_{L2} = (q_2 \tan\phi')(L_2)$

$q_2 =$ Surcharge pressure $= d_2 \times \gamma_{soil}$
$d_2 =$ Depth of soil, ft
$\gamma_{soil} =$ Unit weight of soil, pcf
$\phi' =$ Interface friction angle, degrees
$L_2 =$ Length of runout, ft

$F_{at} = (V \tan\phi')(d_{at})$

$V =$ Average horizontal stress $= K_o \times y$
$K_o = 1 - \sin(r)$
$r =$ Internal friction angle of soil, degrees
$y = \gamma_{soil} \times h_{ave}$
$\gamma_{soil} =$ Unit weight of soil, pcf
$\phi' =$ Interface friction angle, degrees
$h_{ave} =$ Average depth of trench, ft
$d_{at} =$ Depth of trench, ft

Parameters:

$\gamma_{soil} =$	120	pcf
$\phi' =$	22	deg
$r =$	16	deg

$d_1 =$	2.0	ft
$L_1 =$	6.0	ft
$d_2 =$	4.0	ft
$L_2 =$	2.0	ft
$d_{at} =$	2.0	ft
$h_{ave} =$	3.0	ft

Calculations:

F_{L1} =	581.8	lb / ft
F_{L2} =	387.9	lb / ft
F_{at} =	210.7	lb / ft
T =	1,180.4	lb / ft

Compare force required for pullout (T) with the actual tensile force in the geosynthetics from Part 1:

T =	1,180	lb / ft
T_{act} =	0	lb / ft

$T > T_{act}$

Therefore, the runout lengths are sufficient to prevent pullout.

3. Infinite Slope Analysis of Composite Liner System

Calculate factor of safety:

$$F.S. = A\frac{tan\,\phi'}{tan\,\beta} + B\frac{c'}{\gamma H}$$

See Stability Charts for Infinite Slopes on page N-2B-14 for procedure.

Note: Interface friction angles are selected conservatively from laboratory testing of similar material/interfaces and from engineering judgment and knowledge of materials.

Protective Cover/Leachate Collection Layer-Geotextile Interface:

Δ' =	31	deg
β =	18.43	deg
A =	1	
a' =	61	psf
B =	3.3	
γ =	120	pcf
H =	2	ft

Assuming a saturated leachate collection layer, then maximum head on composite liner system is equal to H. Therefore r_u and parameter A are as calculated below.

$$r_u = (H \times \gamma_w \times \cos^2\beta) / (T \times \gamma)$$

where T is the maximum head on the composite liner system and γ_w is 62.4 pcf.

r_u = 0.47

slope ratio, b= 3.00 Therefore parameter A is equal to 0.45 and parameter B is equal to 3.3 according to the charts on page N-2B-14.

F.S. =	2.6

Geotextile-Geomembrane Interface:

Δ' =	26	deg
β =	18.43	deg
A =	1	
a' =	26	psf
B =	3.3	
γ =	120	pcf
H =	2	ft

The seepage will be entirely contained within the leachate collection layer. Therefore pore pressure and r_u are equal to zero and parameter A is equal to 1.

slope ratio, b= 3.00 Therefore parameter A is equal to 0.45 and parameter B is equal to 3.3 according to the charts on page N-2B-14.

F.S. = 1.8

Geomembrane-GCL Interface:

Δ' =	22	deg
β =	18.43	deg
A =	1	
a' =	100	psf
B =	3.3	
γ =	120	pcf
H =	2	ft

No seepage will occur between this interface. Therefore pore pressure and ru are equal to zero and parameter A is equal to 1.

slope ratio, b= 3.00 Therefore parameter B is equal to 3.3 according to the charts on page N-2B-14.

F.S. = 2.6

GCL (Internal):

ϕ' =	45	deg
β =	18.43	deg
A =	1	
c' =	100	psf
B =	3.3	
γ =	120	pcf
H =	2	ft

No seepage will occur between this interface. Therefore pore pressure and ru are equal to zero and parameter A is equal to 1.

slope ratio, b= 3.00 Therefore parameter B is equal to 3.3 according to the charts on page N-2B-14.

F.S. =	4.4

GCL-Clay Liner Interface:

Δ' =	22	deg
β =	18.43	deg
A =	1	
a' =	100	psf
B =	3.3	
γ =	120	pcf
H =	2	ft

No seepage will occur between this interface. Therefore pore pressure and ru are equal to zero and parameter A is equal to 1.

slope ratio, b= 3.00 Therefore parameter B is equal to 3.3 according to the charts on page N-2B-14.

F.S. =	2.6

Clay Liner (Internal):

ϕ' =	25	deg
β =	18.43	deg
A =	1	
c' =	0	psf
B =	3.3	
γ =	120	pcf
H =	2	ft

No seepage will occur between this interface. Therefore pore pressure and ru are equal to zero and parameter A is equal to 1.

slope ratio, b= 3.00 Therefore parameter B is equal to 3.3 according to the charts on page N-2B-14.

F.S. =	1.4

A factor of safety of 1.3 is acceptable for short-term stability (Reference 4, page 3-2). Therefore, the liner system is stable as designed. All the assumptions and values in the above demonstrations must be verified prior to construction.

Required:

B. Use infinite slope stability analysis to verify the stability of the evapotranspiration (ET) monolithic alternative final cover system.

Note:

The ET monolithic alternative final cover system consists of a 1-foot-thick vegetation layer, a 2-foot-thick vegetation support layer, and an additional 1-foot-thick vegetative support (intermediate cover) layer. It is assumed that the top 3-feet of the alternative final cover will be one layer since roots penetrate this thickness and the lower 1-foot of the alternative final cover will be a separate layer that lies on top of the waste.

Method:

Use Duncan and Buchianani's method for infinite stability analysis.

References:

1. US Army Corps of Engineers, *Slope Stability*, Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.
2. Day, Robert W., *Geotechnical Engineer's Portable Handbook*, McGraw Hill, New York, 2000.

Infinite Slope Stability Analysis of ET Monolithic Alternative Final Cover System (Top Layer of Final Cover Saturated)

Calculate factor of safety:

$$F.S. = A\frac{\tan\phi'}{\tan\beta} + B\frac{c'}{\gamma H}$$

See Stability Charts for Infinite Slopes on page N-2B-14 for procedure.

where: H = thickness of material above interface (ft)

Note: The ET covers strength parameters are selected to represent the soil covers strength if it is placed at 75 percent of the materials maximum dry density. Interface friction angles are selected conservatively from Figure 7.10, Reference 2 (see page N-2B-15). Cohesion is selected conservatively from Figure 7.8, Reference 2 (see page N-2B-16).

Input Parameters:

Vegetation Layer/Vegetation Support Layer (Intermediate Cover) Interface:

Δ' =	16	deg	(see page N-2B-15)
β =	14.04	deg	
A =	0.45		
a' =	172.8	psf	(see page N-2B-16)
B =	4.3		
γ =	112	pcf	
H =	3	ft	

Calculate pore pressure ratio for saturated soil:

$$r_u = \frac{X}{T} \times \frac{\gamma_w}{\gamma} Cos^2\beta$$

See Stability Charts for Infinite Slopes on page N-2B-14.

To be conservative the soil above the interface evaluated is assumed to be saturated (X=T). This assumption provides maximum pore pressure ratio (r_u) as shown on page N-2B-14. Therefore, the analysis is conservative.

r_u= 0.52
slope ratio, b= 4.00

Use r_u and slope ratio, b, to determine parameters A and B on page N-2B-14.

F.S. =	2.7

Vegetation Support Layer (Intermediate Cover)/Waste Interface:

Δ' =	16	deg	(see page N-2B-15)
β =	14.04	deg	
A =	0.45		
a' =	172.8	psf	(see page N-2B-16)
B =	4.3		
γ =	116	pcf	
H =	4	ft	

Calculate pore pressure ratio for saturated soil:

$$r_u = \frac{X}{T} \times \frac{\gamma_w}{\gamma} Cos^2\beta$$

See Stability Charts for Infinite Slopes on page N-2B-14.

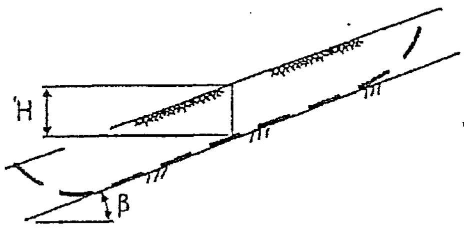
To be conservative the soil above the interface evaluated is assumed to be saturated (X=T). This assumption provides maximum pore pressure ratio (r_u) as shown on page N-2B-14. Therefore, the analysis is conservative.

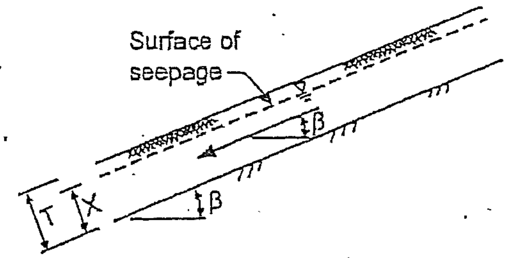
r_u= 0.51
slope ratio, b= 4.00

Use r_u and slope ratio, b, to determine parameters A and B on page N-2B-14.

F.S. =	2.1

A factor of safety of 1.5 is acceptable for long-term stability.
Therefore, the final cover system is stable as designed.





γ = total unit weight of soil

γ_w = unit weight of water

c' = cohesion intercept

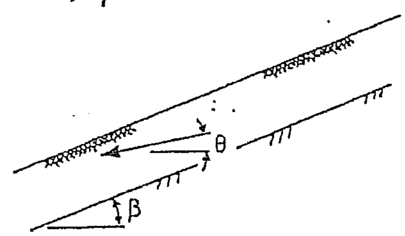
ϕ' = friction angle

r_u = pore pressure ratio = $u/\gamma H$

u = pore pressure at depth H

Seepage parallel to slope

$$r_u = \frac{X}{T}\frac{\gamma_w}{\gamma}\cos^2\beta$$

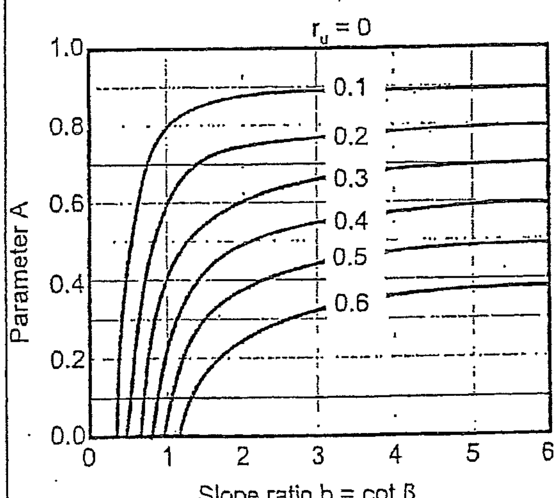


Seepage emerging from slope

$$r_u = \frac{\gamma_w}{\gamma}\frac{1}{1+\tan\beta\tan\theta}$$

Steps:

1. Determine r_u from measured pore pressure or formulas at right.
2. Determine A and B from charts below.
3. Calculate $F = A\dfrac{\tan\phi'}{\tan\beta} + B\dfrac{c'}{\gamma H}$



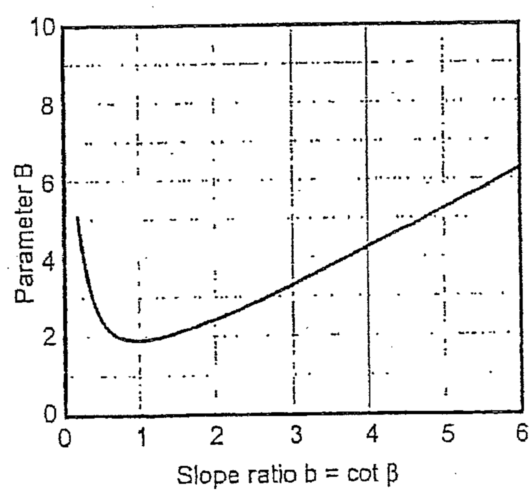


Figure E-7. Slope stability charts for infinite slopes (after Duncan, Buchianani, and DeWet 1987)

APPENDIX N-3

SETTLEMENT, STRAIN AND HEAVE ANALYSIS

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06-05-15

SETTLEMENT, STRAIN, AND HEAVE ANALYSIS

This appendix includes the settlement analysis for foundation soils and final cover system. Settlement analysis for foundation soils is included in Appendix N-3A. Liner system settlement analysis evaluation points are shown on Sheet N-3A-2. Pages N-3A-3 through N-3A-7 contain the procedure and calculations for foundation settlement analysis. Page N-3A-8 contains a summary of the liner slopes after settlement occurs. Pages N-3A-9 and N-3A-10 contain the calculations for the heave analysis. A strain analysis demonstrating that the liner and leachate collection systems will maintain their integrity and perform as designed is included on pages N-3A-11 through N-3A-12. Based on this settlement analysis, a demonstration has been provided in Appendix M to show that the LCS will continue to maintain less than 12-inches of head on the liner system after settlement.

The final cover and solid waste settlement and strain analysis have been performed to demonstrate that the final cover will maintain positive drainage and its components will be stable after settlement. This analysis is included in Appendix N-3B. The location of the evaluation points used for the final cover and solid waste settlement and strain calculations is shown on Sheet N-3B-2. The solid waste primary and secondary settlement analyses are provided on pages N-3B-3 through N-3B-6. Strain calculations are provided on page N-3B-7.

APPENDIX N-3A

FOUNDATION SETTLEMENT, HEAVE, AND LINER STRAIN ANALYSIS

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Includes pages N-3A-1 through N-3A-12

Required:

1. Estimate the settlement of the landfill subgrade due to the proposed expansion.

Notes:

1. Impact of subgrade settlement on the leachate collection system is analyzed in Appendix L. It is demonstrated in Appendix L that the leachate collection system will function as designed after subgrade soils consolidate.

Method:

1. Waste filling and final cover installation will result in loading of the foundation soils, causing consolidation. The magnitude of consolidation will be a function of the net stress increase and properties of the foundation soils (i.e. previous consolidation pressure, void ratio (density), and compression).

A. Select locations to represent floor grades and pipe slopes:

Assume the following:

1) Consolidation will be minimum at the location of the minimum fill height.

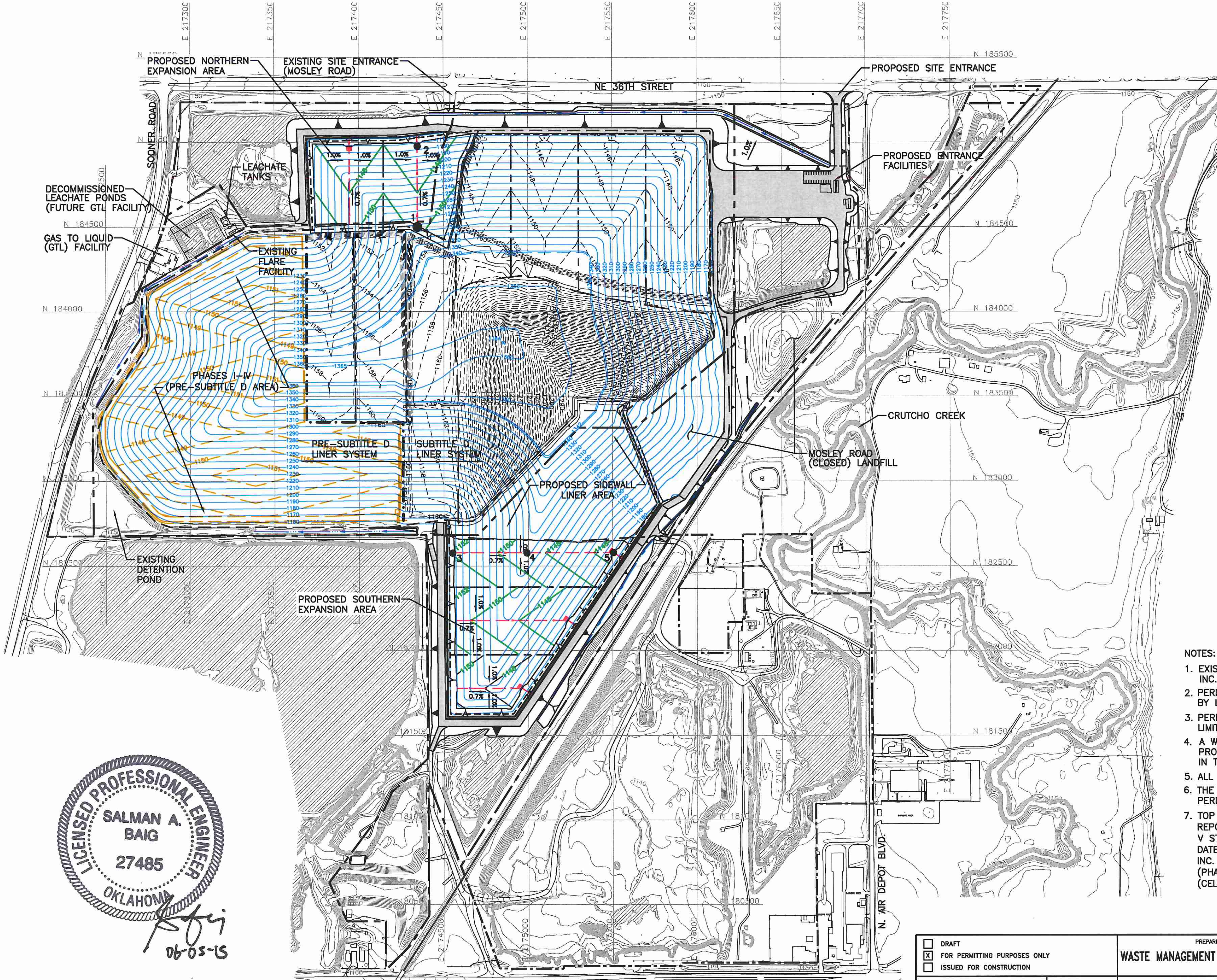
2) Consolidation will be maximum at the location of the maximum fill height.

Evaluation points were selected where critical slopes of leachate collection system are expected for evaluating the impact of settlement on the performances of the leachate collection layer and leachate collection pipes.

B. Review geotechnical information and develop a generalized soil profile typical for the areas of maximum fill and maximum excavation. Use representative soil moisture and unit weight values from the laboratory testing results. Consolidation parameters (e.g., compressibility) were taken from laboratory consolidation test results and selected literature values for similar materials.

References:

1. Day, Robert W., Geotechnical Engineer's Portable Handbook, 2000.
2. Das, Braja M., Principles of Geotechnical Engineering, 5th edition, 2002.
3. Acar, Yalcin B.& Daniel, David E., *Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics,* Volume 2, American Society of Civil Engineers, 1995.
4. Holtz, Robert D., Kovacs, William D., and Sheahan, Thomas C., An Introduction to Geotechnical Engineering, 2nd edition, 2011.



0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- PHASE BOUNDARY
- N 183000 STATE PLANE GRID COORDINATE
- 1180 EXISTING CONTOUR
- 1150 PROPOSED FINAL COVER CONTOUR
- 1150 PROPOSED EXCAVATION CONTOUR
- 1150 APPROXIMATE PRE–SUBTITLE D CONTOUR (SEE NOTE 6)
- 1240 TOP OF CLAY AS–BUILT CONTOUR (SEE NOTE 7)
- LEACHATE COLLECTION PIPE
- LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- PROPOSED DRAINAGE CHANNEL
- APPROXIMATE PRE–SUBTITLE D/ SUBTITLE D LINER LOCATION
- 1 EVALUATION POINT

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. A WASTE–FREE BUFFER ZONE OF AT LEAST 100–FEET OFFSET FROM THE PROPOSED PERMIT BOUNDARY FOR THE LANDFILL EXPANSION AREA INCLUDED IN THIS MODIFICATION WILL BE MAINTAINED.
5. ALL PROPOSED EXCAVATION SIDESLOPES ARE 3(HORIZONTAL):1(VERTICAL).
6. THE PRE–SUBTITLE D GRADES WERE REPRODUCED FROM THE LATERAL EXPANSION PERMIT APPLICATION REVISED FEBRUARY 2002 BY CARDINAL ENGINEERING INC.
7. TOP OF CLAY AS–BUILT CONTOURS WERE REPRODUCED FROM THE VERIFICATION REPORTS PREPARED BY: GERALD L. McGARVIN, L.S. DATED JUNE 1994 (PHASE V STAGE I), OCTOBER 1995 (PHASE V STAGE I), RONALD A. LAVARNWAY RPLS DATED SEPTEMBER 1998 (PHASE V, STAGE II), AND LEMKE LAND SURVEYING, INC. DATED DECEMBER 2001 (PHASE IV STAGES II AND III), JANUARY 2004 (PHASE VIII), SEPTEMBER 2004 (PHASE VII), MAY 2009 (PHASE X), JULY 2011 (CELLS 11B AND 12B), NOVEMBER 2012 (CELLS 9B AND 10B).

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O:\0086\356\EXPANSION 2013\APPENDIX N\N-3A-2-EVALUATION POINT LOCS.dwg, uacholonu, 1:2

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 06/2015	DRAWN BY: SRF
FILE: 0086-356-11	DESIGN BY: SS
CAD: N-3A-2-EVAL PTS.DWG	REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
CA 3804 PE–06/30/2015

TIER III PERMIT MODIFICATION
FOUNDATION SETTLEMENT
EVALUATION POINT LOCATIONS
EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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SHEET N–3A–2

Solution: The following equations were used to calculate various soil properties for the settlement analysis:

$$\gamma_m = \gamma_{dry}\left(1 + \frac{w}{100}\right) \qquad \gamma_{sat} = \gamma_{dry} + \frac{(e_o \gamma_w)}{(1 + e_o)}$$

$$e_o = \frac{(1 - V_s)}{V_s} \qquad V_s = \frac{\gamma_{dry}}{G_s \gamma_w}$$

The following equations were used to calculate loading for the settlement analysis:

$$p_{o(liner)} = 0.5(H_{o(liner)}\gamma_{m(liner)}) + (H_{o(dl)}\gamma_{m(dl)})$$

$$p_o = 0.5 * H_o * (\gamma_{sat} - \gamma_w) + (H_{o(liner)} * \gamma_{m(liner)}) + (H_{o(dl)}\gamma_{m(dl)})$$

$$\Delta p = (H_{waste}\gamma_{waste}) + (H_{fc}\gamma_{fc})$$

The following equation was used to calculate the settlement of the subsurface material.

$$S = \frac{C_c H_o}{1 + e_o} \text{Log}\left(\frac{p_o + \Delta p}{p_o}\right)$$

The following equation was used to calculate the thickness of each layer after settlement.

$$H_f = H_o - S$$

Description of Variables:

τ_f = undrained shear strength (psf)
q_u = unconfined compressive strength (psf)
H_o = Initial Thickness of Sublayer (ft)
γ_{dry} = Dry Unit Weight (pcf)
γ_m = Moist Unit Weight (pcf)
γ_{sat} = Saturated Unit Weight (pcf)
γ_w = Unit Weight of Water (pcf)
G_s = Specific Gravity
e_o = Initial Void Ratio
p_o = Initial Average Effective Overburden Pressure (psf)
Δp = Increase of Vertical Pressure (psf)
p_c = Preconsolidation Pressure (psf)
S = Settlement (ft)
C_c = Compression Index
C_r = Recompression Index
H_f = Final Thickness of Sublayer (ft)

Symbols for Indices:

$_{fc}$ = Final Cover
$_{dl}$ = Drainage Layer

LOAD DATA FOR LAYERS ABOVE THE EVALUATED STRATA:

Note: Weight of materials above the evaluated strata (e.g., drainage layer, compacted clay liner, and surface sand) are assumed to have moist units weights for the purpose of calculating the overburden pressure generated by these layers to estimate P_o and ΔP. The location of the evaluation points are shown on Sheet N-3A-2.

Evaluation Point 1

Final Cover Elevation (ft-msl)=	1293.2	Top of Waste Elevation (ft-msl)=	1289.17
Top of Drainage Layer Elevation (ft-msl)=	1153.6	Top of Liner Elevation (ft-msl)=	1151.6

Waste Thickness (ft)=	135.6	γ_{waste}(pcf)=	60	p_{waste} (psf)=	8,134
Drainage Layer Thickness (ft)=	2	γ_{dl} (pcf)=	116	p_{dl} (psf)=	232
Final Cover Thickness (ft)=	4	γ_{fc} (pcf)=	116	p_{fc} (psf)=	464

Evaluation Point 2

FC Elev. (ft-msl)=	1175.1	Top of Waste Elevation (ft-msl)=	1171.1
Top of Drainage Layer Elevation (ft-msl)=	1150.1	Top of Liner Elevation (ft-msl)=	1148.1

Waste Thickness (ft)=	21.0	γ_{waste}(pcf)=	60	p_{waste} (psf)=	1,259
Drainage Layer Thickness (ft)=	2	γ_{dl} (pcf)=	116	p_{dl} (psf)=	232
Final Cover Thickness (ft)=	4	γ_{fc} (pcf)=	116	p_{fc} (psf)=	464

Evaluation Point 3

FC Elev. (ft-msl)=	1175.9	Top of Waste Elevation (ft-msl)=	1171.9
Top of Drainage Layer Elevation (ft-msl)=	1156.0	Top of Liner Elevation (ft-msl)=	1154.0

Waste Thickness (ft)=	15.9	γ_{waste}(pcf)=	60	p_{waste} (psf)=	953
Drainage Layer Thickness (ft)=	2	γ_{dl} (pcf)=	116	p_{dl} (psf)=	232
Final Cover Thickness (ft)=	4	γ_{fc} (pcf)=	116	p_{fc} (psf)=	464

Evaluation Point 4

FC Elev. (ft-msl)=	1280.8	Top of Waste Elevation (ft-msl)=	1276.8
Top of Drainage Layer Elevation (ft-msl)=	1153.1	Top of Liner Elevation (ft-msl)=	1151.1

Waste Thickness (ft)=	123.7	γ_{waste}(pcf)=	60	p_{waste} (psf)=	7,422
Drainage Layer Thickness (ft)=	2	γ_{dl} (pcf)=	116	p_{dl} (psf)=	232
Final Cover Thickness (ft)=	4	γ_{fc} (pcf)=	116	p_{fc} (psf)=	464

Evaluation Point 5

FC Elev. (ft-msl)=	1178.6	Top of Waste Elevation (ft-msl)=	1174.6
Top of Drainage Layer Elevation (ft-msl)=	1149.3	Top of Liner Elevation (ft-msl)=	1147.3

Waste Thickness (ft)=	25.3	γ_{waste}(pcf)=	60	p_{waste} (psf)=	1,520
Drainage Layer Thickness (ft)=	2	γ_{dl} (pcf)=	116	p_{dl} (psf)=	232
Final Cover Thickness (ft)=	4	γ_{fc} (pcf)=	116	p_{fc} (psf)=	464

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
FOUNDATION SETTLEMENT

Evaluation Point 1:

Unit	H_o (ft)	G_s	γ_{dry} (pcf)	γ_w (pcf)	γ_{moist} (pcf)	$\gamma_{saturated}$ (pcf)	Moisture Content (%)	V_s	n	e_o	C_c[1]	p_o	Δp	S[2]	H_f
Liner	2.0	2.40	96.7	62.4	118.9	118.8	23	0.646	0.354	0.549	0.096	350.9	8,598	0.175	1.825
Alluvium (1149.6 ft-msl to 1144 ft-msl)	5.6	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	748.4	8,598	0.093	5.507
Alluvium (1144 ft-msl to 1134 ft-msl)	10.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,213.5	8,598	0.137	9.863
Alluvium (1134 ft-msl to 1124 ft-msl)	10.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,586.8	8,598	0.122	9.878
Alluvium (1124 ft-msl to 1118 ft-msl)	6.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,885.5	8,598	0.067	5.933
														0.593	

[1] C_c is the slope of the e-log p plot and was determined using the equation $C_c=0.156e_o+0.0107$ for plastic materials (liner), the equation $C_c=0.3*(e_o-0.27)$ for soils with a low plasticity (Alluvium).
[2] Settlement has been estimated from top of liner grades.

Evaluation Point 2:

Unit	H (ft)	G_s	γ_{dry} (pcf)	γ_w (pcf)	γ_{moist} (pcf)	$\gamma_{saturated}$ (pcf)	Moisture Content (%)	V_s	n	e_o	C_c[1]	p_o	Δp	S[2]	H_f
Liner	2.0	2.40	96.7	62.4	118.9	118.8	23	0.646	0.354	0.549	0.096	350.9	1,723	0.096	1.904
Alluvium (1146.1 ft-msl to 1141 ft-msl)	5.1	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	723.5	1,723	0.041	5.059
Alluvium (1141 ft-msl to 1131 ft-msl)	10.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,163.8	1,723	0.059	9.941
Alluvium (1131 ft-msl to 1121 ft-msl)	10.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,537.1	1,723	0.049	9.951
Alluvium (1121 ft-msl to 1109 ft-msl)	12.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,947.8	1,723	0.050	11.950
														0.295	

[1] C_c is the slope of the e-log p plot and was determined using the equation $C_c=0.156e_o+0.0107$ for plastic materials (liner), the equation $C_c=0.3*(e_o-0.27)$ for soils with a low plasticity (Alluvium).
[2] Settlement has been estimated from top of liner grades.

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
FOUNDATION SETTLEMENT

Evaluation Point 3:

Unit	H (ft)	G_s	γ_{dry} (pcf)	γ_w (pcf)	γ_{moist} (pcf)	$\gamma_{saturated}$ (pcf)	Moisture Content (%)	V_s	n	e_o	C_c[1]	p_o	Δp	S^2	H_f
Liner	2.0	2.40	96.7	62.4	118.9	118.8	23	0.646	0.354	0.549	0.096	350.9	1,417	0.087	1.913
Alluvium (1152 ft-msl to 1145 ft-msl)	7.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	818.0	1,417	0.046	6.954
Alluvium (1145 ft-msl to 1141 ft-msl)	4.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,365.0	1,417	0.019	3.981
Alluvium (1141 ft-msl to 1131 ft-msl)	10.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,750.6	1,417	0.039	9.961
Alluvium (1131 ft-msl to 1123 ft-msl)	8.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	2,086.6	1,417	0.027	7.973
														0.218	

[1] C_c is the slope of the e-log p plot and was determined using the equation C_c=0.156e_o+0.0107 for plastic materials (liner), the equation C_c=0.3*(e_o-0.27) for soils with a low plasticity (Alluvium).
[2] Settlement has been estimated from top of liner grades.

Evaluation Point 4:

Unit	H (ft)	G_s	γ_{dry} (pcf)	γ_w (pcf)	γ_{moist} (pcf)	$\gamma_{saturated}$ (pcf)	Moisture Content (%)	V_s	n	e_o	C_c[1]	p_o	Δp	S^2	H_f
Liner	2.0	2.40	96.7	62.4	118.9	118.8	23	0.646	0.354	0.549	0.096	350.9	7,886	0.170	1.830
Alluvium (1149.1 ft-msl to 1141 ft-msl)	8.1	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	872.7	7,886	0.122	7.978
Alluvium (1141 ft-msl to 1131 ft-msl)	10.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,462.1	7,886	0.121	9.879
Alluvium (1131 ft-msl to 1123 ft-msl)	8.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,798.1	7,886	0.088	7.912
														0.502	

[1] C_c is the slope of the e-log p plot and was determined using the equation C_c=0.156e_o+0.0107 for plastic materials (liner), the equation C_c=0.3*(e_o-0.27) for soils with a low plasticity (Alluvium).
[2] Settlement has been estimated from top of liner grades.

EAST OAK RECYCLING AND DISPOSAL FACILITY
0086-356-11-40
FOUNDATION SETTLEMENT

Evaluation Point 5:

Unit	H (ft)	G_s	γ_{dry} (pcf)	γ_w (pcf)	γ_{moist} (pcf)	$\gamma_{saturated}$ (pcf)	Moisture Content (%)	V_s	n	e_o	C_c[1]	p_o	Δp	S[2]	H_f
Liner	2.0	2.40	96.7	62.4	118.9	118.8	23	0.646	0.354	0.549	0.096	350.9	1,984	0.102	1.898
Alluvium (1145.3 ft-msl to 1140 ft-msl)	5.3	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	733.4	1,984	0.045	5.255
Alluvium (1140 ft-msl to 1130 ft-msl)	10.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,183.7	1,984	0.064	9.936
Alluvium (1130 ft-msl to 1122 ft-msl)	8.0	1.80	84.0	62.4	99.5	99.7	18.4	0.748	0.252	0.337	0.020	1,519.7	1,984	0.044	7.956
														0.256	

[1] C_c is the slope of the e-log p plot and was determined using the equation $C_c=0.156e_o+0.0107$ for plastic materials (liner), the equation $C_c=0.3*(e_o-0.27)$ for soils with a low plasticity (Alluvium).

[2] Settlement has been estimated from top of liner grades.

Slope from Evaluation Point 1 to Evaluation Point 2

Prior to Settlement				Predicted Settlement		After Settlement			
Length	Elevation Point 1 (ft-msl)	Elevation Point 2 (ft-msl)	Slope (Percent)	Evaluation Point 1 (ft)	Evaluation Point 2 (ft)	Length	Elevation Point 1 (ft-msl)	Elevation Point 2 (ft-msl)	Slope (Percent)
475.8	1151.6	1148.1	**0.7**	0.59	0.30	475.8	1151.0	1147.8	**0.7**

Slope from Evaluation Point 3 to Evaluation Point 4

Prior to Settlement				Predicted Settlement		After Settlement			
Length	Elevation Point 3 (ft-msl)	Elevation Point 4 (ft-msl)	Slope (Percent)	Evaluation Point 3 (ft)	Evaluation Point 4 (ft)	Length	Elevation Point 3 (ft-msl)	Elevation Point 4 (ft-msl)	Slope (Percent)
440.7	1154.0	1151.1	**0.7**	0.22	0.50	440.7	1153.8	1150.6	**0.7**

Slope from Evaluation Point 4 to Evaluation Point 5

Prior to Settlement				Predicted Settlement		After Settlement			
Length	Elevation Point 4 (ft-msl)	Elevation Point 5 (ft-msl)	Slope (Percent)	Elevation Point 4 (ft)	Elevation Point 5 (ft)	Length	Elevation Point 4 (ft-msl)	Elevation Point 5 (ft-msl)	Slope (Percent)
513.5	1151.1	1147.3	**0.7**	0.50	0.26	513.5	1150.6	1147.0	**0.7**

Required: 1. Estimate the potential heave of the excavation bottom that may occur due to the excavation of overburden soils.

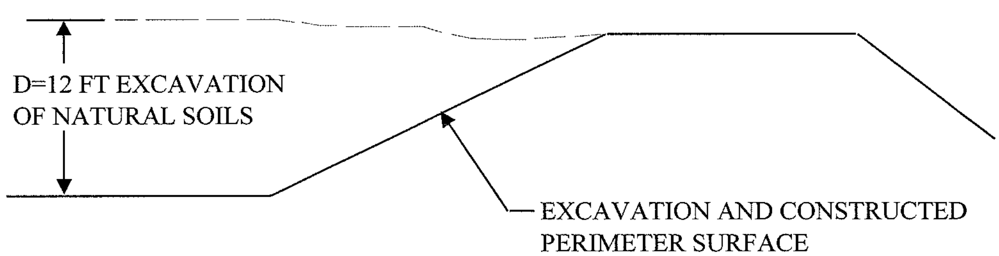
Method: Heave will be calculated using standard consolidation theory.

References:

1. Terzaghi, Karl and Peck, Ralph Soil Mechanics in Engineering Principle, 3rd Ed., 1996
2. Das, Braja M., Principles of Geotechnical Engineering, 5th Ed., 2002.
3. Day, Robert W., Geotechnical Engineer's Portable Handbook, 2000.

Solution:

Diagram for Heave Analysis:



Definition of Terms/Variables:

C_{ss} = swell index	P_o = present overburden pressure
e_o = initial void ratio	D = depth of excavation
γ = unit weight of soil (waste)	H_i = depth of soil layer

The consolidation parameters for the Alluvium stratum excavated at the site are:

Alluvium:

γ_{dry} =	84	pcf
Natural Moisture Content=	18.4	%
γ_{moist} =	99.5	pcf
e_o =	0.337	
C_c =	0.020	
C_{ss} =	0.053	
D =	12	ft

1) Estimate Potential Heave of the Excavation Bottom

The change in loading is due to the excavation of overburden soils.

The maximum depth of excavation is approximately: 12 ft
through 1 soil layers, therefore:

$\Delta P = D \times \gamma_{moist}$

$\Delta P =$ 1,193 psf

Using the standard consolidation theory:

$S = C_{ss} H_i \log((P_o - \Delta P) / P_o)$ (Reference 1)

Alluvium:

$P_o = (H_i/2) \times \gamma_{moist} + \Delta P$

$P_o =$ 1,790 psf
$S =$ -0.302 ft

Projected Heave = -0.302 ft

Strain Percentage in Liner System

References:

1. Quian, Xuede, R.M. Koerner, D. H. Gray, Geotechnical Aspects of Landfill Design and Construction, 2002.
2. Koerner, Robert M., Designing with Geosynthetics, 3rd Edition, 2005

Required:

Determine the strain percentage in the Subtitle D liner system based on the total settlement between evaluation points listed below.

Solution:

$$Strain = \frac{L_f - L_o}{L_o} x\ 100$$

(Ref. 1, page 472)

L_f= Final distance between evaluation points (ft)
L_o= Initial distance between evaluation points (ft)

Strain between points 1 and 2:

Initial Distance:

Elev. Point 1=	1151.6	ft-msl
Elev. Point 2=	1148.1	ft-msl
Plan View Distance=	475.8	ft
L_o=	475.7729	ft

Final Distance:

Elev. Point 1=	1151.0	ft-msl
Elev. Point 2=	1147.8	ft-msl
Plan View Distance=	475.8	ft
L_f=	475.7708	ft

Strain= -0.0004%

Strain between points 3 and 4:

Initial Distance:

Elev. Point 3=	1154.0 ft-msl
Elev. Point 4=	1151.1 ft-msl
Plan View Distance=	440.7 ft
L_o=	440.6895 ft

Final Distance:

Elev. Point 3=	1153.8 ft-msl
Elev. Point 4=	1150.6 ft-msl
Plan View Distance=	440.7 ft
L_f=	440.6915 ft

Strain= 0.0004%

Strain between points 4 and 5:

Initial Distance:

Elev. Point 4=	1151.1 ft-msl
Elev. Point 5=	1147.3 ft-msl
Plan View Distance=	513.5 ft
L_o=	513.5541 ft

Final Distance:

Elev. Point 4=	1150.6 ft-msl
Elev. Point 5=	1147.0 ft-msl
Plan View Distance=	513.5 ft
L_f=	513.5523 ft

Strain= -0.0003%

Conclusion:

Strain is acceptable. The compacted clay component of the liner system has the smallest average allowable tensile strain value which is 0.5 percent (Reference 2, Page 469). The allowable tensile strain for GCL is 10% (Reference 2, Page 645). The allowable tensile strain for an HDPE geomembrane is 25 percent (Reference 2, page 94) and the allowable tensile strain is more than 20 percent for geotextile (reference 3, page 112). The maximum calculated strain (0.0005%) is below the allowable tensile strain for the components of the liner system; therefore, the system will be stable.

APPENDIX N-3B

FINAL COVER AND SOLID WASTE SETTLEMENT AND STRAIN ANALYSIS

LICENSED PROFESSIONAL ENGINEER
SALMAN A. BAIG
27485
OKLAHOMA

06-05-15

Includes pages N-3B-1 through N-3B-8

Required: Estimate the total settlement in the municipal solid waste and the strain in the final cover:

A. Primary Settlement
B. Secondary Settlement
C. Total Settlement
D. Strain

Method: Settlement of municipal solid waste (MSW) can be modeled using consolidation theory for clay soils. Settlement can be calculated using the following equation:

$$S = \frac{H_0 \Delta e}{1 + e_0} \qquad \text{(Eqn 1)}$$

where:

S = settlement, ft
H_o = initial waste height, ft
e_o = initial void ratio
Δe = change in void ratio

Primary and secondary consolidation of the MSW are then computed by substituting appropriate expressions for the change in void ratio.

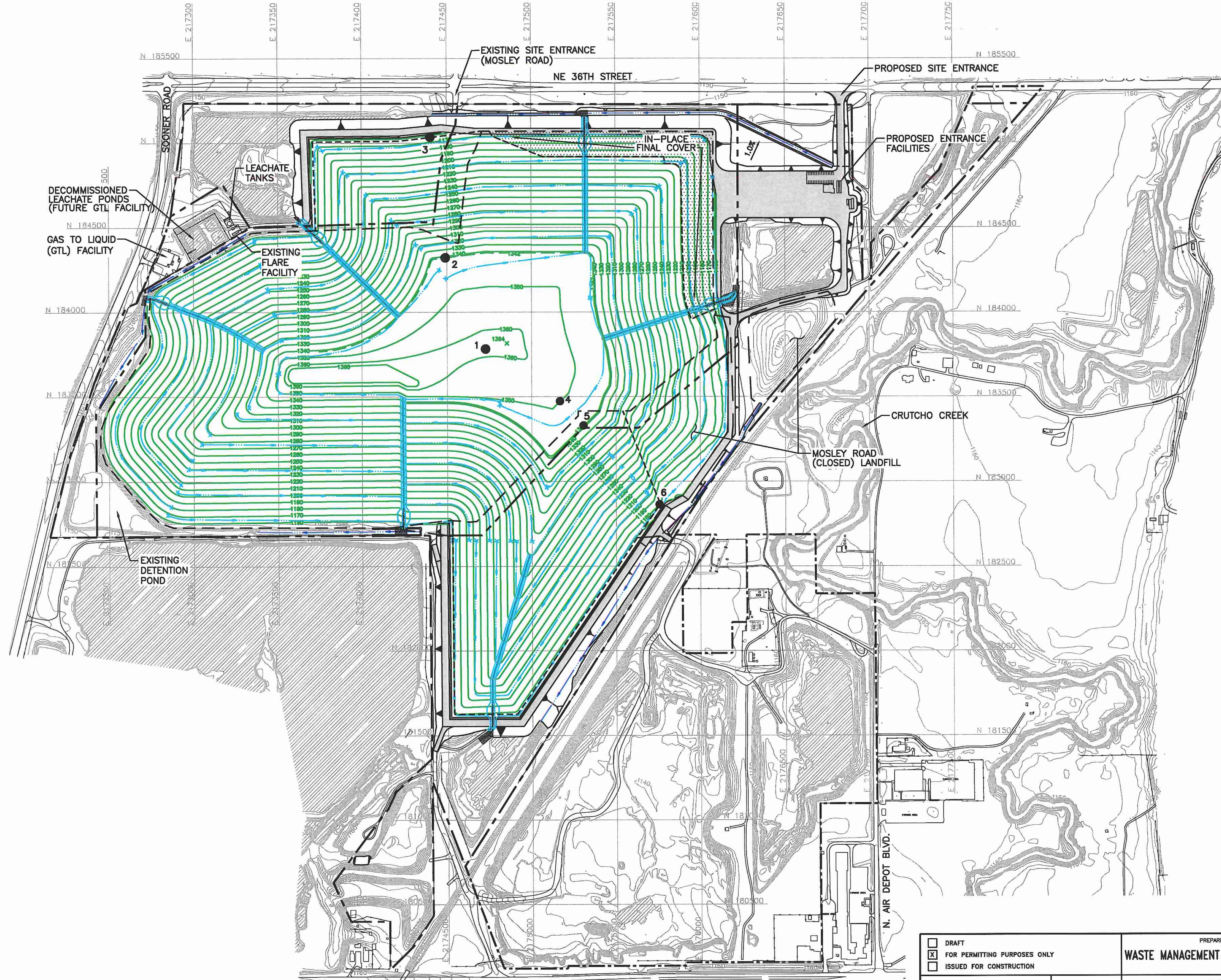
Calculate strain as outlined in Reference 2 by Xuede Quian.

References:

1. Sowers, George F., Settlement of Solid Waste, *Proceedings of the Eighth International Conference on Soil Mechanics and Foundations Engineering, 1973.*

2. Quian, Xuede, R.M. Koerner, D. H. Gray, Geotechnical Aspects of Landfill Design and Construction, 2002.

3. Koerner, Robert M., Designing with Geosynthetics, 5th Edition, 2002



N
0 300 600
SCALE IN FEET

LEGEND

— · — · —	PROPERTY BOUNDARY
— — · —	EXISTING PERMIT BOUNDARY
— · — · —	PROPOSED PERMIT BOUNDARY
— — — —	PERMITTED LIMITS OF WASTE
- - - - -	PROPOSED LIMITS OF WASTE
— — — —	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
1180	EXISTING CONTOUR
1280	PROPOSED FINAL COVER CONTOUR
	PROPOSED DRAINAGE CHANNEL
	PROPOSED DRAINAGE SWALE
	PROPOSED DRAINAGE CHUTE
	IN-PLACE FINAL COVER
●1	EVALUATION POINT

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. IN-PLACE FINAL COVER LIMITS REPRODUCED FROM SOIL VERIFICATION SURVEY PREPARED BY LEMKE LAND SURVEYING, INC. DATED JUNE 2013.

LICENSED PROFESSIONAL ENGINEER
SALMAN A. BAIG
27485
OKLAHOMA

06-05-15

O:\0086\356\EXPANSION 2013\APPENDIX N\N-3B-2-EVALUATION POINT LOCS.dwg, uacholonu, 1:2

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 06/2015
FILE: 0086-356-11
CAD: N-3B-2-EVAL PTS.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

Weaver Consultants Group
CA 3804 PE-06/30/2015

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

TIER III PERMIT MODIFICATION
FINAL COVER SETTLEMENT
EVALUATION POINT LOCATIONS
EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM

SHEET N-3B-2

Solution: Note: Evaluation points are shown on Sheet N-3B-2.

A) Primary Settlement of Waste

MSW will undergo primary consolidation due to its own weight, final cover, equipment, etc. Primary consolidation occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. In addition, by the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

$\Delta e = C_c \times \log((\sigma'_o + \Delta\sigma)/\sigma'_o)$ (Eqn 2)

where:
C_c = primary compression index
$C_c = 0.15e_o$ for fills low in organic content (Ref. 1)
$C_c = 0.55e_o$ for fills high in organic content (Ref. 1)
$\Delta\sigma$ = change in loading
σ'_o = effective stress at mid height of refuse

For this site assume: $C_c = 0.4 \times e_o$

e_o = init. void ratio = 2 to 15

USE => 1.8

Substituting Eqn 2 into Eqn 1, Primary Settlement is calculated as:

$$S_p = \frac{H_o x C_c}{1 + e_o} \log \frac{\sigma'_o + \Delta\sigma}{\sigma'_o}$$ (Ref. 2, page 451)

S_p = Primary settlement, ft
γ_{msw} = unit weight of waste, pcf
γ_{cov} = unit weight of cover, pcf
$\sigma'_o = 0.5\ \gamma_{msw}\ H_o$
$\Delta\sigma = \gamma_{cov}\ T_c$

Parameters:

e_o =	1.8	
C_c =	0.72	
γ_{cov} =	116	pcf (avg of cover, cap and erosion/drainage layer)
T_c =	4	feet (thickness of final cover)
γ_{msw} =	60	pcf

For the following evaluation points, the primary settlement is:

Evaluation Point	H_o (ft)	Primary Settlement, S_p (ft)
1	175.1	1.66
2	187.5	1.66
3	14.7	1.18
4	64.4	1.55
5	182.0	1.66
6	10.0	1.04

B) Secondary Settlement of Solid Waste

Secondary consolidation continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay. The settlement-log time relationship is similar to secondary compression of soils and can be expressed by:

$$\Delta e = \alpha \log (t_2/t_1) \qquad \text{(Eqn 3)}$$

where:

α = secondary compression factor
α = 0.03 e_o for conditions unfavorable to decay (Ref. 1)
α = 0.09 e_o for conditions favorable to decay (Ref. 1)
t_1 = initial time in years
t_2 = time at which settlement is determined in years

For this site assume:

α = 0.06 xe_o

Substituting Eqn 3 into Eqn 1, secondary settlement is calculated as:

$$S_c = \frac{H_o \alpha}{1 + e_o} \log (t_2/t_1) \qquad \text{(Ref. 2, page 451)}$$

Parameters

e_o = 1.8
α = 0.108
t_1 = 0.083 years

Using the following heights of MSW and a thirty year secondary settlement period, the following secondary settlement is calculated:

when:

H_o =	175.1 ft	
t_2 (yrs)	S_c (ft)	% 30 yr consolidation
0.5	5.27	30%
1	7.30	42%
2	9.33	54%
4	11.37	66%
8	13.40	78%
15	15.24	88%
30	17.28	100%

H_o =	187.5 ft	
t_2 (yrs)	S_c (ft)	% 30 yr consolidation
0.5	5.64	30%
1	7.82	42%
2	9.99	54%
4	12.17	66%
8	14.35	78%
15	16.32	88%
30	18.50	100%

H_o =	14.7 ft	
t_2 (yrs)	S_c (ft)	% 30 yr consolidation
0.5	0.44	30%
1	0.61	42%
2	0.78	54%
4	0.95	66%
8	1.12	78%
15	1.28	88%
30	1.45	100%

H_o =	64.4 ft	
t_2 (yrs)	S_c (ft)	% 30 yr consolidation
0.5	1.94	30%
1	2.69	42%
2	3.43	54%
4	4.18	66%
8	4.93	78%
15	5.61	88%
30	6.35	100%

H_o =	182.0 ft	
t_2 (yrs)	S_c (ft)	% 30 yr consolidation
0.5	5.47	30%
1	7.59	42%
2	9.70	54%
4	11.81	66%
8	13.93	78%
15	15.84	88%
30	17.96	100%

H_o =	10.0 ft	
t_2 (yrs)	S_c (ft)	% 30 yr consolidation
0.5	0.30	30%
1	0.42	42%
2	0.53	54%
4	0.65	66%
8	0.77	78%
15	0.87	88%
30	0.99	100%

C) Total Settlement of Solid Waste

Total Settlement is the combination of primary and secondary settlement. For the following MSW heights, the Total Settlement is:

Thickness of waste column, ft = 175.1	Primary Settlement =	1.66 ft
(Evaluation Point 1)	Secondary Settlement =	17.28 ft
	Total Settlement =	18.93 ft
Thickness of waste column, ft = 187.5	Primary Settlement =	1.66 ft
(Evaluation Point 2)	Secondary Settlement =	18.50 ft
	Total Settlement =	20.16 ft
Thickness of waste column, ft = 14.7	Primary Settlement =	1.18 ft
(Evaluation Point 3)	Secondary Settlement =	1.45 ft
	Total Settlement =	2.63 ft
Thickness of waste column, ft = 64.4	Primary Settlement =	1.55 ft
(Evaluation Point 4)	Secondary Settlement =	6.35 ft
	Total Settlement =	7.90 ft
Thickness of waste column, ft = 182.0	Primary Settlement =	1.66 ft
(Evaluation Point 5)	Secondary Settlement =	17.96 ft
	Total Settlement =	19.62 ft
Thickness of waste column, ft = 10.0	Primary Settlement =	1.04 ft
(Evaluation Point 6)	Secondary Settlement =	0.99 ft
	Total Settlement =	2.03 ft

D) Strain Percentage in Cover System

Determine the strain percentage in the cover system based on maximum potential total settlement assuming that the cover system is not placed over the waste fill for one year and approximately 42% of secondary settlement occurs during that first year.

$$Strain = \frac{L_f - L_o}{L_o} x\ 100$$

L_f= Final distance between evaluation points (ft)
L_o= Initial distance between evaluation points (ft)

Points 1 and 2:

Initial Distance:

Elev. Point 1=	1364.0	ft-msl	(Reference 2, Page 472)
Elev. Point 2=	1342.0	ft-msl	
Plan View Distance=	588.5	ft	
L_o=	588.91	ft	

Final Distance:

Elev. Point 1=	1345.07	ft-msl
Elev. Point 2=	1321.84	ft-msl
Plan View Distance=	588.5	ft
L_f=	588.96	ft

Strain= 0.008%

Points 2 and 3:

Initial Distance:

Elev. Point 2=	1342.0	ft-msl
Elev. Point 3=	1163.1	ft-msl
Plan View Distance=	719.1	ft
L_o=	741.06	ft

Final Distance:

Elev. Point 4=	1321.84	ft-msl
Elev. Point 3=	1160.47	ft-msl
Plan View Distance=	719.14	ft
L_f=	737.02	ft

Strain= -0.545%

Points 4 and 5:

Initial Distance:

Elev. Point 4=	1350.0	ft-msl
Elev. Point 5=	1342.0	ft-msl
Plan View Distance=	201.3	ft
L_o=	201.48	ft

Final Distance:

Elev. Point 4=	1342.10	ft-msl
Elev. Point 5=	1322.38	ft-msl
Plan View Distance=	201.32	ft
L_f=	202.28	ft

Strain= 0.399%

Points 5 and 6:

Initial Distance:

Elev. Point 5=	1342.0	ft-msl
Elev. Point 6=	1170.0	ft-msl
Plan View Distance=	648.0	ft
L_o=	670.44	ft

Final Distance:

Elev. Point 5=	1322.38	ft-msl
Elev. Point 6=	1167.97	ft-msl
Plan View Distance=	648	ft
L_f=	666.14	ft

Strain= -0.641%

Conclusion: The performance of the ET AFC final cover system will not be adversely affected by the minimal amount of strain initiated by settlement. All components will be in compression.

APPENDIX O

WASTE EXCLUSION PLAN

Note: This appendix includes the following.

- An ODEQ cover letter for a Tier I Permit Modification for the Waste Exclusion Plan issued on September 22, 2014.
- The updated Waste Exclusion Plan.

SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

September 22, 2014

Ms. Paula Carboni
Waste Management of Oklahoma, Inc.
3201 Mosley Road
Oklahoma City, OK 73141

Re: Updated Waste Exclusion Plan (WEP)
East Oak R&D Facility (Permit No. 3555036)
Oklahoma County, Oklahoma

Dear Ms. Paula Carboni:

The Oklahoma Department of Environmental Quality (DEQ) received the Updated Waste Exclusion Plan (WEP) for East Oak Recycling & Disposal Facility on September 12, 2014. The WEP was updated to include management procedures for oil-field waste. These procedures incorporate the non-hazardous industrial waste requirements set forth in the July 19, 2014 DEQ letter.

The WEP is accepted as submitted. If you have any questions, please contact Rachel Hanigan at (405) 702-5196.

