Geosyntec consultants

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Tampa, FL 33637
PH 813-558-0990
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9 December 2014

Mr. Cory Dilmore, P.E.
Florida Department of Environmental Protection
Permit Processing Central District
2600 Blair Stone Road, MS 4565
Tallahassee, Florida 32399

Subject: Intermediate Modification Permit Application
Cells 11-13 Base Grade Modifications
J.E.D. Solid Waste Management Facility (WACS #89544)
Osceola County, Florida

Dear Mr. Dilmore:

Transmitted herewith are two copies of the J.E.D. Solid Waste Management Facility (JED facility) Intermediate Modification Permit Application (Application). This Application is submitted on behalf of Omni Waste of Osceola County, LLC (Omni) for the JED facility located in St. Cloud, Florida. This Application package contains one hard-copy of the Application, one electronic copy of the Application, and one check in the amount of $5000 (in accordance with Rule 62-701.315(4), F.A.C.).

If you have any questions or need additional information, please do not hesitate to contact the undersigned.

Sincerely,

Craig R. Browne, P.E.
Project Engineer
Florida P.E. No. 68613

Attachment

Copies to: Michael Kaiser, PWSFL

FLFLORI035 FLORIDA DEPT OF ENVIRONMENTAL IESI Corporation 12/5/2014

Ref Nbr	Invoice Nbr	Cust Nbr	Invc Date	Invoice Amount	Amount Paid	Disc Taken	Net Check Amt
003028781	PERMIT	IESI	12/03/14	5,000.00	5,000.00	0.00	5,000.00

102117183

THE FACE OF THIS DOCUMENT HAS A COLORED BACKGROUND ON WHITE PAPER - THE BACK CONTAINS AN ARTIFICIAL WATERMARK - HOLD AT AN ANGLE TO VIEW

Fleet Maine, N.A.
South Portland, ME
52-153/112

IESI Corporation
2301 Eagle Parkway, Suite 200
Fort Worth, TX 76177
(817) 632-4000

Check # 102117183

Check Date	Check Amount
12/5/2014	*******$5,000.00

** Void after 120 davs **
** Not valid over $100,000 without two signatures **

Five Thousand and 00/100-- USD

PAY TO THE ORDER OF FLORIDA DEPT OF ENVIRONMENTAL PROTEC

[redacted]

Authorized Signature

BORDER CONTAINS MICROPRINTING

[redacted]

Prepared for

Omni Waste of Osceola County, LLC
1501 Omni Way
St. Cloud, Florida 34773

INTERMEDIATE PERMIT MODIFICATION APPLICATION: BASE GRADE REVISIONS TO PHASE 4 (CELLS 11-13)

J.E.D. Solid Waste Management Facility
Osceola County, Florida

Prepared by

Geosyntec consultants
13101 Telecom Drive, Suite 120
Temple Terrace, Florida 33637
Authorization No.: 4321

Project No. FL2478

December 2014

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

Craig Browne, P.E.
Florida Registration No. 68613
(Expiration: 28 February 2015)
Date: 12/9/2014

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J.E.D. SOLID WASTE MANAGEMENT FACILITY
OSCEOLA COUNTY, FLORIDA

1 INTRODUCTION

Geosyntec Consultants (Geosyntec) has prepared this intermediate modification permit application report (Report) to present the proposed modifications to the base (liner and leachate collection system) grades for Phase 4 (Cells 11 through 13) at the J.E.D. Solid Waste Management (JED) facility, located in Osceola County, Florida. The JED facility is owned and operated by Omni Waste of Osceola County, LLC (Omni), a Progressive Waste Solutions Company.

This Application is being submitted to the Florida Department of Environmental Protection (FDEP) on behalf of Omni and has been prepared in accordance with Florida Administrative Code (F.A.C.) Chapter 62-701. The remainder of this Report provides: (i) DEP Form 62-701.900(1) – *Application for a Permit to Construct, Operate, Modify or Close a Solid Waste Management Facility* in **Attachment 1**; (ii) a description of the proposed base grade revisions; (iii) Intermediate Modification Permit Drawings (Permit Drawings) in **Attachment 1**; (iv) a history of enforcement actions in **Attachment 3**; (v) supporting design calculations in **Attachment 4** through **Attachment 6**; and (vi) a revised geocomposite technical specification in **Attachment 7**. It is intended that this Report and attachments meet the requirements of an Engineering Report per Rule 62-701.320(7)(d), F.A.C. A check in the amount of $5,000 for the permit application fee is also included in this submittal package.

This Report was prepared by Mr. Craig R. Browne, P.E. and reviewed by Dr. Kwasi Badu-Tweneboah, P.E., both of Geosyntec. Professional engineer certification is provided on the cover sheet of this report, on the DEP Form 62-701.900(1), and on each sheet of the Permit Drawings.

2 PROPOSED MODIFICATIONS

As currently permitted, under FDEP Permit 0199726-023-SC-MM, the base grades in Cells 11 through 13 of the JED facility are designed with a conventional "herringbone" pattern with leachate collection and leak detection system piping in the valley of the herringbone-shaped cells as depicted in the 2011 Renewal Permit Drawings included as Appendix B of the "Renewal Permit Application to Operate Phases 1 through 4 of the J.E.D. Solid Waste Management Facility" (Geosyntec, 2011b). The base grades in each cell are sloped such that the leachate drains towards a single low point (i.e., sump) located along the perimeter of the landfill. The bottom slopes (or grades) of the currently permitted Cells 11-13 are two percent, with the leachate corridor inclination of one percent.

In an effort to minimize the import of soil fill needed for cell construction, Omni has proposed revisions to the base grades in Cells 11 through 13. The proposed base grade revisions will also follow a herringbone pattern except that the inclination of the leachate and leak detection pipe corridor will be reduced under the top deck area and the inclination of the liner system slopes will be reduced as shown on the Drawings (**Attachment 2**). The inclination of the leachate and leak detection pipe corridor under the 3 horizontal to 1 vertical (3H:1V) waste side slope areas will remain as currently permitted. The following sections provide supporting permitting information and details for the proposed base grade revisions and corresponding design evaluations.

3 GENERAL INFORMATION

3.1 Introduction

This section presents and addresses the general requirements in Rule 62-701, F.A.C., not specifically addressed in other sections or appendices of this permit application. Specifically, this section is organized to provide the information required by Parts A through R of FDEP Form 62-701.900(1).

3.2 Location

The JED facility is a Class I landfill located in eastern Osceola County, Florida, west of highway U.S. 441, approximately 6.5 miles south of Holopaw. The JED facility is located in Sections 11, 13, and 14 of Township 28 South, Range 32 East, and Sections 17 and 18 of Township 28 South, Range 33 East, Osceola County, Florida. The site location is shown in the 2011 Renewal Permit Drawings. The main entrance of the facility is located at latitude 28° 02' 57", longitude 81° 03' 10", on highway U.S. 441 while the center of the landfill footprint is located at latitude 28º 03' 32" and longitude 81º 05' 46".

3.3 Site Description

The property is generally bounded by the Bronson's, Inc. Property to the north and west, Clay Whaley Property to the south, and highway U.S. 441 to the east. The landfill facility is connected to highway U.S. 441 with an approximately 3-mile long access road. The JED property comprises a total of approximately 2,179 acres, of which approximately 360 acres are covered by the landfill footprint. The proposed footprint of Phase 4 of landfill development is approximately 47 acres.

3.4 Prohibitions

This section provides information required by Part C of Form 62-701.900(1) that pertain to regulatory landfill prohibitions as described in Section 62-701.300, FAC. The proposed base grade modifications will not alter the horizontal or vertical extents of the disposal area. As such, the JED facility will continue to satisfy FDEP siting criteria requirements described by Section 62-701.300(2). Accordingly, Parts C.1 through C.10 of Form 62-701.900(1) have been marked as "No Change."

3.5 Solid Waste Management Facility Permit Requirements

3.5.1 Overview

As previously stated, FDEP Form 62-701.900(1) has been completed for this application. A dated, signed and sealed copy of FDEP Form 62-701.900(1) is included in **Attachment 1** of this application.

3.5.2 Operation Plan

The proposed base grade modifications are not intended to modify the currently approved landfill operations. As such, a revised operation plan is not included herein.

3.5.3 Closure Plan

The proposed base grade modifications will not modify the currently approved landfill closure plan. As such, a revised closure plan is not included herein.

3.5.4 Intermediate Modification Permit Drawings

Attachment 2 includes the Permit Drawings for the proposed base grade modifications. The Permit Drawings are numbered consistent with the 2011 Permit Renewal Drawings (Geosyntec, 2011b) to facilitate review of the proposed modifications. Only the sheets that depict portions of the Phase 4 landfill geometry that are proposed to be modified have been included in **Attachment 2**.

3.5.5 Compliance History

As required by Rule 62-701.320(7), F.A.C., a history of solid waste management facility enforcement actions against Omni or parent company in the State of Florida is presented in **Attachment 3**.

3.5.6 Public Notification

This intermediate modification permit application does not propose to substantially modify the currently approved FDEP solid waste construction permit. As such, in accordance with the requirements of Rule 62-701.320(8)(a), F.A.C., a Notice of Application is not required..

3.5.7 Airport Safety

The proposed base grade modifications will not alter the horizontal or vertical extents of the disposal area. As such, the JED facility will continue to satisfy the airport safety requirements provided in Rule 62-701.320(13), F.A.C.

3.6 Permit Application Requirements

3.6.1 Overview

The documentation required by Rule 62-701.330(3)(a) through (h), F.A.C., [Part E of FDEP Form 62-701.900(1)] is discussed below.

3.6.2 Permit Drawings

Attachment 2 includes the Permit Drawings for the proposed base grade modifications. The Permit Drawings are numbered consistent with the 2011 Permit Renewal Drawings (Geosyntec, 2011b) to facilitate review of the proposed modifications. Only the sheets that depict portions of the Phase 4 landfill geometry that are proposed to be modified have been included in **Attachment 2**.

3.6.3 Estimated Population for the Service Area

Information on the estimated population for the service area was most recently provided in the 2011 Permit Renewal Application (Geosyntec, 2011b). The proposed modifications will not alter the service area.

3.6.4 Type, Source of Solid Waste, and Annual Quantity

Information on the type, source, and annual quantity of accepted waste was most recently provided in the 2011 Permit Renewal Application (Geosyntec, 2011b). The proposed modifications will not alter the previously estimated waste disposal rate of 6,000 tons/day, or 1,716,000 tons/year.

3.6.5 Anticipated Life

As of May 2014 (date of most recent topographic survey), the existing operations (Cells 1-10) plus the proposed development for Phase 4 (Cells 11-13) of the JED facility have approximately 16,042,603 yd^3 of remaining disposal capacity. The proposed base grade modifications will increase the remaining disposal capacity in Cells 1-13 to approximately 16,137,103 yd^3. At an estimated in-place unit weight of approximately 1,600 lb/yd^3 (including daily cover), landfill operations for 6 days per week or 286 days per year, and a 3% annual waste growth rate, the expected life including existing operations and Phase 4 under build-out conditions is estimated to be approximately 5.5 years (to early 2020). The anticipated life of the facility at final build-out is estimated to be approximately 20 years (to mid-2034).

No change is proposed to the final design height of the JED facility; the maximum height of the facility during its operation was provided in the 2011 Renewal Permit Drawings (Geosyntec, 2011b).

3.7 General Criteria for Landfills

3.7.1 Floodplain

The proposed base grade modifications will not alter the horizontal or vertical extents of the disposal area. As such, the JED facility will continue to satisfy the floodplain requirements provided in requirement of Rule 62-701.340(3)(c), F.A.C.

3.7.2 Horizontal Separation

The proposed base grade modifications will not alter the horizontal or vertical extents of the disposal area. As such, the JED facility will continue to satisfy the horizontal separation requirements of Rule 62-701.340(3)(c), F.A.C.

3.8 Landfill Construction Requirements

The applicable landfill construction requirements in Part G of FDEP Form 62-701.900(1), and Rule 62-701.400, F.A.C., are described in subsequent sections of this Report and corresponding attachments.

3.9 Hydrogeological and Geotechnical Investigation Requirements

No additional hydrogeological or geotechnical investigations have been performed in support of the proposed Intermediate Modification. As such, Parts H and I on FDEP Form 62-701.900(1) have been marked as "No Change". However, geotechnical bearing capacity, settlement, and slope stability analyses are presented in Section 4 to support the proposed modifications to the base grades as required by Rule 62-701.410, F.A.C.

3.10 Vertical Expansion of Landfills

The proposed Intermediate Modification to the base grades of Cells 11-13 does not involve an increase in maximum waste elevation. As such, Part J on FDEP Form 62-701.900(1) has been marked as "Not Applicable".

3.11 Landfill Operation Requirements

The proposed Intermediate Modification to the base grades of Cells 11-13 does not involve modifications that would require changes to the landfill operations. As such, Part K on FDEP Form 62-701.900(1) has been marked as "No Change".

3.12 Water Quality Monitoring Requirements

The proposed Intermediate Modification to the base grades of Cells 11-13 does not involve modifications that would require changes to the water quality monitoring plan. As such, Part L on FDEP Form 62-701.900(1) has been marked as "No Change".

3.13 Special Waste Handling Requirements

The proposed Intermediate Modification to the base grades of Cells 11-13 does not involve modifications that would require changes to the management of special waste. As such, Part M on FDEP Form 62-701.900(1) has been marked as "No Change".

3.14 Landfill Final Closure and Long-Term Care Requirements

The proposed Intermediate Modification to the base grades of Cells 11-13 does not involve modifications that would require changes to the landfill closure and long-term care plans. As such, Parts O, P, and Q on FDEP Form 62-701.900(1) have been marked as "No Change".

3.15 Financial Assurance

The proposed Intermediate Modification to the base grades of Cells 11-13 does not involve modifications that would require changes to the financial assurance cost estimates. As such, Part R on FDEP Form 62-701.900(1) has been marked as "No Change".

4 GEOTECHNICAL DESIGN

4.1 Overview

This section presents a summary of the geotechnical engineering design evaluations prepared in support of the proposed liner and leachate collection system (LCS) geometry, revisions for Cells 11, 12, and 13 at the JED facility. The modified LCS includes revisions to the design liner system grades such that the slope of the LCS pipe corridors under the top deck areas are reduced from 1.0% to 0.5% and the liner system (floor area of cells that drain to the LCS pipe corridors) are reduced from 2.0% to 1.5% for Cell 11 and from 2.0% to 1.4% for Cells 12 and 13. Due to the proposed modifications to the LCS grades for Cells 11-13, Geosyntec has evaluated the resulting bearing capacity (Section 4.2), settlement (Section 4.3), and slope stability (Section 4.4) based on the requirements of Rules 62-701.400(2) and 62-701.410(2)(e), F.A.C.

4.2 Bearing Capacity

Bearing capacity calculations were most recently provided in Appendix F of the 2007 Vertical Expansion Permit Application (Geosyntec, 2007). In this analysis, a worst-case loading scenario was assumed to evaluate the factor of safety (FS) against bearing capacity failure. The bearing capacity analysis was conservatively performed by assuming that the load due to the landfill at final build-out (i.e., at elevation 330 ft) acts uniformly across the minimum width of the landfill. Because the maximum waste fill elevation is not proposed to change, the loading assumptions are representative of those anticipated for the revised configuration of Cells 11-13. In addition, the minimum landfill width was assumed to be 1,430 ft in the previous bearing capacity calculations (Geosyntec, 2007), whereas the minimum width for the Cells 11-13 area is approximately 2,400 ft. As such, the FS against bearing capacity failure will remain at least 14.5 as calculated for the 2007 Vertical Expansion Permit Application (Geosyntec, 2007). A FS of 3 or higher is typically considered acceptable

4.3 Subgrade Settlement

Due to the proposed changes in the base slopes and leachate pipe corridor inclination, total and differential subgrade settlements were evaluated for representative critical sections as part of the foundation analysis in accordance with Rule 62-701.410(2)(e)2, F.A.C. A one-dimensional settlement analysis was performed to estimate the total settlement at each end of the critical sections taking into consideration the thickness of the compacted subgrade fill, bottom liner system, waste, and the final cover system. The corresponding settlement calculations are included in **Attachment 4**. The results of the settlement analyses were used to evaluate the impact of anticipated settlements on the performance of the LCS and the proposed liner system.

Based on the results of the settlement analysis presented in **Attachment 4**, the post-settlement slopes of the base grades for Cells 11-13 are calculated to be greater than 1.0 percent while the post-settlement slopes of the leachate collection and leak detection pipes in Cells 11-13 are calculated to be greater than 0.3 percent. Accordingly, the base grades and leachate collection and leak detection system pipe corridor inclination have been designed to meet the minimum requirements of Rule 62-701.400(4)(c), F.A.C. In addition, the strain induced on the geomembrane component of the liner system was calculated to be essentially negligible.

4.4 Slope Stability

The proposed design modifications discussed herein include changes to the cell floor configurations for Cells 11-13, while the side slope inclination and the maximum height of the landfill are to be maintained. While the resulting FS against slope failure is not expected to be impacted by the proposed changes to Cells 11-13 of the JED facility, slope stability analyses were nevertheless performed to quantify the FS against slope failure for the proposed configuration. The stability analyses performed and the results of the analyses are presented in **Attachment 5**.

The slope stability analyses evaluated circular (rotational) and non-circular shear failure surfaces within the waste mass and the foundation soils. In addition, slope stability analysis of non-circular (block) shear failure surfaces through the waste mass and along the bottom liner system was performed.

As required by Rule 62-701.400(2), F.A.C., landfills must be designed to achieve a minimum FS of 1.5 using peak strength values to prevent failures of side slopes and deep-seated failures. Based on the results of the slope stability analyses presented in **Attachment 5**, the minimum FS for the proposed landfill configuration met or exceeded 1.5. In addition, the minimum required peak interface friction angle required to achieve a minimum FS of 1.5 is calculated to be 11.3 degrees. By comparison, the previously calculated minimum required peak interface friction angle was 11.6 degrees. As such, no change to the specified interface friction angle requirements is proposed. It is noted that the minimum required peak interface friction angle (of 11.6 degrees) is incorporated into Section 02790 of the currently approved Technical Specifications, which were provided to FDEP as part of the 2007 Vertical Expansion Permit Application (Geosyntec, 2007).

5 LEACHATE MANAGEMENT SYSTEM

5.1 Description

The leachate management system consists of primary and secondary leachate collection and removal systems in each cell, a leachate transmission pipeline, and flexible leachate storage containers. In Cells 11-13, the liner system in each cell is sloped such that leachate drains towards a central leachate collection pipe and ultimately to a single low point (i.e., sump) located along the perimeter of the landfill. The elevation of the liner subgrade is above the seasonal high ground water level except in the sump areas. As currently approved, sump construction will place the bottom of the sumps 2 to 3 feet below the elevation of the seasonal high water level. As such, Omni will attempt to schedule construction of the sump area during periods of low ground water level. Otherwise, the sump area will be dewatered during construction. After construction, the liner system will be held in place by the weight of the protective cover soil and LCS gravel.

The proposed base grade modifications will maintain the general configuration of the currently approved liner and LCS in Cells 11-13. However, as described in Section 4, the design slopes of the liner system and portions of LCS pipe corridors are proposed to be reduced.

5.2 Geocomposite Design

Because the design slope inclination and corresponding drainage lengths of the LCS are proposed to be modified, calculations were performed to evaluate the required primary geocomposite transmissivity needed to limit the leachate head to no more than 1 ft above the primary geomembrane, in accordance with Rule 62-701.400(3)(c)1, F.A.C.. Likewise, calculations were performed to evaluate the required secondary geocomposite transmissivity needed to limit the leachate head on the secondary geomembrane to the thickness of the secondary drainage geocomposite, in accordance with Rule 62-701.400(3)(c)2, F.A.C. Design calculations for the geocomposite component of the modified LCS are provided in **Attachment 6**. Due to the revised geocomposite transmissivity requirements presented in **Attachment 6**, the geocomposite Technical Specification has been revised and is provided in **Attachment 7**.

5.3 Leachate Removal and Transmission Design

The components of the leachate removal system include the leachate sump pumps and the associated fittings and piping. The transmission system consists of piping used to convey the leachate from the sumps to the leachate storage facility.

Each cell will be equipped with three submersible leachate pumps. Two pumps are dedicated to the removal of leachate from the primary LCS and the third pump will be dedicated to removing leachate collected from the secondary LCS (or leak detection system). Sump pump sizing requirements were based on the peak daily leachate generated from the largest cell (Cell 19 at 23.5 acres). The design flow rate was previously calculated, as part of the 2011 Lateral Expansion Permit Application (Geosyntec, 2011a), to be 121.4 gallons per minute (gpm). Based on the calculations provided in **Attachment 6** (see Tables 1a and 1b), the peak daily leachate generation rate is calculated to be 507 ft^3/acre/day and 496 ft^3/acre/day for Cell 11 and Cells 12 & 13, respectively. For Cell 11 (11.4 acres), the calculated design flow rate is 60 gpm when assuming a FS of 2. For Cells 12 and 13 (17.5 and 17.6 acres, respectively), the calculated design flow rate is 91 gpm when assuming a FS of 2. Based on these calculated design flow rates, the currently approved sump pump and leachate transmission pipe sizing remain suitable for the proposed modifications in Cells 11-13.

6 REFERENCES

Geosyntec Consultants (2007) "Major Modification Application for Vertical Expansion of the J.E.D. Solid Waste Management Facility (Phases 1-3)," received by FDEP on 18 September 2007.

Geosyntec Consultants (2011a) "Landfill Lateral Expansion – Application for a Major Permit Modification, J.E.D. Solid Waste Management Facility," received by FDEP on 18 February 2011.

Geosyntec Consultants (2011b) "Renewal Permit Application to Operate Phases 1 through 4 of the J.E.D. Solid Waste Management Facility," received by FDEP on 10 November 2011.

ATTACHMENT 1
FDEP FORM 62-701.900(1)

Florida Department of
Environmental Protection
Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

DEP Form #: 62-701.900(1), F.A.C.

Form Title: Application to Construct, Operate, Modify, or Close a Solid Waste Management Facility

Effective Date: August 12, 2012

Incorporated in Rule: 62-701.330(3), F.A.C.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPLICATION TO CONSTRUCT, OPERATE, MODIFY, OR CLOSE A SOLID WASTE MANAGEMENT FACILITY

APPLICATION INSTRUCTIONS AND FORMS

Northwest District	Northeast District	Central District	Southwest District	South District	Southeast District
160 Governmental Center	7777 Baymeadows Way West	3319 Maguire Boulevard	13051 North Telecom Pkwy	2295 Victoria Ave, Suite 364	400 North Congress Avenue
Suite 308	Suite 100	Suite 232	Temple Terrace, FL 33637	P.O. Box 2549	Suite 200
Pensacola, FL 32502-5794	Jacksonville, FL 32256-7590	Orlando, FL 32803-3767	813-632-7600	Fort Myers, FL 33901-3881	West Palm Beach, FL 33401
850-595-8300	904-256-1700	407-897-4100		239-344-5600	561-681-6600

INSTRUCTIONS TO APPLY FOR A SOLID WASTE MANAGEMENT FACILITY PERMIT

I. General

Solid Waste Management Facilities shall be permitted pursuant to Section 403.707, Florida Statutes (FS) and in accordance with Florida Administrative Code (FAC) Chapter 62-701. A minimum of four copies of the application shall be submitted to the appropriate Department office having jurisdiction over the facility. The appropriate fee in accordance with Rule 62-701.315, FAC, shall be submitted with the application by check made payable to the Department of Environmental Protection (DEP).

Complete appropriate sections for the type of facility for which application is made. Entries shall be typed or printed in ink. All blanks shall be filled in or marked "Not Applicable" or "No Substantial Change". Information provided in support of the application shall be marked "Submitted" and the location of this information in the application package indicated. The application shall include all information, drawings, and reports necessary to evaluate the facility. Information required to complete the application is listed on the attached pages of this form.

II. Application Parts Required for Construction and Operation Permits

A. Landfills and Ash Monofills - Submit Parts A through S
B. Asbestos Monofills - Submit Parts A, B, C, D, E, F, I, K, M, O through S
C. Industrial Solid Waste Disposal Facilities - Submit Parts A through S

NOTE: Portions of some Parts may not be applicable.

NOTE: For facilities that have been satisfactorily constructed in accordance with their construction permit, the information required for A, B and C type facilities does not have to be resubmitted for an operation permit if the information has not substantially changed during the construction period. The appropriate portion of the form should be marked "no substantial change".

III. Application Parts Required for Closure Permits

A. Landfills and Ash Monofills - Submit Parts A, B, L, N through S
B. Asbestos Monofills - Submit Parts A, B, M, O through S
C. Industrial Solid Waste Disposal Facilities - Submit Parts A, B, L through S

NOTE: Portions of some Parts may not be applicable.

IV. Permit Renewals

The above information shall be submitted at time of permit renewal in support of the new permit. However, facility information that was submitted to the Department to support the expiring permit, and which is still valid, does not need to be re-submitted for permit renewal. Portions of the application not re-submitted shall be marked "no substantial change" on the application form.

V. Application Codes

S	-	Submitted
LOCATION	-	Physical location of information in application
N/A	-	Not Applicable
N/C	-	No Substantial Change

VI. Listing of Application Parts

PART A: GENERAL INFORMATION

PART B: DISPOSAL FACILITY GENERAL INFORMATION

PART C: PROHIBITIONS

PART D: SOLID WASTE MANAGEMENT FACILITY PERMIT REQUIREMENTS, GENERAL

PART E: LANDFILL PERMIT REQUIREMENTS

PART F: GENERAL CRITERIA FOR LANDFILLS

PART G: LANDFILL CONSTRUCTION REQUIREMENTS

PART H: HYDROGEOLOGICAL INVESTIGATION REQUIREMENTS

PART I: GEOTECHNICAL INVESTIGATION REQUIREMENTS

PART J: VERTICAL EXPANSION OF LANDFILLS

PART K: LANDFILL OPERATION REQUIREMENTS

PART L: WATER QUALITY AND LEACHATE MONITORING REQUIREMENTS

PART M: SPECIAL WASTE HANDLING REQUIREMENTS

PART N: GAS MANAGEMENT SYSTEM REQUIREMENTS

PART O: LANDFILL CLOSURE REQUIREMENTS

PART P: OTHER CLOSURE PROCEDURES

PART Q: LONG-TERM CARE

PART R: FINANCIAL ASSURANCE

PART S: CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
APPLICATION FOR A PERMIT TO CONSTRUCT, OPERATE, MODIFY OR CLOSE A SOLID WASTE MANAGEMENT FACILITY

Please Type or Print

PART A. GENERAL INFORMATION

1. Type of disposal facility (check all that apply):
   - ☑ Class I Landfill
   - ☐ Ash Monofill
   - ☐ Class III Landfill
   - ☐ Asbestos Monofill
   - ☐ Industrial Solid Waste
   - ☐ Other (describe):

____

____

____

NOTE: Waste Processing Facilities should apply on Form 62-701.900(4), FAC;
Yard Trash Disposal Facilities should notify on Form 62-701.900(3), FAC;
Compost Facilities should apply on Form 62-709.901(1), FAC; and
C&D Disposal Facilities should apply on Form 62-701.900(6), FAC

2. Type of application:
   - ☑ Construction
   - ☐ Operation
   - ☐ Construction/Operation
   - ☐ Closure
   - ☐ Long-term Care Only

3. Classification of application:
   - ☐ New
   - ☐ Substantial Modification
   - ☐ Renewal
   - ☑ Intermediate Modification
   - ☐ Minor Modification

4. Facility name: J.E.D. Solid Waste Management Facility

5. DEP ID number: 89544 (WACS) County: Osceola

6. Facility location (main entrance):
   1501 Omni Way, St. Cloud, FL 34773

7. Location coordinates:

   Section: 11,13,14,17, & 18 Township: 28S Range: 32E & 33E

   Latitude: 28 ° 3 ' 32 " Longitude: 81 ° 5 ' 46 "

   Datum: WGS84 Coordinate method: DGPS

   Collected by: Johnston's Surveying Company/Affiliation: Johnston's Surveying

8. Applicant name (operating authority): Omni Waste of Osceola County, LLC

Mailing address: 1501 Omni Way | St. Cloud | FL | 34773
Street or P.O. Box | City | State | Zip

Contact person: Michael Kaiser Telephone: (904) 673-0446

Title: Southeast Region Engineer

michael.kaiser@progressivewaste.com
E-Mail address (if available)

9. Authorized agent/Consultant: Geosyntec Consultants

Mailing address: 13101 Telecom Drive, Suite 120 | Temple Terrace | FL | 33637
Street or P.O. Box | City | State | Zip

Contact person: Craig R. Browne, P.E. Telephone: (813) 558-0990

Title: Senior Engineer

cbrowne@geosyntec.com
E-Mail address (if available)

10. Landowner (if different than applicant): N/A

Mailing address: ____________________
Street or P.O. Box | City | State | Zip

Contact person: ____________________ Telephone: (_____) ____________

____
E-Mail address (if available)

11. Cities, towns, and areas to be served:
Primarily Osceola, Brevard, Indian River, Okeechobee, Orange, Polk, Volusia, Sumter, Lake, Seminole, Pasco, Hillsborough, Hardee, and Highlands Counties. Other Florida counties are served as waste streams are available.

12. Population to be served:
Current: 5,870,000 (approx.) Five-Year Projection: 6,240,000 (approx.)

13. Date site will be ready to be inspected for completion: N/A

14. Expected life of the facility: 20 years

15. Estimated costs: (Estimated costs correspond to construction of Cells 11 through 13 and closure of Phases 1 through 4 - excluding the 43.2-acre partially closed area)

Total Construction: $ 16,200,000 Closing Costs: $ 7,800,000

16. Anticipated construction starting and completion dates:
From: December 2014 To: December 2018

17. Expected volume or weight of waste to be received:
__________ yds^3/day 6,000 tons/day __________ gallons/day

PART B. DISPOSAL FACILITY GENERAL INFORMATION

1. Provide brief description of disposal facility design and operations planned under this application:
This application is being submitted to revise the design grades for the liner and leachate collection system within Cells 11 - 13.

2. Facility site supervisor: Dave Collins
Title: Landfill Manager Telephone: (407) 891-3720
david.collins@progressivewaste.com
E-Mail address (if available)

3. Disposal area: Total acres: 360 Used acres: 125 Available acres: 235

4. Weighing scales used: ☑ Yes ☐ No

5. Security to prevent unauthorized use: ☑ Yes ☐ No

6. Charge for waste received: ________ $/yds³ 35 $/ton

7. Surrounding land use, zoning:

☐ Residential	☐ Industrial
☑ Agricultural	☐ None
☐ Commercial	☐ Other (describe):

8. Types of waste received:

☑ Household	☑ C & D debris
☑ Commercial	☑ Shredded/cut tires
☑ Incinerator/WTE ash	☐ Yard trash
☑ Treated biomedical	☐ Septic tank
☑ Water treatment sludge	☑ Industrial
☐ Air treatment sludge	☑ Industrial sludge
☐ Agricultural	☑ Domestic sludge
☑ Asbestos	☑ Other (describe):

Waste tires and industrial liquid waste for solidification.

9. Salvaging permitted: ☐ Yes ☑ No

10. Attendant: ☑ Yes ☐ No — Trained operator: ☑ Yes ☐ No

11. Trained spotters: ☑ Yes ☐ No — Number of spotters used: Minimum of 1 per work face

12. Site located in: ☑ Floodplain ☑ Wetlands ☐ Other (describe):

13. Days of operation: Monday thru Sunday

14. Hours of operation: Mon-Fri: 5am to 4pm, Sat: 6am to 12pm, Sun: 6am to 10am

15. Days working face covered: each working day

16. Elevation of water table: 79 ft. Datum Used: NGVD 29

17. Number of monitoring wells: 68

18. Number of surface monitoring points: 2

19. Gas controls used: ☑ Yes ☐ No — Type controls: ☑ Active ☐ Passive

Gas flaring: ☑ Yes ☐ No — Gas recovery: ☑ Yes ☐ No

20. Landfill unit liner type:

- ☐ Natural soils
- ☐ Single clay liner
- ☐ Single geomembrane
- ☐ Single composite
- ☐ Slurry wall
- ☐ Double geomembrane
- ☑ Geomembrane & composite (Cells 5 thru 23)
- ☑ Double composite (Cells 1 thru 4)
- ☐ None
- ☑ Other (describe):

A GCL layer is provided below primary geomembrane liner in the sump area in Cells 5 through 23.

21. Leachate collection method:

- ☑ Collection pipes
- ☑ Geonets (geocomposite)
- ☐ Well points
- ☐ Perimeter ditch
- ☐ Double geomembrane
- ☐ Gravel layer
- ☐ Interceptor trench
- ☐ None
- ☑ Other (describe):

Sand layer above the geocomposite.

22. Leachate storage method:

- ☐ Tanks
- ☑ Surface impoundments with flexible storage containers
- ☐ Other (describe):

23. Leachate treatment method:

- ☑ Oxidation
- ☐ Chemical treatment
- ☐ Secondary
- ☐ Settling
- ☐ Advanced
- ☐ None
- ☑ Other (describe):

Oxidation performed through aeration in one of the three leachate storage area cells.

24. Leachate disposal method:

- ☑ Recirculated
- ☐ Pumped to WWTP
- ☑ Transported to WWTP
- ☐ Discharged to surface water/wetland
- ☐ Injection well
- ☐ Percolation ponds
- ☐ Evaporation
- ☐ Spray irrigation
- ☐ Other (describe):

25. For leachate discharged to surface waters:

Name and Class of receiving water:

N/A

26. Storm Water:

Collected: ☑ Yes ☐ No

Type of treatment:

Dry and wet retention for landfill and dry retention for access road.

Name and Class of receiving water:

Bull Creek, Class III

27. Environmental Resources Permit (ERP) number or status:

Current ERP Numbers are ERP49-0199752-001-EI (Phase 1 Individual), ERP49-0199752-002-EI (Conceptual), ERP-49-0199752-003-EI (Phase 2 Individual), ERP49-0199752-004-EM (Phase 3 Individual), ERP-49-0199752-006-EM (Conceptual Permit Mod.), ERP-49-0199752-007-EM (Leachate Storage Facility), ERP-49-0199752-008 (Leachate Storage Facility Mod.).

PART C. PROHIBITIONS (62-701.300, FAC)

LOCATION

S ☐ ____________ N/A ☐ N/C ☑ 1. Provide documentation that each of the siting criteria will be satisfied for the facility; (62-701.300(2), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 2. If the facility qualifies for any of the exemptions contained in Rules 62-701.300(12) through (18), FAC, then document this qualification(s);

S ☐ ____________ N/A ☐ N/C ☑ 3. Provide documentation that the facility will be in compliance with the burning restrictions; (62-701.300(3), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 4. Provide documentation that the facility will be in compliance with the hazardous waste restrictions; (62-701.300(4), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 5. Provide documentation that the facility will be in compliance with the PCB disposal restrictions; (62-701.300(5), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 6. Provide documentation that the facility will be in compliance with the biomedical waste restrictions; (62-701.300(6), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 7. Provide documentation that the facility will be in compliance with the Class I surface water restrictions; (62-701.300(7), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 8. Provide documentation that the facility will be in compliance with the special waste for landfills restrictions; (62-701.300(8), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 9. Provide documentation that the facility will be in compliance with the liquid restrictions; (62-701.300(10), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 10. Provide documentation that the facility will be in compliance with the used oil and oily waste restrictions; (62-701.300(11), FAC)

PART D. SOLID WASTE MANAGEMENT FACILITY PERMIT REQUIREMENTS, GENERAL (62-701.320, FAC)

LOCATION

S ☑ Attached N/A ☐ N/C ☐ 1. Four copies, at minimum, of the completed application form, all supporting data and reports; (62-701.320(5)(a), FAC)

S ☑ Report & Attachments N/A ☐ N/C ☐ 2. Engineering and/or professional certification (signature, date, and seal) provided on the applications and all engineering plans, reports, and supporting information for the application; (62-701.320(6), FAC)

S ☑ Attached Letter N/A ☐ N/C ☐ 3. A letter of transmittal to the Department; (62-701.320(7)(a), FAC)

LOCATION | **PART D CONTINUED**

LOCATION				
S ☑	Attachment 1	N/A ☐	N/C ☐	4. A completed application form dated and signed by the applicant; (62-701.320(7)(b), FAC)
S ☑	Attached	N/A ☐	N/C ☐	5. Permit fee specified in Rule 62-701.315, FAC in check or money order, payable to the Department; (62-701.320(7)(c), FAC)
S ☑	Report	N/A ☐	N/C ☐	6. An engineering report addressing the requirements of this rule and with the following format: a cover sheet, text printed on 8 ½ inch by 11 inch consecutively numbered pages, a table of contents or index, the body of the report and all appendices including an operation plan, contingency plan, illustrative charts and graphs, records or logs of tests and investigations, engineering calculations; (62-701.320(7)(d), FAC)
S ☐		N/A ☐	N/C ☑	7. Operation Plan and Closure Plan; (62-701.320(7)(e)1, FAC)
S ☐		N/A ☐	N/C ☑	8. Contingency Plan; (62-701.320(7)(e)2, FAC)
S ☑	Attachment 2	N/A ☐	N/C ☐	9. Plans or drawings for the solid waste management facilities in appropriate format (including sheet size restrictions, cover sheet, legends, north arrow, horizontal and vertical scales, elevations referenced to NGVD 1929) showing: (62-701.320(7)(f), FAC)
S ☐		N/A ☐	N/C ☑	a. A regional map or plan with the project location in relation to major roadways and population centers;
S ☐		N/A ☐	N/C ☑	b. A vicinity map or aerial photograph no more than one year old showing the facility site and relevant surface features located within 1000 feet of the facility;
S ☐		N/A ☐	N/C ☑	c. A site plan showing all property boundaries certified by a Florida Licensed Professional Surveyor and Mapper;
S ☑	Attachment 2	N/A ☐	N/C ☐	d. Other necessary details to support the engineering report, including referencing elevations to a consistent, nationally recognized datum, and identifying the method used for collecting latitude and longitude data;
S ☐		N/A ☐	N/C ☑	10. Documentation that the applicant either owns the property or has legal authority from the property owner to use the site; (62-701.320(7)(g), FAC)
S ☐		N/A ☑	N/C ☐	11. For facilities owned or operated by a county, provide a description of how, if any, the facilities covered in this application will contribute to the county's achievement of the waste reduction and recycling goals contained in Section 403.706, FS; (62-701.320(7)(h), FAC)

LOCATION **PART D CONTINUED**

S ☐ ____________ N/A ☐ N/C ☑ 12. Provide a history and description of any enforcement actions taken by the Department against the applicant for violations of applicable statutes, rules, orders, or permit conditions relating to the operation of any solid waste management facility in the state; (62-701.320(7)(i), FAC)

S ☐ ____________ N/A ☑ N/C ☐ 13. Proof of publication in a newspaper of general circulation of notice of application for a permit to construct or substantially modify a solid waste management facility; (62-701.320(8), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 14. Provide a description of how the requirements for airport safety will be achieved, including proof of required notices if applicable. If exempt, explain how the exemption applies; (62-701.320(13), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 15. Explain how the operator and spotter training requirements and special criteria will be satisfied for the facility; (62-701.320(15), FAC)

PART E. LANDFILL PERMIT REQUIREMENTS (62-701.330, FAC)

LOCATION

S ☐ ____________ N/A ☐ N/C ☑ 1. Regional map or aerial photograph no more than five years old showing all airports that are located within five miles of the proposed landfill; (62-701.330(3)(a), FAC)

S ☑ Attachment 2 N/A ☐ N/C ☐ 2. Plot plan with a scale not greater than 200 feet to the inch showing: (62-701.330(3)(b), FAC)

S ☑ Attachment 2 N/A ☐ N/C ☐ a. Dimensions;

S ☐ ____________ N/A ☐ N/C ☑ b. Locations of proposed and existing water quality monitoring wells;

S ☐ ____________ N/A ☐ N/C ☑ c. Locations of soil borings;

S ☑ Attachment 2 N/A ☐ N/C ☐ d. Proposed plan of trenching or disposal areas;

S ☑ Attachment 2 N/A ☐ N/C ☐ e. Cross sections showing original elevations and proposed final contours which shall be included either on the plot plan or on separate sheets;

S ☑ Attachment 2 N/A ☐ N/C ☐ f. Any previously filled waste disposal areas;

S ☐ ____________ N/A ☐ N/C ☑ g. Fencing or other measures to restrict access;

LOCATION			PART E CONTINUED
S ☑	Attachment 2	N/A ☐ N/C ☐	3. Topographic maps with a scale not greater than 200 feet to the inch with five foot contour intervals showing: (62-701.330(3)(c), FAC)
S ☑	Attachment 2	N/A ☐ N/C ☐	a. Proposed fill areas;
S ☐		N/A ☐ N/C ☑	b. Borrow areas;
S ☐		N/A ☐ N/C ☑	c. Access roads;
S ☐		N/A ☐ N/C ☑	d. Grades required for proper drainage;
S ☐		N/A ☐ N/C ☑	e. Cross sections of lifts;
S ☐		N/A ☐ N/C ☑	f. Special drainage devices if necessary;
S ☐		N/A ☐ N/C ☑	g. Fencing;
S ☐		N/A ☐ N/C ☑	h. Equipment facilities;
S ☑	Report Sect. 3.6	N/A ☐ N/C ☐	4. A report on the landfill describing the following: (62-701.330(3)(d), FAC)
S ☐		N/A ☐ N/C ☑	a. The current and projected population and area to be served by the proposed site;
S ☐		N/A ☐ N/C ☑	b. The anticipated type, annual quantity, and source of solid waste expressed in tons;
S ☑	Report Sect. 3.6	N/A ☐ N/C ☐	c. Planned active life of the facility, the final design height of the facility, and the maximum height of the facility during its operation;
S ☐		N/A ☐ N/C ☑	d. The source and type of cover material used for the landfill;
S ☐		N/A ☐ N/C ☑	5. Provide evidence that an approved laboratory shall conduct water quality monitoring for the facility in accordance with Chapter 62-160, FAC; (62-701.330(3)(g), FAC
S ☐		N/A ☐ N/C ☑	6. Provide a statement of how the applicant will demonstrate financial responsibility for the closing and long-term care of the landfill; (62-701.330(3)(h), FAC)

PART F. GENERAL CRITERIA FOR LANDFILLS (62-701.340, FAC)

LOCATION

S ☐ ____________ N/A ☐ N/C ☑ 1. Describe (and show on a Federal Insurance Administration flood map, if available) how the landfill or solid waste disposal unit shall not be located in the 100 year floodplain where it will restrict the flow of the 100 year flood, reduce the temporary water storage capacity of the floodplain unless compensating storage is provided, or result in a washout of solid waste; (62-701.340(3)(b), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 2. Describe how the minimum horizontal separation between waste deposits in the landfill and the landfill property boundary shall be 100 feet, measured from the toe of the proposed final cover slope; (62-701.340(3)(c), FAC)

PART G. LANDFILL CONSTRUCTION REQUIREMENTS (62-701.400, FAC)

LOCATION

S ☑ Report & Attach. 5 N/A ☐ N/C ☐ 1. Describe how the landfill shall be designed so the solid waste disposal units will be constructed and closed at planned intervals throughout the design period of the landfill, and shall be designed to achieve a minimum factor of safety of 1.5 using peak strength values to prevent failures of side slopes and deep-seated failures; (62-701.400(2), FAC)

S ☐ ____________ N/A ☐ N/C ☐ 2. Landfill liner requirements; (62-701.400(3), FAC)

S ☑ Report N/A ☐ N/C ☐ a. General construction requirements; (62-701.400(3)(a), FAC)

S ☐ ____________ N/A ☐ N/C ☑ (1) Provide test information and documentation to ensure the liner will be constructed of materials that have appropriate physical, chemical, and mechanical properties to prevent failure;

S ☑ Report & Attach. 5 N/A ☐ N/C ☐ (2) Document foundation is adequate to prevent liner failure;

S ☐ ____________ N/A ☐ N/C ☑ (3) Constructed so bottom liner will not be adversely impacted by fluctuations of the ground water;

S ☐ ____________ N/A ☐ N/C ☑ (4) Designed to resist hydrostatic uplift if bottom liner located below seasonal high ground water table;

S ☐ ____________ N/A ☐ N/C ☑ (5) Installed to cover all surrounding earth which could come into contact with the waste or leachate;

LOCATION	PART G CONTINUED
S ☐ ____ N/A ☑ N/C ☐	b. Composite liners; (62-701.400(3)(b), FAC)
S ☐ ____ N/A ☑ N/C ☐	(1) Upper geomembrane thickness and properties;
S ☐ ____ N/A ☑ N/C ☐	(2) Design leachate head for primary leachate collection and removal system (LCRS) including leachate recirculation if appropriate;
S ☐ ____ N/A ☑ N/C ☐	(3) Design thickness in accordance with Table A and number of lifts planned for lower soil component;
S ☑ Report N/A ☐ N/C ☐	c. Double liners; (62-701.400(3)(c), FAC)
S ☐ ____ N/A ☐ N/C ☑	(1) Upper and lower geomembrane thickness and properties;
S ☑ Report & Attach. 6 N/A ☐ N/C ☐	(2) Design leachate head for primary LCRS to limit the head to one foot above the liner;
S ☐ ____ N/A ☐ N/C ☑	(3) Lower geomembrane sub-base design;
S ☑ Report & Attach. 6 N/A ☐ N/C ☐	(4) Leak detection and secondary leachate collection system minimum design criteria (k ≥ 10 cm/sec, head on lower liner ≤ 1 inch, head not to exceed thickness of drainage layer);
S ☑ Report N/A ☐ N/C ☐	d. Standards for geosynthetic components; (62-701.400(3)(d), FAC)
S ☐ ____ N/A ☐ N/C ☑	(1) Factory and field seam test methods to ensure all geomembrane seams achieve the minimum specifications;
S ☐ ____ N/A ☐ N/C ☑	(2) Geomembranes to be used shall pass a continuous spark test by the manufacturer;
S ☐ ____ N/A ☐ N/C ☑	(3) Design of 24-inch-thick protective layer above upper geomembrane liner;
S ☐ ____ N/A ☐ N/C ☑	(4) Describe operational plans to protect the liner and leachate collection system when placing the first layer of waste above a 24-inch-thick protective layer;
S ☐ ____ N/A ☐ N/C ☑	(5) HDPE geomembranes, if used, meet the specifications in GRI GM13, and LLDPE geomembranes, if used, meet the specifications in GRI GM17;
S ☐ ____ N/A ☑ N/C ☐	(6) PVC geomembranes, if used, meet the specifications in PGI 1104;

LOCATION		PART G CONTINUED
S ☐ ______ N/A ☐ N/C ☑	(7)	Interface shear strength testing results of the actual components which will be used in the liner system;
S ☑ Report & Attach. 7 N/A ☐ N/C ☐	(8)	Transmissivity testing results of geonets if they are used in the liner system;
S ☐ ______ N/A ☐ N/C ☑	(9)	Hydraulic conductivity testing results of geosynthetic clay liners if they are used in the liner system;
S ☑ Report & Attach. 7 N/A ☐ N/C ☐	e.	Geosynthetic specification requirements; (62-701.400(3)(e), FAC)
S ☐ ______ N/A ☐ N/C ☑	(1)	Definition and qualifications of the designer, manufacturer, installer, QA consultant and laboratory, and QA program;
S ☑ Report & Attach. 7 N/A ☐ N/C ☐	(2)	Material specifications for geomembranes, geocomposites, geotextiles, geogrids, and geonets;
S ☐ ______ N/A ☐ N/C ☑	(3)	Manufacturing and fabrication specifications including geomembrane raw material and roll QA, fabrication personnel qualifications, seaming equipment and procedures, overlaps, trial seams, destructive and non-destructive seam testing, seam testing location, frequency, procedure, sample size, and geomembrane repairs;
S ☐ ______ N/A ☐ N/C ☑	(4)	Geomembrane installation specifications including earthwork, conformance testing, geomembrane placement, installation personnel qualifications, field seaming and testing, overlapping and repairs, materials in contact with geomembranes, and procedures for lining system acceptance;
S ☐ ______ N/A ☐ N/C ☑	(5)	Geotextile and geogrids specifications including handling and placement, conformance testing, seams and overlaps, repair, and placement of soil materials and any overlying materials;
S ☑ Report & Attach. 7 N/A ☐ N/C ☐	(6)	Geonet and geocomposites specifications including handling and placement, conformance testing, stacking and joining, repair, and placement of soil materials and any overlying materials;
S ☐ ______ N/A ☐ N/C ☑	(7)	Geosynthetic clay liner specifications including handling and placement, conformance testing, seams and overlaps, repair, and placement of soil materials and any overlying materials;

LOCATION		PART G CONTINUED
S ☐ ____________ N/A ☑ N/C ☐		f. Standards for soil liner components; (62-701.400(3)(f), FAC)
S ☐ ____________ N/A ☑ N/C ☐	(1)	Description of construction procedures including over-excavation and backfilling to preclude structural inconsistencies and procedures for placing and compacting soil components in layers;
S ☐ ____________ N/A ☑ N/C ☐	(2)	Demonstration of compatibility of the soil component with actual or simulated leachate in accordance with EPA Test Method 9100, or an equivalent test method;
S ☐ ____________ N/A ☑ N/C ☐	(3)	Procedures for testing in situ soils to demonstrate they meet the specifications for soil liners;
S ☐ ____________ N/A ☑ N/C ☐	(4)	Specifications for soil component of liner including at a minimum:
S ☐ ____________ N/A ☑ N/C ☐		(a) Allowable particle size distribution, and Atterberg limits including shrinkage limit;
S ☐ ____________ N/A ☑ N/C ☐		(b) Placement moisture and dry density criteria;
S ☐ ____________ N/A ☑ N/C ☐		(c) Maximum laboratory-determined saturated hydraulic conductivity using simulated leachate;
S ☐ ____________ N/A ☑ N/C ☐		(d) Minimum thickness of soil liner;
S ☐ ____________ N/A ☑ N/C ☐		(e) Lift thickness;
S ☐ ____________ N/A ☑ N/C ☐		(f) Surface preparation (scarification);
S ☐ ____________ N/A ☑ N/C ☐		(g) Type and percentage of clay mineral within the soil component;
S ☐ ____________ N/A ☑ N/C ☐	(5)	Procedures for constructing and using a field test section to document the desired saturated hydraulic conductivity and thickness can be achieved in the field;
S ☐ ____________ N/A ☑ N/C ☐		g. If a Class III landfill is to be constructed with a bottom liner system, provide a description of how the minimum requirements for the liner will be achieved;

LOCATION				PART G CONTINUED
S ☑	Report Sect. 5	N/A ☐	N/C ☐	3. Leachate collection and removal system (LCRS); (62-701.400(4), FAC)
S ☐		N/A ☐	N/C ☑	a. The primary and secondary LCRS requirements; (62-701.400(4)(a), FAC)
S ☐		N/A ☐	N/C ☑	(1) Constructed of materials chemically resistant to the waste and leachate;
S ☐		N/A ☐	N/C ☑	(2) Have sufficient mechanical properties to prevent collapse under pressure;
S ☐		N/A ☐	N/C ☑	(3) Have granular material or synthetic geotextile to prevent clogging;
S ☐		N/A ☐	N/C ☑	(4) Have a method for testing and cleaning clogged pipes or contingent designs for reducing leachate around failed areas;
S ☑	Report	N/A ☐	N/C ☐	b. Other LCRS requirements; (62-701.400(4)(b) and (c), FAC
S ☐		N/A ☐	N/C ☑	(1) Bottom 12 inches having hydraulic conductivity $\geq 1 \times 10^{3}$ cm/sec;
S ☐		N/A ☐	N/C ☑	(2) Total thickness of 24 inches of material chemically resistant to the waste and leachate;
S ☑	Report & Attach. 4	N/A ☐	N/C ☐	(3) Bottom slope design to accommodate for predicted settlement and still meet minimum slope requirements;
S ☐		N/A ☐	N/C ☑	(4) Demonstration that synthetic drainage material, if used, is equivalent or better than granular material in chemical compatibility, flow under load, and protection of geomembranes liner;
S ☐		N/A ☐	N/C ☑	4. Leachate recirculation; (62-701.400(5), FAC)
S ☐		N/A ☐	N/C ☑	a. Describe general procedures for recirculating leachate;
S ☐		N/A ☐	N/C ☑	b. Describe procedures for controlling leachate runoff and minimizing mixing of leachate runoff with storm water;
S ☐		N/A ☐	N/C ☑	c. Describe procedures for preventing perched water conditions and gas buildup;

LOCATION **PART G CONTINUED**

S ☐ ____________ N/A ☐ N/C ☑ d. Describe alternate methods for leachate management when it cannot be recirculated due to weather or runoff conditions, surface seeps, wind-blown spray, or elevated levels of leachate head on the liner;

S ☐ ____________ N/A ☐ N/C ☑ e. Describe methods of gas management in accordance with Rule 62-701.530, FAC;

S ☐ ____________ N/A ☐ N/C ☑ f. If leachate irrigation is proposed, describe treatment methods and standards for leachate treatment prior to irrigation over final cover, and provide documentation that irrigation does not contribute significantly to leachate generation;

S ☐ ____________ N/A ☐ N/C ☑ 5. Leachate storage tanks and leachate surface impoundments; (62-701.400(6), FAC)

S ☐ ____________ N/A ☐ N/C ☑ a. Surface impoundment requirements; (62-701.400(6)(b), FAC)

S ☐ ____________ N/A ☐ N/C ☑ (1) Documentation that the design of the bottom liner will not be adversely impacted by fluctuations of the ground water;

S ☐ ____________ N/A ☐ N/C ☑ (2) Designed in segments to allow for inspection and repair, as needed, without interruption of service;

S ☐ ____________ N/A ☐ N/C ☑ (3) General design requirements;

S ☐ ____________ N/A ☐ N/C ☑ (a) Double liner system consisting of an upper and lower 60-mil minimum thickness geomembrane;

S ☐ ____________ N/A ☐ N/C ☑ (b) Leak detection and collection system with hydraulic conductivity ≥ 1 cm/sec;

S ☐ ____________ N/A ☐ N/C ☑ (c) Lower geomembrane place on subbase ≥ 6 inches thick with $k \leq 1 \times 10^{-5}$ cm/sec or on an approved geosynthetic clay liner with $k \leq 1 \times 10^{-7}$ cm/sec;