Sincerely,

Hillary Young

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/rh

707 NORTH ROBINSON, P.O. BOX 1677, OKLAHOMA CITY, OKLAHOMA 73101-1677

WASTE MANAGEMENT

EAST OAK RECYCLING AND DISPOSAL FACILITY

3201 Mosley Road
Oklahoma City, Oklahoma 73141
(405) 427-1112
Fax (405) 427-1139

September 9, 2014

Hillary Young., P.E.
Engineering Manager
Solid Waste Permitting
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

SUBJECT: Updated Waste Exclusion Plan (WEP)
Tier I Permit Modification
East Oak Recycling and Disposal Facility, MSW Permit No. 3555036
Oklahoma County, Oklahoma

Dear Ms. Young:

The purpose of this permit modification, submitted on behalf of Waste Management of Oklahoma, Inc., (WMO) and East Oak Recycling and Disposal Facility (RDF), is to update the waste exclusion plan. The modification has been prepared as required by Oklahoma Administrative Code (OAC) 252:515-29-2(b). This plan is being submitted to the agency to replace the current WEP that was submitted in 2012. A copy of this plan will be put in the site's operating record.

If you have any questions, or need any additional information, please call me at (214)796-8710 or email me at pcarboni@wm.com.

Sincerely,

Paula Carboni
Area Environmental Manager
Waste Management of Oklahoma, Inc.

cc: Pete Schultze, WMO (operating record)

WASTE MANAGEMENT

Updated Waste Exclusion Plan

For
East Oak Recycling & Disposal Facility
Oklahoma City, Oklahoma
Permit # 3555036

December 2008
Revised September 2014

TABLE OF CONTENTS

ATTACHMENTS

1.0 Introduction

The purpose of this document is to present an updated Waste Exclusion Plan (WEP) for nonhazardous industrial waste (NHIW) acceptance at Quarry Recycling & Disposal Facility (RDF) in accordance with Subchapter 29 and 31 of the OAC 252:515. The WEP specifically provides pre-acceptance procedures to determine the acceptability of a waste pursuant to facility permit conditions, operational capabilities, and state and federal regulations. The program sets forth procedures to monitor incoming waste loads and verify that the incoming waste corresponds with the pre-acceptance waste characterization and the provisions of the facility permit.

This WEP additionally sets forth methods as precautions and controls to determine record and monitor incoming wastes to detect and prevent entry or disposal of regulated hazardous wastes, regulated polychlorinated biphenyl's (PCB) wastes, radioactive, regulated infectious biomedical wastes, or other unpermitted wastes. Hazardous wastes are wastes defined as hazardous waste in OAC 252:515 and/or by the Federal government under the Resource Conservation and Recovery Act (RCRA) and subsequent amendments. Additionally, this program includes a control and record keeping system for tabulation of information obtained from these procedures. The program sets forth for the notification to the administrative authority of the rejection and removal of any wastes that may be reclassified as an excluded waste subsequent to acceptance and/or disposal.

2.0 Pre-Acceptance Procedures

Pre-acceptance procedures are used to determine the acceptability of a waste into the facility. These procedures reasonably ensure that (1) regulated hazardous wastes, (2) PCB wastes, (3) radioactive wastes, (4) untreated regulated infectious biomedical wastes, and (5) other unpermitted wastes are excluded from disposal at Quarry RDF. The pre-acceptance procedure is the process by which a decision to accept or reject a particular waste is made prior to its shipment to the facility. The procedure is based on provisions of the facility permit, current state and federal regulations, employee health/safety, and the environment. Pre-acceptance requirements specify what information regarding the waste a generator must provide before a determination can be made pertaining to acceptability for disposal. Pre-acceptance requirements may include, but are not limited to, laboratory analysis and associated quality assurance/quality control data, material safety data sheets, process flow diagrams, and generator process knowledge information. Whether or not the above information is required is based upon type of industrial generator, and characteristics of each individual waste stream. Information pertaining to the waste is submitted to Waste Management's (WM) designated Waste Evaluation Program for disposal consideration.

The generator of a NHIW that will be considered for disposal will complete WM's Waste Profile Form, the ODEQ NHIW Certification Form, if applicable, and supply any process knowledge information, material safety data sheets, laboratory results, or other documentation/certifications as required by the Waste Evaluation Program in order to determine the waste is non-hazardous. **Attachment A** contains copies of typical WCDF, ODEQ NHIW Certification Form, and other forms that may be used in the approval process. Based on this information, the Waste Evaluation Program will determine if the waste is acceptable or if additional testing or information is necessary before a decision can be made. Analytical test methods will be consistent with Federal and State approved methods.

As per OAC 252:515:31-2a, 3a, & 3b, the generator who generates waste streams identified in 515:31 Appendix F, **Attachment B**, and generate >10 cubic yards per month are required to complete the ODEQ NHIW Certification form.

Prior to acceptance, the following shall be completed through the Waste Evaluation Program:

- review waste profiles and associated documentation to ensure acceptability of waste into the landfill
- review landfill permits, state, and federal requirements regarding acceptance of NHIW
- issue waste specific approvals after reviewing necessary data and waste is determined to be acceptable NHIW

Waste Evaluation Personnel have experience and/or training in the following areas:

- waste evaluation and approval procedures
- analytical tests necessary for waste determination
- interpreting analytical results and significance of laboratory QA/QC
- definition of hazardous waste and exclusions
- basic chemistry
- definition of NHIW and current regulatory procedures for managing NHIW

- facility's approved programs and procedures including WEP
- notification and recordkeeping requirements
- asbestos acceptance
- sources of radiation and radiation safety

If a waste is shown to be characteristically hazardous, listed hazardous, radioactive, untreated regulated infectious biomedical, or to contain regulated concentrations of PCB, the waste will not be approved for disposal. A nonhazardous waste may not be approved for disposal based on physical characteristics such as extreme odor or incompatibility with other waste streams. Waste Management reserves the right to reject any NHIW waste stream.

If the waste is deemed acceptable by the Waste Evaluation Program, a copy of the approval is sent to the facility. The approval includes the generator and waste name, volume approved, if applicable, any acceptance conditions, restrictions, or applicable operational requirements thought necessary to protect human health and the environment, analytical data, expiration date and ODEQ NHIW Certification Form. **Attachment C** contains a typical written approval. The expiration date will not exceed three years from the date of approval. The generator is responsible for notifying the ODEQ and Waste Management immediately if the NHIW generating process or waste stream changes.

The Waste Evaluation Program also identify any special management procedures that may be required for disposal. For example, a dusty waste may be required to be containerized before shipment to the landfill and the landfill operators may be instructed to bury the container rather than directly compacting to reduce blowing dust on the working face.

After approval from the Waste Evaluation Program is obtained, the generator/customer is required to sign a Service Agreement that lists terms and conditions that include waste restrictions. Every customer who has an account with the facility, including residential trash-hauling companies, signs a Service Agreement that includes waste restrictions. As a reminder to every incoming vehicle at the facility, signs indicating restricted wastes are posted along the landfill entrance.

The Waste Evaluation Program will conduct periodic reviews of each approved NHIW at least every three years based upon the variability and quantity of waste. For these periodic reviews, the NHIW generator will complete either a new waste profile or a Recertification of Generator's Waste Profile Sheet, **Attachment A**. On a periodic basis, for each approved NHIW, current analyses will be requested from the generator as necessary. The frequency at which updated analytical testing will be requested will be determined by the Waste Evaluation Program and based upon potential variability and quantity of the waste received at the site. If analyses are determined to be necessary, new analytical testing will be provided at least every four years. As per OAC 252:515-3c, in the event a NHIW process or waste stream changes, the generator shall immediately notify the DEQ and WM of such change and update appropriate paperwork.

3.0 Incoming Waste Procedures

After the waste approval has been obtained from the Waste Evaluation Program and the generator has been notified of any restrictions/requirements associated with the waste, necessary information is communicated to the disposal facility. Information regarding each approved NHIW is available at the disposal facility. When an NHIW load arrives at the landfill it is required to be accompanied by a signed tracking document which specifies generator and waste information if the generator disposes greater than ten cubic yards in a calendar month. **Attachment D** contains a typical NHIW tracking document. Scale house personnel review the tracking document and ensure that the corresponding approval is valid.

All NHIW waste is viewed at the scalehouse and/or as it is off-loaded at the active work face by facility personnel. If an inconsistency in the waste or any potentially hazardous waste is identified, the material will not be processed and the generator and Waste Evaluation Personnel will be notified. If the discrepancy cannot be reasonably explained by the generator and approved immediately by WM Waste Evaluation Program, the waste will be reloaded and rejected or properly managed by WM. See Section 5.0 for further information.

All waste, including residential and commercial trash, is viewed while processing at the work face for identification of potentially hazardous, radioactive, PCB bearing, free liquids (unless previously approved as a liquid waste stream for solidification), unapproved NHIW, and potentially regulated infectious waste. Facility personnel are trained, as described in Section 6.0, to identify potentially unacceptable waste.

As required by OAC 252:515 29-3(a)(b) random load inspections of incoming waste will be conducted on a regular basis to ensure that incoming loads do not contain prohibited wastes. Random load inspections will be conducted at a frequency of five inspections per month. The inspections shall include at a minimum the date and time of inspection, the person conducting the inspection and the result of the inspection. **Attachment E** contains a typical random load inspection. Random load inspections will be maintained in the operating record for review.

If WM personnel identify any hazardous waste, radioactive waste, PCB bearing, or regulated infectious waste, the waste will be rejected and the Department will be notified as indicated in Section 5.0.

4.0 Waste Restrictions

Waste defined as characteristically hazardous or listed hazardous by 40 CFR 261 will not be approved for disposal at the facility. Regulated PCB, untreated infectious biomedical, or radioactive wastes will also not be approved for disposal at the facility.

All wastes defined in OAC 252:515-31-2 will be managed with the pre-acceptance approval process described in Section 3.0. The following wastes may not be subject to the pre-acceptance approval process but may require special handling at the landfill:

- uncontaminated asbestos (will still require manifest & waste shipment record)
- slaughterhouse waste, dead animals (may be required to be buried before compacting)

Also, as defined in OAC 252:515-31-1, generators disposing of less than 10 cubic yards of NHIW per calendar month may be excluded from the approval process described in Section 3.0. However, verification that the waste is not hazardous may still be required.

Transporters will be asked to communicate what type of waste they are carrying while at the scalehouse. Any waste requiring special handling will be identified and communication will be made to the disposal area. Operators at the disposal area will view all loads.

Friable asbestos containing waste is managed at the facility in accordance with state and federal regulation. Friable asbestos containing waste will be managed in accordance with all applicable regulations, including OAC 252:515-19-31. See Section 8.0 for further information.

5.0 Waste Rejection and Notification Procedures

As per OAC 252:515 29-3e, the Solid Waste Management Division of the Oklahoma DEQ will be notified by the end of the next working day if any waste identified and rejected prior to receipt as a prohibited waste; or any load identified and rejected at the gate, during random inspections, or upon disposal at the working face, as a prohibited waste.

The notification will include the reason for rejection, date of rejection, the name, address, phone number and contact person of the waste generator when such data can be obtained; and/or the name of driver, tag number of the vehicle, carrier name, address, telephone number, and contact person if such information can be obtained.

If radioactive waste is identified in incoming waste at the landfill, it will be isolated and DEQ Radiation Management will be notified immediately. The waste will not be transported from the landfill until a DOT exemption can be issued.

As per OAC 252:515 29-3f, if WM is unable to determine the generator of the restricted waste, the waste will be segregated and covered with a tarp or earthen material (if can be accomplished safely) or put in a container and tarped until proper characterization and disposal can be implemented.

As per OAC 252:515 29-3g, if WM must properly handle the rejected waste for proper disposal, a hazardous waste determination will be made on the waste. Once determination is completed, WM will properly manage the waste.

As per OAC 252:515 29-3h, WM will submit verification of proper disposal to the DEQ and a copy will be filed in the site operating record.

6.0 Training of On-Site Personnel

As per OAC 252:515 29-3(c)(d), landfill personnel responsible for waste acceptance will receive training in waste acceptance/exclusion procedures. The training will include the following topics:

- review of the WEP and WEP implementation procedures
- discussion of employees responsibilities pertaining to waste exclusion
- discussion of approval/pre-acceptance procedures
- definition and examples of NHIW
- discussion of necessary documentation for NHIW
- discussion of inspection procedures
- definition, recognition, and specific examples of hazardous waste, regulated infectious waste, radioactive waste, and PCB waste.
- operating procedure when a potentially hazardous/dangerous waste is identified
- internal notification procedure when a questionable waste is identified
- notification requirements
- recordkeeping and reporting requirements (including monthly reports)

This training may be conducted in several segments throughout the year. Facility personnel will receive at least eight hours of initial training per year. Annual refresher training will be done a minimum of 4 hours per year for each employee. Each training session will be documented and a record will be kept for each employee. **Attachment F** contains a typical training documentation form. Trained personnel will be on site during landfill operating hours.

7.0 Recordkeeping and Monthly Reporting

As per OAC 252:515 29-4 and 252:515 31-4, all information required to approve NHIW will be maintained at the disposal facility. This information will include the WCDF, written approval from the Waste Evaluation Program, and may include any of the following used to characterize the waste;

- ODEQ NHIW Certification Form
- laboratory analysis
- MSDS
- process knowledge information
- certifications
- manifests
- DEQ approval letters if WM chooses to gain DEQ approval of a particular NHIW

Monthly NHIW reports will be submitted to the Oklahoma DEQ including waste type, quantity, and source of waste disposed during the month. The monthly NHIW report will include, at a minimum, all generators who dispose of greater than ten cubic yards per month. These reports will be submitted no later than the last day of the month following the reporting period.

8.0 Asbestos Management

The information in this section discusses proper management of asbestos containing waste that is received by the WM Quarry Landfill. WM used the ODEQ Guidance on Asbestos Management for this section of the WEP.

The definition of regulated asbestos-containing material (RACM) includes the following:

- Friable asbestos material
- Category I nonfriable asbestos-containing material (ACM) that becomes friable
- Category 1 nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading
- Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder

Friable asbestos received at the landfill must be wetted and packaged as described below:

- Double bagged in 6-mil plastic bags: or
- Single bagged in one 6-mil plastic bag and placed in a disposable drum; or
- Contained in any other manner approved in advance, by Air Quality Division director of the DEQ.

Bulk components containing friable asbestos received at the landfill must be:

- Wrapped with at least two layers of 6-mil plastic and duct tape (or other securing medium)

Any time RACM is off-loaded, vehicles or trailers must have the following:

- Warning signs visible from all sides with minimum 20 inches by 14 inches upright format that reads:

DANGER
ASBESTOS DUST HAZARD
CANCER AND LUNG DISEASE HAZARD
Authorized Personnel Only

- U.S. DOT Class 9 placards are required on each side and each end of any vehicle or trailer transporting quantities greater that 3 disposal bags, 1 disposal drum, or any amount of wrapped bulk RACM on public roadways.

The following are disposal procedures to be followed at the landfill:

- Trucks are to approach the disposal locations as closely as possible for unloading of ACM waste;
- Bags, drums, and wrapped components shall be examined as the are off-loaded;
- Bags, drums, and wrapped components shall be placed on the ground at the disposal site, not pushed or thrown out of the trucks; and
- Personnel off-loading containers shall wear protective equipment consisting of head, body and foot protection and, at a minimum, half face-piece, air purifying, and dual-cartridge respirators equipped with high-efficiency filters.

All RACM must be covered with a minimum of 6 inches of compacted nonasbestos-containing material (i.e. uncontaminated soil) at the end of each operating day. Municipal solid waste, tarps, and alternate daily cover materials do not classify as nonasbestos-containing material.

All nonfriable asbestos material must cover with a minimum of 6 inches of nonasbestos-containing material prior to compaction or other landfill activities that could create RACM. In event RACM is created, the facility is responsible for fulfilling all NESHAP requirements.

The facility must comply with the following reporting requirements:

- Report in writing by the following working day is any significant amount of RACM is received improperly packaged or uncovered during landfill operations. A copy of the Waste Shipment Record (WSR) shall be included with report.
- A copy of the signed WSR must be sent to the generator within 30 days of receipt of the waste.
- If a discrepancy between quantity on the WSR and that actually received is not resolved within 15 days of receipt of the RACM, the facility must immediately report in writing to the DEQ. The report should include the discrepancy and attempts to reconcile it along with a copy of the WSR.

The WSR is required for RACM and contain the following information:

- Name, address, and phone number of the waste generator;
- Name, address, and phone number of the transporter(s);
- Quantity of RACM in cubic yards;
- Presence of improperly packaged RACM;
- Date of receipt

The WSRs and documentation of discrepancies shall between WSR and actual amounts be maintained in the facility's operating record for a minimum of two years.

The facility must maintain in operating records, until closure, the location of all RACM including the following:

- The depth and area;
- Quantity in cubic yards;
- A map of diagram depicting the location of the ACM waste.

The facility must notify the ODEQ in writing at least 45 days prior to excavation or otherwise disturbing any RACM that has been deposited and covered.

- Scheduled staring and completion dates;
- Reason for disturbing waste;
- Procedures to be used to control emissions, during the excavation, storage, transport, and ultimate disposal of the excavated RACM; and
- Location of any temporary storage site and the final disposal site,

9.0 Oil-Field Waste Management

The information in this section discusses proper receipt of oil-field waste that is received by the WM Quarry Landfill. WM used the July 19, 2014 ODEQ letter for this section of the WEP.

- NHIW certification form, **Attachment A**, must be submitted to the DEQ and WM by the generator and maintained in operating record of the disposal site.
- Each waste stream must have a separate NHIW certification for each type of waste material at each well site or other site from which waste is received.
- Recordkeeping for these wastes will follow Section 7.0 of the WEP
- NHIW certification forms should coincide with generator documentation required by OCC.

ATTACHMENT A
DOCUMENTATION USED FOR NHIW APPROVALS

- Waste Management Profile Form
- Waste Management Process Knowledge Form
- Profile Addendum: State of Oklahoma
  - Non-Hazardous Industrial Waste Notification/Certification Form
  - Letter of Authorization for Permission to Characterize, Ship, Dispose and Otherwise Represent Waste Streams
- Profile Amendment Request Form
- Profile Renewal Form

WASTE MANAGEMENT

EZ Profile™

Requested Facility: ______________________ ☐ Unsure Profile Number: ____________

☐ Check if there are multiple generator locations. Attach locations. ☐ COD ☐ Renewal? Original Profile Number: ____________

A. GENERATOR INFORMATION (MATERIAL ORIGIN)

1. Generator Name: ______________________
2. Site Address: ______________________
   (City, State, ZIP) ______________________
3. County: ______________________
4. Contact Name: ______________________
5. Email: ______________________
6. Phone: ____________ 7. Fax: ____________
8. Generator EPA ID: ______________________ ☐ N/A
9. State ID: ______________________ ☐ N/A

B. BILLING INFORMATION ☐ SAME AS GENERATOR

1. Billing Name: ______________________
2. Billing Address: ______________________
   (City, State, ZIP) ______________________
3. Contact Name: ______________________
4. Email: ______________________
5. Phone: ____________ 6. Fax: ____________
7. WM Hauled? ☐ Yes ☐ No
8. P.O. Number: ______________________

C. MATERIAL INFORMATION

1. Common Name: ______________________
   Describe Process Generating Material: ☐ See Attached

2. Material Composition and Contaminants: ☐ See Attached

1.	
2.	
3.	
4.	
	≥100%

3. State Waste Codes: ______________________ ☐ N/A
4. Color: ______________________
5. Physical State at 70°F: ☐ Solid ☐ Liquid ☐ Other: ________
6. Free Liquid Range Percentage: ______ to ______ ☐ N/A (Solid)
7. pH: ____________ to ____________ ☐ N/A (Solid)
8. Strong Odor: ☐ Yes ☐ No Describe: ____________
9. Flash Point: ☐ <140°F ☐ 140°–199°F ☐ ≥200° ☐ N/A (Solid)

D. REGULATORY INFORMATION

1. EPA Hazardous Waste? ☐ Yes* ☐ No
   Code: ______________________
2. State Hazardous Waste? ☐ Yes ☐ No
   Code: ______________________
3. Is this material non-hazardous due to Treatment, Delisting, or an Exclusion? ☐ Yes* ☐ No
4. Contains Underlying Hazardous Constituents? ☐ Yes* ☐ No
5. Contains benzene and subject to Benzene NESHAP? ☐ Yes* ☐ No
6. Facility remediation subject to 40 CFR 63 GGGGG? ☐ Yes* ☐ No
7. CERCLA or State-mandated clean-up? ☐ Yes* ☐ No
8. NRC or State-regulated radioactive or NORM waste? ☐ Yes* ☐ No

***If Yes, see Addendum (page 2) for additional questions and space.**

9. Contains PCBs? → If Yes, answer a, b and c. ☐ Yes ☐ No
   a. Regulated by 40 CFR 761? ☐ Yes ☐ No
   b. Remediation under 40 CFR 761.61 (a)? ☐ Yes ☐ No
   c. Were PCB imported into the US? ☐ Yes ☐ No
10. Regulated and/or Untreated Medical/Infectious Waste? ☐ Yes ☐ No
11. Contains Asbestos? ☐ Yes ☐ No
    → If Yes: ☐ Non-Friable ☐ Non-Friable – Regulated ☐ Friable

E. ANALYTICAL AND OTHER REPRESENTATIVE INFORMATION

1. Analytical attached ☐ Yes
   Please identify applicable samples and/or lab reports:
2. Other information attached (such as MSDS)? ☐ Yes

F. SHIPPING AND DOT INFORMATION

1. ☐ One-Time Event ☐ Repeat Event/Ongoing Business
2. Estimated Quantity/Unit of Measure: ______________________
   ☐ Tons ☐ Yards ☐ Drums ☐ Gallons ☐ Other: ________
3. Container Type and Size: ______________________
4. USDOT Proper Shipping Name: ☐ N/A
   ____

G. GENERATOR CERTIFICATION (PLEASE READ AND CERTIFY BY SIGNATURE)

By signing this EZ Profile™ [illegible] hereby certify that all information submitted in this and all attached documen[illegible] all relevant information necessary for proper material characterization and to identify known and suspected haz[illegible] from a sample that is representative as defined in 40 CFR 261 - Appendix I or by using an equivalent method [illegible] in the process or new analytical) will be identified by the Generator and be disclosed to Waste Management pri[illegible]

If I am an agent signing on behalf of the Generator, I have confirmed with the Generator that information contained in this Profile is accurate and complete.

Name (Print): ______________________ Date: ____________

Title: ______________________

Company: ______________________

Certification Signature

THINK GREEN.

QUESTIONS? CALL 800 963 4776 FOR ASSISTANCE

WASTE MANAGEMENT PROCESS KNOWLEDGE FORM

Name of Waste: ______________________ Waste Code: ______________________

For all waste classes please indicate, based on process knowledge, that analysis for the following chemical constituents is **NOT REQUIRED:**

- ☐ TCLP Metals — (Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver)
- ☐ TCLP Volatiles — (Benzene, Carbon Tetrachloride, Chlorobenzene, Chloroform, 1,2-Dicholorethane, 1,1-Dichloroethylene, Methyl Ethyl Ketone, Tetrachloroethylene, Trichloroethylene, Vinyl Chloride)
- ☐ TCLP Semi-Volatiles — (o-Cresol, m-Cresol, p-Cresol, Cresol (total), Pentachlorophenol, 2,4,5-Trichlorophenol, 2,4,6-Tricholorophenol, 1-4, Dichlorobenzene, 2,4-Dinitritoluene, Hexachlorobenzene, Hexachlorobutadiene, Hexachloroethane, Nitrobenzene, Pyridine)
- ☐ TCLP Pesticides/Herbicides — (Chlorodane, Endrin, Heptachlor, Heptachlor epoxide, Lindane, Methoxychlor, Toxaphane, 2,4-D, 2,4,5-TP (Silvex))
- ☐ R,C,I — (Reactivity, Corrosivity, Ignitability Characteristics)
- ☐ Polychlorinated Biphenyls — (TSCA regulated and as otherwise defined by federal, state, and/or local regulations)
- ☐ Radioactive Materials — (as defined by federal, state, and/or local regulations)
- ☐ All applicable UHC (underlying hazardous constituents) and LDR (land disposal restrictions) regulatory issues have been evaluated and it has been determined that UHCs and LDRs are either not applicable or have been met.

Additionally, for Texas CLASS 2 INDUSTRIAL WASTES, please indicate based on process knowledge that analysis for the following constituents is **NOT REQUIRED:**

- ☐ TAC 335 Subchapter R, Appendix 1, Table 1, Constituents Not Listed Above or Analyzed For
- ☐ Class I Ignitable
- ☐ Class I Corrosive
- ☐ If waste is a petroleum substance or contains contamination from petroleum substances (as defined in TAC 335.1), total petroleum hydrocarbon (TPH) concentration is less than or equal to 1500 parts per million (ppm)

PLEASE DESCRIBE IN DETAIL PROCESS GENERATING WASTE/PROCESS KNOWLEDGE USED TO ELIMINATE PARAMETERS/CONSTITUENTS NOT TESTED FOR:

I certify that the above mentioned information contains true and accurate descriptions of the waste and that all relevant information regarding known or suspected hazards has been disclosed. I further certify that the waste describe above is not a "Hazardous Waste" as defined by USEPA regulations and/or State regulations.

Print Name: ______________________ Signature: ______________________

Title: ______________________ Date: ______________________

Profile Addendum: State of Oklahoma
NON-HAZARDOUS INDUSTRIAL WASTE NOTIFICATION/CERTIFICATION FORM

Generator Name: ______________________________

Mailing Address: ______________________________

City: ____________ State: ____________ Zip Code: ____________

Point of Generation

General Contact: ______________________ Title: ____________

Address: ______________________ City: ____________

State: ____________ Zip Code: ____________ Telephone: ( ) ____________

Waste Information

Waste Name: ______________________________

If waste was generated out-of-state, is it classified as hazardous in the state of origin? Yes No NA-Okla Waste

The waste stream is: New Previously approved (Previous Approval Number ____________)

Approximate amount of waste to be disposed under this disposal plan?

____________ Tons Pounds Cubic Yards Drum Other ____________

Disposal Frequency?

One-time Weekly Monthly Annually

Physical Characteristics?

Solid Sludge Liquid Combination

Method used to determine waste is non-hazardous: Analysis Generator Knowledge Both

Process generating waste (be specific and use additional sheets if necessary):

____

____

Disposal Facility Information

Facility name: ______________________ Permit #: ____________

Generator Certification

I understand this form must be signed by the original waste generator or other persons authorized by 27A O.S. §2-10-501(H).

To the best of my knowledge, I certify:

- The information contained herein is accurate, complete, and representative of the waste to be disposed;
- The waste identified above is not a characteristically hazardous waste as identified by 40 CFR 261, Subpart C, is not a listed hazardous waste as identified by 40 CFR 261, Subpart D or contaminated with a listed hazardous waste, and is not otherwise identified as a hazardous waste by the Department of Environmental Quality; and
- This waste will be managed in accordance with all applicable statutes and rules of the Department of Environmental Quality.

Generator's Signature: ______________________ **Title:** ____________

Name: (Print) ______________________ **Date:** ____________

FOR DEQ USE ONLY: Approved by: ______________________ Date: ____________

WASTE MANAGEMENT

Profile Addendum: State of Oklahoma
NON-HAZARDOUS INDUSTRIAL WASTE NOTIFICATION/CERTIFICATION FORM

Instructions for Completing the NHIW Certification

Enter the name of the generating facility, generator mailing address, address where the waste was generated, contact name and title of person at the generating facility who is knowledgeable about the waste, and phone number.

Detailed Waste Description

1. Identify the name of the waste.
2. Identify the approximate amount of waste to be disposed under the plan, its frequency of disposal, and its physical characteristics.
3. Identify if the waste was determined to be non-hazardous by either knowledge of process, testing, or both. If requested by DEQ, the generator must be able to provide information about the waste, such as a list of chemical constituents entering into the waste and a list of chemical constituents likely to be in the waste, laboratory analyses, MSDS sheets, and other information used by the generator to determine the waste is non-hazardous.
4. Identify the process generating the waste. Please note that the waste generating description must be specific and sufficient to demonstrate the waste is non-hazardous.

Designated Receiving Landfill

Identify the name of the landfill to receive the waste and its DEQ permit number.

Generator Certification

Read the certification and sign and date the form. **Please note that the certification may only be dated and signed by one of the following:** 1) the original waste generator; 2) a person who identifies and is under contract with a generator and whose activities under the contract cause the waste to be generated; 3) a party to a remediation project under an order of the DEQ or under the auspices for the Oklahoma Energy Resources Board or other agencies of other states; or 4) a person responding to an environmental emergency.

The completed notification from should be submitted to the DEQ at the following address. Once submitted, the generator may dispose of the waste at the designated landfill.

Department of Environmental Quality
Solid Waste Compliance Unit
P.O. Box 1677
Oklahoma City, OK 73102

Phone (405) 702-5100
Fax (405) 702-5101

WASTE MANAGEMENT

Profile Addendum: State of Oklahoma

LETTER OF AUTHORIZATION FOR PERMISSION TO CHARACTERIZE, SHIP, DISPOSE AND OTHERWISE REPRESENT WASTE STREAMS

F. Additional Waste Stream Information

This letter is being submitted to reflect and document that the Generator listed below has granted full and complete authorization, for

______________________ (an) employee(s) of ______________________ company to sign all waste documents on
(Delegated individual or all) (Broker)

behalf of Generator. This document hereby authorizes ______________________ company
(Broker)

to function in the capacity of "generator" (as that term defined in state and federal rules and regulations) with regard to legally proper waste classification, representation, shipment and disposal and to otherwise act as Generator's agent to characterize, ship, dispose and otherwise represent all waste streams in accordance with all local, state and federal rules and regulations. Such authorization includes but is not limited to execution of the following types of waste-related documents:

- Waste Characterization Data (WCD) Forms/Waste Profiles
- Waste Manifests – Uniform Hazardous Waste Manifests and Non-Hazardous Manifests
- Process Knowledge Forms or Letters
- Waste Profile Amendment Request Forms
- WCD/Profile Recertification Forms
- Land Ban Forms
- One Time Waste Shipment Forms/Authorizations

______________________ company is required to provide Generator with copies of all documents executed in accordance
(Broker)

with this authorization.

This authorization will expire on ______________________ or when written notice is provided by the generator to
(Expiration Date)

Waste Management revoking this authorization.

Respectfully,

Company Name: ______________________ Date: ______________________

Name (Print): ______________________

Signature: ______________________ Title: ______________________

Profile Amendment Request Form

WASTE MANAGEMENT

______________________________ hereby requests an amendment to WMI profile #: ______________________________
(Contact Name)

to include the following:

Amendment Type: ☐ One Time Only Request (Event) ☐ Permanent Addition to Profile (Base)

☐ Additional Analytical/MSDS to be added to profile (see attached)

☐ Volume Increase (specify volume) __________ ☐ Tons ☐ Cubic Yards ☐ Drums ☐ Gallons ☐ Other (specify) __________

☐ Constituent(s) to be added and/or modify current range in chemical composition:

Chemicals or constituents to be added/modify	Low	High	Units

☐ Change current ranges on profile (specify below)

pH Range _____ to _____ Free Liquid Range _____ to _____

☐ Other (specify) ______________________________

GENERATOR CERTIFICATION

By signing this form, the Generator hereby certifies:

The information provided in this document, the referenced Waste Management Generator's Waste Profile Sheet, and all other referenced documents contain true and accurate descriptions of the waste material. All information regarding known or suspected hazards in the possession of the Generator has been disclosed.

Generator/Customer Signature: ______________________________ Date: ______________

Company Name: ______________________________

Name (Print): ______________________________ Title: ______________

FOR WASTE MANAGEMENT USE ONLY

Submitted By: ______________________________ Date: __________ Time: __________
(W.M. Initials)

WM Approval: ______________________________ Date: __________

Agency Approval Required: ☐ Yes ☐ No

☐ Profile Extension

Original Expiration Date __________

Requested Extension __________

New Expiration Date __________

☐ Analytical Extension

Analytical Due Date __________

Requested Extension __________

New Analytical Due Date __________

Conditions/Precautions: ______________________________

EZ Profile™ Addendum

WASTE MANAGEMENT

Only complete this Addendum if prompted by responses on EZ Profile™ (page 1) or to provide additional information. Sections and question numbers correspond to EZ Profile™.

Profile Number: ___________

C. MATERIAL INFORMATION

Describe Process Generating Material (Continued from page 1): If more space is needed, please attach additional pages.

Material Composition and Contaminants (Continued from page 1): If more space is needed, please attach additional pages.

5.	
6.	
7.	
8.	
9.	
10.	
	≥100%

D. REGULATORY INFORMATION

Only questions with a "Yes" response in Section D on the EZ Profile™ form (page 1) need to be answered here.

1. EPA Hazardous Waste
   a. Please list all USEPA listed and characteristic waste code numbers:
   b. Is the material subject to the Alternative Debris standards (40 CFR 268.45)? ☐ Yes ☐ No
   c. Is the material subject to the Alternative Soil standards (40 CFR 268.49)? → If Yes, complete question 4. ☐ Yes ☐ No
   d. Is the material exempt from Subpart CC Controls (40 CFR 264.1083 and 265.1084)? ☐ Yes ☐ No
      → If Yes, please select one of the following:
      ☐ Waste has been determined to be LDR exempt [265.1083(c)(4) and 265.1084(c)(4)] based on the fact that it meets all applicable organic treatment standards (including UHCs for D-coded characteristic wastes) or a Specified Technology has been utilized.
      ☐ Waste does not qualify for a LDR exemption, but the average VOC at the point of origination is <500 ppmw and this determination was based on analytical testing (upload copy of analysis) or generator knowledge.
2. State Hazardous Waste → Please list all state waste codes: ___________
3. For material that is Treated, Delisted, or Excluded → Please indicate the category, below:
   ☐ Delisted Hazardous Waste ☐ Excluded Waste under 40 CFR 261.4 → Specify Exclusion: ___________
   ☐ Treated Hazardous Waste Debris ☐ Treated Characteristic Hazardous Waste → If checked, complete question 4.
4. Underlying Hazardous Constituents → Please list all Underlying Hazardous Constituents:
5. Benzene NESHAP → Please include percent water/moisture in chemical composition.
   a. Are you a TSDF? → If yes, please complete Benzene NESHAP questionnaire. If not, continue.
   b. What is your facility's current total annual benzene quantity in Megagrams? ☐ <1 Mg ☐ 1-9.99 Mg ☐ ≥10 Mg
      1. Flow weighted average benzene concentration is ________ ppmw.
   c. Is this waste soil from remediation at a closed facility? ☐ Yes ☐ No
      1. Benzene concentration in remediation waste is ________ ppmw.
   d. Has material been treated to remove 99% of the benzene or to achieve <10 ppmw? ☐ Yes ☐ No
   e. Is material exempt from controls in accordance with 40 CFR 61.342? ☐ Yes ☐ No
      → If yes, specify exemption: ___________
   f. Based on your knowledge of your waste and the BWON regulations, do you believe that this waste stream is subject to treatment and control requirements at an off-site TSDF? ☐ Yes ☐ No
6. 40 CFR 63 GGGGG → Does the material contain <500 ppmw VOHAPs at the point of determination? ☐ Yes ☐ No
7. CERCLA or State-Mandated clean up → Please submit the Record of Decision or other documentation to assist others in the evaluation for proper disposal.
8. NRC or state regulated radioactive or NORM Waste → Please identify Isotopes and pCi/g: ___________

WASTE MANAGEMENT

Additional Profile Information

Profile Number: ____________

C. MATERIAL INFORMATION

Material Composition and Contaminants (Continued from page 2):

If more space is needed, please attach additional pages.

11.	
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36.	
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38.	
39.	
40.	
	≥100%

D. REGULATORY INFORMATION

1. EPA Hazardous Waste
   a. Please list all USEPA listed and characteristic waste code numbers (Continued from page 2):

WASTE MANAGEMENT

EZ Profile Renewal Form

Profile Number: ____________________

Common Name: ____________________

Generator Name: ____________________

Disposal Site: ____________________

1. **Are there ANY changes in the raw materials used in the generating process or in the process itself?**

   ☐ Yes ☐ No

2. **Have you obtained any laboratory analysis or new applicable documents for this material?**

   ☐ Yes ☐ No

   → **If Yes, please attach and identify the new documents noting representative sample IDs and changes:**

RECERTIFICATION STATEMENT

By signing this form, the generator hereby certifies: The information provided in this document, the attached Waste Management's Generator's Waste Profile Sheet, and all other attached documents contain true and accurate descriptions of this material. All new information regarding known or suspected hazards in the possession of the generator have been disclosed.

Name: ____________________

Date: ____________________

Position/ Title: ____________________

Company: ____________________

Certification Signature

ATTACHMENT B
APPENDIX F NHIW WASTE STREAMS

APPENDIX F. NHIW WASTESTREAMS

(1) Air pollution control equipment residues
(2) Arsenically-treated wood that meets the exemption criteria of 40 CFR 261.4(b)(9)
(3) Auto shredder fluff
(4) Blasting media and other abrasives used to remove surface coatings
(5) Coal combustion ash per 40 CFR 261.4(b)(4)
(6) Combustible materials as defined in 49 CFR 173.120 and 173.124, that are not regulated as hazardous wastes
(7) Containers which are RCRA empty in accordance with 40 CFR 261.7, or empty containers which have held pesticides (i.e., herbicides, fungicides, or rodenticides)
(8) Cooling tower waters and other cooling process related wastes
(9) Incinerator ash
(10) Industrial sludges and industrial mud trap residues
(11) Industrial wastewater treatment plant sludge (excluding sludge that is exclusively sanitary sewage)
(12) Ink wastes
(13) Lab related wastes, including lab packs
(14) Lighting fixture ballasts containing non-TSCA regulated PCBs per 40 CFR Part 761
(15) Miscellaneous chemical spill residue, primarily non-fuel related
(16) Municipal and non-industrial wastewater treatment plant sludges
(17) Non-hazardous pesticides (i.e., herbicides, fungicides, & rodenticides)
(18) Oil filters meeting the requirements of 40 CFR 261.4(b)(13)
(19) Outdated and off-specification products
(20) Outdated, off-specification, or mislabeled over-the-counter medicines which are not hazardous in accordance with 40 CFR 261, Subparts C or D
(21) Paint waste and related solvents
(22) Petroleum contaminated soil and debris, oily rags and absorbents with > 1000 ppm TPH
(23) Pharmaceutical waste not identified in (20)
(24) Refractory & foundry sands and slag, retort, fly ash, cement kiln dust
(25) Resins, polymers, and adhesives
(26) Sludges containing materials washed from the interior of bulk materials carriers such as tank trucks or railroad tank cars
(27) Wastes exempted by the RCRA Bevill waste exclusion in 40 CFR 261.4(b)(7)
(28) Wastes rendered non-hazardous that were formerly hazardous pursuant to 40 CFR 261, Subpart C
(29) Unknowns
(30) Wastes from metal plating processes

ATTACHMENT C
WRITTEN APPROVAL

WASTE MANAGEMENT

Non-Hazardous WAM Approval

Requested Management Facility:

Profile Number: ______________________ Waste Approval Expiration Date: ______________________

APPROVAL DETAILS

Approval Decision: ☐ Approved ☐ Not Approved Profile Renewal: ☐ Yes ☐ No

Management Method: ______________________

Generator Name: ______________________

Management Facility Precautions, Special Handling Procedures or Limitation on approval:

WM Authorization Name: ______________________ Title: ______________________

WM Authorization Signature: ______________________ Date: ______________

Agency Authorization (If Required): ______________________ Date: ______________

ATTACHMENT D
NHIW WASTE TRACKING FORM

NON-HAZARDOUS MANIFEST

WM WASTE MANAGEMENT

NON-HAZARDOUS MANIFEST	1. Generator's US EPA ID No.	Manifest Doc No.	2. Page 1 of	

3. Generator's Mailing Address: 4. Generator's Phone	Generator's Site Address (If different than mailing): SAME	A. Manifest Number WMNA «number» B. State Generator's ID
5. Transporter 1 Company Name WASTE MANAGEMENT	6. US EPA ID Number	C. State Transporter's ID D. Transporter's Phone
7. Transporter 2 Company Name	8. US EPA ID Number	E. State Transporter's ID F. Transporter's Phone
9. Designated Facility Name and Site Address	10. US EPA ID Number	G. State Facility ID H. State Facility Phone

GENERATOR

11. Description of Waste Materials	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt./Vol.	I. Misc. / Waste Code
a. WM Profile #				Y	
b. WM Profile #					
c. WM Profile #					
d. WM Profile #					

J. Additional Descriptions for Materials Listed Above	K. Disposal Location Cell Level Grid

15. Special Handling Instructions and Additional Information

Purchase Order #   EMERGENCY CONTACT / PHONE NO.:

16. GENERATOR'S CERTIFICATE:

I hereby certify that the above-described materials are not hazardous wastes as defined by CFR Part 261 or any applicable state law, have been fully and accurately described, classified and packaged and are in proper condition for transportation according to applicable regulations.

Printed Name	Signature	Month	Day	Year

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed Name	Signature	Month	Day	Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed Name	Signature	Month	Day	Year

FACILITY

19. Certificate of Final Treatment/Disposal

I certify, on behalf of the above listed treatment facility, that to the best of my knowledge, the above-described waste was managed in compliance with all applicable laws, regulations, permits and licenses on the dates listed above.

20. Facility Owner or Operator: Certification of receipt of non-hazardous materials covered by this manifest.

Printed Name	Signature	Month	Day	Year

White- ORIGINAL   Blue- TREATMENT, STORAGE, DISPOSAL FACILITY COPY   Yellow- TRANSPORTER #2 COPY

Pink- TRANSPORTER #1 COPY   Gold- GENERATOR #1 COPY

ATTACHMENT E
RANDOM INSPECTION FORM

EAST OAK RDF
LOAD CHECK INSPECTION REPORT

Hauler Company Name ______________________________ Date _________ Time _________
(or "private citizen")
Driver 's Name ______________________________
Telephone Number (___)________________
Vehicle license
number and state ____________

1. Type of vehicle:
   - ___Drop Box
   - ___Compactor
   - ___Dump Truck
   - ___Other ___________
   - ___Pick up
   - ___Trailer
   - ___Car

2. Size of load:
   - ___cubic yards

3. Types of wastes:
   - ___Food waste
   - ___Paper waste
   - ___Yard debris
   - ___Cardboard
   - ___Wood
   - ___Sheetrock

4. Prohibited wastes which can be recycled:
   - ___Appliances
   - ___Lead acid batteries
   - ___Motor oil
   - ___Tires

5. Prohibited wastes:
   - ___None present
   - ___Liquid:

   type:____________________
   ____
   ____
   amount________gallons
   Solid: __________________
   type:____________________
   ____
   ____
   amount:________________

6. Action taken (*if prohibited or unauthorized wastes found*): ______________________________
____
____

7. Additional comments (*if any*): ____
____
____

8. Name of Inspector:
____

9. Signature of Inspector:
______________________date________

10. Name of Hauler:
____

11. Signature of Hauler:
______________________date________

ATTACHMENT F
TRAINING DOCUMENTATION FORM

LIFCHGR

MEETING ATTENDANCE SHEET

(Photocopy this sheet prior to your safety meeting and place it in the room for employees to sign as they enter)

Date: ______________________ Time: ______________________

Topic: ____

Presenter: ______________________ Department: ______________________

Printed Name	Signature	Printed Name	Signature

Instructions:
1. This form must be completed at each safety meeting.
2. Make additional copies as required.
3. Keep a copy of the completed attendance sheets in this binder.

Absent:

Date Covered:

EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3555036

APPENDIX P
CLOSURE AND POSTCLOSURE PLAN

Prepared for

Waste Management of Oklahoma, Inc.

June 2015

Revised January 2016

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24436
OKLAHOMA

1/15/16

Prepared by

Weaver Consultants Group, LLC
CA 3804 PE 6/30/2017
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0086-356-11-40-04

CONTENTS

LIST OF FIGURES

Figure

1 INTRODUCTION

The Closure Plan will include the necessary actions to be completed at the site before the facility can be certified as closed. In accordance with Oklahoma Administrative Code (OAC) 252:515-25-3, copies of all closure documentation will be maintained on file at the site or at the owner/operator's place of business through the post-closure monitoring period. The Postclosure Plan sets forth the maintenance and monitoring during the postclosure period.

The Postclosure Plan will be in effect for a thirty year period to ensure that the closed landfill facility will continue to retain its integrity and will not pose a threat to human health or the environment. Costs associated with the postclosure period, and the unit costs will be updated per OAC 252:515-27-4. If the permit is transferred, the facility shall adhere to the requirements of OAC 252:515-27-5 to comply with permit transfers.

2 REGULATIONS

This Closure and Postclosure Plan has been prepared pursuant to OAC 252:515-25.

2.1 Closure Requirements

OAC 252:515-25 requires that all MSWLFs install a final cover system that is designed to minimize infiltration and erosion. The final cover system will consist of an erosion layer/vegetation layer underlain by an infiltration/vegetative support layer. The facility will be closed in accordance with the provisions included in this Closure Plan and in a manner that minimizes the need for further maintenance and controls and minimizes post-closure escape of waste and waste constituents into the environment.

Prior to beginning final closure of the landfill, the owner/operator is required to give notice of intent to close the site. Oklahoma Department of Environmental Quality (ODEQ) regulations require closure to begin a minimum of 30 days after final receipt of wastes, and further require 6 months minimum notice prior to beginning closure activities. The site must provide public notice of intent to close no later than 90 days prior to closure. ODEQ requires completion of all closure activities within 180 days following the beginning of closure unless otherwise approved.

OAC 252:515-25-34(c) requires closure to be certified by an independent registered engineer and OAC 252:515-25-36(a) requires that a notice be recorded in the deed to the property noting that the land has been used as a solid waste disposal facility.

ODEQ also requires third party closure/postclosure cost estimates to be updated if additional active areas are constructed, if final cover is constructed, or the landfill gas collection and control system (GCCS) is expanded (if applicable). The cost estimates will be updated annually consistent with OAC 252:515-27-34. The facility will maintain financial assurance based on the annual cost updates.

2.2 Postclosure Requirements

For landfills closing after October 9, 1993, OAC 252:515-25-51 requires a 30-year postclosure maintenance period including maintenance of the integrity and effectiveness of the final cover, maintaining and operating the leachate collection system, monitoring groundwater, and maintaining any gas venting, collection, or monitoring systems. OAC 252:515-25-2 requires submittal of a postclosure monitoring and maintenance plan for the final cover, groundwater monitoring, and gas control systems. The Landfill Gas Management Plan (LGMP) is included in Appendix G. The Groundwater Sampling and

Analysis Plan (GWSAP) was prepared by Biggs and Mathews Consulting Engineers and Hydrogeologists, and is included in Appendix F. These monitoring systems will remain in-place throughout the postclosure period.

3 FINAL COVER SYSTEM

3.1 Introduction

The final cover system for the East Oak Recycling and Disposal Facility (RDF) has been developed to incorporate the requirements of OAC 252:515-25-32(b)(2)(D). OAC 252:515-25-33(c) states that within 180 days after closure activities are initiated, the owner shall complete the installation of the final cover system as well as other closure requirements as described in OAC 252:515-25-32. A site plan is included as Figure 3-1.

3.2 Cover System Design

The final cover system design includes an evapotranspiration (ET) alternative final cover system. The detailed design of the final cover system is included in the ODEQ-approved Alternative Final Cover (AFC) Design (see Appendix J), prepared by Weaver Boos Consultants, LLC–Southwest (WBC) in August 2007 and summarized below.

ET Final Cover
• A vegetative layer consisting of a 12-inch layer of earthen material capable of sustaining plant growth • A 24-inch vegetative support layer • A 12-inch intermediate cover

3.3 Cover System Installation

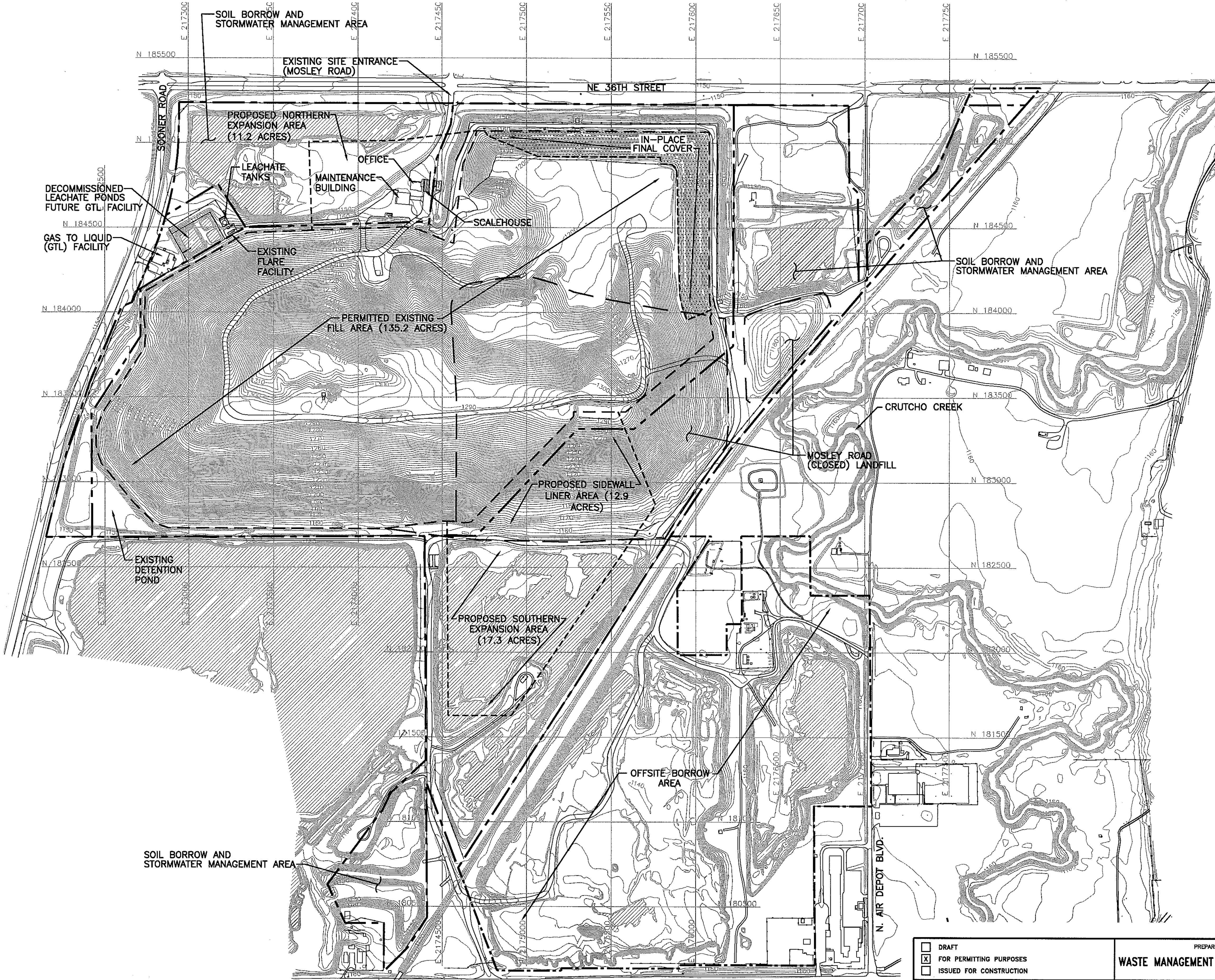
3.3.1 Construction Procedures

As noted in the QA/QC Plan (refer to Appendix I-4 of the AFC Design Modification, dated August 2007 included in Appendix J), appropriate field survey controls will be implemented to control the final lift of solid waste as well as the successive soil layers of the final cover system. The material used for the vegetation support layer shall classify as CL, CH, ML, SM, or SC according to the Unified Soil Classification System. Soil will be obtained from on-site and off-site borrow areas. The vegetation support layer material should be placed in one 24-inch lift. The material will be compacted by "tracking-in" the material 2 to 4 passes of the low pressure earth moving equipment.

The vegetation layer will be placed over the vegetation support layer. This layer consists of soil capable of supporting vegetative growth. The soil is placed in one lift (12-inch minimum thickness) over the entire surface of the final cover and is compacted in place with low pressure earth moving equipment. The vegetation layer will be seeded per the Vegetation Plan (refer to Appendix I-5 of the AFC Design Modification dated June 2004(see Appendix J)).

3.3.2 Final Cover Testing Procedures

As noted in the AFC Design Modification, dated August 2007 (see Appendix J), aspects of the final cover installation will be observed and approved by an independent registered professional engineer licensed in the State of Oklahoma. A certification report, attesting to completion of the installation of the final cover system and to implementation of the Quality Assurance/Quality Control Plan will be signed and sealed by a registered professional engineer and submitted to the ODEQ. Testing will be conducted, as outlined in the AFC Design Modification dated August 2007 (see Appendix J), to provide control and verification during construction of the final cover.



N

0 300 600

SCALE IN FEET

LEGEND

PROPERTY BOUNDARY
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY
PERMITTED LIMITS OF WASTE
PROPOSED LIMITS OF WASTE
MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000 STATE PLANE GRID COORDINATE
1180 EXISTING CONTOUR
IN-PLACE FINAL COVER

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24486
OKLAHOMA

1/15/16

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. IN-PLACE FINAL COVER AREA REPRODUCED FROM LEMKE LAND SURVEYING, INC. VERIFICATION SURVEY DATED JULY 2013 (FINAL COVER AREA 1).

☐ DRAFT
☒ FOR PERMITTING PURPOSES
☐ ISSUED FOR CONSTRUCTION

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

DATE: 08/2015
FILE: 0086-356-11
CAD: FIG 3-1 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

REVISIONS

NO.	DATE	DESCRIPTION
1	01/2016	ADDED BORROW AREAS

Weaver Consultants Group
CA 3804 PE – 06/30/2017

TIER III PERMIT MODIFICATION SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM

FIGURE 3-1

O:\0086\356\EXPANSION 2013\APPENDIX P\FIGURE 3-1.dwg, sford, 1:2

4 CLOSURE PROCEDURES

4.1 Closure Sequence

Waste Management of Oklahoma, Inc., will conduct ongoing closure of the landfill throughout its active life. This procedure allows for successive closure of fill areas by placement of final cover, construction of drainage and erosion control features, and establishment of vegetative cover. This procedure will be followed until all phases have been closed.

The active area of the landfill is approximately 163.3 acres. This includes the pre-Subtitle D area, Phases V through XII and sidewall liner above Phases VII/VIII and above Phases IX through XII. The closure area and construction time associated with placing the final cover system over the area is detailed below.

The final cover will consist of a monolithic soil alternative final cover system. Soil will be obtained from on-site borrow areas or from local offsite sources.

4.2 Closure During Active Life

As described above, the final cover will be constructed as fill areas achieve the design grades. Should closure of the landfill become necessary at any time during the active life of the landfill, the following steps will be taken:

- Engineering plans will be developed to address site closure at the time of discontinued waste filling.
- The final waste received will be placed and properly compacted.
- Excavations will be filled with suitable material, and the site will be graded to promote runoff and prevent ponding.
- The final cover system will be constructed according to specifications.
- The top of the landfill will be regraded and reshaped as needed to provide the proper slope for positive drainage.
- During the first growing season following application of final cover, the site will be vegetated with permanent vegetation, using the methods included in the Vegetation Plan (refer to the AFC Design Modification Dated August 2007, included in Appendix J).

- Additional soil will be added to the sideslopes, as needed, and the soil will be processed using a disc to prepare the soil for seeding.
- A surface water management system will be constructed to minimize erosion.
- A closure certification will be prepared by an independent registered professional engineer and submitted to ODEQ for approval.
- All proper notices and documentations will be filed with the appropriate agencies.

4.3 Additional Closure Information

The area for refuse disposal encompasses approximately 163.3 acres excluding the buffer zones, drainage areas, and unsuitable areas. To date, Waste Management of Oklahoma, Inc., is utilizing the entire permitted area of the site. The estimated maximum capacity of the landfill is 18,455,405 cubic yards.

The facility is classified as a Municipal Solid Waste Landfill (MSWLF) and accepts residential, commercial, and light industrial waste, as well as asbestos. No regulated hazardous waste or liquid wastes are accepted at this site.

There are currently two permanent on-site structures, an office/scalehouse and a maintenance building. These structures will be removed to develop future portions of the landfill. These structures will be rebuilt/relocated to the east as noted on Figure 3-1. All other structures that are on site at the time of final closure will be removed or decommissioned. All equipment used during the operation and closure of the landfill will be removed from the site after final closure has been certified as complete.

The access roads will be maintained throughout the active life and postclosure period of the landfill. Facilities at the site, including the perimeter fencing, will be maintained throughout the postclosure period.

Final wastes or affected soils remaining on-site at the time final closure has been completed will be transported to a facility permitted to handle the wastes and/or affected soils. Currently, only ODEQ approved closure activities have occurred at the site and, therefore, a plan for remedying all former improper closure at the site is not applicable.

Prior to initiating closure, the existing conditions and applicable regulations will be reevaluated to ensure that this Closure Plan is still applicable.

4.4 Borrow Area

The soil borrow area and stormwater management areas as well as off-site soil borrow area utilized by the landfill for operational cover soils ~~is~~ are shown on Figure 3-1. ~~This~~ The off-site soil borrow area consists of approximately 98 acres. The excavation of the borrow areas will continue.~~, and a~~ As excavation activities are completed, ~~vegetation will~~

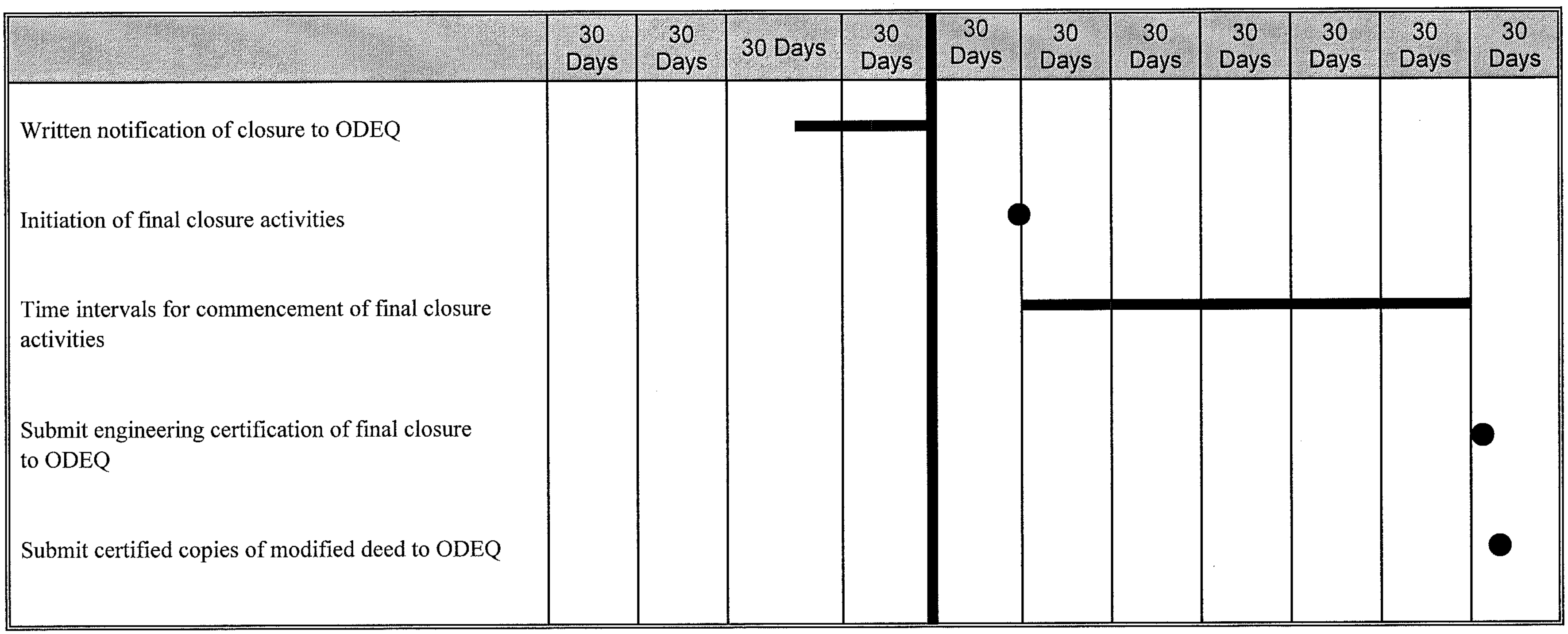
~~be established.~~ the borrow areas will be reshaped and revegetated or otherwise reclaimed, within 120 days of the date the area ceased being used. Excess surface water flow into the borrow areas will be handled through means of pumping during development to allow continued excavation of solid material. All site surface water discharge locations will be included in the site Stormwater Pollution Prevention Plan (SWPPP).

Vegetation will be established as the excavation reaches the permitted grades. After vegetation is established in the borrow area, it will be routinely inspected throughout the life of the site and the closure/postclosure periods. The vegetative cover will be capable of self-regeneration and will require no maintenance. If bare spots develop, then the area will be re-seeded and maintained (e.g., watered and fertilized) as noted above until the vegetation is re-established. Also, during these inspections the slopes will be inspected and if necessary reshaped to maintain their grades.

5 CLOSURE SCHEDULE

The site will be closed in an orderly fashion, consistent with OAC 252:515-25-33. The final closure schedule is presented in Figure 5-1.

Figure 5-1: Final Closure Schedule
East Oak Recycling and Disposal Facility



Note: Schedule is based on anticipated date of beginning final closure activities.
Heavy vertical line signifies final receipt of waste.

6 POSTCLOSURE ACTIVITIES

6.1 Introduction

This Postclosure Plan has been prepared for the East Oak RDF consistent with OAC 252:515-25-53. In accordance with OAC 252:515-25-51(b) postclosure care maintenance will commence immediately upon completion of final closure requirements. Postclosure activities will continue for a period of 30 years minimum, unless the ODEQ approves a postclosure period of a different duration or if ODEQ extends the postclosure period (consistent with OAC 252:515-25-52).

6.2 Monitoring and Maintenance

Postclosure inspections shall be performed on a quarterly basis during the first three years of the postclosure period. Subsequent inspections will be performed semi-annually for the next two years and annually for the remainder of the postclosure period. Additional inspections may be conducted to observe repairs or evaluate problem areas discovered during prior inspections.

The quarterly, semi-annual, and annual postclosure inspections will consist of the inspection and evaluation of the final cover system and vegetative cover, the drainage and erosion control structures, the leachate collection system, and the security system. The frequency and specific inspections associated with the groundwater monitoring and gas monitoring programs are addressed in the LGMP in Appendix G and the GWSAP in Appendix F.

6.2.1 Final Cover

Postclosure care will verify the integrity of the final cover system and its ability to minimize infiltration and erosion. The following conditions should be examined during the inspection:

- Settlement
- Cracking
- Erosion
- Animal burrows

- Other disturbances affecting either the thickness or configuration of the final cover system

Maintenance and repairs should be conducted as soon as practical and may consist of filling in areas of settlement, regrading, and slope restabilization. In areas of substantial settlement or displacement of the final cover system, the integrity of the cap should be reevaluated and any necessary repairs made. The final cover system should be maintained to provide the proper slope, to promote surface water runoff, and to assure continuity of the final cover components to minimize infiltration and leachate production.

Included as part of the final cover system inspection, the integrity of the vegetation and its ability to minimize infiltration and erosion will be determined. The following conditions should be examined during the inspection:

- Erosion
- Overgrowth of shrubs, trees, and other deep-rooted vegetation
- Patches of dead vegetation

Maintenance and repairs of the vegetative cover may consist of the following activities:

- Reseeding, fertilizing, liming, and mulching of washed out areas
- Brush removal
- Mowing

Reseeding should be conducted as necessary to assure proper vegetative growth over all areas of the final cover. Mowing and removal of deep-rooted brush and vegetation should be performed at least twice per growing season.

6.2.2 Drainage and Erosion Controls Structures

Drainage and erosion controls will be inspected throughout the postclosure period to ensure that surface water is conveyed away from the landfill to the perimeter drainage system. Items or conditions to be examined include the following:

- Erosion
- Settlement
- Structural integrity of berms, letdown structures, and other drainage and erosion control structures
- Silt and sediment buildup

Maintenance and repairs should be conducted as soon as practical, and may consist of the following activities:

- Replacement of riprap, gabions, or other structural lining installed for erosion protection
- Removal of obstructions to permit conveyance of surface water
- Placement of fill and regrading
- Removal of silt and sediment
- Repairs to berms
- Repair of replacement of stacked hay bales or silt fencing

6.2.3 Leachate Collection System

Postclosure care of the leachate collection system consists of operation and maintenance of the leachate collection system, as well as any storage, pumping, or conveyance systems. As required by OAC 252:515-25-54(b)(2)(B), the leachate collection system will be equipped with a system for automatic and continuous leachate removal.

The leachate collection system will be observed during each scheduled inspection event throughout the postclosure period. Based on the results of the inspections, more frequent or less frequent monitoring may be required due to problems with the system or changes in the rate of production of leachate. During these inspections, leachate collection sumps and/or piping, clean-outs, or inspection points will be observed to determine the effectiveness of the system in removing leachate and minimizing the head on the liner system.

Maintenance, on an annual or otherwise as-needed basis, may include flushing and pressure cleaning of the leachate collection and removal pipes.

6.2.4 Groundwater Monitoring System

The GWSAP includes a discussion of the procedures for monitoring the groundwater monitoring wells. At a minimum, groundwater sampling will be performed every six months in accordance with OAC 252:515-25-54(b)(1)(A) and the GWSAP (refer to Appendix F).

6.2.5 Surface Water Monitoring Program

The postclosure monitoring activities will adhere to the requirements of the Oklahoma Pollution Discharge Elimination System (OPDES) Multi-Sector General Permit. ~~It is anticipated that postclosure monitoring regarding surface water will be primarily to assure control of sediment in water discharged from the site. Surface water monitoring will be performed visually once every quarter and laboratory tested once per year each year the site is in operation in accordance with the OPDES General Permit.~~

6.2.6 Landfill Gas Monitoring System

The Landfill Gas Monitoring Plan (LGMP) provides a description of the procedures to be followed for monitoring the perimeter probes. At a minimum, landfill gas monitoring probes will be sampled every six months in accordance with OAC 252:515-25-54(b)(1)(B).

6.2.7 Site Security and Access Control

Postclosure care of the security system is necessary to control unauthorized access and prevent illegal dumping of wastes. Inspection of the security system at the site should be performed during the postclosure inspections. Signs shall be posted on the outer perimeter indicating that the site is a closed MSWLF, as required by OAC 252:515-25-54(a)(1). The closed facility will be maintained as necessary to provide access to the closed areas throughout the postclosure period.

Maintenance and repairs should be implemented as soon as practical and may include the repair of access roads and repairs or replacement of fencing and locks.

7 POSTCLOSURE LAND USE

There are no current planned uses for the East Oak RDF after closure. Should use of the closed landfill not associated with solid waste activities be considered, plans will be prepared and submitted to the ODEQ for review and approval per OAC 252-515-25-57.

8 POSTCLOSURE REPORTING REQUIREMENTS

8.1 Annual Postclosure Report

Beginning one year after the ODEQ's approval of the certification of final closure, Waste Management of Oklahoma, Inc., will submit an annual postclosure maintenance and monitoring report to the ODEQ until the postclosure period ends. This report will document the maintenance performed at the site and summarize all monitoring data for the previous year. The report shall be submitted by April 1st of each year after ODEQ's certification of final closure.

8.2 Certification of Postclosure Performance

At the conclusion of the postclosure period, Waste Management of Oklahoma, Inc., will submit, in lieu of the annual postclosure report, a certification, signed by both Waste Management of Oklahoma, Inc., and a professional engineer registered in the State of Oklahoma, indicating that the MSWLF was maintained and monitored in accordance with the approved postclosure plan, the permit, and applicable regulations. This certification will also indicate whether monitoring throughout the postclosure period has shown the presence of elevated levels of any constituent or if any evidence of contamination related to site operations has been found and if so, what corrective measures were taken. The certification will be maintained in the Site Operating Record.

APPENDIX Q

CLOSURE AND POSTCLOSURE COST ESTIMATES

Note: This appendix includes the following.

- An ODEQ cover letter for a Tier I Permit Modification for the C/PC cost update issued on February 19, 2015.
- The C/PC Cost Update.

Upon ODEQ approval of the Tier III Permit Modification, the C/PC cost estimates will be updated and provided to ODEQ. Upon ODEQ approval of the C/PC cost estimate updates, East Oak RDF will update the financial mechanism accordingly.

WASTE MANAGEMENT

EAST OAK RECYCLING AND DISPOSAL FACILITY

3201 Mosley Road
Oklahoma City, Oklahoma 73141
(405) 427-1112
Fax (405) 427-1139

February 19, 2015

Hillary Young, PE
Chief Environmental Engineer
Land Protection Division
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

**SUBJECT: Tier I Permit Modification: Closure/Postclosure Cost Update
East Oak Recycling and Disposal Facility
MSW Permit No. 3555036
Oklahoma County, Oklahoma**

Dear Ms. Young:

On behalf of Waste Management of Oklahoma, Inc. (WMO) and East Oak Recycling and Disposal Facility (RDF), the purpose of this Tier I Permit Modification is to provide the attached updates to the Closure/Postclosure Cost based on 2nd quarter of 2015 changes (i.e., landfill gas construction activities).

Per the February 7, 2014 submittal of the C/PC update that included 2014 landfill gas construction activities; the current C/PC cost is $9,031,740.55.00 (Closure: $4,465,694.56 and Postclosure Cost: $4,566,045.99) in 2014 dollars. Based on the construction of the 2015 landfill gas construction activities the updated C/PC cost is $9,266,432.45 (Closure: $4,544,267.49 and Postclosure Cost: $4,722,164.96) in 2015 dollars. Upon ODEQ approval of the updated C/PC cost, East Oak RDF will update the financial mechanism accordingly.

If you have any questions, or need any additional information, please call (405-417-8124).

Sincerely,

**Guy R. Campbell
Engineering/Environmental Manager
Waste Management of Oklahoma, Inc.**

Attachments: Table H.1 Site Data
Table H.2 Closure Cost Estimate
Table I.1 Post Closure Estimate

cc: Pete Schultze, WMO (operating record)
Paula Carboni, WMO

Table H.1 Site Data

FACILITY NAME: East Oak RDF
COUNTY: Oklahoma County
PERMIT NUMBER: 3555036
Updated: February 19, 2015

DESCRIPTION	QUANTITY	UNITS
Total Permitted Area	158.9	acres
Active Portion		
Composite Lined	126.20	acres
Soil Lined	10.00	acres
Final Cover Area		
Composite Lined	126.20	acres
Soil Lined	10.00	acres
Perimeter Fencing	7,600	linear feet
Groundwater Monitoring Wells	692.0	linear feet
Methane Gas Probes	240.0	linear feet
Terraces	4,000	linear feet
Letdown Channels	1,500	linear feet
Perimeter Drainage Ditches	7,400	linear feet
Average Daily Flow	2,000	tons/day
Landfill Disposal Cost	$17.72	$/ton
Off-Site Borrow Area	133.00	acres
On-site Borrow Area	0.00	acres
Number of Groundwater Monitoring Wells	14	wells
Number of LFG Monitoring Probes	14	probes
Total Cost of LFG System	$3,497,000	lump sum

Table H.2 Closure Cost Estimate

FACILITY NAME: East Oak RDF
FACILITY TYPE: MSWLF
FACILITY LOCATION: Oklahoma County
Updated: February 19, 2015

	Task/Service	Quantity	Units	Multiplier	2015 Unit Cost	Subtotal
1	**PRELIMINARY SITE WORK**					
a	Conduct Site Evaluation		lump sum	1	$3,481.71	$3,481.71
b	Dispose Final Waste					
	Average Daily Flow	2,000	tons/day			
	Disposal Cost	10,000	$/ton	5 days of waste	$17.72	$177,200.00
c	Remove Temporary Building(s)	1	lump sum	1	$3,192.74	$3,192.74
d	Remove Equipment	1	lump sum	1	$2,606.22	$2,606.22
e	Repair/Replace Perimeter Fencing	7,600	linear feet	25% of fencing	$3.42	$6,498.00
f	Clean Leachate Line(s)	1	lump sum	1	$1,576.97	$1,576.97
2	**MONITORING EQUIPMENT**					
a	Rework/Replace	692.0	VLF	25% of wells	$73.22	$12,667.06
rea	Monitoring Well(s)			0		
rea	Monitoring Well(s)			0		
b	Plug Abondoned Monitoring Well(s)	692.0	VLF	25% of wells	$29.31	$5,070.63
c	Rework/Replace Methane Probe(s)	240.0	VLF	25% of probes	$63.23	$3,793.80
d	Plug Abondoned Methane Probe(s)	240.0	VLF	25% of probes	$23.10	$1,386.00
e	Rework/Replace Remediation and/or Gas Control Equipment	5% of equipment capital cost	lump sum	1	$3,497,000.00	$174,850.00
3	**CONSTRUCTION**					
a	Complete Site Grading	136.20	acres	1	$1,380.41	$188,011.84
b	Construct Final Cap					
	Compacted On-site Clay Cap or	439,472	cubic yards	1	$4.96	$2,179,781.12
	Compacted Off-site Clay Cap or		cubic yards		$8.05	
	Install Geosynthetic Clay Liner Cap		square feet		$0.51	
c	Construct Landfill Gas Venting Layer					
	Place Sand or		acres	1	$36,910.77	
	Install Net and Geotextile		square feet	1	$0.37	$0.00
d	Install Passive Landfill Gas Vents		acres	1	$884.23	$0.00
e	Install Flexible Membrane Liner		square feet	1	$0.40	$0.00
f	Drainage Layer					
	Place Sand or		acres	1	$36,910.77	
	Install Net and Geonet		square feet	1	$0.37	$0.00

Table H.2 Closure Cost Estimate (Continued)

FACILITY NAME: East Oak RDF
FACILITY TYPE: MSWLF
FACILITY LOCATION: Oklahoma County

	Task/Service	Quantity	Units	Multiplier	2015 Unit Cost	Subtotal
g	Place On-site Topsoil	219,736	cubic yards	1	$2.13	$468,037.68
	Place Off-site Topsoil		cubic yards	1	$17.04	
h	Establish Vegetative Cover	136.20	acres	1	$523.86	$71,349.73
I	ODEQ/ODM Off-Site Soil Borrow Area	133.00	acres	1	$523.86	$69,673.38
j	ODEQ/ODM On-Site Soil Borrow Area	0.00	acres	1	$523.86	$0.00
4	**DRAINAGE/EROSION CONTROL**					
a	Construct Terraces	4,000	linear feet	1	$8.93	$35,720.00
b	Construct Letdown Channels	1,500	linear feet	1	$8.38	$12,570.00
c	Clean Perimeter Drainage Ditches	7,400	linear feet	50% of ditches	$6.80	$25,160.00
5	**SUBTOTAL**					
6	**SUBTOTAL**					$3,442,626.88
7	**ADMINISTRATIVE SERVICES**	1	lump sum	1	10%	$344,262.69
8	**TECHNICAL and PROFESSIONAL SERVICES**	1	lump sum	1	12%	$413,115.23
9	**CLOSURE CONTINGENCY**	1	lump sum	1	10%	$344,262.69
10	**TOTAL FINAL CLOSURE**					**$4,544,267.49**

Table I.1 Post Closure Estimate
FACILITY NAME: East Oak RDF
FACILITY TYPE: MSWLF
FACILITY LOCATION: Oklahoma County
Updated: February 19, 2015

	Task/Service	Quantity	Units	Multiplier	2015 Unit Cost	Subtotal
1	**SITE MAINTENANCE**					
a	Site Inspection	4	per year	30 yrs	$633.36	$76,003.20
b	General Maintenance	1	lump sum	30 years	$1,898.56	$56,956.80
c	Remediation and/or Gas Control Equipment	5% of equipment capital cost	lump sum	one per 5 yrs for 30 years	$3,497,000.00	$1,049,100.00
2	**MONITORING EQUIPMENT**					
a	Rework/Replace Monitoring Well(s)	692.0	VLF	25% of wells	$73.70	$12,750.10
b	Plug Abandoned Well(s)	692.0	VLF	25% of wells	$29.31	$5,070.63
c	Final Plugging of Monitoring Wells	692.0	VLF	1	$29.31	$20,282.52
d	Rework/Replace Methane Probe(s)	240.0	VLF	25% of wells	$63.23	$3,793.80
e	Plug Abandoned Probe(s)	240.0	VLF	0	$23.10	$1,386.00
f	Final Plugging of Methane Probes	240.0	VLF	1	$23.10	$5,544.00
g	Final Plugging of Piezometer(s)	0	VLF	1	$23.10	$0.00
3	**SAMPLING and ANALYSIS**					
a	Groundwater Monitoring Wells	14	wells	2/yr for 30 years	$682.94	$573,669.60
b	Methane Gas Probes	14	probes	2/yr for 30 years	$44.31	$37,220.40
c	Surface Water Monitoring Points	2	points	2/yr for 30 years	$82.31	$9,877.20
d	Leachate	1	sample	2/yr for 30 years	$132.62	$7,957.20
4	FINAL COVER MAINTENANCE					
a	Mow and Fertilize Vegetative Cover	136.20	acres	30 years	$209.52	$856,098.72
b	Repair Erosion, Settlement, and Subsidence for On-site Soils	136.20	acres	2 CY/acre for 30 years	$3.03	$24,761.16
	Repair Erosion, Settlement, and Subsidence for Off-site Soils		acres	2 CY/acre for 30 years	$18.17	
c	Re-seed Vegetative Cover	136.20	acres	20% of area for 30 years	$523.85	$14,269.67
5	LEACHATE MANAGEMENT					
a	Clean Leachate Line(s)	1	lump sum	30 years	$1,624.12	$48,723.60

Table I.1 Post Closure Estimate (Continued)

FACILITY NAME: East Oak RDF
FACILITY TYPE: MSWLF
FACILITY LOCATION: Oklahoma County

	Task/Service	Quantity	Units	Multiplier	2015 Unit Cost	Subtotal
b	Maintain Leachate Collection Systems and Equipment	1	lump sum	30 years	$2,523.13	$75,693.90
c	Collect, Treat, Transport and Dispose Leachate	100,000	gallons/year	30 years	$0.32	$960,000.00
6	SUBTOTAL					
7	SUBTOTAL					$3,839,158.50
8	ADMINISTRATIVE SERVICES		lump sum	1	6%	$230,349.51
9	TECHNICAL and PROFESSIONAL SERVICES		lump sum	1	7%	$268,741.10
10	POST-CLOSURE CONTINGENCY		lump sum	1	10%	$383,915.85
11	TOTAL POST CLOSURE					**$4,722,164.96**

APPENDIX R

TITLE V OPERATING PERMIT

Note: This appendix includes the following.

- Title V Operating Permit Renewal No. 2011-226-TVR2 issued on ~~June 30, 2014~~ September 24, 2015.

~~A modification to the Title V Operating Permit has been concurrently submitted to the Air Quality Division based on the Tier III Permit Modification.~~

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

Ms. Paula Carboni, Environmental Manager
Waste Management of Oklahoma, Inc.
P.O. Box 400
Ferris, Texas 75125

SUBJECT: Title V Operating Permit Modification **No. 2011-226-TVR2 (M-2)**
Waste Management of Oklahoma, Inc.
East Oak Recycling and Disposal Facility (Facility ID: No. 2061)
3201 Mosley Road, Oklahoma City OK 73141
Section 21, Township 12N, Range 2W,
Oklahoma City, Oklahoma County, OK

Dear Ms. Carboni:

Enclosed is the permit authorizing operation of the referenced facility above. Please note that this permit is issued subject to standard and specific conditions, which are attached. These conditions must be carefully followed since they define the limits of the permit and will be confirmed by periodic inspections.

Also note that you are required to annually submit an emissions inventory for this facility. An emissions inventory must be completed on approved AQD forms and submitted (hardcopy or electronically) by April 1st of every year. Any questions concerning the form or submittal process should be referred to the Emissions Inventory Staff at 405-702-4100.

Thank you for your cooperation. If we may be of further service, or you have any questions about this permit, please contact me, mark.chen@deq.ok.gov, or at (405) 702-4196.

Sincerely,

Mark Chen

Mark Chen, P.E., Senior Environmental Engineer
New Source Permits Section
AIR QUALITY DIVISION

Enclosures

PART 70 PERMIT

AIR QUALITY DIVISION
STATE OF OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY
707 NORTH ROBINSON, SUITE 4100
P. O. BOX 1677
OKLAHOMA CITY, OKLAHOMA 73101-1677

Permit No. 2011-226-TVR2 (M-2)

Waste Management of Oklahoma, Inc.

having complied with the requirements of the law, is hereby granted permission to operate/modify their East Oak Recycling and Disposal Facility located at 3201 Mosley Road, Oklahoma City, Section 21, Township 12N, Range 2W, Oklahoma County, Oklahoma, subject to Major Source Standard Conditions dated July 21, 2009, and Specific Conditions, both attached.

This permit shall expire on June 30, 2019, five (5) years from the issuance date of the original Title-V renewal permit, 2011-226-TVR2, except as Authorized under Section VIII of the Standard Conditions.

Phillip Fielder

Phillip Fielder, P.E.
Permits and Engineering Group Manager

9/24/2015
Date

DEQ Form #100-890 **Revised 10/20/06**

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

MEMORANDUM **September 22, 2015**

TO: Phillip Fielder, P.E., Permits and Engineering Group Manager

THROUGH: Phil Martin, P.E., Engineering Manager, Existing Source Permits Section

THROUGH: Peer Review

FROM: Mark Chen, P.E., New Source Permits Section

SUBJECT: Evaluation of Title-V Permit Application **No. 2011-226-TVR2 (M-2)**
Waste Management of Oklahoma, Inc.
East Oak Recycling and Disposal Facility (Facility ID: 2061)
3201 Mosley Road, Oklahoma City, Oklahoma
Latitude N 35.50749°, Longitude W 97.41459°
Section 21, Township 12N, Range 2W
Oklahoma City, Oklahoma County, Oklahoma
Directions: From downtown OKC, take Interstate I-35 north for 3 miles, take NE 36th Street exit, go east on NE 36th Street for 2.5 miles, then, turn south into the facility.

SECTION I. INTRODUCTION

Through Weaver Boos Consultants, LLC, Waste Management of Oklahoma, Inc. (WMO) has requested a modification of the Part 70 Title-V operating permit for their East Oak Recycling and Disposal Facility (RDF) (SIC 4953, NAICS 562212). East Oak RDF is an active municipal solid waste (MSW) landfill under DEQ Land Protection Division (LPD) Solid Waste ID. No. 3555036. Currently, the facility is operating under Air Quality Division (AQD) Permit No. 2011-226-TVR2 (M-1) issued on June 24, 2015. The original landfill gas collection and control system (GCCS) and flare were constructed under Permit No. 96-471-C, which was issued on February 25, 1997. The original Title V Permit No. 99-405-TV was issued on January 31, 2001. On April 22, 2013, this facility was authorized the addition of a landfill gas (LFG) to liquids (GTL) facility under Permit No. 2005-152-TVR (M-1). The GTL facility utilizes the LFG at the facility to produce liquid hydrocarbons that can be used and sold as fuel. East Oak RDF proposed to construct a full scale GTL plant with commercial production capacity and the proposal was permitted in Permit No. 2005-152-TVR (M-3) issued on June 27, 2014. The full scale GTL plant was incorporated into the Title-V renewal permit, Permit No. 2011-226-TVR2 issued on June 30, 2014. The plant startup date is expected to be in the first quarter of 2016. In this permit modification, WMO requested to expand permitted landfill design capacity from 14,612,882 megagrams (Mg) to 15,143,602 Mg. The emission increase is less than 5 TPY, which is not considered significant and is qualified as a minor modification under OAC 252:100-8-7.2(b)(1)(A), therefore, this permit is processed as a Tier I minor modification. AQD also uses this opportunity to update applicable state rules and federal regulations related to the facility.

SECTION II. FACILITY DESCRIPTION

The facility is comprised of two adjacent landfills, one is the Mosley Road Landfill and the other is East Oak RDF. The Mosley Road Landfill operated from 1975 to 1987, while the East Oak RDF began operations in 1987. A minor Title V modification in 2003 permitted the expansion of the East Oak RDF and allowed the site to fill in the area between the two original sites, thus creating one large landfill, which is known as East Oak RDF. The total land area is approximately 200 acres for landfill operation, and 50 acres are originally from Mosley Road Landfill and 150 acres are developed by East Oak RDF. Currently, the facility operates 6 days a week and receives nonhazardous solid waste from Great Metropolitan Oklahoma City Area, including Edmond, Yukon, Mustang, Moore and Norman. The facility typically receives approximately 2,000 ton/day of municipal, commercial, and industrial nonhazardous waste. The facility also accepts nonhazardous liquid and semi-solid waste at its solidification area. The East Oak RDF has recently increased their design capacity from approximately 18.413 million cubic yard (or 14.612 million Mg) to 19.808 million cubic yard (or 15.144 million Mg). At the end of 2014, the facility is estimated to have accepted total waste of 9.936 million Mg since 1975, which is estimated based on WM's record and the EPA's LandGEM Version 3.02 Model conducted on 7/2/2015. The remaining permitted capacity is approximately 5.208 million Mg.

LFG is usually generated by microbiological processes associated with waste decomposition, and LFG is composed primarily of methane (CH_4) and carbon dioxide (CO_2): CO_2 content ranging from 30 to 50% and CH_4 from 40 to 60%. Initial decomposition of the wastes is continuous and rapid until the entrained oxygen within the refuse is depleted. The second stage is anaerobic decomposition that can be divided into two separate and independent processes: non-methanogenic and methanogenic. CO_2 is a byproduct of the non-methanogenic process and CH_4 is a byproduct of the methanogenic process. LFG may contain small amounts of non-methane organic compounds (NMOC), which include trace volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). The production of LFG begins a few months after initial waste placement and continues until the microbial reactions are limited by substrate or moisture availability. LFG production is also affected by the solid waste disposal rate and varies over the life of the landfill. Generally, LFG production increases with time until a peak volume is reached shortly after landfill closure. In general, the LFG collection system consists of a network of vertical extraction wells, horizontal header pipes, and gas condensate sumps, and the collected LFG is processed and is either transported to off-site users or sent to on-site flare.

The GTL facility is currently operated by Envia Energy Oklahoma City. The existing GTL facility is located at 3500 North Sooner Road on the same site of WM's landfill operation (Section 21, Township 12N, Range 2W) and is authorized to use LFG to produce liquid hydrocarbons in Permit 2011-226-TVR2. The existing GTL facility is essentially a demonstration unit to demonstrate the latest waste-to-energy and gas-to-liquid process or technology and the facility has accumulated more than 10,000 hours of successful operation. In Permit No. 2011-226-TVR2 application, Envia Energy Oklahoma City proposed to construct a full scale GTL facility with commercial production capacity. This proposal was originally permitted in Permit No. 2005-152-TVR (M-3) and then modified in Permit No. 2011-226-TVR (M-1) issued on June 24, 2015.

In the GTL process/technology, the first step is to remove the moisture and H_2S (sulfur-containing compounds) from the LFG and to treat and prepare the LFG for the oncoming chemical reactions. The next step is to convert the methane to a specific syngas through a specific reaction condition. The last reaction step is to convert the syngas to various liquid hydrocarbons via Fischer-Tropsch chemistry, such as naphtha, diesel, and wax products. The final process is to separate and purify the products to meet the customers' specifications. The waste gaseous streams are recycled and combusted either in the process heater or landfill flares. Essentially speaking, the CO_2 in LFG goes through various processes as inert compound and does not significantly involve in any chemical reaction. Both LFG and natural gas are permitted either as feedstock to the GTL process or as fuel to burners/flares in this Title-V renewal permit. The emission units in the GTL facility are process heaters and product storage tanks. Both process heaters and product storage tanks are sized to meet the requirement in the commercial production scale capacity. A stack will be constructed to vent process exhaust streams from the GTL facility.

Briefly speaking, because the facility has a landfill design capacity greater than 2.5 million Mg and 2.5 million cubic meters (m^3) and has non-methane organic compound (NMOC) emission rate greater than 50 Mg/yr, therefore, the facility is required to comply with the New Source Performance Standards (NSPS) in Title 40 Code of Federal Regulations (CFR) Part 60, NSPS, Subpart WWW and 40 CFR Part 63, NESHAP, Subpart AAAA and is required to install and operate a gas collection and control system (GCCS). The facility has an active GCCS that routes collected landfill gas (LFG) from current 125 extraction wells either to the existing dual utility flares or to the GTL facility. The number of LFG extraction wells will be increased to comply with 40 CFR Part 60, NSPS Subpart WWW. Currently, the flare system is capable of processing 4,500 standard cubic feet per minute (SCFM) of LFG, which is limited by the capacity of the LFG blowers. The dual utility flare stacks have total design capacity to burn 5,600 SCFM of LFG or 12,258 SCFM of hydrogen-rich gas, in accordance with the maximum exit velocities specified in 40 CFR Part 60.18. During abnormal operations of the GTL facility, such as an emergency shutdown, high flow rates of hydrogen-rich gas will be sent to the flare for thermal destruction but shall not exceed the design capacity of 12,258 SCFM. Based on WMO record through dual flare, the LFG generation rate was measured at 2,227 SCFM on 8,717 hours per year in 2014. The GTL facility was not in operation in 2014. After the construction/operation of the proposed GTL facility, the emissions are expected to be lower than the current emissions because the methane in the LFG is converted to liquids instead of combusted as gaseous pollutants through flares.

SECTION III. EQUIPMENT

Emission units (EU) have been arranged into Emission Unit Groups (EUG) in the Equipment Section. Table 1 lists the EUGs.

Table 1. Emission Unit (EU) Information

EU ID #	Emission Sources	EU Group Name
EUG-1	Uncollectable LFG Fugitives from Underground & PM_{10} and $PM_{2.5}$ Fugitives From Earthmoving Operations	Landfill Operation
EUG-2	Dual Flare System	GCCS and LFG Flare
EUG-3	Storage tanks and Truck Loading	GTL Processes

There are three main sources of emissions at the facility. Once MSW is placed in the landfill, it is compacted and covered with soil/dirt/earth. The anaerobic decomposition of buried organic wastes within the covered landfill produces a biogas commonly referred to as LFG. EUG-1 includes uncollectable LFG fugitives from underground and PM_{10} fugitives, which is caused by earthmoving operation equipment, such as dozers, compactors, dump trucks, excavators, graders, and tractors.

EUG-2 includes GCCS and LFG dual flare system. The GCCS consists of a network of extraction wells (currently 125 wells, with numbers changing over time) and collection pipes that collect LFG generated within the landfill. The GCCS is also comprised of a blower system which induces negative pressure within the landfill and transfers the collected LFG to the dual open flare system for burning or to the landfill gas treatment system that is prior to the gas to liquids (GTL) processing facility.

EUG-3 includes all GTL processes and associated equipment. GTL process converts the treated LFG using various pieces of equipment into liquid hydrocarbons and water. Emissions from this process are fully contained and any exhaust gases, volatile organic compounds (VOC), hazardous air pollutant (HAP), or process vent emissions are collected and routed back either to the dual flare system or to the process exhaust vent stack. The GCCS is designed to operate continuously. Upon GTL facility shut down, the LFG will be directed to the dual flare system for combustion.

SECTION IV. AIR EMISSIONS

This Title-V renewal operating permit includes the following emission sources:

- Landfill Gas Generation and Uncollectable Fugitive LFG
- Flare Operations
- Landfill Gas Treatment System (LFGTS) and Gas to Liquids (GTL) Facility
- Earthmoving Equipment Operations
- Insignificant Activities
- Greenhouse Gas (GHG) Emissions

Landfill Gas Generation

Municipal solid waste is accepted and taken directly to the landfill for disposal. The anaerobic decomposition of organic material in the waste results in the generation of a biogas commonly referred to as LFG. Consisting of approximately 50 percent methane and 50 percent carbon dioxide, LFG also includes other trace compounds and water vapor.

The EPA's Landfill Gas Emissions Model (LandGEM) Version 3.02 (5/2005) was used to determine the NMOC and maximum LFG generation for the site, based on the current site conditions and forecasts. The NMOC is determined based on the model's input parameters: (1) landfill's total design capacity of 15,143,602 Mg, (2) waste acceptance data, (3) a methane generation rate constant of 0.05 yr^{-1}, (4) a potential methane generation capacity of 170 m^3/Mg, and (5) a LandGEM default NMOC concentration of 600 parts per million by volume (ppmv). Based on the results of the modeling, the maximum NMOC generation rate in LFG is estimated at 284.72 TPY or 258.30 Mg per year in 2025, which is greater than 50 Mg per year. The LandGEM software program was conducted on 7/30/2015.

The maximum LFG generation is determined based on LandGEM model's default inventory parameters: (1) the landfill's total design capacity of 15,143,602 Mg, (2) waste acceptance data, (3) a methane generation rate constant of 0.04 yr^{-1}, (4) a methane generation capacity of 100 m^3/Mg, and (5) a LandGEM default NMOC concentration of 600 parts per million by volume (ppmv). The LandGEM software program was conducted on 7/2/2015. Based on the results of the modeling, the landfill will generate a maximum of 31.99 million cubic meters per year (m^3/yr) of methane (CH_4) in 2025. Methane is assumed to be 50 percent of the total volume of LFG, then, the maximum projected LFG generation rate for the landfill is estimated to be 4,299 SCFM in 2025. In Permit No. 2011-226-TVR2 (M-1), the maximum LFG generation rate was estimated at 4,564 SCFM, which was based on a projected waste acceptance average rate at 538,648 Mg/yr over a period of 2006-2014. The estimated 4,299 SCFM is based on actual waste acceptance average rate at 486,885 Mg/yr over a period of 2006-2014. In accordance with the EPA AP-42 (11/98), Section 2.4, "MSW Landfills", the GCCS may be assumed to have a 75% collection efficiency of generated LFG and the remaining 25% of LFG is considered as uncollectable fugitives to the air from underground. VOC content is based on 39% of NMOC in LFG per LandGEM Model Version 3.02 (5/2005). HAP content is based on 17.96% of NMOC in LFG per LandGEM Model Version 3.02 (5/2005). Table 2 lists potential fugitive emissions from landfill site.

Table 2. Potential Landfill Fugitive Emissions
(Based on 8,760 hours/year of operations)

Pollutants	Emission Factors	Emission Rate (TPY)
VOC	216 ppmv in LFG	13.42
HAP	107.76 ppmv in LFG	7.62

Flare Operations

The dual flare system consists of two open flares which are both 36 feet in height with 10 inch diameter stacks and 12 inch diameter tips situated on a single skid. Each flare stack has a maximum capacity of 2,800 SCFM of LFG or 6,129 SCFM of hydrogen-rich gas and is equipped with a thermocouple located near the stack exit to determine the flame presence. Currently, each flare blower is capable of processing a maximum of 2,250 SCFM of LFG from the landfill gas collection system. Upon main flame loss at the flares both the waste gas valve will be closed and the landfill gas blower will be shut off. Automatic re-ignition will be attempted resuming normal flare operation. If the pilot re-ignition or main flame are not detected within a specified period of time the flare will shut down and a signal will be sent to the autodialer to notify personnel of the flare system failure (shutdown). A master flow control valve installed along the main LFG header regulates the amount of LFG extracted from the landfill. This valve is also used as an isolation valve to prevent the direct release of LFG emissions from the collection system during system repairs. Monitoring ports in the main header, upstream from the valve, are used to measure LFG flow, pressure, and composition.

Air emissions from the flare are primarily NO_x, CO, SO_2, HCl, PM_{10}, $PM_{2.5}$, and VOC. The air emission estimates for the flare system are based on a worst-case scenario when the GTL is not in operation and all generated LFG is sent to the flares and the emission calculation are based on the following conditions:

1. System's maximum design flowrate at 4,500 SCFM of landfill gas.
2. LFG constituents of 50% methane.
3. Emission factors for SO_2 is based on the default concentration of SO_2 in the LFG as listed in AP-42 (11/98) Table 2.4-1.
4. Emission factors from manufacturer for NO_x and CO, and from AP-42 (11/98) Table 2.4-5 for PM. The emission factor is the same for the PM_{10}, and $PM_{2.5}$.
5. LFG's heating value of 500 BTU/ft^3.
6. A destruction (combustion) efficiency rate of 98% for VOCs and HAPs.
7. Estimates of HAP emissions are based on LFG constituent concentrations in AP-42 (11/98) Table 2.4-1 or site specific LFG samples with the system's design flow rate (4,500 SCFM) of LFG being collected and combusted in the flares.

Table 3. Potential Flare Emissions
(Based on 8,760 hours/year of operations)

Pollutants	**Emission Factors**	**Emission Rate (TPY)**
NO_x	0.068 lb/MMBTU	40.21
CO	0.37 lb/MMBTU	218.78
Particulate Matter, PM_{10}, or $PM_{2.5}$	0.00104 lb/hr/scfm of CH_4	10.03
SO_2	--------	9.08
HAP	--------	5.14
VOC		1.12

Landfill Gas Treatment System (LFGTS) and GTL Facility

A portion of the collected LFG is directed to a landfill gas treatment system prior to being sent to the GTL facility. The LFG is filtered through at least a 10 micron screen to reduce the particulate matter size, de-watered using gas coolers and a dryer, and compressed in the treatment system. Based on the DEQ Evaluation of Applicability Determination No. 2005-152-AD (M-2), issued September 15, 2011, the LFG treatment system operates as the control device prior to the treated gas being subsequently used by the GTL facility. Therefore, the treated gas used during the gas to liquids process is not subject 40 CFR Part 60, Subpart WWW. Under normal operation, all process exhaust streams will be vented to the flare or process exhaust vent stack.

In Permit No. 2011-226-TVR2, additional emission sources in the proposed commercial production plant include one (1) 7.0 MMBTUH heater, which was to burn only natural gas (no LFG), two (2) 30,000 gallon diesel storage tanks, two (2) 30,000 gallon wax storage tanks, and two (2) 15,000 gallon naphtha fixed roof storage tanks. In Permit No. 2011-226-TVR2 (M-1), additional emission sources in the proposed commercial production plant include two (2) 30,000 gallon diesel storage tanks, two (2) 4,000 gallon diesel storage tanks, two (2) 30,000 gallon wax storage tanks, and two (2) 15,000 gallon naphtha internal floating roof storage tanks. In addition, there are two (2) 20,000 gallon mixed hydrocarbon process tanks added to the facility. However, these two hydrocarbon tanks do not store the finished products, but are in-process tanks that hold hydrocarbons prior to being transferred to other equipment, and therefore not considered storage tanks. The diesel and wax products have a vapor pressure less than 1.5 psia at the maximum storage temperature, the VOC emissions are estimated less than 5 TPY, therefore, these tanks meet the specification requirement of OAC 252:100, Appendix I, and are considered insignificant activities. The naphtha products shall be submerged-filled according to OAC 252:100-37-15(b).

Naphtha internal roof storage tank emissions were calculated using the TANKS 4.0.9d computer software and using a total annual naphtha throughput of 562,500 gallons per year. VOC emissions for the diesel and naphtha truck loading operation are estimated using AP-42 (1/95), Equation (1) in Section 5.2, "Transportation and Marketing of Petroleum Liquids," and Tables 5.2-1 and 7.1-2. VOC emissions from naphtha truck loading were calculated based on 562,500 gallons per year throughput, 99.79 molecular weight, 19.01 psia true vapor pressure, and 120°F bulk liquid temperature. The naphtha vapor will be collected and routed to the flare with 98% destruction efficiency. VOC emissions from diesel truck loading were calculated based on 2,039,000 gallons per year throughput, 201.20 molecular weight, 0.24 psia true vapor pressure, and 120°F bulk liquid temperature. Table 4 shows the VOC emissions from the LFGTS GTL Facility.

Table 4. LFGTS GTL Facility Emissions

Emission Source	**NO_X**	**CO**	**VOC**
	TPY	**TPY**	**TPY**
Naphtha Storage Tank	----	----	0.08
Naphtha Truck Loading	----	----	0.14
Diesel Truck Loading	----	----	0.63
Totals	----	----	**0.85**

The LFG generation at the East Oak RDF is not enough to operate both facilities, one facility is at the Landfill to supply the Dual Flare System at their maximum capacities, and the other facility is to supply LFGTS GTL Facility. That means, the methane in the LFG can either be burned through the dual flares, or can be treated in the GTL Facility and converted to other products, but the methane in the LFG cannot be done in both ways. Therefore, all criteria pollutants emissions, which are caused by the residual/waste gaseous streams from the GTL facility and combusted in the flare system will not be included in the emission estimation. Table 3 shows the potential emissions from the dual flares, which is considered the worst case scenario for the emissions from the GTL Facility.

Earthmoving Equipment Operations

Particulate emissions are generated during on-site earthmoving operations, which include the excavation of landfill cells and the placement of daily cover soil over the freshly placed waste at the landfill's working face. To control particulate emissions from earthmoving operations, water is sprayed on the surfaces by a water truck, as needed. Particulate emissions from the various earthmoving operations are based on the operating hours of the earthmoving equipment and the number and types of vehicles.

Air emissions generated from the landfill's earthmoving operations, which include the emissions from four (4) bulldozers, one (1) compactor, three (3) excavators, three (3) dump trucks, one (1) tractors, and one (1) grader operations at the site. Dozing, compacting, and grading emissions were estimated using emission factors derived from AP-42 (10/98), Table 11.9-1, Section 11.9, "Western Surface Coal Mining." Emissions from dump truck and excavator operations were estimated using emission factors derived from AP-42 (11/06), Table 13.2.4-1, Section 13.2.4, "Aggregate Handling and Storage Piles." Emissions from vehicle travel on unpaved roads were estimated using emission factors derived from AP-42 (11/06), Tables 13.2.2-1 and 13.2.2-2, Section 13.2.2, "Introduction to Fugitive Dust Sources, Unpaved Roads."

Dozing and compacting operation emissions were estimated using emission factors derived from AP-42 (10/98), Table 11.9-1, for handling overburden materials, Section 11.9, "Western Surface Coal Mining." The emission factor equation is presented below:

$$E = k\ (s)^a/(M)^b$$

Where k, a, and b are empirical constants, given below and

E = Emission factor (lb/hr)
s = Mean material silt content (%), 6.9% from Table 11.9-3
M = Mean material moisture content (%), 12.0% for landfill soil cover
k = 0.75 lb/hr for PM_{10} and 0.105 lb/hr for $PM_{2.5}$
a = 1.5 for PM_{10} and $PM_{2.5}$
b = 1.4 for PM_{10} and $PM_{2.5}$

The total working hours of four (4) bulldozers and one (1) compactor are 18,270 hours per year. Each vehicle operates 12 hours/day, 6 days/week, and 52 weeks per year.

The emission factor equation for grading operation is from Table 11.9-1 and presented below:

$$E = k\ (0.051)\ (S)^a$$

E = Emission factor (lb/VMT)
S = Mean vehicle speed (mph), 4 mph for grader vehicle
k = 0.60 lb/VMT for PM_{10} and 0.031 lb/VMT for $PM_{2.5}$
a = 2.0 for PM_{10} and $PM_{2.5}$

The total VMT (Vehicle Mile Traveled) for one grader vehicle is 2,496 miles per year. The vehicle works 2 hours/day, 6 days/week, and 52 weeks per year.

Emissions from dump truck and excavator operations were estimated using emission factors derived from AP-42 (11/06), Table 13.2.4-1, Section 13.2.4, "Aggregate Handling and Storage Piles." The emission factor equations, Equation (1) in Section 13.2.4.3 is presented below:

$$Emission\ Factor, E = k(0.0032)\frac{(U/5)^{1.3}}{(M/2)^{1.4}}$$

Where k, U, and M are parameters, given in the next page :

E = Emission factor (lb/ton)
k = Particle size multiplier, 0.35 for PM_{10} and 0.053 for $PM_{2.5}$
U = Mean wind speed, 10 miles/hour
M = Mean material moisture content (%), 12.0% for landfill soil/dirt

The total weight of soil/dirt, which are loaded to the truck and then unloaded to the ground, is estimated to be 336,000 tons per year, which is 200,000 cubic yard (CY) of soil/dirt with the soil density of 1.68 ton/CY.

Fugitive emissions from vehicle traffic are estimated based on AP-42 (11/2006), Section 13.2.2, "Introduction to Fugitive Dust Sources, Unpaved Roads." The Equation (1a), the formula for industrial roads, is used to calculate the PM_{10} emissions.

$$E = k\ (s/12)^{a}\,(w/3)^{b}$$

Where k, a, and b are empirical constants, given below and

E = site-specific emission factor (lb/VMT)
s = surface material silt content (%), 6.4% for MSW Landfills
w = mean vehicle weight (tons), 18 tons
k = 1.5 lb/VMT for PM_{10} and 0.15 lb/VMT for $PM_{2.5}$
a = 0.9 for PM_{10} and $PM_{2.5}$
b = 0.45 for PM_{10} and $PM_{2.5}$

The emission factors are determined to be 1.908 lb of PM_{10} and 0.191 lb of $PM_{2.5}$ per VMT. It is assumed that a 10 wheeler is used to transport in 14 tons of MSW with total vehicle weight at 25 tons and the mean vehicle weight at 18 tons for each trip to the site. The total unpaved road is 1.0 mile from the site entrance to the end of the active landfill area. The two trips in and out of the site traveled by a vehicle are 2 miles, one trip is full and one trip is empty. It will take a vehicle 145 times a day to deliver about 2,000 tons MSW/day. Based on 6 day/week and 52 week/year operation, the PM_{10} fugitive emissions are estimated to be 86.31 TPY before dust control, such as water spraying. Application of water to the unpaved roads at the facility is considered a reasonable precaution to minimize fugitive dust and is required per OAC 252:100-29. Based on the control efficiency of 70% for application of water, the controlled PM_{10} fugitive emissions are reduced to 25.89 TPY. The corresponding $PM_{2.5}$ fugitive emissions are 2.59 TPY.

Table 5. PM_{10} and $PM_{2.5}$ Dust Fugitive Emissions

Emission Source	**PM_{10} (TPY)**	**$PM_{2.5}$ (TPY)**
Bulldozing and Compaction	3.92	0.55
Dump Track, Tractor, & Excavator Loading	0.04	0.01
Dump Track, Tractor, & Excavator Unloading	0.04	0.01
Grading	0.61	0.03
MSW Delivery Truck Travel on Unpaved Roads	25.89	2.59
Total Emissions	**30.50**	**3.19**

Insignificant and Trivial Activities

Other minor sources and activities that may generate air emissions at the facility are listed below. These insignificant sources qualify under one or more of the activities listed in the DEQ's Insignificant Activities and Trivial Activities OAC 252:100 Appendices I and J, respectively.

- (2) 30,000-gallon wax tanks (GTL Facility)
- (2) 30,000-gallon diesel tanks (GTL Facility)
- (2) 4,000-gallon diesel tanks (GTL Facility)
- (1) 10,000-gallon diesel tank (Landfill Facility)
- (1) 63,300-gallon leachate storage tank
- (1) 21,000-gallon leachate storage tank (overflow only)
- (1) 575-gallon hydraulic oil storage tank
- (1) 575-gallon engine oil storage tank
- (1) 450-gallon diesel storage tank (mobile)
- (1) 300-gallon transmission oil storage tank
- (1) 300-gallon used oil storage tank
- Welding and soldering operations
- Solidification of liquid wastes
- Leachate pond use
- Safety Kleen parts cleaner operations
- Shingle grinding
- Truck loading of liquid hydrocarbons

The appropriate records of hours, quantity, or capacity will be maintained sufficient to demonstrate that the insignificant sources qualify as Insignificant Activities or Trivial Activities. However, their air emissions will not be presented and listed in this section.

Greenhouse Gas (GHG) Emissions

The Greenhouse Gas (GHG) Emissions are estimated based on the following conditions:

- Maximum LFG generation rate at 4,500 SCFM of LFG to the dual flare system
- LFG constituents of 50% methane and 50% carbon dioxide
- LFG's heating value of 506 BTU/ft^3
- Global warming potential (GWP) and emission factors are listed below:

Pollutants	GWP Factor	Emission Factor kg/MMBTU
CO_2	1	52.07
CH_4	25	0.0032
N_2O	298	0.00063

- The GHG emissions from the 7.0 MMBTUH heater are estimated based on AP-42 (7/98), Table 1.4-2, Section 1.4, "Natural Gas Combustion," and based on 8,760 hours per year operation and 1,000 BTU/SCF average heating value. The emission factors from natural gas combustion are listed below. The GHG emissions from other sources in the GTL facility are considered negligible.

Pollutants	GWP Factor	Emission Factor
		lb/10^6 SCF
CO_2	1	120,000
CH_4	25	2.3
N_2O	298	2.2

GHG emissions are expressed as CO_2e. Table 6 lists annual potential facility-wide Greenhouse Gas emissions based on the EUGs. Table 7 lists annual potential facility-wide Greenhouse Gas emissions based on the nature of the generation. Both in Tables 7 and 8, the GHG emissions are presented both as metric ton per year (MTPY) and TPY.

Table 6. Potential Facility-Wide Greenhouse Gas Emissions

Emissions Source	Total CO_2e	
	MTPY	TPY
EUG-1 and EUG-2, Landfill Operations and Flares	124,860	137,633

Table 7. Potential Facility-Wide Greenhouse Gas Emissions

Emissions Source	Total CO_2e	
	MTPY	TPY
Biogenic Generation	124,539	137,280
Anthropogenic Generation	321	353
Total Emissions	124,860	137,633

At the time of the submission of this application, there are no federal regulatory requirements applicable to greenhouse gas emissions from the East Oak RDF and covered by Title V Permit Program authority. Federal GHG Mandatory Reporting Rule requirements published at 40 CFR Part 98 were enacted under sections 114(a)(1) and 208 of the Clean Air Act and, as such, are not included in the definition of "applicable requirements", as found at 40 CFR 70.2 and 71.2, to be included in a Title V Permit. However, for the worst case scenario, the biogenic carbon dioxide emissions are preferably included and counted in the air emission estimation.