S ☐ ____________ N/A ☐ N/C ☑ (d) Design calculation to predict potential leakage through the upper liner;

S ☐ ____________ N/A ☐ N/C ☑ (e) Daily inspection requirements, and notification and corrective action requirements if leakage rates exceed that predicted by design calculations;

S ☐ ____________ N/A ☐ N/C ☑ (4) Description of procedures to prevent uplift, if applicable;

LOCATION | **PART G CONTINUED**

S ☐ ______ N/A ☐ N/C ☑	(5) Design calculations to demonstrate minimum two feet of freeboard will be maintained;
S ☐ ______ N/A ☐ N/C ☑	(6) Procedures for controlling vectors and off-site odors;
S ☐ ______ N/A ☑ N/C ☐	b. Above-ground leachate storage tanks; (62-701.400(6)(c), FAC)
S ☐ ______ N/A ☑ N/C ☐	(1) Describe tank materials of construction and ensure foundation is sufficient to support tank;
S ☐ ______ N/A ☑ N/C ☐	(2) Describe procedures for cathodic protection for the tank, if needed;
S ☐ ______ N/A ☑ N/C ☐	(3) Describe exterior painting and interior lining of the tank to protect it from the weather and the leachate stored;
S ☐ ______ N/A ☑ N/C ☐	(4) Describe secondary containment design to ensure adequate capacity will be provided and compatibility of materials of construction;
S ☐ ______ N/A ☑ N/C ☐	(5) Describe design to remove and dispose of stormwater from the secondary containment system;
S ☐ ______ N/A ☑ N/C ☐	(6) Describe an overfill prevention system, such as level sensors, gauges, alarms, and shutoff controls to prevent overfilling;
S ☐ ______ N/A ☑ N/C ☐	(7) Inspections, corrective action, and reporting requirements;
S ☐ ______ N/A ☑ N/C ☐	(a) Weekly inspection of overfill prevention system;
S ☐ ______ N/A ☑ N/C ☐	(b) Weekly inspection of exposed tank exteriors;
S ☐ ______ N/A ☑ N/C ☐	(c) Inspection of tank interiors when tank is drained, or at least every three years;
S ☐ ______ N/A ☑ N/C ☐	(d) Procedures for immediate corrective action if failures detected;
S ☐ ______ N/A ☑ N/C ☐	(e) Inspection reports available for Department review;
S ☐ ______ N/A ☑ N/C ☐	c. Underground leachate storage tanks; (62-701.400(6)(d), FAC)

LOCATION **PART G CONTINUED**

S ☐ _____________ N/A ☑ N/C ☐ (1) Describe materials of construction;

S ☐ _____________ N/A ☑ N/C ☐ (2) A double-walled tank design system to be used with the following requirements:

S ☐ _____________ N/A ☑ N/C ☐ (a) Interstitial space monitoring at least weekly;

S ☐ _____________ N/A ☑ N/C ☐ (b) Corrosion protection provided for primary tank interior and external surface of outer shell;

S ☐ _____________ N/A ☑ N/C ☐ (c) Interior tank coatings compatible with stored leachate;

S ☐ _____________ N/A ☑ N/C ☐ (d) Cathodic protection inspected weekly and repaired as needed;

S ☐ _____________ N/A ☑ N/C ☐ (3) Describe an overfill prevention system, such as level sensors, gauges, alarms, and shutoff controls to prevent overfilling, and provide for weekly inspections;

S ☐ _____________ N/A ☑ N/C ☐ (4) Inspection reports available for Department review;

S ☐ _____________ N/A ☑ N/C ☐ d. Schedule provided for routine maintenance of LCRS; (62-701.400(6)(e), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 6. Liner systems construction quality assurance (CQA); (62-701.400(7), FAC)

S ☐ _____________ N/A ☐ N/C ☑ a. Provide CQA Plan including:

S ☐ _____________ N/A ☐ N/C ☑ (1) Specifications and construction requirements for liner system;

S ☐ _____________ N/A ☐ N/C ☑ (2) Detailed description of quality control testing procedures and frequencies;

S ☐ _____________ N/A ☐ N/C ☑ (3) Identification of supervising professional engineer;

S ☐ _____________ N/A ☐ N/C ☑ (4) Identify responsibility and authority of all appropriate organizations and key personnel involved in the construction project;

S ☐ _____________ N/A ☐ N/C ☑ (5) State qualifications of CQA professional engineer and support personnel;

LOCATION **PART G CONTINUED**

S ☐ ____________ N/A ☐ N/C ☑ (6) Description of CQA reporting forms and documents;

S ☐ ____________ N/A ☐ N/C ☑ b. An independent laboratory experienced in the testing of geosynthetics to perform required testing;

S ☐ ____________ N/A ☐ N/C ☑ 7. Soil liner CQA; (62-701.400(8), FAC)

S ☐ ____________ N/A ☐ N/C ☑ a. Documentation that an adequate borrow source has been located with test results, or description of the field exploration and laboratory testing program to define a suitable borrow source;

S ☐ ____________ N/A ☐ N/C ☑ b. Description of field test section construction and test methods to be implemented prior to liner installation;

S ☐ ____________ N/A ☐ N/C ☑ c. Description of field test methods, including rejection criteria and corrective measures to insure proper liner installation;

S ☐ ____________ N/A ☐ N/C ☑ 8. For surface water management systems at aboveground disposal units, provide documentation showing the design of any features intended to convey stormwater to a permitted or exempted treatment system; (62-701.400(9), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 9. Gas control systems; (62-701.400(10), FAC)

S ☐ ____________ N/A ☐ N/C ☑ a. Provide documentation that if the landfill is receiving degradable wastes, it will have a gas control system complying with the requirements of Rule 62-701.530, FAC;

S ☐ ____________ N/A ☑ N/C ☐ 10. For landfills designed in ground water, provide documentation that the landfill will provide a degree of protection equivalent to landfills designed with bottom liners not in contact with ground water; (62-701.400(11), FAC)

PART H. HYDROGEOLOGICAL INVESTIGATION REQUIREMENTS (62-701.410(1), FAC)

LOCATION

S ☐ ____________ N/A ☐ N/C ☑ 1. Submit a hydrogeological investigation and site report including at least the following information:

S ☐ ____________ N/A ☐ N/C ☑ a. Regional and site specific geology and hydrology;

S ☐ ____________ N/A ☐ N/C ☑ b. Direction and rate of ground water and surface water flow including seasonal variations;

LOCATION **PART H CONTINUED**

S ☐ _____________ N/A ☐ N/C ☑ c. Background quality of ground water and surface water;

S ☐ _____________ N/A ☐ N/C ☑ d. Any on-site hydraulic connections between aquifers;

S ☐ _____________ N/A ☐ N/C ☑ e. Site stratigraphy and aquifer characteristics for confining layers, semi-confining layers, and all aquifers below the landfill site that may be affected by the landfill;

S ☐ _____________ N/A ☐ N/C ☑ f. Description of topography, soil types, and surface water drainage systems;

S ☐ _____________ N/A ☐ N/C ☑ g. Inventory of all public and private water wells within a one mile radius of the landfill including, where available, well top of casing and bottom elevations, name of owner, age and usage of each well, stratigraphic unit screened, well construction technique, and static water level;

S ☐ _____________ N/A ☐ N/C ☑ h. Identify and locate any existing contaminated areas on the site;

S ☐ _____________ N/A ☐ N/C ☑ i. Include a map showing the locations of all potable wells within 500 feet of the waste storage and disposal areas;

S ☐ _____________ N/A ☐ N/C ☑ 2. Report signed, sealed, and dated by P.E. and/or P.G.;

PART I. GEOTECHNICAL INVESTIGATION REQUIREMENTS (62-701.410(2), FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. Submit a geotechnical site investigation report defining the engineering properties of the site including at least the following:

S ☐ _____________ N/A ☐ N/C ☑ a. Description of subsurface conditions including soil stratigraphy and ground water table conditions;

S ☐ _____________ N/A ☐ N/C ☑ b. Investigate for the presence of muck, previously filled areas, soft ground, lineaments, and sink holes;

S ☐ _____________ N/A ☐ N/C ☑ c. Estimates of average and maximum high water table across the site;

S ☐ _____________ N/A ☐ N/C ☑ d. Foundation analysis including:

S ☐ _____________ N/A ☐ N/C ☑ (1) Foundation bearing capacity analysis;

LOCATION **PART I CONTINUED**

S ☑ Report & Attach. 4 N/A ☐ N/C ☐ (2) Total and differential subgrade settlement analysis;

S ☑ Report & Attach. 5 N/A ☐ N/C ☐ (3) Slope stability analysis;

S ☐ ____________ N/A ☐ N/C ☑ e. Description of methods used in the investigation, and includes soil boring logs, laboratory results, analytical calculations, cross sections, interpretations, and conclusions;

S ☐ ____________ N/A ☐ N/C ☑ f. An evaluation of fault areas, seismic impact zones, and unstable areas as described in 40 CFR 258.13, 40 CFR 258.14, and 40 CFR 258.15;

S ☑ Report N/A ☐ N/C ☐ 2. Report signed, sealed, and dated by P.E. and/or P.G.;

PART J. VERTICAL EXPANSION OF LANDFILLS (62-701.430, FAC)

LOCATION

S ☐ ____________ N/A ☑ N/C ☐ 1. Describe how the vertical expansion shall not cause or contribute to leachate leakage from the existing landfill, shall not cause objectionable odors, or adversely affect the closure design of the existing landfill;

S ☐ ____________ N/A ☑ N/C ☐ 2. Describe how the vertical expansion over unlined landfills will meet the requirements of Rule 62-701.400, FAC with the exceptions of Rule 62-701.430(1)(c), FAC;

S ☐ ____________ N/A ☑ N/C ☐ 3. Provide foundation and settlement analysis for the vertical expansion;

S ☐ ____________ N/A ☑ N/C ☐ 4. Provide total settlement calculations demonstrating that the final elevations of the lining system, gravity drainage, and no other component of the design will be adversely affected;

S ☐ ____________ N/A ☑ N/C ☐ 5. Minimum stability factor of safety of 1.5 for the lining system component interface stability and for deep stability;

S ☐ ____________ N/A ☑ N/C ☐ 6. Provide documentation to show the surface water management system will not be adversely affected by the vertical expansion;

S ☐ ____________ N/A ☑ N/C ☐ 7. Provide gas control designs to prevent accumulation of gas under the new liner for the vertical expansion;

PART K. **LANDFILL OPERATION REQUIREMENTS** (62-701.500, FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. Provide documentation that the landfill will have at least one trained operator during operation and at least one trained spotter at each working face; (62-701.500(1), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 2. Provide a landfill operation plan including procedures for: (62-701.500(2), FAC)

S ☐ _____________ N/A ☐ N/C ☑ a. Designating responsible operating and maintenance personnel;

S ☐ _____________ N/A ☐ N/C ☑ b. Emergency preparedness and response, as required in subsection 62-701.320(16), FAC;

S ☐ _____________ N/A ☐ N/C ☑ c. Controlling types of waste received at the landfill;

S ☐ _____________ N/A ☐ N/C ☑ d. Weighing incoming waste;

S ☐ _____________ N/A ☐ N/C ☑ e. Vehicle traffic control and unloading;

S ☐ _____________ N/A ☐ N/C ☑ f. Method and sequence of filling waste;

S ☐ _____________ N/A ☐ N/C ☑ g. Waste compaction and application of cover;

S ☐ _____________ N/A ☐ N/C ☑ h. Operations of gas, leachate, and stormwater controls;

S ☐ _____________ N/A ☐ N/C ☑ i. Water quality monitoring;

S ☐ _____________ N/A ☐ N/C ☑ j. Maintaining and cleaning the leachate collection system;

S ☐ _____________ N/A ☐ N/C ☑ 3. Provide a description of the landfill operation record to be used at the landfill, details as to location of where various operational records will be kept (i.e. DEP permit, engineering drawings, water quality records, etc.); (62-701.500(3), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 4. Describe the waste records that will be compiled monthly and provided to the Department annually; (62-701.500(4), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 5. Describe methods of access control; (62-701.500(5), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 6. Describe load checking program to be implemented at the landfill to discourage disposal of unauthorized waste at the landfill; (62-701.500(6), FAC)

LOCATION | **PART K CONTINUED**

S ☐ ____________ N/A ☐ N/C ☑ 7. Describe procedures for spreading and compacting waste at the landfill that include: (62-701.500(7), FAC)

S ☐ ____________ N/A ☐ N/C ☑ a. Waste layer thickness and compaction frequencies;

S ☐ ____________ N/A ☐ N/C ☑ b. Special considerations for first layer of waste placed above the liner and leachate collection system;

S ☐ ____________ N/A ☐ N/C ☑ c. Slopes of cell working face and side grades above land surface, and planned lift depths during operation;

S ☐ ____________ N/A ☐ N/C ☑ d. Maximum width of working face;

S ☐ ____________ N/A ☐ N/C ☑ e. Description of type of initial cover to be used at the facility that controls:

S ☐ ____________ N/A ☐ N/C ☑ (1) Vector breeding/animal attraction;

S ☐ ____________ N/A ☐ N/C ☑ (2) Fires;

S ☐ ____________ N/A ☐ N/C ☑ (3) Odors;

S ☐ ____________ N/A ☐ N/C ☑ (4) Blowing litter;

S ☐ ____________ N/A ☐ N/C ☑ (5) Moisture infiltration;

S ☐ ____________ N/A ☐ N/C ☑ f. Procedures for applying initial cover, including minimum cover frequencies;

S ☐ ____________ N/A ☐ N/C ☑ g. Procedures for applying intermediate cover;

S ☐ ____________ N/A ☐ N/C ☑ h. Time frames for applying final cover;

S ☐ ____________ N/A ☐ N/C ☑ i. Procedures for controlling scavenging and salvaging;

S ☐ ____________ N/A ☐ N/C ☑ j. Description of litter policing methods;

S ☐ ____________ N/A ☐ N/C ☑ k. Erosion control procedures;

LOCATION | **PART K CONTINUED**

S ☐ ____________ N/A ☐ N/C ☑ 8. Describe operational procedures for leachate management including: (62-701.500(8), FAC)

S ☐ ____________ N/A ☐ N/C ☑ a. Leachate level monitoring;

S ☐ ____________ N/A ☐ N/C ☑ b. Operation and maintenance of leachate collection and removal system, and treatment as required;

S ☐ ____________ N/A ☐ N/C ☑ c. Procedures for managing leachate if it becomes regulated as a hazardous waste;

S ☐ ____________ N/A ☐ N/C ☑ d. Identification of treatment or disposal facilities that may be used for off-site discharge and treatment of leachate;

S ☐ ____________ N/A ☐ N/C ☑ e. Contingency plan for managing leachate during emergencies or equipment problems;

S ☐ ____________ N/A ☐ N/C ☑ f. Procedures for recording quantities of leachate generated in gal/day and including this in the operating record;

S ☐ ____________ N/A ☐ N/C ☑ g. Procedures for comparing precipitation experienced at the landfill with leachate generation rates and including this information in the operating record;

S ☐ ____________ N/A ☐ N/C ☑ h. Procedures for water pressure cleaning or video inspecting leachate collection systems;

S ☐ ____________ N/A ☐ N/C ☑ 9. Describe how the landfill receiving degradable wastes shall implement a gas management system meeting the requirements of Rule 62-701.530, FAC; (62-701.500(9), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 10. Describe procedures for operating and maintaining the landfill stormwater management system to comply with the requirements of Rule 62-701.400(9), FAC; (62-701.500(10), FAC)

S ☐ ____________ N/A ☐ N/C ☑ 11. Equipment and operation feature requirements; (62-701.500(11), FAC)

S ☐ ____________ N/A ☐ N/C ☑ a. Sufficient equipment for excavating, spreading, compacting, and covering waste;

S ☐ ____________ N/A ☐ N/C ☑ b. Reserve equipment or arrangements to obtain additional equipment within 24 hours of breakdown;

S ☐ ____________ N/A ☐ N/C ☑ c. Communications equipment;

LOCATION **PART K CONTINUED**

S ☐ _____________ N/A ☐ N/C ☑ d. Dust control methods;

S ☐ _____________ N/A ☐ N/C ☑ e. Fire protection capabilities and procedures for notifying local fire department authorities in emergencies;

S ☐ _____________ N/A ☐ N/C ☑ f. Litter control devices;

S ☐ _____________ N/A ☐ N/C ☑ g. Signs indicating operating authority, traffic flow, hours of operation, and disposal restrictions;

S ☐ _____________ N/A ☐ N/C ☑ 12. Provide a description of all-weather access road, inside perimeter road, and other on-site roads necessary for access at the landfill; (62-701.500(12), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 13. Additional record keeping and reporting requirements; (62-701.500(13), FAC)

S ☐ _____________ N/A ☐ N/C ☑ a. Records used for developing permit applications and supplemental information maintained for the design period of the landfill;

S ☐ _____________ N/A ☐ N/C ☑ b. Monitoring information, calibration and maintenance records, and copies of reports required by permit maintained for at least 10 years;

S ☐ _____________ N/A ☐ N/C ☑ c. Maintain annual estimates of the remaining life of constructed landfills, and of other permitted areas not yet constructed, and submit this estimate annually to the Department;

S ☐ _____________ N/A ☐ N/C ☑ d. Procedures for archiving and retrieving records which are more than five years old;

PART L. WATER QUALITY MONITORING REQUIREMENTS (62-701.510, FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. A water quality monitoring plan shall be submitted describing the proposed ground water and surface water monitoring systems, and shall meet at least the following requirements:

S ☐ _____________ N/A ☐ N/C ☑ a. Based on the information obtained in the hydrogeological investigation and signed, dated, and sealed by the P.G. or P.E. who prepared it; (62-701.510(2)(a), FAC)

LOCATION	PART L CONTINUED
S ☐ _____________ N/A ☐ N/C ☑	b. All sampling and analysis performed in accordance with Chapter 62-160, FAC; (62-701.510(2)(b), FAC)
S ☐ _____________ N/A ☐ N/C ☑	c. Ground water monitoring requirements; (62-701.510(3), FAC)
S ☐ _____________ N/A ☐ N/C ☑	(1) Detection wells located downgradient from and within 50 feet of disposal units;
S ☐ _____________ N/A ☐ N/C ☑	(2) Downgradient compliance wells as required;
S ☐ _____________ N/A ☐ N/C ☑	(3) Background wells screened in all aquifers below the landfill that may be affected by the landfill;
S ☐ _____________ N/A ☐ N/C ☑	(4) Location information for each monitoring well;
S ☐ _____________ N/A ☐ N/C ☑	(5) Well spacing no greater than 500 feet apart for downgradient wells and no greater than 1500 feet apart for upgradient wells, unless site specific conditions justify alternate well spacings;
S ☐ _____________ N/A ☐ N/C ☑	(6) Properly selected well screen locations;
S ☐ _____________ N/A ☐ N/C ☑	(7) Monitoring wells constructed to provide representative ground water samples;
S ☐ _____________ N/A ☐ N/C ☑	(8) Procedures for properly abandoning monitoring wells;
S ☐ _____________ N/A ☐ N/C ☑	(9) Detailed description of detection sensors, if proposed;
S ☐ _____________ N/A ☐ N/C ☑	d. Surface water monitoring requirements; (62-701.510(4), FAC)
S ☐ _____________ N/A ☐ N/C ☑	(1) Location of and justification for all proposed surface water monitoring points;
S ☐ _____________ N/A ☐ N/C ☑	(2) Each monitoring location to be marked and its position determined by a registered Florida land surveyor;
S ☐ _____________ N/A ☐ N/C ☑	e. Initial and routine sampling frequency and requirements; (62-701.510(5), FAC)
S ☐ _____________ N/A ☐ N/C ☑	(1) Initial background ground water and surface water sampling and analysis requirements;

LOCATION **PART L CONTINUED**

S ☐ _____________ N/A ☐ N/C ☑ (2) Routine monitoring well sampling and analysis requirements;

S ☐ _____________ N/A ☐ N/C ☑ (3) Routine surface water sampling and analysis requirements;

S ☐ _____________ N/A ☐ N/C ☑ f. Describe procedures for implementing evaluation monitoring, prevention measures, and corrective action as required; (62-701.510(6), FAC)

S ☐ _____________ N/A ☐ N/C ☑ g. Water quality monitoring report requirements; (62-701.510(8), FAC)

S ☐ _____________ N/A ☐ N/C ☑ (1) Semi-annual report requirements; (see paragraphs 62-701.510(5)(c) and (d), FAC for sampling frequencies)

S ☐ _____________ N/A ☐ N/C ☑ (2) Documentation that the water quality data shall be provided to the Department in an electronic format consistent with requirements for importing into Department databases, unless an alternate form of submittal is specified in the permit;

S ☐ _____________ N/A ☐ N/C ☑ (3) Two and one-half year report requirements, or every five years if in long-term care, signed dated, and sealed by P.G. or P.E.;

PART M. SPECIAL WASTE HANDLING REQUIREMENTS (62-701.520, FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. Describe procedures for managing motor vehicles; (62-701.520(1), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 2. Describe procedures for landfilling shredded waste; (62-701.520(2), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 3. Describe procedures for asbestos waste disposal; (62-701.520(3), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 4. Describe procedures for disposal or management of contaminated soil; (62-701.520(4), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 5. Describe procedures for disposal of biological wastes; (62-701.520(5), FAC)

PART N. GAS MANAGEMENT SYSTEM REQUIREMENTS (62-701.530, FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. Provide documentation for a gas management system that will: (62-701.530(1), FAC)

S ☐ _____________ N/A ☐ N/C ☑ a. Be designed to prevent concentrations of combustible gases from exceeding 25% the LEL in structures and 100% the LEL at the property boundary;

S ☐ _____________ N/A ☐ N/C ☑ b. Be designed for site specific conditions;

S ☐ _____________ N/A ☐ N/C ☑ c. Be designed to reduce gas pressure in the interior of the landfill;

S ☐ _____________ N/A ☐ N/C ☑ d. Be designed to not interfere with the liner, leachate control system, or final cover;

S ☐ _____________ N/A ☐ N/C ☑ 2. Provide documentation that will describe locations, construction details, and procedures for monitoring gas at ambient monitoring points and with soil monitoring probes; (62-701.530(2), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 3. Provide documentation describing how the gas remediation plan and odor remediation plan will be implemented; (62-701.530(3), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 4. Landfill gas recovery facilities; (62-701.530(5), FAC)

S ☐ _____________ N/A ☐ N/C ☑ a. Provide information required in Rules 62-701.320(7) and 62-701.330(3), FAC;

S ☐ _____________ N/A ☐ N/C ☑ b. Provide information required in Rule 62-701.600(4), FAC, where relevant and practical;

S ☐ _____________ N/A ☐ N/C ☑ c. Provide estimates of current and expected gas generation rates and description of condensate disposal methods;

S ☐ _____________ N/A ☐ N/C ☑ d. Provide description of procedures for condensate sampling, analyzing, and data reporting;

S ☐ _____________ N/A ☐ N/C ☑ e. Provide closure plan describing methods to control gas after recovery facility ceases operation, and any other requirements contained in Rule 62-701.400(10), FAC;

PART O. LANDFILL FINAL CLOSURE REQUIREMENTS (62-701.600, FAC)

LOCATION

S ☐ ______________ N/A ☐ N/C ☑ 1. Closure permit requirements; (62-701.600(2), FAC)

S ☐ ______________ N/A ☐ N/C ☑ a. Application submitted to the Department at least 90 days prior to final receipt of wastes;

S ☐ ______________ N/A ☐ N/C ☑ b. Closure plan shall include the following:

S ☐ ______________ N/A ☐ N/C ☑ (1) Closure design plan;

S ☐ ______________ N/A ☐ N/C ☑ (2) Closure operation plan;

S ☐ ______________ N/A ☐ N/C ☑ (3) Plan for long-term care;

S ☐ ______________ N/A ☐ N/C ☑ (4) A demonstration that proof of financial assurance for long-term care will be provided;

S ☐ ______________ N/A ☐ N/C ☑ 2. Closure design plan including the following requirements: (62-701.600(3), FAC)

S ☐ ______________ N/A ☐ N/C ☑ a. Plan sheet showing phases of site closing;

S ☐ ______________ N/A ☐ N/C ☑ b. Drawings showing existing topography and proposed final grades;

S ☐ ______________ N/A ☐ N/C ☑ c. Provisions to close units when they reach approved design dimensions;

S ☐ ______________ N/A ☐ N/C ☑ d. Final elevations before settlement;

S ☐ ______________ N/A ☐ N/C ☑ e. Side slope design including benches, terraces, down slope drainage ways, energy dissipaters, and description of expected precipitation effects;

S ☐ ______________ N/A ☐ N/C ☑ f. Final cover installation plans including:

S ☐ ______________ N/A ☐ N/C ☑ (1) CQA plan for installing and testing final cover;

S ☐ ______________ N/A ☐ N/C ☑ (2) Schedule for installing final cover after final receipt of waste;

S ☐ ______________ N/A ☐ N/C ☑ (3) Description of drought resistant species to be used in the vegetative cover;

LOCATION | **PART O CONTINUED**

S ☐ ____________ N/A ☐ N/C ☑ (4) Top gradient design to maximize runoff and minimize erosion;

S ☐ ____________ N/A ☐ N/C ☑ (5) Provisions for cover material to be used for final cover maintenance;

S ☐ ____________ N/A ☐ N/C ☑ g. Final cover design requirements;

S ☐ ____________ N/A ☐ N/C ☑ (1) Protective soil layer design;

S ☐ ____________ N/A ☐ N/C ☑ (2) Barrier soil layer design;

S ☐ ____________ N/A ☐ N/C ☑ (3) Erosion control vegetation;

S ☐ ____________ N/A ☐ N/C ☑ (4) Geomembrane barrier layer design;

S ☐ ____________ N/A ☐ N/C ☑ (5) Geosynthetic clay liner design, if used;

S ☐ ____________ N/A ☐ N/C ☑ (6) Stability analysis of the cover system and the disposed waste;

S ☐ ____________ N/A ☐ N/C ☑ h. Proposed method of stormwater control;

S ☐ ____________ N/A ☐ N/C ☑ i. Proposed method of access control;

S ☐ ____________ N/A ☐ N/C ☑ j. Description of the proposed or existing gas management system which complies with Rule 62-701.530, FAC;

S ☐ ____________ N/A ☐ N/C ☑ 3. Closure operation plan shall include: (62-701.600(4), FAC)

S ☐ ____________ N/A ☐ N/C ☑ a. Detailed description of actions which will be taken to close the landfill;

S ☐ ____________ N/A ☐ N/C ☑ b. Time schedule for completion of closing and long-term care;

S ☐ ____________ N/A ☐ N/C ☑ c. Describe proposed method for demonstrating financial assurance for long-term care;

S ☐ ____________ N/A ☐ N/C ☑ d. Operation of the water quality monitoring plan required in Rule 62-701.510, FAC;

S ☐ ____________ N/A ☐ N/C ☑ e. Development and implementation of gas management system required in Rule 62-701.530, FAC;

LOCATION **PART O CONTINUED**

S ☐ _____________ N/A ☐ N/C ☑ 4. Certification of closure construction completion including: (62-701.600(6), FAC)

S ☐ _____________ N/A ☐ N/C ☑ a. Survey monuments; (62-701.600(6)(a), FAC)

S ☐ _____________ N/A ☐ N/C ☑ b. Final survey report; (62-701.600(6)(b), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 5. Declaration to the public; (62-701.600(7), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 6. Official date of closing; (62-701.600(8), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 7. Justification for and detailed description of procedures to be followed for temporary closure of the landfill, if desired; (62-701.600(9), FAC)

PART P. OTHER CLOSURE PROCEDURES (62-701.610, FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. Describe how the requirements for use of closed solid waste disposal areas will be achieved; (62-701.610(1), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 2. Describe how the requirements for relocation of wastes will be achieved; (62-701.610(2), FAC)

PART Q. LONG-TERM CARE (62-701.620, FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. Maintaining the gas collection and monitoring system; (62-701.620(5), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 2. Stabilization report requirements; (62-701.620(6), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 3. Right of access; (62-701.620(7), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 4. Requirements for replacement of monitoring devices; (62-701.620(8), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 5. Completion of long-term care signed and sealed by professional engineer; (62-701.620(9), FAC)

PART R. **FINANCIAL ASSURANCE** (62-701.630, FAC)

LOCATION

S ☐ _____________ N/A ☐ N/C ☑ 1. Provide cost estimates for closing, long-term care, and corrective action costs estimated by a P.E. for a third party performing the work, on a per unit basis, with the source of estimates indicated; (62-701.630(3) & (7), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 2. Describe procedures for providing annual cost adjustments to the Department based on inflation and changes in the closing, long-term care, and corrective action plans; (62-701.630(4) & (8), FAC)

S ☐ _____________ N/A ☐ N/C ☑ 3. Describe funding mechanisms for providing proof of financial assurance and include appropriate financial assurance forms. (62-701.630(5), (6), & (9), FAC)

PART S. CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

1. Applicant:

The undersigned applicant or authorized representative of Omni Waste of Osceola County, LLC ______________________________ is aware that statements made in this form and attached information are an application for a intermediate modification permit from the Florida Department of Environmental Protection, and certifies that the information in this application is true, correct, and complete to the best of his/her knowledge and belief. Further, the undersigned agrees to comply with the provisions of Chapter 403, Florida Statutes, and all rules and regulations of the Department. It is understood that the Permit is not transferable, and the Department will be notified prior to the sale or legal transfer of the permitted facility.

Mike Kaiser (signature)	1501 Omni Way
Signature of Applicant or Agent	Mailing Address
Mike Kaiser, Southeast Region Engineer	St. Cloud, FL 34773
Name and Title (please type)	City, State, Zip Code
michael.kaiser@progressivewaste.com	(904) 673-0446
E-Mail Address (if available)	Telephone Number
	Date: 12/8/14

Attach letter of authorization if agent is not a government official, owner, or corporate officer.

2. Professional Engineer registered in Florida (or Public Officer if authorized under Sections 403.707 and 403.7075, Florida Statutes):

This is to certify that the engineering features of this solid waste management facility have been designed/examined by me and found to conform to engineering principles applicable to such facilities. In my professional judgment, this facility, when properly maintained and operated, will comply with all applicable statutes of the State of Florida and rules of the Department. It is agreed that the undersigned will provide the applicant with a set of instructions of proper maintenance and operation of the facility.

(signature)	13101 Telecom Drive, Suite 120
Signature	Mailing Address
Craig R. Browne, Senior Engineer	Temple Terrace, FL 33637
Name and Title (please type)	City, State, Zip Code
	cbrowne@geosyntec.com
	E-Mail Address (if available)
68613	(813) 558-0990
Florida Registration Number (please affix seal)	Telephone Number
	Date: 12/9/2014

CRAIG R. BROWNE LICENSE No. 68613 ★ STATE OF FLORIDA PROFESSIONAL ENGINEER

WSI Waste Services, Inc.
2893 Executive Park Drive, Suite 305, Weston, Florida 33331

January 24, 2011

RE: Omni Waste of Osceola County, LLC

To Whom It May Concern:

This is to confirm that Michael Kaiser is an authorized signatory of Omni Waste of Osceola County, LLC (the "Corporation"), with authority to execute and deliver all documents and instruments required in connection with environmental matters for the Corporation, including without limitation, permit applications, modifications and financial assurances for permits issued to the Corporation.

Omni Waste of Osceola County, LLC

William P. Hulligan
Manager

Waste Services, Inc.

William P. Hulligan
Executive Vice President, U.S. Operations

ATTACHMENT 2
INTERMEDIATE MODIFICATION PERMIT DRAWINGS

J.E.D. SOLID WASTE MANAGEMENT FACILITY

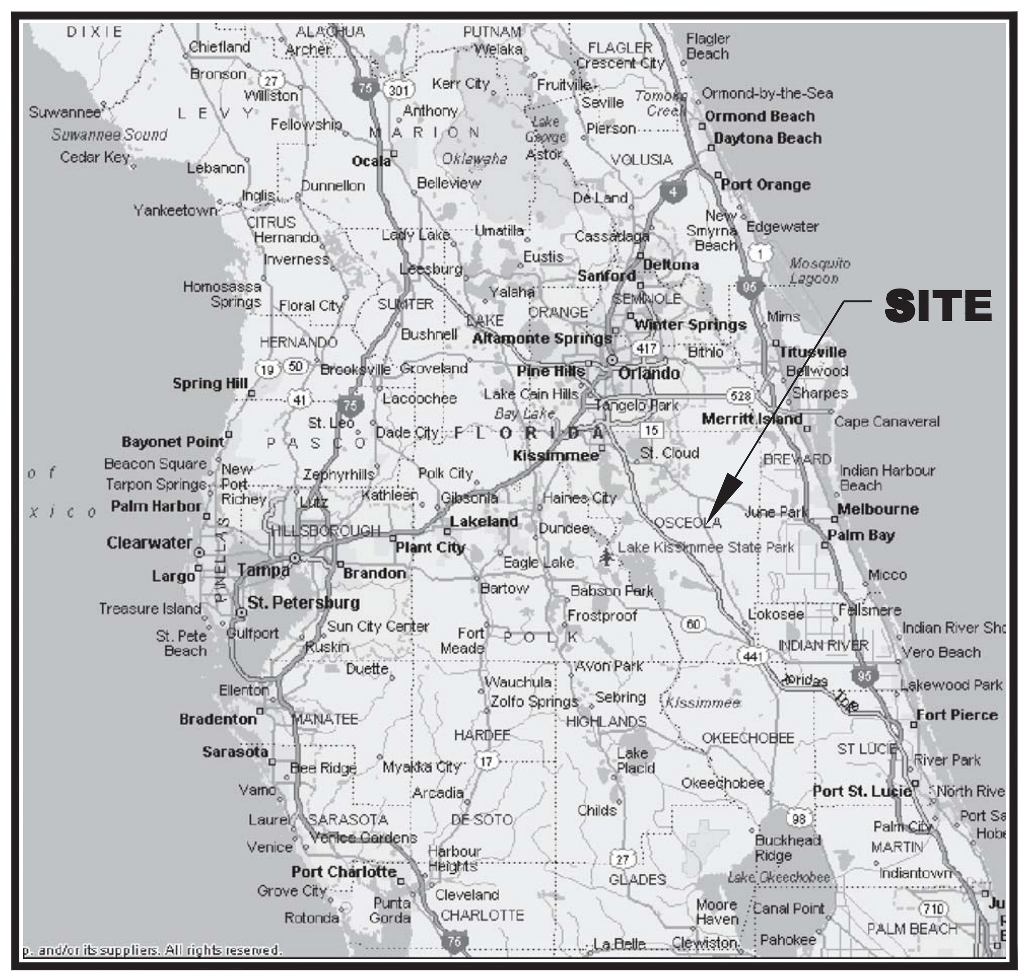
ST.CLOUD, FLORIDA

BASE GRADE REVISIONS

PHASE 4 (CELLS 11-13) DISPOSAL AREA

INTERMEDIATE MODIFICATION PERMIT DRAWINGS

DECEMBER 2014



LOCATION MAP

0 32

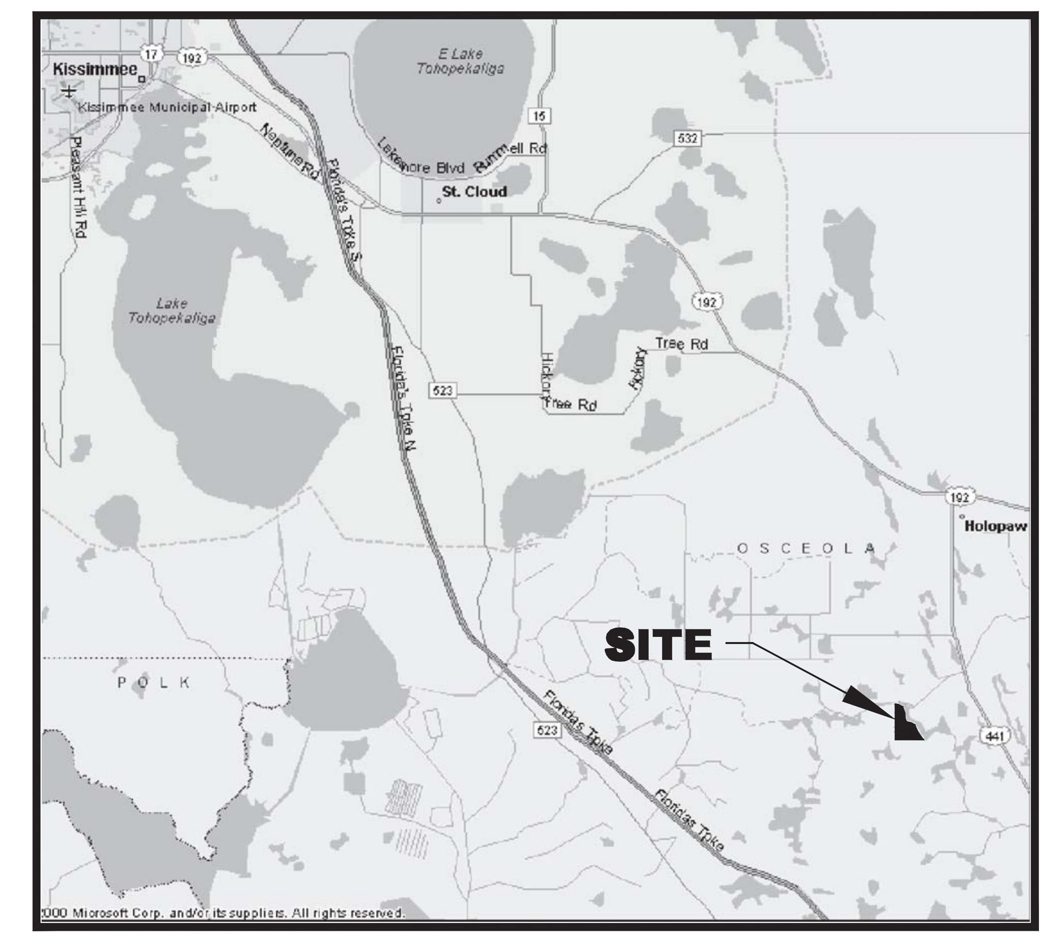
SCALE: 1" = 32 MILES

LIST OF DRAWINGS

SHEET NUMBER	SHEET TITLE	REVISION
1	TITLE SHEET	0
2	EXISTING SITE CONDITIONS AND AERIAL PHOTOGRAPH	NOTES 1 AND 2
3	TOPOGRAPHIC MAP OF THE SITE	1
4	SITE CHARACTERIZATION PLAN I	1
5	SITE CHARACTERIZATION PLAN II	NOTES 1 AND 2
6	SITE DEVELOPMENT PLAN	NOTES 1 AND 2
7	BASE GRADING PLAN - PHASE 3	NOTES 1 AND 2
8	BASE GRADING PLAN - PHASE 4	1
9	LEACHATE COLLECTION SYSTEM LAYOUT PLAN I	1
10	LEACHATE COLLECTION SYSTEM LAYOUT PLAN II	NOTES 1 AND 2
11	LANDFILL CROSS SECTIONS I	1
12	LANDFILL CROSS SECTIONS II	1
13	LANDFILL CROSS SECTIONS III	NOTES 1 AND 2
14	PERIMETER BERM TYPICAL SECTIONS	NOTES 1 AND 2
15	LINER SYSTEM DETAILS I - CELLS 8 THROUGH 13	NOTES 1 AND 2
16	LINER SYSTEM DETAILS II - CELLS 8 THROUGH 13	NOTES 1 AND 2
17	LEACHATE SUMP PLAN - CELLS 8 THROUGH 13	1
18	SECONDARY SUMP CROSS SECTIONS - CELLS 8 THROUGH 13	NOTES 1 AND 2
19	PRIMARY SUMP CROSS SECTIONS - CELLS 8 THROUGH 13	NOTES 1 AND 2
20	LEACHATE SUMP CROSS SECTIONS - CELLS 8 THROUGH 13	1
21	LEACHATE COLLECTION SYSTEM DETAILS - CELLS 8 THROUGH 13	NOTES 1 AND 2
22	LEACHATE STORAGE FACILITY PLAN	NOTES 1 AND 2
23	LEACHATE STORAGE FACILITY CROSS SECTIONS	NOTES 1 AND 2
24	LEACHATE MANAGEMENT SYSTEM SCHEMATIC DIAGRAM	NOTES 1 AND 2
25	GROUNDWATER MONITORING NETWORK	1
26	PHASE 3 CONSTRUCTION SEQUENCING	NOTES 1 AND 2
27	PHASE 4 CONSTRUCTION SEQUENCING	2
28	WASTE FILL SEQUENCING PLAN I	NOTES 1 AND 2
29	WASTE FILL SEQUENCING PLAN II	NOTES 1 AND 2
30	GAS MANAGEMENT SYSTEM PLAN I	NOTES 1 AND 2
31	GAS MANAGEMENT SYSTEM PLAN II	NOTES 1 AND 2
32	CONCEPTUAL LAYOUT OF HORIZONTAL GAS COLLECTORS	1
33	GAS MANAGEMENT DETAILS I	NOTES 1 AND 2
34	GAS MANAGEMENT DETAILS II	NOTES 1 AND 2
35	GAS MANAGEMENT DETAILS III	NOTES 1 AND 2
36	GAS MANAGEMENT DETAILS IV	NOTES 1 AND 2
37	LANDFILL GAS PIPELINE DETAILS	NOTES 1 AND 2
38	SCALE AND ADMINISTRATIVE AREA LAYOUT	NOTES 1 AND 2
39	FINAL COVER SYSTEM GRADING PLAN I	NOTES 1 AND 2
40	FINAL COVER SYSTEM GRADING PLAN II	NOTES 1 AND 2
41	FINAL COVER SYSTEM DETAILS	NOTES 1 AND 2
42	STORM WATER MANAGEMENT PLAN	NOTES 1 AND 2
43	STORM WATER MANAGEMENT DETAILS I	NOTES 1 AND 2
44	STORM WATER MANAGEMENT DETAILS II	NOTES 1 AND 2
45	STORM WATER DRAINAGE STRUCTURE DETAILS	NOTES 1 AND 2

NOTES:

1. THESE PERMIT DRAWINGS MODIFY PREVIOUSLY APPROVED PERMIT DRAWINGS (AS INDICATED BY NOTE 2). ONLY THE SHEETS THAT HAVE BEEN MODIFIED (INDICATED IN BOLD FONT IN THE DRAWING LIST) ARE INCLUDED IN THE PERMIT DRAWING SET. THERE ARE NO SUBSTANTIAL CHANGES TO THE REMAINING DRAWINGS (WHICH HAVE BEEN SCREENED IN THE DRAWING LIST).
2. REFER TO RENEWAL PERMIT DRAWINGS SUBMITTED TO FDEP IN NOVEMBER 2011 WITH SELECT SHEETS REVISED IN JANUARY 2012.



VICINITY MAP

0 4

SCALE: 1" = 4 MILES

SEQUENTIAL DETAIL NUMBER

SHEET ON WHICH THE ABOVE DETAIL IS PRESENTED

DETAIL REFERENCE KEY

DETAIL NUMBER

SHEET ON WHICH THE ABOVE DETAIL IS FIRST REFERENCED

DETAIL (TYPICAL)

LINER SYSTEM AT BASE

SCALE: NTS

XREF: FL1962.01X000.DWG

DETAIL BAR REFERENCE KEY

EXAMPLE: DETAIL 1 WHICH IS PRESENTED ON SHEET 7 WAS FIRST REFERENCED ON SHEET 5.

SEQUENTIAL SECTION LETTER

SHEET ON WHICH THE ABOVE SECTION IS PRESENTED

SECTION REFERENCE KEY

SECTION LETTER

SHEET ON WHICH THE ABOVE SECTION IS FIRST REFERENCED

SECTION (TYPICAL)

PERIMETER BERM

SCALE: 1" = 10

XREF: FL1962.01X000.DWG

SECTION BAR REFERENCE KEY

EXAMPLE: SECTION C WHICH IS PRESENTED ON SHEET 5 WAS FIRST REFERENCED ON SHEET 3.

REV	DATE	DESCRIPTION	DRN	APP
0	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB

Geosyntec consultants

13101 TELECOM DRIVE, SUITE 120
TEMPLE TERRACE, FLORIDA 33637 USA
PH: 813.558.0990 - FX:813.558.9726
AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions

1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE: TITLE SHEET

PROJECT: INTERMEDIATE PERMIT MODIFICATION
PHASE 4 (CELLS 11-13) BASE GRADE REVISIONS

SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE

12/9/2014

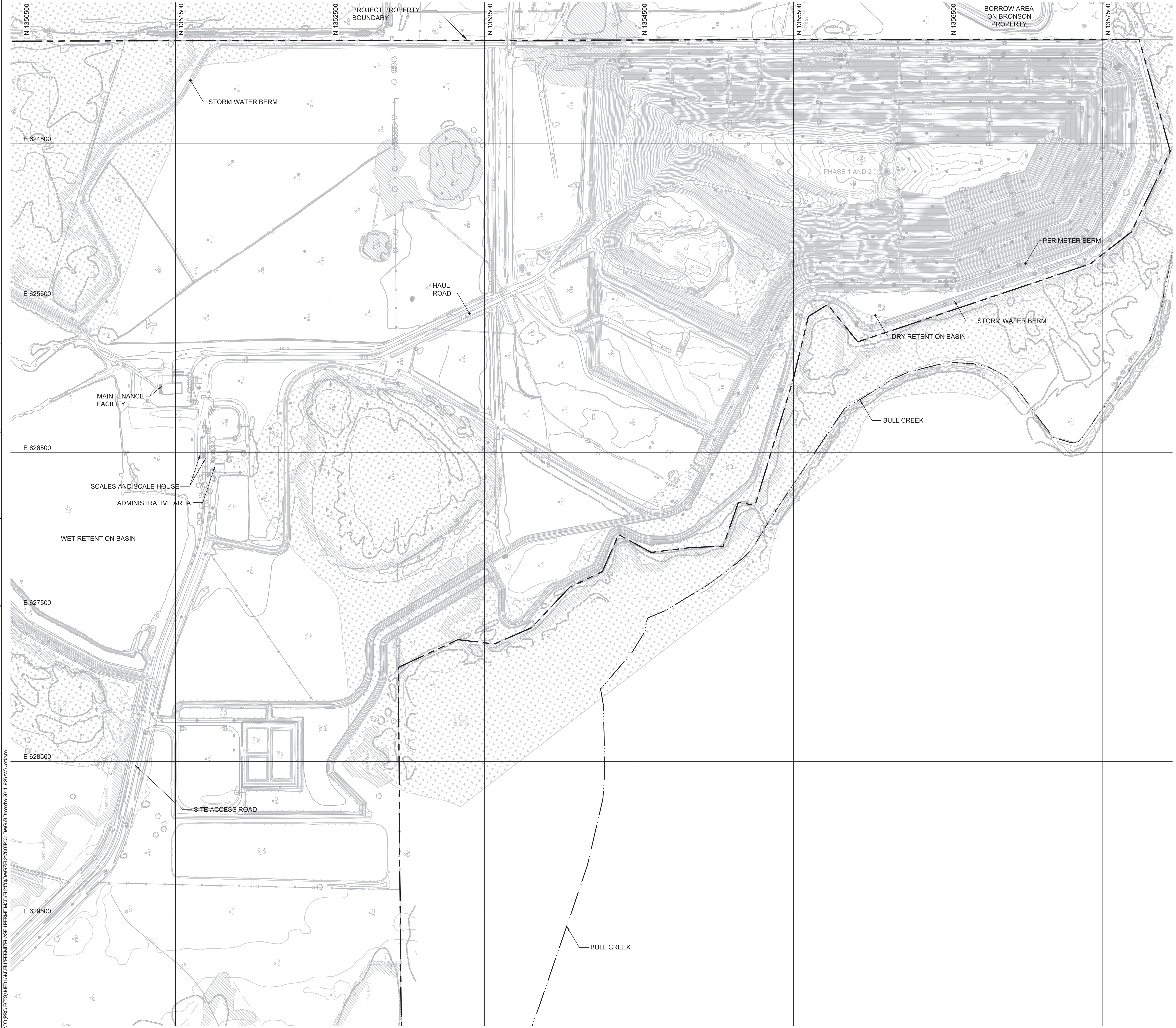
DATE

CRAIG BROWNE - LICENSE NO. 68613

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P010
REVIEWED BY:	KBT	DRAWING NO.:	1 OF 45
APPROVED BY:	CRB		

PERMIT DRAWING



0 300' 600'
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- APPROXIMATE LOCATION OF INTERMITTENT STREAM
- EXISTING GROUND ELEVATION (FEET) (SEE NOTE 3)
- EXISTING FENCE
- WETLAND BOUNDARY BY PHOTO INTERPRETATION BY BRA (SEE NOTE 4)
- WETLAND BOUNDARY BY FIELD SURVEY (SEE NOTE 4)
- 100-YEAR FLOODPLAIN (SEE NOTE 5)

NOTES:

1. NORTHING AND EASTING COORDINATES SHOWN REPRESENT FLORIDA STATE PLANE EAST ZONE NORTH AMERICAN DATUM OF 1983 (NAD83).THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)(FEET).
2. THE PROPERTY BOUNDARY IS BASED ON A COMPOSITE BOUNDARY SURVEY PROVIDED BY JOHNSTON SURVEYING INC., KISSIMMEE FLORIDA, DATED AUGUST 12, 1999.
3. TOPOGRAPHIC INFORMATION SHOWN ON THIS DRAWING WAS PROVIDED BY BASE MAPPING CO. LTD BASED ON AN AERIAL PHOTOGRAPH TAKEN ON 16 MAY 2014.
4. THE WETLAND BOUNDARY INFORMATION SHOWN IS BASED ON: A FIELD SURVEY DATED 15 MAY 2002 BY JOHNSTON SURVEYING INC. OF WETLANDS BOUNDARIES FLAGGED BY BIOLOGICAL RESEARCH ASSOCIATES, INC. (BRA), THE EXISTING JURISDICTIONAL WETLAND DETERMINATIONS, A PHOTO INTERPRETATION OF WETLAND BOUNDARIES BY BRA IN AREAS OUTSIDE THE LIMITS OF CONSTRUCTION, AND A FIELD SURVEY DATED 24 NOVEMBER 2010 BY PEAVEY & ASSOCIATES OF WETLAND BOUNDARIES FLAGGED BY ENTRIX, INC.
5. THE 100-YEAR FLOODPLAIN BOUNDARY SHOWN WAS PROVIDED BY THE OSCEOLA COUNTY GIS DEPARTMENT ON JANUARY 9, 2002 AND RECONFIRMED WITH THE OSCEOLA COUNTY GIS DEPARTMENT ON 24 SEPTEMBER 2010.