Air Emissions Summary

Table 8 shows the total potential facility-wide emissions of all air pollutants after modification.

Table 8. Total Potential Facility-Wide Air Emissions After Modification

Pollutants	Dual Flare	GTL Facility	Fugitive	Facility	Total
	TPY	TPY	TPY	TPY	TPY
NO_x	40.21	-----	-----	-----	40.21
CO	218.78	-----	-----	-----	218.78
VOC	1.12	0.85	13.42	-----	15.39
PM_{10}	10.03	-----	30.50	-----	40.53
$PM_{2.5}$	10.03	-----	3.19	-----	13.22
SO_2	9.08	-----	-----	-----	9.08
HAP	5.14	-----	7.62	-----	12.76
GHG	-----	-----	-----	137,663.00	137,663

Table 9. Potential Facility–Wide Emissions Before And after Modification

	Potential Emissions (Tons/Yr)										
	VOC		HAP	NO_x	CO	SO_2	$PM_{2.5}$		PM_{10}		GHG[c]
	Fugitive	Non-fugitive					Fugitive	Non-fugitive	Fugitive	Non-fugitive	
Before Modification [a]	14.25	1.97	13.23	40.21	218.78	9.08	3.19	10.03	30.5	10.03	137,663
After Modification [b]	13.42	1.97	12.76	40.21	218.78	9.08	3.19	10.03	30.5	10.03	137,663
Proposed Change [b]	**(0.89)**	0.00	**(0.47)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a] As represented in Permit 2011-226-TVR2 (M-1), issued June 24, 2015.
[b] Includes emission changes due to landfill capacity expansion in this permit.

Table 9 shows that the net emission increase is less than 5 TPY, which is not considered significant, therefore, this permit will be processed as a Tier I minor modification.

SECTION V. INSIGNIFICANT ACTIVITIES

The insignificant activities identified and justified in the application and listed in OAC 252:100-8, Appendix I, are duplicated below. Record keeping for activities indicated with a "*" is specified in the Specific Conditions. Any activity to which a state or federal applicable requirement applies is not insignificant even if it is included on this list.

1. Emissions from stationary internal combustion engines rated less than 50 hp output. There are two 12-hp gasoline fired compressors, and two 16-hp gasoline fired welders in the facility.
2. * Emissions from fuel storage/dispensing equipment operated solely for facility owned vehicles if fuel throughput is not more than 2,175 gallons/day, averaged over a 30-day period. There is an 10,000-gallon diesel storage tank with a maximum daily throughput less than 2,175 gallon.
3. * Storage tanks with less than or equal to 10,000 gallons capacity that store volatile organic liquids with a true vapor pressure less than or equal to 1.0 psia at maximum storage temperature. There are one 575-gallon engine oil storage tank, one 575-gallon hydraulic oil tank, one 300-gallon transmission oil storage tank, one 300-gallon used oil tank, one 450-gallon mobile diesel tank, and all organic liquids stored in the tanks have a true vapor pressures less than 1.0 psia at maximum storage temperature.
4. * Welding and soldering operations utilizing less than 100 pounds of solder and 53 tons per year of electrodes. There are welding activities in maintenance building.
5. * Activities having the potential to emit no more than 5.0 TPY (actual) of any criteria pollutant. The applicant identified insignificant activities including solidification, leachate pond, waste oil burner, and Safety Kleen parts cleaner, two 30,000 gallon diesel storage tanks, two 4,000 gallon diesel storage tanks, and two 30,000 gallon wax storage tanks. Calculated emissions from the activities are less than the de minimis level.

SECTION VI. OKLAHOMA AIR QUALITY RULES

OAC 252:100-1 (General Provisions) [Applicable]
Subchapter 1 includes definitions but there are no regulatory requirements.

OAC 252:100-2 (Incorporation by Reference) [Applicable]
This subchapter incorporates by reference applicable provisions of Title 40 of the Code of Federal Regulations listed in OAC 252:100, Appendix Q. These requirements are addressed in the "Federal Regulations" section.

OAC 252:100-3 (Air Quality Standards and Increments) [Applicable]
Primary Standards are in Appendix E and Secondary Standards are in Appendix F of the Air Pollution Control Rules. At this time, all of Oklahoma is in attainment of these standards.

OAC 252:100-5 (Registration, Emissions Inventory and Annual Operating Fees) [Applicable]
Subchapter 5 requires sources of air contaminants to register with Air Quality, file emission inventories annually, and pay annual operating fees based upon total annual emissions of regulated pollutants. Emission inventories have been submitted and fees paid for the past years.

OAC 252:100-8 (Permits for Part 70 Sources) [Applicable]
Part 5 includes the general administrative requirements for Part 70 permits. Any planned changes in the operation of the facility that result in emissions not authorized in the permit and that exceed the "Insignificant Activities" or "Trivial Activities" thresholds require prior notification to AQD and may require a permit modification. Insignificant activities refer to those individual emission units either listed in Appendix I (OAC 252:100) or whose actual calendar year emissions do not exceed the following limits.

- 5 TPY of any one criteria pollutant
- 2 TPY of any one hazardous air pollutant (HAP) or 5 TPY of multiple HAPs or 20% of any threshold less than 10 TPY for a HAP that the EPA may establish by rule

The facility is classified a Part 70 source as specified in NSPS Subpart WWW since design capacity of the landfill is greater than 2.5 million megagrams or 2.5 million cubic meters. As such, a Title V (Part 70) operating permit is required.

OAC 252:100-9 (Excess Emission Reporting Requirements) [Applicable]
Except as provided in OAC 252:100-9-7(a)(1), the owner or operator of a source of excess emissions shall notify the Director as soon as possible but no later than 4:30 p.m. the following working day of the first occurrence of excess emissions in each excess emission event. No later than thirty (30) calendar days after the start of any excess emission event, the owner or operator of an air contaminant source from which excess emissions have occurred shall submit a report for each excess emission event describing the extent of the event and the actions taken by the owner or operator of the facility in response to this event. Request for affirmative defense, as described in OAC 252:100-9-8, shall be included in the excess emission event report. Additional reporting may be required in the case of ongoing emission events and in the case of excess emissions reporting required by 40 CFR Parts 60, 61, or 63.

OAC 252:100-13 (Open Burning) [Applicable]
Open burning of refuse and other combustible material is prohibited except as authorized in the specific examples and under the conditions listed in this subchapter.

OAC 252:100-17 (Incinerators) [Not Applicable]
An "incinerator" is defined as "a combustion device specifically designed for the destruction, by high temperature burning, of solid, semi-solid, liquid, or gaseous combustible wastes and from which the solid residues contain little or no combustion material." Under 252:100-17-2.1, flares and other pollution control devices are exempted from Subchapter 17.

OAC 252:100-19 (Particulate Matter) [Applicable]
This subchapter specifies a PM emissions limitation of 0.6 lbs/MMBTU from fuel-burning units with a rated heat input of 10 MMBTUH or less. AP-42 (7/98), Table 1.4-2 lists total PM emissions for natural gas combustion from heaters, boilers, etc., to be 0.01 lbs/MMBTU. The permit requires the use of natural gas for all fuel-burning units to ensure compliance with Subchapter 19.

This subchapter also limits emissions of PM from industrial processes. Per AP-42 factors, there are no significant PM emissions from any other industrial activities at this facility.

OAC 252:100-25 (Visible Emissions and Particulates) [Applicable]
No discharge of greater than 20% opacity is allowed except for short-term occurrences which consist of not more than one six-minute period in any consecutive 60 minutes, not to exceed three such periods in any consecutive 24 hours. In no case shall the average of any six-minute period exceed 60% opacity.

OAC 252:100-29 (Fugitive Dust) [Applicable]
This subchapter states that no person shall cause or permit the discharge of any visible fugitive dust emissions beyond the property line on which the emissions originate in such a manner as to damage or to interfere with the use of adjacent properties, or cause air quality standards to be exceeded, or interfere with the maintenance of air quality standards. Precautions are stated in Specific Conditions to minimize fugitive dust.

OAC 252:100-31 (Sulfur Compounds) [Applicable]
Part 2 also limits the ambient air impact of hydrogen sulfide emissions from any new or existing source to 0.2 ppmv for a 24-hour average (equivalent to 283 $\mu g/m^3$).
Estimated ambient concentrations of H_2S for the facility is 0.0095 ppmv for a 24-hour average which is well below the ambient standard.
Part 5 limits sulfur dioxide emissions from new fuel-burning equipment (constructed after July 1, 1972). For gaseous fuels the limit is 0.2 lb/MMBtu heat input. The flare does not meet the definition of "fuel-burning equipment."
Part 5 also requires that all thermal devices for petroleum and natural gas processing facilities regulated under OAC 252:100-31-26(a) shall have installed, calibrated, maintained, and operated an alarm system that will signal noncombustion of the gas. The equipment at this facility does not meet the definition of "petroleum or natural gas process equipment" and, therefore, is not subject to this requirement.

OAC 252:100-37 (Volatile Organic Compounds) [Applicable]
Part 3 requires storage tanks constructed after December 28, 1974, with a capacity of 400 gallons or more and storing a VOC with a vapor pressure greater than 1.5 psia to be equipped with a permanent submerged fill pipe or with an organic vapor recovery system. The naphtha tanks will be subject to this subpart and will accordingly be submerged-filled.
Part 5 limits the VOC content of coatings used in coating lines or operations. This facility will not normally conduct coating or painting operations except for routine maintenance of the facility and equipment, which is exempt.
Part 7 requires fuel-burning and refuse-burning equipment to be operated to minimize emissions of VOC. The operation of fuel-burning or refuse-burning equipment shall be based on manufacturer's data and good engineering practice, that the equipment is not overloaded; that it is properly cleaned, operated, and maintained; and that temperature and available air are sufficient to provide essentially complete combustion. The process heater will be subject to this subpart.

OAC 252:100-42 (Toxic Air Contaminants (TAC)) [Applicable]
This subchapter regulates toxic air contaminants (TAC) that are emitted into the ambient air in areas of concern (AOC). Any work practice, material substitution, or control equipment required by the Department prior to June 11, 2004, to control a TAC, shall be retained, unless a modification is approved by the Director. Since no AOC has been designated there are no specific requirements for this facility at this time.

OAC 252:100-43 (Testing, Monitoring, and Recordkeeping) [Applicable]
This subchapter provides general requirements for testing, monitoring and recordkeeping and applies to any testing, monitoring or recordkeeping activity conducted at any stationary source. To determine compliance with emissions limitations or standards, the Air Quality Director may require the owner or operator of any source in the state of Oklahoma to install, maintain and operate monitoring equipment or to conduct tests, including stack tests, of the air contaminant source. All required testing must be conducted by methods approved by the Air Quality Director and under the direction of qualified personnel. A notice-of-intent to test and a testing protocol shall be submitted to Air Quality at least 30 days prior to any EPA Reference Method stack tests. Emissions and other data required to demonstrate compliance with any federal or state emission limit or standard, or any requirement set forth in a valid permit shall be recorded, maintained, and submitted as required by this subchapter, an applicable rule, or permit requirement. Data from any required testing or monitoring not conducted in accordance with the provisions of this subchapter shall be considered invalid. Nothing shall preclude the use, including the exclusive use, of any credible evidence or information relevant to whether a source would have been in compliance with applicable requirements if the appropriate performance or compliance test or procedure had been performed.

OAC 252:100-47 (Control of Emissions from Existing MSW Landfills) [Not Applicable]
Existing MSW landfills having a design capacity greater than 2.5 million megagrams or 2.5 million cubic meters are required to obtain a Part 70 permit. Landfills having NMOC emissions of at least 50 Mg/yr are required to install a gas collection and control system (GCCS) in accordance with the requirements of 40 CFR Part 60.752. This facility is subject to 40 CFR Part 60, NSPS, Subpart WWW. This subchapter affects existing MSW landfills. Since this landfill

was modified after May 30, 1991, this landfill is not considered existing, therefore, this landfill is not subject to this subchapter.

The following Oklahoma Air Pollution Control Rules are not applicable to this facility

OAC 252:100-11	Alternative Reduction	Not requested
OAC 252:100-15	Mobile Sources	Not in source category
OAC 252:100-23	Cotton Gins	Not type of emission unit
OAC 252:100-24	Feed & Grain Facility	Not in source category
OAC 252:100-33	Nitrogen Oxides	Not type of emission unit
OAC 252:100-39	Nonattainment Areas	Not in a subject area

SECTION VII. FEDERAL REGULATIONS

PSD, 40 CFR Part 52 [Not Applicable At This Time]
Any future increases of emissions must be evaluated for PSD if they exceed a significance level (40 TPY NOx, 100 TPY CO, 40 TPY SO_2, 40 TPY VOC, 25 TPY TSP, 15 TPY PM_{10}, 10 TPY of $PM_{2.5}$, 75,000 TPY of CO_2e, 0.6 TPY Pb, 10 TPY TRS). Total emissions of CO_2e are greater than the major source threshold of 100,000 TPY. However, GHG emissions are not considered for major source determination based on U.S. Supreme Court's ruling dated July 23, 2014 in Utility Air Regulatory Group vs. Environmental Protection Agency (UARG vs. EPA).

NSPS, 40 CFR Part 60 [Subparts A, VVa, and WWW are Applicable]
Subpart A, General Provisions. This subpart specifies standards only for control devices used to achieve compliance with an applicable NSPS Subpart. A flare is a "Best Demonstrated Technology (BDT)" for landfill gas destruction. §60.18 specifies that no visible emissions exceed a total of 5 minutes during any two consecutive hours. For non-assisted flare, the net heating value of combusted gas shall be greater than 7.45 MJ/SCM (200 BTU/SCF) and an exit velocity less than 18.3 m/s (60 ft/s) for landfill gas. Maximum permitted velocity (V_{max}) can be determined by the equation:

$$log_{10}(V_{max}) = \frac{H_T + 28.8}{31.7}$$

For gases containing greater than 8.0 percent hydrogen, the flare shall be operated with an exit velocity less than 37.2 m/s (122 ft/s) and less than the velocity, V_{max}, as determined by the following equation:

$$V_{max} = (XH_2 - K_1)*K_2$$

Where K_1, K_2, and XH_2 are given below:

V_{max} = Maximum permitted velocity (m/sec)
K_1 = Constant, 6.0 volume percent hydrogen
K_2 = Constant, 3.9 (m/sec)/volume percent hydrogen
XH_2 = The volume percent hydrogen, on a wet basis, as calculated by using the American Society for Testing and Materials (ASTM) Method D1946-77. (Incorporated by reference as specified in §60.17)

Subpart Cc, Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills. This subpart contains emission guidelines and compliance times for the control of certain designated pollutants from certain designated municipal solid waste landfills. OAC 252:100-47 specifies the applicable Subpart Cc requirements as implemented through the State Plan. The East Oak RDF is not subject to OAC 252:100-47, therefore, is not subject to this subpart.
Subpart Kb, VOL Storage Vessels. This subpart affects storage vessels for volatile organic liquids (VOLs) which have a storage capacity greater than or equal to 19,813 gallons and which commenced construction, reconstruction, or modification after July 23, 1984. The diesel and wax product storage tanks associated with the proposed GTL facility have a capacity less than 151 m^3 (39,890 gallon) and a maximum true vapor pressure less than 15 kPa. The naphtha storage tank has a capacity less than 75 m^3 (19,813 gallon). Therefore, the storage tanks are not subject to the requirements of 40 CFR Part 60, Subpart Kb.
Subpart VVa, Equipment Leaks of VOC in the Synthetic Organic Chemical Manufacturing Industry for Which Construction, Reconstruction, or Modification Commenced after November 7, 2006. This subpart affects each valve, pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, and flange or other connector in VOC service and any devices or systems required by this subpart which commenced construction or modification after November 7, 2006, and which is located at a synthetic organic manufacturing facility. facility will commence construction after November 7, 2006; however, in accordance with 40 CFR §60.480a(d)(2), the facility has a design capacity to produce less than 1,000 Mg/yr (1,102 tons/yr) of any chemical listed in 40 CFR §60.489, and as such is exempt from the standards identified in 40 CFR §§60.482-1a through 60.482-11a. The facility will comply with applicable recordkeeping requirements.
Subpart WWW, Municipal Solid Waste Landfills. This subpart was signed on March 12, 1996, and affects each municipal solid waste landfill (MSWL) that commenced construction, reconstruction, or modification, or began accepting waste on or after May 30, 1991, and has a design capacity greater than 2.5 million cubic meters and 2.5 million megagrams. MSWLs with a design capacity greater than the threshold are subject to a Part 70 (Title V) permitting requirement. An installation of a LFG collection and control system is required to minimize NMOC emissions with a destruction efficiency 98% if NMOC emissions are greater than 50 Mg/yr, based on calculation. Design capacity of the facility is greater than 2.5 million Mg and calculated NMOC emissions are 258.30 Mg/year, which is greater than the threshold of 50 Mg/year. The estimate is based on LandGEM Model Version 3.02 (5/2005), the recommended default values in AP-42, and an average waste acceptance rate of 486,885 Mg/yr between years of 2006 and 2014. The facility is in compliance with this subpart because the LFG collection and control system is installed and operated at the facility.

NESHAP, 40 CFR Part 61 [Subpart M Applicable]
There are no emissions of any of the regulated pollutants: arsenic, asbestos, beryllium, benzene, coke oven emissions, mercury, radionuclides, or vinyl chloride.
Subpart J, Equipment Leaks (Fugitive Emission Sources) of Benzene. This subpart affects process streams, which contain more than 10% benzene by weight.
Subpart M, National Emission Standard for Asbestos. Section 61.154, Standard for active waste disposal sites, requires each owner or operator of an active waste disposal site that receives asbestos-containing waste material from a source covered under §61.149, 61.150, or 61.155 to

meet the requirements of this section. This facility is subject to this subpart because it receives asbestos-containing materials. The permit requires the facility to comply with all applicable requirements.

NESHAP, 40 CFR Part 63 [Subpart AAAA Applicable]

Subpart AAAA, Municipal Solid Waste Landfills. This subpart applies to all municipal solid waste landfills that are: (1) major sources as defined by 40 CFR Part 63.2 of Subpart A as stated in §63.1935(a)(1); (2) collocated with a major source as stated in §63.1935(a)(2); (3) meeting the NSPS WWW applicability thresholds of 2.5 million Mg and 2.5 million m^3 and having estimated uncontrolled NMOC emissions of 50 Mg/yr as calculated according to §60.754(a) as stated in §63.1935(a)(3); or (4) meeting only the design capacity threshold of 2.5 million Mg and 2.5 million m^3 but have a bioreactor and are not permanently closed as of January 16, 2003 as stated in §63.1935(b)(3). This subpart requires that all affected landfills meet the requirements of 40 CFR Part 60, Subpart Cc or WWW, and requires timely control of bioreactors. The facility is subject to this subpart according to §63.1935(a)(3). This subpart also requires such landfills to meet the startup, shutdown, and malfunction (SSM) requirements of the general provisions of this part and provides that compliance with the operating conditions shall be demonstrated by parameter monitoring results that are within the specified ranges. It also includes additional reporting requirements. These requirements apply under 40 CFR Part 60.752(b)(2) since the facility has uncontrolled NMOC emissions of 50 Mg/yr as calculated. A "Start-up, Shutdown and Malfunction" plan shall be maintained on-site. The permit requires the facility to comply with all applicable requirements.

Subpart DDDDD, Industrial, Commercial, and Institutional Boilers and Process Heaters. On January 31, 2013, the EPA took final action on its reconsideration of certain issues in the emission standards for the control of HAP from industrial, commercial, and institutional boilers and process heaters at major sources of HAP. The compliance dates for the rule are January 31, 2016, for existing sources and, January 31, 2013, or upon startup, whichever is later, for new sources. A boiler or process heater is new or reconstructed if construction or reconstruction of the boiler or process heater commenced on or after June 4, 2010. The East Oak RDF is not a major source of HAPs as defined in §63.2 or §63.761 and therefore, the process heater associated with the GTL facility is not subject to the requirements of 40 CFR Part 63, Subpart DDDDD.

CAM, 40 CFR Part 64 [Not Applicable]

This part applies to any pollutant-specific emission unit at a major source that is required to obtain an operating permit, for any application for an initial operating permit submitted after April 18, 1998, that addresses "large emissions units," or any application that addresses "large emissions units" as a significant modification to an operating permit, or for any application for renewal of an operating permit, if it meets all of the following criteria.

- It is subject to an emission limit or standard for an applicable regulated air pollutant
- It uses a control device to achieve compliance with the applicable emission limit or standard
- It has potential emissions, prior to the control device, of the applicable regulated air pollutant of 100 TPY or 10/25 TPY of HAP.

The facility does not meet the applicability criteria and is therefore not an affected facility.

Chemical Accident Prevention Provisions, 40 CFR Part 68 [Not Applicable]
This facility does not process or store more than the threshold quantity of any regulated substance (Section 112r of the Clean Air Act 1990 Amendments). More information on this federal program is available on the web page: www.epa.gov/ceppo.

Stratospheric Ozone Protection, 40 CFR Part 82 [Subpart A and F Applicable]
These standards require phase out of Class I & II substances, reductions of emissions of Class I & II substances to the lowest achievable level in all use sectors, and banning use of nonessential products containing ozone-depleting substances (Subparts A & C); control servicing of motor vehicle air conditioners (Subpart B); require Federal agencies to adopt procurement regulations which meet phase out requirements and which maximize the substitution of safe alternatives to Class I and Class II substances (Subpart D); require warning labels on products made with or containing Class I or II substances (Subpart E); maximize the use of recycling and recovery upon disposal (Subpart F); require producers to identify substitutes for ozone-depleting compounds under the Significant New Alternatives Program (Subpart G); and reduce the emissions of halons (Subpart H).
Subpart A identifies ozone-depleting substances and divides them into two classes. Class I controlled substances are divided into seven groups; the chemicals typically used by the manufacturing industry include carbon tetrachloride (Class I, Group IV) and methyl chloroform (Class I, Group V). A complete phase-out of production of Class I substances is required by January 1, 2000 (January 1, 2002, for methyl chloroform). Class II chemicals, which are hydrochlorofluorocarbons (HCFCs), are generally seen as interim substitutes for Class I CFCs. Class II substances consist of 33 HCFCs. A complete phase-out of Class II substances, scheduled in phases starting by 2002, is required by January 1, 2030.
Subpart F requires that any persons servicing, maintaining, or repairing appliances except for motor vehicle air conditioners; persons disposing of appliances, including motor vehicle air conditioners; refrigerant reclaimers, appliance owners, and manufacturers of appliances and recycling and recovery equipment comply with the standards for recycling and emissions reduction.
The standard conditions of the permit address the requirements specified at § 82.156 for persons opening appliances for maintenance, service, repair, or disposal; § 82.158 for equipment used during the maintenance, service, repair, or disposal of appliances; § 82.161 for certification by an approved technician certification program of persons performing maintenance, service, repair, or disposal of appliances; § 82.166 for recordkeeping; § 82.158 for leak repair requirements; and § 82.166 for refrigerant purchase records for appliances normally containing 50 or more pounds of refrigerant.

This facility does not utilize any Class I & II substances

SECTION VIII. COMPLIANCE

Inspection

An initial compliance inspection was conducted on March 25, 2014. Present for the inspection were Mr. Shawn Cockrell, Landfill Operations Manager of WMO, and Mark Chen of Air Quality Division at the landfill site. An initial compliance inspection was conducted again on

April 20, 2015. Present for the inspection were Mr. Noah Whitmore, Engineering Manager, and Mr. Jim Berryman, Project Manager of Envia Energy, and Mark Chen of Air Quality Division. The facility was constructed and is operating as described in the permit application. The GTL Demonstration Unit at 3500 North Sooner Road was not running in 2014-2015, and all LFG went to the dual flare system. All insignificant activities have been confirmed at the landfill and GTL sites. Operational records, reports, repair and test data are maintained at the landfill office and GTL site office. Since there are no significant changes at the facility from April 20, 2015 to August 2015, there is no need to inspect the facility again

Tier Classification and Public Review

This application has been determined to be Tier I based on the request for a modification to a Part 70 permit for a facility change that is considered a minor modification as defined in OAC 252:100-8-7.2(b)(1)(A) based on the fact that this modification:

1. will not violate any applicable requirements
2. will not involve relaxation or removal of current monitoring, reporting, or recordkeeping requirements. This modification requires new monitoring, reporting, and recordkeeping requirements but not modifications to existing requirements
3. does not require a case by case determination of an emission limitation or other standard, or a source-specific determination for temporary sources of ambient impacts, or a visibility or increment analysis
4. does not establish or change a permit term or condition for which there is no underlying applicable requirement to avoid some other applicable requirements
5. is not considered a modification under NSPS, PSD, or NESHAP
   A change in the material stored in a tank is not a modification if the tank was capable of storing the material previously.

A proposed version of this permit modification was sent to EPA Region VI for a 45-day comment/review. EPA review period started on August 7, 2015, and ended on September 21, 2015. No comments were received from the EPA Region VI.

The applicant has submitted an affidavit that they are not seeking a permit for land use or for any operation upon land owned by others without their knowledge. The affidavit certifies that the applicant owns the real property.

Fees Paid

Part 70 operating permit minor modification application fee of $3,000 was received on July 10, 2015.

SECTION IX. SUMMARY

The facility was constructed and is operating as described in the permit application. Ambient air quality standards are not threatened at this site. There are no active Air Quality compliance or enforcement issues concerning this facility that would prohibit issuance of the permit. Issuance of the operating permit is recommended.

PERMIT TO OPERATE
AIR POLLUTION CONTROL FACILITY
SPECIFIC CONDITIONS

Waste Management of Oklahoma, Inc. **Permit No. 2011-226-TVR2 (M-2)**
East Oak Recycling and Disposal Facility

The permittee is authorized to operate in conformity with the specifications submitted to Air Quality on July 6, 2015 and July 30, 2015. The Evaluation Memorandum dated September 22, 2015, explains the derivation of applicable permit requirements and estimates of emissions; however, it does not contain operating limitations or permit requirements. Continuing operations under this permit constitutes acceptance of, and consent to, the conditions contained herein.

1. The permittee shall be authorized to operate this facility continuously (24 hours per day, every day of the year). [OAC 252:100-8-6(a)]

2. Collected LFG shall be routed to open flares for combustion. The open flares shall be operated in accordance with 40 CFR 60.18. A portion or all of the gas may be sent to a GTL (Gas to Liquids) facility for treatment. All emissions from any atmospheric vent from the gas treatment system shall be subject to the requirements of 40 CFR 60.752(b)(2)(iii)(A) or (B). [OAC 252:100-8-6(a)]

3. The naphtha tanks shall be submerged-filled. [OAC 252: 100-37-15(b)]

4. When LFG is routed to the flare, the following conditions shall apply. [40 CFR Part 60, §60.752(b)(2)(iii)(A)]
   a. Permittee shall properly operate and maintain the flare in accordance with current industry standards.
   b. The flare system shall be designed for a maximum flow rate of 4,500 SCFM of landfill gas.
   c. The flare shall be designed to burn up to 12,258 SCFM of hydrogen-rich gas at maximum exit velocity of 122 ft/s.
   d. The flare shall achieve a control efficiency of 98%.
   e. The flare shall have an alarm system to notify operators of pilot malfunction.
   f. Records that document proper maintenance, malfunctions and repairs shall be maintained.

5. The facility is subject to NSPS (New Source Performance Standards), 40 CFR Part 60, Subpart WWW, Standards of Performance for Municipal Solid Waste Landfills. The permittee shall comply with all applicable standards contained therein, including but not limited to: [40 CFR Part 60, §60.750 – §60.759]

   a. §60.750 Applicability, designation of affected facility, and delegation of authority.
   b. §60.751 Definitions.

c. §60.752 Standards for air emissions from municipal solid waste landfills.

(1) If design capacity of either landfill changes or landfill gas emission rates change significantly, an updated collection and control system design plan shall be required; the permittee shall have the updated collection and control system design plan prepared by a professional engineer. The updated plan shall be submitted to Land Protection Division (LPD) not later than 12 months after the facility determines an updated collection and control system design plan is necessary. As needed, expansions to the existing collection and control system will be made to comply with the following: [§60.752(b)(2)(i) & (b)(2)(ii)]

(i) The system shall handle the maximum expected gas flow rate from the entire landfill. [§60.752(b)(2)(ii)(A)(*1*)]

(ii) The system shall collect gas from each area, cell, or group of cells in the landfill in which the initial solid waste has been placed for a period of: [§60.752(b)(2)(ii)(A)(*2*)]

(A) 5 years or more if active.

(B) 2 years or more if closed or at final grade.

(iii) The system shall collect gas at a sufficient extraction rate. [§60.752(b)(2)(ii)(A)(*3*)]

(iv) The system shall be designed to minimize off-site migration of subsurface gas. [§60.752(b)(2)(ii)(A)(*4*)]

(2) The collected gas shall be routed to either of the following: [§60.752(b)(2)(iii)]

(i) Open flare(s) designed and operated in accordance with 40 CFR 60.18. [§60.752(b)(2)(iii)(A)]

(ii) A control system designed and operated to reduce NMOC by 98 weight-percent, or, when an enclosed combustion device is used for control, to either reduce NMOC by 98 weight-percent or reduce the outlet NMOC concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen. [§60.752(b)(2)(iii)(B)]

(iii) A treatment system that processes the collected gas for subsequent sale or use. All emissions from any atmospheric vent from the gas treatment system shall be subject to 60.752(b)(2)(iii)(A) or (B). [§60.752(b)(2)(iii)(C)]

d. §60.753 Operational standards for collection and control systems.

(1) The owner or operator shall operate the collection system with negative pressure at each wellhead except under the following conditions or unless otherwise specified in the Design Plan approved by the LPD. [§60.753(b)]

(i) A fire or increased well temperature. The owner or operator shall record instances when positive pressure occurs in efforts to avoid fire. The records shall be submitted with the semi-annual reports as provided in 60.757(f)(1). [§60.753(b)(1)]

(ii) If a geo-membrane or synthetic cover is used, pressure limits for MSW landfills utilizing these shall be stated in the design plan. [§60.753(b)(2)]

(iii) A decommissioned well. A well may experience a static positive pressure after shut down to accommodate for declining flows. Wells may be decommissioned as long as the actions are reported to the LPD within ten days of permanent shut in and/or final plugging. [§60.753(b)(3)]

(2) The permittee shall operate the collection system to control methane concentration less than 500 ppm above background at the surface of the landfill. To determine if this level is exceeded, a surface testing shall be conducted around the perimeter of the collection area along a pattern that traverses the landfill at 30 meter intervals and where visual observations indicate elevated concentration of LFG or unless otherwise specified in the Design Plan approved by the LPD. [§60.753(d)]

(3) The permittee shall operate the system to vent all collected gases to an enclosed flare, an open flare, a Treatment System or equivalent combustion device. In the event the collection or control system is inoperable, the gas mover system shall be shut down and all valves in the collection and control system contributing to venting of the gas to the atmosphere shall be closed within one hour. [§60.753(e)]

e. §60.754 Test methods and procedures.

f. §60.755 Compliance provisions.

(1) The permittee shall continue to install a landfill gas collection no later than 60 days after the date on which the initial solid waste has been in place waste for a period of 5 years or more if active; or 2 years or more if closed or at final grade. The system shall be operated properly such that LFG is collected from each area, cell, or group of cells in the landfill in which solid waste has been placed for 5 years or more if active; 2 years or more if closed or at final grade. [§60.755(b)]

g. §60.756 Monitoring of operations.

(1) The permittee shall calibrate, maintain, and operate according to the manufacturer's specifications, the following equipment or unless otherwise specified in the Design Plan approved by the LPD: [§60.756(c)]

(i) A heat sensing device, such as an ultraviolet beam sensor or thermocouple, shall be installed at the pilot light or the flame itself to indicate the continuous presence of the flame. [§60.756(c)(1)]

(ii) A gas flow rate measuring device that provides a measurement of gas flow to or bypass of the control device as specified in 40 CFR §60.756. [§60.756(c)(2)]

(2) Each owner or operator seeking to demonstrate compliance with §60.752(b)(2)(iii) using a device other than an open flare or an enclosed combustor shall provide information satisfactory to the Administrator as proved in §60.752(b)(2)(i)(B) describing the operation of the control device, the operating parameters that would indicate proper performance, and appropriate monitoring procedures. The Administrator shall review the information and either approve it, or request that additional information be submitted. The Administrator may specify additional appropriate monitoring procedures. [§60.756(d)]

h. §60.757 Reporting requirements.

i. §60.758 Recordkeeping requirements.

(1) The owner or operator shall keep for at least 5 years up-to-date, readily accessible, on-site records of the following information. Off-site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable. [§60.758(a)]

(i) Maximum design capacity. [§60.757(a)(2)(ii)]
(ii) Current amount of solid waste in-place. [§60.758(a)]
(iii) Year-by-year waste acceptance rate. [§60.758(a)]
(iv) Subsequent tests or monitoring. [§60.758(b)]
(v) Control device vendor specifications until the control device is removed. [§60.758(b)]
(vi) Records of the control equipment for the following data:
(A) Landfill gas flow, recorded at least once every 15 minutes; and
(B) The presence of the flare pilot flame or flare flame. [§60.758(b)]

j. §60.759 Specifications for active collection systems.

6. The facility is subject to NESHAP (National Emission Standards for Hazardous Air Pollutants), 40 CFR Part 61, Subpart M, National Emission Standard for Asbestos. The permittee shall comply with all applicable standards contained therein, including but not limited to: [40 CFR Part 61, §61.140 - §61.157]

a. §61.140 Applicability.
b. §61.141 Definitions.
c. §61.151 Standard for inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations.
d. §61.153 Reporting.
e. §61.154 Standard for active waste disposal sites.
(1) There must be no visible emissions to the outside air from any active waste disposal site where asbestos-containing waste has been deposited or [§61.154(a)]
(i) At the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall be covered with at least 15 centimeters (6 inches) of compact non-asbestos-containing material. [§61.154(c)(1)]
(ii) Use an alternative emissions control method that has received prior written approval by EPA. [§61.154(d)]
(2) For all asbestos-containing waste material received, the permittee shall:
(i) Maintain waste shipment records including following information: [§61.154(e)(1)]
(A) The name, address, and telephone number of the waste generator.
(B) The name, address, and telephone number of the transporter(s).
(C) The quantity of the asbestos-containing waste material in cubic meters (cubic yards).
(D) The presence of improperly enclosed or uncovered waste, or any asbestos-containing waste material nor sealed in leak-tight containers. Report in writing to the local, State, or EPA regional office.
(E) The date of receipt.
(ii) As soon as possible (less than 30 days) after receipt of the waste, send a copy of the signed waste shipment record to the waste generator. [§61.154(e)(2)]

(iii) Upon discovering a discrepancy between the quantity of waste designated on the waste shipment records and quantity acutely received, attempt to reconcile the discrepancy with the waste generator. [§61.154(e)(3)]

(iv) Retain a copy of all records and reports for at least two years. [§61.154(e)(4)]

(3) Maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area. [§61.154(f)]

(4) Upon closure, comply with all the provisions of §61.151. [§61.154(g)]

(5) Submit to LPD, upon closure of the facility, a copy of records of asbestos waste disposal locations and quantities. [§61.154(h)]

(6) Furnish upon request, and make records available during normal business hours for inspection by LPD personnel. [§61.154(i)]

(7) Notify the LPD in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site and is covered. [§61.154(j)]

(i). Scheduled starting and completion dates.

(ii). Reason for disturbing the waste.

(iii). Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material

(iv). Location of any temporary storage site and the final disposal site.

f. §61.156 Cross-reference to other asbestos regulations.

g. §61.157 Delegation of authority.

7. The facility is subject to NESHAP (National Emission Standards for Hazardous Air Pollutants), 40 CFR Part 63, Subpart AAAA, Municipal Solid Waste Landfills. The permittee shall comply with all applicable standards contained therein, including but not limited to: [40 CFR Part 63, §63.1930 – §63.1990]

What This Subpart Covers

a. §63.1930 What is the purpose of this subpart?

b. §63.1935 Am I subject to this subpart?

c. §63.1940 What is the affected source of this subpart?

d. §63.1945 When do I have to comply with this subpart?

e. §63.1947 When do I have to comply with this subpart if I own or operate a bioreactor?

f. §63.1950 When am I no longer required to comply with this subpart?

g. §63.1952 When am I no longer required to comply with the requirements of this subpart if I own or operate a bioreactor?

Standards

h. §63.1955 What requirements must I meet?

(1) Compliance with the requirements of 40 CFR Part 60, Subpart WWW. [§63.1955(a)(1)]

(2) Compliance with the requirements in 40 CFR 63.1960 through 63.1985 and with the general provisions specified in Table 1 of 40 CFR 63, Subpart AAAA. [§63.1955(b)]

(3) For approval of collection and control systems that include any alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping or reporting provisions, you must follow the procedures in 40 CFR 60.752(b)(2). If alternatives have already been approved under 40 CFR part 60 subpart WWW or the Federal plan, or EPA approved and effective State or tribal plan, these alternatives can be used to comply with this subpart, except that all affected sources must comply with the Startup, Shutdown, and Malfunction (SSM) requirements in 40 CFR 63 Subpart A of this part as specified in Table 1 of the NESHAP and all affected sources must submit compliance reports every 6 months as specified in §63.1980(a) and (b), including information on all deviations that occurred during the 6-month reporting period. Deviations for continuous emission monitors or numerical continuous parameter monitors must be determined using a 3 hour monitoring block average. [§63.1955(c)]

General and Continuing Compliance Requirements

i. §63.1960 How is compliance determined?

(1) Prepare and maintain a Start-up, Shutdown and Malfunction plan for that part of the collection and control system operated by the permittee. [§63.1960]

j. §63.1965 What is a deviation?

(1) A deviation occurs when the control device operating parameter boundaries described in 40 CFR 60.758(c)(1) of subpart WWW are exceeded. [§63.1965(a)]

(2) A deviation occurs when 1 hour or more of the hours during the 3-hour block averaging period does not constitute a valid hour of data. A valid hour of data must have measured values for at least three 15-minute monitoring periods within the hour. [§63.1965(b)]

(3) A deviation occurs when a SSM plan is not developed, implemented, or maintained on site. [§63.1965(c)]

k. §63.1975 How do I calculate the 3-hour block average used to demonstrate compliance?

Notifications, Records, and Reports

l. §63.1980 What records and reports must I keep and submit?

(1) Submit semi-annual "NSPS" reports and annual certification as required. [§63.1980(a)]

(2) Keeping records of occurrence and duration of any start-up shutdown or malfunction of process source or malfunction of required air pollution control and monitoring equipment, as well as any actions taken during start-up, shutdown or malfunction which are not consistent with procedures in the "Shutdown and Malfunction" plan. [§63.1980(b)]

Other Requirements and Information

m. §63.1985 Who enforces this subpart?

n. §63.1990 What definitions apply to this subpart?

8. The facility is subject to New Source Performance Standards, 40 CFR Part 60, Subpart VVa, Standard of Performance Equipment Leaks of VOC in the Synthetic Organic Chemical Manufacturing Industry. The permittee shall comply with all applicable standards contained therein. [40 CFR Part 60, §60.480 – §60.487]

a. § 60.480 Applicability and designation of affected facility.
b. § 60.481 Definitions.
c. § 60.482-1 Standards: General.
d. § 60.482-9 Standards: Delay of repair.
e. § 60.482-10 Standards: Closed vent systems and control devices.
f. § 60.483-1 Alternative standards for valves—allowable percentage of valves leaking.
g. § 60.486 Recordkeeping requirements.
h. § 60.487 Reporting requirements.

9. The permittee shall take reasonable precautions to minimize fugitive dust from traffic on paved/unpaved road and all activities. These precautions shall include, but are not limited to: [OAC 252:100-29-3]

   a. The use, where possible, of water or chemicals for control of dust in the grading of roads, driveways and parking lots or the clearing of land. [OAC 252:100-29-3(1)]
   b. The application of water or suitable chemicals or some other covering on surfaces that can create air-borne dusts under normal conditions. [OAC 252:100-29-3(2)]
   c. The covering or wetting of open-bodied trucks, trailers, or railroad cars when transporting dusty materials in areas where the general public must have access. [OAC 252:100-29-3(4)]
   d. The planting and maintenance of vegetative ground cover as necessary. [OAC 252:100-29-3(5)]

10. The following records shall be maintained on-site to verify insignificant activities. [OAC 252:100-8-6(a)(3)(B)]

    a. Throughputs of the diesel storage tanks.
    b. Activities having the potential to emit no more than 5.0 TPY (actual) of any criteria pollutant. List the activity with estimated actual annual emissions.
    c. Storage tanks with less than or equal to 10,000 gallons capacity that store volatile organic liquids with a true vapor pressure less than or equal to 1.0 psia at maximum storage temperature. List size and contents including vapor pressure of materials stored.

11. The permittee shall maintain records of operations as listed below. These records shall be retained on-site or at a local field office for a period of at least five years following dates of recording, and shall be made available to regulatory personnel upon request. [OAC 252:100-8-6 (a)(3)(B)]

    a. Records as required by NSPS, 40 CFR Part 60, Subpart VVa.
    b. Records as required by NSPS, 40 CFR Part 60, Subpart WWW.
    c. Records as required by NESHAP, 40 CFR Part 61, Subpart M.
    d. Records as required by NESHAP, 40 CFR Part 63, Subpart AAAA.

12. No later than 30 days after each anniversary date of the issuance of the original Title V permit for this facility (January 31, 2001), the permittee shall submit to Air Quality Division of DEQ, with a copy to the US EPA, Region 6, a certification of compliance with the terms and conditions of this permit. [OAC 252:100-8-6 (c)(5)(A) & (D)]

13. No later than 30 days after each six (6) month period, after the date of the issuance of the original Part 70 operating permit (January 31, 2001), the permittee shall submit to AQD a report of the results of any required monitoring. All instances of deviations from permit requirements since the previous report shall be clearly identified in the report.
[OAC 252:100-8-6 (a)(3)(C)(i) and (ii)]

14. This permit supersedes all previous Air Quality operating permits for this facility which will become cancelled upon the issuance date of this permit.

TITLE V (PART 70) PERMIT TO OPERATE / CONSTRUCT STANDARD CONDITIONS (July 21, 2009)

SECTION I. DUTY TO COMPLY

A. This is a permit to operate / construct this specific facility in accordance with the federal Clean Air Act (42 U.S.C. 7401, et al.) and under the authority of the Oklahoma Clean Air Act and the rules promulgated there under. [Oklahoma Clean Air Act, 27A O.S. § 2-5-112]

B. The issuing Authority for the permit is the Air Quality Division (AQD) of the Oklahoma Department of Environmental Quality (DEQ). The permit does not relieve the holder of the obligation to comply with other applicable federal, state, or local statutes, regulations, rules, or ordinances. [Oklahoma Clean Air Act, 27A O.S. § 2-5-112]

C. The permittee shall comply with all conditions of this permit. Any permit noncompliance shall constitute a violation of the Oklahoma Clean Air Act and shall be grounds for enforcement action, permit termination, revocation and reissuance, or modification, or for denial of a permit renewal application. All terms and conditions are enforceable by the DEQ, by the Environmental Protection Agency (EPA), and by citizens under section 304 of the Federal Clean Air Act (excluding state-only requirements). This permit is valid for operations only at the specific location listed.
[40 C.F.R. §70.6(b), OAC 252:100-8-1.3 and OAC 252:100-8-6(a)(7)(A) and (b)(1)]

D. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit. However, nothing in this paragraph shall be construed as precluding consideration of a need to halt or reduce activity as a mitigating factor in assessing penalties for noncompliance if the health, safety, or environmental impacts of halting or reducing operations would be more serious than the impacts of continuing operations. [OAC 252:100-8-6(a)(7)(B)]

SECTION II. REPORTING OF DEVIATIONS FROM PERMIT TERMS

A. Any exceedance resulting from an emergency and/or posing an imminent and substantial danger to public health, safety, or the environment shall be reported in accordance with Section XIV (Emergencies). [OAC 252:100-8-6(a)(3)(C)(iii)(I) & (II)]

B. Deviations that result in emissions exceeding those allowed in this permit shall be reported consistent with the requirements of OAC 252:100-9, Excess Emission Reporting Requirements.
[OAC 252:100-8-6(a)(3)(C)(iv)]

C. Every written report submitted under this section shall be certified as required by Section III (Monitoring, Testing, Recordkeeping & Reporting), Paragraph F.
[OAC 252:100-8-6(a)(3)(C)(iv)]

SECTION III. MONITORING, TESTING, RECORDKEEPING & REPORTING

A. The permittee shall keep records as specified in this permit. These records, including monitoring data and necessary support information, shall be retained on-site or at a nearby field office for a period of at least five years from the date of the monitoring sample, measurement, report, or application, and shall be made available for inspection by regulatory personnel upon request. Support information includes all original strip-chart recordings for continuous monitoring instrumentation, and copies of all reports required by this permit. Where appropriate, the permit may specify that records may be maintained in computerized form.

[OAC 252:100-8-6 (a)(3)(B)(ii), OAC 252:100-8-6(c)(1), and OAC 252:100-8-6(c)(2)(B)]

B. Records of required monitoring shall include:
(1) the date, place and time of sampling or measurement;
(2) the date or dates analyses were performed;
(3) the company or entity which performed the analyses;
(4) the analytical techniques or methods used;
(5) the results of such analyses; and
(6) the operating conditions existing at the time of sampling or measurement.

[OAC 252:100-8-6(a)(3)(B)(i)]

C. No later than 30 days after each six (6) month period, after the date of the issuance of the original Part 70 operating permit or alternative date as specifically identified in a subsequent Part 70 operating permit, the permittee shall submit to AQD a report of the results of any required monitoring. All instances of deviations from permit requirements since the previous report shall be clearly identified in the report. Submission of these periodic reports will satisfy any reporting requirement of Paragraph E below that is duplicative of the periodic reports, if so noted on the submitted report. [OAC 252:100-8-6(a)(3)(C)(i) and (ii)]

D. If any testing shows emissions in excess of limitations specified in this permit, the owner or operator shall comply with the provisions of Section II (Reporting Of Deviations From Permit Terms) of these standard conditions. [OAC 252:100-8-6(a)(3)(C)(iii)]

E. In addition to any monitoring, recordkeeping or reporting requirement specified in this permit, monitoring and reporting may be required under the provisions of OAC 252:100-43, Testing, Monitoring, and Recordkeeping, or as required by any provision of the Federal Clean Air Act or Oklahoma Clean Air Act. [OAC 252:100-43]

F. Any Annual Certification of Compliance, Semi Annual Monitoring and Deviation Report, Excess Emission Report, and Annual Emission Inventory submitted in accordance with this permit shall be certified by a responsible official. This certification shall be signed by a responsible official, and shall contain the following language: "I certify, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete."

[OAC 252:100-8-5(f), OAC 252:100-8-6(a)(3)(C)(iv), OAC 252:100-8-6(c)(1), OAC 252:100-9-7(e), and OAC 252:100-5-2.1(f)]

G. Any owner or operator subject to the provisions of New Source Performance Standards ("NSPS") under 40 CFR Part 60 or National Emission Standards for Hazardous Air Pollutants ("NESHAPs") under 40 CFR Parts 61 and 63 shall maintain a file of all measurements and other information required by the applicable general provisions and subpart(s). These records shall be maintained in a permanent file suitable for inspection, shall be retained for a period of at least five years as required by Paragraph A of this Section, and shall include records of the occurrence and duration of any start-up, shutdown, or malfunction in the operation of an affected facility, any malfunction of the air pollution control equipment; and any periods during which a continuous monitoring system or monitoring device is inoperative.

[40 C.F.R. §§60.7 and 63.10, 40 CFR Parts 61, Subpart A, and OAC 252:100, Appendix Q]

H. The permittee of a facility that is operating subject to a schedule of compliance shall submit to the DEQ a progress report at least semi-annually. The progress reports shall contain dates for achieving the activities, milestones or compliance required in the schedule of compliance and the dates when such activities, milestones or compliance was achieved. The progress reports shall also contain an explanation of why any dates in the schedule of compliance were not or will not be met, and any preventive or corrective measures adopted. [OAC 252:100-8-6(c)(4)]

I. All testing must be conducted under the direction of qualified personnel by methods approved by the Division Director. All tests shall be made and the results calculated in accordance with standard test procedures. The use of alternative test procedures must be approved by EPA. When a portable analyzer is used to measure emissions it shall be setup, calibrated, and operated in accordance with the manufacturer's instructions and in accordance with a protocol meeting the requirements of the "AQD Portable Analyzer Guidance" document or an equivalent method approved by Air Quality.

[OAC 252:100-8-6(a)(3)(A)(iv), and OAC 252:100-43]

J. The reporting of total particulate matter emissions as required in Part 7 of OAC 252:100-8 (Permits for Part 70 Sources), OAC 252:100-19 (Control of Emission of Particulate Matter), and OAC 252:100-5 (Emission Inventory), shall be conducted in accordance with applicable testing or calculation procedures, modified to include back-half condensables, for the concentration of particulate matter less than 10 microns in diameter (PM_{10}). NSPS may allow reporting of only particulate matter emissions caught in the filter (obtained using Reference Method 5).

K. The permittee shall submit to the AQD a copy of all reports submitted to the EPA as required by 40 C.F.R. Part 60, 61, and 63, for all equipment constructed or operated under this permit subject to such standards. [OAC 252:100-8-6(c)(1) and OAC 252:100, Appendix Q]

SECTION IV. COMPLIANCE CERTIFICATIONS

A. No later than 30 days after each anniversary date of the issuance of the original Part 70 operating permit or alternative date as specifically identified in a subsequent Part 70 operating permit, the permittee shall submit to the AQD, with a copy to the US EPA, Region 6, a certification of compliance with the terms and conditions of this permit and of any other applicable requirements which have become effective since the issuance of this permit.

[OAC 252:100-8-6(c)(5)(A), and (D)]

B. The compliance certification shall describe the operating permit term or condition that is the basis of the certification; the current compliance status; whether compliance was continuous or intermittent; the methods used for determining compliance, currently and over the reporting period; and a statement that the facility will continue to comply with all applicable requirements. [OAC 252:100-8-6(c)(5)(C)(i)-(iv)]

C. The compliance certification shall contain a certification by a responsible official as to the results of the required monitoring. This certification shall be signed by a responsible official, and shall contain the following language: "I certify, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete." [OAC 252:100-8-5(f) and OAC 252:100-8-6(c)(1)]

D. Any facility reporting noncompliance shall submit a schedule of compliance for emissions units or stationary sources that are not in compliance with all applicable requirements. This schedule shall include a schedule of remedial measures, including an enforceable sequence of actions with milestones, leading to compliance with any applicable requirements for which the emissions unit or stationary source is in noncompliance. This compliance schedule shall resemble and be at least as stringent as that contained in any judicial consent decree or administrative order to which the emissions unit or stationary source is subject. Any such schedule of compliance shall be supplemental to, and shall not sanction noncompliance with, the applicable requirements on which it is based, except that a compliance plan shall not be required for any noncompliance condition which is corrected within 24 hours of discovery. [OAC 252:100-8-5(e)(8)(B) and OAC 252:100-8-6(c)(3)]

SECTION V. REQUIREMENTS THAT BECOME APPLICABLE DURING THE PERMIT TERM

The permittee shall comply with any additional requirements that become effective during the permit term and that are applicable to the facility. Compliance with all new requirements shall be certified in the next annual certification. [OAC 252:100-8-6(c)(6)]

SECTION VI. PERMIT SHIELD

A. Compliance with the terms and conditions of this permit (including terms and conditions established for alternate operating scenarios, emissions trading, and emissions averaging, but excluding terms and conditions for which the permit shield is expressly prohibited under OAC 252:100-8) shall be deemed compliance with the applicable requirements identified and included in this permit. [OAC 252:100-8-6(d)(1)]

B. Those requirements that are applicable are listed in the Standard Conditions and the Specific Conditions of this permit. Those requirements that the applicant requested be determined as not applicable are summarized in the Specific Conditions of this permit. [OAC 252:100-8-6(d)(2)]

SECTION VII. ANNUAL EMISSIONS INVENTORY & FEE PAYMENT

The permittee shall file with the AQD an annual emission inventory and shall pay annual fees based on emissions inventories. The methods used to calculate emissions for inventory purposes shall be based on the best available information accepted by AQD.

[OAC 252:100-5-2.1, OAC 252:100-5-2.2, and OAC 252:100-8-6(a)(8)]

SECTION VIII. TERM OF PERMIT

A. Unless specified otherwise, the term of an operating permit shall be five years from the date of issuance. [OAC 252:100-8-6(a)(2)(A)]

B. A source's right to operate shall terminate upon the expiration of its permit unless a timely and complete renewal application has been submitted at least 180 days before the date of expiration. [OAC 252:100-8-7.1(d)(1)]

C. A duly issued construction permit or authorization to construct or modify will terminate and become null and void (unless extended as provided in OAC 252:100-8-1.4(b)) if the construction is not commenced within 18 months after the date the permit or authorization was issued, or if work is suspended for more than 18 months after it is commenced. [OAC 252:100-8-1.4(a)]

D. The recipient of a construction permit shall apply for a permit to operate (or modified operating permit) within 180 days following the first day of operation. [OAC 252:100-8-4(b)(5)]

SECTION IX. SEVERABILITY

The provisions of this permit are severable and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

[OAC 252:100-8-6 (a)(6)]

SECTION X. PROPERTY RIGHTS

A. This permit does not convey any property rights of any sort, or any exclusive privilege.

[OAC 252:100-8-6(a)(7)(D)]

B. This permit shall not be considered in any manner affecting the title of the premises upon which the equipment is located and does not release the permittee from any liability for damage to persons or property caused by or resulting from the maintenance or operation of the equipment for which the permit is issued. [OAC 252:100-8-6(c)(6)]

SECTION XI. DUTY TO PROVIDE INFORMATION

A. The permittee shall furnish to the DEQ, upon receipt of a written request and within sixty (60) days of the request unless the DEQ specifies another time period, any information that the DEQ may request to determine whether cause exists for modifying, reopening, revoking,

reissuing, terminating the permit or to determine compliance with the permit. Upon request, the permittee shall also furnish to the DEQ copies of records required to be kept by the permit.
[OAC 252:100-8-6(a)(7)(E)]

B. The permittee may make a claim of confidentiality for any information or records submitted pursuant to 27A O.S. § 2-5-105(18). Confidential information shall be clearly labeled as such and shall be separable from the main body of the document such as in an attachment.
[OAC 252:100-8-6(a)(7)(E)]

C. Notification to the AQD of the sale or transfer of ownership of this facility is required and shall be made in writing within thirty (30) days after such sale or transfer.
[Oklahoma Clean Air Act, 27A O.S. § 2-5-112(G)]

SECTION XII. REOPENING, MODIFICATION & REVOCATION

A. The permit may be modified, revoked, reopened and reissued, or terminated for cause. Except as provided for minor permit modifications, the filing of a request by the permittee for a permit modification, revocation and reissuance, termination, notification of planned changes, or anticipated noncompliance does not stay any permit condition.
[OAC 252:100-8-6(a)(7)(C) and OAC 252:100-8-7.2(b)]

B. The DEQ will reopen and revise or revoke this permit prior to the expiration date in the following circumstances: [OAC 252:100-8-7.3 and OAC 252:100-8-7.4(a)(2)]

(1) Additional requirements under the Clean Air Act become applicable to a major source category three or more years prior to the expiration date of this permit. No such reopening is required if the effective date of the requirement is later than the expiration date of this permit.
(2) The DEQ or the EPA determines that this permit contains a material mistake or that the permit must be revised or revoked to assure compliance with the applicable requirements.
(3) The DEQ or the EPA determines that inaccurate information was used in establishing the emission standards, limitations, or other conditions of this permit. The DEQ may revoke and not reissue this permit if it determines that the permittee has submitted false or misleading information to the DEQ.
(4) DEQ determines that the permit should be amended under the discretionary reopening provisions of OAC 252:100-8-7.3(b).

C. The permit may be reopened for cause by EPA, pursuant to the provisions of OAC 100-8-7.3(d). [OAC 100-8-7.3(d)]

D. The permittee shall notify AQD before making changes other than those described in Section XVIII (Operational Flexibility), those qualifying for administrative permit amendments, or those defined as an Insignificant Activity (Section XVI) or Trivial Activity (Section XVII). The notification should include any changes which may alter the status of a "grandfathered source," as defined under AQD rules. Such changes may require a permit modification.

[OAC 252:100-8-7.2(b) and OAC 252:100-5-1.1]

E. Activities that will result in air emissions that exceed the trivial/insignificant levels and that are not specifically approved by this permit are prohibited. [OAC 252:100-8-6(c)(6)]

SECTION XIII. INSPECTION & ENTRY

A. Upon presentation of credentials and other documents as may be required by law, the permittee shall allow authorized regulatory officials to perform the following (subject to the permittee's right to seek confidential treatment pursuant to 27A O.S. Supp. 1998, § 2-5-105(18) for confidential information submitted to or obtained by the DEQ under this section):

(1) enter upon the permittee's premises during reasonable/normal working hours where a source is located or emissions-related activity is conducted, or where records must be kept under the conditions of the permit;
(2) have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;
(3) inspect, at reasonable times and using reasonable safety practices, any facilities, equipment (including monitoring and air pollution control equipment), practices, or operations regulated or required under the permit; and
(4) as authorized by the Oklahoma Clean Air Act, sample or monitor at reasonable times substances or parameters for the purpose of assuring compliance with the permit.

[OAC 252:100-8-6(c)(2)]

SECTION XIV. EMERGENCIES

A. Any exceedance resulting from an emergency shall be reported to AQD promptly but no later than 4:30 p.m. on the next working day after the permittee first becomes aware of the exceedance. This notice shall contain a description of the emergency, the probable cause of the exceedance, any steps taken to mitigate emissions, and corrective actions taken.

[OAC 252:100-8-6 (a)(3)(C)(iii)(I) and (IV)]

B. Any exceedance that poses an imminent and substantial danger to public health, safety, or the environment shall be reported to AQD as soon as is practicable; but under no circumstance shall notification be more than 24 hours after the exceedance.

[OAC 252:100-8-6(a)(3)(C)(iii)(II)]

C. An "emergency" means any situation arising from sudden and reasonably unforeseeable events beyond the control of the source, including acts of God, which situation requires immediate corrective action to restore normal operation, and that causes the source to exceed a technology-based emission limitation under this permit, due to unavoidable increases in emissions attributable to the emergency. An emergency shall not include noncompliance to the extent caused by improperly designed equipment, lack of preventive maintenance, careless or improper operation, or operator error. [OAC 252:100-8-2]

D. The affirmative defense of emergency shall be demonstrated through properly signed, contemporaneous operating logs or other relevant evidence that:

(1) an emergency occurred and the permittee can identify the cause or causes of the emergency;
(2) the permitted facility was at the time being properly operated;
(3) during the period of the emergency the permittee took all reasonable steps to minimize levels of emissions that exceeded the emission standards or other requirements in this permit. [OAC 252:100-8-6 (e)(2)]

E. In any enforcement proceeding, the permittee seeking to establish the occurrence of an emergency shall have the burden of proof. [OAC 252:100-8-6(e)(3)]

F. Every written report or document submitted under this section shall be certified as required by Section III (Monitoring, Testing, Recordkeeping & Reporting), Paragraph F.
[OAC 252:100-8-6(a)(3)(C)(iv)]

SECTION XV. RISK MANAGEMENT PLAN

The permittee, if subject to the provision of Section 112(r) of the Clean Air Act, shall develop and register with the appropriate agency a risk management plan by June 20, 1999, or the applicable effective date. [OAC 252:100-8-6(a)(4)]

SECTION XVI. INSIGNIFICANT ACTIVITIES

Except as otherwise prohibited or limited by this permit, the permittee is hereby authorized to operate individual emissions units that are either on the list in Appendix I to OAC Title 252, Chapter 100, or whose actual calendar year emissions do not exceed any of the limits below. Any activity to which a State or Federal applicable requirement applies is not insignificant even if it meets the criteria below or is included on the insignificant activities list.

(1) 5 tons per year of any one criteria pollutant.
(2) 2 tons per year for any one hazardous air pollutant (HAP) or 5 tons per year for an aggregate of two or more HAP's, or 20 percent of any threshold less than 10 tons per year for single HAP that the EPA may establish by rule.
[OAC 252:100-8-2 and OAC 252:100, Appendix I]

SECTION XVII. TRIVIAL ACTIVITIES

Except as otherwise prohibited or limited by this permit, the permittee is hereby authorized to operate any individual or combination of air emissions units that are considered inconsequential and are on the list in Appendix J. Any activity to which a State or Federal applicable requirement applies is not trivial even if included on the trivial activities list.
[OAC 252:100-8-2 and OAC 252:100, Appendix J]

SECTION XVIII. OPERATIONAL FLEXIBILITY

A. A facility may implement any operating scenario allowed for in its Part 70 permit without the need for any permit revision or any notification to the DEQ (unless specified otherwise in the permit). When an operating scenario is changed, the permittee shall record in a log at the facility the scenario under which it is operating. [OAC 252:100-8-6(a)(10) and (f)(1)]

B. The permittee may make changes within the facility that:

(1) result in no net emissions increases,
(2) are not modifications under any provision of Title I of the federal Clean Air Act, and
(3) do not cause any hourly or annual permitted emission rate of any existing emissions unit to be exceeded;

provided that the facility provides the EPA and the DEQ with written notification as required below in advance of the proposed changes, which shall be a minimum of seven (7) days, or twenty four (24) hours for emergencies as defined in OAC 252:100-8-6 (e). The permittee, the DEQ, and the EPA shall attach each such notice to their copy of the permit. For each such change, the written notification required above shall include a brief description of the change within the permitted facility, the date on which the change will occur, any change in emissions, and any permit term or condition that is no longer applicable as a result of the change. The permit shield provided by this permit does not apply to any change made pursuant to this paragraph.

[OAC 252:100-8-6(f)(2)]

SECTION XIX. OTHER APPLICABLE & STATE-ONLY REQUIREMENTS

A. The following applicable requirements and state-only requirements apply to the facility unless elsewhere covered by a more restrictive requirement:

(1) Open burning of refuse and other combustible material is prohibited except as authorized in the specific examples and under the conditions listed in the Open Burning Subchapter. [OAC 252:100-13]

(2) No particulate emissions from any fuel-burning equipment with a rated heat input of 10 MMBTUH or less shall exceed 0.6 lb/MMBTU. [OAC 252:100-19]

(3) For all emissions units not subject to an opacity limit promulgated under 40 C.F.R., Part 60, NSPS, no discharge of greater than 20% opacity is allowed except for:
   (a) Short-term occurrences which consist of not more than one six-minute period in any consecutive 60 minutes, not to exceed three such periods in any consecutive 24 hours. In no case shall the average of any six-minute period exceed 60% opacity;
   (b) Smoke resulting from fires covered by the exceptions outlined in OAC 252:100-13-7;
   (c) An emission, where the presence of uncombined water is the only reason for failure to meet the requirements of OAC 252:100-25-3(a); or

(d) Smoke generated due to a malfunction in a facility, when the source of the fuel producing the smoke is not under the direct and immediate control of the facility and the immediate constriction of the fuel flow at the facility would produce a hazard to life and/or property. [OAC 252:100-25]

(4) No visible fugitive dust emissions shall be discharged beyond the property line on which the emissions originate in such a manner as to damage or to interfere with the use of adjacent properties, or cause air quality standards to be exceeded, or interfere with the maintenance of air quality standards. [OAC 252:100-29]

(5) No sulfur oxide emissions from new gas-fired fuel-burning equipment shall exceed 0.2 lb/MMBTU. No existing source shall exceed the listed ambient air standards for sulfur dioxide. [OAC 252:100-31]

(6) Volatile Organic Compound (VOC) storage tanks built after December 28, 1974, and with a capacity of 400 gallons or more storing a liquid with a vapor pressure of 1.5 psia or greater under actual conditions shall be equipped with a permanent submerged fill pipe or with a vapor-recovery system. [OAC 252:100-37-15(b)]

(7) All fuel-burning equipment shall at all times be properly operated and maintained in a manner that will minimize emissions of VOCs. [OAC 252:100-37-36]

SECTION XX. STRATOSPHERIC OZONE PROTECTION

A. The permittee shall comply with the following standards for production and consumption of ozone-depleting substances:

(1) Persons producing, importing, or placing an order for production or importation of certain class I and class II substances, HCFC-22, or HCFC-141b shall be subject to the requirements of §82.4;
(2) Producers, importers, exporters, purchasers, and persons who transform or destroy certain class I and class II substances, HCFC-22, or HCFC-141b are subject to the recordkeeping requirements at §82.13; and
(3) Class I substances (listed at Appendix A to Subpart A) include certain CFCs, Halons, HBFCs, carbon tetrachloride, trichloroethane (methyl chloroform), and bromomethane (Methyl Bromide). Class II substances (listed at Appendix B to Subpart A) include HCFCs. [40 CFR 82, Subpart A]

B. If the permittee performs a service on motor (fleet) vehicles when this service involves an ozone-depleting substance refrigerant (or regulated substitute substance) in the motor vehicle air conditioner (MVAC), the permittee is subject to all applicable requirements. Note: The term "motor vehicle" as used in Subpart B does not include a vehicle in which final assembly of the vehicle has not been completed. The term "MVAC" as used in Subpart B does not include the air-tight sealed refrigeration system used as refrigerated cargo, or the system used on passenger buses using HCFC-22 refrigerant. [40 CFR 82, Subpart B]

C. The permittee shall comply with the following standards for recycling and emissions reduction except as provided for MVACs in Subpart B: [40 CFR 82, Subpart F]

(1) Persons opening appliances for maintenance, service, repair, or disposal must comply with the required practices pursuant to § 82.156;
(2) Equipment used during the maintenance, service, repair, or disposal of appliances must comply with the standards for recycling and recovery equipment pursuant to § 82.158;
(3) Persons performing maintenance, service, repair, or disposal of appliances must be certified by an approved technician certification program pursuant to § 82.161;
(4) Persons disposing of small appliances, MVACs, and MVAC-like appliances must comply with record-keeping requirements pursuant to § 82.166;
(5) Persons owning commercial or industrial process refrigeration equipment must comply with leak repair requirements pursuant to § 82.158; and
(6) Owners/operators of appliances normally containing 50 or more pounds of refrigerant must keep records of refrigerant purchased and added to such appliances pursuant to § 82.166.

SECTION XXI. TITLE V APPROVAL LANGUAGE

A. DEQ wishes to reduce the time and work associated with permit review and, wherever it is not inconsistent with Federal requirements, to provide for incorporation of requirements established through construction permitting into the Source's Title V permit without causing redundant review. Requirements from construction permits may be incorporated into the Title V permit through the administrative amendment process set forth in OAC 252:100-8-7.2(a) only if the following procedures are followed:

(1) The construction permit goes out for a 30-day public notice and comment using the procedures set forth in 40 C.F.R. § 70.7(h)(1). This public notice shall include notice to the public that this permit is subject to EPA review, EPA objection, and petition to EPA, as provided by 40 C.F.R. § 70.8; that the requirements of the construction permit will be incorporated into the Title V permit through the administrative amendment process; that the public will not receive another opportunity to provide comments when the requirements are incorporated into the Title V permit; and that EPA review, EPA objection, and petitions to EPA will not be available to the public when requirements from the construction permit are incorporated into the Title V permit.
(2) A copy of the construction permit application is sent to EPA, as provided by 40 CFR § 70.8(a)(1).
(3) A copy of the draft construction permit is sent to any affected State, as provided by 40 C.F.R. § 70.8(b).
(4) A copy of the proposed construction permit is sent to EPA for a 45-day review period as provided by 40 C.F.R.§ 70.8(a) and (c).
(5) The DEQ complies with 40 C.F.R. § 70.8(c) upon the written receipt within the 45-day comment period of any EPA objection to the construction permit. The DEQ shall not issue the permit until EPA's objections are resolved to the satisfaction of EPA.
(6) The DEQ complies with 40 C.F.R. § 70.8(d).
(7) A copy of the final construction permit is sent to EPA as provided by 40 CFR § 70.8(a).

(8) The DEQ shall not issue the proposed construction permit until any affected State and EPA have had an opportunity to review the proposed permit, as provided by these permit conditions.

(9) Any requirements of the construction permit may be reopened for cause after incorporation into the Title V permit by the administrative amendment process, by DEQ as provided in OAC 252:100-8-7.3(a), (b), and (c), and by EPA as provided in 40 C.F.R. § 70.7(f) and (g).

(10) The DEQ shall not issue the administrative permit amendment if performance tests fail to demonstrate that the source is operating in substantial compliance with all permit requirements.

B. To the extent that these conditions are not followed, the Title V permit must go through the Title V review process.

SECTION XXII. CREDIBLE EVIDENCE

For the purpose of submitting compliance certifications or establishing whether or not a person has violated or is in violation of any provision of the Oklahoma implementation plan, nothing shall preclude the use, including the exclusive use, of any credible evidence or information, relevant to whether a source would have been in compliance with applicable requirements if the appropriate performance or compliance test or procedure had been performed.

PART 70 PERMIT

AIR QUALITY DIVISION
STATE OF OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY
707 NORTH ROBINSON, SUITE 4100
P. O. BOX 1677
OKLAHOMA CITY, OKLAHOMA 73101-1677

Permit No. 2011-226-TVR2 (M-2)

Waste Management of Oklahoma, Inc.

having complied with the requirements of the law, is hereby granted permission to operate/modify their East Oak Recycling and Disposal Facility located at 3201 Mosley Road, Oklahoma City, Section 21, Township 12N, Range 2W, Oklahoma County, Oklahoma, subject to Major Source Standard Conditions dated July 21, 2009, and Specific Conditions, both attached.

This permit shall expire on June 30, 2019, five (5) years from the issuance date of the original Title-V renewal permit, 2011-226-TVR2, except as Authorized under Section VIII of the Standard Conditions.

Phillip Fielder, P.E.
Permits and Engineering Group Manager

Date

DEQ Form #100-890

Revised 10/20/06

Ms. Paula Carboni, Environmental Manager
Waste Management of Oklahoma, Inc.
P.O. Box 400
Ferris, Texas 75125

SUBJECT: Title V Operating Permit Modification **No. 2011-226-TVR2 (M-2)**
Waste Management of Oklahoma, Inc.
East Oak Recycling and Disposal Facility (Facility ID: No. 2061)
3201 Mosley Road, Oklahoma City OK 73141
Section 21, Township 12N, Range 2W,
Oklahoma City, Oklahoma County, OK

Dear Ms. Carboni:

Enclosed is the permit authorizing operation of the referenced facility above. Please note that this permit is issued subject to standard and specific conditions, which are attached. These conditions must be carefully followed since they define the limits of the permit and will be confirmed by periodic inspections.

Also note that you are required to annually submit an emissions inventory for this facility. An emissions inventory must be completed on approved AQD forms and submitted (hardcopy or electronically) by April 1st of every year. Any questions concerning the form or submittal process should be referred to the Emissions Inventory Staff at 405-702-4100.

Thank you for your cooperation. If we may be of further service, or you have any questions about this permit, please contact me, mark.chen@deq.ok.gov, or at (405) 702-4196.

Sincerely,

Mark Chen, P.E., Senior Environmental Engineer
New Source Permits Section
AIR QUALITY DIVISION

Enclosures

APPENDIX S

ECONOMIC LIFE ESTIMATE

Note: This appendix includes the following:

- An ODEQ cover letter for a Tier III Permit Modification for the Economic Life Estimate update issued on February 19, 2015.
- The Economic Life Estimate.

EAST OAK RECYCLING AND DISPOSAL FACILITY

3201 Mosley Road
Oklahoma City, Oklahoma 73141
(405) 427-1112
Fax (405) 427-1139

WASTE MANAGEMENT

February 19, 2015

Hillary Young, PE
Chief Environmental Engineer
Land Protection Division
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

SUBJECT: Economic Life Estimate
East Oak Recycling and Disposal Facility
MSW Permit No. 3555036
Oklahoma County, Oklahoma

Dear Ms. Young:

On behalf of Waste Management of Oklahoma, Inc (WMO) and East Oak Recycling and Disposal Facility (RDF), the purpose of this letter is to provide the ODEQ the "Economic Life of the Disposal Facility" in accordance with OAC 252:515, Subchapter 27 (for the purposes of this regulation, it is our understanding that "Life of Site" is defined as the remaining life of the capacity over the currently constructed fill areas). Consistent with OAC 252:515-27-8(c), the Economic Life of the facility as of December 31, 2014 is approximately 3.9 years. The supporting calculations for this estimate are attached.

If you have any questions, or need any additional information, please call (405-417-8124).

Sincerely,

Guy R Campbell

Guy R. Campbell
Engineering Manager
Waste Management of Oklahoma, Inc

cc: Pete Schultze, WMO (operating record)
Paula Carboni, WMO

Prep By: GRC
Date: 02-19-15

EAST OAK RDF
2014 ECONOMIC LIFE OF SITE CALCULATION

Purpose: Estimate the economic life of the site as of December 31, 2014 consistent with OAC 252:515-27-8.

Reference:
1. Title 252 Department of Environmental Quality, Chapter 515 Management of Solid Waste, OAC 252:515-27-8 (Economic life of disposal facility), effective June 1, 2003.
2. Information Provided by WASTE MANAGEMENT OF OKLAHOMA and third party estimates.

Method:
1. Estimate the constructed remaining airspace as of January 19, 2014.
2. Estimate the constructed remaining airspace as of January 31, 2014.
3. Estimate the constructed remaining airspace as of December 31, 2014.
4. Determine the annual waste acceptance rate from January 1, 2014 through December 31, 2014.
5. Determine the economic life of the site as of December 31, 2014.

Solution:

1. Estimate the constructed remaining airspace as of January 19, 2014.

Constructed Remaining Airspace: 4,009,130 cy as of the January 19, 2014 aerial.

DAS compiled a topographic map for this facility from aerial photography. The volume of remaining capacity (waste and daily/intermediate cover) was determined using an AutoCAD-based software package. Existing contours as of January 19, 2014 were compared to the intermediate contour plan.

2. Estimate the constructed remaining airspace as of January 31, 2014.

- To determine the amount of waste consumed between January 19, 2014 and January 31, 2014, the actual tonnage for January was prorated and converted to cubic yards. Please note that for the entire month of January there are 23-business days (5 business days/week) and between January 19, 2014 and January 31, 2014, there are only business days. 8 days

Based on gate receipts for the East Oak RDF, the facility received: 10,425 35,311.40 tons of waste during January 2014. A prorated waste acceptance rate for the remainder of January will be used to estimate the amount of airspace consumed between the January 19, 2014 aerial and January 31, 2014.

Amount of waste accepted in January = 35,311.4 tons/23 business days in January = 1,535.28 tons/day

Using an in-place density rate (i.e., site specific density) = 1,151 lb/cy

Airspace consumed between 1/19/2014 and 1/31/2014

$$\frac{1{,}535.28 \text{ tons/day} \times 8 \text{ days} \times 2{,}000 \text{ lb/ton}}{1{,}151 \text{ lb/cy}}$$

Airspace consumed = 21,342 cy

Constructed Remaining Airspace: 3,987,788 cy as of January 31, 2014.

Prep By: GRC
Date: 02-19-15

EAST OAK RDF
2014 ECONOMIC LIFE OF SITE CALCULATION

3. Estimate the constructed remaining airspace as of December 31, 2014.

Tons of waste received between January 31, 2014 and December 31, 2014:

Tons received = 361,316.10 tons (based on 2014 gate receipts)

Using an in-place density rate (i.e., site specific density) = 1,151 lb/cy

Airspace consumed between 1/31/2014 and 12/31/2014

$$\frac{361{,}316.10 \text{ tons} \times 2{,}000 \text{ lb/ton}}{1{,}151 \text{ lb/cy}}$$

Airspace consumed = 627,830 cy

Constructed Remaining Airspace: 3,359,958 cy as of December 31, 2014.

4. Determine the annual waste acceptance rate from January 1, 2014 through December 31, 2014.

The acceptance rate is based on gate receipts for the site between January 2014 and December 2014.

W = 396,627.5 tons
793,255,000 lb

5. Determine the economic life of the site as of December 31, 2014.

L = {[V - (P x V)] x D} / W (Ref 1)

L = Life of the site, years ("Life of the Site" is defined as the remaining life of the capacity over the currently constructed fill areas)
V = Volume of remaining airspace, cy
P = Amount of remaining airspace consumed by daily cover, %
D = In-place density of waste, lb/cy
W = Expected annual waste acceptance rate, lb/yr

V =	3,359,958	cy (refer to Section 3)
P =	0.2	(per OAC 252:515-27-8)
D =	1,151	lb/cy (Site specific density)
W =	793,255,000	lb (refer to Section 4)

L =	3.9	years

EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3555036

APPENDIX T

RECORDKEEPING AND REPORTING
EXAMPLE FORMS

Prepared for

Waste Management of Oklahoma, Inc.

June 2015

Prepared by

Weaver Consultants Group, LLC
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0086-356-11-40-04

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

MONTHLY REPORT FOR SOLID WASTE DISPOSAL FACILITIES

(Please see instructions prior to completing this form)
Due by the 10th of the month following the reporting month

Administrative Services
Accounts Receivable
P. O. Box 2036
Oklahoma City, OK 73101-2036

Report month/year: ____________

Facility Name: ____________
Mailing Address: ____________
____

Permit Number: ____________

Phone Number: ____________

Total # of Days open: 0

COMPLETE SECTIONS 5-10 ONLY IF SCALES GO DOWN

DAY	(1) Total weight accepted (tons)	(2) Weight which is reused or recycled in accordance with facility permit (tons)	(3) Weight accepted from a DEQ approved emergency or special event (tons)	(4) Weight accepted from large industrial waste generators with DEQ exemption certificate (tons)	(5) Time scales placed out of service	(6) Time scales placed into service	(7) Total volume accepted (yd3)	(8) Volume which is reused or recycled in accordance with facility permit (yd3)	(9) Volume accepted from a DEQ approved emergency or special event (yd3)	(10) Volume accepted from large industrial waste generators with DEQ exemption certificate (yd3)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
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20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
Total	0	0	0	0	0	0	0	0	0	0

I hereby certify that the information reported above is accurate and correct to the best of my knowledge and includes all solid waste received at this facility.

Signature of authorized agent: ____________ Phone #: ____________ Date: ____________

INSTRUCTIONS FOR COMPLETING THE MONTHLY REPORT FOR SOLID WASTE DISPOSAL FACILITIES

The monthly report for solid waste disposal facilities should be submitted to the DEQ no later than the 10th of the month following the reporting month and should include all solid waste received during the month. **If no solid waste is received in a given month, a monthly report is still required. Please include a notation that no solid waste was received during the month.**

1. In the spaces provided, enter the month and year covered by the report, the facility name, permit number, mailing address, and phone number.

2. For each operating day of the month, provide the following and identify which days during the month the facility was closed.

Column 1: **Total weight accepted**: Enter the total weight, **in tons**, of all waste accepted at the facility for each day. The total must include weights to be reported in columns 2, 3, and 4.

Column 2: (Only applicable to landfill disposal facilities) **Weight which is reused or recycled in accordance with facility permit**: Enter the weight, **in tons**, of waste accepted at the facility which was productively reused at the facility in accordance with the facility's permit OR was recovered and sold in accordance with the facility's permit.

Column 3: (Only applicable to landfill disposal facilities) **Weight accepted from a DEQ approved emergency or special event**: Enter the weight, **in tons**, of waste accepted at the facility from an emergency or special event for which the facility received prior approval from the DEQ to waive the state disposal fee.

Column 4: (Only applicable to landfill disposal facilities) **Weight accepted from large industrial waste generators with DEQ exemption certificate**: Enter the weight, **in tons**, of waste received from large industrial waste generators **which was accompanied by a large industrial waste generator fee exemption certificate issued by the DEQ.**

Column 5: (Only applicable to landfill disposal facilities) **Time scales placed out-of-service**: Enter the approximate time (hour:minute) the scales became inoperative.

Column 6: (Only applicable to landfill disposal facilities) **Time scales placed into service**: Enter the approximate time (hour:minute) the scales were placed into service.

Note: Section 2-10-802 of the Oklahoma Solid Waste Management Act requires operators of certain landfill disposal facilities to weigh all solid waste received at the landfill. ***Only when the scales are inoperative may a landfill record the volume of waste***

Column 7: **Total volume accepted**: Enter the total volume **in cubic yards** of all waste accepted at the facility. The total must include volumes to be reported in columns 8, 9, and 10.

Column 8: (Only applicable to landfill disposal facilities) **Volume which is reused or recycled in accordance with facility permit**: Enter the volume, **in cubic yards**, of waste accepted at the facility which was productively reused at the facility in accordance with the facility's permit OR was recovered and sold in accordance with the facility's permit.

Column 9: (Only applicable to landfill disposal facilities) **Volume accepted from a DEQ approved emergency or special event**: Enter the volume, **in cubic yards**, of waste accepted at the facility from an emergency or special event for which the facility received prior approval from the DEQ to waive the state disposal fee.

Column 10: (Only applicable to landfill disposal facilities) **Volume accepted from large industrial waste generators with DEQ exemption certificate**: Enter the volume, **in cubic yards**, of waste received from large industrial waste generators **which was accompanied by a large industrial waste generator fee exemption certificate issued by the DEQ.**

3. At the end of the month, calculate the total down time for the scales (hours:minutes) and include in the space provided. Sum each column and include in the appropriate column.

QUARTERLY RETURN FOR SOLID WASTE LANDFILLS

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

Permit Number	Quarter	Year	DEQ Invoice Number
______________	________	________	______________

Facility Name: ______________________________

Mailing Address: ______________________________

____

____

Remit report with payment to:
Oklahoma Department of Environmental Quality
Administrative Service - Accounts Receivable
P.O. Box 2036
Oklahoma City, OK 73101-2036
(405)702-1071
Fax No: (405) 702-7120

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

Typed/Printed Name of Authorized Agent: ______________________________ Date: ______________

Signature of Authorized agent: ______________________________ Phone No.: ______________

INSTRUCTIONS FOR COMPLETING THE QUARTERLY RETURN FOR SOLID WASTE LANDFILLS

GENERAL INSTRUCTIONS

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

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

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

SPECIFIC LINE INSTRUCTIONS

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

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

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

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

Line 12: If line 13 of last quarter's return is $40,000, enter $0.00, otherwise:
If line 9 is less than 100 tons/day, multiply line 8 by $0.50.
If line 9 is equal to or more than 100 tons/day, multiply line 8 by $0.25.

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

Line 13: If line 13 of last quarter's return is less than $40,000, add line 13 of last quarter's return and line 12 of this quarter's return.
If line 13 of last quarter's return is $40,000, enter $40,000.00.

Line 14: If line 13 of last quarter's return is less than $40,000.00, enter $0.00.
If line 13 of last quarter's return is $40,000 AND this return in filed on time, multiply line 11 by 0.10. Otherwise, enter $0.00.

PENALTIES

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

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

If you have any questions, please contact Land Protection Division Solid Waste Unit Mike Stickney (405) 702-5184.

NHIW Monthly Report

Month/Year: Facility:______________________________ Permit Number:______________

Date	Generator Name	Waste Name	App #	Amount

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

NHIW CERTIFICATION

Please read instructions prior to completing this form.

Generator Name: ____________________

Mailing Address: ____________________ City ____________ State ____ Zip ________

Point of Generation Address: ____________________ City ____________ State ____ Zip ________

Generator Contact: ____________________ Title ____________ Telephone ________

DETAILED WASTE DESCRIPTION

Waste Name: ____________________

If waste was generated out-of-state, is it classified as hazardous in the state of origin? ☐ Yes ☐ No ☐ NA- Okla. waste

Approximate amount of waste to be disposed: ________ ☐ Tons ☐ Cubic yards ☐ Other ________ ☐ Pounds ☐ Drum

Disposal frequency: ☐ One-time ☐ Monthly ☐ Weekly ☐ Annually

Physical characteristics: ☐ Solid ☐ Sludge ☐ Liquid ☐ Combination

Method used to determine waste is non-hazardous: ☐ Analysis ☐ Generator knowledge ☐ Both

Process generating waste (be specific and use additional sheets if necessary):

____

____

____

____

____

DESIGNATED RECEIVING LANDFILL

Name: ____________________ Permit #: ____________

GENERATOR CERTIFICATION

I understand this form must be signed by the original waste generator or other persons authorized by 27A O.S§2-10-501(H).

To the best of my knowledge, I certify:

- The information contained herein is accurate, complete, and representative of the waste to be disposed;
- The waste identified above is not a characteristically hazardous waste as identified by 40 CFR 261, Subpart C, is not a listed hazardous waste as identified by 40 CFR 261, Subpart D or contaminated with a listed hazardous waste, and is not otherwise identified as a hazardous waste by the Department of Environmental Quality; and
- This waste will be managed in accordance with all applicable statutes and rules of the Department of Environmental Quality.

____

Generator Signature

____

Printed name | Title | Date

INSTRUCTIONS FOR COMPLETING THE NHIW CERTIFICATION

Enter the name of the generating facility, generator mailing address, address where the waste was generated, contact name and title of person at the generating facility who is knowledgeable about the waste, and phone number.

DETAILED WASTE DESCRIPTION

1. Identify the name of the waste.
2. Identify the approximate amount of waste to be disposed under the plan, its frequency of disposal, and its physical characteristics.
3. Identify if the waste was determined to be non-hazardous by either knowledge of process, testing, or both. If requested by DEQ, the generator must be able to provide information about the waste, such as a list of chemical constituents entering into the waste and a list of chemical constituents likely to be in the waste, laboratory analyses, MSDS sheets, and other information used by the generator to determine the waste is non-hazardous.
4. Identify the process generating the waste. Please note that the waste generating description must be specific and sufficient to demonstrate the waste is non-hazardous.

DESIGNATED RECEIVING LANDFILL

Identify the name of the landfill to receive the waste and its DEQ permit number.

GENERATOR CERTIFICATION

Read the certification and sign and date the form. **Please note that the certification may only be dated and signed by one of the following:** 1) the original waste generator; 2) a person who identifies and is under contract with a generator and whose activities under the contract cause the waste to be generated; 3) a party to a remediation project under an order of the DEQ or under the auspices of the Oklahoma Energy Resources Board or other agencies of other states; or 4) a person responding to an environmental emergency.

The completed notification form should be submitted to the DEQ at the following address. Once submitted, the generator may dispose of the waste at the designated landfill.

Department of Environmental Quality
Solid Waste Compliance Unit
P. O. Box 1677
Oklahoma City, OK 73102
Phone (405) 702-5100
Fax (405) 702-5101

APPENDIX U

COPY OF SURETY BOND

Note: This appendix includes a copy of the current surety bond previously submitted to ODEQ.

WASTE MANAGEMENT

WASTE MANAGEMENT INC.

1001 Fannin, Suite 4000
Houston, TX 77002
(713) 512-6200

March 4, 2015

UPS 2 Days

Ms. Carol Bartlett, Environmental Programs Specialist
Oklahoma Department of Environmental Quality
Land Protection Division
707 North Robinson
Oklahoma City, OK 73101
(405) 702-5109

RE: East Oak Recycling and Disposal Facility, Permit # 3555036
Muskogee Community Recycling and Disposal Facility, Permit # 3551020
Quarry Recycling and Disposal Facility, Permit # 3572042

Dear Carol,

Enclosed are the following:

1. Riders to be attached to the existing bonds for the above-referenced facilities.
2. Revised Exhibit A's for the Standby Trust Agreements for the bonds associated for these sites.
3. For your convenience are letters addressed to Hillary Young providing updated Closure and Post-Closure cost estimates.

If you have any questions, please feel free to contact me at (713) 265-1322.

Sincerely,

Diana Seng

Diana Seng
Director of Treasury & Financial Assurance

cc: Guy Campbell, WMI
Paula Carboni, WMI
Susie Becvar, JPMorgan Chase Bank

Standby Trust Agreement Dated January 26, 2011
Waste Management of Oklahoma, Inc., Grantor
JPMorgan Chase Bank, N.A., Trustee

EXHIBIT A
(Revised 3/4/2015)

Name of Facility:	East Oak Sanitary Landfill
Address:	3201 Mosley Road Oklahoma City, Oklahoma 73111
Name of Surety: **Address:**	Evergreen National Indemnity Company 6140 Parkland Blvd., Suite 321 Cleveland, OH 44124
Surety's Bond Number:	800437
Amount:	$9,266,432.45

Persons Designated as East Oak Sanitary Landfill's representatives:

Devina Rankin, Vice President and Treasurer
Diana Seng, Authorized Representative
Ed Egl, Assistant Treasurer

INCREASE RIDER TO SURETY BOND

PURPOSE: **INCREASE**

To be attached to Surety Bond Number 800437 issued by Evergreen National Indemnity Company, as Surety, in the amount of Nine Million Thirty One Thousand Seven Hundred Forty and 55/100 Dollars ($9,031,740.55) (Closure: $4,465,694.56 and Post-Closure: $4,566,045.99), on behalf of Waste Management of Oklahoma, Inc., in favor of the Oklahoma Department of Environmental Quality.

In consideration of the premium charged for the attached bond, it is mutually understood and agreed by the Principal and the Surety that the bond shall be modified to read as follows: The above said bond amount shall be Nine Million Two Hundred Sixty Six Thousand Four Hundred Thirty Two and 45/100 Dollars ($9,266,432.45) (Closure: $4,544,267.49 and Post-Closure: $4,722,164.96), effective the 16th day of March 2015.

All other items, limitations and conditions of said bond except as herein expressly modified shall remain unchanged.

Signed, sealed and dated this 2nd day of March 2015.

Principal: **Waste Management of Oklahoma, Inc.**

By: Kathleen P. Price

Kathleen P. Price, Attorney-In-Fact

Surety: **Evergreen National Indemnity Company**

By: ______________________

Cheryl C. May, Attorney-In-Fact

POWER OF ATTORNEY

KNOWN ALL MEN BY THESE PRESENTS that Waste Management, Inc. and each of its direct and indirect majority owned subsidiaries (the "WM Entities"), have constituted and appointed and do hereby appoint Cheryl C. May, Kathleen P. Price, and Julie K. Bowers of Evergreen National Indemnity Company, each its true and lawful Attorney-in-fact to execute under such designation in its name, to affix the corporate seal approved by the WM Entities for such purpose, and to deliver for and on its behalf as surety thereon or otherwise, bonds of any of the following classes, to wit:

1. Surety bonds to the United States of America or any agency thereof, and lease and miscellaneous surety bonds required or permitted under the laws, ordinances or regulations of any State, City, Town, Village, Board or any other body or organization, public or private.

2. Bonds on behalf of WM Entities in connection with bids, proposals or contracts.

The foregoing powers granted by the WM Entities shall be subject to and conditional upon the written direction of a duly appointed officer of the applicable WM Entity (or any designee of any such officer) to execute and deliver any such bonds.

The signatures and attestations of such Attorneys-in-fact and the seal of the WM Entity may be affixed to any such bond, policy or to any certificate relating thereto by facsimile and any such bond, policy or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the applicable WM Entity when so affixed.

IN WITNESS WHEREOF, the WM Entities have caused these presents to be signed by the Vice President and Treasurer and its corporate seal to be hereto affixed. This power of attorney is in effect as of March 2, 2015.

Witness:

Diana Jerry

On behalf of Waste Management, Inc. and each of the other WM Entities

Devina A. Rankin

Devina A. Rankin
Vice President and Treasurer

EVERGREEN NATIONAL INDEMNITY COMPANY
MAYFIELD HEIGHTS, OH
POWER OF ATTORNEY

POWER NO. **800437**

KNOW ALL MEN BY THESE PRESENTS: That the Evergreen National Indemnity Company, a corporation in the State of Ohio does hereby nominate, constitute and appoint: ***Cheryl C. May***

its true and lawful Attorney(s)-In-Fact to make, execute, attest, seal and deliver for and on its behalf, as Surety, and as its act and deed, where required, any and all bonds, undertakings, recognizances and written obligations in the nature thereof, PROVIDED, however, that the obligation of the Company under this Power of Attorney shall not exceed **NINE MILLION TWO HUNDRED SIXTY SIX THOUSAND FOUR HUNDRED THIRTY TWO AND 45/100 DOLLARS ($9,266,432.45)**

This Power of Attorney is granted and is signed by facsimile pursuant to the following Resolution adopted by its Board of Directors on the 23rd day of July, 2004:

> "RESOLVED, That any two officers of the Company have the authority to make, execute and deliver a Power of Attorney constituting as Attorney(s)-in-fact such persons, firms, or corporations as may be selected from time to time.
> FURTHER RESOLVED, that the signatures of such officers and the Seal of the Company may be affixed to any such Power of Attorney or any certificate relating thereto by facsimile; and any such Power of Attorney or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company; and any such powers so executed and certified by facsimile signatures and facsimile seal shall be valid and binding upon the Company in the future with respect to any bond or undertaking to which it is attached."

IN WITNESS WHEREOF, the Evergreen National Indemnity Company has caused its corporate seal to be affixed hereunto, and these presents to be signed by its duly authorized officers this 1st day of December, 2014.

EVERGREEN NATIONAL INDEMNITY COMPANY

EVERGREEN NATIONAL INDEMNITY COMPANY CORPORATE SEAL 1939 OHIO

By: Matthew T. Tucker, President

By: David A. Canzone, CFO

Notary Public)
State of Ohio) SS:

On this 1st day of December, 2014, before the subscriber, a Notary for the State of Ohio, duly commissioned and qualified, personally came Matthew T. Tucker and David A. Canzone of the Evergreen National Indemnity Company, to me personally known to be the individuals and officers described herein, and who executed the preceding instrument and acknowledged the execution of the same and being by me duly sworn, deposed and said that they are the officers of said Company aforesaid, and that the seal affixed to the preceding instrument is the Corporate Seal of said Company, and the said Corporate Seal and signatures as officers were duly affixed and subscribed to the said instrument by the authority and direction of said Corporation, and that the resolution of said Company, referred to in the preceding instrument, is now in force.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal at Cleveland, Ohio, the day and year above written.

NOTARIAL SEAL STATE OF OHIO
PENNY M HAMM
NOTARY PUBLIC
STATE OF OHIO
Comm. Expires
April 04, 2017

Penny M. Hamm, Notary Public
My Commission Expires April 4, 2017

State of Ohio) SS:

I, the undersigned, Secretary of the Evergreen National Indemnity Company, a stock corporation of the State of Ohio, DO HEREBY CERTIFY that the foregoing Power of Attorney remains in full force and has not been revoked; and furthermore that the Resolution of the Board of Directors, set forth herein above, is now in force.

Signed and sealed in Mayfield Hts, Ohio this 2nd day of March 2015.

EVERGREEN NATIONAL INDEMNITY COMPANY CORPORATE SEAL 1939 OHIO

Wan C. Collier, Secretary

APPENDIX V

LIQUID WASTE BULKING FACILITY OPERATING PLAN

Note: This appendix includes the following.

- An ODEQ cover letter for a Tier I Permit Modification for the Liquid Waste Bulking Facility issued on November 15, 2011.
- The Liquid Waste Bulking Facility Operating Plan.

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

STEVEN A. THOMPSON
Executive Director

MARY FALLIN
Governor

November 15, 2011

Mr. Greg Vance
Waste Management of Oklahoma
3201 Mosley Road
Oklahoma City, OK 73141

Subject: Tier I Permit Modification – Liquid Waste Bulking Facility
East Oak Landfill
Oklahoma County, Permit # 3555036

Dear Mr. Vance:

The Department received an application dated November 2, 2011 for the above referenced submittal at the East Oak Landfill. The Department reviewed the submitted application and found it to be technically complete.

Pursuant to Oklahoma Administrative Code (OAC) 252:4-7-58(2) the submittal was processed as a Tier I Application. The Department approves the permit modification, which is effective on the date that it was signed. Please contact Wesley Squyres at (405) 702-5197, if there are any questions concerning the permit modification.

Sincerely,

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

ST/WS

cc: Jonathan Queen, Weaver Boos Consultants

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

SOLID WASTE PERMIT MODIFICATION

The Department of Environmental Quality hereby approves the following modification:

Permit Number:	**3555036**
Facility:	**East Oak Recycling & Disposal Facility**
Facility Type:	**Municipal Solid Waste Landfill**
County:	**Oklahoma County**

Modification: Construct a liquid waste bulking facility at the permitted facility

MODIFICATION CONDITIONS:

1. The mixing of liquid waste with a bulking agent must be performed over a lined area or area with secondary containment.

2. The mixing area must be separate from the working face of the landfill.

3. The application signed by Jonathan V. Queen, P.E., is considered approved and is incorporated as part of this modification.

4. The permittee is authorized to operate in conformity with the application described above. Commencing operations under this permit modification constitutes acceptance of, and consent to, the conditions contained herein.

Date: 11/16/11

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

ST/WS

LIQUID WASTE BULKING FACILITY
OPERATING PLAN

EAST OAK RECYCLING AND DISPOSAL FACILITY
PERMIT NO. 3555036
OKLAHOMA COUNTY, OKLAHOMA

Prepared for

Waste Management of Oklahoma, Inc.

November 2011

LICENSED PROFESSIONAL ENGINEER
JONATHAN V.
QUEEN
24456
OKLAHOMA

11/2/11

Prepared by

Weaver Boos Consultants, LLC–Southwest
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770

Project No. 0086-356-17-04-01

WEAVER
BOOS
CONSULTANTS
LLC
SOUTHWEST

6420 SOUTHWEST BLVD, SUITE 206
FORT WORTH, TEXAS 76109
PHONE: 817.735.9770
FAX: 817.735.9775
www.weaverboos.com

Chicago, IL
Naperville, IL
Springfield, IL
South Bend, IN
St. Louis, MO
Columbus, OH
Denver, CO
Fort Worth, TX
Clermont, FL
Grand Rapids, MI
Portland, OR

November 2, 2011
Project No. 0086-356-17-04-01

Mr. Wesley Squyres
Solid Waste Permitting Unit
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, Oklahoma 73102

Re: Liquid Waste Bulking Facility Operating Plan
Tier I Permit Modification
East Oak Recycling and Disposal Facility (RDF), Permit No. 3555036
Oklahoma County, Oklahoma

Dear Mr. Squyres:

The purpose of this Tier I permit modification, submitted on behalf of Waste Management of Oklahoma, Inc. (WMO), is to permit a liquid waste bulking facility at the referenced site. Attached is a Liquid Waste Bulking Facility Operating Plan, which documents the design and operational procedures for accepting, handling, and bulking of liquid waste. This plan has been prepared consistent with Oklahoma Administrative Code (OAC) 252:515-19-71 and 74. This Liquid Waste Bulking Facility Operating Plan is intended to replace the existing permitted Liquid Waste Restriction Text (Section 8.18 of the Operating Plan) included as part of the Tier III Permit Modification approved by ODEQ on May 15, 2008 and the Stabilization of Liquid Waste Request approved by ODEQ on February 9, 1994. While reviewing the attached Liquid Waste Bulking Facility Operating Plan, please note the following.

- **Lined Areas Required.** Per OAC 252:515-19-74(b), *"mixing activities must be performed on lined areas or areas with secondary containment."* As shown on Drawings 1 and 2 (see Appendix A of the Liquid Waste Bulking Facility Operating Plan), the proposed liquid waste bulking facility is located over a permitted waste fill area that is lined in accordance with Subtitle D requirements.
- **Separate Area.** Per OAC 252:515-19-74(c), *"mixing areas must be separate from the working face unless otherwise approved."* As shown on Drawings 1 and 2 (see Appendix A of the Liquid Waste Bulking Facility Operating Plan), the proposed location of the liquid waste bulking facility is located separate from the working face of the landfill. However, it should be noted that the location of the liquid waste bulking facility may be relocated over a permitted waste fill area that is lined in accordance with Subtitle D requirements to accommodate landfill activities, but will remain separate from the working face.

A copy of this submittal was placed in the site operating record for this facility. During the course of your review, if you have any questions or require further information, please call.

Sincerely,
Weaver Boos Consultants, LLC-Southwest

Jonathan V. Queen, P.E.
Project Engineer

Attachments: Liquid Waste Bulking Facility Operating Plan

cc: Greg Vance, Waste Management of Oklahoma, Inc.
Randy Melton, Waste Management of Oklahoma, Inc.

CONTENTS

1 INTRODUCTION

1.1 Purpose

The purpose of this operating plan is to document the design and operation procedures of a container type liquid waste bulking facility. The facility is located over a composite lined area and separate from the working face of the landfill. Processing or bulking of liquid material is typically needed to allow direct disposal to the landfill (i.e., liquid waste material requires bulking to pass the paint filter test). The liquid material collected and temporarily stored at the facility will be either bulked and disposed of in the landfill or transported and processed at an offsite permitted facility. This plan has been prepared consistent with Oklahoma Administrative Code (OAC) 252:515-19-71 and 74.

1.2 Summary of Waste Processing Operations

The liquids collected and temporarily stored at the facility will be bulked (i.e., solidified) and disposed of in the landfill. The installation of a liquid storage and processing facility at the East Oak Recycling and Disposal Facility (RDF) will provide an essential service for restaurants and food processing plants, car and truck washes, and other commercial and industrial facilities in the communities of Oklahoma County and the surrounding area.

The liquids storage and processing area will be located separate from the working face of the active face of the landfill. However, it should be noted that the location of the liquid waste bulking facility may be relocated over a permitted waste fill area that is lined in accordance with Subtitle D requirements to accommodate landfill activities, but will remain separate from the working face. The area will consist of two liquid holding tanks (optional) and a mixing area that will include two mixing tanks (second mixing tank optional) and bulking agent stockpiles. As shown on Drawing 2, the solidification process will involve the use of mixing tanks and liquid holding tanks. The holding tanks will provide temporary storage of liquid wastes until liquids are off-loaded by gravity discharge into the mixing tanks. The holding tanks and/or second mixing tank will only be installed if the volume of liquids generated at the site warrants its use. The mixing and liquid holding tanks will be connected by a valve and a transfer pipe (single-wall) used for transferring the liquids for solidification. The transfer pipe will be installed above grade and periodically inspected to verify the integrity of the pipe.

Liquid waste will be unloaded in the receiving area from transport vehicles into either the holding tanks or directly to the mixing tanks if they are not in use. Containment will be provided by an earthen berm as shown on Drawings 2, 3, and 4 (or a detention area adjacent to the liquid waste bulking operation).

As shown on Drawing 2, containment for the mixing tank area will be provided by a 1-foot-high earthen berm that will be located around the perimeter of the mixing area or a detention area which the liquid waste bulking operation drains toward. As shown on Drawings 3 and 4, the berm has been sized to contain the volume of the holding tank as well as the volume of stormwater provided by the 25-year, 24-hour storm.

Liquid waste material will be stored in the liquid holding tank. The liquid waste will gravity drain from the liquid holding tank to the mixing tanks. The onsite bulking process will be conducted in the mixing tanks using a backhoe or a front-end loader to add and mix the bulking agent with the liquids. The bulking agent may consist of lime, fly ash, kiln dust, foundry dust, sawdust, wood chips, auto shredder fluff, or other acceptable materials. The bulked waste will then be transported and disposed of in the landfill.

Manifests and pre-characterization of liquids will be used to control the liquids accepted at the facility. A more complete discussion of the quality control process is presented in the following sections.

2 WASTE DESCRIPTION AND HANDLING PLAN

2.1 Description of Waste

Untreated liquid waste, which typically cannot pass the paint filter test, include grease trap waste, grit trap waste, nonhazardous industrial wastes, and other nonhazardous liquids. These liquids will generally be transported to the facility by private haulers in vacuum trucks, tank trucks, and sealed containers. The liquids will originate from restaurants and food processing plants, car and truck washes, and other commercial and industrial facilities.

2.2 Processing Method

The bulking process involves the addition of a solid material that will absorb the liquid and form a sludge that can be disposed of in the landfill. Materials used for bulking will include lime, fly ash, kiln dust, foundry dust, sawdust, wood chips, auto shredder fluff, and other bulking agents. The bulking process has the advantage of being a simple process that does not require discharge to a Publicly Owned Treatment Works, such as a wastewater treatment plant.

2.3 Bulking Agents

The bulking agent used in the liquid waste solidification process will be lime, fly ash, kiln dust, foundry dust, sawdust, wood chips, and auto shredder fluff or other acceptable materials. The following is a brief description of selected bulking agents.

Lime

Lime is a grayish-white powder, often called quicklime. It is obtained by heating (calcimining) limestone and releasing carbon dioxide from the calcium carbonate. Lime has been used in similar processes for many years and is very effective in solidifying many types of sludges.

Fly Ash

Fly ash is the particulate matter collected in air pollution control equipment used for cleaning flue gas from burning pulverized coal. It has been used in similar processes almost as long as lime and is very effective in solidifying many types of sludges.

Kiln Dust

Kiln dust is the particulate matter collected in air pollution control equipment used for cleaning exhaust gases from kilns in the manufacture of cement. It is very effective in solidifying many types of sludges.

Foundry Dust

Foundry dust is the particulate matter collected in air pollution control equipment used for cleaning exhaust gases from the casting of metals in a foundry. It is very effective in solidifying many types of sludges. Foundry dust mixing ratios vary greatly depending on the foundry process.

Sawdust

Woodworking machines produce large quantities of sawdust. The particulate matter that is removed from the air exhaust systems for these machines can be used to solidify grease trap waste. Other types of sawdust material with larger particles may be placed on the waste to temporarily control odors.

Wood Chips

Wood chips are produced through the grinding and chipping of wood material such as trees, stumps, and clean wood products. It has been effective in solidifying liquids and may be placed on top of the waste to control odors.

Auto Shredder Fluff

Auto shredder fluff consists of the residual light fraction of shredder residue and may contain fibrous textiles, polyurethane foams, plastics, rubber, and a wide variety of light metal content.

Other Bulking Agents

As recycling capabilities continue to provide additional bulking agents, East Oak RDF will use these materials in accordance with OAC 252:515-19-71 and 74.

2.4 Monitoring Incoming Liquid Waste

Incoming liquid waste will be documented on a Non-Hazardous Industrial Waste (NHIW) Certification Form or other required manifest. An example generator waste profile sheet is presented in Appendix B. Incoming waste will also be pre-characterized by the generator in accordance with the facility's approved Waste Exclusion Plan. The pre-characterization will include analytical analysis and/or process information as necessary to make the determination that the waste is nonhazardous. No waste material will be accepted at the site until the following items have been confirmed (consistent with the currently approved WEP):

- Generator waste profile sheet provided with appropriate supporting information;
- Site management internal approval has been received;
- The generator has submitted a NHIW Certification form to Oklahoma Department of Environmental Quality (ODEQ);
- A NHIW tracking document accompanies the load; and
- Expiration dates and approval volumes for waste streams, noted on the Approval Form, have not been exceeded.

2.5 Waste Storage and Processing

Accepted loads of liquid waste will be directed to the processing area for discharge into the liquid holding tanks (optional) or mixing tanks. The liquids will be temporarily stored at the facility (no longer than 24 hours) and either be bulked and disposed of in the landfill, or transported and processed at a permitted offsite facility. Bulked wastes will pass a paint filter test (EPA SW-846/9095) before they are transported for disposal to the landfill working face.

Operation of the facility will include the following:

- Secondary containment using a 1-foot-high berm (or a detention area adjacent to the bulking operation).
- Control of dust by wetting the roads and facility area and covering the bulking agent storage tanks when not in use.
- Control of odors by covering the tanks, or using sawdust or wood chips for temporary odor masking.
- Protect the health and environment of employees, citizens, and surrounding communities by operating the facility in accordance with ODEQ, Environmental Protection Agency (EPA), Occupational Safety and Health Administration, and other applicable regulations.
- Facility personnel will be trained in the bulking procedure, acceptable testing method, recognition of waste streams and their compatibility, daily operations, recordkeeping and reporting, implementation of emergency procedures, and regulations pertaining to liquid waste disposal as set forth by the ODEQ.

2.6 Testing and Recordkeeping

The testing and recordkeeping requirements are listed below.