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

Geosyntec consultants
13101 TELECOM DRIVE, SUITE 120
TEMPLE TERRACE, FLORIDA 33637 USA
PH: 813.558.0990 - FX:813.558.9726
AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE: TOPOGRAPHIC MAP OF THE SITE

PROJECT: SOLID WASTE RENEWAL PERMIT

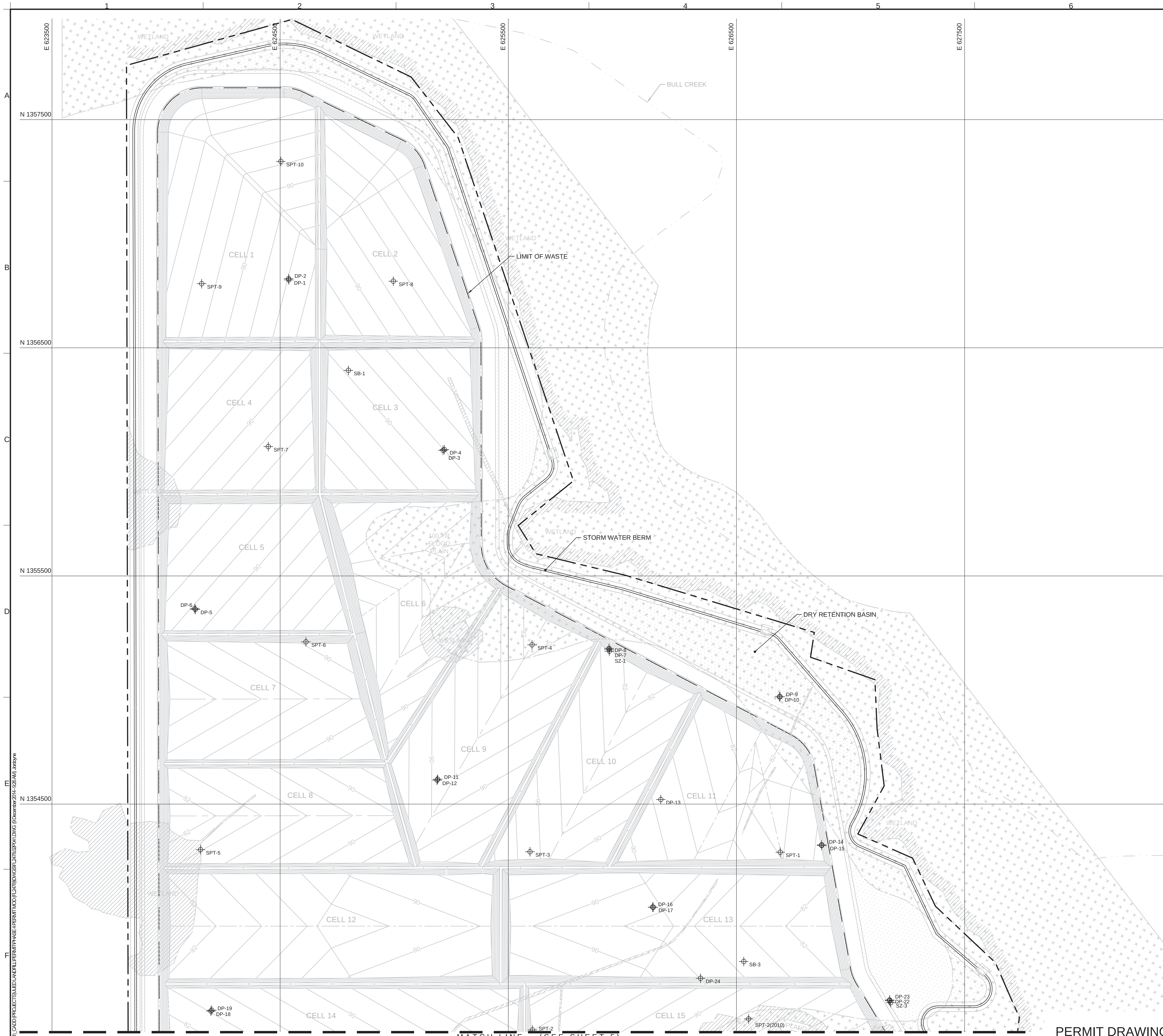
SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

SIGNATURE
12/9/2014
DATE
CRAIG BROWNE - LICENSE NO. 68613

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P031
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB		3 OF 45

PERMIT DRAWING



N

0 200' 400'

SCALE IN FEET

LEGEND

PROPERTY BOUNDARY

APPROXIMATE LOCATION OF INTERMITTENT STREAM

SUBBASE ELEVATION (FEET) (SEE NOTE 5)

WETLAND BOUNDARY BY PHOTO INTERPRETATION BY BRA (SEE NOTE 3)

WETLAND BOUNDARY BY FIELD SURVEY (SEE NOTE 3)

100-YEAR FLOODPLAIN (SEE NOTE 4)

STORM WATER MANAGEMENT POND

DP-2 DIRECT PUSH / MONITORING WELL LOCATION

SZ-1 SHELL ZONE WELL LOCATION

SB-1 ROTOSONIC BORING LOCATION

SPT-1 STANDARD PENETRATION TEST (SPT) BORING LOCATION

SPT-1(2010) STANDARD PENETRATION TEST (SPT) BORING LOCATION PERFORMED BY GEOSYNTEC IN 2010

Point # (Note 6)	Northing	Easting	Top of Casing EL. (FT)	Ground EL. (FT)
DP-1	1,356,797.91	624,537.79	84.12	81.20
DP-2	1,356,802.93	624,536.96	84.11	81.20
DP-3	1,356,050.85	625,213.95	82.22	79.30
DP-4	1,356,053.84	625,219.58	82.24	79.30
DP-5	1,355,353.25	624,128.08	84.13	81.60
DP-6	1,355,356.37	624,125.45	84.23	81.60
DP-7	1,355,177.88	625,941.53	82.63	79.60
DP-8	1,355,182.23	625,941.31	82.78	79.60
DP-9	1,354,970.41	626,691.23	81.58	78.90
DP-10	1,354,970.16	626,687.84	81.59	78.90
DP-11	1,354,609.00	625,190.27	84.06	81.20
DP-12	1,354,604.52	625,187.66	84.18	81.20
DP-13	1,354,519.86	626,168.29	83.09	80.00
DP-14	1,354,321.35	626,873.19	81.97	78.90
DP-15	1,354,318.16	626,873.34	81.98	78.90
DP-16	1,354,048.17	626,132.23	82.57	79.50
DP-17	1,354,047.58	626,135.33	82.58	79.50
DP-18	1,353,592.44	624,195.90	84.38	81.20
DP-19	1,353,596.07	624,200.39	84.34	81.20
DP-20	1,353,034.67	625,503.33	83.07	79.80
DP-21	1,353,030.01	625,502.82	83.00	79.80
DP-22	1,353,637.77	627,171.49	81.00	78.30
DP-23	1,353,641.31	627,170.88	81.27	78.30
DP-24	1,353,736.22	626,342.40	82.22	79.20
SB-1	1,356,401.00	624,799.00	-	80.00

Point # (Note 6)	Northing	Easting	Top of Casing EL. (FT)	Ground EL. (FT)
SB-2	1,353,191.00	624,139.00	-	82.00
SB-3	1,353,810.00	626,532.00	-	79.20
SPT-1	1,354,289.00	626,692.00	-	79.30
SPT-2	1,353,510.00	625,606.00	-	79.40
SPT-3	1,354,291.00	625,595.00	-	80.10
SPT-4	1,355,198.00	625,604.00	-	80.20
SPT-5	1,354,300.00	624,151.00	-	82.30
SPT-6	1,355,211.00	624,613.00	-	80.80
SPT-7	1,356,067.00	624,448.00	-	80.40
SPT-8	1,356,792.00	624,996.00	-	80.10
SPT-9	1,356,781.00	624,156.00	-	81.50
SPT-10	1,357,317.00	624,503.00	-	81.00
SPT-11	1,351,994.00	624,604.00	-	80.70
SPT-12	1,351,602.00	625,635.00	-	80.40
SPT-13	1,351,240.00	626,443.00	-	81.10
SPT-14	1,350,398.00	626,102.00	-	81.00
SPT-15	1,349,802.00	625,707.00	-	80.70
SZ-1	1,355,170.25	625,942.43	82.43	79.60
SZ-2	1,353,030.47	625,511.10	83.16	79.80
SZ-3	1,353,629.43	627,175.45	81.27	78.30
SPT-1(2010)	1,352,101.58	626,189.62	-	79.93
SPT-2(2010)	1,353,558.01	626,553.26	-	78.79
SPT-3(2010)	1,352,965.21	627,387.97	-	78.22
SPT-4(2010)	1,352,714.69	627,035.50	-	77.46
SPT-5(2010)	1,351,944.10	626,526.17	-	83.54

NOTES:

1. NORTHING AND EASTING COORDINATES SHOWN REPRESENT FLORIDA STATE PLANE EAST ZONE NORTH AMERICAN DATUM OF 1983 (NAD83).THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)(FEET).
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4. THE 100-YEAR FLOODPLAIN BOUNDARY SHOWN WAS PROVIDED BY THE OSCEOLA COUNTY GIS DEPARTMENT ON JANUARY 9, 2002 AND RECONFIRMED WITH THE OSCEOLA COUNTY GIS DEPARTMENT ON 24 SEPTEMBER 2010.
5. PROPOSED SUBBASE GRADING IS SHOWN IN THE BACKGROUND TO ILLUSTRATE TEST LOCATIONS RELATIVE TO THE JED DISPOSAL FACILITY LAYOUT.
6. DP, SB, SPT, SZ, SPT (2010) GROUND ELEVATIONS CORRESPOND TO THE EXISTING ELEVATION AT THE TIME OF INSTALLATION / DRILLING.

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

Geosyntec consultants
13101 TELECOM DRIVE, SUITE 120
TEMPLE TERRACE, FLORIDA 33637 USA
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AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE:

SITE CHARACTERIZATION PLAN I

PROJECT:

SOLID WASTE RENEWAL PERMIT

SITE:

J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE

12/9/2014

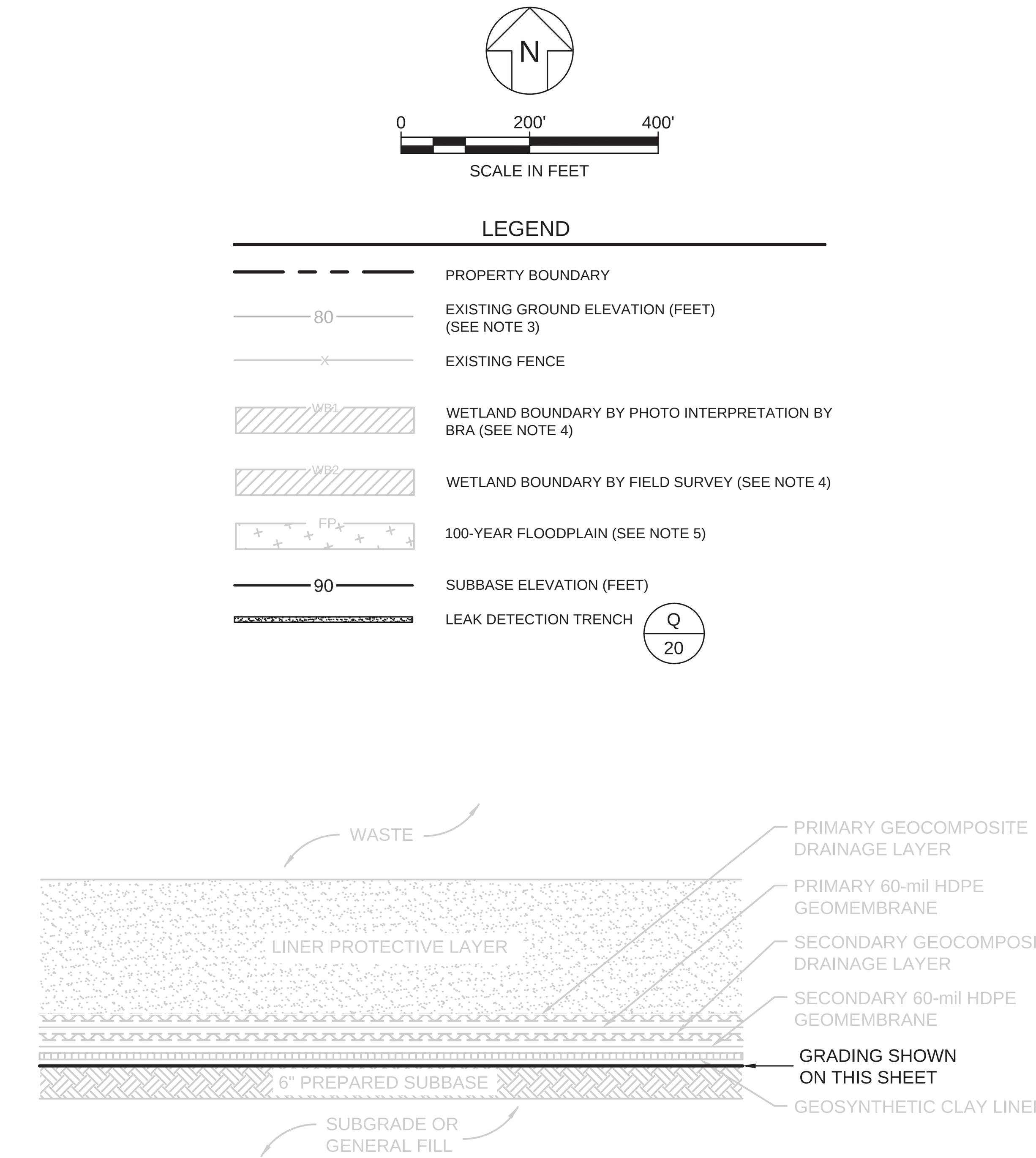
DATE

CRAIG BROWNE - LICENSE NO. 68613

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P041
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	4 OF 45	

PERMIT DRAWING



GRADING KEY MAP

SCALE: 1" = 2"

XREF: FL1962.02K2012

NOTES:

1. NORTHING AND EASTING COORDINATES SHOWN REPRESENT FLORIDA STATE PLANE EAST ZONE NORTH AMERICAN DATUM OF 1983 (NAD83).THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)(FEET).
2. THE PROPERTY BOUNDARY IS BASED ON A COMPOSITE BOUNDARY SURVEY PROVIDED BY JOHNSTON SURVEYING INC., KISSIMMEE FLORIDA, DATED AUGUST 12, 1999.
3. TOPOGRAPHIC INFORMATION SHOWN ON THIS DRAWING WAS PROVIDED BY BASE MAPPING CO. LTD BASED ON AN AERIAL PHOTOGRAPH TAKEN ON 16 MAY 2014.
4. THE WETLAND BOUNDARY INFORMATION SHOWN IS BASED ON: A FIELD SURVEY DATED 15 MAY 2002 BY JOHNSTON SURVEYING INC. OF WETLANDS BOUNDARIES FLAGGED BY BIOLOGICAL RESEARCH ASSOCIATES, INC. (BRA), THE EXISTING JURISDICTIONAL WETLAND DETERMINATIONS, A PHOTO INTERPRETATION OF WETLAND BOUNDARIES BY BRA IN AREAS OUTSIDE THE LIMITS OF CONSTRUCTION, AND A FIELD SURVEY DATED 24 NOVEMBER 2010 BY PEAVEY & ASSOCIATES OF WETLAND BOUNDARIES FLAGGED BY ENTRIX, INC.
5. THE 100-YEAR FLOODPLAIN BOUNDARY SHOWN WAS PROVIDED BY THE OSCEOLA COUNTY GIS DEPARTMENT ON JANUARY 9, 2002 AND RECONFIRMED WITH THE OSCEOLA COUNTY GIS DEPARTMENT ON 24 SEPTEMBER 2010.

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

Geosyntec consultants
13101 TELECOM DRIVE, SUITE 120
TEMPLE TERRACE, FLORIDA 33637 USA
PH: 813.558.0990 - FX:813.558.9726
AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE: BASE GRADING PLAN - PHASE 4

PROJECT: SOLID WASTE RENEWAL PERMIT

SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE 12/9/2014 DATE

CRAIG BROWNE - LICENSE NO. 68613

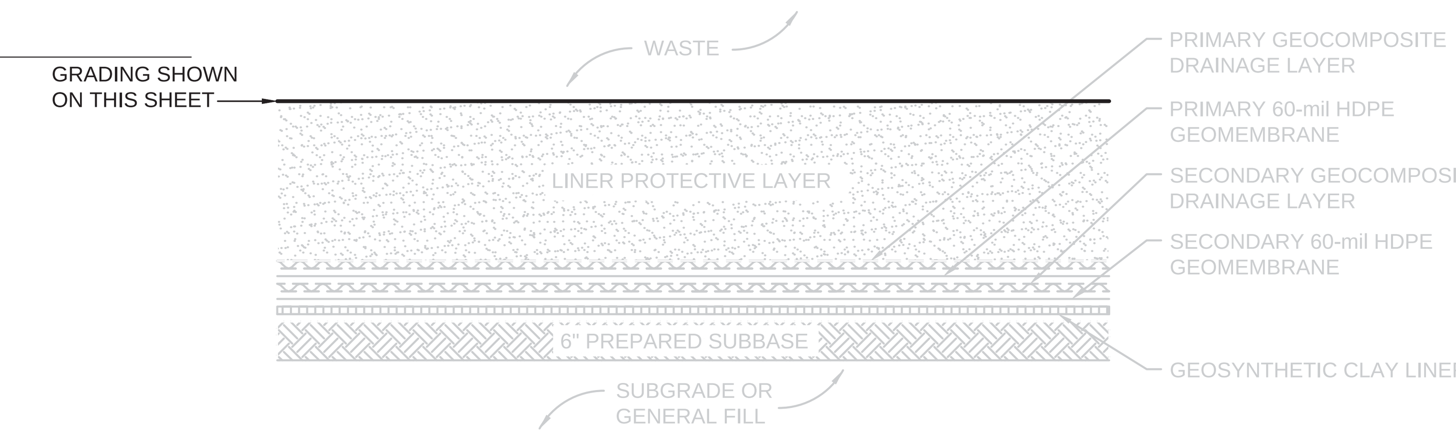
CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P081
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	8 OF 45	

PERMIT DRAWING

LEGEND

- PROPERTY BOUNDARY
- EXISTING GROUND ELEVATION (FEET) (NOTE 3)
- EXISTING FENCE
- WETLAND BOUNDARY BY PHOTO INTERPRETATION BY BRA (NOTE 4)
- WETLAND BOUNDARY BY FIELD SURVEY (NOTE 4)
- 100-YEAR FLOODPLAIN (NOTE 5)
- STORM WATER MANAGEMENT BASIN
- TOP OF PROTECTIVE COVER LAYER ELEVATION (FEET)
- LEACHATE TRANSMISSION PIPE AND MANHOLE
- LEACHATE COLLECTION PIPE AND SUMP



GRADING KEY MAP

SCALE: 1" = 2"

XREF: FL1962.02X2012

NOTES:

1. NORTHING AND EASTING COORDINATES SHOWN REPRESENT FLORIDA STATE PLANE EAST ZONE NORTH AMERICAN DATUM OF 1983 (NAD83).THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)(FEET).
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5. THE 100-YEAR FLOODPLAIN BOUNDARY SHOWN WAS PROVIDED BY THE OSCEOLA COUNTY GIS DEPARTMENT ON JANUARY 9, 2002 AND RECONFIRMED WITH THE OSCEOLA COUNTY GIS DEPARTMENT ON 24 SEPTEMBER 2010.
6. PHASE 2 (CELLS 5 THROUGH 7) HAS BEEN CONSTRUCTED AND HAS WASTE DISPOSED IN CELLS 5 AND 6. CELL 7 WASTE DISPOSAL OPERATIONS ARE PENDING FDEP APPROVAL.

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

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AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
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ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE: LEACHATE COLLECTION SYSTEM LAYOUT PLAN I

PROJECT: SOLID WASTE RENEWAL PERMIT

SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE 12/9/2014 DATE

CRAIG BROWNE - LICENSE NO. 68613

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P091
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	9 OF 45	

PERMIT DRAWING

A/7 SECTION

LANDFILL CROSS SECTION

SCALE: 1" = 200' (HOR) ; 1" = 20' (VERT)

GENERAL NOTES:

1. THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) (FEET).

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

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Progressive Waste Solutions
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TEL: 407-891-3720 FAX: 407-891-3730

TITLE: LANDFILL CROSS SECTIONS I

PROJECT: SOLID WASTE RENEWAL PERMIT

SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

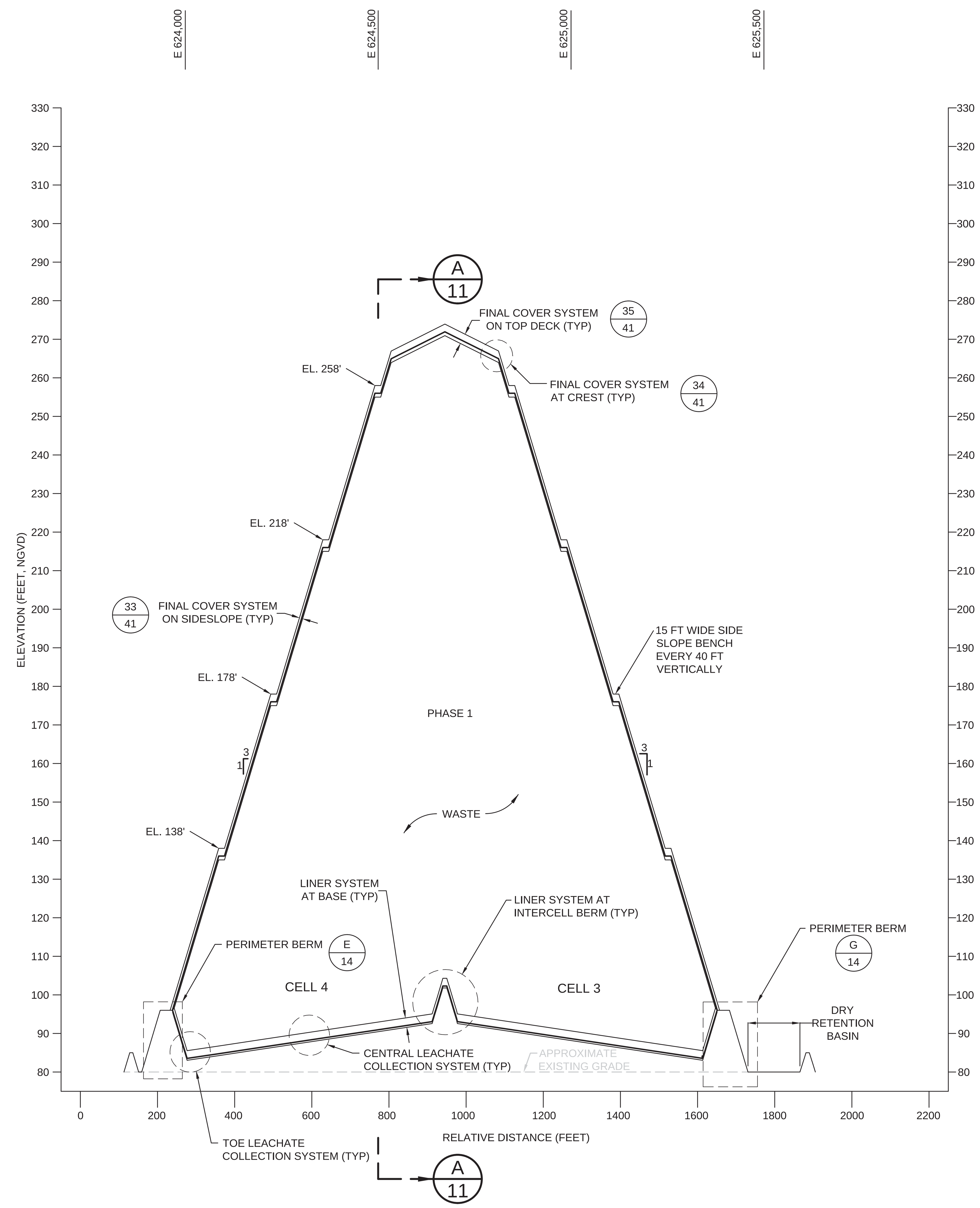
SIGNATURE 12/9/2014 DATE

CRAIG BROWNE - LICENSE NO. 68613

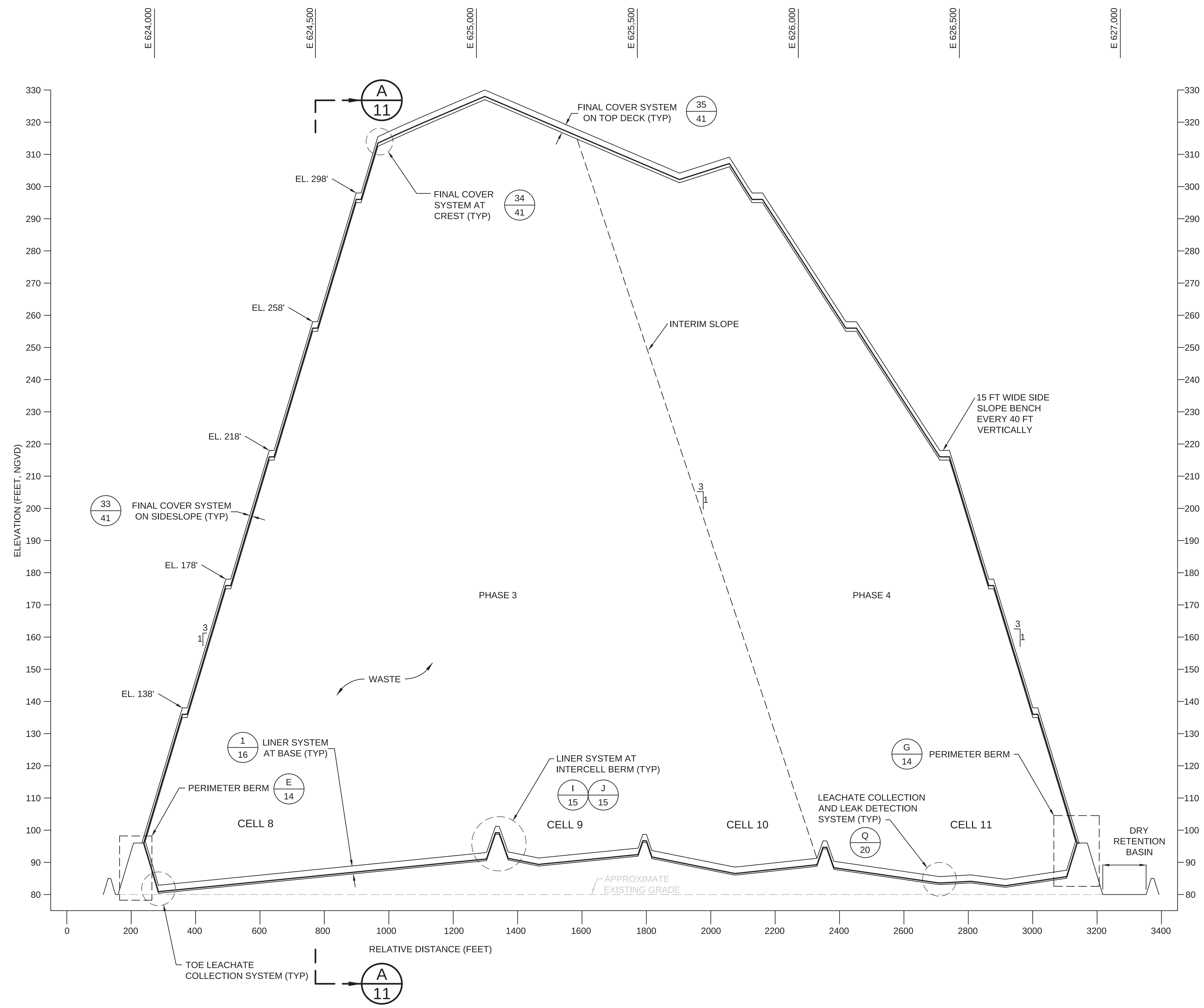
CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P111
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB		11 OF 45

PERMIT DRAWING



B/7 SECTION
LANDFILL CROSS SECTION
SCALE: 1" = 200' (HOR) ; 1" = 20' (VERT)



C/7 SECTION
LANDFILL CROSS SECTION
SCALE: 1" = 200' (HOR) ; 1" = 20' (VERT)

GENERAL NOTES:

1. THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) (FEET).

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

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AUTHORIZATION NUMBER: 4321

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TITLE: LANDFILL CROSS SECTIONS II

PROJECT: SOLID WASTE RENEWAL PERMIT

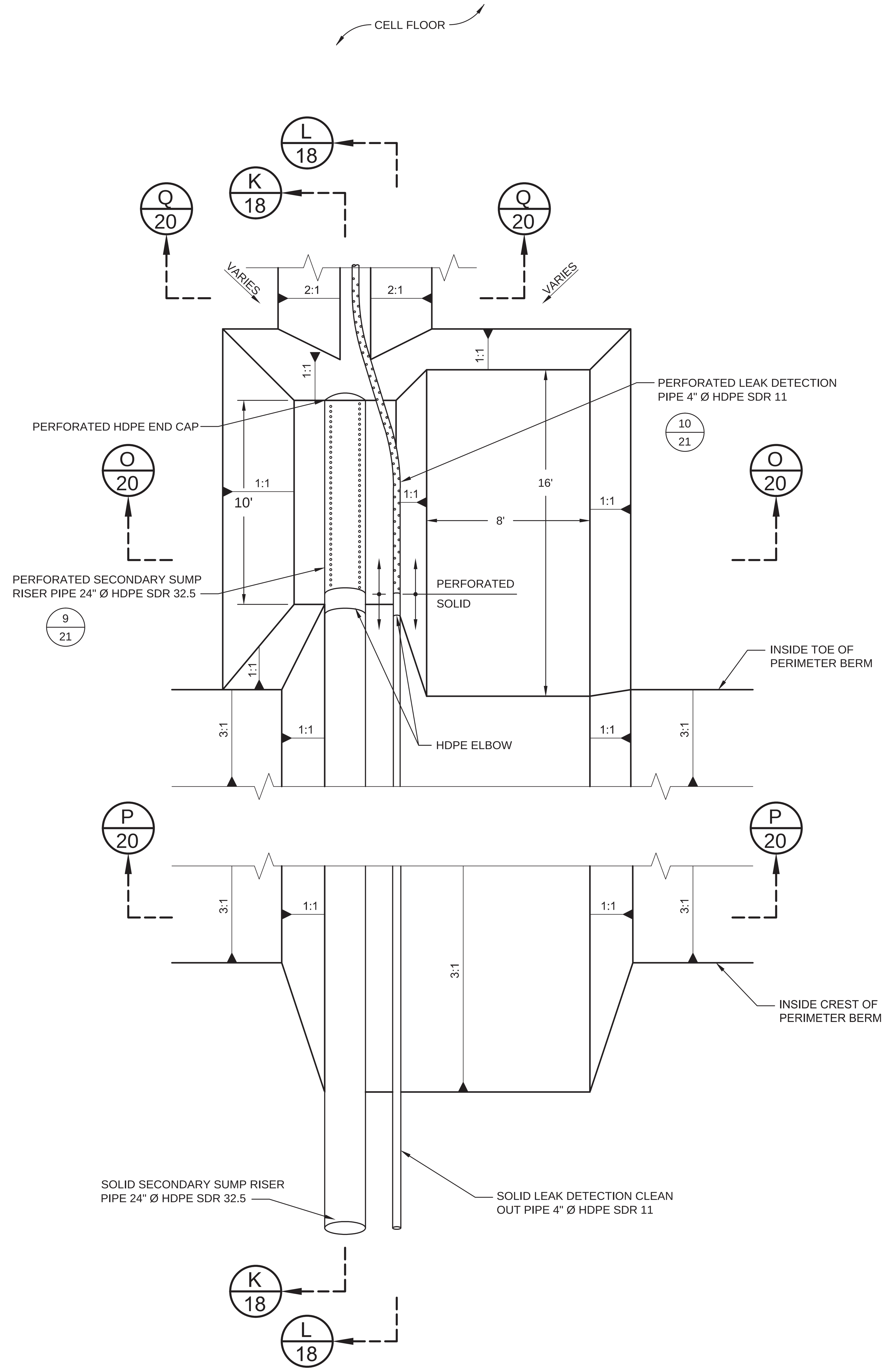
SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE
12/9/2014
DATE
CRAIG BROWNE - LICENSE NO. 68613

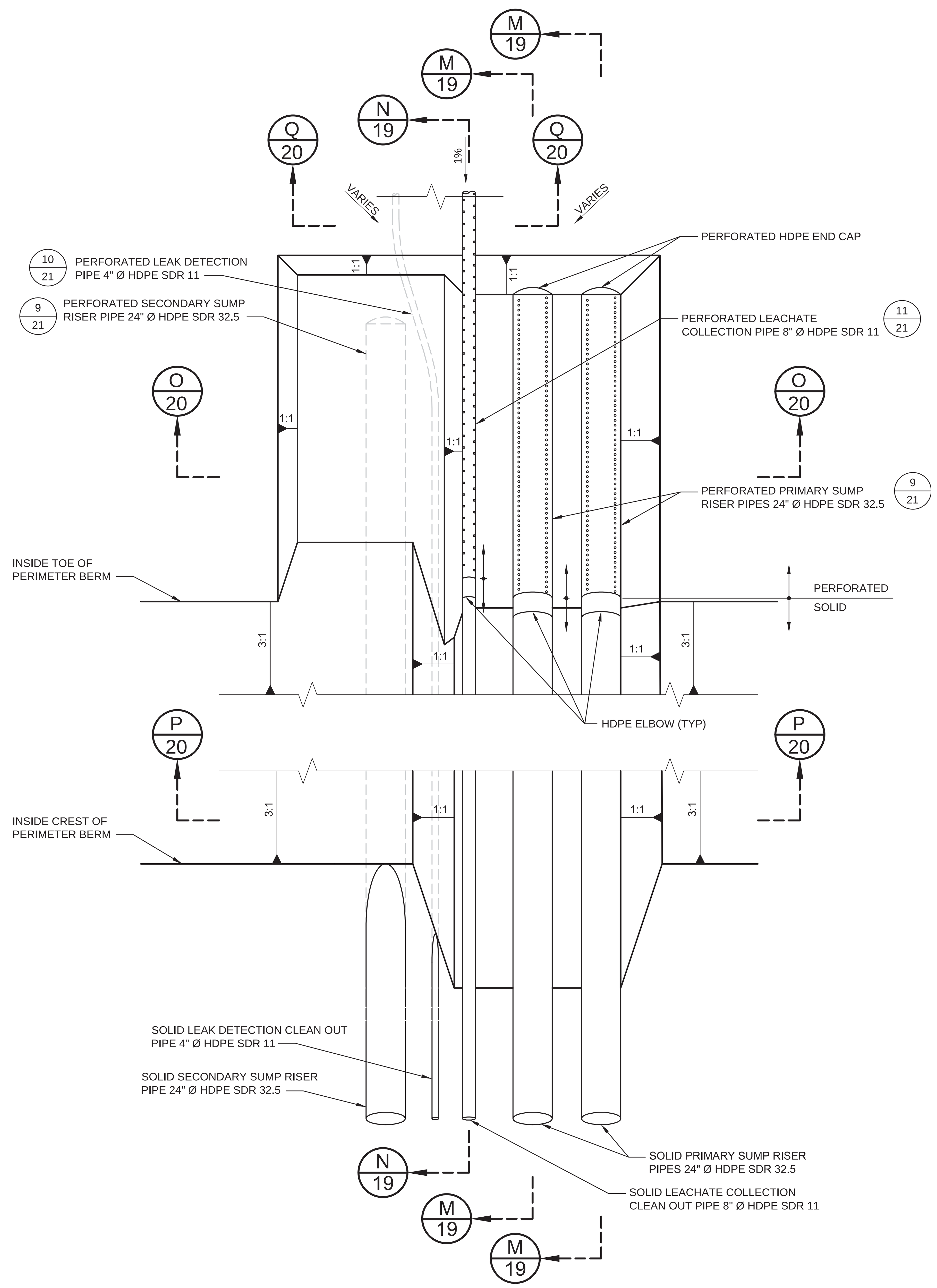
CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P111
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	12 OF 45	

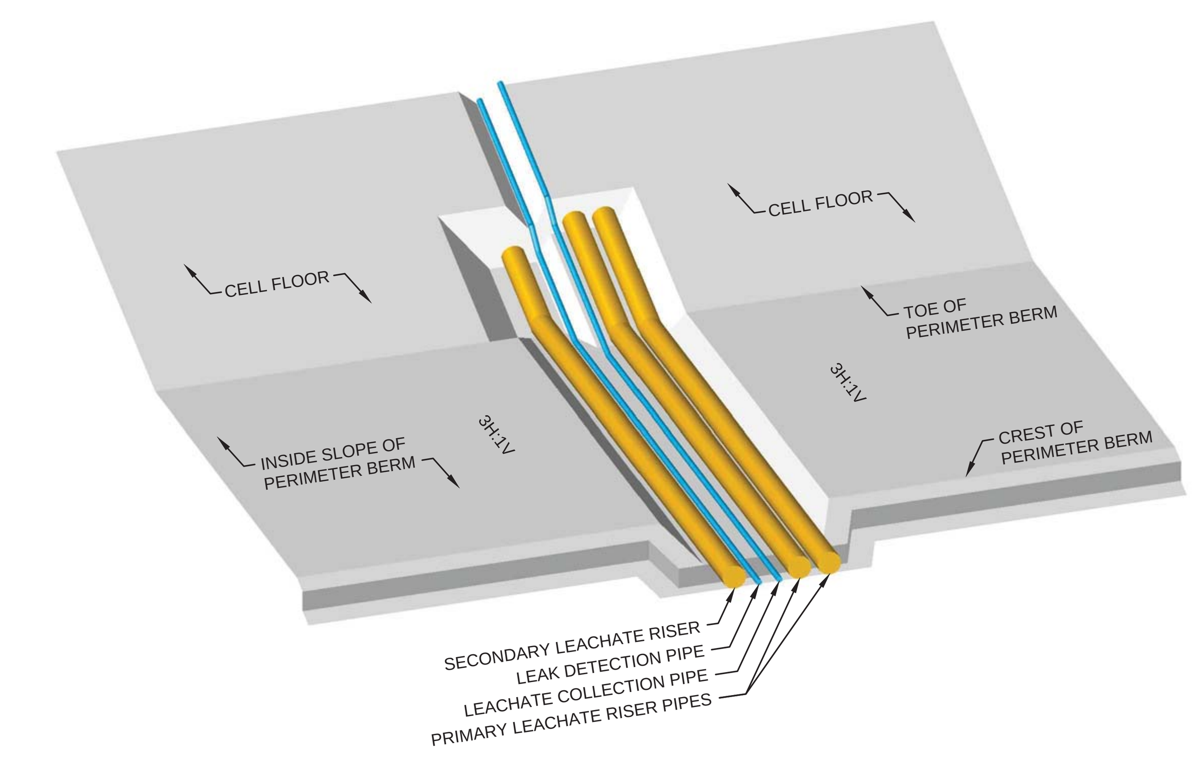
PERMIT DRAWING



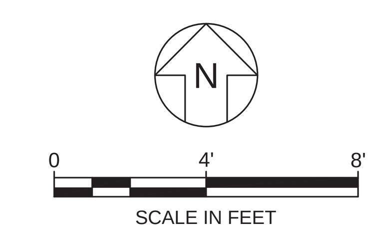
4/7 PLAN DETAIL (TYPICAL)
SECONDARY LEACHATE COLLECTION SUMP
SCALE: 1" = 4'
XREF: FL1962.02X2018



5/7 PLAN DETAIL (TYPICAL)
PRIMARY LEACHATE COLLECTION SUMP
SCALE: 1" = 4'
XREF: FL1962.02X2018



LEACHATE COLLECTION SUMP (3-D VIEW)
(NOT TO SCALE)



NOTES:

1. ALL SUMP RISERS SHALL BE PROVIDED WITH SEALABLE BLIND FLANGES AS APPROVED BY THE ENGINEER. ALL FLANGES FOR ALL PIPE SIZES SHALL HAVE RED RUBBER GASKETS. THE NUTS, BOLTS, AND WASHERS USED TO SECURE THE BLIND FLANGES SHALL BE ZINC PLATED.
2. ALL PIPE PENETRATIONS THROUGH LINER SYSTEM SHALL BE DOUBLE BANDED WITH NON-ADJUSTABLE STAINLESS STEEL CLAMPS (SEE SHEET 21 FOR DETAIL).

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

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AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE: LEACHATE SUMP PLAN - CELLS 8 THROUGH 13

PROJECT: SOLID WASTE RENEWAL PERMIT

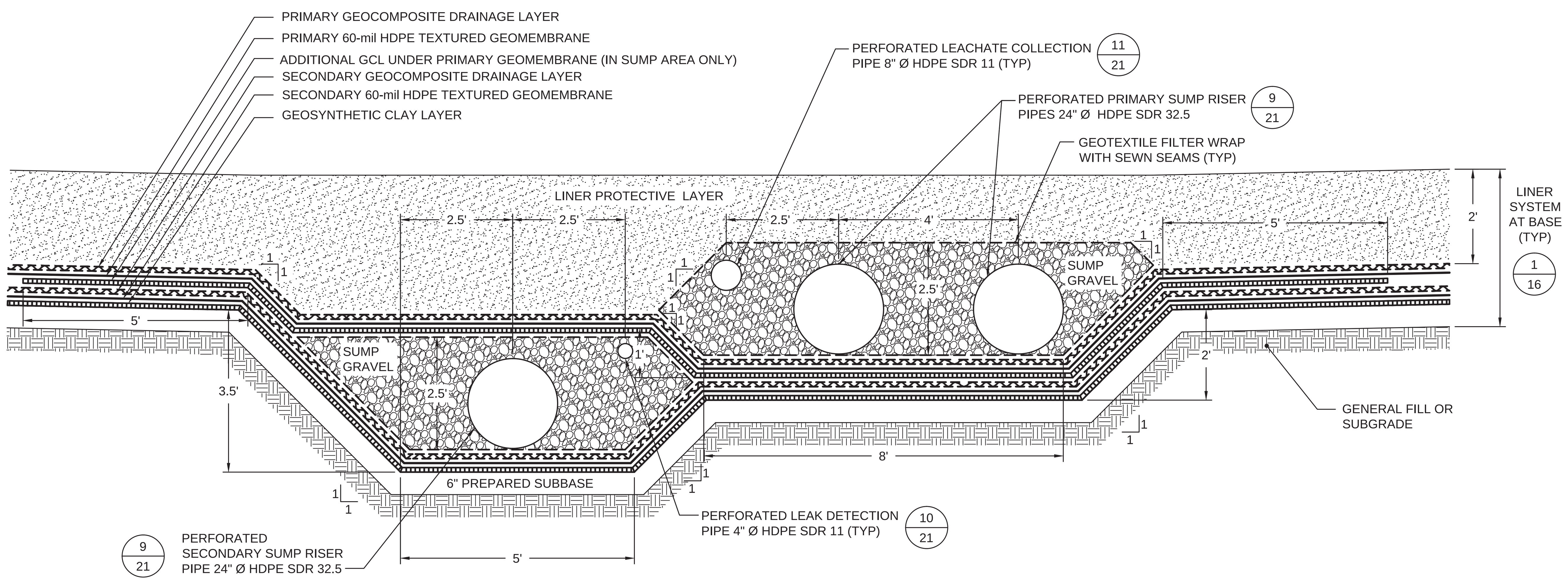
SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE
12/9/2014
DATE
CRAIG BROWNE - LICENSE NO. 68613

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

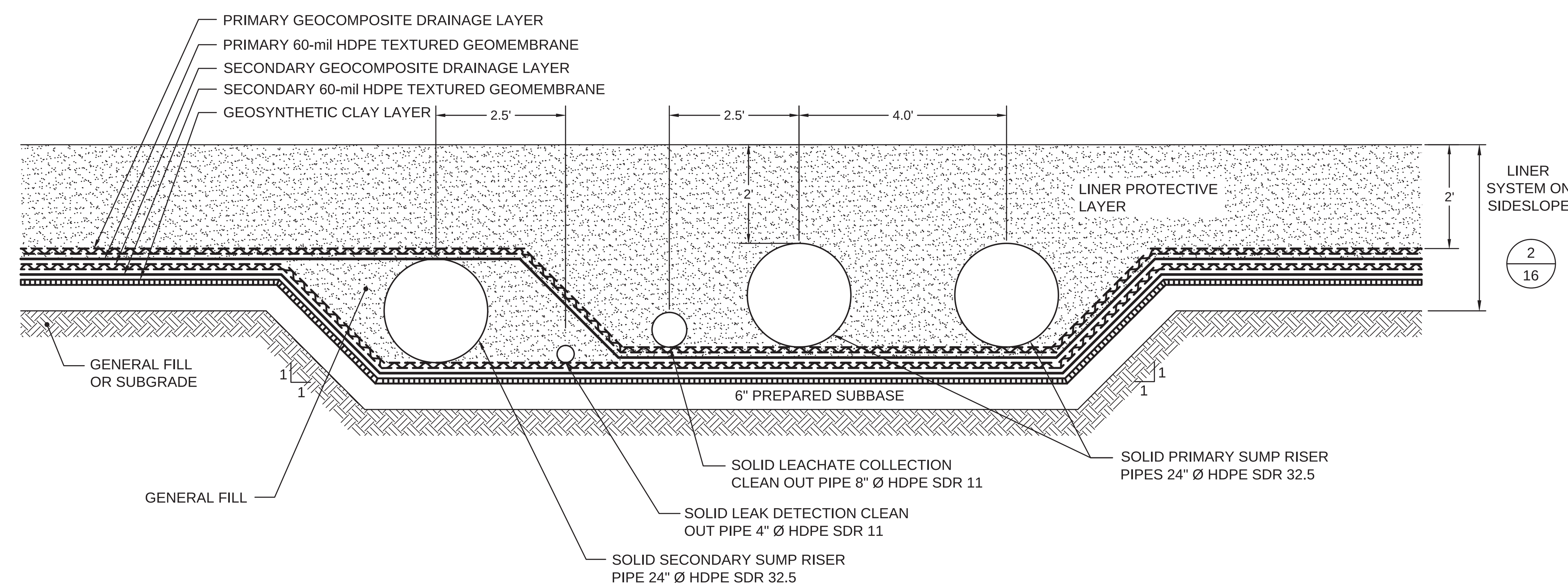
DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P171
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	17 OF 45	

PERMIT DRAWING



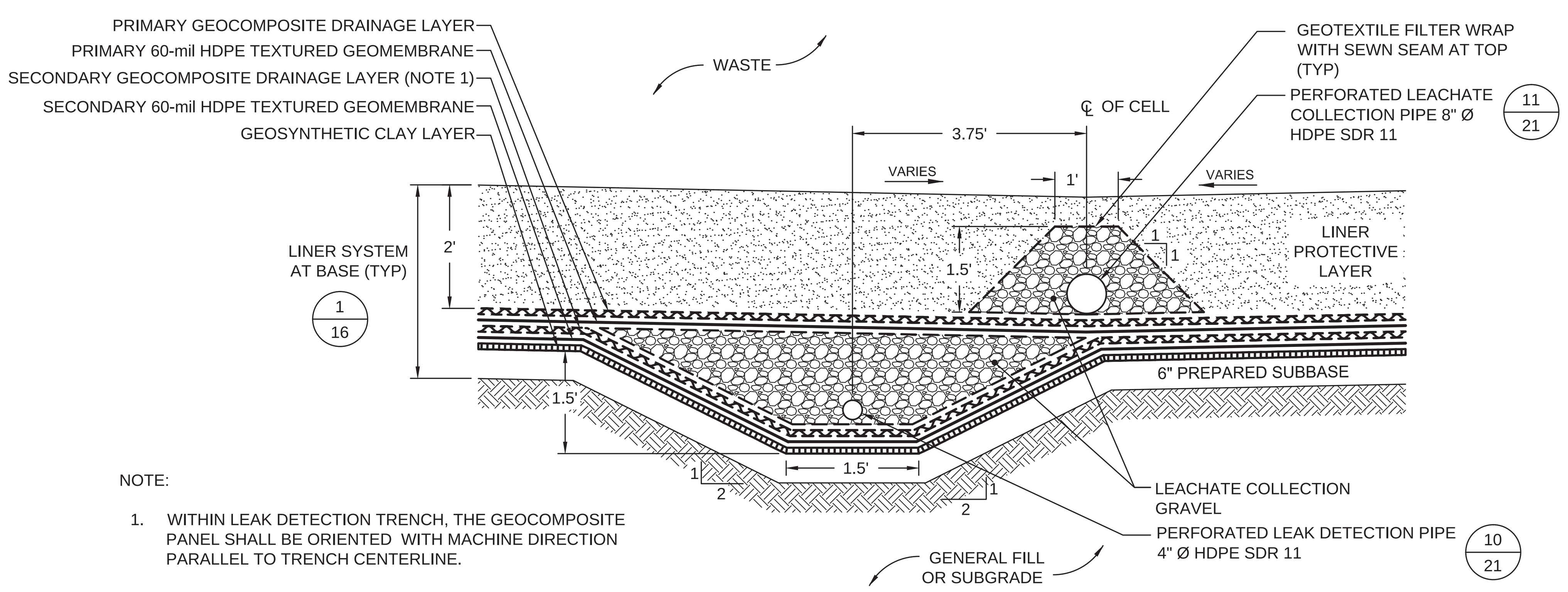
O/17 SECTION LEACHATE COLLECTION SUMP

SCALE: NOT TO SCALE
XREF: FL1962.02X2019



P/17 SECTION RISER TRENCH ON SIDE SLOPE

SCALE: NOT TO SCALE
XREF: FL1962.02X2020



NOTE:

1. WITHIN LEAK DETECTION TRENCH, THE GEOCOMPOSITE PANEL SHALL BE ORIENTED WITH MACHINE DIRECTION PARALLEL TO TRENCH CENTERLINE.

Q/7 SECTION LEACHATE COLLECTION AND LEAK DETECTION SYSTEMS

SCALE: NOT TO SCALE
XREF: FL1962.02X2016

NOTES:

1. DETAILS ARE SHOWN TO SCALE AS NOTED EXCEPT FOR THE GEOSYNTHETICS WHICH ARE SHOWN AT AN EXAGGERATED SCALE FOR CLARITY.

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

Geosyntec consultants
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AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE:
LEACHATE SUMP CROSS SECTIONS - CELLS 8 THROUGH 13

PROJECT:
SOLID WASTE RENEWAL PERMIT

SITE:
J.E.D. SOLID WASTE MANAGEMENT FACILITY

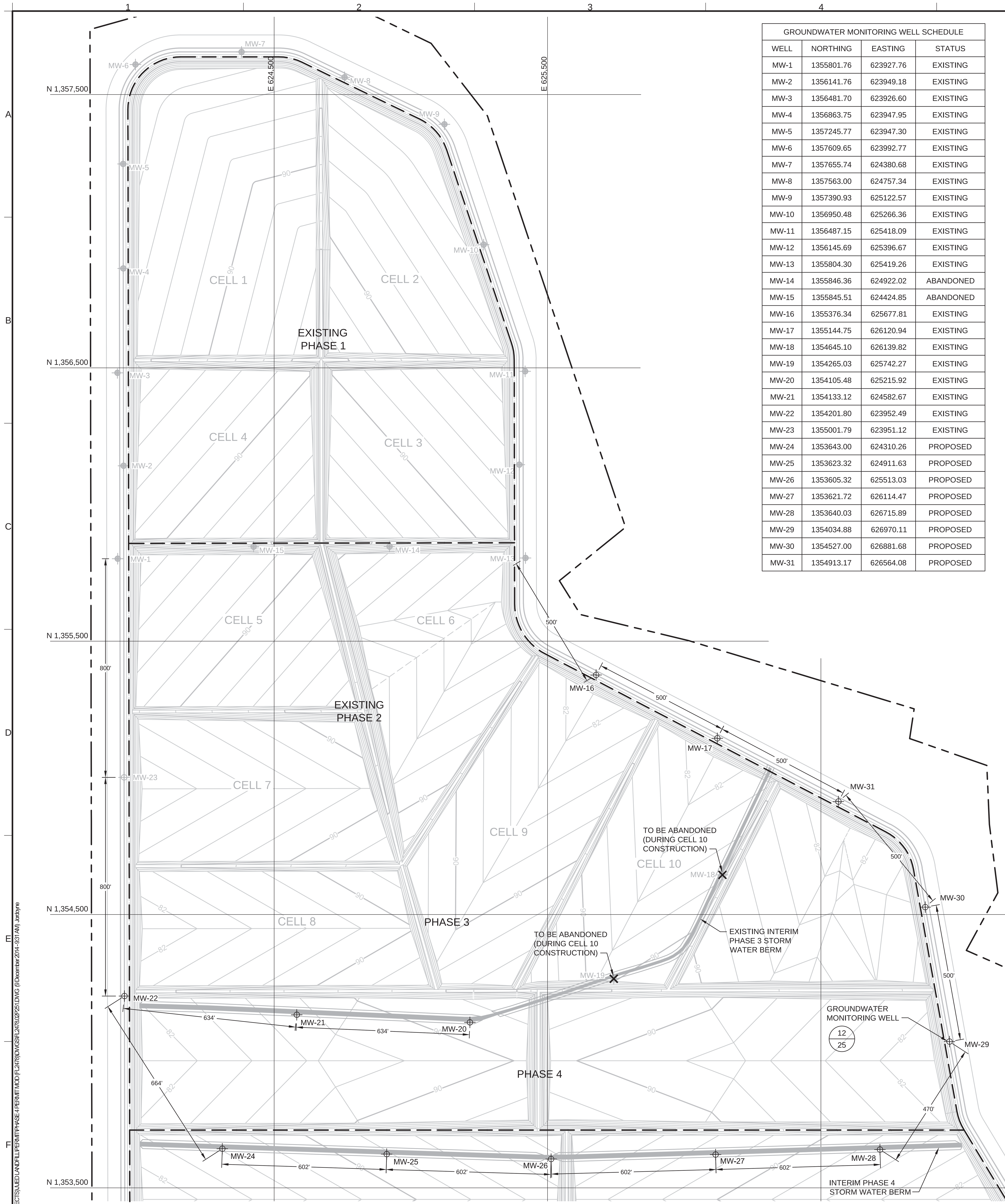
SIGNATURE
12/9/2014
DATE
CRAIG BROWNE - LICENSE NO. 68613

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P201
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	20 OF 45	

PERMIT DRAWING

GROUNDWATER MONITORING WELL SCHEDULE			
WELL	NORTHING	EASTING	STATUS
MW-1	1355801.76	623927.76	EXISTING
MW-2	1356141.76	623949.18	EXISTING
MW-3	1356481.70	623926.60	EXISTING
MW-4	1356863.75	623947.95	EXISTING
MW-5	1357245.77	623947.30	EXISTING
MW-6	1357609.65	623992.77	EXISTING
MW-7	1357655.74	624380.68	EXISTING
MW-8	1357563.00	624757.34	EXISTING
MW-9	1357390.93	625122.57	EXISTING
MW-10	1356950.48	625266.36	EXISTING
MW-11	1356487.15	625418.09	EXISTING
MW-12	1356145.69	625396.67	EXISTING
MW-13	1355804.30	625419.26	EXISTING
MW-14	1355846.36	624922.02	ABANDONED
MW-15	1355845.51	624424.85	ABANDONED
MW-16	1355376.34	625677.81	EXISTING
MW-17	1355144.75	626120.94	EXISTING
MW-18	1354645.10	626139.82	EXISTING
MW-19	1354265.03	625742.27	EXISTING
MW-20	1354105.48	625215.92	EXISTING
MW-21	1354133.12	624582.67	EXISTING
MW-22	1354201.80	623952.49	EXISTING
MW-23	1355001.79	623951.12	EXISTING
MW-24	1353643.00	624310.26	PROPOSED
MW-25	1353623.32	624911.63	PROPOSED
MW-26	1353605.32	625513.03	PROPOSED
MW-27	1353621.72	626114.47	PROPOSED
MW-28	1353640.03	626715.89	PROPOSED
MW-29	1354034.88	626970.11	PROPOSED
MW-30	1354527.00	626881.68	PROPOSED
MW-31	1354913.17	626564.08	PROPOSED

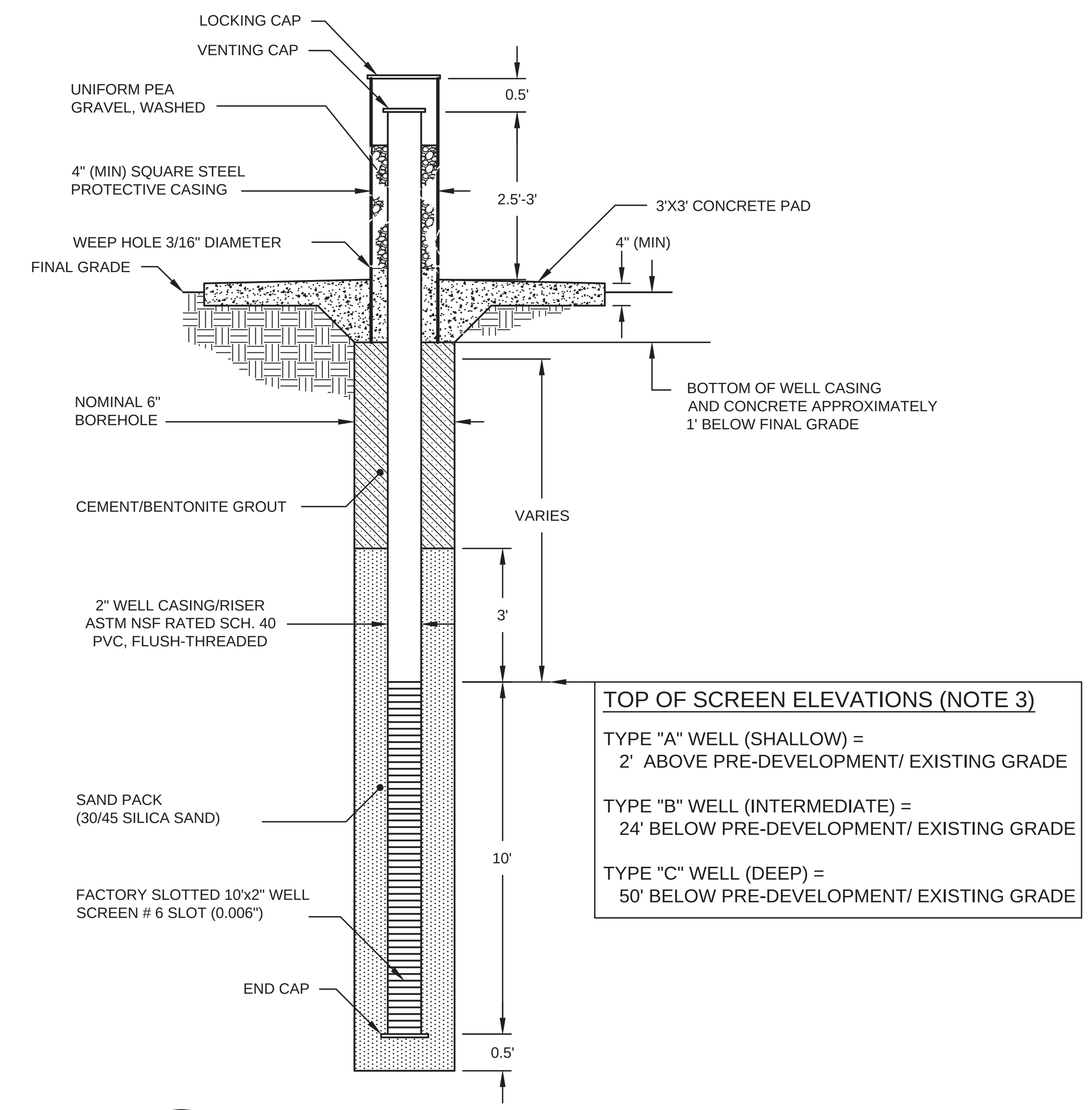


PHASES 1 THROUGH 4
GROUNDWATER MONITORING WELL LAYOUT
SCALE: 1" = 200'

SCALE IN FEET (0, 200', 400')

LEGEND

- PROPERTY BOUNDARY
- SUBBASE ELEVATION (FEET)
- EXISTING GROUNDWATER MONITORING WELL LOCATION
- GROUNDWATER MONITORING WELL LOCATION



12/25 DETAIL (TYPICAL)
GROUNDWATER MONITORING WELL
SCALE: NOT TO SCALE
XREF: FL1962.02X1206

NOTES:

1. NORTHING AND EASTING COORDINATES SHOWN REPRESENT FLORIDA STATE PLANE EAST ZONE NORTH AMERICAN DATUM OF 1983 (NAD83).THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)(FEET).
2. THE PROPERTY BOUNDARY IS BASED ON A COMPOSITE BOUNDARY SURVEY PROVIDED BY JOHNSTON SURVEYING INC., KISSIMMEE FLORIDA, DATED AUGUST 12, 1999.
3. AT EACH MONITORING WELL LOCATION A THREE WELL CLUSTER WILL BE INSTALLED TO SHALLOW, INTERMEDIATE, AND DEEP ELEVATIONS. THESE WELLS WILL BE SPACED 5 FEET APART AND ARRANGED PARALLEL TO THE PERIMETER MAINTENANCE ROAD OR INTERCELL BERM ALIGNMENTS OR ON TOP OF THE INTERIM STORM WATER BERMS.