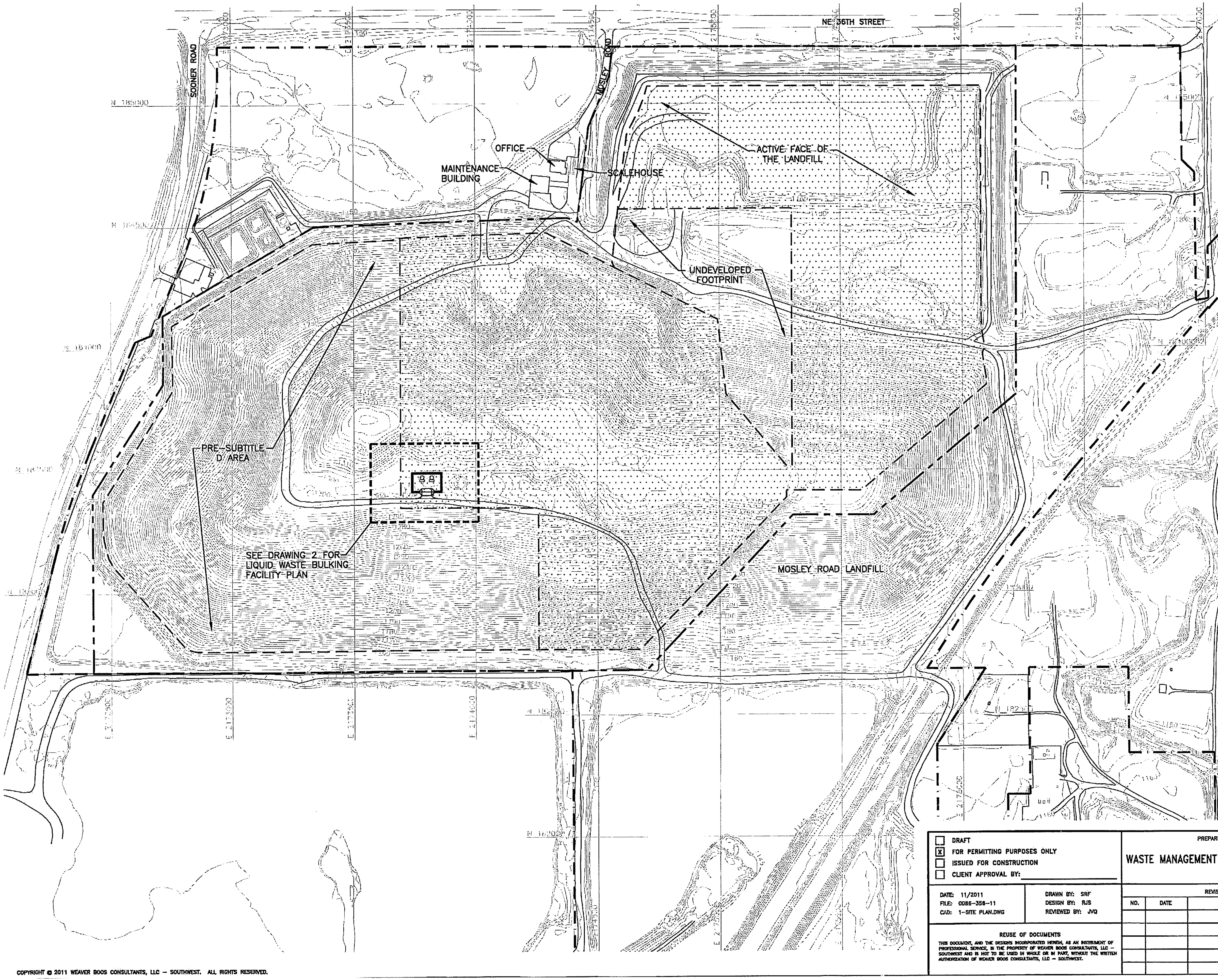
- The Paint Filter Liquids Test (EPA Method SW-846/9095) is required immediately prior to disposal of the waste in the landfill. Representative grab samples shall be obtained at a rate of one per batch of treated material.
- Records concerning the completed generator waste profile sheets, waste receipts, and test results shall be maintained in the Site Operating Record.

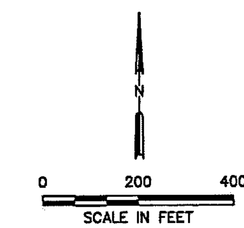
2.7 Training of Operational Personnel

Personnel involved in the bulking facility shall receive adequate training in the bulking procedure, acceptable testing method, recognition of waste streams and their compatibility, daily operations, recordkeeping and reporting, implementation of emergency procedures, and regulations pertaining to liquid waste disposal.

APPENDIX A

DRAWINGS





LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- LANDFILL PERMIT BOUNDARY
- LANDFILL LIMITS OF WASTE
- STATE PLANE COORDINATE
- EXISTING CONTOUR
- FENCE LINE
- COMPOSITE LINED AREA (SEE NOTE 3)
- LIMITS OF COMPOSITE LINED AREA

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY AMI ENGINEERING, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 27, 2011.
2. THE LANDFILL PERMIT BOUNDARY AND LIMITS OF WASTE WAS REPRODUCED FROM THE TIER III PERMIT MODIFICATION LATERAL EXPANSION APPLICATION FOR EAST OAK RDF APPROVED IN MAY 2008.
3. REMAINING UNDEVELOPED FOOTPRINT IS SCHEDULED TO BE CONSTRUCTED IN 2013-2014.
4. THE LOCATION OF THE LIQUID WASTE BULKING FACILITY MAY BE RELOCATED OVER A PERMITTED WASTE FILL AREA THAT IS LINED IN ACCORDANCE WITH SUBTITLE D REQUIREMENTS TO ACCOMMODATE LANDFILL ACTIVITIES, BUT WILL REMAIN SEPARATE FROM THE WORKING FACE.

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24456
OKLAHOMA

11/2/11

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION ☐ CLIENT APPROVAL BY:________	PREPARED FOR WASTE MANAGEMENT OF OKLAHOMA, INC.	SITE PLAN EAST OAK RDF OKLAHOMA COUNTY, OKLAHOMA
DATE: 11/2011 FILE: 0086-356-11 CAD: 1-SITE PLAN.DWG DRAWN BY: SRF DESIGN BY: RJS REVIEWED BY: JVQ	REVISIONS NO. / DATE / DESCRIPTION	Weaver Boos Consultants
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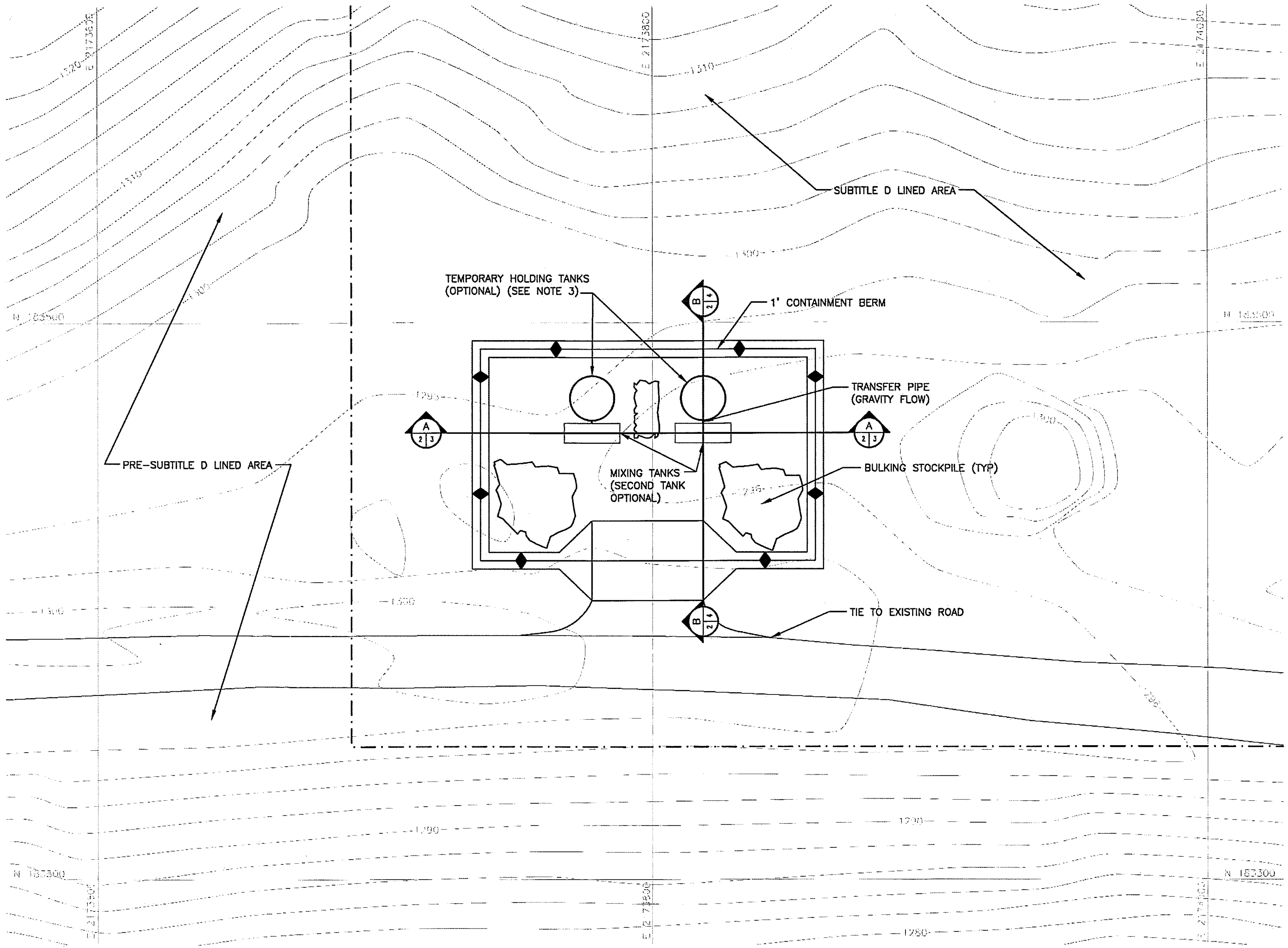
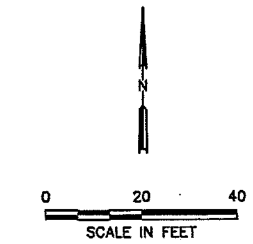
O:\0086\356\LIQUID WASTE BULKING FACILITY (2011)\1-SITE PLAN.dwg, rspicer, 1:2





LEGEND:

N 183500	STATE PLANE COORDINATE
1300	EXISTING CONTOUR
— · — · —	LIMITS OF COMPOSITE LINED AREA

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY AMI ENGINEERING, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 27, 2011.
2. THE LOCATION OF THE LIQUID WASTE BULKING FACILITY MAY BE RELOCATED OVER A PERMITTED WASTE FILL AREA THAT IS LINED IN ACCORDANCE WITH SUBTITLE D REQUIREMENTS TO ACCOMMODATE LANDFILL ACTIVITIES, BUT WILL REMAIN SEPARATE FROM THE WORKING FACE.
3. MINIMAL GRADING WORK MAY BE REQUIRED TO ALLOW GRAVITY FLOW FROM HOLDING TANKS TO MIXING TANKS.

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24456
OKLAHOMA

Jon VQ
11/2/11

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- [ ] CLIENT APPROVAL BY: ____

DATE: 11/2011
FILE: 0086-356-11
CAD: 2-FACILITY PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

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PREPARED FOR

WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

LIQUID WASTE BULKING FACILITY PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

Weaver Boos Consultants

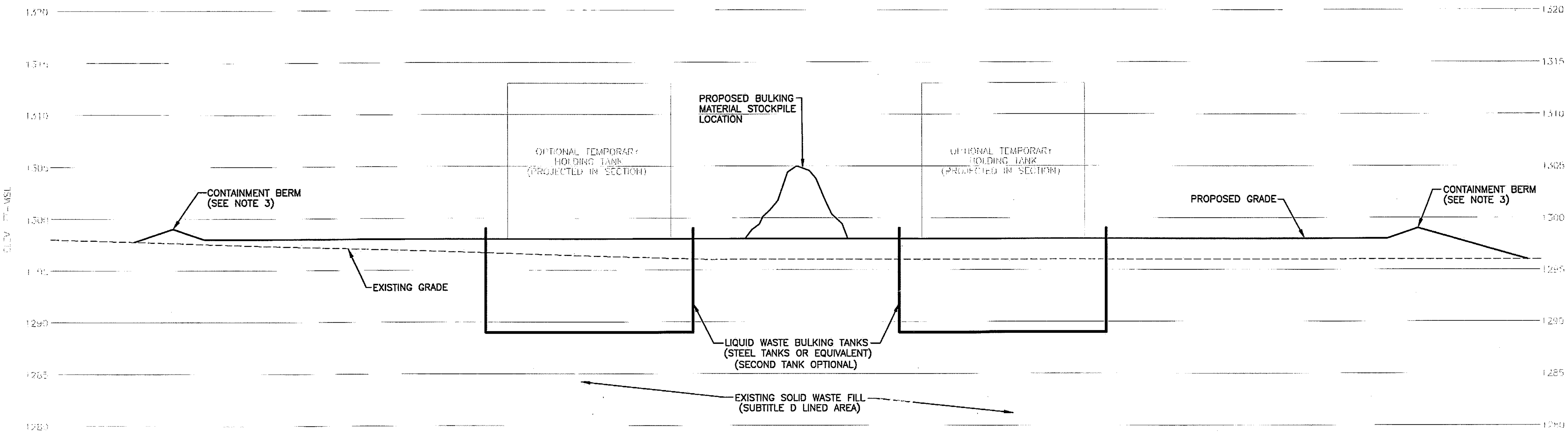
CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735-9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWING 2

O:\0086\356\LIQUID WASTE BULKING FACILITY (2011)\2-BULKING FACILITY PLAN.dwg, rspicer, 1:2



HOLDING TANK AND MIXING AREA SECTION A 2|3

0 5 10
SCALE IN FEET

SECONDARY CONTAINMENT VOLUME CALCULATIONS

LIQUID WASTE BULKING FACILITY AREA SECONDARY CONTAINMENT WILL PROVIDE STORAGE TO CONTAIN EITHER THE VOLUME OF THE LARGEST TANK (25,000 GALLONS) OR THE 25–YEAR 24 HOUR STORM EVENT (7.2 INCHES), WHICHEVER IS LARGER.

VOLUME OF LARGEST TANK = 25,000 gal $\times \frac{1\ ft^3}{7.481\ gal}$ = 3,342 ft^3

VOLUME OF 25–YEAR 24 hr STORM = 7.2 INCHES x STORAGE AREA
= (7.2"/12') x (9,150 ft^2)
= 5,488 ft^3

PROVIDE STORAGE FOR 5,490 ft^3. VOLUME PROVIDED BY 1 FOOT OF THE CONTAINMENT BERM = 1 ft x 9,150 ft^2 = 9,150 ft^3

VOLUME PROVIDED (9,150 ft^3) > VOLUME REQUIRED (5,490 ft^3)

TOTAL DEPTH OF SECONDARY CONTAINMENT IS 1 FT. THEREFORE THE VOLUME PROVIDED BY 1 FT. BERM IS GREATER THAN THE VOLUME OF TANK AND THE 25–YR 24 HR STORM EVENT.

LEGEND

------------ EXISTING GRADE

———————— PROPOSED GRADE (SEE NOTE 4)

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24456
OKLAHOMA

11/2/11

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY AMI ENGINEERING, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 27, 2011.
2. IN THE EVENT BOTH MIXING TANKS ARE BEING UTILIZED FOR STABILIZATION, ADDITIONAL LIQUID WASTE SHALL BE TEMPORARILY STORED IN THE TEMPORARY LIQUID WASTE STORAGE TANK UNTIL A MIXING TANK BECOMES AVAILABLE FOR PROCESSING.
3. CONTAINMENT BERM SHALL BE MAINTAINED AT A MINIMUM OF ONE FOOT IN DEPTH FOR THE PERIMETER OF THE LIQUID WASTE BULKING AREA.
4. PROPOSED GRADE SHALL DRAIN AWAY FROM CONTAINMENT STRUCTURES AT A MINIMUM OF 0.1% SLOPE.

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WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

LIQUID WASTE BULKING AREA
TYPICAL SECTION A

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

Weaver Boos Consultants

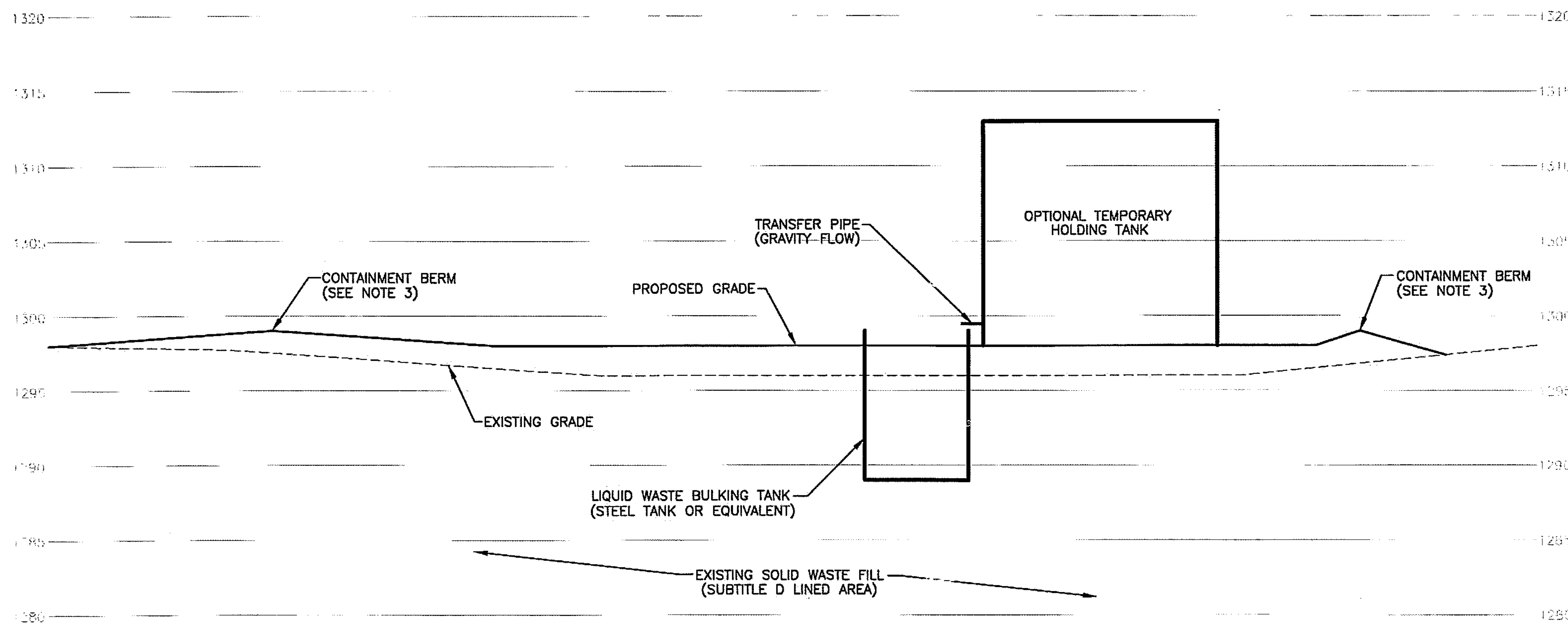
CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735–9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWING 3

O:\0086\356\LIQUID WASTE BULKING FACILITY (2011)\3-BULKING AREA SECTION A.dwg, rspicer, 1:2



HOLDING TANK AND MIXING AREA SECTION B 2 | 4

0 5 10
SCALE IN FEET

SECONDARY CONTAINMENT VOLUME CALCULATIONS

LIQUID WASTE BULKING FACILITY AREA SECONDARY CONTAINMENT WILL PROVIDE STORAGE TO CONTAIN EITHER THE VOLUME OF THE LARGEST TANK (25,000 GALLONS) OR THE 25–YEAR 24 HOUR STORM EVENT (7.2 INCHES), WHICHEVER IS LARGER.

VOLUME OF LARGEST TANK = 25,000 gal x $\frac{1 \text{ ft}^3}{7.481 \text{ gal}}$ = 3,342 ft^3

VOLUME OF 25–YEAR 24 hr STORM = 7.2 INCHES x STORAGE AREA
= (7.2"/12') x (9,150 ft^2)
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PROVIDE STORAGE FOR 5,490 ft^3. VOLUME PROVIDED BY 1 FOOT OF THE CONTAINMENT BERM = 1 ft x 9,150 ft^2 = 9,150 ft^3

VOLUME PROVIDED (9,150 ft^3) > VOLUME REQUIRED (5,490 ft^3)

TOTAL DEPTH OF SECONDARY CONTAINMENT IS 1 FT. THEREFORE THE VOLUME PROVIDED BY 1 FT. BERM IS GREATER THAN THE VOLUME OF TANK AND THE 25–YR 24 HR STORM EVENT.

LEGEND

- – – – – – – EXISTING GRADE
- ———— PROPOSED GRADE (SEE NOTE 4)

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24456
OKLAHOMA

11/2/11

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY AMI ENGINEERING, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 27, 2011.
2. IN THE EVENT BOTH MIXING TANKS ARE BEING UTILIZED FOR STABILIZATION, ADDITIONAL LIQUID WASTE SHALL BE TEMPORARILY STORED IN THE TEMPORARY LIQUID WASTE STORAGE TANK UNTIL A MIXING TANK BECOMES AVAILABLE FOR PROCESSING.
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4. PROPOSED GRADE SHALL DRAIN AWAY FROM CONTAINMENT STRUCTURES AT A MINIMUM OF 0.1% SLOPE.

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FILE: 0086-356-11 | DESIGN BY: RJS
CAD: 4-SECTION B.DWG | REVIEWED BY: JVQ

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PREPARED FOR

WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS		
NO.	DATE	DESCRIPTION

LIQUID WASTE BULKING AREA TYPICAL SECTION B

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

Weaver Boos Consultants

CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO
FORT WORTH, TX (817) 735-9770
GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWING 4

O:\0086\356\LIQUID WASTE BULKING FACILITY (2011)\4-BULKING AREA SECTION B.dwg, rspicer, 1:2

APPENDIX B

EXAMPLE GENERATOR WASTE PROFILE SHEET

WASTE MANAGEMENT

Generator's Non-hazardous Waste Profile Sheet

Requested Disposal Facility: ______________________ Profile Number: ______________________

☐ Renewal for Profile Number: ______________________ Waste Approval Expiration Date: ______________________

☐ Check here if there are multiple generating locations for this waste. Attach additional locations.

A. Waste Generator Facility Information (must reflect location of waste generation/origin)

1. Generator Name: ______________________
2. Site Address: ______________________
3. City/ZIP: ______________________
4. State: ______________________
5. County: ______________________
6. Contact Name/Title: ______________________
7. Email Address: ______________________
8. Phone: ______________________ 9. FAX: ______________________
10. NAICS Code: ______________________
11. Generator USEPA ID #: ______________________
12. State ID# (if applicable): ______________________

B. Customer Information ☐ same as above

P. O. Number: ______________________

1. Customer Name: ______________________
2. Billing Address: ______________________
3. City, State and ZIP: ______________________
4. Contact Name: ______________________
5. Contact Email: ______________________
6. Phone: ______________________ FAX: ______________________
7. Transporter Name: ______________________
8. Transporter ID # (if appl.): ______________________
9. Transporter Address: ______________________
10. City, State and ZIP: ______________________

C. Waste Stream Information

1. DESCRIPTION
   a. Common Waste Name: ______________________
      State Waste Code(s): ______________________
   b. Describe Process Generating Waste or Source of Contamination:
   c. Typical Color(s): ______________________
   d. Strong Odor? ☐ Yes ☐ No Describe: ______________________
   e. Physical State at 70°F: ☐ Solid ☐ Liquid ☐ Powder ☐ Semi-Solid or Sludge ☐ Other: ______________________
   f. Layers? ☐ Single layer ☐ Multi- layer ☐ NA
   g. Water Reactive? ☐ Yes ☐ No If Yes, Describe: ______________________
   h. Free Liquid Range (%): _______ to _______ ☐ NA(solid)
   i. pH Range: _______ to _______ ☐ NA(solid)
   j. Liquid Flash Point: ☐ < 140°F ☐ 140°- 199°F ☐ ≥ 200°F ☐ NA(solid)
   k. Flammable Solid: ☐ Yes ☐ No
   l. Physical Constituents: List all constituents of waste stream - (e.g. Soil 0-80%, Wood 0-20%): ☐ (See Attached)

Constituents (Total Composition Must be ≥ 100%)	Lower Range	Unit of Measure	Upper Range	Unit of Measure
1.				
2.				
3.				
4.				
5.				
6.				

2. ESTIMATED QUANTITY OF WASTE AND SHIPPING INFORMATION
   a. ☐ One Time Event ☐ Base ☐ Repeat Event
   b. Estimated Annual Quantity: ____________ ☐ Tons ☐ Cubic Yards ☐ Drums ☐ Gallons ☐ Other (specify): ____________
   c. Shipping Frequency: ____________ Units per ☐ Month ☐ Quarter ☐ Year ☐ One Time ☐ Other
   d. Is this a U.S. Department of Transportation (USDOT) Hazardous Material? (If yes, answer e.) ☐ Yes ☐ No
   e. USDOT Shipping Description (if applicable): ______________________
3. SAFETY REQUIREMENTS (Handling, PPE, etc.): ______________________

WASTE MANAGEMENT

Generator's Non-hazardous Waste Profile Sheet

D. Regulatory Status (Please check appropriate responses)

1. Waste Identification:
   a. Does the waste meet the definition of a USEPA listed or characteristic hazardous waste as defined by 40 CFR Part 261? ☐ Yes ☐ No
      1. If yes, please complete a hazardous waste profile.
   b. Does the waste meet the definition of a state hazardous waste other than identified in D.1.a? ☐ Yes ☐ No
      1. If yes, please complete a hazardous waste profile.
2. Is this waste included in one or more of categories below (Check all that apply)? If yes, attach supporting documentation. ☐ Yes ☐ No
   ☐ Delisted Hazardous Waste ☐ Excluded Wastes Under 40CFR 261.4
   ☐ Treated Hazardous Waste Debris ☐ Treated Characteristic Hazardous Waste
3. Is the waste from a Federal (40 CFR 300, Appendix B) or state mandated clean-up? If yes, see instructions. ☐ Yes ☐ No
4. Does the waste represented by this waste profile sheet contain radioactive material? ☐ Yes ☐ No
   a. If yes, is disposal regulated by the Nuclear Regulatory Commission? ☐ Yes ☐ No
   b. If yes, is disposal regulated by a State Agency for radioactive waste/NORM? ☐ Yes ☐ No
5. Does the waste represented by this waste profile sheet contain Polychlorinated Biphenyls (PCBs)? ☐ Yes ☐ No
   (If yes, list in Chemical Composition - C.1.I)
   a. If yes, are the PCBs regulated by 40 CFR 761? ☐ Yes ☐ No
   b. If yes, is it remediation waste from a project being performed under the Self-Implementing option provided in 40 CFR 761.61(a)? ☐ Yes ☐ No
   c. If yes, were the PCBs imported into the US? ☐ Yes ☐ No
6. Does the waste contain untreated, regulated medical or infectious waste? ☐ Yes ☐ No
7. Does the waste contain asbestos? ☐ Yes ☐ No
   a. If Yes, ☐ Friable ☐ Non Friable
8. Is this profile for remediation waste from a facility that is a major source of Hazardous Air Pollutants (Site Remediation NESHAP, 40 CFR 63 subpart GGGGG)? ☐ Yes ☐ No
   a. If yes, does the waste contain <500 ppmw VOHAPs at the point of determination? ☐ Yes ☐ No

E. Generator Certifcation (Please read and certify by signature below)

By signing this Generator's Waste Profile Sheet, I hereby certify that all:

1. Information submitted in this profile and all attached documents contain true and accurate descriptions of the waste material;
2. Relevant information within the possession of the Generator regarding known or suspected hazards pertaining to this waste has been disclosed to WM/the Contractor;
3. Analytical data attached pertaining to the profiled waste was derived from testing a representative sample in accordance with 40 CFR 261.20(c) or equivalent rules; and
4. Changes that occur in the character of the waste (i.e. changes in the process or new analytical) will be identified by the Generator and disclosed to WM (and the Contractor if applicable) prior to providing the waste to WM (and the contractor if applicable).
5. Check all that apply:
   ☐ a. Attached analytical pertains to the waste. Identify laboratory & sample ID #'s and parameters tested: ______ # Pages: ______
   ☐ b. Only the analysis identified on the attachment pertain to the waste (identify by laboratory & sample ID #'s and parameters tested). Attachment #: ______
   ☐ c. Additional information necessary to characterize the profiled waste has been attached (other then analytical, such as MSDS). Indicate the number of attached pages: ______
   ☐ d. I am an agent signing on behalf of the Generator, and the delegation of authority to me from the Generator for this signature is available upon request.

Certification Signature: ______ Title: ______

Company Name: ______ Name (Print): ______

Date: ______

EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3555036

APPENDIX W

ALTERNATIVE DAILY COVERS

Prepared for

Waste Management of Oklahoma, Inc.

April 2015

Prepared by

Weaver Boos Consultants, LLC–Southwest
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WBC Project No. 0086-356-11-40-04

APPENDIX W

ALTERNATIVE DAILY COVERS

Note: This appendix includes the following.

- An ODEQ cover letter for a Tier I Permit Modification for Alternative Daily Cover issued on February 22, 2010.
- The Alternative Daily Cover Operating Plan.

STEVEN A. THOMPSON
Executive Director

O K L A H O M A
DEPARTMENT OF ENVIRONMENTAL QUALITY

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

February 22, 2010

Mr. Guy Campbell
Waste Management of Oklahoma
3201 Mosley Road
Oklahoma City, OK 73141

Subject: Tier I Permit Modification – Alternative Daily Cover
East Oak Landfill
Oklahoma County, Permit # 3555036

Dear Mr. Campbell:

The Department received an original application dated December 10, 2009 and a resubmittal dated February 5, 2010 for the above referenced submittal at the East Oak Landfill. The Department reviewed the submitted application and found it to be technically complete.

Pursuant to Oklahoma Administrative Code (OAC) 252:4-7-58(2) the submittal was processed as a Tier I Application. The Department approves the permit modification, which is effective on the date that it was signed. Please contact Wesley Squyres at (405) 702-5197, if there are any questions concerning the permit modification.

Sincerely,

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

ST/WS

cc: Don Fletcher, Waste Management
Jeff Young, Weaver Boos Consultants

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

SOLID WASTE PERMIT MODIFICATION

The Department of Environmental Quality hereby approves the following modification:

Permit Number:	**3555036**
Facility:	**East Oak Recycling & Disposal Facility**
Facility Type:	**Municipal Solid Waste Landfill**
County:	**Oklahoma County**

Modification: To allow the use of following materials as alternate daily cover (ADC):

1. Wood chips.
2. Petroleum Contaminated Material.
3. Tire chips.

MODIFICATION CONDITIONS:

1. General Conditions (applicable to all ADC):
   a) A minimum of 6 inches of ADC must be applied to the working face at the end of the day.
   b) ADC materials must be stored at the landfill in a manner that will prevent storm water run-on and runoff.
   c) The alternate daily cover shall not be used more than six consecutive days, without placing six inches of earthen cover on the seventh day.
   d) Six inches of earthen materials must be used instead of any ADC, if the working face will remain unused for more than 24 hours.

2. Specific conditions for Wood chips:
   a) Wood chips must be mixed with a minimum 50% soil.

3. Specific conditions for Petroleum Contaminated Material:
   a) All materials must meet the standards in the Waste Exclusion Plan (WEP).
   b) Each petroleum contaminated material generator must provide laboratory analysis indicating compliance with the WEP.
   c) Waste Management of Oklahoma must request ODEQ approval for each petroleum contaminated generator prior to acceptance.

4. Specific conditions for Tire chips:
   a) Tire chips must not be used on any area of the landfill that has the potential for hot loads or fire.

5. The application signed by Jeffery P. Young, P.E., is considered approved and is incorporated as part of this modification.

6. The permittee is authorized to operate in conformity with the application described above. Commencing operations under this permit modification constitutes acceptance of, and consent to, the conditions contained herein.

Date: 2/23/10

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

ST/WS

EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3555036

ALTERNATIVE DAILY COVER
OPERATING PLAN

Prepared for

Waste Management of Oklahoma, Inc.

December 2009

Revised February 2010

Prepared by

Weaver Boos Consultants, LLC–Southwest
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WBC Project No. 0086-356-11-09-01

WEAVER
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6420 SOUTHWEST BLVD, SUITE 206
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Denver, CO
St. Louis, MO
Columbus, OH
Beaverton, OR
Fort Worth, TX

February 5, 2010
Project No. 0086-356-11-09-01

Wesley Squyres
Solid Waste Permitting Unit
Oklahoma Department of Environmental Quality
707 North Robinson Avenue
Oklahoma City, Oklahoma 73102

RE: Tier I Permit Modification
Notice of Deficiency (NOD) – Alternate Daily Cover (ADC) Options
East Oak Recycling and Disposal Facility (MSW Permit No. 3555036)
Oklahoma County, Oklahoma

Dear Mr. Squyres:

On behalf of Waste Management of Oklahoma, Inc. (WMO), please find enclosed our response to your January 14, 2010 Oklahoma Department of Environmental Quality (ODEQ) NOD letter regarding the referenced project. This response letter contains each item identified in the ODEQ NOD letter (in bold) and a response to each item in the same order listed within the Agency's first NOD letter.

1. **The Department does not allow the use of fly ash or auto shredder fluff as ADC.**

Response:

Fly ash and auto shredder fluff materials have been removed from the ADC Operating Plan, as shown on pages 1 and 2.

2. **Wood chips will be approved as ADC with a mix of a minimum 50 percent with soil.**

Response:

Additional text has been added to pages 2 and 3 of the ADC Operating Plan indicating that wood chip ADC will be mixed with a minimum of 50 percent soil.

3. **Petroleum contaminated material as ADC may be approved, as stated in the application, with approval from the Department for each petroleum contaminated material source.**

Response:

WMO will request ODEQ approval for each petroleum contaminated material source, as noted on page 2 of the ADC Operating Plan.

4. Tire chips may be used as ADC.

Response:

Tire chips are included on page 2 of the ADC Operating Plan.

If you have any questions or require additional information, please call.

Sincerely,
Weaver Boos Consultants, LLC – Southwest

Jeffrey P. Young, P.E.
Senior Engineer

Attachments: Attachment – Alternative Daily Cover Operating Plan

cc: Guy R. Campbell, Waste Management of Oklahoma, Inc.
Don Fletcher, Waste Management of Oklahoma, Inc.

CONTENTS

1 INTRODUCTION

A daily cover with at least six (6) inches of earthen material or an approved Alternative Daily Cover (ADC) will be placed over the exposed solid waste at the end of each operating day. The cover is used to prevent and control disease vectors, fires, odors, blowing litter, and scavenging at the facility. The material will be employed sufficiently to minimize washout and keep any rainfall from exiting the active disposal area.

ADC that may be used at this site includes wood chips, tire chips, or petroleum contaminated material. Please note per the May 16, 2008 ODEQ approval of the Tier III Permit Modification, tarps and spray type ADC are also approved for use. In accordance with Section 252:515-19-51(d) of the ODEQ Municipal Solid Waste Regulations, material characteristics, operation methods, inspection procedures, and limitations are discussed in this plan.

2 GENERAL MATERIAL DESCRIPTION

The following is a general material description of the ADC that may be used at this site.

- Wood Chip ADC – The wood chips that will be used at this site will be the chippings of clean wood material, brush, and/or leaves mixed with a minimum of 50 percent soil.
- Tire Chip ADC – The tire chips that will be used at this site will be the chippings of waste tires.
- Petroleum Contaminated Material ADC – The petroleum contaminated material that will be used at this site will meet the standards included in the site Waste Exclusion Plan (WEP). Each petroleum contaminated material generator will provide laboratory analysis indicating compliance with the site WEP. Waste Management of Oklahoma, Inc. will request ODEQ approval for each petroleum contaminated generator prior to acceptance.

3 OPERATIONAL METHODS

The following are operational procedures that will be used to employ the ADC that may be used at this site.

- Wood chip – The wood chip operational method includes the following:
  - Wood chip material will be mixed with a minimum of 50 percent soil.
  - At least six (6) inches of wood chip/soil mixture will be placed over the working face.
  - The working area will be surrounded by a contaminated water containment berm and/or stormwater diversion berm.
  - The wood chips will be covered with waste within a 24-hour period.
- Tire Chip ADC – The tire chip ADC operational method includes the following:
  - At least six (6) inches of tire chips will be placed over the working face.
  - The working area will be surrounded by a contaminated water containment berm and/or stormwater diversion berm.
  - The tire chips will be covered with waste within a 24-hour period.
- PCM ADC – The PCM ADC operational method includes the following:
  - At least six (6) inches of PCM will be placed over the working face.
  - The working area will be surrounded by a contaminated water containment berm and/or stormwater diversion berm.
  - The PCM will be covered with waste within a 24-hour period.

4 VERIFICATION AND INSPECTION

At the end of each working day, site personnel will visually inspect the working face to verify that the approved ADC has been placed over the exposed wastes. Site personnel will also routinely assess the effectiveness of the ADC in controlling vectors, fires, odors, and windblown waste.

5 LIMITATION ON ADC USE

Limitations on the use of ADC are listed below.

- ADC will not be used during six consecutive days without placing six inches of earthen material on the seventh day.
- If the working face area will remain unused for more than 24 hours, then the area in which the ADC was used will be covered with six inches of soil.

APPENDIX X

RECYCLING PLAN

Note: This appendix includes the following.

- An ODEQ cover letter for a Tier I Permit Modification and Recycling Plan issued on May 11, 2011.
- The Recycling Plan.

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

STEVEN A. THOMPSON
Executive Director

MARY FALLIN
Governor

May 11, 2011

Mr. Guy Campbell
Waste Management of Oklahoma
3201 Mosley Road
Oklahoma City, OK 73141

REC'D MAY 17

Subject: Recycling Plan
East Oak Landfill
Oklahoma County, Permit # 3555036

Dear Mr. Campbell:

The Department received the Recycling Plan dated May 10, 2011. The application proposes to recycle at/adjacent the working face; recycled materials will be stored in roll-off containers. The following list includes items that may be recycled:

- Ferrous and non-ferrous metal
- Mixed rigid plastic
- Corrugated cardboard and boxes
- Mixed paper products

Surface water will be controlled with diversion berms, any water that comes into contact with the recycled material will be considered contaminated and handled as leachate. No recycled materials will be stored on the ground overnight. Recycled material will not be stored in a quantity exceeding that which may be reasonably expected to be used or recycled within one year.

The Department approves the recycling plan as submitted. Should you have any questions or need additional information, please contact Wesley Squyres at (405) 702-5197.

Sincerely,

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

ST/WS

WEAVER
BOOS
CONSULTANTS
LLC
SOUTHWEST

6420 SOUTHWEST BLVD, SUITE 206
FORT WORTH, TEXAS 76109
PHONE: 817.735.9770
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Chicago, IL
Naperville, IL
Springfield, IL
South Bend, IN
St. Louis, MO
Columbus, OH
Denver, CO
Fort Worth, TX
Clermont, FL
Grand Rapids, MI
Portland, OR

May 10, 2011
Project 0086-356-11-30-01

Mr. Wesley Squyres
Solid Waste Permitting Unit
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, Oklahoma 73107-1677

Re: Recycling Plan
Tier I Permit Modification
East Oak Recycling and Disposal Facility (RDF) – Permit No. 3555036
Oklahoma County, Oklahoma

Dear Mr. Squyres:

The purpose of this letter, submitted on behalf of Waste Management of Oklahoma, Inc. (WMO) is to provide a Recycling Plan in accordance with Oklahoma Administrative Code (OAC) 252:515-19-39(a) for the East Oak RDF. The location of the recycling process and storage area will be at/adjacent the working face of the landfill and may be routinely relocated within the landfill limits of waste. However, it should be noted that the location of the storage area may be relocated to an area outside the landfill limits of waste, but within WMO property (i.e., soil borrow area), to accommodate landfill activities. A Site Plan has been provided for your reference. No mining (excavation) of in-place waste is requested at this time; only recyclable processing at the working face of incoming loads is requested.

All recyclable material will be stored in roll-off containers and in a manner to control vectors, prevent odors, prevent windblown material/litter, prevent fires, and ensure safety. Recyclable material will not be stockpiled on the ground over night. Consistent with OAC 252:515-1-7, recyclable material will not be stored in a quantity exceeding that which may be reasonable expected to be used or recycled. When necessary, the recyclable material will be transferred off-site to an appropriate recycling facility.

SITE OPERATIONS

Accepted Waste

The following list includes items that may or may not be recycled at this facility.

- Ferrous and non-ferrous metals

- Mixed rigid plastics (e.g., 5-gal. pails, crates, pallets)
- Corrugated cardboard and boxes
- Mixed paper products (i.e., brown paper bags, newspapers, magazines/catalogues, paper board, phone books, etc.)

Material Handling and Processing

Landfill customers and/or hauling trucks transporting municipal solid waste (MSW) to the site will access the working face using existing site access roads. Their loads will be dumped at the working face. Landfill personnel will examine the load for recyclable material. If recyclables are present, they will be identified and removed from the load. All recyclable material recovered will be sorted and moved to an area to be stored in roll-off containers. Recyclable material will not be stockpiled on the ground over night. The recyclable material will be stored in these areas until an end-use is identified. It should be noted that the location of the storage area may be relocated to an area outside the landfill limits of waste, but within WMO property (i.e., soil borrow area), to accommodate landfill activities. All recyclable material will be stored in roll-off containers and in a manner to control vectors, prevent odors, prevent windblown material/litter, prevent fires, and ensure safety. Recyclable material will not be stockpiled on the ground over night. Consistent with OAC 252:515-1-7, recyclable material will not be stored in a quantity exceeding that which may be reasonable expected to be used or recycled. All recycling activities will be performed to ensure the safety of all employees involved.

Surface Water Protection Plan

Surface water will be handled in accordance with OAC 252:515-17, including minimizing/controlling the amount of surface water that will come into contact with the recycling materials that will be stored in roll-off containers typically adjacent to the working face. Surface water will be controlled through the use of diversion berms, diversion ditches, and detention areas. Surface water that comes into contact with waste in the recycling area will be considered contaminated water and treated as leachate. Contaminated water will be controlled through the use of containment berms or other containment methods. As noted, the location of the storage area may be relocated to an area outside the landfill limits of waste to accommodate landfill activities and if so, will also be located outside the surface water and containment structures. However, the recyclable materials will be stored in roll-off containers in a manner to minimize/control the amount of stormwater/surface water that will contact the recyclables. Additionally, the recyclable materials will be stored in a location that if stormwater/surface water was to come into contact with the recyclable material containers, it would not be discharged offsite, into waters of the State or waters of the United States.

Dust Control

Dust resulting from recycling vehicular traffic will be kept to a minimum within the property through the utilization of a water truck. The roads and surfaces used by vehicles will be sprayed with water when conditions require dust to be minimized.

Facility Closure

The recycling processing will likely operate throughout the active life of the facility. During closure of the site, the recycling processing will be decommissioned and all recyclable material will be removed from the site. Closure activity will be completed in accordance with the approved ODEQ Closure and Postclosure Plan and OAC 252:515-25.

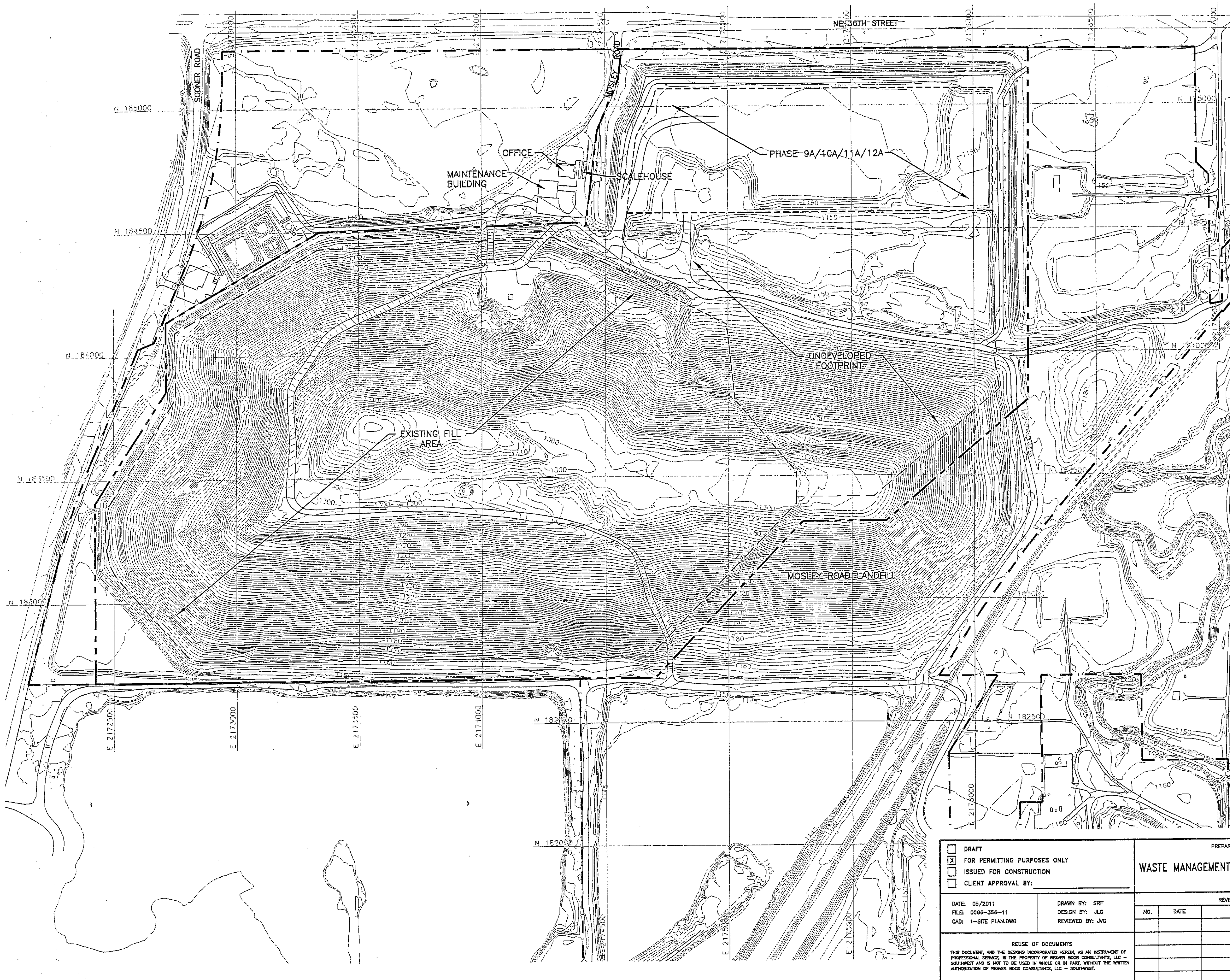
Consistent with OAC 252:4-7-58, please process this request as a Tier I Permit Modification. During the course of your review, if you need additional information or have any questions please call.

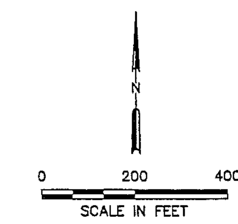
Sincerely,
Weaver Boos Consultants, LLC-Southwest

Jonathan V. Queen, P.E.
Project Engineer

Attachments: Appendix A – Site Plan

cc: Guy R. Campbell, Waste Management of Oklahoma, Inc.
Don Fletcher, Waste Management of Oklahoma, Inc.





LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- LANDFILL PERMIT BOUNDARY
- LANDFILL LIMITS OF WASTE
- CONSTRUCTED LIMITS OF WASTE
- N 182000 STATE PLANE COORDINATE
- 1180 EXISTING CONTOUR
- FENCE LINE

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY AMI ENGINEERING, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 27, 2011.
2. THE LANDFILL PERMIT BOUNDARY AND LIMITS OF WASTE WAS REPRODUCED FROM THE TIER III PERMIT MODIFICATION LATERAL EXPANSION APPLICATION FOR EAST OAK RDF APPROVED IN MAY 2008.
3. RECYCLING ACTIVITIES WILL OCCUR ADJACENT TO THE WORKING FACE. THE WORKING FACE WILL ROUTINELY BE RELOCATED TO ACCOMMODATE LANDFILL ACTIVITIES. RECYCLING ACTIVITIES WILL ADHERE TO THE RECYCLING PLAN REQUIREMENTS.

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24456
OKLAHOMA

5/4/11

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY: ____________

DATE: 05/2011
FILE: 0086-356-11
CAD: 1-SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: JLG
REVIEWED BY: JVQ

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PREPARED FOR

WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

Weaver Boos Consultants

CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735-9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWING 1

O:\0086\356\ROOF SHINGLE RECYCLING\1-SITE PLAN.dwg, 5/4/2011 4:34:21 PM, sford, 1:2

APPENDIX Y

ROOFING SHINGLE RECYCLING PLAN

Note: This appendix includes the following.

- An ODEQ cover letter for a Tier I Permit Modification for asphalt shingles recycling issued on June 9, 2010.
- The Roofing Shingle Recycling Plan.

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

June 9, 2010

Mr. Guy Campbell
Waste Management of Oklahoma
3201 Mosley Road
Oklahoma City, OK 73141

Subject: Tier I Permit Modification – Asphalt Shingles Recycling
East Oak Landfill
Oklahoma County, Permit # 3555036

Dear Mr. Campbell:

The Department received an application dated June 2, 2010 for the above referenced modification at the East Oak Landfill. The Department reviewed the submitted application and found it to be technically complete.

Pursuant to Oklahoma Administrative Code (OAC) 252:4-7-58(2) the submittal was processed as a Tier I Application. The Department approves the permit modification, which is effective on the date that it was signed. Please contact Wesley Squyres at (405) 702-5197, if there are any questions concerning the permit modification.

Sincerely,

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

ST/WS

cc: Don Fletcher, Waste Management
Jonathan Queen, Weaver Boos Consultants

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

SOLID WASTE PERMIT MODIFICATION

The Department of Environmental Quality hereby approves the following modification:

Permit Number:	**3555036**
Facility:	**East Oak Recycling & Disposal Facility**
Facility Type:	**Municipal Solid Waste Landfill**
County:	**Oklahoma County**

Modification: To allow accumulation of roofing asphalt shingles for the purpose of recycling.

MODIFICATION CONDITIONS:

1. The application signed by Jonathan V. Queen, P.E., is considered approved and is incorporated as part of this modification.

2. The permittee is authorized to operate in conformity with the application described above. Commencing operations under this permit modification constitutes acceptance of, and consent to, the conditions contained herein.

3. All processed and unprocessed material may not be accumulated for more than one year.

4. All processing and storage will be in the area designated on Drawing 1 as explained by note number 3.

Date: 6/9/10

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

ST/WS

WEAVER
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Naperville, IL
Springfield, IL
South Bend, IN
St. Louis, MO
Columbus, OH
Denver, CO
Fort Worth, TX
Clermont, FL
Grand Rapids, MI
Portland, OR

June 2, 2010
Project 0086-363-11-09-13

Mr. Wesley Squyres
Solid Waste Permitting Unit
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, Oklahoma 73102

Re: Roofing Shingle Recycling Plan
Tier I Permit Modification
East Oak Recycling and Disposal Facility (RDF) – Permit No. 3555036
Oklahoma County, Oklahoma

Dear Mr. Squyres:

The purpose of this letter, submitted on behalf of Waste Management of Oklahoma, Inc. (WMO) is to provide a Roofing Shingle Recycling Plan for the East Oak RDF. The approximate location of the proposed roofing shingle material processing and storage area is shown on Drawing 1. However, it should be noted that the location of the processing and storage area may be routinely relocated within the landfill permit boundary (in an area that has not been developed for solid waste disposal) and soil borrow area to accommodate landfill activities.

The processing and storage areas at the site will not exceed 10-acres. All unprocessed material will be processed within one year of the time it arrives at the landfill. Additionally, processed material will not be stored in a quantity exceeding that which may be reasonable expected to be used or recycled within one year, consistent with Oklahoma Administrative Code (OAC) 252:515-1-7. The processed roofing shingle material is will be distributed to third parties for off-site uses (i.e., additive to hot mix asphalt, road base, etc.). A process diagram that outlines the facility operations is included as Drawing 2. The site will consist of a material receiving area, a material processing area that will include a grinder unit to reduce material size (grinder unit to be brought to site as needed), and a processed material storage area.

SITE OPERATIONS

Accepted Waste

Source-separated roofing shingle material from area residents, local businesses, and other landfill customers will be directed to the material off-loading and storage area shown on

Drawing 1 and Drawing 2. For the purposes of this submittal, roofing shingle material is defined as composition shingles commonly made of fiberglass or recycled paper based products mixed with asphalt, which is covered with mineral granules. Additional, small amount of roof decking (wood) and roofing fabric may be commingled. Those loads that are determined to possess an excessive amount of non-roofing shingle waste will be directed to the landfill working face for disposal.

Waste Exclusion Program

Landfill personnel will monitor the unloading of the roofing shingle material and remove non-roofing shingle waste material that may be commingled with the incoming loads. Other removed unacceptable material will also be transported to the active landfill working area for disposal.

Material Handling and Processing

A process diagram of the roofing shingle material processing area is shown on Drawing 2. Trucks delivering roofing shingle material to the site will access the processing area using the existing access road shown on Drawing 1. Roofing shingle materials requiring size reduction will be moved from the roofing shingle material stockpile, by a front-end loader or similar equipment, to the grinder unit for grinding. Once the roofing shingle material is processed, the processed shingles will be stored in the processed material storage area. The processed shingles will be stored in this area until an end-use is identified. The processing and storage areas at the site will not exceed 10-acres. Consistent with OAC 252:515-1-7, material in the processed material stockpile will not be stored in a quantity exceeding that which may be reasonable expected to be used or recycled within one year. Additionally, unprocessed roofing shingle material will be processed within one year of the time it arrives onsite.

Surface Water Protection Plan

Given that stormwater that contacts roofing shingles material or the processed roofing shingles is not considered contaminated, the stormwater runoff from the roofing shingles processing area will be handled as uncontaminated stormwater runoff. Currently, due to construction of permitted perimeter berms in the northern portion of the site, stormwater runoff from the roofing shingles processing area will be contained and will not be discharged off-site. If during operations stormwater runoff impacts the stored processed material (e.g., erosion of the stockpiled material) straw bales or a silt fence will be constructed downstream of the processing and storage area to prevent washout.

Dust Control

Watering the affected areas with the site's water truck will control dust created by the use of the site access road and from the roofing shingle material processing operation.

Facility Closure

Upon decommissioning of the roofing shingle material processing area, remaining roofing shingle material will be disposed of at the working face of the landfill. Processed roofing shingle material will either be distributed for an off-site use (i.e., additive to hot mix asphalt, road base, etc.) or will be disposed of at the working face of the landfill.

During the course of your review, if you need additional information or have any questions please call.