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

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AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE: GROUNDWATER MONITORING NETWORK

PROJECT: SOLID WASTE RENEWAL PERMIT

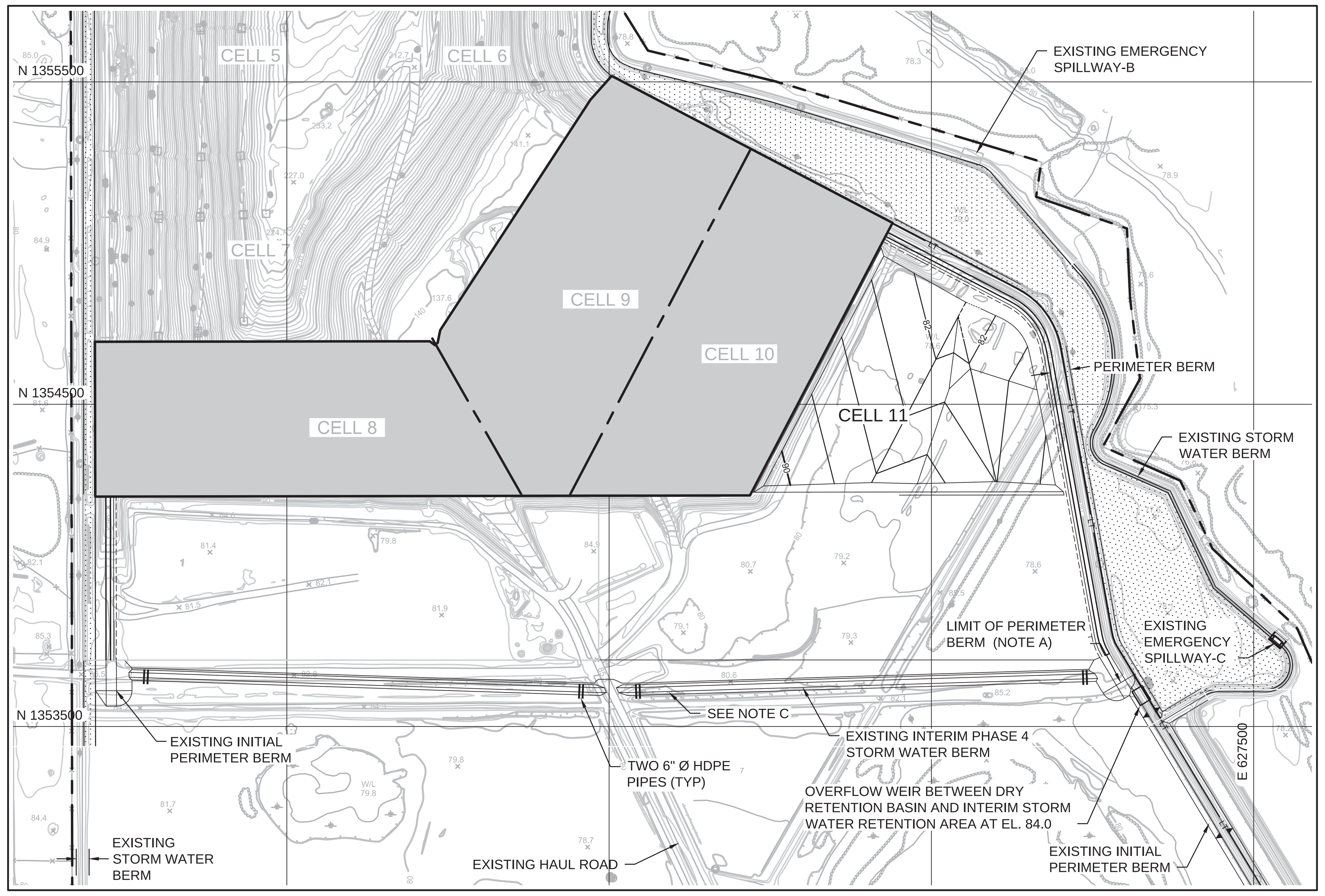
SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

SIGNATURE 12/9/2014 DATE
CRAIG BROWNE - LICENSE NO. 68613

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P251
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	25 OF 45	

PERMIT DRAWING



PHASE 4-A CONSTRUCTION SEQUENCING

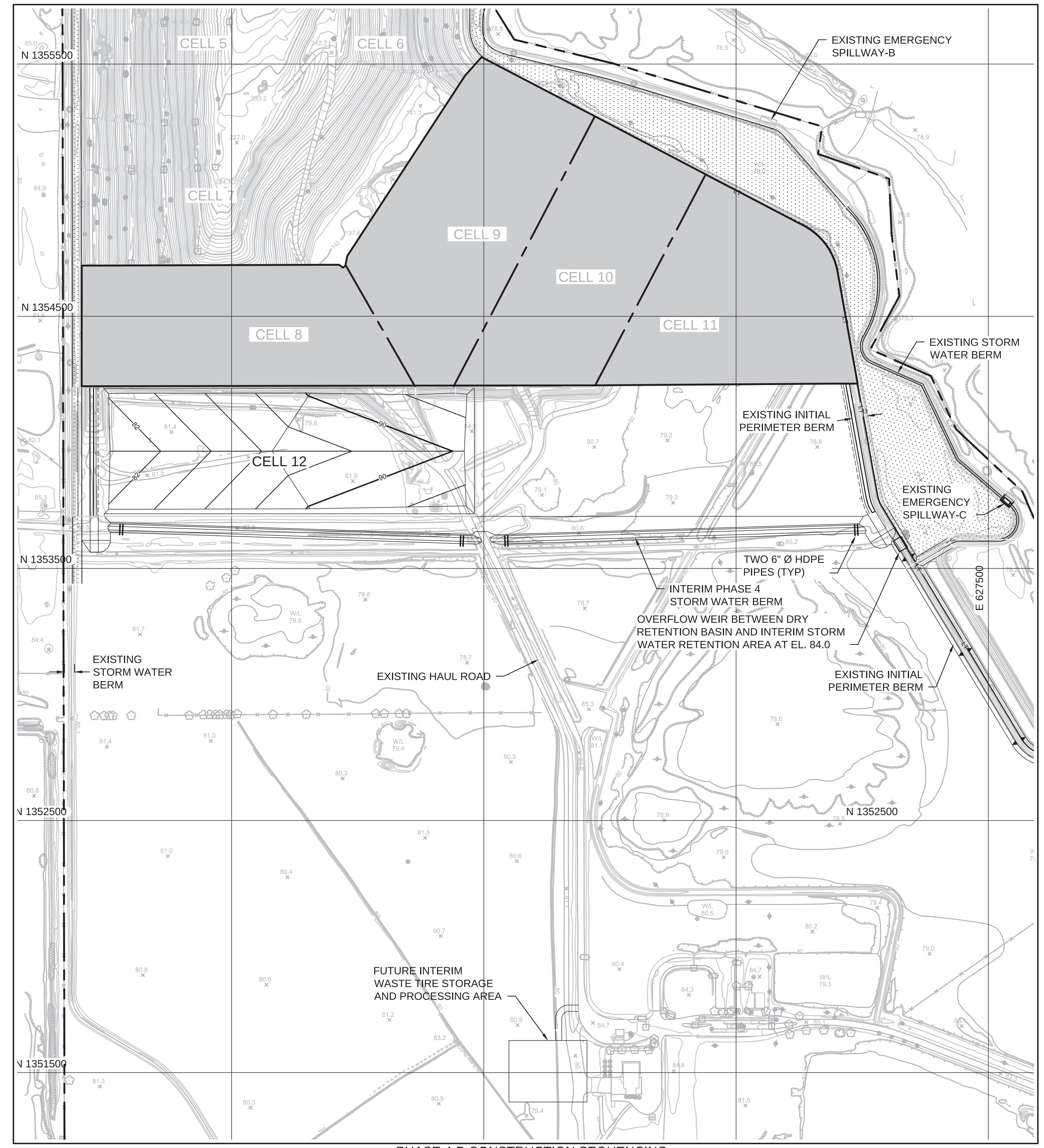
SCALE: 1" = 300'

PHASE 4-A CONSTRUCTION SEQUENCING NOTES

A. EXTEND EXISTING PERIMETER BERM (CREST EL. 96.0) TO 100 FT SOUTH OF LIMITS OF CELL 11 DURING CONSTRUCTION OF CELL 11.

B. CONSTRUCT CELL 11.

C. ABANDON TEMPORARY WATER QUALITY MONITORING WELLS MW-30 AND 31, AND INSTALL NEW MONITORING WELLS AT SAME LOCATION IN FINAL CONSTRUCTED PERIMETER BERM FOR CELL 11.



PHASE 4-B CONSTRUCTION SEQUENCING

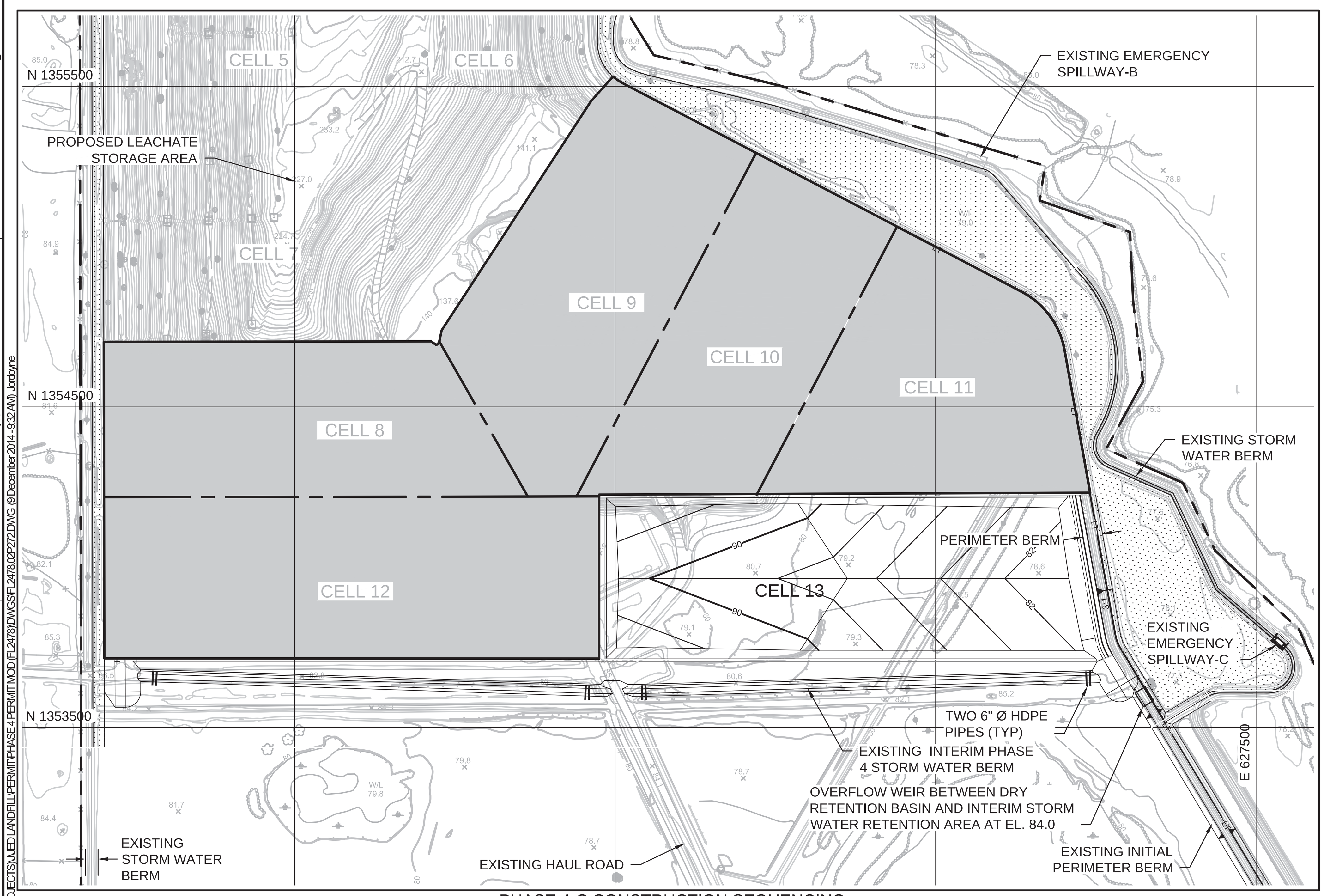
SCALE: 1" = 300'

PHASE 4-B CONSTRUCTION SEQUENCING NOTES

A. RELOCATE WASTE TIRE STORAGE AND PROCESSING AREA PRIOR TO BEGINNING CELL 12 CONSTRUCTION. NEW INTERIM LOCATION TO BE WEST OF THE EXISTING MAINTENANCE SHOP (SHEET 10). SIZE AND DETAILS WILL BE CONSISTENT WITH APPROVED WASTE TIRE STORAGE AND PROCESSING PLAN.

B. EXTEND EXISTING PERIMETER BERM TO 100 FT SOUTH OF LIMITS OF CELL 12 DURING CONSTRUCTION OF CELL 12.

C. CONSTRUCT CELL 12.



PHASE 4-C CONSTRUCTION SEQUENCING

SCALE: 1" = 300'

PHASE 4-C CONSTRUCTION SEQUENCING NOTES

A. EXTEND EXISTING PERIMETER BERM TO 100FT SOUTH OF LIMITS OF CELL 13 DURING CONSTRUCTION OF CELL 13.

B. CONSTRUCT CELL 13.

N

0 300' 600'

SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- 80 EXISTING GROUND ELEVATION (FEET) (NOTE 4)
- EXISTING FENCE
- 90 PROPOSED SUBBASE ELEVATION (FEET)
- STORM WATER MANAGEMENT BASIN

NOTES:

1. NORTHING AND EASTING COORDINATES SHOWN REPRESENT FLORIDA STATE PLANE EAST ZONE NORTH AMERICAN DATUM OF 1983 (NAD83).
2. THE ELEVATIONS SHOWN REPRESENT NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)(FEET).
3. THE PROPERTY BOUNDARY BASED ON A COMPOSITE BOUNDARY SURVEY PROVIDED BY JOHNSTON SURVEYING INC., KISSIMMEE FLORIDA, DATED AUGUST 12, 1999.
4. TOPOGRAPHIC INFORMATION SHOWN ON THIS DRAWING WAS PROVIDED BY BASE MAPPING CO. LTD BASED ON AN AERIAL PHOTOGRAPH TAKEN ON 16 MAY 2014.
5. RUNOFF FROM THE LANDFILL WILL BE DIRECTED TO, RETAINED BY, AND INFILTRATED WITHIN THE CONSTRUCTED STORM WATER MANAGEMENT SYSTEM.
6. DURING CELL CONSTRUCTION, CONTRACTOR STAGING AREAS WILL BE LOCATED IN ADJACENT FURTURE CELL FOOTPRINT.

PERMIT DRAWING

REV	DATE	DESCRIPTION	DRN	APP
2	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
1	JAN 2012	REVISED PER FDEP COMMENTS, RAI #1	JWO	VMD
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

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TEL: 407-891-3720 FAX: 407-891-3730

TITLE: PHASE 4 CONSTRUCTION SEQUENCING

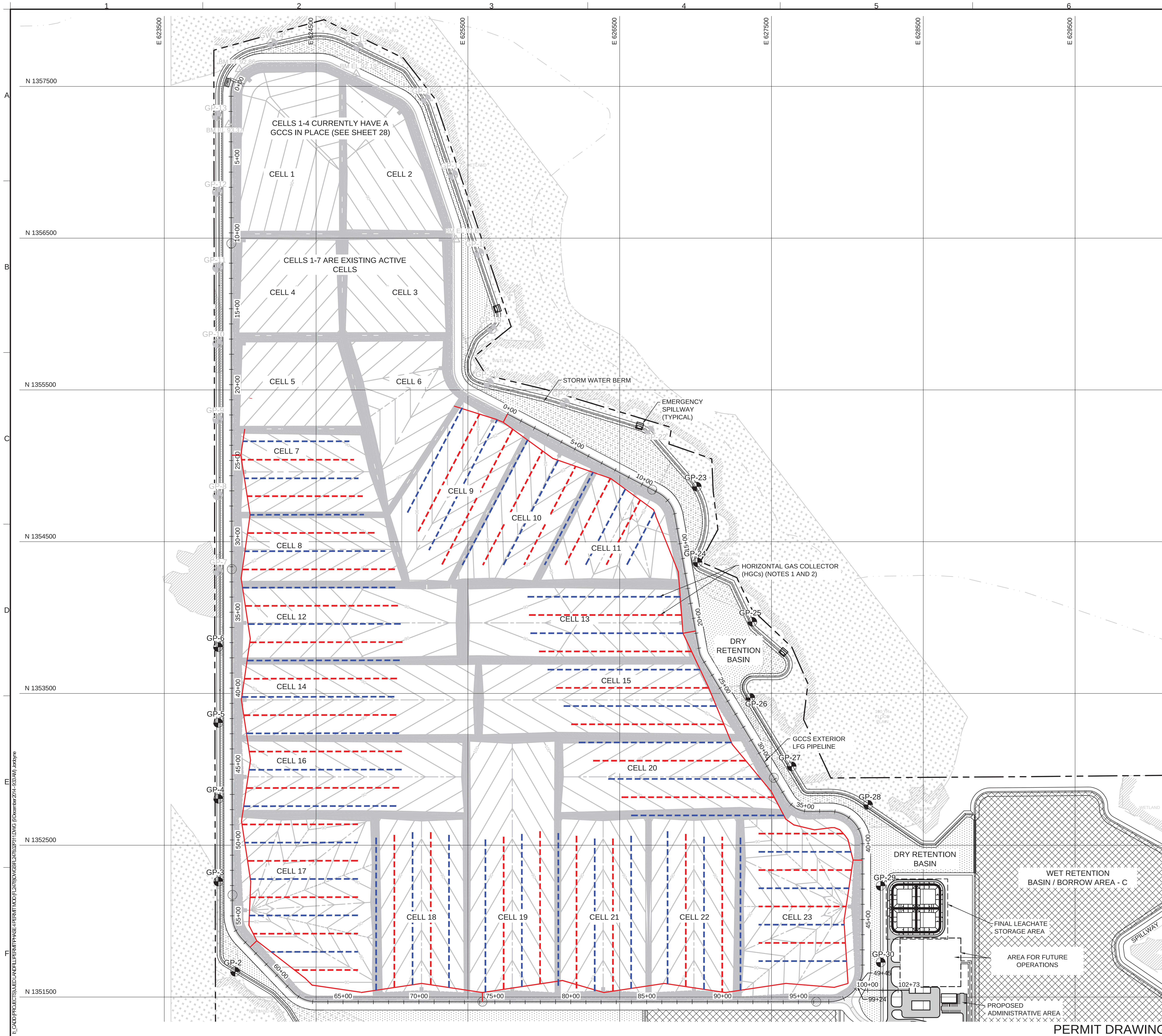
PROJECT: SOLID WASTE RENEWAL PERMIT

SITE: J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE
12/9/2014
DATE
CRAIG BROWNE - LICENSE NO. 68613

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P272
REVIEWED BY:	KBT	DRAWING NO.:	
APPROVED BY:	CRB	27 OF 45	



N

0 300' 600'

SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- EXISTING FENCE
- STORMWATER MANAGEMENT BASIN
- WET RETENTION / BORROW AREA BOUNDARY
- SUBGRADE ELEVATION (FEET)
- GP-18 EXISTING GAS MONITORING PROBE
- GP-23 PROPOSED GAS MONITORING PROBE
- PROPOSED HDPE HEADER PIPE (NOTE 5 AND 6)
- CONDENSATE KNOCKOUT POT
- 1+00 EXTERNAL HEADER ALIGNMENT - "LFG PIPELINE"
- UPPER TIER HGC
- LOWER TIER HGC

NOTES:

1. HORIZONTAL GAS COLLECTORS (HGCs) MAY BE USED AS TEMPORARY INTERIM LFG CONTROL MEASURES DURING WASTE FILLING OPERATIONS. THE LAYOUTS OF THE VERTICAL EXTRACTION WELLS ON SHEETS 33 AND 34 ARE DESIGNED TO PROVIDE ADEQUATE COVERAGE FOR THE DESIGN CAPACITY OF THE LANDFILL, THEREFORE, OPERATION OF THE HGCs WILL NOT INCREASE THE MAXIMUM ANTICIPATED GAS FLOWS FOR THE GAS MANAGEMENT SYSTEM (GMS). AS THE LANDFILL REACHES FINAL GRADES AND VERTICAL LFG WELLS ARE INSTALLED WITHIN A GIVEN CELL, THE LANDFILL OPERATOR MAY OPT TO ABANDON THE HGCs WITHIN THAT CELL, OR OPERATE EACH HGC FOR AS LONG AS IT IS FUNCTIONAL.

2. THE HGC WELL LAYOUT PRESENTED ON THIS SHEET IS PERMIT LEVEL ONLY, AND IS BASED ON THE PERMITTED HGC DESIGN PREPARED BY GOLDER ASSOCIATES (PERMIT NO. S049-199726-015), SUBMITTED TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, CENTRAL DISTRICT, ON 21 JULY 2010. THE HGC DESIGN FOR CELLS 7, 8 AND 9 IS ALREADY PERMITTED. FOR ALL DETAILS CONCERNING THE HGCs, INCLUDING CONNECTION DETAILS, SPACING, LENGTHS AND ELEVATIONS, REVIEWER SHALL REFER TO THE AFFOREMENTIONED PERMIT AND THE ENGINEERING REPORT PREPARED BY GOLDER ASSOCIATES.

REV	DATE	DESCRIPTION	DRN	APP
1	DEC 2014	INTERMEDIATE PERMIT MODIFICATION	JWO	CRB
0	NOV 2011	ISSUED FOR FDEP APPROVAL	JWO	VMD

Geosyntec consultants
13101 TELECOM DRIVE, SUITE 120
TEMPLE TERRACE, FLORIDA 33637 USA
PH: 813.558.0990 - FX:813.558.9726
AUTHORIZATION NUMBER: 4321

Progressive Waste Solutions
1501 OMNI WAY
ST. CLOUD, FLORIDA 34773
TEL: 407-891-3720 FAX: 407-891-3730

TITLE:

CONCEPTUAL LAYOUT OF HORIZONTAL GAS COLLECTORS

PROJECT:

SOLID WASTE RENEWAL PERMIT

SITE:

J.E.D. SOLID WASTE MANAGEMENT FACILITY

SIGNATURE

12/9/2014

DATE

CRAIG BROWNE - LICENSE NO. 68613

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

DESIGN BY:	CRB	DATE:	DECEMBER 2014
DRAWN BY:	JWO/CMV	PROJECT NO.:	FL2478.02
CHECKED BY:	CRB	FILE:	FL2478.02P311
REVIEWED BY:	KBT	DRAWING NO.:	32 OF 45
APPROVED BY:	CRB		

PERMIT DRAWING

ATTACHMENT 3
HISTORY OF ENFORCEMENT ACTIONS

Progressive Waste Solutions of FL, Inc. Compliance History (formerly Waste Services of FL, Inc.)

Date	Facility	Location	Permit Number	Issuing Agency	Type of Action	Nature of Violation	Disposition	Fine or Penalty
09/06/13	Opa Locka Recycling and Transfer Station	Opa Locka, FL	0075972-013-SO/SW-1087	FDEP/ DERM	NOV	Acceptance of unacceptable material	Closed. $500 fee paid.	$500

Note:
As of 2/14/2014 and subsequent to all facility permit transfer to Progresswe Waste Solutions of FL, Inc. (fka Waste Services of Florida, Inc.)
List includes only those violations which have been issued fines or consent orders for facilities in Florida within the last five (5) years.

ATTACHMENT 4
SETTLEMENT CALCULATIONS

Geosyntec consultants

COMPUTATION COVER SHEET

Client: **PWSFL** Project: **JED Cell 11-13 Base Grade Revs.** Project No.: **FL2478**

Phase No.: **01**

Title of Computations **SUBGRADE SETTLEMENT ANALYSIS**

Computations by:	Signature		29 October 2014 (Date)
	Printed Name	Victor M. Damasceno, Ph.D. P.E.	
	Title	Project Engineer	
Assumptions and Procedures Checked by: (peer reviewer)	Signature		30 October 2014 (Date)
	Printed Name	Craig R. Browne, P.E.	
	Title	Project Engineer	
Computations Checked by:	Signature		30 October 2014 (Date)
	Printed Name	Kwasi Badu-Tweneboah, Ph.D., P.E.	
	Title	Associate	
Computations Backchecked by: (originator)	Signature		31 October 2014 (Date)
	Printed Name	Victor M. Damasceno, Ph.D., P.E.	
	Title	Project Engineer	
Approved by: (pm or designate)	Signature		9 December 2014 (Date)
	Printed Name	Craig R. Browne, P.E.	
	Title	Project Engineer	

Approval notes:

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

SUBGRADE SETTLEMENT ANALYSIS
J.E.D. SOLID WASTE MANAGEMENT FACILITY
ST. CLOUD, OSCEOLA COUNTY, FLORIDA

1 INTRODUCTION

The purpose of this analysis is to calculate the settlement of foundation soils below the liner system and to estimate the liner post-settlement grades and tensile strains for the proposed base grade revisions for Cells 11, 12, and 13 at the J.E.D. Solid Waste Management (JED) facility. The performance of the liner and leachate collection system is evaluated to ensure that:

- A minimum 0.3% slope is maintained along the leachate collection corridor pipes.
- A minimum 1.0% slope is maintained along portions of the leachate collection system (i.e., cross slopes) that drain towards the leachate collection corridor pipes. .
- Maximum tensile strains in the liner system do not exceed the maximum allowable tensile strains for the geomembrane liner.

2 METHODOLGY

Elastic settlement theory is used to calculate settlement for sandy soils while one-dimensional (1-D) consolidation theory is used to calculate settlement for clayey soils as described below.

For elastic and consolidation settlement calculations, a simplified one-dimensional stress distribution is used to calculate stress increase under a loaded area. One-dimensional stress distribution assumes that stress dissipation does not occur with depth. As such, the change in stress in the foundation soils is assumed to be equal to the weight of the materials placed or removed vertically above the location of interest. This stress distribution is appropriate for locations with foundation footprints significantly larger than the depth of potentially settlement prone soils. In this case the maximum depth of compressible soil extends approximately 300 ft below ground surface (bgs), compared to the average width of the proposed landfill of approximately 1,400 to 3,000 ft.

A one-dimensional stress distribution typically results in an overestimation of settlement beneath the crest of a large slope and an underestimation of settlement at the toe of a slope.

Therefore, this simplification results in a conservative estimation of the settlements that could occur along the leachate collection system.

2.1 Elastic Settlement

Settlement of foundation soils exhibiting elastic settlement behavior (i.e., sandy, cohesionless soil units) are calculated using the following equation (Lambe and Whitman, 1969):

$$\Delta S = \frac{\Delta \sigma_v'}{D} \Delta H \qquad (1)$$

where,

ΔS = total settlement for a ΔH thick layer (ft)

ΔH = layer thickness (ft)

$\Delta \sigma'_v$ = change in effective vertical stress at the mid-point of the layer (psf)

D = constrained elastic modulus = $\frac{E(1-\mu)}{(1+\mu)(1-2\mu)}$ (psf)

E = elastic modulus $=(194+8N)(1-\mu^2)tsf$ (U.S. Army Corp of Engineers, 1990)

N = is the average measured Standard Penetration Test (SPT) "N" value

μ = Poisson's ratio

2.2 1-D Consolidation Settlement

Settlement of foundation soils exhibiting plastic settlement behavior (i.e., clay/clayey, cohesive soil units) are calculated using equations for conventional 1-D consolidation theory used in geotechnical engineering. The clayey foundation soils are conservatively assumed to be normally consolidated and the settlement is calculated using the following equation (Holtz and Kovacs, 1981):

$$\Delta S = C_{c\varepsilon} \cdot \Delta H \cdot \log\left(\frac{\sigma'_{vo} + \Delta \sigma'_v}{\sigma'_{vo}}\right) \qquad (2)$$

where:

ΔS = total settlement for a ΔH thick layer (ft)

ΔH = initial thickness of compressible layer (ft)

$C_{c\varepsilon}$ = modified compression index

σ'_{vo} = initial effective overburden stress (psf)

$\Delta \sigma'_{v}$ = increase in effective stress due to overburden pressure of the landfill (psf)

2.3 Settlement and Strain Calculation Steps

A summary of the steps used to perform the settlement and liner strain calculations is presented as follows:

- Potentially critical cross sections are identified that include the flattest liner system slopes, and therefore, the highest potential for adverse effects due to settlement (i.e., leachate collection corridors and cell cross-slopes).
- Calculation points are selected along the identified cross sections at locations where change in grade occurs in the final cover system and the liner system.
- For each calculation point, the subsurface profile beneath the liner system is identified and broken into distinct layers, consistent with standard penetration test (SPT) boring intervals (i.e., 2-ft layers for top 10 ft and 5-ft layers thereafter), and material properties (i.e., strength parameters and layer classification – N-values and sands or clays). For points that do not coincide with boring locations, the subsurface profile parameters were calculated using the Inverse Distance Weighted Average (IDWA) method, detailed in Section 3.
- Using Equations 1 and 2, the settlement for each subsurface layer is calculated. The total settlement at a point is found by summing the contribution of the settlement from each compressible layer beneath a point.
- Calculated settlements are subtracted from the proposed subgrade elevation of the liner system to obtain the post-settlement subgrade elevation.
- Post-settlement grades are evaluated based on post-settlement elevations and the horizontal distance between each pair of adjacent calculation points.
- Pre- and post-settlement elevations between a pair of adjacent calculation points are

used to assess the pre- and post-settlement length of the liner between the two calculation points. The difference in length relative to the initial length between the calculation points is used to assess the strain in the liner system according to the following equation:

$$\varepsilon = \frac{L_o - L_f}{L_o} \times 100 \tag{3}$$

where:

ε = strain in the liner system (+ indicates compression, – indicates tension)

L_f = final length between calculation points based on post-settlement elevations

L_o = initial length between calculation points based on pre-settlement elevations

The estimated tensile strains were compared to the conservative allowable tensile strain of 5% (Berg and Bonaparte, 1993) for the liner system geomembrane.

3 INVERSE DISTANCE WEIGHTED AVERAGE

This section describes the methodology used to estimate subsurface parameters at any given point inside the landfill footprint (i.e., calculation points). The IDWA method was used to estimate N-values and material properties (i.e., sand or clay) for the calculation points used in the settlement analysis. The IDWA method provides a weighted average that is influenced most by nearby data, as such, as the distance to other data points increases, the average is less affected. A common IDWA method is also known as Shepard's Method, described as follows:

$$F = \sum_{i=0}^{n-1} \left(w_i N_i \right) \tag{4}$$

where n is the number of surrounding points, N is the set of data points being interpolated (i.e., N-values obtained from borings at a given depth), and w is the weighing function, defined as follows:

$$w = \frac{d_i^{-p}}{\sum_{j=0}^{n-1} d_j^{-p}} \tag{5}$$

where *p* is the power parameter (typically equal to 2) and *d* is the distance between the desired point and surrounding data.

The IDWA method allows a parameter (i.e., N-value) to be estimated at any point within the footprint of the landfill, at any given depth. The advantage is that the IDWA method allows information from deeper borings to be added to shallow surrounding borings without modifying the measured data.

Data from 150 to 300 ft below land surface (bls) were interpreted based on measured N-values and the subsurface model presented in the *Geotechnical Investigation Report* included as Appendix D of the 2011 Lateral Expansion Permit Application (Geosyntec, 2011). A summary of the measured N-values for the borings are presented in Figure 1. Figure 2 presents a summary of the measured and calculated N-values versus depth.

4 SUBSURFACE STRATIGRAPHY

Information regarding subsurface stratigraphy and geotechnical properties used for the settlement calculations is summarized below. A detailed discussion of the soil layers and empirical correlations used to estimate soil properties is presented in the *Geotechnical Investigation Report* (Geosyntec, 2011). The subsurface stratigraphy encountered at the site generally consists of the following:

- Undifferentiated sands (i.e., sands and silty sandy soils) comprising the Post Hawthorn formation to a depth of 155 ft, bgs.
- Interbedded clay, silts, and sands with varying thickness are encountered from approximately 155 to 300 ft, bgs. These layers include soils from the Peace River Formation, Arcadia Formation interbedded with cohesive and sandy soils, comprising the Hawthorn formation.

The groundwater table was assumed to be at the original ground surface (i.e., EL 80 ft, National Geodetic Vertical Datum 1929 (NAVD29)) and all soils within the undifferentiated sand layer and Hawthorn Group were considered to be fully saturated.

5 MATERIAL PROPERTIES

Material properties used in the settlement analyses are discussed in the following subsections and summarized in Table 1.

5.1 Structural Fill, Liner and Final Cover Systems

The soil material to be used as structural fill and the protective layer components of the liner and final cover systems was assumed to have a unit weight of 120 pcf. The protective layer soils for the liner and final cover systems were considered as vertical loading for the foundation soils in this calculation package. The structural fill was also assumed as vertical loading; however, the settlement of the structural fill layer itself was neglected because it is installed in controlled compacted lifts.

5.2 Waste

Waste was considered as vertical loading for the foundation soils in this calculation package. The unit weight of the compacted waste, including initial cover soils, is assumed to be 70 pcf. Settlement of the waste itself is not calculated because it is above the liner system and therefore does not affect the subgrade settlement calculations.

5.3 Subsurface Soils

The unit weight of the sandy subsurface soils is assumed to be 115 pcf. The elastic and constrained moduli of the sandy soils are calculated for each SPT interval (i.e., 5-ft layers) and SPT N-value. Figure 1 shows a compilation of the SPT data obtained at the site for a total of 21 soil borings with SPTs (i.e., 15 borings from 2002 and 6 borings from 2010). Typical values of Poisson's ratio for sand range between 0.3 and 0.4 (see Table 2). For the purpose of this calculation package, the Poisson's ratio is conservatively assumed to be 0.3 for the subsurface sandy soils.

As discussed in the 2010 Geotechnical Investigation Report, the unit weight of the subsurface clayey soils is assumed to be 115 pcf and the modified compression index ($C_{c\varepsilon}$) is assumed to be 0.10.

6 CROSS SECTIONS ANALYZED

Slopes along leachate collection corridors and the base liner were analyzed within the cells proposed as part of the lateral expansion and previously permitted cells that will experience increased overburden loading due to the proposed final cover grading plan. The locations of the settlement points on the proposed liner and final cover grading plans are illustrated on Figures 3 and 4, respectively.

7 RESULTS

Settlement calculations performed using MathCAD® are presented in Attachment 1. The calculation results are summarized in Tables 3 and 4 for the analyzed points.

Inspection of Tables 3 and 4 reveals that the calculated post-settlement subgrade slopes along leachate collection corridor pipes meet or exceed 0.3%, and the calculated post-settlement subgrade slopes along the cell floor cross-slopes draining towards leachate collection pipes meet or exceed 1.0%. The maximum calculated liner tensile strain in the liner system for all cases analyzed is 0.006%, which is less than the allowable tensile strain of 5% (Berg and Bonaparte, 1993) for polyethylene geomembrane materials.

8 CONCLUSIONS

Based on the results of the settlement calculations, the following conclusions can be made:

- a minimum slope of 0.3% will be maintained along leachate collection corridor pipes and a minimum grade of 1.0% will be maintained along the cell floor cross slopes draining towards leachate collection pipes for the post-settlement conditions; and
- maximum tensile strains in the liner system are less than the allowable tensile strain for the liner system geosynthetic components.

9 REFERENCES

Berg, R.R. and Bonaparte, R., (1993) "Long-Term Allowable Tensile Stresses for Polyethylene Geomembranes," Geotextiles and Geomembranes, Vol. 12, pp. 287-306.

Coduto, D.P., (2001) "*Foundation Design, Principles and Practices*," Prentice-Hall, Inc. Upper Saddle River, NJ.

Geosyntec Consultants (2011), "*Landfill Lateral Expansion – Application for a Major Permit Modification, J.E.D. Solid Waste Management Facility,*" February 2011.

Holtz, R.D., and Kovacs, W.D. (1981) "*An Introduction to Geotechnical Engineering*," Prentice-Hall Inc., Englewood Cliffs, NJ.

Lambe, T.W., and Whitman, R.V., (1969) "*Soil Mechanics*," John Wiley and Sons, Inc., New York.

U.S. Army Corps of Engineers (1990). "Engineering and Design: Settlement Analysis" Engineer Manual 1110-1-1904.

TABLES

Table 1

Summary of Material Properties

Material	Unit Weight (lb/ft^3)	Layer Thickness (ft)	Elastic Modulus	$C_{c\varepsilon}$
Liner and Final Cover Systems Protective Layers	120	2 and 3, respectively	---	---
Waste	70	Varies	---	---
Structural Fill	120	Varies	---	---
Surficial Soils (Post Hawthorn Formation):				
Sands	115	Varies[1]	Varies with SPT	---
Clays	115	Varies[1]		0.1
Hawthorn Group Soils:				
Sands	115	Varies[1]	Varies with SPT	---
Clays	115	Varies[1]		0.1

Notes: 1. Thickness and/or presence of sand or clay layer varies according to actual boring information and IDWA extrapolation for point locations that do not coincide with a boring location.

Table 2

Typical Ranges of Poisson's Ratio
(Coduto, 2001)

TABLE 14.1 TYPICAL VALUES OF POISSON'S RATIO FOR SOILS AND ROCKS (Adapted from Kulhawy, et al., 1983)

Soil or Rock Type	Poisson's Ratio, ν
Saturated clay, undrained conditions	0.50
Partially saturated clay	0.30–0.40
Dense sand, drained conditions	0.30–0.40
Loose sand, drained conditions	0.10–0.30
Sandstone	0.25–0.30
Granite	0.23–0.27

Table 3

Summary of Settlement Calculation Results

Point ID[1,2]	Init. Elev. (ft)	Final Elev. (ft)	Settlement
11.1	80.500	79.494	1.006 ft
11.2	84.000	81.100	2.900 ft
11.3	86.311	82.529	3.782 ft
11.4	82.160	80.449	1.711 ft
11.5	83.958	82.279	1.679 ft
11.6	90.230	85.623	4.607 ft
11.7	84.362	81.295	3.067 ft
11.8	86.977	83.961	3.016 ft
11.9	83.275	81.572	1.703 ft
12.1	80.000	79.297	0.703 ft
12.2	86.423	82.124	4.299 ft
12.3	90.230	85.485	4.745 ft
12.4	88.754	84.373	4.381 ft
12.5	84.154	81.086	3.068 ft
12.6	92.000	87.201	4.799 ft
12.7	88.630	84.030	4.600 ft
13.1	80.000	79.306	0.694 ft
13.2	86.627	82.361	4.266 ft
13.3	90.479	85.856	4.623 ft
13.4	89.780	85.051	4.729 ft
13.5	85.154	81.670	3.484 ft
13.6	90.753	85.906	4.847 ft
13.7	87.266	82.726	4.540 ft

Notes: 1. Refer to Figures 3 and 4 for point location.
2. Definition of Point ID: X.Y where X is the Cell number and Y is the point identified within the Cell.

Table 4

Summary of Slope and Tensile Strain Calculation Results

Cell	Point 1	Point 2	Initial Slope (%)	Final Slope (%)	Allowable (%)	Strain (%)
11	11.2	11.1	1.0	0.46	0.30	3.9E-03
	11.3	11.2	1.0	0.62	0.30	3.1E-03
	11.4	11.1	1.0	0.57	0.30	3.3E-03
	11.5	11.4	0.5	0.51	0.30	-4.6E-05
	11.6	11.7	1.5	1.11	1.00	5.2E-03
	11.8	11.9	1.5	1.00	1.00	5.9E-03
12	12.2	12.1	1.0	0.44	0.30	4.0E-03
	12.3	12.2	0.5	0.44	0.30	2.8E-04
	12.4	12.5	1.4	1.00	1.00	4.8E-03
	12.6	12.7	1.4	1.32	1.00	1.1E-03
13	13.2	13.1	1.0	0.46	0.30	3.9E-03
	13.3	13.2	0.5	0.47	0.30	2.4E-04
	13.4	13.5	1.4	1.02	1.00	4.6E-03
	13.6	13.7	1.4	1.28	1.00	1.7E-03

FIGURES

Figure 1

Summary of Measured N-Values
JED Facility, St. Cloud, FL

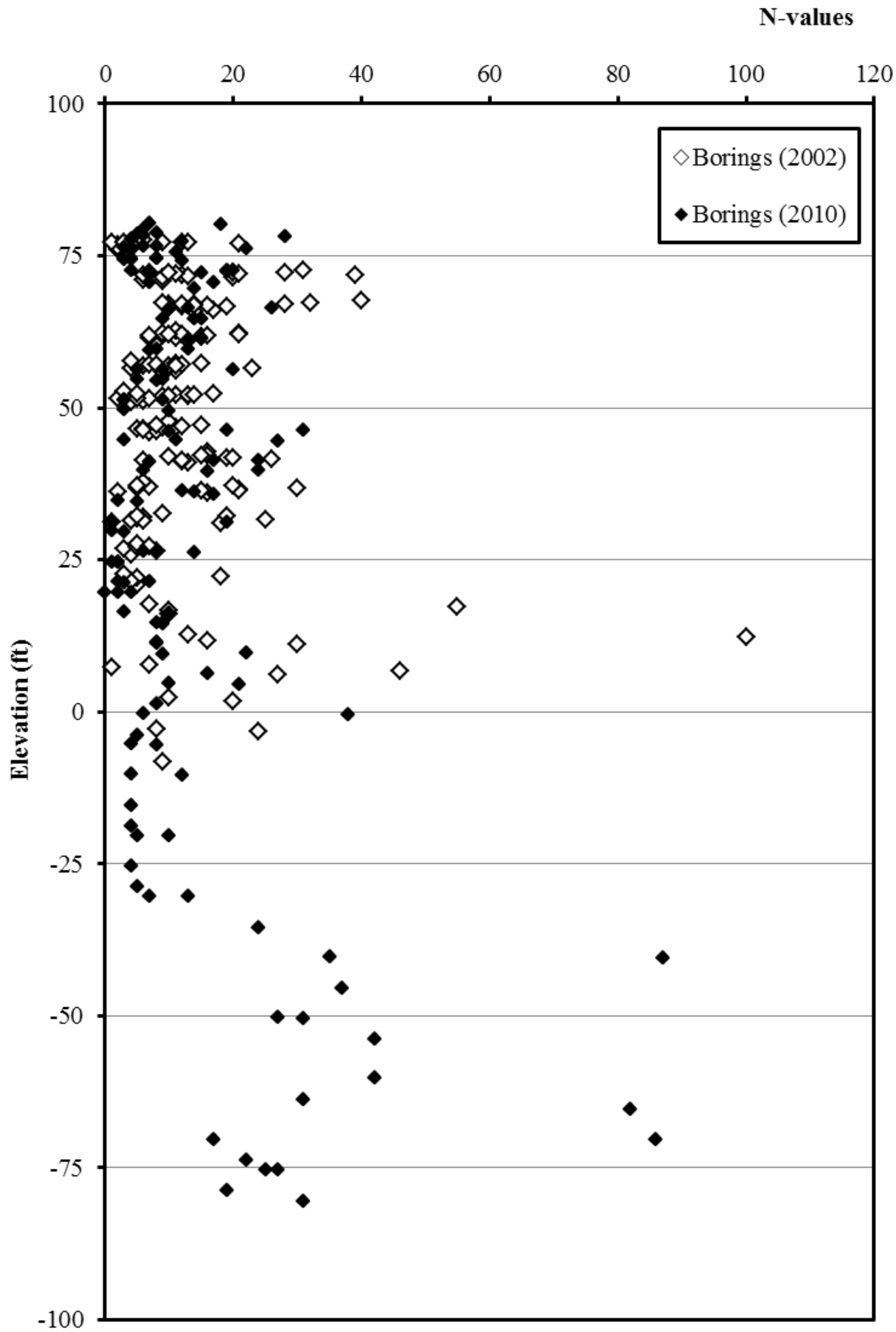
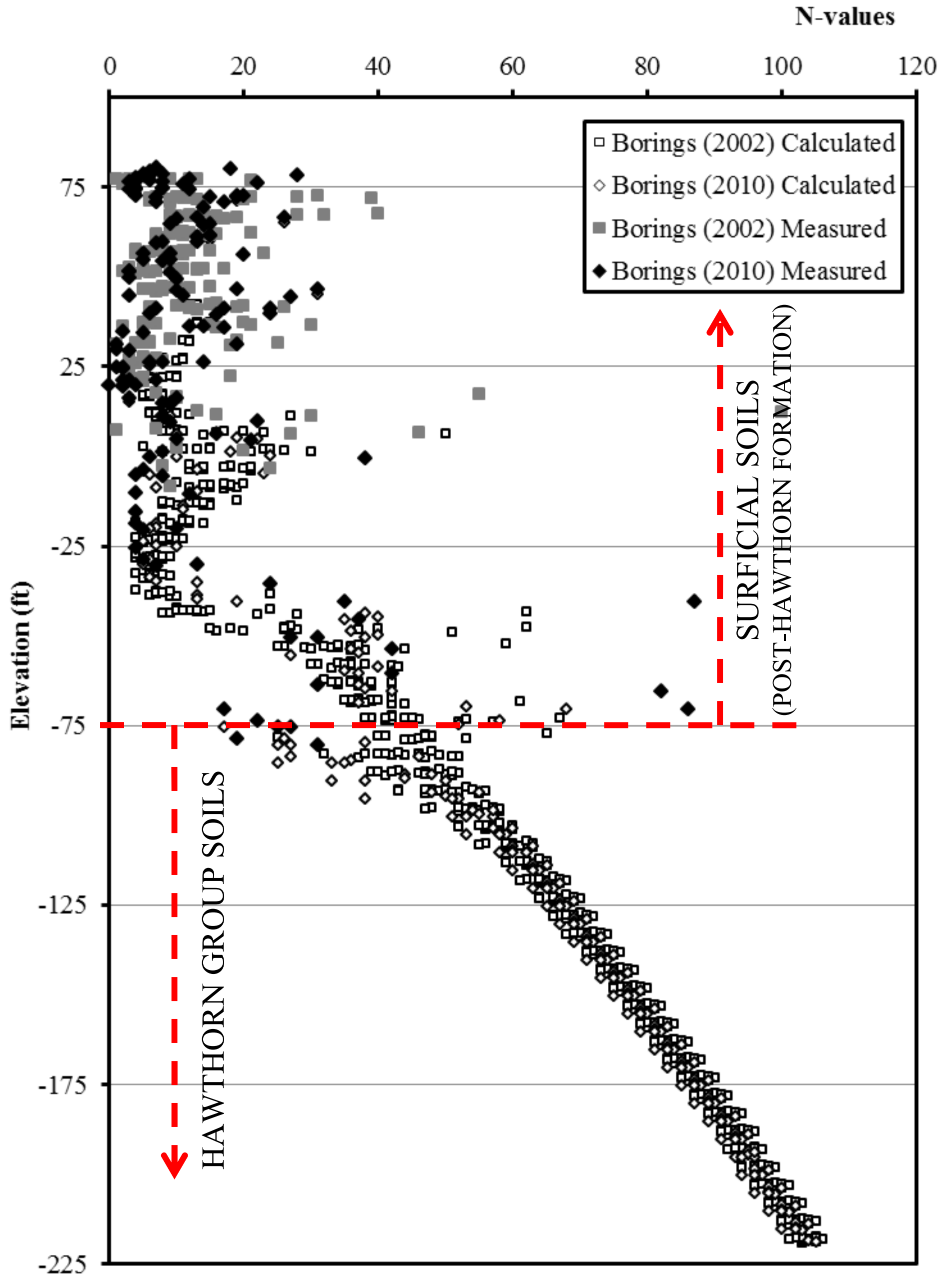


Figure 2

Summary of Measured and Calculated[1] N-Values
JED Facility, St. Cloud, FL



Notes: 1. N-values calculated using the IDWA method.