Sincerely,
Weaver Boos Consultants, LLC-Southwest

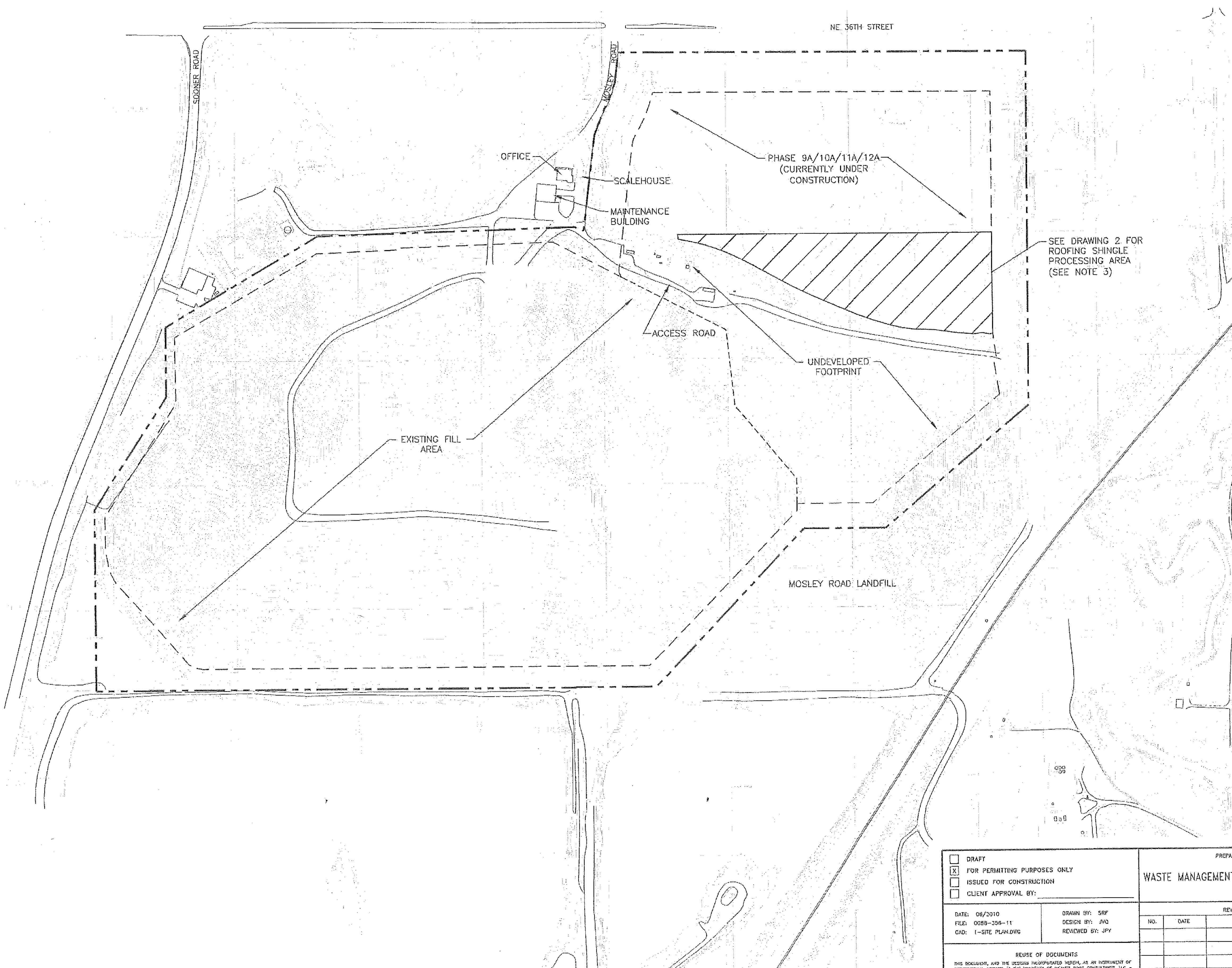
Jonathan V. Queen, P.E.
Project Engineer

Attachments: Appendix A – Drawings

cc: Guy R. Campbell, Waste Management of Oklahoma, Inc.
Don Fletcher, Waste Management of Oklahoma, Inc.

APPENDIX A

DRAWINGS



0 200 400
SCALE IN FEET

LEGEND:

- LANDFILL PERMIT BOUNDARY
- LANDFILL LIMITS OF WASTE
- CONSTRUCTED LIMITS OF WASTE
- STATE PLANE COORDINATE
- EXISTING CONTOUR
- FENCE LINE

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY AMI ENGINEERING, INC. FROM AERIAL PHOTOGRAPHY FLOWN FEBRUARY 23, 2010.
2. THE LANDFILL PERMIT BOUNDARY AND LIMITS OF WASTE WAS REPRODUCED FROM THE TIER III PERMIT MODIFICATION LATERAL EXPANSION APPLICATION FOR EAST OAK RDF APPROVED IN MAY 2008.
3. THE LOCATION OF THE ROOFING SHINGLE MATERIAL PROCESSING AND STORAGE AREA IS APPROXIMATE AND MAY VARY. THE FACILITY MAY BE RELOCATED, AS NEEDED, BASED ON FIELD CONDITIONS AND/OR SITE ACTIVITIES. THE ROOFING SHINGLE MATERIAL PROCESSING AND STORAGE AREA MAY BE RELOCATED WITHIN THE PERMIT BOUNDARY (IN AN AREA THAT HAS NOT BEEN DEVELOPED FOR SOLID WASTE DISPOSAL) OR EXISTING SOIL BORROW AREA.

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION
- [ ] CLIENT APPROVAL BY: __________

DATE: 08/2010
FILE: 0088-356-11
CAD: 1-SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: JVQ
REVIEWED BY: JPY

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PREPARED FOR

WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

PERMIT MODIFICATION SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

Weaver Boos Consultants

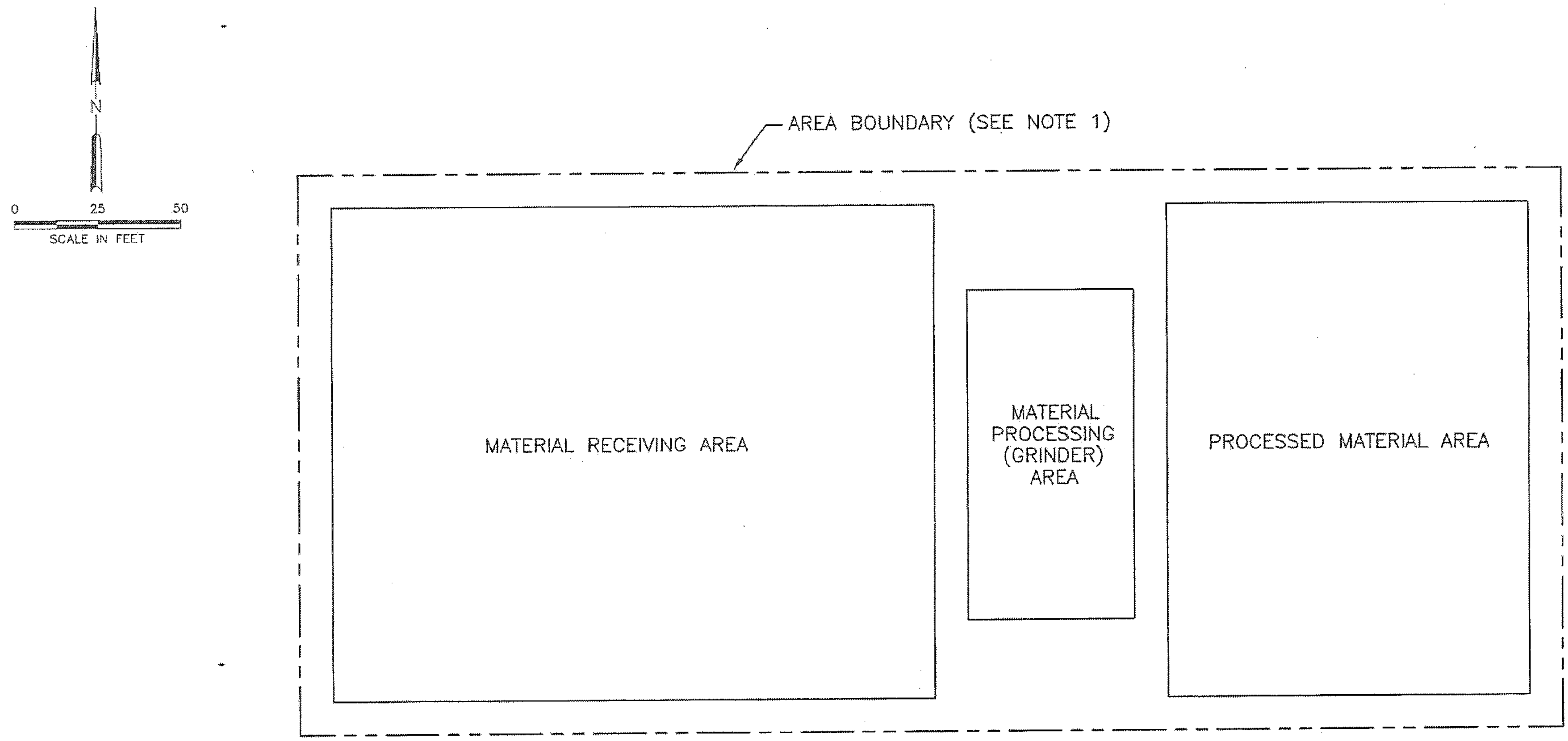
CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735-9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWING 1

O:\0088\356\ROOF SHINGLE RECYCLING\1-SITE PLAN.dwg, sford, 1:2



NOTES:

1. STRAW BALES OR A SILT FENCE WILL BE INSTALLED ALONG THE DOWNSTREAM AREA BOUNDARY, IF NEEDED. SEE THE SURFACE WATER PROTECTION PLAN SECTION FOR MORE INFORMATION.
2. THE ROOFING SHINGLE PROCESSING AND STORAGE AREA MAY BE LOCATED WITHIN THE LANDFILL PERMIT BOUNDARY (IN AN AREA THAT HAS NOT BEEN DEVELOPED FOR SOLID WASTE DISPOSAL) OR WITHIN THE SOIL BORROW AREA.

ROOFING SHINGLE PROCESSING AREA

WASTE MANAGEMENT OF OKLAHOMA, INC.
EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

Weaver Boos Consultants

CHICAGO, IL
NAPERVILLE, IL
COLUMBUS, OH
DENVER, CO

FORT WORTH, TX
(817) 735-9770

GRIFFITH, IN
SOUTH BEND, IN
SPRINGFIELD, IL
ST. LOUIS, MO

DRAWN BY: SRF	DATE: 06/2010	FILE: 0086-356-11
REVIEWED BY: JVQ	CAD: ROOF SHINGLES.DWG	DRAWING 2

O:\0086\356\ROOF SHINGLE RECYCLING\2-ROOF SHINGLE PROCESSING AREA.dwg, sford, 1:1

EAST OAK RECYCLING AND DISPOSAL FACILITY
OKLAHOMA COUNTY, OKLAHOMA
PERMIT NO. 3555036

APPENDIX Z

USACE INFORMATION

Prepared for

Waste Management of Oklahoma, Inc.

June 2015

Revised May 2016

Prepared by

Weaver Consultants Group, LLC
CA 3804 PE 06/30/2017
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0086-356-11-40-01

CONTENTS

USACE INDIVIDUAL PERMIT SUMMARY

The development of the site requires the filling of a portion of an unnamed tributary of the North Canadian River, a Section 404 Jurisdictional Water. In order to fill this portion of the unnamed tributary of the North Canadian River, a Section 404 Individual Permit will be required from the United States Army Corps of Engineers (USACE).

As part of the USACE permit process, a Section 401 ODEQ Water Quality Division (WQD) Certification will be required. The purpose of this certification is to determine whether a proposed discharge will comply with Oklahoma water quality standards. This certification was received on February 25, 2016. A copy of the Section 401 ODEQ WQD certification is provided on pages Z-A1 and Z-A2).

Excerpts from the April 2015 Section 404 Individual Permit Application are included in this appendix. Any additional USACE and/or ODEQ WQD submittals will be placed in the site operating record, along with the USACE Section 404 Individual Permit and the ODEQ Section 401 WQD Certification.

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

February 25, 2016

Mr. Guy R. Campbell
Waste Management of Oklahoma, Inc.
3201 Mosley Road
Oklahoma City, OK 73141

RE: Application No. SWT-2015-437, East Oak Recycling and Disposal Facility and Mosley Road Landfill Expansion

Dear Mr. Campbell:

The Department of Environmental Quality (DEQ) has received your request for a Water Quality Certification under Section 401 of the Federal Clean Water Act [33 U.S.C. §1251 et seq. (1972)], for activities in the unnamed tributary to the North Canadian River to be permitted under Section 404 of the Act. DEQ rules governing 401 Water Quality Certification are contained in Oklahoma Administrative Code (O.A.C.) § 252:611-3 (2011) pursuant to 27A O.S. § 2-6-103(C)(2) (OSCN 1999). For copies of the DEQ rules and regulations related to the 401 procedures, please access it online at www.deq.state.ok.us/rules/611.pdf or contact the DEQ Office of External Affairs at (800) 869-1400.

We have reviewed and examined the proposed project as described in Public Notice No. SWT-2015-437 and your application. The unnamed tributary to North Canadian River is assigned the following default beneficial uses through the Oklahoma Water Quality Standards (WQS): Warm Water Aquatic Community, Agriculture: Livestock and Irrigation, Primary Body Contact Recreation, and Aesthetics (OAC 785:45-5-3). To obtain a copy of the most recent version of the Oklahoma WQS, please go online to http://www.owrb.ok.gov/util/rules/pdf_rul/current/Ch45.pdf or contact the Oklahoma Water Resources Board at (405) 530-8800.

The proposed project will impact 1,890 linear feet of an unnamed tributary by placing fill material to accommodate expansion and consolidation of two landfills into one unit. The applicant requests no mitigation be required based on multiple factors.

The project is located in Section 21, Townships 12 North, Range 2 West of the Indian Meridian, in Oklahoma County, Oklahoma.

The conditions attached to this conditional Certification will be terms of the 404 permit. The state may require compliance with these conditions under state and/or federal law. Failure to comply with the conditions or any other applicable state requirements may result in proceedings brought by the state for the suspension, termination, modification or revocation of this Certification and/or for injunctive relief, damages and/or penalties as allowed by law. This Certification may be revoked or modified upon subsequent amendments or revisions to Oklahoma's Water Quality Standards requirements or upon expiration of the federal permit for the described activity.

This conditioned Water Quality Certification does not supersede the requirements of a Section 404 permit from the U.S. Army Corps of Engineers, a permit required by the local floodplain board, or any other permit required for this project.

707 NORTH ROBINSON, P.O. BOX 1677, OKLAHOMA CITY, OKLAHOMA 73101-1677

printed on recycled paper with soy ink

The certification is granted subject to the following conditions:

1) All spills of fuel or other pollutants in excess of five gallons shall be reported to DEQ, within twenty-four (24) hours, to the Pollution Prevention Hotline at 1-800-522-0206.
2) All fueling and servicing of vehicles and equipment shall be done above at least 100 feet from the first defined bank of the River.
3) Activities authorized by Department of the Army permits sometimes require floodplain development permits. Communities participating in the National Flood Insurance Program are required by that program to review all proposed development to determine if a floodplain permit is required.
4) Permittees shall provide access to the property to DEQ for inspection purposes.
5) Any material and fuels used in the project shall be stored and/or stockpiled above the Ordinary High Water Mark (OHWM) and shall be removed from a likely flood zone prior to any predicted flood.

If you have any questions concerning this matter, please contact Elena Jigoulina at 405-702-8200.

Sincerely,

Joe Long, Environmental Programs Manager
Watershed Planning Section
Water Quality Division

cc: Timothy Hartsfield, Regulatory Branch, U.S. Army Corps of Engineers, Tulsa
Richard Hatcher, Director, Oklahoma Department of Wildlife Conservation
Kevin Burgess, U. S. Fish and Wildlife Service, Tulsa
Derek Smithee, Water Quality Programs Division, Oklahoma Water Resources Board
Brooks Tramell, Monitoring, Assessment and Wetlands Programs, Oklahoma Conservation Commission
Tami Sundquist, EPA Region 6 (6WQ-EM)
Julie Bays, Public Protection Unit Chief, Attorney General of Oklahoma

EXCERPTS FROM THE APRIL 2015 SECTION 404 INDIVIDUAL PERMIT APPLICATION

Weaver
Consultants
Group

Project #:0086-356-11-40-01
April 30, 2015

Marcus Ware
Regulatory Specialist
US Army Corps of Engineers, Tulsa District
1645 South 101st East Avenue
Tulsa, Oklahoma 74128

Re: Application for Section 404 Individual Permit
East Oak Recycling and Disposal Facility
Oklahoma County, Oklahoma

Dear Mr. Ware:

The purpose of this permit application, submitted on behalf of Waste Management of Oklahoma, Inc., (WMO) is to obtain a Section 404 Individual Permit for the referenced facility that will allow the site to fill a portion of a unnamed tributary of the North Canadian River.

The East Oak Recycling and Disposal Facility (RDF) is an existing municipal solid waste (MSW) landfill in the City of Oklahoma City (OKC). The entrance to the landfill is located off of NE 36th Street, approximately 2.5 mile east of Interstate 35. The site location is shown on Drawing 1 (Appendix A). Waste Management of Oklahoma, Inc. (WMO) proposes to expand the existing East Oak RDF. The expansion of the East Oak RDF permit boundary also includes an incorporation of Mosley Road Landfill permit boundary. The comparison of the permitted and proposed project areas is listed in Table 1-1.

Table 1-1
Project Area Information

Description	Existing East Oak RDF	Existing Mosley Road Landfill	Proposed Site
Permit Boundary	158.8 acres	71.765	282.96 acres
Waste Disposal Area	135.2 acres	55.7	191.8 acres

The permitted completion plan and the proposed completion plans are shown on Drawing 5 and 6 respectively (Appendix A). For the proposed project, the existing permitted final cover erosion control structures and perimeter channels have been redesigned to effectively minimize erosion of final cover soils and increase detention of stormwater before it is discharged from the site. The proposed perimeter drainage system includes detention/retention ponds and pond outlet control structures.

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Site Background

Mosley Road Landfill initiated operation in 1971 and was permitted by the Oklahoma State Department of Health (OSDH) in 1973. Mosley Road Landfill was closed in 1987. East Oak RDF was permitted by ODEQ in 1986. East Oak RDF was permitted to expand (east) and fill the valley between East Oak RDF and Mosley Road Landfill. This valley fill expansion included the East Oak RDF waste disposal area overlying the Mosley Road Landfill waste disposal area. East Oak RDF was permitted to expand again in May of 2008 north of Mosley Road Landfill waste disposal area. This northern expansion also included the East Oak RDF waste disposal area overlaying the Mosley Road Landfill waste disposal area. The proposed expansion of the East Oak RDF will be toward the northwest and south. The southern expansion will include the East Oak RDF waste disposal area overlaying the Mosley Road Landfill disposal area. Therefore, the East Oak RDF will encompass the Mosley Road Landfill to the west, north, and south, including overlaying the Mosley Road Landfill on the west, north, and south slope.

WMO is the owner of the Mosley Road Landfill and holder of ODEQ Permit No. 3555011. WMO is also the owner of the East Oak RDF and holder of ODEQ Permit No. 3555036. The facility accepts municipal solid waste (MSW) and nonhazardous industrial solid waste (NHIW) in accordance with OAC 252:515. WMO is a subsidiary of Waste Management, Inc. (WM). WM is the leading provider of comprehensive waste management services in North America. The existing facility is located at 3201 Mosley Road in Oklahoma County.

Surrounding Land Use

Land use of the adjacent properties is mostly closed landfill, undeveloped property, agricultural property, commercial/light industrial, and mining. The locations of residential areas and businesses are presented on Drawing 3 – Land Use Map in Appendix A.

In general, the land use is described below for the surrounding areas:

North – The land use to the immediate north of East Oak RDF is the Northeast 36th Street right-of-way, which is the access route to the facility. A closed landfill owned by OKC exists to the immediate north of Northeast 36th Street.

East – Located directly east of the East Oak RDF is the Burlington Northern Santa Fe Railroad right-of-way, predominantly agricultural property, soil mining, and other mixed uses within the City of Midwest City (MWC). The MWC Wastewater Treatment Facility is also located approximately a half-mile east of the site.

West, Northern Portion – Located directly west of the northern portion of the East Oak RDF is the N. Sooner Road right-of-way and an undeveloped woodland property owned by OKC that extends to the North Canadian River.

West, Southern Portion – Located directly west of the southern portion of the East Oak RDF includes the Mosley Road right-of-way, property that is used as a sand mining operation and property owned by OKC that extends to the North Canadian River.

South – Located directly south of the southernmost portion of the East Oak RDF is a single residency, Northeast 23rd Street right-of-way and a variety of uses within the MWC. This area contains several small commercial/light industrial businesses and a mining operation.

The use of this area for a municipal solid waste landfill represents a compatible land use for the following reasons.

- Landfill operations have occurred in the area of this facility since 1971.
- The land use of property adjacent to the facility is dominated by landfill, mining, and agricultural activities and undeveloped property.
- OKC has approved a PUD (PUD-1534) for the site.

Previous USACE Permitting for This Project

2013 Goshawk Report

In September 2013, Goshawk Environmental Consulting, Inc. (Goshawk) performed a preliminary jurisdictional determination for the proposed East Oak RDF expansion areas. As described in the report, the eastern half of Expansion Area 1 (northwest area) is utilized for operational facilities (entrance road, scalehouse/office building, maintenance shop, and parking). The western and northwestern portions of Expansion Area 1 have been utilized as soil borrow area. A corridor along the central portion of Expansion Area 1 was present and was described as open, periodically maintained grassland. The stream/swale was dry during the field reconnaissance. The stream should flow north from Expansion Area 1 under Northeast 36th Street through an existing box culvert. However, soil borrow area operations in the area will not allow water to flow north under Northeast 36th Street. The stream/swale did not exhibit an ordinary high water mark or a well-defined bed-and-bank condition and is better characterized as a broad, flat, well vegetated swale. Since there is no defined bed-and-bank condition within the vegetated swale and this portion of the stream is hydrologically isolated from the surrounding watershed, it was Goshawk's opinion that the stream no longer exhibited the criteria to be considered a "Water of the U.S.".

The north portion of Expansion Area 2 (southern area) is an existing landfill and topographically higher than the surrounding landscape. The southern portion of Expansion Area 2 is an open-water pond and is a result of historical aggregate mining and/or soil borrow operations. The open-water pond meets the criteria to be classified as a wetland; however, the pond was excavated within an upland for purposes of mining/borrow and there is no surface connection to the North Canadian River or any other potential WATERS. Therefore, the pond is considered isolated and not regulated by the United States Army Corps of Engineers (USACE). Expansion Area 1 and Expansion Area 2 are shown on Drawing 4 in Appendix A.

Goshawk also completed a threatened and endangered species review of the proposed soil borrow area. As noted in the report, the site does not provide habitat for and would not likely be occupied by any federally listed threatened and endangered species.

2014 Section 404 Jurisdiction Determination

On April 9, 2014, Weaver Boos Consultants, LLC – Southwest, (WBC) submitted a Section 404 Jurisdiction Determination request to the US Army Corps of Engineers (USACE). The letter submitted to the USACE included a description of the proposed project, the preliminary 404 jurisdictional determination report prepared by Goshawk, and a threatened and endangered species review. The April 9, 2014 submittal, which includes the 2013 Goshawk Report, is included in Appendix C-1. In a letter dated August 26, 2014, the USACE did not concur with the Goshawk findings and claimed jurisdiction over Expansion Area 1, which includes the excavated stream channel (unnamed tributary of the North Canadian River), and/or borrow area. The August 26, 2014 USACE letter is included in Appendix C-2.

On October 28, 2014, the USACE, WBC, and Goshawk met onsite to discuss the project in detail. The USACE contacted WBC by email on October 29, 2014 to reaffirm jurisdiction of the Expansion Area 1 stream channel and borrow area. The USACE and WBC met via teleconference on November 10, 2014 to continue discussions and project. The USACE indicated that the borrow area activities were considered excavation on stream; that through the development of the borrow area, including the excavation in the stream, the borrow area activities had widened the jurisdictional area. Therefore, the placement of fill in the borrow area would be regulated. The USACE requested that a Section 404 Individual Permit Application be submitted for the project.

Permitting and Development History Expansion Area 1

2009 Goshawk Report

In October 2009, Goshawk performed a preliminary jurisdictional determination to identify "waters of the US" (including wetlands) for a proposed soil borrow area. As described in the 2009 Goshawk Report, a unnamed tributary of the North Canadian River transversed the proposed soil borrow area from the northeast corner toward the south central portion of the soil borrow area and back to the northwest corner of the soil borrow area, with a varying width of 35 feet in the eastern portion of the site along Mosley Road and 6 feet as the stream meandered back toward the northwest. As noted in the 2009 Goshawk Report, the unnamed tributary was the only likely jurisdictional waters within the proposed soil borrow area. The western section of the proposed soil borrow area, which would be disturbed to develop the proposed borrow area, was where the unnamed tributary originated and only collected rain water and minimal stormwater runoff due to the levee system along the North Canadian River, Sooner Road, and Northeast 36th Street. The majority of the stormwater runoff from the landfill south of the proposed soil borrow area was conveyed directly to the eastern section of the proposed soil borrow area through a system of landfill drainage structures (i.e., swales and chutes). Therefore, the impact to the jurisdictional waters located on the proposed soil borrow area due to the development of the soil borrow area would be minimal. Goshawk assessed the amount of impact would be well within the limits allowed under Nationwide Permit (NWP) 44 – Mining Activities. Goshawk recommended submitting a Pre-Construction Notification (PCN) to the US Army Corps of Engineers (USACE), Tulsa District for impacts to the stream under NWP 44.

2009 PCN and NWP 44 Authorization

On December 15, 2009, WBC submitted a PCN to the USACE for NWP 44 authorization to develop the proposed soil borrow location. The letter submitted to the USACE included a description of the proposed project, the preliminary 404 jurisdictional determination report prepared by Goshawk, a threatened and endangered species review, and a national registrar of historic places review. The December 15, 2009 submittal, which includes the 2009 Goshawk Report, is included in Appendix D-1. In a letter dated April 23, 2010, USACE indicated that the proposed soil borrow location was not subject to regulation pursuant to Section 404 of the Clean Water Act (CWA) and that a permit would not be required. The April 23, 2010 USACE letter is included in Appendix D-2. The permitted soil borrow area plan is included on Drawings 8 and 9 in Appendix A.

2010 Soil Borrow PUD (PUD-1419) City of Oklahoma City Approval

In May of 2010, WBC submitted a Planned Unit Development (PUD) application to the City of Oklahoma City (OKC) to request the use of the property northeast of the East Oak RDF to be used as a soil borrow area. OKC requires a PUD application to pass the City zoning and planning commission prior to development. The PUD application included a Master Development Plan showing the proposed soil borrow area excavation grades and limits consistent with the area assessed in the 2009 Goshawk Report. The PUD included proposed buffer zones and existing buffer zones surrounding the proposed soil borrow area. A 100-foot buffer between the proposed soil borrow area and Northeast 36th Street and Sooner Road was provided on the north and west boundaries. On October 19, 2010, the City approved PUD-1419 to authorize soil borrow activities (Appendix D-3). The permitted soil borrow area plan is included on Drawings 8 and 9 in Appendix A.

Existing Box Culvert Under Northeast 36th Street

An existing box culvert located under Northeast 36th Street has been the assumed point of stormwater discharge off-site for the soil borrow area and other developed northern portions of the WMO property. This would be evident from a review of the United States Geological Survey (USGS) map (Drawing 2, Appendix A). This existing box culvert should allow the unnamed tributary of the North Canadian River to flow under Northeast 36th Street to the northern adjacent property and continue north towards the North Canadian River. During several large storm events in the summer and early fall 2010, it was observed that stormwater actually appeared to be flowing from the north to south through the existing box culvert. Discussions with site personnel indicated that this is a common occurrence and it was assumed to be caused by debris buildup on the north side of Northeast 36th Street. WMO began discussion with the OKC regarding maintenance activities on the north side of Northeast 36th Street that would allow for the drainage of stormwater off the WMO property toward the north. While considering maintenance activities, the WMO site surveyor (Lemke Land Surveying Inc.) completed a field survey of the existing box culvert and areas north of Northwest 36th Street. The field survey determined that the existing box culvert did not flow toward the north as anticipated or indicated on the USGS map but actually flows toward the south onto the WMO property, including allowing several areas on the north side of Northeast 36th Street to drain south onto WMO property. Additionally, the field survey indicated a second corrugated metal pipe (CMP) culvert about 200 feet north of the existing box culvert that is set 16 inches above the flow line of the unnamed tributary. Field survey results are included on Drawing 10.

To further investigate the flow direction of the existing box culvert, Oklahoma County (County) was contacted regarding the availability of Northeast 36th Street design plans. The County provided design plans dated February 1968, which are included in Appendix

D-4. The design plans not only show that the existing box culvert was designed to flow from north to south, but they also show that the existing flow line prior to the existing box culvert was from north to south. Clearly the north to south flow on this existing box culvert is contradictory to the natural flow direction of the unnamed tributary of the North Canadian River that flows south to north. Additionally, with the areas on the north side of Northeast 36th Street draining back toward WMO property and the placement of a CMP culvert north of Northeast 36th Street, this portion of the unnamed tributary is isolated and/or disconnected from the northern portion of the unnamed tributary that continues on to the North Canadian River.

Oklahoma City Department of Public Works

WBC corresponded in November/December 2010 with OKC to propose an alternative discharge location offsite. The correspondence is included in Appendix D-5. OKC provided a response letter dated December 22, 2010 (Appendix D-6) stating that since the existing box culvert, located in the natural low of the soil borrow area property, did not allow the proper flow of water off-site, it was acceptable to discharge stormwater via an existing CMP culvert west of the soil borrow area. OKC requested in their December 2010 letter that they be provided with a copy of ODEQ approval prior to stormwater discharge. On February 23, 2011, WBC submitted a copy of the ODEQ approval to OKC as requested. The ODEQ permitting of the soil borrow area is discussed in more detail below. The February 23, 2011 OKC submittal is included in Appendix D-7. Approval to proceed with the alternative stormwater discharge location was provided by email from OKC on March 16, 2011 (Appendix D-8). In accordance with OKC's approval, WMO has been discharging stormwater that collects in the borrow area through the existing stormwater structure west of the soil borrow area. The 2010 and 2011 Site Plans are included on Drawings 10 and 11 in Appendix A.

Oklahoma Department of Environmental Quality

WBC began correspondence with ODEQ regarding proposed soil borrow activities on November 8, 2010. This November submittal revised the site's Closure and Postclosure (CPC) Plan to include the additional soil borrow areas. The revised CPC Plan was approved by ODEQ on November 24, 2010. Additional correspondence was submitted to ODEQ on January 28, 2011. This January 2011 submittal included a County-filed temporary easement for access, allowing ODEQ access to the soil borrow areas and a revised CPC Plan. The revised CPC Plan included a specific pumping plan for the northwest soil borrow area. The January 28, 2011 ODEQ submittal is included in Appendix D-9. ODEQ approved the temporary easement and revised CPC Plan on February 14, 2011 (Appendix D-10). The 2010 and 2011 Site Plans are included on Drawings 10 and 11, in Appendix A.

Since 2011, WMO has continued to develop and operate the soil borrow area within local, state, and federal regulations, including the approvals and authorizations discussed above. The 2012, 2013, and 2014 Site Plans are included in Drawings 12, 13, and 14, in Appendix A, indicating the continued development of the soil borrow area.

Agency Authorization

The expansion of the East Oak RDF will also require zoning authorization, FEMA approval, and ODEQ approval.

Zoning Authorization

OKC approved a PUD for the proposed expansion on July 30, 2014 (PUD-1534). This PUD application included a site-wide Master Development Plan that authorizes the northern and southern expansion of the East Oak RDF. This PUD also consolidated the previous PUD and a Special Permit that were previously approved for the operation of the East Oak RDF. PUD-1534 allows for the eventual transition of portions of the soil borrow areas to a state-of-the-art landfill that will be operated, regulated, tested, and maintained in a safe and environmentally responsible manner. This PUD will also take advantage of buffers, natural buffers, and landscape buffers previously established in accordance the previous PUD. Excerpts from the PUD application are included in Appendix E.

FEMA Approval

The expansion of East Oak RDF will require a modification to the current 100-year floodplain. A modification to the 100-year floodplain requires the approval from OKC and Federal Emergency Management Agency (FEMA). A Conditional Letter of Map Revision (CLOMR) will be submitted to the Oklahoma City Floodplain Administrator to obtain a floodplain permit. After OKC approves the CLOMR Request, it will be forwarded on to the Federal Emergency Management Agency (FEMA) for final approval. The CLOMR will be prepared to meet all applicable FEMA regulations for the proposed site improvements at the East Oak RDF. The purpose of the CLOMR is to obtain approval to revise the effective floodplain and allow the development of the proposed landfill expansion. Once the landfill is developed, a LOMR will be issued to officially revise the floodplain. The CLOMR will analyze the pre-project condition of the landfill site, which represented the existing condition of the area in and around the site as of a January 2014 aerial survey and the post-project condition (consistent with the completion plan in this modification). The CLOMR will demonstrate that a minimum of 3 feet of freeboard is maintained between the 100-year water surface data and the channel banks or perimeter road for the proposed conditions, with minimal impacts to the 100-year and 500-year floodplains and the floodway. The 100-year floodplain for the proposed East Oak RDF expansion is shown on Drawing 6 and 7.

ODEQ Approval

The expansion of the East Oak RDF will require a modification to the ODEQ Solid Waste Permit. The modification will be developed to show that the design and operation of the East Oak RDF expansion will be in compliance with Oklahoma Administrative Code (OAC) 252:515 Management of Solid Waste. Location Restriction correspondence has already been completed for the modification and numerous agencies have issued approval/coordination letters regarding the proposed expansion. These approvals are summarized in the following table.

<table>
<tr><th>Agency</th><th>Coordination Topic</th></tr>
<tr><td>Federal Aviation Administration (FAA)
Approved 7/3/14 and 7/21/14</td><td>FAA identified no objection to the proposed landfill expansion from the standpoint of potential wildlife hazards to aircraft or obstruction to air navigation.</td></tr>
<tr><td>Oklahoma Biological Survey
Approved 4/10/14</td><td rowspan="2">According to these state agencies, the proposed landfill expansion poses no danger to endangered or threatened wildlife. Additionally, an on-site habitat assessment was performed and determined no endangered or threatened species are known to exist near the proposed landfill expansion.</td></tr>
<tr><td>Oklahoma Department of Wildlife Conservation
Approved 7/7/14</td></tr>
<tr><td>Oklahoma Scenic River Commission
Approved 4/9/14</td><td>There are no state-designated scenic river areas located within or near the proposed landfill expansion.</td></tr>
<tr><td>Oklahoma Natural Areas Registry
Approved 4/15/14</td><td rowspan="4">There are no public recreation or preservation areas designated by a federal, state, or local agency located within ½ mile of the proposed landfill expansion. This includes no scenic river drainage basins, no natural heritage areas, and no federal or state parks or recreation areas.</td></tr>
<tr><td>Oklahoma Tourism and Recreation Department
Approved 5/2/14</td></tr>
<tr><td>United States Department of the Interior Bureau of Reclamation
Approved 4/15/14</td></tr>
<tr><td>Oklahoma City Parks & Recreation
Approved 8/6/14</td></tr>
<tr><td>Oklahoma Water Resource Board (OWRB)
Approved 4/17/14</td><td>The OWRB identified no existing or planned public water supply surface water intakes located within 1 mile or less upstream from the proposed landfill expansion.</td></tr>
</table>

nature and similar in their impact upon water quality and aquatic environment as the current landfill and soil borrow activities, (2) would have minimal adverse effects if performed separately, and (3) will have minimal accumulative adverse effects on water quality and aquatic environment based on the East Oak RDF operations within the local, state, and federal regulations. Although the project will result in the loss of jurisdictional waters of the US, we believe the adverse effects will be minimal to the unnamed tributary of the North Canadian River considering: (1) the contradictory to natural flow direction of the existing box culvert; (2) drainage areas north of Northeast 36th Street draining back toward the WMO property; and (3) placement of the CMP culvert north of Northeast 36th Street above the flowline. These three considerations isolate and/or disconnect the southern portion of the unnamed tributary from the northern portion of the unnamed tributary that continues on to the North Canadian River. Additional considerations that result in minimal effect to the unnamed tributary include; (4) the USACE, City, and ODEQ approved soil borrow activities (5) the City and ODEQ approved alternative discharge location pumping plans. These two considerations have solved an operational problem created by the three previously stated considerations and have allowed for the site to utilize on-site resources while managing stormwater in a controller manner. Based on the information provided, WMO requests that the USACE issue a Section 404 Individual Permit without requiring compensatory mitigation.

We appreciate your assistance with this request. If you need additional information or have any questions, please call.

Sincerely,
Weaver Consultants Group, LLC

Jonathan V. Queen, P.E.
Senior Project Engineer

Attachments: Permit Application

cc: Guy R. Campbell, Waste Management of Oklahoma, Inc.
Pete Schultze, Waste Management of Oklahoma, Inc.

U.S. ARMY CORPS OF ENGINEERS
APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT
33 CFR 325. The proponent agency is CECW-CO-R.

Form Approved - OMB No. 0710-0003 Expires: 30-SEPTEMBER-2015

Public reporting for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME
First - Guy Middle - R. Last - Campbell
Company - Waste Management of Oklahoma, Inc.
E-mail Address - gcampbe1@wm.com

8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - Jonathan Middle - V. Last - Queen
Company - Weaver Consultants Group, LLC
E-mail Address - jqueen@wcgrp.com

6. APPLICANT'S ADDRESS:
Address- 3201 Mosley Road
City - Oklahoma City State - OK Zip - 73141 Country - USA

9. AGENT'S ADDRESS:
Address- 6420 Southwest Blvd., Suite 206
City - Fort Worth State - TX Zip - 76109 Country - USA

7. APPLICANT'S PHONE NOs. w/AREA CODE
a. Residence b. Business 405-417-8124 c. Fax

10. AGENTS PHONE NOs. w/AREA CODE
a. Residence b. Business 817-735-9770 c. Fax

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Jonathan V. Queen to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

[signature] SIGNATURE OF APPLICANT 4/30/15 DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)
East Oak Recycling and Disposal Facility

13. NAME OF WATERBODY, IF KNOWN (if applicable)
Unnamed Tributary of the North Canadian River

14. PROJECT STREET ADDRESS (if applicable)
Address 3201 Mosley Road
City - Oklahoma City State- OK Zip- 73141

15. LOCATION OF PROJECT
Latitude: •N 35° 30' 2" Longitude: •W 97° 24' 56"

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)
State Tax Parcel ID R141152100 Municipality Oklahoma City
Section - 21 Township - 12 North Range - 2 West

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list).

a. Address- See attached "Additional Information" sheet.

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
Oklahoma City	Zoning	PUD-1534		2014-07-30	
See attached.					
See attached.					
See attached.					

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT 4/30/15 DATE

SIGNATURE OF AGENT 4/30/15 DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

ENG FORM 4345
ADDITIONAL INFORMATION

Block 22

See Drawing 15. Filling to be completed with standard earth moving equipment (i.e., backhoe, bulldozer, trackhoe, haul truck, compactor).

Block 25

Waste Management of Oklahoma, Inc. is the only adjoining property owner to this portion of the unnamed tributary of the North Canadian River.

Block 26

Line 2 – Various local, state, and federal agencies related to ODEQ location restrictions as noted in the attached letter.

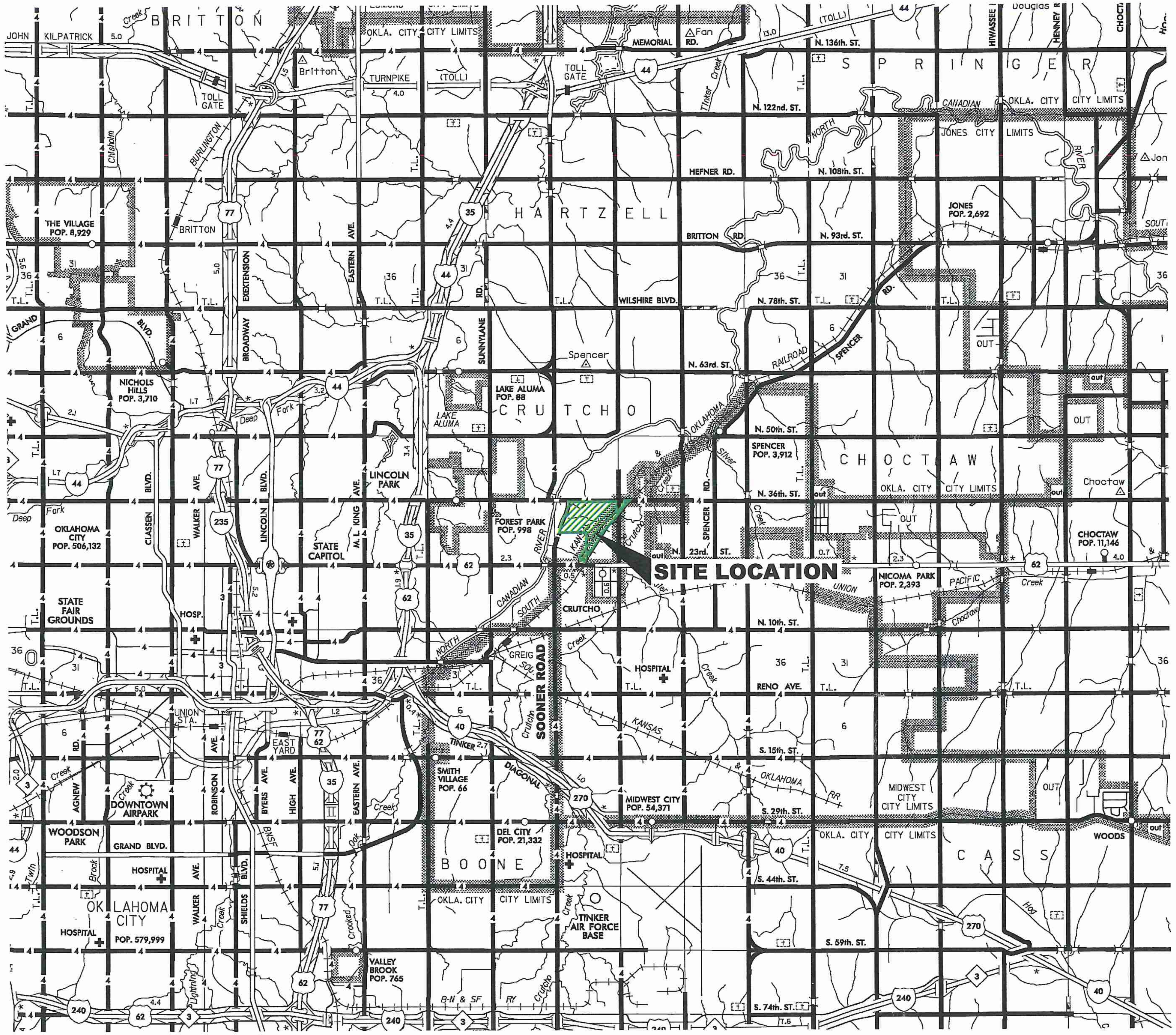
Line 3 – Previous approvals have been obtained for development of this area as a borrow area as noted in the attached letter.

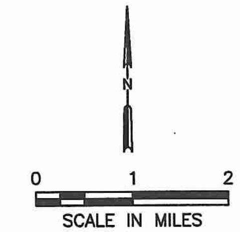
Line 4 – Additional state and federal approvals will be required as noted in the attached letter.

APPENDIX A

DRAWINGS

DRAWINGS





LEGEND

- U.S.NUMBERED HIGHWAY
- STATE NUMBERED HIGHWAY
- INTERSTATE HIGHWAY ROUTE
- PAVED ROAD
- GRAVEL ROAD
- GRADED & DRAINED ROAD
- UNIMPROVED ROAD
- PRIMITIVE ROAD
- PROJECTED ROAD
- RESIDENTIAL ROAD
- N0001 COUNTY ROAD ID NO.
- MILEAGE BETWEEN POINTS
- DIVIDED HIGHWAY, 4 OR MORE LANES
- UNDIVIDED HIGHWAY, 3 OR MORE LANES
- TRAFFIC CIRCLE
- HIGHWAY GRADE SEPARATION
- TRAFFIC INTERCHANGE
- STATE LINE
- COUNTY LINE
- CIVIL TOWNSHIP LINE
- SECTION LINE
- RURAL DEVELOPMENT AREA
- GOVERNMENT PROPERTY LINE
- MATCH LINE
- COUNTY SEAT
- TOWN CENTER
- CORPORATE LIMITS
- CIVIL TOWNSHIP, ROAD IN PLACE
- INSET BOUNDARY
- ELEVATION ABOVE SEA LEVEL
- MOUNTAIN RANGE, BUTTE OR MESA
- SMALL MONUMENT
- MARSH OR SWAMP LANDS
- DRAINAGE DITCH
- IRRIGATION DITCH
- LAKE, RESERVOIR OR POND WITH DAM
- ROAD OVER DAM
- DRY LAKE SUBJECT TO FLOOD
- SMALL BRIDGES CLOSELY SPACED
- HIGHWAY BRIDGE, OVER 20FT. IN LENGTH
- GENERAL BRIDGE, LONG CROSSING
- ARCH BRIDGE
- TRUSS BRIDGE,W-WOOD,S-STEEL,C-CONCRETE
- CONCRETE DIP OR FORD
- FORD ROAD ESTABLISHED
- INTERMITTENT STREAM
- NARROW STREAM
- DOCK PIER OR LANDING
- NAVIGABLE STREAM WITH LOCK & DAM
- WIDE STREAM OR RIVER
- TRIANGULATION STATION
- RAILROAD, ANY NUMBER OF TRACKS
- RAILROAD WITH STATION INDICATED
- GRADE CROSSING
- UNDERPASS, R.R. ABOVE
- OVERPASS, R.R. BELOW
- RAILROAD ON STREET
- MILITARY AIRFIELD
- AIRPORT WITH COMPLETE FACILITIES
- AIRPORT WITH LIMITED FACILITIES
- LANDING STRIP, PRIVATE FIELD
- AIRPORT, GENERAL OUTLINE OF FIELD RUNWAYS SHOWN IN POSITION
- ROADSIDE PARK Picnic Grounds
- PLAYGROUNDS
- BATHING BEACH OR SWIMMING POOL
- SCENIC SITE
- MOTEL
- CAMP OR LODGE, Permanent with buildings
- SMALL PARK SP-State, CP-County MP-Municipal, TP-Trailer Park
- FOREST RANGER STATION
- OBSERVATION OR LOOKOUT TOWER
- CAMP SITE
- FISH HATCHERY
- GOLF COURSE OR COUNTRY CLUB
- ATHLETIC FIELD OR AMUSEMENT PARK
- FAIRGROUNDS, RACE COURSE
- DWELLING
- NUMBER OF DWELLINGS CLOSLEY SPACED
- COMBINED BUSINESS AND DWELLING
- POST OFFICE
- POST OFFICE COMBINATIONS
- SEASONAL DWELLINGS
- CHURCH OR OTHER RELIGOUS BUILDING
- CEMETERY
- CHURCH WITH CEMETERY ADJACENT
- REST HOME
- HOSPITAL
- SMALL BUSINESS
- INDUSTRY
- SAW MILL
- MINE SHAFT OR DRIFT
- OIL OR GAS FIELD
- GAUGING OR PUMPING STATION
- WAREHOUSE
- GRAVEL PIT
- QUARRY
- SCHOOL
- COMMUNITY HALL OR LODGE
- DRIVE-IN THEATER
- CORRECTIONAL INSTITUTION
- HIGHWAY GARAGE
- JUNK YARDS & DUMPS A-Automobile, B-Scrap Building Material, D-Refuse, Garbage or trash dump, F-Sanitary Fill, G-Other
- SEWAGE DISPOSAL PLANT
- WATER SUPPLY STAND PIPE
- POWER PLANT
- BOOSTER STATION
- POWER SUBSTATION
- KOMA TELEVISION OR RADIO STATION
- MILITARY INSTALLATION

NOTES:

1. REPRODUCED FROM OKLAHOMA'S GENERAL HIGHWAY MAP, OKLAHOMA COUNTY, OKLAHOMA (OKLAHOMA DEPARTMENT OF TRANSPORTATION PLANNING DIVISION AUGUST 2007).

Z-18

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR WASTE MANAGEMENT OF OKLAHOMA, INC.	SECTION 404 PERMIT GENERAL SITE LOCATION MAP EAST OAK RDF OKLAHOMA COUNTY, OKLAHOMA
DATE: 04/2015 FILE: 0086-356-11 CAD: 1-GEN_LOC.DWG DRAWN BY: SRF DESIGN BY: RJS REVIEWED BY: JVQ	REVISIONS NO. | DATE | DESCRIPTION	
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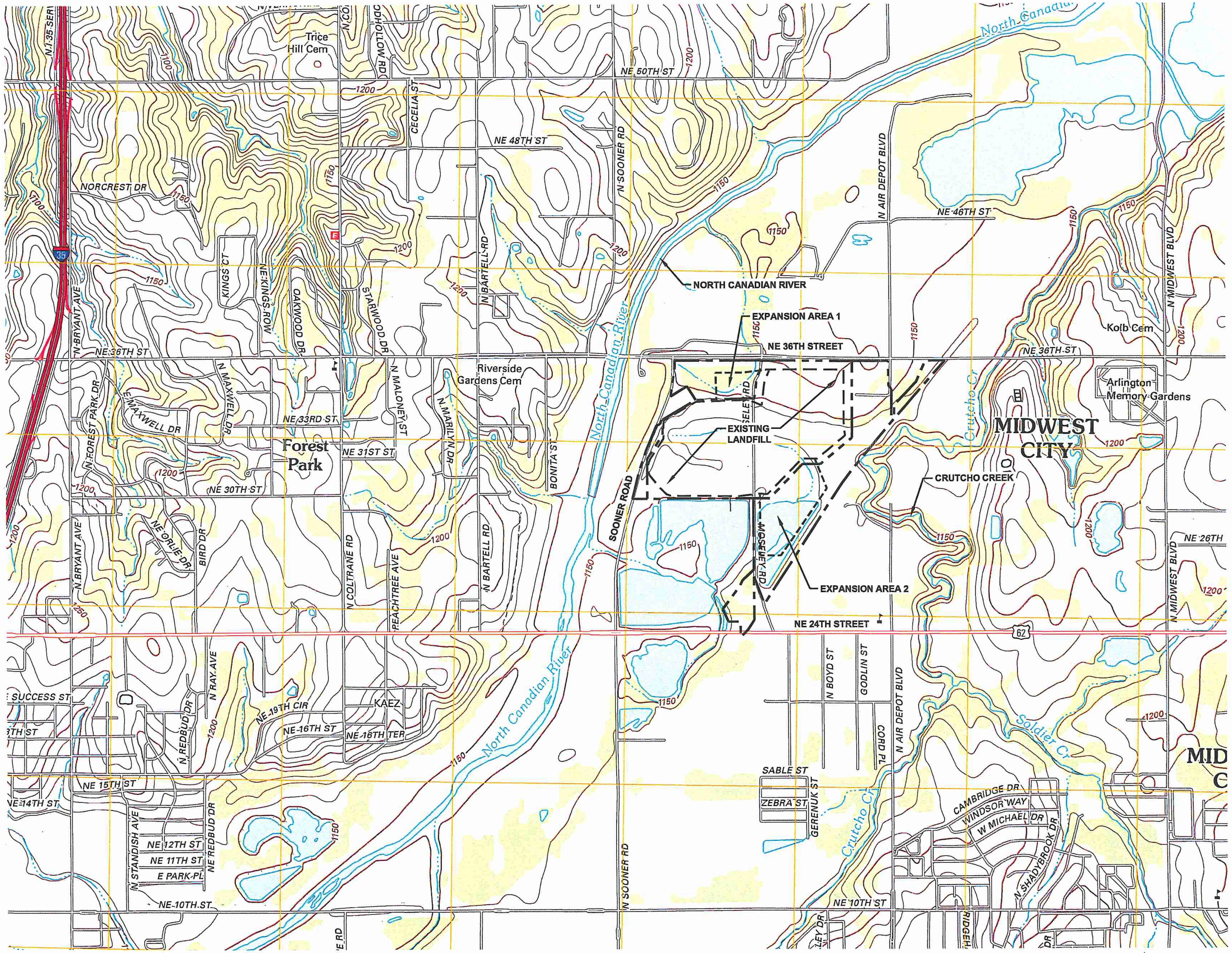

N

0 1000 2000

SCALE IN FEET

LEGEND

EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY
PERMITTED LIMITS OF WASTE
PROPOSED LIMITS OF WASTE

ROAD CLASSIFICATION

Interstate Route
US Route
Ramp
State Route
Local Road
4WD

Interstate Route US Route State Route

SPENCER, OK
2012

MIDWEST CITY, OK
2012

NOTE:
1. ADAPTED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (MIDWEST CITY, OKLAHOMA 2012 AND SPENCER, OKLAHOMA 2012).

Z-19

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☐ ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 2-TOPO MAP.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

SECTION 404 PERMIT
GENERAL TOPOGRAPHIC MAP

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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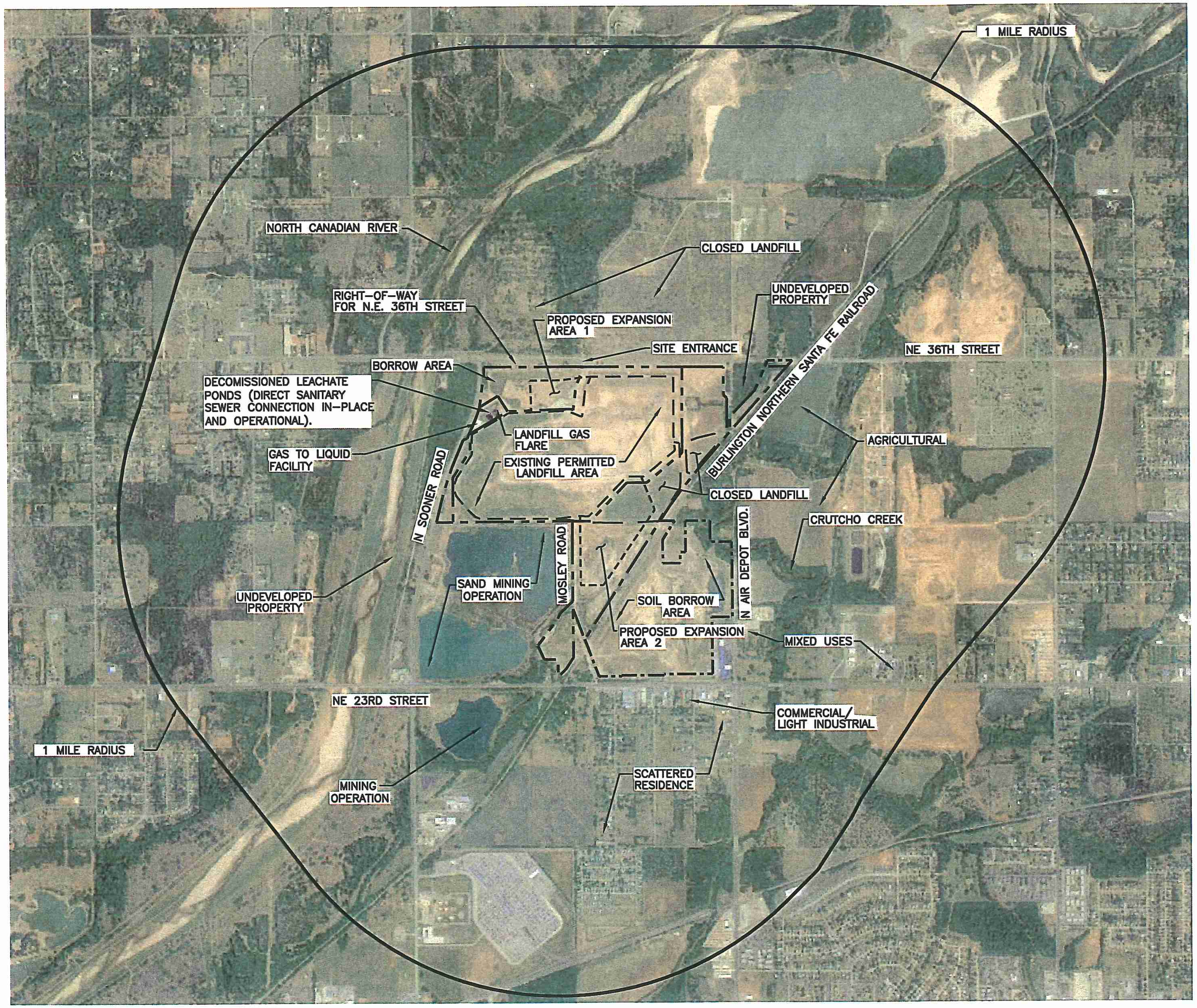

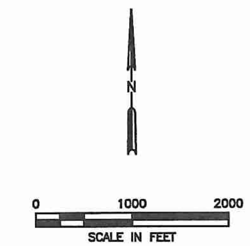

LEGEND

— · — · — · —	PROPERTY BOUNDARY
——— · – ———	EXISTING PERMIT BOUNDARY
—— – —— – ——	PROPOSED PERMIT BOUNDARY
— — — — —	PERMITTED LIMITS OF WASTE
- - - - - - - -	PROPOSED LIMITS OF WASTE
—— —— ——	MOSLEY ROAD LANDFILL LIMITS OF WASTE

NOTES:

1. AERIAL PHOTOGRAPHY PROVIDED BY WWW.MAPS.GOOGLE.COM DATED 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.

Z-20

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PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

SECTION 404 PERMIT LAND USE MAP

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

DATE: 04/2015
FILE: 0086-356-11
CAD: 3-LAND USE MAP.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

REVISIONS

NO.	DATE	DESCRIPTION

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0 300 600
SCALE IN FEET

LEGEND

—·—·—	PROPERTY BOUNDARY
— - —	EXISTING PERMIT BOUNDARY
—·—	PROPOSED PERMIT BOUNDARY
— — —	PERMITTED LIMITS OF WASTE
- - - -	PROPOSED LIMITS OF WASTE
— — —	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
—1180—	EXISTING CONTOUR
	IN-PLACE FINAL COVER

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. IN-PLACE FINAL COVER AREA REPRODUCED FROM LEMKE LAND SURVEYING, INC. VERIFICATION SURVEY DATED JULY 2013 (FINAL COVER AREA 1).