Figure 3
Locations of Analyzed Settlement Points on Liner Grading Plan
JED Facility, St. Cloud, FL

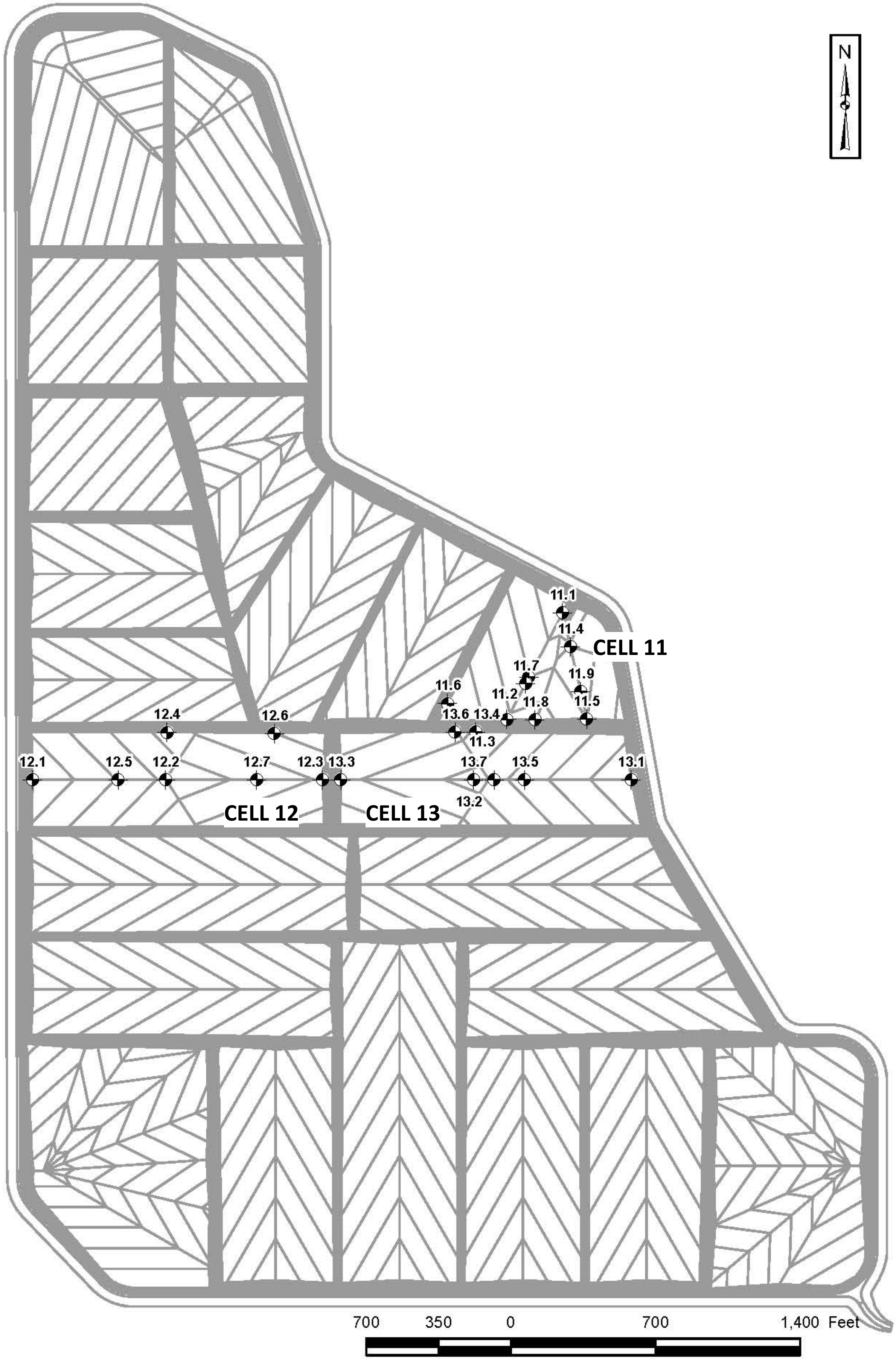
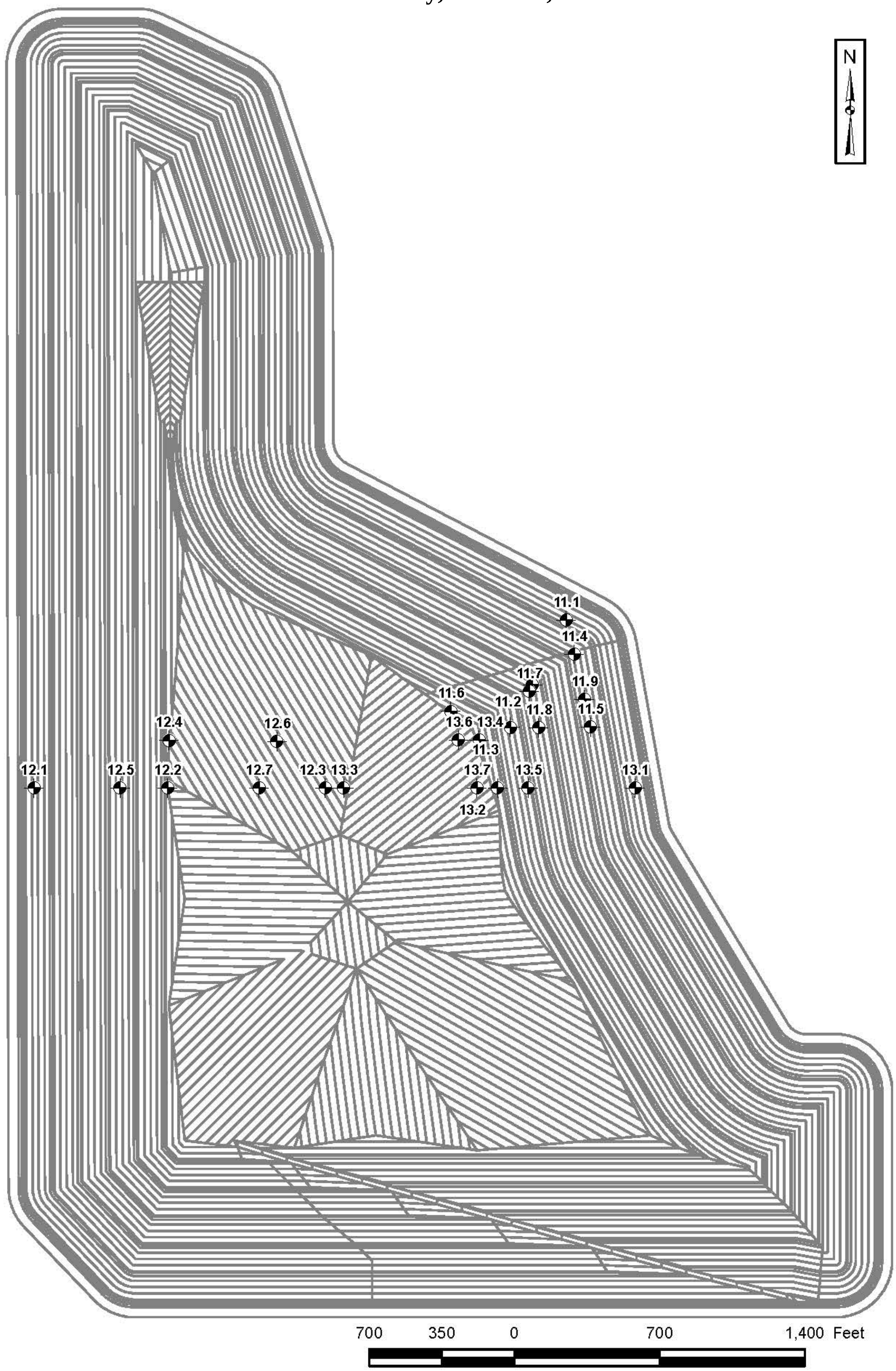


Figure 4
Locations of Analyzed Settlement Points on Final Cover Grading Plan
JED Facility, St. Cloud, FL



ATTACHMENT 1

Settlement Calculations

General Site Data and Overburden Properties:

Misc Constants -- Material Properties and Thicknesses

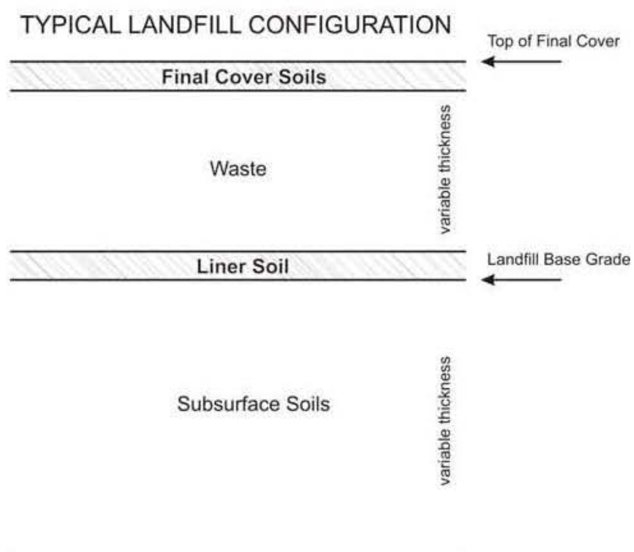
Unit weight of overburden materials:	$\gamma_{waste} := 70pcf$	$\gamma_{cover} := 120pcf$
	$\gamma_{fill} := 120pcf$	$\gamma_{bliner} := 120pcf$
Thickness of final cover and bottom liner:	$t_{cover} := 3ft$	$t_{bliner} := 2ft$

The waste thickness is calculated based on 3D CADD surfaces and the general equaltions are as follows:

$$H_{waste} := H_{final} - t_{cover} - (H_{base} + t_{bliner})$$

where H_{final} = elevation of top of final cover

H_{base} = elevation of top of base grade



Vertical Stress Increment: $\Delta\sigma := H_{waste} \cdot \gamma_{waste} + t_{cover} \cdot \gamma_{cover} + H_{fill} \cdot \gamma_{fill} + t_{bliner} \cdot \gamma_{bliner}$

General Clay Properties

Average unit weight of soil:	$\gamma_{soil} := 115pcf$	
Average moisture content:	$w := mean(29, 29.4, 24.9, 20.4, 38.7, 26.5, 37.9, 29.7, 54.4)$	$w = 32.3$
Average plasticity index:	$I_p := mean(65, 70, 58)$	$I_p = 64.3$
Average liquid limit:	$LL := mean(100, 96, 87)$	$LL = 94.3$
Average plastic limit:	$PL := mean(35, 26, 29)$	$PL = 30$
Specific Gravity:	$G_s := 2.65$	
Estimated in-situ void ratio:	$e_0 := \frac{w}{100} \cdot G_s$	$e_0 = 0.857$
Modified Compression Index:	$C_{c\varepsilon} := 0.1$	(Geotechnical Investigation Report, 2010)

Poisson's Ratio: Sand $\mu_1 := 0.3$

Saturated Clay = 0.5
Partially Saturated Clay = 0.3 - 0.4
Dense sand = 0.3 - 0.4
Loose sand = 0.1 - 0.3
(Coduto, 2001)

Depth to groundwater table: $GWT := 0ft$

SPT Data format and definition

Modulus of Elasticity: $E = (194 + 8N)\cdot\left(1 - \mu^2\right)tsf$ (US Army Corp of Engineers, 1990)

Constrained Modulus: $D = E\cdot\frac{(1 - \mu)}{(1 + \mu)\cdot(1 - 2\mu)}$ (US Army Corp of Engineers, 1990)

SPT Interpolation Equations:

The Inverse Distance Weighted Average (IDWA) was calculated as a function of depth for all the borings based on existing soil boring data. IDWA was selected because this method provides a weighted average that is influenced most by nearby data. As the distance to other soil boring locations increases, the weighted average is affected less. A common IDWA method is also known as Shepard's Method, described as follows.

$$F = \sum_{i=0}^{n-1} \left(w_i \cdot N_i\right)$$

where n is the number of surrounding points, N is the set of data points being interpolated, and w is the weighing function, defined as follows:

$$w_i = \frac{\left(d_i\right)^{-p}}{\sum_{j=0}^{n-1} \left(d_j\right)^{-p}}$$

where p is the power parameter (typically equal to 2) and d is the distance between the interpolated point and surrounding data, calculated as:

$$d_i = \sqrt{\left(x - x_i\right)^2 + \left(y - y_i\right)^2 + \left(z - z_i\right)^2}$$

This method allows a N-value to be determined at any point within the footprint of the landfill at any given depth. Note that existing N-values are not replaced.

Settlement is calculated at any given location based on the N-values obtained through this interpolation as follows.

SPT Based Settlement Formulation:

Elastic Theory:
Settlement Sandy Soils: $\Delta S_{sand} = \Delta H\cdot\frac{\Delta\sigma}{D}$ (Lambe and Whitman, 1969 - Constrained Modulus Definition)

1D Consolidation Theory: (Normally consolidated clays, 1D Theory - Terzaghi)

Clayey Soils:

$$\Delta S_{clay} = C_c \cdot \frac{\Delta H}{1 + e_0} \cdot \log\left(\frac{\sigma_{eff} + \Delta\sigma}{\sigma_{eff}}\right)$$

Notes:

1. The settlement calculation uses the Elastic theory as presented in Lambe and Whitman (1969) for the non-cohesive soil (i.e., sandy) layers and applies Terzaghi's One Dimensional theory of consolidation to calculate the settlement in the cohesive soil layers.

SPT Based Settlement Calculations

Total settlement:

$\Delta S =$

	0	1	2
0	"Under SPT-N1"	5.173	"ft"
1	"Under SPT-N2"	3.789	"ft"
2	"Under SPT-N3"	0.998	"ft"
3	"Under SPT-N4"	3.794	"ft"
4	"Under SPT-N5"	3.179	"ft"
5	"Under SPT-N6"	2.603	"ft"
6	"Under SPT-O1"	1.742	...

slopes =

	0	1	2	3	4
8	12.3	12.2	0.5	0.44	0.0002757692
9	12.4	12.5	1.4	1	0.0047955218
10	12.6	12.7	1.4	1.32	0.0011226929
11	13.2	13.1	1	0.46	0.0039368923
12	13.3	13.2	0.52	0.47	0.0002383869
13	13.4	13.5	1.4	1.02	0.004565715
14	13.6	13.7	1.4	1.28	...

$\text{minimumslope} = 0.44 \cdot \%$

$\text{maximumstrain} = 5.92 \times 10^{-3} \cdot \%$

ATTACHMENT 5
SLOPE STABILITY CALCULATIONS

Geosyntec consultants

COMPUTATION COVER SHEET

Client: **PWSFL** Project: **JED Cells 11-13 Base Grade Revision** Project No.: **FL2478**

Phase No.: **01**

Title of Computations **SLOPE STABILITY ANALYSIS**

Computations by:	Signature		30 October 2014
	Printed Name	Craig R. Browne, P.E.	Date
	Title	Project Engineer	
Assumptions and Procedures Checked by: (peer reviewer)	Signature		31 October 2014
	Printed Name	Rutuparna Joshi, E.I.	Date
	Title	Senior Staff Engineer	
Computations Checked by:	Signature		31 October 2014
	Printed Name	Kwasi Badu-Tweneboah, Ph.D., P.E.	Date
	Title	Associate	
Computations Backchecked by: (originator)	Signature		31 October 2014
	Printed Name	Craig R. Browne, P.E.	Date
	Title	Project Engineer	
Approved by: (pm or designate)	Signature		9 December 2014
	Printed Name	Craig R. Browne, P.E.	Date
	Title	Project Engineer	

CRAIG R. BROWNE LICENSE No. 68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

SLOPE STABILITY ANALYSIS
J.E.D. SOLID WASTE MANAGEMENT FACILITY
ST. CLOUD, OSCEOLA COUNTY, FLORIDA

1 INTRODUCTION

This calculation package is prepared in support of the proposed base grade revisions for Cells 11, 12, and 13 at the J.E.D. Solid Waste Management (JED) facility. The proposed base grade revisions involve reducing the design slope of the leachate corridors in some areas from 1.0% to 0.5% and the cross-slope grades (floor of cells that drain to the leachate corridors) from 2.0% to 1.5% for Cell 11 and from 2.0% to 1.4% for Cells 12 and 13. The footprint and maximum landfill height above ground surface will not change as a result of the base grade revisions. Analyses are performed to evaluate the factor of safety (FS) for slope stability with respect to potential shear failure surfaces through the waste mass and foundation soils and shear failure surfaces passing through the waste mass and along the liner system.

2 METHODS OF ANALYSIS

2.1 Overview

Appendix D of the *Major Modification Application for Vertical Expansion of the J.E.D. Solid Waste Management Facility (Phases 1 through 3)*, prepared by Geosyntec, dated September 2007 (Geosyntec, 2007), presented slope stability analyses for the (i) critical cross section (final waste configuration), (ii) perimeter berm, and (iii) interim configuration geometry. The stability of the critical cross section and the perimeter berm were subsequently evaluated in Appendix E of the *Landfill Lateral Expansion – Application for a Major Permit Modification, J.E.D. Solid Waste Management Facility*, prepared by Geosyntec, dated February 2011 (2011 Lateral Expansion Permit Application) (Geosyntec, 2011). The perimeter berm geometry will remain the same as that presented by Geosyntec in the 2011 Lateral Expansion Permit Application. However, the base grade slopes in Cells 11, 12, and 13 are proposed to be modified. As such, the critical cross section is evaluated herein to account for the revised base grades. The interim configuration geometry was evaluated assuming a cell floor cross-slope of 1% instead of 2% (Geosyntec, 2007). As such, the geometry assumed for the interim scenario is representative of the proposed base grades in Cells 11, 12, and 13 and this scenario is not re-evaluated herein.

2.2 Waste Slope Stability and Foundation Stability

Slope stability analyses of circular and non-circular slip surfaces were performed using Spencer's method (Spencer, 1967), as implemented in the computer program *Slide* version 6.0 (Rocscience, 2010). Spencer's method is utilized because it satisfies vertical and horizontal force equilibrium and moment equilibrium. *Slide* was used to generate potential slip surfaces, calculate the FS for each of these surfaces, and identify the slip surface with the lowest FS. The slip surface with the lowest FS is considered the critical potential slip surface. Information required for the analyses includes:

- the geometry of the landfill (e.g., liner system and final fill grades) at the cross section location
- the subsurface soil stratigraphy at the cross section location
- the material properties for waste, structural fill, liner system, and subsurface materials
- the groundwater table elevation for the cross section location

3 TARGET FACTOR OF SAFETY

Based on the requirements of Chapter 62-701, of the Florida Administrative Code (FAC), a target FS of 1.5 was used for the slope stability analyses performed herein.

4 INPUT PARAMETERS

4.1 Geometry

The proposed modification of Cells 11, 12, and 13 at the JED facility will not alter the currently permitted maximum landfill height of 330 ft, National Geodetic Vertical Datum of 1929 (NGVD 29) (approximately 250 feet above existing ground surface). In addition, the currently permitted landfill side slopes (3 horizontal to 1 vertical (3H:1V) between the benches with 15-ft wide benches every 40 vertical feet) are not proposed to change with this intermediate modification.

The proposed base grades for Cells 11, 12, and 13 at the JED facility are shown on the Intermediate Modification Permit Drawings. As noted in the drawings, the cell floor grades for Cell 11 consist of a double "herringbone" pattern with a cell floor slope of 1.5% and a leachate corridor slope of 1% beneath the 3H:1V sideslope and 0.5% where the leachate corridor runs parallel to the slope contours (i.e., parallel to the perimeter of the cell). Cells 12 and 13 are designed with a single "herringbone" pattern with a cell floor slope of 1.4% and a leachate corridor slope of 1% beneath the 3H:1V sideslope and 0.5% beneath the landfill top deck area (i.e., the flatter portion of the landfill surface beyond the crest of the 3H:1V sideslopes).

The ground water table was modeled at existing ground level or approximately EL 80 ft, NGVD 29.

4.1.1 Subsurface Stratigraphy

A simplified subsurface stratigraphy was used for the stability analyses. A detailed discussion of the stratigraphy underlying the proposed JED facility was presented in the *Geotechnical Investigation Report* submitted in Appendix D of the 2011 Lateral Expansion Permit Application (Geosyntec, 2011). The simplified subsurface is composed of (from top to bottom):

- loose to medium dense silty sands to approximately 155 feet in depth
- an underlying formation, referred to as the Hawthorn Group, consisting of an 11.5 ft thick clay layer underlain by undifferentiated sands, silty sands, and clayey sands with dolomite cementation.

4.1.2 Liner System Geometry

The proposed liner system for Cells 11 through 13 consists of a double liner system over a compacted liner subbase and subgrade. The liner system consists of (from bottom to top): (i) a geosynthetic clay liner (GCL); (ii) secondary 60-mil HDPE textured geomembrane; (iii) secondary geocomposite drainage layer; (iv) primary 60-mil HDPE textured geomembrane; (v) primary geocomposite drainage layer; and (vi) a liner protective layer. As the maximum head on the primary geomembrane is designed to be less than 12 inches, a phreatic surface within the landfill was not considered.

4.1.3 Critical Cross Section

Typical cross sections for the proposed final configuration of the JED facility are shown on the Lateral Expansion Permit Drawings (Geosyntec, 2011) and the Intermediate Permit

Modification Drawings. The cross sections consist of (from bottom to top): (i) foundation soils; (ii) a compacted subgrade; (iii) the double liner system; (iv) municipal solid waste (MSW); and (v) the final cover system. The critical cross section is the one in which the landfill top slope reaches the maximum elevation of 330 feet (NGVD 29). The top area of the landfill is sloped at 5 percent. The landfill side slopes are inclined at 3H:1V between benches. Benches are provided every 40 vertical feet and each have a width of 15 feet.

4.2 Material Properties

4.2.1 Soil Properties

Soil properties used for the stability analyses were selected based on the results of the site characterization program described in the Geotechnical Investigation Report submitted with the Lateral Expansion Permit Application (Geosyntec, 2011). For the Hawthorn Formation, a unit weight of 115 pcf and a peak effective friction angle of 30 degrees were selected for the non-cohesive soils. The Hawthorn confining layer, composed of cohesive soils, was assigned a unit weight equal to 120 pcf and undrained shear strength of 5,000 psf. For the loose to medium dense silty sand layer above the Hawthorn Formation, a unit weight of 115 pcf and a peak effective friction angle of 30 degrees were also selected. For the perimeter berm fill and compacted subgrade, a unit weight of 120 pcf and a peak effective friction angle of 35 degrees were used in the analysis. This is consistent with typical values for compacted silty sand. For the liner protective layer, a unit weight of 120 pcf and a peak effective friction angle of 30 degrees were used in the analysis. These strength parameters are also consistent with those previously presented by Geosyntec (2007 and 2011).

The soil properties, from bottom to top, are summarized in the following table.

Material	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Hawthorn Formation	115	0	30
Hawthorn Confining layer	120	5,000	0
Silty Sand	115	0	30
Berm Fill/Compacted Subgrade	120	0	35
Liner Protective Layer	120	0	30
Final Cover System	120	0	35

4.2.2 Waste Material Properties

The waste material disposed in the landfill primarily consists of MSW. Attachment 1 presents the unit weight versus depth relationship used in the analyses (Kavazanjian, 1995). The unit weight of MSW is a function of the overburden and therefore varies with depth (i.e., the unit weight of MSW increases with depth). As shown, the unit weight varies linearly with depth from 0 to 115 feet (35 meters) with a unit weight variation of 41.4 pcf (6.5 kN/m^3) to 66.9 pcf (10.5 kN/m^3), respectively. It varies asymptotically between 115 feet (35 meters) and 328 feet (100 meters) to a unit weight of approximately 83.4 pcf (13.1 kN/m^3).

For the slope stability analysis of the proposed final configuration of the JED facility, the MSW was divided into three sublayers. Each sublayer was assigned a unit weight corresponding to its midpoint depth.

The shear strength of the MSW was modeled using a truncated linear Mohr-Coulomb envelope presented by Kavazanjian (1995) and included in Attachment 1. As shown, the shear strength envelope has a constant value for shear stress of 500 psf (24 kPa) in the normal stress range of 0 to 625 psf (30 kPa) and transitions to a linear relationship corresponding to an effective friction angle of 33 degrees.

4.3 <u>Cases Analyzed</u>

The following slope failure mechanisms were evaluated:

- Case 1 – Final Configuration Circular Failure Mechanism: Circular slip surfaces that pass through the MSW and/or the foundation soils of the final configuration of the proposed vertical expansion.
- Case 2 – Final Configuration Non-circular (block) Failure Mechanism: Non-circular slip surfaces that pass through the MSW and/or the foundation soils of the final configuration of the proposed vertical expansion.
- Case 3 – Final Configuration Sliding Block Failure Mechanism: Sliding block slip surfaces that pass through the MSW and along the double liner system. This represents the proposed "herringbone" bottom grades in Cells 11 through 13 of the JED facility.

5 RESULTS

The results for Cases 1 through 3 for the proposed final configuration of the JED facility are presented in Attachments 2, 3, and 4 respectively. The critical slip surface is shown for each analysis with the computed FS value. The output files from the slope stability software (*Slide*) are also presented in the respective attachments.

5.1 Case 1 - Final Configuration Circular Shear Surfaces

The results of the circular shear surface slope stability analyses for the critical cross section for the proposed final configuration of the JED facility are included in Attachment 2. For the proposed landfill configuration and the input parameters discussed above, the minimum FS was evaluated to be 2.34 for the critical slip surface that passes through the waste and foundation soils. The minimum calculated factors of safety for failure surfaces that pass through the waste mass and foundation soils exceed the established minimum requirement of 1.5.

5.2 Case 2 - Final Configuration Non-circular Shear Surfaces

The results of the non-circular shear surface slope stability analyses for the critical cross section for the proposed final configuration of the JED facility are included in Attachment 3. For the proposed landfill configuration and the input parameters discussed above, the minimum FS was evaluated to be 2.22 for the critical slip surface that passes through the waste and foundation soils. The minimum calculated factors of safety for failure surfaces that pass through the waste mass and foundation soils exceed the established minimum requirement of 1.5.

5.3 Case 3 – Final Configuration Sliding Block Shear Surfaces

The results of the sliding block slope stability analyses for the critical cross section for the proposed final configuration of the JED facility are included in Attachment 4. Based on the sensitivity analyses performed for shearing along the liner system, a minimum peak interface friction angle of 11.3° is required to meet a FS of 1.5. It is noted that the required interface friction angle is within the range of (or less than) typical soil-geosynthetic and geosynthetic-geosynthetic interface friction angles reported in the literature (e.g., Martin et al., 1984; Koerner et al., 1986; Williams and Houlihan, 1986). A summary of typical interface friction angles is provided in Table 1.

6 SUMMARY AND CONCLUSIONS

The results of the waste mass and foundation slope stability analyses, including the perimeter berm, for the proposed lateral expansion configuration of the JED facility (i.e., Cases 1, 2, and 3) exceeded the minimum slope stability requirement of 1.5.

7 REFERENCES

Geosyntec Consultants (2007), "*Major Modification Application for Vertical Expansion of the J.E.D. Solid Waste Management Facility (Phases 1 through 3),*" September 2007.

Geosyntec Consultants (2011), "*Landfill Lateral Expansion – Application for a Major Permit Modification, J.E.D. Solid Waste Management Facility,*" February 2011.

Kavazanjian Jr, E., Matasovic, N., Bonaparte, R., and Schmertmann, G. (1995), "*Evaluation of MSW Properties for Seismic Analysis,*" Proceedings, Geoenvironmental 2000, Vol II, New Orleans, LA, February, pp. 1126-1141.

Koerner, R.M., Martin, J.P., and Koerner, G.R., "Shear Strength Parameters Between Geomembranes and Cohesive Soils," Journal of Geotextiles and Geomembranes, Vol. 4, No. 1, pp. 21-30, 1986.

Martin, J.P., Koerner, R.M., and Whitty, J.E., "Experimental Friction Evaluation of Slippage Between Geomembranes and Geotextiles," Proceedings of the International Conference on Geomembranes, Denver, Colorado, pp. 191-196, 1984.

Rocscience (2010), *Slide Version 6.0 - 2D Limit Equilibrium Slope Stability Analysis. www.rocscience.com,* Rocscience Inc., Toronto, Ontario, Canada.

Spencer, E. (1973), "The Thrust Line Criterion in Embankment Stability Analysis," *Géotechnique*, Vol. 23, No. 1, pp. 85-100.

Williams, N.D., and Houlihan, M.F., "Evaluation of Friction Coefficients Between Geomembranes, Geotextiles, and Related Products," Proceedings of the 3rd International Conference on Geotextiles, IFAI, Vienna, 1986.

TABLE

Table 1

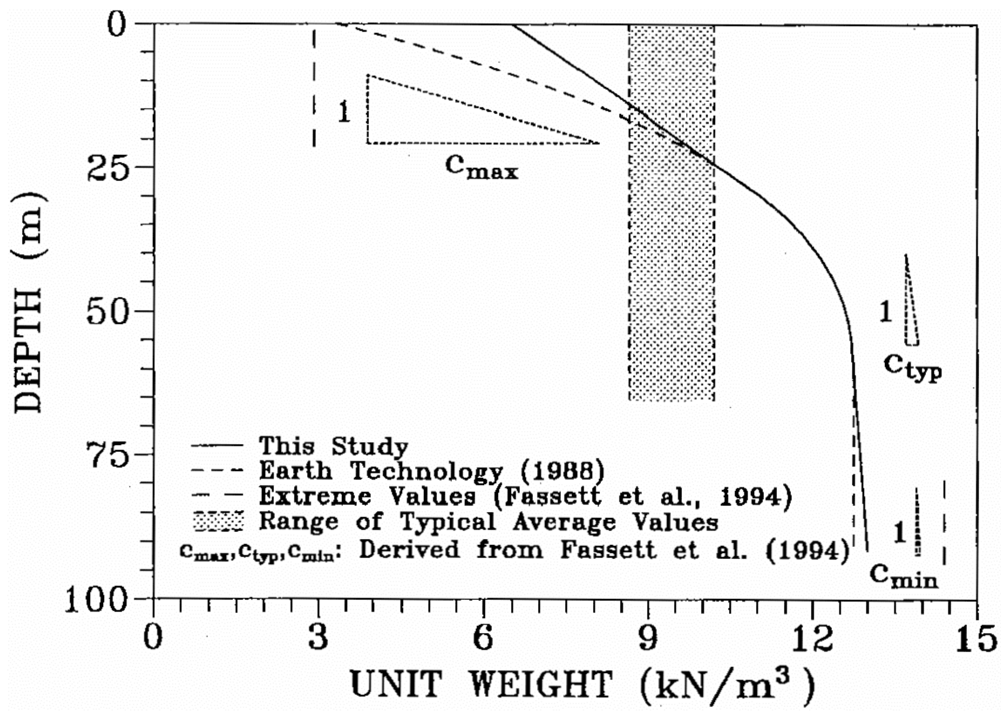
SUMMARY OF DOCUMENTED INTERFACE FRICTION VALUES

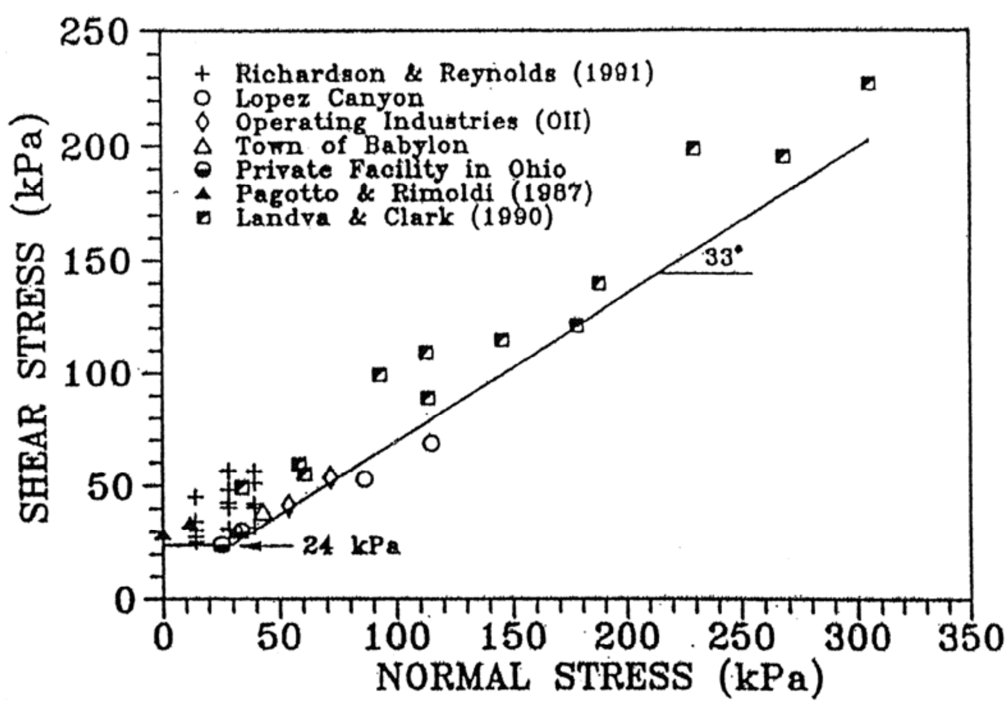
GEOSYNTHETIC / GEOSYNTHETIC	δ (degrees)
Smooth HDPE / Nonwoven Geotextile	6 to 12
Textured HDPE / Nonwoven Geotextile	25 to 35
Smooth HDPE / Geonet	8 to 15
Textured HDPE / Geonet	8 to 15
Textured HDPE / Geocomposite Drainage Layer	17 to 29
Geonet / Nonwoven Geotextile	14 to 22
Smooth HDPE / GCL (hydrated)	5 to 12
Textured HDPE / GCL (hydrated)	18 to 37
GEOSYNTHETIC / SOIL	**tan δ / tan ϕ'**
Smooth HDPE / Clay	0.4 to 0.7
Textured HDPE / Clay	0.8 to 0.9
Smooth HDPE / Sand	0.5 to 0.6
Textured HDPE / Sand	0.7 to 0.8
Needlepunched Geotextile / Sand	0.8 to 1.0
Needlepunched Geotextile / Angular Gravel	0.7 to 0.9
Needlepunched Geotextile / Rounded Gravel	0.6 to 0.8
Needlepunched Geotextile / Silty Sands	0.96
Geogrid / Soil	1.0
GCL / Sand	δ = 17 to 35 degrees

Notes:

1. δ = interface friction angle; ϕ' = soil internal friction angle.
2. Adapted from tests by Martin et al. (1984), Williams and Houlihan (1986), Koerner et al. (1986), manufacturers literature, and unpublished results from Geosyntec Consultants.

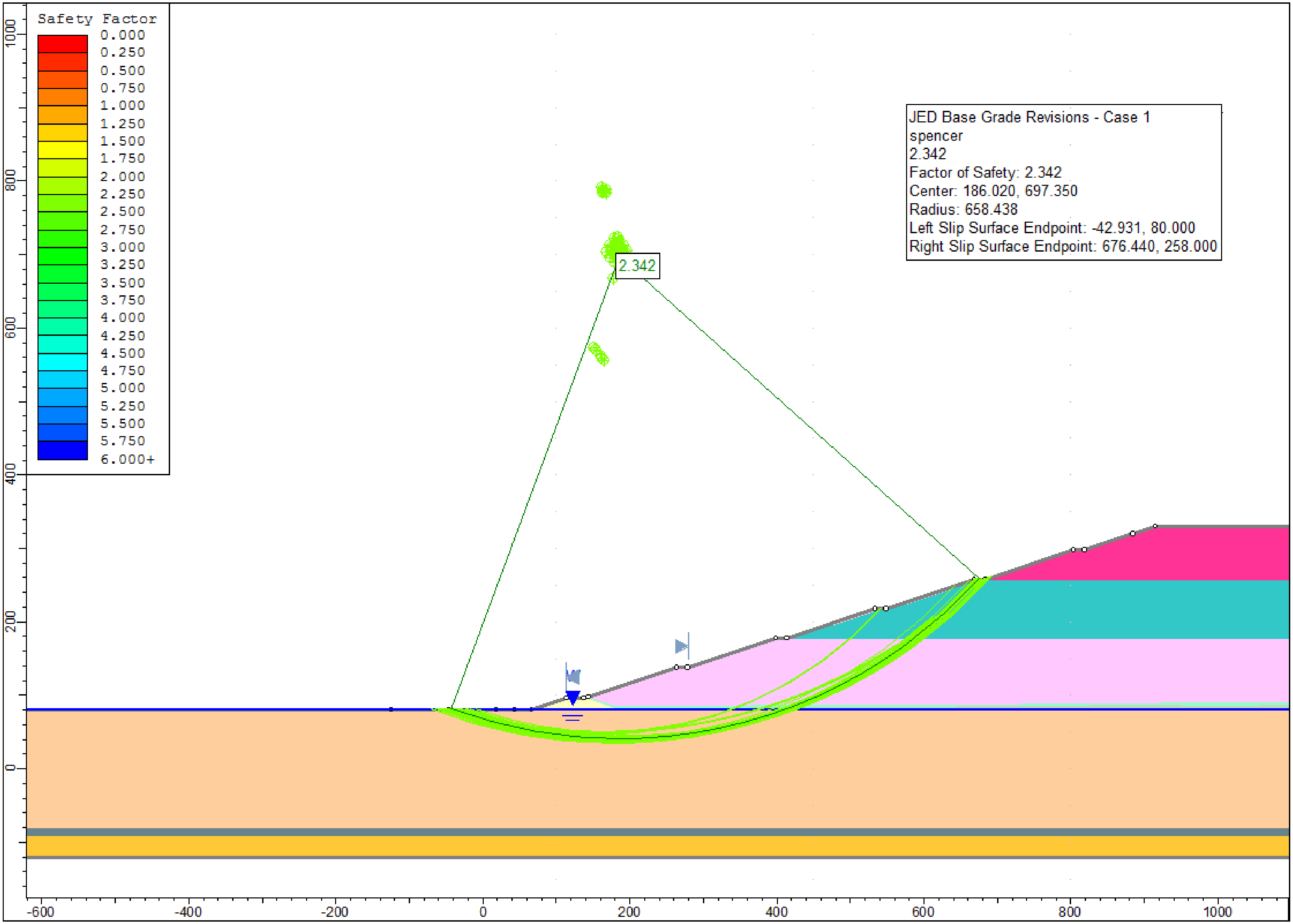
ATTACHMENT 1





Unit Weight and Shear Strength Relationships for MSW (Kavazanjian, 1995)

ATTACHMENT 2



Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
JED Base Grade Revisions - Case 1
spencer
2.342
Factor of Safety: 2.342
Center: 186.020, 697.350
Radius: 658.438
Left Slip Surface Endpoint: -42.931, 80.000
Right Slip Surface Endpoint: 676.440, 258.000
2.342
1000
800
600
400
200
0
-600
-400
-200
0
200
400
600
800
1000

Slide Analysis Information

JED Base Grade Revisions - Case 1

Project Summary

File Name: Case 1 - 3to1_15wide_found_Circ.sli
Slide Modeler Version: 6.031
Project Title: JED Base Grade Revisions - Case 1

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Material Properties

Property	Berm Fill	Compacted Subgrade	Silty Sand	Hawthorne Formation	Final Cover System	Liner System	Upper MSW	Middle MSW
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function
Unit Weight [lbs/ft3]	120	120	115	115	120	120	54	72
Cohesion [psf]	0	0	0	0	0	0		
Friction Angle [deg]	35	35	30	30	35	30		
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Shear Normal Functions

Name: MSW-Kavazanjian et al. 1995

Normal (psf)	Shear (psf)
0	500
625	500
24000	15680

Property	Lower MSW	Hawthorn-Cohesive
Color		
Strength Type	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	82	120
Cohesion [psf]		5000
Friction Angle [deg]		0
Water Surface	Water Table	Water Table
Hu Value	1	1

Shear Normal Functions

Name: MSW-Kavazanjian et al. 1995

Normal (psf)	Shear (psf)
0	500
625	500
24000	15680

Global Minimums

Method: spencer

FS: 2.342870
Center: 185.611, 697.812
Radius: 659.023
Left Slip Surface Endpoint: -43.778, 80.000
Right Slip Surface Endpoint: 676.403, 258.000
Resisting Moment=1.43178e+009 lb-ft
Driving Moment=6.11121e+008 lb-ft
Resisting Horizontal Force=2.02619e+006 lb
Driving Horizontal Force=864834 lb
Total Slice Area=47011.2 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 18204
Number of Invalid Surfaces: 0

List Of Coordinates

Water Table

X	Y
-953.45	80
1200	80

External Boundary

X	Y
684	258
669	258
549	218
534	218
414	178
399	178
279	138
264	138
144	98
137.891	95.9638
114	96
66	80
43.151	80
18.44	80
-45.8665	80
-124.463	80
-953.45	80
-953.45	-80
-953.45	-90.5
-953.45	-120
1200	-120
1200	-90.5
1200	-80
1200	80
1200	92.66
1200	94.66
1200	136
1200	176
1200	216
1200	256
1200	328
1200	319.516
1200	330
915	330
885	320
819	298
804	298

Material Boundary

X	Y
66	80
134.221	80
192	80

Material Boundary

X	Y
137.891	95.9638
144	96
180	84

Material Boundary

X	Y
180	86
915	93.23
1200	94.66

Material Boundary

X	Y
150	96
180	86

Material Boundary

X	Y
-953.45	-80
1200	-80

Material Boundary

X	Y
684	256
1200	256

Material Boundary

X	Y
549	216
1200	216

Material Boundary

X	Y

180	84
915	91.23
1200	92.66

Material Boundary

X	Y
264	136
279	136
399	176
414	176
534	216
549	216
669	256
684	256
804	296

Material Boundary

X	Y
804	296
819	296
885	318
915	328
1200	328

Material Boundary

X	Y
147	97
148.5	96.5
150	96

Material Boundary

X	Y
144	96
147	97

Material Boundary

X	Y
147	97
264	136

Material Boundary

X	Y

1200	328
1200	330

Material Boundary

X	Y
414	176
1200	176

Material Boundary

X	Y
279	136
1200	136

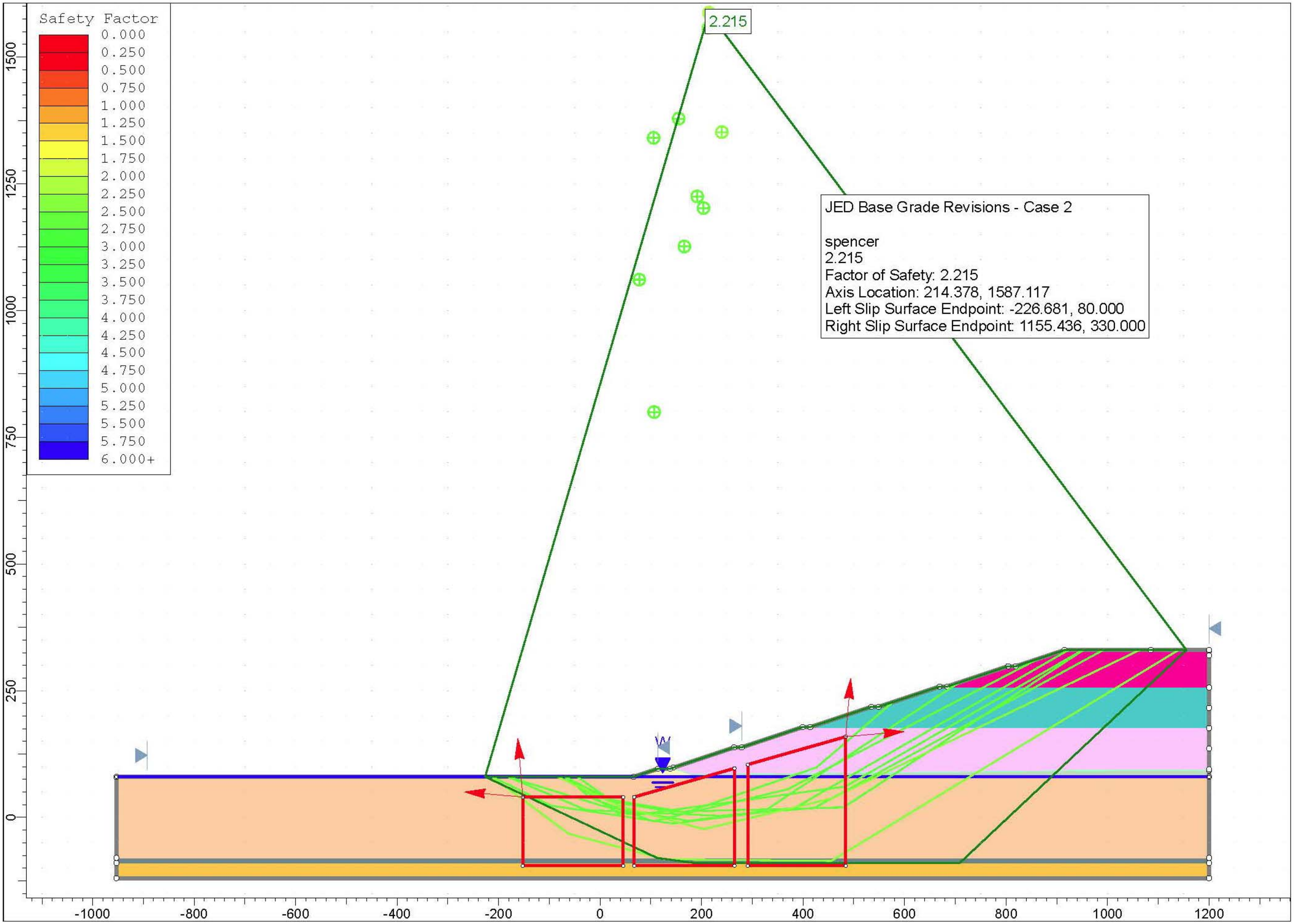
Material Boundary

X	Y
-953.45	-90.5
1200	-90.5

Material Boundary

X	Y
180	84
192	80
1200	80

ATTACHMENT 3



Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.215
JED Base Grade Revisions - Case 2
spencer
2.215
Factor of Safety: 2.215
Axis Location: 214.378, 1587.117
Left Slip Surface Endpoint: -226.681, 80.000
Right Slip Surface Endpoint: 1155.436, 330.000
W
1500
1250
1000
750
500
250
0
-1000
-800
-600
-400
-200
0
200
400
600
800
1000
1200

Slide Analysis Information

JED Base Grade Revisions - Case 2

Project Summary

File Name: Case 2 - 3to1_15wide_found_Block.slim
Slide Modeler Version: 6.031
Project Title: JED Base Grade Revisions - Case 2

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Enabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 175
Right Projection Angle (Start Angle): 5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Berm Fill	Compacted Subgrade	Silty Sand	Hawthorne Formation	Final Cover System	Liner System	Upper MSW	Middle MSW
Color								
							Shear	Shear

Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Normal function	Normal function
Unit Weight [lbs/ft3]	120	120	115	115	120	120	54	72
Cohesion [psf]	0	0	0	0	0	0		
Friction Angle [deg]	35	35	30	30	35	30		
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Shear Normal Functions

Name: MSW-Kavazanjian et al. 1995

Normal (psf)	Shear (psf)
0	500
625	500
24000	15680

Property	Lower MSW	Hawthorn-cohesive
Color		
Strength Type	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	82	120
Cohesion [psf]		5000
Friction Angle [deg]		0
Water Surface	Water Table	Water Table
Hu Value	1	1

Shear Normal Functions

Name: MSW-Kavazanjian et al. 1995

Normal (psf)	Shear (psf)
0	500
625	500
24000	15680

Global Minimums

Method: spencer

FS: 2.214500
Axis Location: 214.378, 1587.117
Left Slip Surface Endpoint: -226.681, 80.000
Right Slip Surface Endpoint: 1155.436, 330.000
Resisting Moment=1.25405e+010 lb-ft
Driving Moment=5.6629e+009 lb-ft
Resisting Horizontal Force=6.72992e+006 lb
Driving Horizontal Force=3.03902e+006 lb

Total Slice Area=274869 ft2

Global Minimum Coordinates

Method: spencer

X	Y
-226.681	80
111.998	-79.924
185.262	-89.9999
708.673	-89.9996
1155.44	330

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3525
Number of Invalid Surfaces: 1476

Error Codes:

Error Code -108 reported for 201 surfaces
Error Code -111 reported for 214 surfaces
Error Code -112 reported for 1061 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

List Of Coordinates

Water Table

X	Y
-953.45	80
1200	80

Block Search Window

X	Y
-152.273	40.1689

-152.273	-95.4706
45.4139	-95.4706
45.4139	40.1689

Block Search Window

X	Y
264.851	-95.4706
264.851	96.6053
67.0585	40.1689
67.0585	-95.4706

Block Search Window

X	Y
483.999	-95.4706
483.999	159.135
290.939	104.049
290.939	-95.4706

External Boundary

X	Y
684	258
669	258
549	218
534	218
414	178
399	178
279	138
264	138
144	98
137.891	95.9638
114	96
66	80
-953.45	80
-953.45	-80
-953.45	-90
-953.45	-120
1200	-120
1200	-90
1200	-80
1200	80
1200	92.66
1200	94.66
1200	136
1200	176
1200	216

1200	256
1200	328
1200	319.516
1200	330
1085	330
915	330
819	298
804	298

Material Boundary

X	Y
146	80
192	80
1200	80

Material Boundary

X	Y
137.891	95.9638
144	96
180	84
192	80

Material Boundary

X	Y
180	86
915	93.23
1200	94.66

Material Boundary

X	Y
150	96
180	86

Material Boundary

X	Y
-953.45	-80
1200	-80

Material Boundary

X	Y
684	256
1200	256

Material Boundary

X	Y
549	216
1200	216

Material Boundary

X	Y
180	84
915	91.23
1200	92.66

Material Boundary

X	Y
264	136
279	136
399	176
414	176
534	216
549	216
669	256
684	256
804	296

Material Boundary

X	Y
804	296
819	296
915	328
1085	328
1200	328

Material Boundary

X	Y
147	97
148.5	96.5
150	96

Material Boundary

X	Y
144	96
147	97

Material Boundary

X	Y
147	97
264	136

Material Boundary

X	Y
1200	328
1200	330

Material Boundary

X	Y
414	176
1200	176

Material Boundary

X	Y
279	136
1200	136

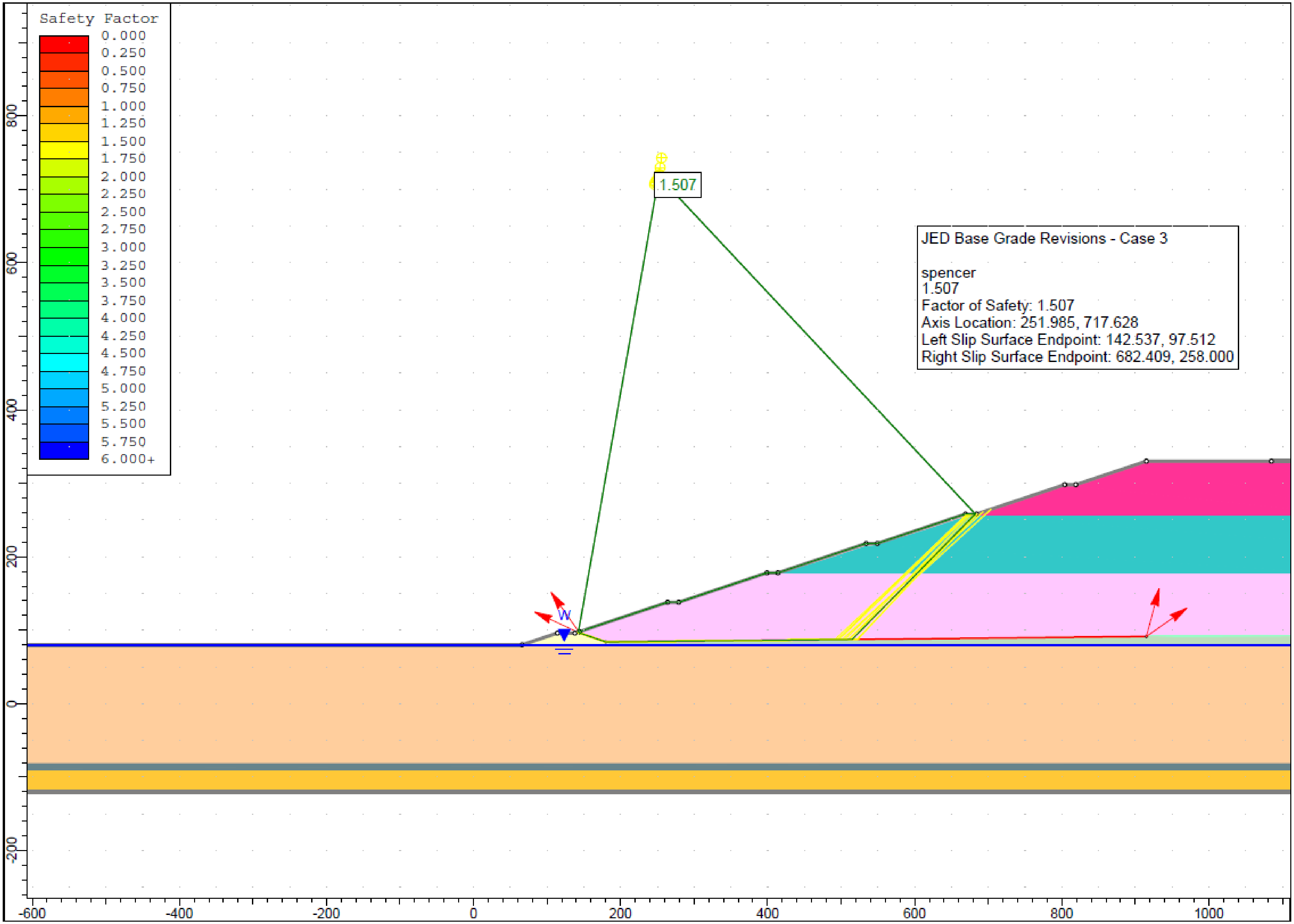
Material Boundary

X	Y
66	80
146	80
147.639	80.1366

Material Boundary

X	Y
-953.45	-90
1200	-90

ATTACHMENT 4



Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.507
JED Base Grade Revisions - Case 3
spencer
1.507
Factor of Safety: 1.507
Axis Location: 251.985, 717.628
Left Slip Surface Endpoint: 142.537, 97.512
Right Slip Surface Endpoint: 682.409, 258.000
W
800
600
400
200
0
-200
-600
-400
-200
0
200
400
600
800
1000

Slide Analysis Information

JED Base Grade Revisions - Case 3

Project Summary

File Name: Case 3 - 3to1_15wide_found_Liner-Block.slim
Slide Modeler Version: 6.031
Project Title: JED Base Grade Revisions - Case 3

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Enabled
Left Projection Angle (Start Angle): 125
Left Projection Angle (End Angle): 155
Right Projection Angle (Start Angle): 35
Right Projection Angle (End Angle): 75
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Berm Fill	Compacted Subgrade	Silty Sand	Hawthorne Formation	Final Cover System	Liner System	Upper MSW	Middle MSW
Color								
							Shear	Shear

Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Normal function	Normal function
Unit Weight [lbs/ft3]	120	120	115	115	120	120	54	72
Cohesion [psf]	0	0	0	0	0	0		
Friction Angle [deg]	35	35	30	30	35	11.3		
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Shear Normal Functions

Name: MSW-Kavazanjian et al. 1995

Normal (psf)	Shear (psf)
0	500
625	500
24000	15680

Property	Lower MSW	Hawthorn-cohesive
Color		
Strength Type	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	82	120
Cohesion [psf]		5000
Friction Angle [deg]		0
Water Surface	Water Table	Water Table
Hu Value	1	1

Shear Normal Functions

Name: MSW-Kavazanjian et al. 1995

Normal (psf)	Shear (psf)
0	500
625	500
24000	15680

Global Minimums

Method: spencer

FS: 1.506570
Axis Location: 251.985, 717.628
Left Slip Surface Endpoint: 142.537, 97.512
Right Slip Surface Endpoint: 682.409, 258.000
Resisting Moment=5.81212e+008 lb-ft
Driving Moment=3.85786e+008 lb-ft
Resisting Horizontal Force=779051 lb
Driving Horizontal Force=517104 lb

Total Slice Area=36019.1 ft2

Global Minimum Coordinates

Method: spencer

X	Y
142.537	97.5122
144.3	96.1
180	84.1
514.887	87.3942
682.409	258

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 4639
Number of Invalid Surfaces: 361

Error Codes:

Error Code -106 reported for 4 surfaces
Error Code -108 reported for 261 surfaces
Error Code -111 reported for 24 surfaces
Error Code -112 reported for 72 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

List Of Coordinates

Water Table

X	Y
-953.45	80
1200	80

Block Search Polyline

X	Y
144.3	96.1
180	84.1
915	91.33

External Boundary

X	Y
684	258
669	258
549	218
534	218
414	178
399	178
279	138
264	138
144	98
137.891	95.9638
114	96
66	80
-953.45	80
-953.45	-80
-953.45	-90
-953.45	-120
1200	-120
1200	-90
1200	-80
1200	80
1200	92.66
1200	94.66
1200	136
1200	176
1200	216
1200	256
1200	328
1200	319.516
1200	330
1085	330
915	330
819	298
804	298

Material Boundary

X	Y
146	80
192	80
1200	80

Material Boundary

X	Y
137.891	95.9638
144	96
180	84
192	80

Material Boundary

X	Y
180	86
915	93.23
1200	94.66

Material Boundary

X	Y
150	96
180	86

Material Boundary

X	Y
-953.45	-80
1200	-80

Material Boundary

X	Y
684	256
1200	256

Material Boundary

X	Y
549	216
1200	216

Material Boundary

X	Y
180	84
915	91.23
1200	92.66

Material Boundary

X	Y
264	136
279	136
399	176
414	176
534	216
549	216
669	256
684	256
804	296

Material Boundary

X	Y
804	296
819	296
915	328
1085	328
1200	328

Material Boundary

X	Y
147	97
148.5	96.5
150	96

Material Boundary

X	Y
144	96
147	97

Material Boundary

X	Y
147	97
264	136

Material Boundary

X	Y
1200	328
1200	330

Material Boundary

X	Y
414	176
1200	176

Material Boundary

X	Y
279	136
1200	136

Material Boundary

X	Y
66	80
146	80

Material Boundary

X	Y
-953.45	-90
1200	-90

ATTACHMENT 6
GEOCOMPOSITE DESIGN CALCULATIONS

Geosyntec consultants

COMPUTATION COVER SHEET

Client: **PWSFL** Project: **JED Cells 11-13 Base Grade Revision** Project No.: **FL2478**
Phase No.: **01**

Title of Computations **GEOCOMPOSITE DESIGN EVALUATION**

Computations by:
Signature
Printed Name Ramil Mijares, Ph.D.
Title Engineer
Date 30 October 2014

Assumptions and Procedures Checked by: (peer reviewer)
Signature
Printed Name Alex Rivera, P.E.
Title Engineer
Date 31 October 2014

Computations Checked by:
Signature
Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.
Title Associate
Date 6 November 2014

Computations Backchecked by: (originator)
Signature
Printed Name Ramil Mijares, Ph.D.
Title Engineer
Date 6 November 2014

Approved by: (pm or designate)
Signature
Printed Name Craig R. Browne, P.E.
Title Project Engineer
Date 9 December 2014

CRAIG R. BROWNE LICENSE No.68613 STATE OF FLORIDA PROFESSIONAL ENGINEER

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **Ramil Mijares** Date: **31-Oct-14** Reviewed by: **A. Rivera** Date: **31-Oct-14**

Client: **PWSFL** Project: **JED Cells 11-13 Base Grade Revs.** Project No.: **FL2478** Phase No.: **01**

GEOCOMPOSITE DESIGN EVALUATION
J.E.D. SOLID WASTE MANAGEMENT FACILITY
ST. CLOUD, OSCEOLA COUNTY, FLORIDA

1 INTRODUCTION

The purpose of this calculation package is to evaluate the engineering design and performance of the geocomposite component of the modified leachate collection system (LCS) that is proposed for Cells 11, 12, and 13 at the J.E.D. Solid Waste Management (JED) facility. The modified LCS includes revisions to the design base liner grades such that the slope of the leachate corridors in some areas are reduced from 1.0% to 0.5% and the cross-slope grades (floor of cells that drain to the leachate corridors) are reduced from 2.0% to 1.5% for Cell 11 and from 2.0% to 1.4% for Cells 12 and 13. The LCS is comprised of primary and secondary leachate collection and removal systems in the cells. The primary LCS is a component of the proposed primary liner system that consists of a geocomposite drainage layer on top of the primary geomembrane liner. This primary geocomposite drainage layer is designed to collect the leachate that percolates vertically through the waste and convey it to a sump for removal from the cell. The primary LCS is designed to limit the leachate head to no more than 1 ft above the primary geomembrane, in accordance with Rule 62-701.400(3)(c)1, Florida Administrative Code (F.A.C.).

The secondary LCS is a component of the proposed liner system that consists of a lateral drainage layer between the primary and secondary liners. This secondary lateral drainage layer is designed to collect leachate that may leak through the primary liner system and convey it to a sump for removal. The secondary LCS components include a secondary geocomposite drainage layer, secondary leak detection pipe, and a leachate collection sump. The secondary drainage system is designed to limit the leachate head on the secondary geomembrane to the thickness of the secondary drainage geocomposite, in accordance with Rule 62-701.400(3)(c)2, F.A.C.

2 DESCRIPTION OF RELEVANT SYSTEMS AND OPERATIONS

2.1 General Layout

Currently, Cells 1 through 10 have been constructed at the JED facility as part of Phase 1 through Phase 3 development. Cells 11, 12, and 13 are permitted to be constructed as part of Phase 4 development under FDEP Permit 0199726-023-SC-MM. As described above, the base grades in Cells 11, 12, and 13 are proposed to be modified as part of the revised landfill design proposed in this intermediate permit modification application.

The currently permitted design for Cells 11, 12, and 13 is a conventional "herringbone" pattern with a leachate collection and leak detection system in the valley of the herringbone-shaped cell as depicted in the 2011 Renewal Permit Drawings included as Appendix B of the "Renewal Permit Application to Operate Phases 1 through 4 of the J.E.D. Solid Waste Management Facility," (Geosyntec, 2011). The proposed revisions to the geometry of Cells 11, 12, and 13 will also follow the herringbone design except that the base slopes and pipe corridor slopes will be lowered to the grades shown on the Intermediate Permit Modification drawings.

2.2 Liner System

The double liner system in Cells 11, 12, and 13 at the JED facility will consist of the following component from top to bottom:

- 24-inch thick protective soil layer;
- primary geocomposite drainage layer (consisting of a geonet with non-woven geotextile heat-bonded on both side);
- primary 60-mil textured high density polyethylene (HDPE) geomembrane liner;
- secondary geocomposite drainage layer (consisting of a geonet with non-woven geotextile heat-bonded on both side);
- secondary 60-mil textured HDPE geomembrane liner;
- geosynthetic clay liner (GCL); and
- compacted prepared subbase.

2.3 Initial and Intermediate Covers

An initial soil cover of 6 inches will be placed on top of all exposed waste at the end of each day's operation to control vectors, fires, blowing litter, odors, and scavenging. A 1-ft thick intermediate cover of clean soil will be placed on top of the waste following the completion of any intermediate lift of waste, which will not have additional waste placed within 30 to 60 days. The initial cover and intermediate cover will be graded to facilitate runoff and limit infiltration. The thickness and grade of the intermediate cover will be maintained until additional waste or the final cover is placed.

3 HELP MODEL OVERVIEW

3.1 Purpose

The Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.07 [Schroeder, et. al., 1994a, 1994b] was used to estimate leachate generation rates, leakage through geomembranes, and maximum head on geomembranes for the proposed LCS for Cells 11 through 13. The HELP model is a quasi-two dimensional water balance computer program used to evaluate the movement of water through the waste and components of the liner system. The computer program, along with site-specific weather data and design information, was utilized to estimate runoff, evapotranspiration, drainage, leachate collection, and liner leakage for the initial startup, intermediate development, and the final build-out configurations.

The estimated leachate generation rates and other information obtained from the HELP model were used to evaluate the performance of the proposed primary and secondary LCS.

3.2 Landfill Development Conditions Analyzed

To estimate leachate generation rates for different landfill development conditions, four waste configurations were analyzed assuming an area of 1 acre. The leachate generation rates, leakage through the geomembranes, and the maximum heads on the primary and secondary geomembranes were estimated for the cases described below.

Case 1: This scenario considered the initial conditions of operation in a cell after the placement of a start-up lift of waste for a total of 10 ft of waste. For this case, no runoff from the daily cover surfaces, and no surface vegetation was assumed.

Case 2: This scenario considered an intermediate condition with 80 ft of waste. For this case, 50 percent runoff from the intermediate cover surfaces was allowed and poor surface vegetation was assumed.

Case 3: This scenario considered an intermediate condition with 150 ft of waste. For this case, 70 percent runoff from the intermediate cover surfaces was allowed and poor surface vegetation was assumed.

Case 4: This scenario considered the maximum waste height of 220 ft, prior to construction of the final cover. For this case, 100 percent runoff from the intermediate cover surfaces was allowed and fair surface vegetation was assumed.

3.3 Geocomposite Properties

The geocomposite properties used in the calculation of heads, leachate generation rate, and leakage for the landfill are based on properties of commercially available geocomposites. It is not the objective of this calculation to identify specific geocomposites for use in the construction of the future cells. However, the performance of commercially available geocomposites was checked to evaluate if they meet the minimum requirements of the proposed LCS design.

3.4 Reduction Factors

The reduction factors used to predict the long-term performance of the drainage geocomposite layer in the liner system are discussed in this section. The following discussion describes the application of reduction factors to transmissivity of drainage geocomposites (in bottom liner system) as suggested by Richardson, et al. (2000).

The required transmissivity ($\theta_{req'd}$) is the minimum transmissivity required for a candidate geocomposite to maintain the head on the geomembrane liner below the regulatory requirement of 12 inches. The required transmissivity ($\theta_{req'd}$) is obtained by applying a factor of safety (FS) to the long-term-in-soil transmissivity (θ_{LTIS}) of the candidate geocomposite. Koerner (1998) provides the following relationship between θ_{LTIS} and $\theta_{req'd}$:

$$\theta_{LTIS} = \frac{\theta_{req'd}}{\Pi(RF)} = \frac{\theta_{req'd}}{RF_{in} * RF_{cr} * RF_{cc} * RF_{bc}} \quad \text{[Equation 3.1]}$$

where:

$$FS = \frac{\theta_{LTIS}}{\theta_{model}} \quad \text{[Equation 3.2]}$$

FS = the overall factor of safety;

θ_{LTIS} = the long-term-in-soil hydraulic transmissivity of the drainage geocomposite;

$\theta_{req'd}$ = the minimum transmissivity required to maintain the head on the geomembrane liner below the regulatory requirement. This is the transmissivity measured in a geosynthetics testing laboratory;

θ_{model} = the minimum transmissivity required to maintain the head on the geomembrane liner as calculated in the HELP model;

RF_{in} = reduction factor for elastic deformation or intrusion of the adjacent geotextiles into the drainage channel;

RF_{cr} = reduction factor for creep deformation of the drainage core and/or adjacent geotextile into the drainage channel;

RF_{cc} = reduction factor for chemical clogging and/or precipitation of chemicals in the drainage core space;

RF_{bc} = reduction factor for biological clogging in the drainage core space; and

$\Pi(RF)$ = cumulative reduction factors.

Written by: **Ramil Mijares** Date: **31-Oct-14** Reviewed by: **A. Rivera** Date: **31-Oct-14**

Client: **PWSFL** Project: **JED Cells 11-13 Base Grade Revs.** Project No.: **FL2478** Phase No.: **01**

There are also other reduction factors (i.e., RF_{IMCO}, RF_{IMIN}, RF_{CD}, RF_{PC}) that were not used in the analyses. A description of these reduction factors and the reasons for not using them in the analyses are as follows:

RF_{IMCO} = reduction factor for immediate compression. This reduction factor was not used as the geocomposite transmissivity used in the analyses was measured under a normal stress equal to or greater than the anticipated normal stress in the field.

RF_{IMIN} = reduction factor for immediate intrusion. This reduction factor may not be used if the geocomposite transmissivity test simulates the boundary conditions in the field. This reduction factor was not used in the analyses since geocomposite transmissivity was measured under field conditions.

RF_{CD} = reduction factor for chemical degradation. This reduction factor can be assumed to be 1.0 if the geocomposite is not expected to degrade during the design life of the facility or be exposed to harmful chemicals. This reduction factor was not used in the analyses because degradation due to harmful chemicals is not expected.

RF_{PC} = reduction factor for particulate clogging. This reduction factor can be assumed to be 1.0 if an adequate filter fabric is selected. This reduction factor was not used in the analyses because the geotextile filter fabric is expected to adequately prevent clogging.

Richardson et. al. (2000) provide the following guidance for reduction factors for geonets and geocomposites for which the transmissivity is measured using seating times of 100 or more hours under the same boundary conditions as in the field.

Applications	Normal Stress	Liquid	RF_{in}	RF_{cc}	RF_{bc}
Facility cover drainage layer Low retaining wall drainage	Low	Water	1.0-1.2	1.0-1.2	1.2-1.5

Written by:	Ramil Mijares	Date:	31-Oct-14	Reviewed by:	A. Rivera	Date:	31-Oct-14
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Applications	Normal Stress	Liquid	RF_{in}	RF_{cc}	RF_{bc}
Facility leachate collection layer; Facility and Leachate Pond leakage collection and detection layer	High	Leachate	1.0-1.2	1.5-2.0	1.5-2.0

The GSE Drainage Design Manual (GSE, 2007) and the SKAPS Compressive Creep Report (TRI, 2011) provide the following reduction factors for creep deformation (RF_{cr}) for GSE and Skaps products, respectively, as a function of applied stress. These reduction factors for creep deformation (RF_{cr}) were integrated into the analyses.

Applied Stress (psf)	GSE Average Creep Reduction Factor (RF_{cr})	SKAPS Creep Reduction Factor (RF_{cr})	Average Creep Reduction Factor (RF_{cr})
1,000	1.01	1.030 (Est'd)	1.02
5,000	1.08	1.045	1.06
10,000	1.12	1.065	1.09
15,000	1.14	1.113	1.13

The creep reduction factors used in the analysis were conservatively assigned based on the applied stress calculated for each case and the average creep reduction factor shown above. The reduction factors used in the HELP model analysis for the primary geocomposite drainage layer are summarized in the table below.

Case	Applied Stress[1] (psf)	RF_{in}	RF_{cr}	RF_{cc}	RF_{bc}	$\Pi(RF)$
1	686	1.0	1.02	1.50	1.50	2.30
2	4,568	1.1	1.06	1.75	1.75	3.57
3	9,642	1.1	1.09	1.75	1.75	3.67
4	15,000	1.1	1.13	1.75	1.75	3.81

[1] Applied Stress values were calculated using weighted averages of unit weights by depths as presented in the *MSW Unit Weight Versus Depth Relationship* [Kavazanjian, 1995]. This relationship is shown on Figure 1.

A review of the GSE (2007) and SKAPS (TRI, 2011 and 2014) creep reduction factors for 200-mil to 270-mil geocomposite products compared to 300-mil or thicker products reveals that the thinner products typically have a creep reduction factor approximately 20% greater than the thicker product. Accordingly, the reduction factors used in the HELP analysis for the secondary geocomposite drainage layer are summarized in the table below.

Case	Applied Stress[1] (psf)	RF_{in}	RF_{cr}	RF_{cc}	RF_{bc}	$\Pi(RF)$
1	686	1.0	1.22	1.50	1.50	2.75
2	4,568	1.1	1.27	1.75	1.75	4.29
3	9,642	1.1	1.31	1.75	1.75	4.41
4	15,000	1.1	1.36	1.75	1.75	4.57

[2] Applied Stress values were calculated using weighted averages of unit weights by depths as presented in the *MSW Unit Weight Versus Depth Relationship* (Kavazanjian, 1995). This relationship is shown on Figure 1.

3.5 Transmissivity Values Used in HELP Model Analyses

The transmissivity values calculated by the HELP model (θ_{model}) for the candidate geocomposite were evaluated such that the head on the primary geomembrane liner is no greater than 12 inches and the head on the secondary geomembrane liner is less than or equal to the thickness of the secondary geocomposite. The required transmissivity values ($\theta_{req'd}$) were then computed by applying the cumulative reduction factors ($\Pi(RF)$) and the assumed FS of 2.

The required transmissivity values represent transmissivity values obtained from typical manufacturer laboratory testing at a gradient corresponding to the initial minimum liner slopes of 1.5 percent (Cell 11) and 1.4 percent (Cells 12 and 13), under normal loads of approximately 700 psf (with 24-hour seating time) to 15,000 psf (with 100-hour seating time) (i.e., stress range applicable to JED facility), and with the same boundary conditions as in the field (i.e., primary geocomposite drainage layer sandwiched between liner protective cover soils and a textured geomembrane for the primary system and geocomposite drainage layer sandwiched between two textured geomembranes for the secondary system).

3.6 Input Data for HELP Model

The HELP model requires weather, soil, and basic design data as input and uses solution techniques that account for above-surface and subsurface hydraulic processes including precipitation, runoff, and evapotranspiration. The simulation period used in the HELP model analysis was 30 years.

3.6.1 Weather Data Description

The weather data required in the HELP model includes evapotranspiration, precipitation, temperature, and solar radiation. The description for the inputs required for these processes include:

3.6.1.1 Evapotranspiration

Evapotranspiration inputs include: evaporative zone depth, maximum leaf area index, starting and ending dates of the growing season, normal average wind speed, and normal average quarterly relative humidity. A description of the values used for the JED facility analysis is provided below.

- Evaporative zone depth – the maximum depth at which water can be removed by evapotranspiration. The default values of evaporative zone depth provided by the HELP model are 10 inches for bare areas, 22 inches for fair vegetation, and 40 inches for excellent vegetation. The evaporative zone depth values used in the HELP model for each scenario analyzed were conservatively assumed as follows:

Case	Evaporative zone depth (in)
1	10
2	12
3	12
4	12

- Maximum leaf area index (LAI) – the ratio of the area of actively transpiring vegetation to the surface area of the land. The amount of water removed due to evapotranspiration increases as the LAI increases. The LAI typically ranges from zero (bare ground) to 5.0 (excellent stand of grass). The LAI values used for each case are as follows:

Case	LAI
1	0.0
2	1.0
3	1.0
4	2.0

- Start and end dates of the growing season – provided by the HELP model for Orlando, Florida. The default values for the growing season start date is the 0^{th} day of the year and the growing season end date is the 367^{th} day.

- Normal average annual wind speed – based on the default values provided by the HELP model for Orlando, Florida. The average wind speed utilized in the HELP analysis was 8.6 miles per hour (mph).

- Normal average quarterly relative humidity – default normal average quarterly relative humidity values for Orlando, Florida were used as provided by the HELP model. Values utilized in the analyses include:

Quarter	Humidity%
First	72
Second	72
Third	80
Fourth	76

3.6.1.2 Precipitation

The HELP model provides default and synthetically generated precipitation data for specific cities in the United States. However, precipitation data for Orlando is not available in the HELP Model Version 3.07. Daily precipitation data files for a 30-year period from 1975 to 2004 were obtained from the National Climatic Data Center (NCDC) website. Fort Drum's precipitation data was used to simulate the rainfall at the JED Landfill. A summary of the annual rainfall for the 30-year period used in the analysis (1974 thru 2004) is presented in Table 3. As shown in the table, the average annual rainfall over the 30-year period is 53.1 inches and the maximum annual rainfall is 72.7 inches in 2004.

3.6.1.3 Temperature

The default normal mean monthly temperature data provided by the HELP model for Orlando, Florida was used to provide the temperature input data for all the cases analyzed.

3.6.1.4 Solar Radiation Data

Solar radiation data for the JED Landfill was synthetically generated for the site using the HELP model. The default station latitude for Orlando was 27.8 degrees.

3.6.2 Soil and Design Data

The soil and design data required in the HELP model include model plan area, runoff, initial moisture content, and layer data. The following is the description for the data used in the analyses.

3.6.2.1 Model Plan Area

Areas were assumed equal to 1 acre (43,560 ft^2) in the HELP analyses.

3.6.2.2 Runoff

This input parameter specifies the percentage of area that will allow drainage from the surface. The percentage of runoff assumed for each case was as follows:

Case	Runoff %
1	0
2	50
3	70
4	100

3.6.2.3 Initial Moisture Content

Default values for initial moisture content were calculated by the HELP model for approximately steady-state conditions and used for all soil layers.

3.6.2.4 Layer Data

Layer data was selected based on Geosyntec's experience, knowledge with local soils and site conditions, and HELP model recommendations. The HELP model provides default parameter values based on the Unified Soil Classification System (USCS) soil classification system or the United States Department of Agriculture (USDA) textural classification system.

The HELP model recognizes four general types of layers: (i) vertical percolation layer; (ii) lateral drainage layer designed to convey drainage laterally to a collection and removal system; (iii) soil barrier layer designed to restrict vertical leakage or percolation through which a saturated vertical flow is allowed; and (iv) geomembrane liners as barrier layers.

3.6.2.5 Geomembrane Liner

Pinhole density refers to the number of assumed defects with a hole diameter equal to or smaller than the geomembrane thickness. A conservative hole diameter of 1 mm was used in the HELP model analyses. Two pinholes per acre were assumed in the analyses, which is a typical assumption for a manufacturer with a good quality control program.

Installation defects refers to the assumed number of defects in a given area with a hole diameter larger than the geomembrane thickness. For this analysis, a hole size of 1 cm^2 was used in the HELP model analyses. Installation defects are the result of seaming faults and punctures during installation. Two defects per acre were assumed in the analyses, which is a typical assumption for a project with a good construction quality assurance (CQA) program.

3.6.2.6 Liner System Drainage Path Lengths

The longest drainage paths utilized in the HELP model analysis for the proposed primary LCS were 395 ft for Cell 11 and 330 ft for Cells 12 and 13.

3.6.2.7 Liner System Slope

To conservatively account for subgrade settlement, the performance evaluation for the proposed LCS design for Cell 11, 12, and 13 assumed the following slope values for each case. It is noted that the design slope was assumed for Case 1 (initial loading conditions) and the minimum allowable slope of 1.0% was assumed for Case 4 (maximum loading conditions).

Case	Cell 11 Slope (%)	Cell 12/13 Slope (%)
1	1.5	1.4
2	1.3	1.2
3	1.2	1.1
4	1.0	1.0

3.6.2.8 Surface Soil Texture

The surface soil texture for waste was used in all cases.

3.6.2.9 Surface Vegetation

The surface vegetation of each case used the following values.

Case	Surface Vegetation Number	Description
1	1	Bare ground
2	2	Poor surface vegetation
3	2	Poor surface vegetation
4	3	Fair surface vegetation

3.6.2.10 Leachate Recirculation

Leachate collected from the bottom liner system at the JED facility will be re-circulated. A separate HELP analysis was performed for each case using the leachate recirculation option in the HELP model, to ensure the primary leachate collection and the secondary leak detection systems meet the regulatory requirements for maximum head on the geomembranes. However, the recirculation option requires the input of the recirculation rate as a percentage of leachate collected and not a constant rate. To control the leachate recirculation rate being modeled, the daily precipitation data used in the HELP model analyses was increased by a constant rate to simulate the effect of leachate recirculation. Each HELP model recirculation analyses was performed assuming a leachate recirculation rate of approximately 2 inch per acre per month (in/ac/month), which corresponds to approximately 54,000 gallons per acre per month (gal/ac/month). Therefore, the daily precipitation input for the 30-year period was increased by 0.0667 in./ac/day (or 1,800 gal/ac/day).

4 HELP MODEL ANALYSES

HELP model analyses were performed for Cases 1 through 4 to calculate the minimum transmissivity value (θ_{model}) required to maintain a head on the primary geomembrane liner less than or equal to 12 inches and on the secondary geomembrane liner less than the thickness of the secondary geocomposite. The minimum transmissivity calculated using the HELP model was then used to compute the required transmissivity values ($\theta_{req'd}$) using the cumulative reduction factors and the assumed FS of 2. A final check was made to ensure that the computed required transmissivity values were within the range of the transmissivity values for commercially available geocomposites when tested under the conditions discussed above.

The HELP model uses McEnroe's equation to calculate the head on the geomembrane liner. However, it has been demonstrated that the maximum head on the geomembrane liner, as calculated by McEnroe's equation, is valid only when the head lies within the thickness of the geocomposite (Ellithy and Zhao, 2001). Furthermore, McEnroe's equations are mathematically sensitive under certain ranges of drainage layer slope and hydraulic conductivity and may produce incorrect results. As such, the head on the geomembrane liner computed by the HELP model was not used.

The head on the bottom liner system was computed using the method presented by Giroud et al. (2004). Giroud et al. (2004) developed an alternative method based on simplified assumptions and numerical methods for calculating the maximum liquid thickness and the maximum head in drainage systems composed of two layers, with the lower layer being a geocomposite. The solution for maximum liquid thickness and maximum head takes into consideration the leachate generation rate, the hydraulic conductivities of the two layers, the length of the drainage path, and the slope. The leachate generation rate, q_h, was obtained from the HELP model analysis output for the peak monthly average lateral drainage in the geocomposite drainage layer.

A summary of the input data used in the HELP model analysis is presented in Attachment A. Output files from the HELP model for each case are included in Attachment B. The parameters used to compute the heads using Giroud et al. (2004) are presented in the spreadsheets included in Attachment C of this calculation package.

5 HELP MODEL RESULTS

Tables 1a, 1b, 2a, and 2b present a summary of the results for lateral drainage and head on liner for each case analyzed for the proposed primary and secondary LCS for the landfill facility, respectively. The properties of the primary and secondary geocomposite drainage layers used in the analyses (e.g., required transmissivity based on laboratory testing) are also presented in Tables 1a, 1b, 2a and 2b.

6 REFERENCES

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TABLES

Table 1a

HEADS ON PRIMARY GEOMEMBRANE FOR CELL 11
COMPUTED USING GIROUD'S METHOD
J.E.D. SOLID WASTE MANAMGEMENT FACILITY
OSCEOLA COUNTY, FLORIDA

						Primary Geocomposite Drainage Layer					HELP Model Results		Heads computed using Giroud's Method		
Case Analyzed	Waste Height	Leacahte Recirculation	Vertical Stress	Drainage Length	Liner System Slope	$\theta_{req'd}$ [1]	RF*FS [3]	θ_{model} [2]	Geonet Thickness	Permeability k	Lateral Drainage (Peak Daily)	Lateral Drainage (Peak Monthly Avg.)	Impingement Rate [4] (Peak Monthly Avg.)		Head on Primary Geomembrane [5]
	(ft)		(psf)	(ft)	(%)	(m^2/sec)		(m^2/sec)	(in)	(cm/s)	(ft^3/ac/day)	(in/ac/mon)	(in/ac/mon)	(ft^3/ac/day)	(in)
Case 1	10	2 in/mon of Recirculation [6]	686	395	1.5	7.42E-04	4.59	1.62E-04	0.300	2.12	507	2.21	2.21	263	12.0
		Without Recirculation	686	395	1.5	2.65E-04	4.59	5.77E-05	0.300	0.76	186	0.84	0.84	100	12.0
Case 2	80	2 in/mon of Recirculation [6]	4,568	395	1.3	1.05E-03	7.14	1.47E-04	0.300	1.93	391	1.75	1.75	209	12.0
		Without Recirculation	4,568	395	1.3	2.36E-05	7.14	3.30E-06	0.300	0.04	13	0.09	0.09	11	12.0
Case 3	150	2 in/mon of Recirculation [6]	9,642	395	1.2	1.02E-03	7.34	1.39E-04	0.300	1.82	341	1.53	1.53	183	12.0
		Without Recirculation	9,642	395	1.2	2.64E-05	7.34	3.59E-06	0.300	0.05	12	0.09	0.09	10	12.0
Case 4	220	2 in/mon of Recirculation [6]	15,000	395	1.0	1.22E-03	7.61	1.60E-04	0.300	2.10	328	1.48	1.48	176	12.0
		Without Recirculation	15,000	395	1.0	2.84E-05	7.61	3.73E-06	0.300	0.05	11	0.08	0.08	9	12.0

Note:

[1] Measured transmissivity during laboratory testing.

[2] Transmissivity used in HELP model analysis.

[3] Assumed FS (Factor of Safety) is 2.0.

[4] Rate of liquid supply (qh) obtained from HELP model analysis.

[5] Analysis performed iteratively by changing the geocomposite transmissivity to obtain a maximum head of almost (but less than) 12 inches on the geomembrane using the Giroud et al (2004) equation.

[6] 2 in/month of recirculation corresponds to approximately 54,000 gallons per acre per month.

Table 1b

HEADS ON PRIMARY GEOMEMBRANE FOR CELLS 12 & 13
COMPUTED USING GIROUD'S METHOD
J.E.D. SOLID WASTE MANAMGEMENT FACILITY
OSCEOLA COUNTY, FLORIDA

						Primary Geocomposite Drainage Layer					HELP Model Results		Heads computed using Giroud's Method		
Case Analyzed	Waste Height	Leacahte Recirculation	Vertical Stress	Drainage Length	Liner System Slope	$\theta_{req'd}$ [1]	RF*FS [3]	θ_{model} [2]	Geonet Thickness	Permeability k	Lateral Drainage (Peak Daily)	Lateral Drainage (Peak Monthly Avg.)	Impingement Rate [4] (Peak Monthly Avg.)		Head on Primary Geomembrane [5]
	(ft)		(psf)	(ft)	(%)	(m^2/sec)		(m^2/sec)	(in)	(cm/s)	(ft^3/ac/day)	(in/ac/mon)	(in/ac/mon)	(ft^3/ac/day)	(in)
Case 1	10	2 in/mon of Recirculation [6]	686	330	1.4	6.48E-04	4.59	1.41E-04	0.300	1.85	496	2.18	2.18	260	12.0
		Without Recirculation	686	330	1.4	1.87E-04	4.59	4.07E-05	0.300	0.53	150	0.69	0.69	83	12.0
Case 2	80	2 in/mon of Recirculation [6]	4,568	330	1.2	9.27E-04	7.14	1.30E-04	0.300	1.70	383	1.74	1.74	207	12.0
		Without Recirculation	4,568	330	1.2	2.86E-05	7.14	4.01E-06	0.300	0.05	16	0.11	0.11	13	12.0
Case 3	150	2 in/mon of Recirculation [6]	9,642	330	1.1	9.09E-04	7.34	1.24E-04	0.300	1.62	334	1.53	1.53	182	12.0
		Without Recirculation	9,642	330	1.1	3.21E-05	7.34	4.37E-06	0.300	0.06	16	0.11	0.11	13	12.0
Case 4	220	2 in/mon of Recirculation [6]	15,000	330	1.0	9.95E-04	7.61	1.31E-04	0.300	1.71	321	1.47	1.47	175	12.0
		Without Recirculation	15,000	330	1.0	3.31E-05	7.61	4.34E-06	0.300	0.06	14	0.10	0.10	12	12.0

Note:

1 Measured transmissivity during laboratory testing.

2 Transmissivity used in HELP model analysis.

3 Assumed FS (Factor of Safety) is 2.0.

4 Rate of liquid supply (qh) obtained from HELP model analysis.

5 Analysis performed iteratively by changing the geocomposite transmissivity to obtain a maximum head of almost (but less than) 12 inches on the geomembrane using the Giroud et al (2004) equation.

6 2 in/month of recirculation corresponds to approximately 54,000 gallons per acre per month.

Table 2a

HEADS ON SECONDARY GEOMEMBRANE FOR CELL 11
COMPUTED USING GIROUD'S METHOD
J.E.D. SOLID WASTE MANAMGEMENT FACILITY
OSCEOLA COUNTY, FLORIDA

Case Analyzed	Waste Height (ft)	Leacahte Recirculation	Vertical Stress (psf)	Drainage Length (ft)	Liner System Slope (%)	Secondary Geocomposite Drainage Layer: $\theta_{req'd}$ [1] (m^2/sec)	RF*FS [3]	θ_{model} [2] (m^2/sec)	Geonet Thickness (in)	Permeability k (cm/s)	HELP Model Results: Lateral Drainage (Peak Daily) (ft^3/ac/day)	Lateral Drainage (Peak Monthly Avg.) (in/ac/mon)	Head on Secondary Geomembrane (in)
Case 1	10	2 in/mon of Recirculation [4]	686	395	1.5	1.54E-04	5.51	2.79E-05	0.200	0.55	86	0.73	0.20
		Without Recirculation	686	395	1.5	1.73E-04	5.51	3.15E-05	0.200	0.62	97	0.82	0.20
Case 2	80	2 in/mon of Recirculation [4]	4,568	395	1.3	2.31E-04	8.57	2.69E-05	0.200	0.53	72	0.61	0.20
		Without Recirculation	4,568	395	1.3	3.09E-04	8.57	3.61E-05	0.200	0.71	96	0.81	0.20
Case 3	150	2 in/mon of Recirculation [4]	9,642	395	1.2	2.73E-04	8.81	3.10E-05	0.200	0.61	76	0.65	0.20
		Without Recirculation	9,642	395	1.2	3.40E-04	8.81	3.86E-05	0.200	0.76	95	0.80	0.20
Case 4	220	2 in/mon of Recirculation [4]	15,000	395	1.0	3.53E-04	9.14	3.86E-05	0.200	0.76	79	0.67	0.20
		Without Recirculation	15,000	395	1.0	4.32E-04	9.14	4.72E-05	0.200	0.93	97	0.83	0.20

Note:

[1] Measured transmissivity during laboratory testing.

[2] Transmissivity used in HELP model analysis.

[3] Assumed FS (Factor of Safety) is 2.0.

[4] 2 in/month of recirculation corresponds to approximately 54,000 gallons per acre per month.

Table 2b

HEADS ON SECONDARY GEOMEMBRANE FOR CELLS 12 & 13
COMPUTED USING GIROUD'S METHOD
J.E.D. SOLID WASTE MANAMGEMENT FACILITY
OSCEOLA COUNTY, FLORIDA

						Secondary Geocomposite Drainage Layer					HELP Model Results		
Case Analyzed	Waste Height (ft)	Leacahte Recirculation	Vertical Stress (psf)	Drainage Length (ft)	Liner System Slope (%)	$\theta_{req'd}$ [1] (m^2/sec)	RF*FS [3]	θ_{model} [2] (m^2/sec)	Geonet Thickness (in)	Permeability k (cm/s)	Lateral Drainage (Peak Daily) (ft^3/ac/day)	Lateral Drainage (Peak Monthly Avg.) (in/ac/mon)	Head on Secondary Geomembrane (in)
Case 1	10	2 in/mon of Recirculation [4]	686	330	1.4	1.40E-04	5.51	2.54E-05	0.200	0.50	87	0.74	0.20
		Without Recirculation	686	330	1.4	1.68E-04	5.51	3.05E-05	0.200	0.60	105	0.88	0.20
Case 2	80	2 in/mon of Recirculation [4]	4,568	330	1.2	2.13E-04	8.57	2.49E-05	0.200	0.49	73	0.62	0.20
		Without Recirculation	4,568	330	1.2	2.74E-04	8.57	3.20E-05	0.200	0.63	94	0.79	0.20
Case 3	150	2 in/mon of Recirculation [4]	9,642	330	1.1	2.51E-04	8.81	2.84E-05	0.200	0.56	77	0.65	0.20
		Without Recirculation	9,642	330	1.1	3.04E-04	8.81	3.45E-05	0.200	0.68	93	0.78	0.20
Case 4	220	2 in/mon of Recirculation [4]	15,000	330	1.0	2.97E-04	9.14	3.25E-05	0.200	0.64	80	0.68	0.20
		Without Recirculation	15,000	330	1.0	3.53E-04	9.14	3.86E-05	0.200	0.76	95	0.80	0.20

Note:

[1] Measured transmissivity during laboratory testing.

[2] Transmissivity used in HELP model analysis.

[3] Assumed FS (Factor of Safety) is 2.0.

[4] 2 in/month of recirculation corresponds to approximately 54,000 gallons per acre per month.

FIGURES

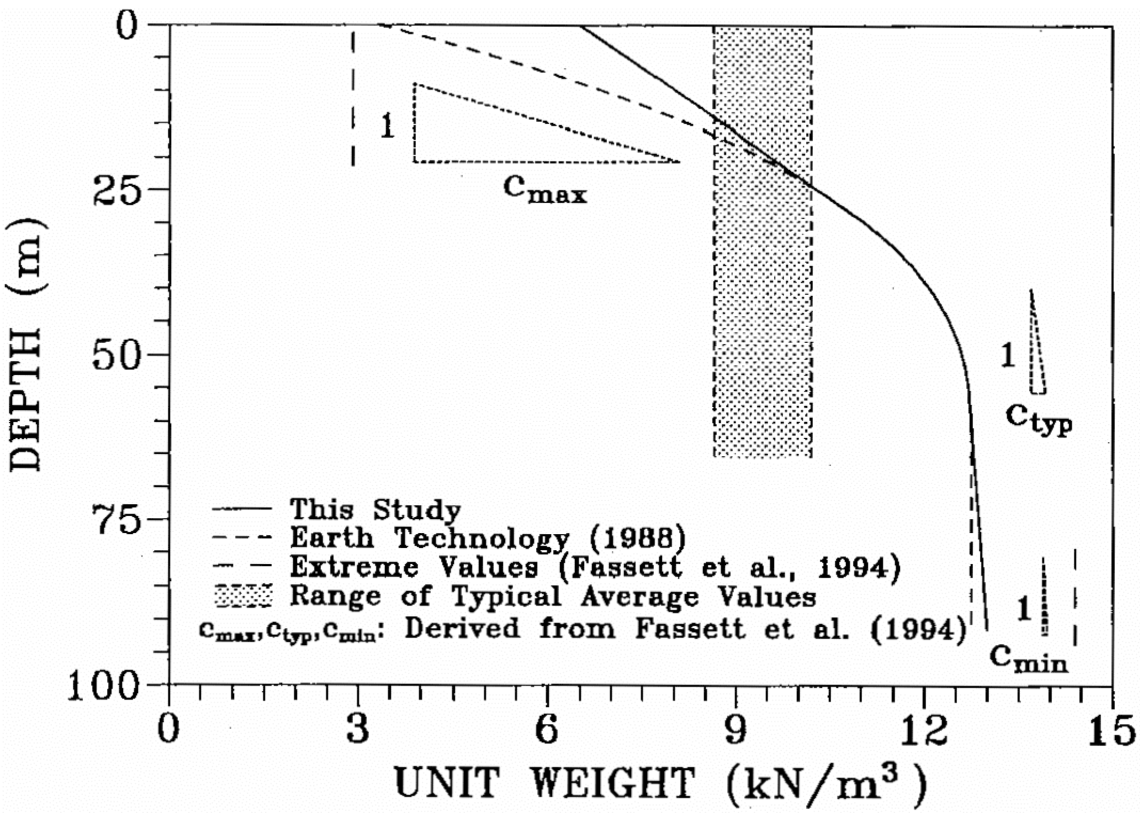

Figure 1. Unit Weight Relationships for MSW (Kavazanjian, 1995)

ATTACHMENT A
Summary of HELP Model Data

CELL 11 - CASE 1 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
10 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	10	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	0	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	0	%
Surface Length	1100	ft
Surface Slope	5	%
Surface Slope Vegetation	1	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	120	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	2.12	395	1.5
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.55	395	1.5
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELL 11 - CASE 2 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
80 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	50	%
Surface Length	800	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	960	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	1.93	395	1.3
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.53	395	1.3
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELL 11 - CASE 3 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
150 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	70	%
Surface Length	600	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	1,800	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	1.82	395	1.2
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.61	395	1.2
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELL 11 - CASE 4 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
220 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	2	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	100	%
Surface Length	300	ft
Surface Slope	5	%
Surface Slope Vegetation	3	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	2,640	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	2.10	395	1.0
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.76	395	1.0
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELL 11 - CASE 1 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
10 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	10	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	0	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	0	%
Surface Length	1100	ft
Surface Slope	5	%
Surface Slope Vegetation	1	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	120	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.76	395	1.5
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.62	395	1.5
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELL 11 - CASE 2 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
80 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	50	%
Surface Length	800	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	960	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.04	395	1.3
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.71	395	1.3
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELL 11 - CASE 3 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
150 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	70	%
Surface Length	600	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	1,800	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.05	395	1.2
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.76	395	1.2
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELL 11 - CASE 4 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
220 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	2	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	100	%
Surface Length	300	ft
Surface Slope	5	%
Surface Slope Vegetation	3	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	2,640	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.05	395	1.0
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.93	395	1.0
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 1 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
10 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	10	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	0	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	0	%
Surface Length	1100	ft
Surface Slope	5	%
Surface Slope Vegetation	1	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	120	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	1.85	330	1.4
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.50	330	1.4
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 2 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
80 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	50	%
Surface Length	800	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	960	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	1.70	330	1.2
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.49	330	1.2
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 3 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
150 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	70	%
Surface Length	600	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	1,800	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	1.62	330	1.1
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.56	330	1.1
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 4 WITH LEACHATE RECIRCULATION
INPUT DATA SUMMARY
220 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	2	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	100	%
Surface Length	300	ft
Surface Slope	5	%
Surface Slope Vegetation	3	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	2,640	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	1.71	330	1.0
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.64	330	1.0
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 1 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
10 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	10	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	0	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	0	%
Surface Length	1100	ft
Surface Slope	5	%
Surface Slope Vegetation	1	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	120	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.53	330	1.4
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.60	330	1.4
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 2 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
80 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	50	%
Surface Length	800	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	960	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.05	330	1.2
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.63	330	1.2
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 3 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
150 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	1	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	70	%
Surface Length	600	ft
Surface Slope	5	%
Surface Slope Vegetation	2	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	1,800	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.06	330	1.1
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.68	330	1.1
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

CELLS 12 & 13 - CASE 4 WITHOUT LEACHATE RECIRCULATION
INPUT DATA SUMMARY
220 FT OF WASTE AND BOTTOM LINER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	12	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	2	
bare ground	0	
poor stand of grass	1	
fair stand of grass	2	
good stand of grass	3.5	
excellent stand of grass	5	
Growing season start day	0	
Growing season end day	367	
Average wind speed	8.6	mph
First quarter relative humidity	72	%
Second quarter relative humidity	72	%
Third quarter relative humidity	80	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Fort Drum
State	Florida
Years for data generation	1975 thru 2004

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (ºF)

January	60.5	July	82.4
February	61.5	August	82.5
March	66.8	September	81.1
April	72	October	74.9
May	77.3	November	67.5
June	80.9	December	62

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	100	%
Surface Length	300	ft
Surface Slope	5	%
Surface Slope Vegetation	3	
bare ground	1	
grass (poor)	2	
grass (fair)	3	
grass (good)	4	
grass (excellent)	5	

F. Geomembrane

Placement of geomembrane	Good
Pinhole (# of defects/area)	2
Defect density per acre	2

G. Material Properties

Layer	Type	Description	Thickness in	Texture number	Porosity vol/vol	Field cap. vol/vol	Wilting point vol/vol	k cm/sec	Length Drain ft	Liner slope %
1	1	Vertical percolation	2,640	18	0.671	0.292	0.077	0.001		
2	1	Vertical percolation	24	1	0.417	0.045	0.018	0.001		
3	2	Lateral drainage	0.300		0.85	0.01	0.005	0.06	330	1.0
4	4	Geomembrane liner	0.060	35				2E-13		
6	2	Lateral drainage	0.200		0.85	0.01	0.005	0.76	330	1.0
7	4	Geomembrane liner	0.060	35				2E-13		
8	3	GCL	0.250	17	0.750	0.747	0.400	3.00E-09		
9	1	Vertical percolation	120	5	0.457	0.131	0.058	0.001		

ATTACHMENT B
HELP Model Output

Cell 11 – With Leachate Recirculation

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE1.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE1.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE1.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE1.D10
OUTPUT DATA FILE:           C:\HELP\11CASE1.OUT


TIME:  14:53     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  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 =      0.2828 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1281 VOL/VOL
```



```
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.0440 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =   2.12280011000     CM/SEC
           SLOPE                      =      1.50   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  4
                                   --------

                     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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                   LAYER  5
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.550000012000     CM/SEC
           SLOPE                      =      1.50   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  6
                                   --------

                     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          =      2.00   HOLES/ACRE
    FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
    FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 7

```
                TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER  17
    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.    =  0.300000003000E-08 CM/SEC
```

LAYER 8

```
            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   5
    THICKNESS                    =    120.00   INCHES
    POROSITY                     =      0.4570 VOL/VOL
    FIELD CAPACITY               =      0.1310 VOL/VOL
    WILTING POINT                =      0.0580 VOL/VOL
    INITIAL SOIL WATER CONTENT   =      0.1310 VOL/VOL
    EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH BARE
         GROUND CONDITIONS, A SURFACE SLOPE OF  5.% AND
         A SLOPE LENGTH OF 1100. FEET.

 SCS RUNOFF CURVE NUMBER              =     78.90
 FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
 EVAPORATIVE ZONE DEPTH               =     10.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE    =      1.813  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE   =      6.710  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.770  INCHES
 INITIAL SNOW WATER                   =      0.000  INCHES
 INITIAL WATER IN LAYER MATERIALS     =     53.097  INCHES
 TOTAL INITIAL WATER                  =     53.097  INCHES
 TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO              FLORIDA

     STATION LATITUDE                        =  27.80 DEGREES
```



```
     MAXIMUM LEAF AREA INDEX                  =   0.00
     START OF GROWING SEASON (JULIAN DATE)    =      0
     END OF GROWING SEASON (JULIAN DATE)      =    367
     EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
     AVERAGE ANNUAL WIND SPEED                =   8.60 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  72.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  80.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  76.00 %


 NOTE:  PRECIPITATION DATA FOR     FORTDRUM           FLORIDA
        WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
        COEFFICIENTS FOR    ORLANDO             FLORIDA
```

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
        COEFFICIENTS FOR    ORLANDO             FLORIDA
          AND STATION LATITUDE  =  27.80 DEGREES
```

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
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	3.313	3.337	4.180	3.901	4.590	6.196
	6.154	5.783	4.964	4.037	3.147	2.821
STD. DEVIATIONS	0.300	0.481	0.781	1.038	1.349	1.114
	1.110	1.019	0.527	0.569	0.481	0.310

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.8208	0.7553	0.6526	1.0146	0.7405	1.0823
	2.0383	2.1187	2.2078	2.1196	1.4684	0.8198
STD. DEVIATIONS	0.9860	0.8189	0.7279	1.1775	0.6740	1.1711
	1.1020	1.2432	1.0458	1.0999	1.1128	0.7948

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.4785	0.4083	0.4074	0.6907	0.4353	0.8642
	1.3447	1.4415	1.4805	1.3930	0.8117	0.4695
STD. DEVIATIONS	0.4345	0.2972	0.3242	1.0370	0.2729	1.1235
	1.5186	1.3302	1.3550	1.3901	0.7740	0.2820

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7021	0.6343	0.6980	0.6881	0.6993	0.6904
	0.7170	0.7230	0.7079	0.7303	0.6931	0.7211
STD. DEVIATIONS	0.1223	0.1351	0.1394	0.1194	0.1346	0.1029
	0.0927	0.0602	0.0130	0.0198	0.0939	0.0706

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1264	0.0742	0.0750	0.3534	0.0805	0.5287
	0.8136	0.8789	0.9595	0.8222	0.3230	0.0879
STD. DEVIATIONS	0.2563	0.1317	0.1690	1.0424	0.1658	1.0261
	1.7078	1.3534	1.5657	1.4415	0.7071	0.1308

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1913	0.1895	0.1902	0.1938	0.1906	0.1944
	0.1954	0.1970	0.1993	0.1990	0.1952	0.1965
STD. DEVIATIONS	0.0333	0.0401	0.0380	0.0336	0.0367	0.0290
	0.0253	0.0164	0.0037	0.0054	0.0264	0.0192

****

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	78.67	(10.922)	285560.9	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	52.423	(3.3460)	190294.75	66.639
LATERAL DRAINAGE COLLECTED FROM LAYER 3	15.83882	(5.11478)	57494.910	20.13403
PERCOLATION/LEAKAGE THROUGH LAYER 4	10.22513	(4.38324)	37117.211	12.99800
AVERAGE HEAD ON TOP OF LAYER 4	0.427	(0.359)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	8.40473	(0.81336)	30509.172	10.68394
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.194	(0.019)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	2.001	(5.1570)	7261.95	2.543

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.13961	506.77524
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.318742	1157.03381
AVERAGE HEAD ON TOP OF LAYER 4	12.080	
MAXIMUM HEAD ON TOP OF LAYER 4	16.837	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	119.7 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02368	85.94440
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.390	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	9.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6710
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1180

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	37.2946	0.3108
2	4.8811	0.2034
3	0.2514	0.8380
4	0.0000	0.0000
5	54.7786	273.8930
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE2.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE2.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE2.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE2.D10
OUTPUT DATA FILE:           C:\HELP\11CASE2.OUT


TIME:  15:15     DATE:  11/ 3/2014


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     TITLE:  JED Solid Waste Management Facility

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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  18
           THICKNESS                  =    960.00   INCHES
           POROSITY                   =      0.6710 VOL/VOL
           FIELD CAPACITY             =      0.2920 VOL/VOL
           WILTING POINT              =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2949 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                 LAYER  2
                                 --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
```



```
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                 LAYER  3
                                 --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.6102 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =   1.92840004000     CM/SEC
           SLOPE                      =      1.30   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                 LAYER  4
                                 --------

                 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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                 LAYER  5
                                 --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.529999971000     CM/SEC
           SLOPE                      =      1.30   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                 LAYER  6
                                 --------

                 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 = 2.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 2.00 HOLES/ACRE
FML PLACEMENT QUALITY = 3 - GOOD

LAYER 7

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

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.	=	0.300000003000E-08 CM/SEC

LAYER 8

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	120.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #18 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 800. FEET.

SCS RUNOFF CURVE NUMBER	=	71.50	
FRACTION OF AREA ALLOWING RUNOFF	=	50.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.176	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.052	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.924	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	303.877	INCHES
TOTAL INITIAL WATER	=	303.877	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ORLANDO FLORIDA

STATION LATITUDE	=	27.80 DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00
START OF GROWING SEASON (JULIAN DATE)	=	0
END OF GROWING SEASON (JULIAN DATE)	=	367
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA FOR FORTDRUM FLORIDA WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA AND STATION LATITUDE = 27.80 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.016	0.001	0.099	0.003	0.038	0.058
	0.047	0.167	0.073	0.025	0.058	0.017
STD. DEVIATIONS	0.042	0.003	0.315	0.010	0.092	0.092
	0.124	0.410	0.228	0.070	0.191	0.062
EVAPOTRANSPIRATION						
TOTALS	3.233	3.461	4.468	4.426	4.942	6.639
	6.613	6.158	5.304	4.302	3.162	2.773

STD. DEVIATIONS	0.235	0.406	0.729	1.018	1.432	1.117
	1.048	0.970	0.351	0.594	0.545	0.364

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.3855	1.1716	1.0543	1.0244	1.0183	0.6556
	0.9756	1.1991	1.1627	1.3081	1.7532	1.7079
STD. DEVIATIONS	0.7240	0.7588	0.8637	0.8214	0.9383	0.6762
	0.8092	0.7139	0.6232	0.6600	0.8224	0.9189

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.7235	0.6266	0.6002	0.5621	0.5690	0.4229
	0.5551	0.6663	0.6665	0.7231	0.8541	0.8286
STD. DEVIATIONS	0.2796	0.2885	0.3237	0.3317	0.3631	0.2864
	0.3255	0.2788	0.2559	0.2802	0.3094	0.3350

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.5995	0.5430	0.5860	0.5816	0.5959	0.5701
	0.5977	0.6013	0.5767	0.6121	0.5928	0.6105
STD. DEVIATIONS	0.0740	0.0814	0.1042	0.0367	0.0828	0.0882
	0.0836	0.0607	0.0651	0.0043	0.0021	0.0139

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1308	0.1194	0.0983	0.0949	0.0926	0.0621
	0.0914	0.1230	0.1361	0.1475	0.1963	0.1623
STD. DEVIATIONS	0.0714	0.0875	0.0819	0.0761	0.0854	0.0648
	0.0797	0.0888	0.1101	0.1303	0.1215	0.0962

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1956	0.1943	0.1912	0.1961	0.1944	0.1922
	0.1950	0.1962	0.1944	0.1997	0.1999	0.1992
STD. DEVIATIONS	0.0241	0.0288	0.0340	0.0124	0.0270	0.0297
	0.0273	0.0198	0.0219	0.0014	0.0007	0.0045

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	78.67	(10.922)	285560.9	100.00
RUNOFF	0.603	(0.6869)	2187.36	0.766
EVAPOTRANSPIRATION	55.480	(3.3712)	201392.77	70.525
LATERAL DRAINAGE COLLECTED FROM LAYER 3	14.41624	(4.90247)	52330.957	18.32567
PERCOLATION/LEAKAGE THROUGH LAYER 4	7.79807	(1.98381)	28306.984	9.91276
AVERAGE HEAD ON TOP OF LAYER 4	0.121	(0.051)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.06726	(0.47347)	25654.146	8.98377
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.196	(0.013)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	1.101	(6.2379)	3995.97	1.399

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	1.498	5437.7178
DRAINAGE COLLECTED FROM LAYER 3	0.10777	391.21616
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.117589	426.84866
AVERAGE HEAD ON TOP OF LAYER 4	2.802	
MAXIMUM HEAD ON TOP OF LAYER 4	4.702	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	61.6 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.01977	71.78060
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.389	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	10.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6710
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0834

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	294.5388	0.3068
2	4.3566	0.1815
3	0.0050	0.0165
4	0.0000	0.0000
5	22.0940	110.4699
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE3.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE3.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE3.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE3.D10
OUTPUT DATA FILE:           C:\HELP\11CASE3.OUT


TIME:  15:26     DATE:  11/ 3/2014


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     TITLE:  JED Solid Waste Management Facility

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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  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 =      0.2943 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
```



```
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1874 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.6436 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =   1.81879997000     CM/SEC
           SLOPE                      =      1.20   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  4
                                   --------

                     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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                   LAYER  5
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.610000014000     CM/SEC
           SLOPE                      =      1.20   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  6
                                   --------

                     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
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```
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
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.   =  0.300000003000E-08 CM/SEC


                        LAYER  8
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
         POOR STAND OF GRASS, A SURFACE SLOPE OF  5.%
         AND A SLOPE LENGTH OF  600. FEET.

SCS RUNOFF CURVE NUMBER            =     71.90
FRACTION OF AREA ALLOWING RUNOFF   =     70.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      2.176  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.924  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =    550.587  INCHES
TOTAL INITIAL WATER                =    550.587  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO               FLORIDA
```



```
STATION LATITUDE                      =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX               =   1.00
START OF GROWING SEASON (JULIAN DATE) =      0
END OF GROWING SEASON (JULIAN DATE)   =    367
EVAPORATIVE ZONE DEPTH                =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED             =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  76.00 %


NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
         WAS ENTERED FROM AN ASCII DATA FILE.


NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA

    NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA
           AND STATION LATITUDE  =  27.80 DEGREES
```

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.024	0.002	0.138	0.005	0.056	0.087
	0.071	0.243	0.107	0.037	0.085	0.026
STD. DEVIATIONS	0.062	0.005	0.428	0.015	0.134	0.136
	0.179	0.589	0.328	0.104	0.275	0.090
EVAPOTRANSPIRATION						
TOTALS	3.232	3.460	4.469	4.428	4.942	6.637
	6.615	6.159	5.303	4.300	3.158	2.777

STD. DEVIATIONS	0.236	0.408	0.730	1.018	1.432	1.116
	1.048	0.968	0.352	0.597	0.548	0.357

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.3374	1.1819	1.0628	0.9953	1.0905	0.7253
	0.9185	1.0588	1.0325	1.1113	1.5155	1.5348
STD. DEVIATIONS	0.6655	0.6662	0.7502	0.7846	0.8721	0.7131
	0.7290	0.6212	0.4968	0.5729	0.7023	0.7844

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.7700	0.6877	0.6658	0.6030	0.6533	0.4878
	0.5879	0.6687	0.6675	0.6992	0.8423	0.8479
STD. DEVIATIONS	0.2888	0.2834	0.3165	0.3465	0.3844	0.3292
	0.3320	0.2663	0.2210	0.2502	0.2911	0.3314

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.6365	0.5745	0.6213	0.6200	0.6437	0.6057
	0.6348	0.6393	0.6128	0.6477	0.6292	0.6477
STD. DEVIATIONS	0.0811	0.0892	0.1147	0.0389	0.0295	0.0939
	0.0895	0.0653	0.0673	0.0141	0.0059	0.0195

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1441	0.1359	0.1170	0.1072	0.1173	0.0798
	0.1021	0.1206	0.1268	0.1298	0.1852	0.1695
STD. DEVIATIONS	0.0740	0.0762	0.0874	0.0855	0.0943	0.0796
	0.0872	0.0768	0.0719	0.0933	0.1000	0.0941

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1955	0.1934	0.1908	0.1968	0.1977	0.1922
	0.1950	0.1963	0.1945	0.1989	0.1997	0.1989
STD. DEVIATIONS	0.0249	0.0297	0.0352	0.0123	0.0091	0.0298
	0.0275	0.0201	0.0214	0.0043	0.0019	0.0060

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES	CU. FEET	PERCENT
PRECIPITATION	78.67 (10.922)	285560.9	100.00
RUNOFF	0.880 (0.9721)	3192.72	1.118
EVAPOTRANSPIRATION	55.479 (3.3580)	201389.08	70.524
LATERAL DRAINAGE COLLECTED FROM LAYER 3	13.56451 (4.36516)	49239.180	17.24297
PERCOLATION/LEAKAGE THROUGH LAYER 4	8.18106 (1.97347)	29697.262	10.39962
AVERAGE HEAD ON TOP OF LAYER 4	0.128 (0.047)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.51338 (0.51542)	27273.561	9.55087
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002 (0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.196 (0.013)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002 (0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	1.231 (6.9054)	4466.77	1.564

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	1.997	7248.7427
DRAINAGE COLLECTED FROM LAYER 3	0.09391	340.89700
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.117284	425.74097
AVERAGE HEAD ON TOP OF LAYER 4	2.796	
MAXIMUM HEAD ON TOP OF LAYER 4	4.655	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	64.4 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02101	76.26230
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.389	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	11.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6586
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0834

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	547.1699	0.3040
2	4.2127	0.1755
3	0.0108	0.0360
4	0.0000	0.0000
5	20.2014	101.0070
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE4.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE4.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE4.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE4.D10
OUTPUT DATA FILE:           C:\HELP\11CASE4.OUT


TIME:  15:35     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  18
           THICKNESS                  =   2640.00   INCHES
           POROSITY                   =      0.6710 VOL/VOL
           FIELD CAPACITY             =      0.2920 VOL/VOL
           WILTING POINT              =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2936 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 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   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
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```
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1864 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.6468 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =   2.09990001000     CM/SEC
           SLOPE                      =      1.00   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  4
                                   --------

                       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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                   LAYER  5
                                   --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.759999990000     CM/SEC
           SLOPE                      =      1.00   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  6
                                   --------

                       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         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
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.   =  0.300000003000E-08 CM/SEC


                        LAYER  8
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
        SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
        FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
        AND A SLOPE LENGTH OF  300. FEET.