Z-21

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PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

SECTION 404 PERMIT SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

DATE: 04/2015
FILE: 0086-356-11
CAD: 4-SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

REVISIONS

NO.	DATE	DESCRIPTION

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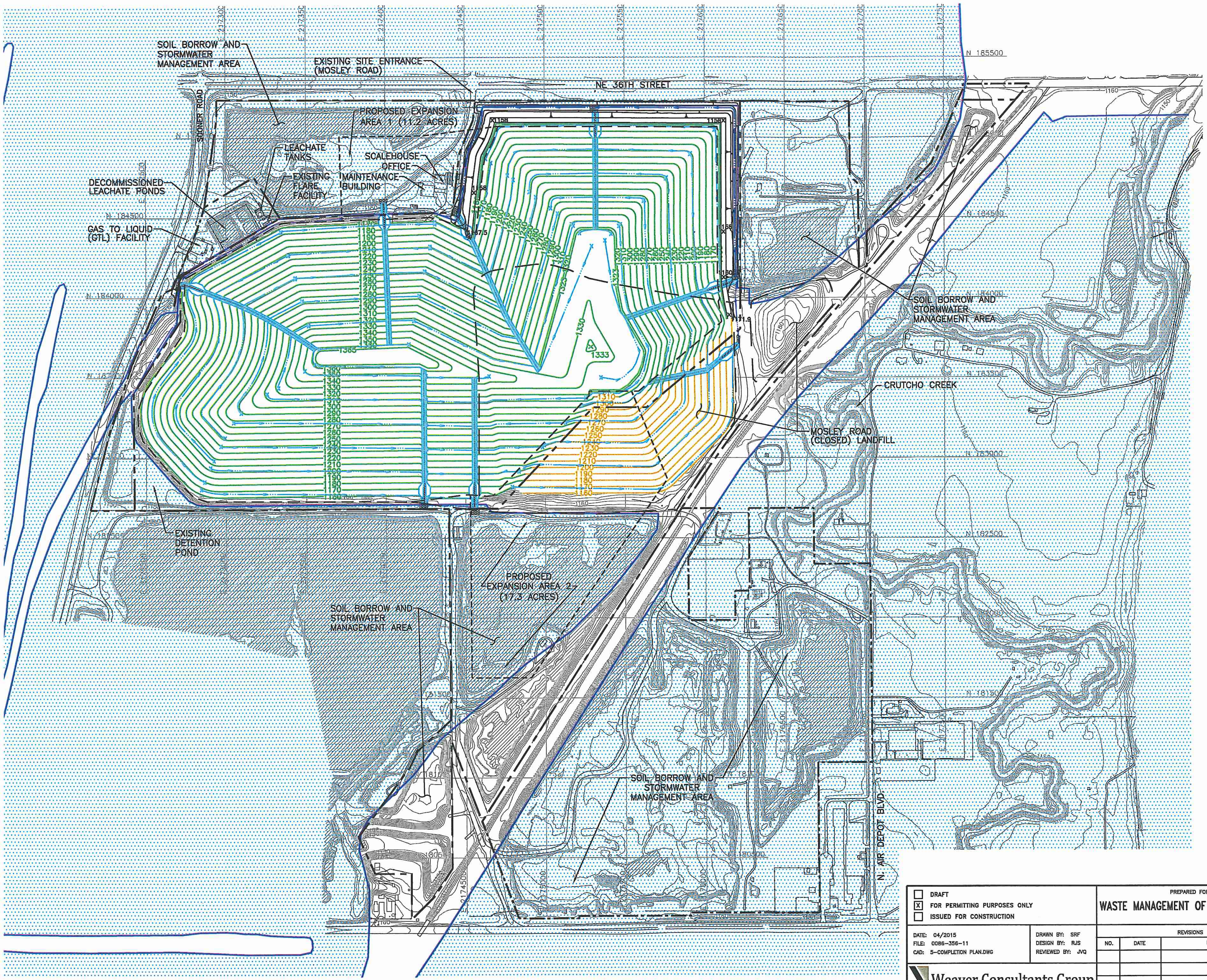

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24456
OKLAHOMA

4/30/15

0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- N 183000 STATE PLANE GRID COORDINATE
- 1160 EXISTING CONTOUR
- 1300 PERMITTED FINAL COVER
- 1300 PERMITTED FINAL COVER (MOSLEY ROAD LANDFILL)
- PERMITTED DRAINAGE SWALE
- PERMITTED LETDOWN STRUCTURE
- CENTERLINE OF CHANNEL
- IN-PLACE FINAL COVER
- 100-YEAR FLOODPLAIN (SEE NOTE 5)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. THE PERMITTED FINAL COVER CONTOURS WERE REPRODUCED FROM THE TIER III PERMIT MODIFICATION LATERAL EXPANSION, PREPARED BY WEAVER BOOS CONSULTANTS, LLC–SOUTHWEST IN AUGUST 2007.
5. NORTH CANADIAN RIVER 100-YEAR FLOODPLAIN DELINEATED BASED ON THE APPROVED INCLUDED IN THE APPROVED 2008 CLOMR (CASE NO. 08-06-0163R) PREPARED BY WEAVER BOOS CONSULTANTS, LLC–SOUTHWEST IN JANUARY 2008.

Z-22

- [ ] DRAFT
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- [ ] ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 5-COMPLETION PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

Weaver Consultants Group

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

SECTION 404 PERMIT PERMITTED COMPLETION PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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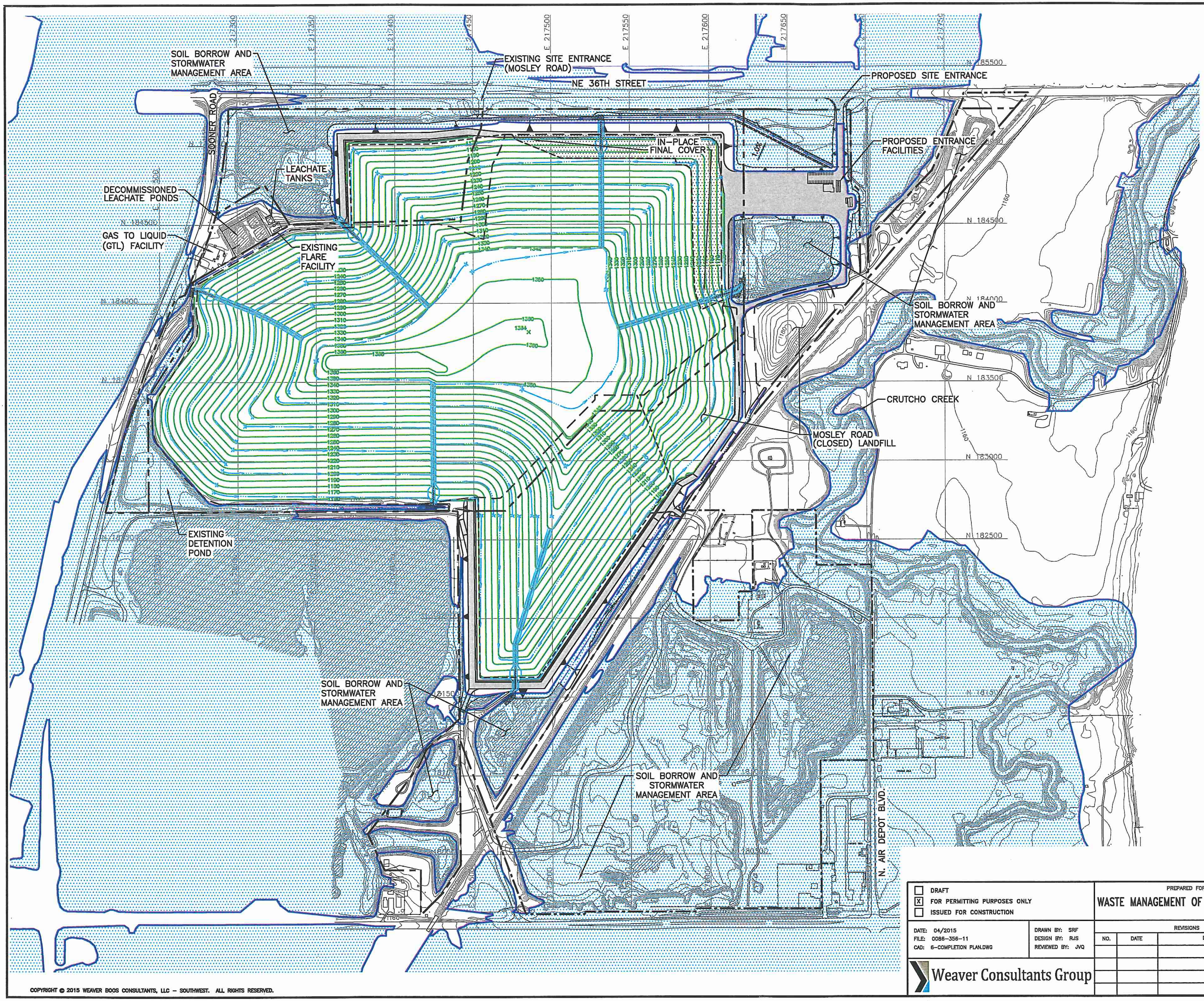

LICENSED PROFESSIONAL ENGINEER
JONATHAN V. QUEEN
24456
OKLAHOMA

4/30/15

N

0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- N 183000 STATE PLANE GRID COORDINATE
- 1180 EXISTING CONTOUR
- 1280 PROPOSED FINAL COVER CONTOUR
- PROPOSED DRAINAGE CHANNEL
- PROPOSED DRAINAGE SWALE
- PROPOSED DRAINAGE CHUTE
- IN-PLACE FINAL COVER
- 100-YEAR FLOODPLAIN

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.
4. IN-PLACE FINAL COVER LIMITS REPRODUCED FROM SOIL VERIFICATION SURVEY PREPARED BY LEMKE LAND SURVEYING, INC. DATED JUNE 2013.
5. 100-YEAR FLOODPLAIN REPRODUCED FROM THE POST-PROJECT CONDITION HYDRAULIC ANALYSIS TO BE INCLUDED IN THE CLOMR.

Z-23

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 6-COMPLETION PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

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SECTION 404 PERMIT
PROPOSED COMPLETION PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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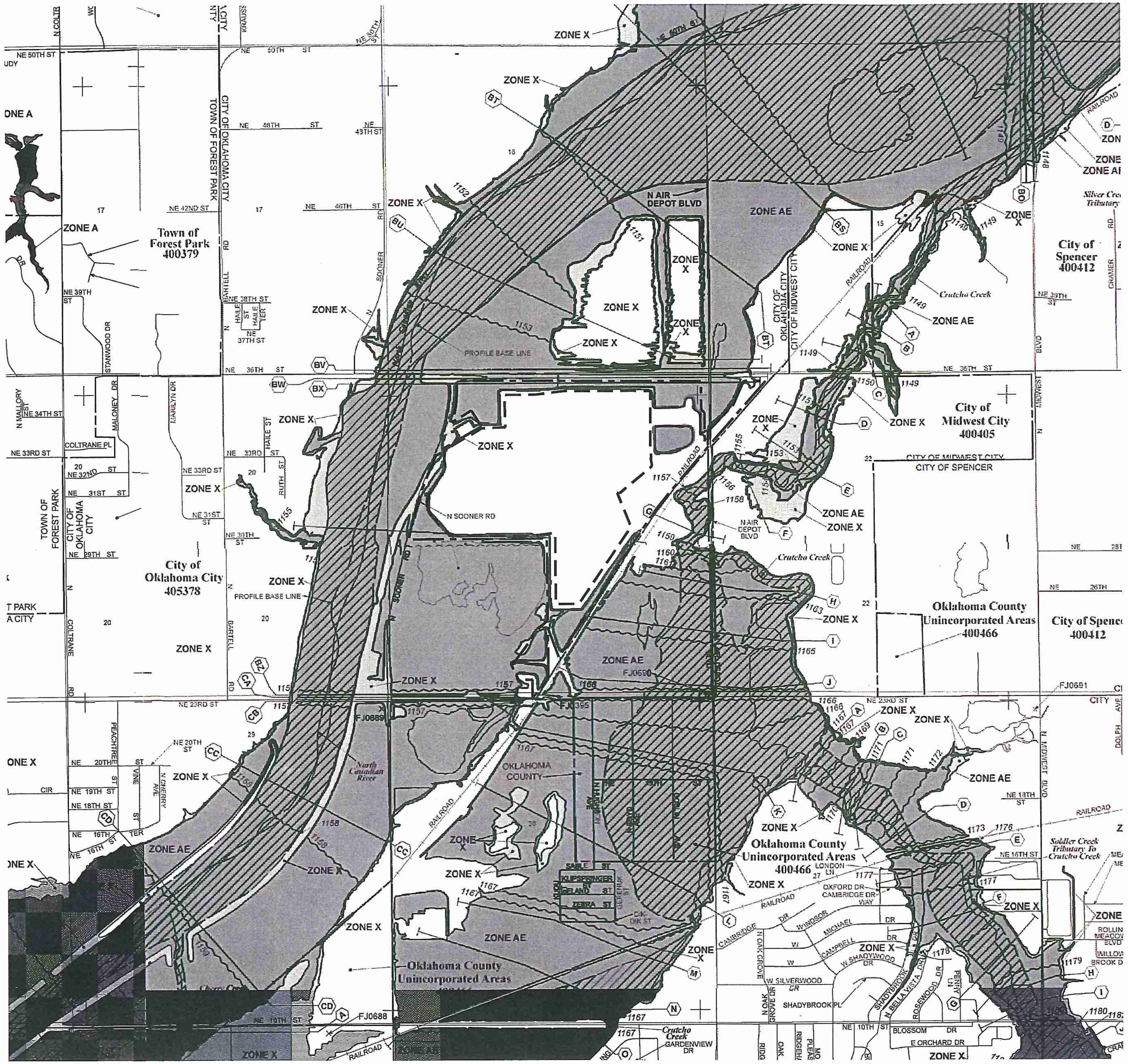

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SCALE IN FEET

LEGEND

LANDFILL PERMIT BOUNDARY

LIMITS OF WASTE

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevation determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance of greater flood event.
ZONE A99	Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000mE	1000-meter Universal Transverse Mercator grid ticks, zone 14
6000000 FT	5000-foot grid values: Texas State Plane coordinate system, North Zone (FIPSZONE = 4201), Lambert projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

NOTES:

1. REPRODUCED FROM FEMA FIRM NUMBERS 40109C0190H, 40109C0195H, 40109C0305H, AND 40109C0310H FOR OKLAHOMA COUNTY, OKLAHOMA AND INCORPORATED AREAS, EFFECTIVE DECEMBER 18, 2009.
2. 100-YEAR FLOODPLAIN REPRODUCED FROM THE POST-PROJECT CONDITION HYDRAULIC ANALYSIS TO BE INCLUDED IN THE CLOMR.

Z-24

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR WASTE MANAGEMENT OF OKLAHOMA, INC.	SECTION 404 PERMIT FIRM
DATE: 04/2015 FILE: 0086-356-11 CAD: 7-FIRM.DWG	DRAWN BY: SRF DESIGN BY: RJS REVIEWED BY: JVQ	EAST OAK RDF OKLAHOMA COUNTY, OKLAHOMA
Weaver Consultants Group	REVISIONS: NO. / DATE / DESCRIPTION	WWW.WCGRP.COM — DRAWING 7 OF 15

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LEGEND

—·—·—	PROPERTY BOUNDARY
— · —	PERMIT BOUNDARY
— — —	PERMITTED LIMITS OF WASTE
—— ——	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
1180	EXISTING CONTOUR

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 13, 2009.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. PERMITTED LIMITS OF WASTE AND MOSLEY ROAD LANDFILL (CLOSED LANDFILL) LIMITS OF WASTE PROVIDED BY WASTE MANAGEMENT OF OKLAHOMA, INC.

Z-25

- [ ] DRAFT
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- [ ] ISSUED FOR CONSTRUCTION

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

SECTION 404 PERMIT
2009 SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

DATE: 04/2015
FILE: 0086-356-11
CAD: 8-2009 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

REVISIONS

NO.	DATE	DESCRIPTION

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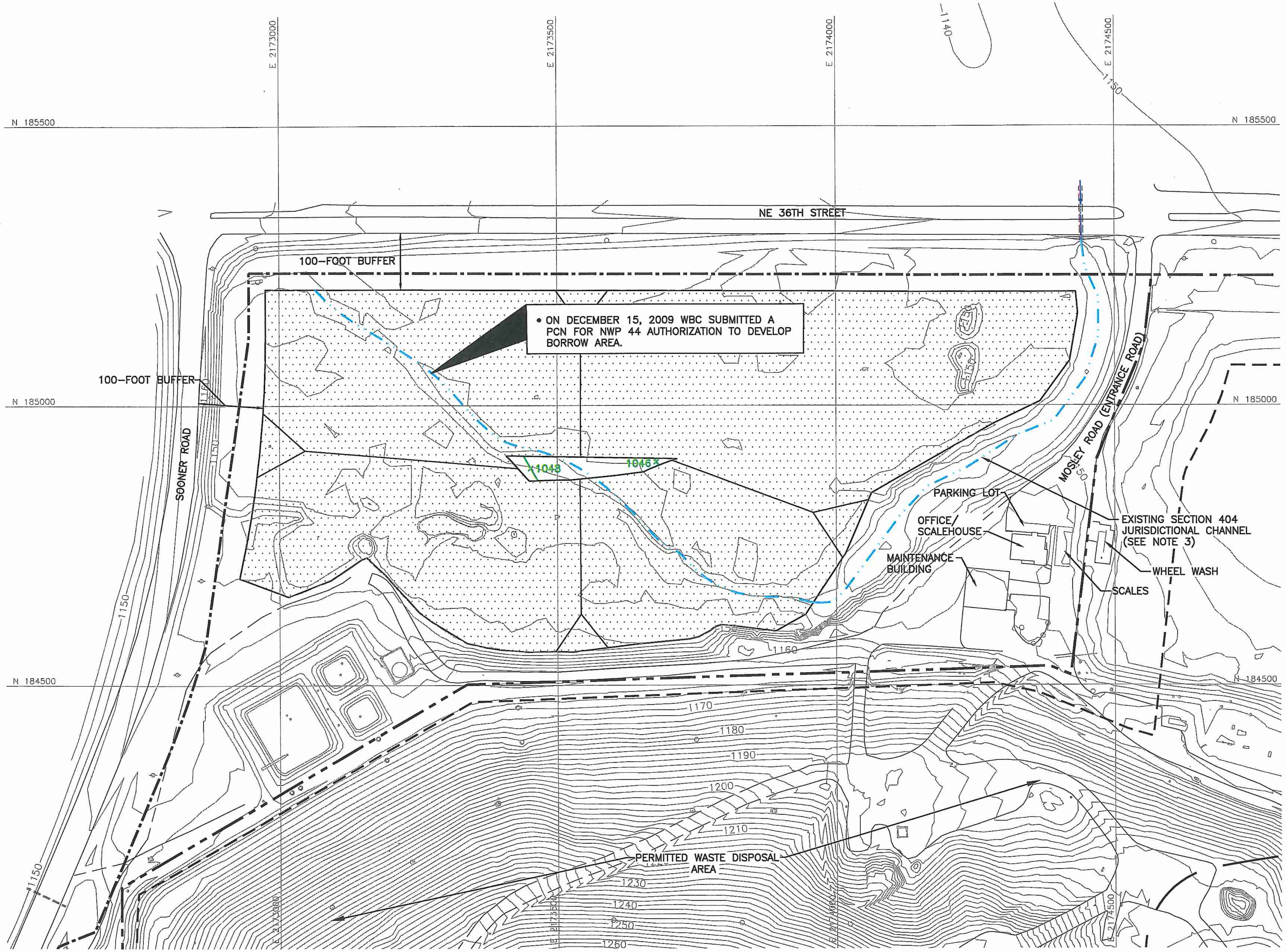

0 100 200

SCALE IN FEET

LEGEND

— · — · —	PROPERTY BOUNDARY
— — · —	PERMIT BOUNDARY
— — — —	PERMITTED LIMITS OF WASTE
—— —— ——	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
——1180——	EXISTING CONTOUR
——1048——	PERMITTED SOIL BORROW CONTOUR
—·—·—	CHANNEL FLOWLINE
⁚⁚⁚⁚	3H:1V EXCAVATION

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 13, 2009. ADDITIONAL CONTOURS WERE REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (SPENCER AND MIDWEST CITY, OKLAHOMA, 1995).
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. EXISTING SECTION 404 JURISDICTIONAL CHANNEL ALIGNMENT BASED ON FIELD RECONNAISSANCE BY GOSHAWK, INC. ON AUGUST 27, 2009.

Z-26

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 9-PERM SOIL BORROW.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

Weaver Consultants Group

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

SECTION 404 PERMIT PERMITTED SOIL BORROW AREA PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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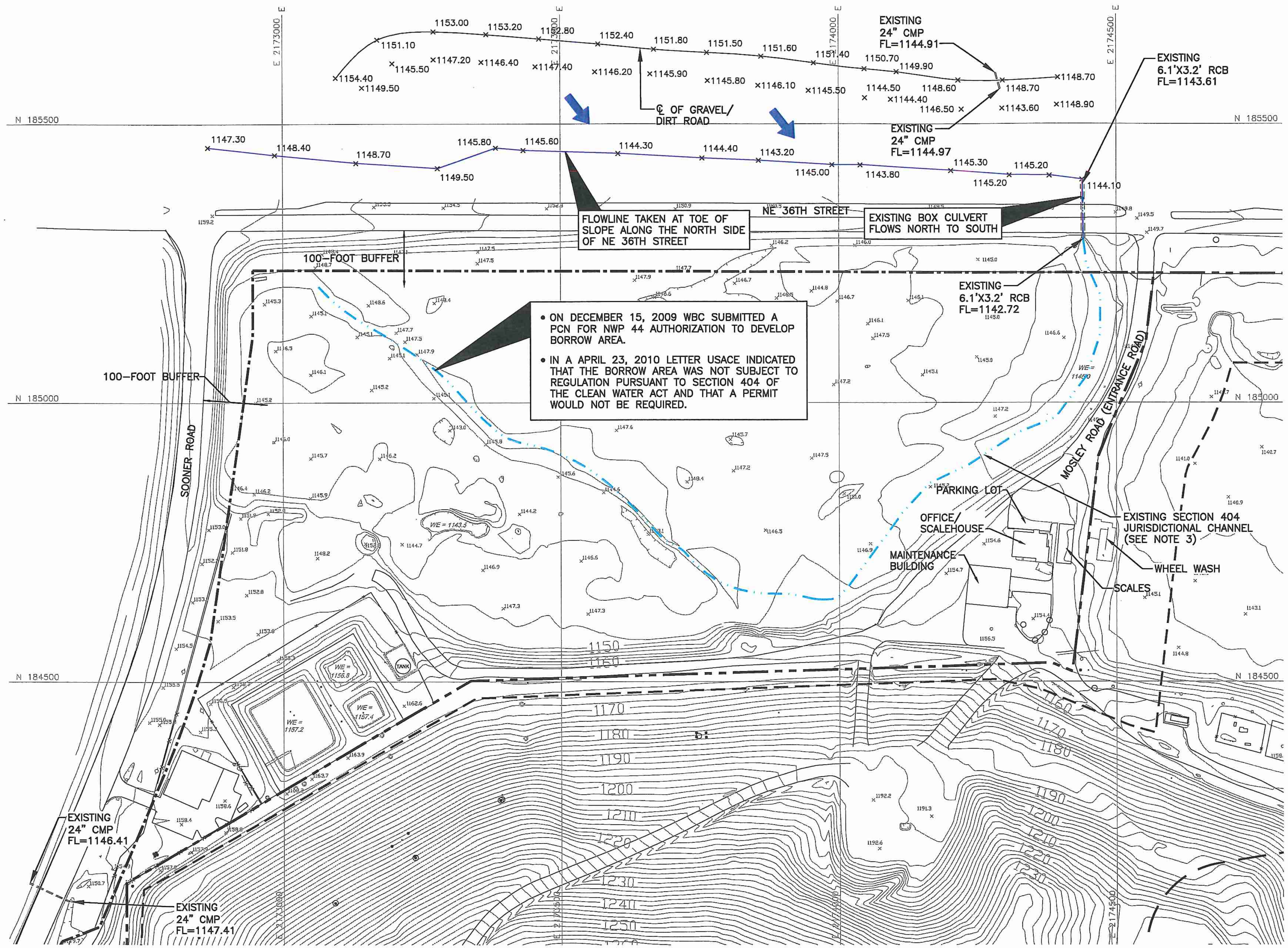

0 100 200
SCALE IN FEET

LEGEND

— · — · —	PROPERTY BOUNDARY
— — - —	PERMIT BOUNDARY
— — — —	PERMITTED LIMITS OF WASTE
—— —— ——	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
——1180——	EXISTING CONTOUR
——·——·——	CHANNEL FLOWLINE
×1144.10	FIELD SURVEY SPOT ELEVATION (SEE NOTE 4)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN FEBRUARY 23, 2010. ADDITIONAL CONTOURS WERE REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (SPENCER AND MIDWEST CITY, OKLAHOMA, 1995).
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. EXISTING SECTION 404 JURISDICTIONAL CHANNEL ALIGNMENT BASED ON FIELD RECONNAISSANCE BY GOSHAWK, INC. ON AUGUST 27, 2009.
4. FIELD SURVEY, FLOWLINE, AND CULVERT ELEVATIONS OBTAINED FROM LEMKE LAND SURVEYING, INC. FROM FIELD SURVEY COMPLETED ON AUGUST 5, 2010 AND NOVEMBER 2, 2010.
5. ON OCTOBER 19, 2010, THE CITY OF OKLAHOMA CITY APPROVED PUD-1419 TO AUTHORIZE SOIL BORROW ACTIVITIES.

Z-27

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 10-2010 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group

SECTION 404 PERMIT 2010 SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

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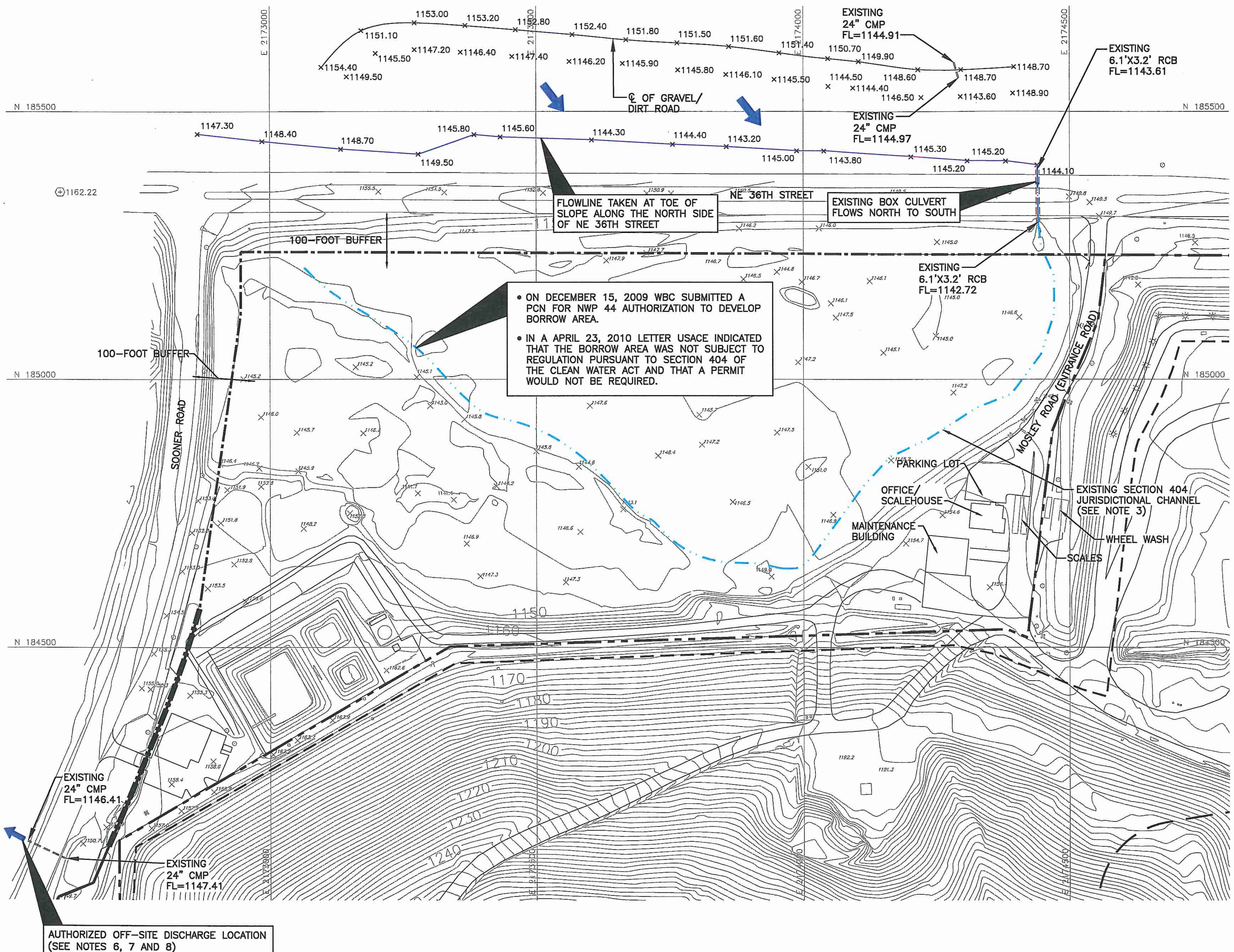

0 100 200
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- N 183000 — STATE PLANE GRID COORDINATE
- 1180 — EXISTING CONTOUR
- CHANNEL FLOWLINE
- ×1144.10 — FIELD SURVEY SPOT ELEVATION (SEE NOTE 4)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 27, 2011. ADDITIONAL CONTOURS WERE REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (SPENCER AND MIDWEST CITY, OKLAHOMA, 1995).
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. EXISTING SECTION 404 JURISDICTIONAL CHANNEL ALIGNMENT BASED ON FIELD RECONNAISSANCE BY GOSHAWK, INC. ON AUGUST 27, 2009.
4. FIELD SURVEY, FLOWLINE, AND CULVERT ELEVATIONS OBTAINED FROM LEMKE LAND SURVEYING, INC. FROM FIELD SURVEY COMPLETED ON AUGUST 5, 2010 AND NOVEMBER 2, 2010.
5. ON OCTOBER 19, 2010, THE CITY OF OKLAHOMA CITY APPROVED PUD-1419 TO AUTHORIZE SOIL BORROW ACTIVITIES.
6. ON NOVEMBER 24, 2010, ODEQ APPROVED A REVISED CPC PLAN THAT INCORPORATES SOIL BORROW ACTIVITIES. ON FEBRUARY 14, 2011, ODEQ APPROVED A REVISED CPC PLAN THAT INCLUDED A SPECIFIC PUMPING PLAN FROM THE SOIL BORROW AREA.
7. ON MARCH 16, 2011, THE CITY OF OKLAHOMA CITY APPROVED AN ALTERNATIVE DISCHARGE LOCATION TO FLOW THROUGH AN EXISTING CMP WEST OF THE SOIL BORROW AREA.
8. IN NOVEMBER 2011, THE SITE SWPPP WAS UPDATED TO INCLUDE THE ALTERNATIVE DISCHARGE LOCATION.

Z-28

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 11-2011 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group

SECTION 404 PERMIT 2011 SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM

DRAWING 11 OF 15

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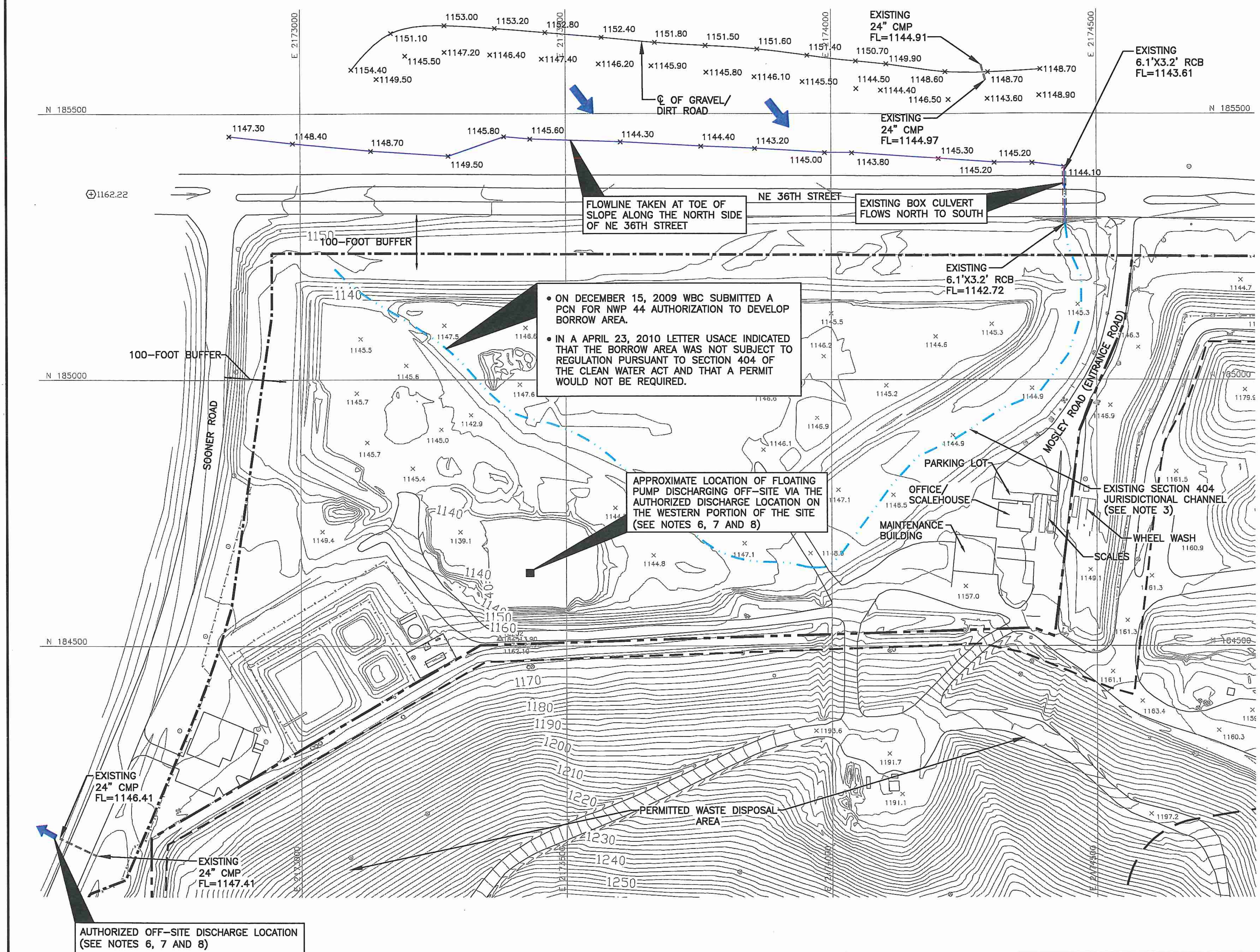

0 100 200
SCALE IN FEET

LEGEND

—·—·—	PROPERTY BOUNDARY
— - —	PERMIT BOUNDARY
— — —	PERMITTED LIMITS OF WASTE
— — —	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
—1180—	EXISTING CONTOUR
—•—	CHANNEL FLOWLINE
×1144.10	FIELD SURVEY SPOT ELEVATION (SEE NOTE 4)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 14, 2012. ADDITIONAL CONTOURS WERE REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (SPENCER AND MIDWEST CITY, OKLAHOMA, 1995).
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. EXISTING SECTION 404 JURISDICTIONAL CHANNEL ALIGNMENT BASED ON FIELD RECONNAISSANCE BY GOSHAWK, INC. ON AUGUST 27, 2009.
4. FIELD SURVEY, FLOWLINE, AND CULVERT ELEVATIONS OBTAINED FROM LEMKE LAND SURVEYING, INC. FROM FIELD SURVEY COMPLETED ON AUGUST 5, 2010 AND NOVEMBER 2, 2010.
5. ON OCTOBER 19, 2010, THE CITY OF OKLAHOMA CITY APPROVED PUD-1419 TO AUTHORIZE SOIL BORROW ACTIVITIES.
6. ON NOVEMBER 24, 2010, ODEQ APPROVED A REVISED CPC PLAN THAT INCORPORATES SOIL BORROW ACTIVITIES. ON FEBRUARY 14, 2011, ODEQ APPROVED A REVISED CPC PLAN THAT INCLUDED A SPECIFIC PUMPING PLAN FROM THE SOIL BORROW AREA.
7. ON MARCH 16, 2011, THE CITY OF OKLAHOMA CITY APPROVED AN ALTERNATIVE DISCHARGE LOCATION TO FLOW THROUGH AN EXISTING CMP WEST OF THE SOIL BORROW AREA.
8. IN NOVEMBER 2011, THE SITE SWPPP WAS UPDATED TO INCLUDE THE ALTERNATIVE DISCHARGE LOCATION.

Z-29

☐ DRAFT
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☐ ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 12-2012 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group

SECTION 404 PERMIT 2012 SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM

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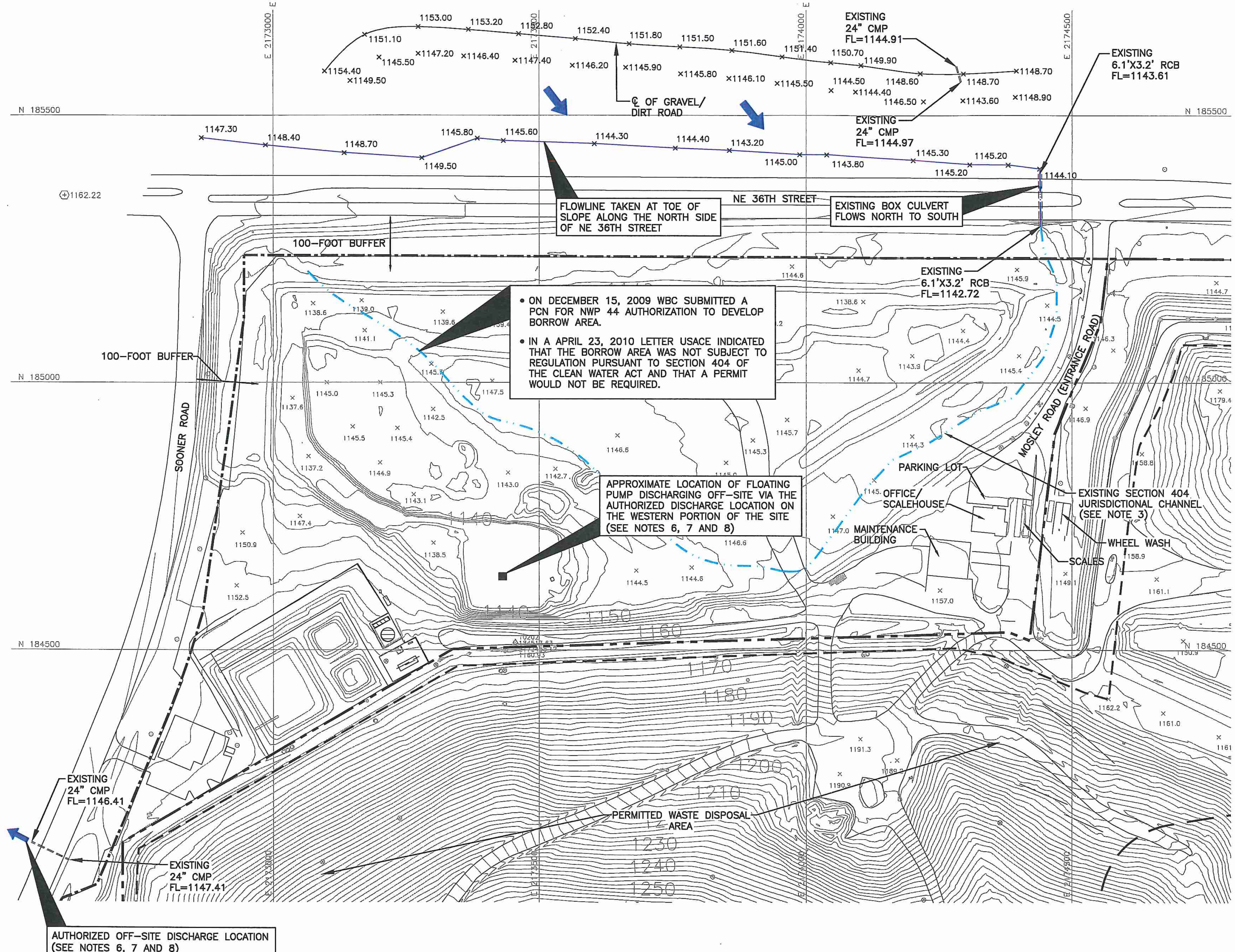

LEGEND

—·—·—	PROPERTY BOUNDARY
—— - ——	PERMIT BOUNDARY
— — —	PERMITTED LIMITS OF WASTE
—— ——	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
—1180—	EXISTING CONTOUR
—·→—	CHANNEL FLOWLINE
×1144.10	FIELD SURVEY SPOT ELEVATION (SEE NOTE 4)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 22, 2013. ADDITIONAL CONTOURS WERE REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (SPENCER AND MIDWEST CITY, OKLAHOMA, 1995).
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
3. EXISTING SECTION 404 JURISDICTIONAL CHANNEL ALIGNMENT BASED ON FIELD RECONNAISSANCE BY GOSHAWK, INC. ON AUGUST 27, 2009.
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5. ON OCTOBER 19, 2010, THE CITY OF OKLAHOMA CITY APPROVED PUD-1419 TO AUTHORIZE SOIL BORROW ACTIVITIES.
6. ON NOVEMBER 24, 2010, ODEQ APPROVED A REVISED CPC PLAN THAT INCORPORATES SOIL BORROW ACTIVITIES. ON FEBRUARY 14, 2011, ODEQ APPROVED A REVISED CPC PLAN THAT INCLUDED A SPECIFIC PUMPING PLAN FROM THE SOIL BORROW AREA.
7. ON MARCH 16, 2011, THE CITY OF OKLAHOMA CITY APPROVED AN ALTERNATIVE DISCHARGE LOCATION TO FLOW THROUGH AN EXISTING CMP WEST OF THE SOIL BORROW AREA.
8. IN NOVEMBER 2011, THE SITE SWPPP WAS UPDATED TO INCLUDE THE ALTERNATIVE DISCHARGE LOCATION.

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☐ DRAFT
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DATE: 04/2015
FILE: 0086-356-11
CAD: 13-2013 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group

SECTION 404 PERMIT 2013 SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM

DRAWING 13 OF 15

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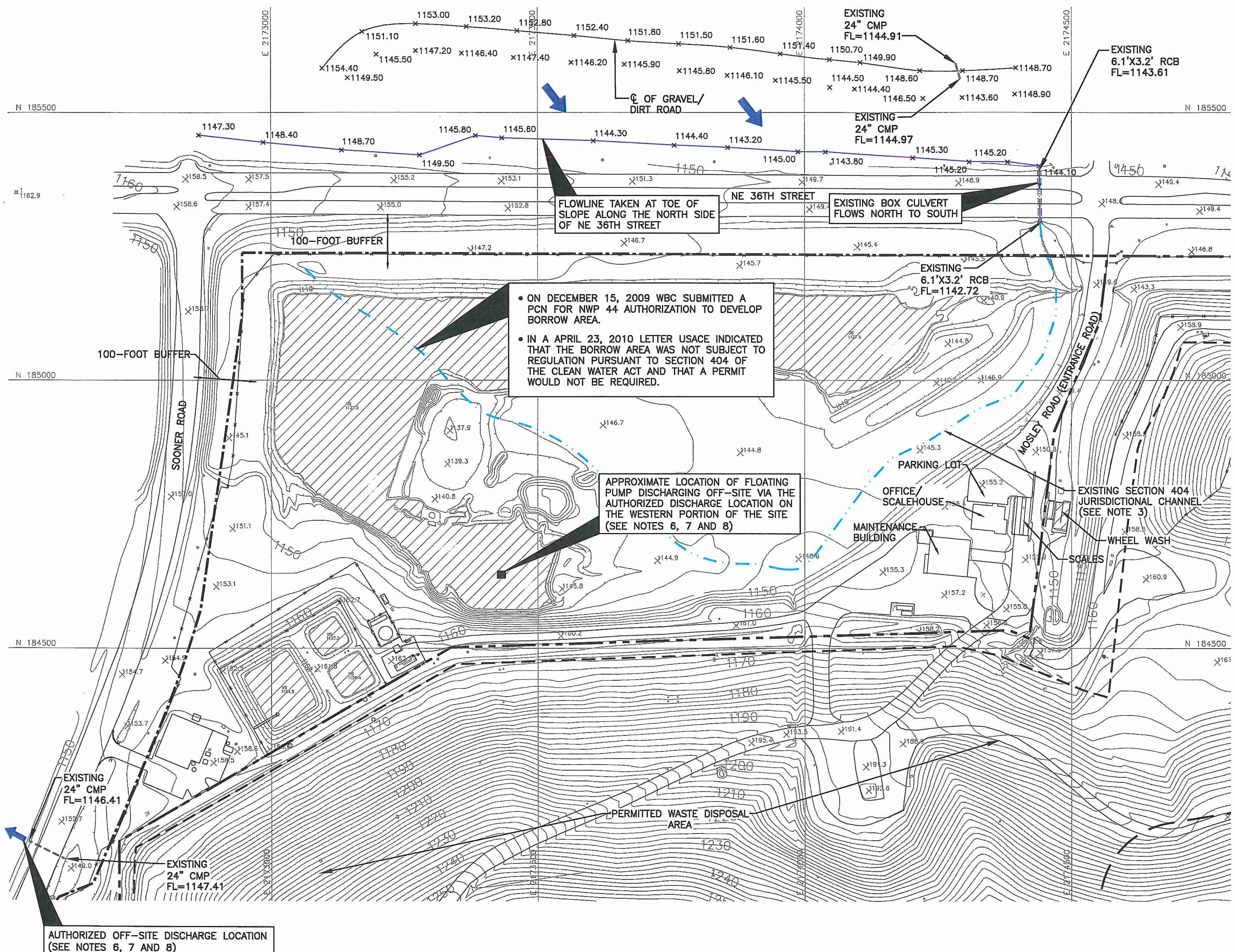

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SCALE IN FEET

LEGEND

— · — · —	PROPERTY BOUNDARY
— — - - — —	PERMIT BOUNDARY
— — — —	PERMITTED LIMITS OF WASTE
—— —— ——	MOSLEY ROAD LANDFILL LIMITS OF WASTE
N 183000	STATE PLANE GRID COORDINATE
—1180—	EXISTING CONTOUR
— · · —	CHANNEL FLOWLINE
×1144.10	FIELD SURVEY SPOT ELEVATION (SEE NOTE 4)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014. ADDITIONAL CONTOURS WERE REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (SPENCER AND MIDWEST CITY, OKLAHOMA, 1995).
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PREPARED BY LEMKE LAND SURVEYING, INC.
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8. IN NOVEMBER 2011, THE SITE SWPPP WAS UPDATED TO INCLUDE THE ALTERNATIVE DISCHARGE LOCATION.

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☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 04/2015
FILE: 0086-356-11
CAD: 14-2014 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group

SECTION 404 PERMIT 2014 SITE PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM

DRAWING 14 OF 15

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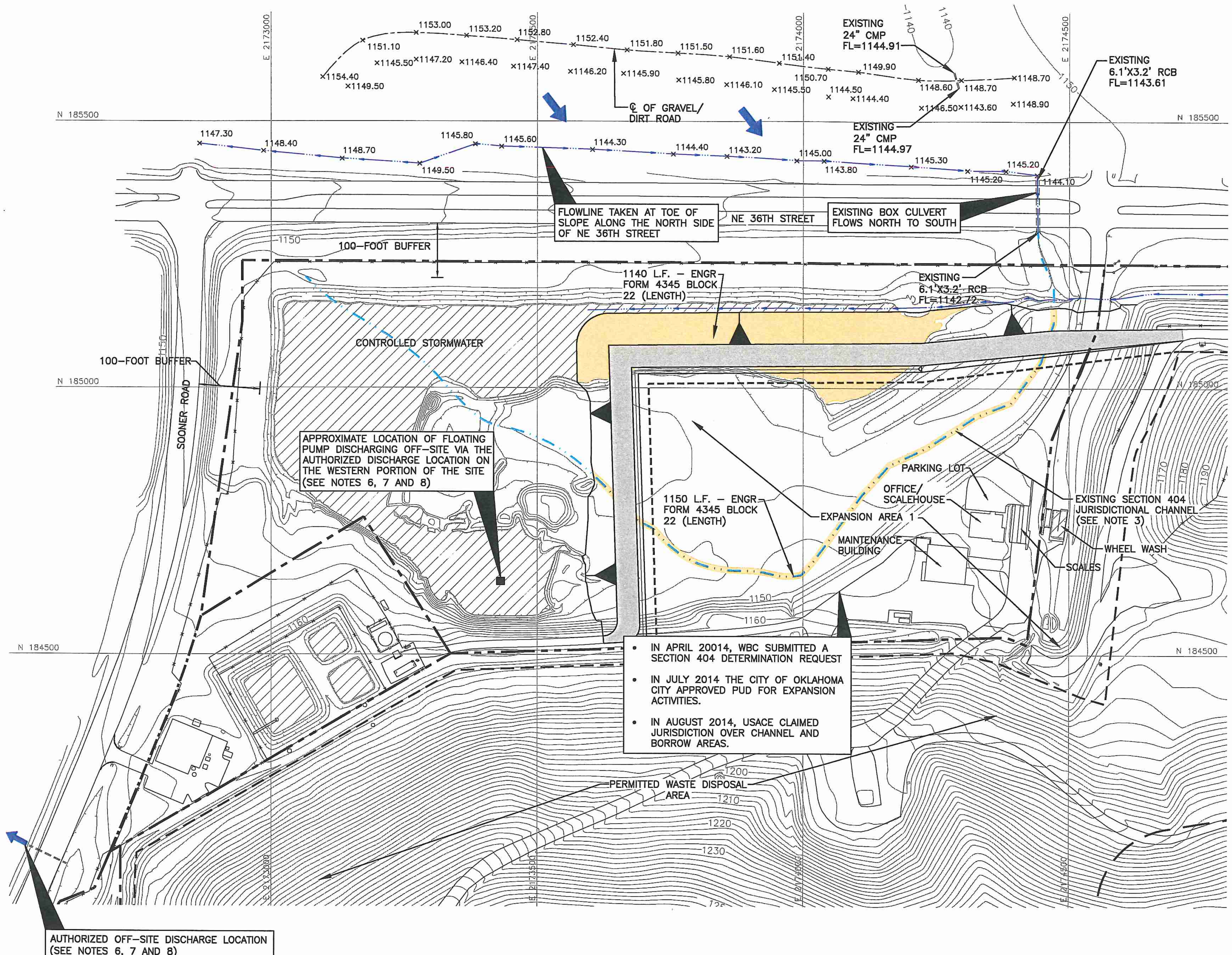

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SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- MOSLEY ROAD LANDFILL LIMITS OF WASTE
- N 185000 — STATE PLANE GRID COORDINATE
- 1180 — EXISTING CONTOUR
- CHANNEL FLOWLINE
- ENGR FORM 4345 BLOCK 22 (AREA)
- ×1144.10 FIELD SURVEY SPOT ELEVATION (SEE NOTE 4)

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN JANUARY 19, 2014. ADDITIONAL CONTOURS WERE REPRODUCED FROM USGS 7.5 MINUTE QUADRANGLE TOPOGRAPHIC MAP (SPENCER AND MIDWEST CITY, OKLAHOMA, 1995).
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7. ON MARCH 16, 2011, THE CITY OF OKLAHOMA CITY APPROVED AN ALTERNATIVE DISCHARGE LOCATION TO FLOW THROUGH AN EXISTING CMP WEST OF THE SOIL BORROW AREA.
8. IN NOVEMBER 2011, THE SITE SWPPP WAS UPDATED TO INCLUDE THE ALTERNATIVE DISCHARGE LOCATION.

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DATE: 04/2015
FILE: 0086-356-11
CAD: 15-2015 SITE PLAN.DWG

DRAWN BY: SRF
DESIGN BY: RJS
REVIEWED BY: JVQ

Weaver Consultants Group

PREPARED FOR
WASTE MANAGEMENT OF OKLAHOMA, INC.

REVISIONS

NO.	DATE	DESCRIPTION

SECTION 404 PERMIT PROPOSED EXPANSION AREA 1 PLAN

EAST OAK RDF
OKLAHOMA COUNTY, OKLAHOMA

WWW.WCGRP.COM