SCS RUNOFF CURVE NUMBER             =     57.30
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   =      2.083  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.924  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    795.962  INCHES
TOTAL INITIAL WATER                 =    795.962  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


          EVAPOTRANSPIRATION AND WEATHER DATA
          -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
        ORLANDO               FLORIDA
```



```
STATION LATITUDE                         =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX                  =   2.00
START OF GROWING SEASON (JULIAN DATE)    =      0
END OF GROWING SEASON (JULIAN DATE)      =    367
EVAPORATIVE ZONE DEPTH                   =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED                =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  76.00 %


NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
       WAS ENTERED FROM AN ASCII DATA FILE.


NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
       COEFFICIENTS FOR    ORLANDO             FLORIDA

    NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
       COEFFICIENTS FOR    ORLANDO             FLORIDA
         AND STATION LATITUDE  =  27.80 DEGREES


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

     AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004
-------------------------------------------------------------------------------
```

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.000	0.000	0.043	0.000	0.004	0.002
	0.009	0.070	0.026	0.002	0.024	0.001
STD. DEVIATIONS	0.002	0.000	0.191	0.000	0.021	0.009
	0.048	0.234	0.132	0.009	0.091	0.006
EVAPOTRANSPIRATION						
TOTALS	3.185	3.519	4.576	4.410	4.905	6.644
	6.598	6.174	5.355	4.382	3.165	2.784

STD. DEVIATIONS	0.227	0.359	0.735	1.086	1.490	1.094
	1.076	0.957	0.361	0.568	0.539	0.366

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.3386	1.1955	1.1332	1.0248	1.1196	0.7953
	0.9628	1.0300	0.9995	1.0825	1.4387	1.4750
STD. DEVIATIONS	0.6407	0.6277	0.6970	0.7565	0.8631	0.7205
	0.7054	0.5954	0.4653	0.5554	0.6769	0.7495

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.7876	0.7101	0.7149	0.6377	0.6848	0.5348
	0.6237	0.6797	0.6709	0.7001	0.8335	0.8436
STD. DEVIATIONS	0.2909	0.2816	0.3043	0.3419	0.3940	0.3522
	0.3327	0.2612	0.2111	0.2349	0.2909	0.3344

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.6506	0.5835	0.6436	0.6434	0.6678	0.6272
	0.6591	0.6627	0.6342	0.6722	0.6530	0.6702
STD. DEVIATIONS	0.1007	0.1278	0.1246	0.0417	0.0336	0.1036
	0.0932	0.0709	0.0760	0.0151	0.0076	0.0331

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1496	0.1414	0.1288	0.1172	0.1273	0.0968
	0.1094	0.1228	0.1258	0.1246	0.1802	0.1668
STD. DEVIATIONS	0.0734	0.0740	0.0836	0.0877	0.0991	0.0895
	0.0862	0.0775	0.0646	0.0722	0.0950	0.0897

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1924	0.1892	0.1904	0.1967	0.1975	0.1917
	0.1949	0.1960	0.1938	0.1988	0.1996	0.1982
STD. DEVIATIONS	0.0298	0.0412	0.0368	0.0127	0.0099	0.0317
	0.0276	0.0210	0.0232	0.0045	0.0023	0.0098

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	78.67	(10.922)	285560.9	100.00
RUNOFF	0.180	(0.3798)	654.98	0.229
EVAPOTRANSPIRATION	55.696	(3.4229)	202176.50	70.800
LATERAL DRAINAGE COLLECTED FROM LAYER 3	13.59554	(4.09357)	49351.801	17.28241
PERCOLATION/LEAKAGE THROUGH LAYER 4	8.42144	(1.92215)	30569.832	10.70519
AVERAGE HEAD ON TOP OF LAYER 4	0.133	(0.044)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.76753	(0.65535)	28196.141	9.87395
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.195	(0.017)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	1.427	(7.5513)	5181.67	1.815

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	1.035	3758.4060
DRAINAGE COLLECTED FROM LAYER 3	0.09039	328.11768
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.116868	424.22913
AVERAGE HEAD ON TOP OF LAYER 4	2.765	
MAXIMUM HEAD ON TOP OF LAYER 4	4.519	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	70.9 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02181	79.18291
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.387	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	12.6 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6083

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0817

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	798.9160	0.3026
2	4.1650	0.1735
3	0.0115	0.0384
4	0.0000	0.0000
5	19.7862	98.9308
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

****
****

Cell 11 – With No Leachate Recirculation

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE1.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE1.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE1.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE1N.D10
OUTPUT DATA FILE:           C:\HELP\11CASE1N.OUT


TIME:  16:42     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  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 =      0.2802 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                  LAYER  2
                                  --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1185 VOL/VOL
```



```
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.0317 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.756600022000     CM/SEC
           SLOPE                      =      1.50   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                  LAYER  4
                                  --------

                   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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                  LAYER  5
                                  --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.620000005000     CM/SEC
           SLOPE                      =      1.50   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                  LAYER  6
                                  --------

                   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          =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 7

```
          TYPE 3 - BARRIER SOIL LINER
          MATERIAL TEXTURE NUMBER  17
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.    =  0.300000003000E-08 CM/SEC
```

LAYER 8

```
       TYPE 1 - VERTICAL PERCOLATION LAYER
          MATERIAL TEXTURE NUMBER   5
THICKNESS                    =    120.00   INCHES
POROSITY                     =      0.4570 VOL/VOL
FIELD CAPACITY               =      0.1310 VOL/VOL
WILTING POINT                =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH BARE
         GROUND CONDITIONS, A SURFACE SLOPE OF  5.% AND
         A SLOPE LENGTH OF 1100. FEET.

SCS RUNOFF CURVE NUMBER            =     78.90
FRACTION OF AREA ALLOWING RUNOFF   =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      1.507  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      6.710  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.770  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =     52.558  INCHES
TOTAL INITIAL WATER                =     52.558  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO              FLORIDA

    STATION LATITUDE                      =  27.80 DEGREES
```



```
MAXIMUM LEAF AREA INDEX                 =   0.00
START OF GROWING SEASON (JULIAN DATE)   =      0
END OF GROWING SEASON (JULIAN DATE)     =    367
EVAPORATIVE ZONE DEPTH                  =  10.0  INCHES
AVERAGE ANNUAL WIND SPEED               =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  76.00 %


NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
         WAS ENTERED FROM AN ASCII DATA FILE.


NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA
```

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA
           AND STATION LATITUDE  =  27.80 DEGREES
```

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.21	3.92	2.61	4.64	7.88
	7.14	7.68	6.58	3.33	2.61	2.23
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
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	1.790	1.735	2.531	2.185	2.927	4.929
	4.993	4.632	4.042	2.704	1.837	1.411
STD. DEVIATIONS	0.866	0.998	1.209	1.214	1.869	1.612
	1.370	1.482	0.914	1.044	0.884	0.897

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.2039	0.2005	0.1520	0.3257	0.2546	0.3606
	0.8071	0.8389	0.8268	0.7773	0.5171	0.2729
STD. DEVIATIONS	0.3393	0.3243	0.2561	0.4555	0.3049	0.4197
	0.4679	0.5279	0.4585	0.4785	0.4349	0.3334

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.4353	0.3542	0.2788	0.7892	0.4443	0.9206
	1.6876	1.8291	1.8288	1.6508	1.0036	0.4954
STD. DEVIATIONS	0.5551	0.4413	0.2929	1.3798	0.4305	1.2363
	1.5442	1.6805	1.5581	1.6715	1.1455	0.4933

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7870	0.7113	0.7794	0.7761	0.7756	0.7516
	0.8025	0.8143	0.7954	0.8162	0.7784	0.8055
STD. DEVIATIONS	0.1548	0.1664	0.1827	0.1344	0.1684	0.1684
	0.0994	0.0717	0.0290	0.0610	0.1221	0.1197

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1581	0.1017	0.0465	0.5348	0.1270	0.6166
	1.1457	1.2605	1.3390	1.1021	0.5472	0.1413
STD. DEVIATIONS	0.3702	0.2855	0.1181	1.4309	0.2427	1.1405
	1.6405	1.6913	1.7366	1.7390	1.0996	0.3219

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1902	0.1885	0.1884	0.1939	0.1875	0.1877
	0.1940	0.1968	0.1987	0.1973	0.1944	0.1947
STD. DEVIATIONS	0.0374	0.0439	0.0442	0.0336	0.0407	0.0421
	0.0240	0.0173	0.0073	0.0147	0.0305	0.0289

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	53.10	(10.929)	192747.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	35.717	(5.2175)	129653.45	67.266
LATERAL DRAINAGE COLLECTED FROM LAYER 3	5.53737	(2.13750)	20100.658	10.42852
PERCOLATION/LEAKAGE THROUGH LAYER 4	11.71778	(5.74744)	42535.535	22.06807
AVERAGE HEAD ON TOP OF LAYER 4	0.593	(0.458)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	9.39341	(1.09314)	34098.086	17.69060
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.193	(0.023)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	2.450	(5.8683)	8895.26	4.615

****

PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.05116	185.72096
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.301440	1094.22632
AVERAGE HEAD ON TOP OF LAYER 4	11.024	
MAXIMUM HEAD ON TOP OF LAYER 4	15.626	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	115.0 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02669	96.88277
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.390	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	9.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6710
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770

*** 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.

****

****

FINAL WATER STORAGE AT END OF YEAR 2004

LAYER	(INCHES)	(VOL/VOL)
1	35.2807	0.2940
2	4.7242	0.1968
3	0.2550	0.8500
4	0.0000	0.0000
5	69.9052	349.5262
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

****
****

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE2.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE2.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE2.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE2N.D10
OUTPUT DATA FILE:           C:\HELP\11CASE2N.OUT


TIME:  17: 1     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  18
           THICKNESS                  =    960.00   INCHES
           POROSITY                   =      0.6710 VOL/VOL
           FIELD CAPACITY             =      0.2920 VOL/VOL
           WILTING POINT              =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2900 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
```



```
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1245 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8316 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.432999991000E-01 CM/SEC
           SLOPE                      =      1.30   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                  LAYER  4
                                  --------

                    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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                  LAYER  5
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.709999979000     CM/SEC
           SLOPE                      =      1.30   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                  LAYER  6
                                  --------

                    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         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
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.   =  0.300000003000E-08 CM/SEC


                        LAYER  8
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
         POOR STAND OF GRASS, A SURFACE SLOPE OF  5.%
         AND A SLOPE LENGTH OF  800. FEET.

SCS RUNOFF CURVE NUMBER            =     71.50
FRACTION OF AREA ALLOWING RUNOFF   =     50.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      1.617  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.924  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =    297.749  INCHES
TOTAL INITIAL WATER                =    297.749  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO               FLORIDA
```



```
STATION LATITUDE                         =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX                  =   1.00
START OF GROWING SEASON (JULIAN DATE)    =      0
END OF GROWING SEASON (JULIAN DATE)      =    367
EVAPORATIVE ZONE DEPTH                   =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED                =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  76.00 %


NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
         WAS ENTERED FROM AN ASCII DATA FILE.


NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA

    NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA
           AND STATION LATITUDE  =  27.80 DEGREES


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

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004
-------------------------------------------------------------------------------
```

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.21	3.92	2.61	4.64	7.88
	7.14	7.68	6.58	3.33	2.61	2.23
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.011	0.000	0.090	0.002	0.031	0.048
	0.041	0.150	0.065	0.021	0.051	0.013
STD. DEVIATIONS	0.030	0.002	0.297	0.007	0.077	0.081
	0.116	0.369	0.208	0.063	0.176	0.049
EVAPOTRANSPIRATION						
TOTALS	1.798	2.212	2.840	2.502	3.167	5.575
	5.550	5.181	4.404	3.076	1.892	1.369

STD. DEVIATIONS	0.814	0.941	1.358	1.522	1.999	1.637
	1.680	1.555	0.958	1.146	0.978	0.798

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0798	0.0700	0.0692	0.0646	0.0673	0.0620
	0.0736	0.0844	0.0843	0.0888	0.0872	0.0850
STD. DEVIATIONS	0.0174	0.0172	0.0188	0.0196	0.0238	0.0207
	0.0247	0.0223	0.0182	0.0182	0.0152	0.0172

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.9257	0.7435	0.4575	0.4474	0.5907	0.3747
	0.9861	1.4507	1.4454	1.5682	1.5785	1.2445
STD. DEVIATIONS	1.1478	0.8326	0.6998	0.6170	0.9334	0.5110
	0.9603	0.9879	0.9884	1.1271	1.2070	1.3098

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7789	0.7039	0.7707	0.7559	0.7775	0.7551
	0.7965	0.7962	0.7801	0.8124	0.7715	0.7964
STD. DEVIATIONS	0.1642	0.1732	0.1923	0.1525	0.1687	0.1482
	0.1350	0.1368	0.0798	0.0484	0.1273	0.1355

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	1.8969	1.7295	1.0207	1.0280	1.2579	0.8774
	2.0386	2.9556	3.0279	3.1485	3.2308	2.4851
STD. DEVIATIONS	2.1449	1.7822	1.3496	1.2827	1.7925	1.0478
	1.8623	1.8899	1.9198	2.0979	2.2600	2.3949

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1897	0.1879	0.1877	0.1902	0.1894	0.1900
	0.1940	0.1939	0.1963	0.1978	0.1942	0.1940
STD. DEVIATIONS	0.0400	0.0461	0.0468	0.0384	0.0411	0.0373
	0.0329	0.0333	0.0201	0.0118	0.0320	0.0330

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES	CU. FEET	PERCENT
PRECIPITATION	53.10 (10.929)	192747.0	100.00
RUNOFF	0.521 (0.6279)	1893.04	0.982
EVAPOTRANSPIRATION	39.567 (5.7499)	143626.55	74.516
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.91613 (0.15672)	3325.546	1.72534
PERCOLATION/LEAKAGE THROUGH LAYER 4	11.81301 (5.83226)	42881.227	22.24742
AVERAGE HEAD ON TOP OF LAYER 4	2.058 (0.941)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	9.29524 (1.27821)	33741.715	17.50571
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002 (0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.192 (0.027)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002 (0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	2.799 (7.0292)	10160.40	5.271

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	1.446	5250.4331
DRAINAGE COLLECTED FROM LAYER 3	0.00364	13.22588
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.124620	452.37094
AVERAGE HEAD ON TOP OF LAYER 4	6.841	
MAXIMUM HEAD ON TOP OF LAYER 4	10.263	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	98.7 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02649	96.15894
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.389	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	10.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6710

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0770

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	285.3067	0.2972
2	4.5440	0.1893
3	0.2550	0.8500
4	0.0000	0.0000
5	75.7057	378.5284
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE3.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE3.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE3.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE3N.D10
OUTPUT DATA FILE:           C:\HELP\11CASE3N.OUT


TIME:  17:16     DATE:  11/ 3/2014


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     TITLE:  JED Solid Waste Management Facility

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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  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 =      0.2910 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
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           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1270 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8337 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.471000001000E-01 CM/SEC
           SLOPE                      =      1.20   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                  LAYER  4
                                  --------

                    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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                  LAYER  5
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.759999990000     CM/SEC
           SLOPE                      =      1.20   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                  LAYER  6
                                  --------

                    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
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INITIAL SOIL WATER CONTENT = 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY = 2.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 2.00 HOLES/ACRE
FML PLACEMENT QUALITY = 3 - GOOD

LAYER 7

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

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.	=	0.300000003000E-08 CM/SEC

LAYER 8

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	120.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #18 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 600. FEET.

SCS RUNOFF CURVE NUMBER	=	71.90
FRACTION OF AREA ALLOWING RUNOFF	=	70.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000 ACRES
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.617 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.052 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.924 INCHES
INITIAL SNOW WATER	=	0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	=	543.088 INCHES
TOTAL INITIAL WATER	=	543.088 INCHES
TOTAL SUBSURFACE INFLOW	=	0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ORLANDO FLORIDA

STATION LATITUDE	=	27.80 DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00
START OF GROWING SEASON (JULIAN DATE)	=	0
END OF GROWING SEASON (JULIAN DATE)	=	367
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA FOR FORTDRUM FLORIDA WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA AND STATION LATITUDE = 27.80 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.21	3.92	2.61	4.64	7.88
	7.14	7.68	6.58	3.33	2.61	2.23
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.016	0.001	0.125	0.003	0.045	0.072
	0.061	0.219	0.094	0.032	0.074	0.019
STD. DEVIATIONS	0.044	0.003	0.405	0.010	0.113	0.120
	0.169	0.531	0.300	0.093	0.253	0.072
EVAPOTRANSPIRATION						
TOTALS	1.798	2.210	2.846	2.504	3.168	5.568
	5.551	5.179	4.407	3.071	1.892	1.373

STD. DEVIATIONS	0.813	0.942	1.363	1.520	2.001	1.631
	1.682	1.556	0.957	1.144	0.979	0.796

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0789	0.0699	0.0689	0.0643	0.0666	0.0614
	0.0717	0.0819	0.0821	0.0863	0.0853	0.0836
STD. DEVIATIONS	0.0163	0.0172	0.0187	0.0200	0.0231	0.0206
	0.0240	0.0214	0.0171	0.0163	0.0131	0.0155

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.9233	0.8136	0.4752	0.4877	0.5922	0.3643
	0.9384	1.3802	1.3871	1.4686	1.5133	1.2107
STD. DEVIATIONS	1.1219	0.9005	0.6899	0.7252	0.9010	0.4809
	0.9194	0.9304	0.9366	1.0337	1.1158	1.2323

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7707	0.6959	0.7618	0.7437	0.7671	0.7388
	0.7871	0.7868	0.7709	0.8020	0.7624	0.7871
STD. DEVIATIONS	0.1590	0.1698	0.1891	0.1598	0.1701	0.1527
	0.1330	0.1350	0.0786	0.0514	0.1251	0.1333

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	1.8337	1.7982	1.0194	1.0584	1.2207	0.8245
	1.8794	2.7257	2.8210	2.8785	3.0273	2.3641
STD. DEVIATIONS	2.0398	1.8422	1.2864	1.4142	1.6833	0.9533
	1.7317	1.7366	1.7807	1.8936	2.0700	2.2192

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1900	0.1880	0.1878	0.1894	0.1891	0.1882
	0.1940	0.1939	0.1963	0.1977	0.1942	0.1940
STD. DEVIATIONS	0.0392	0.0457	0.0466	0.0407	0.0419	0.0389
	0.0328	0.0333	0.0200	0.0127	0.0319	0.0329

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	53.10	(10.929)	192747.0	100.00
RUNOFF	0.761	(0.8899)	2763.19	1.434
EVAPOTRANSPIRATION	39.568	(5.7468)	143632.02	74.518
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.90076	(0.15207)	3269.768	1.69640
PERCOLATION/LEAKAGE THROUGH LAYER 4	11.55468	(5.60360)	41943.492	21.76091
AVERAGE HEAD ON TOP OF LAYER 4	1.954	(0.886)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	9.17434	(1.27754)	33302.859	17.27802
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.192	(0.027)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	2.694	(6.8694)	9778.56	5.073

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	1.934	7020.4219
DRAINAGE COLLECTED FROM LAYER 3	0.00343	12.46864
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.111203	403.66861
AVERAGE HEAD ON TOP OF LAYER 4	6.117	
MAXIMUM HEAD ON TOP OF LAYER 4	9.223	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	97.2 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02618	95.01532
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.389	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	11.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6535
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	531.6869	0.2954
2	4.4777	0.1866
3	0.2550	0.8501
4	0.0000	0.0000
5	71.5755	357.8776
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE4.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE4.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE4.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\11CASE4N.D10
OUTPUT DATA FILE:           C:\HELP\11CASE4N.OUT


TIME:  17:31     DATE:  11/ 3/2014


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     TITLE:  JED Solid Waste Management Facility

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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  18
           THICKNESS                  =   2640.00   INCHES
           POROSITY                   =      0.6710 VOL/VOL
           FIELD CAPACITY             =      0.2920 VOL/VOL
           WILTING POINT              =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2913 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 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   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
```



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           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1267 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8196 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.489999987000E-01 CM/SEC
           SLOPE                      =      1.00   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  4
                                   --------

                        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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                   LAYER  5
                                   --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.930000007000      CM/SEC
           SLOPE                      =      1.00   PERCENT
           DRAINAGE LENGTH            =    395.0    FEET


                                   LAYER  6
                                   --------

                        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         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
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.   =  0.300000003000E-08 CM/SEC


                        LAYER  8
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
        SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
        FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
        AND A SLOPE LENGTH OF  300. FEET.

SCS RUNOFF CURVE NUMBER            =     57.30
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  =      1.537  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.924  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =    788.276  INCHES
TOTAL INITIAL WATER                =    788.276  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


          EVAPOTRANSPIRATION AND WEATHER DATA
          -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
        ORLANDO               FLORIDA
```



```
STATION LATITUDE                         =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX                  =   2.00
START OF GROWING SEASON (JULIAN DATE)    =      0
END OF GROWING SEASON (JULIAN DATE)      =    367
EVAPORATIVE ZONE DEPTH                   =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED                =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  76.00 %


 NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
        WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
        COEFFICIENTS FOR    ORLANDO             FLORIDA

     NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

 JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
 -------     -------     -------     -------     -------     -------
  60.50       61.50       66.80       72.00       77.30       80.90
  82.40       82.50       81.10       74.90       67.50       62.00


 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
        COEFFICIENTS FOR    ORLANDO             FLORIDA
          AND STATION LATITUDE  =  27.80 DEGREES


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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004
-------------------------------------------------------------------------------

                       JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                       -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                2.26     2.21     3.92     2.61     4.64     7.88
                         7.14     7.68     6.58     3.33     2.61     2.23

   STD. DEVIATIONS       1.68     1.68     3.65     1.76     3.99     3.97
                         3.81     3.77     3.81     3.24     1.90     1.87

 RUNOFF
 ------
   TOTALS                0.000    0.000    0.038    0.000    0.003    0.002
                         0.008    0.059    0.024    0.001    0.020    0.001

   STD. DEVIATIONS       0.000    0.000    0.177    0.000    0.014    0.008
                         0.044    0.193    0.124    0.007    0.077    0.002

 EVAPOTRANSPIRATION
 ------------------
   TOTALS                1.782    2.385    2.791    2.504    3.213    5.606
                         5.551    5.240    4.393    3.090    1.907    1.310
```

STD. DEVIATIONS	0.750	0.979	1.409	1.531	1.997	1.609
	1.713	1.536	1.019	1.181	1.038	0.822

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0685	0.0617	0.0619	0.0570	0.0589	0.0539
	0.0629	0.0709	0.0708	0.0755	0.0741	0.0722
STD. DEVIATIONS	0.0137	0.0145	0.0156	0.0149	0.0179	0.0162
	0.0194	0.0170	0.0136	0.0107	0.0101	0.0124

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.9518	0.8955	0.5775	0.4850	0.6198	0.3743
	0.9760	1.4022	1.3867	1.5234	1.5680	1.2182
STD. DEVIATIONS	1.1254	0.9818	0.8158	0.7109	0.9258	0.4733
	0.9277	0.9418	0.9283	1.0159	1.0744	1.1928

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7859	0.7098	0.7770	0.7585	0.7828	0.7619
	0.8028	0.8025	0.7854	0.8251	0.7787	0.8027
STD. DEVIATIONS	0.1622	0.1727	0.1923	0.1626	0.1720	0.1508
	0.1349	0.1370	0.0840	0.0132	0.1211	0.1357

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	1.8528	1.9215	1.1893	1.0374	1.2515	0.8327
	1.9145	2.7152	2.7715	2.9297	3.0873	2.3476
STD. DEVIATIONS	2.0148	1.9536	1.4921	1.3548	1.6987	0.9236
	1.7170	1.7270	1.7333	1.8278	1.9679	2.1177

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1899	0.1880	0.1878	0.1894	0.1892	0.1903
	0.1940	0.1940	0.1962	0.1994	0.1945	0.1940
STD. DEVIATIONS	0.0392	0.0456	0.0465	0.0406	0.0416	0.0377
	0.0326	0.0331	0.0210	0.0032	0.0302	0.0328

****

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES	CU. FEET	PERCENT
PRECIPITATION	53.10 (10.929)	192747.0	100.00
RUNOFF	0.155 (0.3383)	563.67	0.292
EVAPOTRANSPIRATION	39.774 (5.8256)	144379.92	74.906
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.78834 (0.11609)	2861.685	1.48468
PERCOLATION/LEAKAGE THROUGH LAYER 4	11.97853 (5.81768)	43482.078	22.55915
AVERAGE HEAD ON TOP OF LAYER 4	1.988 (0.904)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	9.37299 (1.29542)	34023.957	17.65214
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002 (0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.192 (0.027)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002 (0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	3.008 (7.2089)	10917.86	5.664

****

****

PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	0.967	3509.6682
DRAINAGE COLLECTED FROM LAYER 3	0.00293	10.61819
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.110175	399.93512
AVERAGE HEAD ON TOP OF LAYER 4	5.983	
MAXIMUM HEAD ON TOP OF LAYER 4	8.790	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	104.8 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02669	96.89488
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.387	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	12.6 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6229
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	779.6431	0.2953
2	4.3708	0.1821
3	0.2472	0.8240
4	0.0000	0.0000
5	78.3374	391.6871
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

****
****

Cells 12 & 13 – With Leachate Recirculation

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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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE1.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE1.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE1.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE1.D10
OUTPUT DATA FILE:           C:\HELP\12CASE1.OUT


TIME:  12:55     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  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  =      0.2828 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                  LAYER  2
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1281 VOL/VOL
```



```
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.0445 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =   1.85350001000     CM/SEC
           SLOPE                      =      1.40   PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                  LAYER  4
                                  --------

                    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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                  LAYER  5
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.500000000000     CM/SEC
           SLOPE                      =      1.40   PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                  LAYER  6
                                  --------

                    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          =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

```
                    LAYER  7
                    --------

          TYPE 3 - BARRIER SOIL LINER
          MATERIAL TEXTURE NUMBER  17
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.    =  0.300000003000E-08 CM/SEC
```

```
                    LAYER  8
                    --------

        TYPE 1 - VERTICAL PERCOLATION LAYER
          MATERIAL TEXTURE NUMBER   5
THICKNESS                    =    120.00   INCHES
POROSITY                     =      0.4570 VOL/VOL
FIELD CAPACITY               =      0.1310 VOL/VOL
WILTING POINT                =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
        SOIL DATA BASE USING SOIL TEXTURE #18 WITH BARE
        GROUND CONDITIONS, A SURFACE SLOPE OF  5.% AND
        A SLOPE LENGTH OF 1100. FEET.

SCS RUNOFF CURVE NUMBER            =     78.90
FRACTION OF AREA ALLOWING RUNOFF   =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      1.813  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      6.710  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.770  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =     53.097  INCHES
TOTAL INITIAL WATER                =     53.097  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

```
           EVAPOTRANSPIRATION AND WEATHER DATA
           -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
        ORLANDO              FLORIDA

    STATION LATITUDE                       =  27.80 DEGREES
```



```
MAXIMUM LEAF AREA INDEX                  =   0.00
START OF GROWING SEASON (JULIAN DATE)    =     0
END OF GROWING SEASON (JULIAN DATE)      =   367
EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
AVERAGE ANNUAL WIND SPEED                =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  76.00 %
```

```
NOTE:  PRECIPITATION DATA FOR     FORTDRUM           FLORIDA
         WAS ENTERED FROM AN ASCII DATA FILE.
```

```
NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA
```

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA
           AND STATION LATITUDE  =  27.80 DEGREES
```

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
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	3.313	3.337	4.180	3.901	4.590	6.196
	6.154	5.783	4.964	4.037	3.147	2.821
STD. DEVIATIONS	0.300	0.481	0.781	1.038	1.349	1.114
	1.110	1.019	0.527	0.569	0.481	0.310

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.8124	0.7513	0.6477	1.0028	0.7365	1.0686
	2.0137	2.0918	2.1838	2.0946	1.4556	0.8129
STD. DEVIATIONS	0.9738	0.8145	0.7208	1.1591	0.6714	1.1536
	1.0814	1.2185	1.0306	1.0785	1.0954	0.7856

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.4870	0.4122	0.4121	0.7022	0.4393	0.8789
	1.3674	1.4678	1.5040	1.4157	0.8289	0.4774
STD. DEVIATIONS	0.4481	0.2999	0.3317	1.0561	0.2753	1.1475
	1.5308	1.3500	1.3681	1.4083	0.8012	0.2925

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7129	0.6442	0.7088	0.6989	0.7101	0.7011
	0.7282	0.7342	0.7190	0.7412	0.7038	0.7323
STD. DEVIATIONS	0.1249	0.1375	0.1420	0.1214	0.1374	0.1048
	0.0943	0.0616	0.0133	0.0231	0.0963	0.0720

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1328	0.0754	0.0772	0.3633	0.0816	0.5426
	0.8351	0.9039	0.9822	0.8439	0.3382	0.0929
STD. DEVIATIONS	0.2701	0.1329	0.1766	1.0622	0.1666	1.0530
	1.7262	1.3755	1.5841	1.4656	0.7398	0.1420

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1913	0.1894	0.1902	0.1938	0.1905	0.1944
	0.1954	0.1970	0.1993	0.1989	0.1951	0.1965
STD. DEVIATIONS	0.0335	0.0402	0.0381	0.0337	0.0369	0.0291
	0.0253	0.0165	0.0037	0.0062	0.0267	0.0193

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	78.67	(10.922)	285560.9	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	52.423	(3.3460)	190294.75	66.639
LATERAL DRAINAGE COLLECTED FROM LAYER 3	15.67177	(5.04350)	56888.531	19.92168
PERCOLATION/LEAKAGE THROUGH LAYER 4	10.39305	(4.46560)	37726.762	13.21146
AVERAGE HEAD ON TOP OF LAYER 4	0.439	(0.367)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	8.53463	(0.82998)	30980.721	10.84908
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.194	(0.019)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	2.038	(5.2204)	7396.97	2.590

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.13671	496.25348
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.319700	1160.51038
AVERAGE HEAD ON TOP OF LAYER 4	12.140	
MAXIMUM HEAD ON TOP OF LAYER 4	16.112	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	111.2 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02405	87.28857
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.389	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	9.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6710

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1180

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	37.2946	0.3108
2	4.8808	0.2034
3	0.2256	0.7519
4	0.0000	0.0000
5	55.9208	279.6038
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE2.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE2.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE2.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE2.D10
OUTPUT DATA FILE:           C:\HELP\12CASE2.OUT


TIME:  13: 9     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  18
           THICKNESS                  =    960.00   INCHES
           POROSITY                   =      0.6710 VOL/VOL
           FIELD CAPACITY             =      0.2920 VOL/VOL
           WILTING POINT              =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2949 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
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```
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.6220 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =   1.70410001000     CM/SEC
           SLOPE                      =      1.20   PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                   LAYER  4
                                   --------

                     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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                   LAYER  5
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.490000010000     CM/SEC
           SLOPE                      =      1.20   PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                   LAYER  6
                                   --------

                     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         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                    LAYER  7
                    --------

            TYPE 3 - BARRIER SOIL LINER
            MATERIAL TEXTURE NUMBER  17
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.   =  0.300000003000E-08 CM/SEC


                    LAYER  8
                    --------

        TYPE 1 - VERTICAL PERCOLATION LAYER
            MATERIAL TEXTURE NUMBER   5
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
         POOR STAND OF GRASS, A SURFACE SLOPE OF  5.%
         AND A SLOPE LENGTH OF  800. FEET.

SCS RUNOFF CURVE NUMBER            =     71.50
FRACTION OF AREA ALLOWING RUNOFF   =     50.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      2.176  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.924  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =    303.881  INCHES
TOTAL INITIAL WATER                =    303.881  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


           EVAPOTRANSPIRATION AND WEATHER DATA
           -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO               FLORIDA
```



```
        STATION LATITUDE                        =  27.80 DEGREES
        MAXIMUM LEAF AREA INDEX                 =   1.00
        START OF GROWING SEASON (JULIAN DATE)   =      0
        END OF GROWING SEASON (JULIAN DATE)     =    367
        EVAPORATIVE ZONE DEPTH                  =  12.0  INCHES
        AVERAGE ANNUAL WIND SPEED               =   8.60 MPH
        AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  72.00 %
        AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  72.00 %
        AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  80.00 %
        AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  76.00 %


    NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
            WAS ENTERED FROM AN ASCII DATA FILE.


    NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    ORLANDO            FLORIDA

        NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
    NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    ORLANDO            FLORIDA
              AND STATION LATITUDE  =  27.80 DEGREES
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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.016	0.001	0.099	0.003	0.038	0.058
	0.047	0.167	0.073	0.025	0.058	0.017
STD. DEVIATIONS	0.042	0.003	0.315	0.010	0.092	0.092
	0.124	0.410	0.228	0.070	0.191	0.062
EVAPOTRANSPIRATION						
TOTALS	3.233	3.461	4.468	4.426	4.942	6.639
	6.613	6.158	5.304	4.302	3.162	2.773

STD. DEVIATIONS	0.235	0.406	0.729	1.018	1.432	1.117
	1.048	0.970	0.351	0.594	0.545	0.364

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.3780	1.1629	1.0490	1.0188	1.0132	0.6519
	0.9701	1.1899	1.1538	1.2977	1.7382	1.6973
STD. DEVIATIONS	0.7213	0.7495	0.8603	0.8176	0.9343	0.6734
	0.8057	0.7083	0.6184	0.6494	0.8145	0.9128

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.7317	0.6347	0.6060	0.5674	0.5743	0.4268
	0.5602	0.6759	0.6747	0.7330	0.8686	0.8400
STD. DEVIATIONS	0.2829	0.2960	0.3273	0.3353	0.3671	0.2896
	0.3291	0.2844	0.2612	0.2912	0.3187	0.3413

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.6075	0.5414	0.5967	0.5932	0.6081	0.5820
	0.6105	0.6097	0.5802	0.6225	0.6055	0.6222
STD. DEVIATIONS	0.0807	0.1146	0.1129	0.0397	0.0863	0.0915
	0.0858	0.0675	0.0803	0.0161	0.0025	0.0219

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1345	0.1242	0.1001	0.0967	0.0943	0.0632
	0.0930	0.1286	0.1406	0.1534	0.2070	0.1689
STD. DEVIATIONS	0.0742	0.0988	0.0835	0.0776	0.0870	0.0660
	0.0811	0.0944	0.1164	0.1445	0.1359	0.1021

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1940	0.1895	0.1906	0.1958	0.1942	0.1921
	0.1950	0.1947	0.1915	0.1988	0.1998	0.1987
STD. DEVIATIONS	0.0258	0.0399	0.0361	0.0131	0.0276	0.0302
	0.0274	0.0216	0.0265	0.0051	0.0008	0.0070

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	78.67	(10.922)	285560.9	100.00
RUNOFF	0.603	(0.6869)	2187.36	0.766
EVAPOTRANSPIRATION	55.480	(3.3712)	201392.77	70.525
LATERAL DRAINAGE COLLECTED FROM LAYER 3	14.32090	(4.86741)	51984.875	18.20448
PERCOLATION/LEAKAGE THROUGH LAYER 4	7.89351	(2.02043)	28653.459	10.03410
AVERAGE HEAD ON TOP OF LAYER 4	0.125	(0.055)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.17937	(0.58051)	26061.119	9.12629
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.195	(0.016)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	1.084	(6.2756)	3935.20	1.378

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	1.498	5437.7178
DRAINAGE COLLECTED FROM LAYER 3	0.10547	382.86972
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.117824	427.70126
AVERAGE HEAD ON TOP OF LAYER 4	2.810	
MAXIMUM HEAD ON TOP OF LAYER 4	4.585	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	59.6 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02020	73.32622
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.387	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	10.5 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6710

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0834

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	294.5388	0.3068
2	4.3566	0.1815
3	0.0052	0.0175
4	0.0000	0.0000
5	21.5950	107.9748
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE3.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE3.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE3.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE3.D10
OUTPUT DATA FILE:           C:\HELP\12CASE3.OUT


TIME:  13:32     DATE:  11/ 3/2014


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     TITLE:  JED Solid Waste Management Facility

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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  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  =      0.2943 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =     24.00   INCHES
           POROSITY                  =      0.4170 VOL/VOL
           FIELD CAPACITY            =      0.0450 VOL/VOL
```



```
           WILTING POINT             =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1874 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.30   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.6541 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =   1.62390006000     CM/SEC
           SLOPE                     =      1.10   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                   LAYER  4
                                   --------

                      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       =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS  =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY     =  3 - GOOD


                                   LAYER  5
                                   --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.20   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.560000002000     CM/SEC
           SLOPE                     =      1.10   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                   LAYER  6
                                   --------

                      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         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

LAYER 7

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

```
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.   =  0.300000003000E-08 CM/SEC
```

LAYER 8

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

```
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #18 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 600. FEET.

```
SCS RUNOFF CURVE NUMBER             =     71.90
FRACTION OF AREA ALLOWING RUNOFF    =     70.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      2.176  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.924  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    550.590  INCHES
TOTAL INITIAL WATER                 =    550.590  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ORLANDO FLORIDA


```
STATION LATITUDE                        =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX                 =   1.00
START OF GROWING SEASON (JULIAN DATE)   =      0
END OF GROWING SEASON (JULIAN DATE)     =    367
EVAPORATIVE ZONE DEPTH                  =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED               =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  76.00 %
```

NOTE: PRECIPITATION DATA FOR FORTDRUM FLORIDA WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA AND STATION LATITUDE = 27.80 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.024	0.002	0.138	0.005	0.056	0.087
	0.071	0.243	0.107	0.037	0.085	0.026
STD. DEVIATIONS	0.062	0.005	0.428	0.015	0.134	0.136
	0.179	0.589	0.328	0.104	0.275	0.090
EVAPOTRANSPIRATION						
TOTALS	3.232	3.460	4.469	4.428	4.942	6.637
	6.615	6.159	5.303	4.300	3.158	2.777

STD. DEVIATIONS	0.236	0.408	0.730	1.018	1.432	1.116
	1.048	0.968	0.352	0.597	0.548	0.357

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.3304	1.1761	1.0580	0.9903	1.0854	0.7204
	0.9122	1.0518	1.0235	1.1026	1.5054	1.5279
STD. DEVIATIONS	0.6624	0.6635	0.7473	0.7814	0.8685	0.7081
	0.7255	0.6164	0.4930	0.5625	0.6963	0.7812

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.7774	0.6933	0.6713	0.6078	0.6585	0.4938
	0.5933	0.6761	0.6767	0.7066	0.8521	0.8550
STD. DEVIATIONS	0.2922	0.2860	0.3194	0.3497	0.3880	0.3355
	0.3354	0.2717	0.2261	0.2583	0.2964	0.3344

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.6411	0.5810	0.6267	0.6246	0.6485	0.6101
	0.6395	0.6440	0.6188	0.6530	0.6338	0.6526
STD. DEVIATIONS	0.0817	0.0881	0.1130	0.0391	0.0294	0.0946
	0.0902	0.0659	0.0671	0.0116	0.0059	0.0191

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1475	0.1380	0.1188	0.1089	0.1191	0.0834
	0.1046	0.1246	0.1332	0.1339	0.1915	0.1722
STD. DEVIATIONS	0.0767	0.0775	0.0887	0.0869	0.0958	0.0851
	0.0891	0.0821	0.0782	0.1044	0.1061	0.0955

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1955	0.1942	0.1911	0.1968	0.1977	0.1922
	0.1949	0.1963	0.1949	0.1991	0.1997	0.1989
STD. DEVIATIONS	0.0249	0.0292	0.0344	0.0123	0.0090	0.0298
	0.0275	0.0201	0.0211	0.0035	0.0019	0.0058

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****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES	CU. FEET	PERCENT
PRECIPITATION	78.67 (10.922)	285560.9	100.00
RUNOFF	0.880 (0.9721)	3192.72	1.118
EVAPOTRANSPIRATION	55.479 (3.3580)	201389.08	70.524
LATERAL DRAINAGE COLLECTED FROM LAYER 3	13.48379 (4.33007)	48946.152	17.14035
PERCOLATION/LEAKAGE THROUGH LAYER 4	8.26187 (2.00956)	29990.596	10.50235
AVERAGE HEAD ON TOP OF LAYER 4	0.131 (0.050)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.57364 (0.50523)	27492.316	9.62748
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002 (0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.196 (0.013)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002 (0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	1.251 (6.9136)	4540.79	1.590

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****

PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	1.997	7248.7427
DRAINAGE COLLECTED FROM LAYER 3	0.09198	333.87573
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.116756	423.82455
AVERAGE HEAD ON TOP OF LAYER 4	2.759	
MAXIMUM HEAD ON TOP OF LAYER 4	4.457	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	61.8 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02116	76.81971
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.386	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	11.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6586
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0834

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	547.1699	0.3040
2	4.2127	0.1755
3	0.0113	0.0376
4	0.0000	0.0000
5	20.8158	104.0789
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\RECIR2.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE4.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE4.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE4.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE4.D10
OUTPUT DATA FILE:           C:\HELP\12CASE4.OUT


TIME:  14:18     DATE:  11/ 3/2014


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

    TITLE:  JED Solid Waste Management Facility

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


    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  18
           THICKNESS                 =   2640.00   INCHES
           POROSITY                  =      0.6710 VOL/VOL
           FIELD CAPACITY            =      0.2920 VOL/VOL
           WILTING POINT             =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.2936 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 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   0
           THICKNESS                 =     24.00   INCHES
           POROSITY                  =      0.4170 VOL/VOL
           FIELD CAPACITY            =      0.0450 VOL/VOL
```



```
           WILTING POINT             =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.1864 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.30   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.6584 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =   1.71440005000     CM/SEC
           SLOPE                     =      1.00   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                  LAYER  4
                                  --------

                        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       =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS  =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY     =  3 - GOOD


                                  LAYER  5
                                  --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.20   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.639999986000     CM/SEC
           SLOPE                     =      1.00   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                  LAYER  6
                                  --------

                        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         =      2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
  FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
  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.   =  0.300000003000E-08 CM/SEC


                        LAYER  8
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
  THICKNESS                   =    120.00   INCHES
  POROSITY                    =      0.4570 VOL/VOL
  FIELD CAPACITY              =      0.1310 VOL/VOL
  WILTING POINT               =      0.0580 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
         AND A SLOPE LENGTH OF  300. FEET.

SCS RUNOFF CURVE NUMBER             =    57.30
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   =     2.083  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =     8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =     0.924  INCHES
INITIAL SNOW WATER                  =     0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =   795.966  INCHES
TOTAL INITIAL WATER                 =   795.966  INCHES
TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR


           EVAPOTRANSPIRATION AND WEATHER DATA
           -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO               FLORIDA
```



```
        STATION LATITUDE                      =  27.80 DEGREES
        MAXIMUM LEAF AREA INDEX               =   2.00
        START OF GROWING SEASON (JULIAN DATE) =      0
        END OF GROWING SEASON (JULIAN DATE)   =    367
        EVAPORATIVE ZONE DEPTH                =  12.0  INCHES
        AVERAGE ANNUAL WIND SPEED             =   8.60 MPH
        AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  72.00 %
        AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  72.00 %
        AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  80.00 %
        AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  76.00 %


    NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
             WAS ENTERED FROM AN ASCII DATA FILE.


    NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    ORLANDO             FLORIDA

        NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
    NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    ORLANDO             FLORIDA
               AND STATION LATITUDE  =  27.80 DEGREES


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

    AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004
-------------------------------------------------------------------------------
```

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	4.19	6.09	4.71	6.81	9.98
	9.31	9.85	8.68	5.50	4.71	4.41
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.000	0.000	0.043	0.000	0.004	0.002
	0.009	0.070	0.026	0.002	0.024	0.001
STD. DEVIATIONS	0.002	0.000	0.191	0.000	0.021	0.009
	0.048	0.234	0.132	0.009	0.091	0.006
EVAPOTRANSPIRATION						
TOTALS	3.185	3.519	4.576	4.410	4.905	6.644
	6.598	6.174	5.355	4.382	3.165	2.784

STD. DEVIATIONS	0.227	0.359	0.735	1.086	1.490	1.094
	1.076	0.957	0.361	0.568	0.539	0.366

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.3287	1.1880	1.1255	1.0189	1.1126	0.7909
	0.9562	1.0218	0.9930	1.0732	1.4280	1.4673
STD. DEVIATIONS	0.6370	0.6247	0.6932	0.7529	0.8580	0.7170
	0.7012	0.5910	0.4630	0.5447	0.6723	0.7460

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.7978	0.7175	0.7234	0.6434	0.6919	0.5395
	0.6301	0.6877	0.6768	0.7095	0.8439	0.8514
STD. DEVIATIONS	0.2951	0.2846	0.3083	0.3454	0.3991	0.3558
	0.3370	0.2650	0.2133	0.2461	0.2957	0.3378

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.6583	0.5883	0.6487	0.6486	0.6732	0.6322
	0.6643	0.6685	0.6418	0.6780	0.6582	0.6756
STD. DEVIATIONS	0.0954	0.1284	0.1256	0.0419	0.0335	0.1044
	0.0940	0.0716	0.0719	0.0134	0.0077	0.0329

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1556	0.1451	0.1333	0.1192	0.1306	0.0984
	0.1123	0.1269	0.1278	0.1302	0.1866	0.1697
STD. DEVIATIONS	0.0763	0.0758	0.0860	0.0893	0.1021	0.0911
	0.0886	0.0801	0.0656	0.0870	0.1005	0.0912

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1932	0.1892	0.1903	0.1967	0.1975	0.1917
	0.1949	0.1962	0.1946	0.1989	0.1996	0.1982
STD. DEVIATIONS	0.0280	0.0411	0.0369	0.0127	0.0098	0.0317
	0.0276	0.0210	0.0218	0.0039	0.0023	0.0097

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	78.67	(10.922)	285560.9	100.00
RUNOFF	0.180	(0.3798)	654.98	0.229
EVAPOTRANSPIRATION	55.696	(3.4229)	202176.50	70.800
LATERAL DRAINAGE COLLECTED FROM LAYER 3	13.50414	(4.06455)	49020.023	17.16622
PERCOLATION/LEAKAGE THROUGH LAYER 4	8.51294	(1.95197)	30901.959	10.82149
AVERAGE HEAD ON TOP OF LAYER 4	0.136	(0.046)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.83584	(0.64750)	28444.111	9.96078
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.075	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.195	(0.016)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00003
CHANGE IN WATER STORAGE	1.451	(7.5592)	5265.43	1.844

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.07	32924.098
RUNOFF	1.035	3758.4060
DRAINAGE COLLECTED FROM LAYER 3	0.08837	320.78922
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.116665	423.49271
AVERAGE HEAD ON TOP OF LAYER 4	2.769	
MAXIMUM HEAD ON TOP OF LAYER 4	4.422	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	65.2 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02199	79.81436
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.385	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	12.1 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6083

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0817

*** 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.

****

****

FINAL WATER STORAGE AT END OF YEAR 2004

LAYER	(INCHES)	(VOL/VOL)
1	798.9160	0.3026
2	4.1650	0.1735
3	0.0121	0.0402
4	0.0000	0.0000
5	20.4813	102.4063
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

****
****

Cells 12 & 13 – With No Leachate Recirculation

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE1.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE1.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE1.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE1N.D10
OUTPUT DATA FILE:           C:\HELP\12CASE1N.OUT


TIME:  17:54     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  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 =      0.2802 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                  LAYER  2
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1185 VOL/VOL
```



```
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.0333 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.534600019000     CM/SEC
           SLOPE                      =      1.40   PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                  LAYER  4
                                  --------

                    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        =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                  LAYER  5
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.600000024000     CM/SEC
           SLOPE                      =      1.40   PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                  LAYER  6
                                  --------

                    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          =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 7

```
              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
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.    =  0.300000003000E-08 CM/SEC
```

LAYER 8

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                    =    120.00   INCHES
POROSITY                     =      0.4570 VOL/VOL
FIELD CAPACITY               =      0.1310 VOL/VOL
WILTING POINT                =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH BARE
         GROUND CONDITIONS, A SURFACE SLOPE OF  5.% AND
         A SLOPE LENGTH OF 1100. FEET.

SCS RUNOFF CURVE NUMBER            =     78.90
FRACTION OF AREA ALLOWING RUNOFF   =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      1.507  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      6.710  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.770  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =     52.558  INCHES
TOTAL INITIAL WATER                =     52.558  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO              FLORIDA

    STATION LATITUDE                        =  27.80 DEGREES
```



```
MAXIMUM LEAF AREA INDEX                  =   0.00
START OF GROWING SEASON (JULIAN DATE)    =      0
END OF GROWING SEASON (JULIAN DATE)      =    367
EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
AVERAGE ANNUAL WIND SPEED                =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  76.00 %
```

```
NOTE:  PRECIPITATION DATA FOR     FORTDRUM           FLORIDA
         WAS ENTERED FROM AN ASCII DATA FILE.

NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO            FLORIDA
```

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO            FLORIDA
           AND STATION LATITUDE  =  27.80 DEGREES
```

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.21	3.92	2.61	4.64	7.88
	7.14	7.68	6.58	3.33	2.61	2.23
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
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	1.790	1.735	2.531	2.185	2.927	4.929
	4.993	4.632	4.042	2.704	1.837	1.411
STD. DEVIATIONS	0.866	0.998	1.209	1.214	1.869	1.612
	1.370	1.482	0.914	1.044	0.884	0.897

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.1707	0.1707	0.1324	0.2698	0.2210	0.2973
	0.6674	0.6949	0.6810	0.6503	0.4383	0.2350
STD. DEVIATIONS	0.2777	0.2705	0.2203	0.3709	0.2627	0.3377
	0.3778	0.4256	0.3622	0.3823	0.3540	0.2792

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.4702	0.3830	0.2980	0.8409	0.4812	0.9820
	1.8176	1.9720	1.9719	1.7834	1.0916	0.5337
STD. DEVIATIONS	0.6154	0.4921	0.3315	1.4382	0.4872	1.3173
	1.5986	1.7605	1.6249	1.7589	1.2321	0.5424

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.8500	0.7686	0.8423	0.8390	0.8446	0.8124
	0.8675	0.8801	0.8599	0.8835	0.8413	0.8707
STD. DEVIATIONS	0.1706	0.1817	0.1990	0.1462	0.1715	0.1835
	0.1080	0.0790	0.0318	0.0603	0.1335	0.1308

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1841	0.1229	0.0558	0.5841	0.1500	0.6747
	1.2689	1.3980	1.4824	1.2264	0.6224	0.1643
STD. DEVIATIONS	0.4303	0.3376	0.1534	1.4980	0.2955	1.2329
	1.7047	1.7893	1.8210	1.8529	1.2042	0.3679

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1900	0.1883	0.1883	0.1938	0.1888	0.1877
	0.1940	0.1968	0.1987	0.1975	0.1944	0.1947
STD. DEVIATIONS	0.0381	0.0443	0.0445	0.0338	0.0383	0.0424
	0.0242	0.0177	0.0073	0.0135	0.0308	0.0292

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	53.10	(10.929)	192747.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	35.717	(5.2175)	129653.45	67.266
LATERAL DRAINAGE COLLECTED FROM LAYER 3	4.62880	(1.75767)	16802.559	8.71742
PERCOLATION/LEAKAGE THROUGH LAYER 4	12.62561	(6.10061)	45830.973	23.77779
AVERAGE HEAD ON TOP OF LAYER 4	0.661	(0.490)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	10.15973	(1.17470)	36879.809	19.13380
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.193	(0.022)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	2.593	(6.1829)	9411.41	4.883

****

****

PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.04119	149.51431
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.304440	1105.11609
AVERAGE HEAD ON TOP OF LAYER 4	11.205	
MAXIMUM HEAD ON TOP OF LAYER 4	15.101	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	107.6 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02886	104.74629
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.389	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	9.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6710

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0770

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	35.2807	0.2940
2	4.7466	0.1978
3	0.2550	0.8500
4	0.0000	0.0000
5	74.1489	370.7445
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE2.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE2.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE2.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE2N.D10
OUTPUT DATA FILE:           C:\HELP\12CASE2N.OUT


TIME:  18:15     DATE:  11/ 3/2014


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

     TITLE:  JED Solid Waste Management Facility

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


     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  18
           THICKNESS                 =    960.00   INCHES
           POROSITY                  =      0.6710 VOL/VOL
           FIELD CAPACITY            =      0.2920 VOL/VOL
           WILTING POINT             =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.2900 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =     24.00   INCHES
           POROSITY                  =      0.4170 VOL/VOL
           FIELD CAPACITY            =      0.0450 VOL/VOL
```



```
           WILTING POINT             =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.1242 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.30   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.8315 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.526000001000E-01 CM/SEC
           SLOPE                     =      1.20   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                   LAYER  4
                                   --------

                       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       =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS  =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY     =  3 - GOOD


                                   LAYER  5
                                   --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.20   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.629999995000     CM/SEC
           SLOPE                     =      1.20   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                   LAYER  6
                                   --------

                       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         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

LAYER 7

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

```
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.   =  0.300000003000E-08 CM/SEC
```

LAYER 8

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

```
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #18 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 800. FEET.

```
SCS RUNOFF CURVE NUMBER            =     71.50
FRACTION OF AREA ALLOWING RUNOFF   =     50.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      1.617  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.924  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =    297.742  INCHES
TOTAL INITIAL WATER                =    297.742  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ORLANDO FLORIDA


```
STATION LATITUDE                        =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX                 =   1.00
START OF GROWING SEASON (JULIAN DATE)   =      0
END OF GROWING SEASON (JULIAN DATE)     =    367
EVAPORATIVE ZONE DEPTH                  =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED               =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  76.00 %
```

NOTE: PRECIPITATION DATA FOR FORTDRUM FLORIDA WAS ENTERED FROM AN ASCII DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ORLANDO FLORIDA AND STATION LATITUDE = 27.80 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.21	3.92	2.61	4.64	7.88
	7.14	7.68	6.58	3.33	2.61	2.23
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.011	0.000	0.090	0.002	0.031	0.048
	0.041	0.150	0.065	0.021	0.051	0.013
STD. DEVIATIONS	0.030	0.002	0.297	0.007	0.077	0.081
	0.116	0.369	0.208	0.063	0.176	0.049
EVAPOTRANSPIRATION						
TOTALS	1.798	2.212	2.840	2.502	3.167	5.575
	5.550	5.181	4.404	3.076	1.892	1.369

STD. DEVIATIONS	0.814	0.941	1.358	1.522	1.999	1.637
	1.680	1.555	0.958	1.146	0.978	0.798

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.1008	0.0872	0.0860	0.0795	0.0827	0.0769
	0.0914	0.1060	0.1067	0.1122	0.1095	0.1074
STD. DEVIATIONS	0.0230	0.0240	0.0274	0.0287	0.0336	0.0298
	0.0335	0.0292	0.0225	0.0222	0.0191	0.0219

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.8972	0.7112	0.4377	0.4335	0.5764	0.3547
	0.9844	1.4327	1.4318	1.5505	1.5581	1.2151
STD. DEVIATIONS	1.1356	0.8186	0.6863	0.6176	0.9356	0.4992
	0.9764	1.0029	0.9979	1.1315	1.2244	1.3078

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7630	0.6901	0.7554	0.7400	0.7615	0.7385
	0.7810	0.7806	0.7646	0.7863	0.7562	0.7808
STD. DEVIATIONS	0.1631	0.1701	0.1891	0.1527	0.1682	0.1468
	0.1321	0.1345	0.0793	0.1029	0.1254	0.1332

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	1.6842	1.5067	0.8881	0.8989	1.1160	0.7520
	1.8454	2.6525	2.7280	2.8380	2.9121	2.2250
STD. DEVIATIONS	1.9610	1.6014	1.2166	1.1620	1.6497	0.9291
	1.7299	1.7520	1.7758	1.9326	2.1150	2.2111

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1895	0.1879	0.1877	0.1900	0.1892	0.1896
	0.1940	0.1939	0.1963	0.1953	0.1941	0.1940
STD. DEVIATIONS	0.0405	0.0461	0.0470	0.0392	0.0418	0.0377
	0.0328	0.0334	0.0203	0.0256	0.0322	0.0331

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	53.10	(10.929)	192747.0	100.00
RUNOFF	0.521	(0.6279)	1893.04	0.982
EVAPOTRANSPIRATION	39.567	(5.7499)	143626.55	74.516
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.14635	(0.21344)	4161.268	2.15893
PERCOLATION/LEAKAGE THROUGH LAYER 4	11.58340	(5.80568)	42047.727	21.81499
AVERAGE HEAD ON TOP OF LAYER 4	1.837	(0.859)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	9.09802	(1.27819)	33025.812	17.13428
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.192	(0.027)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	2.766	(6.9923)	10040.37	5.209

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	1.446	5250.4331
DRAINAGE COLLECTED FROM LAYER 3	0.00451	16.38572
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.126948	460.82120
AVERAGE HEAD ON TOP OF LAYER 4	6.419	
MAXIMUM HEAD ON TOP OF LAYER 4	9.323	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	90.3 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02597	94.27657
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.387	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	10.5 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6710

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0770

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	285.3067	0.2972
2	4.5185	0.1883
3	0.2550	0.8500
4	0.0000	0.0000
5	74.7321	373.6606
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE3.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE3.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE3.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE3N.D10
OUTPUT DATA FILE:           C:\HELP\12CASE3N.OUT


TIME:  18:32     DATE:  11/ 3/2014


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     TITLE:  JED Solid Waste Management Facility

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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  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  =    0.2910 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =     24.00   INCHES
           POROSITY                  =      0.4170 VOL/VOL
           FIELD CAPACITY            =      0.0450 VOL/VOL
```



```
           WILTING POINT             =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.1267 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.30   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.8360 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.573999994000E-01 CM/SEC
           SLOPE                     =      1.10   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                   LAYER  4
                                   --------

                     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       =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS  =      2.00   HOLES/ACRE
           FML PLACEMENT QUALITY     =  3 - GOOD


                                   LAYER  5
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                 =      0.20   INCHES
           POROSITY                  =      0.8500 VOL/VOL
           FIELD CAPACITY            =      0.0100 VOL/VOL
           WILTING POINT             =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT  =    0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.680000007000     CM/SEC
           SLOPE                     =      1.10   PERCENT
           DRAINAGE LENGTH           =    330.0    FEET


                                   LAYER  6
                                   --------

                     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
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```
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
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.   =  0.300000003000E-08 CM/SEC


                        LAYER  8
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
         POOR STAND OF GRASS, A SURFACE SLOPE OF  5.%
         AND A SLOPE LENGTH OF  600. FEET.

SCS RUNOFF CURVE NUMBER              =     71.90
FRACTION OF AREA ALLOWING RUNOFF     =     70.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      1.617  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.924  INCHES
INITIAL SNOW WATER                   =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =    543.081  INCHES
TOTAL INITIAL WATER                  =    543.081  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


          EVAPOTRANSPIRATION AND WEATHER DATA
          -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ORLANDO               FLORIDA
```



```
STATION LATITUDE                      =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX               =   1.00
START OF GROWING SEASON (JULIAN DATE) =      0
END OF GROWING SEASON (JULIAN DATE)   =    367
EVAPORATIVE ZONE DEPTH                =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED             =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  76.00 %


NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
         WAS ENTERED FROM AN ASCII DATA FILE.


NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA

    NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    ORLANDO             FLORIDA
           AND STATION LATITUDE  =  27.80 DEGREES
```

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.21	3.92	2.61	4.64	7.88
	7.14	7.68	6.58	3.33	2.61	2.23
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.016	0.001	0.125	0.003	0.045	0.072
	0.061	0.219	0.094	0.032	0.074	0.019
STD. DEVIATIONS	0.044	0.003	0.405	0.010	0.113	0.120
	0.169	0.531	0.300	0.093	0.253	0.072
EVAPOTRANSPIRATION						
TOTALS	1.798	2.210	2.846	2.504	3.168	5.568
	5.551	5.179	4.407	3.071	1.892	1.373

STD. DEVIATIONS	0.813	0.942	1.363	1.520	2.001	1.631
	1.682	1.556	0.957	1.144	0.979	0.796

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0996	0.0870	0.0854	0.0792	0.0820	0.0760
	0.0891	0.1030	0.1040	0.1092	0.1071	0.1055
STD. DEVIATIONS	0.0221	0.0240	0.0273	0.0292	0.0329	0.0297
	0.0327	0.0282	0.0215	0.0202	0.0171	0.0204

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.8993	0.7818	0.4540	0.4762	0.5750	0.3422
	0.9310	1.3648	1.3759	1.4476	1.4992	1.1814
STD. DEVIATIONS	1.1124	0.8750	0.6791	0.7219	0.8997	0.4664
	0.9291	0.9424	0.9463	1.0392	1.1317	1.2315

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7558	0.6831	0.7477	0.7292	0.7519	0.7208
	0.7727	0.7723	0.7556	0.7766	0.7484	0.7726
STD. DEVIATIONS	0.1589	0.1671	0.1861	0.1602	0.1698	0.1581
	0.1307	0.1332	0.0783	0.1098	0.1234	0.1313

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	1.6333	1.5730	0.8839	0.9336	1.0758	0.6996
	1.6849	2.4389	2.5370	2.5759	2.7304	2.1087
STD. DEVIATIONS	1.8660	1.6379	1.1614	1.2849	1.5379	0.8356
	1.5916	1.5983	1.6434	1.7372	1.9298	2.0437

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1897	0.1880	0.1877	0.1892	0.1888	0.1870
	0.1940	0.1939	0.1960	0.1950	0.1942	0.1940
STD. DEVIATIONS	0.0399	0.0458	0.0467	0.0416	0.0426	0.0410
	0.0328	0.0334	0.0203	0.0276	0.0320	0.0330

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES	CU. FEET	PERCENT
PRECIPITATION	53.10 (10.929)	192747.0	100.00
RUNOFF	0.761 (0.8899)	2763.19	1.434
EVAPOTRANSPIRATION	39.568 (5.7468)	143632.02	74.518
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.12708 (0.20931)	4091.306	2.12263
PERCOLATION/LEAKAGE THROUGH LAYER 4	11.32841 (5.57867)	41122.145	21.33478
AVERAGE HEAD ON TOP OF LAYER 4	1.740 (0.807)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	8.98670 (1.28166)	32621.721	16.92464
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002 (0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.191 (0.027)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002 (0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	2.655 (6.8311)	9639.00	5.001

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	1.934	7020.4219
DRAINAGE COLLECTED FROM LAYER 3	0.00428	15.53624
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.113364	411.51276
AVERAGE HEAD ON TOP OF LAYER 4	5.731	
MAXIMUM HEAD ON TOP OF LAYER 4	8.361	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	89.3 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02570	93.28107
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.386	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	11.3 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.6535
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	531.6869	0.2954
2	4.4691	0.1862
3	0.2550	0.8501
4	0.0000	0.0000
5	70.4236	352.1182
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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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\FTDRUM.D4
TEMPERATURE DATA FILE:      C:\HELP\CASE4.D7
SOLAR RADIATION DATA FILE:  C:\HELP\CASE4.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\CASE4.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\12CASE4N.D10
OUTPUT DATA FILE:           C:\HELP\12CASE4N.OUT


TIME:  19: 0     DATE:  11/ 3/2014


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     TITLE:  JED Solid Waste Management Facility

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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  18
           THICKNESS                  =   2640.00   INCHES
           POROSITY                   =      0.6710 VOL/VOL
           FIELD CAPACITY             =      0.2920 VOL/VOL
           WILTING POINT              =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2913 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 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   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.4170 VOL/VOL
           FIELD CAPACITY             =      0.0450 VOL/VOL
```


```
           WILTING POINT              =      0.0180 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.1265 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.30   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8391 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.570000000000E-01 CM/SEC
           SLOPE                      =      1.00    PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                   LAYER  4
                                   --------

                     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        =      2.00    HOLES/ACRE
           FML INSTALLATION DEFECTS   =      2.00    HOLES/ACRE
           FML PLACEMENT QUALITY      =  3 - GOOD


                                   LAYER  5
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =      0.20   INCHES
           POROSITY                   =      0.8500 VOL/VOL
           FIELD CAPACITY             =      0.0100 VOL/VOL
           WILTING POINT              =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.759999990000     CM/SEC
           SLOPE                      =      1.00    PERCENT
           DRAINAGE LENGTH            =    330.0    FEET


                                   LAYER  6
                                   --------

                     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         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
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.   =  0.300000003000E-08 CM/SEC


                        LAYER  8
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
        SOIL DATA BASE USING SOIL TEXTURE #18 WITH A
        FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
        AND A SLOPE LENGTH OF  300. FEET.

SCS RUNOFF CURVE NUMBER            =    57.30
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  =     1.537  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =     8.052  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =     0.924  INCHES
INITIAL SNOW WATER                 =     0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =   788.278  INCHES
TOTAL INITIAL WATER                =   788.278  INCHES
TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR


          EVAPOTRANSPIRATION AND WEATHER DATA
          -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
        ORLANDO               FLORIDA
```



```
STATION LATITUDE                       =  27.80 DEGREES
MAXIMUM LEAF AREA INDEX                =   2.00
START OF GROWING SEASON (JULIAN DATE)  =      0
END OF GROWING SEASON (JULIAN DATE)    =    367
EVAPORATIVE ZONE DEPTH                 =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED              =   8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  80.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  76.00 %


NOTE:  PRECIPITATION DATA FOR     FORTDRUM            FLORIDA
       WAS ENTERED FROM AN ASCII DATA FILE.


NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
       COEFFICIENTS FOR    ORLANDO            FLORIDA

    NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
60.50	61.50	66.80	72.00	77.30	80.90
82.40	82.50	81.10	74.90	67.50	62.00

```
NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
       COEFFICIENTS FOR    ORLANDO            FLORIDA
         AND STATION LATITUDE  =  27.80 DEGREES


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

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1975 THROUGH 2004
-------------------------------------------------------------------------------
```

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.21	3.92	2.61	4.64	7.88
	7.14	7.68	6.58	3.33	2.61	2.23
STD. DEVIATIONS	1.68	1.68	3.65	1.76	3.99	3.97
	3.81	3.77	3.81	3.24	1.90	1.87
RUNOFF						
TOTALS	0.000	0.000	0.038	0.000	0.003	0.002
	0.008	0.059	0.024	0.001	0.020	0.001
STD. DEVIATIONS	0.000	0.000	0.177	0.000	0.014	0.008
	0.044	0.193	0.124	0.007	0.077	0.002
EVAPOTRANSPIRATION						
TOTALS	1.782	2.385	2.791	2.504	3.213	5.606
	5.551	5.240	4.393	3.090	1.907	1.310

STD. DEVIATIONS	0.750	0.979	1.409	1.531	1.997	1.609
	1.713	1.536	1.019	1.181	1.038	0.822

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0910	0.0809	0.0806	0.0734	0.0758	0.0698
	0.0820	0.0937	0.0943	0.1006	0.0984	0.0963
STD. DEVIATIONS	0.0196	0.0212	0.0237	0.0235	0.0275	0.0254
	0.0283	0.0243	0.0185	0.0140	0.0139	0.0173

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.9260	0.8672	0.5528	0.4764	0.5973	0.3558
	0.9619	1.3819	1.3720	1.5014	1.5467	1.1910
STD. DEVIATIONS	1.1182	0.9629	0.7947	0.7111	0.9185	0.4660
	0.9315	0.9437	0.9396	1.0175	1.0867	1.1908

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.7681	0.6941	0.7598	0.7409	0.7647	0.7449
	0.7853	0.7848	0.7680	0.7996	0.7606	0.7851
STD. DEVIATIONS	0.1606	0.1696	0.1888	0.1627	0.1716	0.1487
	0.1321	0.1348	0.0836	0.0538	0.1244	0.1333

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

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	1.6848	1.7338	1.0586	0.9417	1.1199	0.7316
	1.7454	2.4799	2.5445	2.6823	2.8345	2.1431
STD. DEVIATIONS	1.8859	1.7961	1.3621	1.2671	1.5766	0.8431
	1.6047	1.6100	1.6396	1.7093	1.8673	1.9878

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.1898	0.1880	0.1877	0.1892	0.1889	0.1902
	0.1940	0.1939	0.1961	0.1976	0.1942	0.1940
STD. DEVIATIONS	0.0397	0.0458	0.0466	0.0415	0.0424	0.0380
	0.0326	0.0333	0.0214	0.0133	0.0318	0.0329

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1975 THROUGH 2004

	INCHES		CU. FEET	PERCENT
PRECIPITATION	53.10	(10.929)	192747.0	100.00
RUNOFF	0.155	(0.3383)	563.67	0.292
EVAPOTRANSPIRATION	39.774	(5.8256)	144379.92	74.906
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.03670	(0.17016)	3763.206	1.95241
PERCOLATION/LEAKAGE THROUGH LAYER 4	11.73060	(5.78125)	42582.074	22.09222
AVERAGE HEAD ON TOP OF LAYER 4	1.808	(0.840)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	9.15591	(1.29051)	33235.945	17.24331
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00002	(0.00000)	0.074	0.00004
AVERAGE HEAD ON TOP OF LAYER 6	0.192	(0.027)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00002	(0.00002)	0.073	0.00004
CHANGE IN WATER STORAGE	2.976	(7.1722)	10804.11	5.605

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PEAK DAILY VALUES FOR YEARS 1975 THROUGH 2004

	(INCHES)	(CU. FT.)
PRECIPITATION	9.00	32670.000
RUNOFF	0.967	3509.6682
DRAINAGE COLLECTED FROM LAYER 3	0.00385	13.97573
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.109610	397.88455
AVERAGE HEAD ON TOP OF LAYER 4	5.613	
MAXIMUM HEAD ON TOP OF LAYER 4	8.084	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	92.3 FEET	
DRAINAGE COLLECTED FROM LAYER 5	0.02611	94.77955
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00021
AVERAGE HEAD ON TOP OF LAYER 6	0.200	
MAXIMUM HEAD ON TOP OF LAYER 6	0.385	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	12.1 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000038	0.13716
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.6229

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0770

*** 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 2004

LAYER	(INCHES)	(VOL/VOL)
1	779.6431	0.2953
2	4.3564	0.1815
3	0.2509	0.8363
4	0.0000	0.0000
5	77.4100	387.0499
6	0.0000	0.0000
7	0.1875	0.7500
8	15.7200	0.1310
SNOW WATER	0.000	

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ATTACHMENT C
Spreadsheets for Computation of Heads Using Giroud's Method

CELL 11 - Case 1 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in **RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***2.1228***	cm/s	$k_1 = k_b$ =	0.070 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***395***	ft			
Slope (%) =	***1.50***	%			
Liquid Impingement Rate = qh =	***2.2078***	in/month	7.10E-08 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.62E-04 m²/s	1.74E-03 ft²/s	
Slope angle (β)=	0.859 deg	0.015 rad	
Length of Upstream Section (L_u) =	367.9 ft		(Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.005		
Characteristic Parameter = $\lambda_2 = \lambda_t$	9.616		(Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELL 11 - Case 2 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)
2. For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
3. For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)
*4. Manually input numbers in **RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***1.9284***	cm/s	$k_1 = k_b$ =	0.063 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***395***	ft			
Slope (%) =	***1.30***	%			
Liquid Impingement Rate = qh =	***1.7532***	in/month	5.64E-08 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.47E-04 m²/s	1.58E-03 ft²/s	
Slope angle (β)=	0.745 deg	0.013 rad	
Length of Upstream Section (L_u) =	364.8 ft		(Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.005		
Characteristic Parameter = $\lambda_2 = \lambda_t$	10.166		(Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For L_u < L and λ_t < 0.01, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For L_u < L and λ_t > 0.01, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELL 11 - Case 3 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***1.8188***	cm/s	$k_1 = k_b$ =	0.060 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s		3.3E-05 ft/s	Check k1 or kb > k2 or kt
Drainage Length (L)=	***395***	ft			
Slope (%) =	***1.20***	%			
Liquid Impingement Rate = qh =	***1.5348***	in/month		4.93E-08 ft/s	Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.39E-04 m²/s	1.49E-03 ft²/s	
Slope angle (β)=	0.688 deg	0.012 rad	
Length of Upstream Section (L_u) =	362.8 ft		(Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.006		
Characteristic Parameter = $\lambda_2 = \lambda_t$	10.445		(Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**12.00** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**12.00** inches	(Equation 38)

CELL 11 - Case 4 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)
2. For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
3. For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)
4. Manually input numbers in ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***2.0999***	cm/s	$k_1 = k_b$ =	0.069 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***395***	ft			
Slope (%) =	***1.00***	%			
Liquid Impingement Rate = qh =	***1.4750***	in/month	4.74E-08 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.60E-04 m²/s	1.72E-03 ft²/s	
Slope angle (β)=	0.573 deg	0.010 rad	
Length of Upstream Section (L_u) =	363.2 ft	(Equation 19)	
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.007		
Characteristic Parameter = $\lambda_2 = \lambda_t$	14.454	(Equation 17 - derived from Equation 7)	

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELL 11 - Case 1 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)
2. For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
3. For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)
4. Manually input numbers in ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***0.7566***	cm/s	$k_1 = k_b$ =	0.025 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***395***	ft			
Slope (%) =	***1.50***	%			
Liquid Impingement Rate = qh =	***0.8389***	in/month	2.70E-08 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	5.77E-05 m²/s	6.21E-04 ft²/s	
Slope angle (β)=	0.859 deg	0.015 rad	
Length of Upstream Section (L_u) =	345.1 ft	(Equation 19)	
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.005		
Characteristic Parameter = $\lambda_2 = \lambda_t$	3.654	(Equation 17 - derived from Equation 7)	

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELL 11 - Case 2 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)
2. For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
3. For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)
4. Manually input numbers in ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) = ***0.0433*** cm/s $k_1 = k_b$ = 0.001 ft/s
Geocomposite Thickness (t_1) = (t_b) = ***0.300*** in
Sand Permeability (k_2) = (k_t) = ***1.00E-03*** cm/s   3.3E-05 ft/s   Check k1 or kb > k2 or kt
Drainage Length (L)= ***395*** ft
Slope (%) = ***1.30*** %
Liquid Impingement Rate = qh = ***0.0888*** in/month   2.85E-09 ft/s   Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) = 3.30E-06 m²/s   3.55E-05 ft²/s
Slope angle (β)= 0.745 deg   0.013 rad
Length of Upstream Section (L_u) = 161.7 ft   (Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$ 0.012
Characteristic Parameter = $\lambda_2 = \lambda_t$ 0.515   (Equation 17 - derived from Equation 7)
Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}
Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**12.00** inches	(Equation 33)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**12.00** inches	(Equation 38)

CELL 11 - Case 3 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***0.0471***	cm/s	$k_1 = k_b$ =	0.002 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***395***	ft			
Slope (%) =	***1.20***	%			
Liquid Impingement Rate = qh =	***0.0863***	in/month	2.77E-09 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	3.59E-06 m²/s	3.86E-05 ft²/s	
Slope angle (β)=	0.688 deg	0.012 rad	
Length of Upstream Section (L_u) =	167.1 ft	(Equation 19)	
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.012		
Characteristic Parameter = $\lambda_2 = \lambda_t$	0.587	(Equation 17 - derived from Equation 7)	

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELL 11 - Case 4 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)
2. For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
3. For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)
4. Manually input numbers in ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) = ***0.049*** cm/s — $k_1 = k_b$ = 0.002 ft/s

Geocomposite Thickness (t_1) = (t_b) = ***0.300*** in

Sand Permeability (k_2) = (k_t) = ***1.00E-03*** cm/s — 3.3E-05 ft/s — Check k1 or kb > k2 or kt

Drainage Length (L)= ***395*** ft

Slope (%) = ***1.00*** %

Liquid Impingement Rate = qh = ***0.0755*** in/month — 2.43E-09 ft/s — Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) = 3.73E-06 m²/s — 4.02E-05 ft²/s

Slope angle (β)= 0.573 deg — 0.010 rad

Length of Upstream Section (L_u) = 165.6 ft (Equation 19)

Characteristic Parameter = $\lambda_1 = \lambda_b$ 0.015

Characteristic Parameter = $\lambda_2 = \lambda_t$ 0.740 (Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELLS 12 & 13 - Case 1 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***1.8535***	cm/s	$k_1 = k_b$ =	0.061 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s		3.3E-05 ft/s	Check k1 or kb > k2 or kt
Drainage Length (L)=	***330***	ft			
Slope (%) =	***1.40***	%			
Liquid Impingement Rate = qh =	***2.1838***	in/month		7.02E-08 ft/s	Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.41E-04 m²/s	1.52E-03 ft²/s	
Slope angle (β)=	0.802 deg	0.014 rad	
Length of Upstream Section (L_u) =	303.1 ft		(Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.006		
Characteristic Parameter = $\lambda_2 = \lambda_t$	10.918		(Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELLS 12 & 13 - Case 2 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***1.7041***	cm/s	$k_1 = k_b$ =	0.056 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***330***	ft			
Slope (%) =	***1.20***	%			
Liquid Impingement Rate = qh =	***1.7382***	in/month	5.59E-08 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.30E-04 m²/s	1.40E-03 ft²/s	
Slope angle (β)=	0.688 deg	0.012 rad	
Length of Upstream Section (L_u) =	300.1 ft		(Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.007		
Characteristic Parameter = $\lambda_2 = \lambda_t$	11.829		(Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**11.99** inches	(Equation 38)

CELLS 12 & 13 - Case 3 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***1.6239***	cm/s	$k_1 = k_b$ =	0.053 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***330***	ft			
Slope (%) =	***1.10***	%			
Liquid Impingement Rate = qh =	***1.5279***	in/month	4.91E-08 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.24E-04 m²/s	1.33E-03 ft²/s	
Slope angle (β)=	0.630 deg	0.011 rad	
Length of Upstream Section (L_u) =	298.2 ft		(Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.008		
Characteristic Parameter = $\lambda_2 = \lambda_t$	12.374		(Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**12.00** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**12.00** inches	(Equation 38)

CELLS 12 & 13 - Case 4 with Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***1.7144***	cm/s	$k_1 = k_b$ =	0.056	ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in				
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s		3.3E-05	ft/s	Check k1 or kb > k2 or kt
Drainage Length (L)=	***330***	ft				
Slope (%) =	***1.00***	%				
Liquid Impingement Rate = qh =	***1.4673***	in/month		4.72E-08	ft/s	Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	1.31E-04 m²/s	1.41E-03 ft²/s		
Slope angle (β)=	0.573 deg	0.010 rad		
Length of Upstream Section (L_u) =	298.1 ft	(Equation 19)		
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.008			
Characteristic Parameter = $\lambda_2 = \lambda_t$	14.379	(Equation 17 - derived from Equation 7)		

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A**	inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A**	inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A**	inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A**	inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**12.00**	inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**12.00**	inches	(Equation 38)

CELLS 12 & 13 - Case 1 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)
2. For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
3. For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)
4. Manually input numbers in ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***0.5346***	cm/s	$k_1 = k_b$ =	0.018 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***330***	ft			
Slope (%) =	***1.40***	%			
Liquid Impingement Rate = qh =	***0.6949***	in/month	2.23E-08 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	4.07E-05 m²/s	4.38E-04 ft²/s	
Slope angle (β)=	0.802 deg	0.014 rad	
Length of Upstream Section (L_u) =	274.7 ft	(Equation 19)	
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.006		
Characteristic Parameter = $\lambda_2 = \lambda_t$	3.474	(Equation 17 - derived from Equation 7)	

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99** inches	(Equation 38)

CELLS 12 & 13 - Case 2 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***0.0526*** cm/s	$k_1 = k_b$ =	0.002 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300*** in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03*** cm/s		3.3E-05 ft/s	Check k1 or kb > k2 or kt
Drainage Length (L)=	***330*** ft			
Slope (%) =	***1.20*** %			
Liquid Impingement Rate = qh =	***0.1122*** in/month		3.61E-09 ft/s	Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	4.01E-06 m²/s	4.31E-05 ft²/s	
Slope angle (β)=	0.688 deg	0.012 rad	
Length of Upstream Section (L_u) =	143.5 ft		(Equation 19)
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.015		
Characteristic Parameter = $\lambda_2 = \lambda_t$	0.764		(Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**N/A** inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.98** inches	(Equation 33)
		and	$h_{max} = (t_{max})\cdot\cos\beta$ =	**11.98** inches	(Equation 38)

CELLS 12 & 13 - Case 3 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) = ***0.0574*** cm/s $k_1 = k_b$ = 0.002 ft/s

Geocomposite Thickness (t_1) = (t_b) = ***0.300*** in

Sand Permeability (k_2) = (k_t) = ***1.00E-03*** cm/s   3.3E-05 ft/s   Check k1 or kb > k2 or kt

Drainage Length (L)= ***330*** ft

Slope (%) = ***1.10*** %

Liquid Impingement Rate = qh = ***0.1092*** in/month   3.51E-09 ft/s   Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) = 4.37E-06 m²/s   4.71E-05 ft²/s

Slope angle (β)= 0.630 deg   0.011 rad

Length of Upstream Section (L_u) = 147.5 ft   (Equation 19)

Characteristic Parameter = $\lambda_1 = \lambda_b$ 0.015

Characteristic Parameter = $\lambda_2 = \lambda_t$ 0.884   (Equation 17 - derived from Equation 7)

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A**	inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A**	inches	(Equation 21)

For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A**	inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A**	inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**11.99**	inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**11.99**	inches	(Equation 38)

CELLS 12 & 13 - Case 4 without Leachate Recirculation

LEACHATE HEAD COMPUTATIONS FOR LANDFILLS WITH BOTTOM LINER SYSTEM

Reference:

Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid Flow Equations for Drainage Systems Composed of Two Layers Including a Geocomposite", Geosynthetics International, Vo. 11, No. 1.

Assumptions:

1. *Drainage systems consists of two layers, with the bottom layer being a geocomposite;*
2. *Hydraulic conductivity of the bottom drainage layer is greater than that of the top drainage layer;*
3. *The drainage system is underlain by a geomembrane with no defects;*
4. *Length of drainage layer is measured horizontally;*
5. *Liquid impingement rate is uniform and constant (steady-state flow conditions); and*
6. *Liquid impingement rate is smaller than the hydraulic conductivity of top drainage layer.*

Notes:

1. *The indicated equation numbers correspond to the equation numbers in Giroud et al. (2004)*
2. *For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)*
3. *For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)*
4. *Manually input numbers in* ***RED***

Input Parameters

Geocomposite Permeability (k_{HELP}) =	***0.057***	cm/s	$k_1 = k_b$ =	0.002 ft/s	
Geocomposite Thickness (t_1) = (t_b) =	***0.300***	in			
Sand Permeability (k_2) = (k_t) =	***1.00E-03***	cm/s	3.3E-05 ft/s		Check k1 or kb > k2 or kt
Drainage Length (L)=	***330***	ft			
Slope (%) =	***1.00***	%			
Liquid Impingement Rate = qh =	***0.1006***	in/month	3.23E-09 ft/s		Check qh < k2 or kt < k1 or kb

Miscellaneous Calculations and Conversions

Geocomposite Transmissivity (θ_1) = (θ_b) =	4.34E-06 m²/s	4.68E-05 ft²/s	
Slope angle (β)=	0.573 deg	0.010 rad	
Length of Upstream Section (L_u) =	144.5 ft	(Equation 19)	
Characteristic Parameter = $\lambda_1 = \lambda_b$	0.017		
Characteristic Parameter = $\lambda_2 = \lambda_t$	0.986	(Equation 17 - derived from Equation 7)	

Maximum Liquid Thickness: Top Layer = t_{maxt}; Bottom Layer = t_{maxb}; Combined = t_{max}

Maximum Head: Top Layer = h_{maxt}; Bottom Layer = h_{maxb}; Combined = h_{max}

Results

For $L_u \geq L$, flow is in the bottom drainage layer (geocomposite) only.

Is the flow only in the bottom layer?	No	Therefore,	$t_{max} = t_{maxb}$ =	**N/A** inches	(Equation 20)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 21)

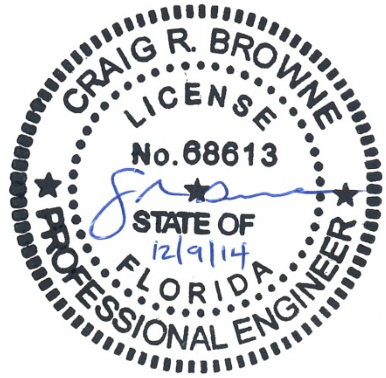
For $L_u < L$ and $\lambda_t < 0.01$, flow is in both the drainage layers (limit case).

Does the limit case apply?	No	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**N/A** inches	(Equation 36)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**N/A** inches	(Equation 40)

For $L_u < L$ and $\lambda_t > 0.01$, flow is in both the drainage layers (general case).

Does the general case apply?	Yes	Therefore,	$t_{max} = t_b + t_{maxt}$ =	**12.00** inches	(Equation 33)
		and	$h_{max} = (t_{max}) \cdot \cos\beta$ =	**12.00** inches	(Equation 38)

ATTACHMENT 7
REVISED TECHNICAL SPECIFICATIONS



SECTION 02740

GEOCOMPOSITES

PART 1 GENERAL

1.01 SCOPE

A. This section includes requirements for primary and secondary geocomposite drainage layer products and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02240 – Protective Soil Layer

B. Section 02770 – Geomembrane

C. Section 02780 – Geosynthetic Clay Liner

D. Section 02790 – Interface Friction Conformance Testing

E. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of American Society of Testing and Materials (ASTM) standards and other standards noted in this specification.

1.04 SUBMITTALS

A. Submit the following to the Engineer for review at least 21 calendar days prior to use:
1. geocomposite Manufacturer and product names;
2. certification of minimum average roll values and the corresponding test procedures for all geocomposite properties listed in Tables 02740-1 through 02740-4; and
3. projected geocomposite delivery dates.

B. Submit to the Engineer for review at least 14 calendar days prior to geocomposite placement, manufacturing quality control certificates for each roll of geocomposite as specified in this section.

C. For each proposed geocomposite material, the Contractor shall submit to the Engineer for review at least 14 calendar days prior to transporting the geocomposite to site the results of manufacturing quality control testing and certification that the geocomposite is manufactured to meet the minimum interface shear strength criteria when tested in compliance with requirements of Section 02790.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The installation of the geocomposite drainage layers will be monitored by the CQA Consultant as required by the CQA Plan.

B. The CQA Consultant will perform material conformance testing of the geocomposites as required by the CQA Plan.

C. The Contractor shall be aware of the activities required of the CQA Consultant by the CQA Plan and shall account for these activities in the installation schedule.

D. The Contractor shall correct all deficiencies and nonconformances identified by the CQA Consultant at no additional cost to the Owner.

PART 2 PRODUCT

2.01 GEOCOMPOSITE

A. Furnish geocomposite drainage layer materials consisting of a polyethylene geonet core with a needle-punched nonwoven geotextile heat laminated to both sides of the geonet core.

B. Furnish geocomposite for the primary and secondary leachate collection drainage layer having properties meeting the required property values shown in Tables 02740-1 through 02740-4. Required geocomposites properties shall be considered minimum average roll values (95 percent lower confidence limit).

C. Furnish geocomposites that are stock products.

D. In addition to the property values listed in Tables 02740-1 through 02740-4, the geocomposites shall:
   1. retain their structure during handling, placement, and long-term service (provide manufacturer’s data for long-term compression creep testing); and
   2. be capable of withstanding outdoor exposure for a minimum of 30 days with no measurable deterioration.

E. Furnish geocomposite that meets the interface shear strength requirements of Section 02790 as tested by an approved testing laboratory.

F. Furnish polymeric threads for stitching that are ultra-violet (UV) light stabilized to at least the same requirements as the geotextile to be sewn. Furnish polyester or polypropylene threads that have a minimum size of 2,000 denier.

G. Furnish geocomposite meeting the transmissivity requirements in Tables 02740-1 through 02740-4 as tested by an approved testing laboratory. The transmissivity of the geocomposites for liner system construction shall be tested in accordance with ASTM D 4716 to demonstrate that the design transmissivity will be maintained for the design period of the facility. The primary and secondary geocomposites used in the bottom liner system shall be tested using the actual boundary materials intended for each geocomposite at the normal loads of 700 and 15,000 pounds per square foot (psf). At the normal load of 700 psf, testing shall be conducted for a minimum period of 24 hours. At the normal load of 15,000 psf, testing shall be conducted for a minimum period of 100 hours unless project-specific data equivalent to the 100-hour period is provided in which case the test shall be conducted for a minimum period of 1 hour.

2.02 MANUFACTURING QUALITY CONTROL

A. Sample and test the geotextile and geonet components of the geocomposite to demonstrate that these materials conform to the requirements of this section.

B. Perform manufacturing quality control tests to demonstrate that the geotextile properties conform to the values specified in Tables 02740-1 through 02740-4. Perform as a minimum, the following manufacturing quality control tests at a minimum frequency of once per 100,000 square feet with minimum of 1 test per lot:

Test	Procedure
Mass per unit area	ASTM D 5261
Grab strength	ASTM D 4632
Tear strength	ASTM D 4533
Static (CBR) puncture strength	ASTM D 6241

C. Perform additional manufacturing quality control tests on the geotextile, at a minimum frequency of once per 250,000 square feet with minimum of 1 test per lot, to demonstrate that the apparent opening size (per ASTM D 4751) and permittivity (per ASTM D 4491) of the geotextile conform to the values specified in Tables 02740-1 through 02740-4.

D. Perform manufacturing quality control tests to demonstrate that the geonet drainage core properties conform to the values specified in Tables 02740-1 through 02740-4. Perform as a minimum, the following manufacturing quality control tests at a minimum frequency of once per 100,000 square feet with minimum of 1 test per lot:

Test	Procedure
Polymer density	ASTM D 792 or 1505
Carbon black	ASTM D 1603 or 4218
Thickness	ASTM D 5199

E. Perform additional manufacturing quality control tests, at a minimum frequency of once per 100,000 square feet with minimum of 1 test per geonet lot, to demonstrate that the geocomposite drainage layers conform to the hydraulic transmissivity (per ASTM D 4716) and ply adhesion (per ASTM D 7005) requirements of Tables 02740-1 through 02740-4.

F. Submit quality control test certificates signed by the geotextile, geonet, and geocomposite manufacturer quality control manager. The quality control certificates shall include:
1. lot, batch, and roll number and identification; and
2. results of manufacturing quality control tests including description of test methods used.

G. Do not supply any geocomposite roll that does not comply with the manufacturing quality control requirements.

H. If a geotextile, geonet, or geocomposite sample fails to meet the quality control requirements of this section, sample and test rolls manufactured at the same time or in the same lot as the failing roll. Continue to sample and test the rolls until the extent of the failing rolls are bracketed by passing rolls. Do not supply failing rolls.

2.03 PACKING AND LABELING

A. The geocomposite shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.

B. Geocomposite rolls shall be labeled with the following information.
1. Fabricator’s name;
2. product identification;
3. lot or batch number;
4. roll number; and
5. roll dimensions.

C. Geocomposite rolls not labeled in accordance with this section or on which labels are illegible upon delivery to the site shall be rejected and replaced with properly labeled rolls at no additional cost to the Owner.

D. If any special handling is required, it shall be so marked on the geotextile component e.g., “This Side Up” or “This Side Against Soil To Be Retained”.

2.04 TRANSPORTATION

A. Geocomposites shall be delivered to the site at least 21 days prior to the planned deployment date to allow the CQA Consultant adequate time to perform conformance testing on the geocomposite samples as required by the CQA Plan.

2.05 HANDLING AND STORAGE

A. The Contractor shall be responsible for storage of the geocomposite at the site.

B. Handling and care of the geocomposite prior to and following installation at the site, is the responsibility of the Contractor. The Contractor shall be liable for all damage to the materials incurred prior to final acceptance by the Owner.

C. The geocomposite shall be stored off the ground and out of direct sunlight, and shall be protected from excessive heat or cold, mud, dirt, and dust. Any additional storage procedures required by the manufacturer shall be the Contractor's responsibility.

PART 3 EXECUTION

3.01 PLACEMENT

A. The Contractor shall not commence geocomposite installation until the CQA Consultant completes conformance evaluation of the geocomposite and quality assurance evaluation of previous work, including evaluation of Contractor's survey results for previous work.

B. For geocomposite with directional hydraulic transmissivity, the Contractor shall install the geocomposite with the high transmissivity direction (usually the roll direction) in the downgradient direction and perpendicular to elevation contours.

C. The Contractor shall handle the geocomposite in such a manner as to ensure the geocomposite is not damaged in any way.

D. The Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

E. The geocomposite shall only be cut using manufacturer's recommended procedures.

F. In the presence of wind, all geocomposite panels shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with cover material.

G. Care shall be taken during placement of geocomposite not to entrap dirt or excessive dust in the geocomposite that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. Care shall be exercised when handling sandbags, to prevent rupture or damage of the sandbags.

H. If necessary, the geocomposite shall be positioned by hand after being unrolled over a smooth rub sheet.

I. Tools shall not be left on, in, or under the geocomposite.

J. After unwrapping the geocomposite from its opaque cover, the geocomposite shall not be left exposed for a period in excess of 30 days.

K. If white colored geotextile is used in the geocomposite, precautions shall be taken against "snowblindness" of personnel.

3.02 SEAMS AND OVERLAPS

A. The components of the geocomposite (i.e., geotextile, geonet, and geotextile) are not bonded together at the ends and edges of the rolls. Each component will be secured or seamed to the like component of adjoining panels.

B. Geotextile Components:
1. The bottom layers of geotextile shall be overlapped. The top layers of geotextiles shall be continuously sewn (i.e., spot sewing is not allowed). Geotextiles shall be overlapped a minimum of 6 inches prior to seaming.
2. No horizontal seams shall be allowed higher than one-third the slope height on slopes steeper than 10 horizontal to 1 vertical.
3. Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile component, shall be used for all sewing. The seams shall be sewn using Stitch Type 401 per Federal Standard No. 751a. The seam type shall be Federal Standard Type SSN-1.

3.03 REPAIR

A. Any holes or tears in the geocomposite shall be repaired by placing a patch extending 2 ft beyond the edges of the hole or tear. The patch shall be secured by tying fasteners through the bottom geotextile and the geonet of the patch, and through the top geotextile and geonet on the slope. The patch shall be secured every 6 inches with approved tying devices. The top geotextile component of the patch shall be heat sealed to the top geotextile of the geocomposite needing repair. If the hole or tear width across the panel is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with this section.

B. All repairs shall be performed at no additional cost to the Owner.

3.04 PLACEMENT OF SOIL MATERIALS

A. The Contractor shall place all soil materials in such a manner as to ensure that:
1. the geocomposite and underlying geosynthetic materials are not damaged;
2. minimal slippage occurs between the geocomposite and underlying layers; and
3. excess tensile stresses are not produced in the geocomposite.

B. Spread soil on top of the geocomposite from the bottom of slopes upward to cause the soil to cascade over the geocomposite rather than be shoved across the geocomposite.

C. For geocomposites overlying the geomembrane, do not place overlying soil material at ambient temperatures below 40 degrees Fahrenheit (F) or above 104°F, unless authorized in writing by the Engineer. For cold (<40°F) and hot (>104°F) weather placement operations, use the additional procedures authorized in writing by the Engineer.

D. Do not drive equipment directly on the geocomposite. Only use equipment above a geocomposite overlying a geomembrane that meets the following ground pressure requirements above the geomembrane:

Maximum Allowable Equipment Ground Pressure (pounds per square inch)	Minimum Thickness of Overlying Soil (inches)
<5	12
<10	18
<20	24
>20	36

TABLE 02740-1
PRIMARY GEOCOMPOSITE PROPERTY VALUES (CELL 11 ONLY)

PROPERTIES (4)	QUALIFIER	UNITS	SPECIFIED VALUES (1)	TEST METHOD
Geonet Component:				
Polymer composition	Minimum	%	95 polyethylene by wt	--
Polymer density	Minimum	g/cm^3	0.93	ASTM D 792 (Md B) or 1505
Carbon black content	Range	%	2 - 3	ASTM D 1603 or 4218
Nominal thickness	Minimum	mil	200	ASTM D 5199
Geotextile Component:				
Type	None	none	Needlepunched nonwoven	--
Polymer composition	Minimum	%	95 polyester or polypropylene	
Mass per unit area	Minimum	oz/yd^2	8	ASTM D 5261
Apparent opening size	Maximum	mm	$O_{95} \leq 0.21$ mm	ASTM D 4751
Permittivity	Minimum	sec^{-1}	0.5	ASTM D 4491
Grab tensile strength	Minimum	lb	200	ASTM D 4632 (2)
Trapezoidal tear strength	Minimum	lb	75	ASTM D 4533 (2)
CBR puncture strength	Minimum	psi	500	ASTM D 6241
Geocomposite:				
Transmissivity	Minimum	m^2/s	See note 3	ASTM D 4716
Ply Adhesion	Minimum	lb/in	1.0	ASTM D 7005

Notes:

1. All values represent minimum average roll values (with the exception of apparent opening size, which is a maximum average roll value).
2. Minimum value measured in machine and cross-machine direction.
3. The design transmissivity of the primary geocomposite drainage layer is measured using water at a gradient of 0.015 under compressive stresses of 700 psf and of 15,000 psf for a period of 24 hours and 100 hours, respectively. For the test, the primary geocomposite shall be sandwiched between 60-mil textured HDPE geomembrane and soil actually used for the liner protective layer. The minimum required transmissivities are 7.5×10^{-4} m^2/s and 1.3×10^{-3} m^2/s under the compressive stresses of 700 psf and 15,000 psf, respectively.
4. See Paragraph 2.02 for required MQC test frequencies.

TABLE 02740-2
SECONDARY GEOCOMPOSITE PROPERTY VALUES (CELL 11 ONLY)

PROPERTIES (4)	QUALIFIER	UNITS	SPECIFIED VALUES (1)	TEST METHOD
Geonet Component:				
Polymer composition	Minimum	%	95 polyethylene by wt	--
Polymer density	Minimum	g/cm^3	0.93	ASTM D 792 (Md B) or 1505
Carbon black content	Range	%	2 - 3	ASTM D 1603 or 4218
Nominal thickness	Minimum	mil	200	ASTM D 5199
Geotextile Component:				
Type	None	none	Needlepunched nonwoven	--
Polymer composition	Minimum	%	95 polyester or polypropylene	
Mass per unit area	Minimum	oz/yd^2	6	ASTM D 5261
Apparent opening size	Maximum	mm	$O_{95} \leq 0.21$ mm	ASTM D 4751
Permittivity	Minimum	sec^{-1}	0.5	ASTM D 4491
Grab tensile strength	Minimum	lb	160	ASTM D 4632 (2)
Trapezoidal tear strength	Minimum	lb	65	ASTM D 4533 (2)
CBR puncture strength	Minimum	psi	435	ASTM D 6241
Geocomposite:				
Transmissivity	Minimum	m^2/s	See note 3	ASTM D 4716
Ply Adhesion	Minimum	lb/in	1.0	ASTM D 7005

Notes:

1. All values represent minimum average roll values (with the exception of apparent opening size, which is a maximum average roll value).
2. Minimum value measured in machine and cross-machine direction.
3. The design transmissivity of the secondary geocomposite drainage layer is measured using water at a gradient of 0.015 under compressive stresses of 700 psf and 15,000 psf for a period of 24 hours and 100 hours, respectively. For the test, the secondary geocomposite shall be sandwiched between two 60-mil textured HDPE geomembranes. The minimum required transmissivities are 1.6×10^{-4} m^2/s and 3.6×10^{-4} m^2/s under the compressive stresses of 700 psf and 15,000 psf, respectively.
4. See Paragraph 2.02 for required MQC test frequencies.

TABLE 02740-3
PRIMARY GEOCOMPOSITE PROPERTY VALUES (CELLS 12 & 13 ONLY)

PROPERTIES (4)	QUALIFIER	UNITS	SPECIFIED VALUES (1)	TEST METHOD
Geonet Component:				
Polymer composition	Minimum	%	95 polyethylene by wt	--
Polymer density	Minimum	g/cm^3	0.93	ASTM D 792 (Md B) or 1505
Carbon black content	Range	%	2 - 3	ASTM D 1603 or 4218
Nominal thickness	Minimum	mil	200	ASTM D 5199
Geotextile Component:				
Type	None	none	Needlepunched nonwoven	--
Polymer composition	Minimum	%	95 polyester or polypropylene	
Mass per unit area	Minimum	oz/yd^2	8	ASTM D 5261
Apparent opening size	Maximum	mm	$O_{95} \leq 0.21$ mm	ASTM D 4751
Permittivity	Minimum	sec^{-1}	0.5	ASTM D 4491
Grab tensile strength	Minimum	lb	200	ASTM D 4632 (2)
Trapezoidal tear strength	Minimum	lb	75	ASTM D 4533 (2)
CBR puncture strength	Minimum	psi	500	ASTM D 6241
Geocomposite:				
Transmissivity	Minimum	m^2/s	See note 3	ASTM D 4716
Ply Adhesion	Minimum	lb/in	1.0	ASTM D 7005

Notes:

1. All values represent minimum average roll values (with the exception of apparent opening size, which is a maximum average roll value).
2. Minimum value measured in machine and cross-machine direction.
3. The design transmissivity of the primary geocomposite drainage layer is measured using water at a gradient of 0.015 under compressive stresses of 700 psf and of 15,000 psf for a period of 24 hours and 100 hours, respectively. For the test, the primary geocomposite shall be sandwiched between 60-mil textured HDPE geomembrane and soil actually used for the liner protective layer. The minimum required transmissivities are 6.5×10^{-4} m^2/s and 1.0×10^{-3} m^2/s under the compressive stresses of 700 psf and 15,000 psf, respectively.
4. See Paragraph 2.02 for required MQC test frequencies.

TABLE 02740-4
SECONDARY GEOCOMPOSITE PROPERTY VALUES (CELLS 12 & 13 ONLY)

PROPERTIES [4]	QUALIFIER	UNITS	SPECIFIED VALUES [1]	TEST METHOD
Geonet Component:				
Polymer composition	Minimum	%	95 polyethylene by wt	--
Polymer density	Minimum	g/cm^3	0.93	ASTM D 792 (Md B) or 1505
Carbon black content	Range	%	2 - 3	ASTM D 1603 or 4218
Nominal thickness	Minimum	mil	200	ASTM D 5199
Geotextile Component:				
Type	None	none	Needlepunched nonwoven	--
Polymer composition	Minimum	%	95 polyester or polypropylene	
Mass per unit area	Minimum	oz/yd^2	6	ASTM D 5261
Apparent opening size	Maximum	mm	$O_{95} \leq 0.21$ mm	ASTM D 4751
Permittivity	Minimum	sec^{-1}	0.5	ASTM D 4491
Grab tensile strength	Minimum	lb	160	ASTM D 4632 [2]
Trapezoidal tear strength	Minimum	lb	65	ASTM D 4533 [2]
CBR puncture strength	Minimum	psi	435	ASTM D 6241
Geocomposite:				
Transmissivity	Minimum	m^2/s	See note 3	ASTM D 4716
Ply Adhesion	Minimum	lb/in	1.0	ASTM D 7005

Notes:

1. All values represent minimum average roll values (with the exception of apparent opening size, which is a maximum average roll value).
2. Minimum value measured in machine and cross-machine direction.
3. The design transmissivity of the secondary geocomposite drainage layer is measured using water at a gradient of 0.015 under compressive stresses of 700 psf and 15,000 psf for a period of 24 hours and 100 hours, respectively. For the test, the secondary geocomposite shall be sandwiched between two 60-mil textured HDPE geomembranes. The minimum required transmissivities are 1.4×10^{-4} m^2/s and 3.0×10^{-4} m^2/s under the compressive stresses of 700 psf and 15,000 psf, respectively.
4. See Paragraph 2.02 for required MQC test frequencies.

[END OF SECTION]